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Front of Thigh

Those who sit idly in the expectation for Gods help are great fools
—Swami Dayanand Saraswati

INTRODUCTION

Front of thigh extends between the hip and knee joints. The superficial fascia contains one big vein, the great saphenous vein, besides the cutaneous nerves, vessels, lymphatics and lymph nodes. The upper third of thigh medially contains the femoral triangle, middle third carries the femoral vessels through the adductor canal. Front of thigh also contains a vast four-headed muscle, the quadriceps femoris, besides the iliopsoas in the uppermost region and adductor muscles on its medial side. Femoral hernia if occurs is seen in the upper medial region of front of thigh.

SURFACE LANDMARKS

Iliac crest is a thick, curved bony margin, forming laterally the lower margin of the waist. The hands are often supported on the iliac crests in a relaxed standing posture. *Anterior superior iliac spine* is the anterior end of the iliac crest (Fig. 3.1). *Tubercle of the iliac crest* is a low bony prominence situated on the outer lip of the iliac crest about 5.0 cm behind the anterior superior iliac spine.

Fold of groin is a shallow curved groove which separates the front of the thigh from the anterior abdominal wall. It represents the flexion crease of the thigh and overlies the inguinal ligament which extends from the anterior superior iliac spine to the pubic tubercle. The downward convexity of the ligament is due to the pull exerted by the fascia lata of the thigh.

Pubic tubercle is a small bony projection felt at the medial end of the fold of groin. Pubic symphysis is formed in the median plane between the right and left pubic bones. Pubic crest is a short bony ridge between the pubic tubercle and pubic symphysis (Fig. 3.2).

The *greater trochanter* of femur lies a hand's-breadth (about 12.5 cm) below the *tubercle of iliac crest*, forming

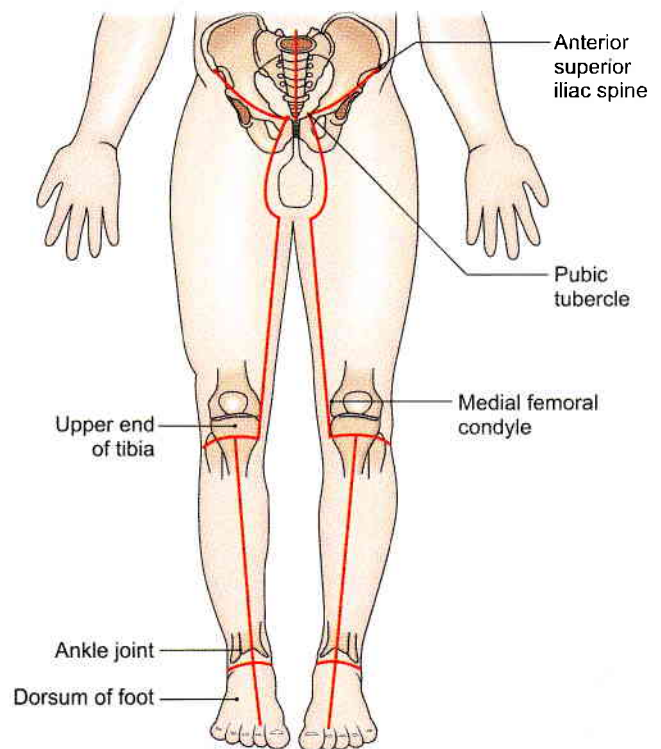


Fig. 3.1: Lines of dissection

a wide (4.5 cm) prominence just in front of the hollow on the side of the hip. The upper margin of the trochanter lies about the same level as the pubic crest.

Midinguinal point lies midway between the anterior superior iliac spine and the pubic symphysis. The femoral artery and the head of the femur lie beneath the midinguinal point (Fig. 3.2).

Midpoint of inguinal ligament lies slightly lateral to midinguinal point. It is the middle point of inguinal ligament. Femoral nerve lies beneath it.

Patella (knee cap) is the largest sesamoid bone of the body, developed in the tendon of quadriceps femoris.

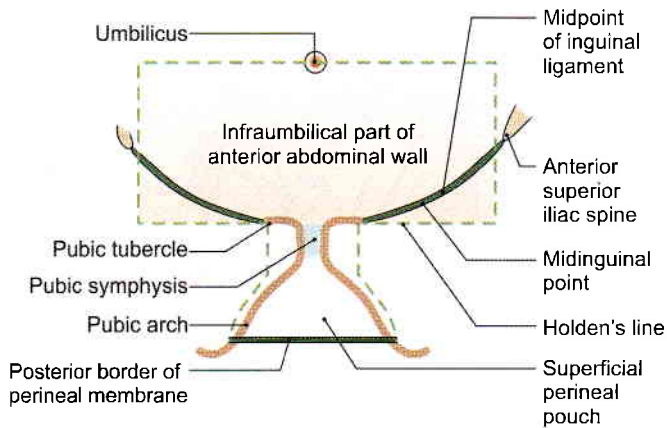


Fig. 3.2: The superficial area into which urine may pass when urethra is injured. The areas within the interrupted lines have a well-defined membranous layer of superficial fascia

It is easily seen and felt in front of the knee. It can be moved freely in a fully extended knee.

Tibial tuberosity is a blunt prominence in front of the upper end of tibia, marking the upper end of the shin.

Ligamentum patellae extends from the apex of patella to the tibial tuberosity. It represents the tendon (5×2.5 cm) of the quadriceps femoris which can be felt best in a half flexed knee.

The medial and lateral *condyles of the femur* and of the *tibia* form large bony masses at the sides of the knee. The most prominent points on the sides of the femoral condyles are called the medial and lateral epicondyles. Vastus medialis forms a fleshy prominence above the medial condyle of femur, particularly in an extended knee.

Adductor tubercle is a bony projection from the uppermost part of the medial condyle of femur to which the tendon of adductor magnus is attached. To palpate the tubercle, flex the knee partly and note the wide, shallow groove that appears posterior to the mass of vastus medialis. The tendon of adductor magnus can be felt in this groove. The tendon can be traced down to the adductor tubercle.

SKIN AND SUPERFICIAL FASCIA

DISSECTION

Make a curved incision from anterior superior iliac spine to the pubic tubercle.

Give a curved incision around the scrotum/pudendal cleft towards upper medial side of thigh. Extend it vertically down below the medial condyle of tibia till the level of tibial tuberosity.

Now make a horizontal incision below the tibial tuberosity till the lateral side of leg (Fig. 3.1).

Reflect the skin laterally, exposing the superficial fatty and deeper membranous layers of superficial fascia. Remove the fatty layer.

Identify the great saphenous vein in the medial part of anterior surface of thigh. Draining into its upper part are its three superficial tributaries, namely superficial circumflex iliac, superficial epigastric and superficial external pudendal. The vertical group of superficial inguinal lymph nodes lie along the upper part of great saphenous vein.

Dissect the superficial inguinal ring 1 cm above and lateral to the pubic tubercle. The spermatic cord and ilioinguinal nerve leave the abdomen through this ring.

Trace the great saphenous vein backwards till it pierces the specialised deep fascia known as cribriform fascia to drain into the femoral vein enclosed in the femoral sheath.

SKIN

The skin of thigh in the region around pubic symphysis, is studded with hair. The presence of few stitches indicates that embalming for preservation of the body has been done from this site.

Procedure for embalming: A 6 cm long vertical incision is given in the upper medial side of thigh. After reflecting skin and fasciae, femoral sheath is incised to visualise the femoral artery. About 10 litres of embalming fluid prepared by mixing appropriate amounts of formalin, glycerine, water, red lead, common salt, etc. is put in the embalming machine connected to a cannula.

A small nick is given in the femoral artery and cannula introduced so that its tip points towards the head end and 8.5 litres of fluid is pumped under 20 lb pressure. Then the direction of cannula is reversed and rest of fluid is pumped in. Lastly, the skin and fasciae are sutured.

SUPERFICIAL FASCIA

The superficial fascia has *two layers*, a superficial fatty layer and a deep membranous layer, which are continuous with the corresponding layers of the anterior abdominal wall. The two layers are most distinct in the uppermost part of the thigh, near the groin, where the cutaneous nerves, vessels and lymph nodes lie between the two layers.

The membranous layer is loosely attached to the deep fascia of the thigh except near the inguinal ligament, where it is firmly attached along a horizontal line. The line of firm attachment is called *Holden's line*. It begins a little lateral to the pubic tubercle and extends laterally for about 8 cm (Fig. 3.2).



The importance of this Holden's line is as follows.

When the urethra is injured in the perineum, urine may flow out or extravasate into the interval deep to the membranous layer of superficial fascia. This urine can pass up into the anterior abdominal wall from where it can enter the upper part of the thigh. However, the firm attachment of the membranous layer of superficial fascia to the deep fascia along Holden's line prevents urine from descending into the thigh beyond the line.

The superficial fascia contains cutaneous nerves, cutaneous arteries, the great saphenous vein and its tributaries, and the superficial inguinal lymph nodes. The nerves and vessels are described below. The inguinal lymph nodes are described later.

Cutaneous Nerves

The skin of the front of the thigh is supplied by following cutaneous nerves derived directly, or indirectly, from the lumbar plexus (Fig. 3.3).

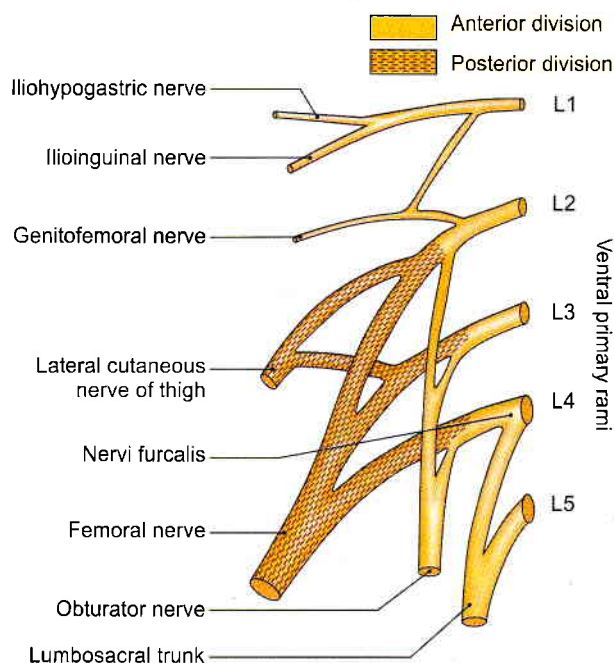


Fig. 3.3: The lumbar plexus and its branches

The *ilioinguinal nerve* (L1) emerges at the superficial inguinal ring, and supplies the skin at the root of the penis or over the mons pubis in the female, the anterior one-third of the scrotum or labium majus, and the superomedial part of the thigh (Fig. 3.4).

The *femoral branch of genitofemoral nerve* (L1, L2) pierces the femoral sheath and the overlying deep fascia 2 cm below the midinguinal point, and supplies most of the skin over the femoral triangle (Fig. 3.4).

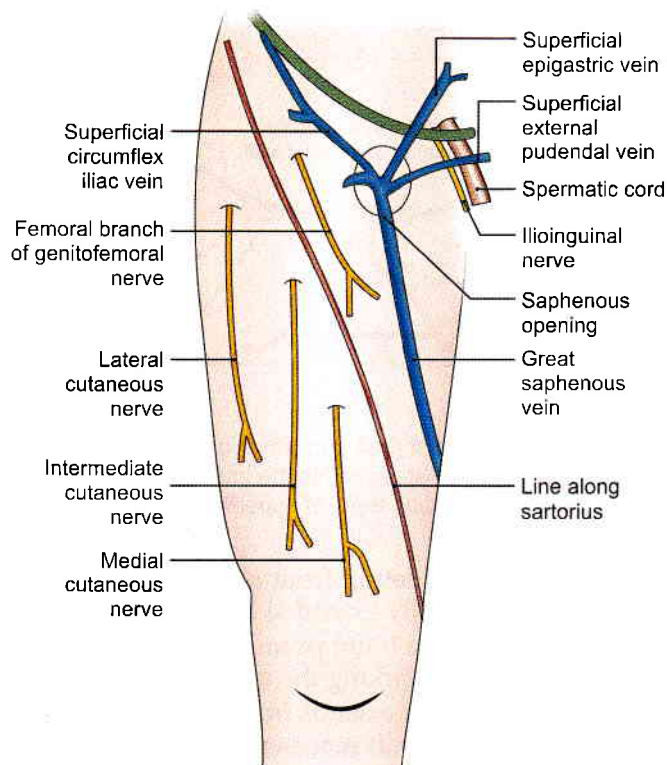


Fig. 3.4: Superficial veins and nerves seen on the front of the thigh

The *lateral cutaneous nerve of thigh* (L2, L3) is a branch of the lumbar plexus. It emerges behind the lateral end of the inguinal ligament, divides into anterior and posterior branches, and supplies the skin on the anterolateral side of the thigh and on the anterior part of the gluteal region.

The *intermediate cutaneous nerve of thigh* (L2, L3) is a branch of the anterior division of the femoral nerve. It pierces the deep fascia at the junction of the upper one-third and middle one-third of the thigh. It divides into two or more branches and supplies a strip of skin on the front of the thigh extending from the sartorius to the knee.

The *medial cutaneous nerve of the thigh* (L2, L3) is a branch of the anterior division of the femoral nerve. It divides into anterior and posterior divisions. The nerve supplies the skin on the medial side of the lower two-thirds of the thigh.

The *saphenous nerve* (L3, L4) is a branch of the posterior division of the femoral nerve. It pierces the deep fascia on the medial side of the knee, runs down in front of the great saphenous vein, and supplies the skin on the medial side of the leg and foot up to the ball of the big toe (see Fig. 8.2).

Before piercing the deep fascia the saphenous nerve gives off the *infrapatellar branch* which runs downwards



and laterally, and supplies the skin over the ligamentum patellae.

Patellar Plexus

It is a plexus of fine nerves situated in front of the patella, the ligamentum patellae and the upper end of the tibia. It is formed by contributions from:

- 1 The anterior division of the lateral cutaneous nerve
- 2 The intermediate cutaneous nerve
- 3 The anterior division of the medial cutaneous nerve
- 4 The infrapatellar branch of the saphenous nerve.

Cutaneous Arteries

Three small arteries arising from the femoral artery can be seen a little below the inguinal ligament (Fig. 3.11).

- 1 *Superficial external pudendal artery* pierces the cribriform fascia, runs medially in front of the spermatic cord, and supplies the external genitalia.
- 2 *Superficial epigastric artery* pierces the cribriform fascia, runs towards the umbilicus, and supplies the lower part of anterior abdominal wall.
- 3 *Superficial circumflex iliac artery* pierces the fascia lata lateral to saphenous opening, runs upwards below the inguinal ligament, and anastomoses at the anterior superior iliac spine with deep circumflex iliac, superior gluteal and lateral circumflex femoral arteries.

Great or Long Saphenous Vein

This is the largest and longest superficial vein of the lower limb (*Saphes* = easily seen).

It begins on the dorsum of the foot from the medial end of the dorsal venous arch, and runs upwards in front of the medial malleolus, along the medial side of the leg, and behind the knee. In the thigh, it inclines forwards to reach the saphenous opening where it pierces the cribriform fascia and opens into the femoral vein. Before piercing the cribriform fascia, it receives three named tributaries corresponding to the three cutaneous arteries, and also many unnamed tributaries (see Figs 3.4 and 11.1).

Superficial Inguinal Lymph Nodes

The superficial inguinal lymph nodes are variable in their number and size. Their arrangement is T-shaped, there being a lower vertical group and an upper horizontal group. The upper nodes can be subdivided into the upper lateral and upper medial groups (Fig. 3.5).

- 1 Lower vertical group drains lymph from most of the lower limb.
- 2 Upper lateral group drains lymph from infra-umbilical part of anterior abdominal wall and gluteal region.

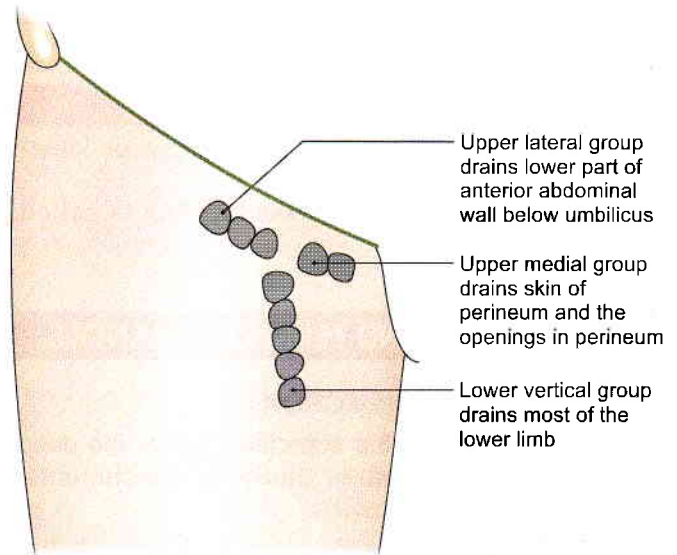


Fig. 3.5: Superficial inguinal lymph nodes

- 3 Upper medial group drains lymph from external genital organs including the terminal ends of the urethra, anal canal and vagina.

Subcutaneous Bursae

Bursae are lubricating mechanisms which are provided at sites of friction to smoothen movement. Undue pressure on them may cause their pathological enlargement. Bursae present in relation to the patella are described here (Fig. 3.6).

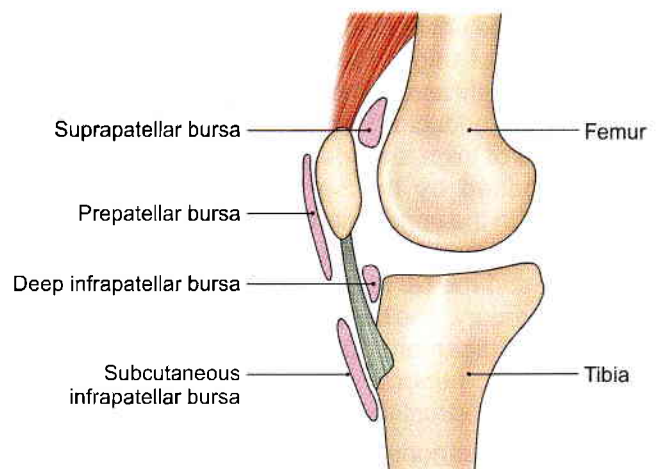


Fig. 3.6: The patellar bursae

Prepatellar Bursa

It lies in front of the lower part of the patella and of the upper part of the ligamentum patellae.

Subcutaneous Infrapatellar Bursa

It lies in front of lower part of the tibial tuberosity and of the lower part of the ligamentum patellae.

Two deep bursae are also present. These are suprapatellar bursa and deep infrapatellar bursa.

CLINICAL ANATOMY

- Prepatellar bursitis is called "housemaids knee" or miner's knee.
- Subcutaneous infrapatellar bursitis is called "clergyman's knee."

DEEP FASCIA AND FEMORAL TRIANGLE

DISSECTION

After the reflection of the superficial fascia, the deep fascia of thigh is visible. Study its attachments, modifications and extensions.

Follow the great saphenous vein through the cribriform fascia and the anterior wall of femoral sheath into the femoral vein. The femoral vein occupies the intermediate compartment of the femoral sheath. Medial compartment of femoral sheath is the femoral canal occupied by a lymph node while the lateral compartment is occupied by the femoral artery.

Give a vertical incision in the deep fascia of thigh from tubercle of iliac crest till the lateral condyle of femur and remove the deep fascia or fascia lata in lateral part of thigh. This will expose the tensor fasciae latae muscle and gluteus maximus muscle getting attached to iliotibial tract. Identify the four heads of quadriceps femoris muscle.

Remove the entire deep fascia from upper one-third of the front of thigh. Identify the sartorius muscle stretching gently across the thigh from lateral to medial side and the adductor longus muscle extending from medial side of thigh towards lateral side into the femur, being crossed by the sartorius. This triangular depression in the upper one-third of thigh is the femoral triangle. The medial border of sartorius forms lateral boundary and medial border of adductor longus forms medial boundary. The base of this triangle is formed by the inguinal ligament. Dissect its boundaries, and contents, e.g. femoral nerve, artery and vein, and accompanying structures.

Expose the sartorius muscle till its insertion into the upper medial surface of shaft of tibia.

DEEP FASCIA/FASCIA LATA

The fascia lata is a tough fibrous sheath that envelops the whole of the thigh like a sleeve. Its attachments, shown in Fig. 3.7, are as follows:

Superiorly it is attached to the boundary line between the lower limb and the pelvis. Thus anteriorly it is attached to the inguinal ligament; laterally to the iliac

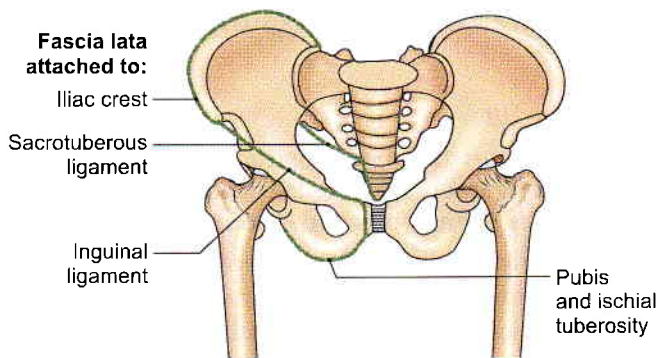


Fig. 3.7: The upper attachments of the fascia lata

crest; posteriorly, through the gluteal fascia to the sacrum, coccyx and sacrotuberous ligament; and medially to the pubis, the pubic arch and the ischial tuberosity.

Inferiorly, on the front and sides of the knee, the fascia lata is attached to subcutaneous bony prominences and the capsule of the knee joint. Posteriorly, it forms the strong popliteal fascia which is continuous below with the fascia of the back of the leg.

Modifications of Fascia Lata

Iliotibial Tract

The fascia lata is thickened laterally where it forms a 5 cm wide band called the iliotibial tract (Fig. 3.8). Superiorly the tract splits into two layers. The superficial lamina is attached to tubercle of iliac crest, and deep lamina to the capsule of hip joint. Inferiorly, the tract is attached to a smooth area on anterior surface of the lateral condyle of tibia. The importance of the iliotibial tract is as follows.

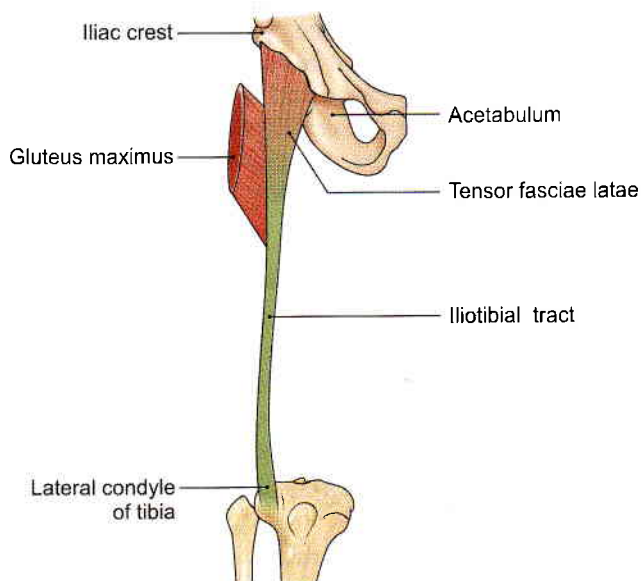


Fig. 3.8: The iliotibial tract with insertion of two muscles



- Two important muscles are inserted into its upper part, between the superficial and deep laminae. These are the three-fourths part of the *gluteus maximus*; and the *tensor fasciae latae*.
- The iliotibial tract stabilizes the knee both in extension and in partial flexion; and is, therefore, used constantly during walking and running. In leaning forwards with slightly flexed knees, the tract is the main support of the knee against gravity.

Saphenous Opening

This is an oval opening in the fascia lata. The centre of the opening is 4 cm below and 4 cm lateral to the pubic tubercle. It is about 2.5 cm long and 2 cm broad with its long axis directed downwards and laterally. The opening has a sharp crescentic lateral margin or falciform margin which lies in front of the femoral sheath. The medial well defined margin of the opening lies at a deeper level. It is formed by the fascia overlying the pectineus. The fascia passes behind the femoral sheath (Fig. 3.4).

The saphenous opening is closed by the *cribriform fascia* formed by modification of superficial fascia which covers the opening.

Intermuscular Septa

Three intermuscular septa divide the thigh into three compartments (Fig. 3.9).

The *lateral intermuscular septum* is the thickest of these septa. It extends from the iliotibial tract to the lateral lip of the linea aspera. It separates the anterior compartment of the thigh from the posterior compartment.

The *medial intermuscular septum* is attached to the medial lip of the linea aspera, and separates the anterior compartment of the thigh from the medial compartment.

The *posterior intermuscular septum* is poorly defined. It separates the medial compartment of the thigh from the posterior compartment.

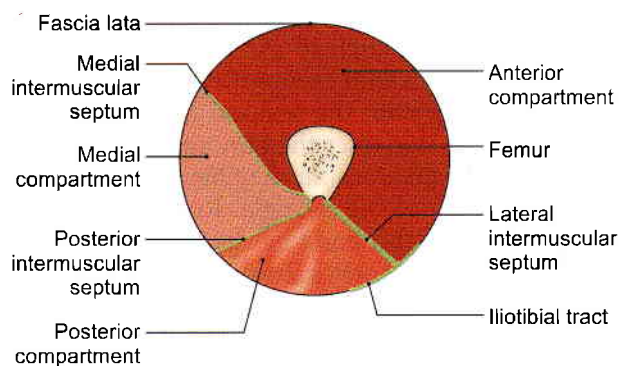


Fig. 3.9: Intermuscular septa and compartments of thigh

CLINICAL ANATOMY

The fascia lata is attached to the inguinal ligament. Extension of the thighs pulls the abdominal wall downwards and makes it tense. To relax the abdomen fully for palpation by an examining physician, the patient is asked to draw the legs up. This overcomes the pull of the fascia lata on the abdominal wall.

FEMORAL TRIANGLE

It is a triangular depression on the front of the upper one-third of the thigh immediately below the inguinal ligament.

Boundaries

The femoral triangle is bounded *laterally* by the medial border of *sartorius*; and *medially* by the medial border of the *adductor longus* (Figs 3.10 to 3.12). Its *base* is formed by the *inguinal ligament*. The *apex*, which is directed downwards, is formed by the point where the medial and lateral boundaries cross.

The apex is continuous, below, with the adductor canal.

The *roof* of the femoral triangle is formed by:

- Skin.
- Superficial fascia containing the superficial inguinal lymph nodes, the femoral branch of the genitofemoral nerve, branches of the ilioinguinal nerve, superficial branches of the femoral artery with accompanying veins, and the upper part of the great saphenous vein.
- Deep fascia, with the saphenous opening and the cribriform fascia (Fig. 3.10b).

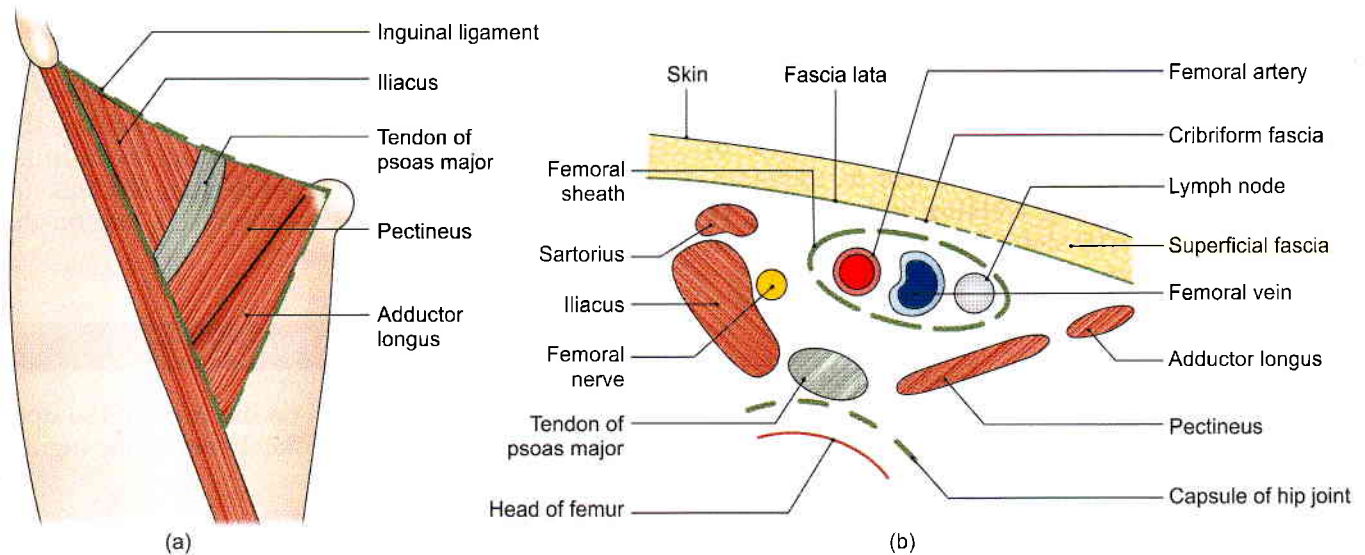
The *floor* of the triangle is formed medially by the *adductor longus* and *pectineus*, and laterally by the *psaos major* and *iliacus* (Figs 3.10 a and b).

Contents

The contents of the femoral triangle (Fig. 3.11) are as follows:

- Femoral artery and its branches:** The femoral artery traverses the triangle from its base at the midinguinal point to the apex. In the triangle, it gives off six branches, three superficial and three deep.
- Femoral vein and its tributaries:** The femoral vein accompanies the femoral artery. The vein is medial to the artery at base of triangle, but posteromedial to artery at the apex.

The femoral vein receives the great saphenous vein, circumflex veins and veins corresponding to the branches of femoral artery.



Figs 3.10a and b: Floor of the femoral triangle: (a) Surface view, and (b) sectional view

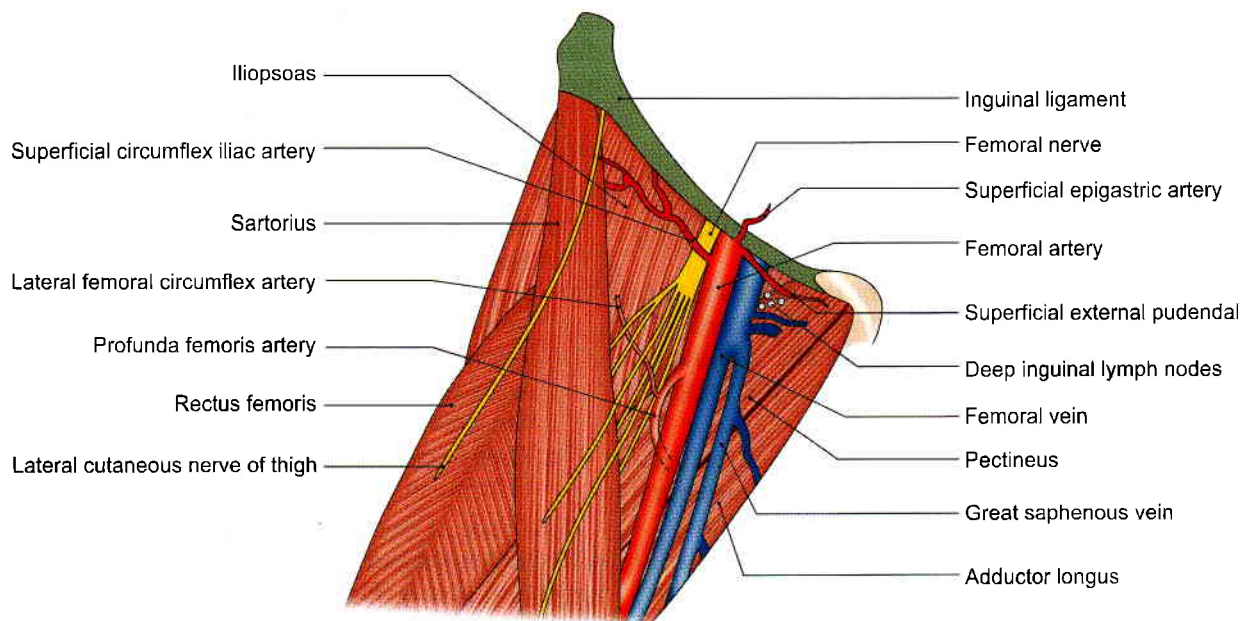


Fig. 3.11: Contents of the right femoral triangle

3 The *femoral sheath* encloses the upper 4 cm of the femoral vessels (Fig. 3.12).

4 Nerves:

- The *femoral nerve* lies lateral to the femoral artery, *outside the femoral sheath*, in the groove between the iliacus and the psoas major muscles. It is described later.
- The *nerve to the pectineus* arises from the femoral nerve just above the inguinal ligament. It passes behind femoral sheath to reach the anterior surface of pectineus.

c. The *femoral branch of the genitofemoral nerve* occupies the lateral compartment of the femoral sheath along with the femoral artery. It supplies most of the skin over the femoral triangle.

d. The *lateral cutaneous nerve of the thigh* crosses the lateral angle of the triangle. Runs on the lateral side of thigh and ends by dividing into anterior and posterior branches. These supply anterolateral aspect of front of thigh and lateral aspect of gluteal region respectively.

5 The *deep inguinal lymph nodes* lie deep to the deep fascia. These lie medial to upper part of femoral vein

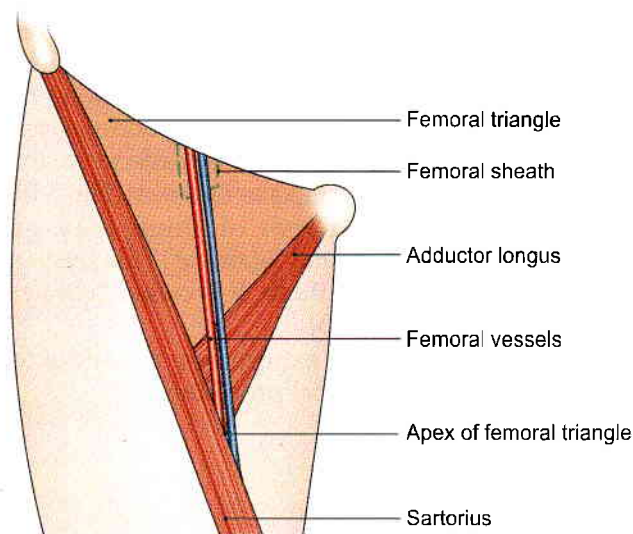


Fig. 3.12: Femoral sheath enclosing the upper parts of the femoral vessels

and receive lymph from superficial inguinal lymph nodes, from glans penis or clitoris and deep lymphatics of lower limb.

Femoral Sheath

This is a funnel-shaped sleeve of fascia enclosing the upper 3 to 4 cm of the femoral vessels. The sheath is formed by downward extension of two layers of the fascia of the abdomen. The anterior wall of the sheath is formed by the fascia transversalis which lies in the anterior abdominal wall deep to the transversus abdominis; and the posterior wall is formed by the fascia iliaca, which covers the iliacus muscle (Fig. 3.13). Inferiorly, the sheath merges with connective tissue around the femoral vessels.

The femoral sheath is asymmetrical. Its lateral wall is vertical, and the medial wall is oblique being directed downward and laterally (Fig. 3.14).

The sheath is divided into the following three compartments by septa (Fig. 3.14).

- The *lateral* or *arterial compartment* contains the *femoral artery* and the *femoral branch of the genitofemoral nerve*.
- The *intermediate* or *venous compartment* contains the *femoral vein*.
- The *medial* or *lymphatic compartment* is the smallest of all, and is known as the *femoral canal* which is described below.

Femoral Canal

This is the medial compartment of the femoral sheath. It is conical in shape, being wide above or at base and narrow below. It is about 1.5 cm long, and about 1.5 cm wide at the base (Figs 3.14, 3.15 and 3.18).

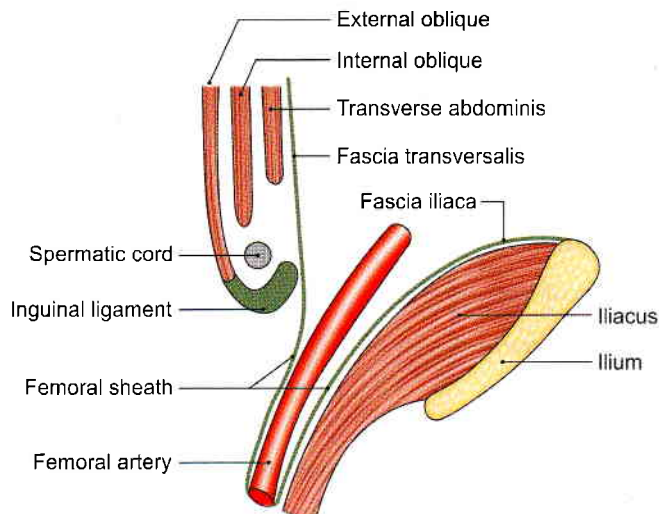


Fig. 3.13: Formation of the femoral sheath by extension of the fascia transversalis and the fascia iliaca into the thigh

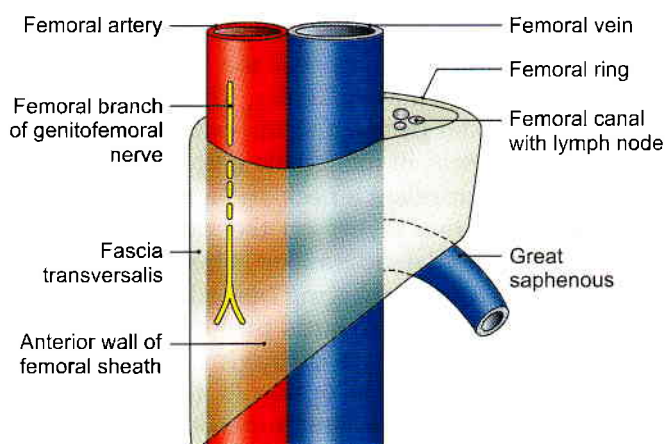


Fig. 3.14: Asymmetry of the right femoral sheath

The base or upper end of femoral canal is called *femoral ring*. The boundaries of ring are important.

It is *bounded* anteriorly by the inguinal ligament, posteriorly by pectineus and its covering fascia, medially by the concave margin of lacunar ligament, and laterally by the septum separating it from femoral vein.

The *inferior epigastric vessels* are closely related to junction of the anterior and lateral walls of ring. The femoral ring is closed by a condensation of extraperitoneal connective tissue called the *femoral septum*.

The parietal peritoneum covering septum from above shows a depression called *femoral fossa*.

The femoral canal contains a lymph node of *Cloquet* or of *Rosenmüller*, lymphatics, and a small amount of areolar tissue. The lymph node drains the glans penis in males and the clitoris in females.

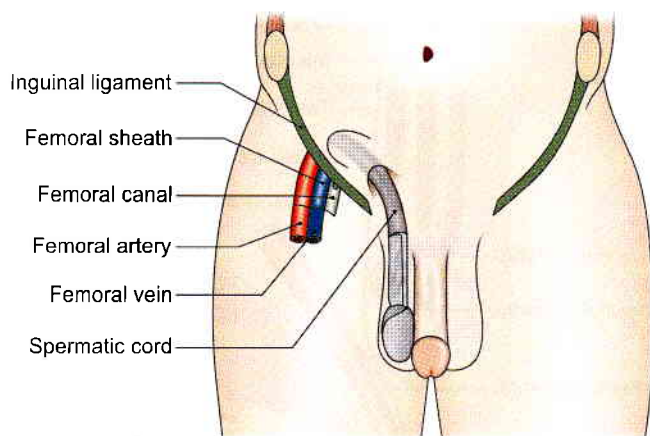


Fig. 3.15: Three compartments of femoral sheath

CLINICAL ANATOMY

- **Femoral hernia:** The femoral canal is an area of potential weakness in the abdominal wall through which abdominal contents may bulge out forming a femoral hernia. A femoral hernia is more common in females because the femoral canal is wider in them than in males. This is associated with the wider pelvis, and the smaller size of the femoral vessels, in the female (Fig. 3.16).

Hernia comprises a neck and a sac. Coverings are the various layers on the sac. Mostly the content of hernial sac is a loop of bowel (Fig. 3.17).

- The course of an enlarging hernial sac is typical. First it passes downwards through the femoral canal, then forwards through the saphenous opening, and finally upwards along with the superficial epigastric and superficial circumflex iliac vessels. For reduction of such a hernia the reverse course has to be followed (Fig. 3.18).
- In cases of strangulation of a femoral hernia, the surgeon has to enlarge the femoral ring. This is possible only by cutting the lacunar ligament; which forms the medial boundary of the ring. Normally this can be done without danger. Occasionally, however, an abnormal obturator artery may lie along the edge of the lacunar ligament; and cutting it may cause alarming haemorrhage (Fig. 3.19).
- **Abnormal obturator artery:** The normal obturator artery is a branch of the internal iliac. It gives a pubic branch which anastomoses with the pubic branch of the inferior epigastric artery. Occasionally, this anastomosis is large and the obturator artery then appears to be a branch of the inferior epigastric. Usually, the abnormal artery passes lateral to the femoral canal in contact with the femoral vein and is safe in an operation

to enlarge the femoral ring. Sometimes, however, the abnormal obturator artery may lie along the medial margin of the femoral ring, i.e. along the free margin of the lacunar ligament. Such an artery is likely to be cut if an attempt is made to enlarge the femoral ring cutting lacunar ligament (Fig. 3.19).

- Lateral cutaneous nerve of thigh may get entangled in the inguinal ligament. This leads to pain on lateral side of thigh. It is called "*meralgia parasthetica*" (Fig. 3.20B).
- The femoral artery is exposed in the adductor canal for various surgical procedures.

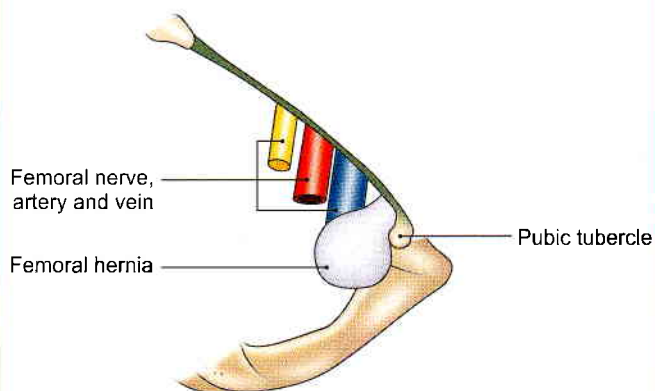


Fig. 3.16: Femoral hernia

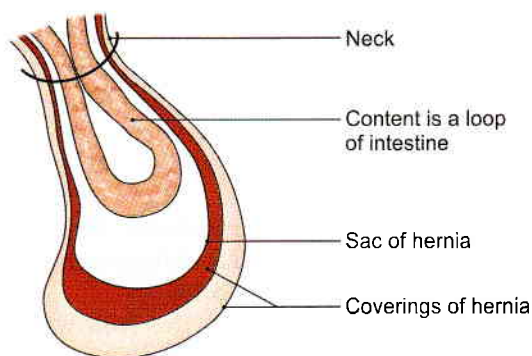


Fig. 3.17: Hernial sac with loop of bowel

FEMORAL ARTERY

This is the chief artery of the lower limb. Developmentally it is not derived from the axis artery. The original axis artery in the uppermost part of the limb is represented by the inferior gluteal artery.

Origin

It is the continuation of external iliac artery. It begins behind the inguinal ligament at the midinguinal point.

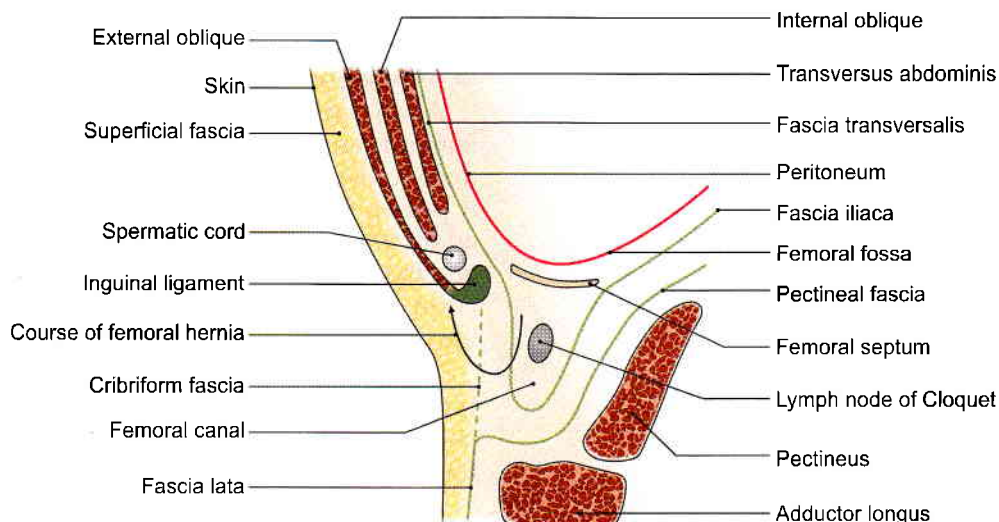


Fig. 3.18: Femoral canal and the course of a femoral hernia

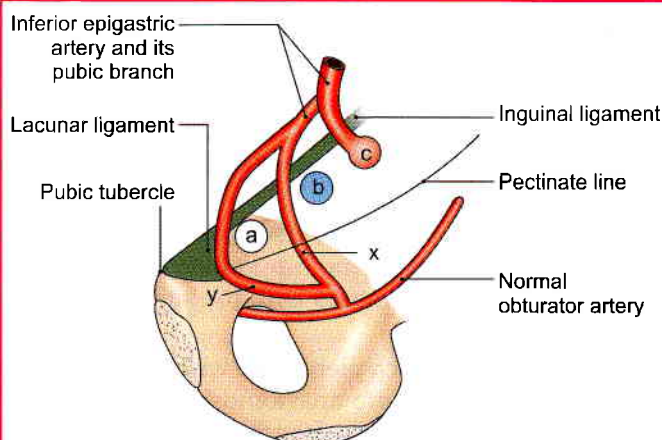


Fig. 3.19: Pubic region seen from behind to show the course of an abnormal obturator artery: a = femoral canal; b = femoral vein; c = junction of external iliac and femoral arteries; x = usual safe course of abnormal obturator artery; y = occasional dangerous position of artery

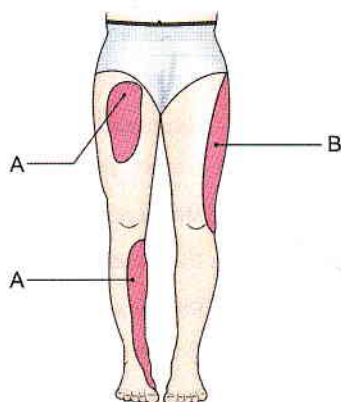


Fig. 3.20: (A) Sensory loss due to injury to femoral nerve, and (B) meralgia parasthetica

Extent and Course

It passes downwards and medially, first in the femoral triangle, and then in the adductor canal. At the lower end of the adductor canal, i.e. at the junction of the middle and lower thirds of the thigh it passes through an opening in the adductor magnus to become continuous with the popliteal artery (Fig. 3.21).

Relations of Femoral Artery in Femoral Triangle

Anterior: Skin, superficial fascia, deep fascia and the anterior wall of the femoral sheath.

Posterior: Psoas major, the pectineus, and the adductor longus. The posterior wall of the femoral sheath intervenes between these structures and the artery (Fig. 3.22).

Medial: The femoral vein. Just below the inguinal ligament the vein is medial to the artery. However, the vein gradually crosses to the lateral side posterior to the artery. It is directly behind the artery at the apex of the femoral triangle, and lateral to the lower end of the artery.

Lateral: The femoral nerve is lateral to the upper part of the artery. Lower down the artery is related to the branches of the nerve.

Branches in the Femoral Triangle

The femoral artery gives off three superficial and three deep branches in the femoral triangle.

The superficial branches are:

- Superficial external pudendal supplies the skin of external genital organs (Fig. 3.11).
- Superficial epigastric for skin and fasciae of lower part of anterior abdominal wall.
- Superficial circumflex iliac for skin along the iliac crest.

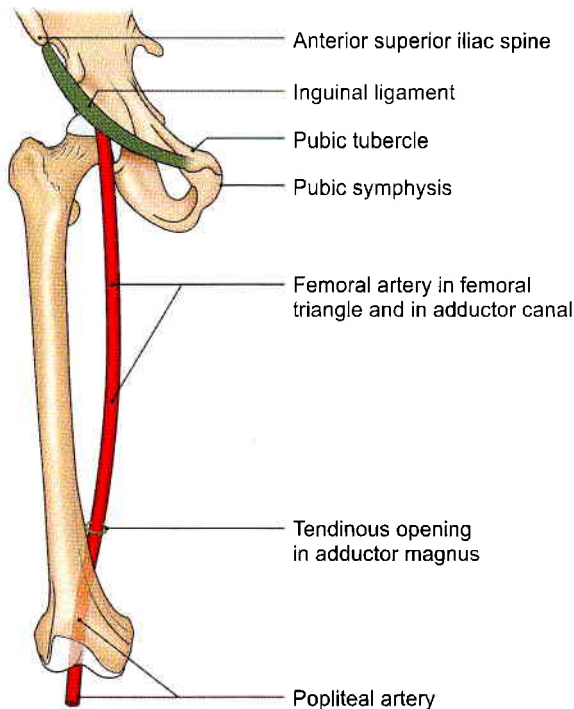


Fig. 3.21: Course and extent of the femoral artery

The deep branches are:

- Profunda femoris (Fig. 3.22)
- Deep external pudendal supplies the external genital organs.
- Muscular branches.

Profunda Femoris Artery

This is the largest branch of the femoral artery (Fig. 3.22). It is the chief artery of supply to all the three compartments of the thigh.

It arises from the lateral side of the femoral artery about 4 cm below the inguinal ligament. The origin lies in front of the iliacus.

As the artery descends, it passes posterior to the femoral vessels. It leaves the femoral triangle by passing deep to the adductor longus. Continuing downwards, it passes first between the adductor longus and the adductor brevis, and then between the adductor longus and the adductor magnus. Its terminal part pierces the adductor magnus to anastomose with upper muscular branches of the popliteal artery.

The profunda femoris artery gives off the medial and lateral circumflex femoral arteries, and three perforating arteries (see Fig. 7.12). It itself ends as the fourth perforating artery.

The *medial circumflex femoral artery* leaves the femoral triangle by passing posteriorly, between the pectineus and the psoas major muscles. It gives an acetabular branch and divides into an ascending and transverse branches. It supplies adductor muscles and head of femur.

The *lateral circumflex femoral artery* runs laterally between the anterior and posterior divisions of the femoral nerve, passes behind the sartorius and the rectus femoris, and divides into ascending, transverse and descending branches.

The ascending branch runs deep to the tensor fasciae latae, gives branches to the hip joint and the greater trochanter, and anastomoses with the superior gluteal artery.

The transverse branch pierces the vastus lateralis and takes part in the cruciate anastomosis on the back of the thigh just below the greater trochanter.

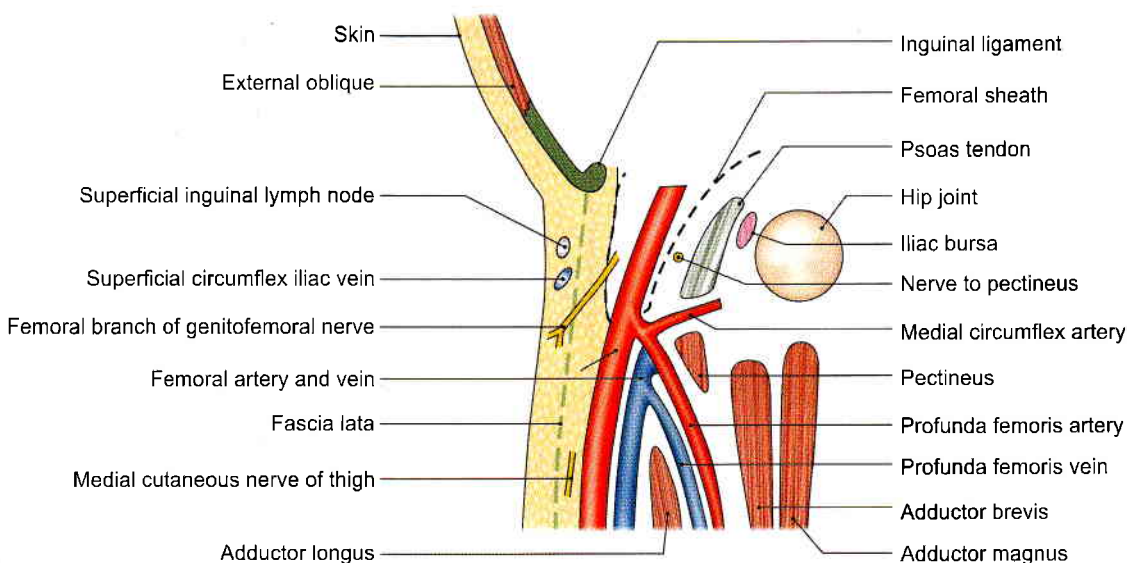


Fig. 3.22: Anterior and posterior relations of the femoral artery in the femoral triangle



The descending branch runs down along the anterior border of the vastus lateralis, accompanied by the nerve to that muscle.

Four *perforating arteries* are described in Chapter 7. These supply muscles attached to linea aspera.

Deep External Pudendal Artery

This branch of the femoral artery passes deep to the spermatic cord, or the round ligament of the uterus, and supplies the scrotum or the labium majus.

Muscular Branches

Numerous *muscular branches* arise from the femoral and profunda femoris artery, or its branches, to supply the muscles of the thigh.

CLINICAL ANATOMY

- The femoral artery can be compressed at the midinguinal point against the head of the femur or against the superior ramus of the pubis to control bleeding from the distal part of the limb in the thigh or leg.
- Pulsations of the femoral artery can be felt at the midinguinal point, against the head of the femur and the tendon of the psoas major. A bilateral absence or feebleness of the femoral pulse may result from coarctation or narrowing of the aorta, or thrombosis, i.e. clotting of blood within the aorta (Fig. 3.23).
- Stab wounds at the apex of the femoral triangle may cut all the large vessels of the lower limb because the femoral artery and vein, and the profunda femoris artery and vein are arranged in one line from before backwards at this site (Fig. 3.24). Injury to femoral vessels results in fatal haemorrhage.
- Since the femoral artery is quite superficial in the femoral triangle, it can be easily exposed for ligation, i.e. tying, or for passing a cannula or a thick needle. Catheters are passed upwards till the heart for certain minor operation (Fig. 3.25).
- The femoral vein is commonly used for *intravenous infusions in infants* and in patients with peripheral circulatory failure.

FEMORAL VEIN

It begins as an upward continuation of the popliteal vein at the lower end of the adductor canal, and ends by becoming continuous with the external iliac vein behind the inguinal ligament, medial to the femoral artery (Figs 3.11 and 3.14).

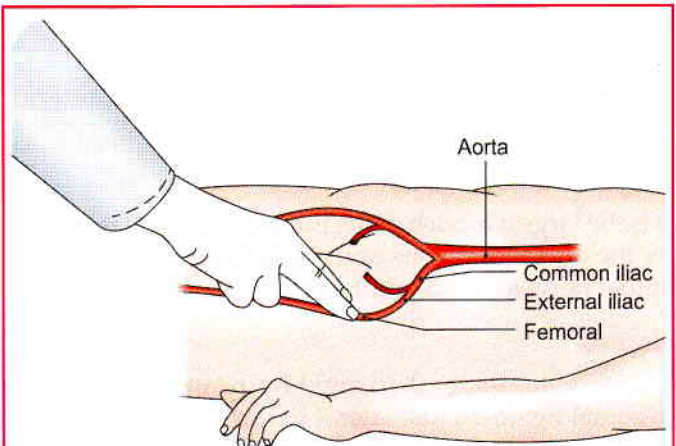


Fig. 3.23: Palpation of femoral pulse at midinguinal point

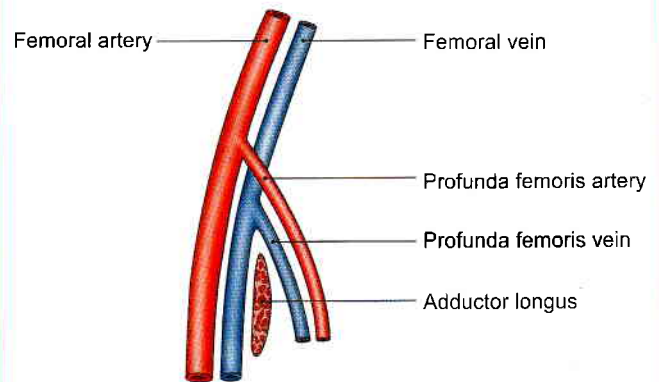


Fig. 3.24: Sagittal sectional view of four vessels

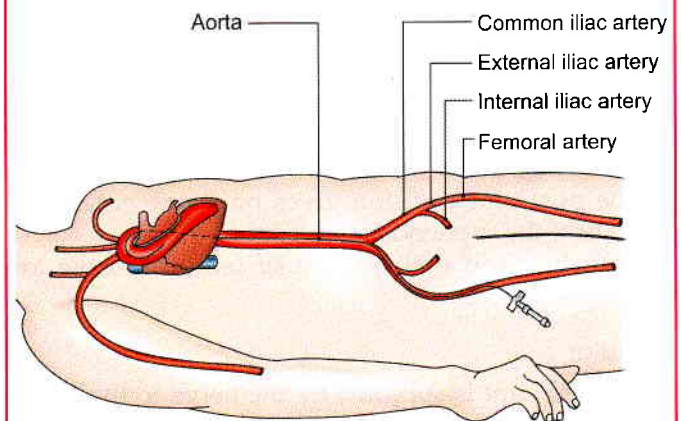


Fig. 3.25: Catheterisation of femoral artery

Tributaries: It receives:

- The great saphenous vein.
- Veins accompanying three deep branches of femoral artery in femoral triangle, i.e. profunda, deep external pudendal, and muscular.
- Lateral and medial circumflex femoral veins.
- The descending genicular and muscular veins in the adductor canal.



FEMORAL NERVE

The femoral nerve is the chief nerve of the anterior compartment of the thigh.

Origin and Root Value

It is the largest branch of the lumbar plexus. It is formed by the dorsal divisions of the anterior primary rami of spinal nerves L2, L3 and L4 (Fig. 3.3).

Course

It enters the femoral triangle by passing behind the inguinal ligament just lateral to the femoral artery.

In the thigh, it lies in the groove between the iliacus and the psoas major, outside the femoral sheath, and lateral to the femoral artery. The nerve is not included in the femoral sheath as its formation is behind the fascia iliaca which is forming posterior wall of the sheath.

After a short course of about 2.5 cm below the inguinal ligament, the nerve divides into anterior and posterior divisions which are separated by the lateral circumflex femoral artery (Figs 3.11 and 3.26).

BRANCHES AND DISTRIBUTION

Muscular

- 1 The anterior division supplies the sartorius.
- 2 The posterior division supplies the rectus femoris, the three vasti and the articularis genu. The articularis genu is supplied by a branch from the nerve to vastus intermedius.

Cutaneous

- 1 The anterior division gives two cutaneous branches, the intermediate and the medial cutaneous nerves of the thigh.
- 2 The posterior division gives only one cutaneous branch, the saphenous nerve.

Branches and distribution of femoral nerve are shown in Fig. 3.26.

Articular

- 1 The hip joint is supplied by the nerve to the rectus femoris.
- 2 The knee joint is supplied by the nerves to the three vasti. The nerve to the vastus medialis contains numerous proprioceptive fibres from the knee joint, accounting for the thickness of the nerve. This is in accordance with *Hilton's law*: Nerve supply to a muscle which lies across a joint, not only supplies the muscle, but also supplies the joint beneath and the skin overlying the muscle.

Vascular

To the femoral artery and its branches.

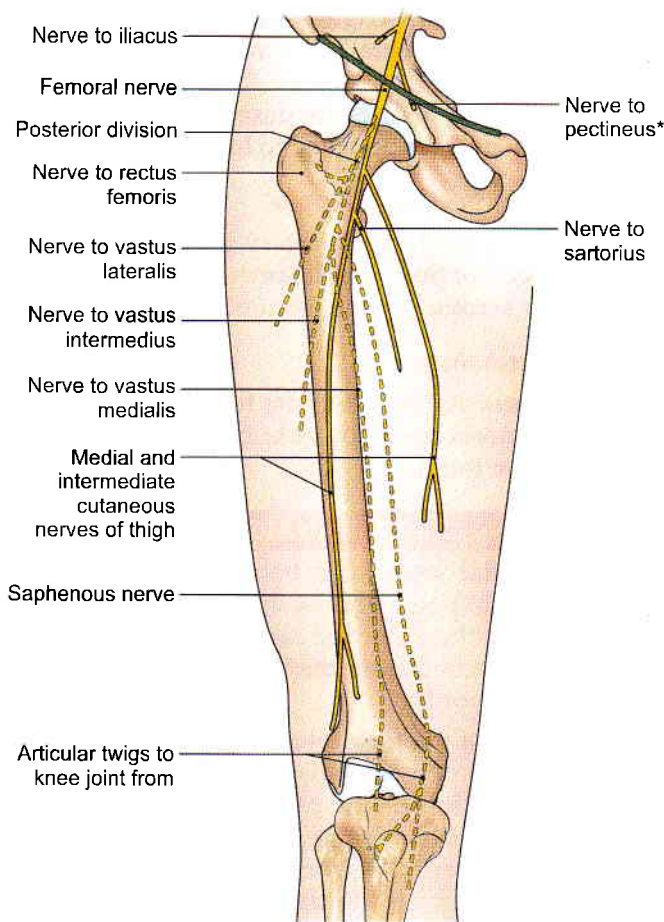


Fig. 3.26: The branches and distribution of femoral nerve

*The nerve to the pectineus arises from the medial side of the femoral nerve just above the inguinal ligament. It passes obliquely downwards and medially, behind the femoral sheath, to reach the anterior surface of the muscle.

CLINICAL ANATOMY

Injury to the femoral nerve by wounds in the groin, though rare, causes paralysis of the quadriceps femoris and a sensory deficit on the anterior and medial sides of the thigh and medial side of leg (Fig. 3.20A).

MUSCLES OF THE FRONT OF THE THIGH

The muscles of the anterior compartment of the thigh are the sartorius, the quadriceps femoris, and the articularis genu (Figs 3.27 and 3.28). In addition to these, some muscles belonging to other regions are also encountered on the front of the thigh. The iliacus and psoas major muscles, which form part of the floor of the femoral triangle, have their origin within the abdomen. The pectineus and adductor longus, also seen in relation to the femoral triangle, are muscles of the

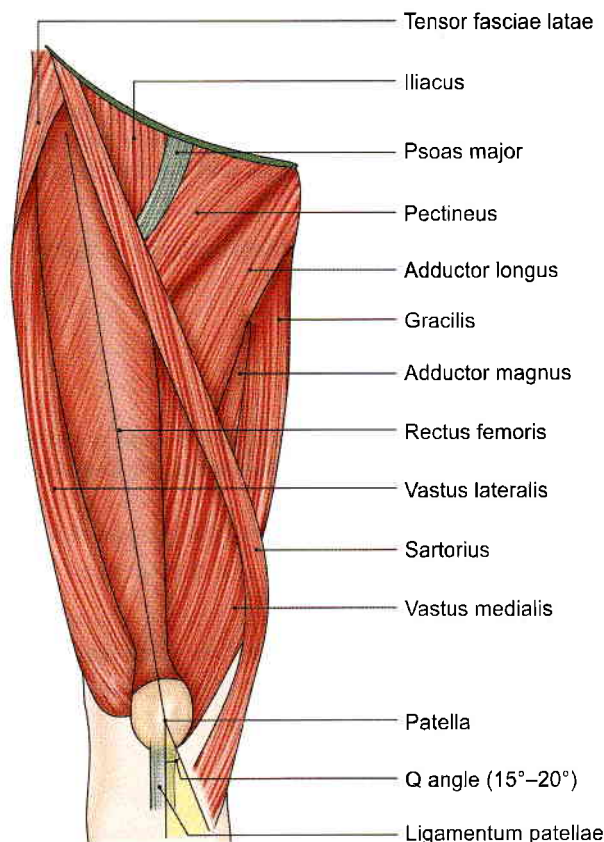


Fig. 3.27: Muscles seen on the front of the thigh

medial compartment of the thigh. They are described in Chapter 4. In the upper lateral corner of the front of the thigh, we see the tensor fasciae latae. This is a muscle of the gluteal region and is described in Chapter 5.

The *sartorius* (sartor = tailor) is long, narrow and ribbon—like. It runs downwards and medially across the front of the thigh. It is the longest muscle in the

body (Fig. 3.29). Its attachments are given in Table 3.1. Its nerve supply and actions are given in Table 3.2.

The *quadriceps femoris* is so called because it consists of four parts. These are the rectus femoris, the vastus lateralis, the vastus medialis, and the vastus intermedius. The rectus femoris is fusiform. It runs more or less vertically on the front of the thigh superficial to the vasti. The three vasti are wrapped around the shaft of the femur in the positions indicated by their names. The attachments of the components of the quadriceps femoris are given in Table 3.1. Their nerve supply and actions are given in Table 3.2.

The *articularis genu* consists of a few muscular slips that arise from the anterior surface of the shaft of the femur, a few centimetres above the patellar articular margin. They are inserted into the upper part of the synovial membrane of the knee joint. They pull the synovial membrane upwards during extension of the knee, thus preventing damage to it.

Iliacus and Psoas Major

These muscles form the lateral part of the floor of the femoral triangle. They are classified as muscles of the iliac region, and also among the muscles of the posterior abdominal wall. Since the greater parts of their fleshy bellies lie in the posterior abdominal wall, they will be described in detail in the section on the abdomen. However, on account of their principal action on the hip joint, the following points may be noted.

- 1 Both have a common insertion on the lesser trochanter of the femur and are the chief and powerful flexors of the hip joint.
- 2 Because of their common insertion and action, the two muscles are often referred to by a common name, the iliopsoas.

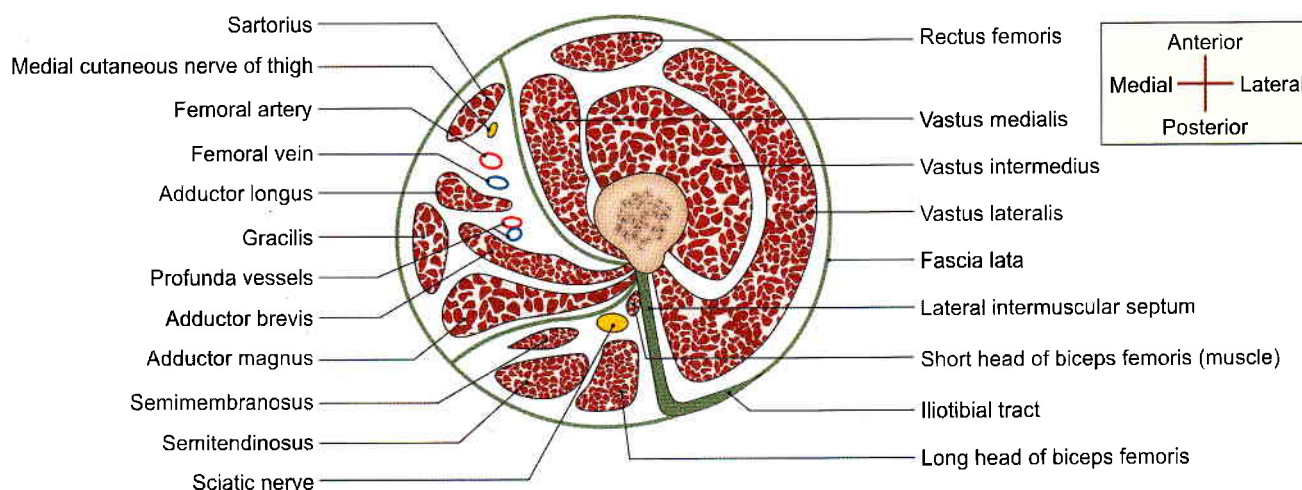


Fig. 3.28: Transverse section through the upper third of the thigh

**Table 3.1: Muscles of the anterior or extensor compartment of thigh**

<i>Muscle</i>	<i>Origin from</i>	<i>Insertion into</i>
1. Sartorius (Latin <i>tailor</i>) (Fig. 3.27)	<ul style="list-style-type: none"> • Anterior superior iliac spine • Upper half of the notch below the spine 	Upper part of the medial surface of the shaft of the tibia in front of the insertions of the gracilis and the semitendinosus
2. Quadriceps femoris		
A. Rectus femoris (Fig. 3.27) fusiform, superficial fibres bipennate, deep fibres straight	<ul style="list-style-type: none"> • Straight head: from the upper half of the anterior inferior iliac spine • Reflected head: from the groove above the margin of the acetabulum and the capsule of the hip joint 	Base of patella, anterior to vastus intermedius
B. Vastus lateralis (Fig. 3.27) forms large part of quadriceps femoris	The origin is linear from <ul style="list-style-type: none"> • Upper part of intertrochanteric line • Anterior and inferior borders of greater trochanter • Lateral lip of gluteal tuberosity • Upper half of lateral lip of linea aspera 	<ul style="list-style-type: none"> • Lateral part of the base of patella • Upper one-third of the lateral border of patella • Expansion to the capsule of knee joint, tibia and iliotibial tract
C. Vastus medialis (Fig. 3.27)	The origin is linear from <ul style="list-style-type: none"> • Lower part of intertrochanteric line • Spiral line • Medial lip of linea aspera • Upper one-fourth of medial supracondylar line 	Medial one-third of the base and upper two-thirds of the medial border of the patella
D. Vastus intermedius (Fig. 3.28)	Upper three-fourths of the anterior and lateral surfaces of the shaft of femur	Base of patella*
3. Articularis genu	Anterior surface of femur	Suprapatellar bursa/synovial membrane of knee joint

*The patella is a sesamoid bone in the tendon of the quadriceps femoris. The ligamentum patellae is the actual tendon of the quadriceps femoris, which is inserted into the upper part of tibial tuberosity

Table 3.2: Nerve supply and actions of muscles

<i>Muscle</i>	<i>Nerve supply</i>	<i>Actions</i>
1. Sartorius	Femoral nerve	Abductor and lateral rotator of thigh Flexor of leg at knee joint These actions are involved in assuming the position in which a tailor work, i.e. palthi posture used during prayer sessions also.
2. Quadriceps femoris		
A. Rectus femoris	Femoral nerve, this branch also supplies hip joint	Extensor of knee joint, also called "kicking muscle". Flexor of hip joint
B. Vastus lateralis	Femoral nerve, this branch also supplies knee joint	Extends knee joint, helps in standing, walking and running
C. Vastus medialis	Same as above	Extends knee joint, prevents lateral displacement of patella. Rotates femur medially during locking stage of extension of knee joint. Action is extremely important for stability of patella.
D. Vastus intermedius	Same as above	Extends knee joint
3. Articularis genu	Femoral nerve	It pulls the synovial membrane upwards during extension of the knee, thus preventing damage to it



- 3 Both are supplied by spinal segments L2 and L3. The psoas is supplied by the branches from the nerve roots, whereas the iliacus is supplied by the femoral nerve.

CLINICAL ANATOMY

- *Testing for Quadriceps Femoris:* A person lies supine with one bare lower limb and hip and knee joints partially flexed. The right hand of physician presses the person's right leg downwards. He is requested to straighten the knee against resistance of the physician's right hand, while his left hand feels the contracting quadriceps muscle above the knee (Fig. 3.29).
- Patellar tendon reflex or knee jerk (L3, L4). The knee joint gets extended on tapping the ligamentum patellae (Fig. 3.30).
- Psoas abscess formed due to tubercular infection of lumbar vertebrae can track down between psoas major muscles and its fascia to reach behind the inguinal ligament into the femoral triangle. It may be mistaken for enlarged lymph nodes (Fig. 3.31).
- Intramuscular injection can be given in anterolateral region of thigh in the vastus lateralis muscle (Fig. 3.32).

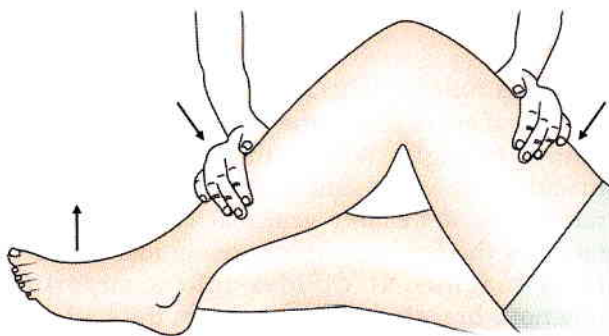


Fig. 3.29: Shows how to test the quadriceps femoris muscle

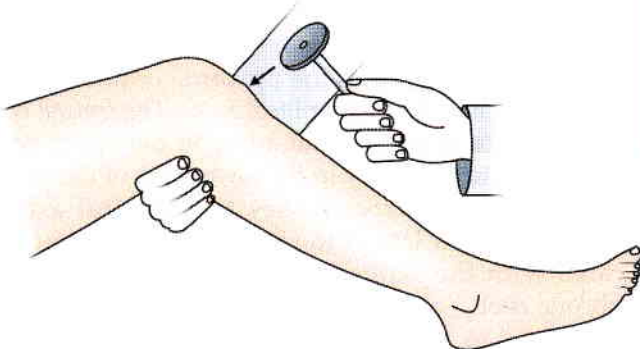


Fig. 3.30: Patellar tendon reflex

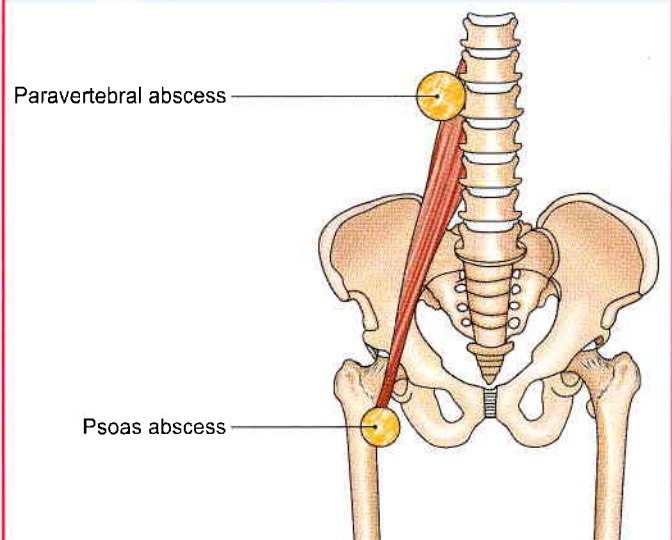


Fig. 3.31: Course of psoas abscess

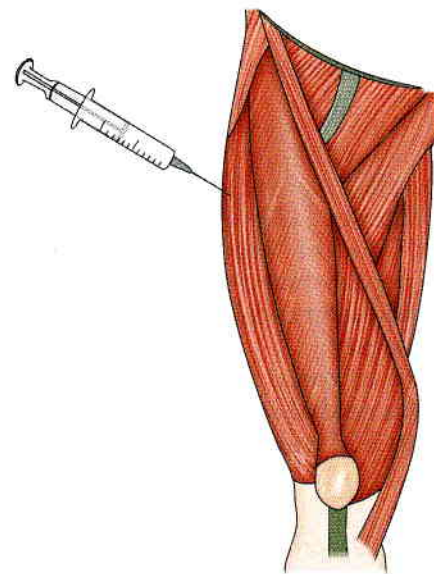


Fig. 3.32: Anterolateral region of thigh

ADDUCTOR/HUNTER'S/SUBSARTORIAL CANAL

DISSECTION

Upper one-third of sartorius forms the lateral boundary of the femoral triangle.

On lifting the middle one-third of sartorius, a part of deep fascia stretching between vastus medialis and adductor muscles is exposed. On longitudinal division of this strong fascia, the adductor canal subsartorial canal/Hunter's canal is visualised (Fig. 3.33).

Dissect its contents, e.g. femoral vessels, saphenous nerve and nerve to vastus medialis, and distal parts of both divisions of obturator nerve.

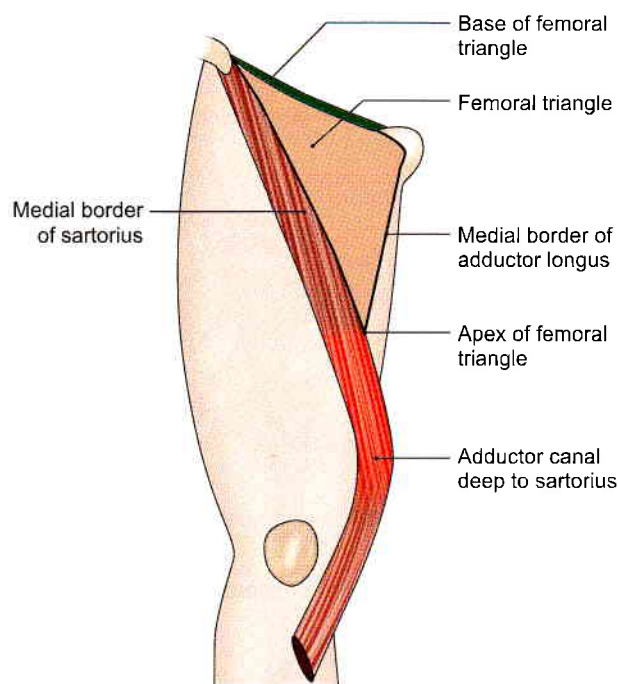


Fig. 3.33: Location of the adductor canal

Features

This is also called the subsartorial canal or Hunter's canal. John Hunter (1729–93) was an anatomist and surgeon at London. Hunter's operation for the treatment of popliteal aneurysm by ligating the femoral artery in the adductor canal is a landmark in the history of vascular surgery.

The adductor canal is an intermuscular space situated on the medial side of the middle one-third of the thigh (Figs 3.33 and 3.34).

Extent

The canal extends from the apex of the femoral triangle, above, to the tendinous opening in the adductor magnus, below.

Shape

The canal is triangular on cross-section.

Boundaries

- It has anterolateral, posteromedial and medial walls.
- The anterolateral wall is formed by the vastus medialis.
- The posteromedial wall or floor is formed by the adductor longus, above, and the adductor magnus, below.
- The medial wall or roof is formed by a strong fibrous membrane joining the anterolateral and posteromedial walls. The roof is overlapped by the sartorius.

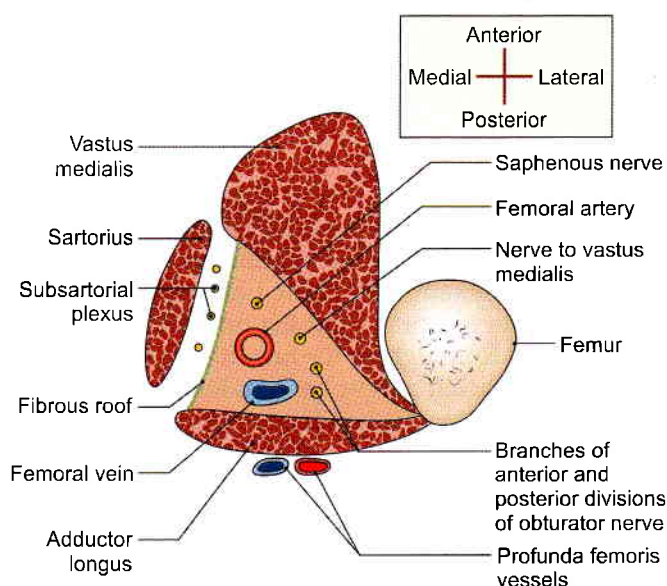


Fig. 3.34: Transverse section through the middle of the right adductor canal, seen from above. Note the boundaries and contents of the canal

The *subsartorial plexus* of nerves lies on the fibrous roof of the canal under cover of the sartorius. The plexus is formed by branches from the medial cutaneous nerve of the thigh, the saphenous nerve, and the anterior division of the obturator nerve. It supplies the overlying fascia lata and the neighbouring skin.

Contents

These are as follows (Fig. 3.35).

- 1 The *femoral artery* enters the canal at the apex of the femoral triangle. Within the canal it gives off muscular branches and a descending genicular branch. The *descending genicular artery* is the last branch of the femoral artery arising just above the hiatus magnus. It divides into a superficial saphenous branch that accompanies the saphenous nerve, and a deep muscular branch that enters the vastus medialis and reaches the knee. Femoral artery leaves the adductor canal through the opening in adductor magnus muscle to continue as popliteal artery in the popliteal fossa.
- 2 Femoral vein begins as the upward continuation of popliteal vein from the popliteal fossa. The *femoral vein* lies posterior to the femoral artery in the upper part, and lateral to the artery in the lower part of the canal.
- 3 The *saphenous nerve* crosses the femoral artery anteriorly from lateral to medial side. It leaves the canal with the saphenous artery by piercing the fibrous roof.
- 4 The *nerve to the vastus medialis* lies lateral to the femoral artery, and enters the vastus medialis in the upper part of the canal.

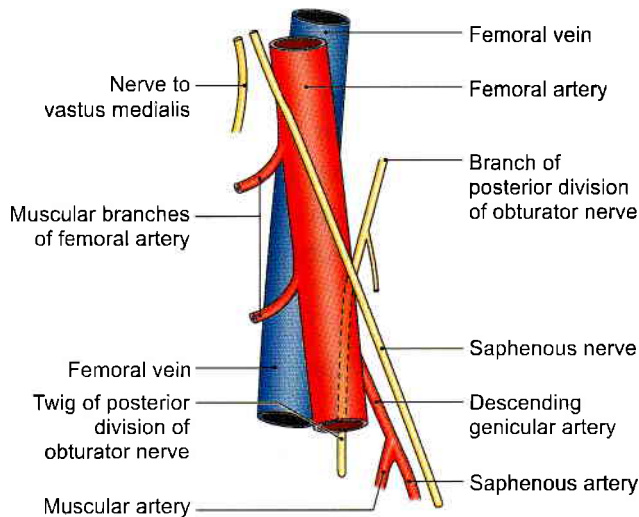


Fig. 3.35: Contents of the adductor canal

- 5 *Branches of two divisions of obturator nerve:* The anterior division emerges at the lower border of the adductor longus, gives branches to the subsartorial plexus, and ends by supplying the femoral artery. The posterior division of the obturator nerve runs on the anterior surface of the adductor magnus, accompanies the femoral and popliteal arteries, and ends by supplying the knee joint (Fig. 3.34).

FACTS TO REMEMBER

- Sartorius is the longest muscle of the body.
- Saphenous is the longest cutaneous nerve.
- Femoral hernia is common in female, while inguinal hernia is common in male
- Embalming for preservation of the dead body is also done through femoral artery
- Insertion of vastus medialis extends to lower level on patella than that of vastus lateralis to stabilise the patella.

CLINICOANATOMICAL PROBLEM

A 50-year-old woman complained of a swelling in upper medial side of her right thigh, when she coughs.

- Where is the swelling and why does it appear when she coughs?
- What is the position of the swelling in relation to pubic tubercle?

Ans: The swelling is the femoral hernia which appears at saphenous opening when she coughs due to raised intra-abdominal pressure. The swelling is inferolateral to the pubic tubercle. The femoral hernia is more common in females due to larger pelvis, larger femoral canal and smaller femoral vessels.

MULTIPLE CHOICE QUESTIONS

- Which is longest superficial vein of lower limb?
 - Long saphenous vein
 - Femoral vein
 - Popliteal vein
 - None of these
- Which of these pair of muscle are inserted into upper part of iliotibial tract?
 - Gluteus maximus and tensor fasciae latae
 - Gluteus maximus and pectineus
 - Pectineus and tensor fasciae latae
 - Adductor longus and pectineus
- Iliotibial tract stabilizes knee in:
 - Extension
 - Partial flexion
 - Both a and b
 - None of above
- Which one of the following make lateral boundary of femoral triangle?
 - Inguinal ligament
 - Adductor longus
 - Medial border of sartorius muscle
 - Pectineus
- Femoral artery is the continuation of:
 - Popliteal artery
 - External iliac artery
 - Profunda femoris artery
 - Obturator artery
- Medial boundary of femoral ring is formed by:
 - Inguinal ligament
 - Pectineus
 - Lacunar ligament
 - Femoral vein
- Which is the largest branch of femoral artery?
 - Superficial external pudendal
 - Superficial epigastric
 - Deep external pudendal
 - Profunda femoris artery
- Which is not a part of quadriceps femoris?
 - Rectus femoris
 - Vastus medialis
 - Sartorius
 - Vastus lateralis



9. Which muscles have common insertion on lesser trochanter of femur?
- Iliacus and psoas major
 - Pectineus and adductor longus
 - Psoas major and Pectineus
 - None of these
10. A femoral hernia is more common in female due to:
- Wider pelvis
 - Smaller size of femoral vessel
 - Femoral canal is wider
 - All of above
11. Which region of thigh is preferred to give intramuscular injection in children?
- Anterolateral region
 - Anteromedial region
 - Posterolateral region
 - Posteromedial region
12. Which vein is commonly used for intravenous infusions in children?
- Femoral vein
 - Long saphenous vein
 - Popliteal vein
 - Short saphenous vein

ANSWERS

1. a 2. a 3. c 4. c 5. b 6. c 7. d 8. c 9. a 10. d 11. a 12. a