

THE PELVIS AND PERINEUM

The pelvis is the area of transition between the trunk and the lower limbs. The bony pelvis serves as the foundation for the pelvic region and it provides strong support for the vertebral column upon the lower limbs. The pelvic cavity is continuous with the abdominal cavity, the transition occurring at the plane of the **pelvic inlet** (Fig. 5.01). The pelvic cavity contains the rectum, the urinary bladder, and the internal genitalia. [G 185]

The perineum is the region of the trunk that is located between the thighs. The **pelvic diaphragm** separates the pelvic cavity from the perineum (Fig. 5.01). The perineum contains the anal canal, the urethra, and the external genitalia (penis and scrotum in the male, vulva in the female).

This chapter begins with the dissection of structures in the anal triangle that are common to both sexes. Dissection of internal and external genitalia is divided into two sections, one for male cadavers and one for female cadavers. Students will be expected to demonstrate knowledge of both male and female anatomy in the pelvis and perineum. Each dissection team should partner with another dissection team that is working on a cadaver of the opposite sex.

SKELETON OF THE PELVIS

Refer to an articulated bony pelvis. The **pelvis** (L. *pelvis*, basin) is formed by two **hip bones** (**os coxae**) joined posteriorly by the **sacrum** (Fig. 5.02A). Each hip bone is formed by three fused bones: **pubis**, **ischium**, and **ilium**. The point of fusion of these three bones is the **acetabulum**. The **coccyx** is attached to the sacrum. [G 185; N 341; R 422; C 253]

On the hip bone, identify: [G 184; N 340; R 419; C 250]

- Iliac fossa
- Iliopubic eminence
- Arcuate line
- Pecten pubis
- Superior pubic ramus
- Pubic symphysis
- Pubic arch
- Ischiopubic ramus—formed by the ischial ramus and the inferior pubic ramus
- Obturator foramen

KEY TO REFERENCES

G = Grant's Atlas, 11th ed., page number
 N = Netter's Atlas, 3rd ed., plate number
 R = Rothen's Color Atlas of Anatomy, 5th ed., page number
 C = Clemente's Atlas, 4th ed., page number

- Ischial tuberosity
- Ischial spine

On the sacrum identify: [G 185; N 341; R 420; C 428]

- Sacral promontory
- Anterior sacral foramina
- Coccyx

The hip bone and sacrum are connected by strong ligaments. On a model with pelvic ligaments, identify (Fig. 5.02A,B): [G 186, 188; N 340; R 430; C 255, 257]

- Sacrotuberous ligament
- Sacrospinous ligament
- Obturator membrane
- Greater sciatic foramen
- Lesser sciatic foramen

Note that the sacrotuberous ligament and sacrospinous ligament convert the **greater and lesser sciatic notches** into the **greater and lesser sciatic foramina**.

The sacroiliac articulation is a synovial joint between the auricular surfaces of the sacrum and the ilium. It is strengthened by an **anterior sacroiliac ligament** and a **posterior sacroiliac ligament** (Fig. 5.02A, B).

Identify the **pubic arch**. Note that the **subpubic angle** (angle of the pubic arch) is wider in females than males. [G 190, 191; N 342; R 422; C 254, 255]

Identify the **pelvic inlet** (**superior pelvic aperture**). The bony rim of the pelvic inlet is called the **pelvic brim**. From anterior to posterior, identify the structures that form the pelvic brim: [G 191; N 341; R 421; C 253]

- Superior margin of the pubic symphysis
- Posterior border of the pubic crest
- Pecten pubis
- Arcuate line of the ilium

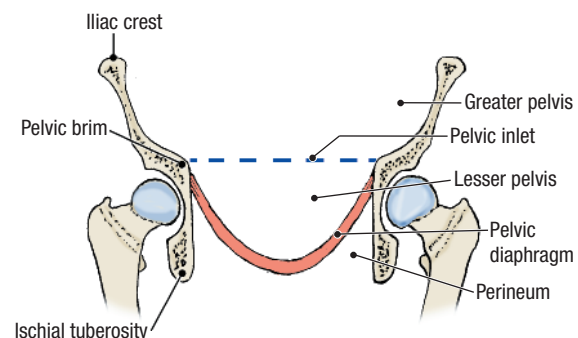


Figure 5.01. The pelvis on coronal section.

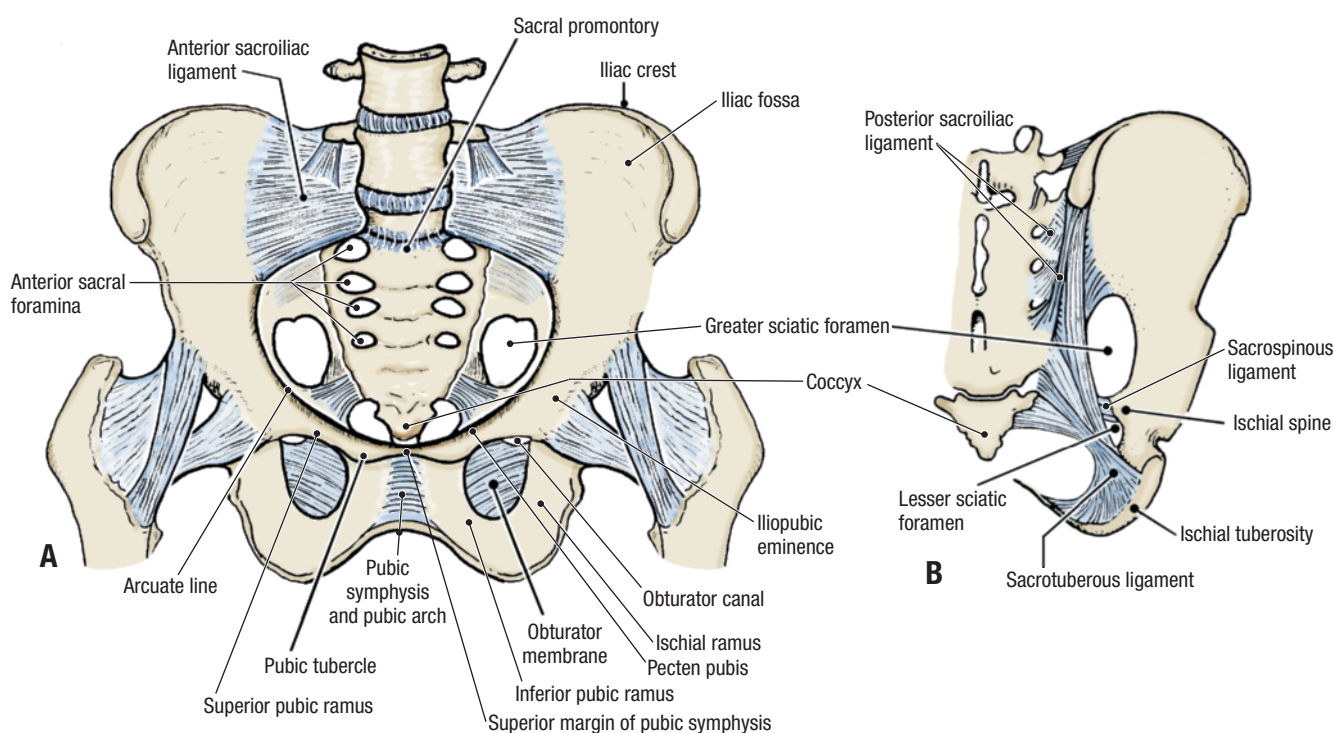


Figure 5.02. Bones and ligaments of the pelvis. A. Anterior view. B. Posterior view.

- Anterior border of the ala (wing) of the sacrum
- Sacral promontory

Identify the **pelvic outlet**. The pelvic outlet is bounded on each side by: [G 192; N 340; R 430; C 256]

- Inferior margin of the pubic symphysis
- Ischiopubic ramus
- Ischial tuberosity
- Sacrotuberous ligament
- Tip of the coccyx

The pelvic inlet divides the pelvis into the **greater (false) pelvis** and **lesser (true) pelvis** (Fig. 5.01). The greater pelvis is situated superior to the pelvic brim and is bounded bilaterally by the ala of the ilium. The lesser pelvis is located inferior to the pelvic brim. The inferior border of the lesser pelvis is the pelvic diaphragm. [G 185]

In the **erect posture** (anatomical position), the anterior superior iliac spines and the anterior aspect of the pubis are in the same vertical plane. In this position, the plane of the pelvic inlet forms an angle of approximately 55 degrees to the horizontal. A line connecting the superior aspect of the pubis with the tip of the coccyx lies in the horizontal plane. [G 184; N 340; R 424]

ANAL TRIANGLE

Before you dissect . . .

The **perineum** is a diamond-shaped area between the thighs that is divided for descriptive purposes into two triangles (Fig. 5.03). The **anal triangle** is the posterior part of the perineum and it contains the anal canal and anus. The **urogenital triangle** is the anterior part of the perineum and contains the urethra

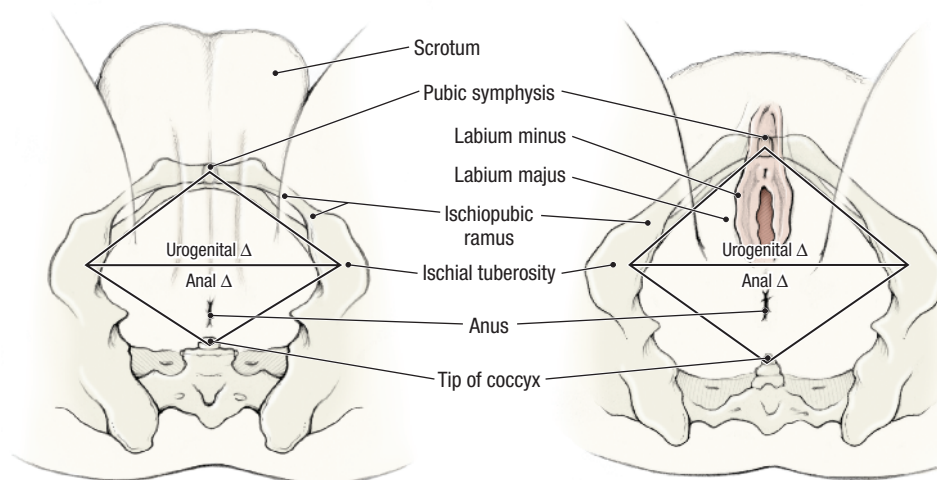


Figure 5.03. Boundaries of the urogenital and anal triangles in the male and female.

and the external genitalia. At the outset of dissection, it is important to understand that the *pelvic diaphragm separates the pelvic cavity from the perineum* (Fig. 5.01). [G 185]

The order of dissection will be as follows. Dissection of the anal triangle will begin with removal of skin from the gluteal region and partial reflection of the gluteus maximus muscle. The nerves and vessels of the ischioanal fossa will be dissected. The fat will be removed from the ischioanal fossa to reveal the inferior surface of the pelvic diaphragm.

Dissection Instructions

SKIN INCISIONS

1. If the lower limb has been dissected previously, reflect the gluteus maximus muscle laterally and move ahead to the dissection of the *ischioanal fossa*. If the lower limb has not been dissected, continue with step 2.
2. Place the cadaver in the prone position.
3. Refer to Figure 5.04.
4. Make an incision that follows the lateral border of the sacrum and the iliac crest from the tip of the coccyx (S) to the midaxillary line (T). If the back has been skinned, this incision has been made previously.
5. Make a midline skin incision from “S” to the posterior edge of the anus.
6. Make an incision that encircles the anus.
7. Make an incision from the anterior edge of the anus down the medial surface of the thigh to point “D” (approximately 7.5 cm down the medial thigh).
8. Make an oblique skin incision from “D” across the posterior surface of the thigh to point “E” on the lateral surface of the thigh. Point E should be approximately 30 cm inferior to the iliac crest.
9. Make a skin incision along the lateral side of the thigh from “T” to “E.”
10. Remove the skin from medial to lateral and place it in the tissue container.
11. Remove the superficial fascia from the surface of the gluteus maximus muscle and place it in the tissue container.

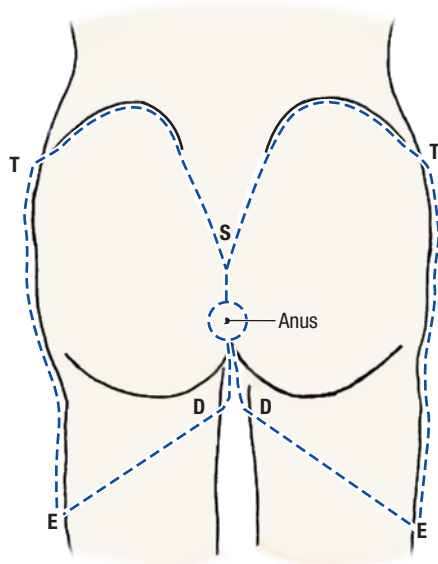


Figure 5.04. Skin incisions.

12. Clean the posterior surface of the **gluteus maximus muscle** (Fig. 5.05). Do not save the **inferior cluneal nerves**, but take care not to cut the deep fascia of the posterior thigh.
13. Use your hands to define the superior margin of the gluteus maximus muscle and separate it from the gluteal aponeurosis, which overlies the gluteus medius muscle (Fig. 5.05). The plane between the gluteus maximus muscle and the gluteus medius muscle can be found by observing the different directions of their muscle fibers.
14. Use scissors to cut the proximal attachment of the gluteus maximus muscle very close the posterior surface of the sacrum and coccyx (dotted line in Fig. 5.05). Start superiorly and work inferiorly. Insert your fingers under the superior margin of the gluteus maximus muscle and loosen it from deeper structures as you cut.
15. Inferiorly, the gluteus maximus muscle is attached to the **sacrotuberous ligament**. Use scissors to detach the gluteus maximus from the sacrotuberous ligament but do not cut the ligament.
16. Reflect the gluteus maximus muscle laterally until the inferior gluteal nerve and vessels prevent further reflection. The entire length of the sacrotuberous ligament should be visible.

ISCHIOANAL FOSSA

The **ischioanal (ischiorectal) fossa** is a wedge-shaped area on either side of the anus. The apex of the wedge is directed superiorly and the base is beneath the skin. The ischioanal fossa is filled with fat that helps accommodate the fetus during childbirth or the distended anal canal during the passage of feces. The ischioanal fat is part of the su-

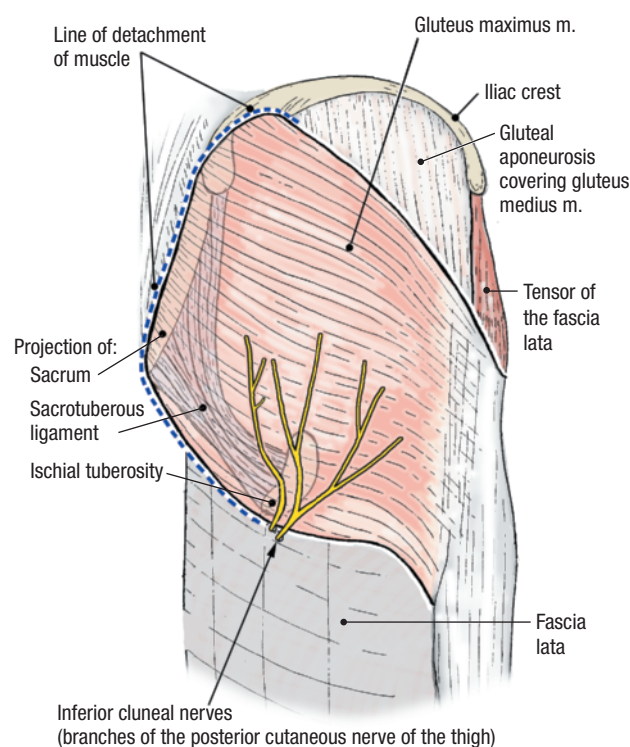


Figure 5.05. The cut used to reflect the gluteus maximus muscle.

perforal fascia of this region. The goal of this dissection is to remove the fat and identify the nerves and vessels that pass through the ischioanal fossa. [G 245; N 391; R 339; C 301]

1. Lateral to the anus, insert closed scissors 4 cm deep into the ischioanal fat. Open the scissors in the transverse direction to tear the fat (**Incision, Fig. 5.06**).
2. Insert your finger into the incision and move it back and forth (medial to lateral) to enlarge the opening.
3. Palpate the **inferior rectal (anal) nerve and vessels** (**Fig. 5.06**). Preserve the branches of the inferior rectal nerve and vessels but use blunt dissection to remove the fat that surrounds them. Dry the area with paper towels if necessary.
4. Use blunt dissection to clean the **external anal sphincter muscle** (**Fig. 5.06**). The external anal sphincter muscle has three parts:
 - **Subcutaneous** – encircling the anus (not visible in dissection)
 - **Superficial** – anchoring the anus to the perineal body and coccyx
 - **Deep** – a circular band that is fused with the pelvic diaphragm
5. Use blunt dissection to clean the **inferior surface of the pelvic diaphragm** (medial boundary of the ischioanal fossa).
6. Use blunt dissection to clean the **fascia of the obturator internus muscle** (the lateral boundary of the ischioanal fossa).

7. Observe that the inferior rectal nerve and vessels penetrate the fascia of the obturator internus muscle. The inferior rectal vessels and nerve exit the **pudendal canal** to enter the ischioanal fossa.
8. Place gentle traction on the inferior rectal vessels and nerve and observe that a ridge is raised in the obturator internus fascia. Carefully incise the obturator fascia along this ridge to open the pudendal canal.
9. Use a probe to elevate the contents of the pudendal canal. The pudendal canal contains the **pudendal nerve** and the **internal pudendal artery and vein**.

After you dissect . . .

Review the boundaries of the true pelvis and the concept that the pelvic diaphragm separates the pelvic cavity from the perineum. In the dissected specimen, review the inferior surface of the pelvic diaphragm and understand that this is the “roof” of the perineum. Use the dissected specimen to review the lateral and medial walls of the ischioanal fossa. Review the external anal sphincter muscle and its blood and nerve supply. Understand that the external anal sphincter muscle is skeletal muscle under voluntary control.

MALE UROGENITAL TRIANGLE

If you are dissecting a female cadaver, go to the dissection of the *Female Urogenital Triangle* (page 110).

Before you dissect . . .

The order of dissection of the male urogenital triangle will be as follows. The skin will be removed from the urogenital triangle. The superficial perineal fascia will be removed and the contents of the superficial perineal pouch will be identified. The skin will be removed from the penis and its parts will be studied. The contents of the deep perineal pouch will be described, but not dissected.

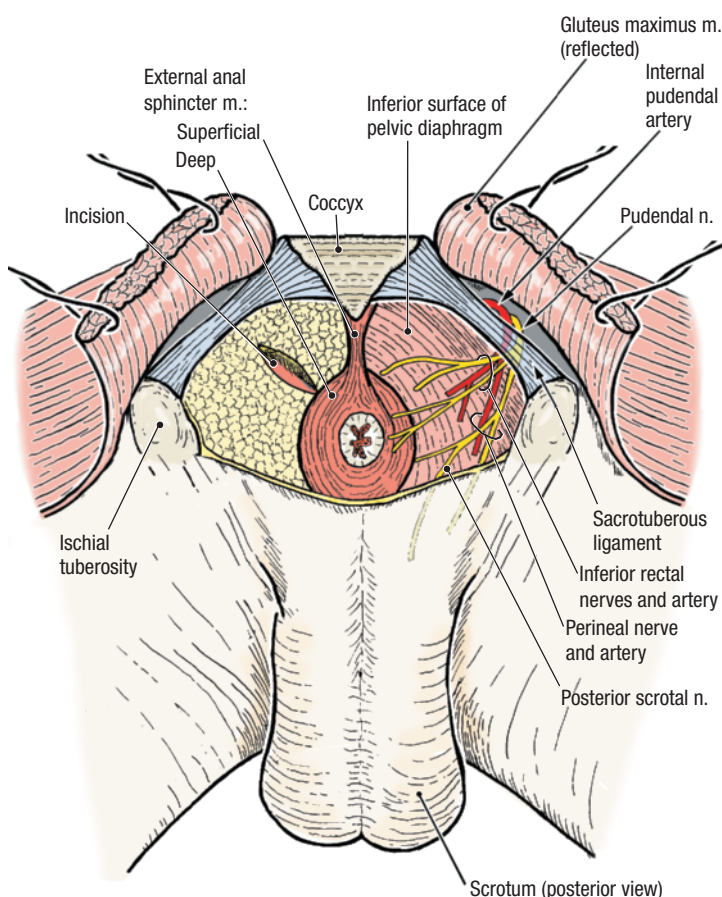


Figure 5.06. Initial incision used to begin the dissection of the ischioanal fossa.

Dissection Instructions

SKIN REMOVAL

1. The scrotum, testis, and spermatic cord were dissected with the anterior abdominal wall (Chapter 4). Review this material.
2. Place the cadaver in the supine position. Stretch the thighs widely apart and brace them. Usually, only one student can work on the urogenital triangle at a time. The dissector should be positioned between the thighs.
3. Make a skin incision that encircles the proximal end of the penis. The skin is very thin.
4. Make a midline skin incision posterior to the proximal end of the penis that splits the scrotum along the scrotal septum. Carry the cut posteriorly as far as the anus.
5. Make an incision in the midline superior to the penis. Stop where the skin of the abdomen was removed previously.

6. Reflect the skin flaps from medial to lateral. Detach the scrotum and skin flaps along the medial thigh and place them in the tissue container.
7. If the cadaver has a large amount of fat in the superficial fascia of the medial thighs, remove a portion of the superficial fascia starting at the ischiopubic ramus and extending down the medial thigh approximately 7 cm. Stay superficial to the deep fascia when removing the superficial fascia.
8. Note that the **posterior scrotal nerve and vessels** enter the urogenital triangle by passing lateral to the external anal sphincter muscle. The posterior scrotal nerve and vessels supply the posterior part of the scrotum.

SUPERFICIAL PERINEAL POUCH [G 245, 246; N 364; R 338; C 300]

The superficial perineal fascia has a superficial fatty layer and a deep membranous layer. The superficial fatty layer is continuous with the superficial fatty layer of the lower abdominal wall, ischioanal fossa, and thigh. The **membranous layer of the superficial perineal fascia (Colles' fascia)** is continuous with the membranous layer of the superficial fascia of the anterior abdominal wall, and the **dartos fascia** of the penis and scrotum (Fig. 5.07A). The membranous layer of the superficial perineal fascia is attached to the ischiopubic ramus as far posteriorly as the ischial tuberosity and to the posterior edge of the **perineal membrane**. The membranous layer of the superficial perineal fascia forms the superficial boundary of the **superficial perineal pouch (space)**.

CLINICAL CORRELATION

Superficial Perineal Pouch

If the urethra is injured in the perineum, urine may escape into the superficial perineal pouch. The urine may spread into the scrotum and penis, and upward into the lower abdominal wall between the membranous layer of the abdominal superficial fascia (Scarpa's fascia) and the aponeurosis of the external oblique muscle (Fig. 5.07B). The urine does not enter the thigh because the membranous layer of the superficial fascia attaches to the fascia lata, ischiopubic ramus, and posterior edge of the perineal membrane.

1. The **contents of the superficial perineal pouch in the male** are **three paired muscles (superficial transverse perineal, bulbospongiosus, and ischio-cavernosus)**, the **crura of the penis**, and the **bulb of the penis** (Fig. 5.08A). The superficial perineal pouch also contains the arteries, veins, and nerves that supply these structures.
2. It is not necessary to identify the membranous layer of the superficial perineal fascia to complete the dissection. Use a probe to dissect through the superficial

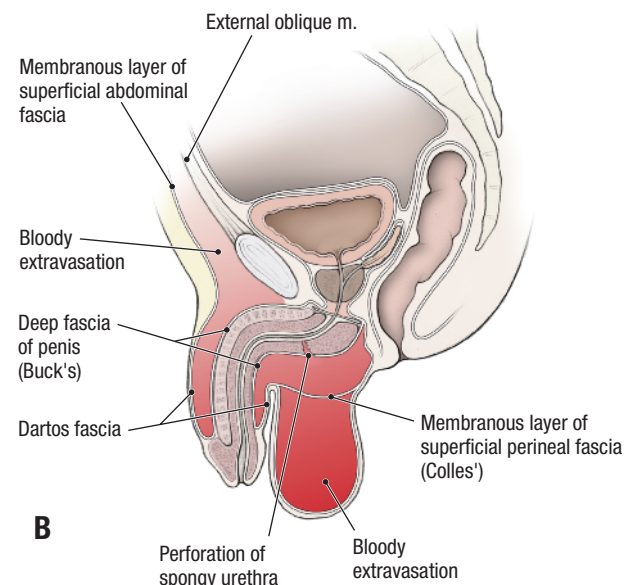
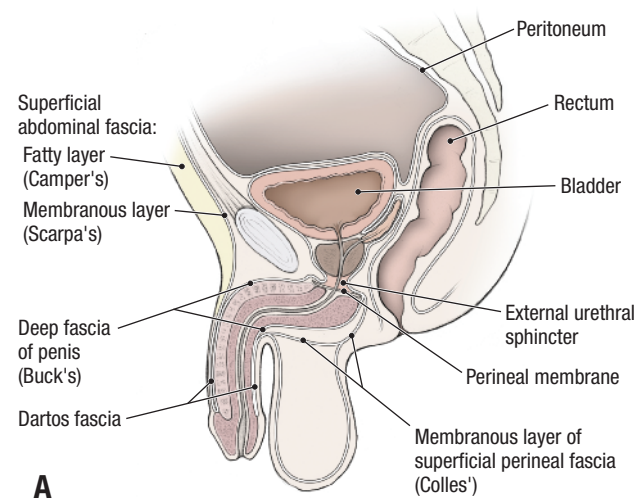


Figure 5.07. Fasciae of the perineum. **A.** The membranous layer of the superficial perineal fascia (Colles' fascia) is continuous with the superficial fascia (dartos fascia) of the scrotum and the penis. It is also continuous with the membranous layer of superficial fascia of the lower abdominal wall (Scarpa's fascia) and is attached to the posterior border of the perineal membrane. **B.** After injury to the urethra in the perineum, extravasated urine is contained in the superficial perineal pouch and spreads into the lower abdominal wall.

perineal fascia approximately 2 cm lateral to the midline.

3. Use blunt dissection to find the **superficial transverse perineal muscle** at the posterior border of the urogenital triangle (Fig. 5.08A). The superficial transverse perineal muscle may be delicate and difficult to find; limit the time spent looking for it. The lateral attachments of the superficial transverse perineal muscle are the ischial tuberosity and the ischiopubic ramus. The medial attachment of the superficial transverse perineal muscle is the **perineal body**. The perineal body is a fibromuscular mass located between the anal canal and the posterior edge of the perineal membrane. It serves as an attachment for several muscles.

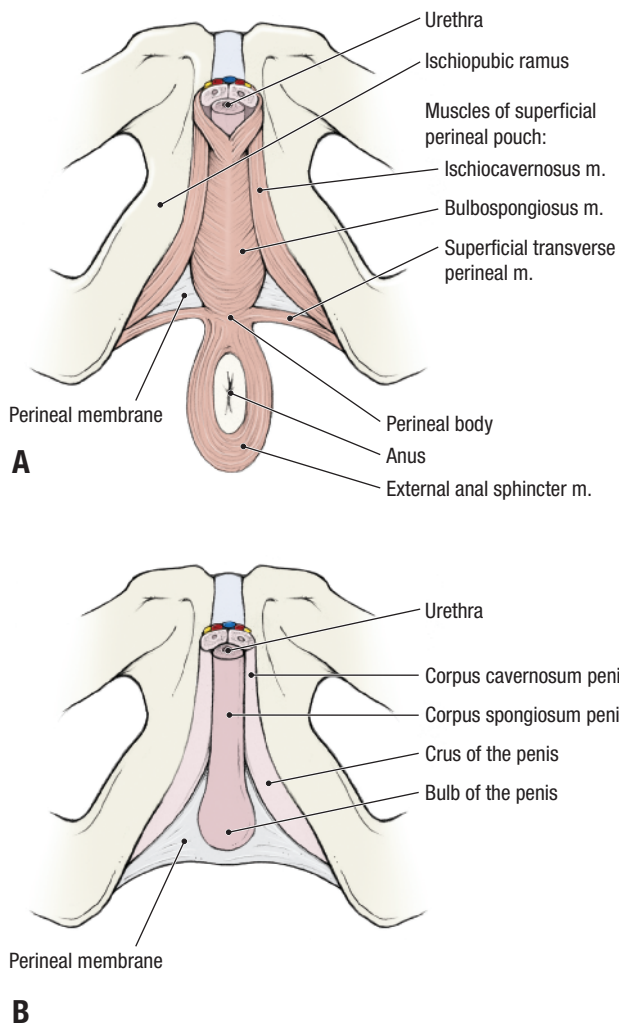


Figure 5.08. Contents of the superficial perineal pouch in the male. **A.** Muscles. **B.** Erectile bodies.

The superficial transverse perineal muscle helps to support the perineal body.

4. Use a probe to clean the surface of the **ischiocavernosus muscle**. The ischiocavernosus muscle covers the superficial surface of the **crus of the penis**. The proximal attachment of the ischiocavernosus muscle is the ischial tuberosity and the ischiopubic ramus. The distal attachment of the ischiocavernosus muscle is the crus of the penis. The ischiocavernosus muscle forces blood from the crus of the penis into the corpus cavernosum penis.
5. Identify the **bulbospongiosus muscle** in the midline of the urogenital triangle. The bulbospongiosus muscle covers the superficial surface of the **bulb of the penis**. The posterior attachments of the bulbospongiosus muscle are the bulbospongiosus muscle of the opposite side (a midline raphe) and the perineal body. The anterior attachment of the bulbospongiosus muscle is the corpus cavernosum penis. The bulbospongiosus muscle compresses the bulb of the penis to expel urine or semen.
6. Use a probe to dissect between the three muscles of the superficial perineal pouch until a small triangular opening is created (Fig. 5.08A). The membrane that becomes visible through this opening is the **perineal**

membrane. The perineal membrane is the deep boundary of the superficial perineal pouch and the erectile bodies are attached to it.

7. Use scissors to divide the bulbospongiosus muscles along their midline raphe. On the right side of the cadaver, remove the bulbospongiosus muscle.
8. Identify the **bulb of the penis** (Fig. 5.08B). The bulb of the penis is continuous with the corpus spongiosum penis and contains a portion of the spongy urethra.
9. On the right side of the cadaver, use blunt dissection to remove the ischiocavernosus muscle from the **crus of the penis** (Fig. 5.08B). The crus of the penis is continuous with the corpus cavernosum penis.

PENIS [G 250; N 364, 365; R 324, 327; C 182, 302]

In the anatomical position, the penis is erect. The surface of the penis that is closest to the anterior abdominal wall is the **dorsal surface of the penis**.

Study a drawing of a transverse section of the **penis** (L. *penis*, tail) (Fig. 5.09). The **superficial fascia of the penis (dartos fascia)** has no fat and contains the **superficial dorsal vein of the penis**. The **deep fascia of the penis (Buck's fascia)** is an investing fascia. Contained within the deep fascia of the penis are the **corpus spongiosum**, **corpus cavernosum (paired)**, **deep dorsal vein of the penis (unpaired)**, **dorsal artery of the penis (paired)**, and **dorsal nerve of the penis (paired)**.

1. Identify the parts of the penis:
 - **Root**
 - **Body (shaft)**
 - **Glans penis**
 - **Corona of the glans**
 - **Prepuce**
 - **Frenulum**
 - **External urethral orifice**
2. Use a scalpel to make a midline incision down the ventral surface of the penis. Remove the skin from the body of the penis, detaching it around the corona of the glans. Do not skin the glans.
3. Use a probe to dissect the **superficial dorsal vein** of the penis. The superficial dorsal vein of the penis drains into the **superficial external pudendal vein** of the inguinal region.

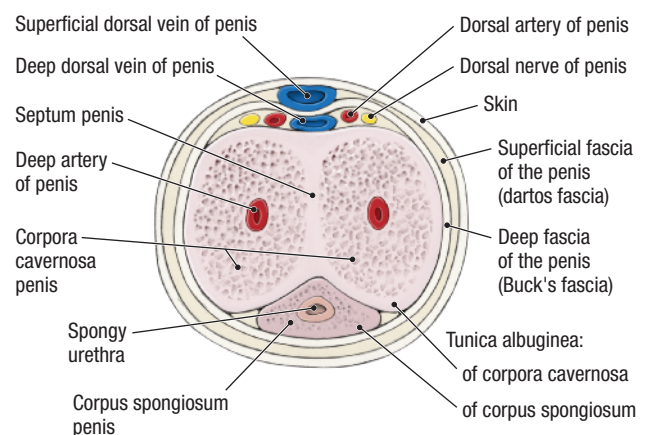


Figure 5.09. Transverse section through the body of the penis.

4. On the dorsum of the penis, use a probe to dissect through the **deep fascia of the penis** and identify (Fig. 5.10): [G 250; R 337; C 302]
 - **Deep dorsal vein of the penis** – a single vein in the midline. Most of the blood from the penis drains through the deep dorsal vein into the **prostatic venous plexus**.
 - **Dorsal artery of the penis (2)** – one artery on each side of the deep dorsal vein. The dorsal artery of the penis is a terminal branch of the internal pudendal artery.
 - **Dorsal nerve of the penis (2)** – one nerve on each side of the midline, lateral to the deep dorsal artery. The dorsal nerve of the penis is a branch of the pudendal nerve.
5. Use a probe to trace the vessels and nerves of the penis proximally. Use an illustration to study the course of the pudendal nerve and the internal pudendal artery (Fig. 5.10). Observe that the dorsal artery and nerve of the penis course deep to the perineal membrane before they emerge onto the dorsum of the penis. The deep dorsal vein passes between the inferior pubic ligament and the anterior edge of the perineal membrane to enter the pelvis, and does not accompany the deep dorsal artery and dorsal nerve proximal to the body of the penis. [G 250, 254; N 383, 390; R 336; C 287, 304]

SPONGY URETHRA [G 255; N 368; R 326, 327; C 290]

The male urethra consists of three portions: **prostatic urethra**, **membranous urethra**, and **spongy urethra** (Fig. 5.11). The spongy urethra is the portion that is located within the corpus spongiosum penis. The next objective is to longitudinally open the spongy urethra.

1. Examine the **external urethral orifice** at the tip of the glans penis. Push a probe into the external urethral orifice, and then use a scalpel to cut down to the probe from both the dorsal and ventral surfaces of the penis.

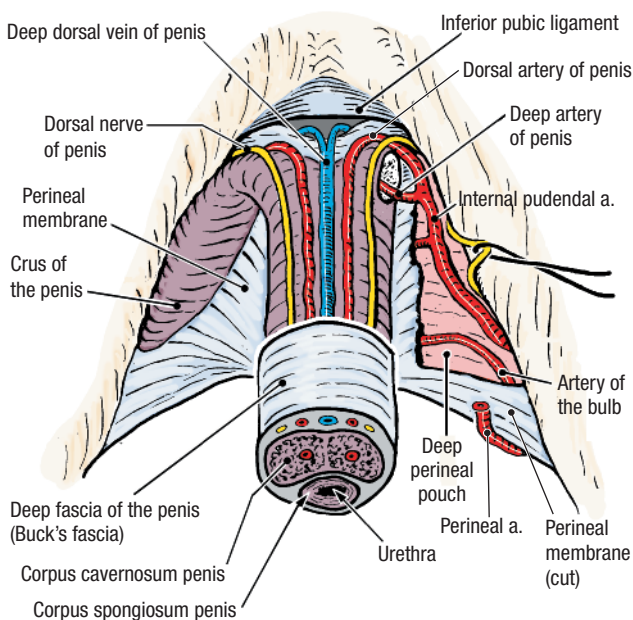


Figure 5.10. Arteries and nerves of the penis.

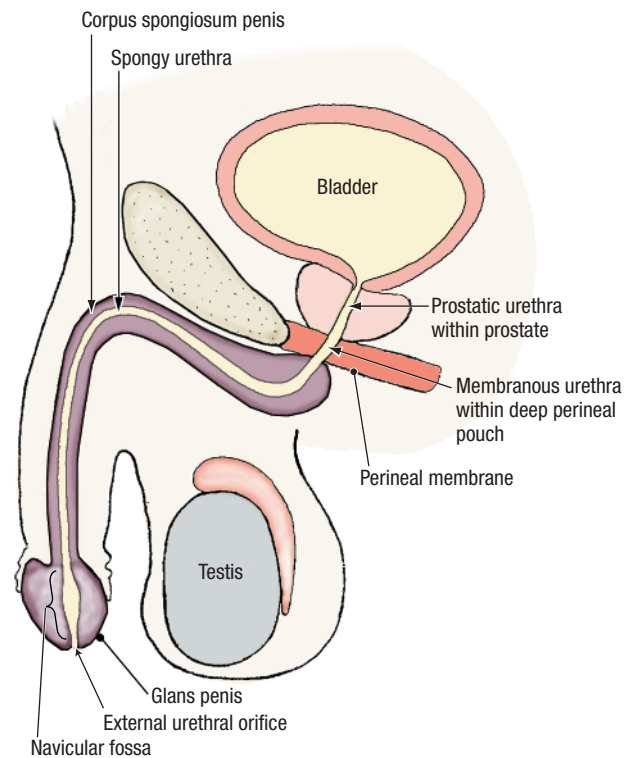


Figure 5.11. Parts of the male urethra.

Cut in the median plane of the penis (it may not be a straight line).

2. Advance the probe proximally, and continue to divide the penis. Dorsal to the probe, the cut should pass between the corpora cavernosa and may split the deep dorsal vein longitudinally. Stop inferior to the pubic symphysis where the two corpora cavernosa separate. Ventral to the probe the cut should divide the corpus spongiosum into equal halves. Stop at the bulb of the penis.
3. In the bulb of the penis, the urethra bends at a sharp angle and passes through the perineal membrane (Fig. 5.11). Carefully complete the cut through the bulb posterior to the urethra but do not cut through the perineal membrane.
4. Examine the interior of the spongy urethra. Identify the **navicular fossa**, a widening of the urethra in the glans penis. The openings of the ducts of the **bulbourethral glands** are in the proximal part of the spongy urethra, but may be too small to see.
5. Note that the **glans penis** (L. *glans*, acorn) is the distal expansion of the corpus spongiosum and that it caps the two corpora cavernosa penis. The spongy urethra terminates by passing through the glans.
6. On the right side of the penis, make a transverse cut through the body of the penis about midway down its length.
7. On the cut surface of the transverse section of the penis, study the relationship of the **corpus cavernosum penis** and **corpus spongiosum penis**. Identify (Fig. 5.09): [G 254; N 364; R 327; C 182]
 - **Tunica albuginea of the corpora cavernosa penis**

- **Tunica albuginea of the corpus spongiosum penis**
 - **Septum penis** (cut)
8. Study the erectile tissue within the corpus spongiosum penis. Observe that the corpus spongiosum penis surrounds the spongy urethra.
 9. Study the erectile tissue within the corpus cavernosum penis (Fig. 5.09). Identify the **deep artery of the penis** near the center of the erectile tissue. Review the origin of the deep artery of the penis from the internal pudendal artery.

DEEP PERINEAL POUCH

The deep perineal pouch (space) will not be dissected. The deep perineal pouch lies superior (deep) to the perineal membrane (Fig. 5.11). The **contents of the deep perineal pouch in the male** are the **membranous urethra**, **external urethral sphincter muscle**, **bulbourethral glands**, **branches of the internal pudendal vessels**, and **branches of the pudendal nerve** (Fig. 5.12).

1. Use an illustration to study the following: [G 247; N 366; C 299]
 - **Membranous urethra** – extends from the perineal membrane to the prostate gland (Fig. 5.11). This is the shortest (approximately 1 cm), thinnest, narrowest, and least distensible part of the urethra.
 - **External urethral sphincter (sphincter urethrae) muscle** – a voluntary muscle that surrounds the membranous urethra (Fig. 5.12). When the external urethral sphincter muscle contracts, it compresses the membranous urethra and stops the flow of urine.
 - **Deep transverse perineal muscle** – has a lateral attachment to the ischial tuberosity and the ischiopubic ramus and a medial attachment to the perineal body (Fig. 5.12). Its fiber direction and function are identical to those of the superficial transverse perineal muscle, which is a content of the superficial perineal pouch.

2. The **bulbourethral glands** are located in the deep perineal pouch. The duct of the bulbourethral gland passes through the perineal membrane and drains into the proximal portion of the spongy urethra.
3. The deep perineal pouch contains branches of the **pudendal nerve** and **internal pudendal artery** that supply the external urethral sphincter muscle, the deep transverse perineal muscle, and the penis (Fig. 5.12).
4. Collectively, the muscles within the deep perineal pouch plus the perineal membrane are known as the **urogenital diaphragm**. This older anatomical nomenclature is still in clinical use.

After you dissect . . .

Return the muscles of the urogenital triangle to their correct anatomical positions. Review the contents of the superficial perineal pouch. Use an illustration to review the course of the internal pudendal artery from its origin in the pelvis to the dorsum of the penis. Use an illustration to review the course and branches of the pudendal nerve. Study an illustration showing the course of the deep dorsal vein of the penis into the pelvis to join the prostatic venous plexus. Draw a cross-section of the penis showing the erectile bodies, superficial fascia, deep fascia, vessels, and nerves. Review an illustration that shows the entire male urethra and identify its parts by name.

MALE PELVIC CAVITY

Before you dissect . . .

The male pelvic cavity contains the urinary bladder anteriorly, male internal genitalia, and the rectum posteriorly (Fig. 5.13). The order of dissection will be as follows. The peritoneum will be studied in the male pelvic cavity. The pelvis will be sectioned in the midline and the cut surface of the sectioned pelvis will be studied. The ductus deferens will be traced from the anterior abdominal wall to the region between the urinary bladder and rectum. The seminal vesicles and prostate gland will be studied.

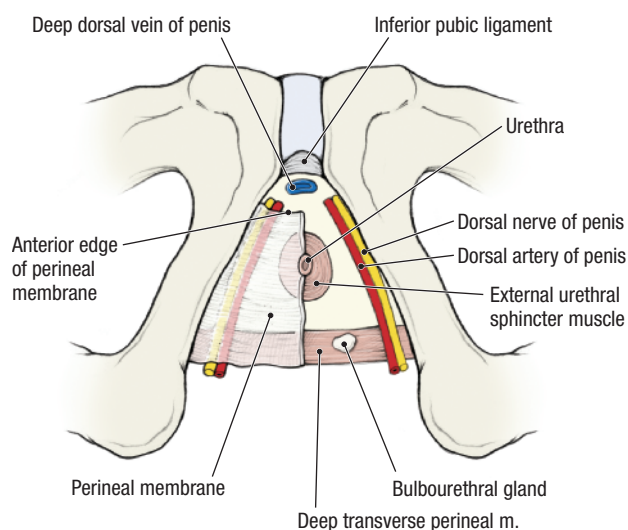


Figure 5.12. Contents of the deep perineal pouch in the male.

CLINICAL CORRELATION

Pelvic Peritoneum

As the urinary bladder fills, the peritoneal reflection is elevated above the level of the pubis and is raised from the anterior abdominal wall. A filled urinary bladder can be approached with a needle just superior to the pubis without entering the peritoneal cavity.

Dissection Instructions

PERITONEUM [G 197, 198; N 348; R 324; C 286]

Examine the **peritoneum** in the male pelvis (Fig. 5.13). The peritoneum passes from the anterior abdominal wall (1) superior to the pubis (2), then onto the superior surface of the urinary bladder (3). The peritoneum then passes inferiorly along the posterior surface of the urinary bladder (4) to the superior ends of the seminal vesicles (5). The peritoneum passes inferiorly between the urinary bladder and the rectum to form the **rectovesical pouch** (6). The peritoneum contacts the anterior surface of the second part of the rectum. At more superior levels, the peritoneum envelops the sides of the rectum (7). At the level of the third sacral vertebra, the peritoneum becomes the sigmoid mesocolon (8). Laterally, a **paravesical fossa** is apparent on each side of the urinary bladder. Further posteriorly, a **pararectal fossa** is apparent on each side of the rectum.

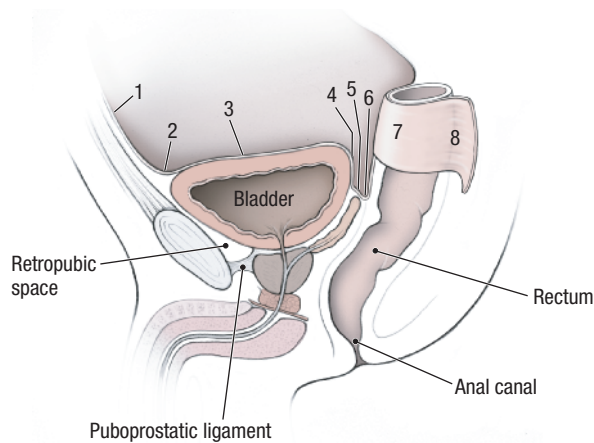


Figure 5.13. Peritoneum in the male pelvis. The numbered features of the peritoneum are explained in the text.

SECTION OF THE PELVIS

The pelvis will be divided in the midline. First, the pelvic viscera and the soft tissues of the perineum will be cut in the midline with a scalpel. The pubic symphysis and vertebral column (up to vertebral level L3) will be cut in the midline with a saw. Subsequently, the right side of the body will be transected at vertebral level L3. The left lower limb and left side of the pelvis will remain attached to the trunk.

Both halves of the pelvis will be used to dissect the pelvic viscera, pelvic vasculature, and nerves of the pelvis. One half of the pelvis will be used to demonstrate the muscles of the pelvic diaphragm.

1. Begin this dissection with a new scalpel blade.
2. In the pelvic cavity make a midline cut, beginning posterior to the pubic symphysis. Carry this midline cut through the superior surface of the urinary bladder. Open the bladder and sponge the interior, if necessary.
3. Identify the internal urethral orifice and insert a probe. Use the probe as a guide and continue the midline cut inferior to the urinary bladder. Divide the prostate gland.

4. Extend the midline cut in the posterior direction. Cut through the anterior and posterior walls of the rectum and the distal part of the sigmoid colon. Sponge them clean.
5. In the perineum, insert the scalpel blade inferior to the pubic symphysis with the cutting edge directed inferiorly. Cut between the halves of the bulb of the penis (sectioned earlier). Cut in the midline through the perineal membrane, perineal body, and anal canal (from pubic symphysis to coccyx).
6. Use a saw to make two cuts in the midline:
 - Pubic symphysis – cut through the pubic symphysis from anterior to posterior.
 - Sacrum – turn the cadaver to the prone position. Cut through the sacrum from posterior to anterior. Do not allow the saw to pass between the soft tissue structures that were cut with the scalpel. Spread the opening and extend the midline cut as far superiorly as the body of the third lumbar vertebra.
7. Return the cadaver to the supine position. To mobilize the right lower limb, use a scalpel to cut the right common iliac vein, right common iliac artery, and right testicular vessels. Cut the right ureter and the branches of the right lumbar plexus.
8. In the transverse plane, cut the psoas major muscle and the quadratus lumborum muscle at vertebral level L3. Use the saw to cut horizontally through the right half of the intervertebral disc between L3 and L4. Now, the right lower limb can be removed.
9. Clean the rectum and anal canal.

MALE INTERNAL GENITALIA [G 197; N 348; R 324; C 289]

1. Study the cut surface of the sectioned specimen. Use an illustration to guide you.
2. Identify the **perineal membrane**. It is located deep to the bulb of the penis and can be identified where the bulb ends (Fig. 5.11). Superior (deep) to the perineal membrane, the **external urethral sphincter muscle** surrounds the **membranous urethra**. The external urethral sphincter muscle may be difficult to see in the sectioned specimen.
3. On the sectioned pelvis, identify the three parts of the urethra: **prostatic urethra**, **membranous urethra**, and **spongy urethra** (Fig. 5.11).
4. Examine the **interior of the prostatic urethra**. The prostatic urethra is approximately 3 cm in length and is the part that passes through the prostate. On the posterior wall of the prostatic urethra identify (Fig. 5.14): [G 209; N 368; R 326; C 289]
 - **Urethral crest** – a longitudinal ridge
 - **Seminal colliculus** – an enlargement of the urethral crest
 - **Prostatic sinus** – the groove on either side of the seminal colliculus
 - **Prostatic utricle** – a small opening on the midline of the seminal colliculus
 - **Opening of the ejaculatory duct** – one on either side of the prostatic utricle
5. Find the **ductus deferens** where it enters the **deep inguinal ring** lateral to the inferior epigastric vessels. Use a probe to break through the peritoneum at the deep inguinal ring. Use blunt dissection to peel the

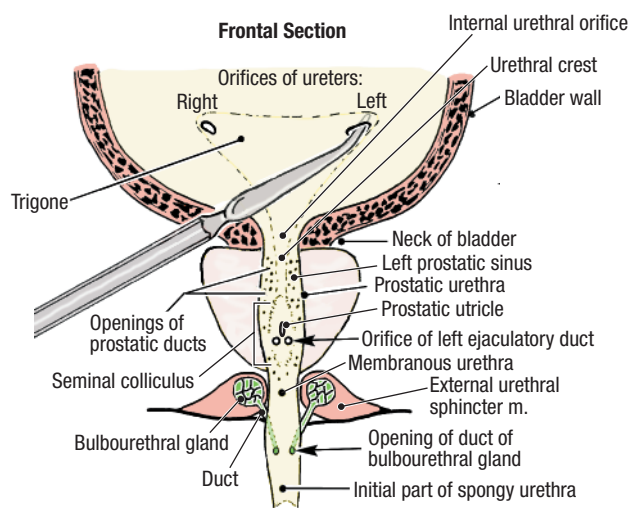


Figure 5.14. Urinary bladder and proximal portion of the male urethra seen in frontal section. The tip of the probe is located in the orifice of the left ureter.

peritoneum off the lateral wall of the pelvis. Strip the peritoneum from lateral to medial, stopping where it comes in contact with the rectum and urinary bladder. Detach the peritoneum and place it in the tissue container.

6. Use blunt dissection to trace the ductus deferens from the deep inguinal ring toward the midline. Observe that the ductus deferens passes superior and then medial to the branches of the internal iliac artery. Note that the ductus deferens crosses superior to the ureter. [G 214; N 350; R 324; C 287]
7. Trace the ductus deferens into the **rectovesical septum**, which is the fascia between the rectum and the urinary bladder. Observe that the ductus deferens is in contact with the fundus (posterior surface) of the urinary bladder.
8. Identify the **ampulla of the ductus deferens**, which is the enlarged portion just before its termination (Fig. 5.15). [G 208; N 367; R 327; C 288]
9. Identify the **seminal vesicle**. The seminal vesicle is located lateral to the ampulla of the ductus deferens in the rectovesical septum. Use blunt dissection to release the seminal vesicle from the connective tissue of the rectovesical septum.
10. Identify the point where the duct of the seminal vesicle joins the ductus deferens to form the **ejaculatory duct** (Fig. 5.15). The ejaculatory duct is delicate and easily torn where it enters the prostate. The ejaculatory duct empties into the prostatic urethra on the seminal colliculus.
11. Observe the **prostate**. The **apex** of the prostate is directed inferiorly and the **base** of the prostate is located superiorly against the neck of the urinary bladder. Use a textbook to study the **lobes of the prostate**.

After you dissect . . .

Review the position of the male pelvic viscera within the lesser pelvis. Review the peritoneum in the pelvic cavity. Trace the ductus deferens from the epididymis to the ejaculatory duct, recalling its relationships to vessels, nerves, the ureter, and the seminal vesicle.

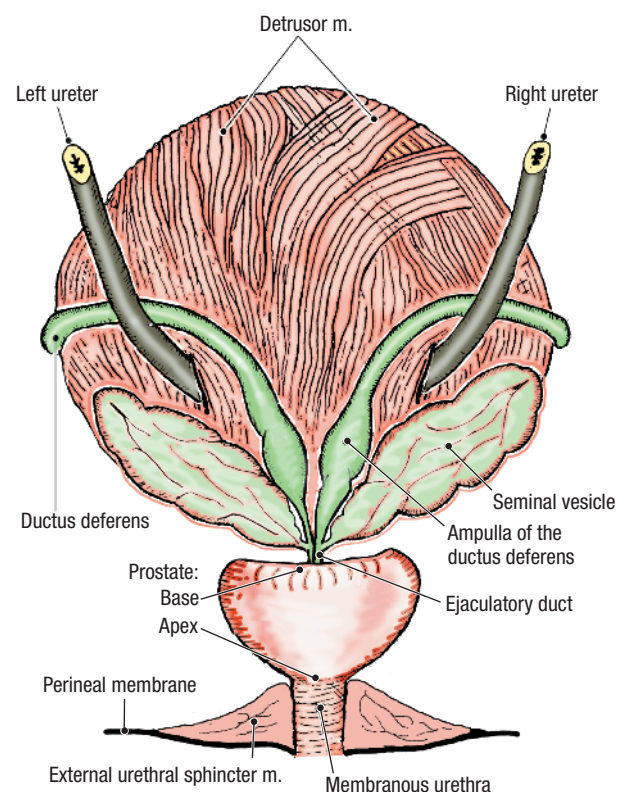


Figure 5.15. Posterior view of the urinary bladder and the male internal genitalia.

URINARY BLADDER, RECTUM, AND ANAL CANAL

Before you dissect . . .

The urinary bladder is a reservoir for urine. When empty, it is located within the pelvic cavity. When filled, it extends into the abdominal cavity. The urinary bladder is a retroperitoneal organ that is surrounded by **endopelvic fascia**. Between the pubic symphysis and the urinary bladder is a potential space called the **retropubic space (prevesical space)** (Fig. 5.13). The retropubic space is filled with fat and loose connective tissue that accommodates the expansion of the urinary bladder. The **puboprostatic ligament** is a condensation of fascia that ties the prostate to the pubis across the retropubic space (Fig. 5.13). The lower one-third of the rectum is surrounded by endopelvic fascia. The middle and upper thirds of the rectum are partially covered by peritoneum (Fig. 5.13).

The order of dissection will be as follows. The parts of the urinary bladder will be studied. The interior of the urinary bladder will be studied. The interior of the rectum and anal canal will be studied.

Dissection Instructions

URINARY BLADDER [G 209; N 353; R 324; C 289]

1. Identify the **parts of the urinary bladder** (Fig. 5.16):
 - **Apex** – the pointed part directed toward the anterior abdominal wall. The apex of the urinary blad-

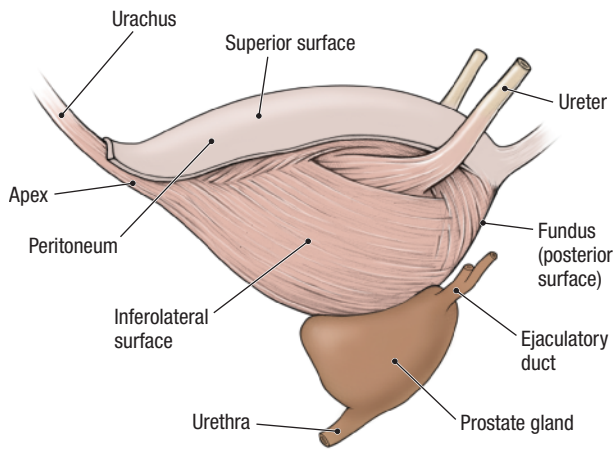


Figure 5.16. Parts of the urinary bladder in the male.

der can be identified by the attachment of the urachus.

- **Body** – between the apex and fundus
 - **Fundus** – the posterior wall, also called the **base of the urinary bladder**. In the male the fundus is related to the ductus deferens, seminal vesicles, and rectum.
 - **Neck** – where the urethra exits the urinary bladder. In the neck of the urinary bladder, the wall thickens to form the involuntary **internal urethral sphincter muscle**.
2. Identify the four **surfaces of the urinary bladder** (Fig. 5.16):
 - **Superior** – covered by peritoneum
 - **Posterior** – covered by the endopelvic fascia of the rectovesical septum
 - **Inferolateral (2)** – covered by endopelvic fascia
 3. Examine the **wall of the urinary bladder** and note its thickness. The wall of the urinary bladder consists of bundles of smooth muscle called the **detrusor muscle** (L. *detrudere*, to thrust out).
 4. Identify the **trigone** on the inner surface of the fundus (Fig. 5.14). The angles of the trigone are the **internal urethral orifice** and the two **orifices of the ureters**. The internal urethral orifice is located at the most inferior point in the urinary bladder. [G 209; N 353; R 326; C 288]
 5. Observe that the mucous membrane over the trigone is smooth. The mucous membrane lining the other parts of the urinary bladder lies in folds when the bladder is empty but will accommodate expansion.
 6. Insert the tip of a probe into the orifice of the ureter and observe that the ureter passes through the muscular wall of the urinary bladder in an oblique fashion. When the urinary bladder is full (distended), the pressure of the accumulated urine flattens the part of the ureter that is within the wall of the bladder and prevents reflux of urine.

CLINICAL CORRELATION

Kidney Stones

Kidney stones pass through the ureter to the urinary bladder and may become lodged in the ureter. The point where the ureter passes through the wall of the urinary bladder is a relatively narrow passage. If a kidney stone becomes lodged, severe colicky pain results. The pain stops suddenly once the stone passes into the bladder.

7. Find the ureter where it crosses the external iliac artery or the bifurcation of the common iliac artery. Use blunt dissection to follow the ureter to the fundus of the urinary bladder.

RECTUM AND ANAL CANAL [G 197, 199; N 348, 374; R 325; C 289, 292]

1. The rectum begins at the level of the third sacral vertebra. Observe the sectioned pelvis and note that the rectum follows the curvature of the sacrum.
2. Identify the **ampulla of the rectum** (Fig. 5.17). At the ampulla, the rectum turns approximately 80 degrees posteriorly (**anorectal flexure**) and is continuous with the anal canal. Observe that the prostate and seminal vesicles are located close to the anterior wall of the rectum (Fig. 5.13).

CLINICAL CORRELATION

Rectal Examination

Digital rectal examination is part of the physical examination. The size and consistency of the prostate gland can be assessed by palpation through the anterior wall of the rectum.

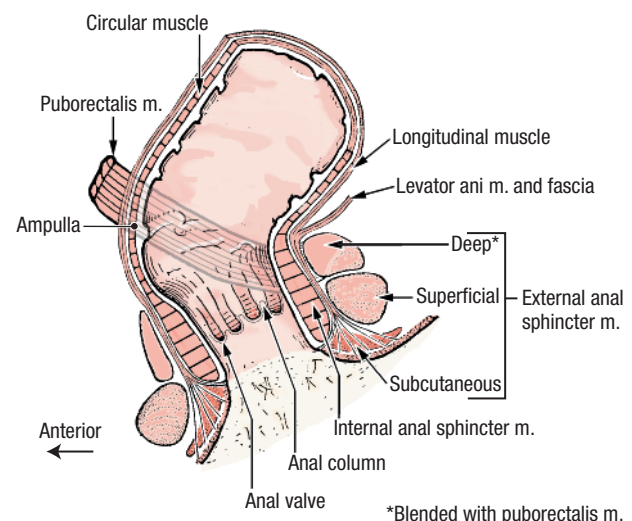


Figure 5.17. Rectum, anal canal, and anal sphincter muscles.

3. Examine the inner surface of the rectum. Note that the mucous membrane is smooth except for the presence of **transverse rectal folds**. There is usually one transverse rectal fold on the right side and two on the left side. The transverse rectal folds may be difficult to identify in some cadavers.
4. Observe that the **anal canal** is only 2.5 to 3.5 cm in length. The anal canal passes out of the pelvic cavity and enters the anal triangle of the perineum.
5. Examine the inner surface of the anal canal (Fig. 5.17). The mucosal features of the anal canal may be difficult to identify in older individuals. Attempt to identify the following:
 - **Anal columns** – five to 10 longitudinal ridges of mucosa in the proximal part of the anal canal. The anal columns contain branches of the **superior rectal artery and vein**.
 - **Anal valves** – semilunar folds of mucosa that unite the distal ends of the anal columns. Between the anal valve and the wall of the anal canal is a small pocket called an **anal sinus**.
 - **Pectinate line** – the irregular line formed by all of the anal valves.

CLINICAL CORRELATION

Hemorrhoids

In the anal columns, the superior rectal veins of the hepatic portal system anastomose with middle and inferior rectal veins of the inferior vena caval system. An abnormal increase in blood pressure in the hepatic portal system causes engorgement of the veins contained in the anal columns, resulting in **internal hemorrhoids**. Internal hemorrhoids are covered by mucous membrane and are relatively insensitive to painful stimuli because the mucous membrane is innervated by autonomic nerves.

External hemorrhoids are enlargements of the tributaries of the inferior rectal veins. External hemorrhoids are covered by skin and are very sensitive to painful stimuli because they are innervated by somatic nerves (inferior rectal nerves).

6. The anal sphincter muscles surround the anal canal. Identify the **external anal sphincter muscle** and the **internal anal sphincter muscle** in the sectioned specimen (Fig. 5.17). The longitudinal muscle of the anal canal separates the two sphincter muscles. If you have difficulty identifying them, use a new scalpel blade to cut another section through the wall of the anal canal to improve the clarity of the dissection.

After you dissect . . .

Use the dissected specimen to review the features of the urinary bladder, rectum, and anal canal. Review the relationships of the seminal vesicles, ampulla of the ductus deferens, and ureters to the rectum and fundus of the urinary bladder. Review the kidney, the abdominal course of the ureter, the pelvic course of the

ureter, and the function of the urinary bladder as a storage organ. Review the parts of the male urethra. Review all parts of the large intestine and recall its function in absorption of water, compaction, and elimination of fecal material. Recall that the external anal sphincter muscle is composed of skeletal muscle and is under voluntary control, whereas the internal anal sphincter muscle is composed of smooth muscle and is involuntary.

INTERNAL ILIAC ARTERY AND SACRAL PLEXUS

Before you dissect . . .

Anterior to the sacroiliac articulation, the **common iliac artery** divides to form the **external** and **internal iliac arteries** (Fig. 5.18). The external iliac artery distributes to the lower limb and the internal iliac artery to the pelvis. The internal iliac artery commonly divides into an anterior division and a posterior division. Branches arising from the anterior division are mainly visceral (branches to the urinary bladder, internal genitalia, external genitalia, rectum, and gluteal region). Branches arising from the posterior division are parietal (branches to the pelvic walls and gluteal region). The branching pattern of the internal iliac artery is variable, so it is important to identify the arteries by their distribution. The internal iliac vein is typically plexiform. To clear the dissection field, remove all tributaries to the internal iliac vein.

The order of dissection will be as follows. The branches of the anterior division of the internal iliac artery will be identified. The branches of the posterior division of the internal iliac artery will be identified. The nerves of the sacral plexus will be dissected. Subsequently, the pelvic portion of the sympathetic trunk will be dissected.

Dissection Instructions

BLOOD VESSELS [G 212; N 382, 383; R 333; C 266]

1. Identify the **common iliac artery** and follow it to its bifurcation.
2. Identify the **internal iliac artery**. Use blunt dissection to follow the internal iliac artery into the lesser pelvis.

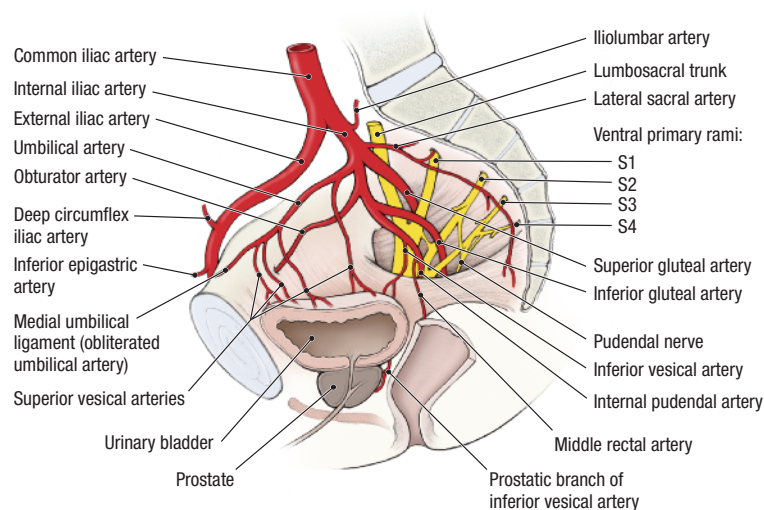


Figure 5.18. Branches of the internal iliac artery in the male.

3. Identify the branches of the anterior division of the internal iliac artery (Fig. 5.18):

- **Umbilical artery** – in the medial umbilical fold, find the **umbilical ligament** (the obliterated portion of the umbilical artery) and use blunt dissection to trace it posteriorly to the umbilical artery. Note that several **superior vesical arteries** arise from the inferior surface of the umbilical artery and descend to the superolateral part of the urinary bladder.
- **Obturator artery** – passes through the obturator canal. Find the obturator artery where it enters the obturator canal in the lateral wall of the lesser pelvis, and follow the artery posteriorly to its origin. In approximately 20% of cases, the obturator artery arises from the inferior epigastric artery (**aberrant obturator artery**). An aberrant obturator artery crosses the pelvic brim and is at risk for injury during surgical repair of a femoral hernia.
- **Inferior vesical artery** – courses toward the fundus of the urinary bladder to supply the bladder, seminal vesicle, and prostate. The inferior vesical artery is a named branch only in the male; in the female, it is an unnamed branch of the vaginal artery.
- **Middle rectal artery** – courses medially toward the rectum. It often arises in common with the inferior vesical artery, making positive identification difficult. Identify the middle rectal artery by tracing it to the rectum. The middle rectal artery, like the inferior vesical artery, sends branches to the seminal vesicle and prostate.
- **Internal pudendal artery** – exits the pelvic cavity by passing through the greater sciatic foramen inferior to the piriformis muscle. The internal pudendal artery often arises from a common trunk with the inferior gluteal artery.
- **Inferior gluteal artery** – passes out of the pelvic cavity between ventral primary rami S2 and S3. The inferior gluteal artery exits the pelvis by passing through the greater sciatic foramen inferior to the piriformis muscle. The inferior gluteal artery may share a common trunk with the internal pudendal artery.

4. Identify the branches of the posterior division of the internal iliac artery (Fig. 5.18):

- **Iliolumbar artery** – passes posteriorly between the lumbosacral trunk and the obturator nerve. It may arise from a common trunk with the lateral sacral artery.
- **Lateral sacral artery** – gives rise to a superior branch and an inferior branch. Observe the inferior branch that passes anterior to the sacral ventral primary rami.
- **Superior gluteal artery** – exits the pelvic cavity by passing between the lumbosacral trunk and the ventral primary ramus of S1.

5. Use an illustration to study the **prostatic venous plexus**, **vesical venous plexus**, and **rectal venous plexus**. All of these plexuses drain into the internal iliac vein.

6. On the dissected specimen, observe the **deep dorsal vein of the penis** just inferior to the pubic symphysis. Verify that the deep dorsal vein of the penis empties into the prostatic venous plexus.

7. Identify the **internal iliac vein**. Follow the internal iliac vein to its junction with the **external iliac vein**. At this junction, the **common iliac vein** is formed.

NERVES [G 220, 221; N 390, 481; R 456; C 296]

The somatic plexuses of the pelvic cavity are the **sacral plexus** and **coccygeal plexus**. They are located between the pelvic viscera and the lateral pelvic wall. These somatic nerve plexuses are formed by contributions from ventral primary rami of spinal nerves L4 to S4. The primary visceral nerve plexus of the pelvic cavity is the **inferior hypogastric plexus**. It is formed by contributions from the hypogastric nerves, sympathetic trunks, and pelvic splanchnic nerves.

1. Use your fingers to dissect the rectum from the anterior surface of the sacrum and coccyx.
2. Retract the rectum medially. Identify the **sacral plexus** of nerves. The sacral plexus is closely related to the anterior surface of the piriformis muscle. Verify the following (Fig. 5.19):

- The **lumbosacral trunk** (ventral primary rami of L4, L5) joins the sacral plexus.
- The ventral primary rami of S2 and S3 emerge between the proximal attachments of the piriformis muscle.
- The **sciatic nerve** is formed by the ventral primary rami of spinal nerves L4 through S3. The sciatic nerve exits the pelvis by passing through the greater sciatic foramen, usually inferior to the piriformis muscle.
- The **superior gluteal artery** usually passes between the **lumbosacral trunk** and the **ventral primary ramus of spinal nerve S1**, and exits the pelvis by passing superior to the piriformis muscle.

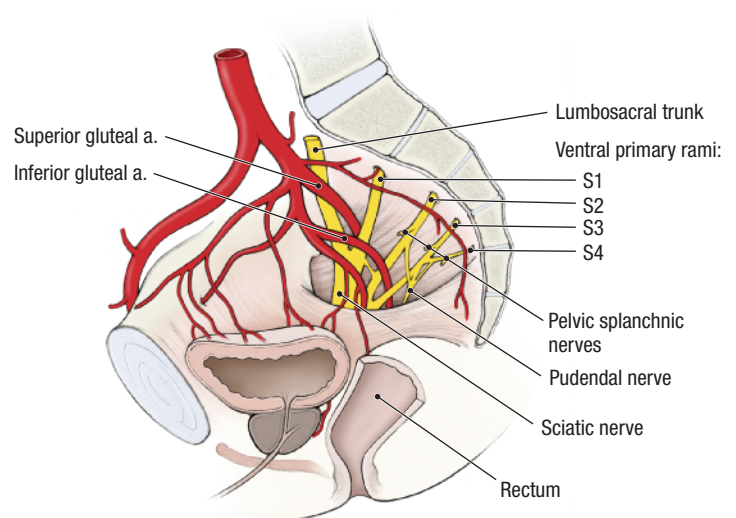


Figure 5.19. Sacral plexus of nerves in the male.

- The **inferior gluteal artery** usually passes between the **ventral primary rami of spinal nerves S2 and S3**. The inferior gluteal artery exits the pelvis by passing inferior to the piriformis muscle.
 - The **pudendal nerve** receives a contribution from the ventral primary rami of spinal nerves S2, S3, and S4. The pudendal nerve exits the pelvis by passing inferior to the piriformis muscle.
3. Identify the **pelvic splanchnic nerves (nervi erigentes)**. Pelvic splanchnic nerves are branches of the ventral primary rami of spinal nerves S2 to S4 (Fig. 5.19). Pelvic splanchnic nerves carry preganglionic parasympathetic axons for the innervation of pelvic organs and the distal gastrointestinal tract (from the left colic flexure through the anal canal). [G 220; N 390; R 334; C 296]
 4. The **sacral portion of the sympathetic trunk** is located on the anterior surface of the sacrum, medial to the ventral sacral foramina. Identify the following:
 - **Sympathetic trunk** – continues from the abdominal region into the pelvis. The sympathetic trunks of the two sides join in the midline near the level of the coccyx to form the **ganglion impar**.
 - **Gray rami communicantes** – connect the sympathetic ganglia to the sacral ventral primary rami. Each gray ramus communicans carries postganglionic sympathetic fibers to a ventral primary ramus for distribution to the lower extremity and perineum.
 - **Sacral splanchnic nerves** – arise from two or three of the sacral sympathetic ganglia and pass directly to the **inferior hypogastric plexus**. Sacral splanchnic nerves carry sympathetic fibers that distribute to the pelvic viscera.

CLINICAL CORRELATION

Pelvic Nerve Plexuses

The pelvic splanchnic nerves (parasympathetic outflow of S2, S3, S4) are closely related to the lateral aspects of the rectum. The inferior hypogastric plexus is located in the connective tissue lateral to the prostate. These autonomic nerve plexuses can be injured during surgery, causing loss of bladder control and erectile dysfunction.

After you dissect . . .

Review the abdominal aorta and its terminal branches. Use the dissected specimen to review the branches of the internal iliac artery. Review the region supplied by each branch. Review the formation of the sacral plexus and the branches that were dissected in the pelvis. Use the dissected specimen and an illustration to review the course of the pudendal nerve from the pelvis to the urogenital triangle.

PELVIC DIAPHRAGM

Before you dissect . . .

The **pelvic diaphragm** is the muscular floor of the pelvic cavity. The pelvic diaphragm is formed by the levator ani muscle and coccygeus muscle plus the fasciae covering their superior and inferior surfaces (Fig. 5.20A,B). The pelvic diaphragm extends from the pubic symphysis to the coccyx. Laterally, the pelvic diaphragm is attached to the fascia covering the obturator internus muscle. The urethra and anal canal pass through a midline opening in the pelvic diaphragm called the **urogenital hiatus**.

Dissection Instructions

1. Perform the dissection of the pelvic diaphragm on one side of the cadaver. Save the side with the best dissection of arteries and nerves for review. [G 193, 194; N 343-345; C 299]
2. Retract the rectum, urinary bladder, prostate, and seminal vesicles medially.

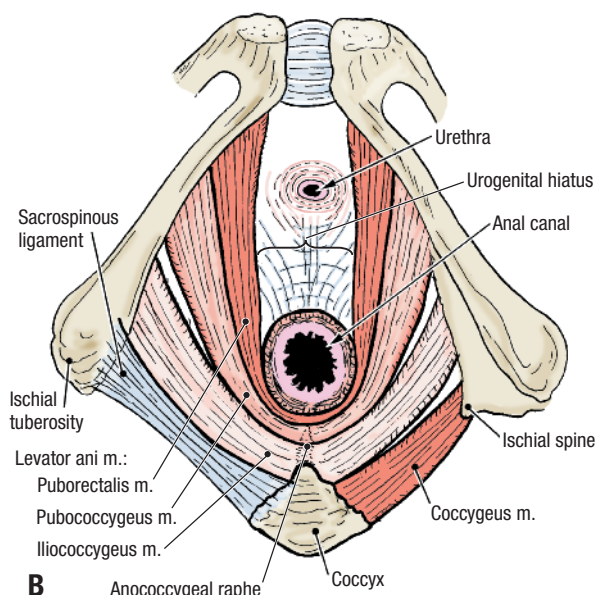
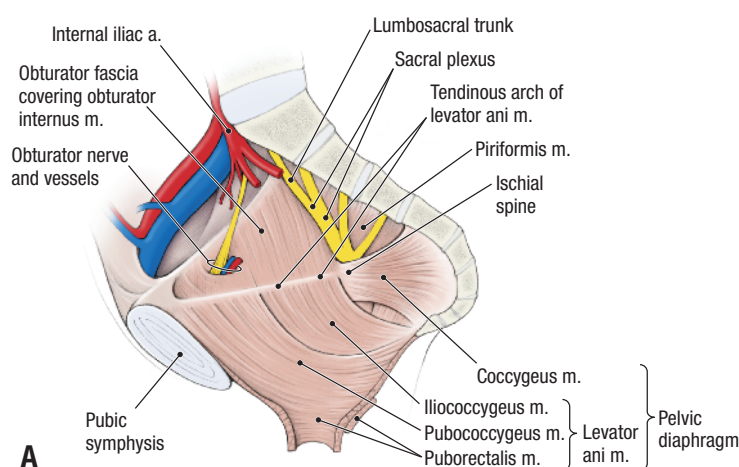


Figure 5.20. Pelvic diaphragm in the male. **A.** Left lateral view. **B.** Inferior view.

3. Use blunt dissection to remove any remaining fat and connective tissue from the superior surface of the pelvic diaphragm.
4. Find the **tendinous arch of the levator ani muscle** (Fig. 5.20A). Palpate the medial surface of the ischial spine. Locate the obturator canal. The tendinous arch lies just inferior to a line connecting these two structures. Note that the tendinous arch is the superior edge of the pelvic diaphragm.
5. Identify the three muscles that form the **levator ani muscle**. The muscles are identified by their proximal attachments. Learn, but do not dissect, their distal attachments. Identify the following:
 - **Puborectalis muscle** – its proximal attachment is the body of the pubis. Its distal attachment is the puborectalis muscle of the opposite side (midline raphe). The pubococcygeus muscle forms the lateral boundary of the urogenital hiatus. The two puborectalis muscles form a “puborectal sling,” which causes the **anorectal flexure** at the ampulla of the rectum (Fig. 5.17). During defecation, the puborectalis muscles relax, the anorectal flexure straightens, and the elimination of fecal matter is facilitated.
 - **Pubococcygeus muscle** – its proximal attachment is the body of the pubis. Its distal attachment is the coccyx and the **anococcygeal raphe**.
 - **Iliococcygeus muscle** – its proximal attachment is the tendinous arch. Its distal attachment is the coccyx and the anococcygeal raphe.
6. The levator ani muscle supports the pelvic viscera and resists increases in intra-abdominal pressure.
7. Identify the **coccygeus muscle**. The coccygeus muscle completes the pelvic diaphragm posteriorly. The proximal attachment of the coccygeus muscle is the ischial spine and its distal attachment is the lateral border of the coccyx and the lowest part of the sacrum.
8. Place one hand in the ischioanal fossa and the other on the superior surface of the pelvic diaphragm. Palpate the thinness of the pelvic diaphragm.
9. Observe that the **obturator internus muscle** forms the lateral wall of the ischioanal fossa. The proximal attachment of the obturator internus muscle is the margin of the obturator foramen and inner surface of the obturator membrane. The distal attachment of the obturator internus muscle will be studied when the gluteal region is dissected. Superior to the tendinous arch of the levator ani muscle, the obturator internus muscle forms the lateral wall of the pelvic cavity. Inferior to the tendinous arch, the obturator internus muscle forms the lateral wall of the perineum.
10. Use your textbook to learn the general pattern of lymphatic drainage of the pelvis, and the location of each of the following groups of lymph nodes: [G 203, 218, 219; N 388]
 - **Internal iliac nodes**
 - **External iliac nodes**
 - **Common iliac nodes**
 - **Sacral nodes**
 - **Lumbar nodes**

After you dissect . . .

Use the dissected specimen to review the proximal attachment and action of each muscle of the pelvic diaphragm. Review the relationship of the branches of the internal iliac artery to the pelvic diaphragm. Review the relationship of the sacral plexus to the pelvic diaphragm. Use an illustration to review the role of the pelvic diaphragm in dividing the pelvic cavity from the perineum. Review the function of the pelvic diaphragm and perineal body in supporting the pelvic and abdominal viscera. Use an illustration to review the lymphatic drainage from the pelvis and perineum. Realize that structures in the perineum (including the scrotum and the lower part of the anal canal) drain into superficial inguinal lymph nodes. The lymphatic drainage of the testis follows the testicular vessels to the lumbar chain of nodes, bypassing the perineal and pelvic drainage systems. Review the formation of the thoracic duct to complete your understanding of the lymph drainage from this region.

FEMALE UROGENITAL TRIANGLE

Before you dissect . . .

The order of dissection of the female urogenital triangle will be as follows. The external genitalia will be examined. The skin will be removed from the labia majora. The superficial perineal fascia will be removed and the contents of the superficial perineal pouch will be identified. The contents of the deep perineal pouch will be described, but not dissected.

Dissection Instructions

EXTERNAL GENITALIA [G 256; N 359; R 350; C 274]

1. Place the cadaver in the supine position. Stretch the thighs widely apart and brace them. Usually, only one student can work on the urogenital triangle at a time. The dissector should be positioned between the thighs.
2. Examine the **vulva** (female external genitalia) (Fig. 5.21). Identify the following structures:
 - **Mons pubis**
 - **Anterior labial commissure**
 - **Labium majus**
 - **Clitoris and prepuce of clitoris**
 - **Labium minus**
 - **Vestibule of the vagina** – the area between the labia minora
 - **External urethral orifice**
 - **Vaginal orifice**
 - **Openings of the paraurethral ducts** – on each side of the external urethral orifice
 - **Posterior labial commissure**

SKIN REMOVAL

1. Refer to Figure 5.22.
2. Make a skin incision in the midline from the anterior margin of the anus to the posterior labial commissure.
3. Make a skin incision that follows the medial surface of the labium majus on each side. Each incision should

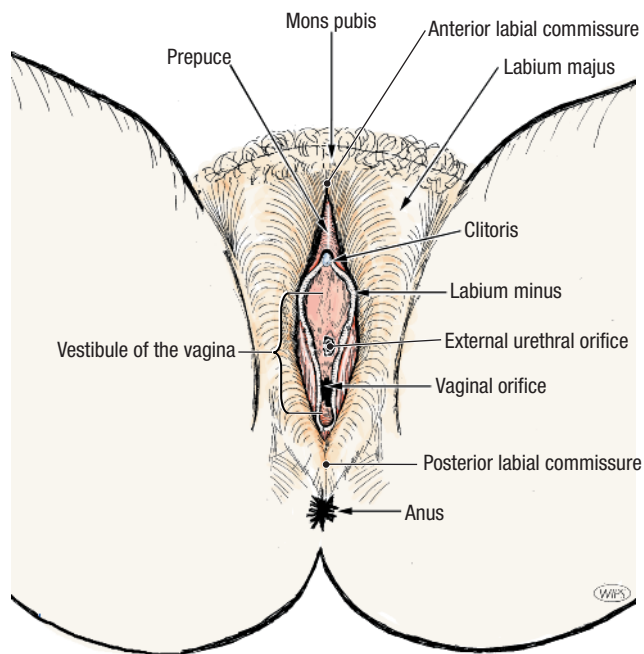


Figure 5.21. Female external genitalia.

begin at the posterior labial commissure, pass lateral to the labium minus, and end at the anterior labial commissure. Extend the incision in the midline to the mons pubis.

4. Make a transverse incision across the mons pubis that extends from the right thigh to the left thigh.
5. Remove the skin from the labium majus (lateral to the incisions). Detach each skin flap along the medial surface of the thigh and place the skin in the tissue container (Fig. 5.22, dashed lines).
6. If the cadaver has a large amount of fat in the superficial fascia of the medial thighs, remove a portion of the superficial fascia that corresponds to the skin that was removed.

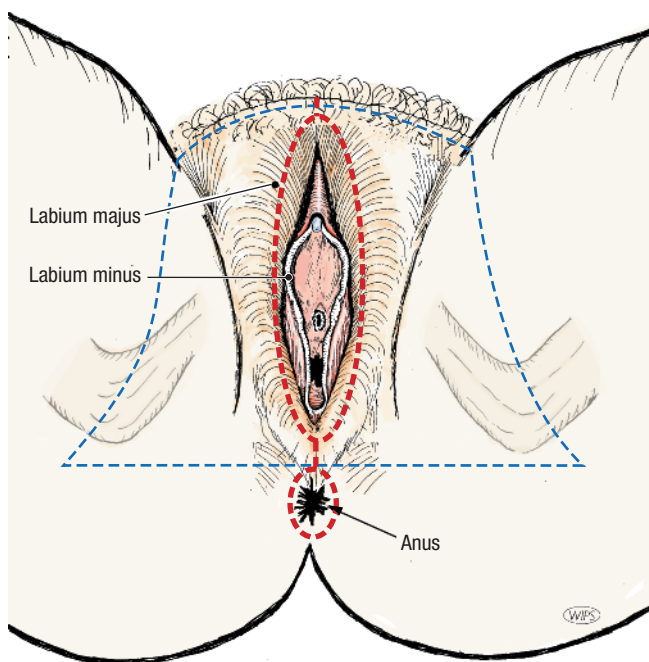


Figure 5.22. Skin incisions.

7. Note that the posterior labial nerve and vessels enter the urogenital triangle by passing lateral to the external anal sphincter muscle. The posterior labial nerve and vessels supply the posterior part of the labium majus.

SUPERFICIAL PERINEAL POUCH AND CLITORIS [G 256-258; N 360, 361; R 352, 353; C 276, 277]

The superficial perineal fascia has a superficial fatty layer and a deep membranous layer. In the female, the superficial fatty layer provides the shape of the labium majus and is continuous with the fat of the lower abdominal wall, ischioanal fossa, and thigh. The **membranous layer of the superficial perineal fascia (Colles' fascia)** is attached to the ischiopubic ramus as far posteriorly as the ischial tuberosity, and to the posterior edge of the **perineal membrane (Fig. 5.23)**. The membranous layer of the superficial perineal fascia forms the superficial boundary the **superficial perineal pouch (space)**.

1. The **contents of the superficial perineal pouch in the female** include **three muscles (ischiocavernosus, bulbospongiosus, and superficial transverse perineal)**, the **crus of the clitoris**, the **bulb of the vestibule**, and the **greater vestibular gland (Fig. 5.24)**. These structures are paired. The superficial perineal pouch also contains the blood vessels and nerves for these structures.
2. It is not necessary to identify the membranous layer of the superficial perineal fascia to complete the dissection. Use a probe to dissect through the superficial perineal fascia approximately 2 cm lateral to the labium minus. Remove the fat that forms the labium majus and place it in the tissue container.
3. Use blunt dissection to find the **superficial transverse perineal muscle** at the posterior border of the urogenital triangle (Fig. 5.24A). The superficial transverse perineal muscle may be delicate and difficult to find; limit the time spent looking for it. The lateral attachment of the superficial transverse perineal muscle

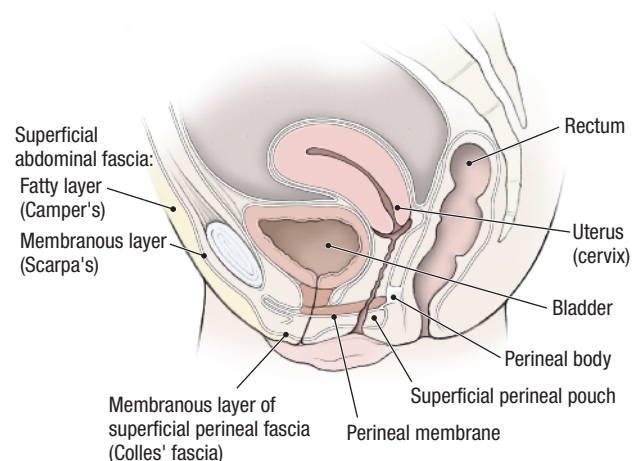


Figure 5.23. Perineal fasciae in the female. The membranous layer of superficial perineal fascia (Colles' fascia) is continuous with the membranous layer of superficial fascia of the lower abdominal wall (Scarpa's fascia). The membranous layer of the superficial perineal fascia is attached along the posterior border of the perineal membrane.

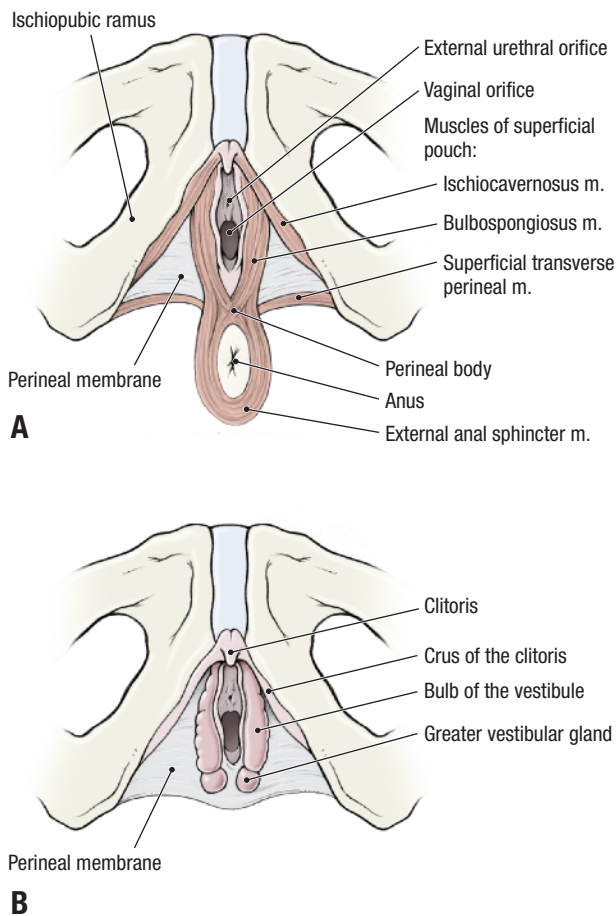


Figure 5.24. Contents of the superficial perineal pouch in the female. **A.** Muscles. **B.** Erectile bodies.

is the ischial tuberosity and the ischiopubic ramus. The medial attachment of the superficial transverse perineal muscle is the **perineal body**. The perineal body is a fibromuscular mass located between the anal canal and the posterior edge of the perineal membrane that serves as an attachment for several muscles. The superficial transverse perineal muscle helps to support the perineal body.

4. Use blunt dissection to clean the surface of the **ischio-cavernosus muscle**. The ischiocavernosus muscle covers the superficial surface of the **crus of the clitoris**. The proximal attachments of the ischiocavernosus muscle are the ischial tuberosity and the ischiopubic ramus. The distal attachment of the ischiocavernosus muscle is the crus of the clitoris. The ischiocavernosus muscle forces blood from the crus of the clitoris into the corpus cavernosum clitoris.
5. Identify the **bulbospongiosus muscle**, which is lateral to the labium minus. The bulbospongiosus muscle covers the superficial surface of the **bulb of the vestibule**. The posterior attachment of the bulbospongiosus muscle is the perineal body. The anterior attachment of the bulbospongiosus muscle is the corpus cavernosum clitoris. The bulbospongiosus

muscle in the female does not join the bulbospongiosus muscle of the opposite side across the midline as it does in the male.

6. Note that the **greater vestibular gland** is found in the superficial perineal pouch immediately posterior to the bulb of the vestibule (Fig. 5.24B).
7. Use a probe to dissect between the three muscles of the superficial perineal pouch until a small triangular opening is created. The membrane that becomes visible through this opening is the **perineal membrane** (Fig. 5.24A). The perineal membrane is the deep boundary of the superficial perineal pouch, and the erectile bodies are attached to it.
8. On the right side of the cadaver, use blunt dissection to remove the bulbospongiosus muscle and identify the **bulb of the vestibule** (Fig. 5.24B). The bulb of the vestibule is an elongated mass of erectile tissue that lies lateral to the vaginal orifice. Anteriorly, the bulbs of the two sides are joined at the **commissure of the bulbs** and the commissure is continuous with the **glans of the clitoris**.
9. On the right side of the cadaver, use blunt dissection to remove the ischiocavernosus muscle from the **crus of the clitoris** (Fig. 5.24B). The crus of the clitoris is continuous with the corpus cavernosum clitoris. The two corpora cavernosa form the **body of the clitoris**.
10. Use an illustration to study the erectile bodies of the clitoris. Note that the glans of the clitoris caps the two corpora cavernosa.

DEEP PERINEAL POUCH

The deep perineal pouch (space) will not be dissected. The deep perineal pouch lies superior (deep) to the perineal membrane (Fig. 5.25). The **contents of the deep perineal pouch in the female** are the **urethra**, a portion of the **vagina**, **external urethral sphincter muscle**, **branches of the internal pudendal vessels**, and **branches of the pudendal nerve**.

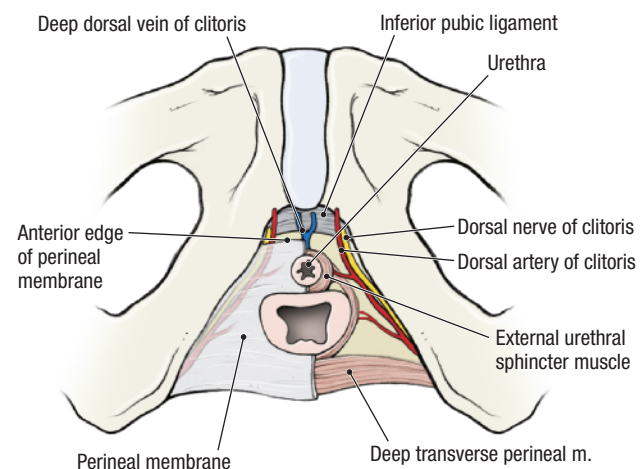


Figure 5.25. Contents of the deep perineal pouch in the female.

1. Use an illustration to study the following: [G 242; N 361; C 278]
 - **Urethra** – extends from the internal urethral orifice in the urinary bladder to the external urethral orifice in the vestibule of the vagina (approximately 4 cm).
 - **External urethral sphincter (sphincter urethrae) muscle** – a voluntary muscle that surrounds the urethra. When the external urethral sphincter muscle contracts, it compresses the urethra and stops the flow of urine.
 - **Deep transverse perineal muscle** – has a lateral attachment to the ischial tuberosity and the ischiopubic ramus and a medial attachment to the perineal body. Its fiber direction and function are identical to those of the superficial transverse perineal muscle, which is a content of the superficial perineal pouch.
2. Other contents of the deep perineal pouch include **branches of the internal pudendal artery** and **branches of the pudendal nerve** that supply the external urethral sphincter muscle, the deep transverse perineal muscle, and the clitoris (Fig. 5.25).
3. Collectively, the muscles within the deep perineal pouch plus the perineal membrane are known as the **urogenital diaphragm**. This older anatomical nomenclature is still in clinical use.

CLINICAL CORRELATION

Obstetrical Considerations

As the head of the baby pushes through the vagina during childbirth, the anus and the levator ani muscle are forced posteriorly toward the sacrum and coccyx. The urethra is forced anteriorly toward the pubic symphysis. Perineal lacerations during childbirth are common, and it may be necessary to surgically widen the vaginal orifice (episiotomy). If the perineal body is lacerated, it must be repaired to prevent weakness of the pelvic floor, which could result in prolapse of the urinary bladder, uterus, or rectum.

To alleviate the pain of childbirth, a **pudendal nerve block** is performed by injecting a local anesthetic around the pudendal nerve where it passes near the ischial spine. To perform the injection, the ischial spine is palpated through the vagina, and the needle is inserted through the skin and directed toward ischial spine.

After you dissect . . .

Replace the muscles of the urogenital triangle in their correct anatomical positions. Review the contents of the superficial perineal pouch. Use an illustration to review the course of the internal pudendal artery from its origin in the pelvis. Use an illustration to review the course and branches of the pudendal nerve. Review an illustration showing the urethra and note its course from the urinary bladder to the perineum.

FEMALE PELVIC CAVITY

Before you dissect . . .

The female pelvic cavity contains the urinary bladder anteriorly, the female internal genitalia, and the rectum posteriorly (Fig. 5.26). The term **adnexa** (L. *adnexa*, adjacent parts) refers to the ovaries, uterine tubes, and ligaments of the uterus. Removal of the uterus (hysterectomy), with or without the ovaries, is a common surgical procedure. If the uterus has been surgically removed from your cadaver, examine it in other cadavers.

The order of dissection will be as follows. The peritoneum will be studied in the female pelvic cavity. The pelvis will be sectioned in the midline and the cut surface of the sectioned pelvis will be studied. The uterus and vagina will be studied. The uterine tube will be traced from the uterus to the ovary. The ovary will be studied.

Dissection Instructions

PERITONEUM [G 224, 225; N 347; R 345; C 258]

1. Examine the **peritoneum** in the female pelvis (Fig. 5.26). The peritoneum passes from the anterior abdominal wall (1) superior to the pubis (2), then onto the superior surface of the urinary bladder (3). The peritoneum then passes from the superior surface of the urinary bladder to the uterus where it forms the **vesicouterine pouch** (4). The peritoneum covers the fundus and body of the uterus (5). It extends over the posterior wall of the vagina near the posterior part of the vaginal fornix. Between the uterus and the rectum, the peritoneum forms the **rectouterine pouch** (6). From the rectouterine pouch, the peritoneum passes onto the anterior surface and sides of the rectum (7). At the level of the third sacral vertebra, the peritoneum forms the sigmoid mesocolon (8). Laterally, a **paravesical fossa** is apparent on each side of the urinary bladder. Further posteriorly, a **pararectal fossa** is apparent on each side of the rectum.

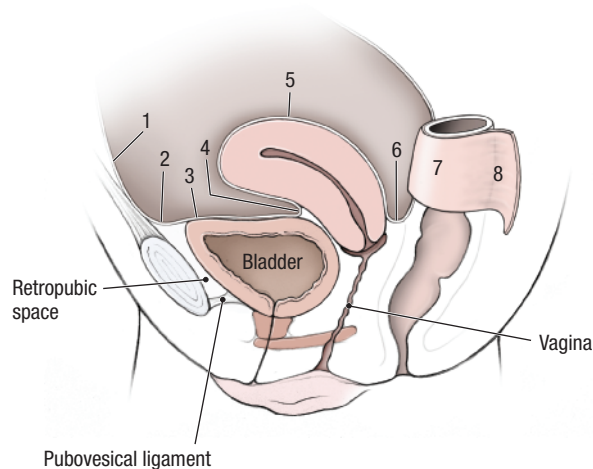


Figure 5.26. Peritoneum in the female pelvis. The numbered features of the peritoneum are explained in the text.

CLINICAL CORRELATION

Pelvic Peritoneum

As the urinary bladder fills, the peritoneal reflection from the anterior abdominal wall to the bladder is elevated above the level of the pubis. A filled urinary bladder can be approached with a needle superior to the pubis without entering the peritoneal cavity.

2. Identify the **broad ligament of the uterus**. The broad ligament of the uterus is formed by two layers of peritoneum that extend from the lateral side of the uterus to the lateral pelvic wall. The **uterine tube** is contained within the superior margin of the broad ligament. The broad ligament has three parts (Fig. 5.27): [G 229; N 355; R 347; C 262]
 - **Mesosalpinx** (Gr. *salpinx*, tube) – supports the uterine tube
 - **Mesovarium** – attaches the ovary to the posterior aspect of the broad ligament
 - **Mesometrium** – the part of the broad ligament that is below the attachment of the mesovarium
3. The tissue enclosed between the two layers of the broad ligament is called **parametrium** (Gr. *para*, beside; *metra*, womb, uterus) (Fig. 5.27).
4. Identify the **round ligament of the uterus**, which is visible through the anterior layer of the broad liga-

ment. Observe that the round ligament of the uterus passes over the pelvic brim and exits the abdominal cavity by passing through the deep inguinal ring, lateral to the inferior epigastric vessels. The round ligament of the uterus passes through the inguinal canal and ends in the labium majus.

5. Identify the **ligament of the ovary**, which is a fibrous cord within the broad ligament that connects the ovary to the uterus.
6. Identify the **suspensory ligament of the ovary**, which is a peritoneal fold that covers the ovarian vessels. The suspensory ligament of the ovary extends into the greater pelvis from the superior aspect of the ovary.
7. The **endopelvic fascia** contains condensations of connective tissue that passively support the uterus. Study an illustration and note the following (Fig. 5.28):
 - **Uterosacral (sacrogenital) ligament**—extends from the cervix to the sacrum. The uterosacral ligament underlies the **uterosacral fold**.
 - **Transverse cervical ligament (cardinal ligament)**—extends from the cervix to the lateral wall of the pelvis
 - **Pubocervical (pubovesical) ligament**—extends from the pubis to the cervix

SECTION OF THE PELVIS

The pelvis will be divided in the midline. First, the pelvic viscera and the soft tissues of the perineum will be cut in the midline with a scalpel. The pubic symphysis and vertebral column (up to vertebral level L3) will be cut in the midline with a saw. Subsequently, the right side of the body will be transected at vertebral level L3. The left

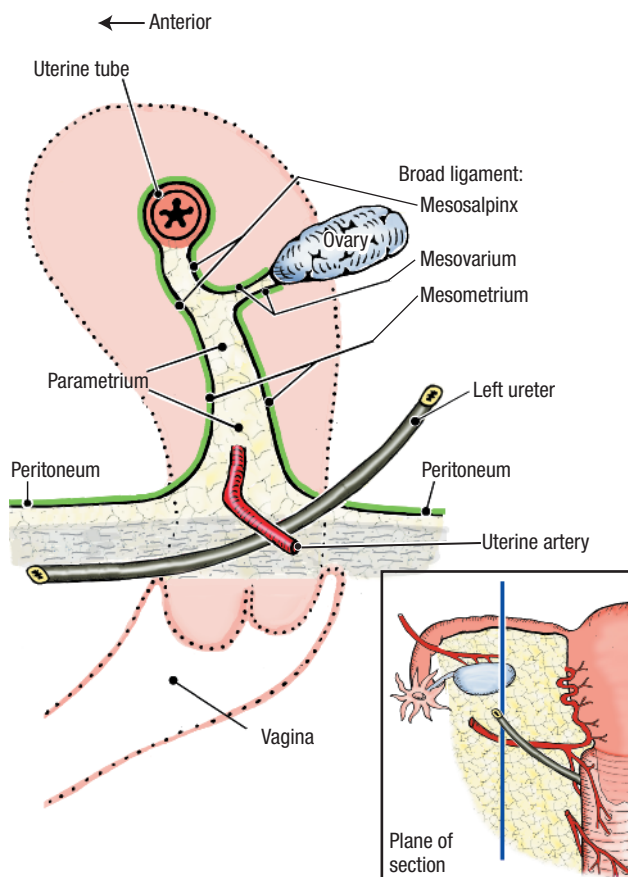


Figure 5.27. Parts of the broad ligament of the uterus.

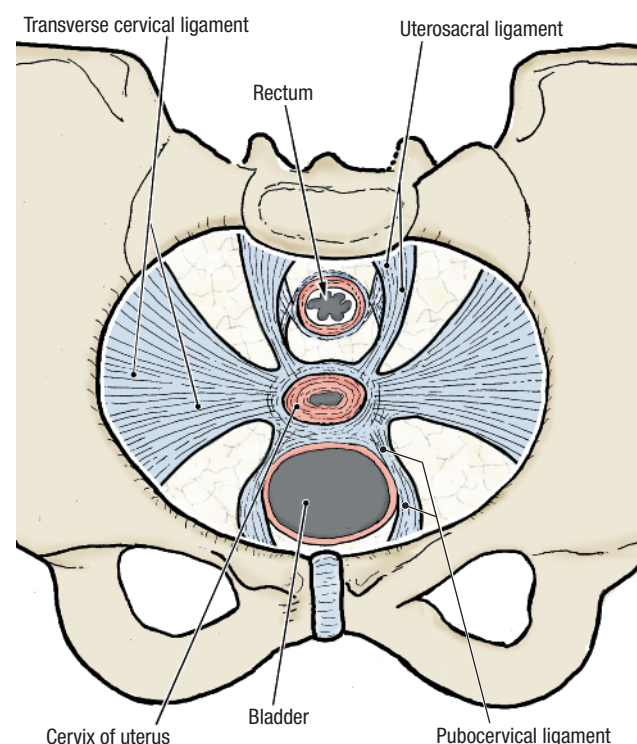


Figure 5.28. Ligaments of the endopelvic fascia that support the uterus.

lower limb and left side of the pelvis will remain attached to the trunk.

Both halves of the pelvis will be used to dissect the pelvic viscera, pelvic vasculature, and nerves of the pelvis. One half of the pelvis will be used to demonstrate the muscles of the pelvic diaphragm.

1. Begin this dissection with a new scalpel blade.
2. Use your hand to position the uterus in the midline. Use a scalpel to divide the uterus in its median plane. Extend the cut through the cervix and into the fornix of the vagina.
3. Beginning posterior to the pubic symphysis, make a midline cut through the superior surface of the urinary bladder. Open the bladder and sponge the interior, if necessary.
4. Identify the internal urethral orifice and insert a probe. Use the probe as a guide and cut through the inferior part of the bladder.
5. Extend the midline cut in the posterior direction. Cut through the anterior and posterior walls of the rectum and the distal part of sigmoid colon. Sponge them clean.
6. In the perineum, insert the tip of a probe into the external urethral orifice. Use the probe as a guide to make a midline cut through the clitoris, dividing it into right and left sides. Extend this cut posteriorly, dividing the urethra and vagina into right and left sides.
7. In the midline, cut through the perineal membrane, perineal body, and anal canal. Extend the cut to the tip of the coccyx.
8. Use a saw to make two cuts in the midline:
 - Pubic symphysis – cut through the pubic symphysis from anterior to posterior.
 - Sacrum – turn the cadaver to the prone position. Cut through the sacrum from posterior to anterior. Do not allow the saw to pass between the soft tissue structures that were cut with the scalpel. Spread the opening and extend the midline cut as far superiorly as the body of the third lumbar vertebra.
9. Return the cadaver to the supine position. To mobilize the right lower limb, use a scalpel to cut the right

common iliac vein, right common iliac artery, and right ovarian vessels. Cut the right ureter and the branches of the right lumbar plexus.

10. In the transverse plane, cut the psoas major muscle and the quadratus lumborum muscle at vertebral level L3. Use the saw to cut horizontally through the right half of the intervertebral disc between L3 and L4. Now, the right lower limb can be removed.
11. Clean the rectum and anal canal.

FEMALE INTERNAL GENITALIA [G 224; N 347, 352; R 345; C 258]

1. Study the cut surface of the sectioned specimen. Use an illustration to guide you.
2. Trace the sectioned urethra anteroinferiorly from the urinary bladder to the **external urethral orifice**. Identify the **external urethral sphincter muscle** that surrounds the urethra. The external urethral sphincter muscle may be difficult to see.
3. In the sectioned specimen, observe the **vagina**. Identify the **vaginal fornix**. The vaginal fornix has four parts: **anterior**, **lateral (2)**, and **posterior** (Fig. 5.29). Observe that the anterior vaginal wall is shorter than the posterior vaginal wall.
4. Observe that the posterior wall of the vagina (near the posterior part of the vaginal fornix) is in contact with the peritoneum that lines the rectouterine pouch.
5. Study the **uterus** (Fig. 5.29). Observe that the uterus is tilted approximately 90 degrees anterior to the axis of the vagina (anteverted). The position of the uterus changes during pregnancy and as the urinary bladder fills. [G 227, 230; N 356; R 346, 347; C 262, 263]
6. Identify the following features of the uterus:
 - **Fundus** – the rounded part of the body that lies superior to the attachments of the uterine tubes
 - **Body** – the part of the uterus between the fundus and the cervix. The **vesical surface** of the body of the uterus faces the vesicouterine pouch and the **intestinal surface** faces the rectouterine pouch. Note that the broad ligament is attached to the lateral surface of the body of the uterus.

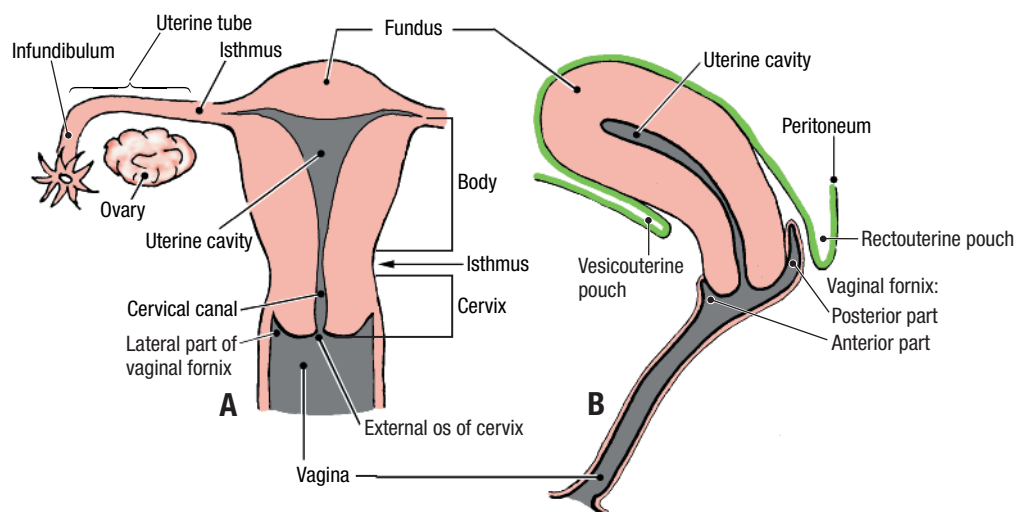


Figure 5.29. The uterus. A. Coronal section. B. Midsagittal section.

- **Isthmus** – the narrowed portion of the body that is superior to the cervix
 - **Cervix** – the thick walled portion of the uterus that protrudes into the vaginal canal
8. Identify the **uterine cavity**. In a coronal section, it is triangular (Fig. 5.29A). In a sagittal section, it is a slit (Fig. 5.29B).
 9. Note that the uterine mucosa is called **endometrium**. The thick muscular wall of the uterus is called **myometrium**. The peritoneal covering on the surface of the uterus is called **perimetrium** (Gr. *pari*, around). The tissues within the broad ligament are called **parametrium** (Gr. *para*, beyond).
 10. Identify the **uterine (fallopian) tube** (Fig. 5.29). Use your fingers to follow the uterine tube laterally within the mesosalpinx. Observe the **isthmus**, which is the narrow, medial one-third of the uterine tube. Note that the distal end of the uterine tube is expanded to form the **infundibulum**. Identify the **fimbriae** around the margin of the infundibulum.
 11. Observe the **ovary**. The ovary is ovoid, with a **tubal (distal) extremity** and a **uterine (proximal) extremity**. The ovarian vessels enter the tubal extremity, and the ovarian ligament is attached to the uterine extremity.
 12. The ovary sits in the **ovarian fossa**. The ovarian fossa is a shallow depression in the lateral pelvic wall bounded by the ureter, external iliac vein, and uterine tube.
 13. Review the abdominal origin and course of the ovarian vessels. Note that they pass through the **suspensory ligament of the ovary**.

After you dissect . . .

Review the relationships of the female internal genitalia. Use the dissected specimen to review the peritoneum in the pelvic cavity. Trace the round ligament of the uterus from the labium majus to the uterus. Review the parts of the broad ligament and review the function of the endopelvic fascia in passive support of the uterus.

URINARY BLADDER, RECTUM, AND ANAL CANAL

Before you dissect . . .

The urinary bladder is a reservoir for urine. When empty, it is located within the pelvic cavity. When filled, it extends into the abdominal cavity. The urinary bladder is a retroperitoneal organ that is surrounded by **endopelvic fascia**. Between the pubic symphysis and the urinary bladder is a potential space called the **retropubic space (prevesical space)** (Fig. 5.26). The retropubic space is filled with fat and loose connective tissue that accommodates the expansion of the urinary bladder. The **pubovesical ligament** is a condensation of fascia that ties the neck of the urinary bladder to the pubis across the retropubic space.

The lower one-third of the rectum is surrounded by endopelvic fascia. The middle and upper thirds of the rectum are partially covered by peritoneum (Fig. 5.26).

The order of dissection will be as follows. The parts of the urinary bladder will be studied. The interior of the urinary bladder will be studied. The interior of the rectum and anal canal will be studied.

Dissection Instructions

URINARY BLADDER [N 353; C 262]

1. Identify the **parts of the urinary bladder** (Fig. 5.30):
 - **Apex** – the pointed part directed toward the anterior abdominal wall. The apex of the urinary bladder can be identified by the attachment of the urachus.
 - **Body** – between the apex and fundus
 - **Fundus** – the posterior wall, also called the **base of the bladder**. In the female the fundus is related to the vagina and cervix.
 - **Neck** – where the urethra exits the urinary bladder. In the neck of the urinary bladder, the wall thickens to form the involuntary **internal urethral sphincter muscle**.
2. Identify the four **surfaces of the urinary bladder** (Fig. 5.30):
 - **Superior** – covered by peritoneum
 - **Posterior** – covered by endopelvic fascia
 - **Inferolateral (2)** – covered by endopelvic fascia
3. Examine the **wall of the urinary bladder** and note its thickness. The wall of the urinary bladder consists of bundles of smooth muscle called the **detrusor muscle** (L. *detrudere*, to thrust out).
4. Identify the **trigone** on the inner surface of the fundus (Fig. 5.31). The angles of the trigone are the **internal urethral orifice** and the two **orifices of the ureters**. The internal urethral orifice is located at the most inferior point in the urinary bladder. [N 353]
5. Observe that the mucous membrane over the trigone is smooth. The mucous membrane lining the other parts of the urinary bladder lies in folds when the bladder is empty but will accommodate expansion.

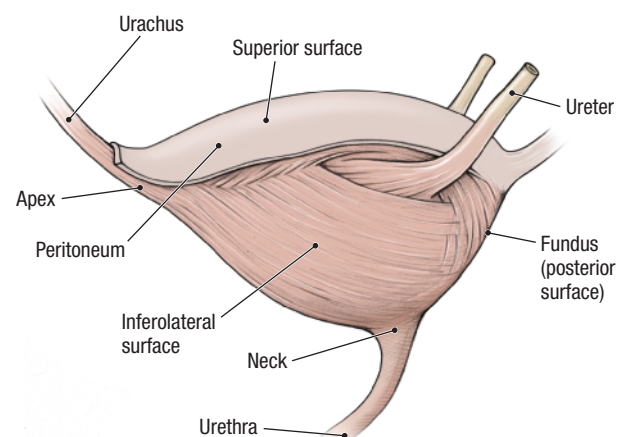


Figure 5.30. Parts of the urinary bladder in the female.

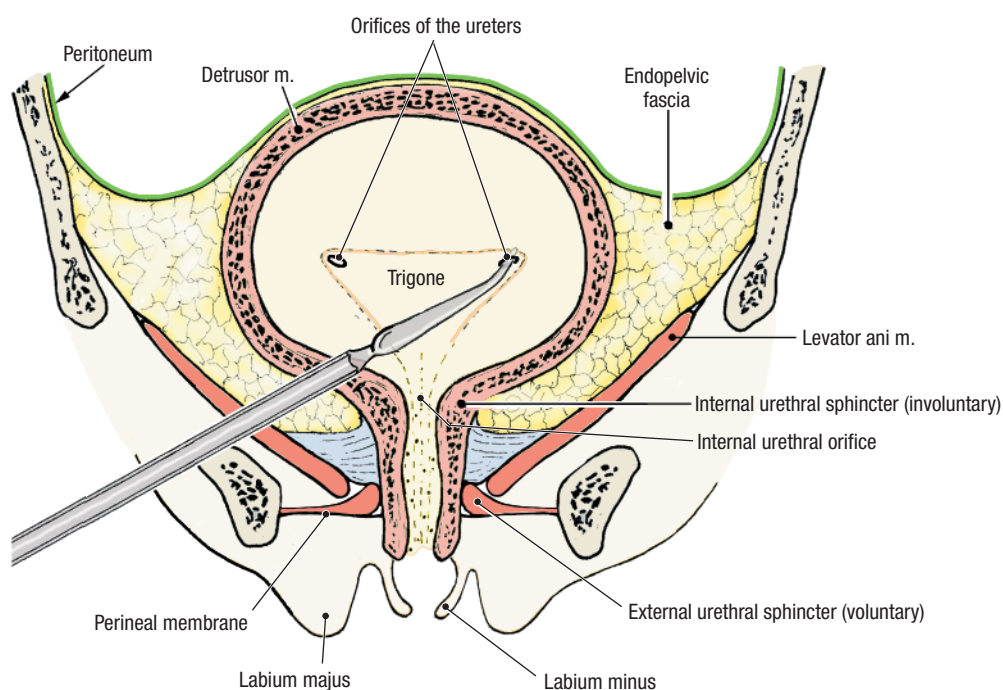


Figure 5.31. Urinary bladder and urethra in the female seen in frontal section. The tip of the probe is located in the orifice of the left ureter.

6. Insert the tip of a probe into the orifice of the ureter and observe that the ureter passes through the wall of the urinary bladder in an oblique fashion. When the urinary bladder is full (distended), the pressure of the accumulated urine flattens the part of the ureter that is within the wall of the bladder and prevents reflux of urine.

CLINICAL CORRELATION

Kidney Stones

Kidney stones pass through the ureter to the urinary bladder and may become lodged in the ureter. The point where the ureter passes through the wall of the urinary bladder is a relatively narrow passage. If a kidney stone becomes lodged, severe colicky pain results. The pain stops suddenly once the stone passes into the bladder.

7. Find the ureter where it crosses the external iliac artery or the bifurcation of the common iliac artery. Use a probe to follow the ureter to the fundus of the urinary bladder. Observe that the ureter crosses inferior to the **uterine artery** and superior to the **vaginal artery**. [G 228; N 380; R 344; C 269]

RECTUM AND ANAL CANAL [G 199, 224; N 347, 374; R 345; C 258, 292]

1. Recall that the rectum begins at the level of the third sacral vertebra. Observe the sectioned pelvis and note that the rectum follows the curvature of the sacrum.

2. Identify the **ampulla of the rectum** (Fig. 5.32). At the ampulla, the rectum turns approximately 80 degrees posteriorly (**anorectal flexure**) and is continuous with the anal canal.
3. Examine the inner surface of the rectum. Note that the mucous membrane is smooth except for the presence of **transverse rectal folds**. There is usually one transverse rectal fold on the right side and two on the left side. The transverse rectal folds may be difficult to identify in some cadavers.
4. Observe that the **anal canal** is only 2.5 to 3.5 cm in length. The anal canal passes out of the pelvic cavity and enters the anal triangle of the perineum.
5. Examine the inner surface of the anal canal (Fig. 5.32). Note that the mucosal features of the anal canal may

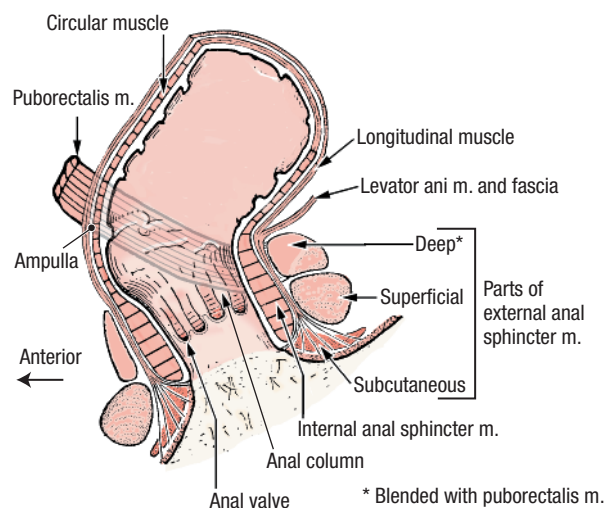


Figure 5.32. Rectum, anal canal, and anal sphincter muscles.

be difficult to identify in older individuals. Attempt to identify the following:

- **Anal columns** – five to 10 longitudinal ridges of mucosa in the proximal part of the anal canal. The anal columns contain branches of the **superior rectal artery and vein**.
- **Anal valves** – semilunar folds of mucosa that unite the distal ends of the anal columns. External to each anal valve is a small pocket called an **anal sinus**.
- **Pectinate line** – the irregular line formed by all of the anal valves.

CLINICAL CORRELATION

Hemorrhoids

In the anal columns, the superior rectal veins of the hepatic portal system anastomose with middle and inferior rectal veins of the inferior vena caval system. An abnormal increase in blood pressure in the hepatic portal system causes engorgement of the veins contained in the anal columns, resulting in **internal hemorrhoids**. Internal hemorrhoids are covered by mucous membrane and are relatively insensitive to painful stimuli because the mucous membrane is innervated by autonomic nerves.

External hemorrhoids are enlargements of the tributaries of the inferior rectal veins. External hemorrhoids are covered by skin and are very sensitive to painful stimuli because they are innervated by somatic nerves (inferior rectal nerves).

6. The anal sphincter muscles surround the anal canal. Identify the **external anal sphincter muscle** and the **internal anal sphincter muscle** in the sectioned specimen (Fig. 5.32). The longitudinal muscle of the anal canal separates the two sphincter muscles. If you have difficulty identifying them, use a new scalpel blade to cut another section through the wall of the anal canal to improve the clarity of the dissection.

After you dissect . . .

Use the dissected specimen to review the features of the urinary bladder, rectum, and anal canal. Review the relationships of the uterus, vagina, and ureters to the rectum and fundus of the urinary bladder. Review the kidney, the abdominal course of the ureter, the pelvic course of the ureter, and the function of the urinary bladder as a storage organ. Review the female urethra. Review all parts of the large intestine and recall its function in absorption of water, compaction, and elimination of fecal material. Recall that the external anal sphincter muscle is composed of skeletal muscle and is under voluntary control, whereas the internal anal sphincter muscle is composed of smooth muscle and is involuntary.

INTERNAL ILIAC ARTERY AND SACRAL PLEXUS

Before you dissect . . .

Anterior to the sacroiliac articulation, the **common iliac artery** divides to form the **external** and **internal iliac arteries** (Fig. 5.33). The external iliac artery distributes to the lower limb and the internal iliac artery to the pelvis. The internal iliac artery commonly divides into an anterior division and a posterior division. Branches arising from the anterior division are mainly visceral (branches to the urinary bladder, internal genitalia, external genitalia, rectum, and gluteal region). Branches arising from the posterior division are parietal (branches to the pelvic walls and gluteal region). The branching pattern of the internal iliac artery is variable, so it is important to identify the arteries by their distribution. The internal iliac vein is typically plexiform. To clear the dissection field, remove all tributaries to the internal iliac vein.

The order of dissection will be as follows. The branches of the anterior division of the internal iliac artery will be identified. The branches of the posterior division of the internal iliac artery will be identified. The nerves of the sacral plexus will be dissected. Finally, the pelvic portion of the sympathetic trunk will be dissected.

Dissection Instructions

BLOOD VESSELS [G 234; N 380, 382; C 269]

1. Identify the **common iliac artery** and follow it to its bifurcation.
2. Identify the **internal iliac artery**. Use blunt dissection to follow the **internal iliac artery** into the lesser pelvis.
3. Identify the branches of the anterior division of the internal iliac artery (Fig. 5.33):
 - **Umbilical artery** – in the medial umbilical fold, find the **umbilical ligament** (the obliterated portion of the umbilical artery) and use blunt dissection to trace it posteriorly to the umbilical artery. Note that several **superior vesical arteries** arise from the inferior surface of the umbilical artery and descend to the superolateral aspect of the urinary bladder.
 - **Obturator artery** – passes through the obturator canal. Find the obturator artery where it enters the obturator canal in the lateral wall of the lesser pelvis, and follow the artery posteriorly to its origin. In approximately 20% of cases, the obturator artery arises from the inferior epigastric artery (**aberrant obturator artery**). An aberrant obturator artery crosses the pelvic brim and is at risk of injury during surgical repair of a femoral hernia.
 - **Uterine artery** – courses along the inferior margin of the broad ligament. Use blunt dissection to trace it to the lateral aspect of the uterus and note that it passes superior to the ureter. The uterine artery divides into a large superior branch to the body and fundus of the uterus and a smaller branch to the

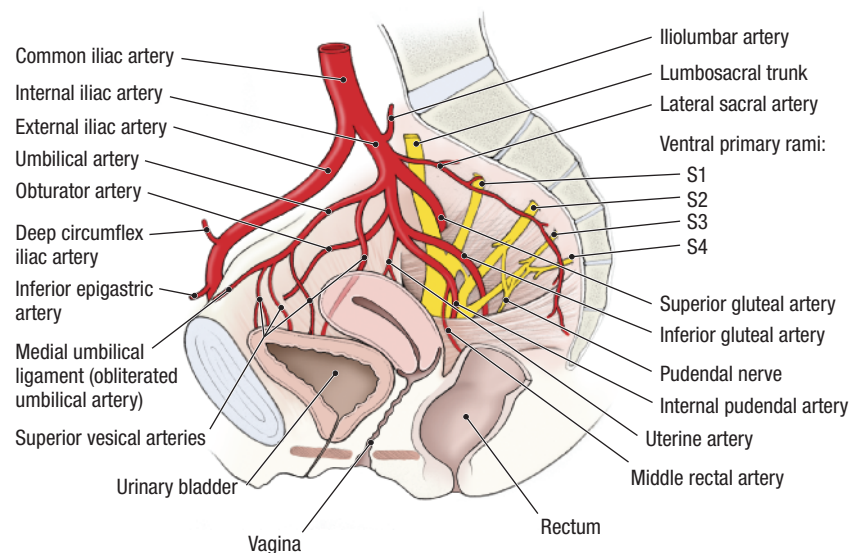


Figure 5.33. Branches of the internal iliac artery in the female.

cervix and vagina. Observe the close relationship of the lateral part of the vaginal fornix to the uterine artery. In the living body, the pulsations of the uterine artery may be felt through the lateral part of the vaginal fornix.

CLINICAL CORRELATION

Uterine Artery

The close proximity of the ureter and the uterine artery near the lateral fornix of the vagina is of clinical importance. During hysterectomy, the uterine artery is tied off and cut. The ureter may be unintentionally clamped, tied off, and severed where it crosses the uterine artery. This would have serious consequences for the corresponding kidney. To recall this relationship, use the mnemonic device “water under the bridge.”

- **Vaginal artery** – passes across the floor of the pelvis, inferior to the ureter. The vaginal artery supplies the vagina and the urinary bladder. Note that the ureter passes between the vaginal artery and the uterine artery.
- **Middle rectal artery** – courses medially toward the rectum. To confirm the identity of the middle rectal artery, follow it to the rectum.
- **Internal pudendal artery** – exits the pelvic cavity by passing through the greater sciatic foramen inferior to the piriformis muscle. The internal pudendal artery often arises from a common trunk with the inferior gluteal artery.
- **Inferior gluteal artery** – passes out of the pelvic cavity between ventral primary rami S2 and S3. The inferior gluteal artery exits the pelvis by passing through the greater sciatic foramen inferior to

the piriformis muscle. The inferior gluteal artery may share a common trunk with the internal pudendal artery.

4. Identify the branches of the posterior division of the internal iliac artery (Fig. 5.33):
 - **Iliolumbar artery** – passes posteriorly between the lumbar trunk and the obturator nerve. It may arise from a common trunk with the lateral sacral artery.
 - **Lateral sacral artery** – gives rise to a superior branch and an inferior branch. Observe the inferior branch that passes anterior to the sacral ventral primary rami.
 - **Superior gluteal artery** – exits the pelvic cavity by passing between the lumbar trunk and the ventral primary ramus of spinal nerve S1.
5. Use an illustration to study the **vesical venous plexus**, **uterine venous plexus**, **vaginal venous plexus**, and **rectal venous plexus**. All of these plexuses drain into the internal iliac vein.
6. In the cadaver, identify the **internal iliac vein**. Follow the internal iliac vein to its junction with the **external iliac vein**. At this junction, the **common iliac vein** is formed.

NERVES [G 220, 234; N 392, 481; R 456; C 296]

The somatic plexuses of the pelvic cavity are the **sacral plexus** and **coccygeal plexus**. They are located between the pelvic viscera and the lateral pelvic wall. These somatic nerve plexuses are formed by contributions from ventral primary rami of spinal nerves L4 to S4. The primary visceral nerve plexus of the pelvic cavity is the **inferior hypogastric plexus**. It is formed by contributions from the hypogastric nerves, sympathetic trunks, and pelvic splanchnic nerves.

1. Use your fingers to dissect the rectum from the anterior surface of the sacrum and coccyx.

2. Retract the rectum medially. Identify the **sacral plexus** of nerves. The sacral plexus is closely related to the anterior surface of the piriformis muscle. Verify the following (Fig. 5.34):

- The **lumbosacral trunk** (ventral primary rami of L4, L5) joins the sacral plexus.
 - The ventral primary rami of S2 and S3 emerge between the proximal attachments of the piriformis muscle.
 - The **sciatic nerve** is formed by the ventral primary rami of spinal nerves L4 through S3. The sciatic nerve exits the pelvis by passing through the greater sciatic foramen, usually inferior to the piriformis muscle.
 - The **superior gluteal artery** usually passes between the **lumbosacral trunk** and the **ventral primary ramus of spinal nerve S1**, and exits the pelvis by passing superior to the piriformis muscle.
 - The **inferior gluteal artery** usually passes between the **ventral primary rami of spinal nerves S2 and S3**. The inferior gluteal artery exits the pelvis by passing inferior to the piriformis muscle.
 - The **puddental nerve** receives a contribution from the ventral primary rami of spinal nerves S2, S3, and S4. The pudental nerve exits the pelvis by passing inferior to the piriformis muscle.
3. Identify the **pelvic splanchnic nerves (nervi erigentes)**. Pelvic splanchnic nerves are branches of the ventral primary rami of spinal nerves S2 to S4 (Fig. 5.34). Pelvic splanchnic nerves carry preganglionic parasympathetic axons for the innervation of pelvic organs and the distal gastrointestinal tract (from the left colic flexure through the anal canal). [G 236, 237, 239; N 392; C 296]
4. The **sacral portion of the sympathetic trunk** is located on the anterior surface of the sacrum, medial to the ventral sacral foramina. Identify the following:
- **Sympathetic trunk** – continues from the abdominal region into the pelvis. The sympathetic trunks of the two sides join in the midline near the level of the coccyx to form the **ganglion impar**.

- **Gray rami communicantes** – connect the sympathetic ganglia to the sacral ventral primary rami. Each gray ramus communicans carries postganglionic sympathetic fibers to a ventral primary ramus for distribution to the lower extremity and the perineum.
- **Sacral splanchnic nerves** – arise from two or three of the sacral sympathetic ganglia and pass directly to the **inferior hypogastric plexus**. Sacral splanchnic nerves carry sympathetic fibers that distribute to the pelvic viscera.

CLINICAL CORRELATION

Pelvic Nerve Plexuses

The pelvic splanchnic nerves (parasympathetic outflow of S2, S3, S4) are closely related to the lateral aspects of the rectum. The inferior hypogastric plexus is located in the connective tissue lateral to the uterus. These autonomic nerve plexuses can be injured during surgery, causing loss of bladder control.

After you dissect . . .

Review the abdominal aorta and its terminal branches. Use the dissected specimen to review the branches of the internal iliac artery. Review the region supplied by each branch. Review the formation of the sacral plexus and the branches that were dissected in the pelvis. Use the dissected specimen and an illustration to review the course of the pudental nerve from the pelvis to the urogenital triangle.

PELVIC DIAPHRAGM

Before you dissect . . .

The **pelvic diaphragm** is the muscular floor of the pelvic cavity. The pelvic diaphragm is formed by the levator ani muscle and coccygeus muscle plus the fasciae covering their superior and inferior surfaces (Fig. 5.35A,B). The pelvic diaphragm extends from the pubic symphysis to the coccyx. Laterally, the pelvic diaphragm is attached to the fascia covering the obturator internus muscle. The urethra, vagina, and anal canal pass through a midline opening in the pelvic diaphragm called the **urogenital hiatus**.

Dissection Instructions

1. Perform the dissection of the pelvic diaphragm on one side of the cadaver. Save the side with the best dissection of arteries and nerves for review. [G 193, 195; N 343, 344; C 271, 272]

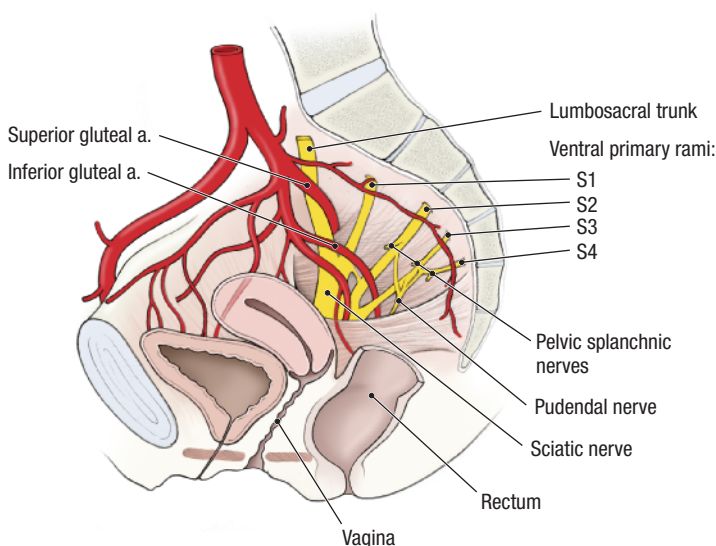


Figure 5.34. Sacral plexus of nerves in the female.

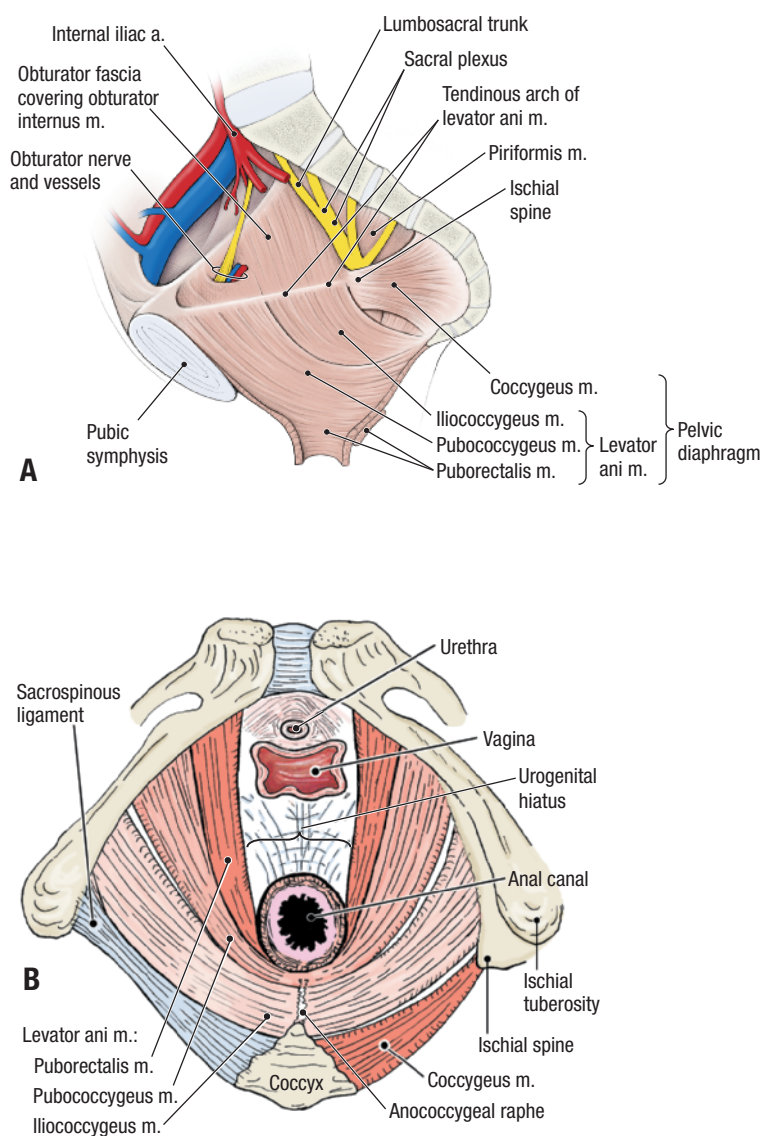


Figure 5.35. Pelvic diaphragm in the female. **A.** Left lateral view. **B.** Inferior view.

2. Retract the urinary bladder, uterus, and rectum toward the midline.
3. Use blunt dissection to remove any remaining fat and connective tissue from the superior surface of the pelvic diaphragm.
4. Find the **tendinous arch of the levator ani muscle** (Fig. 5.35A). Palpate the medial surface of the ischial spine. Locate the obturator canal. The tendinous arch lies just inferior to a line connecting these two structures. Note that the tendinous arch is the superior edge of the pelvic diaphragm.
5. Identify the three muscles that form the **levator ani muscle**. The muscles are identified by their proximal attachments. Learn, but do not dissect, their distal attachments. Identify the following:
 - **Puborectalis muscle** – its proximal attachment is the body of the pubis. Its distal attachment is the puborectalis muscle of the opposite side (midline raphe). The pubococcygeus muscle forms the lateral boundary of the urogenital hiatus. The two puborectalis muscles form a “puborectal sling,” which

causes the **anorectal flexure** at the ampulla of the rectum (Fig. 5.32). During defecation, the puborectalis muscles relax, the anorectal flexure straightens, and the elimination of fecal matter is facilitated.

- **Pubococcygeus muscle** – its proximal attachment is the body of the pubis. Its distal attachment is the coccyx and the anococcygeal raphe.
 - **Iliococcygeus muscle** – its proximal attachment is the tendinous arch. Its distal attachment is the coccyx and the anococcygeal raphe.
6. The levator ani muscle supports the pelvic viscera and resists increases in intra-abdominal pressure.
 7. Identify the **coccygeus muscle**. The coccygeus muscle completes the pelvic diaphragm posteriorly. The proximal attachment of the coccygeus muscle is the ischial spine and its distal attachment is the lateral border of the coccyx and the lowest part of the sacrum.
 8. Place one hand in the ischioanal fossa and the other on the superior surface of the pelvic diaphragm. Palpate the thinness of the pelvic diaphragm.
 9. Observe that the **obturator internus muscle** forms the lateral wall of the ischioanal fossa. The proximal attachment of the obturator internus muscle is the margin of the obturator foramen and inner surface of the obturator membrane. The distal attachment of the obturator internus muscle will be studied when the gluteal region is dissected. Superior to the tendinous arch of the levator ani muscle, the obturator internus muscle forms the lateral wall of the pelvic cavity. Inferior to the tendinous arch, the obturator internus muscle forms the lateral wall of the perineum.
 10. Use your textbook to learn the general pattern of lymphatic drainage of the pelvis, and the location of each of the following groups of lymph nodes: **[G 203, 236, 237; N 386; R 349; C 269]**

- **Internal iliac nodes**
- **External iliac nodes**
- **Common iliac nodes**
- **Sacral nodes**
- **Lumbar nodes**

After you dissect . . .

Use the dissected specimen to review the proximal attachment and action of each muscle of the pelvic diaphragm. Review the relationship of the branches of the internal iliac artery to the pelvic diaphragm. Review the relationship of the sacral plexus to the pelvic diaphragm. Use an illustration to review the role of the pelvic diaphragm in dividing the pelvic cavity from the perineum. Review the function of the pelvic diaphragm and perineal body in supporting the pelvic and abdominal viscera. Use an illustration to review the lymphatic drainage from the pelvis and perineum. Realize that structures in the perineum (including the labia majora and the lower part of the anal canal) drain into superficial inguinal lymph nodes. The lymphatic drainage of the ovary follows the ovarian vessels to the lumbar chain of nodes, bypassing the pelvic drainage systems. Review the formation of the thoracic duct to complete your understanding of the lymph drainage from this region.