

# Chapter 3

## Anatomy of the Groin

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### Arteries and Veins of the Groin

#### *Arteries*

The structures of the groin are in close proximity to major vessels—most notably the femoral and external iliac arteries (Fig. 3.1). Thus, its highly vascular nature comes to no surprise. To clearly describe the arterial blood supply to the inguinal area, it can be divided into two parts: superficial and deep. The superficial vessels supply the skin and subcutaneous tissue, while the deep vessels supply structures such as the muscles and fascia. One must note, however, that anastomoses exist between the superficial and deep vessels.

#### Superficial Arterial Supply

Proximal superficial branches of the femoral artery supply this part of the groin. The specific branches, from lateral to medial, are the superficial circumflex iliac artery, the superficial epigastric artery, and the superficial external pudendal artery (Fig. 3.2).

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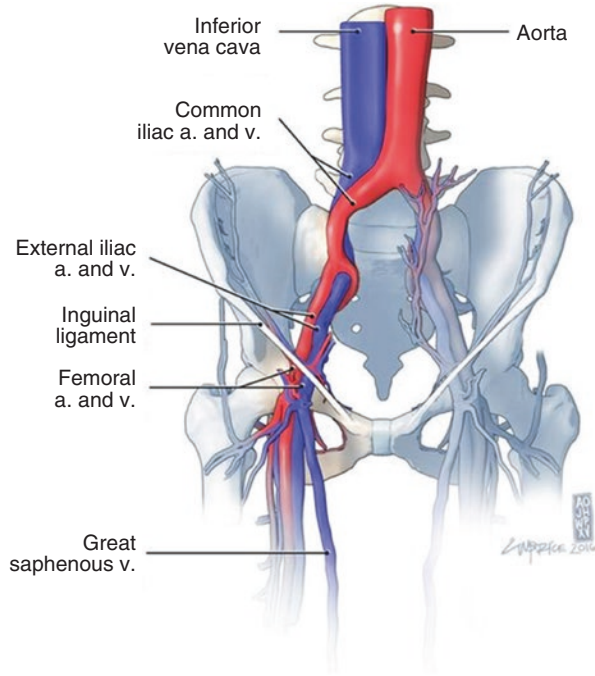
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**Fig. 3.1** An anterior view of the pelvis illustrating the large vessels traversing the inguinal region



### Superficial Circumflex Iliac Artery

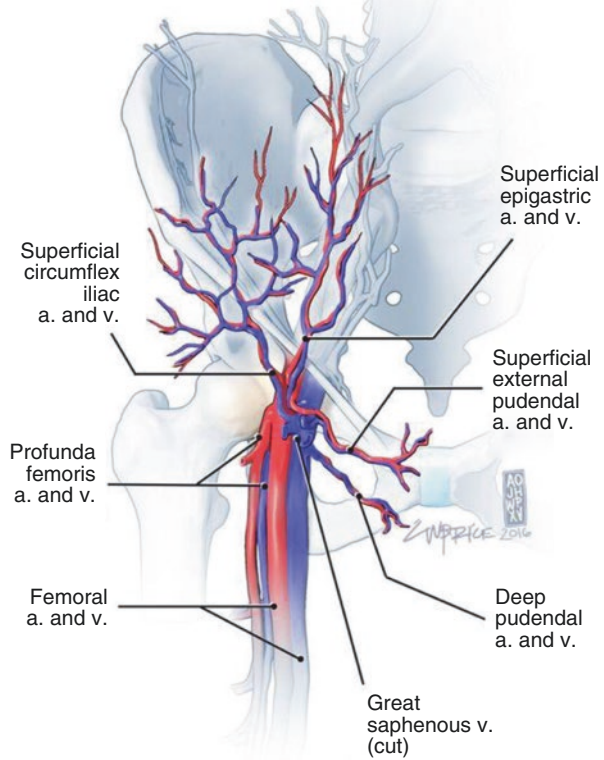
The superficial circumflex iliac artery is the smallest of the three main superficial branches. It pierces through the fascia lata as its origin is usually lateral to the saphenous opening. It travels superolaterally, in the direction of the anterior superior iliac spine, to become highly branching and supplies the region of the skin over the lateral third of the inguinal ligament and the iliac crest. This artery also supplies the superficial fascia and superficial inguinal nodes along its course. It anastomoses with branches of the deep circumflex iliac, superior gluteal, and lateral circumflex femoral artery.

The superficial circumflex artery can be divided into three subtypes: type 1, type 2, and type 3. In type 1 or archetype, it originates below the inguinal ligament and may have branches. Type 2 is seen when it arises from the deep circumflex iliac artery. In type 3, the artery is absent. Type 3 has a prevalence of about 17%.

### Superficial Epigastric Artery

Medial to the superficial circumflex iliac artery, and following a more vertical course, is the superficial epigastric artery. Typically, it originates from the anterior aspect of the femoral artery about 2–5 cm distal to the inguinal ligament. It ascends anterior to the inguinal ligament up to the region just below the umbilicus. It supplies the skin, superficial fascia, and inguinal nodes in midinguinal area. Branches of the superficial epigastric artery anastomose with those of the contralateral artery. It also communicates with the inferior epigastric artery.

**Fig. 3.2** Illustration of the superficial branches that supply the inguinal area



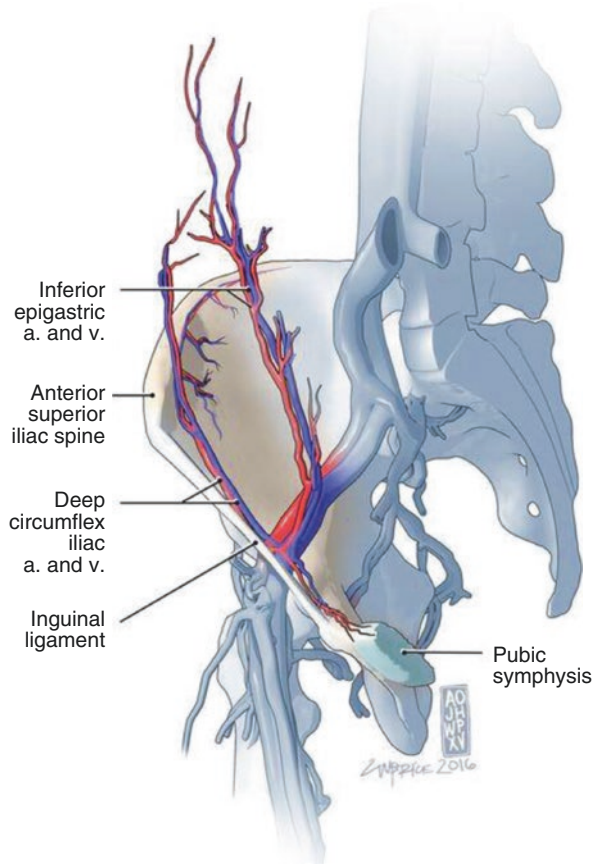
Variations in the origin of the superficial epigastric artery have been previously reported. It often originates from a trunk that is shared with the superficial circumflex iliac artery. It may also branch from the pudendal artery or the profunda femoris artery. Results from studies on the prevalence of this vessel vary widely from 58 to 90%.

### **Superficial External Pudendal Artery**

The superficial external pudendal artery has a medial origin on the femoral artery. It has a medial route, coursing in the direction of the pubic symphysis where it traverses the spermatic cord in males and the round ligament in females. It supplies cutaneous blood flow to the inferior abdomen, the penis, and the scrotum in males and the labia majora in females. It anastomoses with branches of the internal pudendal artery.

The source of the superficial external pudendal artery is almost always the femoral artery, but rarely it may originate from the profunda femoris artery. It has also been observed to share a common trunk with the superficial epigastric artery.

**Fig. 3.3** Illustration of the deep vessels that supply the inguinal area



### Deep Arterial Supply

The deep layer of the groin obtains its blood supply mainly from two arteries: the deep circumflex iliac and the inferior epigastric (Fig. 3.3). More superiorly, some of its supply may be derived from the anterior branches of the subcostal and lumbar arteries. The ascending branch of the deep circumflex iliac, along with the anterior branches of the subcostal and first four lumbar arteries, can be found between the internal oblique and transversus abdominis muscles. Here, their vascular networks supply the muscles that they come into contact with.

### Deep Circumflex Iliac Artery

The deep circumflex iliac artery branches off of the lateral aspect of the external iliac artery and supplies the deep lateral groin. It's a laterally running nerve that forms many anastomoses. Its initial direction is toward the anterior superior iliac spine. Up

to this point, it remains enclosed in a sheath of connective tissue formed from fibers of the transversalis fascia and the iliac fascia. Near the anterior superior iliac spine, three important things occur: (1) it anastomoses with the ascending branch of the lateral circumflex femoral artery, (2) the artery pierces the transversalis fascia and continues laterally along the inner lip of the ilium, and (3) a large ascending branch is given off. The deep circumflex iliac artery continues laterally and posteriorly to anastomose with the iliolumbar and superior gluteal arteries. The ascending branch passes through the transversus abdominis muscle just superior to its origin and continues in a cephalad direction. Here, it runs between, and supplies, the transversus abdominis and inner oblique muscles. It continues in this intermuscular plane to form anastomoses with the lumbar and inferior epigastric arteries. Small proximal branches may also anastomose with the superficial circumflex iliac artery.

### **Inferior Epigastric Artery**

The inferior epigastric artery, a branch of the external iliac artery, has its origin just medial to that of the deep circumflex iliac artery. The inferior epigastric gives off two branches: the pubic and the external spermatic (or cremasteric). The pubic branch crosses the conjoint tendon to travel inferiorly toward the obturator artery. It forms an anastomosis with the obturator artery. When this pubic branch is large (20–30% of cases), it takes the place of the obturator to become the aberrant obturator artery. Notably, this pubic branch may also enter the inguinal (Hesselbach's) triangle. The external spermatic branch joins with the contents of the spermatic cord in the male. Here it supplies the cremasteric muscle and other fascial layers within the cord. It also anastomoses with the testicular artery. In females, the artery is relatively smaller and supplies the round ligament.

The inferior epigastric artery, together with its accompanying vein, forms the lateral border of the inguinal (Hesselbach's) triangle. The artery courses superomedially toward the rectus abdominis muscle, passing near the medial border of the deep inguinal ring. Thus it lies deep to the origin of the spermatic cord. While traveling anterior to the parietal peritoneum, the artery causes an observable elevated fold that is evident from an intraabdominal view of the anterior abdominal wall. This fold is called the lateral umbilical fold. Near the lateral border of the rectus abdominis muscle, in the region of the apex of the inguinal triangle, the artery pierces the transversalis fascia. It continues superiorly, just lateral to the midline, along the posterior aspect of the rectus abdominis where it passes anterior to the arcuate line. It remains between the rectus abdominis and the posterior lamina of the rectus sheath to anastomose with the superior epigastric artery (above the umbilicus) and the lower posterior intercostal arteries. During its ascension, the inferior epigastric artery also gives off several branches that anastomose with other arteries. Its branches join with branches of the superficial epigastric, circumflex iliac, and lumbar arteries. In the end, the inferior epigastric artery supplies muscles of the abdominal wall, peritoneum, and even some areas of skin over the lower abdomen via its cutaneous branches.

A few variations in the origin of the inferior epigastric artery have been noted. It may sometimes branch off of the femoral artery, in which case it ascends to enter the abdominal cavity. It is also not uncommon to have it arising from the external iliac artery via a common trunk with the obturator artery. Rarely, it may originate from the obturator artery itself from the internal iliac artery.

## ***Veins***

The veins of the inguinal region generally tend to accompany their similarly named arteries. Thus, the superficial groin will be drained by the superficial circumflex iliac, the superficial epigastric, and the superficial external pudendal veins. These three superficial veins transport their deoxygenated blood to the saphenous vein. The deeper structures of the groin will be drained mainly by the deep circumflex iliac veins and the inferior epigastric veins. These veins usually occur in pairs, or *venae comitantes*, for each artery, eventually combining to form one common vein. These deep veins drain into the external iliac vein—about 1 cm above the inguinal ligament for the inferior epigastric vein and about 2 cm above the inguinal ligament for the deep circumflex iliac vein.

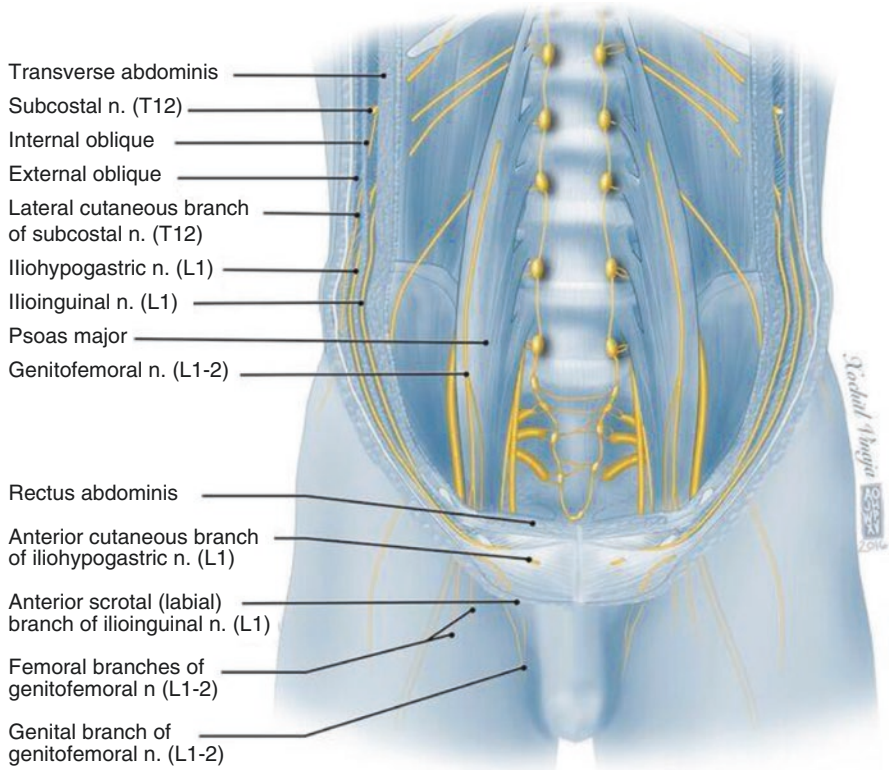
The great saphenous vein usually joins with the femoral vein at the saphenous opening. However, it may also pierce the fascia lata prior to reaching the saphenous ring, it may be duplicated, or a venous network may replace it. Variations of the venous drainage in the vicinity of the saphenous opening are numerous. Most commonly, the superficial circumflex iliac and the superficial epigastric veins combine before joining the saphenous vein. In one variant, all three superficial veins drain directly into the femoral vein.

An inconstant vein, the thoracoepigastric vein, may be observed on the anterior abdominal wall and connects the inferior epigastric vein, or the femoral vein, with the lateral thoracic veins. This essentially communicates the inferior vena cava drainage area to that of the superior vena cava.

Variation of the external iliac vein, which drains the inferior epigastric vein and the deep circumflex iliac vein, is uncommon. Unilateral aplasia, bilateral aplasia, and duplication have all been reported.

## **Nerves of the Groin**

The lumbar plexus originates from the ventral rami of lumbar nerves one to four. The inguinal region receives its somatic motor and sensory innervation from the terminal branches of the lumbar plexus (Fig. 3.4). The groin receives its innervation mainly from three nerves: the iliohypogastric, the ilioinguinal, and the genitofemoral. The femoral and obturator nerves, though they don't innervate the groin, are at



**Fig. 3.4** This illustration highlights the innervation of the inguinal region by nerves originating from the lumbar plexus

risk of damage due to pathology or intervention in this region. Thus, they will also be briefly mentioned as knowledge of their course is a necessity prior to manipulation of this area.

### *Iliohypogastric Nerve*

The iliohypogastric nerve commonly shares its origin with the ilioinguinal nerve. Its fibers originate mainly from L1, but it may also have some contribution from T12. It emerges anterior to the quadratus lumborum and posterolateral to the origin of the psoas muscles. It continues to course on the anterior belly of the quadratus lumborum muscle until it crosses its lateral margin. At this point, it pierces the transversus abdominis muscle and continues in the intermuscular plane between the transversus abdominis and the internal oblique muscles. It continues superior and parallel to the iliac crest and gives off a lateral cutaneous branch (iliac branch) near to the anterior

superior iliac spine. The lateral cutaneous branch sits between the internal and external oblique above the iliac crest. It innervates the skin in the posterolateral gluteal region. An anterior cutaneous branch (hypogastric branch) continues between the internal oblique and the transversus abdominis. As it continues on its medial course, it penetrates the internal oblique and the external oblique aponeurosis to enter the subcutaneous area about 3 cm above the superficial inguinal ring. It innervates the skin just superior to the pubic symphysis. Apart from this sensory function, it also innervates the abdominal muscles that it comes into contact with. The iliohypogastric nerve communicates with neighboring nerves, namely, the subcostal and ilioinguinal nerves.

The lateral cutaneous branch of the inguinal nerve may sometimes be replaced by the lateral thoracic branch of T12. Another possible variation occurs when the anterior cutaneous branch supplies the pyramidalis muscle. At times the hypogastric branch may be replaced by the ilioinguinal nerve in the region of the external inguinal ring. The fibers of the hypogastric branch may also combine with those of the twelfth thoracic nerve. Instead of originating from L1, the iliohypogastric nerve may also originate from T12 and may even obtain some of its fibers from T11. The nerve may be absent in up to 20.6% of persons.

### *Ilioinguinal Nerve*

Though the ilioinguinal nerve shares a common origin with the iliohypogastric nerve, its nerve fibers are usually solely from the L1 nerve root. It takes a similar but more inferior course to the iliohypogastric nerve. It travels above the iliac crest, piercing the transversus abdominis near the anterior superior iliac spine. Further medially it penetrates the inner oblique. It provides motor innervation to these muscles that it comes into contact with. It exits medially through the superficial inguinal ring and branches into an anterior scrotal (labial) branch, a small pubic branch, and crural branches. The anterior scrotal (or labial) branches conduct sensory stimuli from the anterior scrotum or labia majora. The small pubic branch innervates a small area at the base of the penis or clitoris and mons pubis. The crural branches innervate the upper inner thigh and inguinal crease.

Several deviations from the textbook norm have been observed with the ilioinguinal nerve. One such example is seen when it originates from L2 instead of L1. Additionally, in about 5% of cases, it may be formed from two spinal nerve roots. Previous studies have shown that the nerve originates from the lumbar plexus in about 72.5%. In 25% of cases, it arises from a common trunk with the iliohypogastric nerve.

It is surgically important to note that the ilioinguinal nerve may completely bypass the inguinal ring. At times it may pass deep to the inguinal ligament. Also, the ilioinguinal nerve may join with the iliohypogastric in cases where the former is very small. In such cases, it is replaced by a branch of the iliohypogastric nerve. In cases where the ilioinguinal nerve is absent, the iliohypogastric nerve (most commonly), the genital branch of the genitofemoral, or the femoral branch of the genitofemoral innervates its region. On the other hand, the ilioinguinal nerve may



innervate nearby areas if other nerves are absent. It may partially or totally replace the lateral femoral cutaneous nerve or the genital branch of the genitofemoral nerve.

### ***Genitofemoral Nerve***

The first and second lumbar nerves both contribute to the genitofemoral nerve. As the nerve emerges, it pierces through the cephalad portion of the psoas major muscle. It continues caudally, anterior to the belly of the psoas major muscle and deep to the psoas fascia before it divides into a lateral femoral branch and a medial genital branch. The femoral branch travels lateral to the external iliac artery and continues deep to the inguinal ligament into the femoral sheath. It then pierces the anterior lamina of the femoral sheath and the fascia lata superficial and lateral to the origin of the femoral artery. The femoral branch provides sensation to an area of skin on the anterior central thigh, just inferior to the inguinal ligament. It also provides sensory innervation to the femoral artery through its connections with the femoral intermediate cutaneous nerve. The genital branch enters the deep ring of the inguinal canal and innervates the cremasteric muscle within the wall of the spermatic cord in men. Alternatively, it may pass superficial to the deep inguinal ring, traveling in the aponeurosis of the external abdominal oblique. This branch also provides sensory innervation to the anterior scrotum in men and the mons pubis and anterior labia majora in women.

The genital and femoral branches can arise from different locations in the lumbar plexus, either from L1, L2, or occasionally L3. The genital branch may also contain fibers from the T12 ventral ramus. The nerve may divide prior to exiting the psoas muscle in about 20% of cases. When the genitofemoral nerve is absent, the distribution for the genital branch is covered by the ilioinguinal nerve, while the anterior and lateral cutaneous femoral nerves innervate the territory of the femoral branch. Similarly, when the ilioinguinal nerve is absent, branches of the genitofemoral nerve may replace it.

### ***Femoral Nerve and Obturator Nerve***

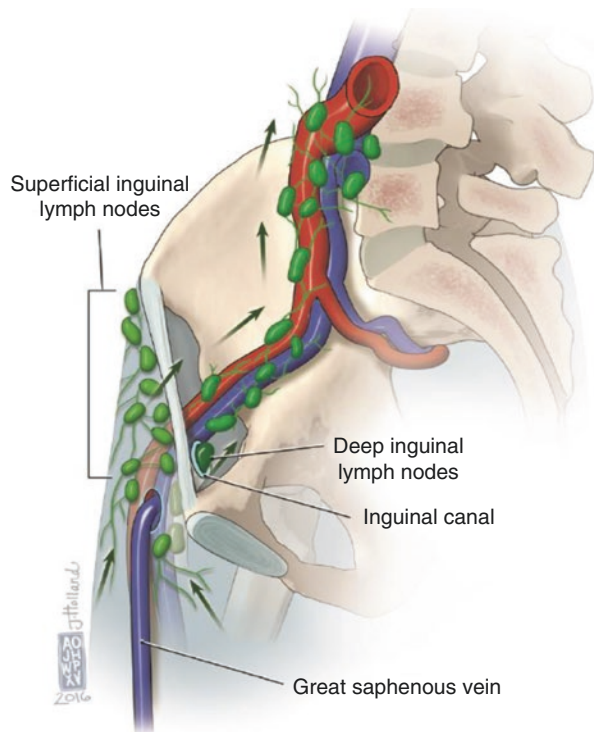
The femoral nerve contains fibers originating from the L2–L4 spinal nerve roots. Initially, it travels between the lateral aspect of psoas major and the iliacus muscle. On its way to the inguinal region, it innervates the iliacus muscle. It then passes deep to the inguinal ligament and into the femoral sheath that is formed, in part, by the transversalis fascia. Also within the femoral sheath are the femoral artery and vein and the node of Cloquet. Within the femoral canal, it lies lateral to the femoral artery, though it may at times be found between the artery and the vein. The femoral nerve innervates the flexors of the hip and the extensors of the knee. It provides sensorineural innervation to the anterior thigh, anteromedial knee, medial leg, and medial foot.

Similar to the femoral nerve, the obturator nerve has contributions from L2–L4 lumbar nerves. It emerges medial to the psoas major muscle and enters the lesser pelvis dorsal to the common iliac vessels then lateral to the internal iliac vessels.

It exits the pelvis through the obturator foramen after dividing into anterior and posterior branches. The anterior branch innervates the medial thigh, the hip joint, and the adductors. The posterior branch passes posterior to the adductor brevis to also supply innervation to the adductors of the hip.

## Lymphatics of the Groin

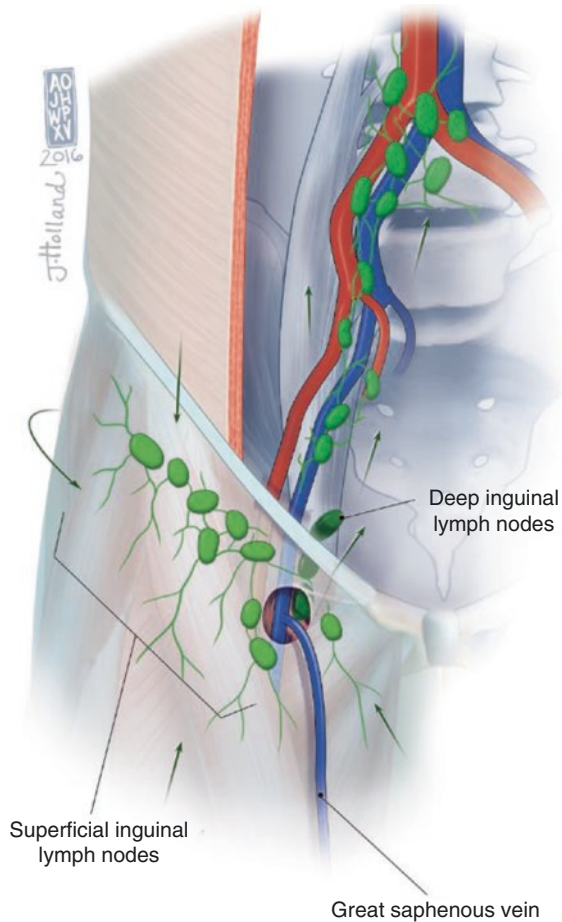
The lymphatic system consists of an interconnected network of channels that begin as close-ended, porous tubes that converge to drain into large veins in the subclavian region. They function to return both nutrients lost during cell-to-cell exchange and interstitial fluid back into circulation. Also contained in the lymphatic fluid are pathogens, immune cells, metabolic products of cells, and cellular debris. Along the course of these lymphatic channels, collections of small encapsulated structures, or lymph nodes, appear in fairly predictable locations. Two such groups, located in the groin, are the superficial inguinal nodes and the deep inguinal nodes as depicted in Fig. 3.5.



**Fig. 3.5** In this medial-to-lateral view of the right hemipelvis, the relationship between the inguinal and pelvic nodes can be seen

## *Superficial Inguinal Nodes*

The superficial inguinal lymph node group is located in the most proximal region of the lower limb. The lymph nodes are arranged parallel to the inguinal ligament (Fig. 3.6). An important differentiating factor between the deep and superficial groups is their relationship to fascias of the inguinal region. The superficial group is located deep to Camper's fascia (also referred to as the superficial fascia) and superficial to the fascia lata (or deep fascia). On the other hand, the deep group lies deep to the fascia lata and is arranged parallel to the femoral vein. The drainage channels that initiate the collection of lymph in the superficial group are located in the dermis. The channels carrying lymph toward the superficial group



**Fig. 3.6** In this figure, the superficial inguinal nodes can be seen on the surface of the fascia lata, inferior to the inguinal ligament

of nodes do not follow the course of the vessels even though they share a similar distribution with the vessels. For the deep inguinal system, their initial vessels are located in the fascia, muscles, periosteum, perichondrium, aponeurosis, and near joints. The channels comprising the deep system follow the course of the blood vessels in the area.

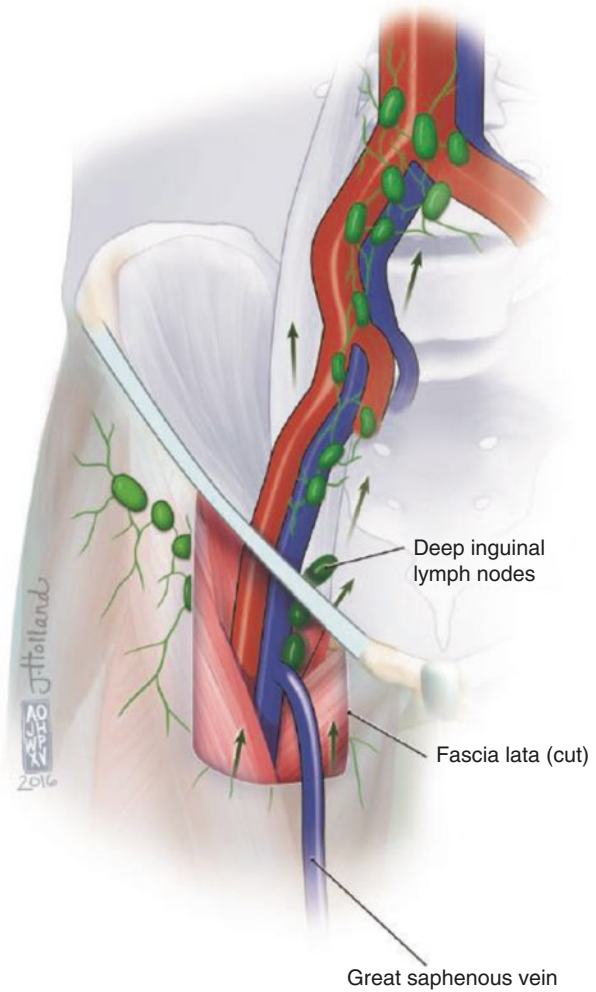
There have been a few proposed methods of dividing the superficial inguinal lymph node group into smaller subgroups. Rouviere divided this group of approximately ten lymph nodes (range of about 4–25) into five groups. In this subclassification system, the junction of the great saphenous vein and the femoral vein was used as the point of reference. Thus, the five groups were named superolateral, superomedial, central, inferolateral, and inferomedial. In Romanes' version of subgroups, the point where the great saphenous vein is terminated was also used as the reference point. However, in this case, only two categories were named. The proximal group was defined as the group that was located in close proximity to the inguinal ligament (about 1 cm distal to its inferior margin), whereas the distal group was that group of nodes closely associated with the termination of the great saphenous vein. Further subdivisions of the proximal group have been described. They can be divided into superolateral and superomedial groups in a similar fashion to that proposed by Rouviere.

The superolateral nodes drain two areas in particular. Their anterior source of lymph originates from the infraumbilical anterior abdominal wall, and the posterior source originates from the gluteal region. The superomedial nodes drain some of the structures of the genitourinary system. In males, these structures are the prepuce of the penis and the scrotum. Also drained by this group of nodes are the inferior anal canal and the perianal region. In females, the prepuce of the clitoris, the superolateral aspect of the uterus along with the structures of the external female genitalia, and the vaginal orifice are drained by the superomedial nodes. The lower limb, with the exception of the posterolateral thigh, is drained by the distal group of lymph nodes.

### ***Deep Inguinal Nodes***

The deep inguinal nodes are located deep to the fascia lata of the thigh and tend to be in close association with the femoral vein (Fig. 3.7). This cluster of one to three lymph nodes receives drainage from the superficial group of lymph nodes as well as deep lymphatics that run with the femoral artery. They also receive direct drainage from the glans of the penis and clitoris. In cases where three deep nodes are present, their locations seem to be fairly constant. One is located just lateral to the femoral ring, one is found within the femoral canal, and one distal to the termination of the great saphenous vein, but still deep to the fascia lata. Though the presence of the node lateral to the femoral ring is variable, the node within the femoral canal is

**Fig. 3.7** With a segment of the fascia lata removed, the deep inguinal nodes can be easily visualized



almost always present. This frequently present node is also known as the node of Cloquet. Cloquet's node drains the deep thigh and communicates directly with the iliac and obturator nodes.

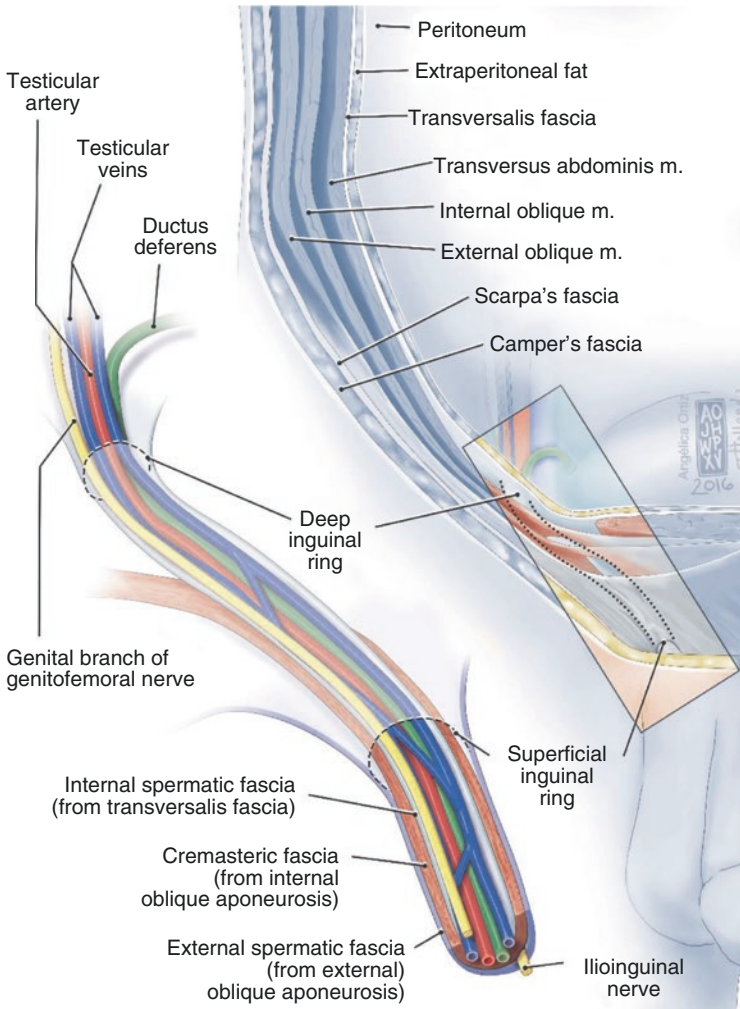
### ***Aberrant Nodes***

Aberrant nodes are small nodes that may be located at the base of the penis, anterior to the pubic symphysis, or within the inguinal canal.

## Anatomical Spaces of the Groin

### *Inguinal Canal*

The inguinal canal is a conduit on each side of the midline of the lower abdominal wall that allows certain structures to pass through (Fig. 3.8). In adults, its length is approximately 4 cm and located 2–4 cm above the inguinal ligament. The canal is defined by the following boundaries:



**Fig. 3.8** This illustration highlights the course of the inguinal canal—from the deep inguinal ring to the superficial inguinal ring. Also seen here are the contents of the inguinal canal

**Anterior:** The external oblique aponeurosis forms the anterior wall. On the lateral part, it is also reinforced by the aponeurosis of internal oblique muscle.

**Posterior (floor):** In most of the population, the lateral side of the posterior wall is formed by the aponeurosis of transversus abdominis muscle and the transversalis fascia. The medial side of the posterior wall is reinforced by the internal oblique aponeurosis.

**Superior (roof):** The superior wall of the inguinal canal is composed of the arched fibers of the lower edge of the internal oblique muscle and by the transverse abdominis muscle and aponeurosis.

**Inferior:** The inferior wall of the canal is formed by the inguinal ligament (*Poupart's ligament*) and the lacunar ligament (*Gimbernat's ligament*).

### Variations

In about 25% of individuals, the lateral side of the posterior wall is formed only by the transversalis fascia.

### Contents of the Inguinal Canal

The contents of inguinal canal will enter through the internal (deep) inguinal ring, pass through the canal, and exit from the external (superficial) inguinal ring.

**Internal (deep) inguinal ring:** It is a normal defect, where an opening/evagination of the transversalis fascia and transversus aponeurosis forms a shape that appears like an inverted “V” or “U.” The internal (deep) inguinal ring’s location corresponds to the midpoint of the inguinal ligament, lying superiorly to it. The ring’s anterior and posterior arms are thickened parts of the transversalis fascia. The inferior border is the iliopubic tract.

**External (superficial) inguinal ring:** This opening is formed by the external oblique aponeurosis. It is shaped like a triangle with its base being a part of the pubic crest and its two borders formed by two crura, the superior (medial) crus and the inferior (lateral) crus. The superior crus is formed by the external oblique aponeurosis and the inferior crus by the inguinal ligament.

### Variations of the Inguinal Canal Contents

The contents of the inguinal canal differ between men and women. In men, the canal contains the spermatic cord and the ilioinguinal nerve and in females the round ligament of the uterus and the ilioinguinal nerve. Even though the ilioinguinal nerve exits from the superficial inguinal ring, it does not enter from the deep ring; therefore it only travels through a part of the canal. In addition, the ilioinguinal nerve in males is not a component of the spermatic cord, rather it is located on the outside traveling next to it.

## Spermatic Cord

The components of the spermatic cord include:

**Three veins:** testicular vein, cremasteric vein, and deferential vein

**Three arteries:** testicular artery, cremasteric artery, and deferential artery

**Two nerves:** genital branch of the genitofemoral nerve and the testicular plexus

**The pampiniform plexus, the ductus deferens, and lymphatics**

The pampiniform plexus lies anteriorly to the cord. Posteriorly to the cord lies the ductus deferens and the remnant of processus vaginalis or hernial sac.

The contents of the spermatic cord are covered by three layers of fascia: the external spermatic fascia (from *external oblique fascia*), the cremasteric fascia (from *internal oblique muscle and fascia*), and the internal spermatic fascia (from *transversalis fascia*).

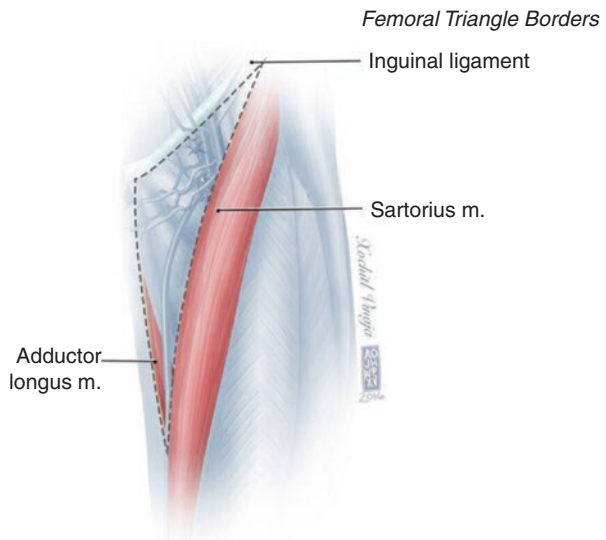
## Femoral Triangle

The femoral triangle is a structural landmark that can be delineated in a standing position where the muscles of the anterior compartment of the thigh are flexed with the hip externally rotated and slightly abducted. Its triangular shape has the apex pointing inferomedially, and it is defined by the following boundaries (Fig. 3.9):

**Superiorly (Base):** The base of the femoral triangle is the inguinal ligament.

**Medially:** It is formed by the lateral border of the adductor longus muscle.

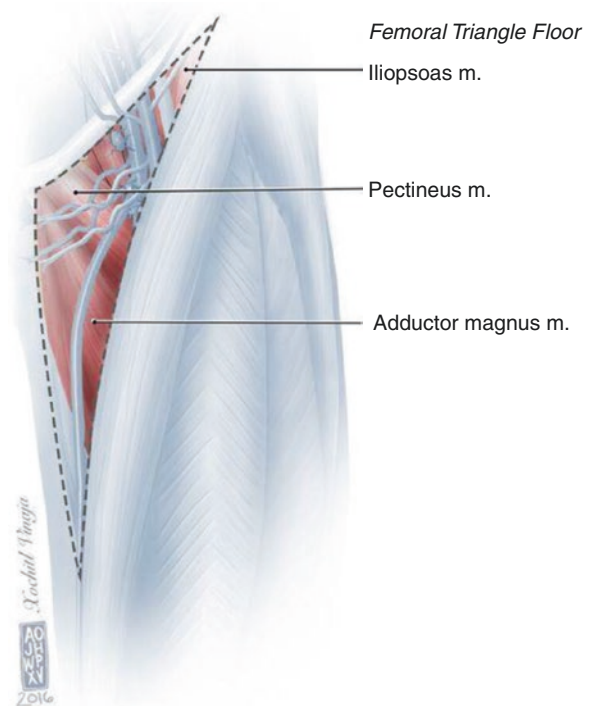
**Laterally:** It is formed by the medial border of the sartorius muscle.



**Fig. 3.9** The borders of the femoral triangle: the base is formed by the inguinal ligament; the medial border is formed from the lateral border of the adductor longus muscle; and the lateral border is by the medial edge of the sartorius muscle



**Fig. 3.10** The floor of the femoral triangle is formed from the iliopsoas, the pectineus, and the adductor magnus muscles



**Floor:** It is formed medially by the adductor longus and pectineus muscles and laterally by the iliacus and psoas major muscles (Fig. 3.10).

**Roof:** It is formed by the fascia lata.

**Apex:** It is formed by the intersection of the medial border of the sartorius muscle and the lateral boarder of the adductor longus muscle.

### Landmarks

The *inguinal ligament* can be felt running from the anterior superior iliac spine to the pubic tubercle when the thigh is externally rotated and abducted.

The *sartorius* muscle can be best outlined, in a sitting position, as a “strap-like” muscle when the hip is flexed, the knee extended, and the thigh slightly abducted and externally rotated.

While tracing the sartorius: **Proximally**, its course will be from the anterior superior iliac spine, running inferomedially, half way to the thigh. **Distally**, it may appear as a soft longitudinal ridge passing toward the posterior part of the medial femoral condyle.

The medial part of *adductor longus* can be felt as a crease when the thigh is adducted against resistance.

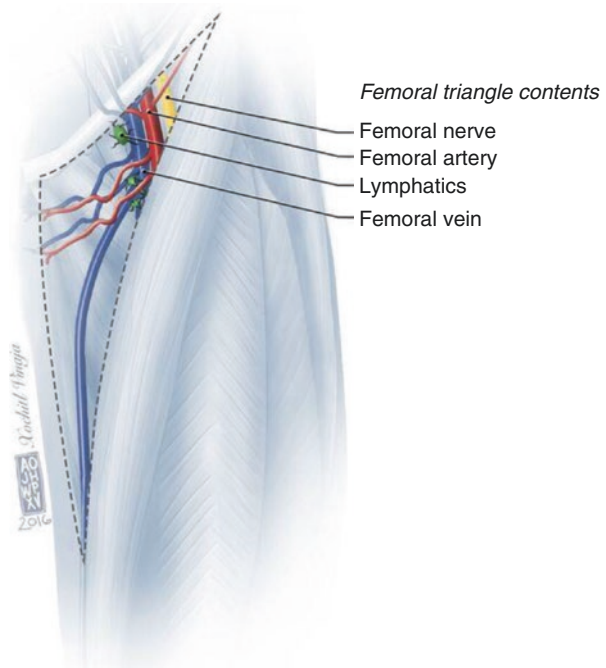
## Contents of the Femoral Triangle

The femoral triangle is a passageway where structures will pass from the abdominal/pelvic cavity to the lower limb. As the inguinal ligament crosses from the anterior superior iliac spine to the pubic tubercle, it produces a space called **retroinguinal space**, which is further separated into two compartments (lateral and medial) by the **iliopectineal arch** (a thickened portion of the iliopsoas fascia). The **lateral compartment**, also called *muscular compartment of the retroinguinal space*, will contain the iliopsoas muscle and the femoral nerve. The **medial compartment**, also called *vascular compartment of the retroinguinal space*, will contain arteries, veins, and lymphatics.

The contents of the femoral triangle from lateral to medial are the following (Fig. 3.11):

- **Femoral nerve** and its terminal branches
- **Femoral artery** and its branches
- **Femoral vein** and its tributaries
- **Femoral canal** which contains fat, loose connective tissue, and lymphatics

Cloquet's node is located within the femoral canal and is thought to be the link between inguinal and iliac/obturator nodes.



**Fig. 3.11** The contents of the femoral triangle are highlighted here: the femoral nerve, femoral artery, femoral vein, and lymphatics

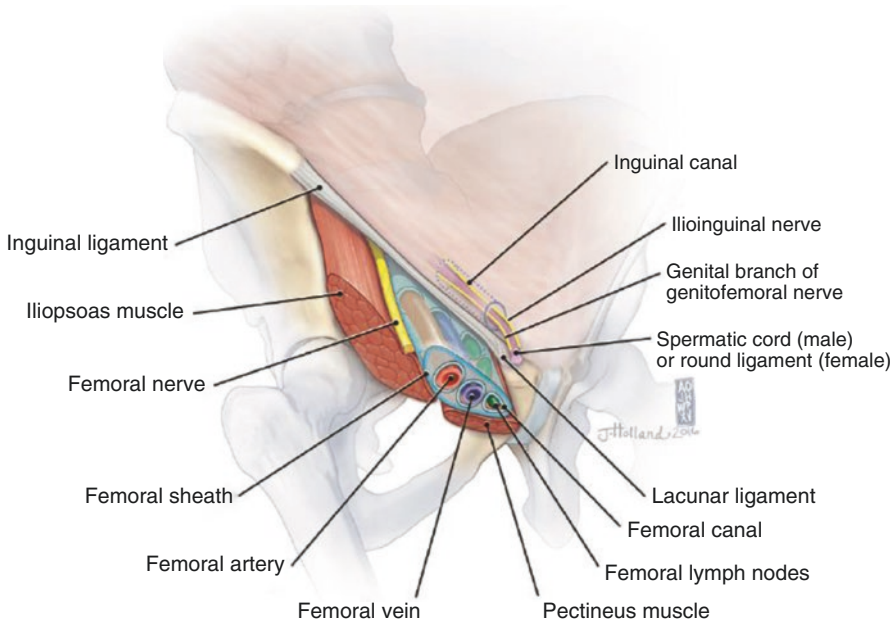
## Variations

It is important to note that, occasionally in the femoral triangle, the femoral nerve can appear as a collection of nerve branches. There is a degree of variability of the location where the femoral nerve divides as described in the literature. Sometimes, it can branch after entering the thigh, or below the inguinal ligament, or upon its course in the femoral triangle.

A conventional way to remember the contents of the femoral triangle is by applying the mnemonic *NAVEL* (nerve, artery, vein, empty space, and lymphatics). However, there have been some instances where the femoral artery lies medially to the femoral vein. Also, a case report described the femoral artery crossing the femoral vein deep into the inguinal ligament and overlying it at the femoral triangle base.

## The Femoral Sheath

The femoral vessels and the lymphatics are the deepest structures, passing from midbase to apex of the femoral triangle, and are enclosed by the **femoral sheath** (Fig. 3.12). The femoral nerve with its terminal branches runs lateral and is located outside the femoral sheath.



**Fig. 3.12** This anterior view of the inguinal region shows the contents of the femoral sheath. The femoral artery, femoral vein, and lymph nodes and vessels are found within the sheath. The femoral nerve lies outside the sheath. The femoral canal represents the most medial region enclosed by the femoral sheath and contains lymph nodes and lymphatic vessels

The femoral sheath is a distal prolongation of extraperitoneal fascia that encloses the vascular compartment. It is formed anteriorly by the transversalis fascia and posteriorly by the iliac fascia. It has the shape of a cone, with its proximal end being wider as it narrows distally and fusing with the vascular adventitia, approximately 3–4 cm from the inguinal ligament. Its role is to provide protection to the vessels, especially during hip joint movements.

The femoral sheath encases the vascular compartment, which is further subdivided by connective tissue into septa, thereby forming the three compartments:

**Lateral compartment:** It contains the femoral artery.

**Intermediate compartment:** It contains the femoral vein.

**Medial compartment:** It contains the femoral canal, which contains lymph vessels and occasionally a deep inguinal node.

### *The Femoral Canal*

The femoral canal (Fig. 3.12) apart from containing lymphatic vessels and lymph nodes, and allowing the femoral vein to distend, is also of high importance in clinical medicine, while it can serve as a conduit for femoral hernias. The canal has the shape of a cone and approximately measures 1.25 cm in length. It is bounded by the following structures:

**Lateral:** Femoral vein and a connective tissue septum

**Medial:** Transversus abdominis aponeurosis and transversalis fascia

**Anterior:** Inguinal ligament, iliopubic tract, or both

**Posterior:** Pectineal ligament (*Cooper's* ligament) and iliac fascia

### **The Proximal Ring**

The proximal ring, also referred as *the femoral ring*, serves as an entrance to the femoral canal. It is wider in diameter, and its boundaries are as follows:

**Lateral:** Femoral vein

**Medial:** Lateral edge of the lacunar ligament, transversus aponeurosis, or both

**Anterior:** Inguinal ligament

**Posterior:** Pectineal ligament (*Cooper's* ligament)

### **The Distal Ring**

The saphenous hiatus will serve as an exit of the femoral canal. It is secured by the distal ring whose boundaries are as follows:

**Lateral:** Femoral sheath

**Medial:** Lacunar ligament or iliopubic tract

**Anterior:** Fascia lata and cribriform fascia

**Posterior:** Pectineal fascia

## Variations

In women, the femoral canal is larger than it is in men. This is due to the fact that women have a wider pelvis and smaller femoral vessels. In addition, the round ligament of the uterus is located above the anterior margin in women, where in men, it is the spermatic cord.

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