



**ВОЛГОГРАДСКИЙ
ГОСУДАРСТВЕННЫЙ
МЕДИЦИНСКИЙ
УНИВЕРСИТЕТ**

The lower extremity

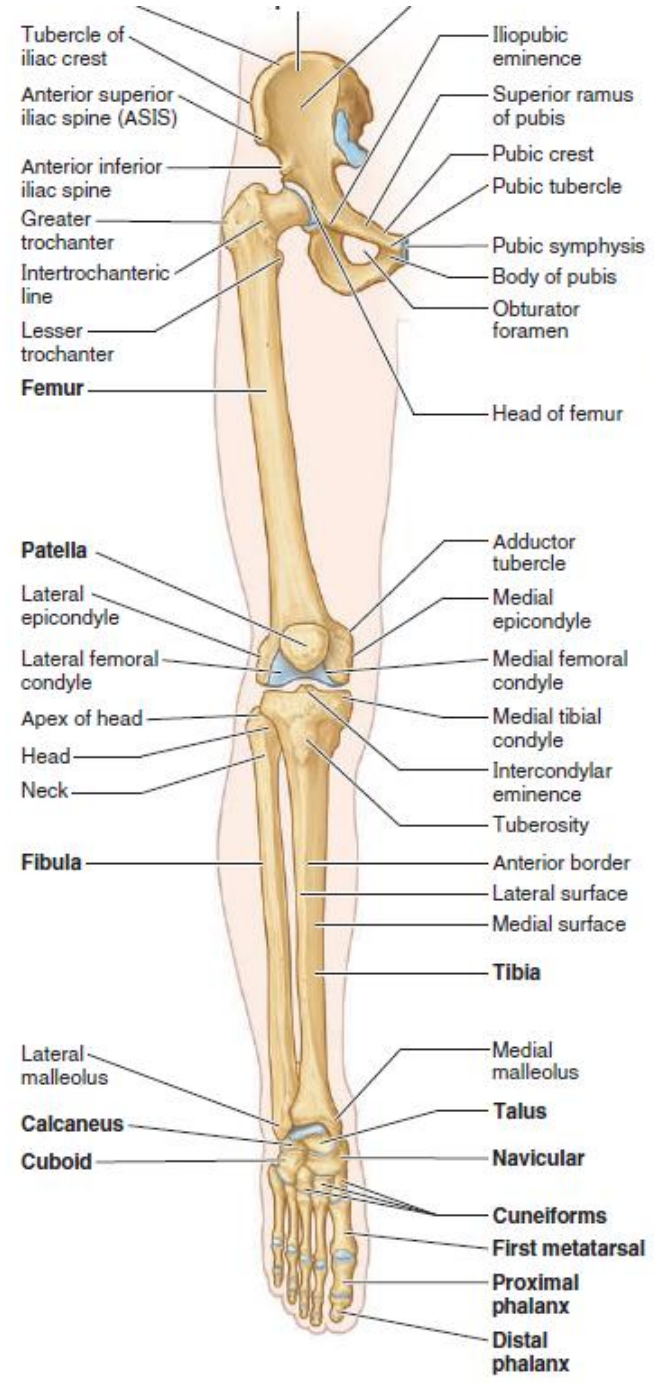
Femoral region (continued).

Knee region

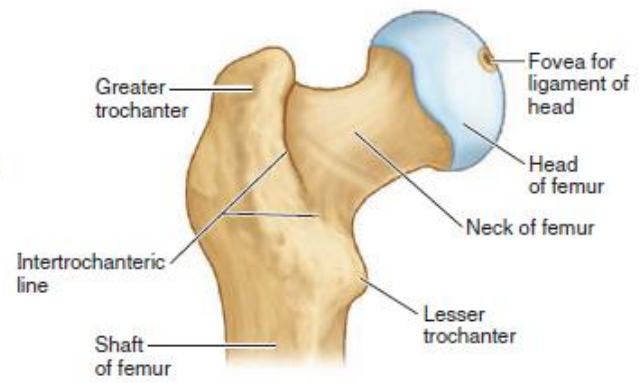
Department for the operative surgery and topographic anatomy, VSMU

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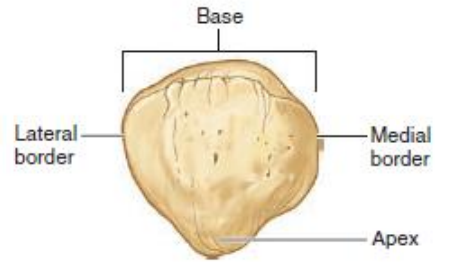
An overview of bones of the lower extremity



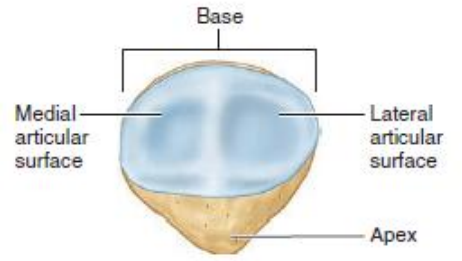
(A) Anterior view



(B) Anterior view of proximal femur

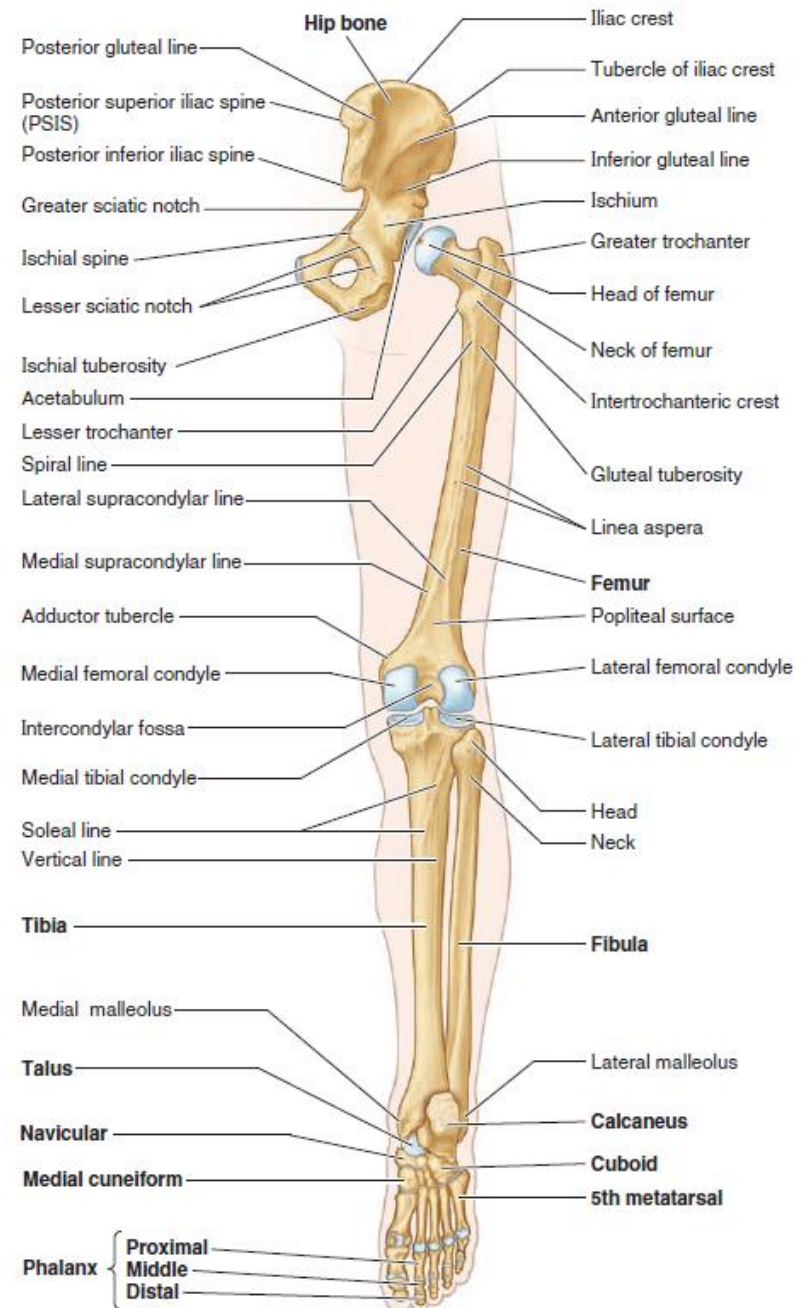


(C) Anterior view of patella



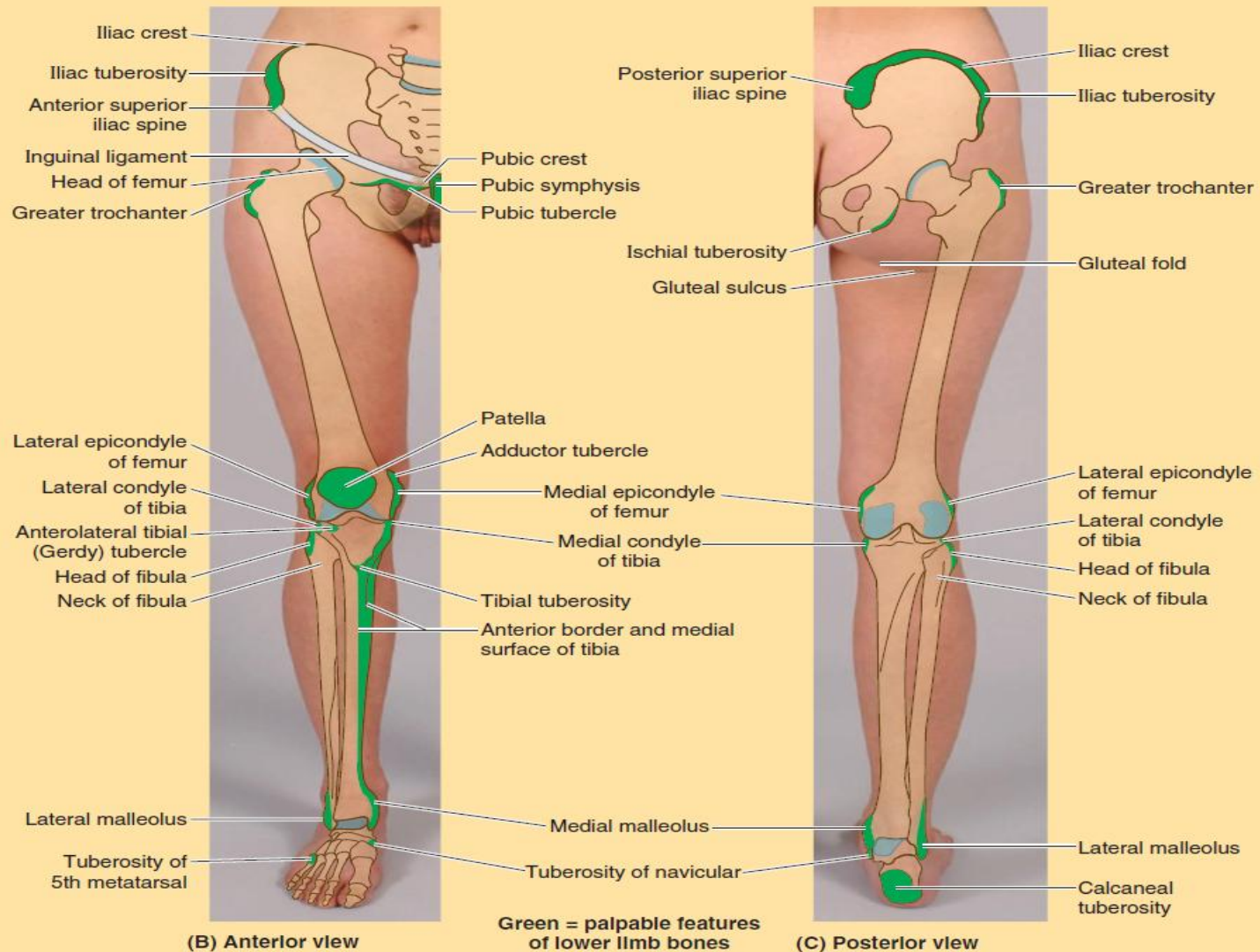
(D) Posterior view of patella

An overview of bones of the lower extremity

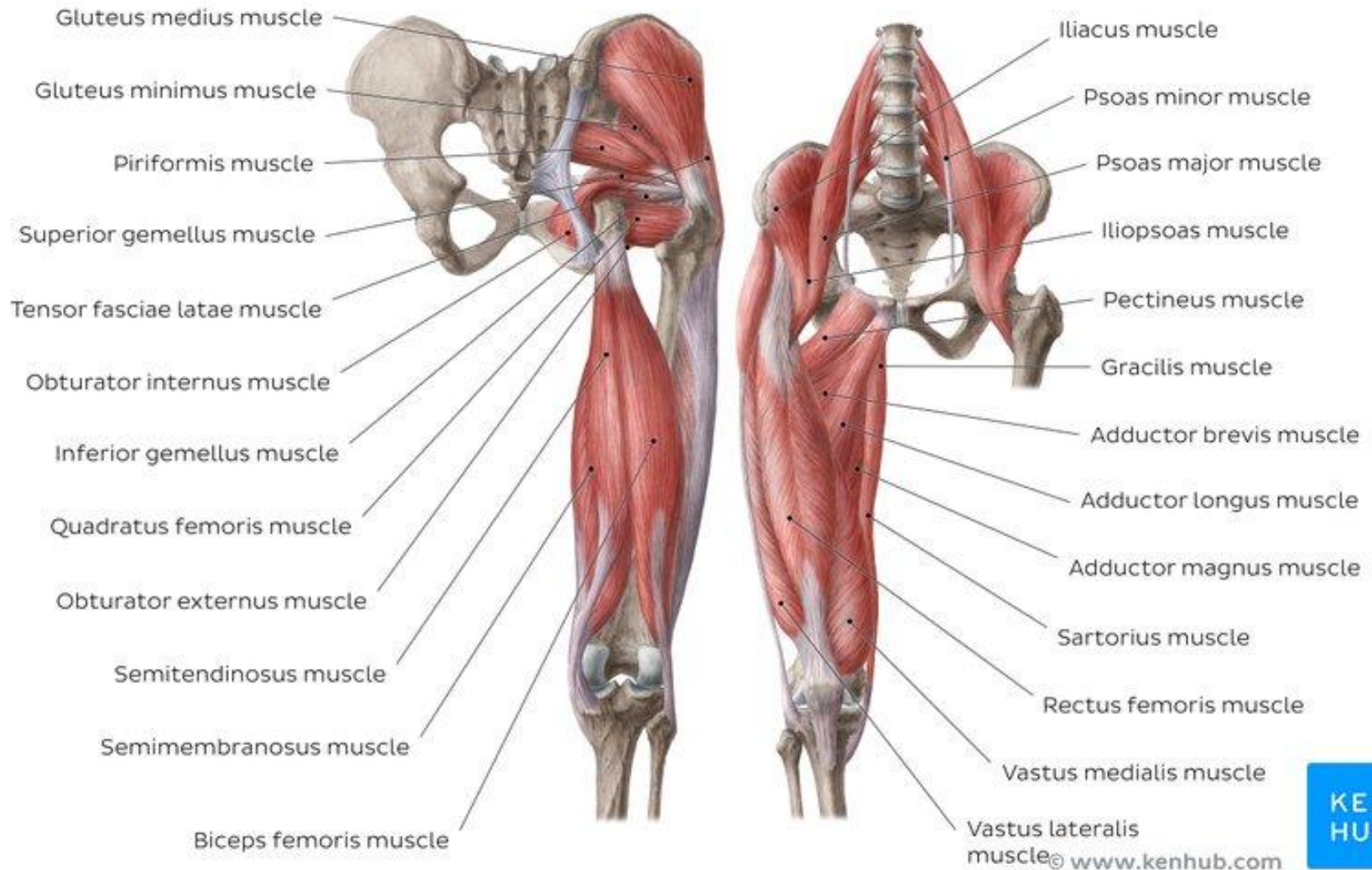


(E) Posterior view

The landmarks of the lower extremity



Muscles of the hip and thigh (anterior and posterior views)



Femoral region



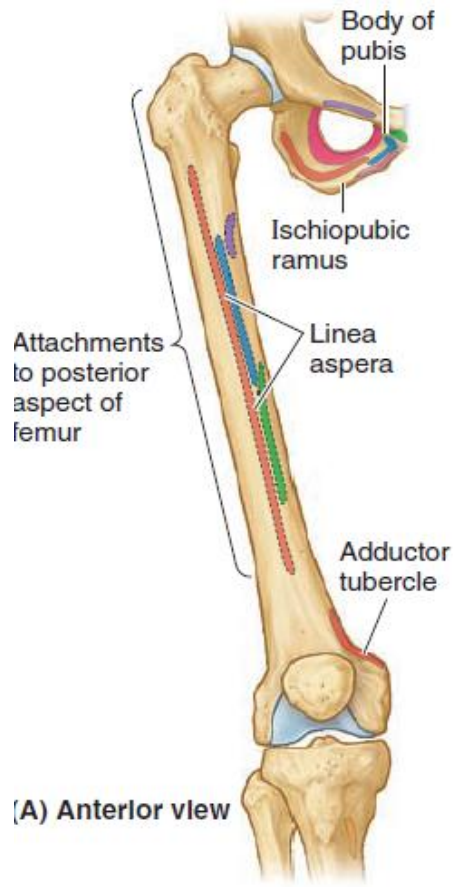
The thigh muscles are separated into three fascial compartments: anterior, medial, and posterior. The walls of these compartments are formed by the fascia lata and three fascial intermuscular septa that arise from the deep aspect of the fascia lata and attach to the linea aspera on the posterior aspect of the femur

Femoral region



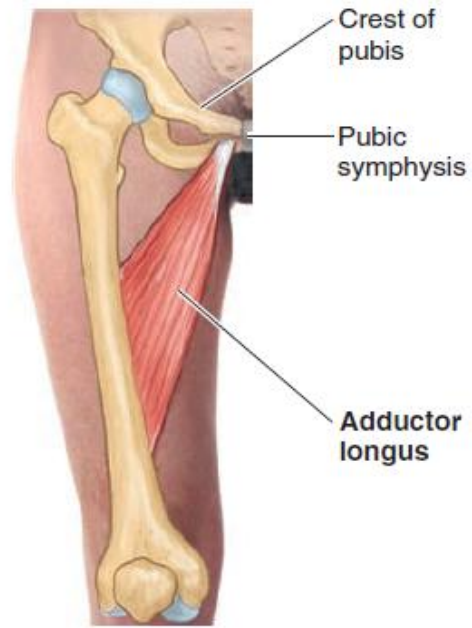
The medial group occupies, you guessed it, the medial compartment of the thigh. It includes the pectineus, adductor magnus, adductor minimus, adductor longus, adductor brevis, and gracilis. These muscles are also called the adductors of the thigh.

The posterior muscle group is the smallest group, occupying the posterior compartment of the thigh. It contains the three hamstring muscles called the semimembranosus, semitendinosus, and biceps femoris.

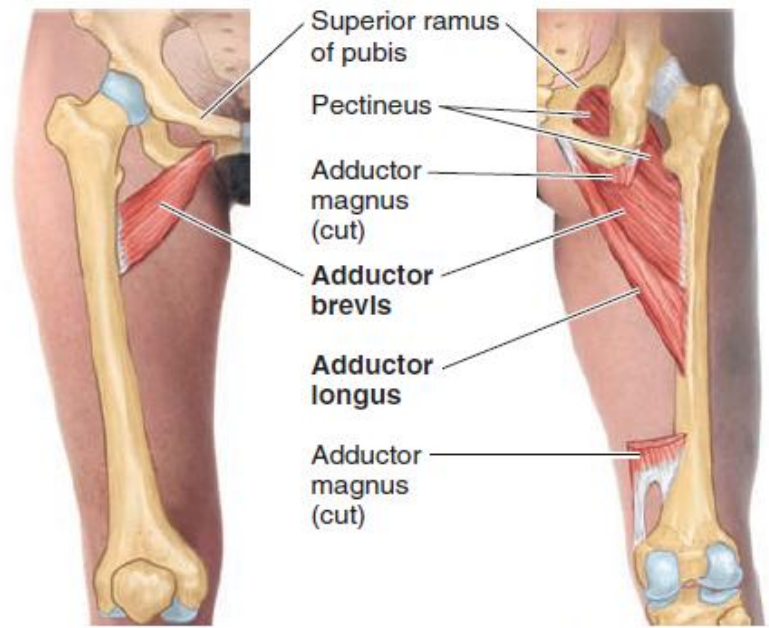


(A) Anterior view

Attachments	
■	Adductor longus
■	Adductor brevis
■	Adductor magnus
■	Gracilis
■	Obturator externus
■	Pectineus



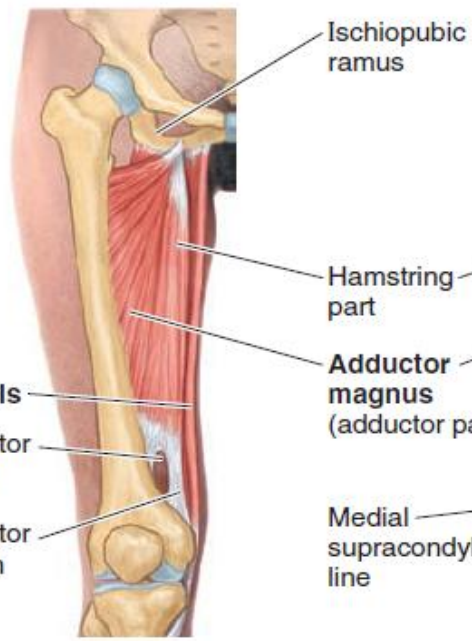
(B) Anterior view



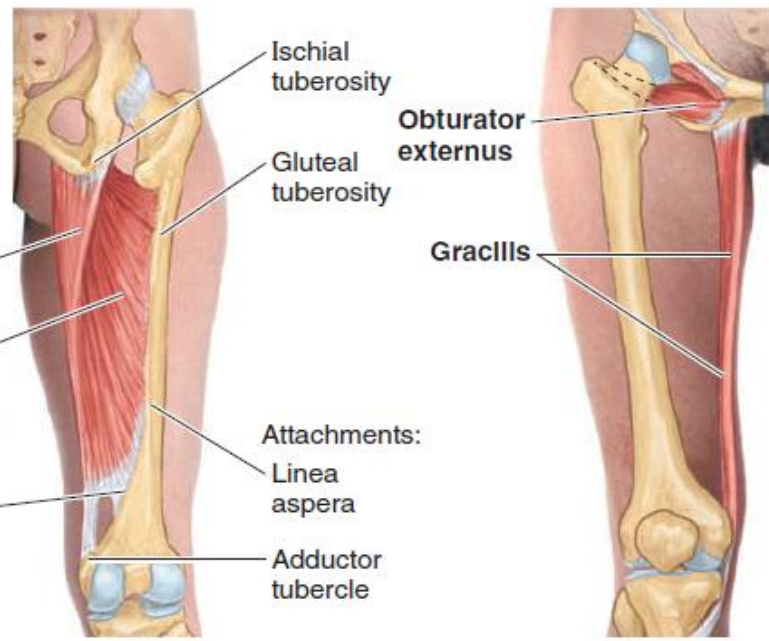
(C) Anterior view



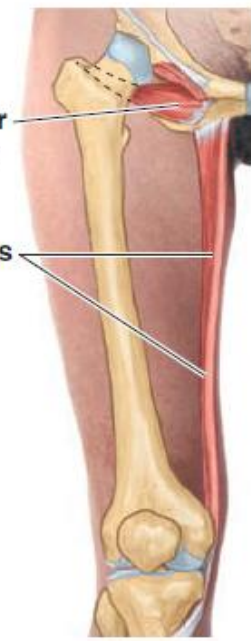
(D) Posterior view



(E) Anterior view



(F) Posterior view



(G) Anterior view

Muscles of thigh

Medial group

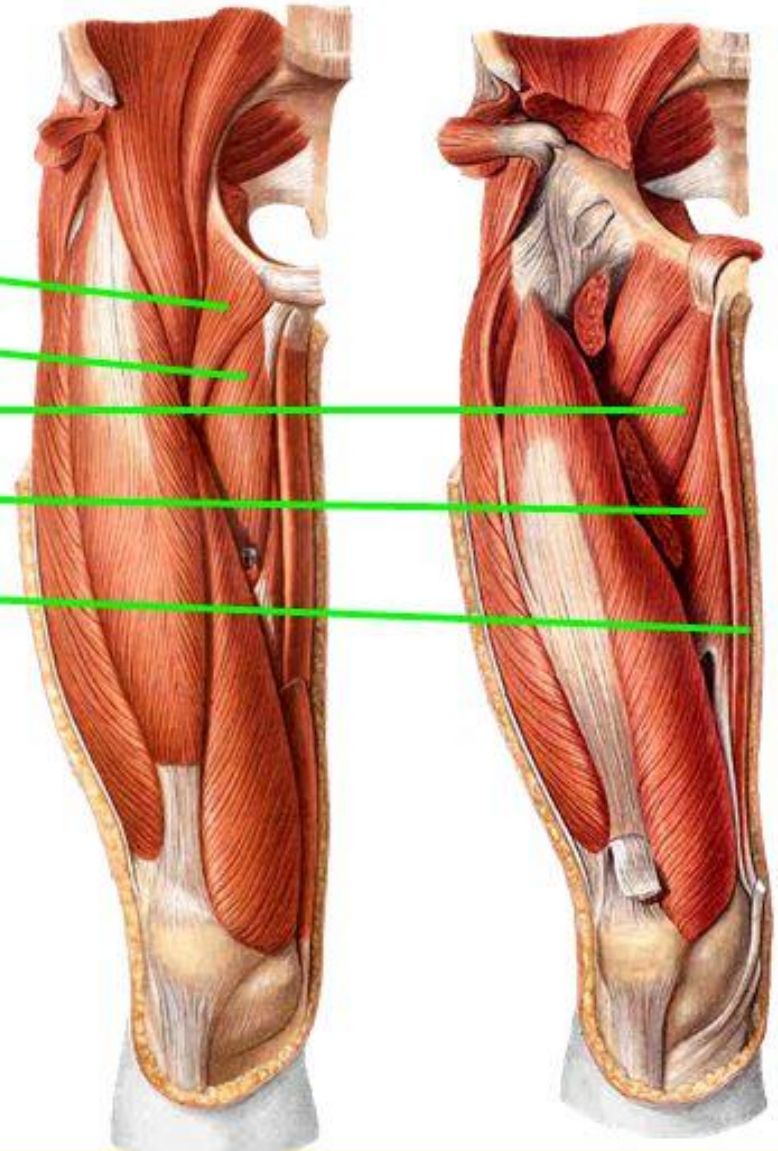
- Pectineus
- Adductor longus
- Adductor brevis
- Adductor magnus
- Gracilis

Action: adduct thigh at hip joint

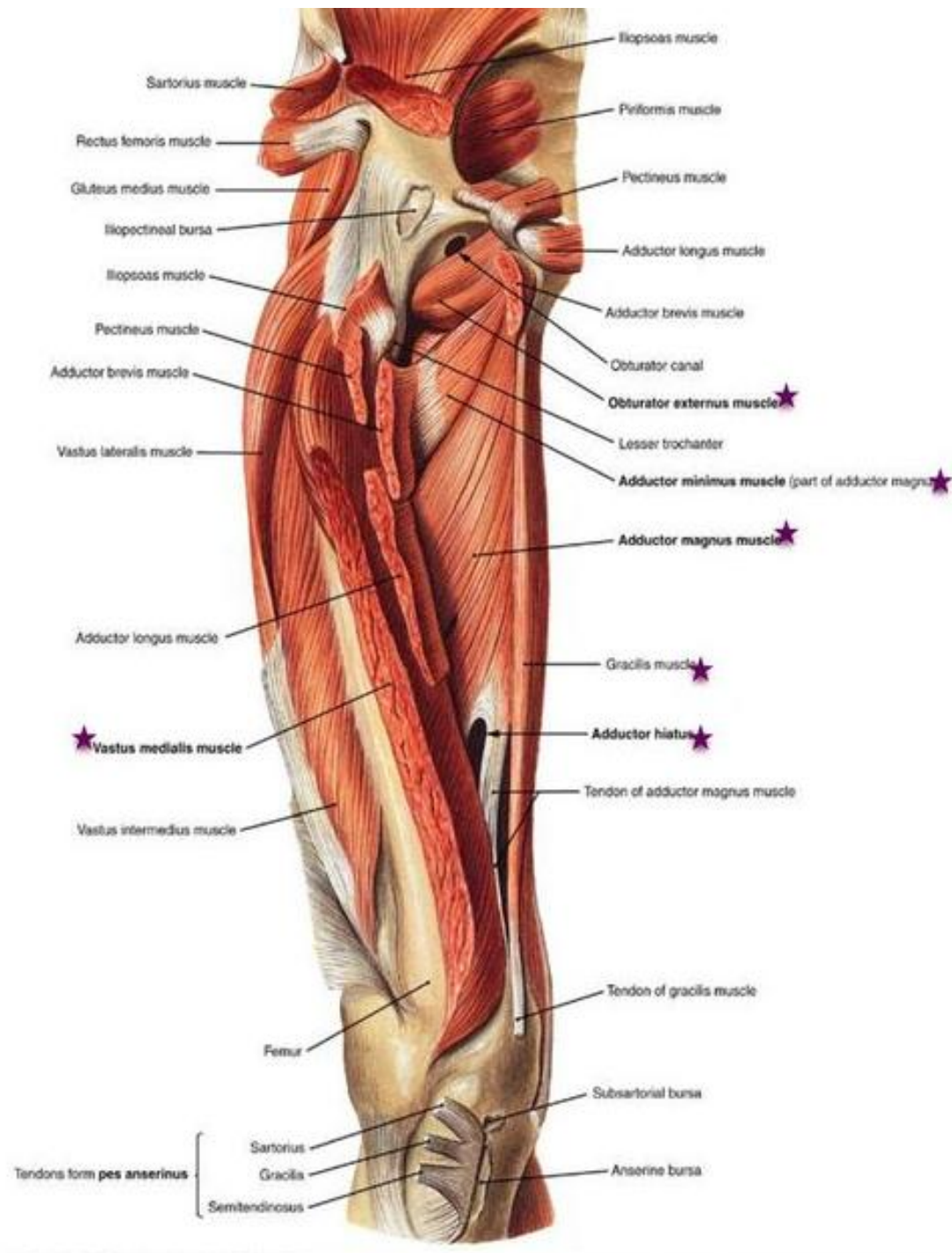
Blood supply:

- Deep femoral a.
- Obturator a.

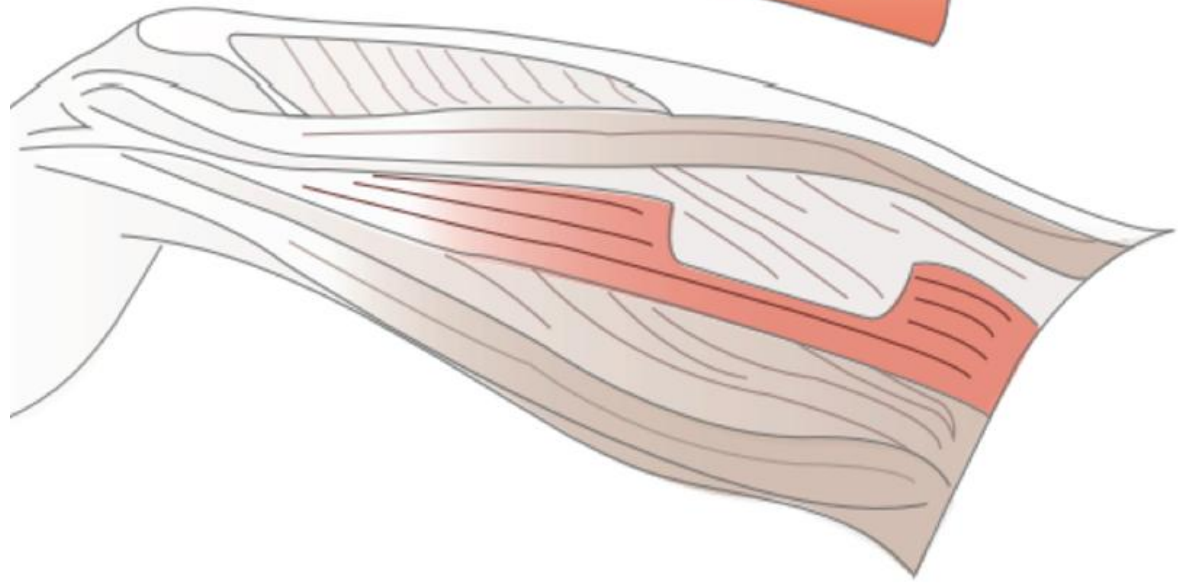
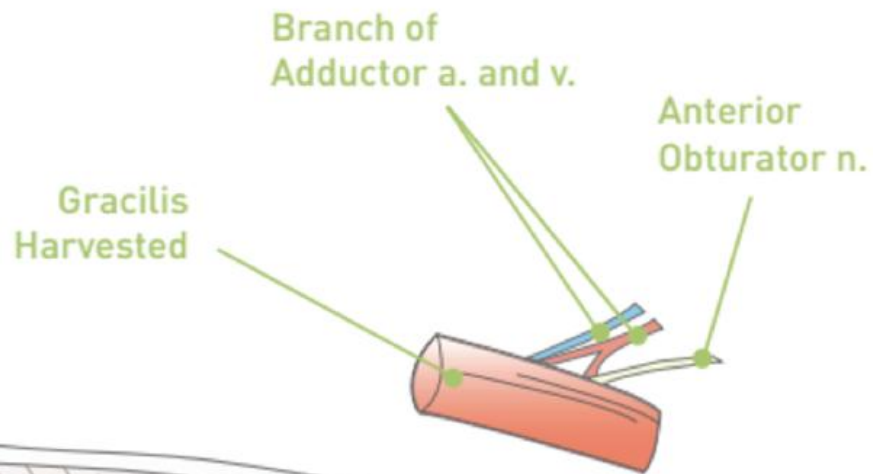
Nerves supply: obturator n.



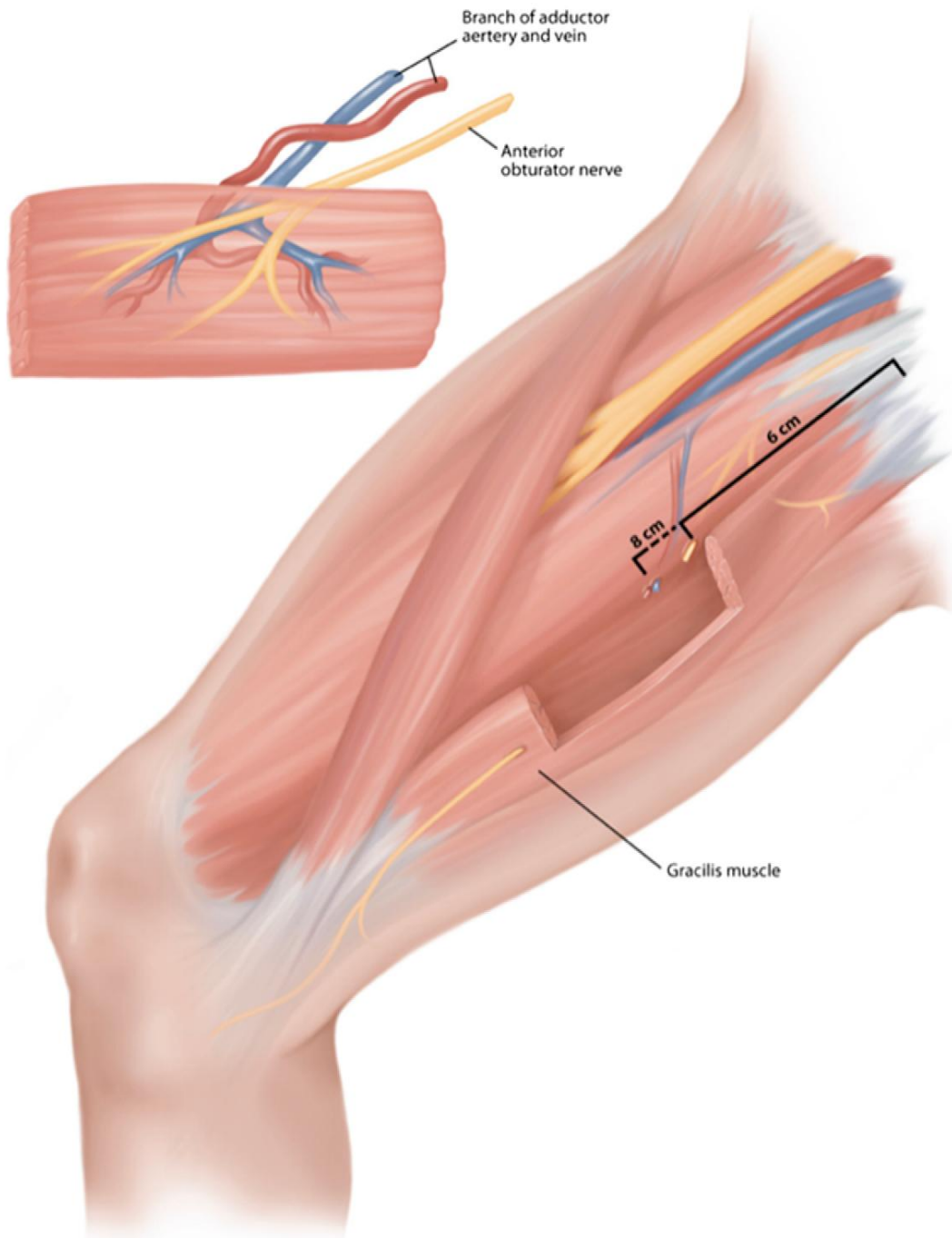
The medial group: adductors of the thigh (deep section)



Transplantation of Gracilis



Because the gracilis is a relatively weak member of the adductor group of muscles, it can be removed without noticeable loss of its actions on the leg.



Surgeons often transplant the gracilis, or part of it, with its nerve and blood vessels to replace a damaged muscle in the forearm or to create a replacement for a nonfunctional external anal sphincter, for example.

Femoral artery



The femoral artery, the chief artery to the lower limb, is the continuation of the external iliac artery distal to the inguinal ligament. The femoral artery enters the femoral triangle deep to the midpoint of the inguinal ligament (midway between the ASIS and the pubic tubercle), lateral to the femoral vein

Femoral Artery



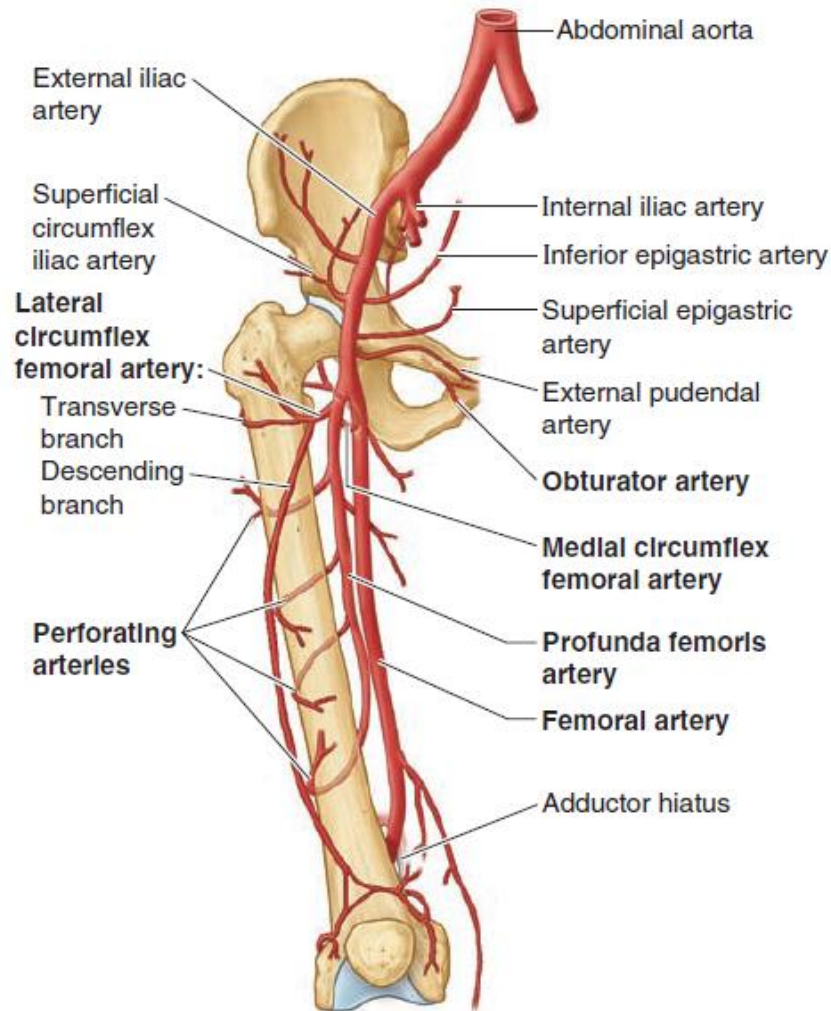
The profunda femoris artery (deep artery of thigh) is the largest branch of the femoral artery and the chief artery to the thigh. It arises from the femoral artery in the femoral triangle. In the middle third of the thigh, it is separated from the femoral artery and vein by the adductor longus. It gives off three or four perforating arteries that wrap around the posterior aspect of the femur and supply the adductor magnus, hamstring, and vastus lateralis muscles.

Femoral Artery

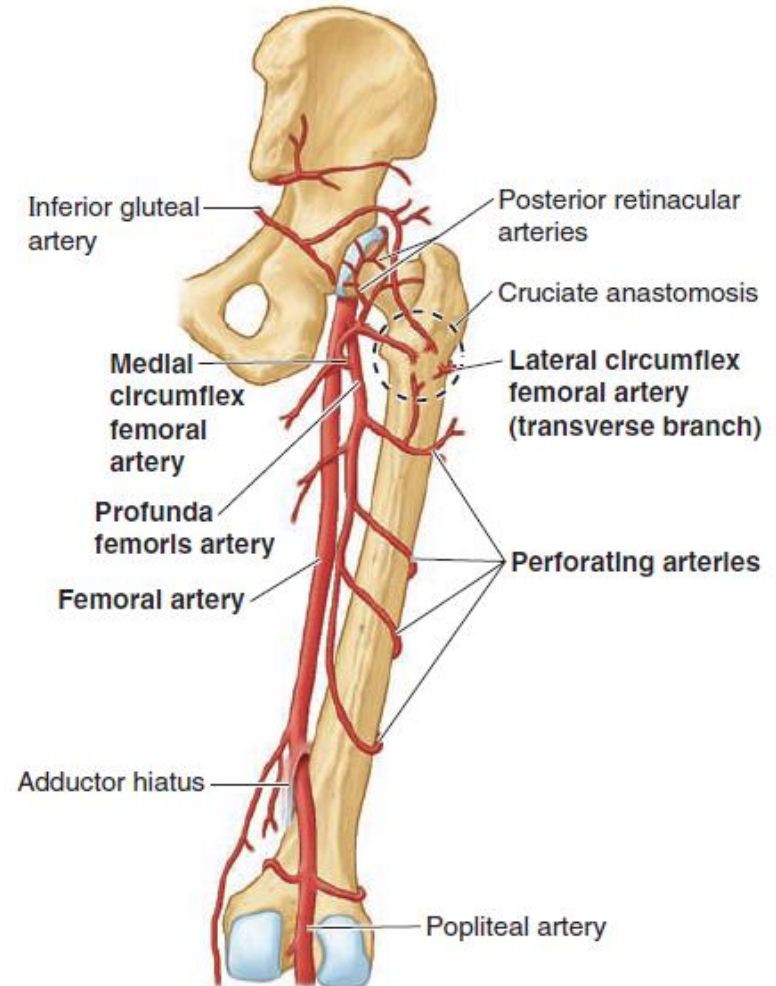


The circumflex femoral arteries are usually branches of the profundus femoris artery, but they may arise from the femoral artery. They encircle the thigh, anastomose with each other and other arteries, and supply the thigh muscles and the proximal end of the femur.

Arteries of anterior and medial thigh

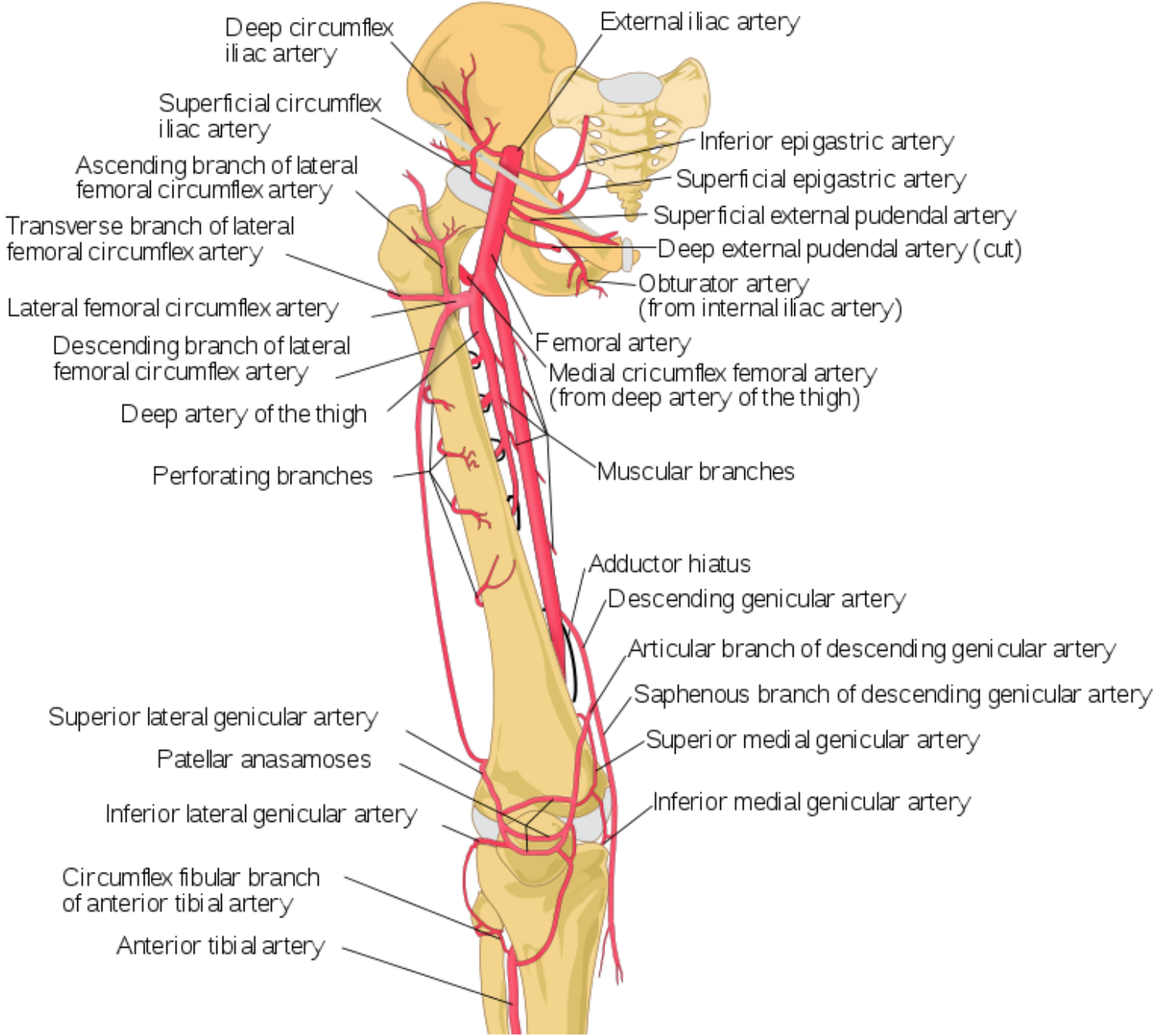


(A) Anterior view



(B) Posterior view

Arteries of anterior and medial thigh



Femoral Artery



The pulse of the femoral artery is usually palpable just inferior to the midpoint of the inguinal ligament.

Normally, the pulse is strong; however, if the common or external iliac arteries are partially occluded, the pulse may be diminished.

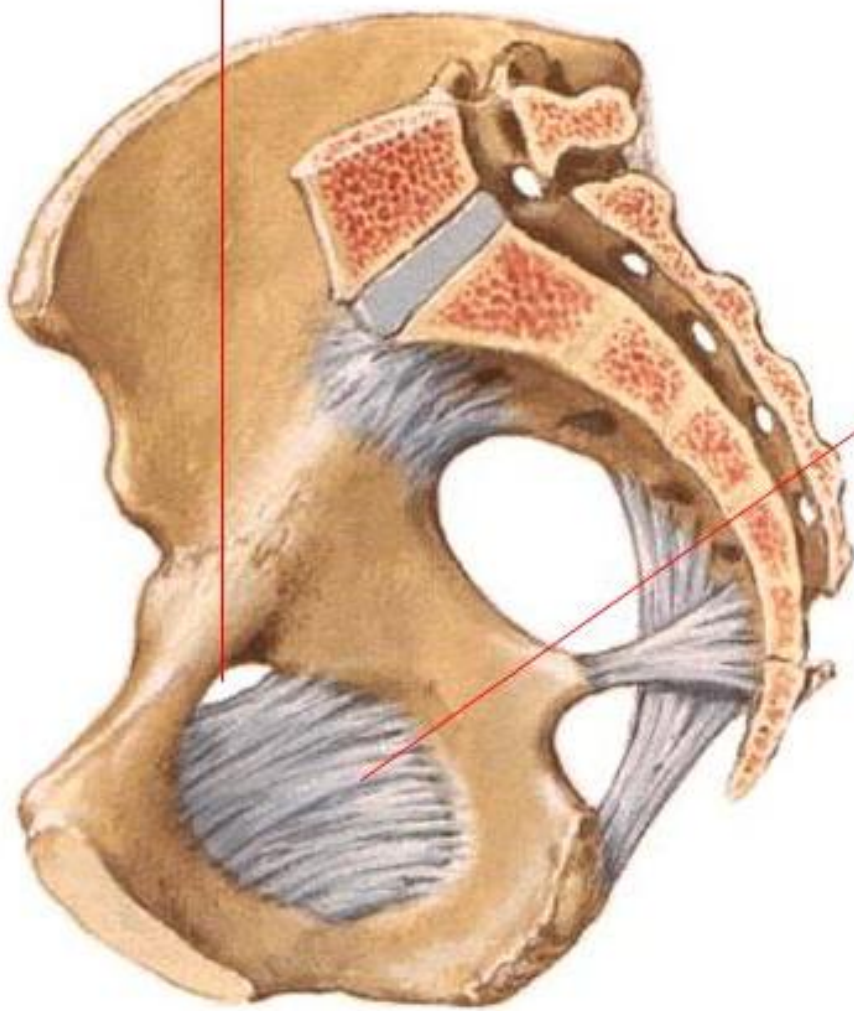
Obturator Artery and Nerve

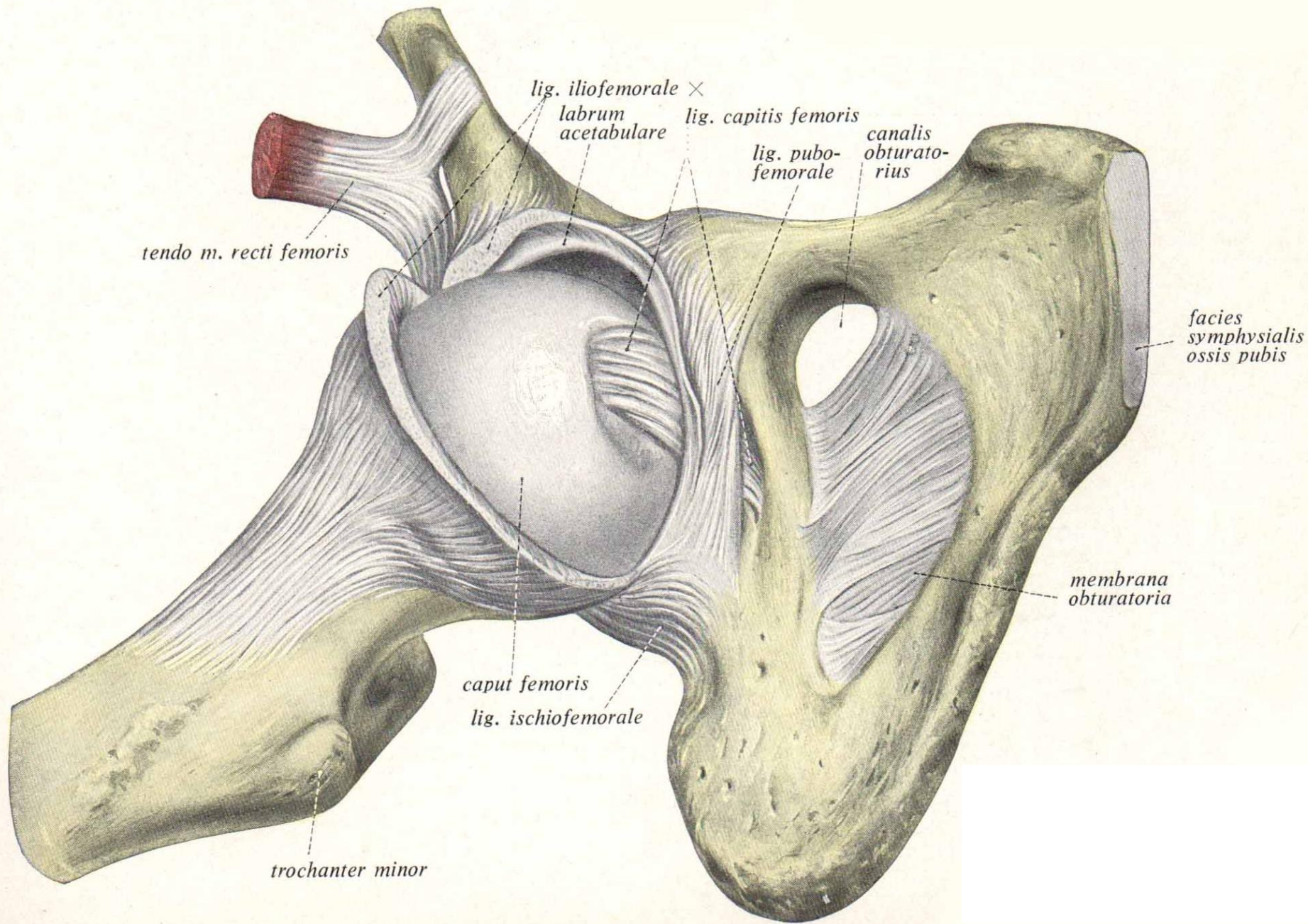


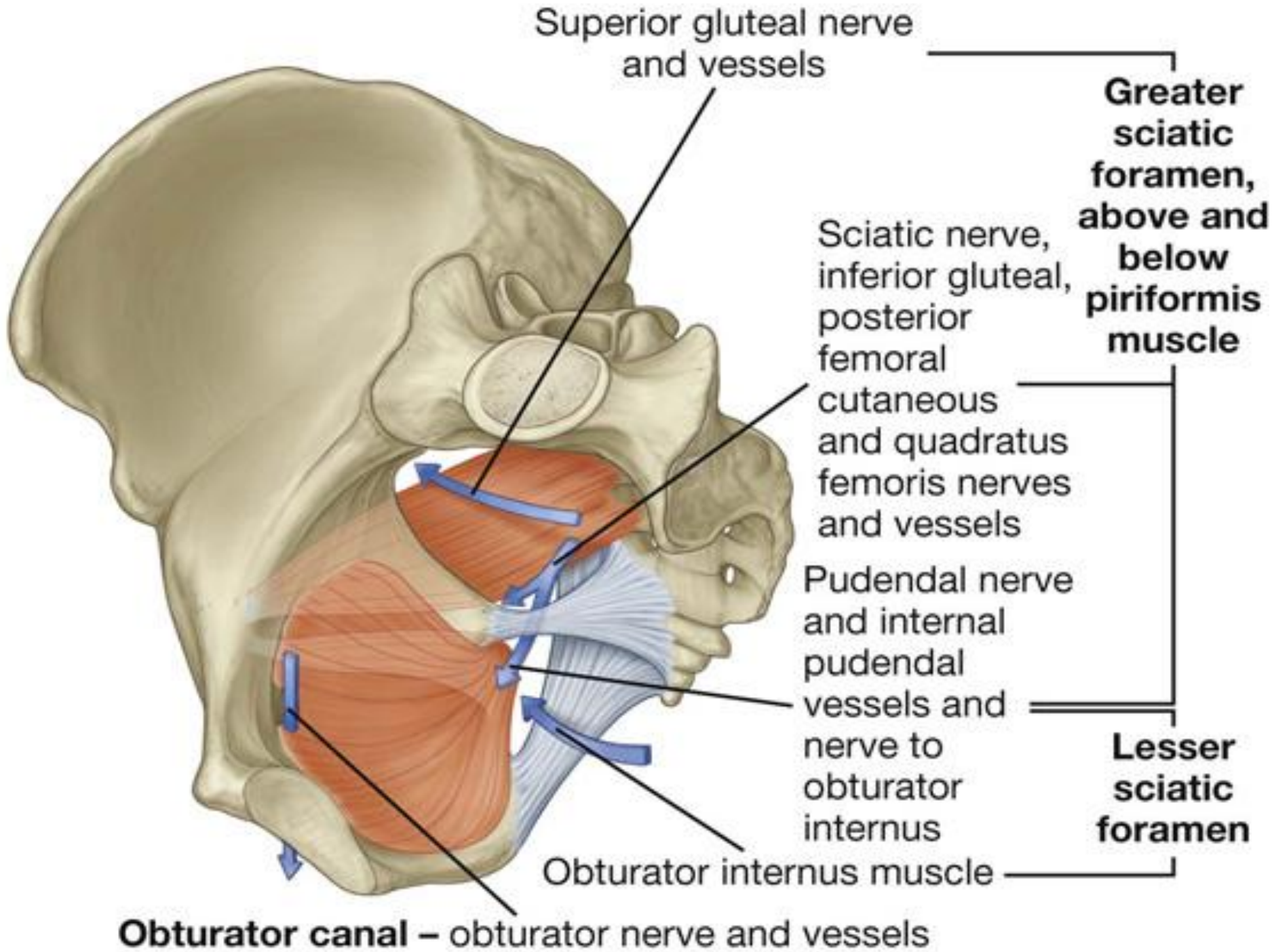
The obturator artery usually arises from the internal iliac artery. The obturator artery passes through the obturator foramen, enters the medial compartment of the thigh, and divides into anterior and posterior branches, which straddle the adductor brevis muscle.

Obturator canal

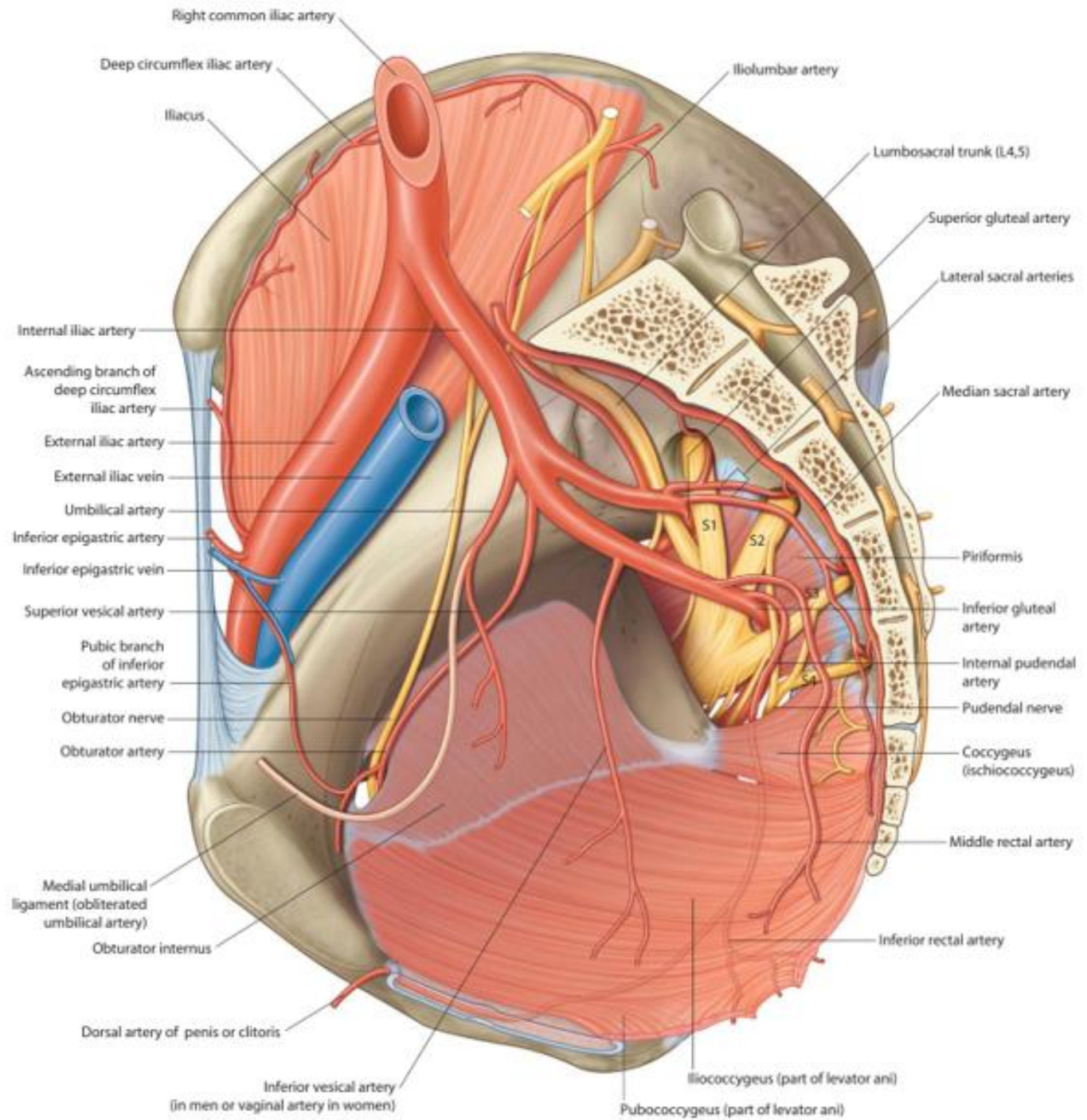
Obturator membrane







Obturator Artery and Nerve



Obturator Artery and Nerve



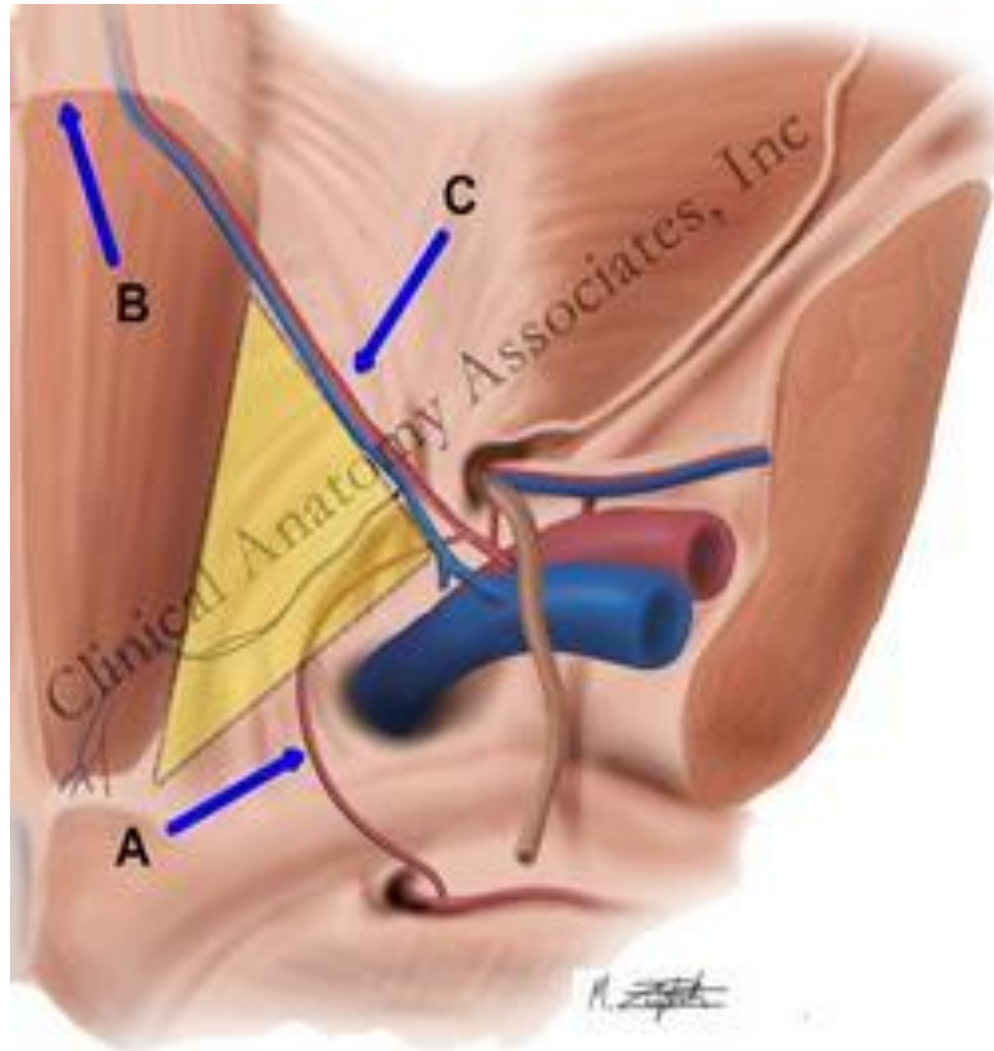
The obturator artery supplies the obturator externus, pectineus, adductors of thigh, and gracilis. Its posterior branch gives off an acetabular branch that supplies the head of the femur.

Obturator Artery and Nerve



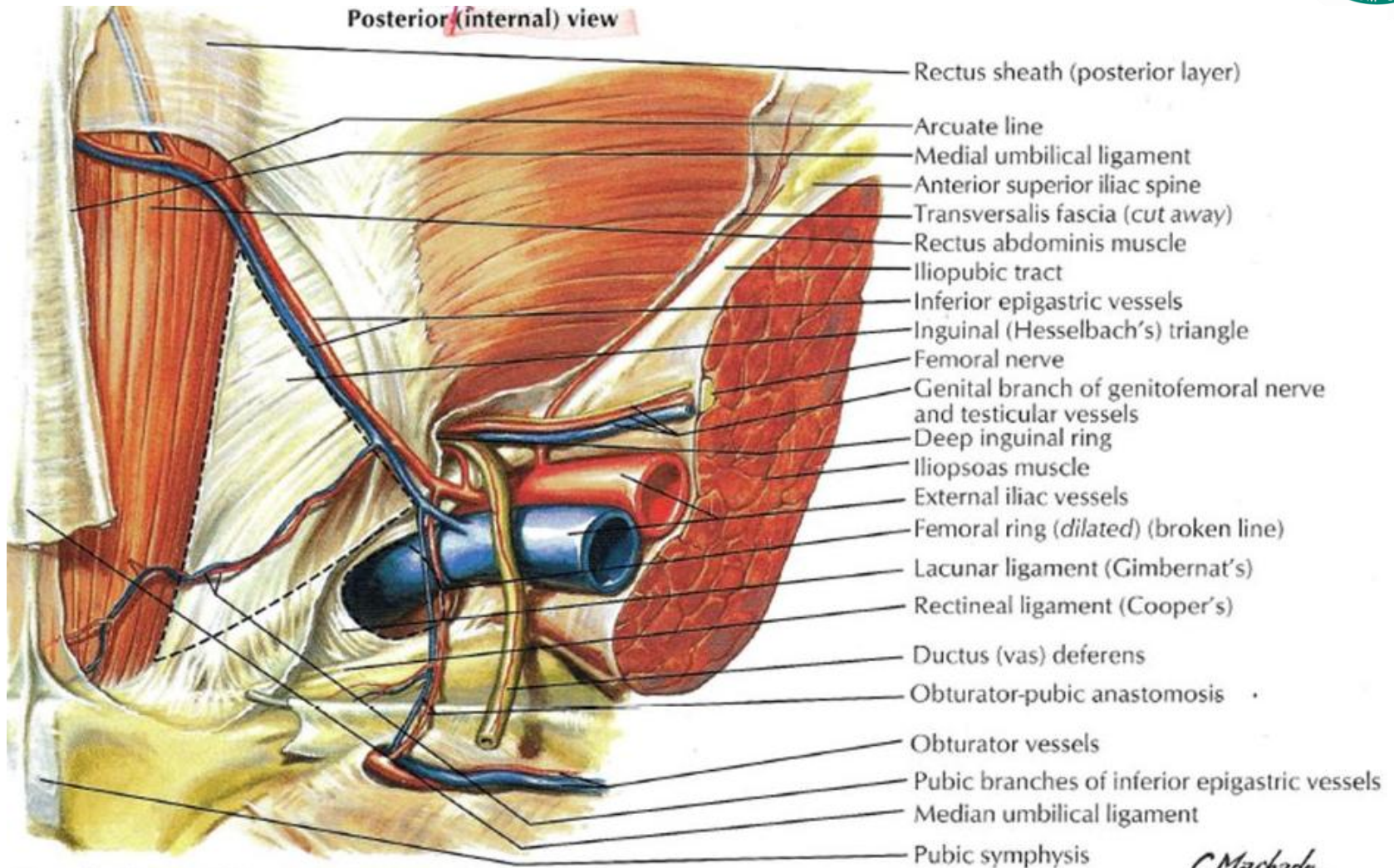
In approximately 20% of people, an enlarged pubic branch of the inferior epigastric artery either takes the place of the obturator artery (replaced obturator artery) or joins it as an accessory obturator artery. These anastomoses can be life-threatening.

Corona Mortis



The corona mortis (blue arrow A) refers to an anatomical variation, a vascular anastomosis between the obturator and the external iliac vascular systems that passes over Cooper's pectineal ligament and posterior to the lacunar (Gimbernath's) ligament.

Corona Mortis



Hesselbach's triangle by Carlos Machado after Frank Netter

C. Machado
M.D.

Corona Mortis



In some cases, the corona mortis is the actual obturator artery that arises from the inferior epigastric artery instead of the internal iliac artery. It can also arise from the external iliac artery. In both cases, it has been called an "aberrant obturator artery". When present, the corona mortis can be injured when a surgeon looks to enlarge the femoral ring by opening the lacunar ligament from the anterior aspect.



Corona Mortis

In this approach the "corona mortis" is not visible, as it is found immediately posterior to the lacunar ligament. This vascular structure could even be endangered in a laparoscopic procedure for inguinal or femoral hernia repair and a staple or tack is driven blindly into the pectineal (Cooper's) ligament. Although called a corona, this anatomical structure is an incomplete circle.

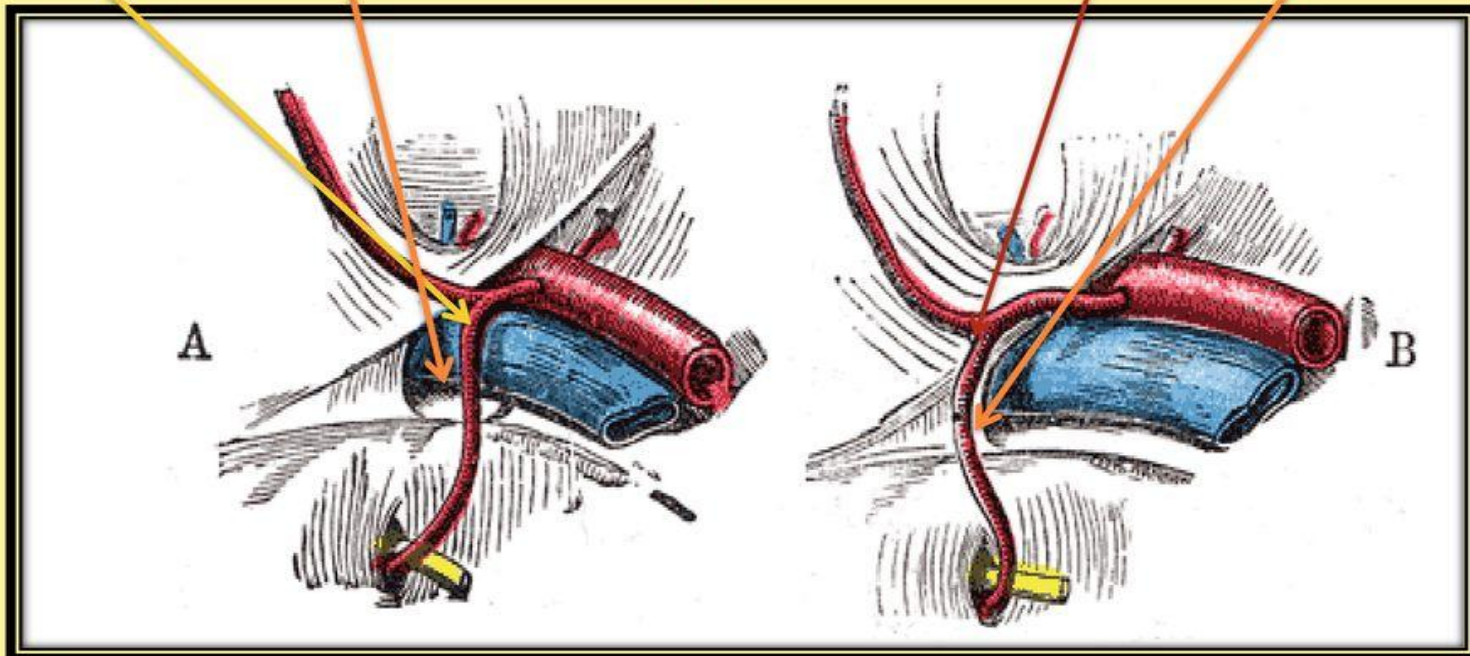
Corona Mortis



Occasionally the obturator artery is entirely replaced by this branch from the inferior epigastric—the *abnormal obturator artery*;

This aberrant vessel usually passes laterally to the femoral canal and is out of harm's way

rarely, it passes behind Gimbernat's ligament and it is then in surgical danger.



Obturator Artery and Nerve



The obturator nerve (L2–L4) descends along the medial border of the psoas muscle and enters the thigh through the obturator foramen with the obturator artery and vein. It divides into anterior and posterior branches, which, like the vessels, straddle the adductor brevis. The anterior branch supplies the adductor longus, adductor brevis, gracilis, and pectineus; the posterior branch supplies the obturator externus and adductor magnus.

Posterior thigh muscles (hamstrings)



The hamstring muscles, or simply the hamstrings, are a group of three long muscles located in the posterior compartment of the thigh, shaping up the surface anatomy of this region. These muscles are the biceps femoris, semimembranosus and semitendinosus muscles.

Posterior thigh muscles (hamstrings)

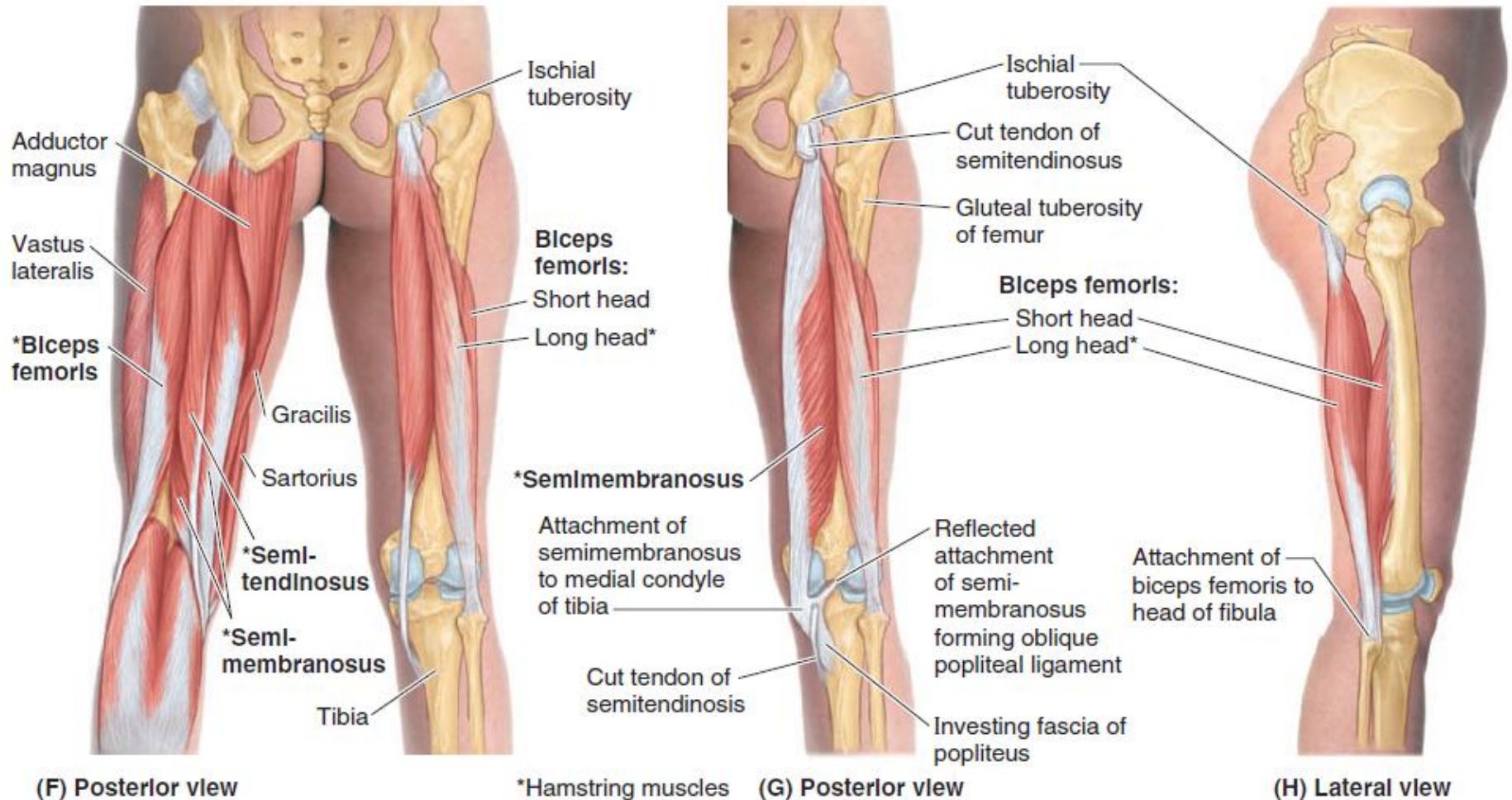


Posterior thigh muscles (hamstrings)

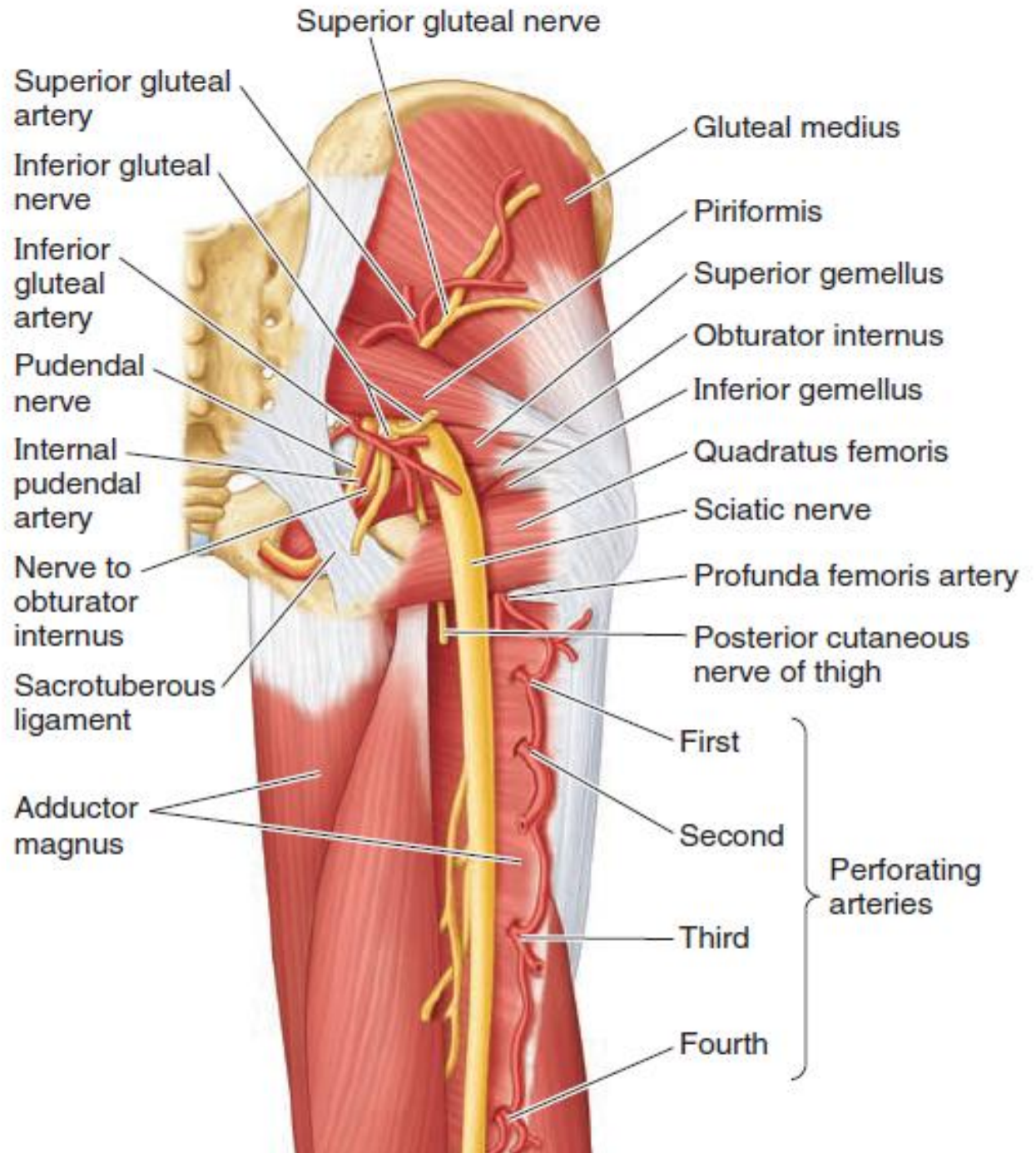


The hamstrings are closely related to each other as they share a common origin point (ischial tuberosity), and they all attach to the proximal parts of the **tibia and fibula**. They are innervated by the tibial and common fibular (peroneal) divisions of the sciatic nerve (L4-S3).

Posterior thigh muscles (hamstrings)

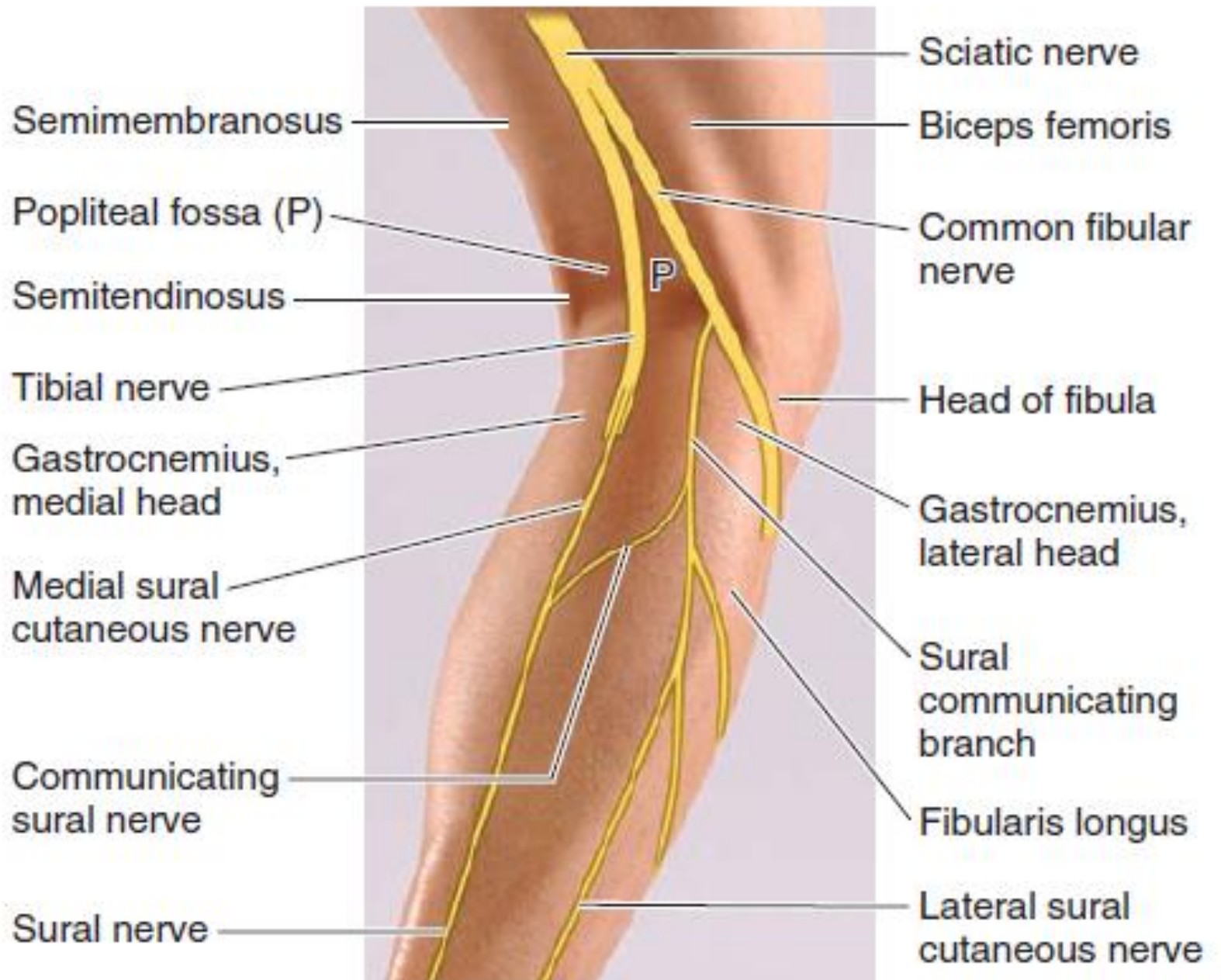


Course of arteries and nerves in gluteal region and posterior thigh

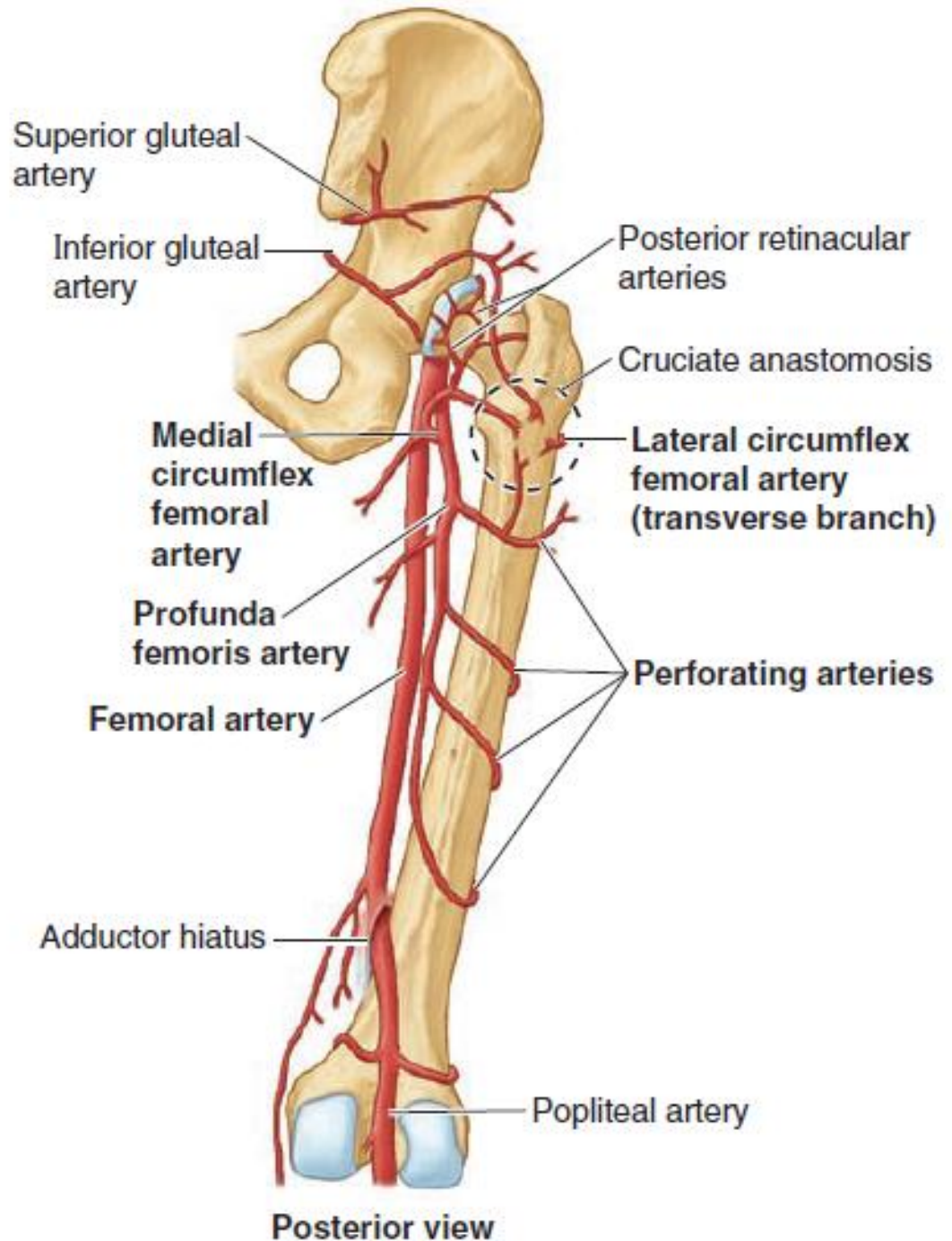


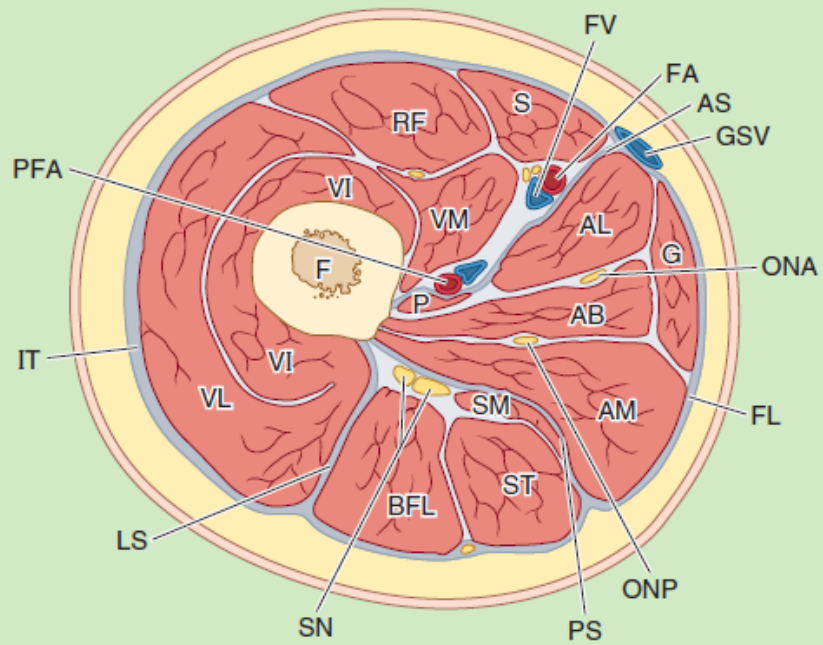
The sciatic nerve usually ends at the superior angle of the popliteal fossa by dividing into the tibial and common fibular nerves



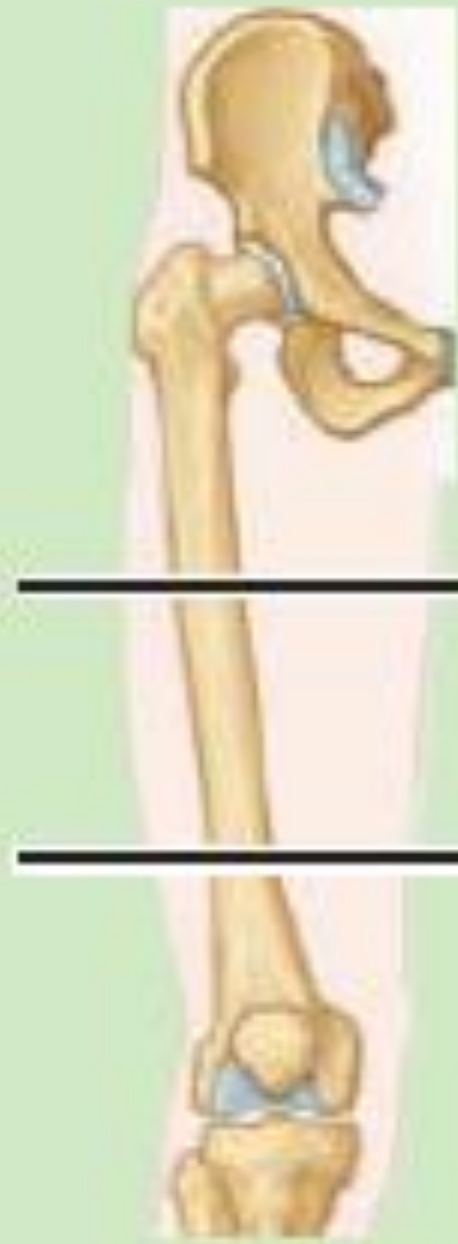
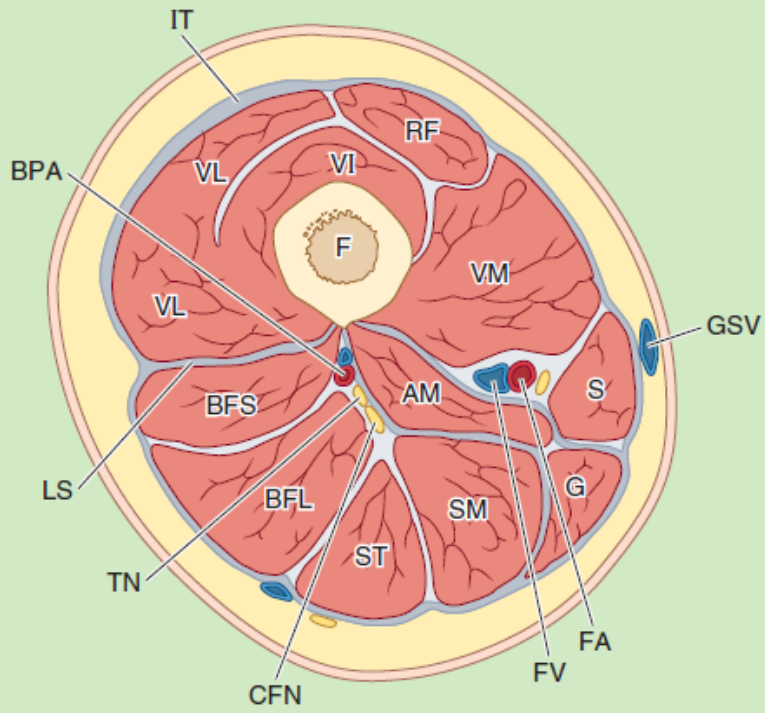


Arteries of gluteal and posterior thigh regions



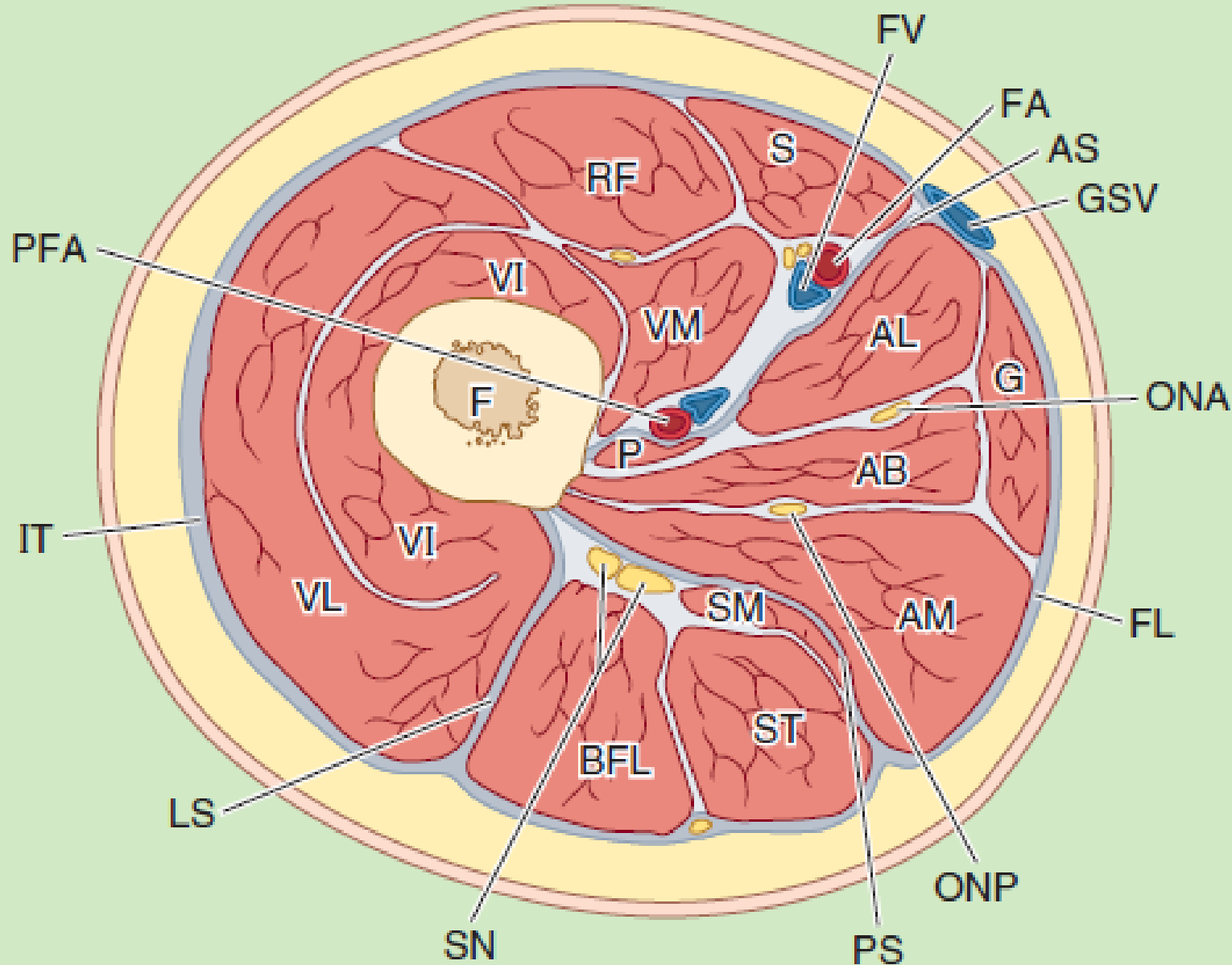


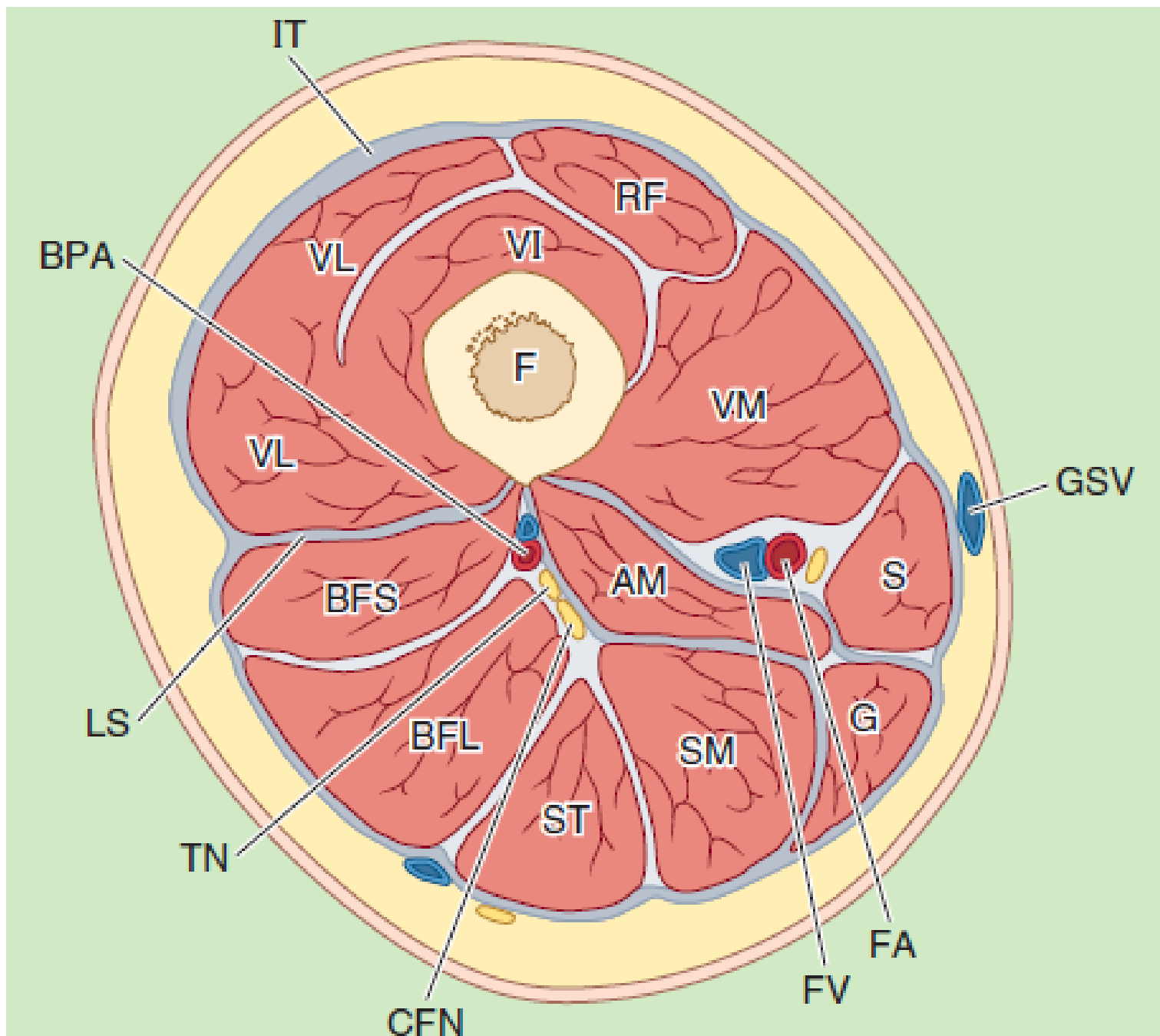
(A)



A

B





Transverse sections (A and B) of thigh, inferior views: labels to previous slides



Key

AB	Adductor brevis	FA	Femoral artery	PS	Posteromedial intermuscular septum
AL	Adductor longus	FL	Fascia lata	RF	Rectus femoris
AM	Adductor magnus	FV	Femoral vein	S	Sartorius
AS	Anteromedial intermuscular septum	G	Gracilis	SM	Semimembranosus
BFL	Long head of biceps femoris	GSV	Great saphenous vein	SN	Sciatic nerve
BFS	Short head of biceps femoris	IT	Iliotibial tract	ST	Semitendinosus
BPA	Branch of profunda femoris artery	LS	Lateral intermuscular septum	TN	Tibial nerve
CFN	Common fibular nerve	ONA	Anterior branch of obturator nerve	VI	Vastus intermedius
F	Femur	ONP	Posterior branch of obturator nerve	VL	Vastus lateralis
		PFA	Profunda femoris artery	VM	Vastus medialis

Knee region



This region includes:

- the prominences (or condyles) of the distal femur and proximal tibia
- the head of the fibula
- the patella (knee cap, which lies anterior to the distal end of the femur)
- joints between the above bony structures

Knee Joint



The knee is primarily a hinge type of synovial joint, allowing flexion and extension; however, the hinge movements are combined with gliding and rolling and with rotation about a vertical axis. The articular surfaces of the knee joint are characterized by their large size and incongruent shapesю



Knee Joint

The knee joint consists of three articulations:

- Two femorotibial articulations (lateral and medial) between the lateral and the medial femoral and tibial condyles
- One intermediate femoropatellar articulation between the patella and the femur

The fibula is not involved in the knee joint.



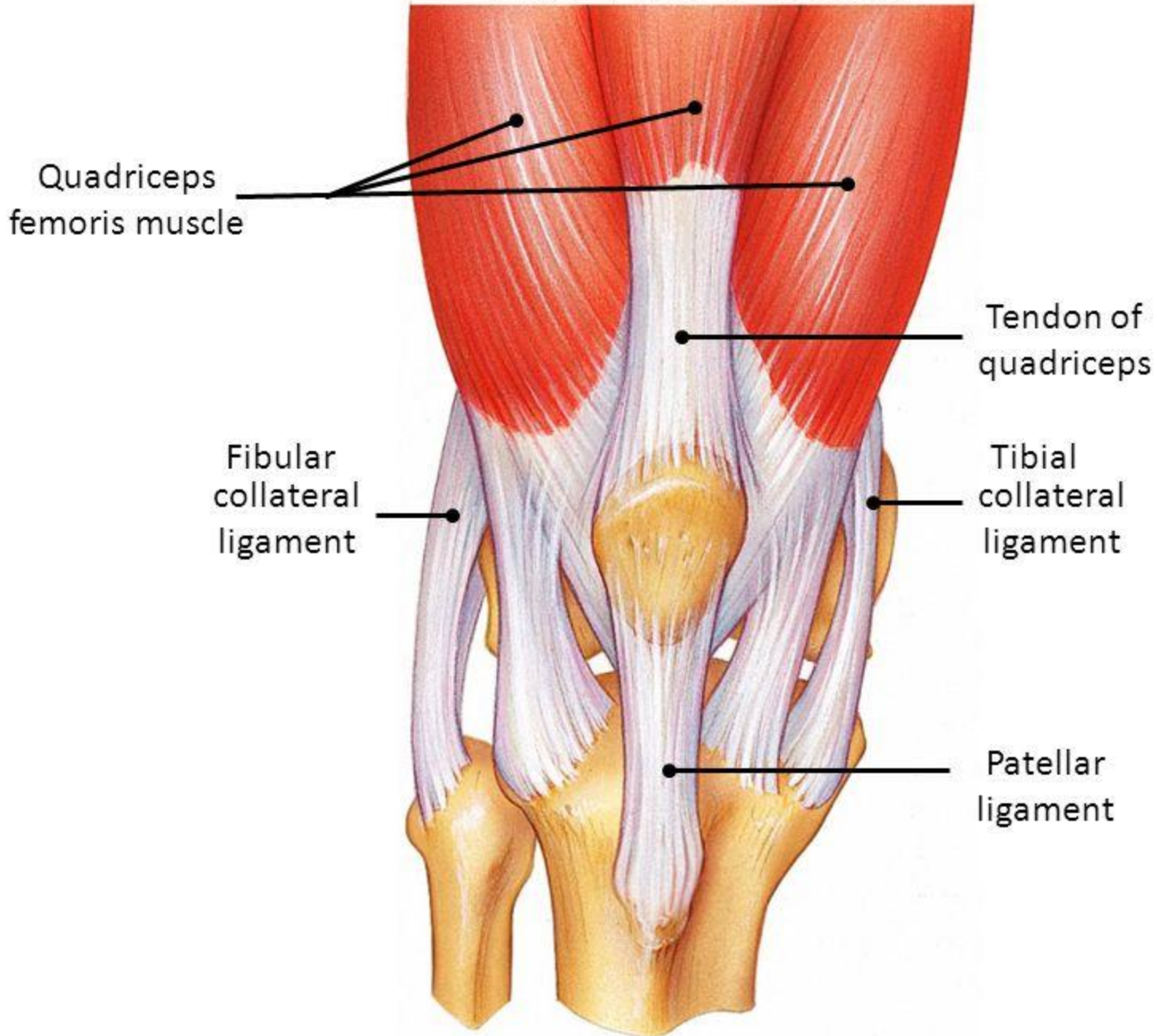
Knee Joint

The stability of the knee joint depends on the:

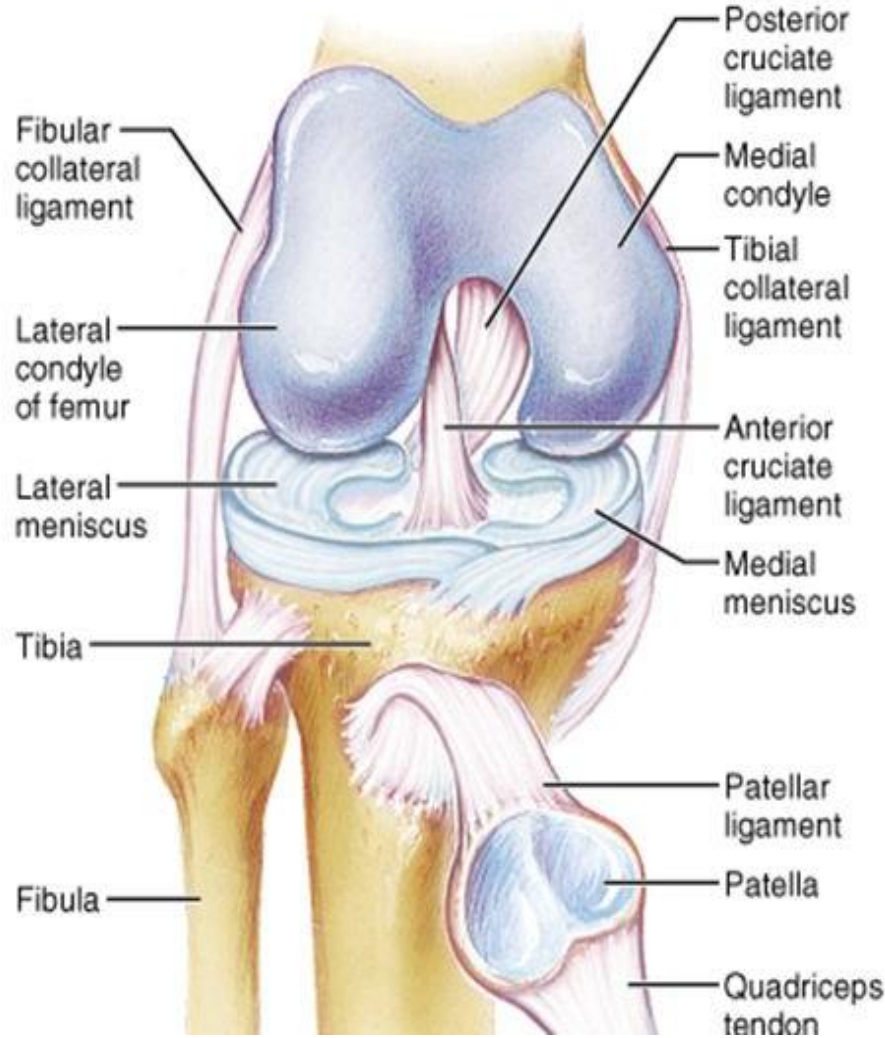
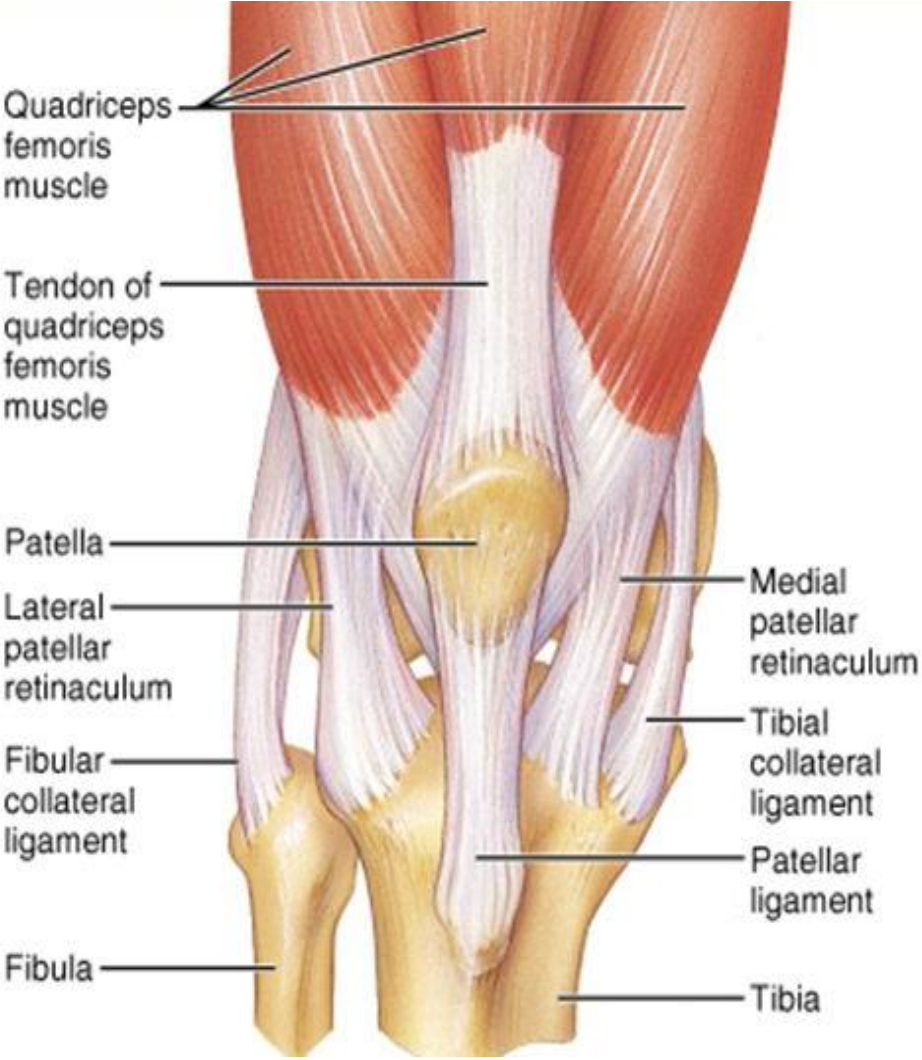
- Strength and actions of surrounding muscles and their tendons
- Ligaments connecting the femur and tibia

Of these supports, the muscles are most important; therefore, many sport injuries are preventable through appropriate conditioning and training. The most important muscle in stabilizing the knee joint is the large quadriceps femoris

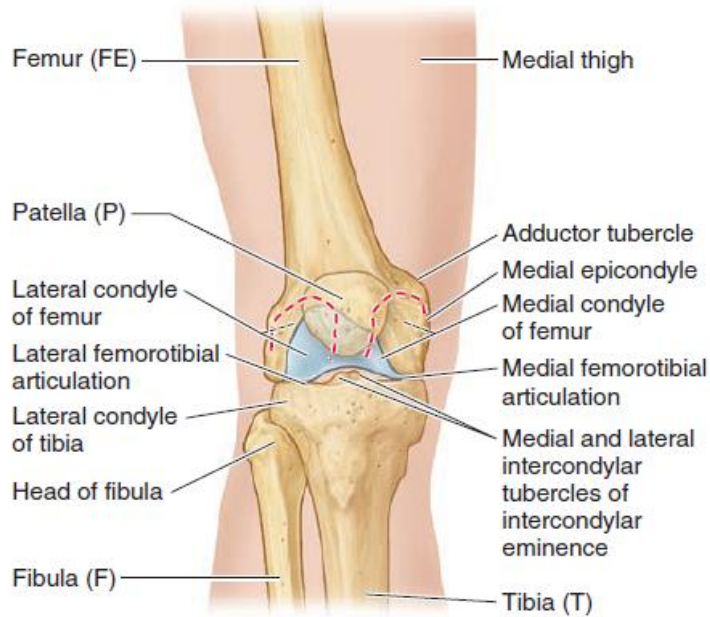
The Knee Joint



Knee Joint

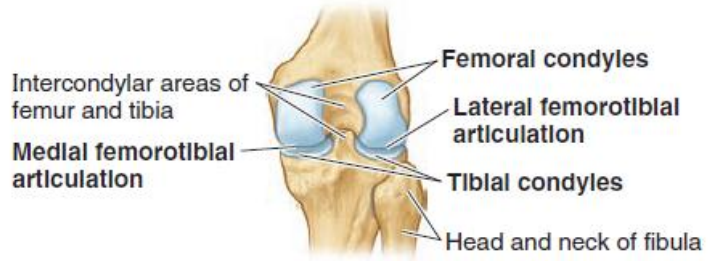


Knee Joint

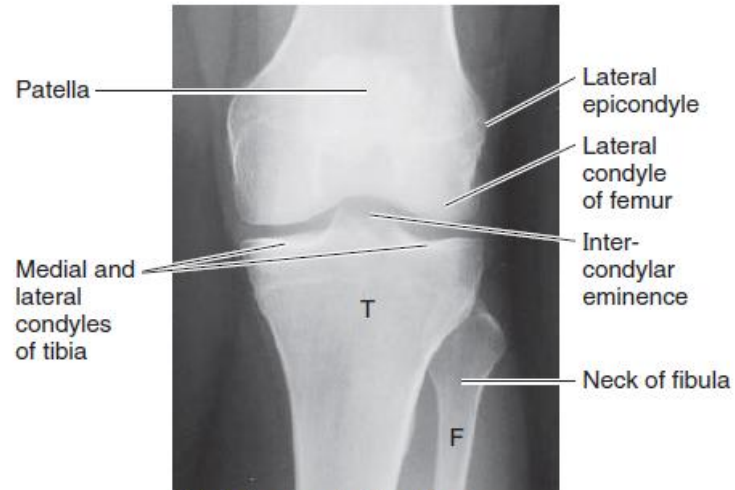


(A) Anterior view

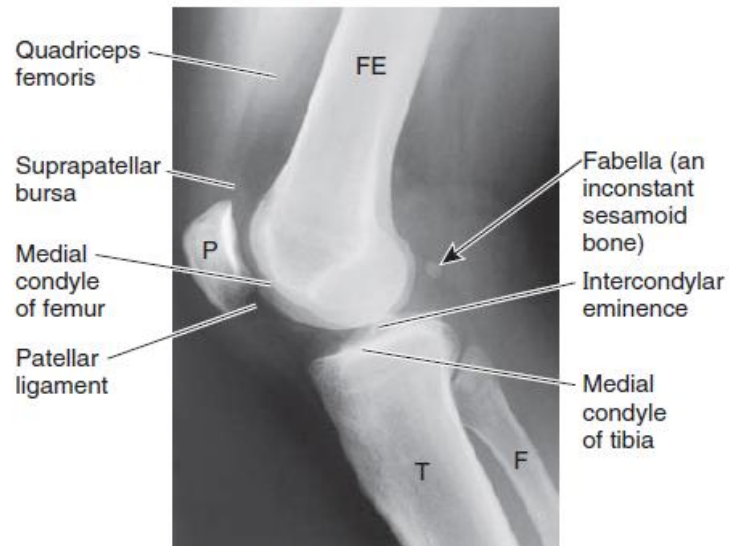
--- Posterior aspect of condyles



(C) Posterior view

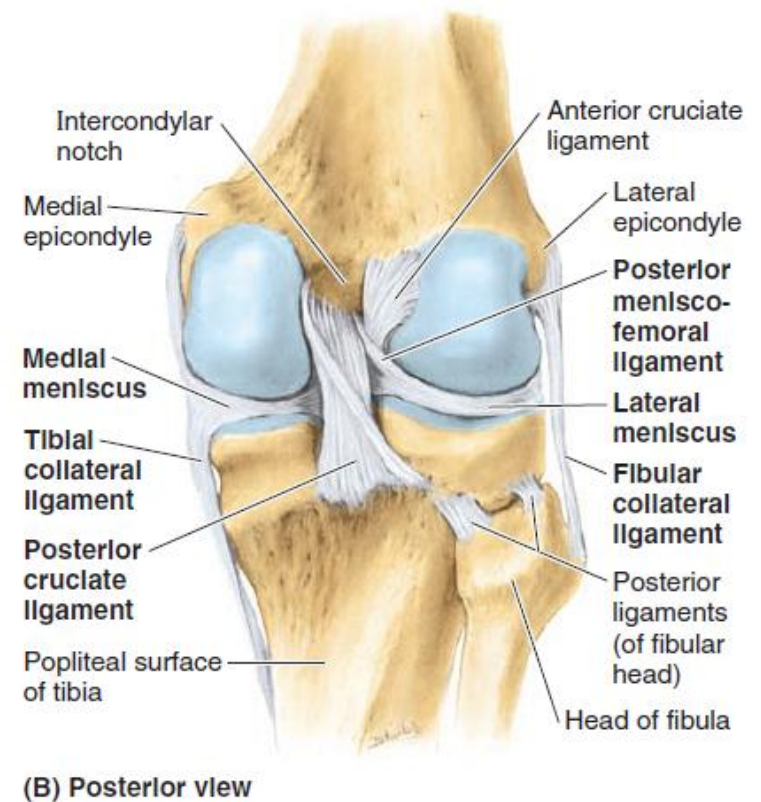
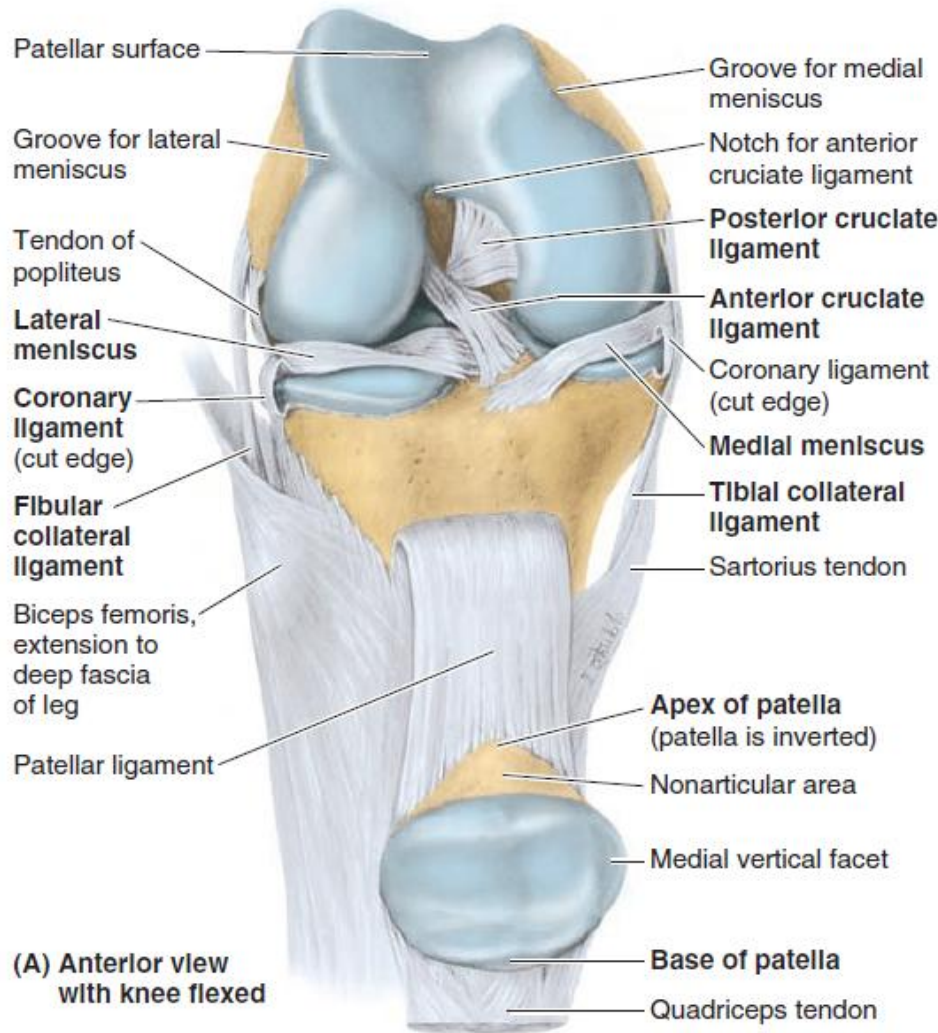


(B) Anteroposterior view



(D) Lateral view

Relations and ligaments of knee joint



Knee Joint



The joint capsule is strengthened by four capsular (intrinsic) ligaments, the patellar, tibial collateral, oblique popliteal, and arcuate popliteal ligaments and one extracapsular ligament, the fibular collateral ligament. The cruciate ligaments (L. crux, cross) join the femur and tibia, crisscrossing within the joint capsule but outside the articular cavity

Knee Joint



The anterior cruciate ligament (ACL), the weaker of the two cruciate ligaments, arises from the anterior intercondylar area of the tibia, just posterior to the attachment of the medial meniscus. It extends superiorly, posteriorly, and laterally to attach to the posterior part of the medial side of the lateral condyle of the femur. The ACL limits posterior rolling of the femoral condyles on the tibial plateau during flexion, converting it to spin.

Knee Joint



The posterior cruciate ligament (PCL), the stronger of the two cruciate ligaments, arises from the posterior intercondylar area of the tibia. The PCL passes superiorly and anteriorly on the medial side of the ACL to attach to the anterior part of the lateral surface of the medial condyle of the femur. The PCL limits anterior rolling of the femur on the tibial plateau during extension, converting it to spin.

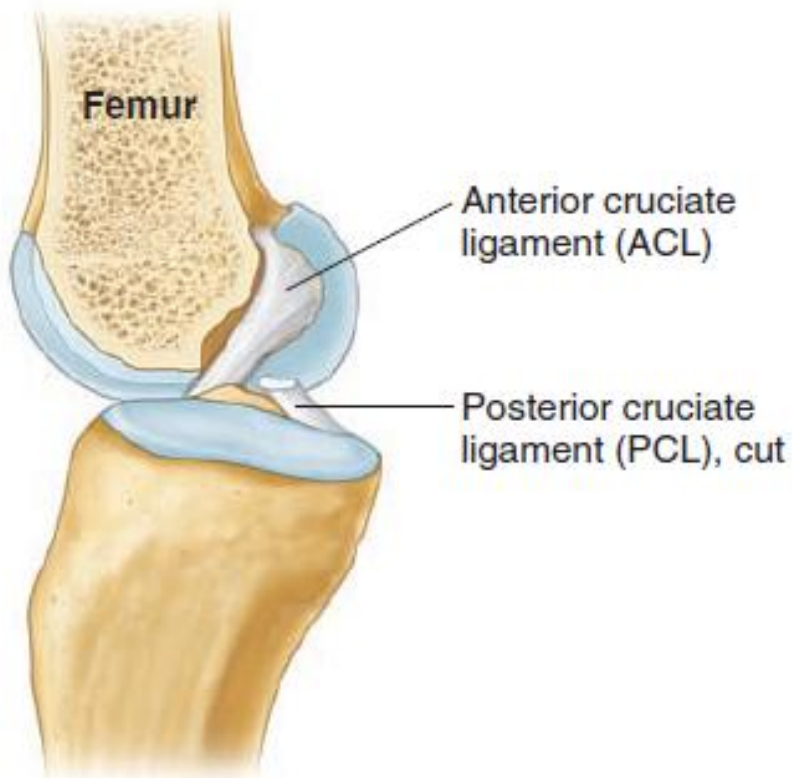


Knee Joint

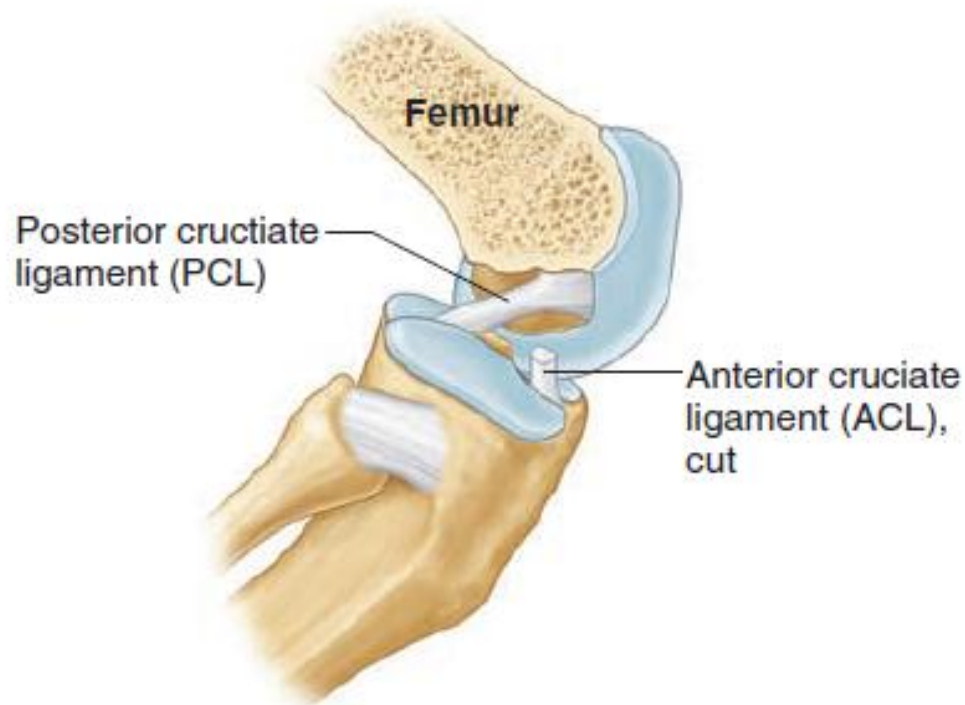
The ACL also prevents posterior displacement of the femur on the tibia and hyperextension of the knee joint.

The PCL also prevents anterior displacement of the femur on the tibia or posterior displacement of the tibia on the femur and helps prevent hyperflexion of the knee joint. In the weightbearing flexed knee, the PCL is the main stabilizing factor for the femur (e.g., when walking downhill)

Knee Joint



(A) Medial view



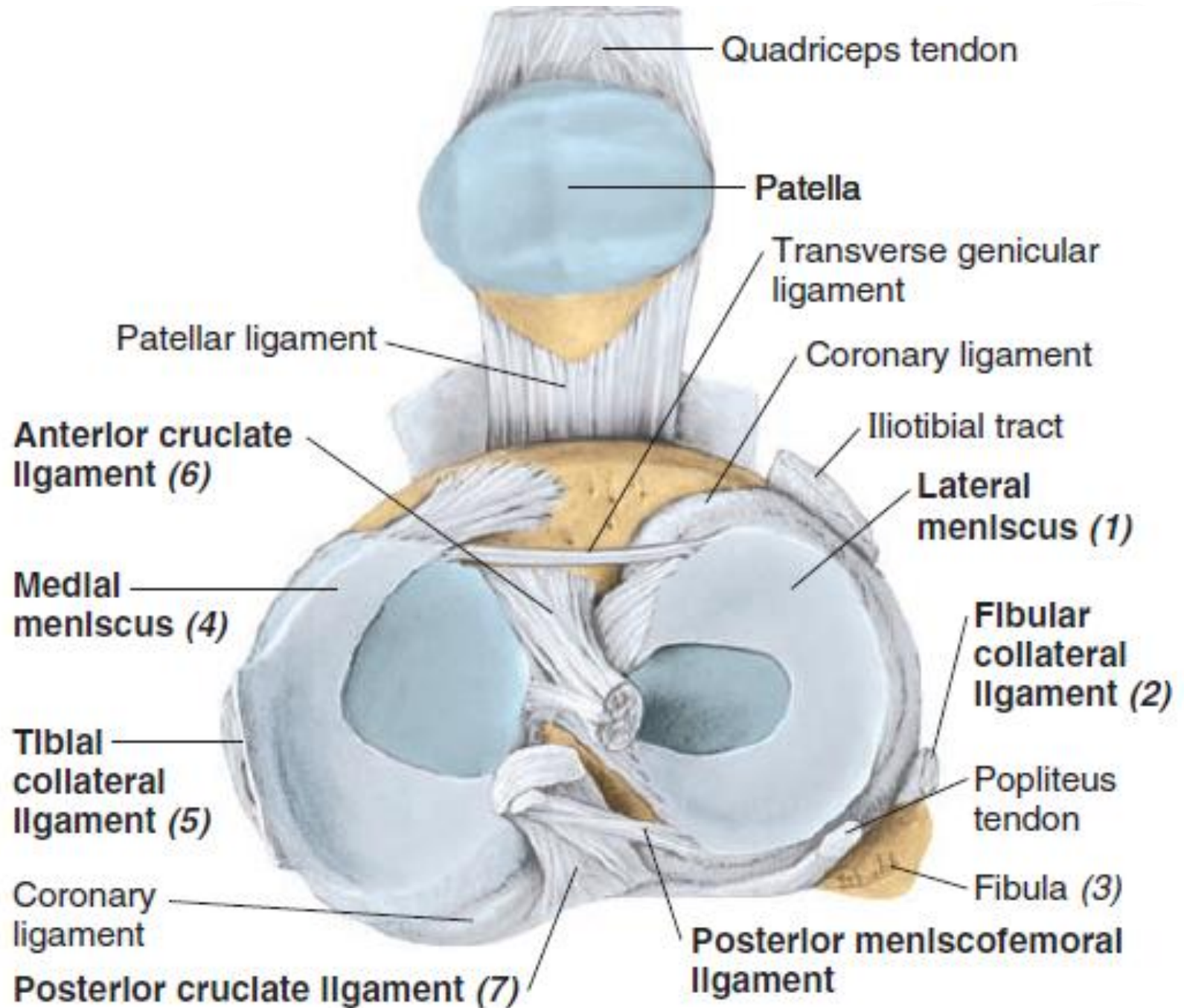
(B) Lateral view

Knee Joint



The menisci of the knee joint are crescentic plates of fibrocartilage on the articular surface of the tibia that deepen the surface and play a role in shock absorption. The menisci are thicker at their external margins and taper to thin, unattached edges in the interior of the joint. Wedge-shaped in transverse section, the menisci are firmly attached at their ends to the intercondylar area of the tibia. Their external margins attach to the fibrous layer of the capsule of the knee joint.

Knee Joint



Knee Joint



The medial meniscus is C-shaped and broader posteriorly than anteriorly. Its anterior end (horn) attaches to the anterior intercondylar area of the tibia, anterior to the attachment of the ACL. Its posterior end attaches to the posterior intercondylar area, anterior to the attachment of the PCL. The medial meniscus firmly adheres to the deep surface of the tibial collateral ligament.

Knee Joint



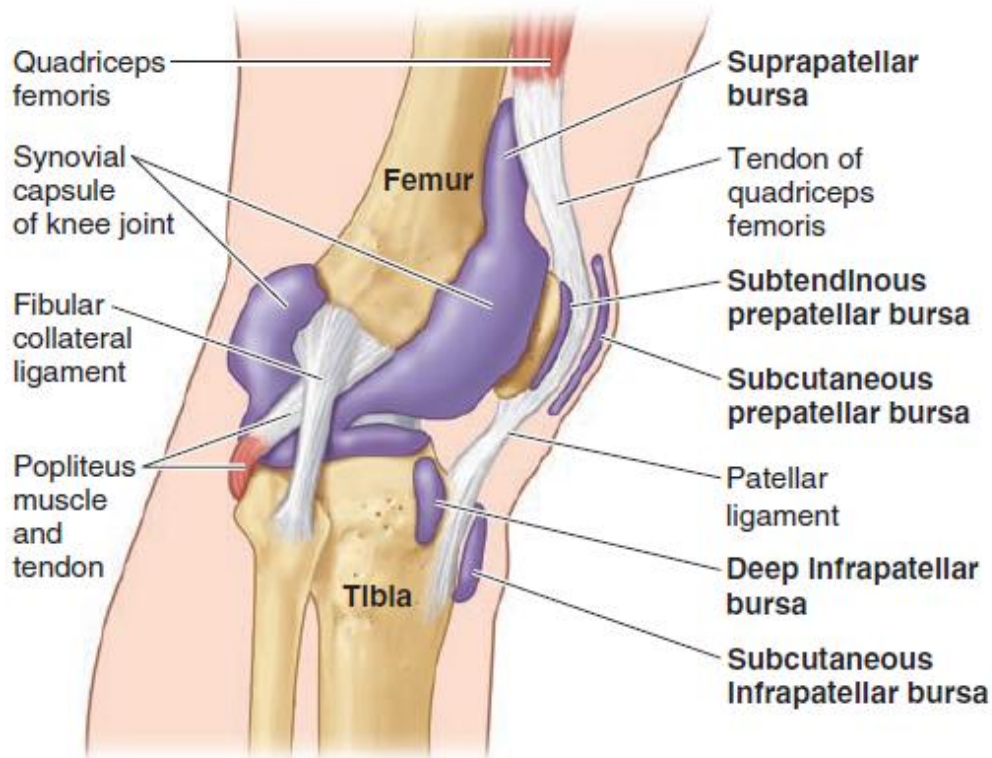
The lateral meniscus is nearly circular and is smaller and more freely movable than the medial meniscus. The tendon of the popliteus separates the lateral meniscus from the fibular collateral ligament. A strong tendinous slip, the posterior menisiofemoral ligament, joins the lateral meniscus to the PCL and the medial femoral condyle.

Bursae around knee

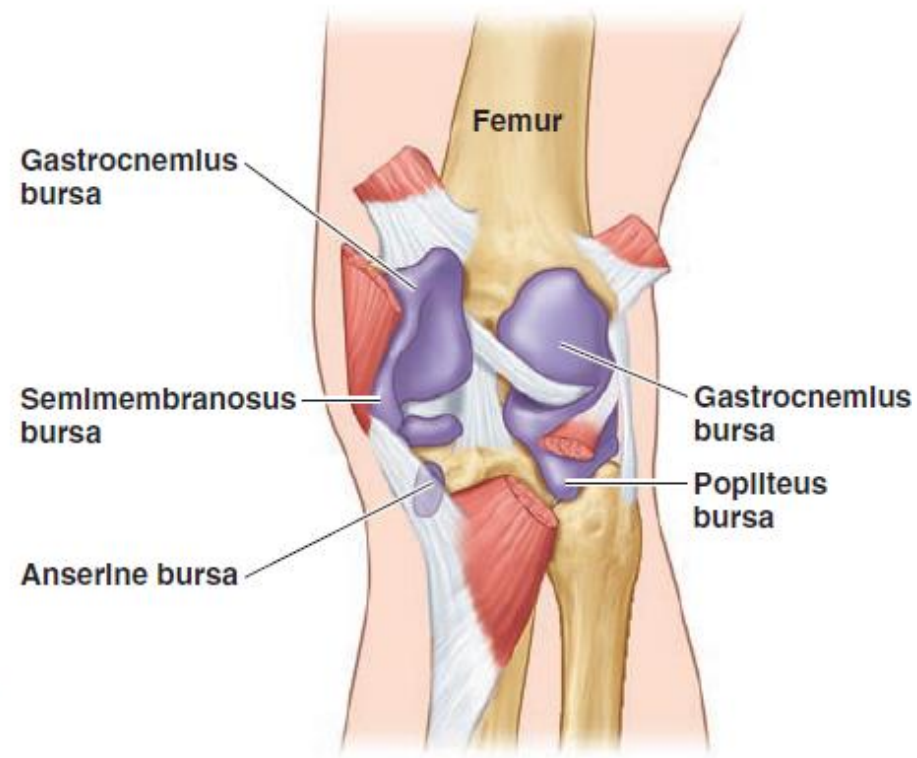


There are at least 12 bursae around the knee joint because most tendons run parallel to the bones and pull lengthwise across the joint during knee movements. The subcutaneous prepatellar and infrapatellar bursae are located at the convex surface of the joint, allowing the skin to be able to move freely during knee movements. Four bursae communicate with the articular cavity of the knee joint: suprapatellar bursa (deep to the distal quadriceps), popliteus bursa, anserine bursa, and gastrocnemius bursa.

Bursae around knee



(A) Lateral view



(B) Posterior view

Knee joint injuries



Knee joint injuries are common because the knee is a low-placed, mobile, weight-bearing joint and its stability depends almost entirely on its associated ligaments and muscles. The most common knee injuries in contact sports are ligament sprains, which occur when the foot is fixed on the ground. If a force is applied against the knee when the foot cannot move, ligament injuries are likely to occur.

Knee joint injuries



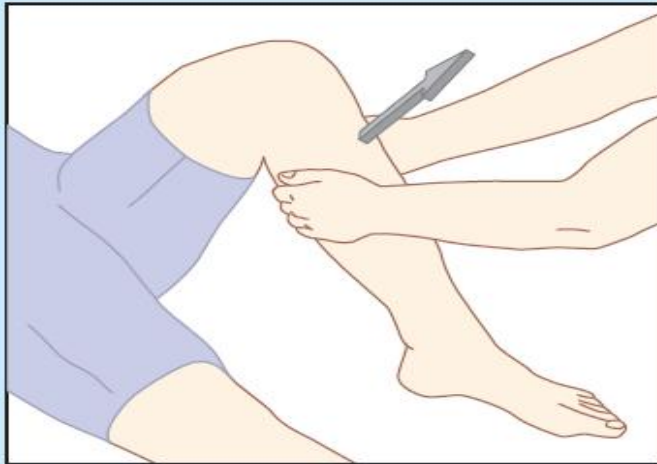
The MCL and LCL are tightly stretched when the leg is extended, preventing disruption of the sides of the joint. The firm attachment of the MCL to the medial meniscus is of clinical significance because tearing of this ligament frequently results in concomitant tearing of the medial meniscus. The injury is frequently caused by a blow to the lateral side of the extended knee or excessive lateral twisting of the flexed knee.

Knee joint injuries



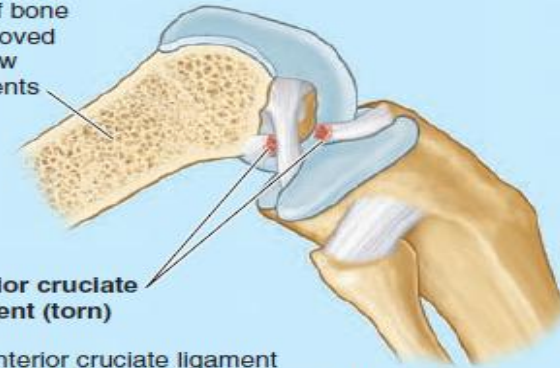
The ACL, which serves as a pivot for rotatory movements of the knee, is taut during flexion and may also tear subsequent to the rupture of the MCL. ACL rupture, one of the most common knee injuries in skiing accidents, for example, causes the free tibia to slide anteriorly under the femur, a sign known as the anterior drawer sign

Knee joint injuries



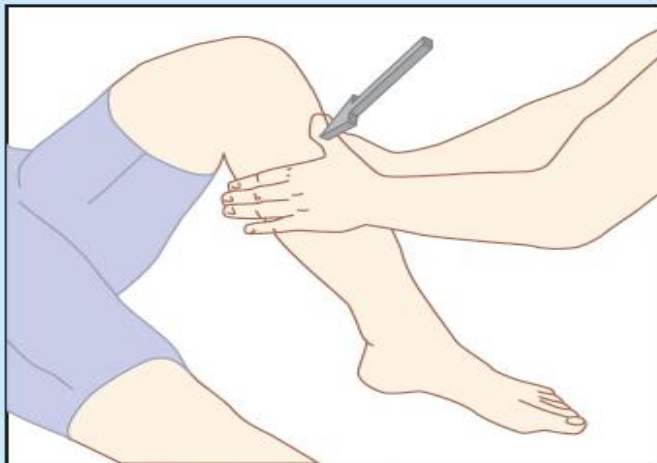
(B) Anterior drawer sign (ACL)

Half of bone is removed to show ligaments



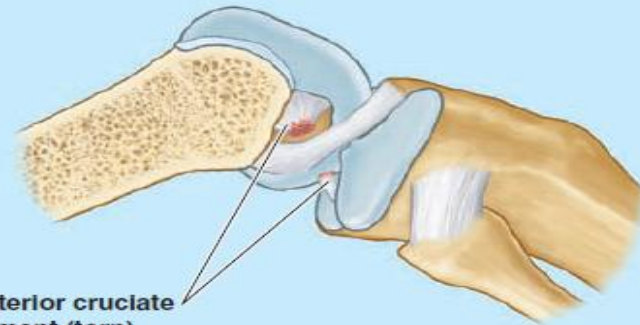
Anterior cruciate ligament (torn)

The anterior cruciate ligament prevents the femur from sliding posteriorly on the tibia and hyperextension of the knee and limits medial rotation of the femur when the foot is on the ground, and the leg is flexed.



(C) Posterior drawer sign (PCL)

Posterior cruciate ligament (torn)



The posterior cruciate ligament prevents the femur from sliding anteriorly on the tibia, particularly when the knee is flexed.



Knee joint injuries

Although strong, PCL rupture may occur when a person lands on the tibial tuberosity when the knee is flexed. PCL ruptures usually occur in conjunction with tibial or fibular ligament tears. The posterior drawer sign, in which the free tibia slides posteriorly under the fixed femur, occurs as a result of PCL rupture.

Knee region



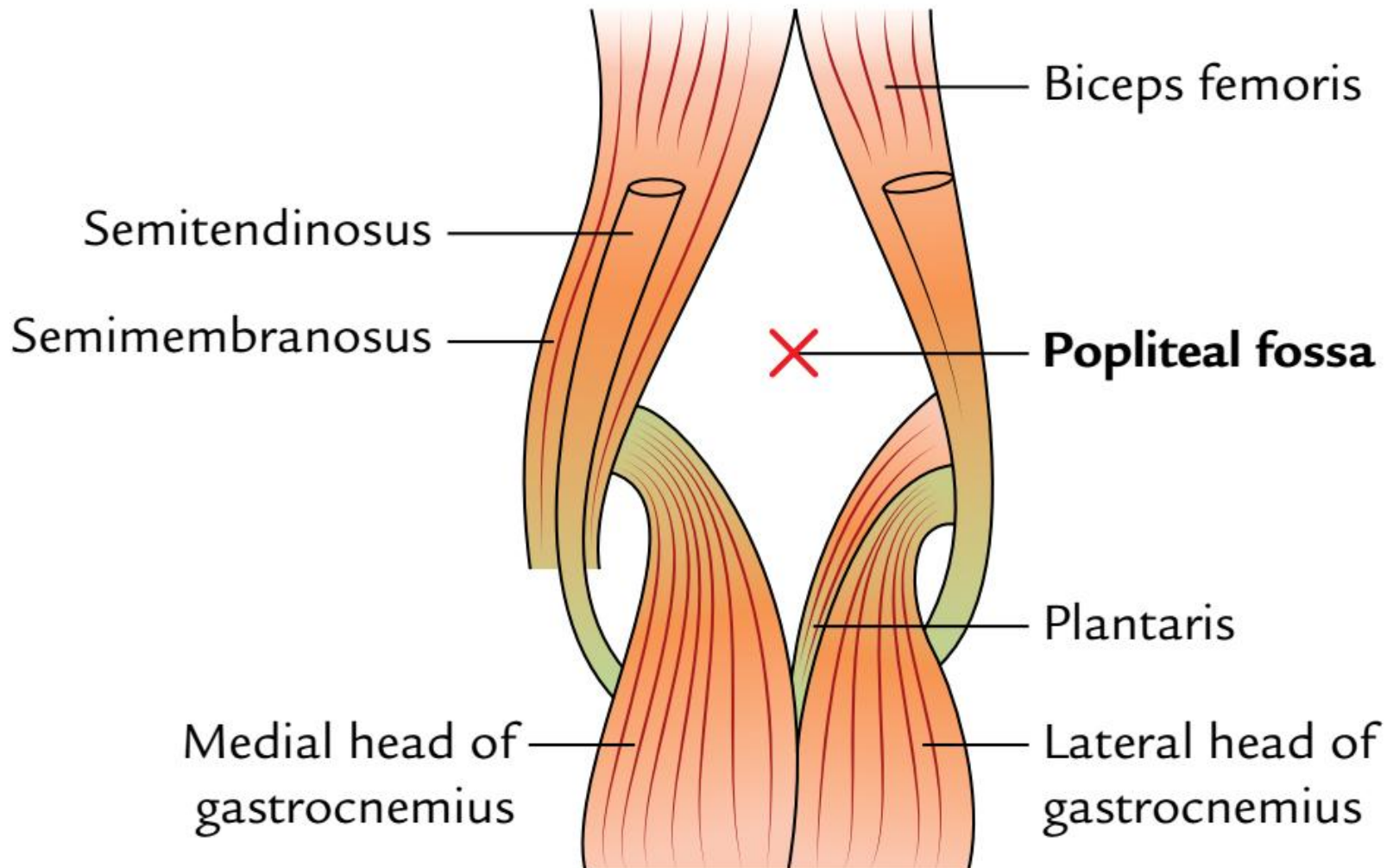
The posterior part of the region is marked by a fossa. This fossa is a well defined, fat-filled space called the popliteal fossa. The word popliteal is derived from the Latin word “poples”, and this fossa mainly transmit neurovascular structures.

Knee region



The popliteal fossa is a diamond-shaped depression located posterior to the knee joint. Important nerves and vessels pass from the thigh to the leg by traversing through this fossa. These include the two terminal branches of the sciatic nerve, the popliteal vessels and short saphenous vein. Several muscles of the thigh and leg form the boundaries of the popliteal fossa. They include the semimembranosus, semitendinosus, biceps femoris, gastrocnemius and popliteus muscles.

The popliteal fossa: boundaries



Knee region



Key facts about the popliteal fossa

Borders

Superomedial: semimembranosus and semitendinosus muscles

Lateral: biceps femoris muscle

Inferior: gastrocnemius muscle

Floor: knee joint capsule, distal femur, proximal tibia, popliteus muscle

Roof: popliteal fascia

Contents

Nerves: tibial, common fibular, sural, posterior femoral cutaneous

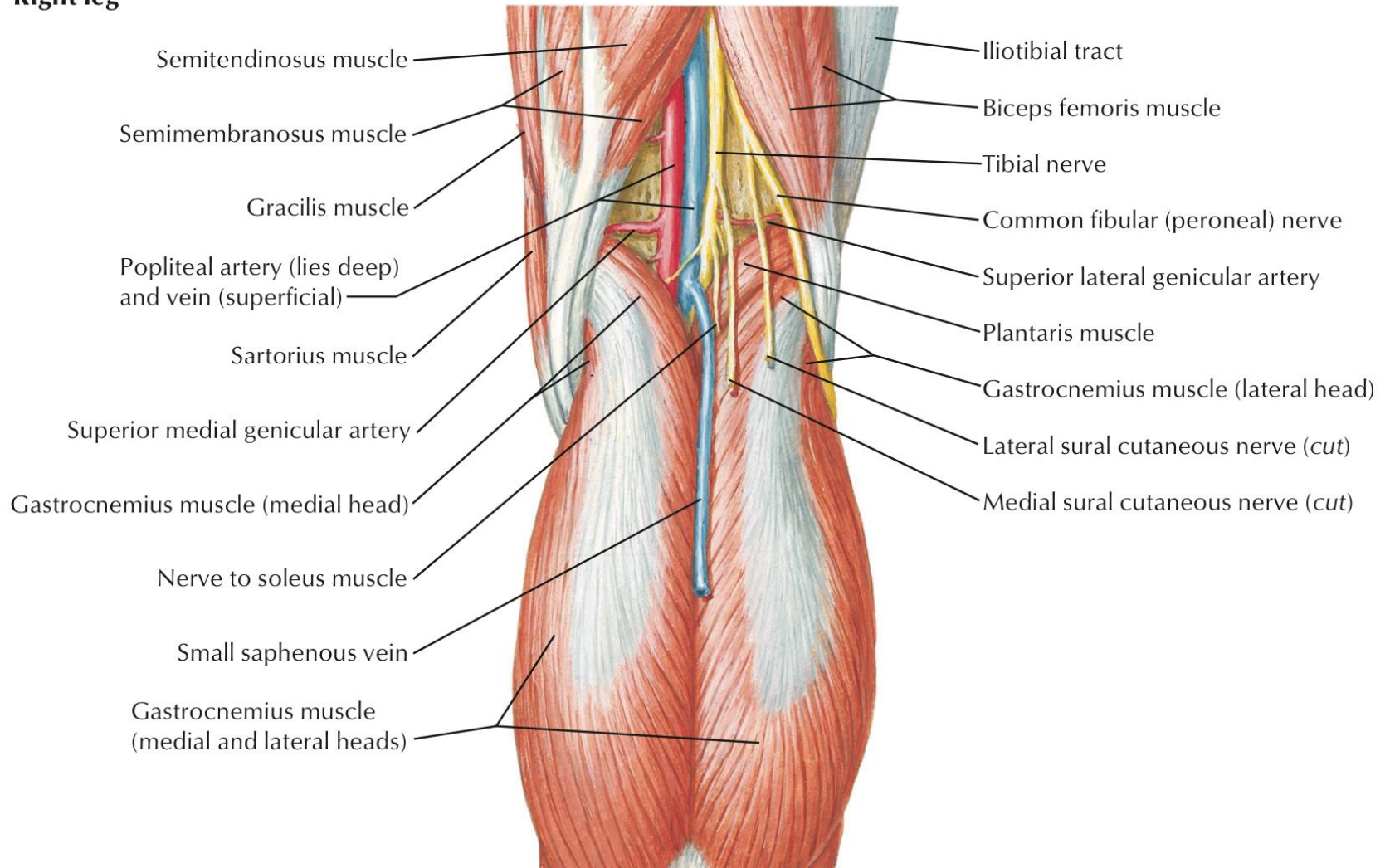
Vessels: popliteal artery and vein, short saphenous vein

Lymph nodes: superficial and deep popliteal lymph nodes

The popliteal fossa



Right leg



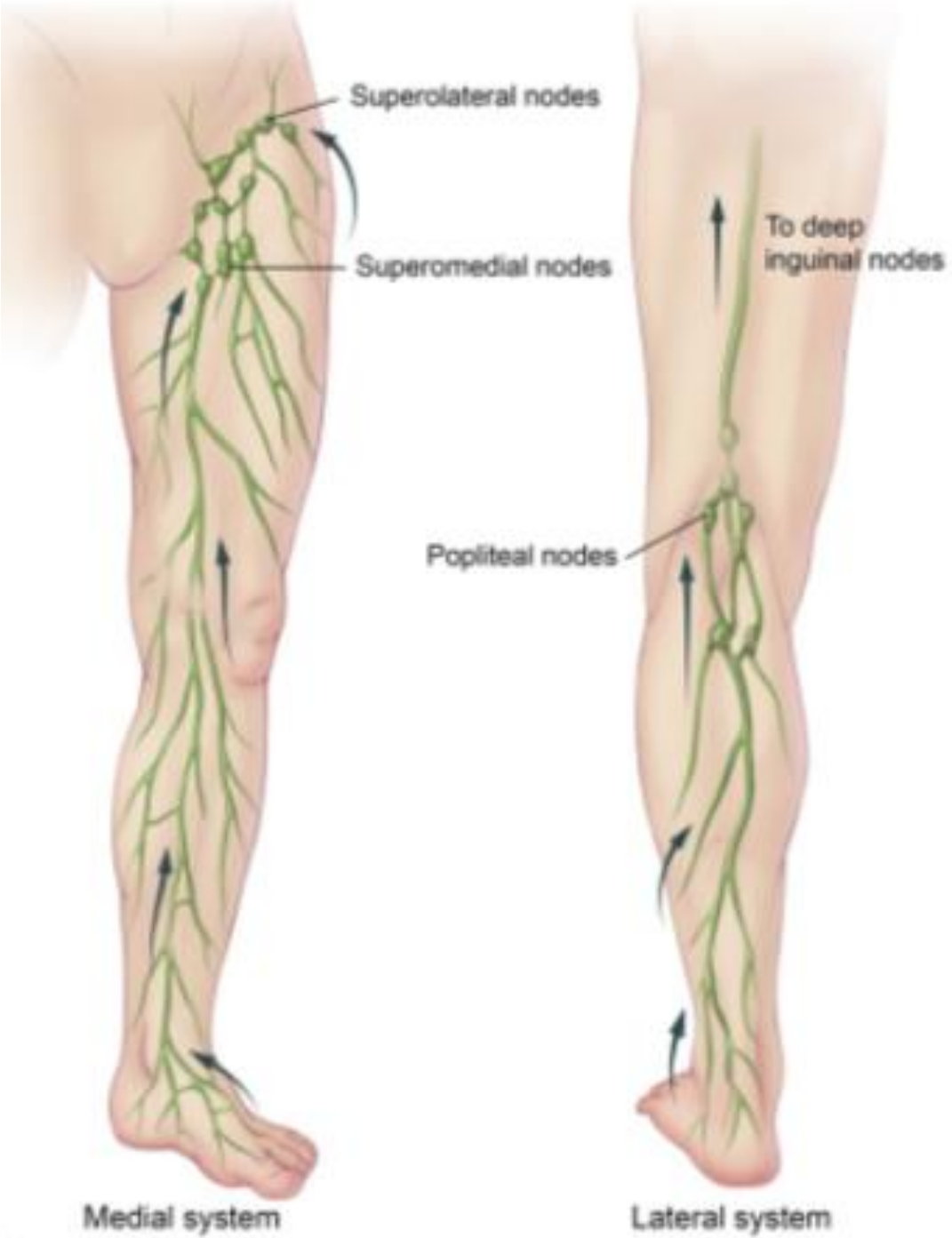


The popliteal fossa: deep lymph nodes

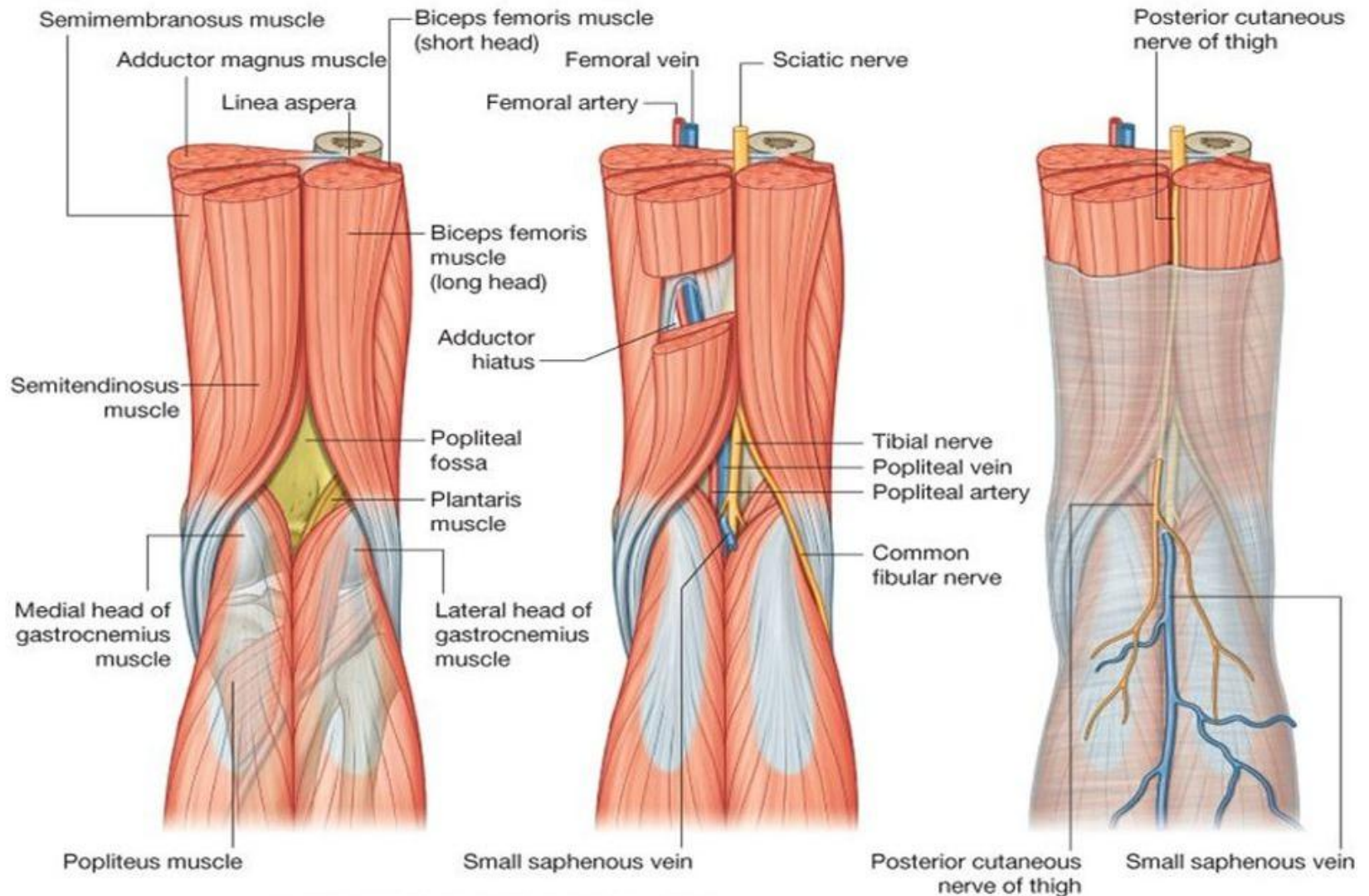
- There may be one or two nodes just under the deep fascia, close to the popliteal fossa vessels.
- They drain the deep tissues of the leg and foot and the knee joint. They also receive superficial lymph vessels from the lateral side of the foot, the heel, and the back of the calf. These drain along the line of the small saphenous vein.



Lymphatic drainage of the lower extremity

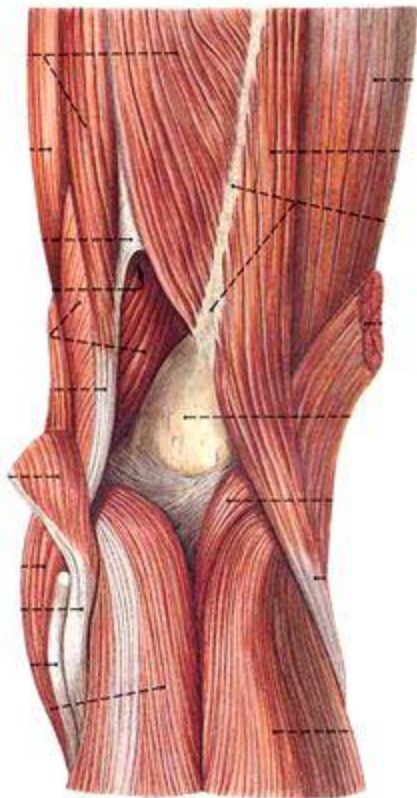
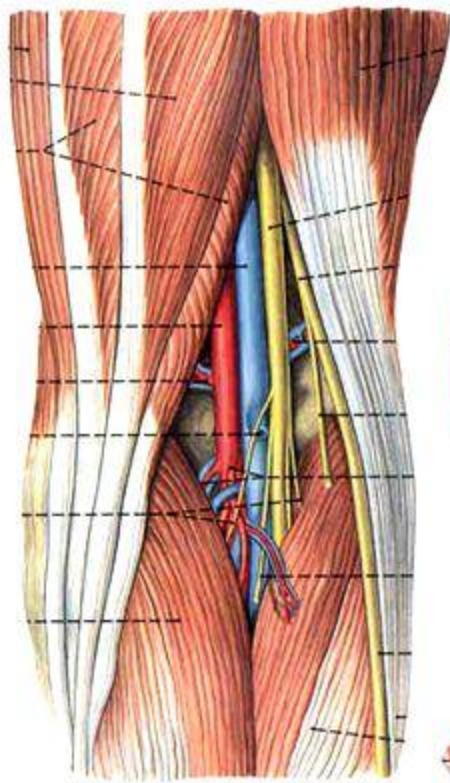


The popliteal fossa

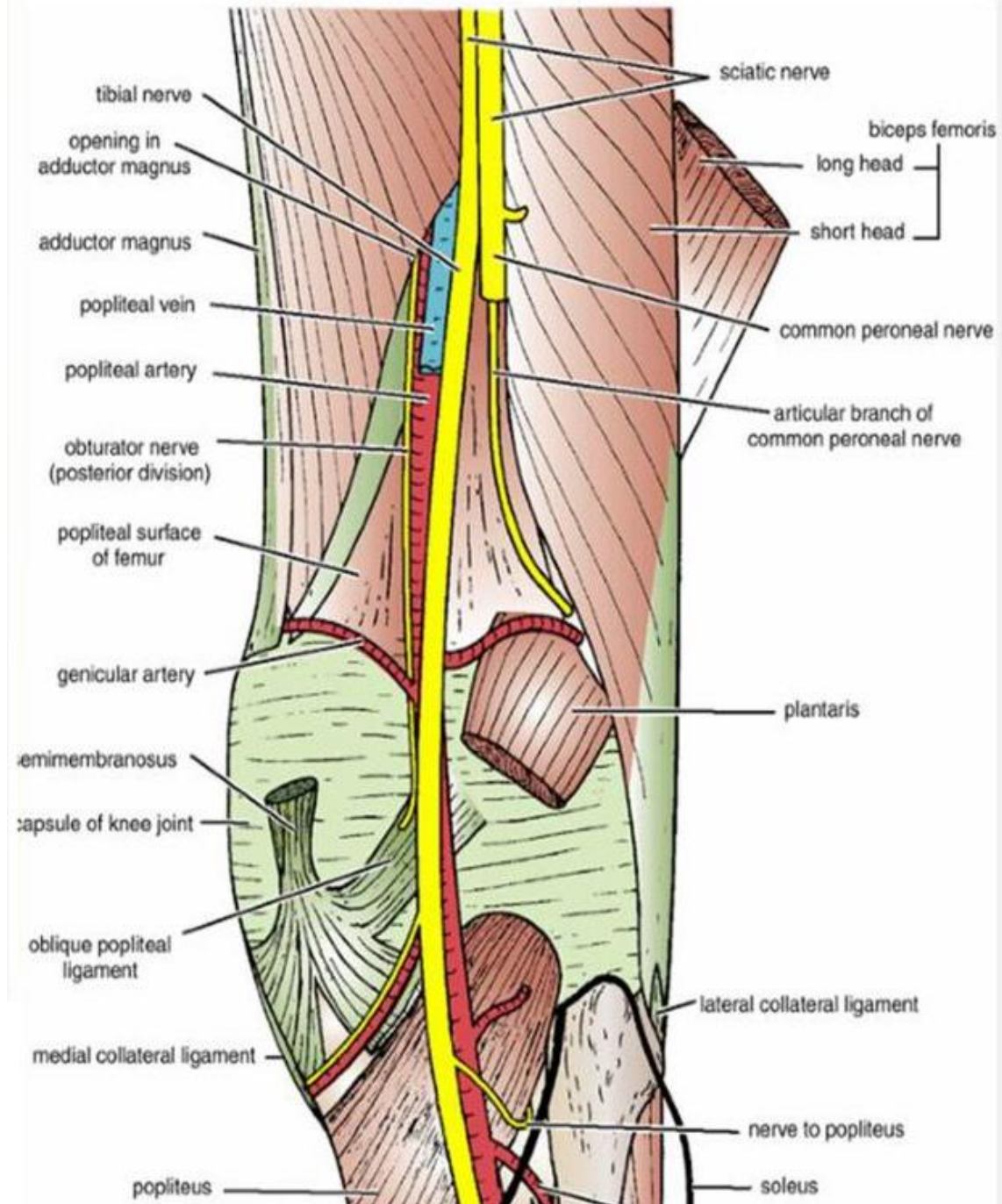


Boundaries of the popliteal fossa

- Diamond-shaped
- Upper lateral boundary: Biceps femoris
- Upper medial boundary: semimembranosus and semitendinosus
- Two lower boundaries are the heads of gastrocnemius
- Posterior wall: deep fascia
- Anterior wall: popliteal surface of the femur, the posterior capsule of the knee joint, and the fascia covering popliteals



Knee region: posterior view, deep section



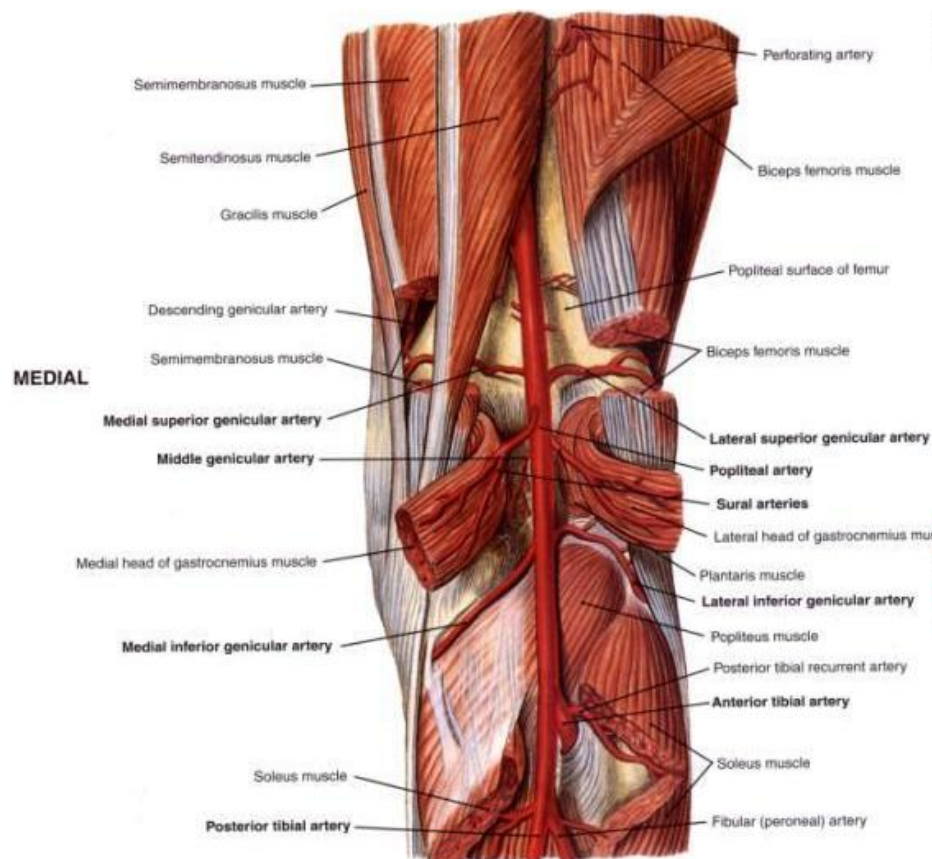
Knee region



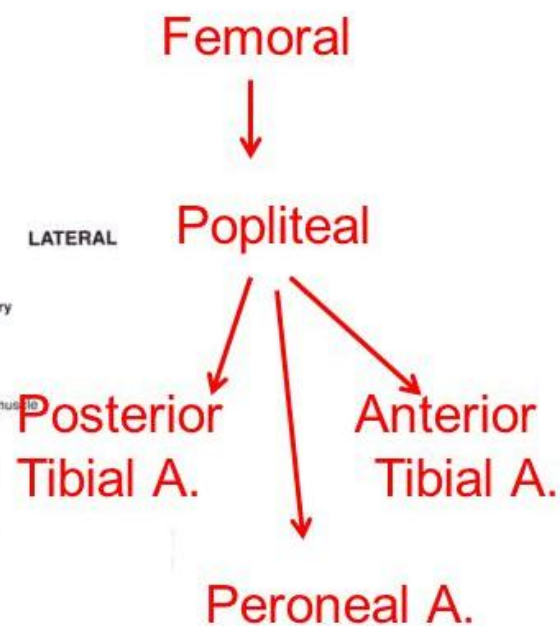
The popliteal artery passes through the popliteal fossa and ends at the inferior

border of the popliteus by dividing into the anterior and posterior tibial arteries. The deepest structure in the popliteal fossa, the popliteal artery, runs close to the joint capsule of the knee joint. Five genicular branches of the popliteal artery supply the joint capsule and ligaments of the knee joint.

Knee region



Region of Popliteal Fossa



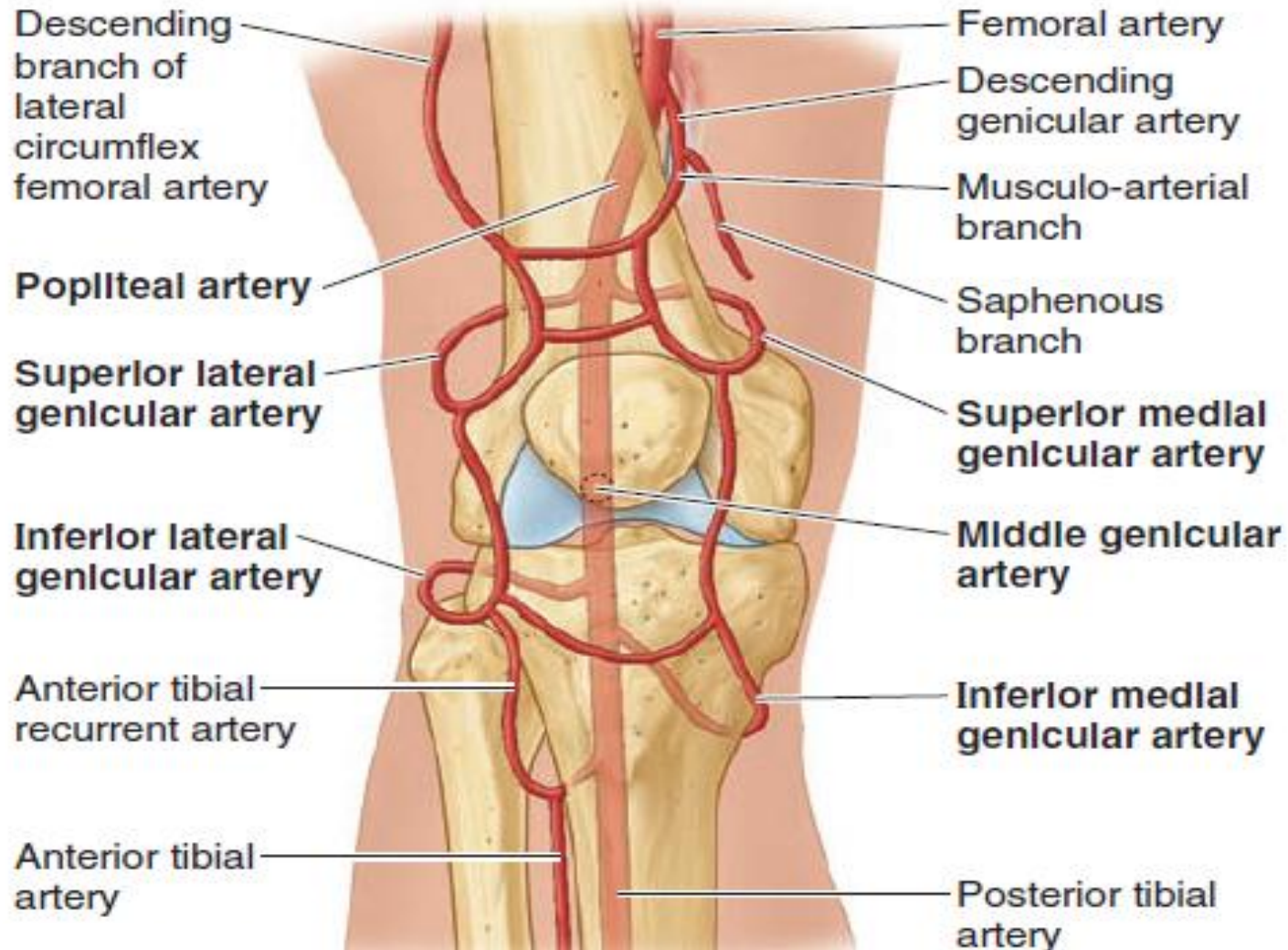
Anastomosing branches of Popliteal Artery:

Medial and lateral superior geniculate aa.

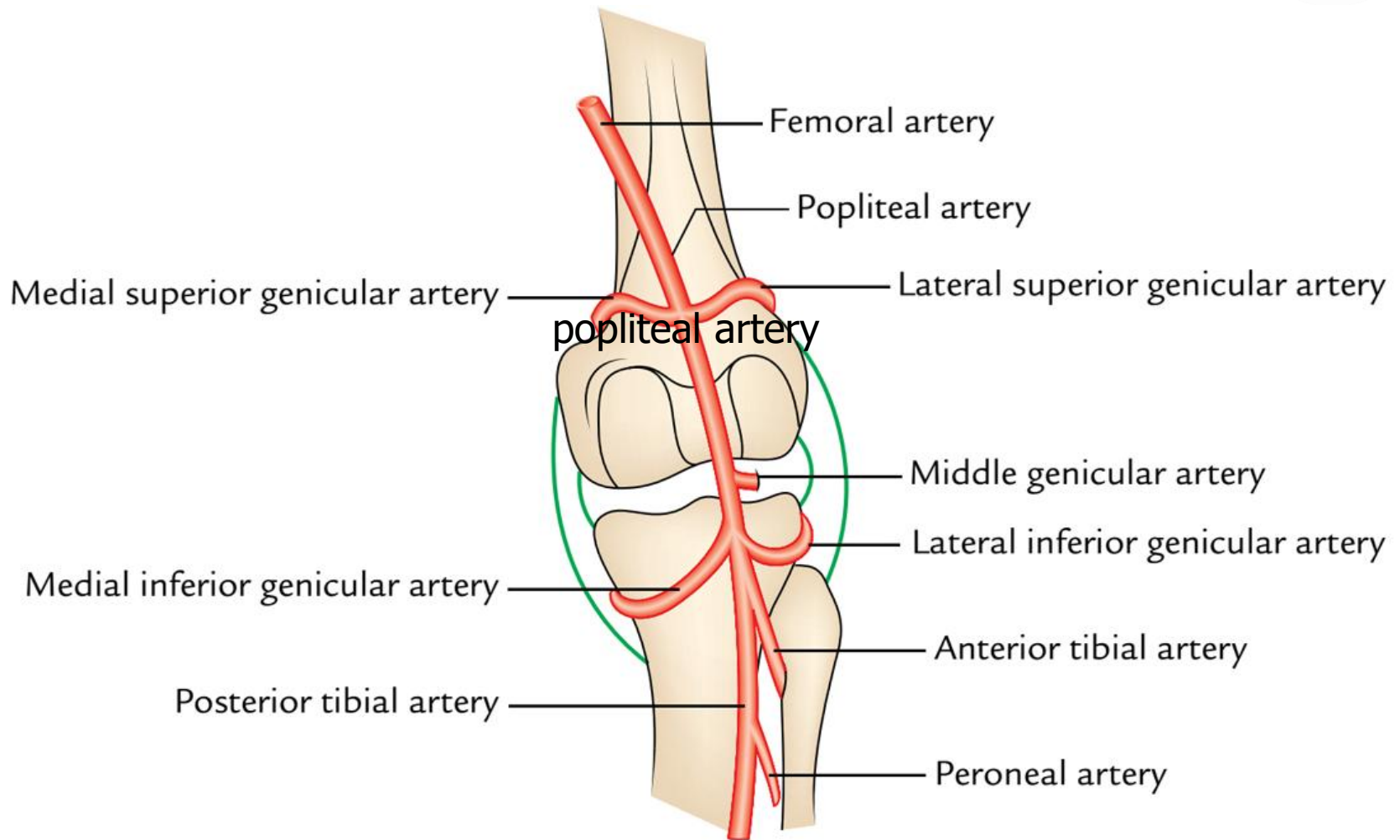
Medial and lateral sural aa.

Medial and lateral inferior geniculate aa.

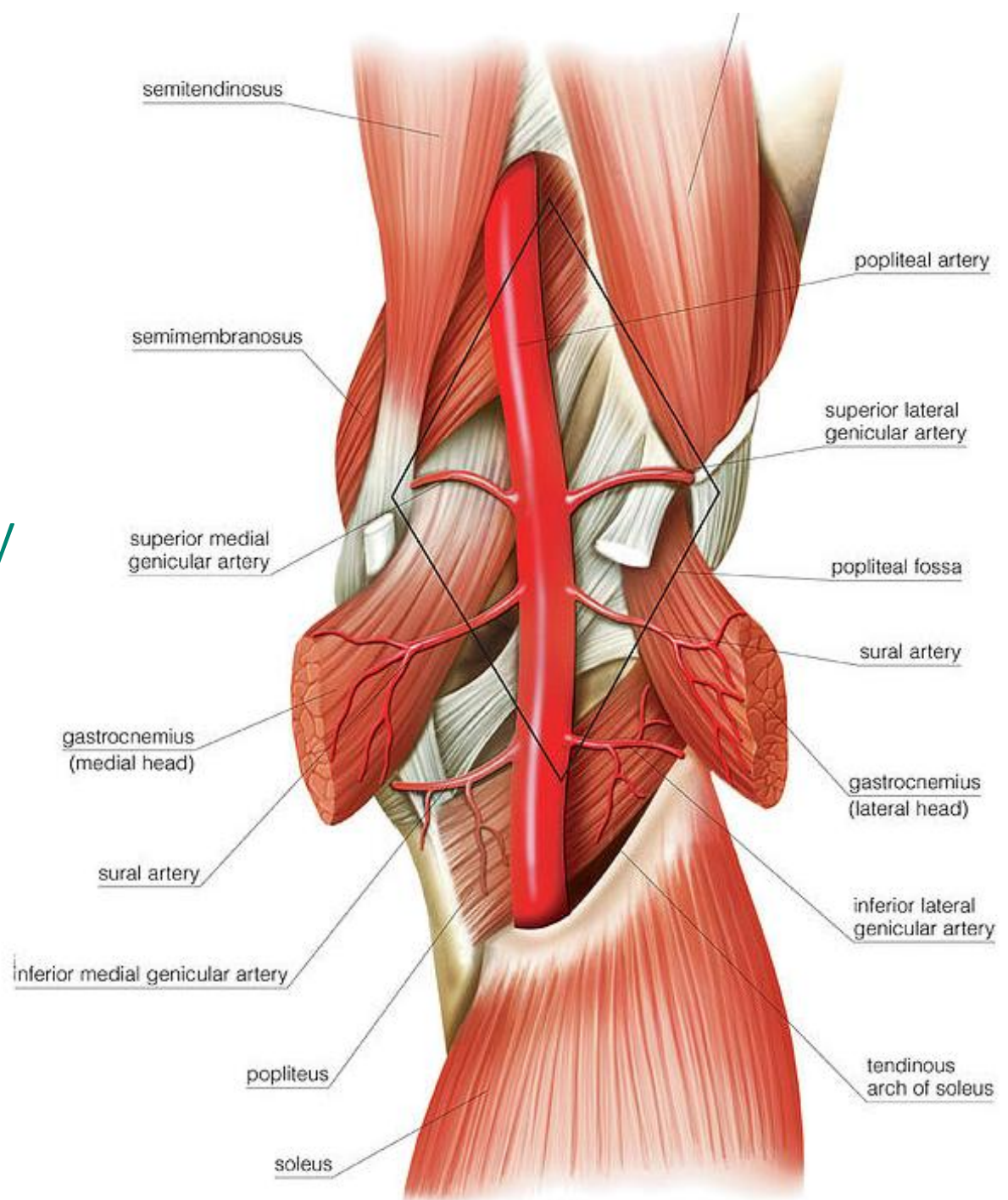
Knee region



Knee region: popliteal artery



Knee region: popliteal artery





Jobert's fossa

This is an older term for a short groove located between the distal adductor magnus muscle anteriorly, and the sartorius and gracilis muscles posteriorly, seen when the thigh is flexed and rotated laterally.

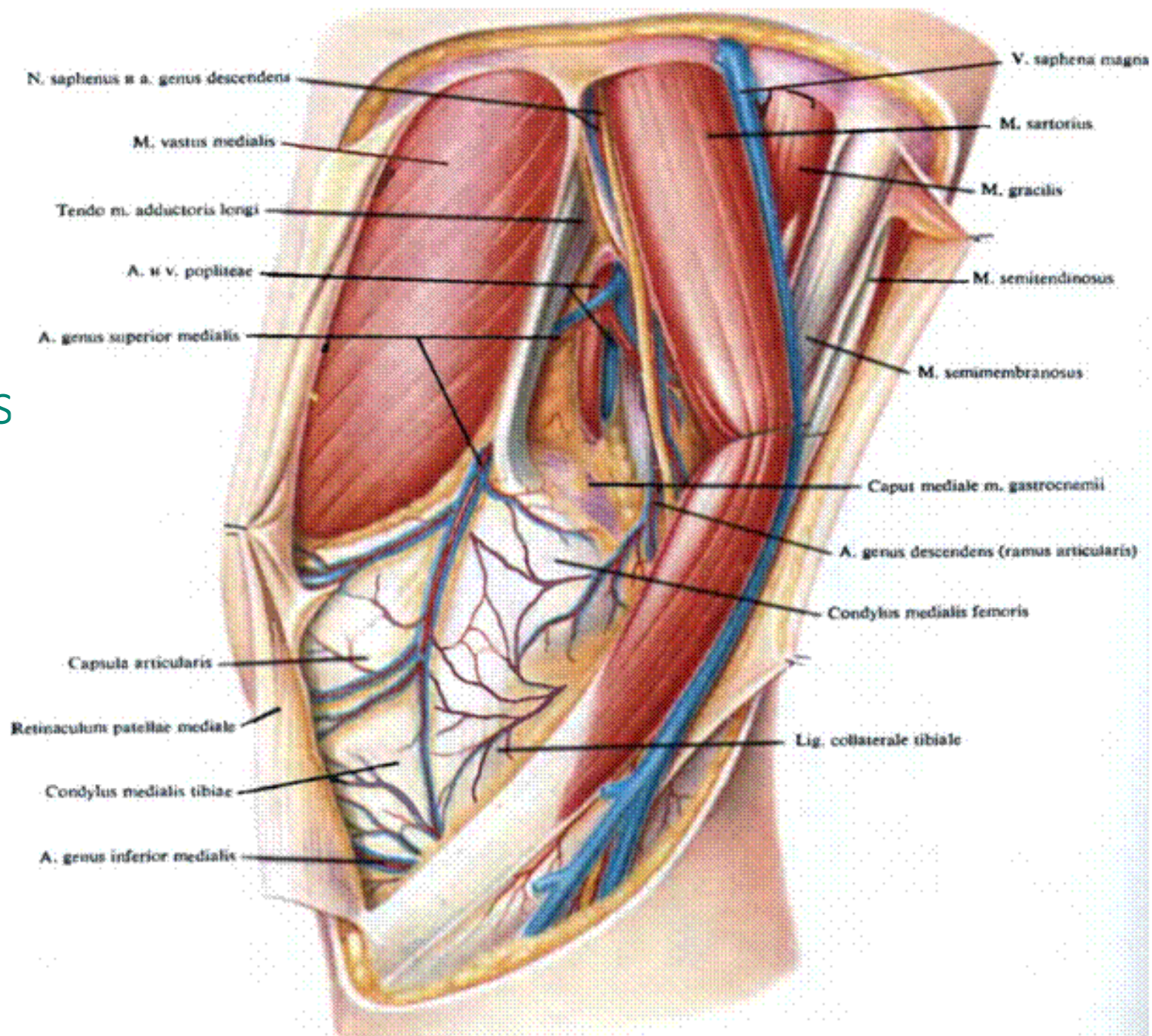


Jobert's fossa

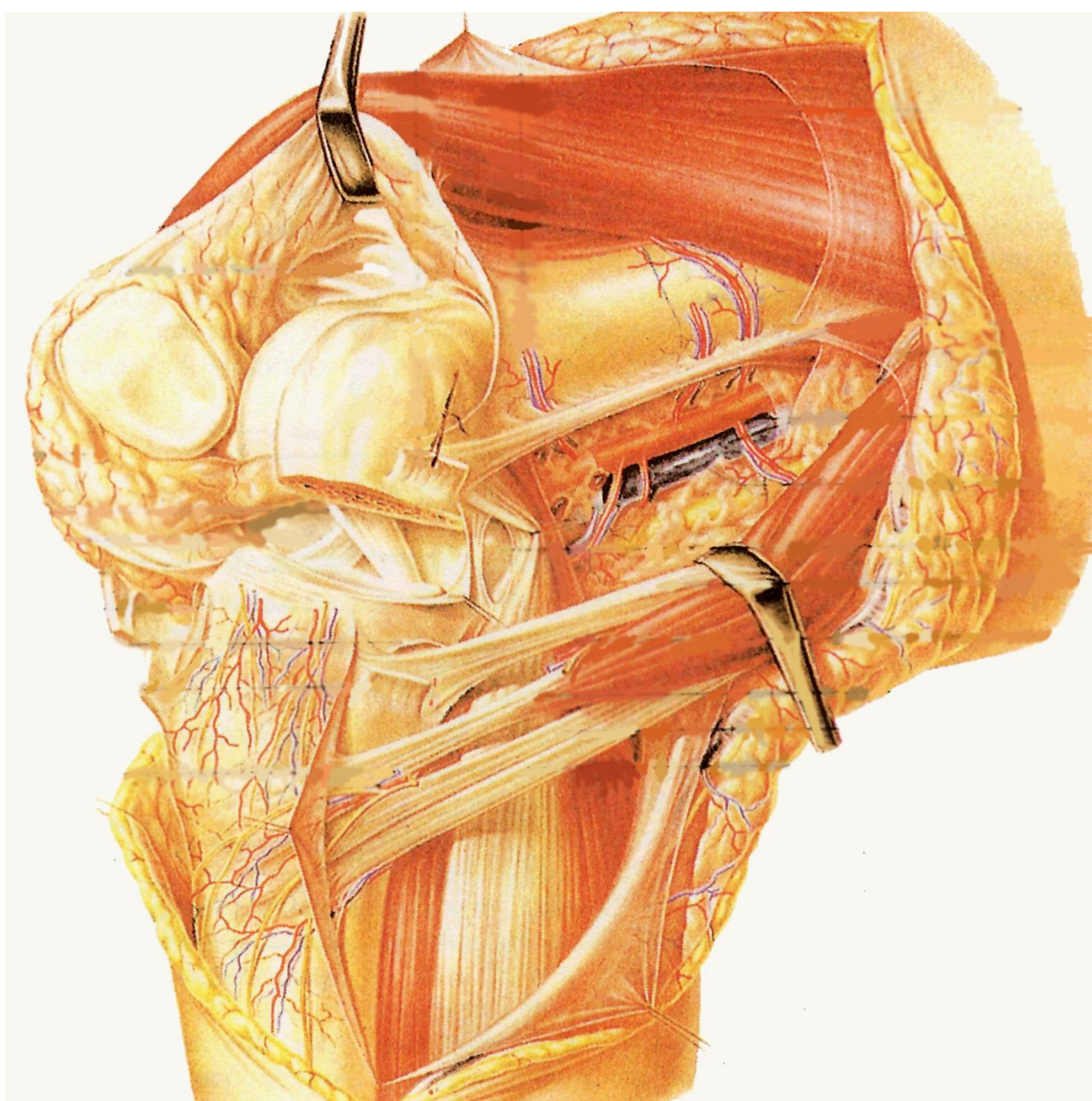


While the term is little used in the working medical parlance, it may continue to serve some clinical utility. Deep to superficial groove, surgical access may be performed to popliteal artery through the gap between the adductor magnus muscle anteriorly, and the semimembranosus and semitendinosus muscles posteriorly

Jobert's fossa



Jobert's
fossa



Knee region



The genicular arteries are the superior lateral, superior medial, middle, inferior, lateral, and inferior medial genicular arteries. They participate in the formation of the genicular anastomosis (L. genu, knee), a peri-articular arterial anastomosis around the knee that provides collateral circulation capable of maintaining blood supply to the leg during full knee flexion.



Knee region

- Popliteal pulse

Palpation of the popliteal pulse is usually performed with the knee flexed in order to relax the hamstrings and popliteal fascia. The pulse is best felt in the inferior part of the fossa but may be difficult to find because of the deep location of the popliteal artery. A loss of the popliteal pulse can indicate femoral artery obstruction.