MEDICAL EDUCATION RESOURCE

Back of Leg A-Z

Introduction

- The **back of the leg (calf)** extends from the popliteal fossa above to the heel below.
- It contains the **superficial and deep posterior compartments**, separated by the transverse intermuscular septum.
- The main **functions** of these muscles:
    - **Plantarflexion of ankle**,
    - **Flexion of toes**,
    - **Venous pumping action** (“peripheral heart” effect).
- Blood supply ? *posterior tibial* and *peroneal arteries*.
- Nerve supply ? *tibial nerve*.

Superficial Fascia

- Lies between the skin and deep fascia.
- Contains:
    - **Small (short) saphenous vein**,
    - **Cutaneous nerves** (sural, posterior cutaneous nerve of thigh, etc.),

    - **Superficial lymphatics**,
    - **Variable fat**, more abundant in the calf.
- Fascia firmly adheres to skin, making subcutaneous infections or abscesses painful and localized.

Small (Short) Saphenous Vein

- **Origin:** Lateral end of dorsal venous arch + lateral marginal vein on dorsum of foot.
- **Course:**
    - Passes **behind the lateral malleolus**.
    - Ascends **lateral to tendo calcaneus**, along midline of calf.
    - Pierces **deep fascia** in lower part of popliteal fossa.
    - Opens into the **popliteal vein**.
- **Drains:** Lateral side of foot, heel, and back of leg.
- **Connections:** Communicates with great saphenous vein and deep veins through **perforators**.
- **Accompanied by:** *Sural nerve* along most of its course.

Great (Long) Saphenous Vein

- **Origin:** Medial end of dorsal venous arch + medial marginal vein of great toe.

- **Course:**
    - Passes **in front of the medial malleolus**, ascends along medial leg and thigh.
    - Pierces *cribriform fascia* at saphenous opening to join **femoral vein**.
- **Tributaries:** Medial marginal vein, superficial epigastric, circumflex iliac, external pudendal veins.
- **Valves:** About **10–15**, one always at *saphenofemoral junction*.
- **Communications:** With small saphenous and deep veins via **perforators** (3 above ankle, 1 below knee, 1 at adductor canal).
- **Applied anatomy:** Valve incompetence ? *varicose veins*.

Comparison between Long and Short Saphenous Veins

FEATURE	LONG (GREAT) SAPHENOUS	SHORT (SMALL) SAPHENOUS
Beginning	Medial end of dorsal venous arch	Lateral end of dorsal venous arch
Relation to malleolus	In front of medial malleolus	Behind lateral malleolus
Valves	10–15	8–10
Sensory nerve related	Saphenous nerve	Sural nerve
Termination	Femoral vein	Popliteal vein

Cutaneous Nerves of Back of Leg

- **Sural nerve (L5, S1, S2):**
  - Branch of *tibial nerve* in popliteal fossa.
  - Descends between *gastrocnemius heads*, joins *peroneal communicating nerve*, accompanies *small saphenous vein*.
  - Runs behind lateral malleolus to lateral foot and little toe.
  - **Supplies:** Skin of lower half of back of leg and lateral side of foot.
- **Posterior cutaneous nerve of thigh (S1–S3):** Upper part of calf.
- **Lateral cutaneous nerve of calf (L4–S1):** Upper two-thirds of lateral leg.
- **Medial calcanean branches (S1, S2):** From tibial nerve ? heel and medial sole.

Dissection

- Incision along lateral and medial borders of calf; reflect skin distally to heel.
- Identify:
  - **Small saphenous vein**,
  - **Sural nerve**,
  - **Posterior cutaneous nerve of thigh**,
  - **Lateral cutaneous nerve of calf**,

    - **Medial calcanean branches**.

- Observe relation of sural nerve with small saphenous vein.

Clinical Anatomy

- **Sural nerve neuroma:** Painful swelling after injury or surgery.
- **Sural nerve graft:** Commonly harvested — purely sensory, superficial, easily identifiable between *tendo calcaneus* and *lateral malleolus*.
- **Varicose veins:** Due to valve incompetence of great or small saphenous veins or perforators.
- **Perforator valve failure:** Allows reverse blood flow ? venous stasis and ulcers.
- **Saphenous venesection:** Great saphenous vein anterior to medial malleolus used for emergency infusion.
- **Deep vein thrombosis (DVT):** Common post-surgical risk; swelling and pain in calf due to clot formation in deep veins.

Deep Fascia

- A dense fibrous sheath surrounding the muscles of the leg.
- Continuous above with the **popliteal fascia**, and below with the **deep fascia of the foot**.
- Firmly attached to the **subcutaneous border of the tibia** and to the **fibula**.

- Sends **intermuscular septa** that divide the leg into **compartments**: anterior, lateral, and posterior.
- In the posterior region, the fascia is strong and thick, contributing to the **muscle-pumping mechanism** aiding venous return.

Boundaries and Subdivisions of the Posterior Compartment

- The **posterior compartment** is divided by a **transverse intermuscular septum** into:
  - **Superficial group** ? *gastrocnemius, soleus, plantaris.*
  - **Deep group** ? *popliteus, flexor digitorum longus, tibialis posterior, flexor hallucis longus.*
- **Boundaries:**
  - **Anteriorly:** Tibia, fibula, interosseous membrane, and intermuscular septa.
  - **Posteriorly:** Deep fascia of the leg.
- **Nerve supply:** Tibial nerve.
- **Arterial supply:** Posterior tibial artery and peroneal artery.

Flexor Retinaculum

- A strong fibrous band extending from **medial malleolus** to the **medial process of calcaneal tuberosity**.
- Converts grooves behind the medial malleolus into **fibro-osseous tunnels** for tendons and neurovascular structures.

- **Structures passing deep to flexor retinaculum (anterior ? posterior):**
  ? **Mnemonic: “Tom, Dick, And Very Nervous Harry”**
    - **T** ? *Tibialis posterior tendon*
    - **D** ? *Flexor digitorum longus tendon*
    - **A** ? *Posterior tibial artery*
    - **V** ? *Venae comitantes*
    - **N** ? *Tibial nerve*
    - **H** ? *Flexor hallucis longus tendon*
- Each tendon is enclosed in a **synovial sheath**, and the artery and nerve are embedded in loose areolar tissue for gliding during ankle movement.

Dissection

- Make a vertical midline incision over the calf and reflect skin laterally and medially.
- Identify and clean the **deep fascia**; note its strong attachment to the tibia.
- Reflect fascia carefully to expose:
    - *Superficial group of muscles (gastrocnemius, soleus, plantaris).*
    - Beneath them lies the **transverse intermuscular septum** separating the **deep group**.
- Trace the **posterior tibial artery and tibial nerve** between deep muscles.

- At the medial ankle, dissect to show **flexor retinaculum** and identify the order of structures deep to it (Tom-Dick-And-Very-Nervous-Harry).

Clinical Anatomy

- **Tarsal Tunnel Syndrome:**
  - Compression of **tibial nerve** under the flexor retinaculum.
  - Causes pain, tingling, or numbness over the sole and toes.
  - May result from swelling, ganglion, or varicosity.
- **Posterior Compartment Syndrome:**
  - Increased pressure within deep fascia compresses posterior tibial vessels and nerve ? ischemic pain and sensory loss on sole.
- **Tendo Calcaneus (Achilles) Strain or Rupture:**
  - Sudden plantarflexion against resistance (e.g. jumping).
  - Leads to loss of heel lift during walking; surgical repair may be required.
- **Varicose Veins:**
  - Failure of perforator valves in posterior compartment.
  - Common near the medial side of the calf.
- **Sural Nerve Graft:**

- Preferred for nerve reconstruction because it is long, superficial, and purely sensory.

Muscles of Back of Leg

The posterior compartment contains **seven muscles**, arranged in **two groups**:

- **Superficial group:** *Gastrocnemius, Soleus, Plantaris*
- **Deep group:** *Popliteus, Flexor digitorum longus, Tibialis posterior, Flexor hallucis longus*
  All are supplied by the **tibial nerve** and participate mainly in **plantar flexion** of the foot and **flexion of the toes**.

Superficial Muscles

1. Gastrocnemius

- **Origin:**
  - *Medial head* – above medial condyle of femur.
  - *Lateral head* – above lateral condyle of femur.
- **Insertion:**
  - Both heads form a broad aponeurosis that merges with *soleus tendon* to form the **tendo calcaneus** (Achilles tendon) ? inserted into posterior surface of calcaneum.
- **Nerve:** Tibial nerve (S1, S2).

- **Action:**
    - Powerful **plantar flexor** of foot.
    - Assists in **flexion of knee**.
- **Clinical note:** Active during jumping and running; spasm causes the “calf cramp”.

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2. Soleus

- **Origin:**
    - Posterior surface of head and upper third of fibula,
    - Soleal line and middle third of tibia,
    - Fibrous arch between them.
- **Insertion:**
    - Joins gastrocnemius to form the **tendo calcaneus**.
- **Nerve:** Tibial nerve (S1, S2).
- **Action:**
    - **Plantar flexion** of foot.
    - Important for **maintaining standing posture** (“antigravity muscle”).
- **Note:** Lacks action on knee joint (unlike gastrocnemius).

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3. Plantaris

- **Origin:** Inferior end of lateral supracondylar ridge of femur and knee capsule.
- **Insertion:** Long thin tendon runs between *gastrocnemius* and *soleus* ? joins *tendo calcaneus* or calcaneum.
- **Nerve:** Tibial nerve (S1, S2).
- **Action:** Weak plantar flexor; may assist in knee flexion.
- **Clinical note:** Often absent; tendon harvested for grafting (e.g. hand reconstruction).

Tendo Calcaneus (Achilles Tendon)

- Formed by **gastrocnemius, soleus, and plantaris**.
- Inserts on **posterior surface of calcaneum**.
- Surrounded by **paratenon** (no true synovial sheath).
- **Bursa:** A small retrocalcaneal bursa lies between tendon and calcaneum.
- **Function:** Transmits powerful plantar-flexing force to foot.
- **Applied:** Rupture causes loss of heel-rise and inability to stand on toes.

Deep Muscles

1. Popliteus

- **Origin:** Lateral surface of lateral femoral condyle and lateral meniscus.

- **Insertion:** Posterior surface of tibia above the soleal line.
- **Nerve:** Tibial nerve (L4–S1).
- **Action:**
    - *Unlocks the knee* by laterally rotating femur on tibia (or medially rotating tibia on femur when limb free).
    - Weakly flexes knee.
- **Clinical note:** Its tendon lies intracapsular but extrasynovial in the knee joint.

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2. Flexor Digitorum Longus (FDL)

- **Origin:** Posterior surface of tibia below soleal line.
- **Insertion:** Divides into four tendons ? bases of distal phalanges of lateral four toes.
- **Nerve:** Tibial nerve (L5–S2).
- **Action:** Flexes lateral four toes; assists in plantar flexion and supports longitudinal arch.

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3. Tibialis Posterior

- **Origin:** Posterior surfaces of tibia, fibula, and interosseous membrane.
- **Insertion:** Tuberosity of navicular, medial cuneiform, and bases of 2nd–4th metatarsals.
- **Nerve:** Tibial nerve (L4, L5).

- **Action:** Plantar flexes and inverts foot; main **support of medial longitudinal arch**.

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4. Flexor Hallucis Longus (FHL)

- **Origin:** Lower two-thirds of posterior surface of fibula and interosseous membrane.
- **Insertion:** Base of distal phalanx of great toe.
- **Nerve:** Tibial nerve (S2, S3).
- **Action:** Flexes great toe; aids plantar flexion; maintains **medial longitudinal arch**.
- **Note:** Its tendon grooves the posterior talus and sustentaculum tali of calcaneum.

Dissection

- Remove the **superficial group** to expose the deep layer beneath the **transverse intermuscular septum**.
- Identify the **popliteus** in the upper part of the leg; below it lie the three long flexors (FDL, TP, FHL) from medial to lateral.
- Trace the **posterior tibial artery** and **tibial nerve** between *FDL* and *TP*.
- Expose the **flexor retinaculum** at the ankle and demonstrate the order of tendons (Tom, Dick, And Very Nervous Harry).

Clinical Anatomy

- **Rupture of Achilles tendon:**

- Sudden pain and gap above heel; patient cannot stand on toes.
- Often occurs in middle-aged athletes (“tennis leg”).

- **Calcaneal bursitis:**
  - Inflammation of retrocalcaneal bursa ? pain on dorsiflexion or wearing tight shoes.
- **Tibial nerve injury:**
  - Loss of plantar flexion and inversion; sensory loss over sole ? **calcaneovalgus deformity** (dorsiflexed, everted foot).
- **Tarsal tunnel syndrome:**
  - Compression of tibial nerve under flexor retinaculum ? pain and paresthesia in sole.
- **Tendonitis of FHL or FDL:**
  - Overuse in dancers and runners ? pain behind medial malleolus.
- **Venous pump failure:**
  - Weakness of calf muscles reduces venous return ? predisposes to varicose veins and edema.

Posterior Tibial Artery

- **Origin:** Terminal branch of the *popliteal artery* at the lower border of popliteus.
- **Course:**

- Passes deep to *gastrocnemius* and *soleus* between *superficial* and *deep* groups of posterior-leg muscles.
- Runs with the **tibial nerve** (nerve crosses artery from medial ? lateral).
- Descends on *tibialis posterior*, accompanied by **two venae comitantes**.
- At the ankle, it passes **deep to the flexor retinaculum** (between FDL and FHL tendons).
- Divides into **medial and lateral plantar arteries** beneath the retinaculum.

- **Relations (from above downward):**
  - Covered by *gastrocnemius, soleus,* and deep fascia.
  - Crossed superficially by *sural nerve* and *small saphenous vein*.
- **Branches:**
  1. **Peroneal (fibular) artery** — large lateral branch.
  2. **Circumflex fibular branch.**
  3. **Nutrient artery** to tibia.
  4. **Muscular branches.**
  5. **Communicating branch** with peroneal artery.
  6. **Medial and lateral plantar arteries** (terminal branches).
- **Surface marking:**

- From midpoint between medial malleolus and Achilles tendon ? to a point midway between medial malleolus and heel.

- **Pulse point:**
  - Felt **posterior to medial malleolus**, halfway between malleolus and Achilles tendon.

Peroneal (Fibular) Artery

- **Origin:** From the **posterior tibial artery** about 2.5 cm below popliteus.
- **Course:**
  - Descends along medial crest of fibula in the posterior compartment.
  - Lies deep to *soleus* and *flexor hallucis longus*.
  - Terminates behind the lateral malleolus, forming **lateral calcaneal branches**.
- **Branches:**
  1. **Muscular branches** to posterior and lateral compartments.
  2. **Nutrient artery to fibula.**
  3. **Perforating branch:** pierces interosseous membrane 5 cm above ankle to anastomose with *anterior lateral malleolar artery.*
  4. **Communicating branch** with posterior tibial artery.
  5. **Lateral calcaneal branches** to heel.

- **Function:** Supplies lateral and posterior compartments of the leg, including *peroneal muscles* and *FHL*.
- **Applied:** Major collateral vessel if posterior tibial artery occluded.

Tibial Nerve

- **Origin:** Larger terminal branch of the **sciatic nerve** in the lower third of the thigh (apex of popliteal fossa).
- **Course:**
  - Descends through the **popliteal fossa**, then passes under *tendinous arch of soleus* .
  - Travels with **posterior tibial artery** on *tibialis posterior* — artery medial to nerve above, then crosses superficial to it.
  - At ankle ? passes **deep to flexor retinaculum**, between *FDL* and *FHL*.
  - Divides into **medial and lateral plantar nerves** beneath retinaculum.
- **Branches:**
  1. **Muscular:**
     - To *gastrocnemius (both heads)*, *soleus*, *plantaris*, *popliteus*, *FDL*, *TP*, *FHL*.
  2. **Cutaneous:**
     - *Medial calcanean branches* to heel.

3. **Articular:**
    - To knee and ankle joints.
4. **Terminal:**
    - *Medial* and *lateral plantar nerves* to sole of foot.

- **Root value:** L4 – S3.
- **Functions:** Motor to posterior-leg and plantar muscles; sensory to sole of foot and heel.

Clinical Anatomy

- **Posterior tibial pulse:**
    - Palpated behind the medial malleolus between *tendo calcaneus* and *flexor retinaculum*.
    - Absence ? *peripheral arterial disease* or *diabetic angiopathy*.
- **Tarsal tunnel syndrome:**
    - Compression of *tibial nerve* under *flexor retinaculum*.
    - Symptoms: Burning pain and tingling in sole, worse at night.
- **Tibial nerve injury:**
    - Loss of plantar flexion and inversion; clawing of toes; anesthesia of sole ? *calcaneovalgus deformity.*

- **Aneurysm or thrombosis of posterior tibial artery:**
    - Produces swelling and pain behind medial malleolus; diminished dorsalis pedis pulse due to poor anastomosis.
- **Peroneal artery occlusion:**
    - May compromise blood flow to lateral leg and heel; collateral flow via perforating branch preserves dorsalis pedis.
- **Deep vein thrombosis (DVT):**
    - Clot formation in deep veins accompanying posterior tibial or peroneal arteries; causes pain, warmth, swelling in calf.

Mnemonics

Structures under the Flexor Retinaculum (medial ankle):
? **Mnemonic:** *“Talented Doctors Are Never Hungry”*

- **T** – Tibialis posterior
- **D** – Flexor digitorum longus
- **A** – Posterior tibial artery
- **N** – Tibial nerve
- **H** – Flexor hallucis longus

(These are arranged from anterior ? posterior.)

Facts to Remember

- **Soleus** acts as a *“peripheral heart”* by pumping venous blood upward during contraction.
- **Soleus** works like the *first gear* of locomotion, while **gastrocnemius** acts as the *second and third gears* during walking or running.
- **Tendo calcaneus (Achilles tendon)** is the *strongest tendon* in the human body.
- **All muscles** of the back of the leg (calf) are supplied by the **tibial nerve**.
- **Posterior tibial artery pulse** is palpated between the *medial malleolus* and the *calcaneum* deep to the *flexor retinaculum*.

Clinicoanatomical Problems (Back of Leg)

1. A basketball player complains of sudden pain and inability to stand on tiptoe after a jump.
? **Diagnosis:** *Rupture of Tendo Calcaneus (Achilles tendon).*
? *Result:* Loss of plantar flexion and a palpable gap above heel.

2. A dancer develops severe pain posterior to the medial malleolus with tingling in the sole.
? **Cause:** *Tarsal Tunnel Syndrome* — compression of tibial nerve under flexor retinaculum.

3. A patient with diabetes has absent posterior tibial pulse behind the medial malleolus.
? **Indicates:** *Peripheral arterial disease* or *diabetic angiopathy.*

4. A soldier complains of calf pain and swelling after prolonged immobility.
? **Diagnosis:** *Deep Vein Thrombosis (DVT).*
? *Pathology:* Thrombosis in deep veins around posterior tibial or peroneal vessels.

5. An elderly woman complains of calf cramps during walking that subside at rest.
? **Diagnosis:** *Intermittent Claudication* due to narrowing of posterior tibial artery.

6. A road accident crush injury to leg produces swelling, pain, and loss of plantar flexion.
? **Condition:** *Posterior compartment syndrome* — compression of posterior tibial artery and nerve.

7. A tennis player reports pain over the back of heel from repetitive plantar flexion.
? **Condition:** *Achilles tendinitis* — inflammation of tendon or its sheath.

8. A patient has pain and swelling over the heel from tight footwear.
? **Diagnosis:** *Calcaneal bursitis* (retrocalcaneal bursa inflammation).

9. A popliteal artery aneurysm compresses its branches — which artery may maintain blood flow to the foot?
? **Answer:** *Peroneal artery* via its perforating branch (collateral circulation).

10. A person sustains a deep laceration on the medial side of the ankle; foot becomes dorsiflexed and everted.
? **Structure injured:** *Tibial nerve* ? loss of plantar flexion and inversion.

11. A surgeon harvesting the sural nerve for grafting must avoid which accompanying structure?
? **Answer:** *Small saphenous vein.*

12. A young athlete presents with persistent calf pain, numbness of heel, and weak plantar flexion.
? **Likely:** *Entrapment neuropathy of tibial nerve* in posterior compartment.

13. A patient with chronic varicose veins develops ulcer near the medial malleolus.
? **Reason:** *Failure of perforator valves* connecting great saphenous and deep veins.

14. Why can calf muscles act as a “peripheral heart”?
? Because contraction of *soleus* and *gastrocnemius* compresses veins ? aids venous return against gravity.

15. During knee surgery, injury to popliteus causes difficulty in initiating flexion. Why?
? *Popliteus unlocks the knee* by lateral rotation of femur on tibia.

16. A fracture of the fibula near the lower end causes foot drop. Which artery remains intact?
? **Answer:** *Posterior tibial artery.*

17. An X-ray shows fracture of the fibular neck with loss of dorsiflexion and eversion. Which nerve?
? **Answer:** *Common peroneal nerve.* (Though not in posterior compartment, it lies close to lateral border of popliteal fossa.)

18. An embolus in the popliteal artery spares the foot circulation. How?
? *Collateral supply* through *peroneal artery* and *plantar anastomoses.*

19. Pain radiating along the sole with sensory loss over heel after prolonged standing suggests?
? *Tibial nerve compression under flexor retinaculum.*

20. A congenital shortening of Achilles tendon causes the child to walk on toes.
? *Condition: Talipes equinus.*

Additional common applied points (for viva and MCQ linkage):

- Soleus acts during standing; gastrocnemius during movement.
- Tendo calcaneus rupture produces “sudden snapping sound” and positive Thompson’s test (no plantar flexion on calf squeeze).
- Posterior tibial artery pulse is an important vascular examination site in diabetics.