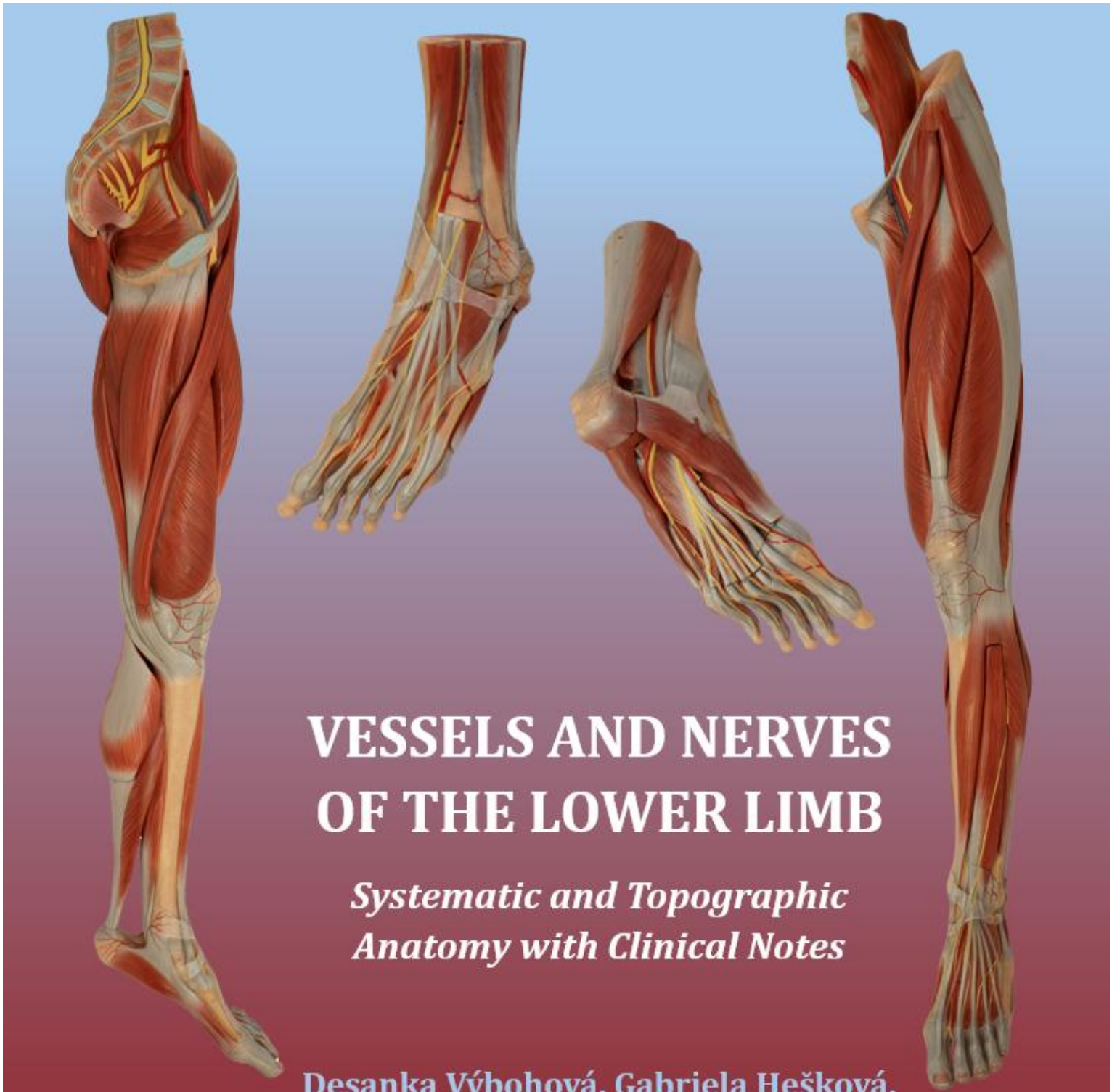
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Comenius University Bratislava



VESSELS AND NERVES OF THE LOWER LIMB

Systematic and Topographic Anatomy with Clinical Notes

Desanka Výbohová, Gabriela Hešková, Dagmar Kalenská, Katarína Lešková, Alena Mazuráková, Sandra Hurta Csizmár

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PREFACE

The present textbook was created as a natural continuation of the lon-standing tradition of our study guides, which have become a popular and frequently used learning resource among our students. Their success and positive reception motivated us to prepare another guide, this time focused on the systematic and topographic anatomy of the vessels and nerves of the lower limb. I hope that this material will be just as useful, practical and beneficial as ots predecessors.

This study guide is based on many years of our teaching experince, on working with students and on everyday practice in anatomy education. Its content and structure were shaped to demonstrate the connection between the theory and practice and to highlight how anatomical knowledge translates into clinincal reasining and decision making.

It is necessary to use this study guide with an anatomical atlas, which provides the detailed visual and spatial information necessary for a comprehensive understanding of the material.

We hope that this textbook will become valuable recource for your study as our previous study guides and that it will help make the challenging study of anatomy more accessible and approachable.

On behalf of the author team

Desanka Výbohová

INTRODUCTION

The study of the lower limb includes many layers of anatomical knowledge: blood vessels, lymphatic vessels and nodes, nerves and of course their mutual relations. This study guide was created with the intention of making this process easier, more accessible, offering students a structural framework that leads them through the systematic anatomy, topographic anatomy and the clinical relevance of this knowledge.

The texbook provides systematic and topographic view at the lower limb.

The first part presents the vessels and nerves sytematicallyone by one, with explanation of their course and function and with important clinical notes.

The second part provides topographic aproach to the lower limb, showing how the vessels and nerves and muscles come together within the anatomical regions and spaces.

The final chapter contains the review questions, that allow students to assess their understanding of the key topics.

SYSTEMATIC ANATOMY OF THE ARTERIES AND VEINS OF THE LOWER LIMB

ARTERIES OF THE LOWER LIMB

The lower limb requires a robust and efficient arterial system to meet its significant metabolic and functional demands. It plays a vital role in locomotion, weight-bearing, and posture, so a continuous blood supply is essential for muscle activity, and blood supply to the skin, bones and joints.

The arterial supply of the lower limb originates from the **right** and **left common iliac arteries** and provides a continuous blood supply through a series of branches and anastomoses. Each common iliac artery is subdivided into the **external iliac artery** which continues as the **femoral artery** supplying most of the free lower limb, and the **internal iliac artery** which supplies mainly the wall and organs of the pelvis, but also the gluteal region, the medial side of the thigh, and perineum.

The vascular supply of the lower limb can be divided into two main areas in terms of the sources of arterial supply:

Continuation of the external iliac artery – ***Main arterial pathway from the femoral to the distal branches***

The **femoral artery** and its branches supply the anterior, medial, and posterior compartments of the thigh. After traversing the adductor hiatus, it continues as the **popliteal artery** behind the knee. The popliteal artery then divides into its terminal branches, the **anterior** and **posterior tibial arteries**, which supply the structures of the leg and foot.

Branches of the internal iliac artery – ***Collateral and regional supply***

The arterial supply to the gluteal region, the medial compartment of the thigh, and perineum is provided by several branches of the internal iliac artery:

- The **superior** and **inferior gluteal arteries**, which supply the gluteal muscles and surrounding tissues.

- The **obturator artery**, which supplies the medial compartment of the thigh and contributes to the blood supply of the hip joint and the head of the femur.

CONTINUATION OF THE EXTERNAL ILIAC ARTERY – Main arterial pathway from the femoral to the distal branches.

FEMORAL ARTERY

Course of the femoral artery

The femoral artery is the continuation of the external iliac artery. It begins **at the level of the inguinal ligament**, where the external iliac artery passes beneath it and enters the **femoral triangle** through the **vascular compartment – lacuna vasorum** (see p. 107).

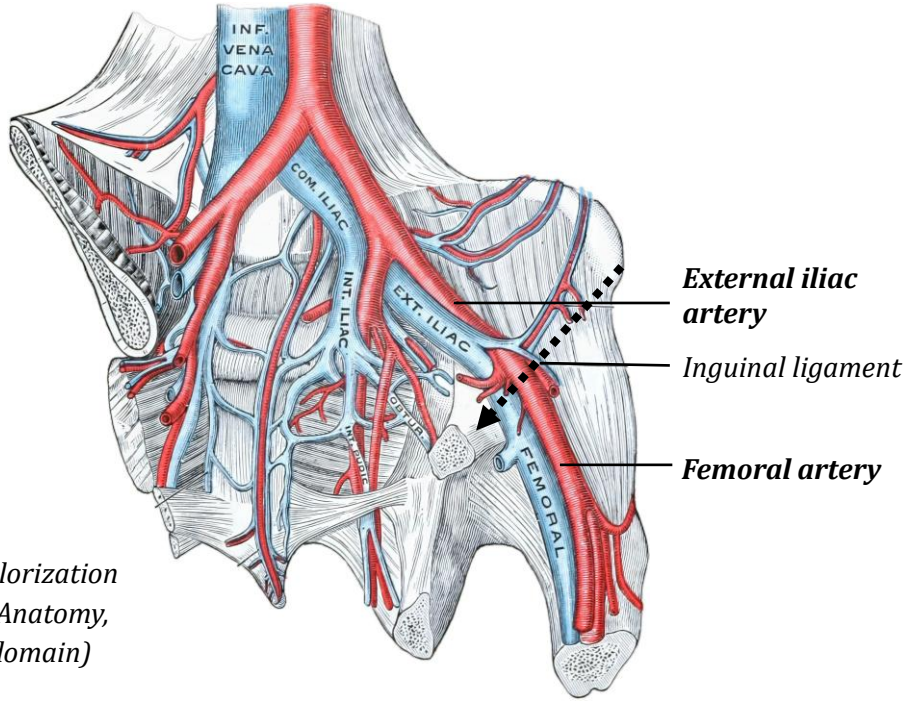


Fig. 1
External iliac artery and femoral artery
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The femoral artery leaves the femoral triangle and enters the **adductor canal** which lies in the middle third of the thigh. It then continues to the **adductor hiatus** (an opening in the adductor magnus muscle). After passing through it, the artery exits the anterior compartment of the thigh and enters the popliteal fossa, where it becomes the popliteal artery. **Within the femoral triangle**, the femoral artery lies relatively superficially, positioned ***medial to the femoral nerve*** and ***lateral to the femoral vein***. At its origin, the artery is located at the midpoint between the anterior superior iliac spine

and the pubic symphysis. At this site, the pulsation of the femoral artery can be readily palpated and is commonly used as a landmark for clinical examination and vascular access. **Within the adductor canal**, the femoral artery passes deep to the sartorius muscle. It is accompanied by the ***femoral vein*** and the ***saphenous nerve***. The femoral vein lies posterior or posterolateral to the artery. The saphenous nerve, a sensory branch of the femoral nerve, exits the canal by piercing the vastoadductor membrane. The femoral artery and vein then continue distally to reach the **adductor hiatus**.

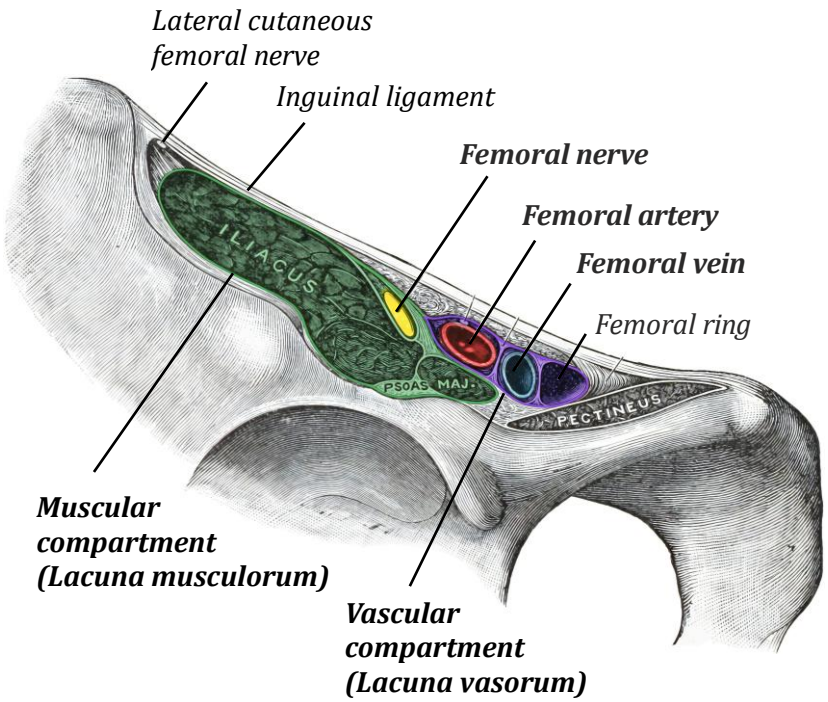


Fig. 2

Vascular compartment (lacuna vasorum) for passage of the femoral artery and femoral vein

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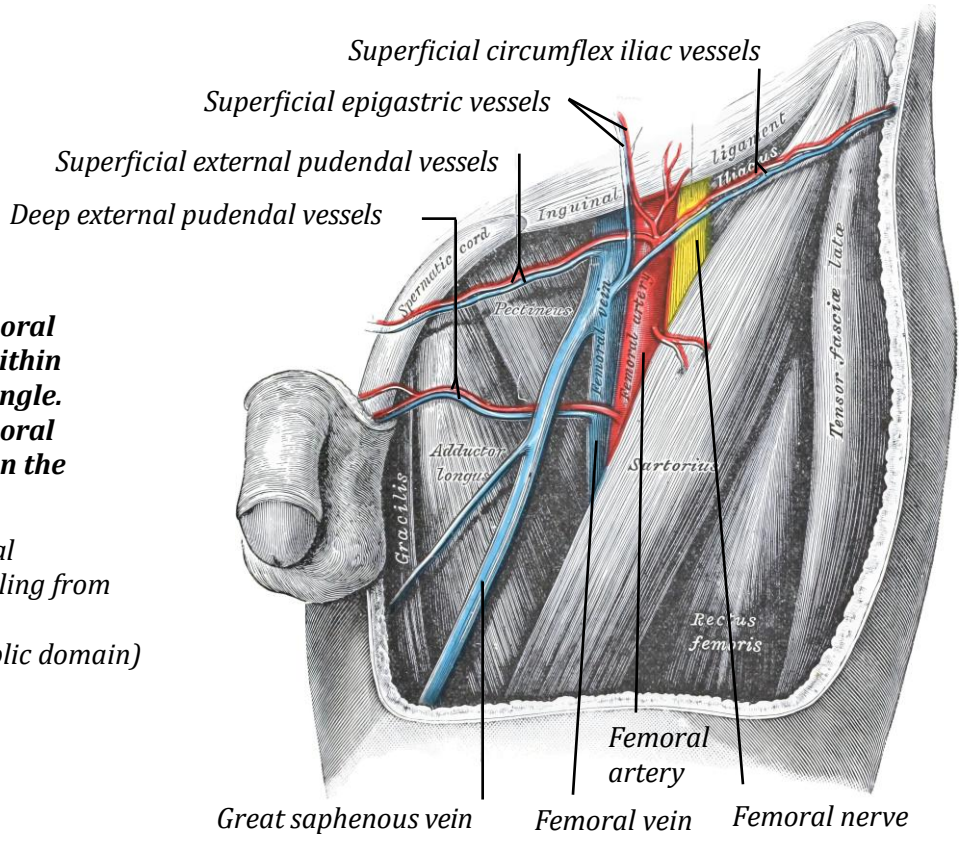


Fig. 3

Relations of the femoral vessels and nerve within the left femoral triangle. Branches of the femoral artery arising within the femoral triangle

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Clinical notes

The femoral triangular region serves as an important access site due to the artery's superficial position.

This region makes it:

- easy to locate the femoral artery for ***cannulation*** *or* ***injections*** *- cardiac catheterization, coronary angiography, endovascular interventions, e.g., stent placement;*

- a possible site for ***arterial blood gas sampling*** *when radial or brachial access is not feasible;*

- palpation of the femoral pulse *is useful for assessing peripheral circulation in the lower limb. In patients with low blood pressure, the femoral artery may still have a palpable pulse even when more distal pulses are absent. Palpation of the femoral artery is usually accessible, even in obese or hypotensive patients.*

- compression *of the femoral artery against the femoral head to* ***control bleeding*** *in lower limb trauma or during surgery to stop bleeding or for use as a proximal control during vascular surgery.*



Fig. 4

Palpation site for the femoral artery pulse: *just below the inguinal ligament, midway between the anterior superior iliac spine and the pubic symphysis*

Drawing from the author's archive

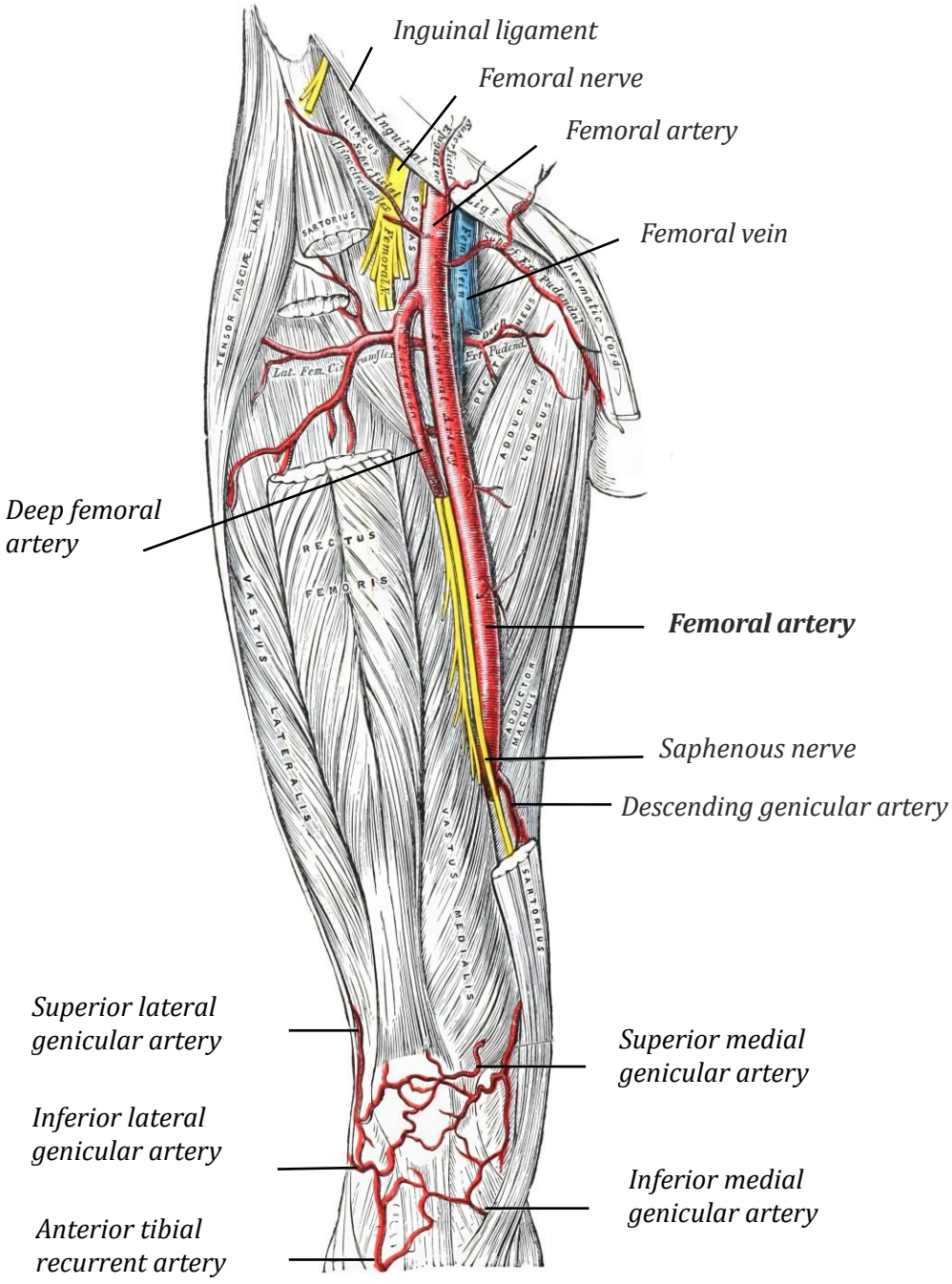


Fig. 5
Femoral artery within the femoral triangle and the adductor canal
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Table 1: Main trunk of the femoral artery

Artery	Course	Structures supplied	Clinical notes
Femoral artery	Continuation of external iliac a. distal to inguinal ligament → passes through femoral triangle → descends in adductor canal → becomes popliteal artery after passing through adductor hiatus	Proximal anterior thigh muscles before giving off deep femoral**;** distal to this point, it functions mainly as a conduit to distal limb**;** continuing as popliteal artery behind knee	Pulse palpable at mid-inguinal point; common catheterization site; injury may result in life-threatening hemorrhage

Branches of the femoral artery

Within the femoral triangle, the femoral artery gives rise to several important superficial and deep branches:

- **Superficial epigastric artery**
- **Superficial circumflex iliac artery**
- **External pudendal arteries** – **superficial** and **deep**
- **Deep femoral artery (Profunda femoris artery)**

Within the adductor canal, the femoral artery gives off only a few small branches, the most significant of which is:

- **Descending genicular artery**.

In addition to the named branches above, the **main trunk of the femoral artery** gives rise to small muscular branches that supply the anterior compartment of the thigh. These typically arise proximal to the origin of the deep femoral (profunda femoris) artery and contribute to the vascularization of the sartorius, vastus medialis, pectineus, and iliopsoas muscles.

After giving rise to the deep femoral artery, the femoral artery continues distally as a principal conduit to the lower limb, passing through the adductor hiatus to become the popliteal artery in the posterior aspect of the knee.

- **Superficial epigastric artery**

It arises from the anterior aspect of the femoral artery, just below the inguinal ligament, within the femoral triangle.

It ascends superficially and travels superiorly toward the umbilicus, supplying the **lower part of the anterior abdominal wall**, including the skin and subcutaneous tissues.

- **Superficial circumflex iliac artery**

It also arises near the origin of the superficial epigastric artery. It runs laterally and parallel to the inguinal ligament toward the anterior superior iliac spine. This artery supplies the skin and superficial fascia over the **inguinal region** and the **lateral aspect of the lower abdomen**. It anastomoses with branches of the deep circumflex iliac artery and other regional arteries.

- **External pudendal arteries**

Two external pudendal arteries are usually present , the superficial and the deep. They arise from the femoral artery within the femoral triangle and course medially toward the external genital region. They supply the skin of the **lower abdominal wall** and the **external genital organs**, including the scrotum and penis in males, and the labia majora in females. Both arteries anastomose with branches of the internal pudendal artery, contributing to the rich collateral circulation of the perineum.

- **Deep femoral artery (Profunda femoris artery)**

It is the largest branch of the femoral artery and serves as the **principal source of blood supply to the hip region** and **the thigh**.

Proximally, it gives off the medial and lateral circumflex femoral arteries. These arteries form an extracapsular arterial ring around the **head** and **neck of the femur**, providing a vital blood supply to these structures.

Through its numerous branches, the deep femoral artery distributes blood to all three muscular compartments of the thigh:

- The medial and lateral circumflex femoral arteries mainly supply the **anterior compartment of the thigh** and the **hip joint region**.

- Direct muscular branches supply the **medial (adductor) compartment of the thigh**.
- **Perforating branches**, which pass through the adductor magnus muscle, serve as the primary arterial supply to the **posterior compartment of the thigh**, including the hamstring muscles.

Thus, the deep femoral artery not only provides the major blood supply to the thigh, but also plays a **key role in the collateral circulation around the hip** and **knee**

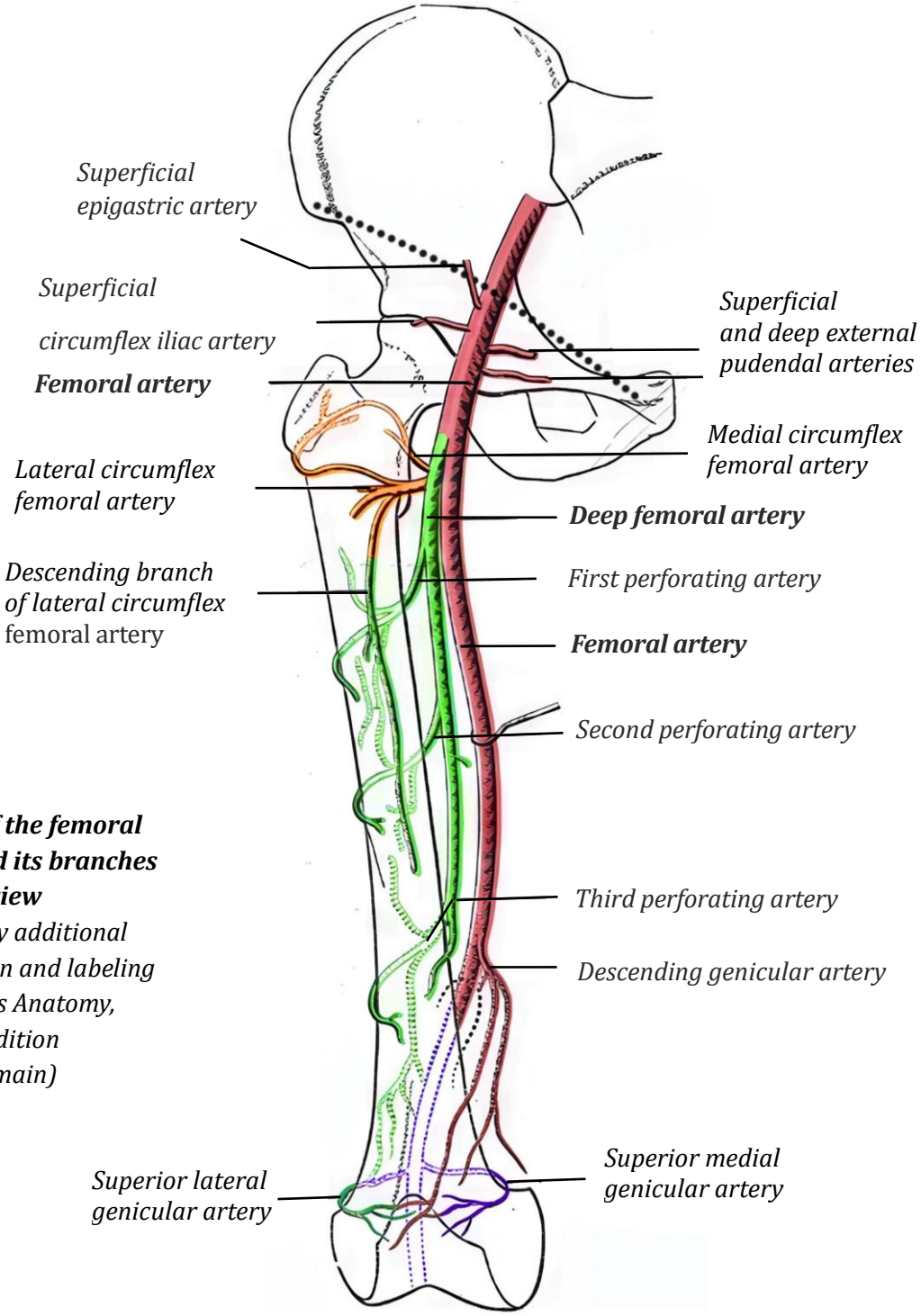


Fig. 6
Scheme of the femoral artery and its branches
Anterior view
Modified by additional colorization and labeling from Gray's Anatomy, 20th U.S. edition (public domain)

regions, ensuring adequate perfusion when the main femoral artery is narrowed or occluded.

Course of the deep femoral artery

Deep femoral artery arises from the posterolateral aspect of the femoral artery approximately 3 – 5 cm below the inguinal ligament, within the femoral triangle.

It runs posterior to the femoral artery and vein and descends deep in the thigh, passing between the pectineus and adductor longus muscles. It then continues further between the adductor longus and adductor brevis or adductor magnus. It does not exit the thigh – it terminates by perforating the adductor magnus muscle, contributing to muscular supply in the posterior compartment.

The deep femoral artery is accompanied by the ***deep femoral vein***.

Branches of the deep femoral artery

- **Lateral circumflex femoral artery** passes laterally, and anterior to the femoral neck, lying deep to the sartorius and rectus femoris muscles. It soon divides into three terminal branches.

  The **ascending branch** anastomoses with branches of the medial circumflex femoral artery, forming an important collateral network that contributes to the blood supply of the neck and head of the femur.

  The **transverse branch** supplies the proximal femur and participates in the cruciate anastomosis, which connects with the medial circumflex femoral, inferior gluteal, and first perforating arteries, providing blood to the adjacent muscles of the thigh and hip region.

  The **descending branch** contributes to the arterial anastomosis around the knee and supplies the vastus lateralis muscle.

- **Medial circumflex femoral artery** courses medially and then turns posteriorly between the pectineus and iliopsoas muscles. It continues between the obturator externus and adductor brevis muscles before reaching the posterior aspect of the femoral neck.

  This artery forms an anastomosis with the lateral circumflex femoral artery and provides the majority of the blood supply to the head and neck of the femur.

Its branches also anastomose with the inferior gluteal artery and the first perforating artery, contributing to the rich vascular network around the proximal femur. In addition, the medial circumflex femoral artery supplies the hip joint region, adductor muscles.

Small but clinically significant acetabular branches, primarily derived from the obturator artery and partly from the medial circumflex femoral artery, pass within the ligament of the head of the femur. These vessels enter the femoral head and play a crucial role in its blood supply during infancy and early childhood. At this stage, the branches of the medial and lateral circumflex femoral arteries are relatively small and not yet fully developed.

- **Perforating arteries** are usually three or four branches that arise from the deep femoral artery along its course in the thigh. These arteries pass through the adductor magnus muscle to reach the posterior compartment, where they supply the hamstring muscles. Small branches also contribute to the vascular supply of the medial (adductor) compartment.

  The perforating arteries anastomose with one another, as well as superiorly with branches of the inferior gluteal artery and inferiorly with branches of the popliteal artery. Through these connections, they form an important collateral network that helps maintain blood flow to the thigh and knee regions, particularly when the main femoral artery is obstructed or ligated.

- **Descending genicular artery**

  It arises from the femoral artery in the adductor canal and passes through the vastoadductor membrane. It then descends to join the genicular anastomosis around the knee, accompanying the saphenous nerve to the knee region

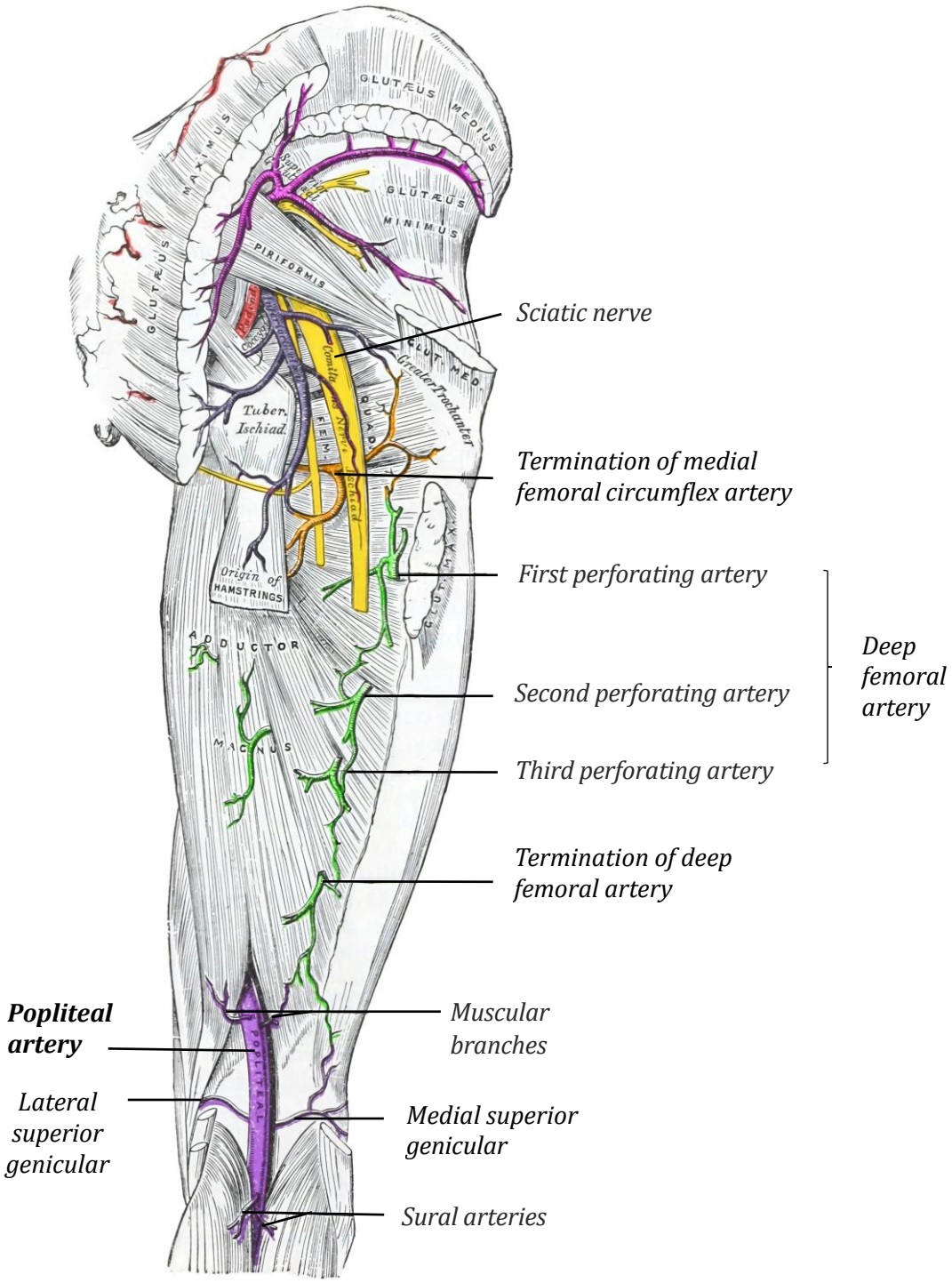


Fig. 7
Arteries of the posterior thigh and popliteal fossa
Modified by additional colorization and labeling from Gray's Anatomy, 20th U.S. edition (public domain)

Clinical notes

*The blood supply to the **femoral head undergoes significant changes from childhood to adulthood**, a fact of **considerable clinical importance**. These developmental differences influence the susceptibility to avascular necrosis following fractures of the femoral neck in both age groups.*

***In children**, the femoral head receives a substantial portion of its blood supply from the acetabular branches of the obturator and medial circumflex femoral arteries, which course within the ligament of the head of the femur. This additional vascular contribution makes the pediatric femoral head more resistant to avascular necrosis after fractures.*

***In adults**, the main blood supply arises from branches of the medial circumflex femoral artery, with a smaller contribution from the lateral circumflex femoral artery. The artery of the ligament of the head of the femur becomes functionally insignificant, rendering the adult femoral head more vulnerable to avascular necrosis following fracture.*

Collateral circulation in femoral artery obstruction

*When the femoral artery becomes narrowed or occluded (for example, due to atherosclerosis), the **deep femoral artery** (profunda femoris artery) serves as the **principal source of collateral blood supply to the lower limb**. Its perforating branches, together with the descending genicular artery, form anastomoses with the genicular branches of the popliteal artery and with branches of the anterior and posterior tibial arteries, enabling blood to bypass the obstruction. In cases of gradual occlusion, these collateral pathways can enlarge over time and maintain adequate perfusion of the limb, resulting in mild or even absent symptoms. In contrast, acute occlusion or traumatic injury does not allow sufficient time for collateral development, often leading rapidly to critical limb ischemia.*

*The **perforating arteries** are also at risk during surgical procedures involving the thigh, such as femoral fracture repair, where iatrogenic damage can lead to ischemia of the posterior thigh muscles.*

Table 2: Superficial branches of the femoral artery

ASIS = anterior superior iliac spine

Artery	Course	Structures supplied	Clinical notes
Superficial epigastric artery	Arises just below inguinal ligament; ascends anteriorly toward umbilicus	Skin and superficial fascia of lower abdominal wall	Forms collateral circulation with inferior epigastric artery; used in flap surgeries
Superficial circumflex iliac artery	Runs laterally, parallel to inguinal ligament toward ASIS	Skin and superficial fascia of lateral inguinal region	Landmark in superficial dissections
Superficial external pudendal artery	Passes medially toward external genitalia	External genitalia, lower abdominal wall	Risk in inguinal hernia repairs or catheterization
Deep external pudendal artery	Passes medially toward external genitalia	External genitalia, deper structures of perineum	Part of pudendal vascular network; careful during perineal surgeries

Table 3: Deep femoral (profunda femoris) artery – principal branch of the femoral artery

Artery/branch	Course	Structures supplied	Clinical notes
Deep femoral (profunda femoris) artery	Arises from femoral artery in femoral triangle; descends between adductors; terminates by giving off perforating arteries that pierce adductor magnus to reach posterior compartment	Provides principal blood supply to thigh muscles in anterior, medial, posterior compartments	Forms collateral pathways around hip and knee, especially when femoral artery is occluded; used in grafts and angiography

Table 4: Branches of the deep femoral (profunda femoris) artery

Artery/branch	Course	Structures supplied	Clinical notes
Medial circumflex femoral artery	Passes posteriorly between pectineus and iliopsoas muscles to reach posterior aspect of thigh	Head and neck of femur, hip joint, and adductor muscles	Principal artery supplying the femoral head; may be injured in femoral neck fractures → risk of avascular necrosis.
Lateral circumflex femoral artery	Runs laterally deep to sartorius and rectus femoris muscles; divides into ascending, transverse, and descending branches	Hip and knee joints, anterior compartment of the thigh	Contributes to blood supply of femoral head and to collateral circulation around hip and knee
Perforating arteries 1 – 2 (3)	Pierce adductor magnus muscle to enter posterior compartment of thigh	Posterior thigh muscles (hamstrings) and part of adductor magnus	Main arterial supply to posterior compartment; participate in collateral circulation
Terminal perforating artery	Pierces distal part of adductor magnus and descends toward posterior thigh and knee region	Distal adductor magnus, hamstrings, and tissues around knee	Contributes to anastomotic network around knee; supports distal collateral circulation

POPLITEAL ARTERY

Course of the popliteal artery

The popliteal artery is the direct continuation of the femoral artery. It begins as the femoral artery passes through the adductor hiatus to enter the popliteal fossa. It then descends vertically within the fossa between the gastrocnemius and popliteus muscles. It terminates at the inferior border of the popliteus muscle by dividing into its two terminal branches – the **anterior tibial artery** and the **posterior tibial artery**.

Within the popliteal fossa, the popliteal artery is the deepest and most medial structure. Superficial and lateral to it lies the **popliteal vein**, followed by the **tibial nerve** and, most laterally, the common **fibular (peroneal) nerve**.

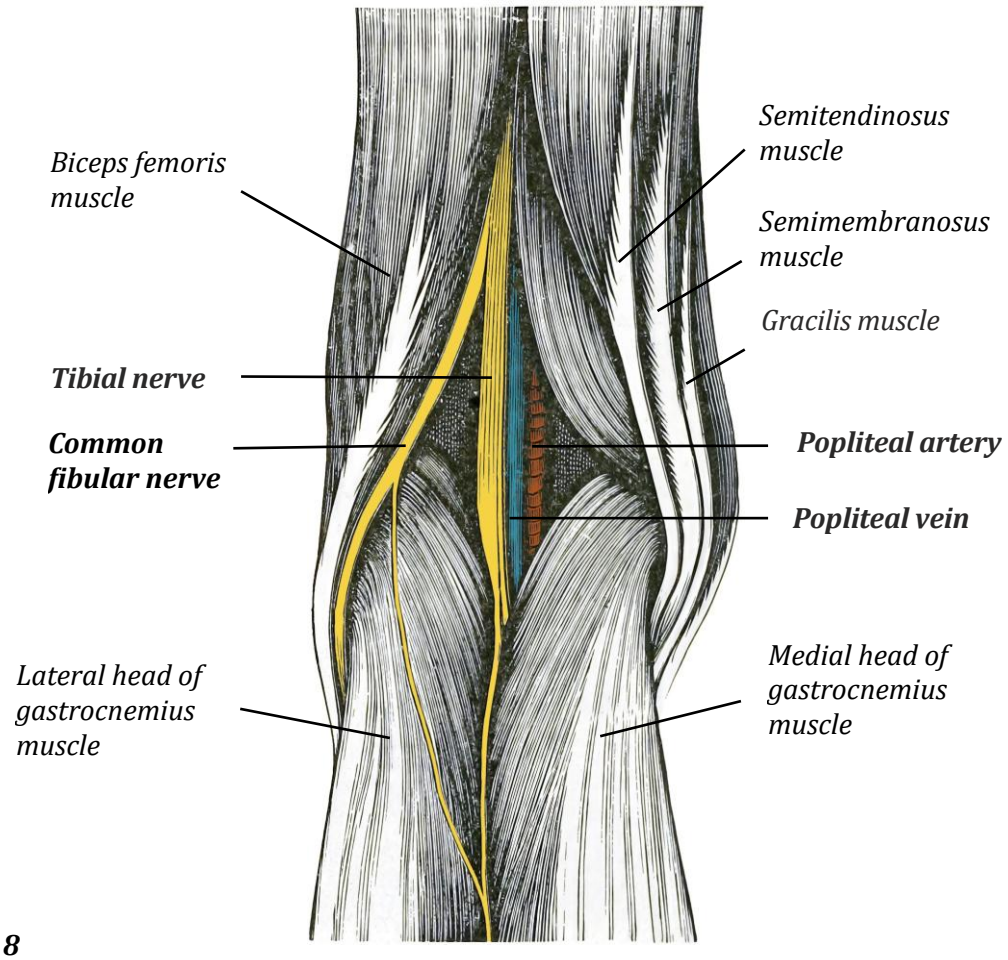


Fig. 8
Relations of the popliteal vessels within popliteal fossa. Left lower limb, posterior view.
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Branches of the popliteal artery

The popliteal artery gives off several branches – genicular, muscular, and terminal.

- The **genicular arteries** form an extensive arterial network around the knee joint.

The genicular arteries are five in number: two superior, two inferior, and one middle. The **superior lateral** and **superior medial genicular arteries** pass above the condyles of the femur. The **inferior lateral** and **inferior medial genicular arteries** pass below the condyles of the tibia. The **middle genicular artery** pierces the capsule of the knee joint to supply the cruciate ligaments and synovial structures.

- The **muscular branches** of the popliteal artery supply the muscles in and around the popliteal fossa – hamstring, triceps surae, plantaris, and popliteus muscles. The largest muscular branches are the **sural arteries** which primarily supply both heads of the gastrocnemius muscle and also send smaller branches to the adjacent connective tissue.

- Two **terminal branches** of the popliteal artery, the **anterior tibial artery** and **posterior tibial artery,** begin at the level of the inferior border of the popliteus muscle within the distal part of the popliteal fossa. While the division occurs at that level, the anterior tibial artery immediately leaves the fossa by piercing the interosseous membrane and continues forward. The posterior tibial artery stays in the posterior compartment.

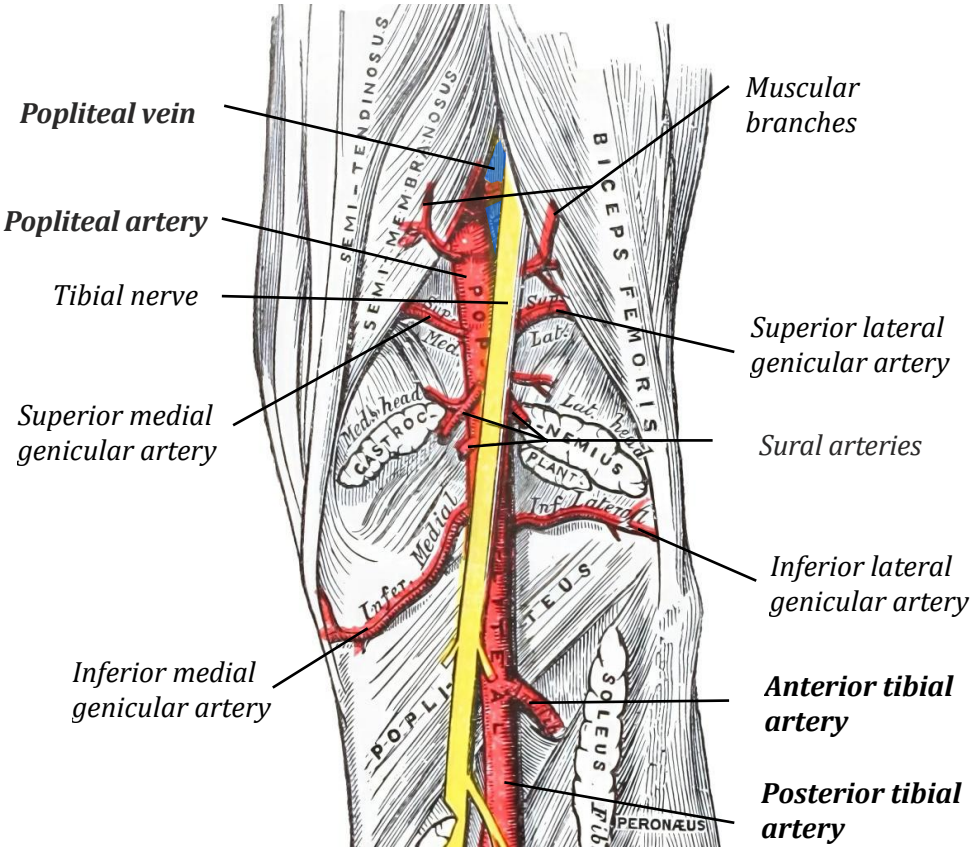


Fig. 9
Popliteal artery and its branches, medial and lateral heads of the gastrocnemius muscle, transected. Right lower limb, posterior view.
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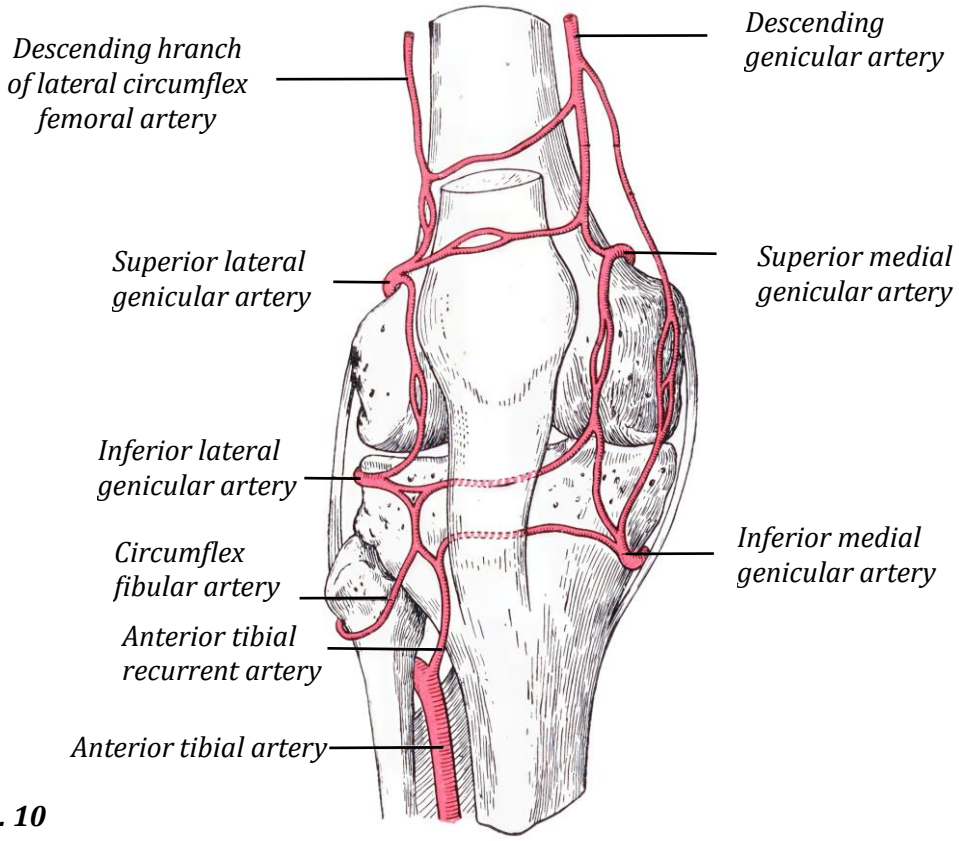


Fig. 10
Arterial anastomotic network around the knee
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Clinical notes

*Besides the **five genicular arteries** of the popliteal artery, the arterial anastomotic network around the knee is reinforced by contributions from:*

- ***Descending genicular artery** – from the femoral artery;*
- *The lowest **perforating artery and the descending branch of the lateral circumflex femoral artery** – from the deep femoral artery;*
- ***Anterior tibial recurrent artery** – from the anterior tibial artery;*
- ***Posterior tibial recurrent artery** – from the posterior tibial artery;*
- ***Circumflex fibular artery** – from the posterior tibial artery.*

These interconnections maintain blood flow to the leg when the popliteal artery is compressed during knee flexion, or when a proximal femoral or popliteal segment is occluded. They are also important during surgical ligation or in traumatic knee dislocations, where disruption of this network can lead to limb-threatening ischemia.

Table 5: Popliteal artery and its branches

Artery		Course	Structures supplied	Clinical notes
Popliteal artery		Continuation of femoral artery through adductor hiatus; lies as the ***most medial and deepest structure in popliteal fossa***	Posterior thigh, knee joint, and leg (through its branches)	Pulse palpable in popliteal fossa (with knee flexed); aneurysm may compress tibial nerve
➡	**Genicular branches** superior, middle, inferior, medial and lateral	Surround knee joint to form genicular anastomosis	Knee joint, capsule, ligaments, and adjacent muscles	Maintain collateral circulation around knee in case of femoral or popliteal artery occlusion
➡	**Sural arteries**	Short muscular branches descending to gastrocnemius and soleus muscles	Posterior leg muscles and overlying skin	Important in muscular blood supply
➡	**Terminal branches: anterior and posterior tibial arteries**	Divide at lower border of popliteus muscle	Leg and foot (through tibial arteries)	Mark transition from thigh to leg arterial system

Clinical notes

Palpation of the popliteal pulse:

The popliteal pulse is less frequently assessed because it can be difficult to palpate compared to pulses such as the dorsalis pedis, or posterior tibial arteries. Proper technique requires the patient's knee to be flexed and firm pressure applied deeply in the popliteal fossa behind the knee. Assessment of this pulse is particularly important when distal pulses (dorsalis pedis and posterior tibial arteries) are weak or absent, as it helps evaluate arterial flow to the lower leg.

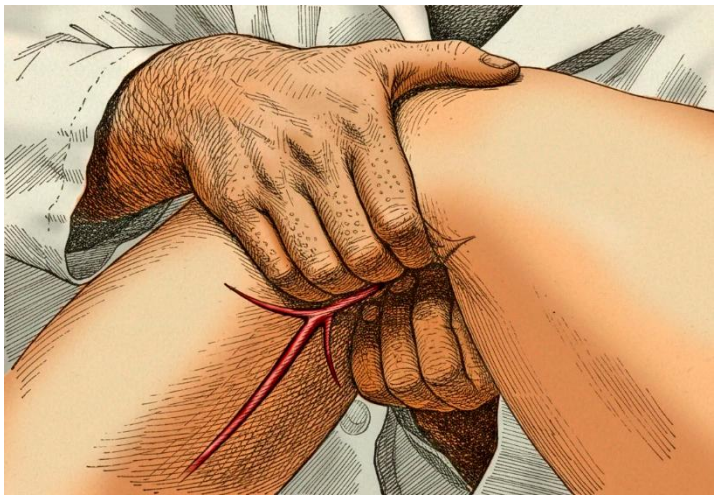


Fig. 11
Palpation site for the popliteal artery pulse: *deep in the popliteal fossa near the midline*
Drawing from the author's archive

ANTERIOR TIBIAL ARTERY

Course of the anterior tibial artery

The anterior tibial artery arises from the popliteal artery within the popliteal fossa and passes forward between the tibia and fibula, piercing the interosseous membrane to enter the anterior compartment of the leg. It descends on the anterior surface of the interosseous membrane, first between the tibialis anterior and extensor digitorum longus muscles, and more distally between the tibialis anterior and extensor hallucis longus muscles. At the level of the ankle, after passing beneath the inferior extensor retinaculum, it continues onto the dorsum of the foot as the **dorsalis pedis artery**.

The anterior tibial artery is accompanied by the deep fibular (peroneal) nerve and the anterior tibial veins.

Branches of the anterior tibial artery

The anterior tibial artery supplies the muscles of the anterior compartment of the leg and contributes to the arterial anastomoses around the knee and ankle.

- The **anterior tibial recurrent artery** arises shortly after the anterior tibial artery enters the anterior compartment. It ascends toward the knee and contributes to the arterial network around the knee.
- Multiple small **muscular branches** supply muscles of the anterior compartment of the leg and also assist in supplying muscles on the lateral aspect of the leg.

- Near the ankle, the **anterior medial malleolar artery** and **anterior lateral malleolar artery** arise just above the ankle joint and contribute to the medial and lateral malleolar arterial networks, respectively.

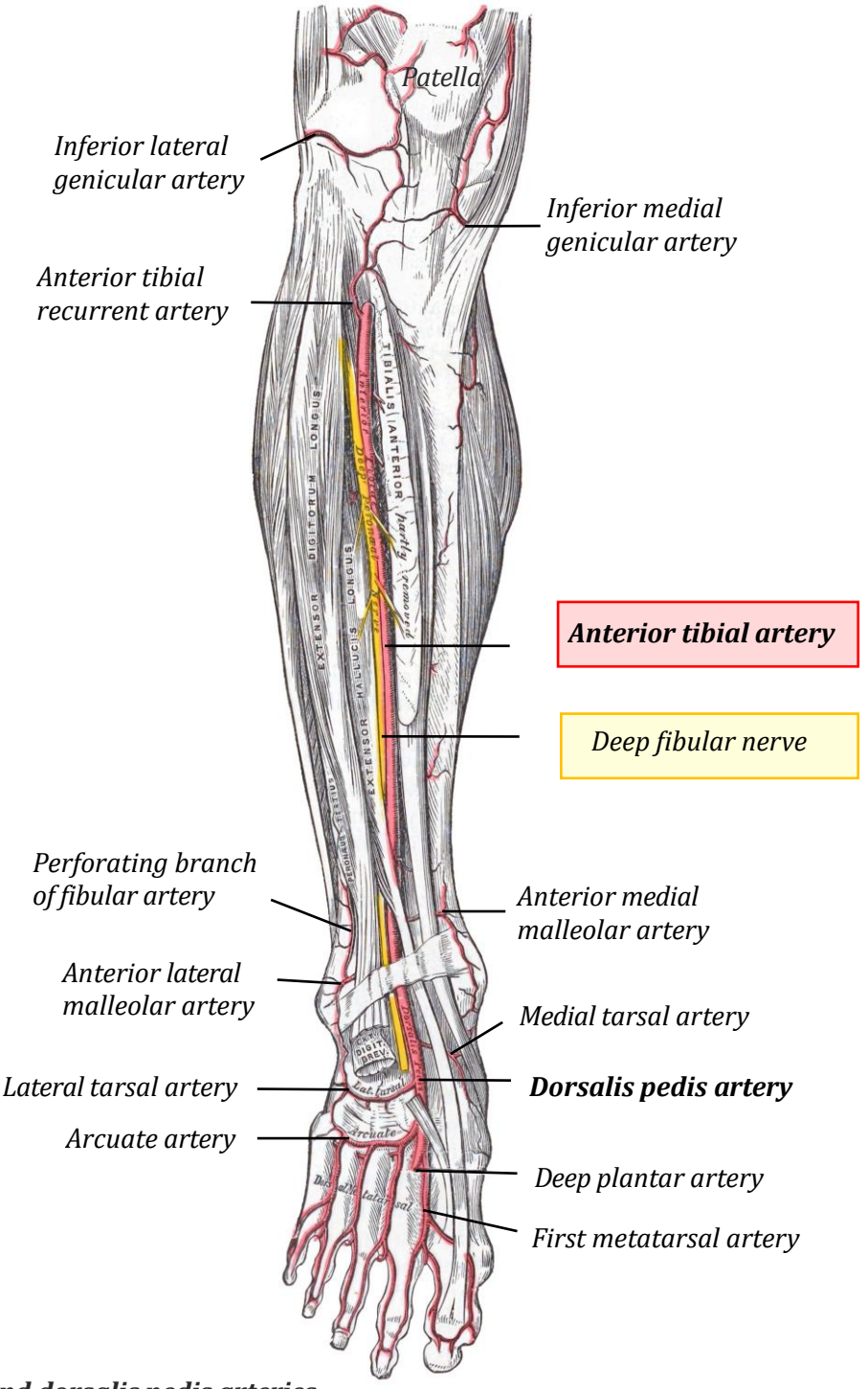


Fig. 12
Anterior tibial and dorsalis pedis arteries
Modified by additional colorization and labeling from Gray's Anatomy, 20th U.S. edition (public domain)

DORSALIS PEDIS ARTERY

Course of the dorsalis pedis artery

The dorsalis pedis artery is the direct continuation of the anterior tibial artery below the ankle joint. It begins just distal to the inferior extensor retinaculum, approximately at the midpoint between the medial and lateral malleoli.

From its origin, it runs anteromedially across the dorsum of the foot, passing over the tarsal bones. Throughout its course, it lies between the tendon of the extensor hallucis longus (medially) and the tendons of the extensor digitorum longus (laterally).

At the level of the first intermetatarsal space, the artery terminates by dividing into the deep plantar artery (which passes to the sole of the foot to join the plantar arterial arch) and the first dorsal metatarsal artery.

The **deep fibular (deep peroneal) nerve** accompanies the dorsalis pedis artery along its course on the dorsum of the foot.

Branches of the dorsalis pedis artery

The dorsalis pedis artery is the principal artery supplying the dorsum of the foot. Along its course, it gives off several important branches:

- The **lateral tarsal artery** passes laterally, deep to the tendons of the extensor digitorum brevis and extensor hallucis brevis muscles, to supply the lateral aspect of the dorsum of the foot. It anastomoses with the arcuate artery. The **medial tarsal arteries** usually have two or more small branches that pass medially to supply the medial border of the foot and contribute to the medial malleolar arterial network.
- The **arcuate artery** arises on the lateral side of the dorsum of the foot and runs laterally across the bases of the metatarsals, beneath the extensor digitorum brevis muscle. It anastomoses with the lateral tarsal artery, forming an arterial loop on the dorsum of the foot.
- The **1st dorsal metatarsal artery** is usually a terminal branch of the dorsalis pedis artery (running in the first intermetatarsal space). The **2nd, 3rd,** and **4th dorsal metatarsal arteries** arise from the arcuate artery and pass distally over the intermetatarsal spaces. Each dorsal metatarsal artery divides into two **dorsal digital arteries** which supply the adjacent sides of the toes.

- The **deep plantar artery** is the second terminal branch of the dorsalis pedis artery.

It penetrates the first intermetatarsal space to enter the sole, where it joins the deep plantar arch (the terminal continuation of the lateral plantar artery), thereby completing the plantar arterial arch.

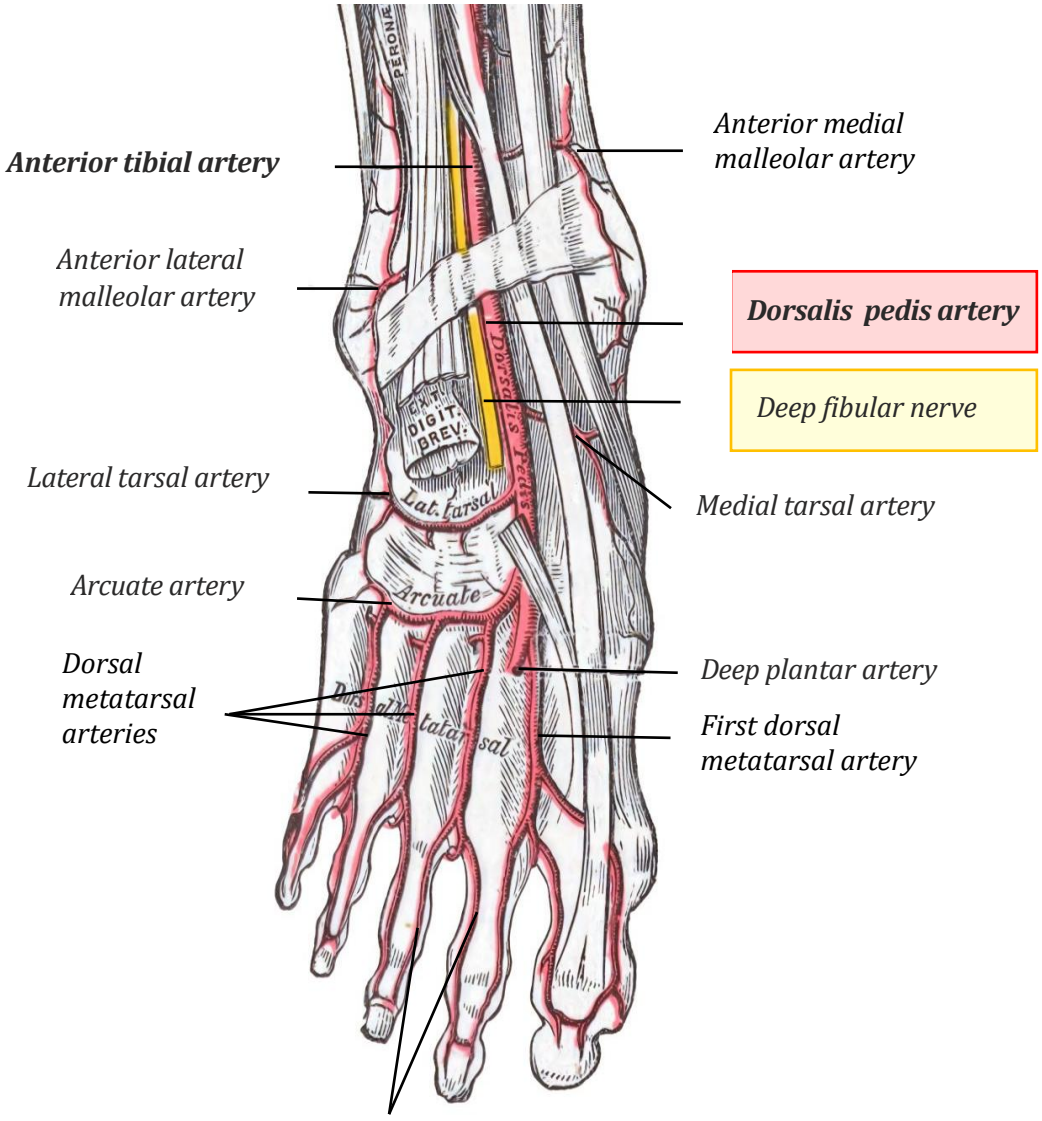


Fig. 13
Dorsalis pedis artery and its branches
Modified by additional colorization and labeling from Gray's Anatomy, 20th U.S. edition (public domain)

Table 6: Anterior tibial artery and its branches

Artery	Course	Structures supplied	Clinical notes
Anterior tibial artery	Arises from popliteal artery; passes through interosseous membrane and descends in anterior compartment of leg accompanied by ***deep fibular nerve***	Anterior compartment muscles of leg and dorsum of foot (via its terminal branch)	Pulse of dorsalis pedis artery used to assess its patency; occlusion may cause ischemia of anterior compartment
➡ **Anterior tibial recurrent artery**	Ascends toward knee joint	Knee joint and adjacent anterior compartment muscles	Contributes to genicular anastomosis around knee
➡ **Anterior lateral and medial malleolar arteries**	Descend toward ankle joint	Ankle joint and surrounding tissues	Contribute to malleolar arterial network around ankle
➡ **Terminal branch: dorsalis pedis artery**	Continuation of anterior tibial artery distal to ankle joint	Back of foot and toes	***Pulse palpable*** lateral to tendon of extensor hallucis longus; important for assessing peripheral circulation

Clinical notes

On the dorsum of the foot, the ***pulse of the dorsalis pedis artery*** *is palpated just distal to the ankle joint. It is usually easy to feel because the artery lies subcutaneously as it passes over the first intermetatarsal space, lateral and parallel to the tendon of the extensor hallucis longus.*

The presence, strength, and symmetry of the dorsalis pedis pulse are important indicators of peripheral arterial perfusion. Absence or diminution of this pulse may suggest peripheral arterial disease, arterial occlusion, or anatomical variation.

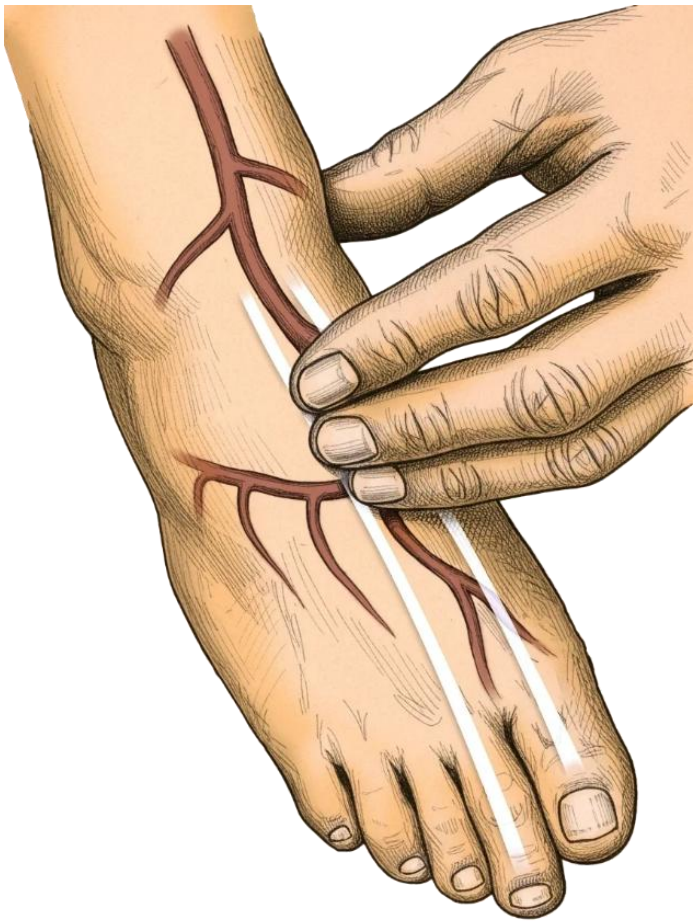


Fig. 14
Palpation site for the dorsalis pedis artery pulse: *on the dorsal aspect of the foot over the tarsal bones, between the tendons of the extensor digitorum longus and extensor hallucis longus.*
Drawing from the author's archive

POSTERIOR TIBIAL ARTERY

Course of the posterior tibial artery

The posterior tibial artery is the direct continuation of the popliteal artery after it gives off the anterior tibial artery. It descends in the deep posterior compartment of the leg, passing beneath the tendinous arch of the soleus muscle. It then runs downward between the superficial and deep groups of the posterior leg muscles, and passes posterior to the medial malleolus within the medial retromalleolar space (tarsal tunnel), deep to the flexor retinaculum. At this point, it is divided into the medial and lateral plantar arteries which supply the sole of the foot.

Throughout its course, the posterior tibial artery is accompanied by the **tibial nerve** and the **posterior tibial veins**.

Branches of the posterior tibial artery

The posterior tibial artery and its branches supply the muscles of the posterior compartment of the leg and, through the fibular artery, also supply the lateral compartment. They contribute to the arterial networks around the knee, ankle, and the heel.

- The **circumflex fibular artery** originates from the initial part of the posterior tibial artery. It passes laterally around the neck of the fibula and contributes to the arterial network around the knee.
- Soon after its origin, the posterior tibial artery gives rise to the **fibular (peroneal) artery**. This vessel descends in the deep posterior compartment of the leg, running parallel to, and more lateral than the posterior tibial artery, along the medial surface of the fibula.

It extends toward the calcaneus and is covered for most of its length by the flexor hallucis longus muscle. During its course, the **fibular artery** gives off several important **branches**:

- **Perforating branch** pierces the interosseous membrane near the distal tibiofibular joint to reach the dorsum of the foot where it anastomoses with the anterior tibial artery.
- **Communicating branch** joins the posterior tibial artery above the ankle, contributing to the collateral circulation.

- **Muscular branches** supply the muscles of the posterior compartment and also has branches that pass laterally to supply muscles of the lateral compartment of the leg.
- **Posterior lateral malleolar branches** participate in the lateral malleolar arterial network.
- **Lateral calcaneal branches** supply the calcaneal (heel) region and participate in the calcaneal arterial network.

- The **posterior medial malleolar branches** pass behind the medial malleolus to the arterial malleolar network overlying the medial malleolus.
- The **calcaneal branches** contribute to the arterial network around the calcaneus.

At the level of the medial retromalleolar space, the posterior tibial artery divides into the **terminal branches** – a small **medial plantar artery** and a much larger **lateral plantar artery** which are the principal blood supply of the sole of the foot.

- The **lateral plantar artery** passes obliquely laterally and forward across the sole, running between the flexor digitorum brevis muscle superficially and the quadratus plantae muscle deeply. At the base of the fifth metatarsal, the lateral plantar artery curves medially to form the **deep plantar arch.** Along its course, the lateral plantar artery gives off the **muscular, cutaneous,** and **lateral calcaneal branches**.
  - The **deep plantar arch** is a distal, convex continuation of the lateral plantar artery which runs along the bases of the metatarsals and is connected with the deep plantar artery of the dorsalis pedis artery. The deep plantar arch gives off:
  - **plantar metatarsal arteries** which are divided into the **proper plantar digital arteries** to supply the medial and lateral plantar aspects of the toes;
  - **perforating branches** pass between the metatarsals to anastomose with the dorsal metatarsal arteries.
- The **medial plantar artery** runs forward along the medial side of the sole, between the abductor hallucis and the flexor digitorum brevis muscle. It gives off:
  - **deep branch** to adjacent muscles of the medial part of the sole and ends by joining the digital branch of the deep plantar arch which supplies the big toe (hallux);
  - **superficial branch** supplies the region of the hallux.

Together, the medial and lateral plantar arteries provide the principal blood supply to the muscles, fascia, and skin of the sole, and they also contribute to extensive anastomoses with the arterial system on the dorsum of the foot.

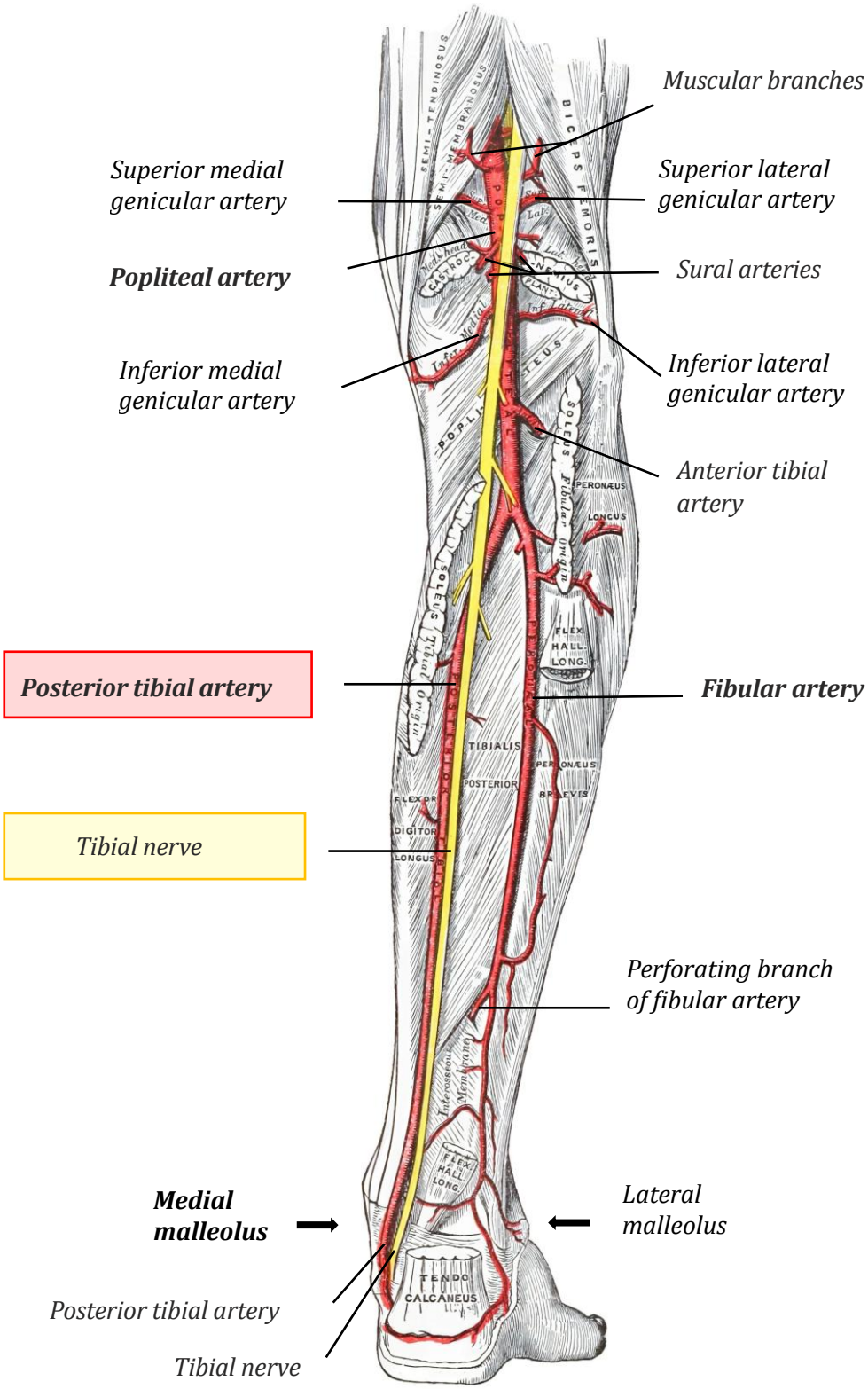


Fig. 15
Popliteal, posterior tibial and fibular arteries
Modified by additional colorization and labeling from Gray's Anatomy, 20th U.S. edition (public domain)

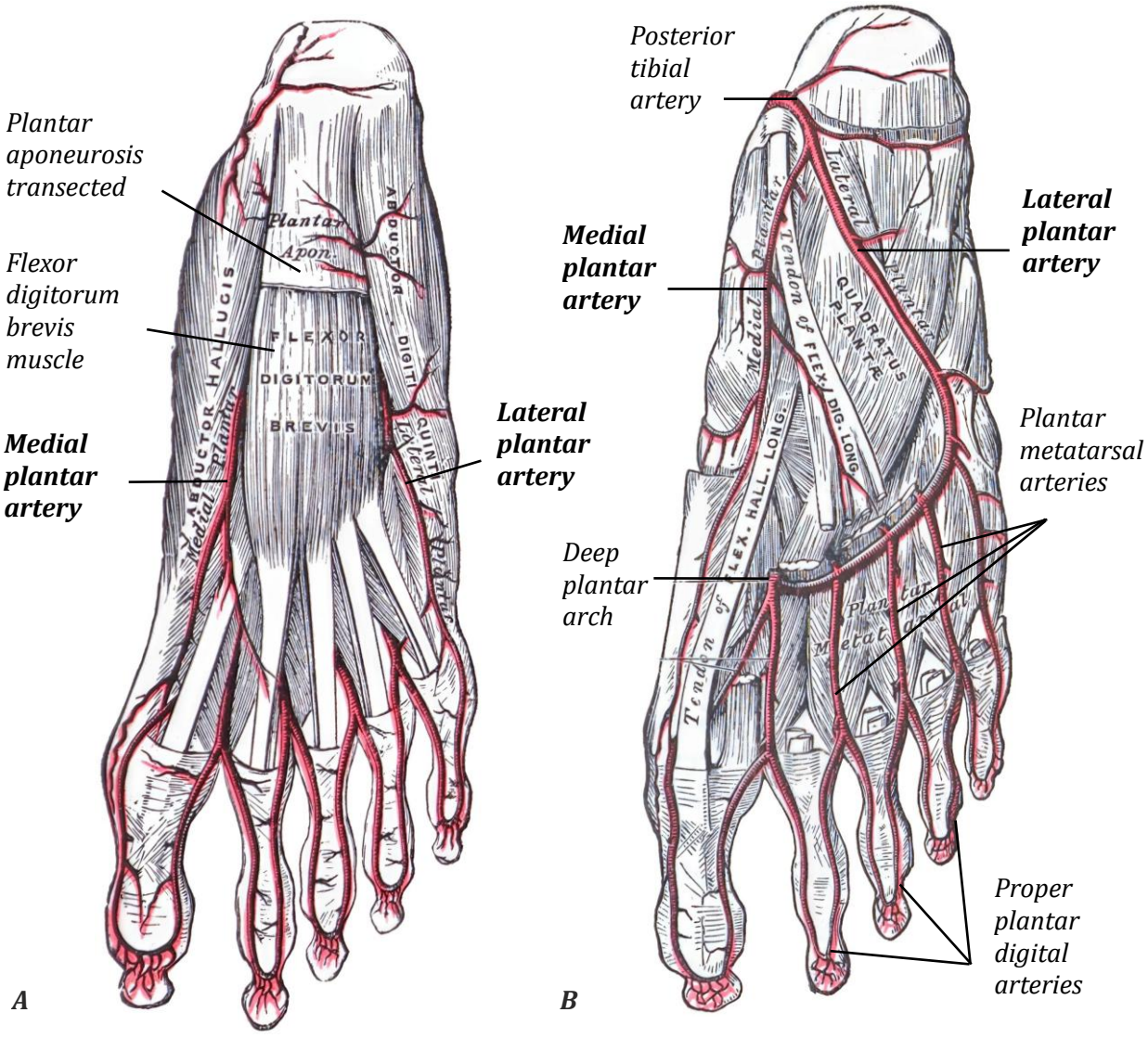
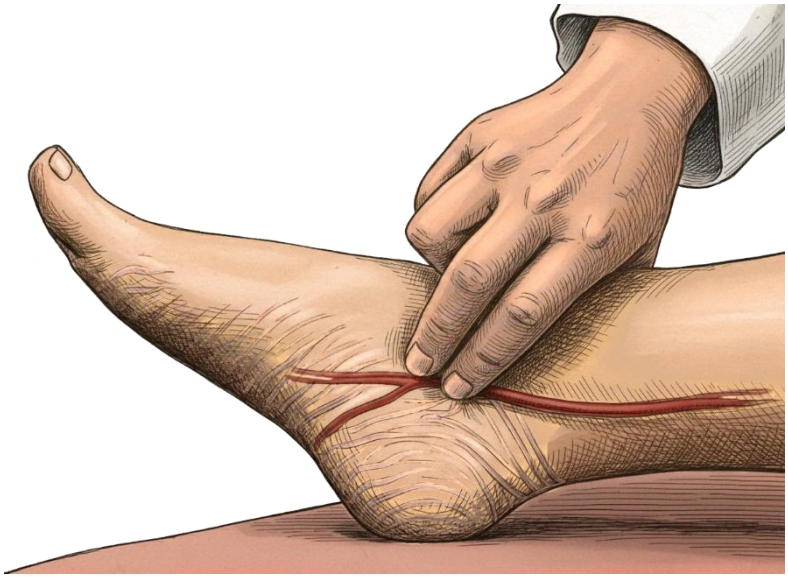


Fig. 16
Plantar arteries
A Superficial view
B Deep view
Modified by additional colorization and labeling from Gray's Anatomy, 20th U.S. edition (public domain)

Table 7: Posterior tibial artery and its branches

Artery	Course	Structures supplied	Clinical notes
Posterior tibial artery	Arises from popliteal artery; descends in posterior compartment of leg accompanied by ***tibial nerve***; passes through medial retromalleolar space	Muscles of posterior compartment of leg; plantar region of foot (via terminal branches)	***Posterior tibial pulse palpable behind the medial malleolus***; key indicator of lower limb perfusion
➡ **Fibular (peroneal) artery**	Descends in deep posterior compartment, running parallel to and lateral to posterior tibial artery	Lateral and posterior compartments of leg	***Major branch of posterior tibial artery***; contributes to collateral circulation around ankle
➡ **Circumflex fibular artery**	Courses around neck of fibula toward knee	Knee joint and adjacent tissues	Participates in the arterial network around knee
➡ **Malleolar arteries and calcaneal branches**(from posterior tibial and fibular arteries)	Descend toward ankle and heel regions	Ankle joint, calcaneus, and adjacent tissues	Contribute to the malleolar and calcaneal arterial networks
➡ **Terminal branches: lateral and medial plantar arteries**	Divide beneath flexor retinaculum at ankle	Plantar surface of foot and toes	Form plantar arterial arch; supply sole of foot

Fig. 17
Palpation site for the tibialis posterior artery pulse: posteroinferior to the medial malleolus, in the groove between the medial malleolus and the heel (calcaneal tuberosity)
Drawing from the author's archive



Clinical notes

Surgical and anesthetic relevance

Knowledge of the exact anatomical course of the posterior tibial artery is essential during regional anesthesia (e.g., tibial nerve block) and surgical procedures involving the ankle and foot, to prevent iatrogenic injury and ensure adequate perfusion postoperatively.

Risk in medial malleolar fractures

The posterior tibial artery may be injured in association with medial malleolar fractures or severe ankle trauma. Laceration, compression by displaced bone fragments, or secondary thrombosis can compromise distal blood flow, leading to potential ischemia of the foot. Therefore, ***careful vascular assessment, including palpation of the posterior tibial pulse, is essential in the evaluation of all ankle fractures****.*

BRANCHES OF THE INTERNAL ILIAC ARTERY – Collateral and regional supply

The arterial supply to the lower limb comes primarily from the femoral artery and its branches. However, a significant additional contribution comes from the pelvic vessels, particularly the **superior gluteal artery**, **inferior gluteal artery,** and the **obturator artery**. All of these arteries originate from the **internal iliac artery**. They participate in anastomotic networks with branches of the femoral and deep femoral arteries, ensuring collateral blood flow and functional integration between the pelvic and lower limb vascular systems.

SUPERIOR GLUTEAL ARTERY

The superior gluteal artery is the largest branch of the posterior division of the internal iliac artery. It courses posteriorly between the lumbosacral trunk and the first sacral nerve. It then exits the pelvic cavity through the **greater sciatic foramen**, specifically via the **suprapiriform foramen** located above the piriformis muscle. It is accompanied by the **superior gluteal vein** and the **superior gluteal nerve**.

The superior gluteal artery supplies the gluteal muscles and the overlying skin, and also contributes to blood supply of the hip joint. It forms a rich anastomotic network with the lateral and medial circumflex femoral arteries as well as the inferior gluteal artery.

INFERIOR GLUTEAL ARTERY

The inferior gluteal artery arises from the anterior trunk of the internal iliac artery. It leaves the pelvic cavity through the **greater sciatic foramen**, specifically via the **infrapiriform foramen** located below the piriformis muscle. It enters the gluteal region deep to the gluteus maximus muscle and runs between the **sciatic nerve** and the **posterior femoral cutaneous nerve**. It is accompanied by the **inferior gluteal vein** and the **inferior gluteal nerve**.

The inferior gluteal artery gives off muscular branches to several surrounding structures, providing the major blood supply to the gluteus maximus muscle, as well as contributions to the proximal parts of the hamstring muscles. It also sends small branches

to the hip joint and the overlying skin. The artery then descends to anastomose with branches of the perforating arteries of the deep femoral (profunda femoris) artery.

OBTURATOR ARTERY

The obturator artery is a branch of the anterior division of the internal iliac artery. It courses anteroinferiorly along the lateral pelvic wall, accompanying the **obturator nerve** and **vein**. The artery leaves the pelvic cavity through the **obturator canal** to enter the medial compartment of the thigh, where it is divided into anterior and posterior branches.

- **Anterior branch** supplies the adductor muscles of the thigh and forms an anastomosis with the medial circumflex femoral artery.
- **Posterior branch** courses toward the gluteal muscles, supplying the adjacent structures.
- **Pubic branch** anastomoses with the pubic branch of the inferior epigastric artery.
- **Acetabular branch** passes through the acetabular notch to reach the ligament of the head of the femur.

Clinical notes

Pubic branch of the obturator artery forms a clinically important anastomosis with the branch of the inferior epigastric artery. This anastomosis can be the site of potentially life-threatening bleeding during surgical procedures such as inguinal hernia repair. It is clinically known as Corona mortis.

Acetabular branch of the obturator artery contributes to the vascular supply of the femoral head, playing a crucial role in its nutrition and development, particularly in children. Clinically, preservation of this artery is important to prevent avascular necrosis of the femoral head.

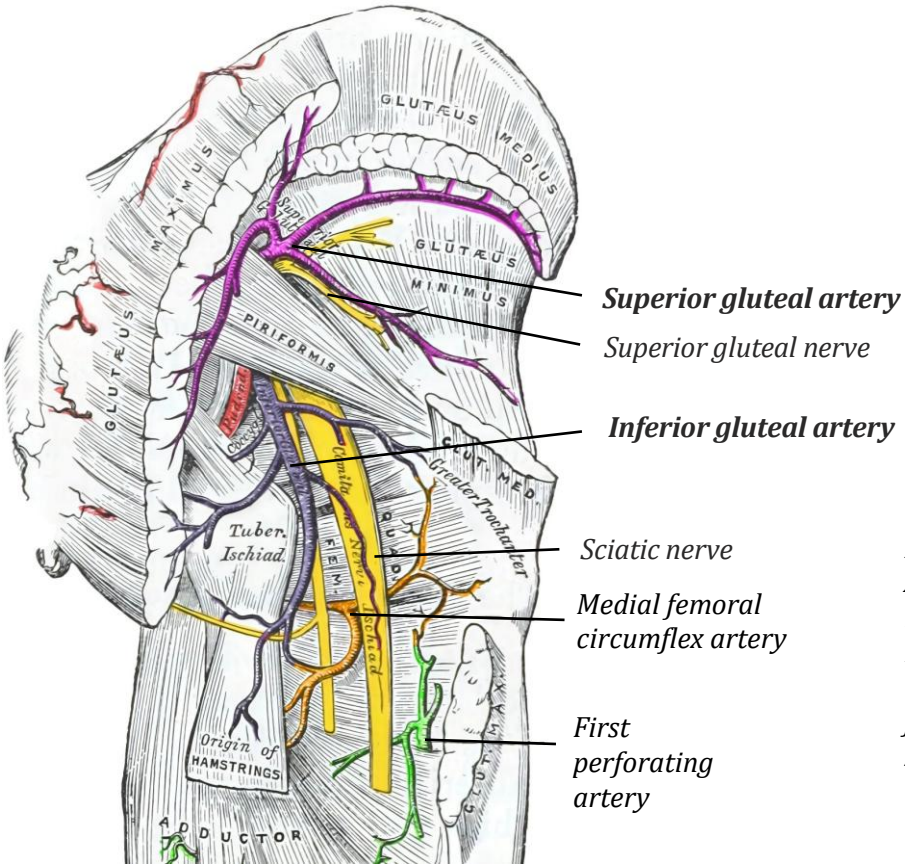


Fig. 18
Arteries of the gluteal region
Modified by additional colorization and labeling from Gray's Anatomy, 20th U.S. edition (public domain)

Clinical notes

Peripheral arterial disease *(PAD) of the lower limb is caused by atherosclerotic narrowing of the arteries supplying the lower limbs, most often the femoral, popliteal, and tibial arteries. Reduced blood flow leads to ischemia distal to the affected arteries, causing symptoms such as pain, weakness, and coldness of the limb.*

On examination, weakened or absent pulses in these arteries indicate stenosis or occlusion within the corresponding segment. ***Palpation of arterial pulses in the lower limbs is a routine clinical examination for suspected ischemia.***

A characteristic symptom of PAD is ***intermittent claudication****: cramping, pain, or heaviness in the calf, thigh, buttocks, or foot during walking, which subsides after a few minutes of rest.*

Chronic ischemia *develops gradually, allowing the formation of collateral circulation. Clinical manifestations include intermittent claudication, trophic skin changes, hair loss, and delayed wound healing.*

Acute ischemia*, in contrast, occurs suddenly, most often due to thrombosis or embolism, and represents a surgical emergency. It presents with severe pain, pallor, coldness, and absent distal pulses.*

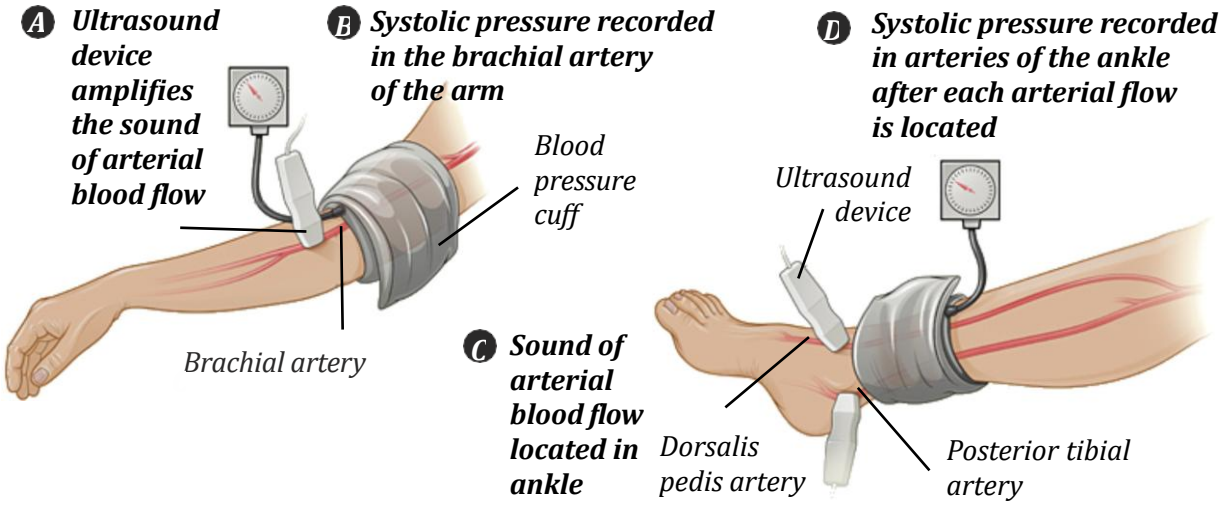


Fig. 19

Doppler ultrasound uses sound waves to visualize blood flow in arteries and veins

This illustration shows the ankle-brachial index (ABI) test, which compares blood pressure in the ankle and arm to assess arterial patencay and hemodynamics
Image by Jmarchn, available under CC BY-SA 3.0, Wikimedia Commons:
https://en.wikipedia.org/wiki/Ankle–brachial_pressure_index#/media/File:Pad_abi_ENG.svg

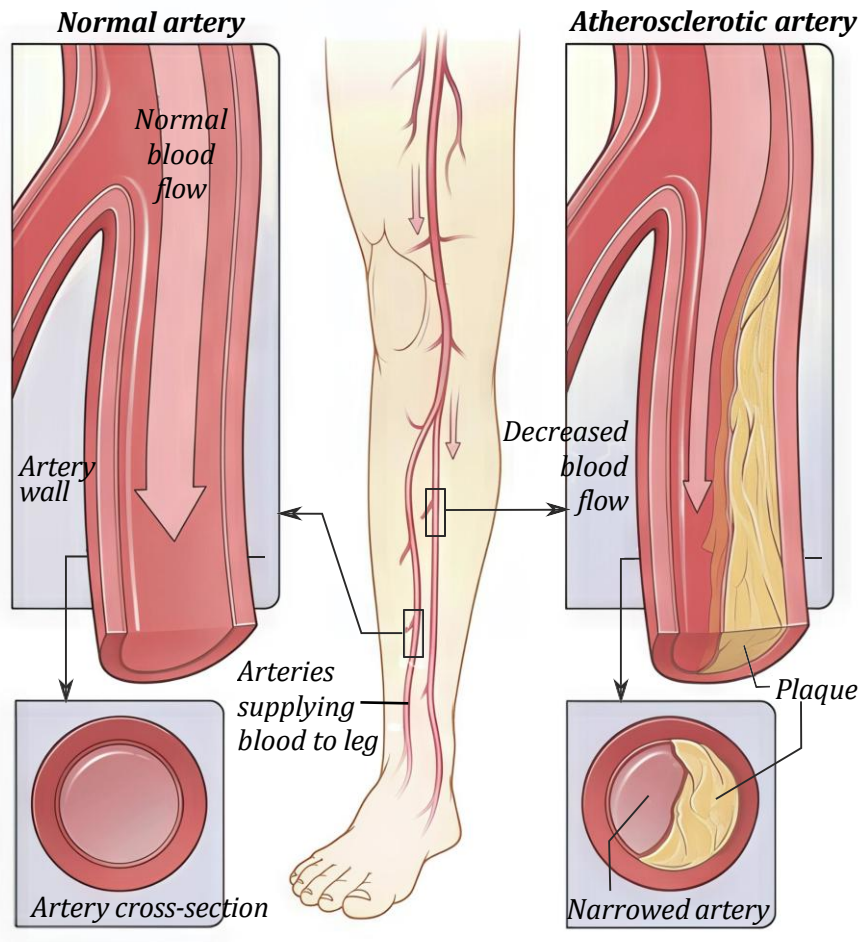


Fig. 20
Peripheral arterial disease
The illustration shows a normal artery with normal blood flow and artery with plaque buildup partially blocking blood flow
Image by Jmarchn, available under CC BY-SA 3.0, Wikimedia Commons: https://en.wikipedia.org/wiki/Peripheral_artery_disease#/media/File:Blausen_Peripheral_Arterial_Disease_eng.svg

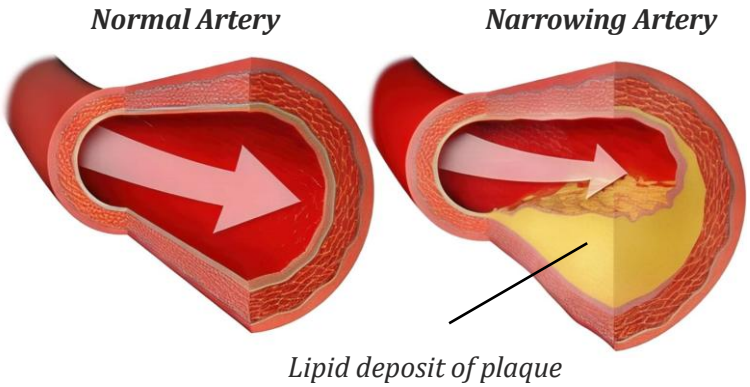


Fig. 21
Atherosclerosis
Illustration of how the buildup of lipids cause a blockage of blood flow to the portion of the artery below the narrowing
Image by Blausen.com staff courtesy of Oregon State University, available under CC BY-SA 2.0, Wikimedia Commons: https://en.wikipedia.org/wiki/Peripheral_artery_disease#/media/File:Atherosclerosis.jpg

Table 8: Summary of the arteries of the lower limb

Key points: Arteries of thigh	
Main arterial axis	External iliac → Femoral artery → Popliteal artery
Major branches	Superficial epigastric, superficial circumflex iliac, superficial and deep external pudendal, profunda femoris (→ medial and lateral circumflex femoral, perforating arteries)
Collateral networks	- Trochanteric anastomosis – around greater trochanter; major supply to femoral head and neck - Cruciate anastomosis – posterior upper thigh; connects external iliac systems (medial and lateral circumflex femoral) and internal (gluteal, obturator); ensures collateral flow
Pulse points	Femoral pulse – mid-inguinal point (midway between ASIS and pubic symphysis)
Clinical relevance	- Femoral artery → site for catheterization and graft access - Medial circumflex femoral artery → crucial for femoral head perfusion (fracture risk → avascular necrosis) - Profunda femoris → major supply to thigh musculature
Key points: Arteries of leg	
Main arterial axis	Popliteal artery → Anterior tibial artery → *dorsalis pedis artery* → Posterior tibial artery → *medial and lateral plantar arteries*
Major branches	- From popliteal: genicular arteries (knee network) - From posterior tibial: fibular artery (lateral & posterior leg) - From anterior tibial: anterior recurrent, malleolar branches, and continuation as dorsalis pedis artery
Anastomotic networks	Genicular anastomosis – around the knee joint Malleolar anastomosis – around the ankle joint Calcaneal network – around the heel region
Pulse points	Popliteal pulse – behind flexed knee Posterior tibial pulse – behind medial malleolus Dorsalis pedis pulse – dorsum of foot, lateral to tendon of extensor hallucis longus
Clinical relevance	Popliteal aneurysm may compress the tibial nerve Posterior tibial and dorsalis pedis pulses are used to assess peripheral perfusion Fibular artery provides collateral flow and is important for reconstructive flaps
Key points: Arteries of gluteal region and thigh	
Major branches	Internal iliac → Superior and inferior gluteal arteries → Obturator artery
Collateral networks	Cruciate anastomosis – posterior upper thigh; connects internal (gluteal, obturator) and external iliac systems (medial and lateral circumflex femoral)
Clinical relevance	Gluteal and obturator arteries – contribute to collateral circulation if the femoral artery is occluded

VEINS OF THE LOWER LIMB

The venous drainage of the lower limb is organized into two systems: the **superficial veins** and the **deep veins**. The deep veins generally follow the arteries, often share their names and drain approximately 85% of blood from the limb, making them functionally more important. The superficial veins, which do not typically accompany arteries, carry the remaining 15% of blood and drain into the deep veins through the perforating veins.

The **perforating veins** normally direct blood from the superficial system - principally from the great and small saphenous veins - into the deep system. In contrast, the **communicating veins** connect veins within the same system (superficial–superficial or deep–deep), helping to equalize venous pressure and providing collateral pathways.

Venous valves, located throughout both superficial and deep veins, play a crucial role in maintaining unidirectional blood flow toward the heart. They prevent retrograde flow and venous pooling which is particularly important in the lower limb where venous blood must ascend against gravity. Deep veins of the lower limb are especially dependent on this mechanism, as they return the majority of blood to the heart.

The effectiveness of venous valves is significantly enhanced by the muscle pump. When walking or performing other movements, muscle contraction compresses the deep veins. This compression increases intraluminal pressure, forcing the proximal valves to open while simultaneously closing the distal valves. In this way, blood is propelled proximally in a stepwise fashion. When the muscles relax, the valves prevent backflow, thereby maintaining forward circulation. This combined action of venous valves and muscle contractions improves venous return from the lower limbs and minimizes venous stasis.

Within the perforating veins, valves ensure blood flow from the superficial system into the deep system while preventing reflux. Incompetence of these valves is a major contributing factor in the development of varicose veins.

In summary, the arrangement of the superficial, deep, and perforating veins, together with the functional integrity of their valves, ensures efficient venous return, stabilizes venous pressure, and protects against venous insufficiency and varicose vein formation.

SUPERFICIAL VEINS OF THE LOWER LIMB

The superficial venous system of the lower limb lies within the subcutaneous tissue and courses independently of the named arteries. It is responsible for draining blood from the skin and superficial fascia. Clinically, these veins are significant as they are frequently involved in varicose vein disease and are commonly utilized as venous grafts in bypass surgery.

Origin of the superficial venous drainage

The superficial venous system of the lower limb originates on the dorsum of the foot in the form of the **dorsal venous arch** which collects blood from the dorsal metatarsal veins. This arch communicates with the **plantar venous network** through the **lateral** and **medial marginal veins**, thereby establishing connections between the dorsal and plantar venous systems.

The two **principal superficial veins of the lower limb**, the **great saphenous vein** and the **small saphenous vein**, originate from the dorsal venous arch of the foot.

The **great saphenous vein** is the longest vein in the human body. It runs anterior to the medial malleolus, ascends along the medial aspect of the leg and thigh, and drains into the femoral vein within the femoral triangle.

The **small saphenous vein** runs posterior to the lateral malleolus, courses superiorly along the posterior aspect of the leg and empties into the popliteal vein within the popliteal fossa.

Course of the great saphenous vein

The great saphenous vein arises from the **medial side** of the **dorsal venous arch** of the foot. It ascends **anterior** to the **medial malleolus**, a clinically important surface landmark, and continues along the **medial aspect of the leg** where it is accompanied by the **saphenous nerve**, a branch from the femoral nerve. The vein then passes **posterior** to the **medial condyle** of the **femur** and continues along the **medial side** of the **thigh**, maintaining a superficial position throughout its course. Near the groin, it traverses the cribriform fascia overlying the saphenous opening in the fascia lata. It then **terminates** in the **femoral vein** within the **femoral triangle**, approximately 2 – 4 cm inferolateral to the pubic tubercle.

The great saphenous vein contains numerous valves, most of which are located in the leg rather than in the thigh. These valves facilitate efficient venous return toward the heart.

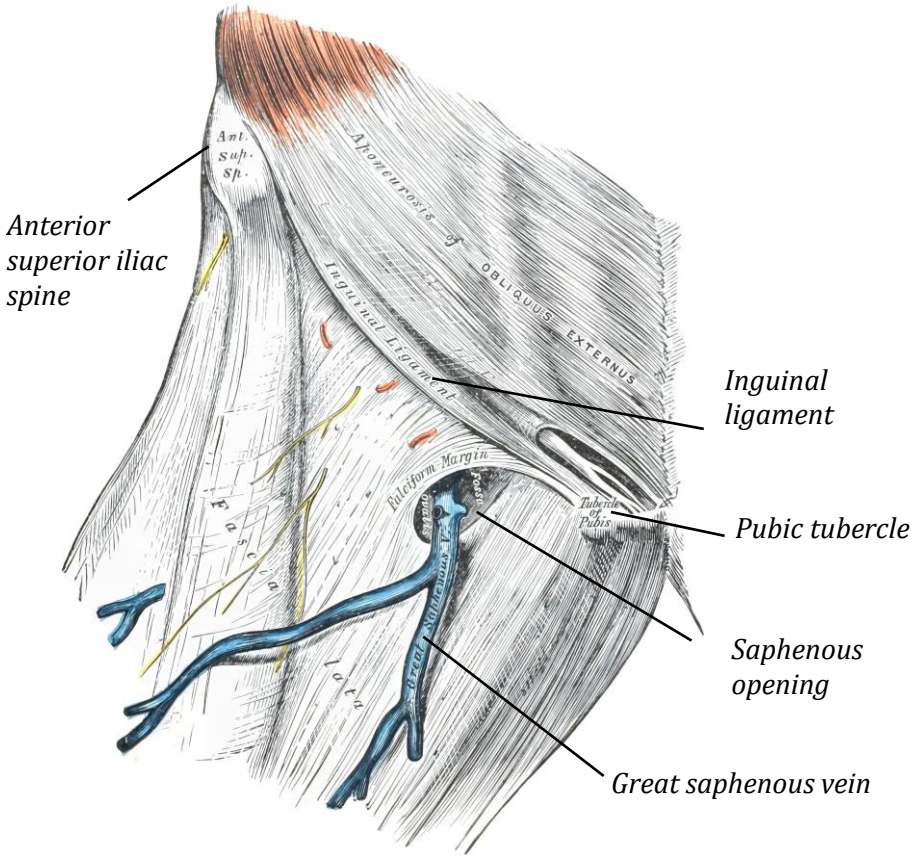


Fig. 22
Terminal portion of the great saphenous vein in the anterior femoral region
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Tributaries of the great saphenous vein

The great saphenous vein receives several tributaries along its course on the medial aspect of the lower limb. It drains blood from the superficial **medial aspect** of the **foot** and **leg**. In the thigh, near its termination, it receives venous blood from the subcutaneous tissue of the **lower abdominal wall** and **external genitalia**, including:

- **superficial circumflex iliac vein**
- **superficial epigastric vein**
- **external pudendal veins.**

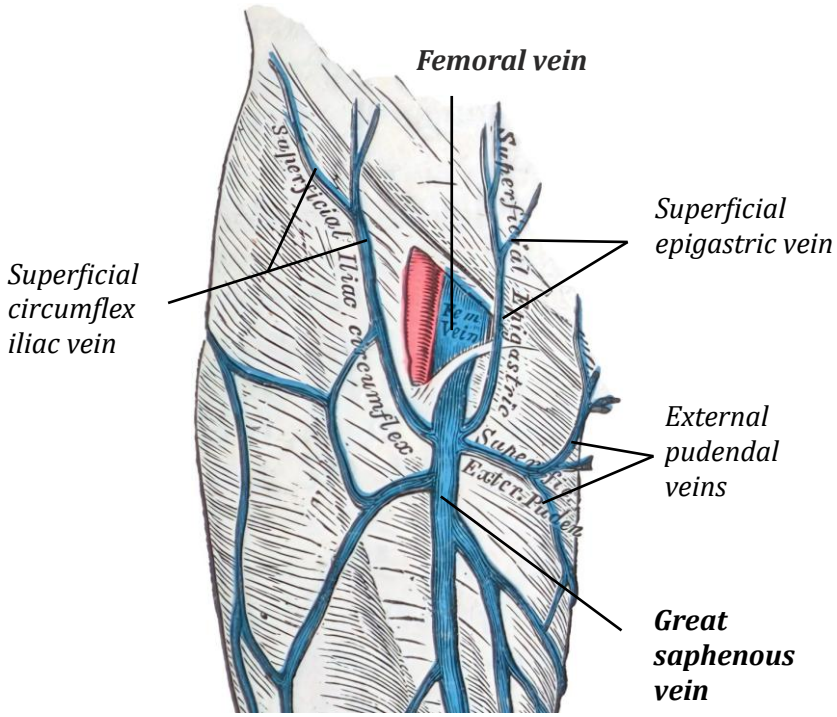


Fig. 23
Great saphenous vein and its tributaries in the anterior femoral region
Modified by additional colorization and labeling from Gray's Anatomy, 20th U.S. edition (public domain)

Course and tributaries of the small saphenous vein

The small saphenous vein originates from the **lateral side** of the **dorsal venous arch** of the foot and passes **behind** the **lateral malleolus**. It ascends along the **posterior aspect** of the **leg** and drains into the **popliteal vein** within the **popliteal fossa**. The small saphenous vein is accompanied by the **sural nerve.**

The small saphenous vein receives tributaries mainly from the **lateral foot** and **posterior leg**.

Communicating veins

The great saphenous vein communicates freely with the small saphenous vein through several communicating veins. Tributaries arising from the medial and posterior aspects of the thigh often unite to form the **accessory saphenous vein**. When present, this vessel frequently serves as the principal communicating channel between the great and small saphenous veins.

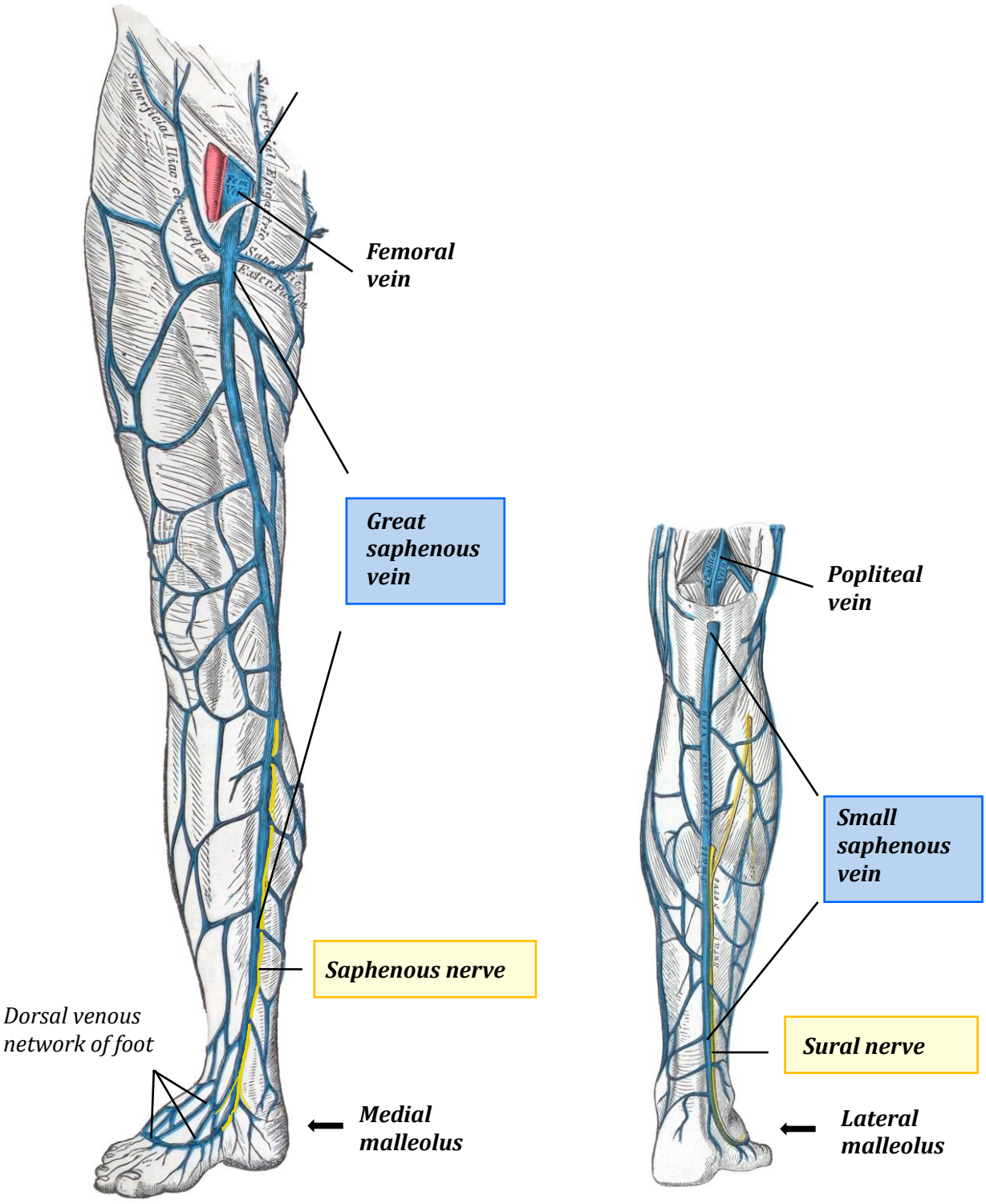


Fig. 24
Great and small saphenous veins with their accompanying nerves
Modified by additional colorization and labeling from Gray's Anatomy, 20th U.S. edition (public domain)

DEEP VEINS OF THE LOWER LIMB

The deep veins are located beneath the deep fascia. In the lower limb, they usually accompany the corresponding arteries as paired venae comitantes*. Deep veins and arteries have the same name. These veins drain blood from the muscles and deep structures of the lower limb.

Venae comitantes** (singular: vena comitans) is a Latin anatomical term meaning "accompanying veins***".

Venae comitantes are usually two small veins running alongside an artery, most commonly in the limbs, enclosed with it in a common vascular sheath. The veins are interconnected by numerous cross-connections (anastomoses), thus forming a venous network around the artery.

Functional advantages of this arrangement:

- Arterial pulsations assist in propelling venous blood proximally, thereby enhancing venous return.
- A close association with the artery reduces the risk of venous collapse in deep tissues.
- Arteriovenous heat exchange contributes to thermoregulation of the limb.

Unlike smaller arteries, large arteries (e.g., femoral or popliteal artery) are usually accompanied by only a single large deep vein. The reason is that the larger caliber of such veins provides sufficient capacity for venous return. A double system is unnecessary, and venous flow is more efficiently handled by one wide channel than by two narrow ones.

Although venous blood from the foot is drained predominantly by the superficial veins, the deep veins also make an important contribution to venous return. Blood from the dorsum of the foot and the anterior compartment of the leg is drained by the **anterior tibial veins**. Venous blood from the plantar surface of the foot drains into the **posterior tibial veins**. The posterior compartment of the leg is drained primarily by the posterior tibial veins, while the **fibular veins** collect blood from the lateral aspect of the leg and empty into the posterior tibial veins.

The **popliteal vein** is formed by the confluence of the anterior and posterior tibial veins. It ascends from the lower border of the popliteus muscle to the adductor hiatus, where it passes through and continues as the femoral vein.

Within the popliteal fossa, the popliteal vein occupies an intermediate position: the popliteal artery lies medial and deep to it, while the tibial nerve and the common fibular nerve are located laterally.

The popliteal vein also receives tributaries accompanying the branches of the popliteal artery around the knee, as well as the small saphenous vein.

The **femoral vein** is the continuation of the popliteal vein. It ascends from the adductor hiatus through the adductor canal and the femoral triangle. It then passes deep to the inguinal ligament within the lacuna vasorum (vascular space) to become the **external iliac vein**. Within the femoral triangle, the femoral vein lies medial to the femoral artery, while the femoral nerve is positioned most laterally. Thus, from medial to lateral, the arrangement of the neurovascular structures is: femoral vein, femoral artery, and femoral nerve.

The two main tributaries of the femoral vein are the deep femoral vein and the great saphenous vein, the latter being a superficial vein of the lower limb.

The **deep femoral vein** (profunda femoris vein) joins the terminal portion of the femoral vein within the femoral triangle. It receives blood from the hamstrings muscles through **perforating veins** that accompany the perforating arteries of the deep femoral artery. In addition, it drains blood from adjacent deep structures of the thigh via the **medial** and **lateral circumflex femoral veins**.

Perforating veins

Perforating veins are small venous channels that connect the superficial venous system with the deep venous system on the lower limbs. They pass through the deep fascia and contain valves that normally direct venous blood in a unidirectional course from the superficial veins to the deep veins.

Among the numerous perforating veins, 3 groups are clinically important:

- Cockett's perforators – on the medial side of the distal leg.
- Boyd's perforator – below the knee, on the inner side of the proximal lower leg.
- Dodd's perforator – on the medial side of the thigh.

Table 9: **Superficial veins of the lower limb and accompanying nerves**

Vein	Course	Accompanying nerve	Clinical notes
Great saphenous vein	Arises from medial side of the dorsal venous arch; ascends ***anterior to medial malleolus***, along medial side of leg and thigh, and drains into ***femoral vein***	***Saphenous nerve*** (accompanies in leg)	Most commonly used vein for coronary and peripheral bypass grafts; frequent site of varicose veins due to valve incompetence; accessible for venipuncture; risk of saphenous nerve injury during vein harvesting or stripping
Small saphenous vein	Begins on lateral side of dorsal venous arch; ascends ***posterior to lateral malleolus*** and along midline of leg to drain into ***popliteal vein***	***Sural nerve*** (posterior leg)	May be used as a graft when great saphenous vein is unavailable; prone to varicosities; risk of sural nerve injury during surgery or vein removal.
Dorsal venous arch of foot	Venous network on the dorsum of foot draining into great (medial) and small (lateral) saphenous veins	***Superficial fibular (peroneal) nerve*** crosses dorsum of foot superficially	Important for venous drainage of foot; visible on surface; site for intravenous access in infants

Clinical notes

The superficial venous system is commonly affected by ***varicose veins*** *due to valvular incompetence, whereas the deep venous system is more prone to* ***deep vein thrombosis.***

Varicose veins

When valves in the superficial veins or perforating veins become incompetent, blood refluxes into the superficial system, leading to dilated and tortuous veins, most commonly affecting the great saphenous vein and its tributaries. Clinically, varicose veins are present as bulging, serpentine superficial veins associated with aching, heaviness, and in severe cases, skin changes and ulcers. Their main clinical significance lies in the risk of developing chronic venous hypertension, venous insufficiency, and ulceration.

Deep vein thrombosis

Deep veins, particularly in the legs, are a common site of thrombus formation (a thrombus is a blood clot). Thrombosis may be present as pain, swelling, and warmth. Clinically, it is significant because a portion of the thrombus, called an embolus, can break free and travel through the bloodstream, potentially leading to a life-threatening pulmonary embolism.

The great saphenous vein is also clinically important as a ***conduit for coronary artery bypass grafting*** *and for* ***venous access*** *anterior to the medial malleolus.*

Venae comitantes may be injured in association with fractures, leading to significant hematoma formation in deep compartments.

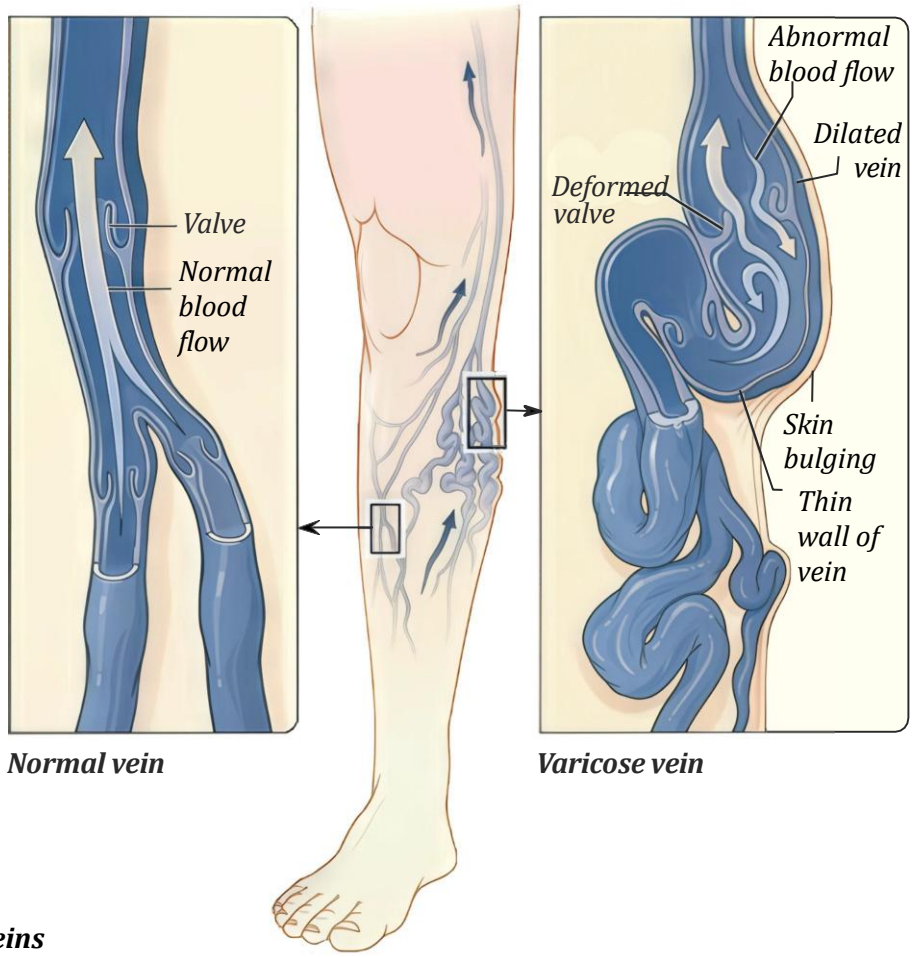


Fig. 25
Varicose veins
How a varicose vein forms in the leg. The figure shows a normal vein with a working valve and normal blood flow, a varicose vein with a deformed valve, abnormal flow, and thin, stretched walls, and the middle image indicates where varicose veins commonly appear.
Image by Jmarchn, available under CC BY-SA 3.0, Wikimedia Commons: https://en.wikipedia.org/wiki/Varicose_veins#/media/File:Varicose_veins-en.svg

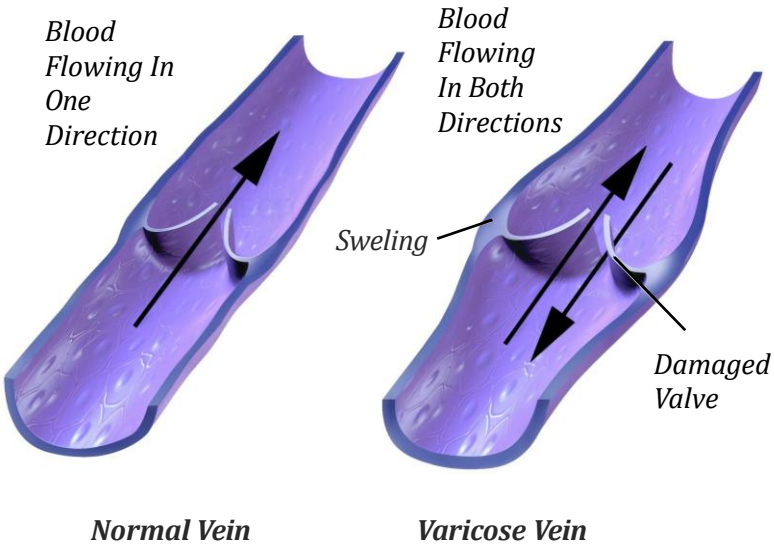


Fig. 26
Normal and varicose veins
Image by: Blausen Medical Communications, Inc. available under CC BY-SA 3.0, Wikimedia Commons: https://commons.wikimedia.org/wiki/File:Blausen_0891_VaricoseVein.png

LYMPHATIC VESSELS OF THE LOWER LIMB

The lymphatic system of the lower limb consists of lymphatic vessels that collect lymph from the tissues and convey it through a series of lymph nodes before it ultimately joins the venous circulation via the thoracic duct. Lymph from the lower limb drains through **superficial and deep lymphatic vessels**, which lead into **popliteal, superficial inguinal and deep inguinal lymph nodes**.

Lymphatic vessels of the lower limb are divided into **superficial** and **deep** lymphatic vessels according to their relationship with the fascia and the deep blood vessels.

SUPERFICIAL LYMPHATIC VESSELS

The superficial lymphatic vessels lie in the **subcutaneous tissue**, above the deep fascia. They accompany the superficial veins but run **independently of blood vessels**. According to their course and area of drainage, they are divided into three main groups: **medial**, **lateral**, and **posterior**.

Medial group (10-15 lymphatic vessels) originates from the **plantar surface** and the **medial half of the dorsum** of the foot. Then it ascends along the **great saphenous vein** on the medial side of the leg and thigh, passes toward the **saphenous hiatus** to reach the **superficial inguinal lymph nodes.** These lymphatic collectors form the largest and clinically the most significant group. The infections or lesions of the whole medial aspect of the lower limb may cause enlargement of the superficial inguinal lymph nodes.

Lateral group (1-3 lymphatic vessels) begins at the **laterodistal portion** of the back of the foot and ascends along the **lateral aspect of the leg**. In the region of the knee, these vessels **curve anteriorly and medially**, joining the medial group to enter the **superficial inguinal lymph nodes**.

Posterior group (1-2 lymphatic vessels) collects lymph from the **heel** and the **lateroproximal part of the dorsum** of the foot. The lymphatic collectors run along the **posterior surface of the leg** along the **small saphenous vein and terminate** in the

popliteal lymph nodes located in the popliteal fossa. From the popliteal nodes, lymph continues through the **deep lymphatic vessels** toward the **deep inguinal lymph nodes**.

Clinicians subdivide the lymphatic collectors into two groups: **anteromedial group** (lateral and medial group in anatomical subdivision) and **posterolateral group** (posterior group in anatomical subdivision).

DEEP LYMPHATIC VESSELS

The deep lymphatic vessels accompany the **deep arteries and veins** of the lower limb. They drain lymph from the **deep structures -** muscles, tendons, joints, and deep connective tissue. These vessels follow the course of the **anterior and posterior tibial**, **fibular** and **femoral** vessels, eventually converging around the **femoral artery and vein**. They terminate in the **deep inguinal lymph nodes** located in the **iliopectineal fossa** medial to the femoral vein.

Lymph nodes of the lower limb

Three major groups of lymph nodes are associated with the lymphatic drainage of the lower limb: p**opliteal lymph nodes, superficial inguinal lymph nodes** and **deep inguinal lymph nodes.**

Popliteal lymph nodes

There are usually 2-3 nodes that are located beneath the **popliteal fascia**, embedded in fatty tissue in the popliteal fossa. They receive lymph from the **posterior group of superficial vessels**, draining the **heel**, **lateroproximal dorsal part of the foot**, and **posterior leg.** Their **efferent vessels** accompany the **deep veins** to reach the **deep inguinal lymph nodes**.

Superficial inguinal lymph nodes

Nodes (8-12) are situated in the **superficial fascia of the inguinal region**, around the **saphenous hiatus.**

They can be subdivided into **superior**, **middle (central)**, and **inferior** groups based on their position and drainage territories.

- **Superior group (superomedial and superolateral nodes)** drains the **skin and subcutaneous tissue of the lower anterior abdominal wall** (below the level of umbilicus), and in females also from the **fundus and a part of the body of the uterus** via lymphatic channels that accompany the round ligament of the uterus.
- **Middle (central) group** collects lymph from the **skin of the perineum** and **gluteal region**, **anal region**, **external genitalia** (scrotum in males, lower part of vagina and vulva in females), and **urethra**.
- **Inferior group (inferomedial and inferolateral nodes)** receives lymph from the superficial lymphatic vessels of the lower limb.

Superficial inguinal lymph nodes form so called T-shaped arrangement. **According to the clinical subdivision,** there are two groups of the superficial inguinal lymph nodes: **horizontal group** (superior and middle group in anatomical subdivision) and **vertical group** (inferior group in anatomical subdivision).

Efferent vessels from the superficial inguinal lymph nodes drain partly into the **deep inguinal lymph nodes**, and partly directly to the **external iliac lymph nodes**. From there, lymph continues to the **common iliac** and then **lumbar** lymph nodes, finally reaching the **lumbar trunks** and the **cisterna chyli**.

Deep inguinal lymph nodes

Deep inguinal lymph nodes are usually **2-5 nodes** located in the **iliopectineal fossa** (the floor of the femoral triangle).

The **most superior** and typically the **largest** of these is the **Cloquet's node** (also known as **Rosenmüller's node**), located **medial to the femoral vein.**

These nodes receive lymph from a part of the **superficial inguinal lymph nodes**, all **deep lymphatic vessels** of the lower limb, and the **popliteal lymph nodes.**

The efferent vessels from the deep inguinal nodes continue to the **external iliac lymph nodes**, then to the **common iliac** and **lumbar lymph nodes**, ultimately reaching the **lumbar trunk** and **cisterna chyli**.

Table 10: Summary of the lymph drainage of the lower limb

LV – lymph vessel, LN – lymph node

Region drained	Lymphatic pathway	Final destination
Foot (plantar/medial dorsal)	Superficial LV (medial group) → Superficial inguinal LN	(Deep inguinal LN →) External iliac LN → Common iliac LN → Lumbar LN → Lumbar trunk → Cisterna chyli
Foot (laterodistal dorsal)	Superficial LV (lateral group) → Superficial inguinal LN	(Deep inguinal LN →) External iliac LN → Common iliac LN → Lumbar LN → Lumbar trunk → Cisterna chyli
Foot (lateroproximal dorsal/heel)	Superficial LV (posterior group) → Popliteal LN → Deep inguinal LN	External iliac LN → Common iliac LN → Lumbar LN → Lumbar trunk → Cisterna chyli
Deep tissues of leg	Deep LV → Deep inguinal LN	External iliac LN → Common iliac LN → Lumbar LN → Lumbar trunk → Cisterna chyli

Clinical notes

Lymphadenopathy (enlarged or abnormal lymph nodes) of the superficial inguinal lymph nodes may indicate infections of the lower limb, external genitalia or fundus of uterus.

Popliteal node enlargement is rare but may accompany infections of the posterior leg or heel.

Cloquet's node is an important landmark in pelvic and oncological surgery, particularly in procedures involving lymph node dissection for malignancies of the lower limb, perineum, or uterus.

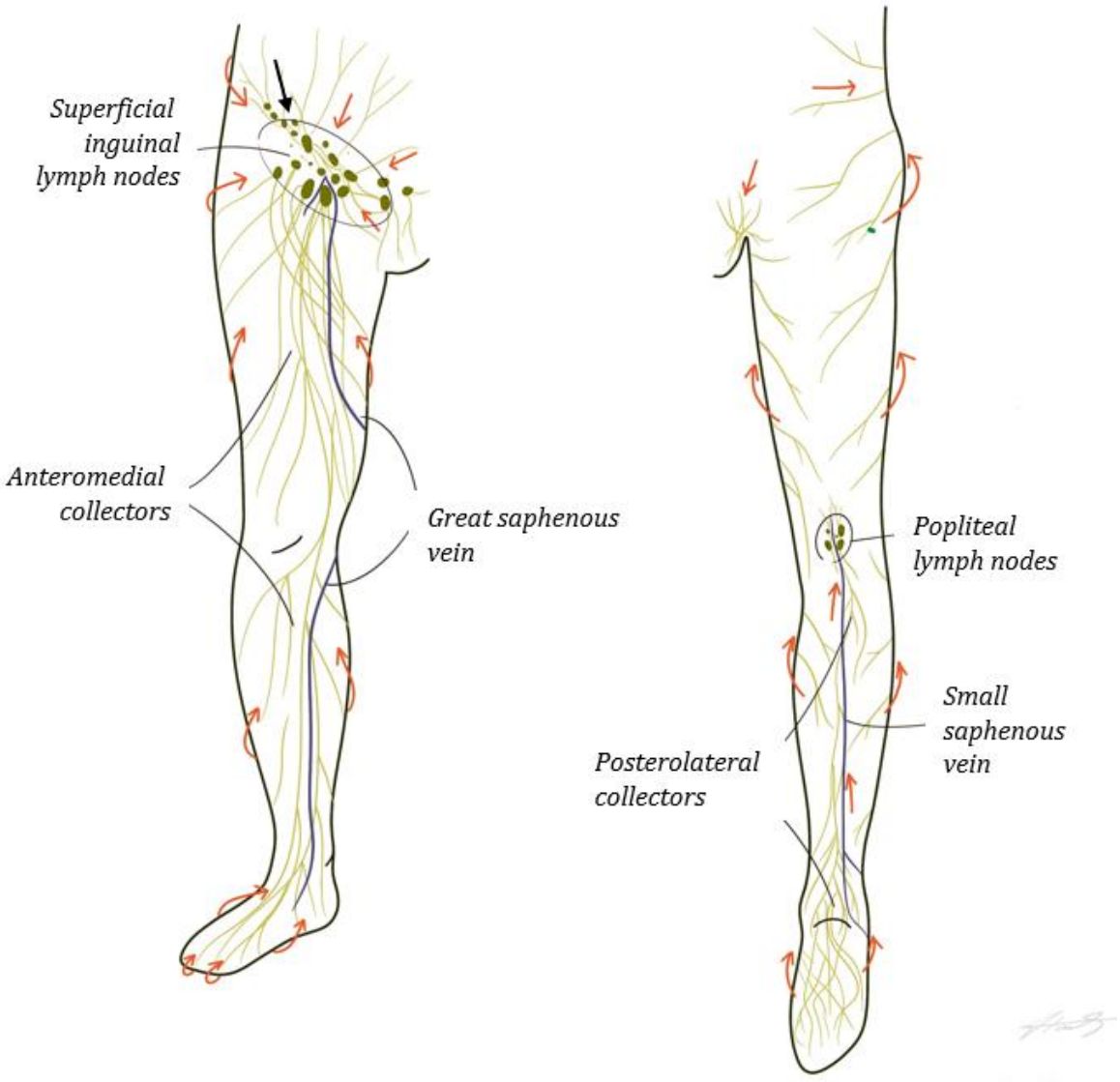


Fig. 27
Superficial lymphatic vessels and nodes of the lower limb
Drawing from the author's archive
Redrawn from Schünke, M., Schulte, E., Schumacher, U., Ross, L. M., & Lamperti, E. D. (2021). *THIEME atlas of anatomy: General anatomy and musculoskeletal system* (4th ed.). Thieme

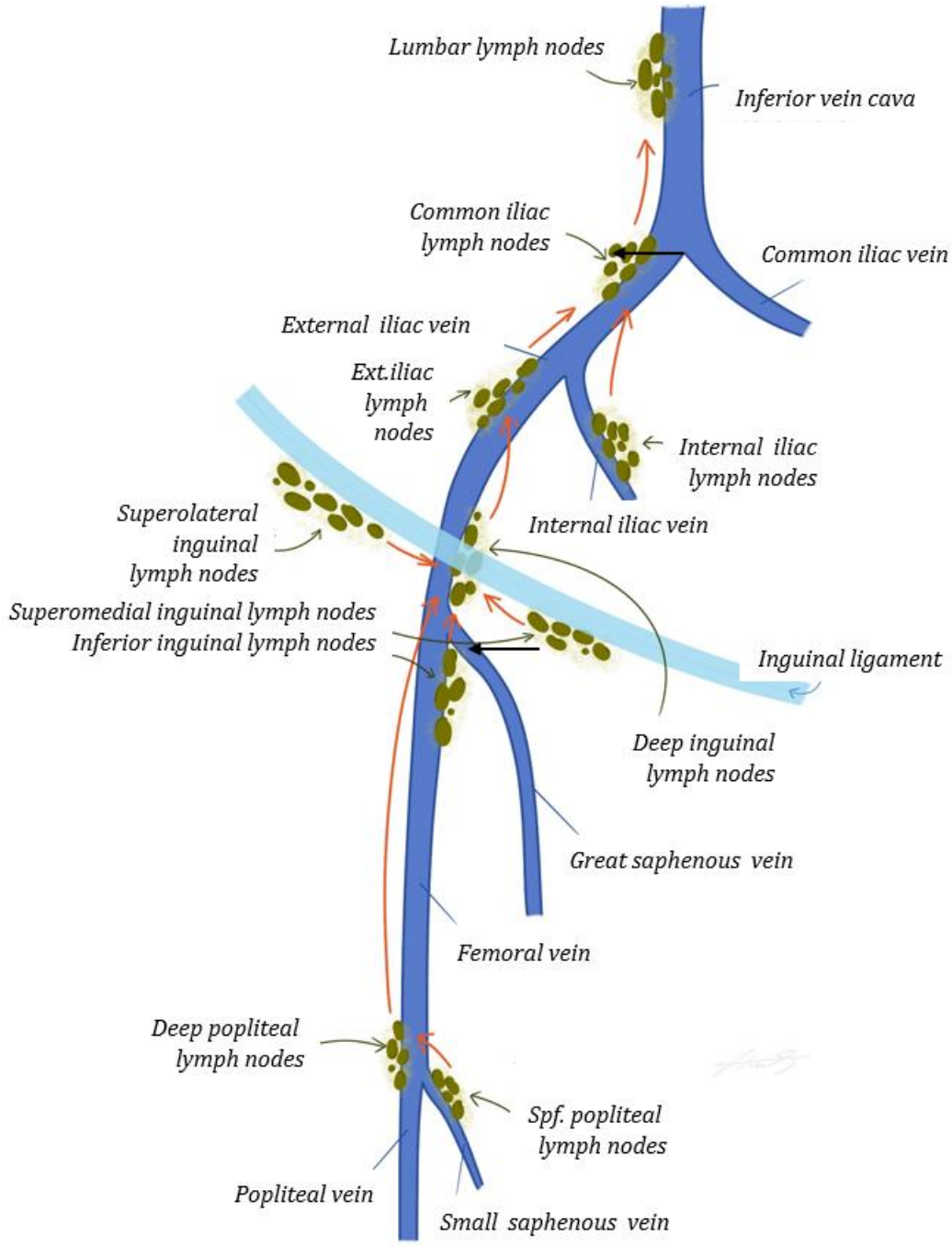


Fig. 28

Lymph nodes of the lower limb along the veins

Drawing from the author's archive

Redrawn from Schünke, M., Schulte, E., Schumacher, U., Ross, L. M., & Lamperti, E. D. (2021). *THIEME atlas of anatomy: General anatomy and musculoskeletal system* (4th ed.). Thieme

SYSTEMATIC ANATOMY OF THE NERVES OF THE LOWER LIMB

LUMBAR AND SACRAL SPINAL NERVES

Spinal cord terminates at the level of the first and second lumbar vertebra. Therefore, the lumbar and sacral spinal nerves descend within the vertebral canal to reach the corresponding intervertebral foramina through which they exit. These nerve fibres thus form a nerve bundle resembling a horse tail (also known as „**cauda equina**"). They pass within the vertebral canal and exit the canal through the intervertebral and sacral foramina.

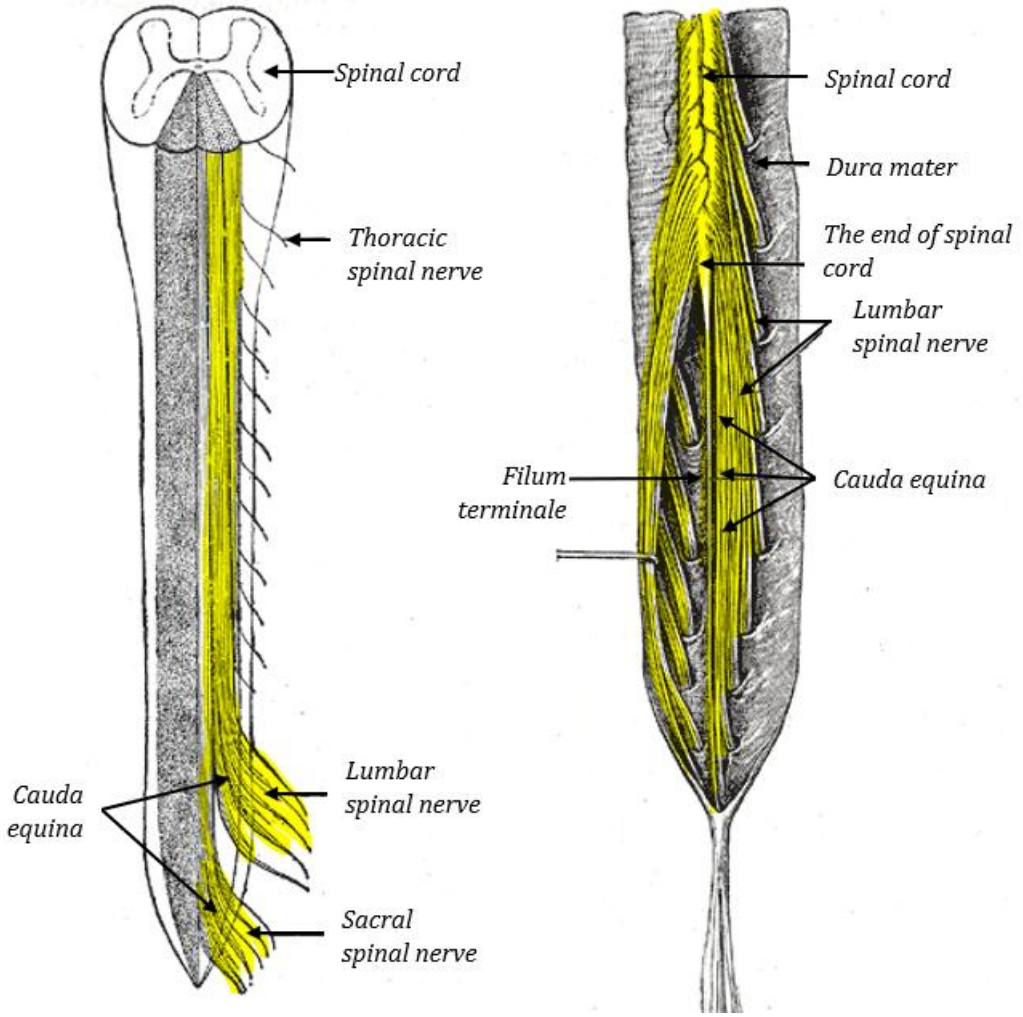


Fig. 29
Spinal cord and cauda equina
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While the **anterior rami of lumbar and sacral spinal nerves form the lumbar and sacral plexuses**, the **posterior rami** supply the paravertebral muscles and the overlying skin. Some sensory fibres continue to the skin in the gluteal region as **the superior and middle cluneal nerves**. Specifically, posterior rami of the lumbar spinal nerves form the **superior cluneal nerves** that convey sensation from the superolateral two-thirds of the gluteal region. The **middle cluneal nerves** formed by sensory fibres from the sacral spinal nerves innervate the skin in the medial third of the gluteal region *(inferior clunial nerves come from the posterior cutaneous femoral nerve from sacral plexus).*

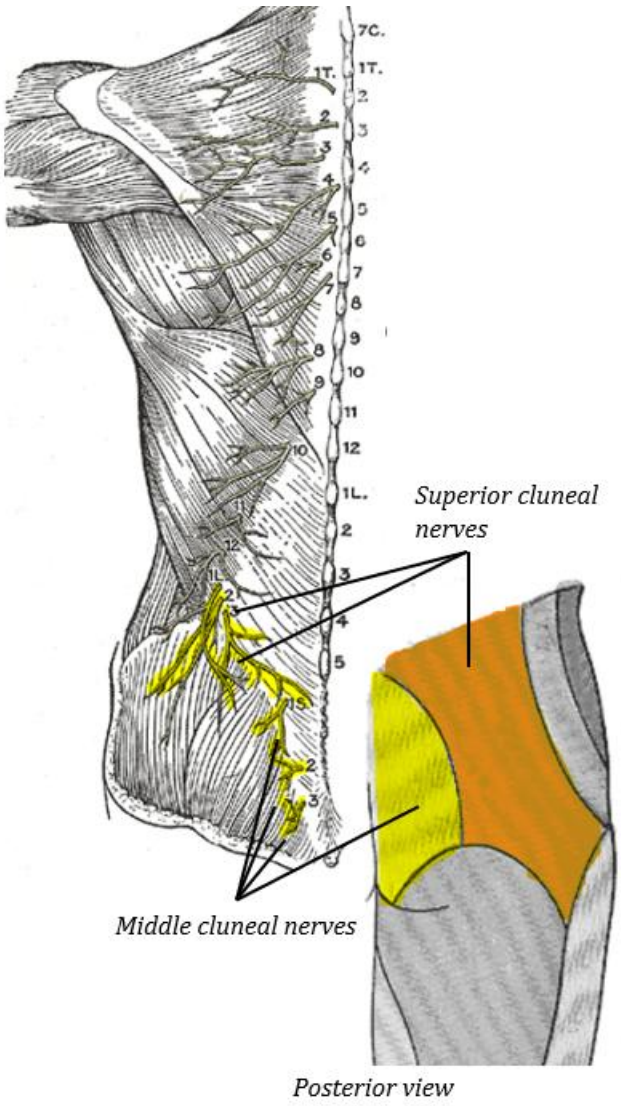


Fig. 30

Posterior rami of lumbar and sacral spinal nerves

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LUMBAR PLEXUS

The lumbar plexus is formed by the union and combination of the **anterior rami of the spinal nerves T12 – L4** (some fibres from the anterior ramus of T12, all fibres of the anterior rami of L1, L2, L3 and majority of the fibres from the anterior ramus L4).

The nerves of the **lumbar plexus** are closely **related to the psoas major muscle**. This muscle originates from the sides of the bodies of TXII – LV vertebrae and from the transverse processes of all lumbar vertebrae.

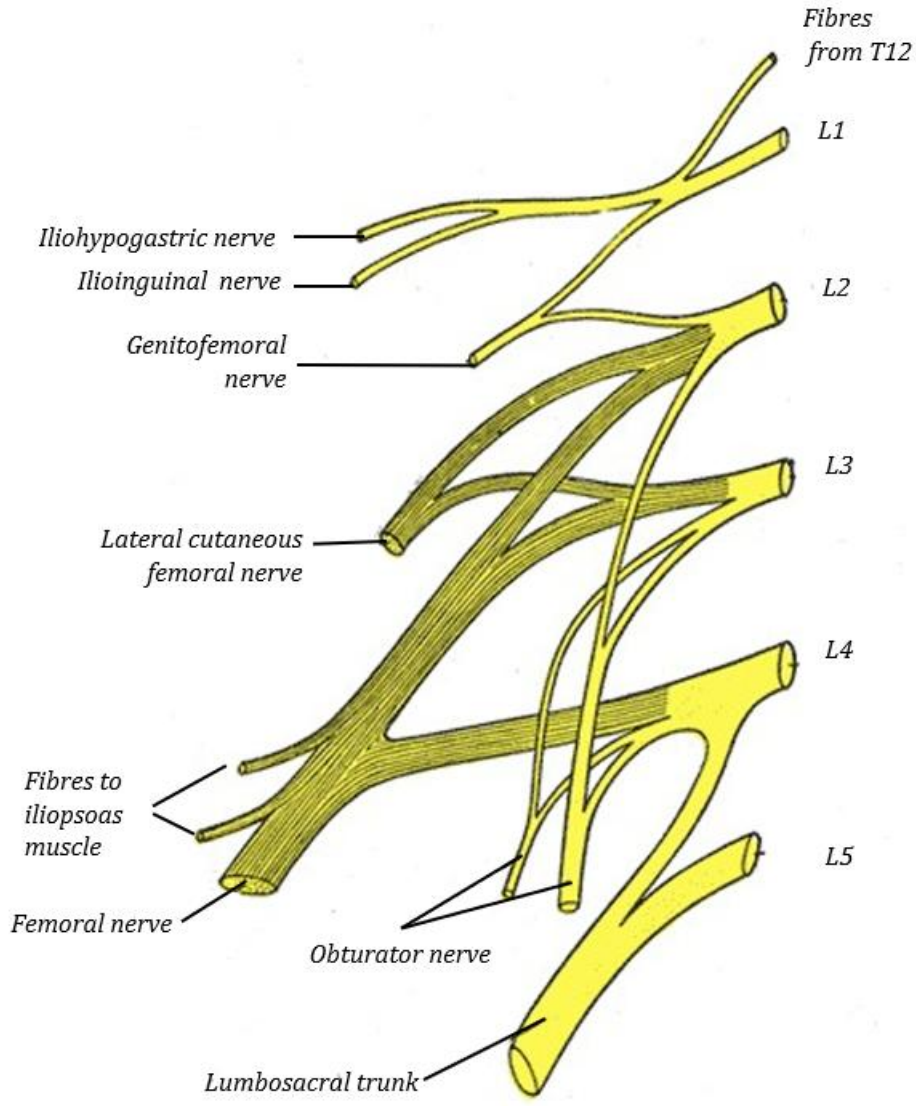


Fig. 31
Lumbar plexus
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The anterior rami of T12 – L4 spinal nerves traverse the posterior part of the psoas major muscle where they unite to form the branches of the lumbar plexus. These branches either emerge from the lateral or medial border of the psoas major muscle or pierce this muscle.

The **iliohypogastric, ilioinguinal, lateral cutaneous femoral and femoral nerves** emerge from the lateral border of psoas major muscle. In contrast, the **genitofemoral nerve** traverses through the muscle and descends at its anterior surface, while the **obturator nerve** emerges and runs along the medial border of the psoas major muscle. All these nerves run retroperitoneally along the posterior abdominal wall.

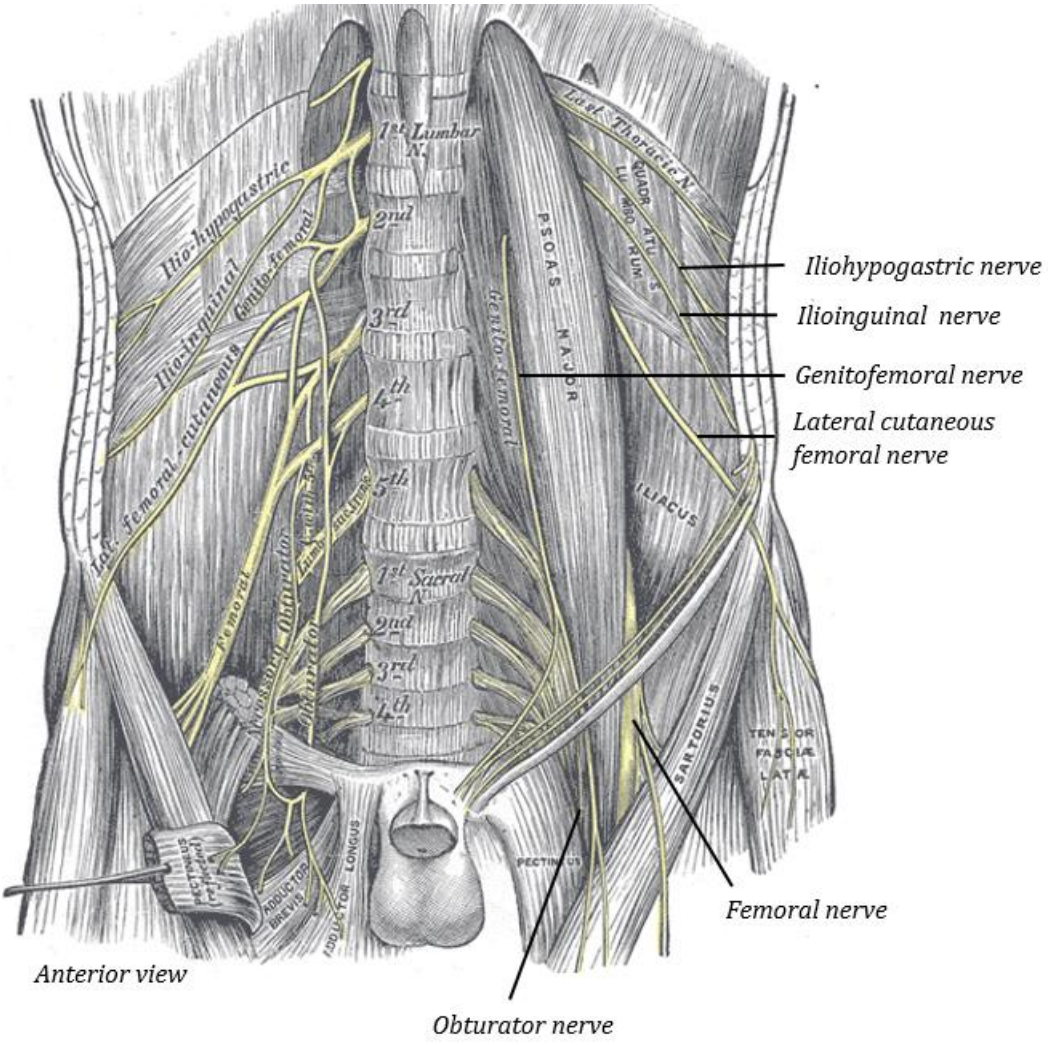


Fig. 32
Relation of the nerves of lumbar plexus to psoas major muscle
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ILIOHYPOGASTRIC NERVE

This nerve is formed by the fibres from the anterior rami of T12 and L1 spinal nerves. It emerges from the lateral border of the psoas major muscle and courses inferior to the subcostal nerve, laterally along the anterior surface of quadratus lumborum muscle, and **posterior** to **the kidney**. At the lateral side of the abdomen, above the iliac crest, the iliohypogastric nerve pierces the transversus abdominis muscle and continues in the layer between the **transverse abdominal muscle and internal oblique muscle**. Passing between these muscles, it gives the **motor fibres** for their innervation.

The sensory fibres of the iliohypogastric nerve form two branches:

- **Lateral cutaneous branch** – runs to the skin above the iliac crest, to the lateral third of the gluteal region and to the hip joint,
- **Anterior cutaneous branch** – continues to the skin at the pubic region and above the inguinal ligament medially.

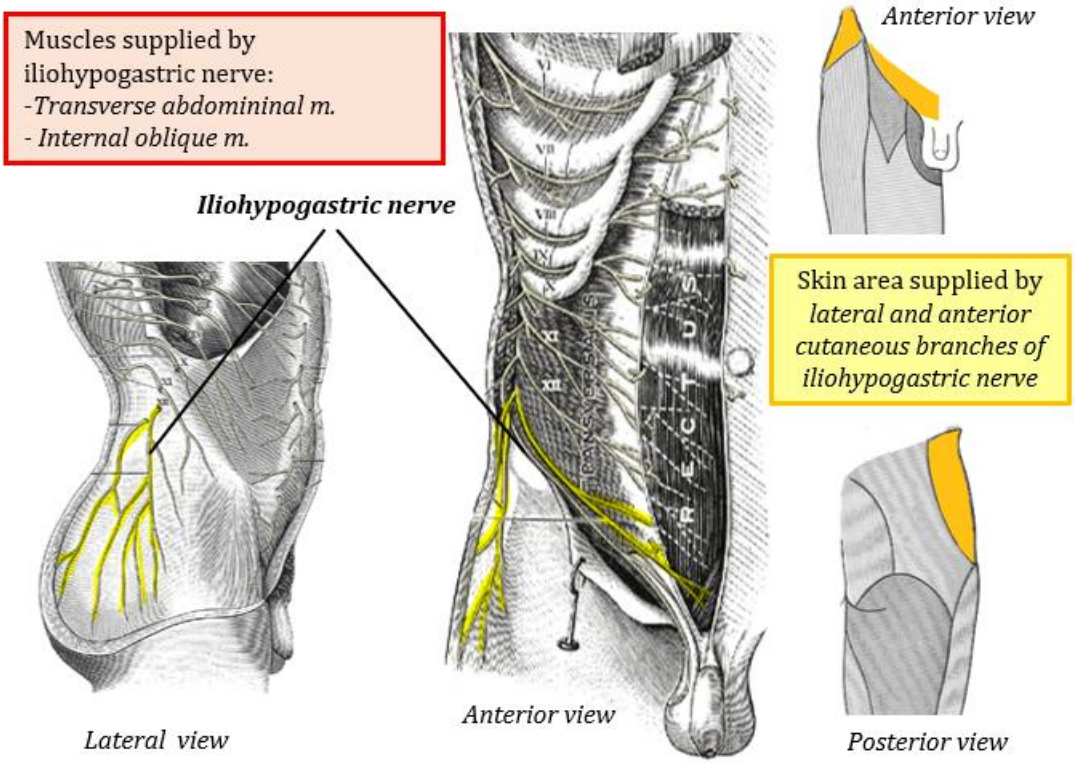


Fig. 33
Iliohypogastric nerve
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ILIOINGUINAL NERVE

The ilioinguinal nerve receives the fibres from the anterior ramus of L1. It runs at the posterior abdominal wall, **posterior to the kidney**, and between the **transverse abdominalmuscle** and **internal oblique muscle**, parallel to and slightly **inferior** to the **iliohypogastric nerve.** Then, it enters the **inguinal canal** through its superior wall (importantly, not through the deep inguinal ring). After a short course, the ilioinguinal nerve exits the inguinal canal through the superficial inguinal ring to supply the skin overlying the medial part of the inguinal ligament and the anterior aspect of the external genitalia.

The ilioinguinal nerve is a **mixed nerve** containing **motor fibres for the transversus abdominis muscle, obliquus internus abdominis muscle and cremaster muscle**. **Sensory fibres** of the ilioinguinal nerve convey sensation from the skin overlying the medial part of the inguinal ligament and the anterior aspect of scrotum, the root of the penis (by **anterior scrotal branches**) in male, and the mons pubis and labia majora (by **anterior labial branches**) in female.

Clinical notes

*The close **relation** of the **ilioinguinal** and **iliohypogastric nerves** to the posterior surface of the **kidney** may result in their irritation by inflammatory processes of the kidney, causing paresthesia or pain in areas corresponding to the sensory distribution of these nerve fibres.*

These nerves may be injured during the retroperitoneal surgery (e.g., open nephrectomy), the ilioinguinal nerve also during the inguinal hernia repair surgery. Their stretching or transection may lead to postoperative paresthesia in the regions of their sensory distribution - areae nervinae (inguinal and pubic regions, external genitalia).

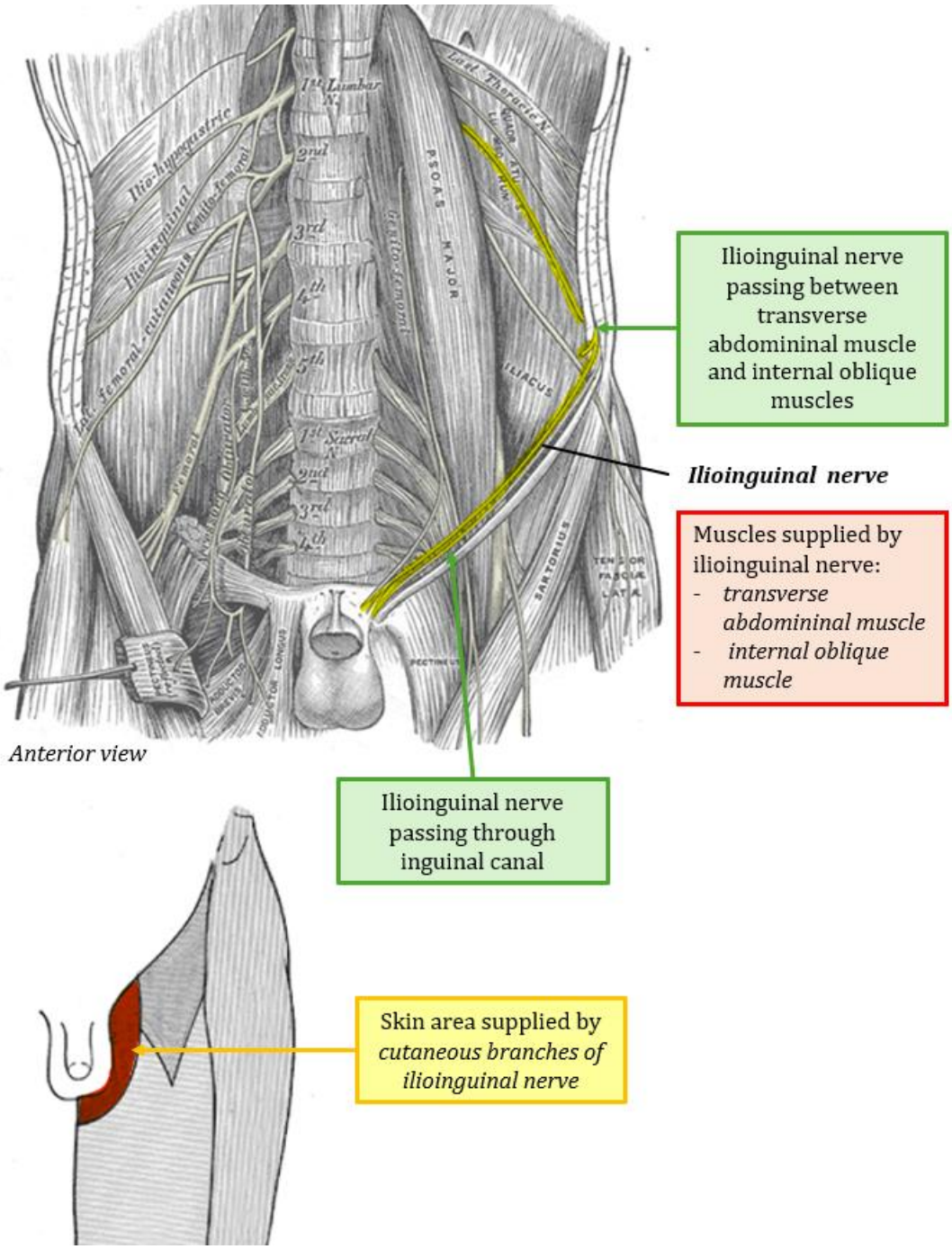


Fig. 34
Ilioinguinal nerve
Modified by additional colorization and labeling from Gray's Anatomy, 20th U.S. Edition (public domain)

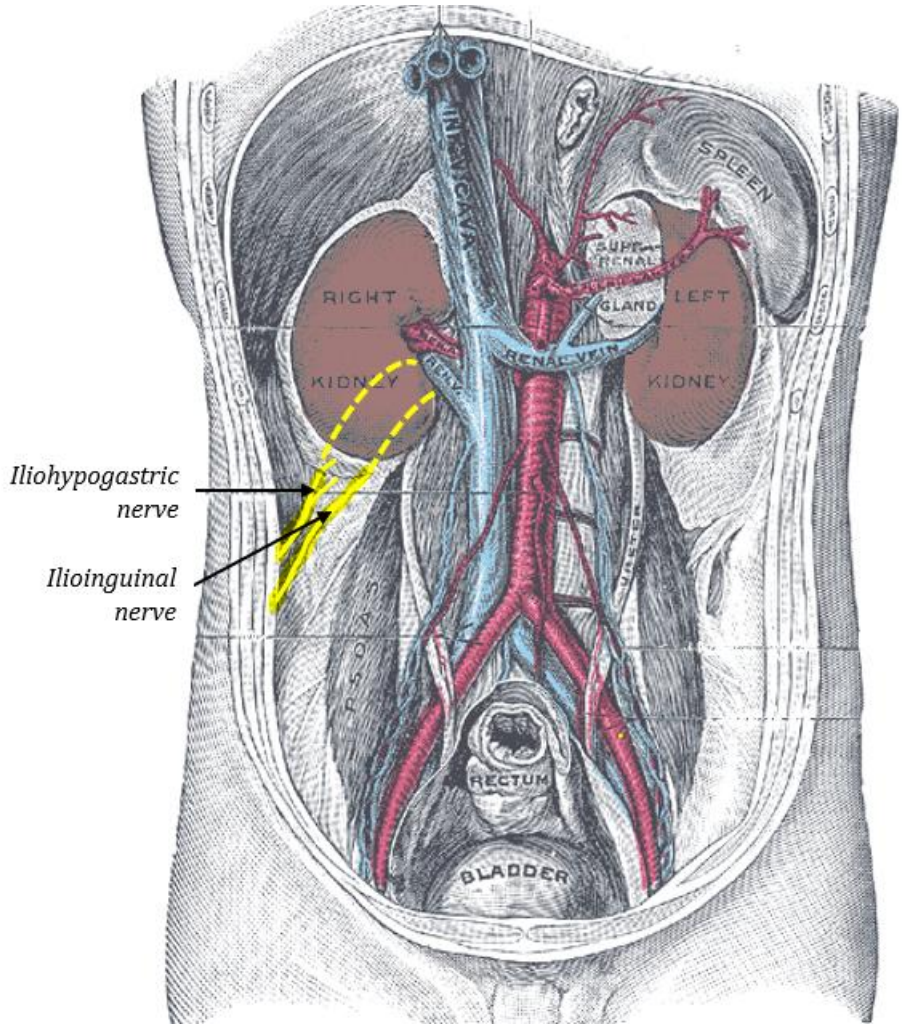


Fig. 35
Iliohypogastric nerve and ilioinguinal nerves behind the kidney
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GENITOFEMORAL NERVE

The genitofemoral nerve is formed by the fibres from the anterior rami of L1 and L2 spinal nerves. It pierces the psoas major muscle and, immediately after emerging, splits into its two main branches: **genital and femoral branches**. Sometimes, it may already be divided into the genital and femoral branch before piercing the muscle. The genital branch is medialdu to the femoral branch.

- **Genital branch** enters the deep inguinal ring and continues **within the inguinal canal** accompanying the ductus deferens in male or the round ligament of uterus in female. Here it gives off the motor fibres for the

cremaster muscle. It exits the canal through the superficial inguinal ring and continues to supply **the skin of the scrotum and labia majora**.

- **Femoral branch** is more lateral branch. It passes **beneath the inguinal ligament, through the lacuna vasorum** (lacuna vasorum is a medially situated part of subinguinal hiatus) and enters the femoral triangle. At the saphenous hiatus (the spot where the great saphenous vein empties into the depth to open into the femoral vein) it emerges superficially to supply the **skin overlying the saphenous hiatus**.

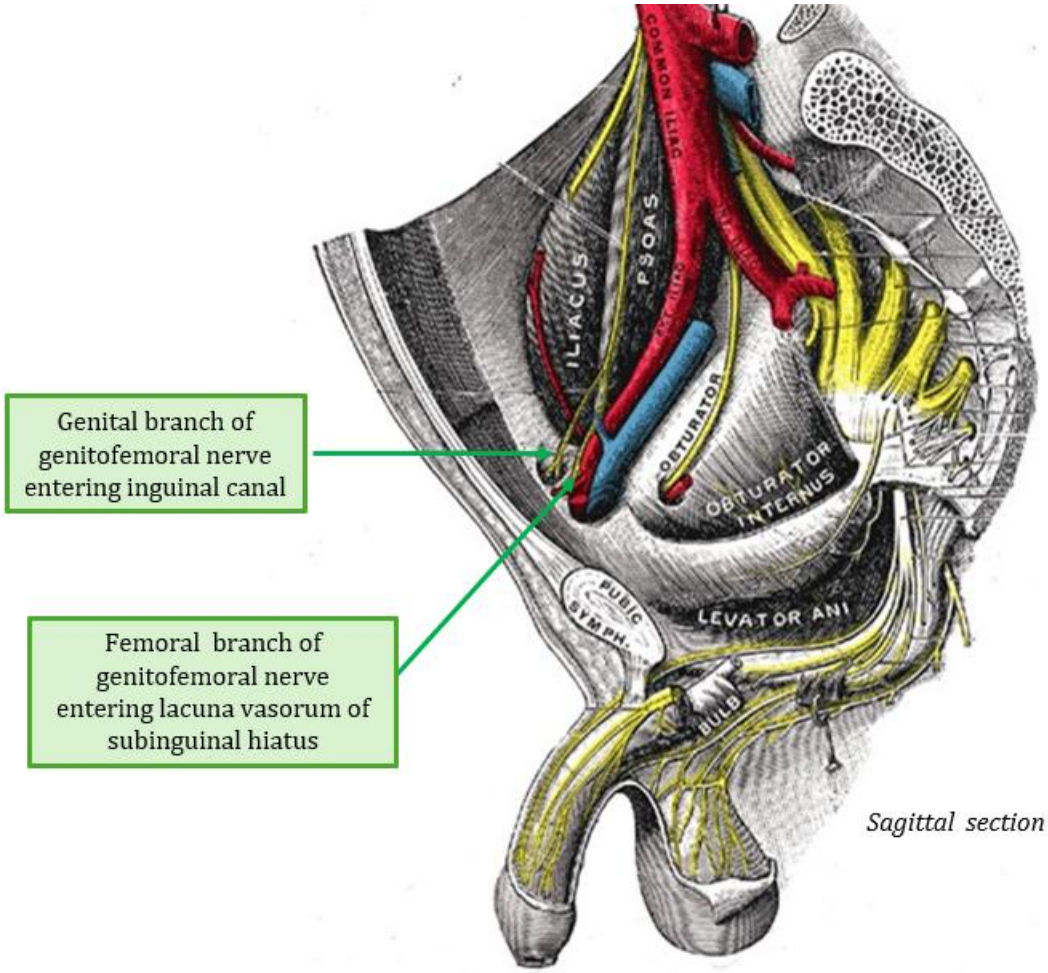


Fig. 36
Genital and femoral branch entering inguinal canal and subinguinal hiatus
Modified by additional colorization and labeling from Gray's Anatomy, 20th U.S. Edition (public domain)

Clinical notes

*The neuralgia of the **genitofemoral nerve** is most commonly iatrogenic, usually result of the open inguinal hernia repair, appendectomy, or lymph node resection. The injury to the nerve presents with burning pain or paresthesia in the inguinal region and external genitalia.*

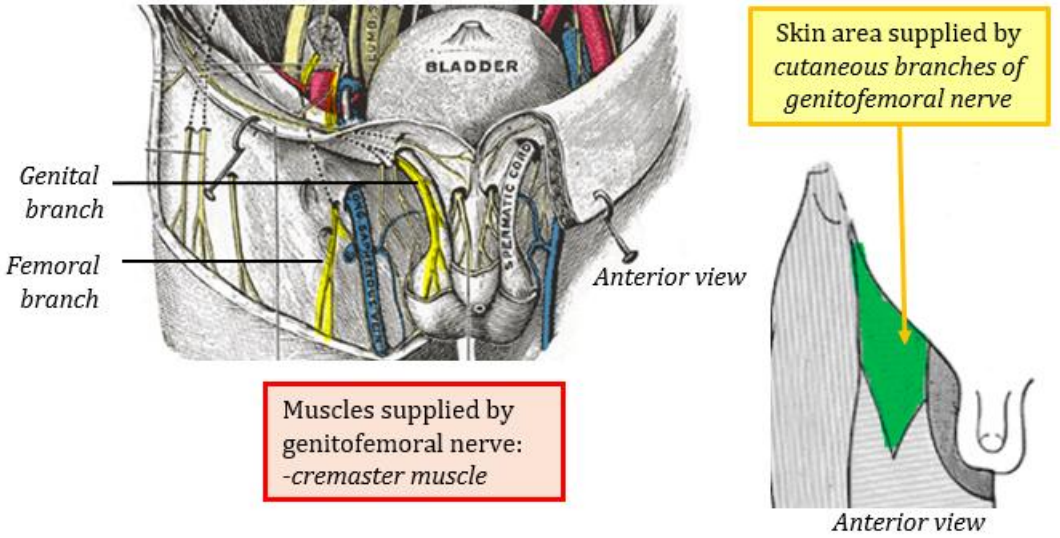


Fig. 37
Genitofemoral nerve
Modified by additional colorization and labeling from Gray's Anatomy, 20th U.S. Edition (public domain)

LATERAL CUTANEOUS FEMORAL NERVE

The lateral cutaneous femoral nerve is formed by the fibres from the anterior rami of L2 and L3 spinal nerves. This nerve emerges from the lateral border of the psoas major muscle approximately at the posterior end of the iliac crest and courses across the iliac fossa toward the superior anterior iliac spine. Here, it passes deep to the inguinal ligament through the lacuna musculorum of the subinguinal hiatus and descends to the skin at the lateral side of the thigh.

The lateral cutaneous femoral nerve is a **purely sensory nerve** supplying the **skin at the lateral side of the femoral region**.

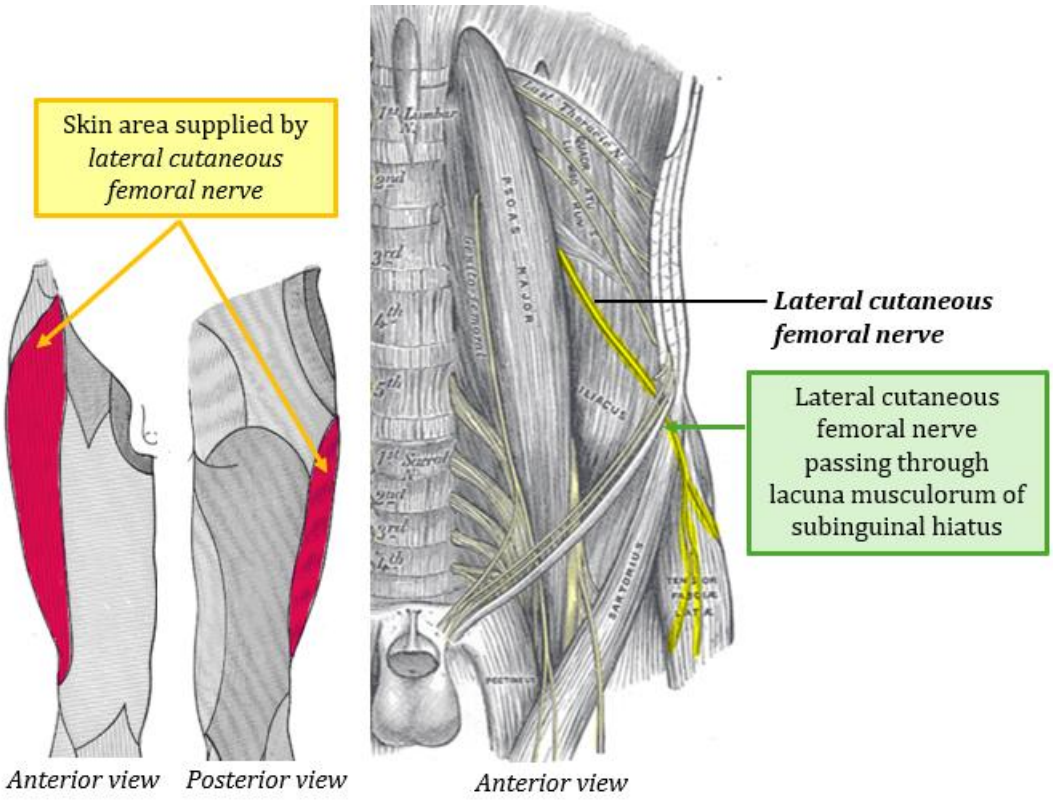


Fig. 38
Lateral cutaneous femoral nerve
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Clinical notes

*The dysfunction of the **lateral femoral cutaneous nerve** is clinically called „**meralgia paresthetica**". The patient usually describes the burning and pain along the lateral side of the thigh. The compression of the nerve below the inguinal ligament close to the superior anterior iliac spine may be caused by the external pressure (belts, skinny jeans **–„skinny jeans syndrome"**). However, this neuralgia commonly occurs during the pregnancy and in obese patients as a result of intraabdominal compression.*

FEMORAL NERVE

The femoral nerve is the most robust nerve of the lumbar plexus. It is formed by the fibres from the anterior rami of L1– L4 spinal nerves. The nerve runs between the iliacus and psoas major muscles and then deep to the inguinal ligament through the lacuna musculorum (lacuna musculorum is a laterally situated part of the subinguinal hiatus) to the femoral triangle. Here, it is lateral to the femoral artery and vein separated from them by the iliopectineal arch.

The femoral nerve gives off the **motor branches for the iliopsoas muscle, quadriceps femoris muscle, sartorius muscle, and to the ventral part of the pectineus muscle**.

The femoral nerve supplies a large area of the skin and the hip joint.

- **Anterior cutaneous branches** arise immediately at the level of the inguinal ligament and descend to the skin at the ventral side of the thigh.
- **Sensory fibres for the coxal and knee joint** usually accompany the motor fibres supplying the muscles surrounding these joints.
- **Saphenous nerve** originates from the femoral nerve within the **femoral triangle – iliopectineal fossa**. It descends to the **adductor canal** where it accompanies the femoral artery and vein. The stem of the saphenous nerve **pierces the vastoadductor membrane** (thickened part of the fascia lata femoris) **to reach the superficial area.** At the level of the upper margin of the patella, upon exiting the adductor canal, the saphenous nerve gives off the **infrapatellar branch** that continues to the antero-medial side of the knee. After exiting the adductor canal, the saphenous nerve descends along the medial aspect of the leg to provide a sensory innervation for medial side of the leg, continues to the medial ankle and medial side of the foot (to the navicular bone). At the leg, the saphenous nerve is accompanied by the great saphenous vein.

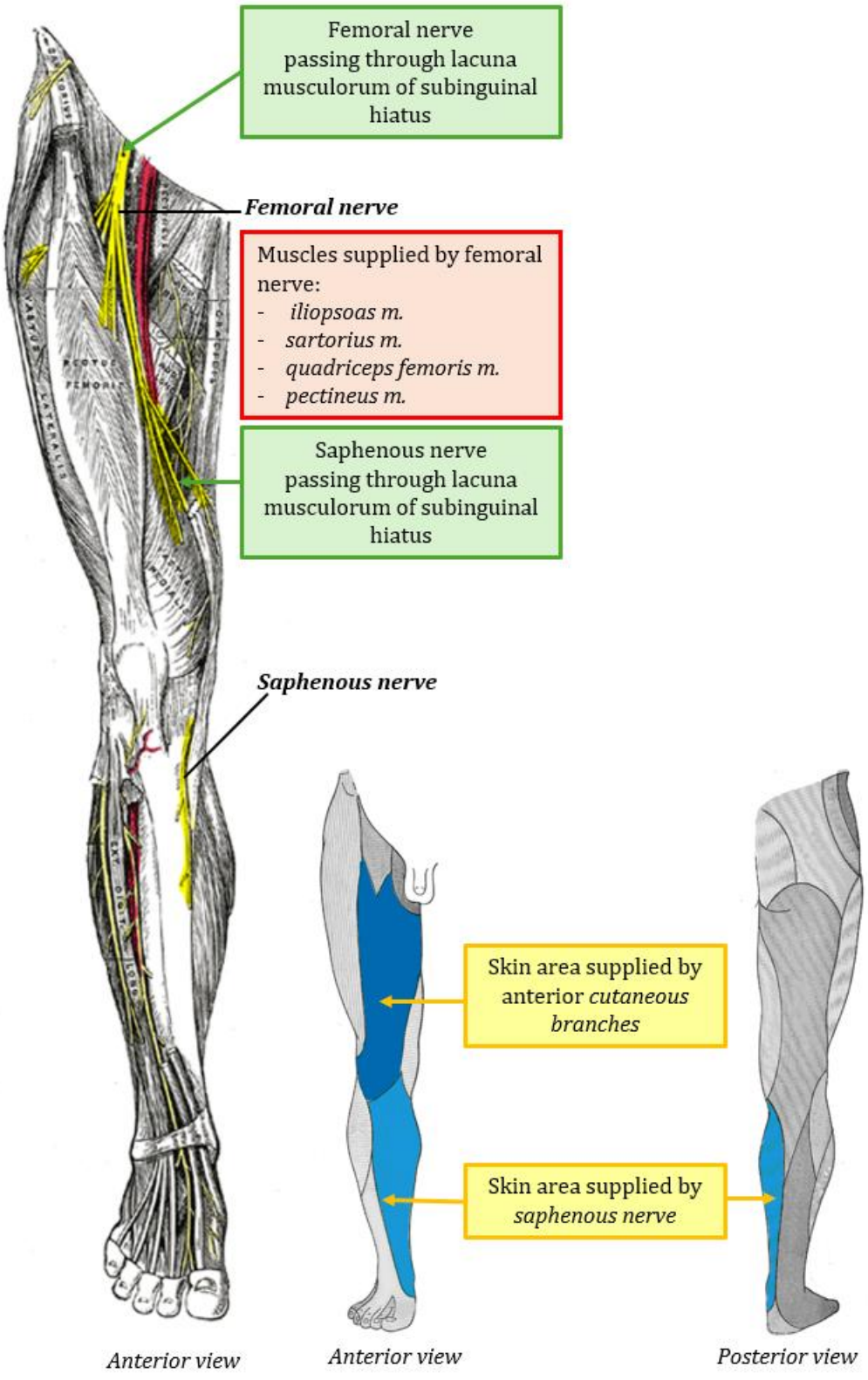


Fig. 39
Femoral nerve
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Clinical notes

*The **femoral nerve** injury may be a complication of the pelvic fractures, however, these injuries have an iatrogenic etiology in most cases.*

The nerve may be affected during the orthopaedic (e.g., hip replacement), abdominal (opened femoral or inguinal hernia repair), or gynaecological surgeries.

The patients with femoral nerve lesions may present with weakness of the knee extension (due to paralysis of the quadriceps femoris muscle), weakness of the hip flexion (due to the paralysis of the sartorius and iliopsoas muscles) and sensory disturbances over the anterior thigh (irritation of the anterior cutaneous branches) or on the medial aspect of the leg (irritation of the saphenous nerve).

*Because of a close anatomical relation of the **saphenous nerve** with the great saphenous vein, the saphenous nerve is susceptible to the injury during the great saphenous vein stripping procedure (surgical procedure used to remove, pull out varicose superficial vein). The saphenous nerve may be also damaged by the leg ulcers occurring on the medial side of the leg.*

OBTURATOR NERVE

The obturator nerve is the only nerve of the lumbar plexus emerging from the medial border of the psoas major muscle. It is formed by the fibres from the anterior rami of L2 – L4 spinal nerves.

The nerve passes at the lateral pelvic wall accompanied by the obturator vessels and related to the pelvic organs – **ovary in female, ductus deferens in male, and ureter in both**. It enters the lower limb inferior to **the superior ramus of the pubis, through the obturator canal** and reaches the medial side of the thigh.

It is usually subdivided into the **anterior branch** passing between the pectineus and adductor brevis muscles, and the **posterior branch** entering the adductor magnus muscle.

The obturator nerve is a mixed nerve. It gives the **motor nerve supply for the medial femoral muscles**. Its sensory fibres supply the **skin at the medial side of the thigh and the hip joint**.

Clinical notes

*The **obturator nerve** injury may result from pelvic fractures or compression by the pelvic tumours, or it may be an intraoperative iatrogenic injury to the nerve during orthopaedic surgery, urologic, and gynaecological procedures involving pelvic lymphadenectomy.*

The obturator nerve lesions may result in paraesthesia, sensory loss, or pain on the medial side of the thigh (involvement of the sensory branches) and/or in weakness of the thigh adduction (due to paralysis of the medial femoral muscles).

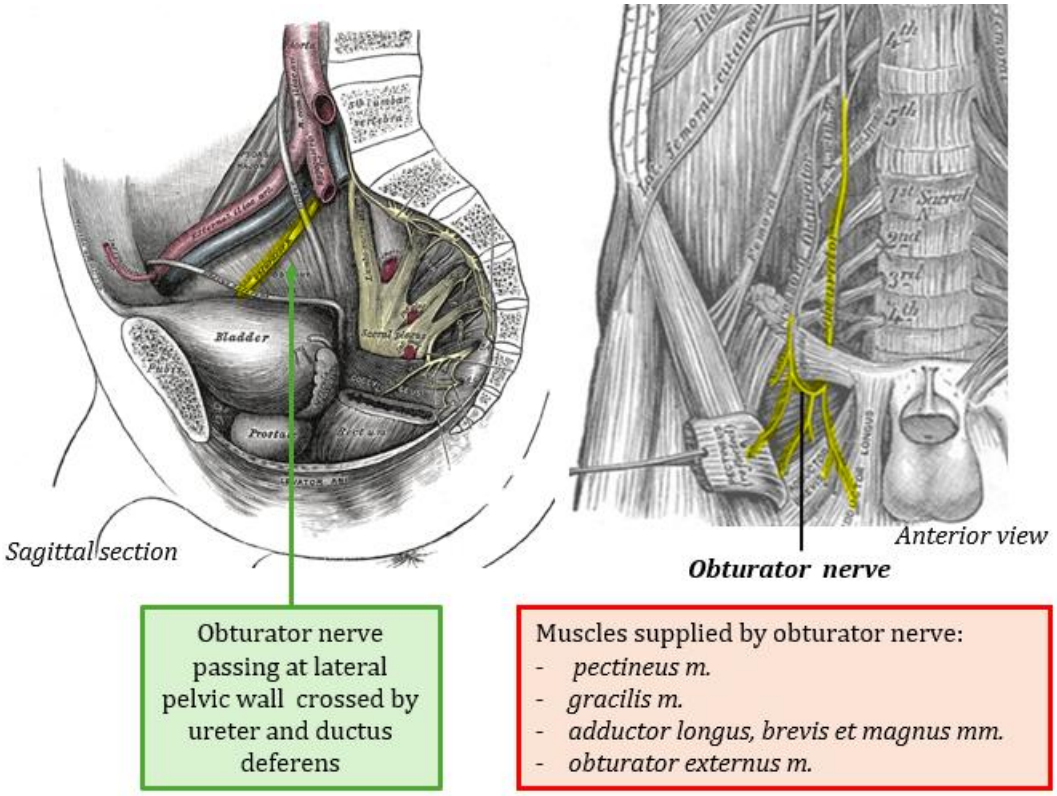


Fig. 40
Obturator nerve
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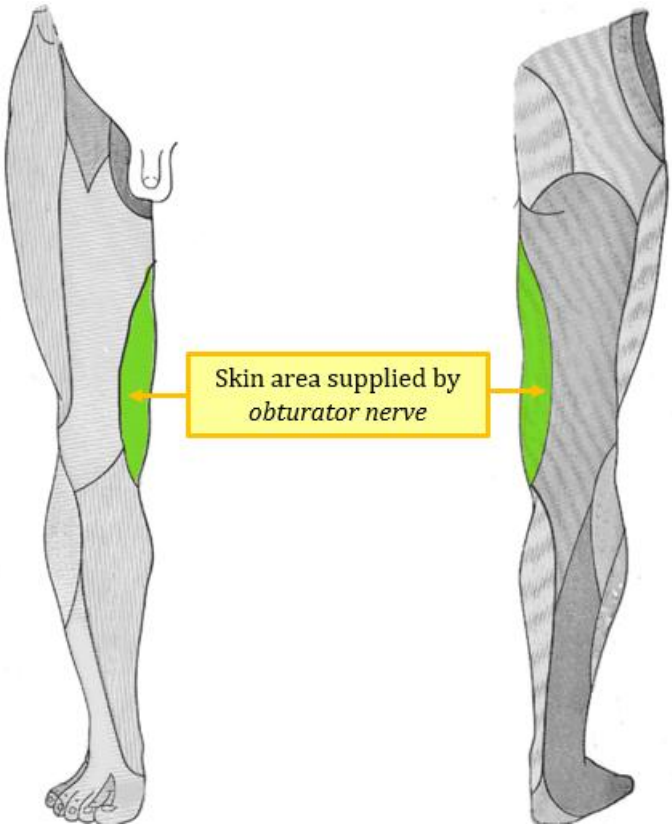


Fig. 41
Skin area of the obturator nerve
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SACRAL PLEXUS

The sacral plexus is formed by the union of the **anterior rami of the spinal nerves L4, L5, S1 – S5, Co** (some fibres from the anterior ramus of L4, L5, all fibres of the anterior rami of S1 – S5 and the coccygeal nerve) at the sides of the sacral bone. The fibres from L4 and L5 join together as the lumbosacral trunk and descend to the sacral spinal nerves.

The nerves of the sacral plexus exit the pelvis through the **greater sciatic foramen** above (the **suprapiriform foramen**) or below (the **infrapiriform foramen**) the piriformis muscle. The piriformis muscle runs from the sacrum to the greater trochanter passing through the greater sciatic foramen.

- **Short motor fibres** arise from the roots of the plexus and supply the **pelvitrochanteric muscles (piriformis, gemellus superior et inferior, obturator internus, and quadratus femoris muscle**).

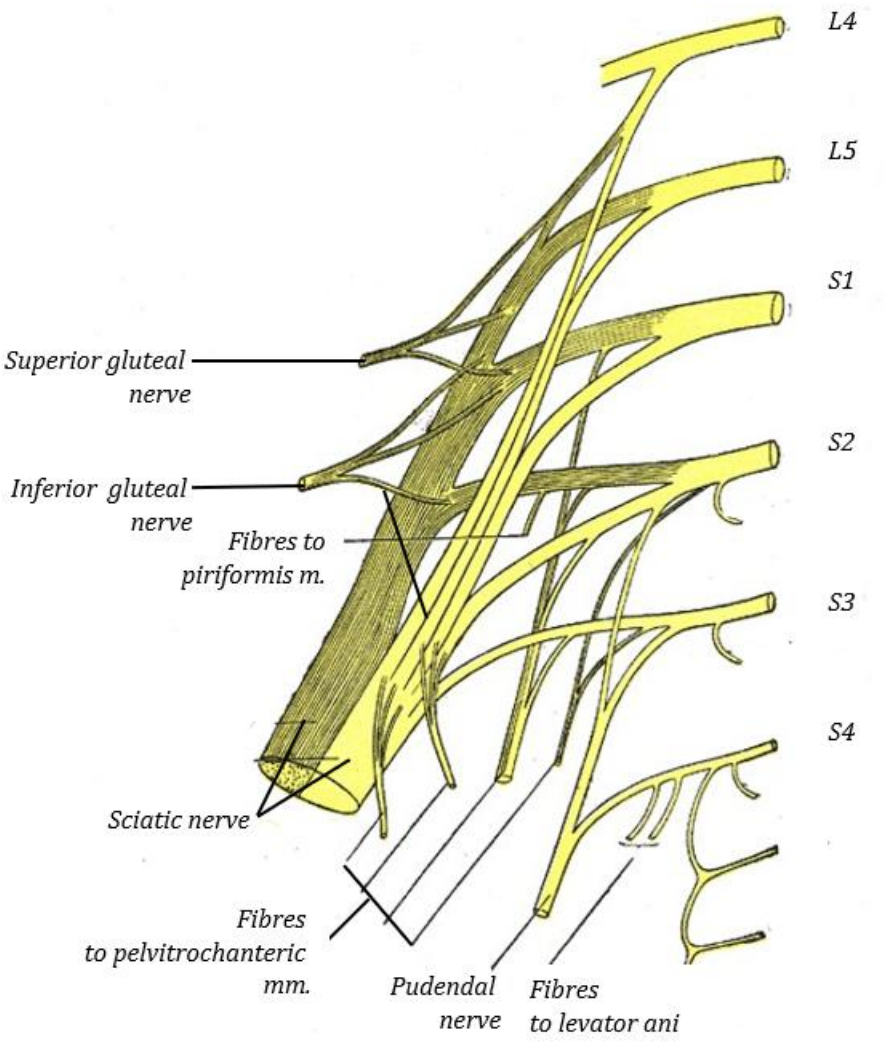


Fig. 42
Sacral plexus
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SUPERIOR GLUTEAL NERVE

The superior gluteal nerve is a motor nerve formed from the fibres of the ventral rami of L4 – S1 spinal nerves. It emerges from the suprapiriform foramen, together with the superior gluteal vessels, and passes between the gluteus medius and gluteus minimus muscles. It gives off the **motor fibres for the gluteus medius, minimus, and tensor fasciae latae muscles** (the last one is also known as gluteus ventralis muscle).

INFERIOR GLUTEAL NERVE

The inferior gluteal nerve arises from the fibres of the anterior rami of L5 – S2 spinal nerves. It leaves the pelvis through the infrapiriform foramen (medial to the sciatic nerve), accompanied by the inferior gluteal vessels and enters the **gluteus maximus muscle** providing its motor innervation. It also gives off the sensory fibres for the hip joint.

Clinical notes

*The **superior and inferior gluteal nerve** lesions are rare and may result from trauma, chronic compression by the osteophytes or tumours. Occasionally, iatrogenic injuries may occur, for example during the total hip replacement or due to the application of intramuscular injection in the gluteal region.*

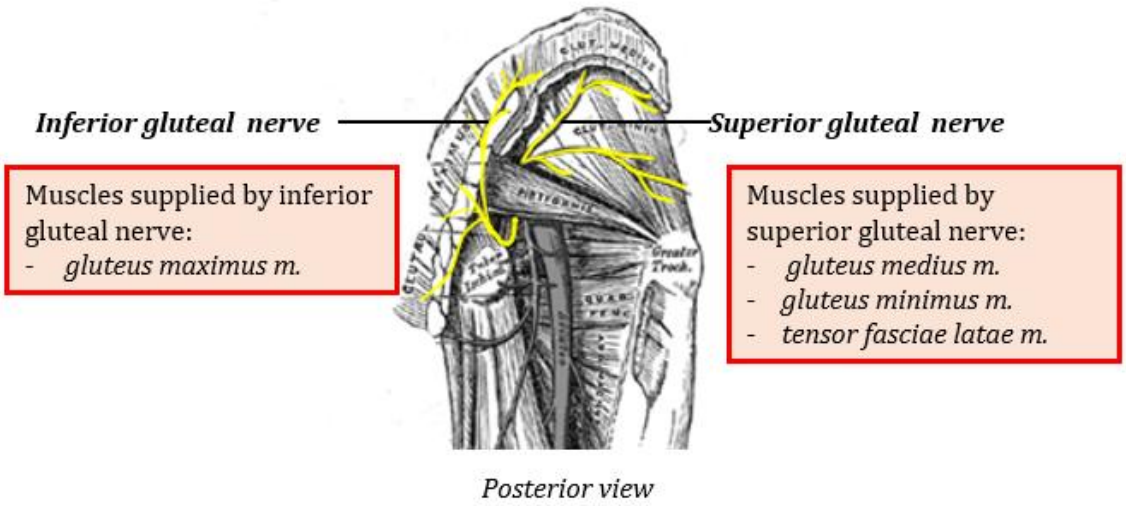


Fig. 43
Superior and inferior gluteal nerves
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POSTERIOR CUTANEOUS FEMORAL NERVE

This purely sensory nerve is formed from the fibres of the anterior rami of S1 – S3 spinal nerves. The posterior cutaneous femoral nerve passes through the infrapiriform foramen, continues underneath the gluteus maximus, and descends along the posterior aspect of the thigh to the level of the knee, providing sensory innervation to the skin of these regions.

At the inferior border of the gluteus maximus, the posterior cutaneous femoral nerve gives off the **inferior cluneal nerves** (that ascend to the skin at the lower third/quarter of the gluteal region) and the **perineal branches** to the skin at the perineum (perineum is the area between the anus and external genitalia – scrotum or vulva).

At the posterior femoral region, the stem of the nerve runs subfascially, while only its branches perforate the superficial fascia to reach the skin.

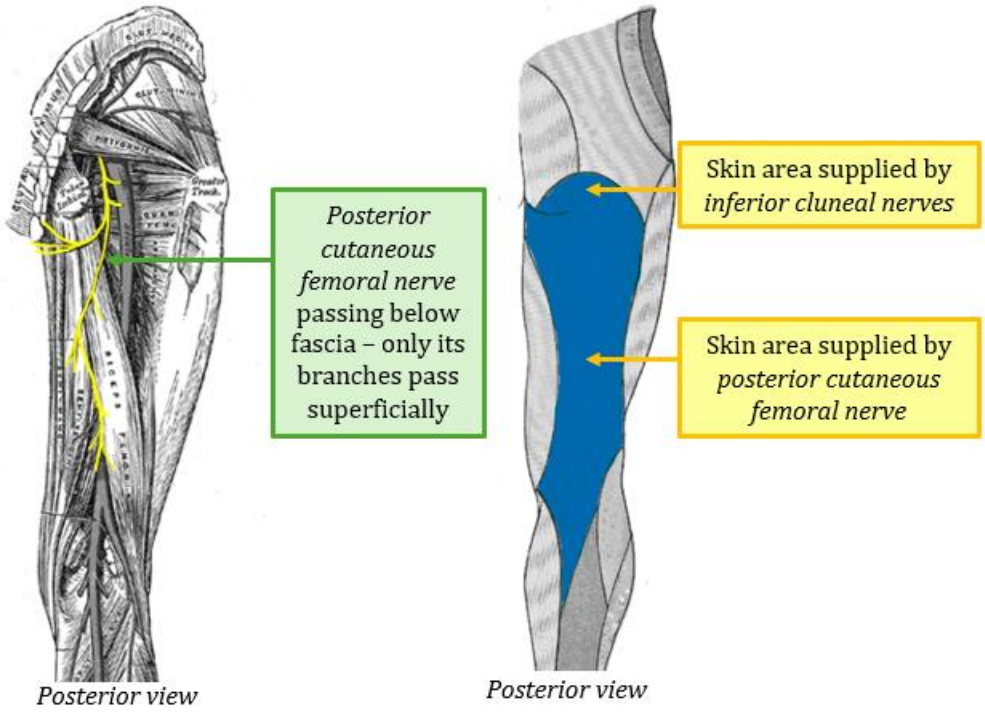


Fig. 44
Posterior cutaneous femoral nerve
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Clinical notes

*The **posterior cutaneous femoral nerve** may be compressed by prolonged sitting on hard surface, during the cycling, or by hypertrophic gluteal or posterior femoral muscles. Such irritation of the nerve results in the paraesthesia, or pain in the femoral region, in the lower third of the gluteal region, and in the perineal region.*

SCIATIC NERVE

The sciatic nerve is the biggest nerve in the human body. It arises from the fibres of the anterior rami of L4 – S3 spinal nerves.

The sciatic nerve nerve leaves the pelvis through the **infrapiriform foramen**. In its proximal part, it passes underneath the gluteus maximus muscle and then, at the thigh, it descends beneath **the long head of the biceps femoris muscle**. Above the popliteal fossa, the sciatic nerve splits into two terminal branches – the **tibial nerve** and **common fibular nerve**.

The sciatic nerve is a mixed nerve. It provides motor nerve supply to the **posterior femoral muscles (biceps femoris, semitendinosus and semimembranosus muscles**) and to the **posterior part of the adductor magnus muscle**. It also gives off sensory fibres to the hip joint and to the knee joint.

Clinical notes

*The **sciatic nerve** may be injured during the inappropriate administration of the intramuscular injection. Traditionally, in adults the intramuscular injections were administered into the gluteus maximus muscle, specifically, the dorsogluteal region (the upper lateral quadrant of the buttock). However, multiple studies have documented sciatic nerve injuries and other complications associated with the dorsogluteal administration. Nowadays, the ventrogluteal region (the area over the gluteus medius and minimus muscles) is recommended as the preferred intramuscular injection site. In*

children or asthenic adults, the vastus lateralis of the quadriceps femoris muscle is preferred intramuscular injection site because of the thickness and distance from large vessels and nerves.

*Occasionally, the sciatic nerve may be compressed by the piriformis muscle leading to so called „**piriformis syndrome**". The piriformis muscle may become a source of a compression when it is hypertrophied or in case of a spasm (usually as a result of chronic postural imbalance, prolonged sitting or trauma) or due to the intrinsic piriformis pathology. The irritation of the nerve produces characteristic symptoms: deep gluteal pain radiating along posterior aspect of the thigh.*

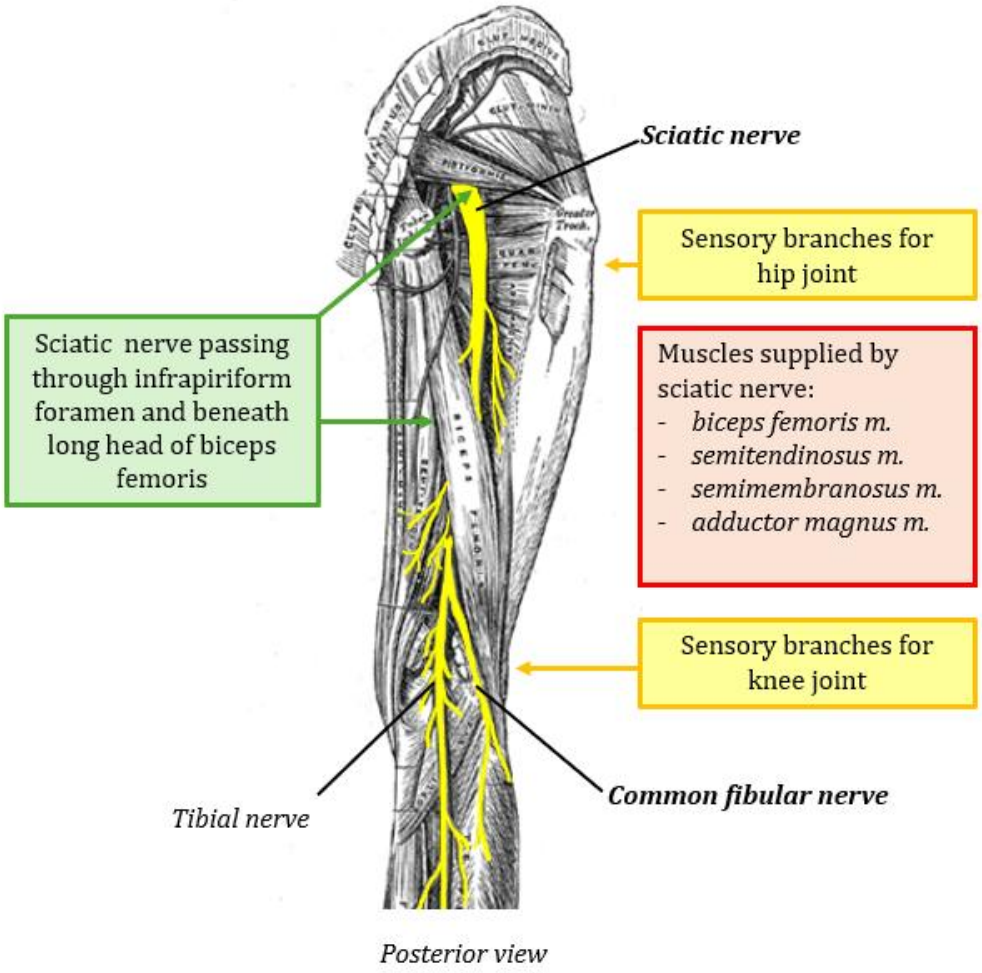


Fig. 45
Sciatic nerve
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TIBIAL NERVE

The tibial nerve runs in the midline of the **popliteal fossa**. It is lateral and superficial to the popliteal vessels, and medial and deep to the common fibular nerve. Passing between the medial and lateral heads of the gastrocnemius muscle and then underneath the tendinous arch of the soleus muscle, it leaves the popliteal fossa.

At the leg, the tibial nerve descends **underneath the triceps surae** and above the deep layer of the posterior crural muscles. Here, it is accompanied by the posterior tibial vessels. The tibial nerve and the vessels continue to the sole of the foot through the **medial retromalleolar space**. The nerve passes posterior to the tendons of the tibialis posterior muscle, flexor digitorum longus muscle and posterior tibial vessels.

The tibial nerve is a mixed nerve.

At the leg it gives off:

- **Muscular branches for the posterior crural muscles** (triceps surae, popilteus, tibialis posterior, flexor digitorum longus, and flexor hallucis longus muscles).
- Interosseous crural nerve – provides sensory fibres for the tibia and the talocrural joint.
- **Medial cutaneous sural nerve** – supplies the skin at the posterior crural region and unites with the communicating branch from the common fibular nerve forming:
  - **sural nerve** – this nerve supplies the skin at the lateral side of the leg, lateral ankle and foot up to the fifth toe (its terminal branch is the **lateral cutaneous dorsal nerve**). The sural nerve accompanies the small saphenous vein.

At the sole of the foot, the tibial nerve splits into the **medial and lateral plantar nerves**. These nerves accompany the medial and lateral plantar vessels underneath the flexor digitorum brevis muscle. Both these nerves are mixed nerves supplying the plantar muscles and the skin at the planta pedis.

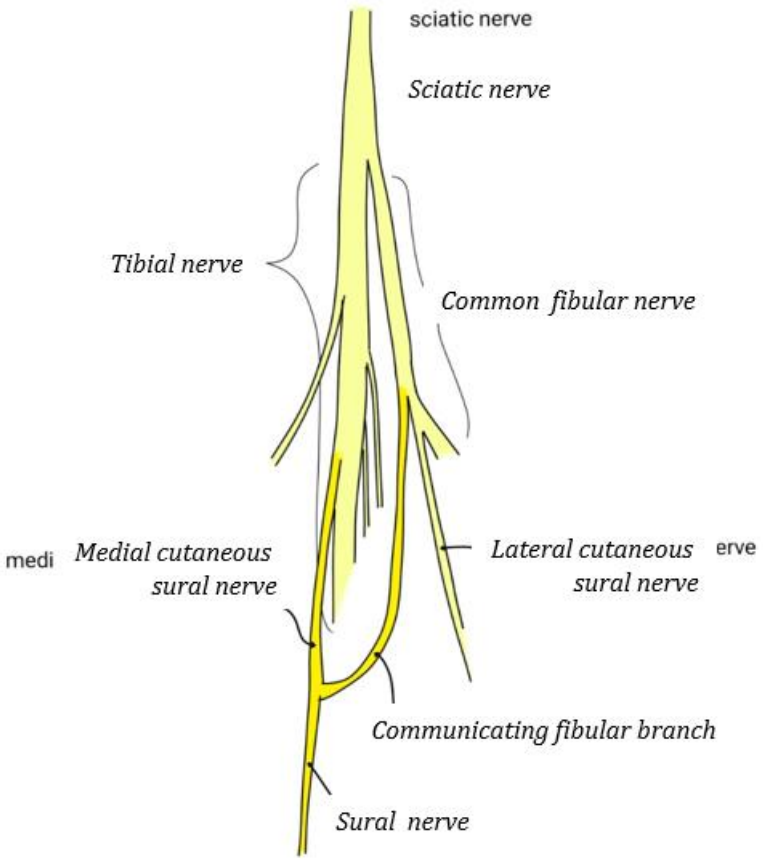


Fig. 46

Sural nerve
Drawing from the author's archive

- **Medial plantar nerve** supplies the flexor digitorum brevis, abductor hallucis, flexor hallucis brevis muscle and the lumbricals I and II. The sensory fibres from the medial plantar nerve innervate the skin at the area of the medial 3 and a half toes.

- **Lateral plantar nerve** supplies the quadratus plantae muscle, abductor digiti minimi, flexor digiti minimi, opponens digiti minimi muscles, lumbricals III and IV, and all interossei muscles (plantar and dorsal). The sensory fibres from the lateral plantar nerve give nerve supply for the skin at the area of the lateral 1 and a half toe.

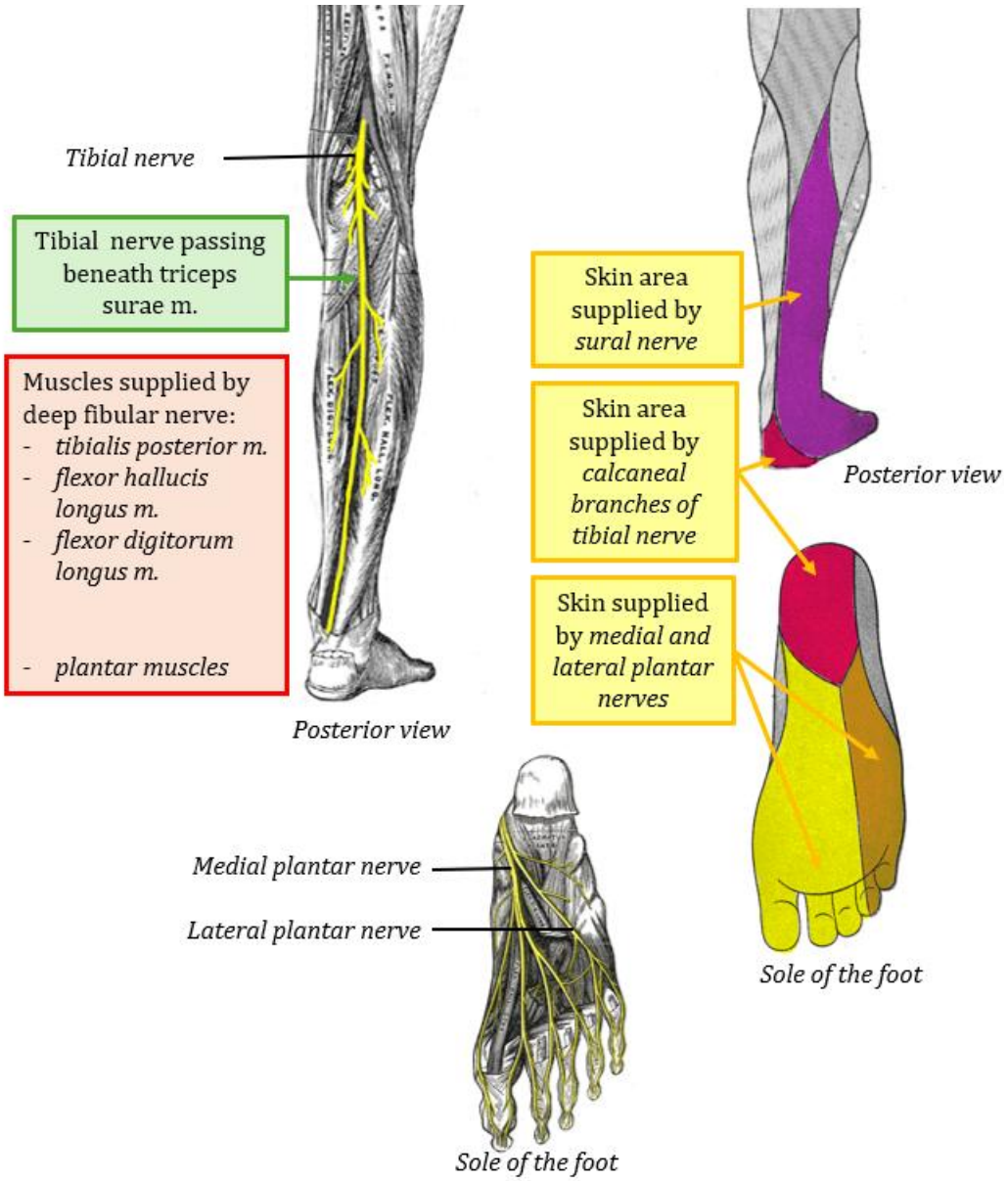


Fig. 47
Tibial nerve
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Clinical notes

*The **tibial nerve** lesions are rare, however, the entrapment of this nerve may occasionally occur. Proximal entrapment is located in the popliteal fossa, or beneath the tendinous arch of the soleus muscle. It is a rare type, often resulting from trauma, tumour, or Baker's cyst (a popliteal cyst caused by herniation of the synovial membrane*

of the knee joint or gastrocnemius-semimembranosus synovial bursa). Patients present with the weakness in plantar flexion and flexion of the toes (due to paralysis of the flexor muscles), and sensory disturbances at the sole of the foot.

Tarsal tunnel entrapment is the most common form, occurring within the medial retromalleolar canal, caused by the compression between the flexor retinaculum and the medial malleolus. It most often results from trauma (e.g., fracture of the medial malleolus, postraumatic fibrosis), or systemic diseases (diabetes, rheumatoid arthritis). Typical symptoms include paresthesia, or pain in the sole of the foot, aggravated by standing or walking.

Distal branches entrapments are very rare. The medial plantar nerve entrapment occurs particularly in runners („jogger's foot") at the point between the navicular tuberosity and the abductor hallucis muscle. As for the lateral plantar nerve, its first branch (inferior calcaneal nerve) is most often entrapped as it passes anterior to the calcaneal tuberosity. Distal entrapments typically manifest as the sensory disturbances.

COMMON FIBULAR NERVE

In **popliteal fossa,** the common fibular nerve runs **along the biceps femoris muscle**. The nerve gives off following sensory branches:

- Sensory fibres for the knee joint and tibiofibular joint
- **Lateral cutaneous sural nerve** for the skin at the lateral side of the calf
- **Communicating fibular branch** that joins the medial cutaneous sural nerve forming the sural nerve.

The common fibular nerve turns **around the neck of fibula** and splits into **the superficial** and **deep fibular nerves.**

SUPERFICIAL FIBULAR NERVE

The superficial fibular nerve enters the lateral crural muscles (**fibularis longus et brevis**) and supplies them. At the distal quarter of the leg, it perforates the fascia and descends superficially to the skin at the back of the foot. Here it splits in two sensory branches:

- **medial cutaneous dorsal nerve** – for the medial side of the big toe and to the adjacent sides of the 2nd and 3rd toe
- **intermediate cutaneous dorsal nerve** – for the lateral 2 and a half toes.

DEEP FIBULAR NERVE

The deep fibular nerve enters the anterior crural compartment. Specifically, it runs with the anterior tibial vessels **between the tibialis anterior muscle and extensor digitorum and hallucis longus muscles**.

At the leg it gives off the motor branches for the **anterior crural muscles**.

Distally, the deep fibular nerve continues to the **back of the foot** where it innervates the muscles (**extensor digitorum brevis and extensor hallucis brevis muscles**). In the first intermetatarsal space, the deep fibular nerve perforates the superficial fascia and continues to the **skin at the adjacent sides of the 1st and the 2nd toe**.

Clinical notes

*The lesions of the **common fibular nerve** are frequent due to its superficial course around the fibular neck. They may result from trauma (e.g., fractures of the fibular head and neck), external compression, iatrogenic injury during the orthopaedic surgery, or entrapment syndromes (most commonly around the origin of the fibularis longus muscle). The clinical signs of the neuropathy include weakness of the ankle and toes extension, „foot drop" (due to the paresis of the anterior crural muscles) and weakness in the eversion (pronation) of the foot (due to the paresis of the lateral crural muscles). The sensory disturbances (tingling, burning or pain) may occur at the back of the foot.*

*Isolated **superficial fibular nerve lesions** are uncommon. The nerve lies deep within the muscles of the lateral compartment, however, may become entrapped as it exits the compartment and enters the superficial subcutaneous tissue. This neuropathy is more often in athletes and dancers. Forced inversion of the foot and plantar flexion could lead to overstretching of the nerve. The ankle and toes extension is normal, while foot eversion is weakened. The sensory impairment involves the back of the foot, except the adjacent sides of the 1st and the 2nd toe.*

*The **deep fibular nerve** lesions are less common than the injuries to the common fibular nerve but may occur as a result of trauma, compression, or entrapment. The deep fibular nerve is often compressed in anterior crural compartment (**anterior compartment syndrome**) or beneath the extensor retinaculum (**anterior tarsal tunnel syndrome**). Clinical signs of the neuropathy include weakness of ankle and toes extension, „**foot drop**" (due to paresis of the anterior crural muscles and muscles of the back of the foot) as well as the sensory disturbances at the skin between the 1st and the 2nd toe.*

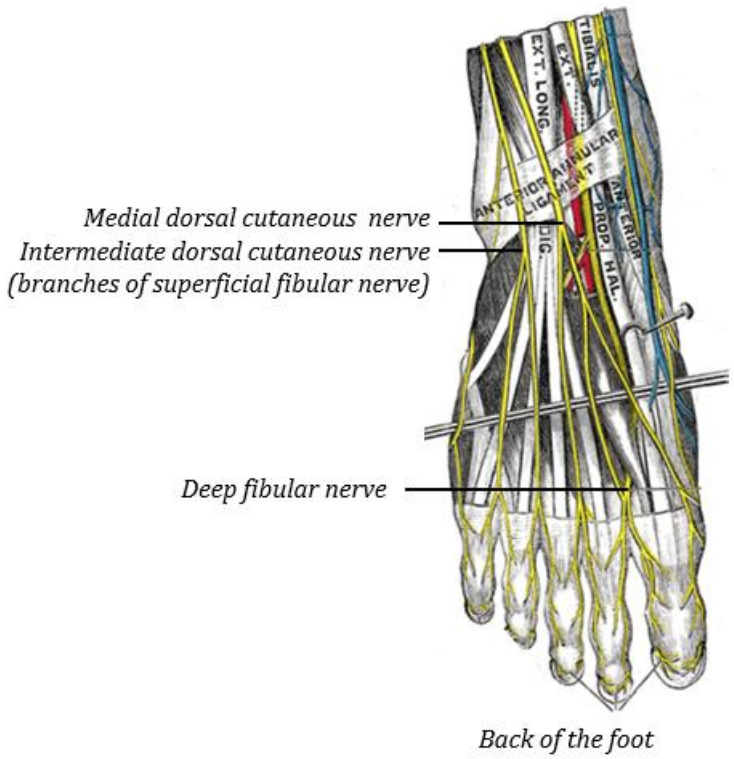


Fig. 48
Nerves at the back of the foot
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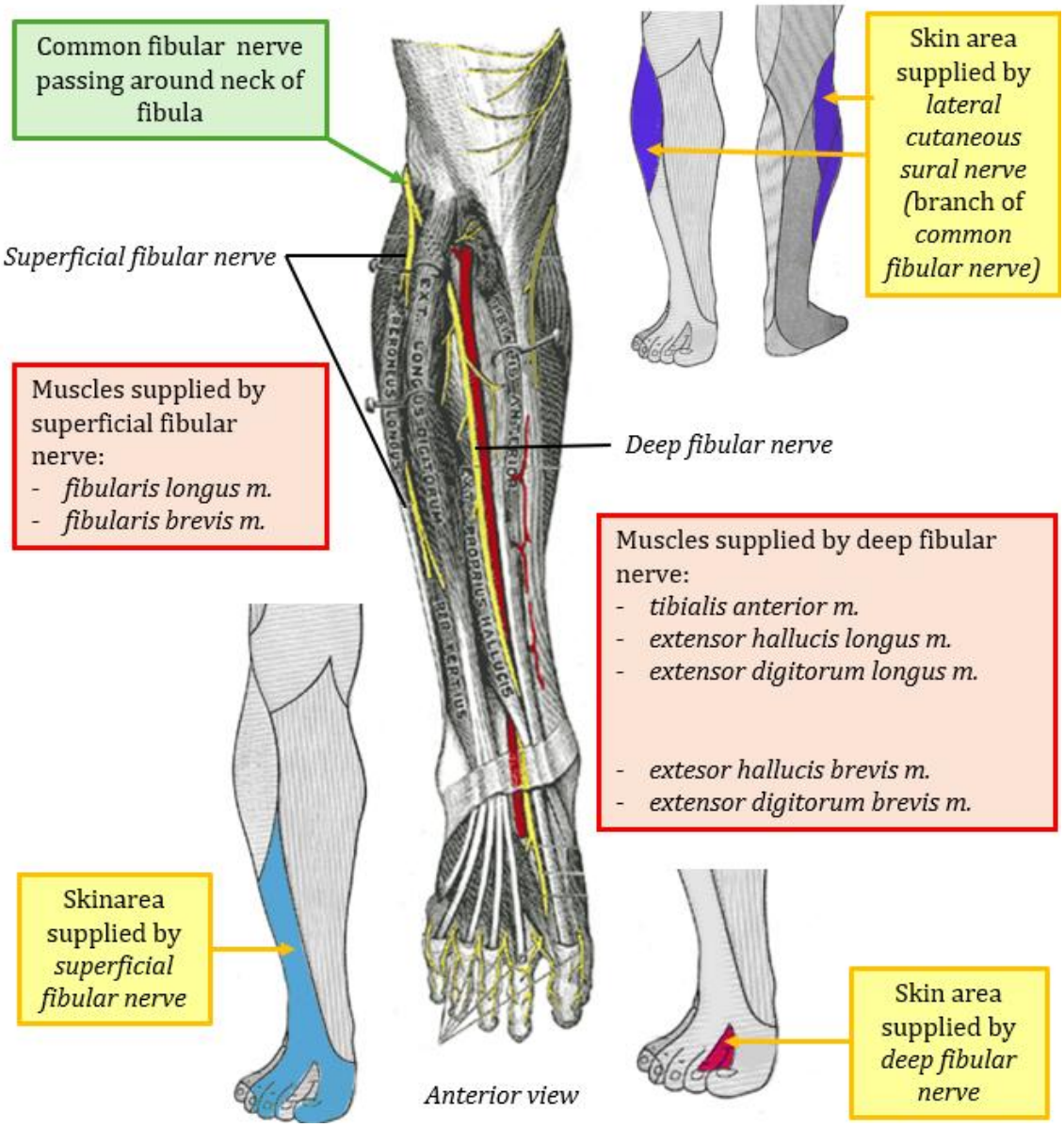


Fig. 48

Common fibular nerve, deep fibular nerve and superficial fibular nerve

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PUDENDAL NERVE

The pudendal nerve is formed by the fibres of the ventral rami of S2 – S4 spinal nerves. It leaves the pelvis through the **infrapiriform foramen** and then curves around the ischial spine and re-enters back to the pelvis through the **lesser sciatic foramen**. Then, it courses at the lateral wall of the **ischioanal fossa** within the pudendal canal (closely related to obturator internus muscle) to eventually reach the perineum and external genitalia passing between the pelvic and the urogenital diaphragms.

The pudendal nerve is a mixed nerve providing sensory branches and **motor fibres** to **the pelvic diaphragm** (including **external anal sphincter)** and to a part of **urogenital diaphragm** (including **external urethral sphincter**).

The main branches of the pudendal nerve:

- **Inferior rectal nerves** supplying the skin around the anus and the external anal sphincter and partially pelvic diaphragm.
- **Perineal branches** contain the motor branches for the urogenital diaphragm and the external urethral sphincter, and the sensory fibres for the skin of the perineum, and external genitalia (via the **posterior scrotal** and **labial branches**).
- **Dorsal nerve of the penis or clitoris** is the terminal purely sensory branch of the pudendal nerve that reaches these structures (penis/clitoris) inferior to the pubic symphysis.

Clinical notes

*The lesions of the **pudendal nerve** are not common but clinically significant as they lead to both motor and sensory symptoms. These lesions may result from trauma (especially pelvic fractures), external compression (prolonged sitting or cycling), or nerve entrapment. The nerve is the most vulnerable as passing through the infrapiriform foramen, around the ischial spine, and between the sacrospinous and sacrotuberous ligaments. The typical symptoms of pudendal neuropathy include*

sensory disturbances and pain in the perineal region, anus, and external genital organs, as well as possible ***faecal or urinary incontinence*** *due to the weakness of the external anal sphincter and the external urethral sphincter. In severe or chronic cases, the genital prolapse may occur because of the reduced muscle tonus of the muscles of the pelvic floor.*

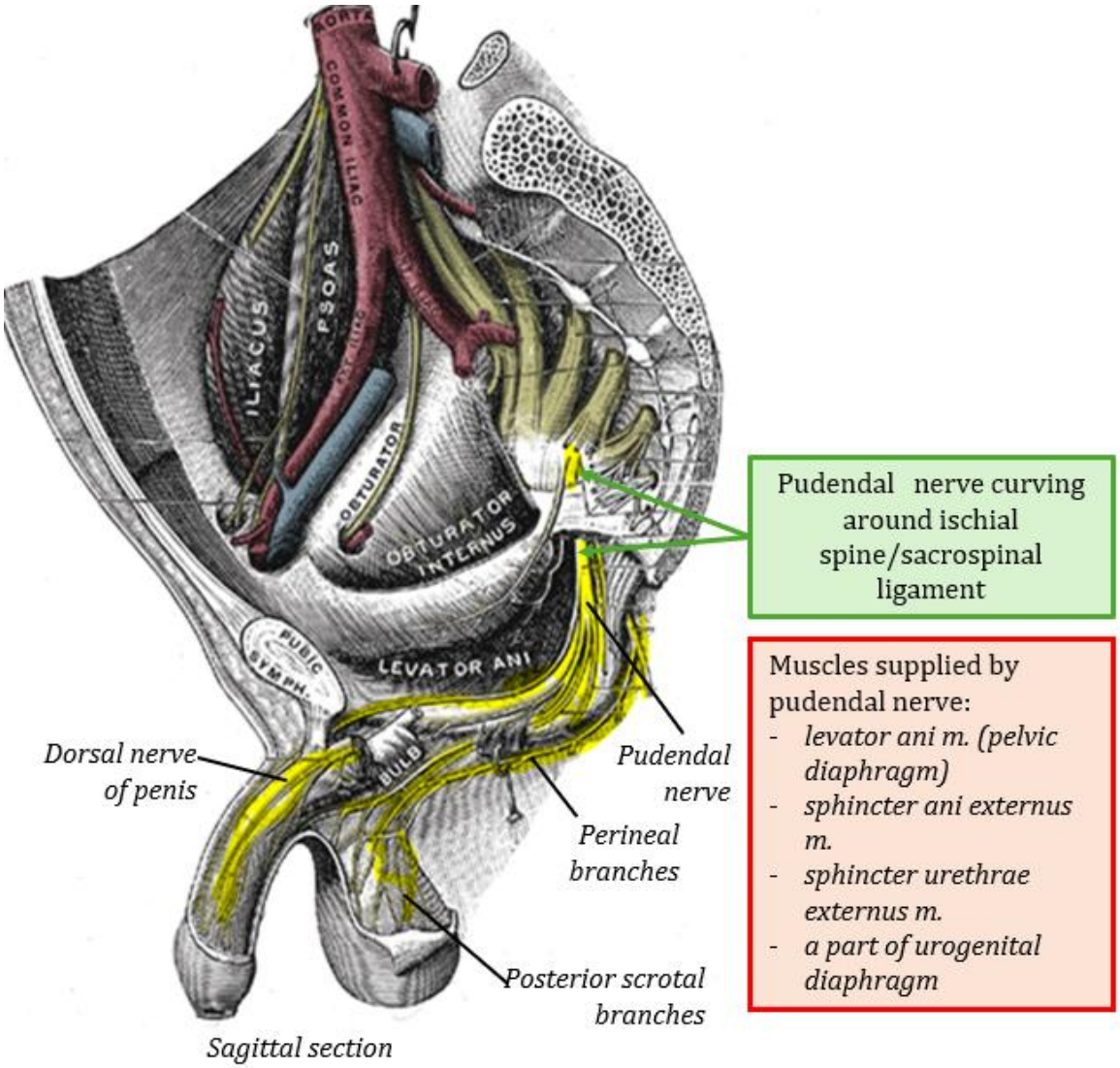


Fig. 49
Pudendal nerve
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Table 11: Lumbar plexus

Nerve	***Motor fibres***	***Sensory fibres***
Iliohypogastric nerve *(fibres from T12 – L1)*	*- transverse abdominal muscle* *- internal oblique muscle*	*- skin above iliac crest, to lateral third of gluteal region and to hip joint* *- skin at pubic region and above e inguinal ligament medially*
Ilioinguinal nerve *(fibres from L1)*	*- transverse abdominal muscle* *- internal oblique muscle*	*- skin overlying medial part of inguinal ligament and anterior aspect of external genital organs*
Genitofemoral nerve *(fibres from L1 – L2)* *- **genital branch*** ***- femoral branch***	*- cremaster muscle*	*- skin at external genital organs* *- skin above saphenous hiatus*
Lateral cutaneous femoral nerve *(fibres from L2 – L3)*		*- skin at lateral side of thigh*
Femoral nerve *(fibres from L1 – L4)*	*- iliopsoas muscle* *- sartorius muscle* *- quadriceps femoris muscle* *- pectineus muscle*	*- skin at anterior side of thigh* *- skin at medial side of leg* *- hip joint* *- knee joint*
Obturator nerve *(fibres from L2 – L4)*	*- pectineus muscle* *- gracilis muscle* *- adductor longus muscle* *- adductor brevis muscle* *- adductor magnus muscle* *- obturator externus muscle*	*- skin at medial side of thigh* *- hip joint*

Table 12: Sacral plexus

Nerve	***Motor fibres***	***Sensory fibres***
Superior gluteal nerve *(fibres from L4 – S1)*	*- gluteus medius muscle* *- gluteus minimus muscle* *-tensor fasciae latae*	
Inferior gluteal nerve *(fibres from L5 – S2)*	*- gluteus maximus muscle*	*- hip joint*
Posterior cutaneous femoral nerve *(fibres from S1 – S3)*		*- posterior aspect of thigh to knee joint, inferior third of gluteal region*
Sciatic nerve *(fibres from L4 – S3)*	*- biceps femoris muscle* *- semitendinosus muscle* *- semimembranosus muscle* *- adductor magnus muscle*	*- hip joint* *- knee joint*
Tibial nerve	*- tibialis posterior muscle* *- flexor hallucis longus muscle* *- flexor digitorum longus muscle* *- plantar muscles*	*- skin at posterior aspect of leg* *- skin overlying lateral ankle* *- skin at sole of foot* *- talocrural joint*
Common fibular nerve		*- skin at lateral side of leg*
Superficial fibular nerve	*- fibularis longus muscle* *- fibularis brevis muscle*	*- skin at back of foot*

Deep fibular nerve	*- tibialis anterior muscle* *- extensor hallucis longus muscle* *- extensor digitorum longus muscle* *-extensor hallucis brevis muscle* *- extensor digitorum brevis muscle*	*- skin at adjacent sides of the 1st and the 2nd toe*
Pudendal nerve *(fibres from S2 – S4)*	**-** *urogenital diaphragm* *- external urethral sphincter muscle* *- a part of the pelvic diaphragm* *- external anal sphincter muscle*	*- skin of the perineum* *- skin around anus* *- skin at external genitalia*

Table 13: **Muscles of the lower limb in a nutshell**

The table presents a brief and simplified overview of the lower limb muscles, highlighting only their main functions

Abbreviations:
ABD, abduction; ADD, adduction; E, extension; F, flexion; F/A, function/action;I, insertion; NS, nerve supply; O, origin; P, pronation; S, supination;

MUSCLES OF THE ILIAC REGION	***MUSCLES OF THE GLUTEAL REGION***	
	SUPERFICIAL GROUP	***DEEP GROUP***
ILIOPSOAS M. ***= iliacus + psoas major*** ***→ Iliacus*** *(**O:** iliac fossa)* ***→ Psoas major*** *(**O:** vertebral bodies + transverse processes TXII – LV)* ***Both:*** ***I:*** *lesser trochanter of femur* ***F/A: F of thigh + both sides contraction raises the trunk from lying to sitting position*** ***NS:*** *femoral n. + fibres from lumbar plexus* ***PSOAS MINOR M.*** *(variable)* ***O:*** *vertebral bodies TXII -LI* ***I:*** *iliac fascia or iliopectineal eminence* ***F/A: very poor F of trunk*** ***NS:*** *fibres from lumbar plexus*	***GLUTEUS MAXIMUS M.*** *O: gluteal surface of iliac ala, dorsal surface of sacrum, coccyx* *I: gluteal tuberosity + iliotibial tract* ***F/A: E of thigh*** ***NS: inferior gluteal n.*** ***GLUTEUS MEDIUS M.*** ***O:*** *gluteal surface of iliac ala* ***I:*** *greater trochanter of femur* ***F/A: ABD, P, S of thigh*** ***NS:*** *superior gluteal n.* ***GLUTEUS MINIMUS M.*** ***O*** *gluteal surface of iliac ala* ***I:*** *greater trochanter of femur* ***F/A: ABD, P, S of thigh*** ***NS:*** *superior gluteal n.* ***TENSOR FASCIE LATAE M.*** ***O:*** *anterior superior iliac spine* ***I:*** *iliotibial tract (lateral condyle of tibia)* ***F/A: tightens fascia lata femoris and stabilizes knee joint in E*** ***NS:*** *superior gluteal n.*	***PIRIFORMIS M.*** ***O:*** *pelvic surface of sacrum* ***I:*** *greater trochanter* ***F/A: S and ABD of thigh*** ***OBTURATOR INTERNUS M.*** ***O:*** *pelvic surface of obturator membrane* ***I:*** *trochanteric fossa* ***F/A: S and ABD of thigh*** ***GEMELLUS SUPERIOR M.*** ***O:*** *ischial spine* ***I:*** *trochanteric fossa* ***F/A: S of thigh*** ***GEMELLUS INFERIOR M.*** ***O:*** *ischial tuberosity* ***I:*** *trochanteric fossa* ***F/A: S of thigh*** ***QUADRATUS FEMORIS M.*** ***O:*** *ischial tuberosity* ***I:*** *intertrochanteric crest* ***F/A: S and ADD of thigh***

MUSCLES OF THE THIGH – FEMORAL MUSCLES

ANTERIOR FEMORAL MUSCLES

SARTORIUS m.
O: *anterior superior iliac spine*
I: *below medial condyle of tibia medially to the tibial tuberosity*
*(**pes anserinus - „goose foot“**)*
F/A: F, ABD and S of thigh, F + P of leg
NS: *femoral n.*

QUADRICEPS FEMORIS M.
O:
→ ***rectus femoris -*** *anterior inferior iliac spine*
→ ***vastus medialis*** *- medial lip of linea aspera*
→ ***vastus lateralis*** *- lateral lip of linea aspera*
→ ***vastus intermedius*** *- ventral surface of femoral shaft*
I: *tibial tuberosity*
F/A: E of leg
+ rectus femoris ***F of thigh***
NS: *femoral n.*

POSTERIOR FEMORAL MUSCLES

O: *ischial tuberosity (except short head of biceps femoris – lateral lip of linea aspera)*
NS: *sciatic n.*
F/A: E of thigh, F of leg

BICEPS FEMORIS M.
I: *head of fibula*

SEMITENDINOSUS M.
I: *below medial condyle of tibia, medially to tibial tuberosity (**pes anserinus)***

SEMIMEMBRANOSUS M.
I: *medial condyle of tibia*

MEDIAL FEMORAL MUSCLES

O: *around obturator foramen (superior and inferior pubic ramus, ramus of ischium and ischial tuberosity, obturator membrane)*
NS: *obturator n.*

PECTINEUS M.
O: *pecten of pubis of superior pubic ramus*
I: *pectineal (spiral) line at the femur*
F/A: ADD of thigh

GRACILIS M.
O: *pubis – closely to pubic symphysis*
I: *below medial condyle of tibia, medially to the tibial tuberosity (**pes anserinus**)*
F/A: ADD of thigh
+ F of leg

ADDUCTOR LONGUS M.
O: *pubis – closely to pubic symphysis*
I: *medial lip of linea aspera*
F/A: ADD and P of thigh

ADDUCTOR BREVIS M.
O: *inferior pubic ramus*
I: *medial lip of linea aspera*
F/A: ADD of thigh

ADDUCTOR MAGNUS M.
O: *inferior pubic ramus + ischial tuberosity*
I: *medial lip of linea aspera + adductor tubercle*
F/A: ADD of thigh

OBTURATOR EXTERNUS M.
O: *external surface of obturator membrane*
I: *trochanteric fossa*
F/A: S of thigh

MUSCLES OF THE LEG – CRURAL MUSCLES

ANTERIOR CRURAL MUSCLES

O: *ventral surface of tibia, fibula and interosseous membrane*
NS: *deep fibular n.*

TIBIALIS ANTERIOR M.
I: *medial cuneiform + base of metatarsal bone I*
F/A: E *(dorsiflexion) and* ***S*** *(inversion)* ***of foot***

EXTENSOR HALLUCIS LONGUS M.
I: *distal phalanx of hallux (big toe)*
F/A: E *(dorsiflexion)* ***of big toe and foot***

EXTENSOR DIGITORUM LONGUS M.
I: *distal phalanges of 2nd to 5th toes*
F/A: E (*dorsiflexion****)*** *of 2nd to 5th toes* ***and foot***

FIBULARIS TERTIUS
I: *base of metatarsal bone V*
F/A: E *(dorsiflexion)* ***of foot***

POSTERIOR CRURAL MUSCLES DEEP GROUP

O: *dorsal surface of tibia, fibula and interosseous membrane*
NS: *tibial n.*

POPLITEUS M.
O: *lateral condyle of femur*
I: *posterior surface of tibia above soleal line*
F/A: stabilizes knee joint

TIBIALIS POSTERIOR M.
I: *navicular bone, medial cuneiform bone*
F/A: plantar F *and* ***S*** *(inversion)* ***of foot***

FLEXOR HALLUCIS LONGUS M.
I: *distal phalanx of big toe*
F/A: F of big toe and foot

FLEXOR DIGITORUM LONGUS M.
I: *distal phalanges of the 2nd to 5th toes*
F/A: F of 2nd to 5th toes and foot

LATERAL CRURAL MUSCLES

O: *fibula*
NS: *superficial fibular n.*

FIBULARIS LONGUS M.
O: *fibular head and proximal part of fibular shaft*
I: *medial cuneiform bone and base of 1st metatarsal bone*
F/A: P (*eversion****) and plantar F of foot***

FIBULARIS BREVIS M.
O: *midle and distal part of fibular shaft*
I: *base of 5th metatarsal bone*
F/A: P (*eversion****) of foot***

POSTERIOR CRURAL MUSCLES SUPERFICIAL GROUP

NS: *tibial n.*

TRICEPS SURAE M.
O:
→ Gastrocnemius, medial head *- medial condyle of femur*
→ Gastrocnemius, lateral head *- lateral condyle of femur*
→ Soleus - soleal line of tibia
I: *calcaneal tuberosity (calcaneal tendon)*
F/A: plantar F of foot
+ gastrocnemius also F of leg

PLANTARIS M.
O: *lateral epicondyle of femur*
I: *fuses with calcaneal tendon*
F/A: weak F of leg

<table>
<tr><th colspan="3">MUSCLES OF THE FOOT</th></tr>
<tr><th><u>DORSAL</u> MUSCLES</th><th colspan="2"><u>PLANTAR</u> MUSCLES</th></tr>
<tr>
<td rowspan="2">O: calcaneus
NS: deep fibular n.

EXTENSOR DIGITORUM BREVIS M.
I: dorsal aspect of middle and distal phalanges of 2nd to 5th toes
F/A: E of 2nd to 5th toes

EXTENSOR HALLUCIS BREVIS M.
I: dorsal aspect of proximal phalanx
F/A: E of big toe</td>
<td><u>MEDIAL</u> GROUP

NS: tibial n.

ABDUCTOR HALLUCIS M.
O: calcaneus
I: proximal phalanx of big toe
F/A: ABD of big toe

FLEXOR HALLUCIS BREVIS M.
O: cuboid and lateral cuneiform bone
I: proximal phalanx of big toe
F/A: F of big toe

ADDUCTOR HALLUCIS M.
O: metatarsal bones II - IV
I: proximal phalanx of big toe
F/A: ADD of big toe</td>
<td rowspan="2"><u>INTERMEDIATE</u> GROUP

NS: tibial n.

FLEXOR DIGITORUM BREVIS M.
O: calcaneus
I: middle phalanges of 2nd to 5th toes
F/A: F of 2nd to 5th toes

QUADRATUS PLANTAE M.
O: calcaneus
I: tendon of the flexor digitorum longus
F/A: assists in F of 2nd to 5th toes

LUMBRICAL MM. I – IV
O: tendons of flexor digitorum longus
I: extensor tendons - dorsal aspect of phalanges of 2nd to 5th toes
F/A: F of metatarsophalangeal joints, E of interphalangeal joints of 2nd to 5th toes

DORSAL INTEROSSEI
O: adjacent sides of metatarsal bones
I: proximal phalanges 2nd to 5th toes
F/A: ABD of toes

PLANTAR INTEROSSEI
O: medial sides of 3rd to 5th metatarsal bones
I: proximal phalanges of toes
F/A: ADD of toes</td>
</tr>
<tr>
<td><u>LATERAL</u> GROUP

NS: tibial n.

ABDUCTOR DIGITI MINIMI M.
O: calcaneus
I: proximal phalanx of little toe
F/A: ABD of little toe

FLEXOR DIGITI MINIMI BREVIS M.
O: 5th metatarsal bone
I: proximal phalanx of little toe
F/A: F of little toe</td>
</tr>
</table>

TOPOGRAPHIC ANATOMY OF THE LOWER LIMB

When describing the topographic regions of the lower limb, the structures within each region can be divided into:

- **Superficial structures** - located within the subcutaneous tissue, immediately beneath the skin. They are embedded in the layer of subcutaneous adipose tissue, which provides cushioning and support while allowing relative mobility. These structures most commonly include cutaneous nerves, superficial vessels (mostly superficial veins), and superficial lymphatic vessels. Their position within the adipose tissue makes them clinically important as accessible landmarks for venous access or local anaesthesia.

- **Deep structures** - located beneath the superficial fascia and subcutaneous tissue, lying within and between the muscle compartments, adjacent to bones, and enclosed by the deep fascia. The deep structures of the lower limb mostly include deep arteries and veins, nerves, muscles, and tendons. These structures are responsible for movement, structural support, and neurovascular supply of the limb.

*Note: **Fascia** is a specialized connective tissue that envelops, supports, and interconnects various anatomical structures throughout the body. The **superficial fascia** represents the subcutaneous connective layer situated between the skin and the underlying musculature. Deep to the subcutaneous tissue is situated the **deep fascia**, a dense and well-organized connective tissue that invests muscles, viscera, and associated structures.*

To describe **superficial structures** (mostly neurovascular structures), the lower limb can be divided into topographic regions as follows:

- Gluteal region
- Anterior femoral region
- Posterior femoral region
- Anterior knee (genual) region
- Posterior knee (genual) region

- Anterior crural region (of the leg)
- Posterior crural region (of the leg)
- Dorsum pedis (back of the foot)
- Planta pedis (sole of the foot)

Note: *Crus is a Latin term for leg*

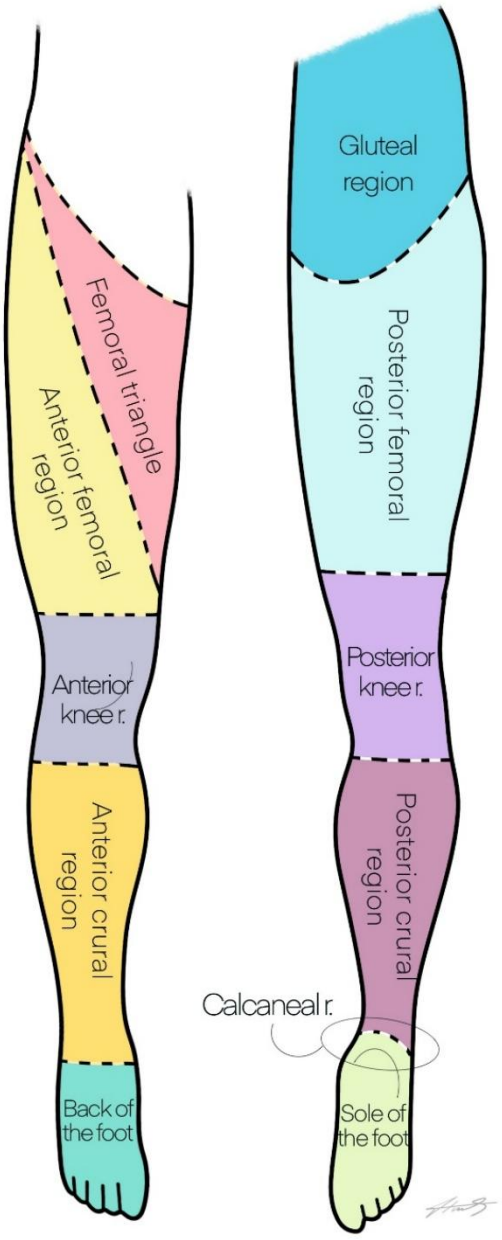


Fig. 50
Topographic regions of the lower limb

Drawing from the author's archive
Redrawn from Mráz, P. (1995). Pitevné cvičenia. Osveta.

To describe the anatomical structures (mostly neurovascular, muscular, and lymphatic structures) situated deeply (**deep topographic structures**), the lower limb can be divided into deep topographic spaces as follows:

- Subinguinal hiatus
- Femoral triangle
- Adductor canal
- Obturator canal
- Deep structures in anterior crural region
- Deep structures of dorsum pedis
- Greater sciatic foramen
- Lesser sciatic foramen
- Deep structures of posterior femoral region
- Popliteal fossa
- Deep structures of posterior crural region
- Lateral retromalleolar space
- Medial retromalleolar space
- Deep structures of planta pedis

SUPERFICIAL STRUCTURES OF THE LOWER LIMB

Basic definitions and overview

As an introduction to the superficial structures of the lower limb, the first is reviewed a basic information about the superficial veins and cutaneous nerves, which is essential for proper understanding the main superficial structures of the lower limb embedded in the subcutaneous tissue beneath the skin.

The skin and the associated subcutaneous tissue of the lower limb contain numerous sensory receptors: mechanoreceptors (perceiving the touch, pressure, vibration or stretch), thermoreceptors (temperature), and nociceptors (pain). Their afferent fibres are carried by so-called **cutaneous branches** (**cutaneous nerves**), which convey the sensory information from the skin to the central nervous system. These nerves

course within the subcutaneous tissue as branches of the specific peripheral nerves arising from the lumbar and sacral plexuses or directly from the plexuses themselves.

The venous system of human body is divided into superficial and deep veins. Deep veins generally accompany the corresponding arteries, enclosed within the muscular compartments and the deep fascia (📖for deep veins, see chapter Deep structures in the distinct topographical regions of the lower limb). In contrast, superficial veins lie within the subcutaneous tissue, independent of the arterial system, and are often visible beneath the skin. Superficial veins play a key role in cutaneous venous drainage and serve as important landmarks for clinical procedures such as intravenous access.

The following section provides information about the distinct topographical regions and the superficial structures located within them (mainly cutaneous nerves supplying the corresponding areas of the skin and the superficial veins).

The arrows show the direction of the information conduction in the nerves and the direction of blood flow within the vessels (→ vein, ← artery, → sensory nerve, ←motor nerve, ⇆ in mixed nerve).

ANTERIOR FEMORAL REGION

The neurovascular structures situated superficially in the anterior femoral region include:

- **Great saphenous vein** (→ femoral vein → external iliac vein → common iliac vein → inferior vena cava)

  In the anterior femoral region, the great saphenous vein ascends on the medial side of the thigh and passes through the saphenous opening, eventually to empty into the femoral vein.

  Note: Saphenous opening (saphenous hiatus) *is an oval-shaped aperture in the deep fascia (fascia lata) covering the femoral triangle (a deep space of the lower limb), situated approximately 3 – 4 cm inferior to the medial aspect of the inguinal ligament. The saphenous opening is covered by the fascia cribrosa (a thin part of the superficial fascia, perforated by structures passing through it – the great saphenous vein and other smaller vessels).*

  In addition to the tributaries from the crural and femoral regions, the great saphenous vein in the anterior femoral region receives also: **external pudendal veins** (venous blood of external genital organs), **superficial epigastric veins**

(venous blood of anterior abdominal wall), **superficial circumflex iliac vein** (venous blood of the abdominal wall over the inguinal ligament).

Note: *The term tributaries refer to the veins that open into/empty into a larger vein.* These tributaries of the great saphenous vein are accompanied by corresponding branches of the femoral artery that supply cutaneous regions of the upper thigh, lower abdomen, and perineum.

Note: *While these arteries (external pudendal, superficial epigastric, and superficial circumflex iliac arteries) are branches of the femoral artery, the corresponding veins are tributaries to the great saphenous vein.*

- **Anterior cutaneous branches of the femoral nerve** (→ lumbar plexus) are sensory branches of the femoral nerve that innervate the skin of the anterior femoral region (the anterior thigh).
- **Lateral cutaneous femoral nerve** (→ lumbar plexus) provides sensory innervation of the lateral aspect of the thigh (extending anterolaterally and variably also posterolaterally).
- **Femoral branch of the genitofemoral nerve** (→ genitofemoral nerve → lumbar plexus) represents a sensory branch of the genitofemoral nerve that passes through the subinguinal hiatus (lacuna vasorum) to innervate the skin of the anterior central part of the upper thigh (skin above the area around the saphenous opening).
- **Cutaneous branches of the obturator nerve** (→ obturator nerve → lumbar plexus) provide a sensory innervation of the medial side of the thigh (these branches may variably extend anteromedially and posteromedially to some extent).
- **Ilioinguinal nerve** (→ lumbar plexus) in the anterior femoral region, it provides sensory innervation of the skin at the anteromedial part of the upper thigh and the area of the external genital organs.

ANTERIOR KNEE (GENUAL) REGION

The neurovascular structures situated superficially in the anterior knee region include:

- **Descending genicular artery** (← femoral artery) is a branch of the femoral artery. The descending genicular artery, together with the corresponding vein and the

saphenous nerve, pierces the vastoadductor membrane to leave the adductor canal and reach more superficial regions. The artery then enters *rete articulare genus* (arterial network around the knee joint), contributing to the arterial supply of the knee joint.

Note: *The vastoadductor membrane forms the roof of the adductor canal.*

- **Saphenous nerve** (→ femoral nerve → lumbar plexus) is the largest sensory branch of the femoral nerve passing along the medial side of the region.
- **Infrapatellar branch of the saphenous nerve** (→ saphenous nerve → femoral nerve ← lumbar plexus) provides a sensory innervation of the skin surrounding the patella (anteromedial and partly the lateral aspect of the knee as well as anteroinferior knee joint capsule).

  In-depth note: *The infrapatellar branch of the saphenous nerve communicates above the knee with the anterior cutaneous branches of the femoral nerve, below the knee with other branches of the saphenous nerve, and on the lateral side of the joint with branches of the lateral femoral cutaneous nerve, forming a plexiform network known as the plexus patellae.*
- **Great saphenous vein** (→ femoral vein → external iliac vein → common iliac vein → inferior vena cava) ascends along the medial side of the knee, accompanied by the saphenous nerve.

Innervation of the skin and subcutaneous tissue in anterior knee region is provided by terminal branches of:

- **Lateral cutaneous femoral nerve** (→ lumbar plexus).
- **Anterior cutaneous branches of the femoral nerve** (→ femoral nerve → lumbar plexus).
- **Cutaneous branches of the obturator nerve** (→ obturator nerve → lumbar plexus).

ANTERIOR CRURAL REGION

The neurovascular structures situated superficially in the anterior crural (leg) region include:

- **Great saphenous vein** (→ femoral vein → external iliac vein → common iliac vein → inferior vena cava) ascends along the medial aspect of the leg.
- **Saphenous nerve** (→ femoral nerve → lumbar plexus) provides sensory innervation of the skin on the medial aspect of the leg, extending distally to the medial aspect of the foot (to the level of the navicular bone).
- **Lateral cutaneous sural nerve** (→ common fibular nerve → sciatic nerve → sacral plexus) is a branch of the common fibular nerve that provides sensory innervation of the skin on the lateral and posterior aspect of the upper part of the leg.
- **Superficial fibular nerve** (→ common fibular nerve → sciatic nerve → sacral plexus) only its sensory fibres enter the superficial anterior crural region distally. These fibres supply the skin at the anterolateral aspect of the leg distally and then the back of the foot.

BACK OF THE FOOT (DORSUM PEDIS)

The neurovascular structures situated superficially in dorsum pedis:

- **Dorsal venous network** drains the skin and subcutaneous tissue and opens into dorsal venous arch of the foot, eventually forming the great and small saphenous vein.
- **Great saphenous vein** (→ femoral vein → external iliac vein → common iliac vein → inferior vena cava) originates from the medial aspect of the dorsal venous arch in the foot, passing anterior to the medial malleolus.
- **Small saphenous vein** (→ popliteal vein → femoral vein → external iliac vein → common iliac vein → inferior vein cava) originates from the lateral aspect of the dorsal venous arch of the foot, passing posterior to the lateral malleolus and ascending superficially along the posterior aspect of the leg.
- **Terminal branches of the saphenous nerve** (→ femoral nerve → lumbar plexus)
    - **Superficial fibular nerve** (→ common fibular nerve → sciatic nerve → sacral plexus) - it runs superficially above the extensor retinaculum to the back of the foot and here it gives off sensory branches **medial dorsal cutaneous nerve** (→ superficial fibular nerve → common fibular nerve → sciatic nerve → sacral plexus) for the skin of the medial margin of the back of the foot and 1st – 3rd toes and

intermediate dorsal cutaneous nerve (→ superficial fibular nerve → common fibular nerve → sciatic nerve → sacral plexus) for the skin of the medial part of the back of the foot and 3rd – 5th toes.

- **Lateral dorsal cutaneous nerve** (→ sural nerve → medial cutaneous sural nerve from tibial nerve + fibular communicating branch from the common fibular nerve → sciatic nerve → sacral plexus) is a branch of sural nerve providing sensory innervation of the skin of the lateral margin of the back of the foot and 5th toe.
    - **Deep fibular nerve** (→ common fibular nerve → sciatic nerve → sacral plexus) emerges superficially between the 1st and 2nd toes, providing sensory innervation to this area by the **dorsal digital nerve (**for the skin of adjoining surfaces of the 1st and 2nd toes).

GLUTEAL REGION

The gluteal region includes following superficial structures:

- **Superior cluneal nerves** (→ posterior rami of the lumbar spinal nerves) provide sensory innervation for the skin of the upper area of the gluteal region.
- **Middle cluneal nerves** (→ posterior rami of the sacral spinal nerves) provide sensory innervation for the skin of the middle area of the gluteal region.
- **Inferior cluneal nerves** (→ posterior cutaneous femoral nerve → sacral plexus) provide sensory innervation for the skin of the lower area of the gluteal region.
- **Lateral cutaneous branch of iliohypogastric nerve** (→ iliohypogastric nerve → sacral plexus) provides sensory innervation of the skin at the lateral aspect of the gluteal region.

POSTERIOR FEMORAL REGION

The neurovascular structures situated superficially in the posterior crural region include:

- **Posterior cutaneous femoral nerve** (→ sacral plexus) provides sensory innervation of the skin in this region. The stem of the nerve passes beneath the fascia, just terminal branches perforate the fascia, run superficially and enter the skin.

- **Lateral cutaneous femoral nerve** (→ lumbar plexus) provides sensory innervation of the skin at the lateral aspect of the thigh (more extensively anterolaterally and less extensively posterolaterally).
- **Cutaneous branches of the obturator nerve** (→ obturator nerve → lumbar plexus) innervate the medial side of the thigh (anteromedial and posteromedial aspect of the thigh).
- **Tributaries of the great saphenous vein** (→ great saphenous vein → femoral vein → external iliac vein → common iliac vein → inferior vena cava).

  In-depth note: *Posterior femoral region contains tributaries of great saphenous vein. The tributaries from medial and posterior aspect of the thigh usually unite to form an* ***accessory saphenous vein*** *that empty into the great saphenous vein at a variable level.*

POSTERIOR KNEE (GENUAL) REGION

The neurovascular structures situated superficially in posterior knee region include:

- **Great saphenous vein** (→ femoral vein → external iliac vein → common iliac vein → inferior vena cava) runs along the **medial aspect of the region** and is accompanied by the **saphenous nerve**.
- **Small saphenous vein** (→ popliteal vein → femoral vein → external iliac vein → common iliac vein → inferior vena cava) pierces the deep fascia and drains into the popliteal vein within the popliteal fossa *(for popliteal fossa, see the chapter Deep structures of the lower limb).*
- **Posterior cutaneous femoral nerve** (→sacral plexus) – its terminal branches descend from the thigh to the skin of the posterior knee region.
- **Lateral cutaneous femoral nerve** (→ lumbar plexus) – as it descends from the thigh its branches terminate at the proximolateral part of the posterior knee region.
- **Medial cutaneous sural nerve** (→ tibial nerve → sciatic nerve → sacral plexus) – may give off proximal branches to the skin of the posterior knee.

- **Lateral cutaneous sural nerve** (→ common fibular nerve → sciatic nerve → sacral plexus) – some of its branches may extend to the skin of the laterodistal part of the region.

POSTERIOR CRURAL REGION

The neurovascular structures situated superficially in posterior crural (leg) region:

- **Small saphenous vein** (→ popliteal vein → femoral vein → external iliac vein → common iliac vein → inferior vena cava) ascends in the middle of the posterior crural region accompanied by the sural nerve.
- **Saphenous nerve** (→ femoral nerve → lumbar plexus) provides the sensory innervation of the skin at the medial aspect of the posterior crural region.
- **Lateral cutaneous sural nerve** (→ common fibular nerve → sciatic nerve → sacral plexus) provides the sensory innervation of the skin at the proximolateral aspect of the posterior crural region.
- **Medial cutaneous sural nerve** (tibial nerve → sciatic nerve → sacral plexus**)** innervates the skin of the middle aspect of posterior crural region. It joins with the fibular communicating branch (from the common fibular nerve) to form the sural nerve.
- **Sural nerve** provides a sensory innervation of the skin on the lateral aspect of the posterior crural region.

SOLE OF THE FOOT (PLANTA PEDIS)

The structures situated superficially in planta pedis (sole of the foot) include:

- **Cutaneous branches of medial and lateral plantar nerves** (→ tibial nerve → sciatic nerve → sacral plexus) innervate the skin of planta pedis (sole of the foot).

Table 14: **Superficial structures in the distinct topographic regions of the lower limb**

Topographic region	Content	
Anterior femoral region	*Vessels*	Great saphenous vein (and its tributaries, mostly *external pudendal vein*, *superficial epigastric vein*, *superficial iliac circumflex vein*)
		Branches of femoral artery (*external pudendal artery*, *superficial epigastric artery, superficial iliac circumflex artery)*
	Nerves	Anterior cutaneous branches of femoral nerve
		Lateral cutaneous femoral nerve
		Femoral branch of genitofemoral nerve
		Cutaneous branches of obturator nerve
Anterior knee (genual) region	*Vessels*	Descending genicular artery
		Great saphenous vein
	Nerves	Saphenous nerve
		Infrapatellar branch of saphenous nerve
		Lateral cutaneous femoral nerve
		Anterior cutaneous branches of femoral nerve
		Cutaneous branches of obturator nerve
		Lateral cutaneous sural nerve
Anterior crural region	*Vessels*	Great saphenous vein
	Nerves	Saphenous nerve
		Lateral cutaneous sural nerve
		Superficial fibular nerve
Back of foot (dorsum pedis)	*Vessels*	Dorsal venous network
		Great saphenous vein
		Small saphenous vein
	Nerves	Saphenous nerve
		Medial dorsal cutaneous nerve
		Intermediate dorsal cutaneous nerve
		Lateral dorsal cutaneous nerve
		Deep fibular nerve
Gluteal region	*Nerves*	Superior cluneal nerve
		Middle cluneal nerves
		Inferior cluneal nerves
		Lateral cutaneous branch of iliohypogastric nerve
Posterior femoral region	*Vessels*	Tributaries of great saphenous vein
	Nerves	Posterior cutaneous femoral nerve
		Lateral cutaneous femoral nerve
		Cutaneous branches of obturator nerve

Posterior knee (genual) region	*Vessels*	Great saphenous vein
		Small saphenous vein
	Nerves	Posterior cutaneous femoral nerve
		Lateral cutaneous femoral nerve
		Medial cutaneous sural nerve
		Lateral cutaneous sural nerve
Posterior crural region	*Vessels*	Small saphenous vein
	Nerves	Branches of saphenous nerve
		Lateral cutaneous sural nerve
		Medial cutaneous sural nerve
		Medial cutaneous sural nerve joins with communicating branch of common fibular nerve = sural nerve
Sole of the foot (planta pedis)	*Nerves*	Cutaneous branches of medial and lateral plantar nerves

DEEP STRUCTURES IN THE DISTINCT TOPOGRAPHIC REGIONS OF THE LOWER LIMB

The following section provides information about the distinct deep topographical regions (borders) and the deep structures located within them.

SUBINGUINAL HIATUS

Subinguinal hiatus (also known as subinguinal space) is an opening between the inguinal ligament and the anterosuperior aspect of the hip bone that serves as a passageway for neurovascular structures and muscles from the abdomen and the pelvis to the anteromedial aspect of the thigh.

Borders of the **subinguinal hiatus**:

- Hip bone – from the anterior superior iliac spine, through the iliopubic eminence (also known as the iliopectineal eminence), to the pubic tubercle.
- Inguinal ligament – expanded between the anterior superior iliac spine and the pubic tubercle.

Note: The i*nguinal ligament represents a reinforced inferior free edge of the aponeurosis of the external oblique abdominal muscle.*

The subinguinal hiatus is divided by the **iliopectineal arch** into two spaces: **lacuna musculorum** (situated laterally) and **lacuna vasorum** (situated medially).

Note: *The iliopectineal arch is a thickened portion of the iliac fascia extended in between the inguinal ligament and the iliopubic eminence*.

A) Lacuna musculorum

Borders of **lacuna musculorum** are as follows:

- Hip bone (inferior border)
- Inguinal ligament (superior border)
- Iliopectineal arch (medial border).

Content of **lacuna musculorum** (a lateral compartment beneath inguinal ligament):

- **Femoral nerve** (*⇆ lumbar plexus) is passing medially within the lacuna musculorum, however, it is lateral to the femoral artery nad vein.
- **Iliopsoas muscle**
- **Lateral cutaneous femoral nerve** (→ lumbar plexus) runs beneath the ligament near the anterior superior iliac spine.

(⇆ the nerve carries both efferent motor fibres and afferent sensory fibres*)

B) Lacuna vasorum

Borders of **lacuna vasorum** are as follows:

- Hip bone (inferior border)
- Inguinal ligament (superior border)
- Iliopectineal arch (lateral border)
- Lacunar ligament (medial border).

Note: *The lacuna vasorum is medially bordered by the lacunar ligament, crescent-shaped extension of the medial end of the inguinal ligament that is attached to the pecten of pubis.*

Content of **lacuna vasorum** (a medial compartment beneath inguinal ligament):

- **Femoral artery** (← external iliac artery ← common iliac artery ← abdominal aorta) is lateral to the femoral vein.
- **Femoral vein** (→ external iliac vein → common iliac vein → inferior vena cava) passes the most medially.
- **Femoral ramus of the genitofemoral nerve** (→ genitofemoral nerve → lumbar plexus) is the sensory branch coursing to the skin above the saphenous opening (saphenous hiatus).
- **Inguinal lymph nodes** – the biggest lymph node is Cloquet's node (also known as Rosenmüller's node), it is most proximal lymph node, situated just inferior to the inguinal ligament.

Note: *The structures of lacuna vasorum are situated in a following order from medial to lateral aspect – lymph nodes, femoral vein, femoral artery, femoral ramus of the genitofemoral nerve.*

Tip to remember: **C**lo**VAN (Clo**quet's node, femoral **V**ein, femoral **A**rtery, femoral ramus of genitofemoral **N**erve**)**

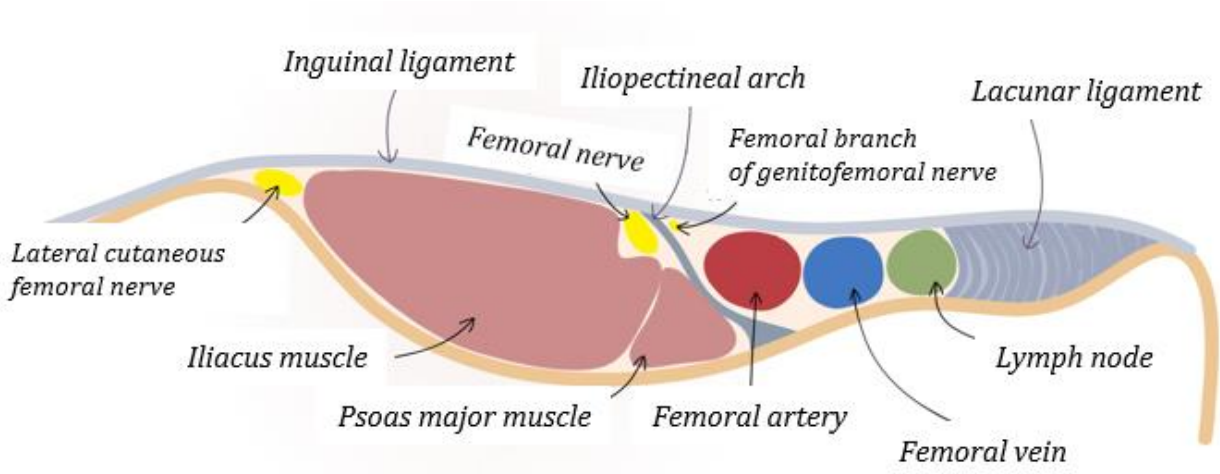


Fig. 51
Subinguinal hiatus - borders and content (schematic)
Drawing from the author's archive

FEMORAL TRIANGLE

Femoral triangle is a wedge-shaped space situated in the anterior upper thigh.

Borders of femoral triangle:

- Inguinal ligament (superior border), representing the base of the triangle
- Medial border of the adductor longus muscle (medial border)
- Medial border of the sartorius muscle (lateral border)
- Iliopectineal fossa, the floor of the femoral triangle, is formed by the pectineus muscle and adductor longus medially and iliopsoas muscle laterally.

Tip to remember: The floor of the femoral triangle – **APPI** (**A**dductor longus, **P**ectineus, **P**soas major, **I**liacus muscle)

The **apex of the femoral triangle** is directed inferiorly and is continuous with the **adductor canal**. The **roof of the femoral triangle** is formed by the fascia lata and the superficial fascia.

Content of femoral triangle (from lateral to medial):

- **Femoral nerve** (⇆ lumbar plexus) gives off following branches within the femoral triangle:
    - **anterior cutaneous branches** (sensory branches for skin of anterior femoral region)
    - **muscular branches** (motor branches for anterior femoral muscles)
    - **saphenous nerve** does not terminate in the thigh but accompanies the femoral artery through the adductor canal and ultimately supplies the skin of the medial side of the leg and dorsum pedis/back of the foot.
- **Femoral artery** (← external iliac artery ← common iliac artery ← abdominal aorta) and its main branch
    - **Deep femoral artery and its branches:**
    - lateral circumflex femoral artery (for the anterior femoral muscles)
    - medial circumflex femoral artery (for the medial and posterior femoral muscles, pelvitrochanteric muscles, and the hip joint)
    - perforating arteries (for the posterior femoral muscles).
- **Femoral vein** (→ external iliac vein → common iliac vein → inferior vena cava) *is a proximal continuation of the popliteal vein. It enters the triangle through the adductor canal. In the femoral triangle, it is situated medially to the femoral artery.*
    - **Lymphatic vessels** are situated the most medially in the femoral triangle.

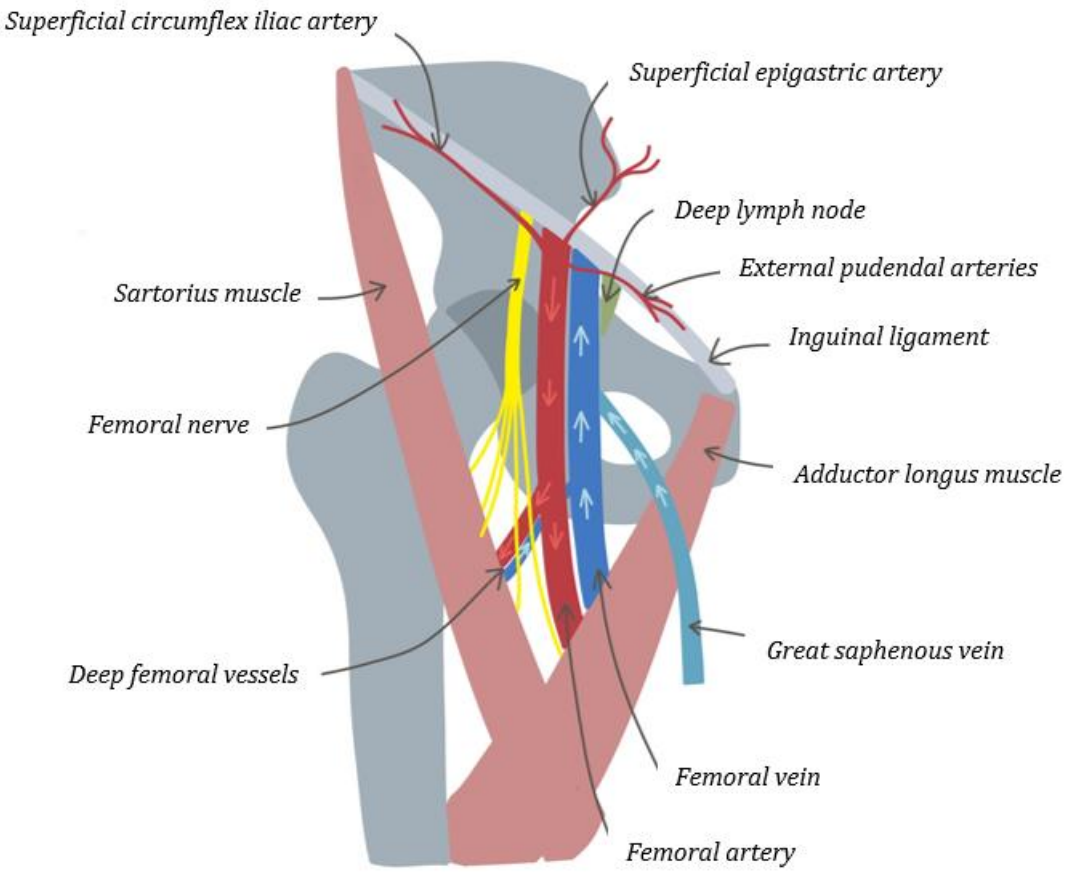


Fig. 52
Femoral triangle – borders and content (schematic)
Drawing from the author's archive

Detailed view of the transition zone between the subinguinal hiatus and the femoral triangle

Femoral sheath lines the femoral artery and vein and the deep inguinal nodes. The femoral sheath has a conical shape and a length of approximately 3 – 4 cm, before it blends with the adventicia of the femoral vessels. The femoral sheath is described as the fascial covering of the femoral artery, vein, and femoral canal beneath the inguinal ligament, which continues into the femoral triangle. In the proximal part of the femoral triangle, only the vessels emerging from the femoral sheath are visible; the femoral ring itself is not directly seen. The femoral ring, the superior opening of the femoral canal, is located proximal to the femoral triangle.

The femoral sheath is medially bordered by lacunar ligament while the femoral nerve is situated laterally to it.

The femoral sheath is divided into three compartments by the vertical septa of connective tissue separating it into functional areas:

- Lateral compartment - contains femoral artery
- Intermediate compartment - contains femoral vein
- Medial compartment - contains loose connective tissue and lymph nodes, this compartment is also known as the **femoral canal.**

The femoral canal provides space for the femoral vein expansion during increased venous return. Its superior opening is termed the femoral ring.

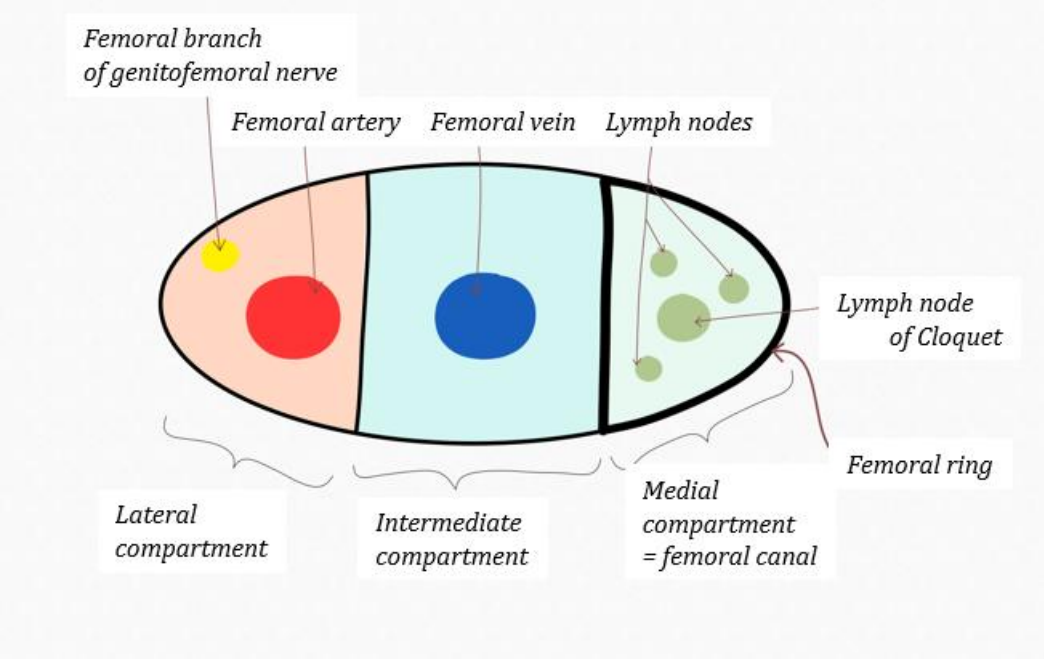


Fig. 53
Femoral sheath
Drawing from the author's archive

> ***Clinical notes***
>
> *Femoral hernias occur when a loop of intestine or peritoneal sac pass through the femoral ring into the femoral canal, below the inguinal ligament, where it may descend into the upper thigh; this type of hernia is more common in females and has a high risk of strangulation due to the narrow boundaries of the canal.*

ADDUCTOR CANAL

Adductor canal (also known as **Hunter's canal**) represents a space that is continuous proximally with the iliopectineal fossa of the **femoral triangle** and distally (through adductor hiatus) continues into the **popliteal fossa**.

Note: *The adductor hiatus is a large gap formed between the insertion of the adductor magnus muscle on the medial supracondylar line and the adductor tubercle, allowing the femoral artery and its accompanying vein to pass from the adductor canal into the popliteal fossa.*

Borders of adductor canal include:

- Vastus medialis muscle (lateral border)
- Adductor longus and adductor magnus muscle (medial border)
- Vastoadductor membrane (anterior border).

Note: *The vastoadductor membrane is a thickened fascial sheet, stretched along the medial side of the thigh between the adductor magnus muscle and the vastus medialis muscle. It forms the roof of the adductor canal.*

Content of the adductor canal includes:

- **Femoral artery** and its branch **descending genicular artery**
  The descending genicular artery arises from the femoral artery during its course through the adductor canal. The descending genicular artery pierces the vastoadductor membrane (together with saphenous nerve) to, ultimately, supply the genuinal/knee joint.
- **Femoral vein** (→ external iliac vein → common iliac vein → inferior vena cava)
- **Saphenous nerve – infrapatellar branch** (infrapatellar branch → saphenous nerve → femoral nerve → lumbar plexus). The saphenous nerve, a branch of the femoral nerve originating in the femoral triangle, passes through the adductor canal and exits it by piercing the vastoadductor membrane (together with descending genicular artery). At this point, it gives off its **infrapatellar branch** (for the anteromedial aspect of the knee).

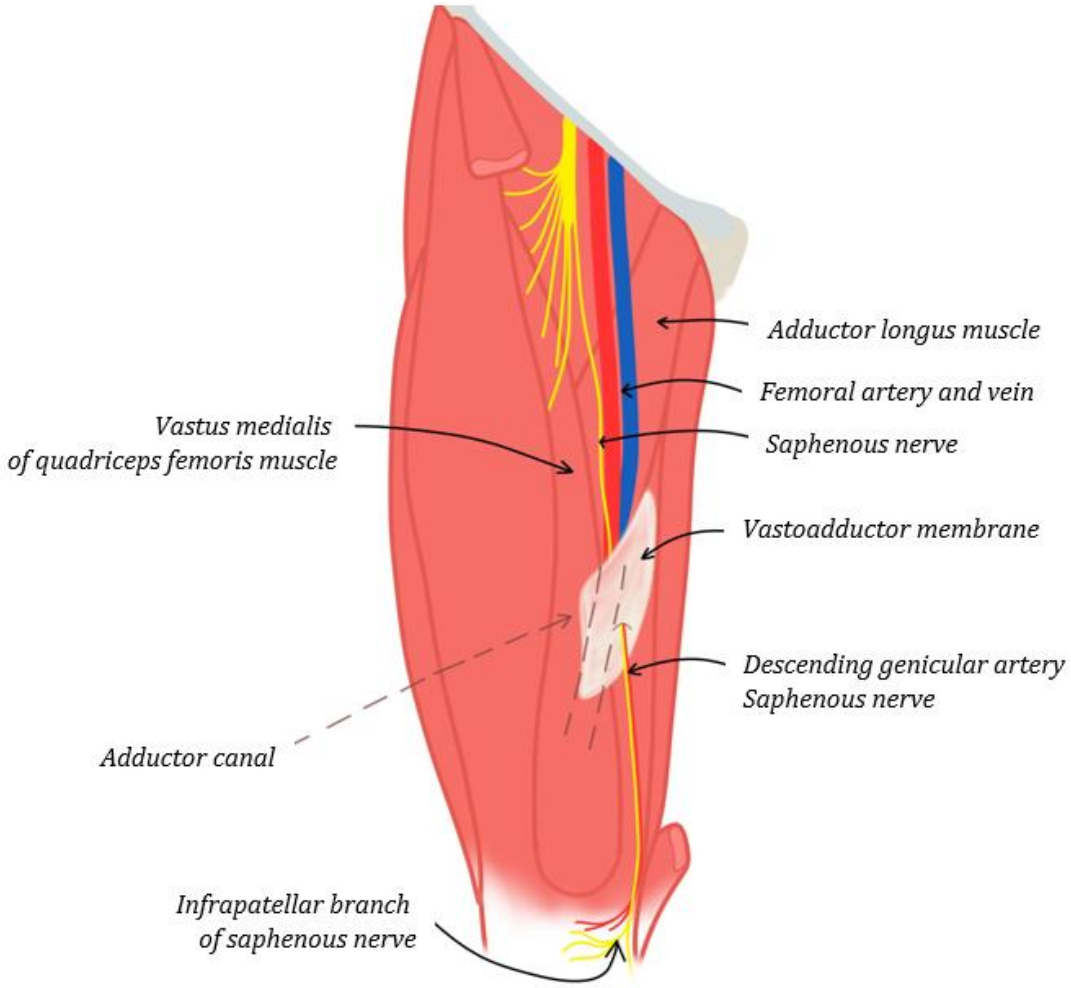


Fig. 54
Adductor canal
Drawing from the author's archive

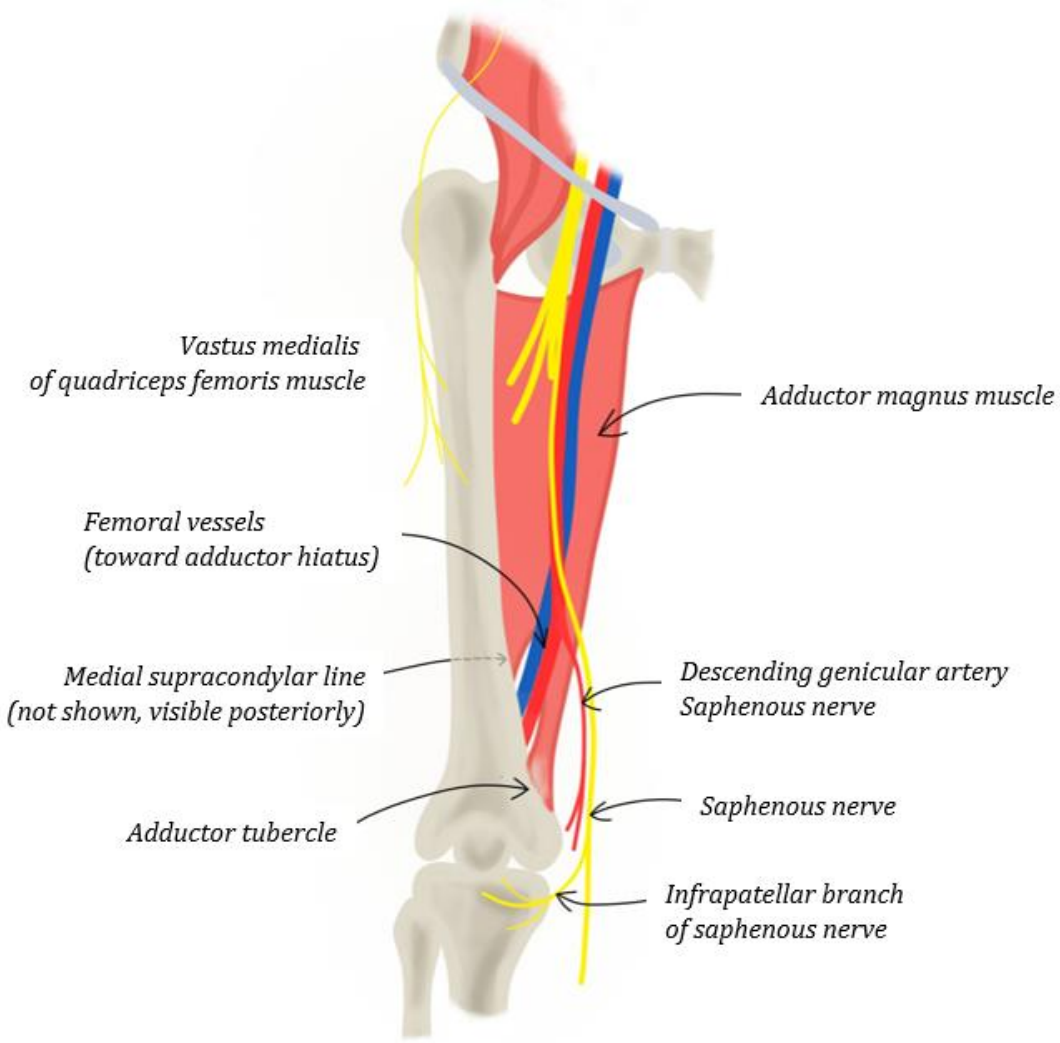


Fig. 55
Adductor hiatus
Drawing from the author's archive

OBTURATOR CANAL

Obturator canal is a small channel located between the superior ramus of the pubis (specifically, obturator groove) and the obturator membrane (that almost completely covers the obturator foramen). The obturator canal serves as a passageway connecting the pelvis and the medial compartment of the thigh.

Borders of the obturator canal include:

- Inferior margin of superior ramus of pubis (superior border)
- Obturator membrane (medial and lateral borders).

Content of the obturator canal:

- **Obturator nerve** (⇆ lumbar plexus) is a mixed nerve descending to the medial aspect of the thigh providing the motor supply for the adductor muscles and overlying skin.
- **Obturator artery** (← internal iliac artery ← common iliac artery ← abdominal aorta) contributes to the arterial supply of the medial compartment of the thigh.
- **Obturator vein** (→ internal iliac vein → common iliac vein → inferior vena cava) drains the venous blood from the medial compartment of the thigh.

Clinical notes

Prior to its passage through the obturator canal, the obturator artery gives rise to the pubic branch, which can form an arterial anastomosis with the inferior epigastric artery (anastomosis may occur between obturator artery and inferior epigastric or external iliac artery), usually located on the posterior aspect of the superior pubic ramus. In addition, the obturator vein can also form a venous anastomosis with either the external iliac vein or the inferior epigastric vein. This vascular variant is referred to as corona mortis (crown of death) because injury to these vessels can lead to severe hemorrhage that is difficult to control.

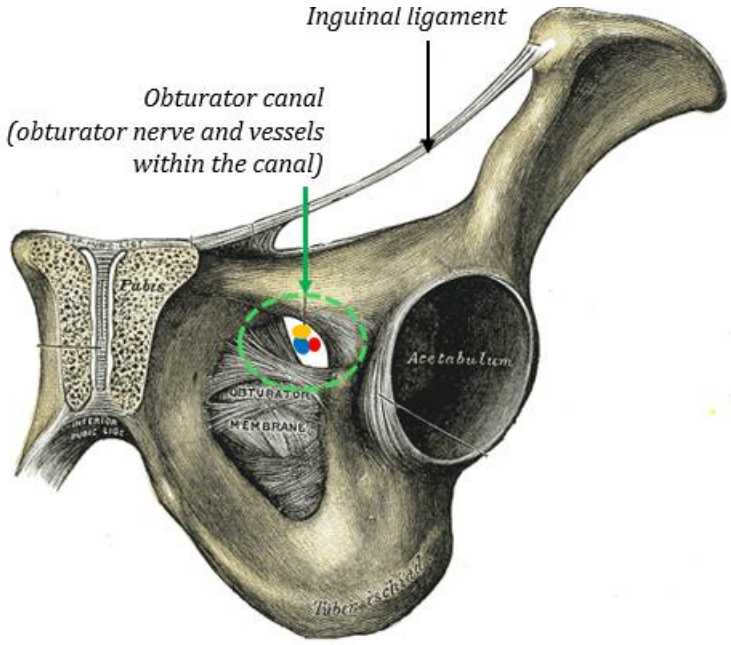


Fig. 56
Obturator canal

Modified by additional colorization and labeling from Gray's Anatomy, 20th U.S. Edition (public domain)

DEEP STRUCTURES OF ANTERIOR CRURAL REGION

Deep structures of the anterior crural region (anterior compartment of the leg), specifically muscles, vessels, and nerves, form a compact functional unit primarily responsible for the dorsiflexion of the foot and toes.

Content of the anterior crural region:

- **Anterior crural muscles** (tibialis anterior muscle, extensor hallucis longus muscle, and extensor digitorum longus muscle)
- **Deep fibular nerve** (⇆ common fibular nerve ⇆ sciatic nerve ⇆ sacral plexus)
- **Superficial fibular nerve** (⇆ common fibular nerve ⇆ sciatic nerve ⇆ sacral plexus)
- **Anterior tibial veins** (→ popliteal vein → femoral vein → external iliac vein → common iliac vein → inferior vena cava)
- **Anterior tibial artery** (← popliteal artery ← femoral artery ← external iliac artery → common iliac artery → aorta).

DEEP STRUCTURES OF THE DORSUM OF PEDIS

The dorsum of pedis (back of the foot) contains a compact layer of muscles, tendons, vessels, and nerves that lie deep to the dorsal fascia and the skin.

Deep structures at the back of the foot:

- **Extensor digitorum longus muscle** (tendon)
- **Extensor hallucis longus muscle** (tendon)
- **Extensor hallucis brevis muscle**
- **Extensor digitorum brevis muscle**
- **Dorsalis pedis artery** (dorsal artery of the foot) (dorsalis pedis artery ← anterior tibial artery ← popliteal artery ← femoral artery ← external iliac artery → common iliac artery → aorta) runs laterally to the extensor hallucis longus tendon, accompanied by the dorsalis pedis vein and the deep fibular nerve.
  At the back of the foot the dorsalis pedis artery (dorsal artery of the foot) gives off:

    - medial tarsal arteries
    - lateral tarsal artery
    - arcuate artery (anastomoses with lateral tarsal artery)
        - dorsal metatarsal arteries (→ first dorsal metatarsal artery → deep plantar artery that anastomoses with plantar arch)
          → dorsal digital arteries
- **Deep fibular nerve** (⇆ common fibular nerve ⇆ sciatic nerve ⇆ sacral plexus) innervates muscles of the back fo the foot.

GREATER SCIATIC FORAMEN

GREATER SCIATIC FORAMEN represents an osteo-ligamentous opening that serves as a passageway between the pelvis and the free lower limb.

Borders of the greater sciatic foramen:

- Greater sciatic notch (superior and anterior borders)
- Sacrotuberous and sacrospinous ligaments (inferior border)

SUPRAPIRIFORM FORAMEN AND **INFRAPIRIFORM FORAMEN**

Greater sciatic foramen is divided by the piriformis muscle into the **suprapiriform foramen** and **infrapiriform foramen**.

Content of the suprapiriform foramen:

- **Superior gluteal artery** (← internal iliac artery ← common iliac artery ← abdominal aorta) supplies the gluteal muscles, the hip joint, and the piriformis muscle as well as the obturator internus muscle. In the gluteal region, it anastomoses with the inferior gluteal artery.
- **Superior gluteal vein** (→ internal iliac vein → common iliac vein → inferior vena cava) drains the structures that are supplied by the superior gluteal artery.
- **Superior gluteal nerve** (← sacral plexus) innervates the gluteus medius and the gluteus minimus muscles as well as the tensor fasciae latae muscle.

Content of the **infrapiriform foramen:**

- **Inferior gluteal artery** (← internal iliac artery ← common iliac artery ← abdominal aorta) provides a blood supply predominantly to the gluteus maximus muscle. It anastomoses with the surrounding arteries.
- **Inferior gluteal vein** (→ internal iliac vein → common iliac vein → inferior vena cava).
- **Inferior gluteal nerve** (← sacral plexus) innervates the gluteus maximus muscle.
- **Posterior cutaneous femoral nerve** (→ sacral plexus) gives off only sensory branches for the skin on the posterior aspect of the thigh.
- **Sciatic nerve** (⇆ sacral plexus) descends from the gluteal region into the posterior compartment of the thigh, where it lies on the adductor magnus muscle and is covered/crossed by the long head of the biceps femoris muscle. Immediately inferior to the lower border of the gluteus maximus muscle and lateral to the ischial tuberosity, the sciatic nerve runs for approximately 1 – 2 cm covered only by the fascia, making it palpable and susceptible to the irritation.
- **Pudendal nerve** (⇆ sacral plexus) enters back to the pelvis through the lesser sciatic notch to enter the ischioanal fossa and the pudendal canal, eventually to reach the perineum (together with the internal pudendal vessels).
- **Internal pudendal artery** (← internal iliac artery ← common iliac artery ← abdominal aorta) is primary arterial supply to the perineum and the external genital organs.
- **Internal pudendal vein** (→ internal iliac vein → common iliac vein → inferior vena cava) drains the area supplied by the internal pudendal artery.

LESSER SCIATIC FORAMEN

Borders of lesser sciatic foramen:

- Sacrospinous ligament, lesser sciatic notch (anterior borders)
- Sacrotuberous ligament (posterior border).

Content of the **lesser sciatic foramen:**

- **Internal pudendal artery** (← internal iliac artery ← common iliac artery ← abdominal aorta)

- **Internal pudendal vein** (→ internal iliac vein → common iliac vein → inferior vena cava)
- **Pudendal nerve** (⇆ sacral plexus).

These structures exit the pelvis through the **infrapiriform foramen**, then enters back through the **lesser sciatic foramen**, and continue to the**ischioanal fossa** and the **pudendal canal** to reach the perineum and the external genital organs.

ISCHIOANAL FOSSA

The ischioanal fossa is a paired triangular-shaped fat-filled space located laterally to the anal canal.

Borders of the ischioanal fossa:

- Levator ani muscle (roof/superior border)
- Perineal fascia (floor/inferior border)
- External anal sphincter, anal canal, levator ani muscle (medial border)
- Obturator internus muscle (lateral border)
- Inferior edge of gluteus maximus and sacrotuberous ligament (posterior border).

The course of the pudendal nerve and the internal pudendal vessels from the pelvis: **Infrapiriform foramen → lesser sciatic foramen → ischioanal fossa and pudendal canal → perineum and external genital organs**

PUDENDAL CANAL

Pudendal nerve and the **internal pudendal vessels** enter the **pudendal canal** (also known as the Alcock's canal), which represents a fascial compartment within the ischioanal fossa. Pudendal canal is situated in the lateral wall of the ischioanal fossa, in the fascia of the obturator internus muscle.

Borders of the pudendal canal:

- Fascia of the obturator internus muscle (medial border)
- Muscle (obturator internus) itself (lateral border).

Further along the course of the pudendal canal, the fibrous wall of the canal disappears. Through this pathway, these structures that are commonly referred as "pudendal neurovascular bundle" (pudendal nerve and internal pudendal vessels) reach the perineum and external genitals. The pudendal nerve may course adjacent to the pudendal canal rather than within it.

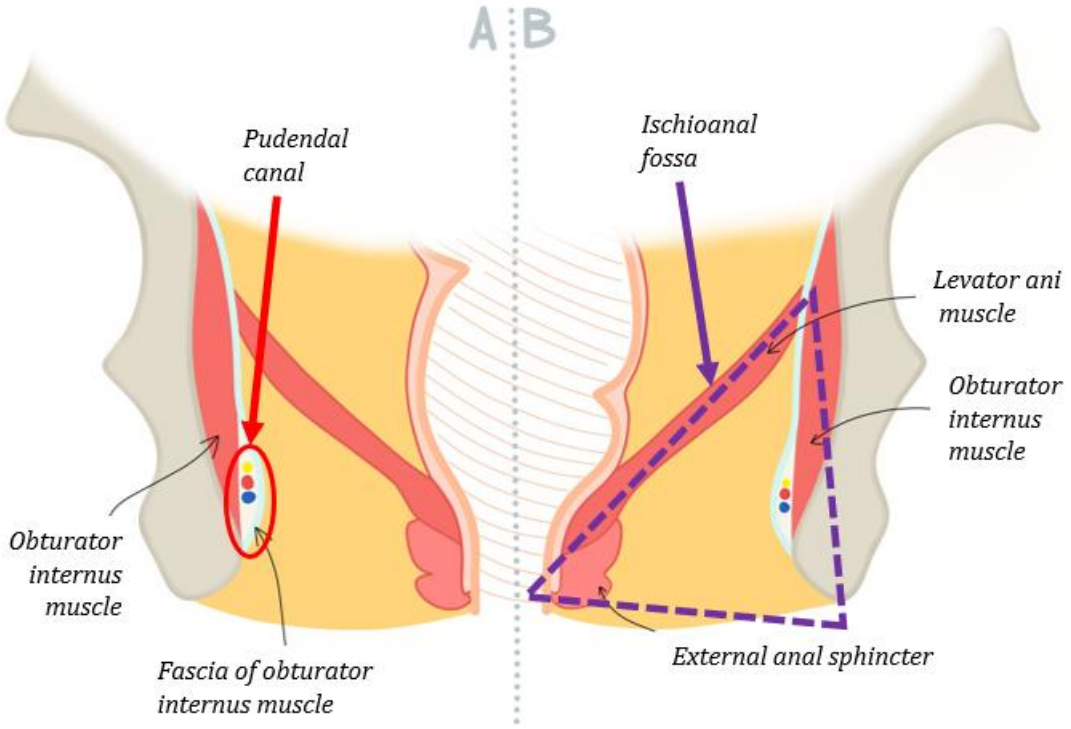


Fig. 56
Ischioanal fossa and pudendal canal
Drawing from the author's archive

DEEP STRUCTURES OF THE POSTERIOR FEMORAL REGION

Posterior femoral region represents the posterior compartment of the thigh.

Deep structures in the posterior femoral region include:

- **Posterior femoral muscles** (biceps femoris muscle, semitendinosus muscle, semimembranosus muscle also known as hamstrings)

- **Stem of the posterior cutaneous femoral nerve** (← sacral plexus) – only its branches pass suprafascially.
- **Sciatic nerve** (⇆ sacral plexus) passes beneath the long head of the biceps femoris muscle.

  Note: *The sciatic nerve divides into its terminal branches, the tibial and common fibular nerve, most commonly in the area proximal to the popliteal fossa.*

- **Perforating arteries** (← deep femoral artery ← femoral artery ← external iliac artery ← common iliac artery ← abdominal aorta) as branches of the deep femoral artery they pierce the adductor magnus muscle to reach the posterior compartment of the thigh where they provide the main arterial supply for the posterior femoral muscles.

POPLITEAL FOSSA

Popliteal fossa is a space situated at the area of transition between the thigh and leg. It is a diamond-shaped space posterior to the knee joint.

Borders of the popliteal fossa:

- Semitendinosus and semimembranosus muscles (proximal and medial border)
- Biceps femoris muscle (proximal and lateral border)
- Gastrocnemius muscle (distal border)

Content of the popliteal fossa:

- **Popliteal artery** (← femoral artery ← external iliac artery ← common iliac artery ← abdominal aorta) enters the fossa through the adductor hiatus. It is situated most deeply and most medially. It gives off:
  - genicular branches (for knee joint)
  - sural arteries (for triceps surae and plantaris muscle)
- **Popliteal vein** (→ femoral vein → external iliac vein → common iliac vein → inferior vena cava) is located slightly lateral and superficial to the artery.
- **Tibial nerve** (⇆ sciatic nerve ⇆ sacral plexus) is situated laterally and superficially to the artery and vein.

  (tibial nerve ⇆ sciatic nerve ⇆ sacral plexus)

- **Common fibular nerve** (⇆ sciatic nerve ⇆ sacral plexus) is situated most laterally and superficially.
- **Lymph nodes** are typically located around the popliteal vein.

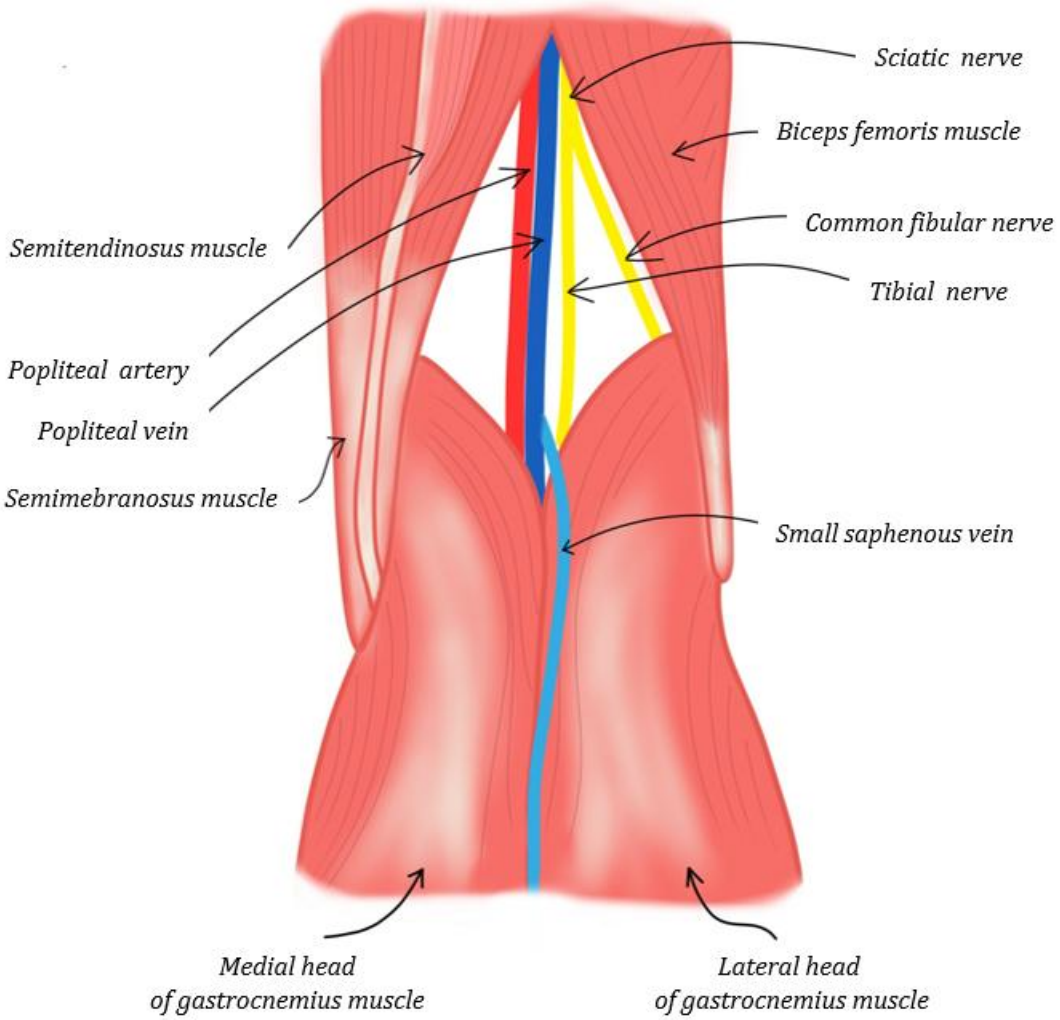


Fig. 57
Popliteal fossa
Drawing from the author's archive

Clinical notes
The popliteal artery is the deepest of the neurovascular structures of popliteal fossa (situated deeply near the capsule of the knee joint). Therefore, it is difficult to palpate

its pulse (it can be detected by deep palpation medial to midline). The wall of the popliteal artery has a reduced muscular layer in favour of elastic membranes. Externally, it is connected to the popliteal vein by fibrous bands, forming a vascular bundle, while the tibial nerve lies outside this bundle. The entire bundle is embedded in adipose connective tissue. Blood flow through the artery remains unchanged even during flexion of the knee joint. However, the structural composition of its wall also makes the popliteal artery the most common site of aneurysm formation among the peripheral arteries.

DEEP STRUCTURES OF POSTERIOR CRURAL REGION

The deep structures of the posterior crural region comprise the muscles and the neurovascular bundle (situated beneath the triceps surae muscle):

- **Posterior crural muscles** (triceps surae muscle, popliteus, flexor digitorum longus muscle, flexor hallucis longus muscle, and tibialis posterior muscle)
- **Posterior tibial artery** (← popliteal artery ← femoral artery ← external iliac artery ← common iliac artery ← abdominal aorta) descends through the deep region of posterior compartment of leg (superficial to deep layer of the posterior crural muscles of the leg, specifically between posterior tibial muscle and flexor hallucis longus muscle.
- **Posterior tibial veins** (→ popliteal vein → femoral vein → external iliac vein → common iliac vein → inferior vena cava) are usually two veins accompanying the posterior tibial atery.
- **Tibial nerve** (⇆ sciatic nerve ⇆ sacral plexus) travels with the posterior tibial vessels.

These structures descend toward the medial ankle and pass posterior to the medial malleolus within the medial retromalleolar space (tarsal tunnel) deep to the flexor retinaculum. Then they continue into the sole of the foot.

MEDIAL RETROMALLEOLAR SPACE

Medial retromalleolar space is a fibro-osseous space behind the medial malleolus that is alos known as the tarsal tunnel.

Borders of medial retromalleolar space:

- Medial malleolus of the tibia (anterior border)
- Calcaneal tuberosity (posterior border)
- Flexor retinaculum (medial border).

  Note: *The flexor retinaculum is a strong fibrous band formed by reinforcement of the deep fascia of the leg. It extends from the medial malleolus to the calcaneus.*

Content of medial retromalleolar space:

- **Tibialis posterior muscle** (tendon)
- **Flexor digitorum longus muscle** (tendon)
- **Posterior tibial artery** (← popliteal artery ← femoral artery ← external iliac artery ← common iliac artery ← abdominal aorta)
- **Posterior tibial vein** (→ popliteal vein → femoral vein → external iliac vein → common iliac vein → inferior vena cava)
- **Tibial nerve** (⇆ sciatic nerve ⇆ sacral plexus)
- **Flexor hallucis longus muscle** (tendon).

LATERAL RETROMALLEOLAR SPACE

Lateral retromalleolar space is a fibro-osseous space situated behind the lateral malleolus.

Borders of lateral retromalleolar space:

- Lateral malleolus of the fibula (anterior border)
- Calcaneal tuberosity (posterior border)
- Superior and inferior fibular retinaculum (lateral border).

Content of lateral retromalleolar space:

- **Fibularis longus muscle** (tendon)
- **Flexor brevis muscle** (tendon).

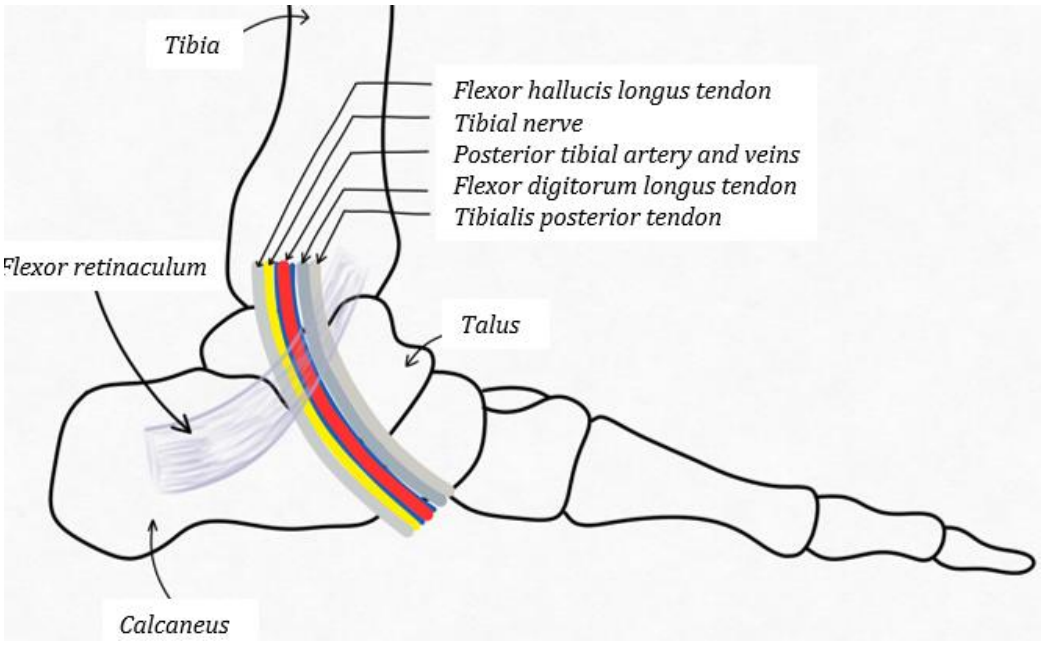


Fig. 58
Medial retromalleolar space
Drawing from the author's archive

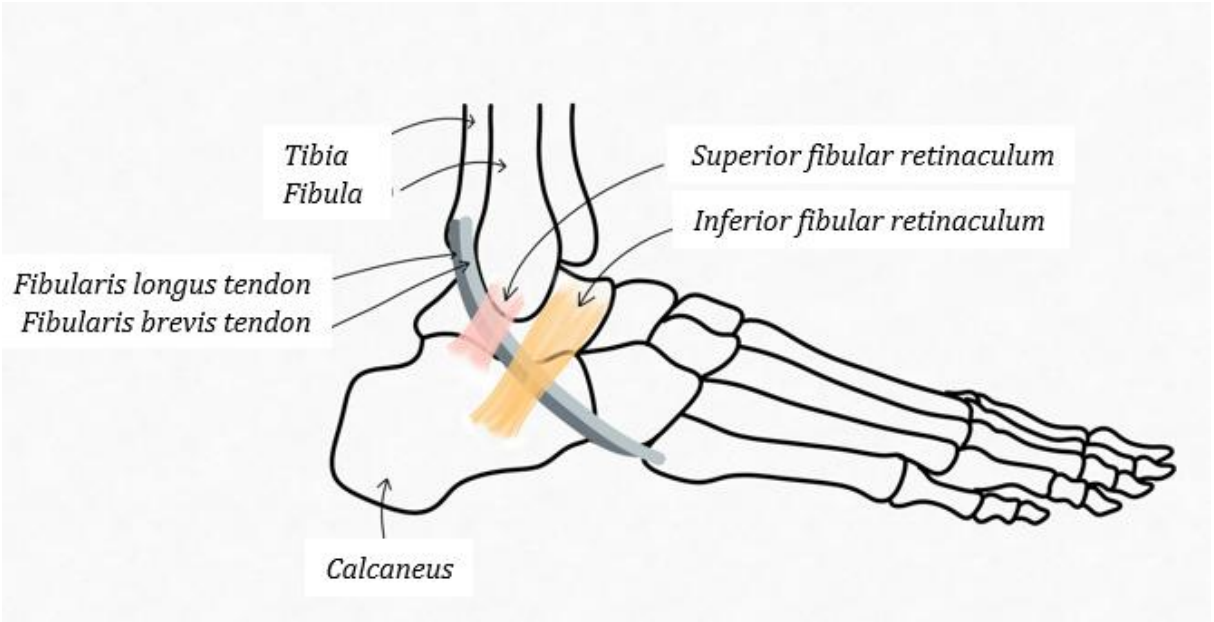


Fig. 59
Lateral retromalleolar space
Drawing from the author's archive

DEEP STRUCTURES OF THE SOLE OF THE FOOT (PLANTA PEDIS)

1. Layer: **Plantar aponeurosis.**

   Note: *The plantar aponeurosis is a thick collagenous structure deep to the superficial fascia and skin of the sole of the foot.*

2. Layer: **Flexor digitorum brevis muscle.**
3. Layer: **Medial and lateral plantar vessels, medial and lateral plantar nerves.**

   In-depth note: *Medial plantar artery and lateral plantar artery are terminal branches of the posterior tibial artery.*

   Medial plantar vessels and nerve runs through the sole of the foot between the abductor hallucis muscle and the flexor hallucis brevis muscle.

   Lateral plantar vessels and nerve runs through the sole of the foot between the flexor digitorum brevis muscle and the quadratus plantae muscle. The lateral plantar artery is a stronger terminal branch of the posterior tibial artery; it gives plantar arch (that anastomoses with deep ramus of medial plantar artery). From the deep plantar arch plantar metatarsal arteries arise and give off the common plantar digital arteries (and perforating arteries) continuing into the proper plantar digital arteries.

4. Layer: **Quadratus plantae muscle, tendon of flexor digitorum longus muscle, and lumbrical muscles**
5. Layer: **Interosseous muscles**

Table 15: Topographic anatomy of the lower limb – deep structures

Topographic region	Borders	Content	
Subinguinal hiatus	→ Inguinal ligament → Hip bone (from anterior superior iliac spine to pubic tubercle)		
• ***Lacuna musculorum***	→ Hip bone (inferior border) → Inguinal ligament (superior border) → Iliopectineal arch (medial border)	*Muscles*	Iliopsoas muscle
		Nerves	Femoral nerve
			Lateral cutaneous femoral nerve
• ***Lacuna musculorum***	→ Hip bone (inferior border) → Inguinal ligament (superior border) → Iliopectineal arch (lateral border) → Lacunar ligament (medial border)	*Nerves*	Femoral branch of genitofemoral nerve
		Vessels	Femoral artery
			Femoral vein
		Lymph	Lymphatics - Cloquet's node
Femoral triangle	→ Inguinal ligament (superior border) → Adductor longus muscle (medial border) → Sartorius muscle (lateral border) → Iliopectineal fossa (floor)	*Nerves*	Femoral nerve
		Vessels	Femoral artery and its branches
			Femoral vein
			Great saphenous vein
		Lymph	Lymphatics
Adductor canal	→ Vastus medialis muscle (lateral border) → Adductor longus and adductor magnus muscles (medial borders) → Vastoadductor membrane (anterior border)	*Vessels*	Femoral artery (and its branch descending genicular artery)
			Femoral vein
		Nerves	Saphenous nerve
Obturator canal	→ Inferior margin of superior ramus of pubis (superior border) → Obturator membrane (medial and lateral borders)	*Vessels*	Obturator artery
			Obturator vein
		Nerve	Obturator nerve

Topographic region	Borders	Content	
Anterior crural region – deep structures		*Muscles*	Anterior crural muscles (tibialis anterior, extensor hallucis longus, extensor digitorum longus)
		Vessels	Anterior tibial artery and veins
		Nerves	Deep fibular nerve
			Superficial fibular nerve
Back of foot (dorsum pedis) – deep structures		*Muscles*	Extensor digitorum longus (tendo)
			Extensor hallucis longus (tendo)
			Extensor hallucis brevis
			Extensor digitorum brevis
		Vessels	Dorsalis pedis artery and its branches (and accompanying veins)
		Nerves	Deep fibular nerve
Greater sciatic foramen	→ Greater sciatic notch (superior and anterior borders) → Sacrotuberous and sacrospinous ligaments(inferior border) → Piriformis muscle		
• ***Suprapiriform foramen***		*Vessels*	Superior gluteal artery and veins
		Nerves	Superior gluteal nerve
• ***Infrapiriform foramen***		*Vessels*	Inferior gluteal artery and veins
			Internal pudendal artery and veins
		Nerves	Inferior gluteal nerve
			Posterior cutaneous femoral nerve
			Sciatic nerve
			Pudendal nerve

<table>
<tr><th>Topographic region</th><th>Borders</th><th>Content</th><th></th></tr>
<tr><td rowspan="2">Lesser sciatic foramen</td><td rowspan="2">→ Sacrospinous ligament, lesser sciatic notch (anterior border)
→ Sacrotuberous ligament (posterior border)</td><td>Vessels</td><td>Internal pudendal artery and veins</td></tr>
<tr><td>Nerves</td><td>Pudendal nerve</td></tr>
<tr><td>Ischioanal fossa</td><td colspan="3">→ Levator ani muscle (roof/superior border)
→ Perineal fascia (floor/inferior border)
→ External anal sphincter, anal canal, levator ani muscle (medial border)
→ Obturator internus muscle (lateral border)
→ Inferior edge of gluteus maximus and sacrotuberous ligament (posterior border)</td></tr>
<tr><td rowspan="2">Pudendal canal (within ischioanal fossa)</td><td rowspan="2">→ Fascia of the obturator internus muscle (medial border)
→ Muscle (obturator internus) itself (lateral border)</td><td>Vessels</td><td>Internal pudendal artery and veins</td></tr>
<tr><td>Nerves</td><td>Pudendal nerve</td></tr>
<tr><td colspan="2" rowspan="4">Posterior femoral region – deep structures</td><td>Muscles</td><td>Posterior femoral muscles (biceps femoris, semitendinosus, semimembranosus)</td></tr>
<tr><td>Vessels</td><td>Perforating arteries (from deep femoral artery)</td></tr>
<tr><td rowspan="2">Nerves</td><td>Posterior cutaneous femoral nerve</td></tr>
<tr><td>Sciatic nerve (tibial nerve, common fibular nerve)</td></tr>
<tr><td rowspan="4">Popliteal fossa</td><td rowspan="4">→ Semitendinosus and semimembranosus muscles (proximal and medial border)
→ Biceps femoris muscle (proximal and lateral border)
→ Gastrocnemius muscle (distal border)</td><td rowspan="2">Vessels</td><td>Popliteal artery</td></tr>
<tr><td>Popliteal vein</td></tr>
<tr><td rowspan="2">Nerves</td><td>Tibial nerve</td></tr>
<tr><td>Common fibular nerve</td></tr>
<tr><td colspan="2" rowspan="3">Posterior crural region – deep structures</td><td>Muscles</td><td>Posterior crural muscles</td></tr>
<tr><td>Vessels</td><td>Posterior tibial artery and veins</td></tr>
<tr><td>Nerves</td><td>Tibial nerve</td></tr>
</table>

Topographic region	Borders	Content	
Lateral retromalleolar space	→ Lateral malleolus of the fibula (ventral border) → Calcaneal tuberosity (dorsal border) → Superior and inferior fibular retinacula (lateral border)	*Muscles*	Fibularis longus (tendon)
			Fibularis brevis (tendon)
Medial retromalleolar space	→ Medial malleolus of the tibia (ventral border) → Calcaneal tuberosity (dorsal border) → Flexor retinaculum (medial border)	*Muscles*	Tibialis posterior (tendo)
			Flexor digitorum longus (tendon)
			Flexor hallucis longus (tendon)
		Vessels	Posterior tibial artery and veins
		Nerves	Tibial nerve
Sole of foot (planta pedis) – deep structures	First layer		Plantar aponeurosis
	Second layer	*Muscles*	Flexor digitorum brevis
	Third layer	*Vessels*	Medial and lateral plantar vessels
		Nerves	Medial and lateral plantar nerves
	Fourth layer	*Muscles*	Quadratus plantae
			Flexor digitorum longus (tendon)
			Lumbricals
	Fifth layer	*Muscles*	Plantar and dorsal interosseous

REVIEW QUESTIONS

VESSELS OF THE LOWER LIMB

Femoral artery:
a/ it is the continuation of the internal iliac artery
b/ at the femoral triangle it is situated more medially than the femoral vein
c/ it gives off the deep femoral artery which supplies the femoral muscles
d/ it gives off the obturator artery
e/ it gives off the branches for the external genital organs

Femoral artery:
a/ it begins under the inguinal ligament within the lacuna vasorum
b/ at the femoral triangle it lies between the femoral vein and the femoral nerve
c/ it runs through the adductor canal
d/ in the adductor canal, it is accompanied by the saphenous nerve
e/ it gives off the descending genicular artery for the knee joint

Deep femoral artery:
a/ it runs through lacuna vasorum of the subinguinal hiatus
b/ it gives off the medial and lateral circumflex femoral arteries
c/ it gives off perforating arteries that pierce (perforate) the adductor magnus muscle (its tendon) to reach the posterior femoral muscles
d/ there are usually 3 perforating arteries
e/ terminal end of the deep femoral artery perforates the adductor magnus as well and it is called the fourth perforating artery

Popliteal artery:
a/ it extends from the adductor hiatus to the upper margin of the soleus muscle
b/ in the popliteal fossa, it is situated the most superficially and the most laterally
c/ it supplies the knee joint
d/ it gives off the descending genicular artery
e/ it gives off the sural branches for arterial supply of the gastrocnemius muscle

Anterior tibial artery:
a/ it is a terminal branch of the femoral artery
b/ it runs through the lateral retromalleolar space
c/ it gives off the fibular artery
d/ it continues at the back of the foot as the dorsalis pedis artery
e/ in the leg, it is accompanied by the tibial nerve

Anterior tibial artery:
a/ it comes from the popliteal artery
b/ it runs along the medial margin of the tibialis anterior muscle
c/ in the leg it is accompanied by the deep fibular nerve
d/ it enters the foot below the flexor retinaculum
e/ it gives off the recurrent arteries for blood supply of the knee joint

Posterior tibial artery:
a/ it runs below the triceps surae muscle
b/ it runs on the surface of the tibialis posterior muscle and the flexor digitorum longus muscle
c/ it gives off the fibular artery
d/ it enters the sole of the foot through the medial retromalleolar space
e/ in the leg, it is accompanied by the superficial fibular nerve

Posterior tibial artery:
a/ it runs between the gastrocnemius and the soleus muscles
b/ it runs through the medial retromalleolar space
c/ it gives off the common interosseous artery
d/ it gives off the sural arteries
e/ in the leg, it is accompanied by the deep fibular nerve

Arteries of the leg and the foot:
a/ posterior tibial artery runs through the lateral retromalleolar space
b/ at the leg, the posterior tibial artery runs between the superficial and the deep group of the posterior crural muscles
c/ posterior tibial artery gives off the medial and lateral tarsal arteries
d/ anterior tibial artery pierces the interosseous membrane
e/ anterior tibial artery runs between the tibialis anterior muscle and the extensor digitorum muscle

Arteries of the foot:
a/ dorsalis pedis artery is lateral to the tendon of the extensor hallucis longus muscle
b/ dorsalis pedis artery runs between the first and the second metatarsal bones
c/ arcuate artery forms the anastomosis with the medial tarsal artery
d/ medial and lateral plantar arteries are branches of the anterior tibial artery
e/ lateral plantar artery forms the deep plantar arch

Superficial veins of the lower limb:
a/ they are formed from the plantar venous network
b/ superficial veins have no valves
c/ at the leg the great saphenous vein is accompanied by the sural nerve

d/ small saphenous vein is usually drained into the popliteal vein
e/ great saphenous vein usually receives the superior epigastric veins

Great saphenous vein:
a/ it is formed from the medial side of the dorsal venous network
b/ it runs through the medial retromalleolar space
c/ at the thigh it is closely accompanied by the saphenous nerve
d/ it receives blood from the external pudendal veins
e/ it pierces the vastoadductor membrane to open into the femoral vein within the adductor canal

Small saphenous vein:
a/ it is formed from the lateral side of the dorsal venous network
b/ it runs superficially in front of the medial malleolus
c/ it runs superficially in the posterior crural region
d/ at the leg, it is accompanied by the saphenous nerve
e/ it enters the popliteal fossa to open into the popliteal vein

Deep veins of the lower limb:
a/ in the femoral triangle, the femoral vein is lateral to the femoral artery
b/ popliteal vein opens into the deep femoral vein
c/ posterior tibial veins run through the medial retromalleolar space
d/ anterior tibial veins run through the lateral retromalleolar space
e/ external pudendal veins open into the great saphenous vein

Veins of the lower limb:
a/ in the femoral triangle, the femoral vein receives the blood from the great saphenous vein
b/ in the adductor canal, the femoral vein is accompanied by the saphenous nerve
c/ in popliteal fossa, the popliteal vein is situated laterally to the popliteal artery
d/ at the leg, the small saphenous vein is accompanied by the saphenous nerve
e/ at the leg, the great saphenous vein is accompanied by the sural nerve

• Name the superficial veins of the lower limb and describe their position to the malleoli / ankles (e.g. in front of ...or behind... lateral or medial malleolus):

• Where are following veins drained (into which vein)?
posterior tibial veins -.....
superficial epigastric veins - .....
small saphenous vein- .....
medial and lateral plantar veins -.....
popliteal vein - ....
great saphenous vein- .....

external pudendal veins - .....
anterior tibial veins - .....
fibular vein -.....

• Name branches of the femoral artery that supply adjacent regions of the trunk:

• Name the superficial and deep veins that run around (next to) the medial malleolus (ankle):

• Which vein runs superficially behind the lateral malleolus and where does it drain /into which vein/?

• Name branches of the deep femoral artery:

• How many perforating arteries are given by the deep femoral artery?

• What do the perforating arteries perforate /pierce?

• What is supplied by the perforating arteries?

• Name the branch/branches of the femoral artery that contributes/contribute to the blood supply of the knee joint:

• Name the branch/branches of the anterior tibial artery that contributes/contribute to the blood supply of the knee joint:

• Name the artery/arteries that gives/give off the branches for the blood supply of the knee joint:

• Name the artery that is the continuation of the anterior tibial artery:

• Name the joint/joints that is/are blood supplied by the anterior tibial artery:

• Name the arteries that are the continuation of the posterior tibial artery:

• Name the branch/branches of the internal iliac artery that contributes/contribute to the blood supply of the lower limb:

• What is supplied by the obturator artery? What is supplied by the superior and inferior gluteal arteries?

• Name the vein that accompanies the sural nerve at the leg:

• Name the vein that accompanies the saphenous nerve at the leg:

• Name the vein that accompanies the saphenous nerve at the thigh:

• Name the artery that gives main blood supply to the knee joint:

• Name the artery that supplies the medial femoral muscles:

CLINICAL QUESTIONS:

- **Where is the optimal spot (location) for the pulse palpation of the femoral artery?**
- **Where is the optimal spot (location) for the pulse palpation of the popliteal artery?**
- **Where is the optimal spot (location) for the pulse palpation of the posterior tibial artery?**
- **Where is the optimal spot (location) for the pulse palpation of the dorsalis pedis artery?**
- **The patient has a fracture of the medial ankle. Which vessels could be damaged by the bony fragments?**
- **The patient has a fracture of the humeral shaft that is complicated by the hematoma between the medial and lateral heads of the triceps. Which artery could be damaged by the bony fragments?**
- **Medical examination revealed the thrombus (clot) in the fibular vein. If the thrombus embolizes, what can we expect? Which vein will it directly enter when it leaves the fibular vein?**
- **Which mechanisms are necessary for the physiologic blood flow toward the heart in the superficial veins and the deep veins?**

NERVES OF THE LOWER LIMB

Lumbar plexus:
a/ it is formed by the ventral rami of the L5-Co spinal nerves
b/ obturator nerve runs along the medial side of the psoas major muscle
c/ genitofemoral nerve is a purely sensory nerve
d/ femoral nerve is the thickest nerve of the lumbar plexus
e/ femoral nerve runs along the lateral side of the psoas major muscle

Lumbar plexus:
a/ lateral cutaneous femoral nerve runs through lacuma musculorum of the subinguinal hiatus
b/ genital branch of the genitofemoral nerve runs through lacuna vasorum of the subinguinal hiatus
c/ femoral branch of the genitofemoral nerve runs through the inguinal canal
d/ ilioinguinal nerve runs through the inguinal canal
e/ obturator nerve runs through lacuna vasorum of the subinguinal hiatus

Lumbar plexus:
a/ lateral cutaneous femoral nerve runs behind the kidney
b/ genital branch of the genitofemoral nerve supplies the cremaster muscle
c/ iliohypogastric nerve runs through the inguinal canal
d/ ilioinguinal nerve runs behind the kidney
e/ ilioinguinal nerve supplies the skin at the anterior aspect of the external genital organs

Femoral nerve:
a/ it runs below the inguinal ligament through lacuna musculorum
b/ it the femoral triangle, it is lateral to the femoral artery
c/ it gives motor nerve supply for the gracilis muscle
d/ it gives off the sensory branches for the skin at the anterior femoral region
e/ its sensory branch - the saphenous nerve supplies the skin at the lateral side of the leg

Femoral nerve:
a/ it is a purely motor nerve
b/ it the femoral triangle, it is medial to the femoral artery and lateral to the femoral vein
c/ it gives motor nerve supply for the sartorius muscle
d/ it gives motor nerve supply for the quadratus femoris muscle
e/ it enters the popliteal fossa through the adductor canal

Obturator nerve:
a/ it enters the lower limb through the subinguinal hiatus
b/ it gives motor nerve supply for the obturator internus muscle
c/ it gives motor nerve supply for the gracilis muscle
d/ it gives sensory nerve supply for the skin at the lateral side of the thigh
e/ it gives motor nerve supply for the adductor longus muscle

Sacral plexus:
a/ it is formed by the dorsal rami of the L5-Co spinal nerves
b/ superior gluteal nerve exits the pelvis through the greater sciatic foramen
c/ sciatic nerve enters the lower limb through the infrapiriform foramen
d/ posterior cutaneous femoral nerve enters the lower limb through the suprapiriform foramen
e/ pudendal nerve runs through the lesser sciatic foramen

Sacral plexus:
a/ superior gluteal nerve supplies the gluteus maximus muscle
b/ inferior gluteal nerve supplies the gluteus medius and minimus muscles
c/ sciatic nerve is the thickest nerve in the human body
d/ posterior cutaneous femoral nerve enters the lower limb through the infrapiriform foramen
e/ posterior cutaneous femoral nerve gives off the inferior cluneal nerves

Sciatic nerve:
a/ it enters the lower limb through the lesser sciatic foramen
b/ in the thigh it runs immediately below the semitendinosus muscle
c/ it gives motor nerve supply for the semitendinosus muscle
d/ it gives motor nerve supply for the pectineus muscle
e/ it gives motor nerve supply for the biceps femoris muscle

Tibial nerve:
a/ it runs below the triceps surae muscle
b/ in the leg, it is accompanied by the posterior tibial vessels
c/ it gives motor nerve supply for the extensor hallucis longus muscle
d/ it gives motor nerve supply for the tibialis posterior muscle
e/ its branches give sensory nerve supply for the skin on the sole of the foot

Tibial nerve:
a/ in the popliteal fossa, it is medial to the common fibular nerve
b/ it runs through the medial retromalleolar space
c/ it gives motor nerve supply for the flexor hallucis longus muscle
d/ it gives motor nerve supply for the popliteus muscle
e/ it gives medial and lateral plantar nerves

Common fibular nerve:
a/ usually it arises from the sciatic nerve above the popliteal fossa
b/ in popliteal fossa, it is medial to the tibial nerve
c/ behind the fibular head, it splits into the superficial and the deep fibular nerves
d/ superficial fibular nerve supplies the lateral crural muscles
e/ deep fibular nerve supplies the muscles at the back of the foot

Deep fibular (peroneal) nerve:
a/ it runs through the lateral retromalleolar space
b/ passing at the leg, it is accompanied by the posterior tibial vessels
c/ in the leg, it is lateral to the tibialis anterior muscle
d/ it gives motor nerve supply for the extensor digitorum longus muscle
e/ it gives sensory nerve supply for the skin over adjacent surfaces of the toes I and II

• Which nerves innervate the muscles of the leg? Write in the form ...group – nerve

• Which nerves innervate the adductors of the thigh?

• Name the nerve that innervates the pronators of the foot:

• Name the nerves that run through the suprapiriform foramen (above the piriformis muscle):

• Name the nerves that run below the piriformis muscle and continue to the free lower limb:

• Which nerves arising from the lumbar plexus supply the external genital organs?

• Name the nerves that pass through the subinguinal hiatus - lacuna vasorum:

• Name the nerves that pass through the subinguinal hiatus - lacuna musculorum:

• Which nerves give sensory nerve supply for the skin at the posterior femoral region?

- **Which muscles and what area of the skin is supplied by the femoral nerve?**
- **Which muscles and what area of the skin is supplied by the obturator nerve?**
- **Which muscles and what area of the skin is supplied by the tibial nerve?**
- **Which muscles and what area of the skin is supplied by the superficial fibular nerve?**

- **Which muscles and what area of the skin is supplied by the deep fibular nerve?**

- **Name purely sensory nerve/nerves arising from the lumbar plexus:**

- **Name purely sensory nerve/nerves and purely motor nerves arising from the sacral plexus:**

CLINICAL QUESTIONS:

Which of following symptoms can be caused by the injury to the obturator nerve?
a/ patient is unable to abduct the thigh
b/ patient is unable to extend the knee joint
c/ patient is unable to abduct the thigh
d/ patient lost skin sensation at the medial side of the thigh
e/ patient lost skin sensation at the lateral side of the thigh

Which of following symptoms can be caused by the injury to the deep fibular nerve and its branches?
a/ patient is unable to do the plantar flexion
b/ patient is unable to abduct the toes
c/ patient is unable to extend the big toe
d/ patient lost sensation of the skin over adjacent surfaces of the 1st toe and 2nd toe
e/ patient lost sensation at the area around the medial malleolus

Which of following symptoms can be caused by the injury to the femoral nerve?
a/ patient is unable to extend the foot
b/ patient is unable to extend the knee joint
c/ patient is unable to abduct the thigh
d/ patient lost skin sensation at the medial side of the leg
e/ patient lost skin sensation at the area around the lateral malleolus

Which of following symptoms can be caused by the injury to the deep fibular nerve?
a/ patient is unable to extend the foot
b/ patient is unable to extend the knee joint
c/ patient is unable to abduct and adduct the toes
d/ patient lost sensation of the skin over adjacent surfaces of toe I (hallux) and toe II
e/ patient lost sensation at the area around medial malleolus

Which of following symptoms can be caused by the injury to the tibial nerve and its branches?
a/ patient is unable to do the plantar flexion
b/ patient is unable to abduct the toes
c/ patient is unable to extend the toe I (hallux)
d/ patient lost skin sensation of the skin over the sole of the foot
e/ patient lost skin sensation at the back of the foot

- **Patient had a fracture of the fibular head complicated by the nerve injury. Due to the nerve injury he cannot extend the foot (the ability to raise the foot is lost). Which nerve was probably damaged ?**

- **Patient received a deep laceration on the medial side of his knee. He notices a loss of skin sensation along the medial side of his right leg and foot. He has no motor deficit. Which nerve was most likely injuried ?**

- **Patient has a deep leg ulcer (ulcus cruris) at the lateral side of the anterior crural region. He complains the loss of the skin sensitivity at the back of the foot. He has no motor deficit. Which nerve is most likely damaged by the leg ulcer?**

- **The patient has a fracture of the medial ankle. Which nerve could be damaged by the bony fragments?**

- **Patient suffers from anterior compartment syndrome of the leg. He complains of the inabitity to do extension of the foot, he displays „the footdrop" . Which nerve is most likely damaged?**

- **Patient underwent the surgery for the tumorous mass at the lateral wall of the pelvis. Examination revealed weaker adduction of the thigh and loss of the skin sensation on the medial side of the thigh. Which nerve is most likely damaged?**

- **A woman underwent the total mastectomy (surgery to remove the whole breast – mammary gland) because of the breast cancer. Incision is healing without complications. However she complains the inability of the protraction of the scapula. Which nerve was most likely injuried during the surgery?**

- **When a nurse attempted to insert the needle to collect the blood from the basilic vein, the patient suddenly complained of tingling and burning of the skin at the medial side of the forearm. Can you explain it? What was accidentally injured?**

- **When a nurse attempted to insert the needle to collect the blood from the cephalic vein, the patient suddenly complained of tingling and burning of the skin at the lateral side of the forearm. Can you explain it? What was accidentally injured?**

TOPOGRAPHIC ANATOMY OF THE LOWER LIMB

Adductor canal:
a/ it is situated above the superficial fascia
b/ it connects the femoral triangle and the popliteal fossa
c/ it is ventrally bordered by the vastoadductor membrane
d/ it contains the deep femoral artery
e/ it contains the saphenous nerve

Which of following structures run in the medial retromalleolar space?
a/ anterior tibial artery
b/ great saphenous vein
c/ posterior tibial artery
d/ tibial nerve
e/ tendon of the extensor hallucis longus muscle

Sensory nerve supply for the skin of the the foot:
a/ tibial nerve supplies the back of the foot on the middle area
b/ sural nerve supplies the back of the foot on the medial side
c/ superficial fibular (peroneal) nerve supplies the skin on the sole of the foot
d/ deep fibular (peroneal) nerve supplies the skin over the adjacent surfaces of the the 1st and 2nd toes
e/ saphenous nerve supplies the back of the foot on the lateral side and the little toe

Which of following structures pass superficially at the posterior crural region:
a/ small saphenous vein
b/ tibial nerve
c/ sural nerve
d/ posterior tibial artery
e/ superficial fibular nerve

Femoral triangle:
a/ proximally it is bordered by the inguinal ligament
b/ medially it is bordered by the sartorius muscle
c/ laterally it is bordered by the adductor longus muscle
d/ femoral vein is situated more medially than the femoral artery
e/ femoral nerve is situated more medially than the femoral artery

Popliteal fossa:
a/ it is distally (inferiorly) bordered by the biceps femoris muscle
b/ it is proximally (superiorly) bordered by the gastrocnemius muscle
c/ tibial nerve is lateral to the common fibular nerve
d/ common fibular (peroneal) nerve is medial to the popliteal artery
e/ popliteal artery is the deepest of the neurovascular structures in the popliteal fossa

Which of following structures run through the medial retromalleolar space:
a/ tendon of the tibialis anterior muscle
b/ tendon of the fibularis longus muscle
c/ tendon of the extensor hallucis longus muscle
d/ tibial nerve
e/ small saphenous vein

Sensory nerve supply for the skin of the thigh and leg:
a/ femoral nerve gives off the sensory branches for the skin at the anterior side of the thigh
b/ obturator nerve gives off the sensory branches for the skin at the lateral side of the thigh
c/ sciatic nerve gives off the sensory branches for the skin at the posterior side of the thigh
d/ saphenous nerve gives sensory nerve supply for the skin at the medial side of the leg
e/ sural nerve gives sensory nerve supply for the skin at the anterior crural region and around the medial ankle

Femoral triangle:
a/ proximally it is bordered by the inguinal ligament
b/ medially it is bordered by the adductor brevis muscle
c/ laterally it is bordered by the gracilis muscle
d/ femoral nerve enters the femoral triangle by passing through the obturator foramen
e/ femoral artery lies on the lateral side of the femoral vein

Sole of the foot:
a/ the skin at the sole of the foot is supplied by the sensory branches of the tibial nerve
b/ medial and lateral plantar arteries are branches of th eanterior tibial artery
c/ medial and lateral plantar vessels are situated below the flexor digitorum brevis
d/ quadratus plantae muscle is situated tightly below the skin
e/ medial and lateral plantar nerves are branches of the deep fibular nerve

Sensory nerve supply for the skin of the thigh and leg:
a/ femoral nerve gives off the sensory branches for the skin at the posterior thigh
b/ obturator nerve gives off the sensory branches for the skin at the medial side of the thigh

c/ sciatic nerve gives off the sensory branches for the skin at the posterior side of the thigh
d/ saphenous nerve gives sensory nerve supply for the skin at the lateral side of the leg
e/ sural nerve gives sensory nerve supply for the skin at the medial side of the leg

• Name the muscles that form the borders of the femoral triangle and write also the nerves that supply them (write... muscle – nerve... e.g. semitendinosus muscle – sciatic nerve):

• Name the muscles that form the borders of the popliteal fossa and write also the nerves that supply them(write... muscle – nerve... e.g. semitendinosus muscle – sciatic nerve):

• Which vessels and nerves are situated in the femoral triangle? Describe their position from lateral to the medial side.

• Which vessels pass through the medial retromalleolar space?

• Which nerve runs through the medial retromalleolar space?

• Name the muscle that is situated immediately below the plantar aponeurosis:

• Which nerve passes through the adductor canal, which vessels pass through the adductor canal?

• What is the adductor hiatus?

• Which muscles form the proximal borders of the popliteal fossa?

• Which muscles form the distal borders of the popliteal fossa?

• Which vessels and nerves are situated in the popliteal fossa? Describe their position from lateral to the medial side . Which of these neurovascular structures is the deepest one?

• Which topographical spaces are connected by the adductor canal?

• Which structures run through the lateral retromalleolar space?

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