

POPLITEAL FOSSA

INTRODUCTION

The popliteal fossa is a diamond-shaped hollow on the back of the knee joint. It becomes prominent when the knee is flexed. This fossa is an important anatomical region because it provides passage for main vessels and nerves from the thigh to the leg.

BOUNDARIES

The fossa is bounded:

Supermedially: Semitendinosus and semimembranosus.

Superolaterally: Biceps femoris.

Inferomedially: Medial head of gastrocnemius.

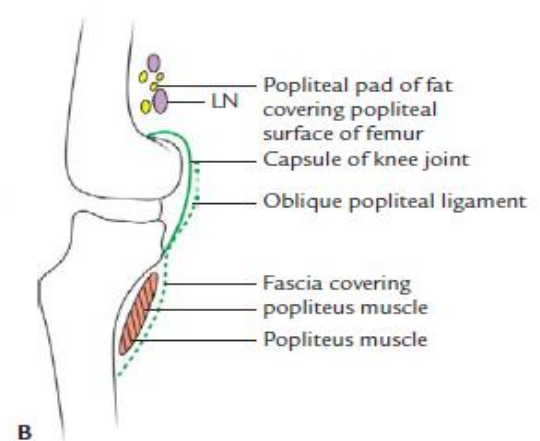
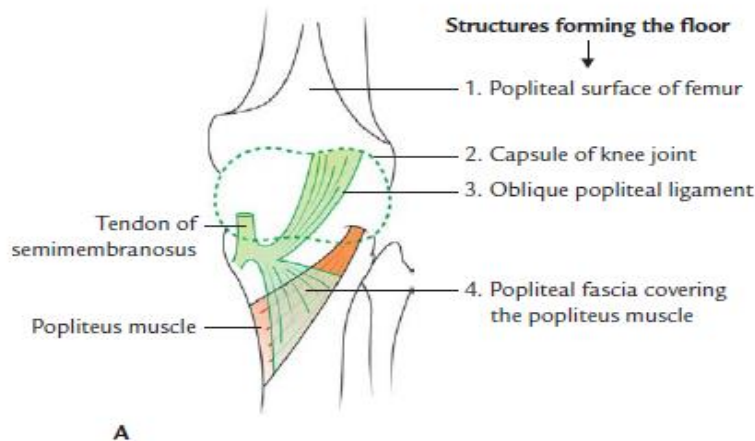
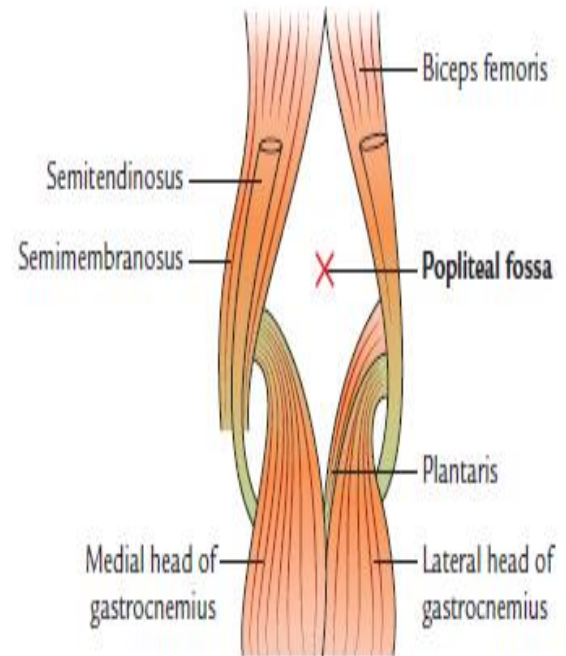
Inferolaterally: Lateral head of gastrocnemius supplemented by the plantaris.

Floor (or anterior wall): It is formed from above downward by:

- The popliteal surface of the femur,
- The capsule of the knee joint and oblique popliteal ligament, and
- The popliteal fascia covering the popliteus muscle.

Roof (or posterior wall): It is formed from the strong popliteal fascia. The superficial fascia over the roof contains:

- Short saphenous vein, and
- Three cutaneous nerves (e.g., (i) terminal part of the posterior cutaneous nerve of thigh, (ii) posterior division of the medial cutaneous nerve of thigh, and (iii) sural communicating nerve). The roof is pierced by all these structures except the posterior division of medial cutaneous nerve of the thigh.



CONTENTS

The main contents of the popliteal fossa are as follows:

1. Popliteal artery and its branches.

2. Popliteal vein and its tributaries.
3. Tibial nerve and its branches.
4. Common peroneal nerve and its branches.
5. Popliteal lymph nodes.
6. Popliteal pad of fat.

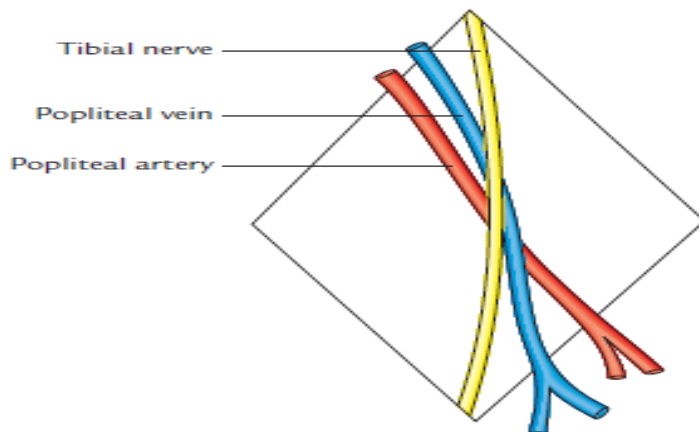
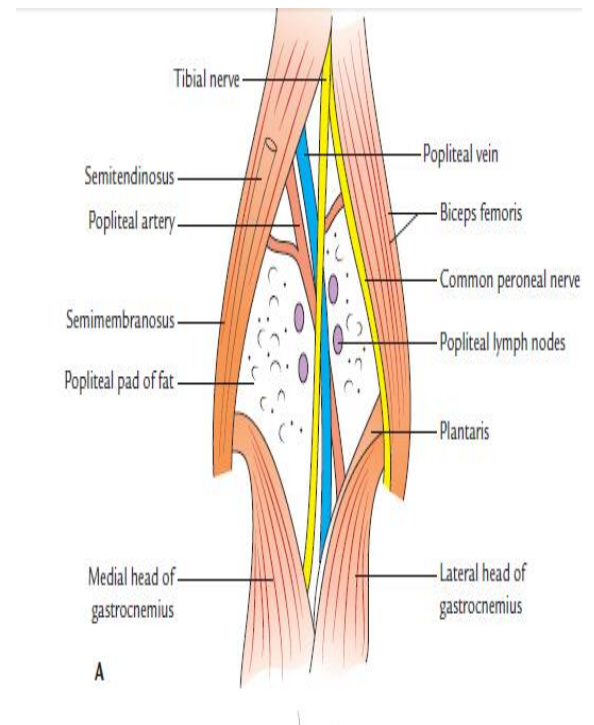
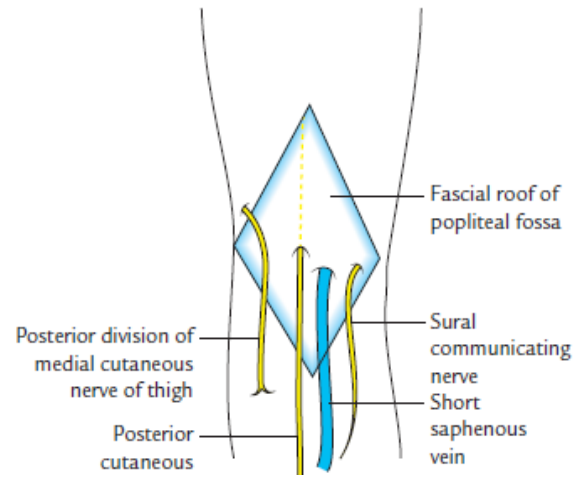
In addition to the above-mentioned structures, the popliteal fossa also contains the following structures:

1. Posterior cutaneous nerve of the thigh.
2. Genicular branch of the obturator nerve.

N.B.

The relationship of tibial nerve, popliteal vein, and popliteal artery in the popliteal fossa: The popliteal artery is crossed superficially by popliteal vein from the lateral to medial side; which in turn is crossed superficially by the tibial nerve from the lateral to medial side. As a result, the relative relationship of these structures differs in the upper, middle, and lower parts of the fossa as follows

- (a) In the upper part of the fossa from the lateral to medial side, the order is Nerve, Vein, and Artery (NVA).
- (b) In the middle part of the fossa from superficial to deep, the order of arrangement is Nerve, Vein, and Artery (NVA).
- (c) In the lower part of the fossa from the lateral to medial side, the order of arrangement is Artery, Vein, and Nerve (AVN).



In the upper part
(from medial to lateral)



In the middle part
(from superior to deep)



In the lower part
(from medial to lateral)



POPLITEAL ARTERY

It is the continuation of femoral artery. It begins at the adductor hiatus (an osseo-aponeurotic opening in the adductor magnus at the junction of middle one-third and lower one-third of the thigh), crosses the floor of popliteal fossa from the medial to lateral side to reach the lower border of the popliteus where it terminates by dividing into **anterior and posterior tibial arteries**.

Relations

These are as follows.

Anterior (deep): Floor of the popliteal fossa (i.e., popliteal surface of femur, posterior aspect of the knee joint, and fascia covering the popliteus muscle).

Posterior (superficial): Popliteal vein, tibial nerve, fascial roof, superficial fascia, and skin (from deep to superficial).

Branches

These are divided into three groups—cutaneous, muscular, and articular (genicular).

1. **Cutaneous branches:** They pierce the roof and supply the overlying skin.

2. **Muscular branches:** They are large and several in number. The upper branches (two or three in number) supply adductor magnus and hamstring muscles. One or two of them anastomose with the fourth perforating artery. The lower muscular branches supply the triceps surae muscles (i.e., two heads of gastrocnemius and soleus) and plantaris.

3. **Genicular (articular) branches:** They are five in number and supply the knee joint.

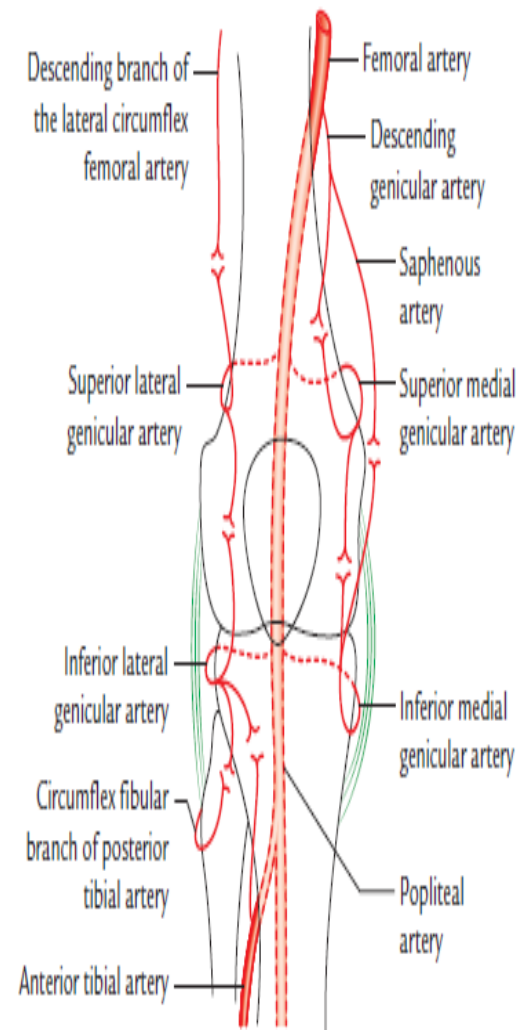
(a) Superior medial and lateral genicular arteries: They wind around the corresponding side of the femur immediately above the corresponding femoral condyles and take part in the formation of **genicular anastomosis**.

(b) Inferior medial and lateral genicular arteries: They wind around the corresponding tibial condyles and pass deep to the corresponding collateral ligaments of the knee joint to take part in the formation of **genicular anastomosis**.

(c) Middle genicular artery: It pierces the oblique popliteal ligament of the knee to supply the cruciate ligaments and synovial membrane of the knee joints.

N.B.

Genicular anastomosis: It is an arterial anastomosis around the knee joint formed by the branches of popliteal, anterior tibial and posterior tibial, femoral, and profunda femoris arteries.



This anastomosis maintains adequate blood supply to the knee joint and leg during flexion of the knee joint, when the popliteal artery is compressed (kinked) and blood flow in it becomes sluggish.

The anastomosis takes place as follows.

1. Superior medial genicular artery anastomosis with the descending genicular branch of the femoral artery and inferior medial genicular artery.
2. Inferior medial genicular artery anastomosis with the superior medial genicular artery and saphenous artery—a branch of the descending genicular artery (a branch of femoral artery).
3. Superior lateral genicular artery anastomosis with the descending branch of the lateral circumflex femoral artery and inferior lateral genicular artery.
4. Inferior lateral genicular artery anastomosis with the superior lateral genicular artery, anterior and posterior recurrent branches of the anterior tibial artery, and circumflex fibular branch of posterior tibial artery.

POPLITEAL VEIN

The popliteal vein is formed at the lower border of the popliteus by the union of veins (venae comitantes) accompanying the anterior and posterior tibial arteries. It ascends superficial to popliteal artery and crosses it from the medial to lateral side in the popliteal fossa. The popliteal vein continues as **femoral vein** at adductor hiatus.

Tributaries

The tributaries of popliteal vein are as follows:

1. Small saphenous vein.
2. Veins corresponding to the branches of popliteal artery.

TIBIAL NERVE (L4, L5; S1, S2, S3)

It is the larger terminal branch of the sciatic nerve. It extends vertically downward from the superior angle to the inferior angle of the popliteal fossa. It crosses popliteal artery superficially from the lateral to medial side with popliteal vein intervening between the artery and nerve.

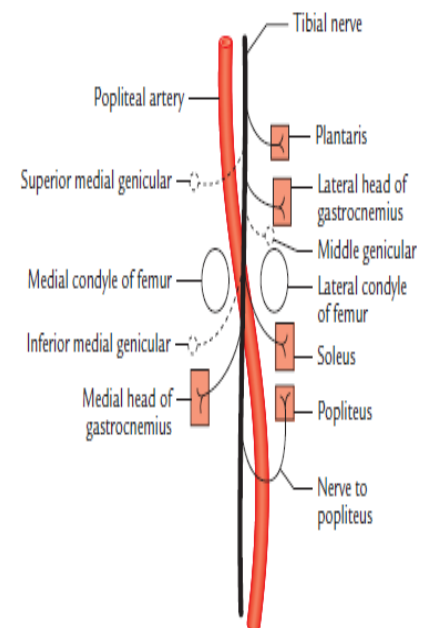
Branches These are as follows:

1. **Muscular branches.** They supply gastrocnemius (both heads), soleus, plantaris, and popliteus.

The nerve to popliteus crosses superficially to the popliteal artery, runs downward and laterally, and then winds around the lower border of popliteus, which it supplies from its deep surface. In addition to the popliteus, it also supplies many other structures.

These structures supplied by the nerve popliteus are:

- (a) Popliteus muscle
- (b) Tibialis posterior muscle
- (c) Superior tibiofibular joint



- (d) Tibia
- (e) Interosseous membrane
- (f) Inferior tibiofibular joint

2. Genicular branches. They are three in number (superior medial genicular, inferior medial genicular, and middle genicular) and accompany the arteries of the same name.

The **middle genicular nerve** pierces the oblique popliteal ligament and supplies the interior of the knee joint.

3. Cutaneous branch. It is called the **sural nerve** and arises about the middle of the popliteal fossa. It runs vertically downward underneath the deep fascial roof of fossa and leaves the fossa by piercing the roof near its inferior angle.

4. Vascular branches. They supply the vasomotor fibers (T10–L2) to the popliteal vessels.

COMMON PERONEAL NERVE (L4, L5; S1, S2)

It is the smaller terminal branch of the sciatic nerve. It appears in the popliteal fossa beneath the long head of the biceps femoris and slopes downward and laterally along the medial side of the tendon of biceps femoris up to the lateral angle of the fossa. Here it crosses superficially to the plantaris, lateral head of gastrocnemius to reach the back of the head of fibula. Finally, it winds around the posterolateral aspect of the neck of fibula, pierces the peroneus longus muscle, and terminates by dividing into **deep** and **superficial peroneal nerves**.

Branches

In the popliteal fossa, the common peroneal nerve gives rise to two cutaneous branches and three genicular branches.

Cutaneous branches

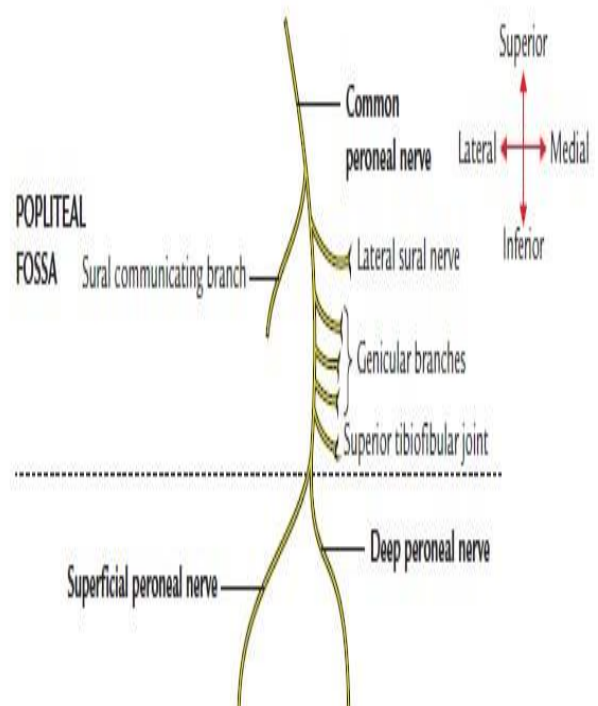
These are as follows:

1. **Sural communicating nerve.** It arises opposite to the head of the fibula, and crosses superficially to the lateral head of gastrocnemius to join the **sural nerve**.

2. **Lateral cutaneous nerve (lateral sural nerve).** It arises lower down and pierces the deep fascia to supply the skin on the upper part of the lateral side of the leg.

Genicular (articular) branches

These are superior lateral genicular, inferior lateral genicular, and recurrent genicular nerves. The first two supply the knee joint and the last one supplies the superior tibiofibular joint.



POPLITEAL LYMPH NODES

They are usually five to six in number and embedded in the popliteal pad of fat. They are found at the following three sites:

1. One node lies at the junction of small saphenous vein and popliteal vein.
2. Few nodes lie deep to the popliteal artery.
3. Remaining nodes are situated on both sides of the popliteal artery.

The popliteal lymph nodes drain into:

- (a) Back and lateral side of calf of the leg, and
- (b) Lateral side of heel and foot.

POSTERIOR CUTANEOUS NERVE OF THE THIGH

It pierces the fascial roof about the middle of the popliteal fossa and provides cutaneous innervation up to the middle of the back of leg.

GENICULAR BRANCH OF THE OBTURATOR NERVE

It is the continuation of the posterior division of the obturator nerve. It first run on the posterior surface of the popliteal artery and then pierces oblique popliteal ligament to supply the capsule of the knee joint.

Clinical note.

- **Popliteal pulse.** To feel the popliteal pulse, first flex the knee to relax the popliteal fascia. Then place the fingertips of both hands in the popliteal fossa with thumbs resting on patient's patella.

Popliteal pulse is the most difficult pulse to feel amongst all the peripheral pulses.

- **Popliteal aneurysm.** The popliteal artery is more prone to aneurysm than any other artery in the body. Clinically, popliteal aneurysm presents as pulsatile midline swelling in the popliteal fossa.

- **Baker's cyst.** It is cystic swelling which occurs in the popliteal fossa due to inflammation of synovial bursa underneath the tendon of semimembranosus or protrusion of synovial membrane of the cavity of knee joint through the fibrous capsule of the joint

N.B.

- The common peroneal nerve can be palpated against the neck of fibula.
- The common peroneal nerve gives no muscular branch. It is the popliteal fossa.

N.B.

All the muscular branches of the tibial nerve arise from its lateral side except the nerve to medial head of gastrocnemius, which arises from its lateral side. Therefore, lateral side of the tibial nerve is termed dangerous side and medial side as the safe side

VENOUS DRAINAGE OF THE LOWER LIMB

INTRODUCTION

The **venous drainage of the lower limb** is of immense clinical and surgical importance. The venous blood of the lower limb is drained against gravity. However, number of factors helps to facilitate its drainage (vide infra). If these factors fail to help the drainage, the stagnation of venous blood in the superficial veins cause **varicose veins** and in the deep veins lead to **deep vein thrombosis**.

Factors Helping the Venous Drainage of the Lower Limb

1. The contraction of the calf muscles (chief factor) squeezes the blood upward along the deep veins. Note the calf muscles act as '**calf pump (peripheral heart)**'.
2. Transmitted pulsations from the adjacent arteries.
3. Presence of valves in the perforating veins prevents the reflux of blood into the superficial veins during contraction of the calf muscles.
4. Presence of valves in the deep veins supports the column of blood and maintains unidirectional upward flow of the blood.
5. Negative intrathoracic pressure becomes more negative during inspiration and yawning.
6. In recumbent position, the '**vis-a-tergo**' is produced by the contraction of the heart and suction action of the diaphragm.

CLASSIFICATION OF THE VEINS

The veins of the lower limb are classified anatomically and functionally into the following three types:

1. Superficial veins.
2. Deep veins.
3. Perforating veins.

The **superficial veins** essentially include the great and small saphenous veins, which represent pre-axial and post-axial veins of the developing lower limb, respectively. They lie in the superficial fascia on the surface of the deep fascia and are thick walled because of the presence of the smooth muscle. They possess valves, which are more numerous in their distal part than in the proximal part. A large proportion of their blood is drained into the deep veins through the perforating veins.

The **deep veins** include the anterior tibial, posterior tibial, peroneal, popliteal, and femoral veins. They are surrounded and supported by the powerful muscles. They possess more valves. They accompany the arteries. Below the knee, they are arranged as a pair of **venae comitantes** along the arteries but above the knee, they form single large vein. All the veins from muscles draining into deep veins also possess valves except those in the soleus where they are arranged in the form of **venous sinuses (soleal sinuses)**.

The **perforating veins (perforators)** connect the superficial veins with the deep veins and pierce the deep fascia. Their valves permit only one-way flow of the blood, from the superficial veins to the deep veins. There are about five perforators along the great saphenous vein, and one perforator along the small saphenous vein.

SUPERFICIAL VEINS / GREAT SAPHENOUS VEIN

The great saphenous vein lies in the superficial fascia and is easily seen (Greek saphenous_easily seen). The great saphenous vein is the **longest vein** of the body and represents the **pre-axial** vein of the lower limb. It is also called long saphenous vein.

Course

It is formed on the dorsum of foot by the union of the medial end of the **dorsal venous arch of the foot** and **medial marginal vein of the foot**. The vein runs upward about 2.5 cm in front of the medial malleolus, crosses obliquely the medial surface of the lower third of tibia, and then ascends a little behind the medial border of tibia to reach the knee, where lies the posteromedial aspect of the knee joint, about one hand-breadth posterior to the patella; from here it runs upward along the medial side of the thigh to reach the saphenous opening (fossa ovalis).

It passes through the saphenous opening after piercing the cribriform fascia and drains into the **femoral vein** after piercing the femoral sheath.

Tributaries

1. **At the commencement:** Medial marginal vein of the big toe.

2. **in the leg:**

(a) Communicating veins with small saphenous and deep veins.

(b) Posterior arch vein. It is fairly large and constant. It collects the blood from the posteromedial aspect of the calf and begins of a series of small venous arches connecting the three medial ankle-perforating veins (perforators).

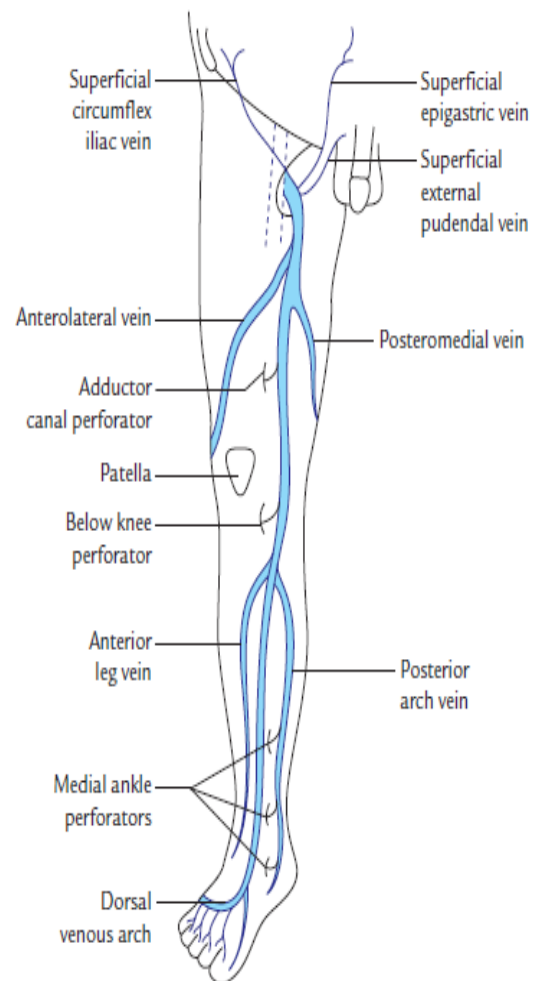
3. **Just below the knee.**

(a) Anterior veins of the leg. They extend diagonally (upward, forward, and medially) across the shin and join the great saphenous vein.

(b) A vein from the calf which communicate with the small saphenous vein.

4. **In the thigh.**

(a) Anterolateral vein. It commences in the lower part of the front of thigh, crosses the apex of femoral triangle, and joins the great saphenous vein in the upper part of the thigh.



(b) Posteromedial vein (accessory saphenous vein). It commences from the posteromedial aspects of the thigh and joins with the great saphenous vein; sometimes it may communicate below with the small saphenous vein.

5. Just before piercing the cribriform fascia.

- (a) Superficial epigastric vein.
- (b) Superficial circumflex iliac vein.
- (c) Superficial external pudendal vein.

These veins accompany the corresponding superficial branches of the femoral artery.

6. **Just before the termination in the femoral vein.** Deep external pudendal vein (last tributary) drains the blood from the anterior part of the perineum.

Valves in the Great Saphenous Vein

There are about 10 to 20 valves in the great saphenous vein, out of which the location of two needs special mention here:

(a) one, which lies just before it pierces the cribriform fascia and (b) the other, which lies at its junction with the femoral vein (**saphenofemoral valve**). It is of great functional significance.

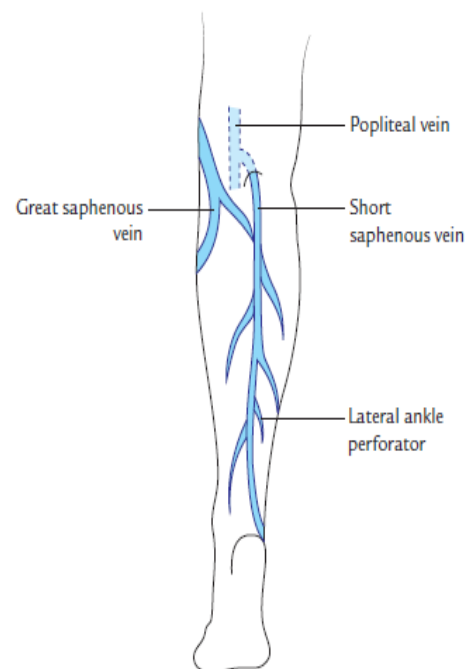
It lies about 3.5 to 4 cm inferolateral to the pubic tubercle. In about 80% individuals, the external iliac vein possesses a valve, which protects the saphenofemoral valve against high venous pressure. In remaining 20% cases who do not have this valve become the victim of high venous pressure and develop **varicose vein**, which commences at the saphenofemoral junction and gradually extends downward.

Surface Marking of the Great Saphenous Vein

1. At ankle, it lies 2.5 cm anterior to the medial malleolus.
2. In leg, it ascends by crossing the medial surface and medial border of the tibia.
3. At knee, it lies about a hand's breadth posterior to the medial margin of the patella.
4. In thigh, it ascends obliquely on the medial aspect of the thigh to reach a point 3.5–4 cm inferolateral to the pubic tubercle (saphenofemoral junction).

SMALL (SHORT) SAPHEOUS VEIN

It is formed below and behind the lateral malleolus by the union of the lateral end of the dorsal venous arch, and the lateral marginal vein of the foot. It runs upward behind the lateral malleolus, along the lateral edge of tendocalcaneus, and is accompanied by the sural nerve on its lateral side. Thereafter it runs in the middle of the back of the leg, pierces the deep fascia, and undergoes a subfascial course between the two heads of the gastrocnemius until it reaches the middle of the popliteal fossa. Here it turns inward to terminate into the popliteal vein. The posterior femoral cutaneous nerve accompanies the upper part of the vein, while passing from deep to superficial. The small saphenous vein contains 7–13 valves.



PERFORATING VEINS (PERFORATORS)

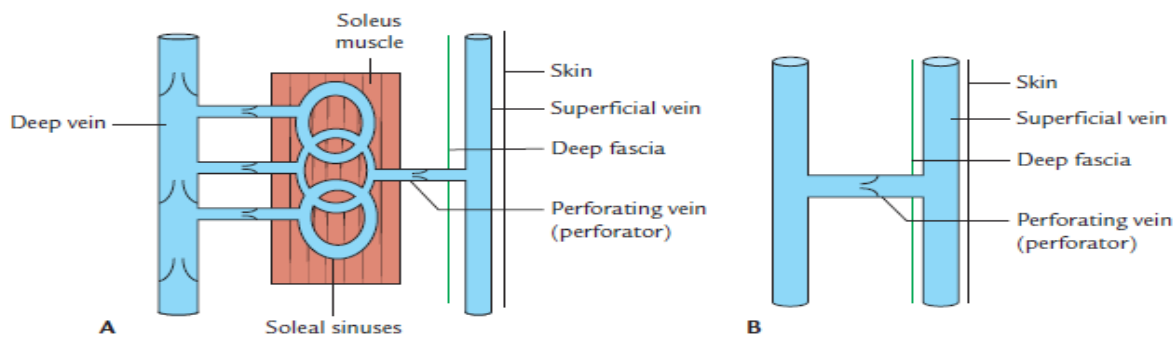
As described earlier they are communicating venous channels between the superficial and deep veins. These veins are called perforators because they perforate the deep fascia. The perforators are classified into two types: indirect and direct

1. Indirect perforators: They connect the superficial veins with the deep veins through muscular veins.
2. Direct perforators: They connect the superficial veins with the deep veins directly.

Location of Perforators

The position of five or six perforators is fairly constant, as mentioned below

1. **An adductor canal (mid-Hunter) perforator:** It connects the great saphenous vein with the femoral vein in the lower part of the adductor (Hunter's) canal.
2. **A knee perforator (Boyd's perforator):** It connects the great saphenous vein with the posterior tibial vein just below the knee and close to the medial border of tibia.



3. **A lateral ankle perforator:** It communicates the short saphenous vein with the peroneal vein. It is situated at the junction of middle and lower third of the leg.

4. **Three medial ankle perforators (of Cockett):** These are situated close to the medial border of the lower third of tibia between the medial malleolus and mid-calf and connect the great saphenous vein with the posterior tibial veins.

(a) Upper medial ankle perforator: It lies at the junction of the middle and lower third of the leg.

(b) Middle medial ankle perforator: It lies about 4cm above the medial malleolus.

(c) Lower medial ankle perforator: It lies posteroinferior to the medial malleolus.

Clinical note.

Calf pump and peripheral heart: In upright position, the venous return from the lower limb against gravity depends largely on the contraction of calf muscles. Therefore, these muscles are termed **calf pump**. The soleus muscle contains venous sinuses filled with blood. When soleus muscle contracts, it pumps the blood from its large venous sinuses into the deep veins, and when it is relaxed it sucks the blood from the superficial veins, and the venous sinuses within it are refilled. The unidirectional blood flow is maintained by the valves in the perforating veins. Hence, the soleus is sometimes termed **peripheral heart**. The soleal sinuses are common site for thrombosis and source of pulmonary embolism in sedentary individuals. The phlebitis of soleal sinus may be dangerous because the spread of infection from here may damage the valves in the perforators.