

Fig. 3.2: Femur (right, posterior view)

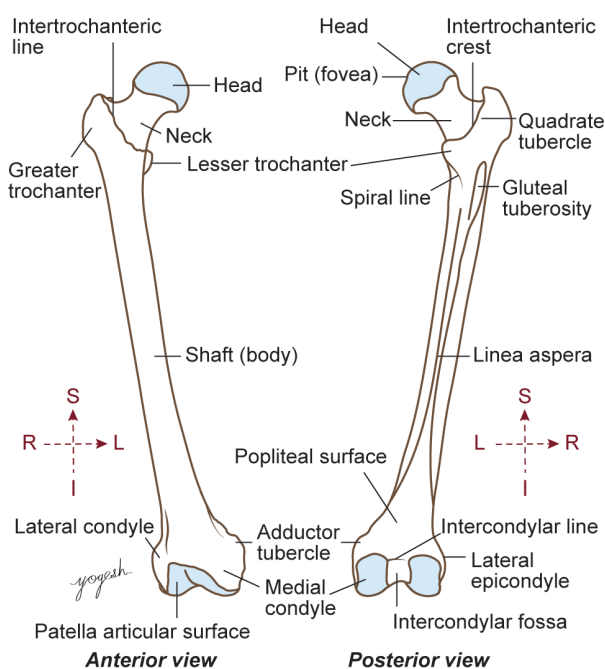


Fig. 3.3: Practice figure: Femur (schematic representation, right, anterior and posterior views)

Upper End of Femur

- The upper end of the femur consists of a head, a neck, greater and lesser trochanters (Figs 3.4 to 3.7, Flowchart 3.1).

Head

- The head of femur is globular or spheroidal and forms about 2/3rd of a sphere. It is directed medially, upward, and slightly forward. It is covered by hyaline cartilage except at the fovea.
- Fovea (fovea capitis femoris):** It is a small depression or pit on the head, near its center.

Attachment: **Ligament of head of femur** (ligamentum teres femoris) is attached to the fovea.

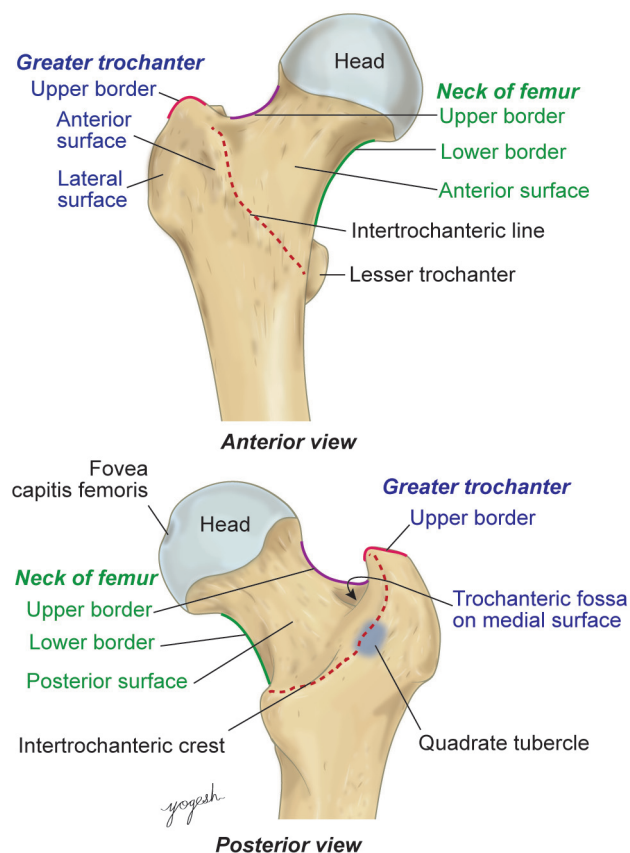


Fig. 3.4: Features of upper end of femur (right, anterior and posterior views)

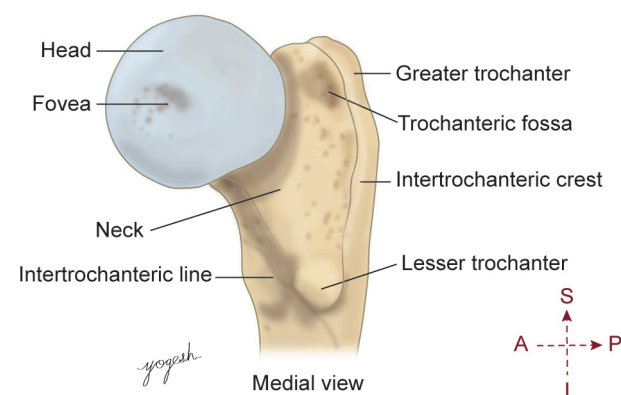


Fig. 3.5: Upper end of femur (right, medial view)

Bones of Leg: Tibia and Fibula

Competencies

AN14.1: Bones: Lower limb: Identify the given bone, its side, important features and keep it in anatomical position.

AN14.3: Describe the importance of ossification of lower end of femur and upper end of tibia.

- The leg is supported by two bones: Tibia and fibula.
- Tibia is the medial and larger bone. It corresponds to the radius of upper limb.
- Fibula is the lateral and slender bone. It corresponds to the ulna of upper limb.

TIBIA

- Tibia is the medial and larger bone of leg (*tibia* = skin bone in Latin).
- Tibia is the second longest bone in the body (femur is the first).^{MCQ}

Parts of tibia

Tibia has three parts (Figs 4.1, 4.2):

- **Upper end:** It is expanded. It has medial and lateral condyles, and tibial tuberosity.
- **Shaft:** It is triangular in cross-section. It has
 - three borders: Anterior, medial, and interosseous (lateral)
 - three surfaces: Medial, lateral, and posterior
- **Lower end:** It has a bony projection as *medial malleolus* on the medial side.

Anatomical Position and Side Determination^{Viva}

Hold the bone in such a way that

- The broad upper end faces upward.
- The tibial tuberosity and sharp anterior border look forward.
- Medial malleolus project from medial side of lower end and helps to determine the side of the bone. For

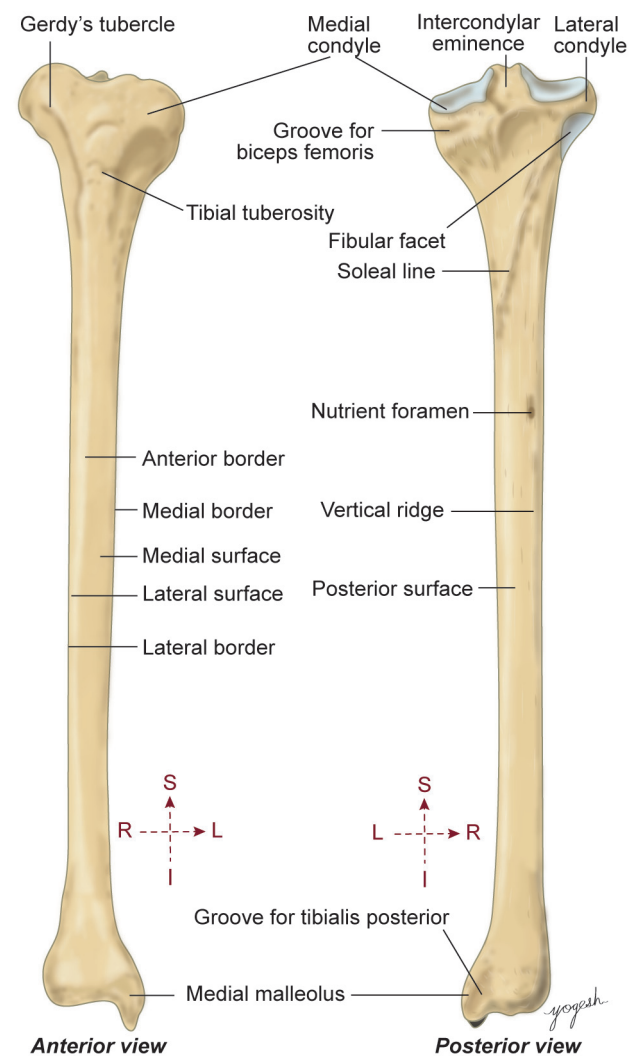


Fig. 4.1: Tibia (right, anterior and posterior views)

example, the medial malleolus of the right tibia is directed on the left.

Features of Tibia

- Tibia consists of an upper end, a shaft, and a lower end.

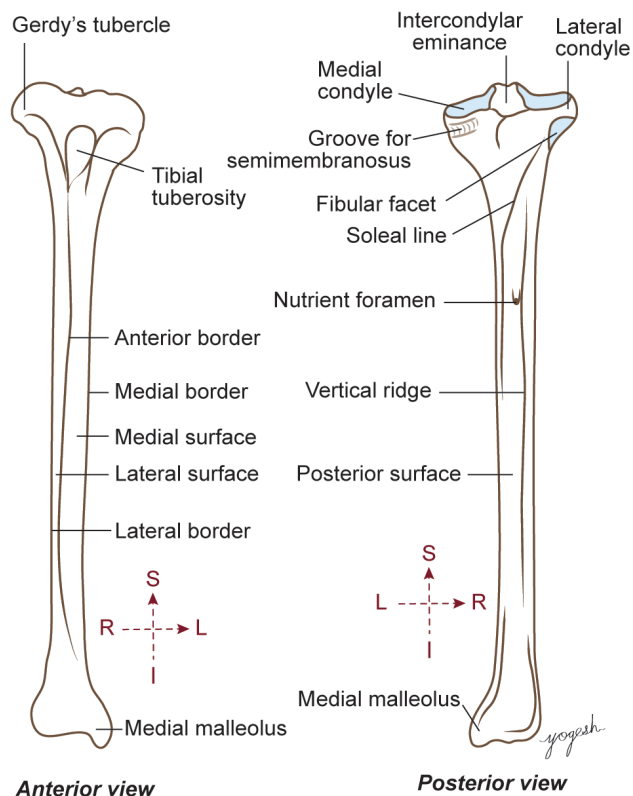


Fig. 4.2: Practice figure: Tibia (right, schematic representation, anterior and posterior views)

Upper End of Tibia

- The upper end of the tibia is expanded. It is broader transversely than anteroposteriorly.
- It has the following (Figs 4.3 to 4.5, Flowchart 4.1):
 - 2 condyles: medial and lateral
 - Intercondylar area
 - Tibial tuberosity

Medial condyle

- Medial condyle is longer than the lateral condyle.
- Medial condyle has four surfaces: Superior, posterior, anterior, and medial.

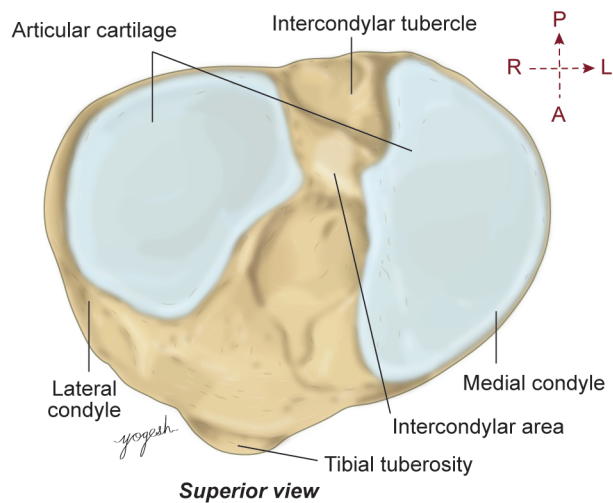


Fig. 4.3: Superior view of tibia (right, superior view)

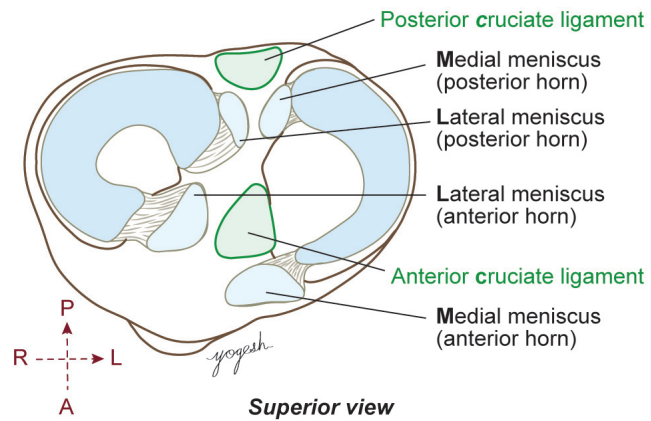


Fig. 4.4: Superior view of tibia (right, superior view) (mnemonic: Medical College Lucknow, Lucknow Medical College)

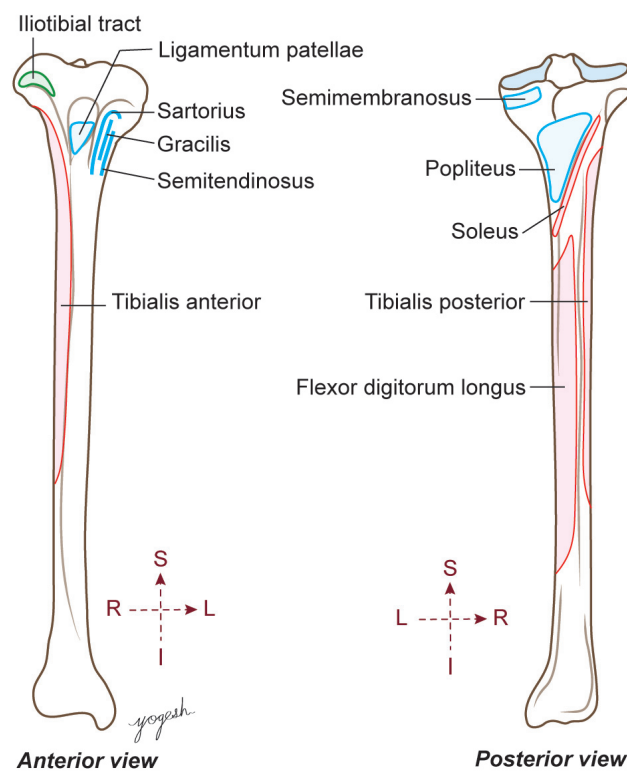
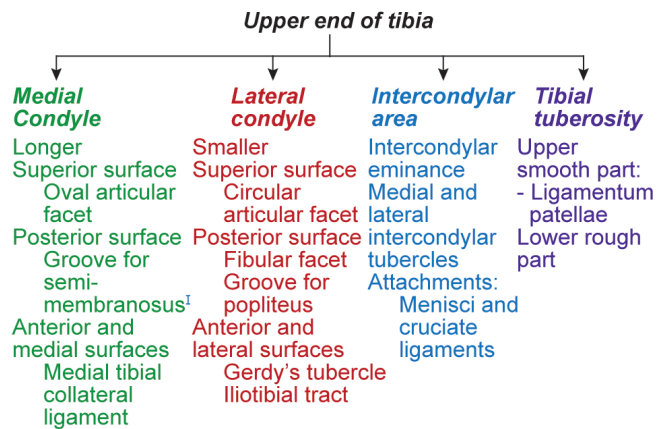
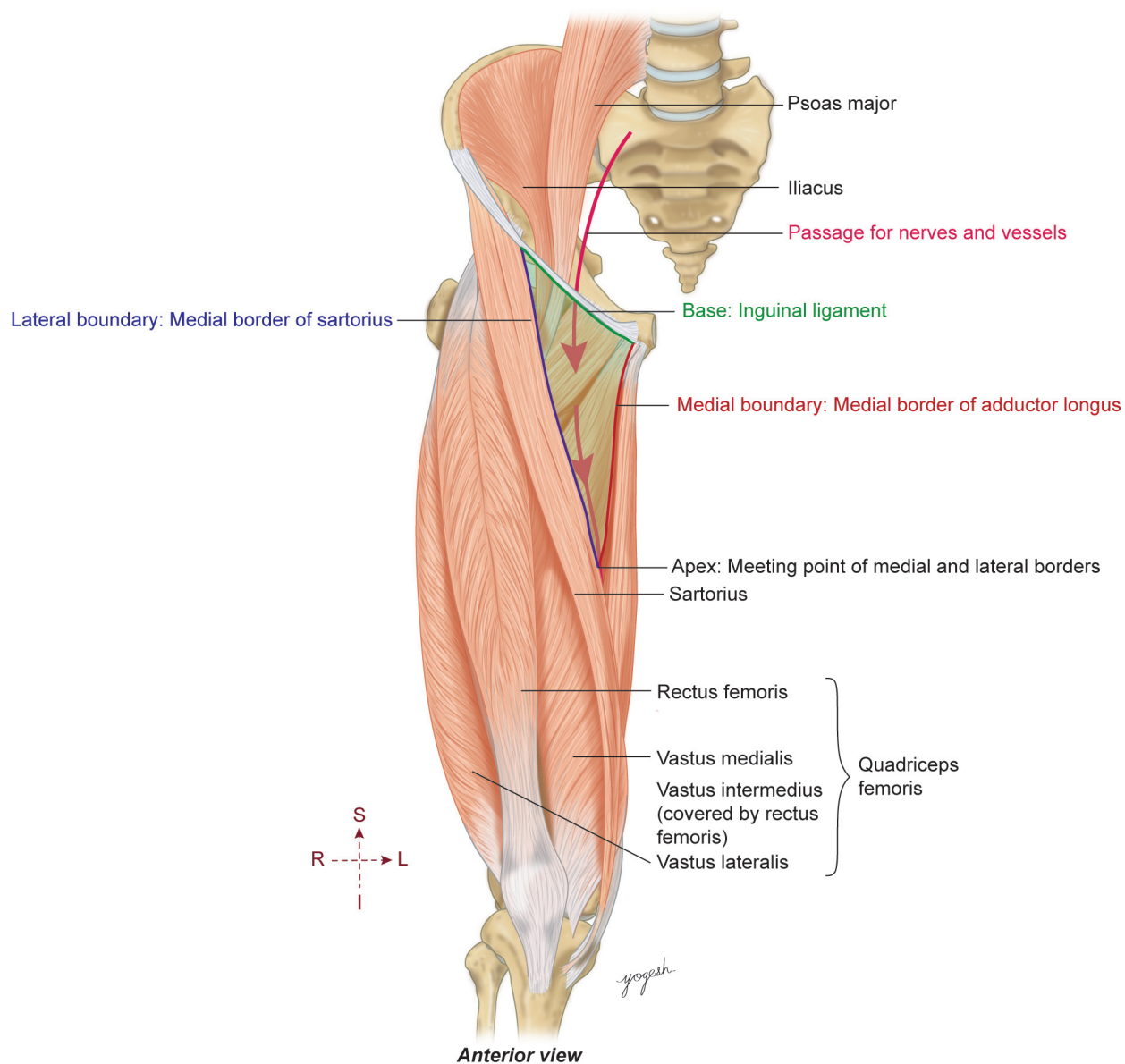


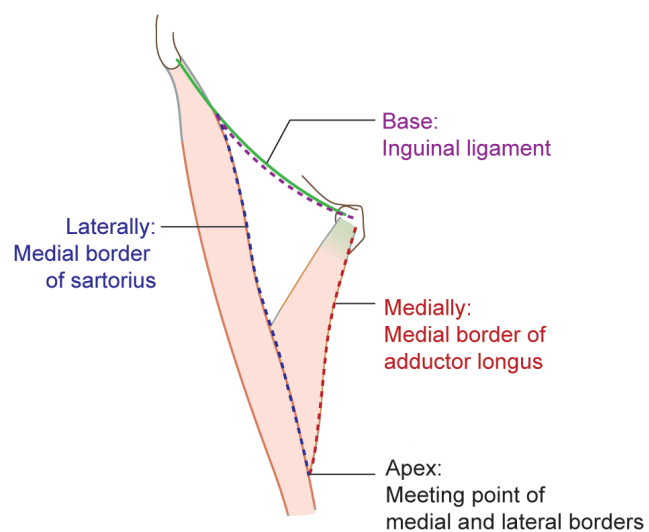
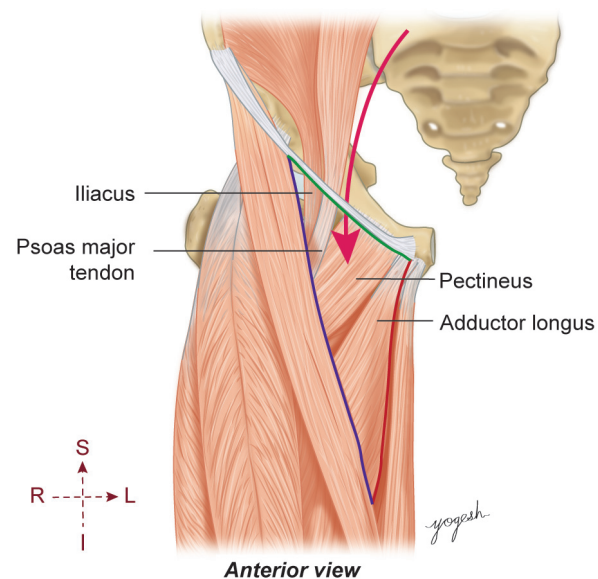
Fig. 4.5: Practice figure: Attachments of tibia (right, anterior and posterior views)

Flowchart 4.1: Upper end of tibia





Anterior view

Fig. 7.1: Boundaries of femoral triangle (right, anterior view)**Fig. 7.2:** Practice figure: Boundaries of femoral triangle (right, anterior view, femoral triangle is demarcated with dotted line)

Anterior view

Fig. 7.3: Muscles forming the floor of femoral triangle (right, anterior view)

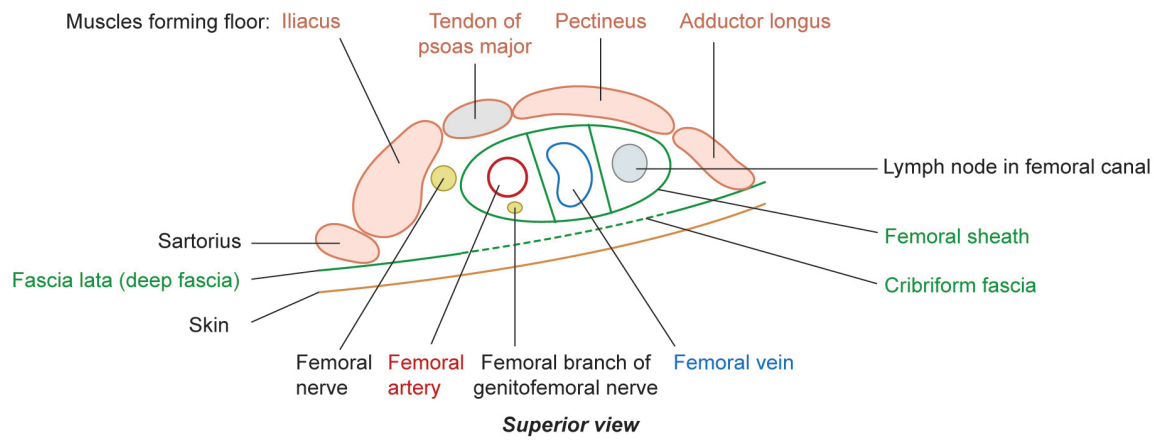


Fig. 7.7: Practice figure: Contents of femoral triangle (Transverse section passing through the femoral triangle, right)

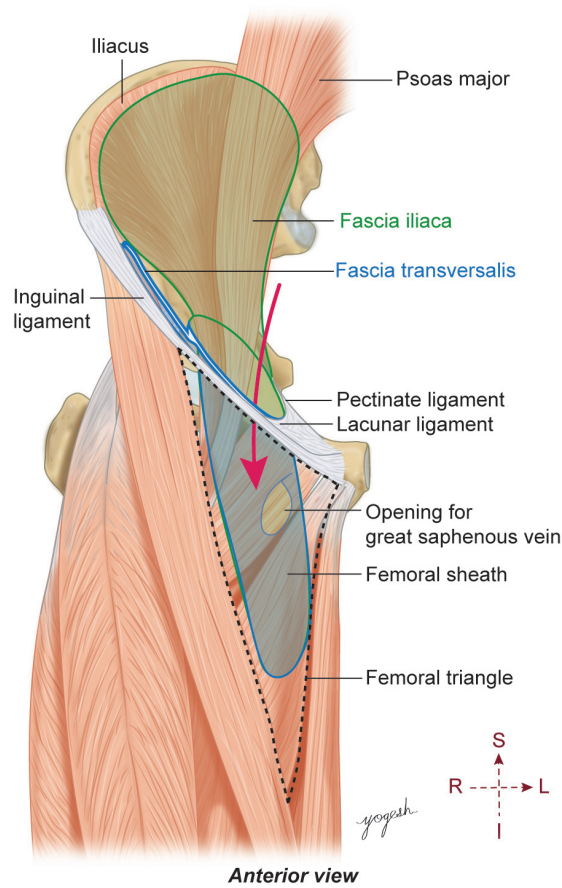
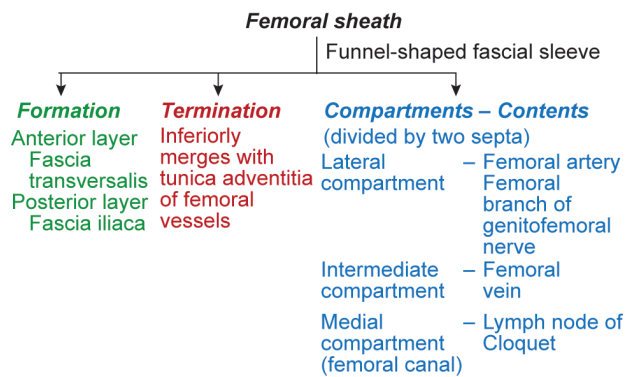


Fig. 7.8: Formation of femoral sheath (right, anterior view)

Flowchart 7.2: Femoral sheath



Clinical integration: Femoral hernia.

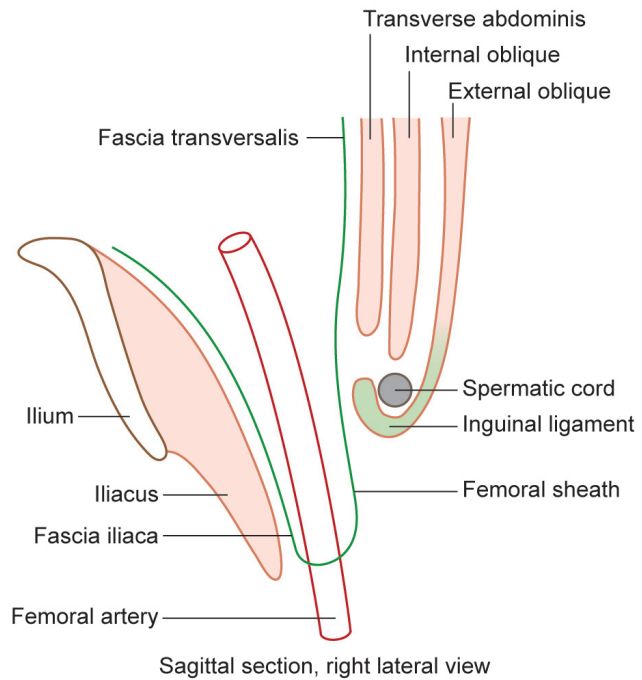


Fig. 7.9: Formation of the femoral sheath (right, sagittal section, right lateral view)

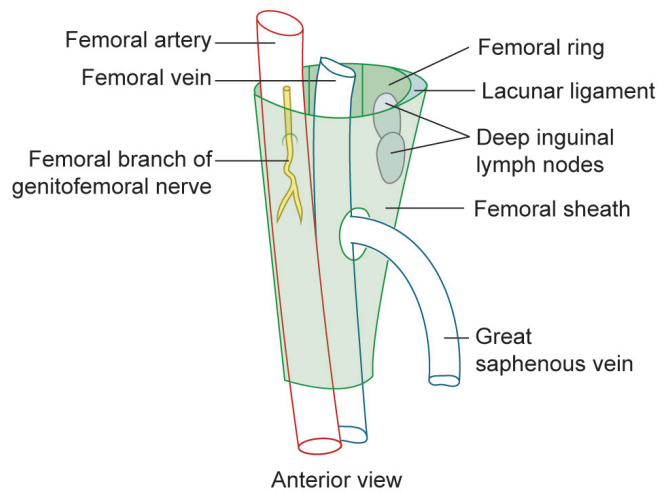


Fig. 7.10: Practice figure: Femoral sheath

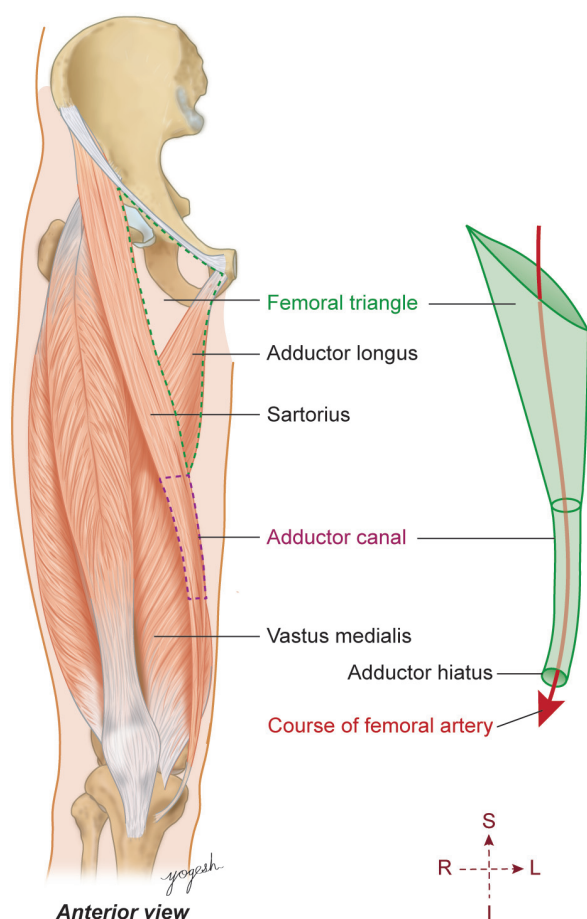
Adductor Canal

Competency

AN15.5: Describe and demonstrate adductor canal with its contents.

INTRODUCTION

- Adductor canal is an *intermuscular tunnel* situated on the medial side of the middle one-third of the thigh (Fig. 9.1).



Anterior view

Fig. 9.1: Adductor canal (right, anterior view)

- Adductor canal is also called:
Subsartorial canal – because adductor canal is covered by sartorius muscle.
Hunter's canal – because John Hunter performed surgeries for the treatment of popliteal aneurysm in the adductor canal [John Hunter, Scottish surgeon, 1728–1793].

Length

- Adductor canal is about 15 cm long.

Extent

- Adductor canal extends from the apex of the femoral triangle superiorly to the tendinous opening in adductor magnus inferiorly.

Shape

- Adductor canal is triangular on cross-section.

Boundaries of Adductor Canal

- The adductor canal has three boundaries (wall) as follows (Fig. 9.2, Flowchart 9.1):

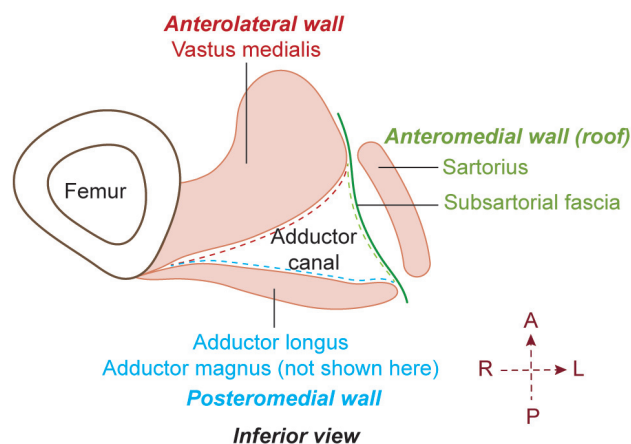


Fig. 9.2: Practice figure: Walls of adductor canal (right, inferior view, section passing through adductor canal, schematic representation)

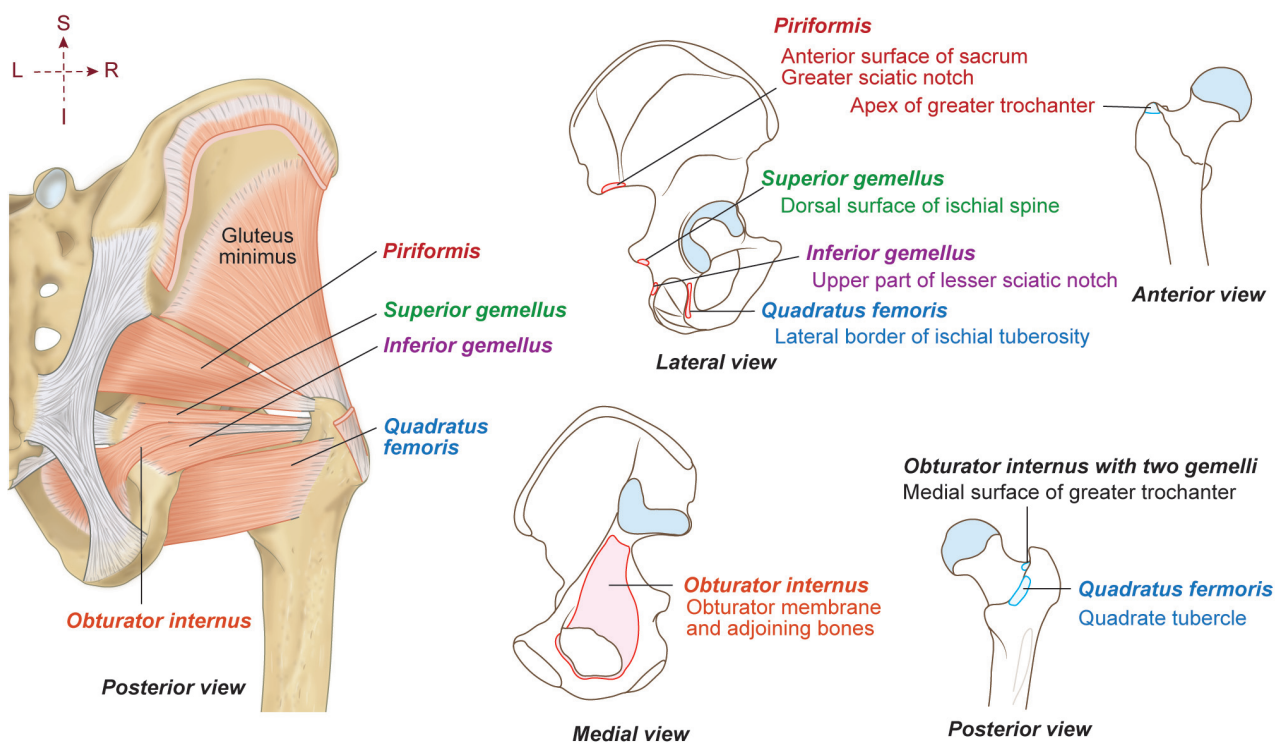


Fig. 10.11: Piriformis, obturator internus, superior and inferior gemelli, and quadratus femoris muscles (right, posterior view, inset showing bony attachments of these muscles)

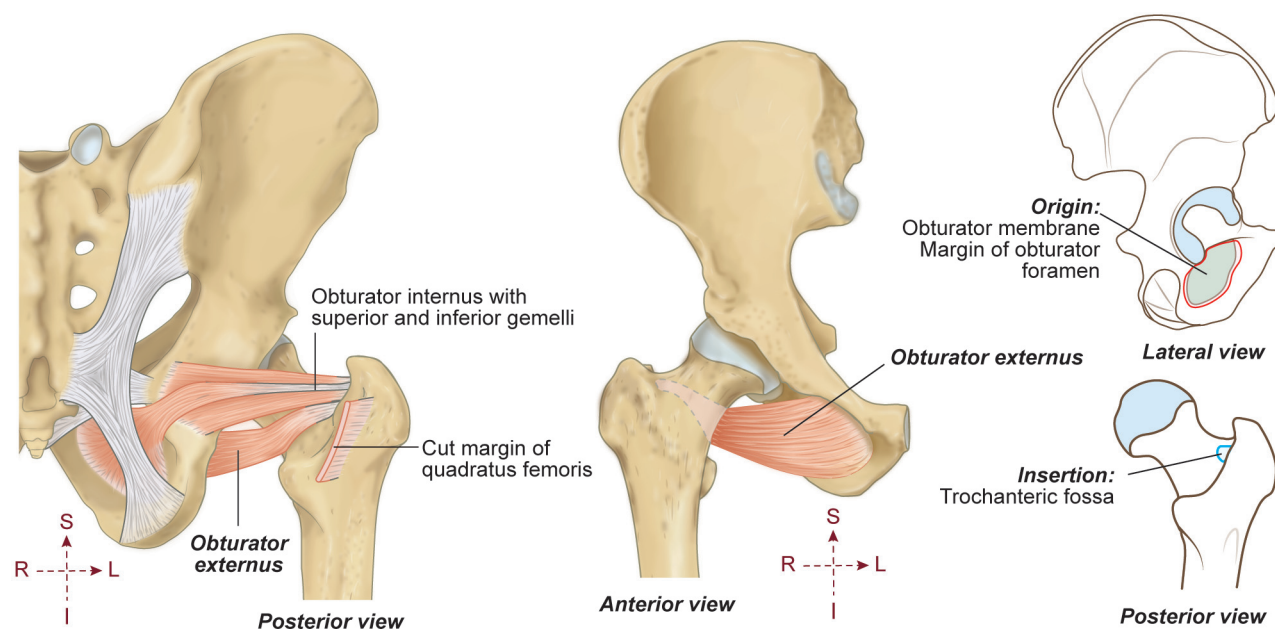


Fig. 10.12: Obturator externus muscle (right, anterior and posterior views, insets showing bony attachments)

Clinical Integration

Trendelenburg's sign [Friedrich Trendelenburg, 1844–1924, German surgeon]

Q. Write a note short on Trendelenburg sign.

- Actions of gluteus medius and minimus muscles: They prevent sagging of pelvis on unsupported side during walking (Fig. 10.15).
- Trendelenburg's sign: During the paralysis of gluteus medius and gluteus minimus muscles of one side

(due to injury to the superior gluteal nerve), the pelvis sags on the healthy side when that foot is off the ground [Pelvis sags on contralateral side when standing on affected leg]. [NEXT](#)

- **Cause:** Damage to superior gluteal nerve (avulsion of tendons of gluteus medius and gluteus minimus muscles, fracture of greater trochanter, dislocation of hip joint).
- **Gait:** Gluteus medius limp; waddling gait; lurching gait.
- **Inabilities:** Inability to perform abduction at hip joint.

Hip replacement surgery

- Hip replacement or arthroplasty is a surgery for the replacement of a worn-out (by osteoarthritis) or damaged hip joint with an artificial joint (prosthesis) (Fig. 12.20). It may be partial or complete hip replacement surgery.

Dynamic hip screw (DHS) fixation

- DHS is an orthopedic implant that is designed for fixation of fractures of neck of femur (Fig. 12.21).

Langenbeck triangle or trigonum iliofemorale: It is useful for the exploration of the hip joint. Boundaries:

Apex: Anterior superior iliac spine

Base: Anatomical neck and greater trochanter of femur

On each side: Lines connecting apex with the base.

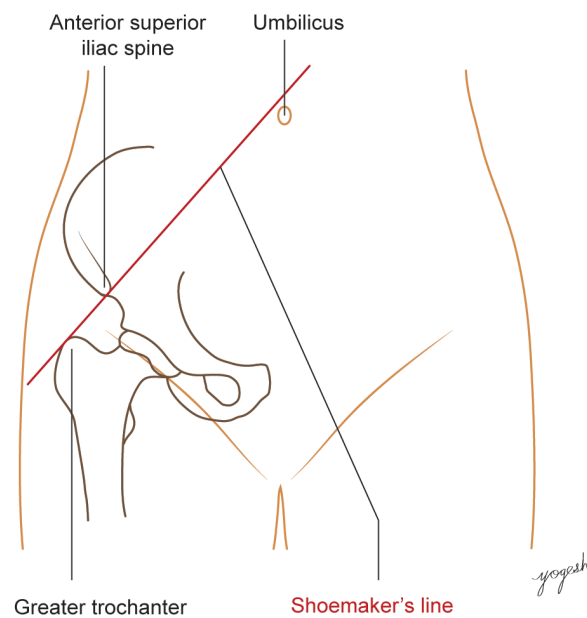


Fig. 12.19: Shoemaker's line (right, anterior view)

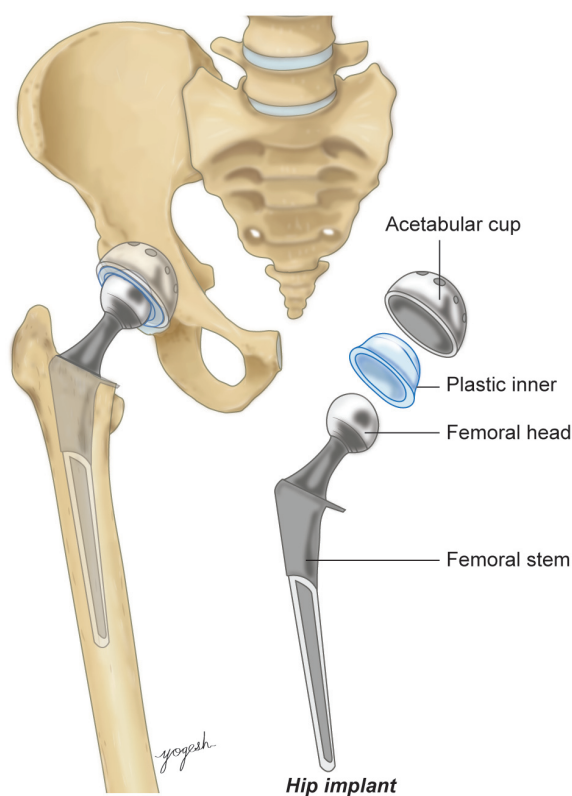


Fig. 12.20: Total hip replacement or arthroplasty

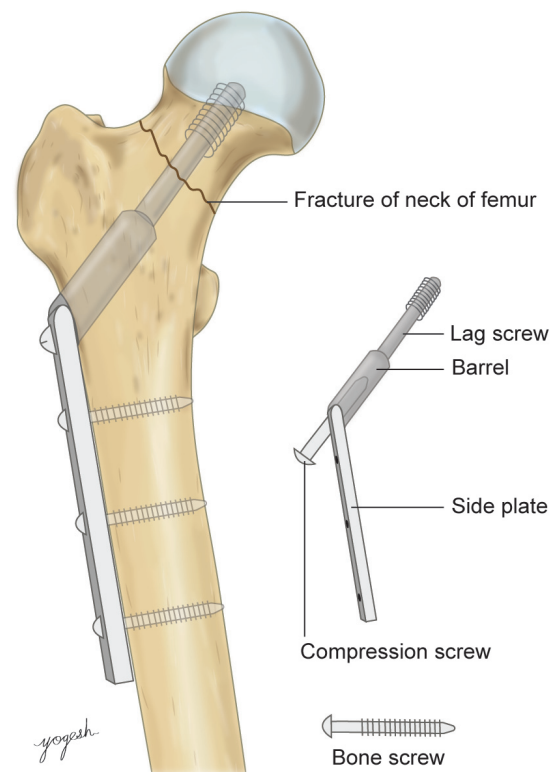


Fig. 12.21: Dynamic hip screw

TIBIAL NERVE

- Tibial nerve is the major nerve that supplies the posterior compartment of leg (Figs 13.12, 13.13, Flowchart 13.4).
- Root value:* Ventral primary rami of L4, L5, S1, S2, S3.

Course

- Tibial nerve is the largest terminal branch of the sciatic nerve. It runs vertically downward in the popliteal fossa from its superior to inferior angle.

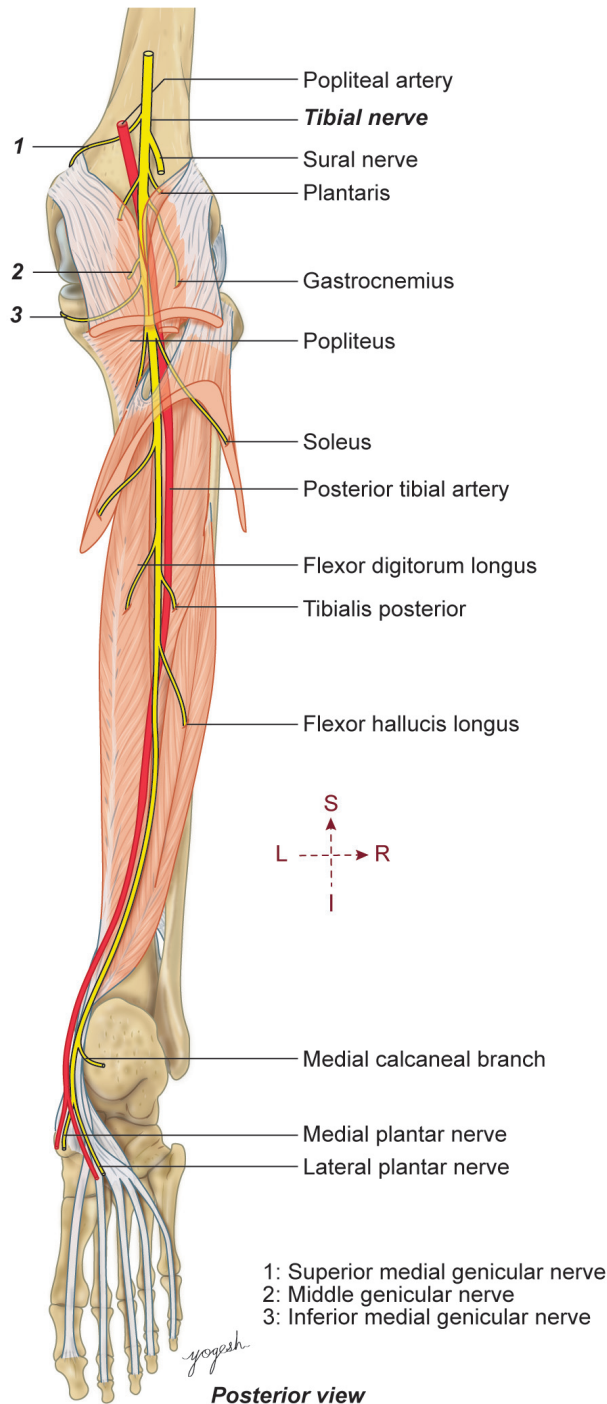


Fig. 13.12: Tibial nerve (right, posterior view, branches of popliteal artery and posterior tibial artery are not shown to maintain clarity)

- Tibial nerve crosses the popliteal vessels superficially from lateral to medial side. Lower down, it continues in the posterior compartment of leg.

Branches

- Muscular branches:* Tibial nerve supplies
 - Medial and lateral heads of gastrocnemius
 - Plantaris
 - Soleus
 - Popliteus
- Cutaneous branch:* Sural nerve that supplies the skin of lower half of the back of leg and the lateral border of foot till the tip of little toe.
- Articular branches:*
 - Superior medial genicular nerve
 - Middle genicular nerve
 - Inferior medial genicular nerve

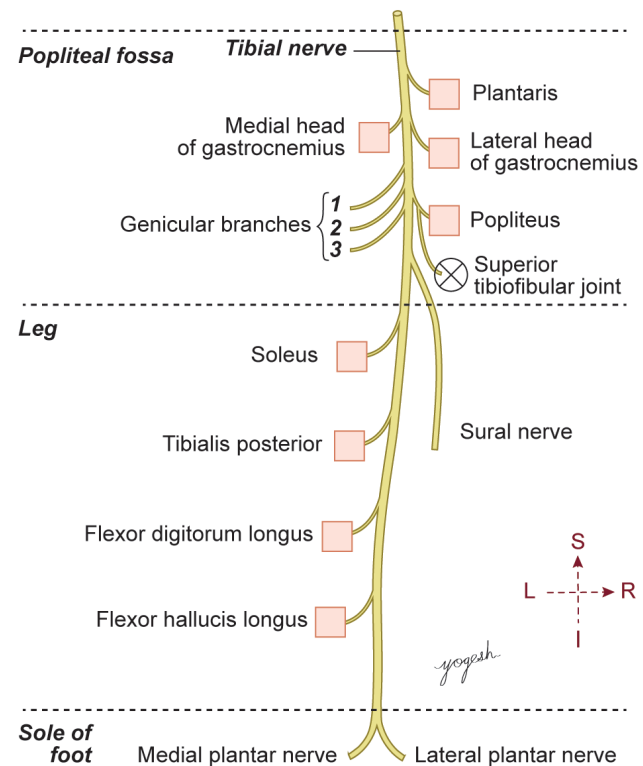
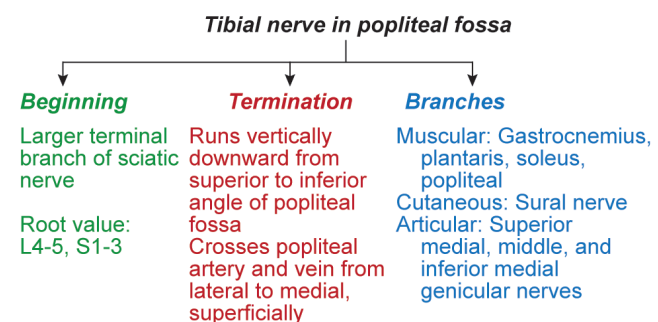


Fig. 13.13: Practice figure: Branches of tibial nerve in popliteal fossa and leg (right) (1: Superior medial genicular nerve, 2: Middle genicular nerve, 3: Inferior medial genicular nerve)

Flowchart 13.4: Tibial nerve in popliteal fossa



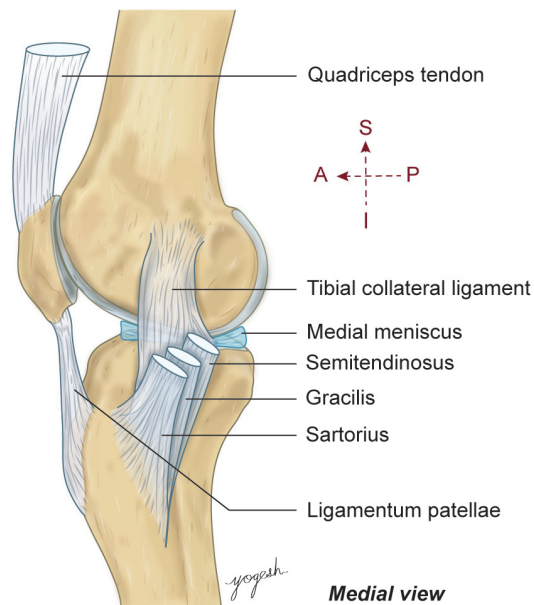


Fig. 17.3: Tibial collateral ligament and ligamentum patellae (right, medial view)

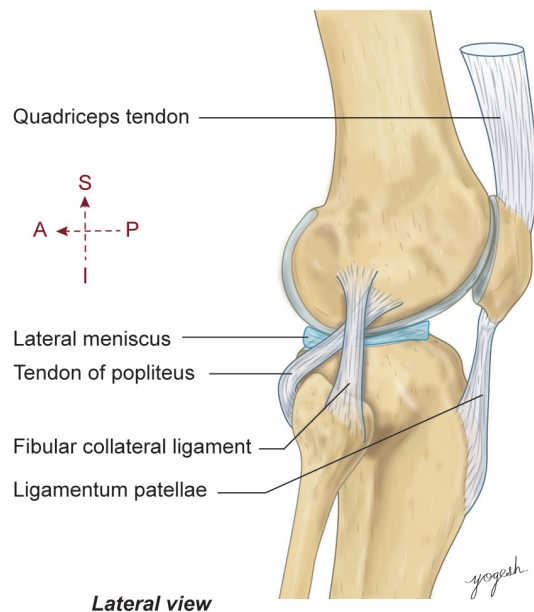


Fig. 17.4: Fibular collateral ligament and ligamentum patellae (right, medial view)

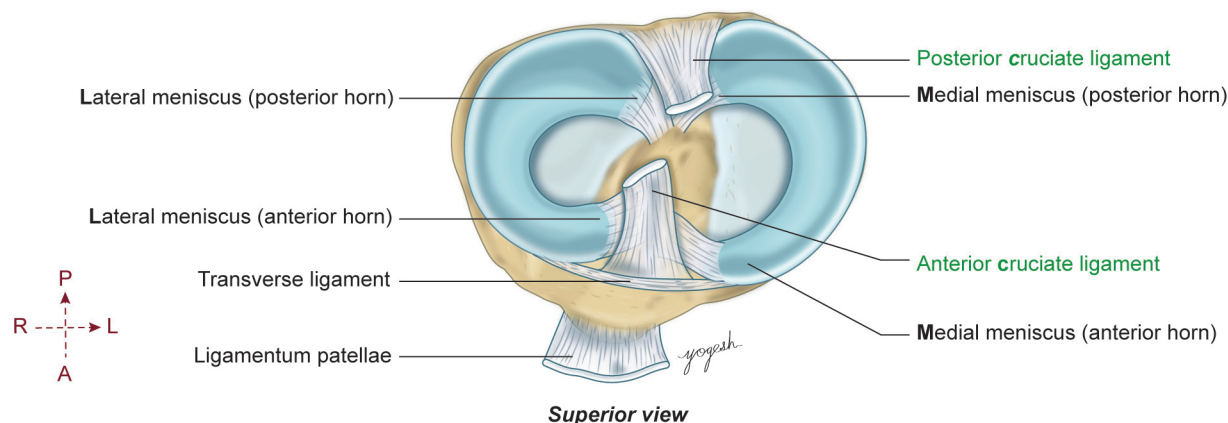


Fig. 17.5: Knee menisci and cruciate ligaments (right, superior view) (Mnemonic: Medical College Lucknow, Lucknow Medical College)

Cruciate ligaments of knee (Fig. 17.5)

- These are strong cord-like fibrous bands that are arranged like a letter X. These ligaments extend between tibia and femur.
- They are as follows:
Anterior cruciate ligament: It extends from anterior part of intercondylar area of tibia to the posterior part of medial surface of lateral condyle of femur.
- *Posterior cruciate ligament:* It extends from posterior part of intercondylar area of tibia to the anterior part of lateral surface of medial condyle of tibia.

Menisci or semilunar cartilages (Fig. 17.5)

- These are two crescent-shaped fibrocartilages found between the articular surfaces of tibia and femur.
- Medial meniscus is semicircular and lateral meniscus is circular. Each meniscus has two ends – anterior and posterior. They are attached to the intercondylar area of the tibia.

Oblique popliteal ligament (Fig. 17.2)

- The oblique popliteal (Bourgy) ligament is an expansion of the tendon of semimembranosus. ^{MCQ} It runs upward and laterally and blends with the posterior aspect of the capsule.
- *Attachments:*
Superior: Intercondylar line and lateral condyle of femur.
Inferior: Posterior margin of medial condyle of tibia.

Arcuate popliteal ligament

- It is a posterior expansion from the short lateral ligament. It is Y-shaped.
- *Attachments:* Stem of the ligaments is attached to the head of fibula. Large posterior band is attached to intercondylar area of tibia. Small anterior limb passes deep to fibular collateral ligament and is attached to the lateral condyle of femur.

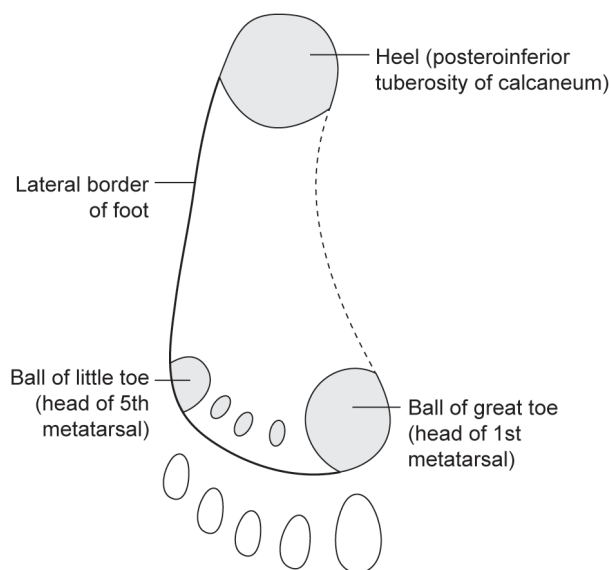


Fig. 21.2: Footprint showing the weight-bearing point of the sole (right, Note: Medial border of foot does not come in contact with ground)

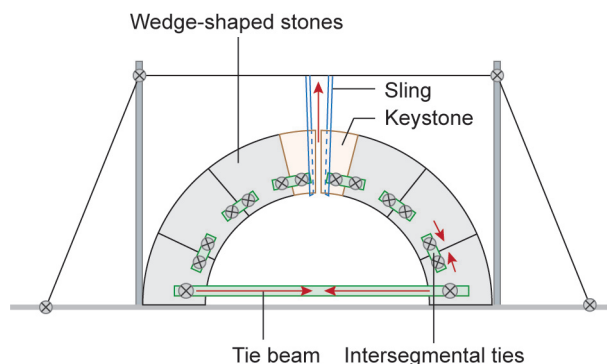
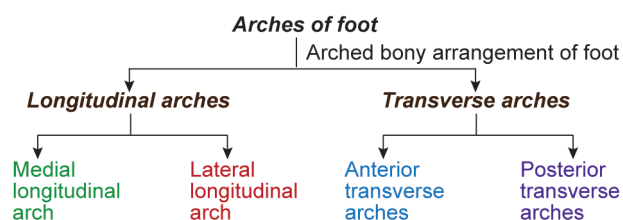


Fig. 21.3: Concept of arches of foot and supports of stone bridge (red arrows indicates the direction of pull of sling, tie beam, and intersegmental ties)

Flowchart 21.1: Classification of arches of foot



STRUCTURE OF ARCHES OF FOOT

Medial Longitudinal Arch (MLA)

Q. Write a short note on medial longitudinal arch.

- Medial longitudinal arch is higher and more mobile than the lateral longitudinal arch. It is a big arc of a small circle (Figs 21.4 to 21.6).

Bones forming MLA

- The medial longitudinal arch is formed by the following bones: ^{Viva}
 1. Medial part of calcaneum

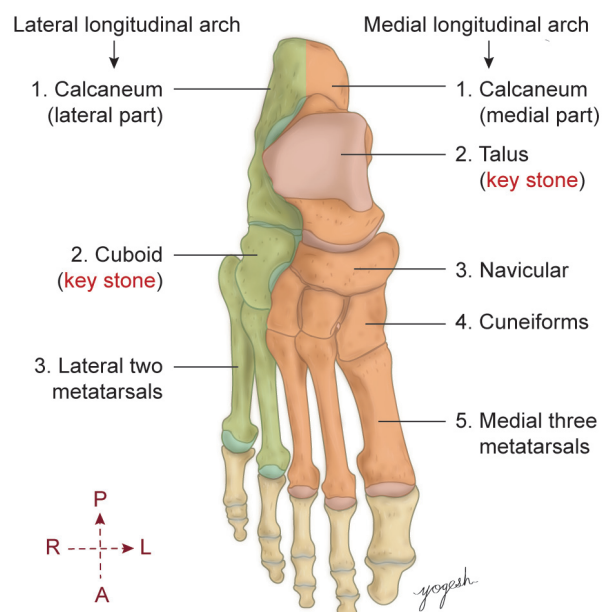


Fig. 21.4: Bones forming the longitudinal arches of foot (right, superior view)

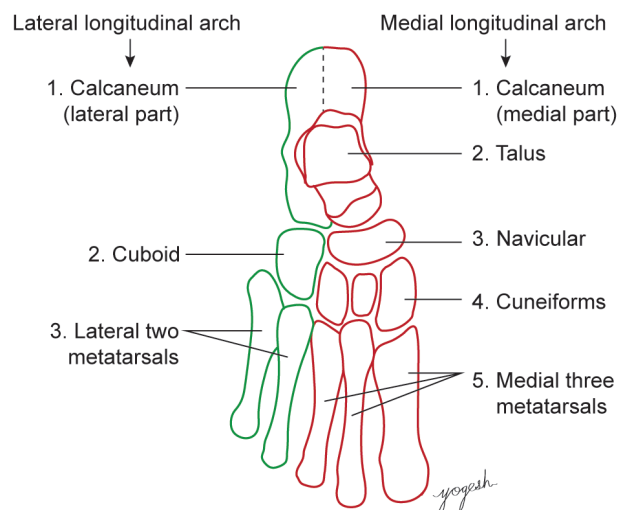


Fig. 21.5: Practice figure: Bones forming the longitudinal arches of foot (right, superior view)

2. Talus
3. Navicular
4. Cuneiform bones
5. 1st–3rd metatarsals.

Ends

- The medial longitudinal arch has anterior and posterior ends.

Anterior end: It is formed by the heads of 1st, 2nd, and 3rd metatarsals.

Posterior end: It is formed by medial tubercle of calcaneum.

Key stone: Talus ^{MCQ}

Summit

- It is the highest point of the arch. The summit of the medial longitudinal arch is formed by the superior articular surface of body of talus.

Boundaries of pelvic inlet

Anterior:

Arcuate or inferior pubic ligament

On either side:

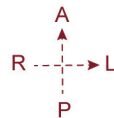
Ischiopubic ramus

Ischial tuberosities

Sacrotuberous ligament

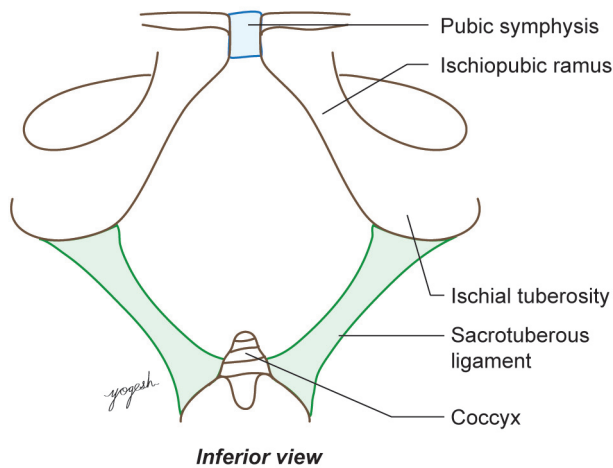
Posteriorly:

Coccyx



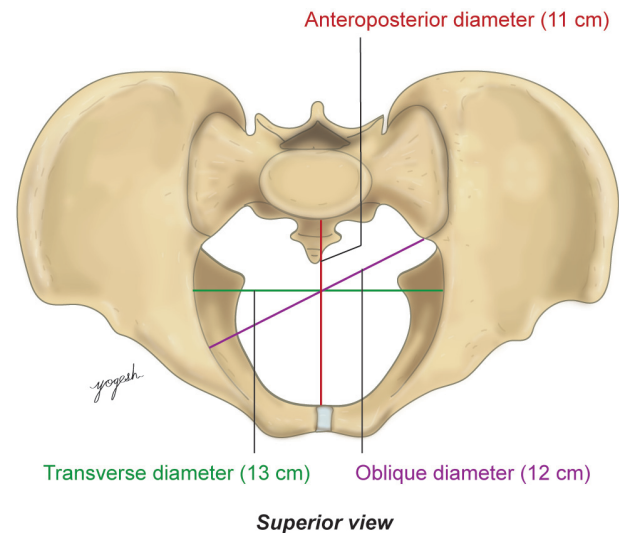
Inferior view

Fig. 4.8: Boundaries of pelvic outlet (green line indicates the pelvic outlet)



Inferior view

Fig. 4.9: Practice figure: Boundaries of pelvic outlet



Superior view

Fig. 4.11: Diameters of pelvic inlet

3. *Oblique diameter*: It extends from the lower end of sacroiliac joint of one side to the middle of the obturator membrane.

Diameters of the pelvic outlet (Fig. 4.12)

1. *Anteroposterior diameter*: It extends from the inferior margin of the pubic symphysis to the tip of sacrum.
2. *Transverse diameter*: It extends between ischial tuberosities; hence, called *bituberous diameter*.
3. *Oblique diameter*: It extends from the midpoint of the sacrotuberous ligament of one side to the junction of ischiopubic rami on the other side.

Conjugate diameter (Fig. 4.13)

1. *External conjugate or Baudelocque diameter*: It extends from upper margin of pubic symphysis to the tip of the spine of S1 vertebra.

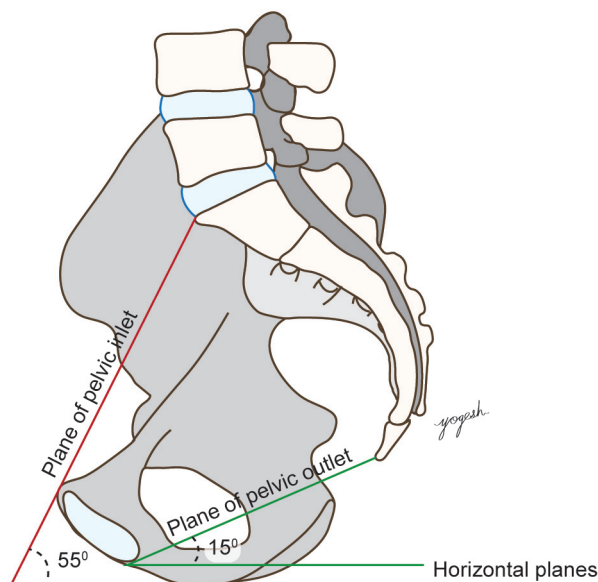


Fig. 4.10: Pelvic inclination

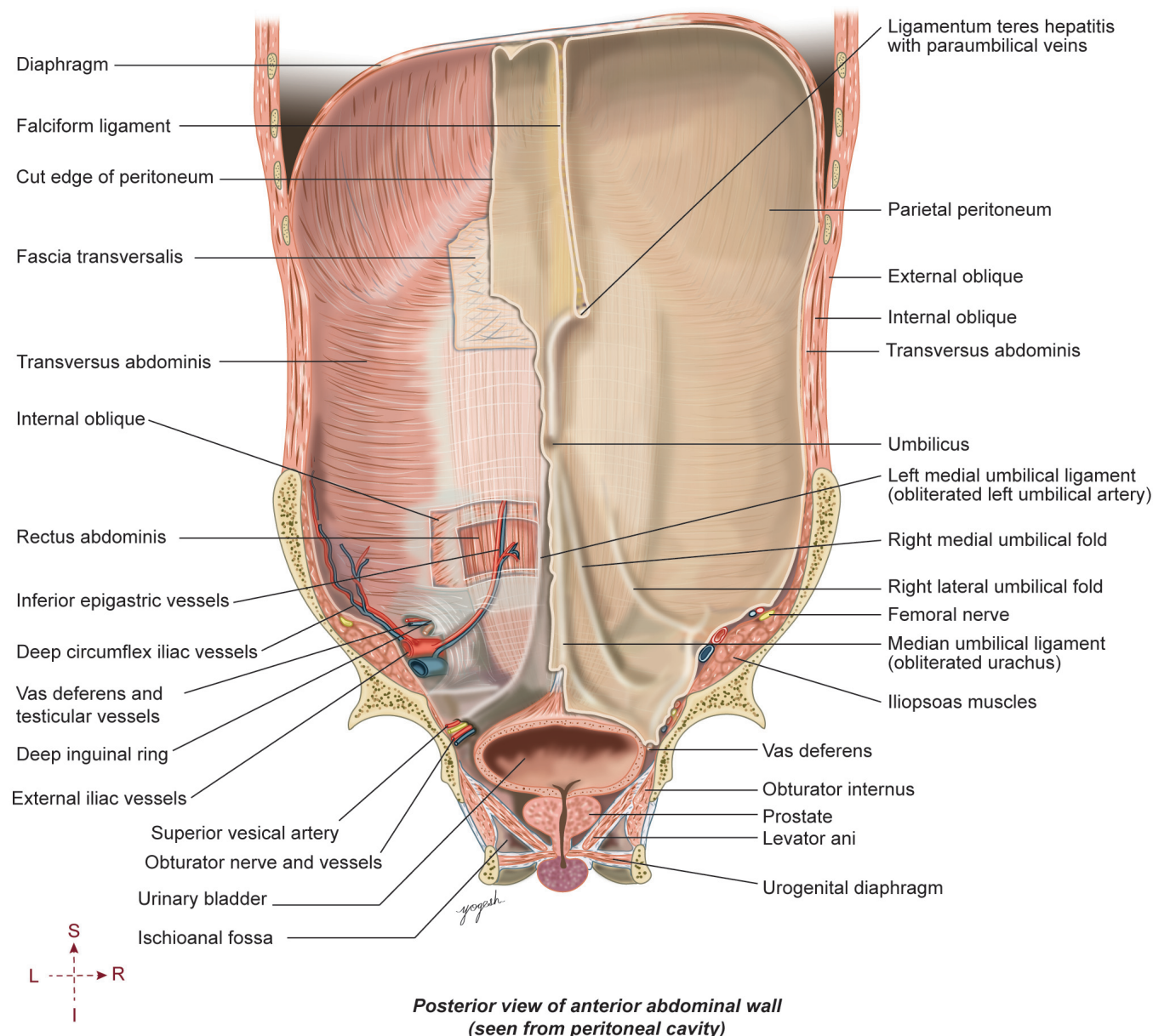


Fig. 5.4: Posterior view of anterior abdominal wall (seen from peritoneal cavity)

3. Linea semilunaris
4. Transverse furrows (*linea transversalis*): These are two to three transverse grooves that correspond to the tendinous intersections of the rectus abdominis muscle.
5. *Line of Venus*: It is a semilunar line with upward convexity. It lies between umbilicus and pubic symphysis, mostly in females.
6. *Linea gravidarum*: Several irregularly branched white lines on the skin of lower abdominal part of parous female are called linea gravidarum. They appear on undue stretching of the anterior abdominal wall by gravid uterus in pregnancy.
7. *Cleavage lines of Langer*: These are horizontal cleavage lines produced by arrangement of bundles of collagen fibers of the dermis. An incision given along these lines heal with invisible linear scars. Hence, in the abdominal surgeries, horizontal

incisions are more preferred by surgeons [Karl Langer, Austrian anatomist, 1819–1887]. *Clinical fact, Viva*

Box 5.1: Umbilicus

- The umbilicus or navel is the normal scar in the anterior abdominal wall formed by the remnant of the umbilical cord. It is the most apparent feature of the anterior abdominal wall.
- *Position*: The position of the umbilicus varies according to the age.
 1. *In newborn*, it is lower than the adult position due to poorly developed pelvic region.
 2. *In adults*, it lies at the level of intervertebral disc between 3rd and 4th lumbar vertebrae.
 3. *In old age*, it lies at lower level due to decreased tone of muscle of abdominal wall.

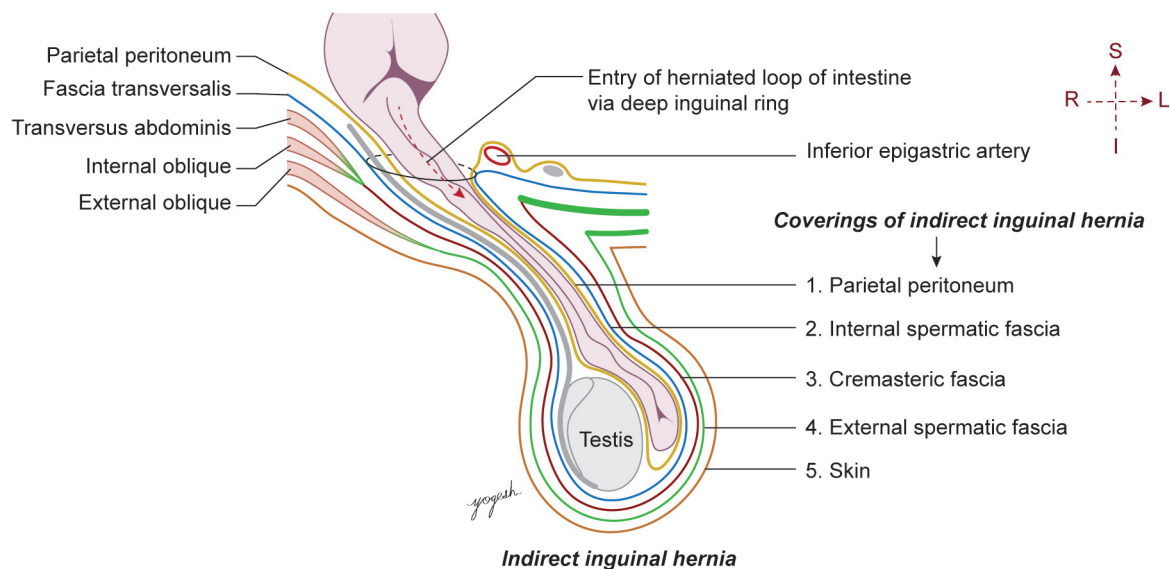


Fig. 7.15: Practice figure: Indirect inguinal hernia (right)

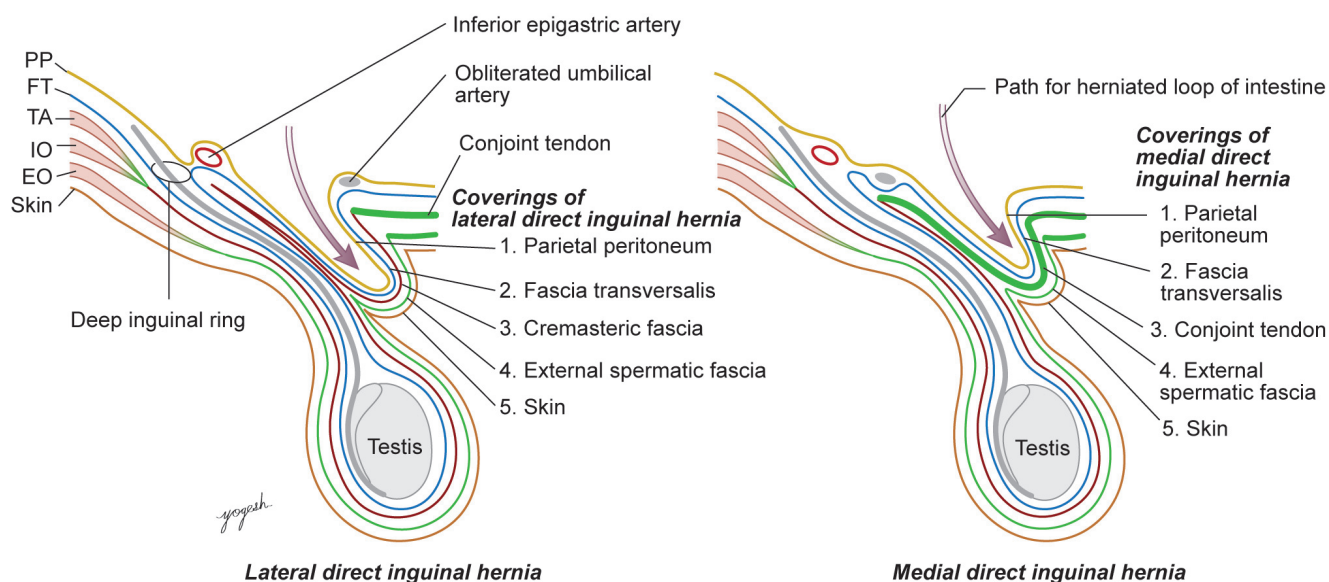
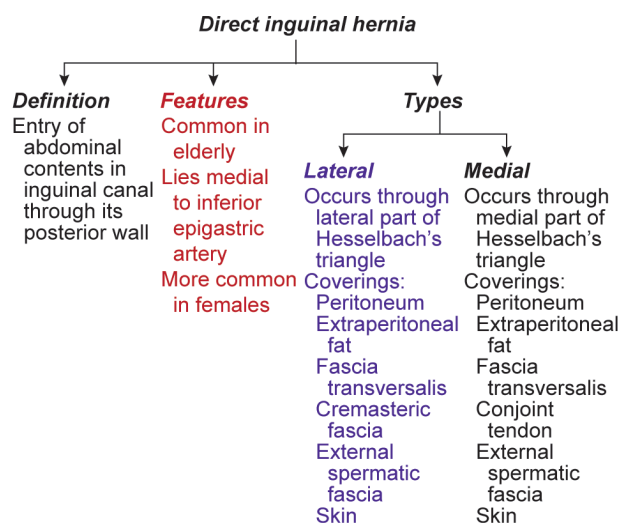


Fig. 7.16: Practice figure: Lateral and medial direct inguinal hernia (Right, anterior view) (PP: parietal peritoneum, FT: fascia transversalis, TA: transversus abdominis, IO: internal oblique, EO: external oblique)

Flowchart 7.6: Direct inguinal hernia



b. *Medial direct inguinal hernia* that occurs through the medial part of Hesselbach's triangle (medial to the medial umbilical ligament) (Fig. 7.16).

Coverings of medial direct inguinal hernia

1. Parietal peritoneum, and extraperitoneal connective tissue
2. Fascia transversalis
3. Conjoint tendon
4. External spermatic fascia
5. Skin

Treatment of hernia

- Treatment of the hernia depends on the cause, signs, symptoms, and the complications: *Herniorrhaphy* is the surgical repair of the hernia or weakened abdominal wall.

Size and Capacity

- Stomach is a very distensible organ. The capacity of the stomach varies with the age as follows:
At birth: 20–30 ml
In newborn: 300 ml (1 ounce)
At puberty: 1000 ml
In adults: 1000–1500 ml [Reference: Gray's Anatomy, 42nd edn.]
- Length: 25 cm (10 inches)

EXTERNAL FEATURES

The stomach has the following presenting features (Figs 13.2, 13.3, Flowchart 13.1):

- Two orifices:** Cardiac and pyloric
- Two curvatures:** Lesser and greater
- Two surfaces:** Anterior and posterior (in distended stomach) or superior and inferior (in empty stomach).



Some Interesting Facts

Previous concept: The stomach has anterior or anterosuperior and posterior or posteroinferior surfaces.

Current concept: When the stomach is distended, it has anterior and posterior surfaces. When the stomach is empty and contracted, the anterior surfaces face superiorly and the posterior surfaces face inferiorly [Reference: Gray's Anatomy, 42nd edn.]

Anatomical Position

Hold the stomach in such a way that ^{Viva, Practical guide}

- The stomach is flat anteroposteriorly.
- Concave lesser curvature faces to the right and convex greater curvature faces to the left and inferiorly.
- Thick pyloric end is directed downward and to the right.
- The cardiac or upper end of the stomach lies at higher level and to the left than the pyloric end.

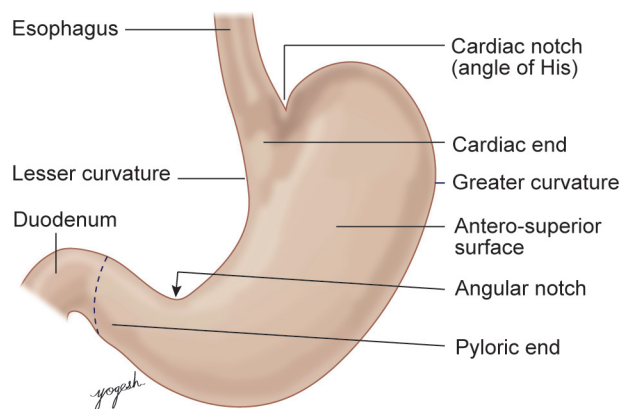


Fig. 13.2: External features of stomach

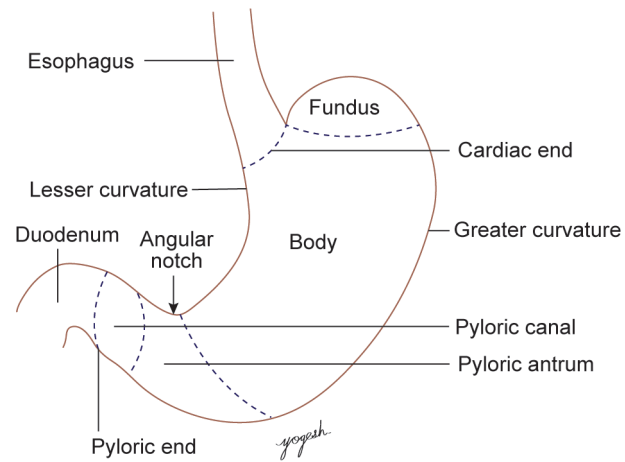
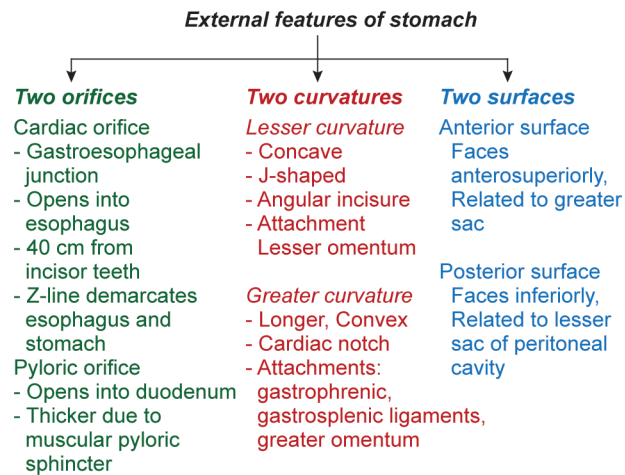


Fig. 13.3: Practice figure: External features and parts of stomach

Flowchart 13.1: External features of stomach



Two Orifices

Cardiac orifice

- It is also called gastroesophageal junction or cardiac end of stomach. At cardiac orifice, the esophagus opens into the stomach.
- Location: It is situated behind the left 7th costal cartilage, 5.5 cm from its junction with the sternum at the level of T11 vertebra. It is about 40 cm from the incisor teeth in adults. ^{Clinical fact}



Some Interesting Facts

- Z-line** is a line of demarcation at gastroesophageal junction. It separates pale-colored esophageal mucosa (lined by stratified squamous epithelium) from pink-colored gastric mucosa (lined by tall columnar epithelium). Z-line is circumferential zigzag line.
- Pad of fat that lies externally at the gastroesophageal junction helps in surgical identification of cardiac end of stomach.
- The sphincter at the cardiac end is physiological and cannot be demonstrated anatomically.

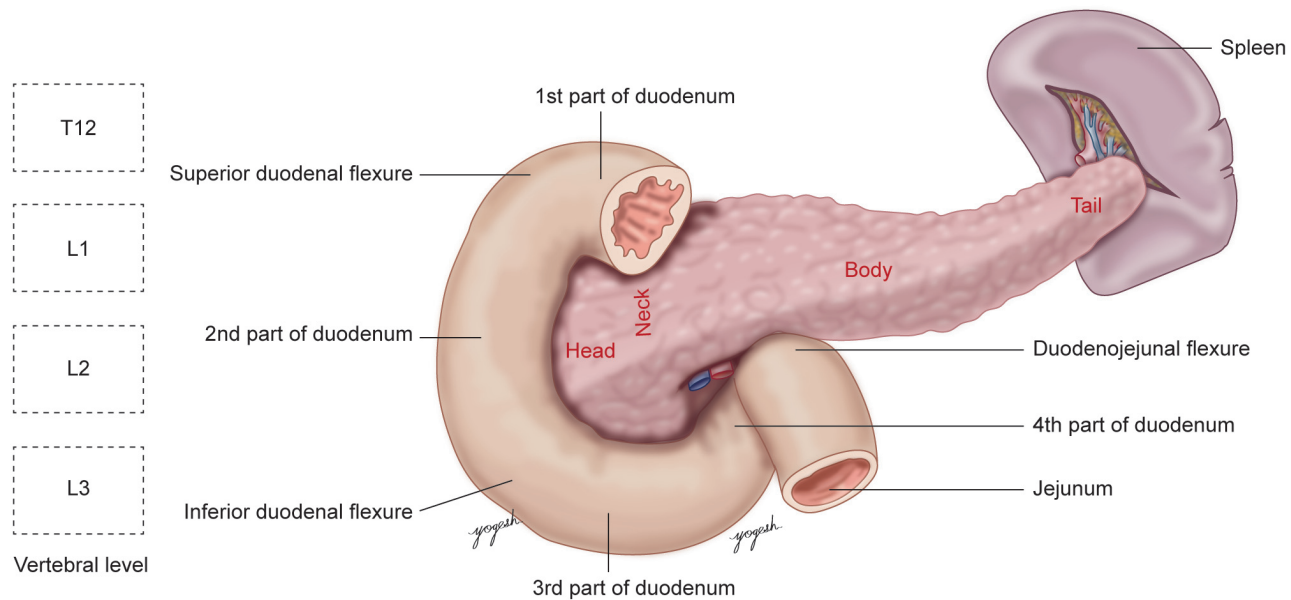


Fig. 20.1: Location of pancreas, duodenum, and spleen

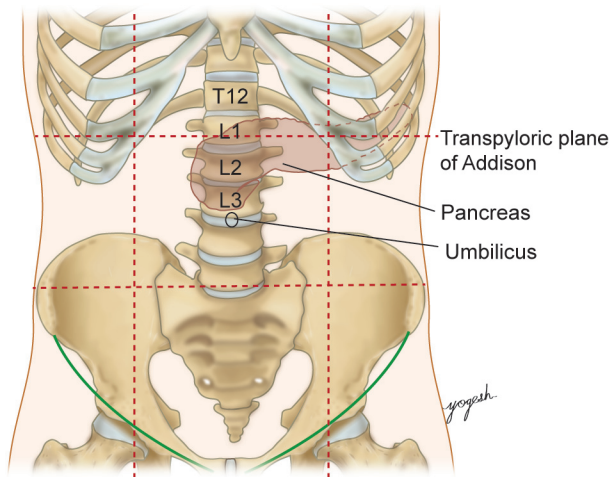


Fig. 20.2: Location of pancreas

Parts of Pancreas

The pancreas is divided into four parts from right to left into the following (Figs 20.3, 20.4):

1. **Head** is an enlarged part that lies in the concavity of the duodenum

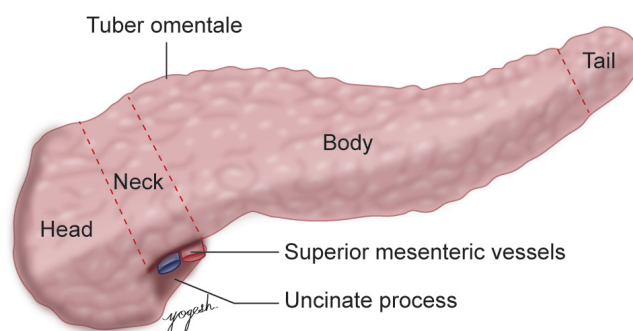


Fig. 20.3: Parts of pancreas

2. **Neck** is a slightly constricted part
3. **Body** is elongated
4. **Tail** is a narrow, pointed part that reaches the hilum of spleen.

Peritoneal Relations of Pancreas

- The ventral surface of pancreas is covered by parietal peritoneum and is crossed by the root of transverse mesocolon.
- The tail of the pancreas is its only intraperitoneal part and lies in the lienorenal ligament. Pancreas lies posterior to the lesser sac.



Some Interesting Facts

- The loose connective tissue that lies posterior to the head of pancreas is called *fusion fascia of Treitz*, and that lies posterior to the body and tail of pancreas is called *fusion fascia of Toldt*. [NEXT](#)
- The important pancreaticoduodenal arcades of arteries and veins are situated in these fascias. [NEXT](#)

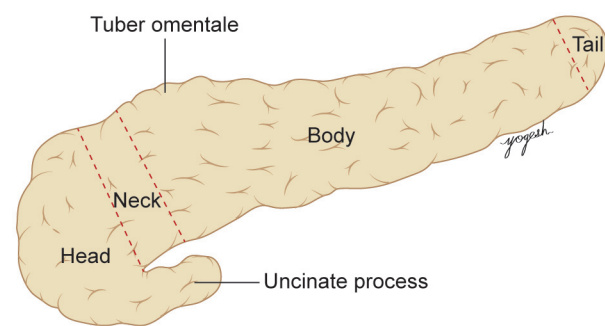


Fig. 20.4: Practice figure: External features of pancreas

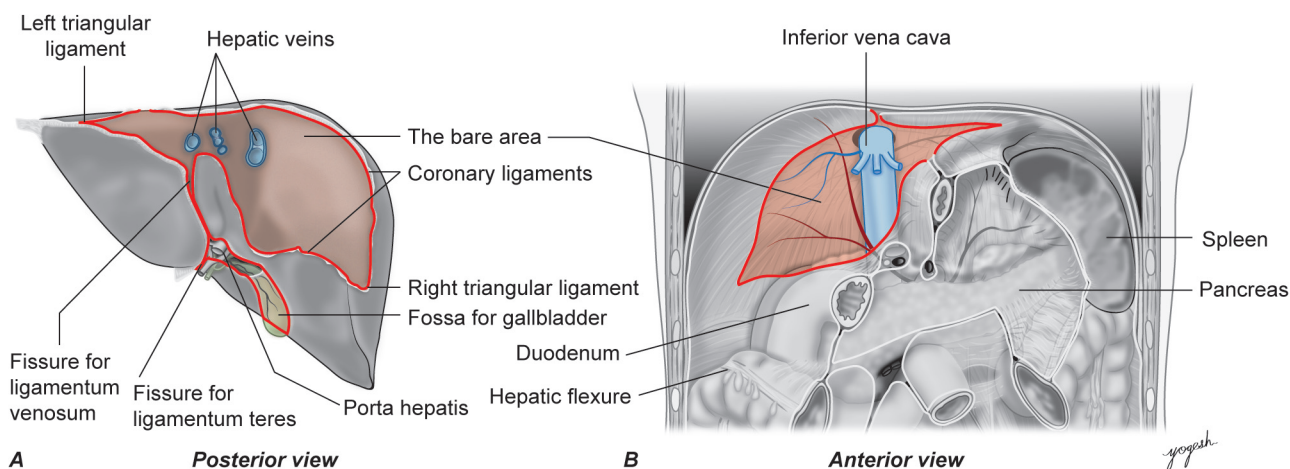


Fig. 21.11: A. Bare areas of liver (posterior view of liver) B. Reflection of peritoneum of liver on the hepatic surface of diaphragm

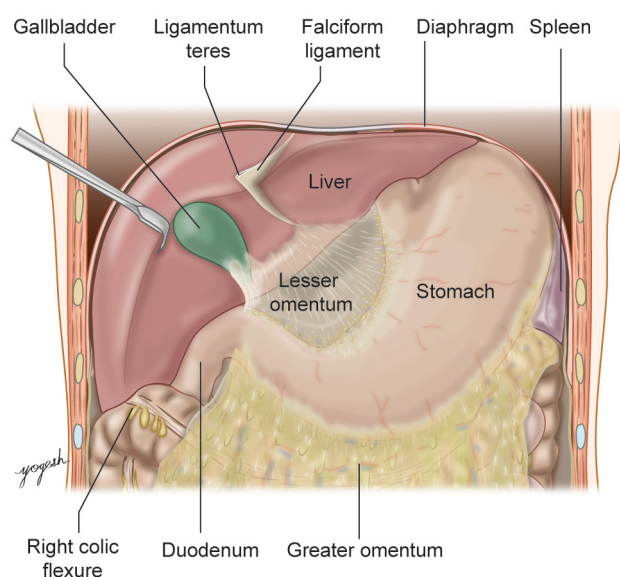
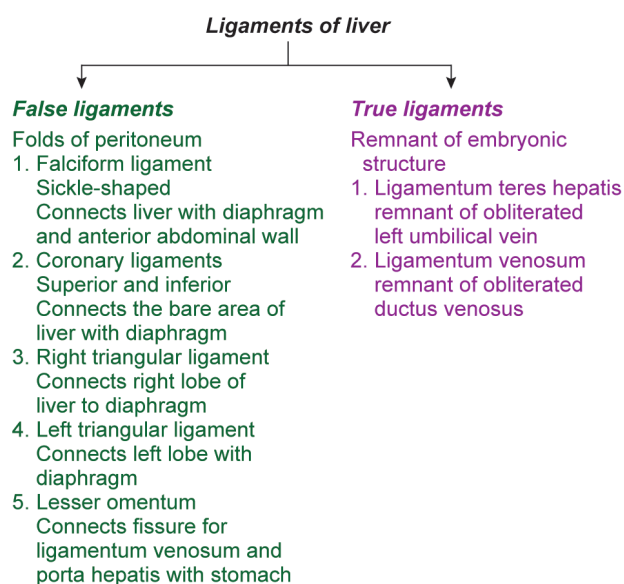


Fig. 21.12: Liver and related viscera (part of anterior abdominal wall is removed to visualize the interior of abdominal cavity)

Flowchart 21.7: Ligaments of liver



Some Interesting Facts

Falciform ligament

- It is a sickle-shaped peritoneal fold that connects the liver to the lower surface of the diaphragm and the anterior abdominal wall up to umbilicus. It develops from ventral mesogastrium.
- **Contents**
 1. Ligamentum teres
 2. Paraumbilical vein (tributary of portal vein)
 3. Accessory portal system of Sappey, which communicates paraumbilical vein with diaphragmatic veins.

Coronary ligament

- It is a triangular fold of peritoneum that connects the bare area of liver with the diaphragm. It consists of two layers – upper and lower. The *upper layer* (parieto-visceral layer) is reflected from the diaphragm to the liver. The *lower layer* (inter-visceral layer) is reflected from the liver to the upper end of right kidney.
- **Tracings**
On the right, both the layers fuse to form right triangular ligament.
On the left, the upper layer is continuous with the right layers of the falciform ligament, and the lower layer is continuous with the peritoneal reflection along the right border of the caudate lobe.
- **Contents**
 1. Connective tissue
 2. Branches of the right phrenic artery.

Right triangular ligament

- It is a small triangular fold of peritoneum that connects the right lobe of liver to the diaphragm. It encloses the apex of the bare area of liver.

Left triangular ligament

- It is a small triangular fold that connects the superior surface of left lobe of liver to the diaphragm. It has upper and lower layers.

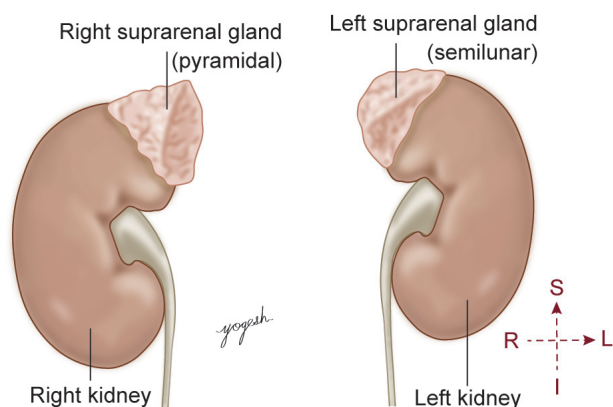


Fig. 24.2: Shape of suprarenal glands (anterior view)

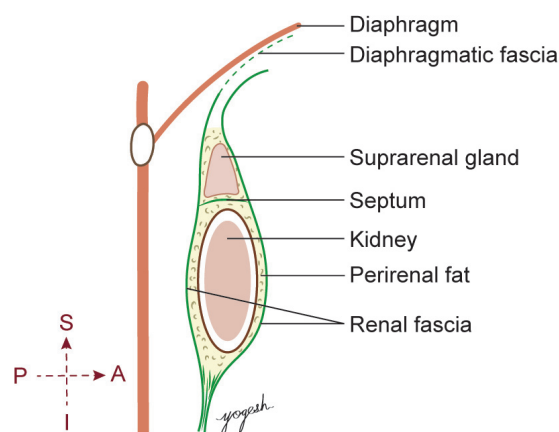


Fig. 24.3: Practice figure: Sheaths of the suprarenal gland (vertical section through posterior abdominal wall in the lumbar region)

External Features and Relations

Right suprarenal gland

- The right suprarenal gland is triangular or pyramidal (Fig. 24.4, Flowchart 24.1).
- It has base, apex, two surfaces (anterior and posterior), two borders (medial and lateral), and a hilum.

Relations

- **Base:** It is directed downward and overlaps the upper pole of right kidney.
- **Apex:** Apex is directed above and overlapped by inferior vena cava.
- **Anterior surface:** It has two areas
 - a. **Medial area** is nonperitoneal and related to the inferior vena cava.
 - b. **Lateral area** is related to bare area of liver in the upper and 2nd part of duodenum in lower part.
- **Posterior surface** is divided into upper and lower areas by a *curved ridge*. **Upper area** is convex and related to the diaphragm, whereas **lower area** is concave and related to the upper pole of kidney.
- **Medial border** is thin and related to the right coeliac ganglion and right phrenic artery.
- **Hilum of right suprarenal gland:** It lies on the anterior surface, near the apex of gland. It gives passage to right suprarenal vein.

Left suprarenal gland

- The left suprarenal gland is crescentic or semilunar-shaped (Fig. 24.4, Flowchart 24.1). It has two ends

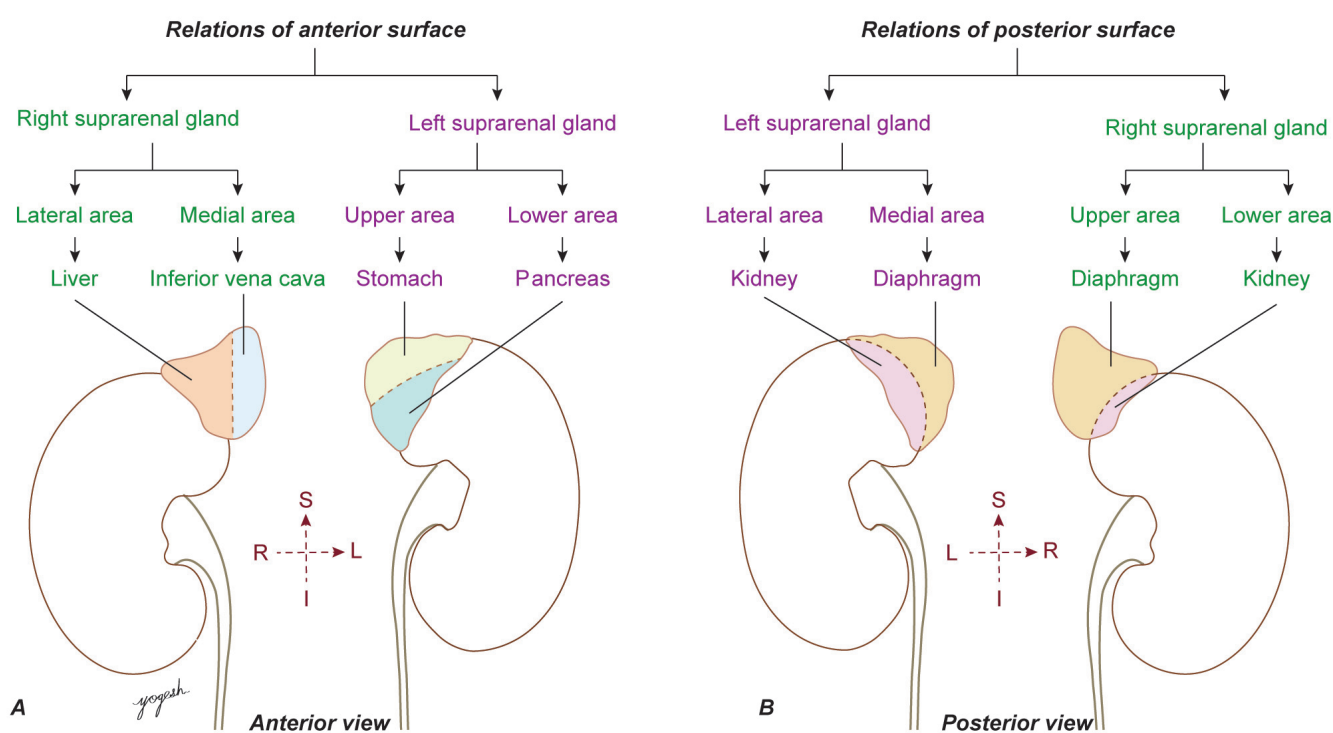


Fig. 24.4: Practice figure: Relations of suprarenal glands (A: anterior view, B: posterior view)

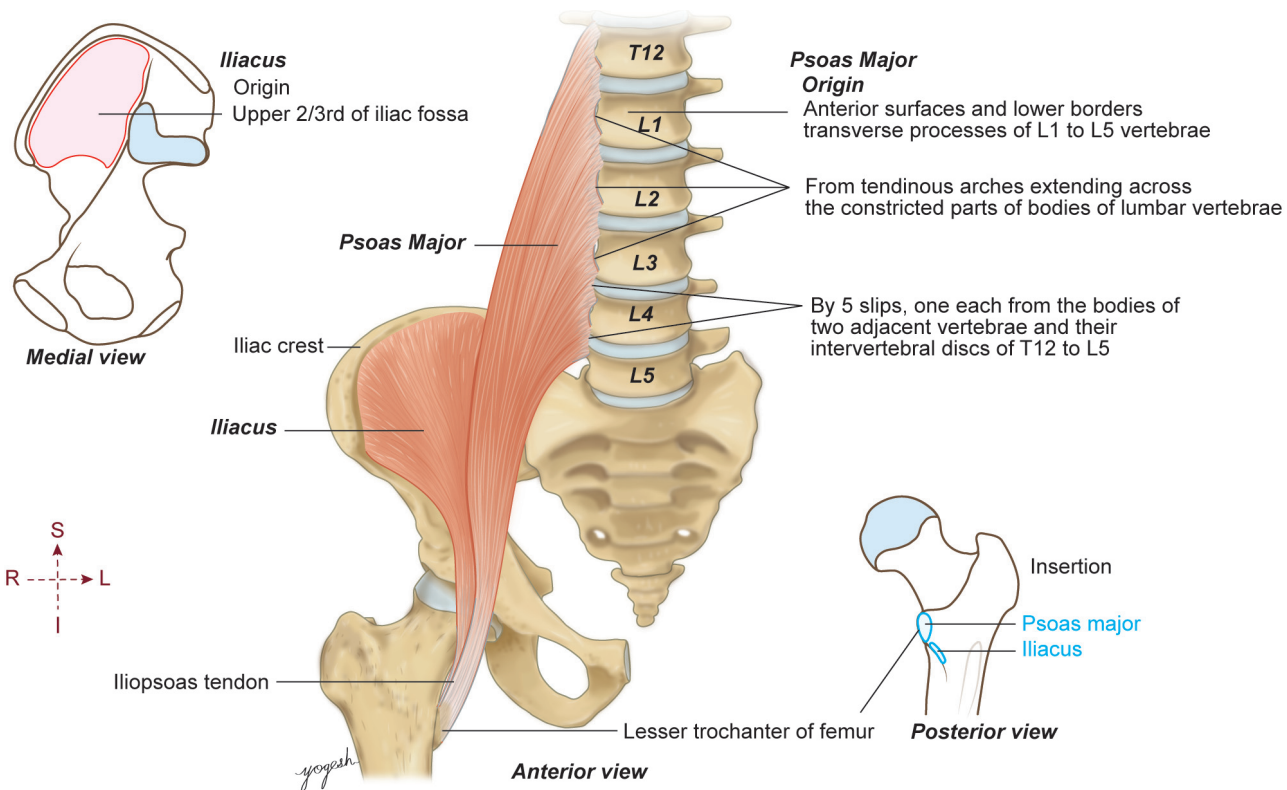


Fig. 26.2: Iliacus and psoas major muscles (right, anterior view, inset: attachments of iliacus, and insertion of iliopsoas tendon)

- When one psoas major muscle contracts, it brings lateral flexion of the trunk on the side of contracted muscle (weak action).
- Medial rotator of hip (weak action).

Nerves emerging from the psoas major muscle practical guide

From the lateral border (above downwards) (Fig. 26.3)

- Subcostal nerve (T12)
- Iliohypogastric nerve (L1)
- Ilioinguinal nerve (L1)
- Lateral cutaneous nerve of thigh (L1, L2)
- Femoral nerve (L2, L3, and L4)

From anterior surface

- Genitofemoral nerve (L1, L2)

From medial border

- Lumbosacral trunk
- Obturator nerve (L2, L3, L4)

Note: Subcostal nerve runs along with subcostal vessels.

Iliacus

- Iliacus is a triangular- or fan-shaped muscle (Fig. 26.2, Flowchart 26.2).

Origin

- It originates from
 - Upper 2/3rds of *iliac fossa*
 - Inner lip of iliac crest
 - Upper surface of lateral part of the sacrum

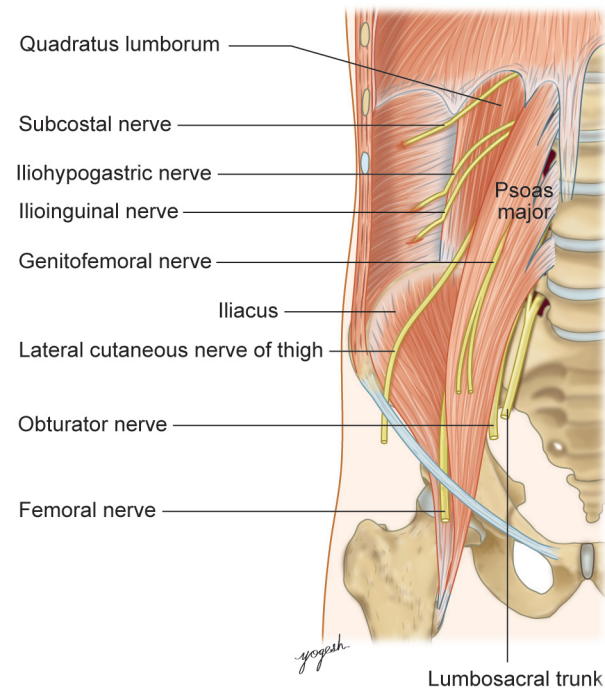
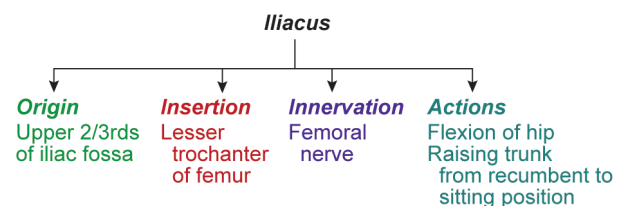


Fig. 26.3: Nerves piercing the psoas major muscle

Flowchart 26.2: Iliacus



Relations of Urinary Bladder (Flowchart 31.2)

Apex

- Apex is connected to the umbilicus by the *median umbilical ligament* (remnant of obliterated urachus).

Base

- *In male*: The upper part of base is separated from the rectum by the rectovesical pouch that contains coils of intestine. The lower part of base is related to (Figs 31.5 and 31.6)
 1. Pair of seminal vesicles
 2. Ampulla of vas deferens
- *Note*: The vas deferens lies medial to the seminal vesicles. The triangular area of the base between the two vas deferentia is separated from the rectum by rectovesical fascia of Denonvilliers (fusion fascia of rectovesical pouch).
- *In female*: The base is separated from the uterine cervix by the *vesicouterine pouch*.

Neck

- It is the lowest and fixed part of the bladder. It lies about 3–4 cm behind the lower border of symphysis pubis.
- *In male*, it is surrounded by the base of prostate. Identification feature
- *In female*, it is surrounded by the pelvic fascia.

Superior surface

- It is triangular and bounded on each side by lateral borders and posteriorly by the posterior border.
- *Lateral border* extends from apex to the ureteric entry into the bladder. Posterior border joins entrances of two ureters into the bladder.
- *In male*, it is completely covered by the peritoneum.
- *In female*, it is covered by the peritoneum except a small area near the posterior border where it is related to uterine cervix. The peritoneum from the superior surface of bladder is reflected on the isthmus of the cervix to form the *vesicouterine pouch*.

Inferolateral surfaces

- The inferolateral surfaces slope downward, forward, and medially and meet with each other in the midline at the *anterior border*.

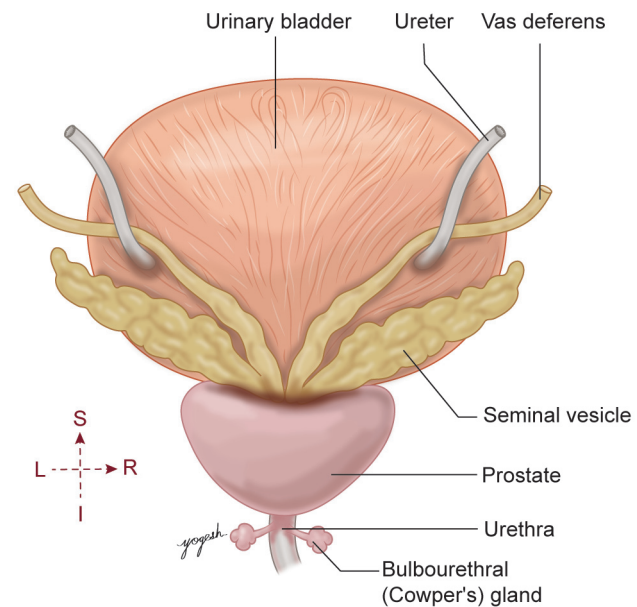


Fig. 31.5: Relation of the base of urinary bladder in the male (posterior view of urinary bladder, male)

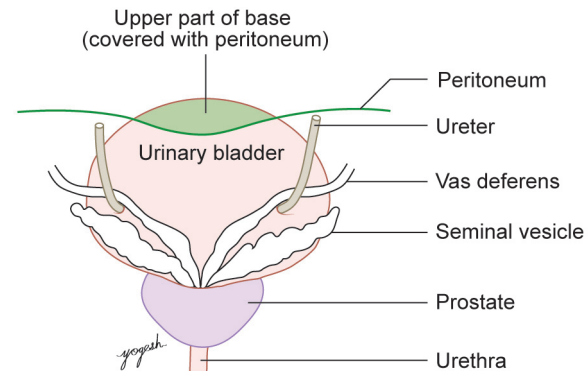
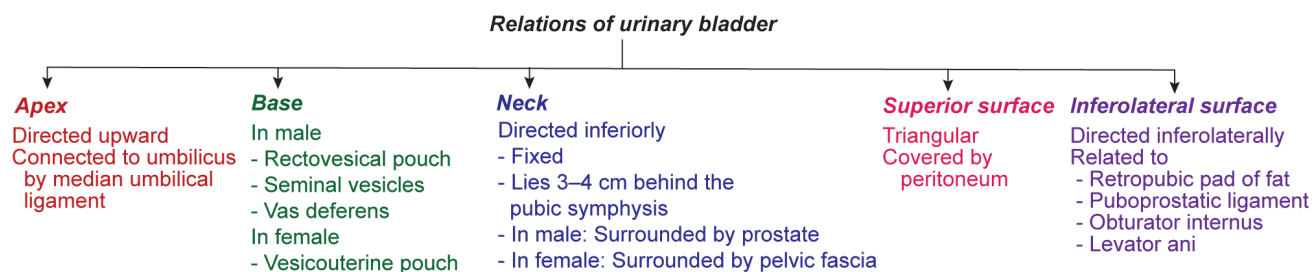


Fig. 31.6: Practice figure: Relation of the base of urinary bladder in the male (posterior view of urinary bladder, male)

- The *anterior border* extends from the apex to the neck and separates two inferolateral surfaces.
- Inferolateral surfaces are devoid of peritoneum.
- *Relations*: These surfaces are related to (Fig. 31.7)
 1. Retropubic pad of fat
 2. Pubic symphysis
 3. Puboprostatic ligaments
 4. Obturator internus muscle
 5. Levator ani muscle

Flowchart 31.2: Relations of urinary bladder



Box 32.1: Features of prostatic urethra

- It is the widest and most dilatable part of male urethra.
- It is fusiform in coronal section and the lumen is crescentic on transverse section (Figs 32.5, 32.6, and Flowchart 32.3).
- **Urethral crest:** It is a median longitudinal mucosal crest that projects posteriorly into the lumen making the lumen crescentic in transverse section. *Viva*
- **Prostatic sinuses:** On each side of prostatic crest, there are shallow depressions called prostatic sinuses. It receives openings of 15–20 prostatic ducts. *Viva*
- **Verumontanum (seminal colliculus; previous name: Colliculus seminalis):** It is a round elevation at the middle of urethral crest. Embryologically, this colliculus corresponds to the Müllerian eminence. *MCQ* It presents 3 orifices of:
 - Middle prostatic utricle
 - Two ejaculatory ducts, one on each side of the prostatic utricle.
- **Prostatic utricle:** It is cul-de-sac (6 mm long), located in the midline at the middle of verumontanum. *Viva* It extends upward and backward from the colliculus in the substance of median lobe of the prostate. It has openings of numerous small glands. It develops from united caudal ends of two Müllerian ducts. It corresponds with the vagina of female; hence, called *vaginus masculinus*. *Viva*

Anterior urethra (spongy part)

- Anterior urethra is about 15 cm long and traverses the corpus spongiosum through the penis. It consists of two parts: Bulbar urethra and penile urethra.

Bulbar urethra

- It is surrounded by bulbospongiosus. The bulbourethral glands open into the bulbar urethra, 2.5 cm below the perineal membrane.

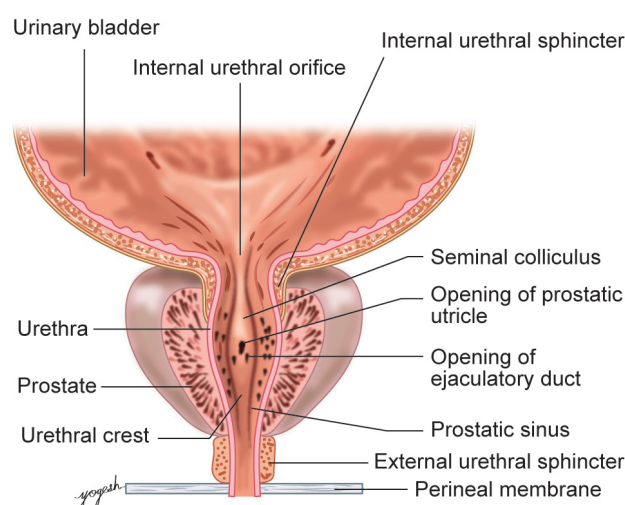


Fig. 32.5: Features of the posterior wall of the prostatic urethra (anterior view, coronal section)

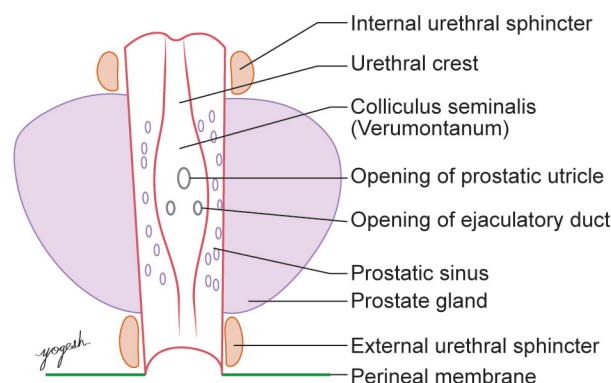


Fig. 32.6: Practice figure: Features of the posterior wall of the prostatic urethra

Penile or pendulous urethra

- It is a narrow, slit-like passage up to the external urethral orifice. *Navicular fossa* is a dilatation of terminal part of penile urethra within the glans penis.
- **External urethral orifice** is the narrowest part of urethra. *MCQ* It is a slit-like opening (6 mm long) and bounded on each side by small *labium*.
- **Urethral glands of Littre** are simple tubular mucous glands which open in the entire anterior or spongy urethra [*Alexis Littre, French physician, and anatomist, 1654–1726*].
- **Urethral lacunae** are the pit-like recesses of urethral mucosa which projects from entire urethra except in the navicular fossa.
- **Lacuna magna or sinus of Gurian** is the largest urethral lacuna located in the roof of the navicular fossa. Its mouth is guarded by mucous fold called *valvule of Guérin* [*Alphonse Guérin, French surgeon, 1816–1895*]. *Viva*

Blood Supply, Lymphatic Drainage, and Innervation

Arterial supply

- Urethra is supplied by *urethral artery* which is the branch of internal pudendal artery. It is also supplied by dorsal penile artery through its circumflex branches.

Venous drainage

- The venous drainage from anterior urethra goes to the dorsal vein of penis (tributary of internal pudendal vein).
- The venous drainage from posterior urethra goes to the prostatic and vesical venous plexuses.

Lymphatic drainage

1. Posterior urethra → internal and external iliac nodes.
2. Anterior urethra → deep inguinal nodes

Innervation

1. Prostatic plexus → supplies smooth muscles of prostate and prostatic urethra.

Surfaces of prostate

Anterior surface

- It is narrow and convex from side-to-side. It is situated about 2 cm behind the lower border of pubic symphysis and separated from pubic arch by:
 - Dorsal vascular complex or Santorini's plexus
 - Retropubic fat
- Puboprostatic ligaments connect the upper part of anterior surface of prostate with pubic bones. Urethra emerges out of the anterior surface near the apex of the prostate.

Inferolateral surfaces

- They are related to the sides of pelvic wall. The anterior fibers of the levator ani enclose the prostate gland in the pubourethral sling (pubourethralis).

Posterior surface

- It is triangular in shape. It is flattened from side-to-side and convex vertically. Near its upper border, it is pierced by ejaculatory ducts on each side of the median plane (Figs 33.4 and 33.5).
- Relations:** It is separated from the rectum by the fascia of Denonvilliers (condensation of pelvic fascia).

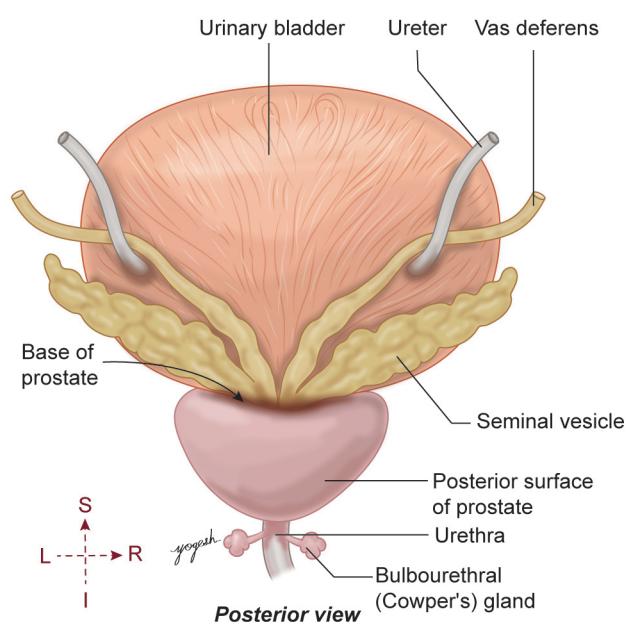


Fig. 33.4: Relations of the prostate gland and urinary bladder in the male (posterior view of urinary bladder, male)

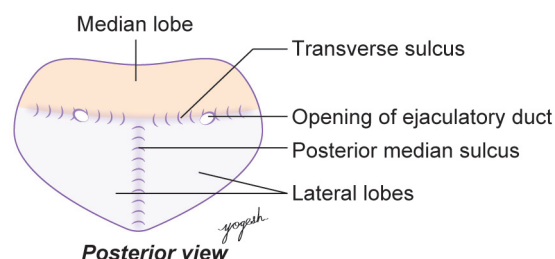


Fig. 33.5: Practice figure: Features of the posterior surface of the prostate

Some Interesting Facts

- The organs with more width than length are prostate, pituitary, pons, caecum, and coeliac trunk.
- Denonvilliers' fascia:** In fetal life, the posterior surface of prostate is separated from the rectum by rectovesical pouch. At birth, the lower part of rectovesical pouch obliterates and forms fascia of Denonvilliers. [Charles-Pierre Denonvilliers, French Surgeon, 1808–1872].
- The part of lateral pelvic fascia that lies anterior to the fascia of Denonvilliers is called *lateral prostatic fascia*, and the part that lies behind the fascia of Denonvilliers is called *lateral rectal fascia*.

Coverings of Prostate

Q. Write a short note on capsules of prostate.

- The prostate is covered by inner true capsule and outer false capsule (Fig. 33.6, Flowchart 33.2).^{Viva}
 - True capsule:** It is formed by the condensation of the peripheral part of the fibrous connective tissue of the gland. It is fibromuscular structure.
 - False capsule (prostatic sheath):** It is a connective tissue sheath surrounding the true capsule. It is derived from visceral layer of the pelvic fascia.
- Relations**
 - Anteriorly false capsule is continuous with puboprostatic ligaments.

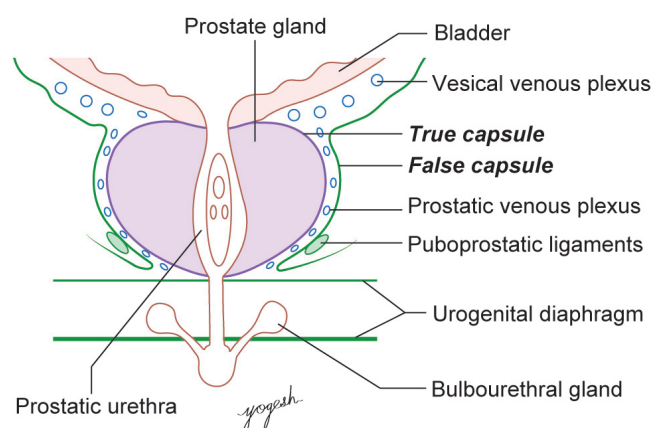
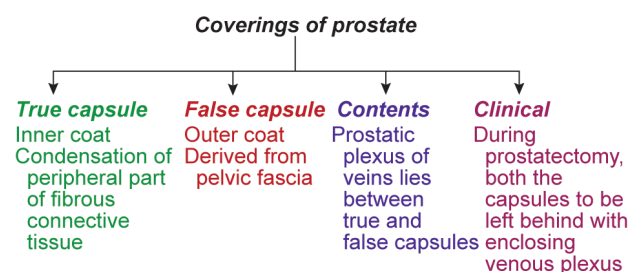


Fig. 33.6: Practice figure: Capsules of the prostate gland (coronal section)

Flowchart 33.2: Coverings of prostate



Lateral borders (right and left) of body of uterus

- Each lateral border is convex and rounded. It is nonperitoneal and provides attachment to broad ligament of the uterus.

**Some Interesting Facts**

- Broad ligament connects the lateral border of uterus with the lateral pelvic wall.
- Uterine tubes enter the uterus at the upper end of the lateral border of uterus (Fig. 34.16). Round ligament is attached to the lateral border antero-inferior to the tube, whereas ligament of ovary is attached posteroinferior to the tube. *Practical guide* Uterine artery ascends upward along the lateral border of uterus. *Identification feature*

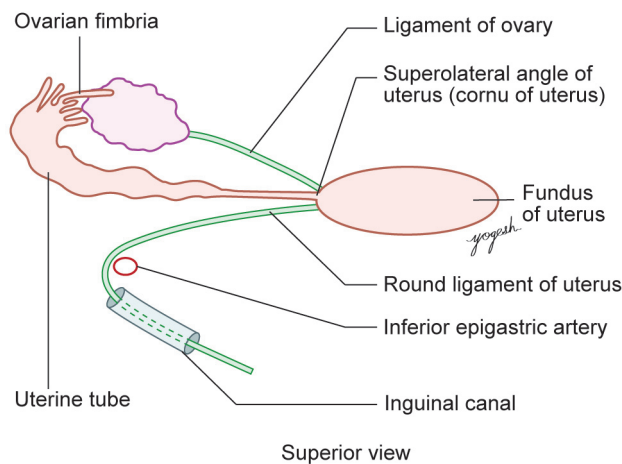


Fig. 34.16: Practice figure: Attachments of the uterine tube, round ligament of uterus, and ligament of ovary to the superolateral angle of uterus (superior view, right fallopian tube)

Cervix of uterus

- The cervix is lower cylindrical part of uterus.
- It measures about 2.5 cm.
- The lower part of the cervix projects into the upper part of vagina; thus, cervix is divisible into two parts:
 - Upper supravaginal
 - Lower vaginal.

**Some Interesting Facts**

- Clinically, the isthmus is the upper one-third of supravaginal part of cervix. Obstetrically this isthmus is considered as lower uterine segment. Structurally, it is similar to the body of the uterus.

Position, Angular, and Axes of Uterus**Q. Define anteversion and ante flexion of uterus.**

- Normal position of uterus:** It is anteversion and ante flexion (Fig. 34.17, Flowchart 34.6).

Anteversion: It is the angle between the long axis of the cervix and long axis of vagina. It is forward tilting of the uterus relative to the vagina. Usual anteversion is about 90° .

Anteflexion: It is the angle between the long axis of the body of uterus and the long axis of the cervix of uterus. It is forward flexion of the uterus at the level of isthmus or internal of the cervix. Usual anteflexion is about 120° (some authors mention it as 120° to 170°).

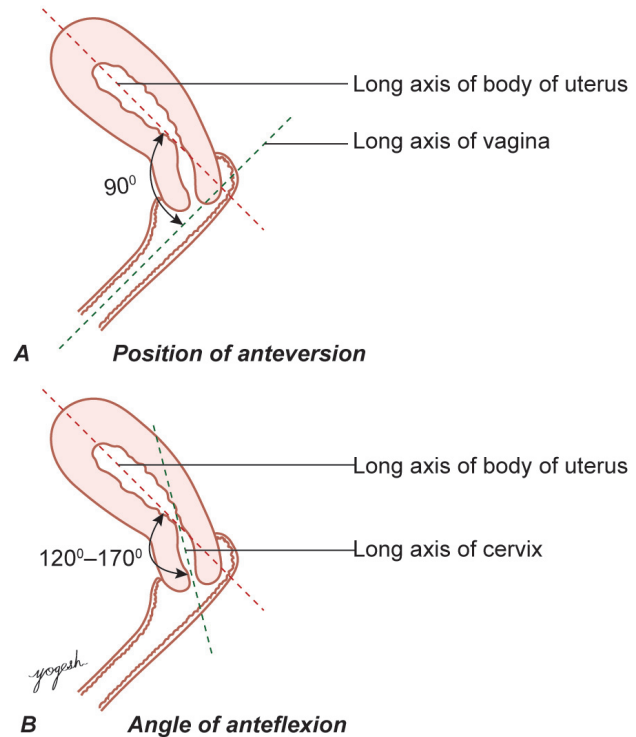
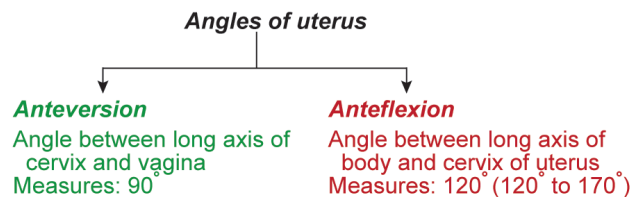


Fig. 34.17: Practice figure: Angulations of the uterus and vagina. A: Angle of anteversion. B: Angle of anteflexion

Flowchart 34.6: Angles of Uterus

Note : Retroversion is backward tilting of uterus

**Some Interesting Facts**

- Retroversion:** In retroverted (tilted or tipped) uterus, the uterus is tilted backward relative to the vagina. Long axis of the uterus corresponds to the axis of the pelvic inlet and the axis of the vagina to the axis of the pelvic cavity and the pelvic outlet.
- Dextrorotation** is the right deviation of the uterus.

Table 36.1: Difference between upper and lower parts of anal canal		
Feature	Upper part of anal canal (above pectinate line)	Lower part of anal canal (below pectinate line)
Development	Endoderm of hindgut	Ectoderm of proctodeum
Lining epithelium	Simple columnar epithelium	Stratified squamous epithelium
Arterial supply	Superior rectal artery	Inferior rectal artery
Venous drainage	Superior rectal vein drains into portal vein	Inferior rectal vein drains into systematic vein
Lymphatic drainage	Internal iliac nodes	Superficial inguinal nodes
Nerve supply	Autonomic nerves	Somatic nerve (inferior rectal)
Sensation	Sensitive to ischemia, distension, spasm	Pain, touch, temperature, pressure
Hemorrhoidal piles	Internal painless piles	External painful piles

Features of upper part (above pectinate line)

The upper part of anal canal is about 15 mm long and lies above the pectinate line. It has the following features (Figs 36.1 and 36.2):

1. *Anal columns of Morgagni*: These are permanent longitudinal mucosal folds. They are 6–10 in number. Anal columns contain terminal branch of superior rectal artery and vein [Giovanni Battista Morgagni, Italian anatomist, 1862–1771]. *Viva*
2. *Anal valves (valves of Ball)*: These are crescentic mucous folds connecting the lower ends of the anal columns. These anal valves have free margin, and upper and lower surfaces. *Viva*
3. *Pectinate line or dentate line*: The free margin of the anal valve forms a line called pectinate or dentate line. *NEXT, Viva*
4. *Anal sinuses*: These are depressions (recesses) above the anal valves. The ducts of the submucosal tubular *anal glands* open in the floor of the anal sinuses. *Viva*
5. *Anal papillae*: These are occasional epithelial projections from the free margin anal valves. Anal papillae represent the remnant of embryonic *anal membrane*. *NEXT*
6. *Anal glands*: These are tubular submucosal glands. Their ducts open in the floor of the anal sinuses.

Note: The upper part of anal canal (above pectinate line) is endodermal in origin and lined by simple columnar epithelium.

Features of middle part

- It is about 15 mm long. It is called *transition zone* or *area of pecten*.

Flowchart 36.1: Anal canal: Location, extent, and relations

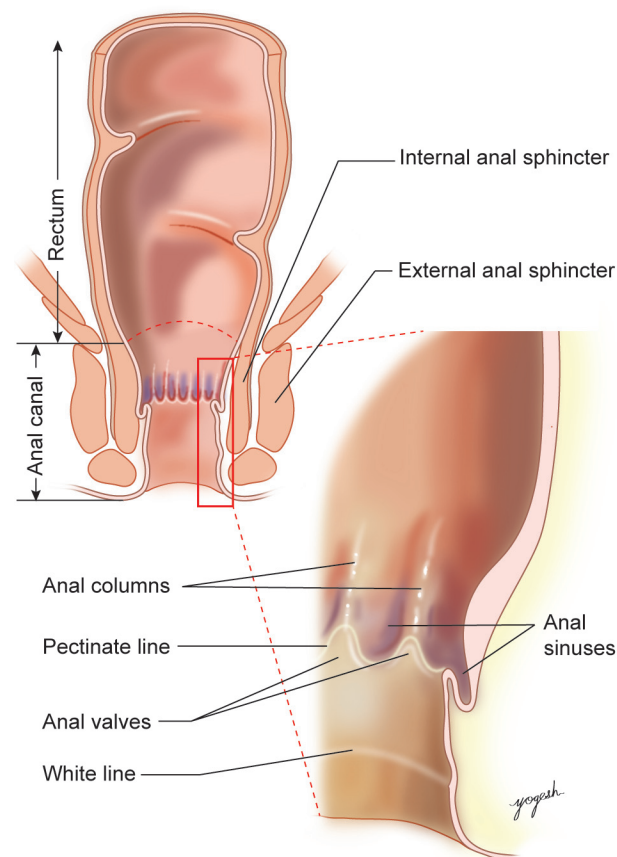
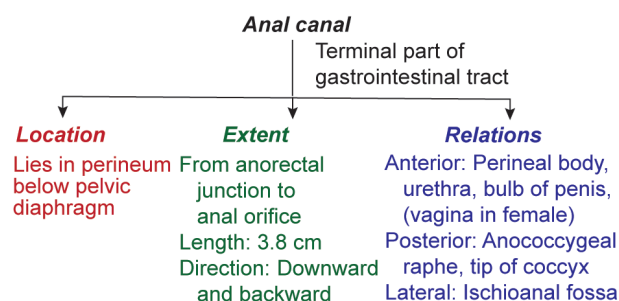


Fig. 36.1: Internal features of lower part of rectum and anal canal (coronal section).

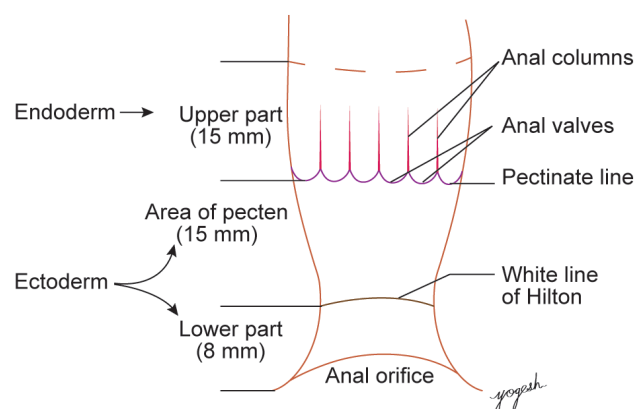


Fig. 36.2: Practice figure: Interior of the anal canal