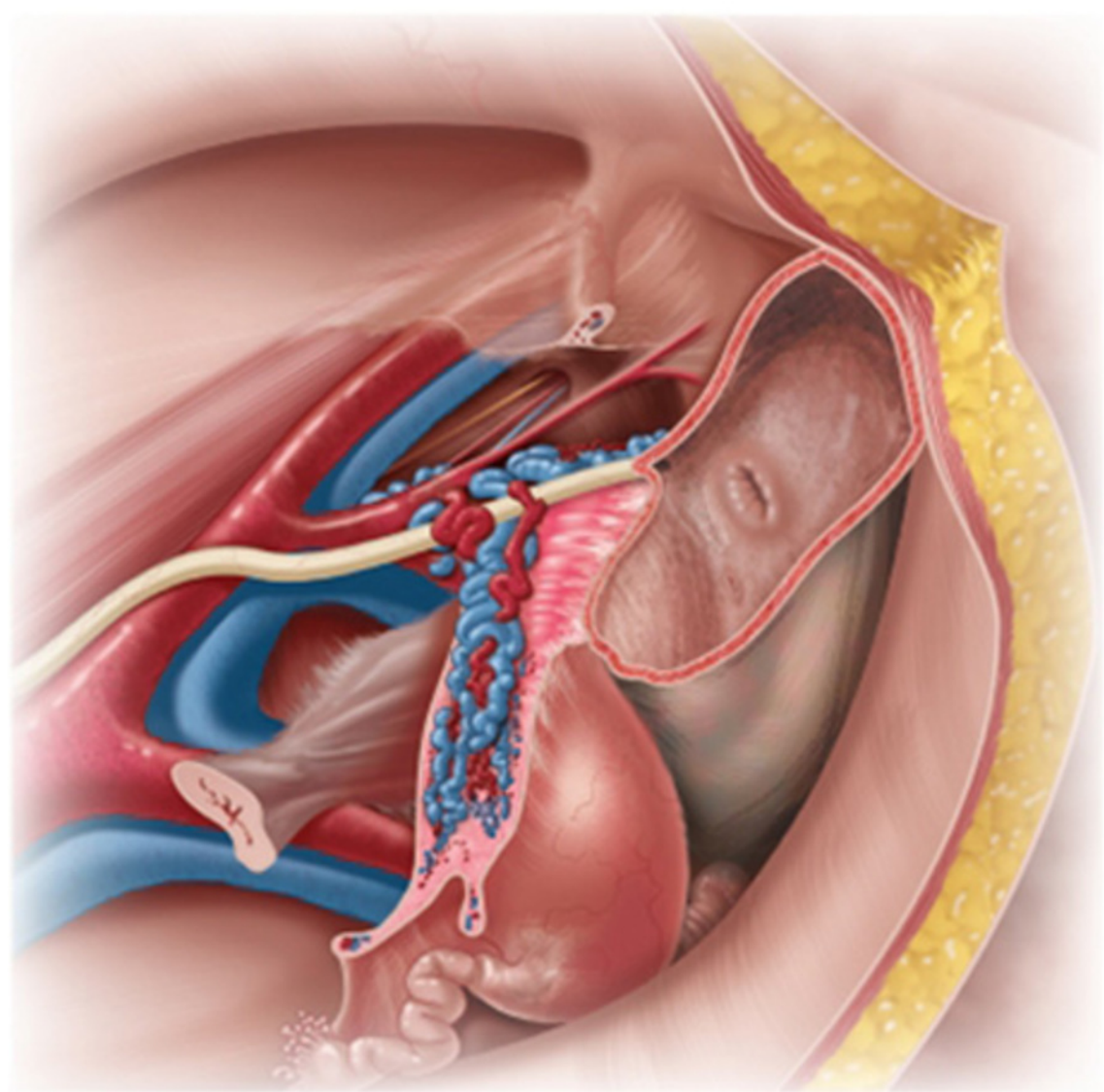


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ATLAS OF PELVIC ANATOMY
AND GYNECOLOGIC SURGERY

FOURTH **4** EDITION

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ATLAS OF PELVIC ANATOMY
AND GYNECOLOGIC SURGERY

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ATLAS OF PELVIC ANATOMY AND GYNECOLOGIC SURGERY

FOURTH **4** EDITION

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ATLAS OF PELVIC ANATOMY AND GYNECOLOGIC SURGERY,
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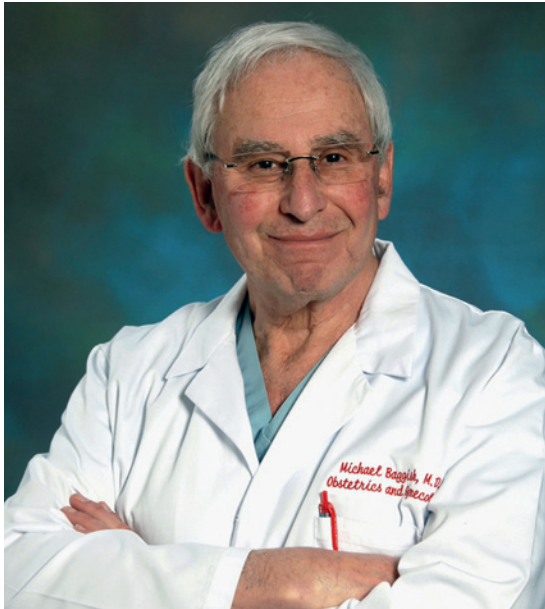
This book is dedicated to my wife, Leslie Baggish; my children, Cindy Baggish, Julia Baggish, Mindy Baggish, Stuart and Pamela Baggish; my grandchildren, Owen and Scarlet Reagan Baggish; and to the memory of my deceased oldest son, Jeffrey Baggish.

Michael S. Baggish, MD

This Atlas is dedicated to my wife, Mona, and my three daughters, Tamara, Lena, and Summer, for their love and support of my professional pursuits. Also, to all the fellows and residents I have had the privilege of working with, for continually motivating me to strive for excellence in the surgical management of my patients.

Mickey M. Karram, MD

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PREFACE

The fourth edition of the *Atlas of Pelvic Anatomy and Gynecologic Surgery* has maintained and extended the original mind-set of the two authors—“a single picture is worth a thousand words”—which holds true for this book as it similarly did for the antecedent three editions. Busy, practicing gynecologists, residents, fellows, and students do not wish to read laborious, wordy descriptions when photographs and illustrations better display the specific anatomy and the detailed operative techniques. Not only do visual images imprint more rapidly, but additionally, the images are more likely to be retained permanently within the memory centers of the prefrontal and limbic portions of the brain.

Important new chapters, as well as pertinent revisions to existing chapters, have been added to this edition. **Chapter 3**, titled “Max Brödel’s Pelvic Anatomy,” is unique. Max Brödel, a world-renowned medical artist, drew detailed medical illustrations for Dr. Howard Kelly’s 1898 textbook *Operative Gynecology*. Howard Kelly was one of the four immortal physicians who comprised the founding staff at Johns Hopkins. The other three physicians were Welch (pathology), Osler (medicine), and Halstead (surgery). Our artist, Joe Chovan, has created full-color reproductions of Brödel’s original black-and-white drawings, showing details of the century-old material that appeared in Kelly’s original two volumes.

Revisions have been made in **Chapters 5 and 6**, as well as **9, 10, 13, 14, 19, 20, 29, 42, 54, 55, 56, 58, and 60**. Drawings that initially appeared as black and white in the first edition have been colorized for the fourth edition. This colorization will be completed to include 100% of all drawings in the next edition. A major revision has been carried out for **Chapter 12** (“Abdominal Hysterectomy”). A step-by-step comparison between laparotomy and laparoscopy has been added to show the operative procedure performed.

Within this fourth edition is a novel illustration technique that has been applied to several chapters, including **Chapters 32 and 37**. An actual photograph was enhanced and added to by our artist using his computer imaging to create a hybrid figure that merged photograph and drawing into a singular, high-resolution picture.

Four additional new chapters have been added to this edition: **Chapter 57** (“Use of Biologic and Synthetic Mesh to Augment Vaginal Prolapse Repair”) provides greatly detailed illustrations relating to the correct and most appropriate uses of mesh materials for reconstructive pelvic surgery. **Chapter 59** (“Avoiding and Managing Synthetic Mesh Complications After Surgeries for Urinary Incontinence and Pelvic Organ Prolapse”) focuses on the most up-to-date information about warnings by the Food and Drug Administration and the current status of commercially available vaginal mesh kits. Numerous illustrations in this chapter show various complications that can occur and the best ways that they can be managed. **Chapter 66** (“Atlas of Vulvar Disorders”) depicts a plethora of common and unusual vulvar disease. Numerous photographs have been included to facilitate for the reader the ability to make the most precise diagnosis and to select the most appropriate treatment regimen. Finally, **Chapter 120**, dedicated to Robotic Surgery, completes the roll of new additions. This latest chapter pictorially describes the techniques of robotics as applied to gynecologic surgery from A to Z.

New photographs have been added to the chapter that deals with the treatment of vulvar hypertrophy. These photographs show the step-by-step surgical methodology required to obtain the most satisfactory results. Several chapters within the Laparoscopic Surgery section have undergone significant revisions, including one that depicts the technique of single entry laparoscopic surgery. **Chapter 121**, which deals with Laparoscopic Complications, has grown with the incorporation of new, unusual photographs and illustrations detailing serious injuries that occur during laparoscopic procedures.

The fourth edition is the most complete volume of the *Atlas of Pelvic Anatomy and Gynecologic Surgery* ever published. We have created a comprehensive resource comprising a multitude of quality photographs and detailed drawings. More than 100 new illustrations have been added, and nearly 200 existing illustrations have been colorized. The overriding goal for this edition was, most importantly, the preservation of exceptional quality.

Michael Baggish, MD
Mickey Karram, MD

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The Editors wish to recognize the following:

Our Artist, Joe Chovan, whose skill and dedication to excellence have made this book the standard by which all other publications in the field of Gynecology are measured. Joe Chovan's unique artistic talents are exemplified in the majority of chapters in the fourth edition and include complex, hybrid drawings coupled with photographs.

Marybeth Thiel of Elsevier. As Senior Content Development Specialist, Marybeth worked tirelessly to keep the publication process moving forward. She most of all facilitated the authors' wishes to comprehensively improve this book.

Kate Dimock of Elsevier, who put together the contract for the fourth edition and who brought a winning publications team together.

Claire Kramer, Senior Project Manager, of Elsevier, who spent many hours in the final editing process ensuring the final compilation of the fourth edition.

Finally: The First Class Team of Contributing Chapter Authors who added a unique panache to the fourth edition of the *Atlas of Pelvic Anatomy and Gynecologic Surgery*.

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P A R T

1

Principles of
Pelvic Anatomy and
Gynecologic Surgery

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SECTION 1

Pelvic Anatomy

-
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Basic Pelvic Anatomy

Michael S. Baggish

See Videos 1-1 to 1-24 on www.ExpertConsult.com.

The anatomy taught in this book is based on actual cadaveric dissection. This section consists entirely of color drawings constructed from anatomic models (cadavers). This section was added to help the reader orient the dissection photographs to the overall geography of abdomen, pelvis, breasts, and extremities. In several pictures, our artist has used actual photographs of body parts (pelvic bone) into which muscles and ligaments were sketched with a computer.

The following terms are used in this section to provide directive relationships: (1) *cranial* = toward the head; (2) *caudal* = toward the foot; (3) *superior* = above; (4) *inferior* = below; (5) *deep* = to the interior; (6) *superficial* = to the surface; (7) *medial* = toward the midline; (8) *lateral* = toward the side; (9) *beneath* = under; (10) *anterior* = to the belly; and (11) *posterior* = to the back.

The surgeon needs to be familiar with certain bony landmarks. The pelvic bones consist of the sacrum and coccyx, the ilium, the pubic bone, and the ischium (Fig. 1-1). The first anterior projection of the sacral vertebra is the **sacral promontory**, and the exaggerated transverse processes form the **sacral ala** (Fig. 1-2). On both anterior and posterior surfaces are the holes, or **foramina**, from which nerve roots exit. Articulating with the last sacral vertebra is the **coccyx** (Fig. 1-3). When the pelvis is observed from above (see Fig. 1-2), the iliac fossa, iliac crest, and anterior superior iliac spine are prominent. The articulations at the sacroiliac joint and the symphysis pubis mark major posterior and anterior joints, respectively. Between the two are the iliopectineal lines and the linea terminalis. Facing the pelvis, the **anterior superior iliac spine** and the **pubic tubercle** mark the boundaries of the **inguinal ligament**. The two **pubic bones** form an **arch** beneath the symphysis pubis. The rhomboid space between ischial and pubic bones is the **obturator foramen** (see Fig. 1-1). The lowest portion of the ischium forms a broad, rounded accumulation of bone referred to as the **ischial tuberosity**. Above that structure is a hemispheric socket (**acetabulum**), where the head of the femur articulates (see Fig. 1-1).

When one faces the back of the pelvis, the **sacrum** and the **sacral canal** are visible. The **ischial tuberosity**, **ischial spines**, and **greater** and **lesser sacral sciatic notches** are identified (Fig. 1-4). From the side, the iliac crest, ischial tuberosity, ischial spine, greater sciatic notch, and lesser sciatic notch are seen, as is the obturator foramen (Fig. 1-5).

The following ligamentous structures can be observed: Cooper's ligaments, the sacroiliac ligaments, the symphysis fibrocartilage, the sacrospinous and sacrotuberous ligaments, the inguinal ligament, the lacunar ligament, and the obturator membrane (Figs. 1-6 through 1-8). The sacrospinous and

Cooper's ligaments are utilized in pelvic reconstructive surgery, as are the pubic symphysis and the anterior longitudinal ligament (overlying the anterior sacral surface, not sketched). Large vessels and nerves cross from the abdomen to the thigh beneath the inguinal ligament and through the obturator foramen. The lacunar ligament forms the medial abutment of the femoral canal and sometimes is referred to as the pectineal portion, or extension, of the inguinal ligament.

The muscles of the pelvis that have practical and special importance for our discussion are the **obturator internus muscle**, which constitutes the "pelvic side wall" or "ovarian fossa," the **coccygeus**, the **piriformis**, and the **levator ani muscles** (Fig. 1-9).

The **obturator fascia** is a well-defined, tough structure. A particularly thickened portion of the obturator fascia is named the **arcus tendineus**, or **white line** (Fig. 1-10). The line stretches from the inner aspect of the ischial spine across the belly of the obturator internus muscle and terminates at the lower margin of the posterior pubic bone (Fig. 1-11).

The levator ani muscle takes its origin from the inferior margin of the pubic bone and the entire arcus (obturator fascia). Several anatomy texts have divided the levator into anterior and posterior portions; however, these subdivisions are artificial and have little practical value (Fig. 1-12). Functionally, the gynecologist can feel this muscle contract by performing a rectovaginal examination and requesting the patient to tighten her muscles as if holding in a bowel movement. At a point 2 cm up (cranial) from the vaginal introitus, the U-shaped muscle is felt along the side and posterior vaginal walls. A similar contraction can be felt posterior to the rectum when the anal sphincter is contracted. Insofar as the rectum is concerned, the levator component can be palpated across the posterior rectal wall. The levator ani in concert with the external sphincter ani squeezes the rectum to narrow the bowel lumen while elevating the anorectum.

The muscles and ligaments divide notches into windows (foramina). The coccygeus is overlain (deep) by the sacrospinous ligament. The piriformis muscle exits the pelvis via the **greater sciatic foramen** and is partially overlain (deep) by the sacrotuberous ligament (see Figs. 1-7 through 1-9). Internally, the hollow iliac fossa is covered by the **iliacus muscle**. At the medial margin and slightly superficial to the iliacus muscles are the **psaos major muscles**. Together with the iliacus (**iliopsoas**), the psaos major muscles pass into the thigh beneath the inguinal ligament to insert on the femur (lesser trochanter). Occasionally, the **psaos minor tendon** may be seen on the anterior surface of the psaos major muscle (Fig. 1-13).

Text continues on page 16.

See Videos 1-1 to 1-24.

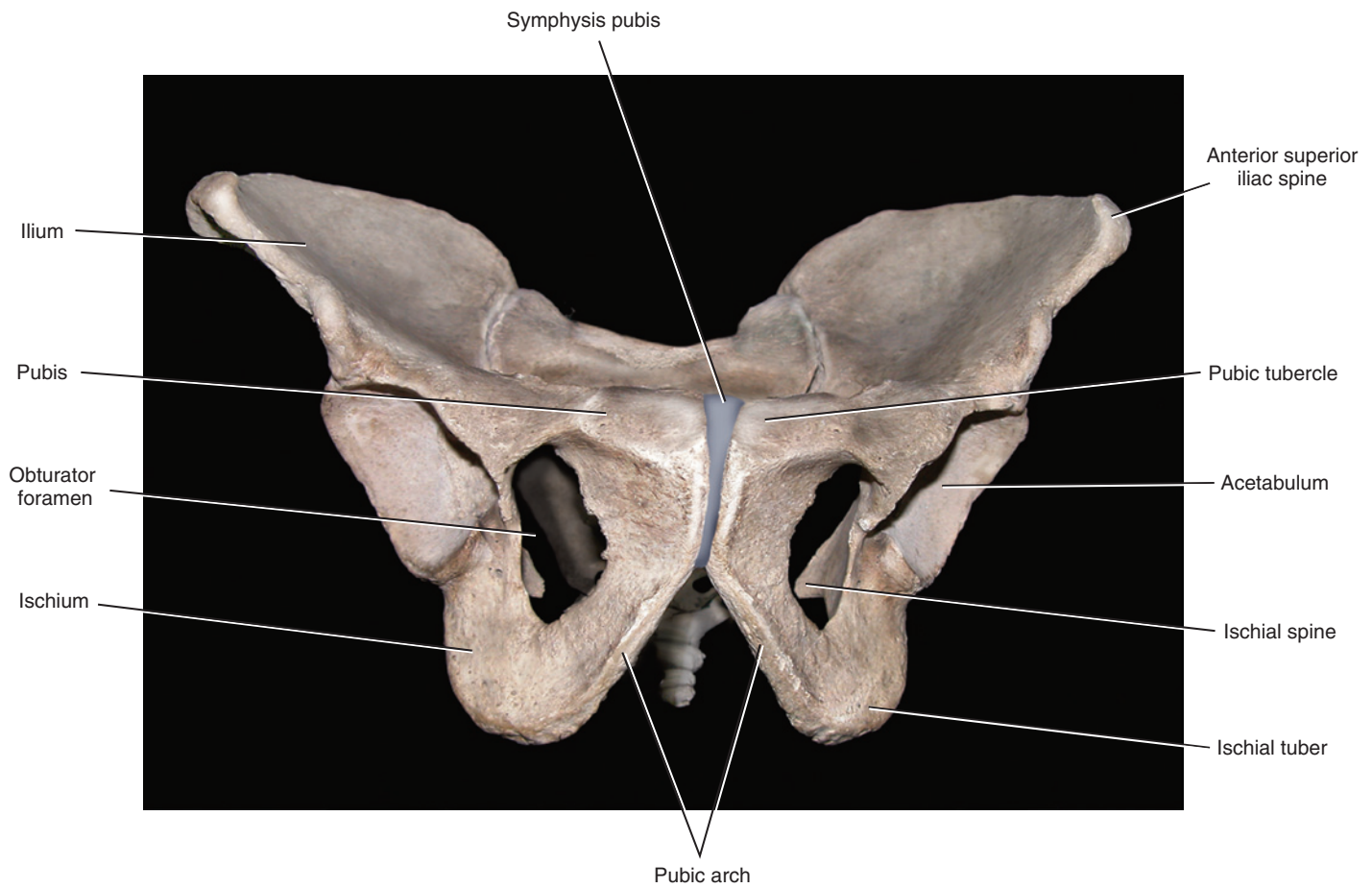


FIGURE 1-1 The pelvic bone consists of the ilium, ischium, and pubis. The ilium is bound to the sacrum at the sacroiliac joints. This anterior aspect of the pelvis shows the pubic arch, symphysis, and obturator foramen via a head-on view.

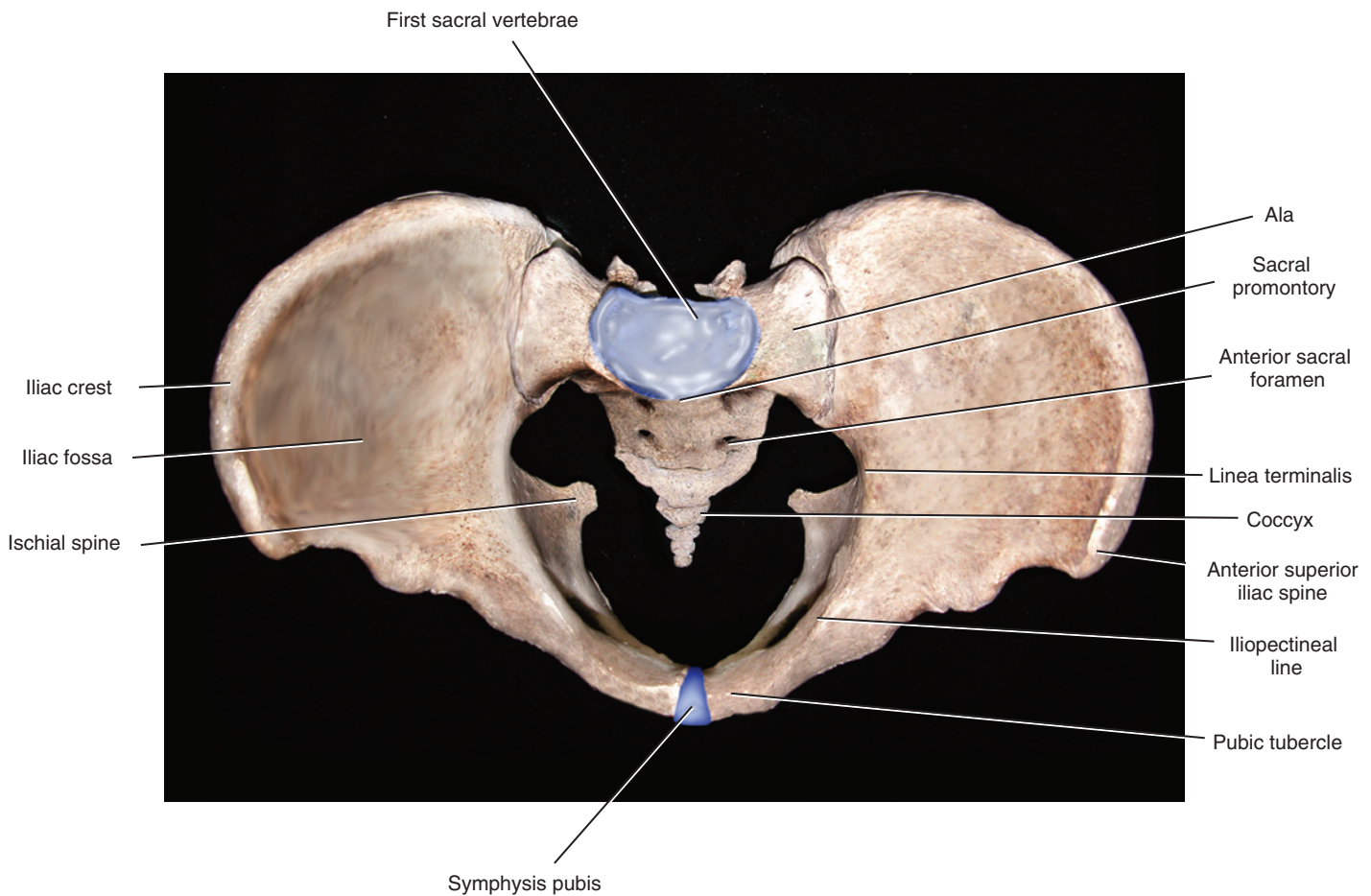


FIGURE 1-2 This overhead view details the pelvic inlet, which is bounded anteriorly by the pubic symphysis and the pubic tubercle; laterally by the iliopectineal line and the linea terminalis; and posteriorly by the sacral alae and the first sacral vertebra. This view also nicely shows the ischial spines.

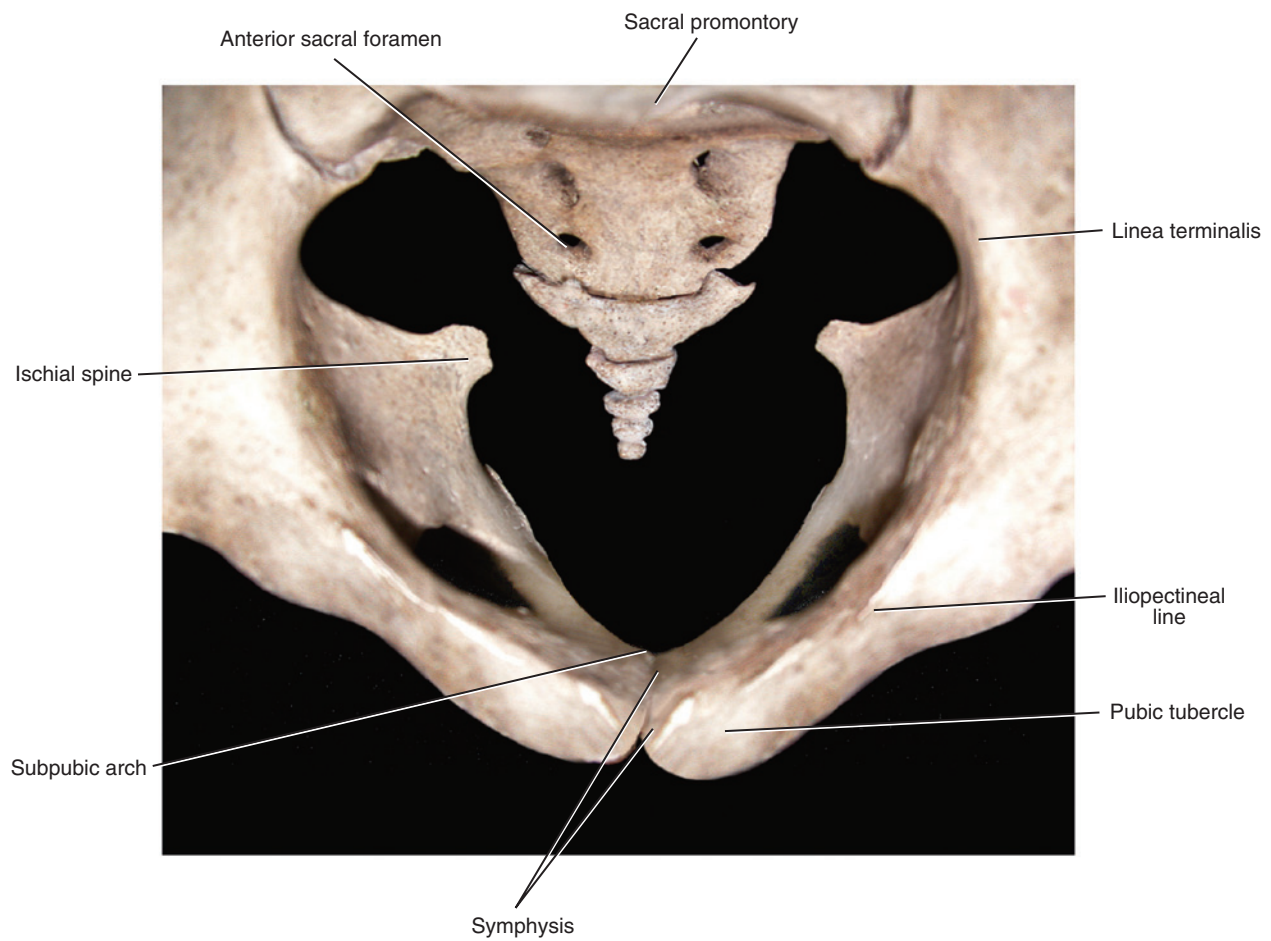


FIGURE 1-3 High-power detail viewed through the pelvic inlet shows the sacrum and coccyx. The anterior sacral foramina are distinct, as are the ischial spines and the subpubic arch.

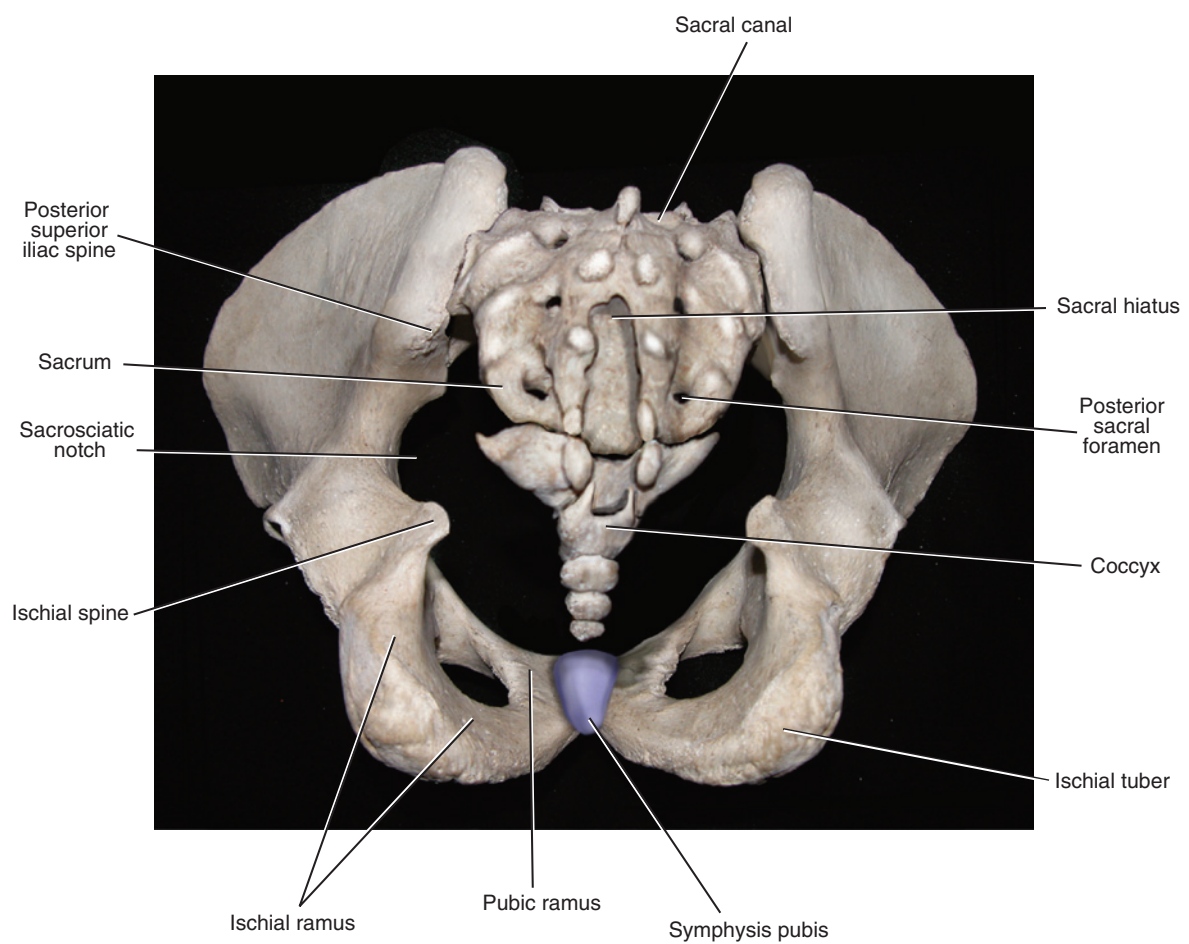


FIGURE 1-4 The posterior view of the pelvis is combined with an outlet "looking-in" perspective. The ischial tuberosity, ischial spine, and greater and lesser sacrosciatic notches are best seen from this vantage point. Posterior sacrum highlights include the sacral hiatus, sacral canal, and posterior sacral foramina.

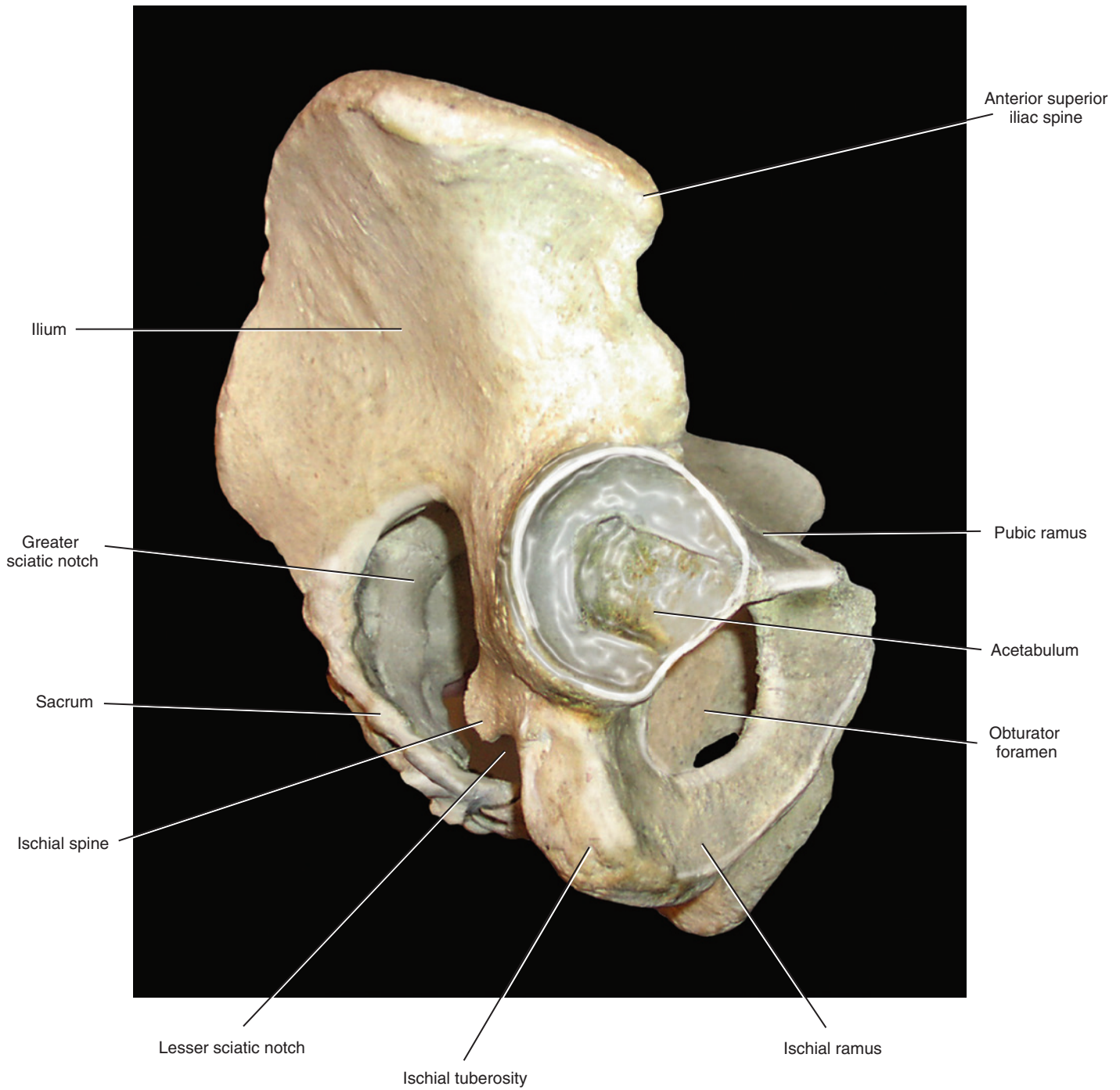


FIGURE 1-5 This right lateral view depicts the acetabulum, sacrosiatic notches, anterior superior iliac spine, and ischium.

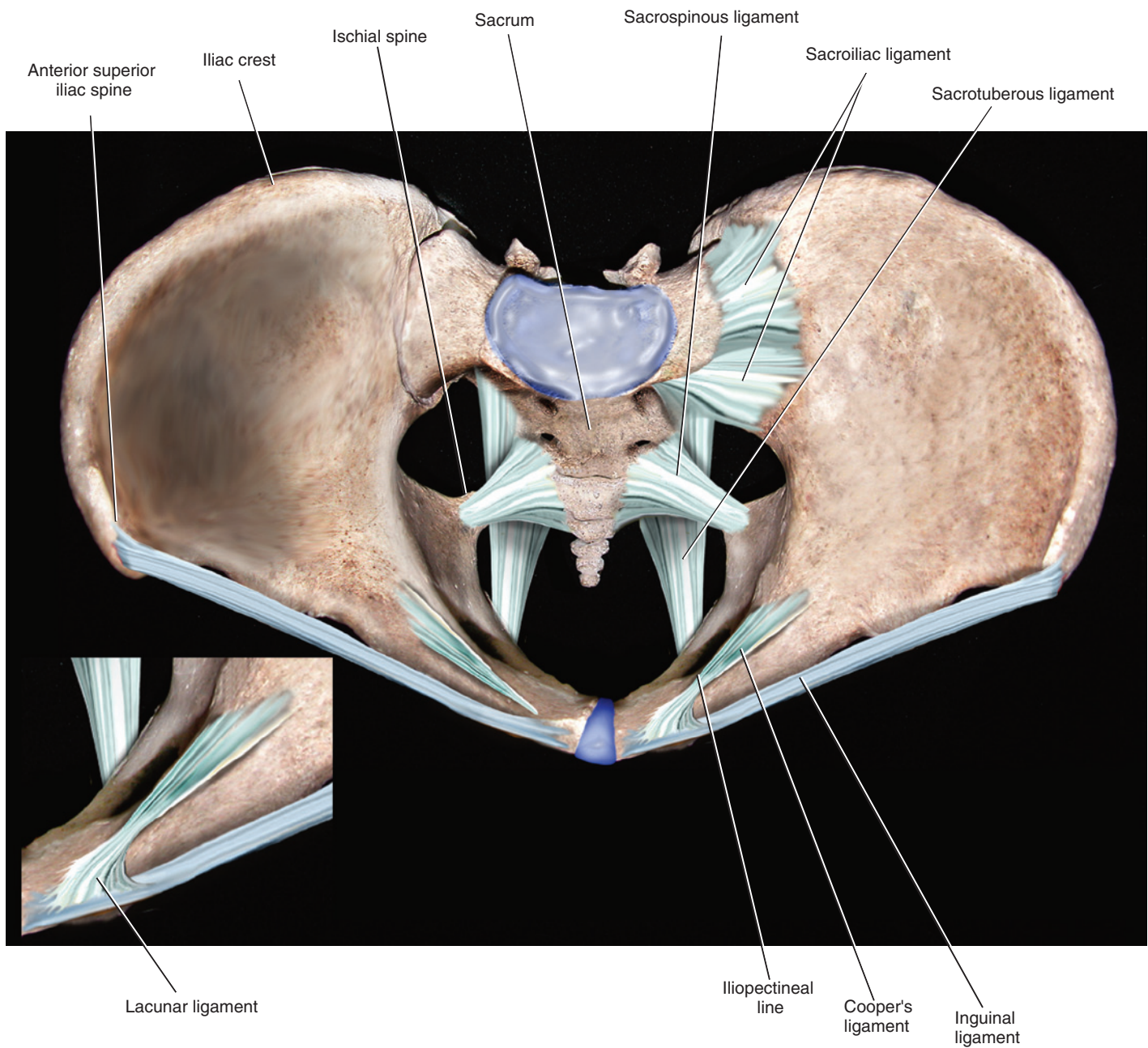


FIGURE 1-6 The inguinal ligament stretches between the anterior superior iliac spine and the pubic tubercle. From the latter is reflected the lacunar ligament, which forms the medial boundary of the femoral canal. Cooper's ligament is a stout structure that clings to the iliopectineal line (see *inset*). Between the ischial spines and the lateral aspect of the sacrum is the sacrospinous ligament. This ligament also creates the greater and lesser sacroscliac foramina.

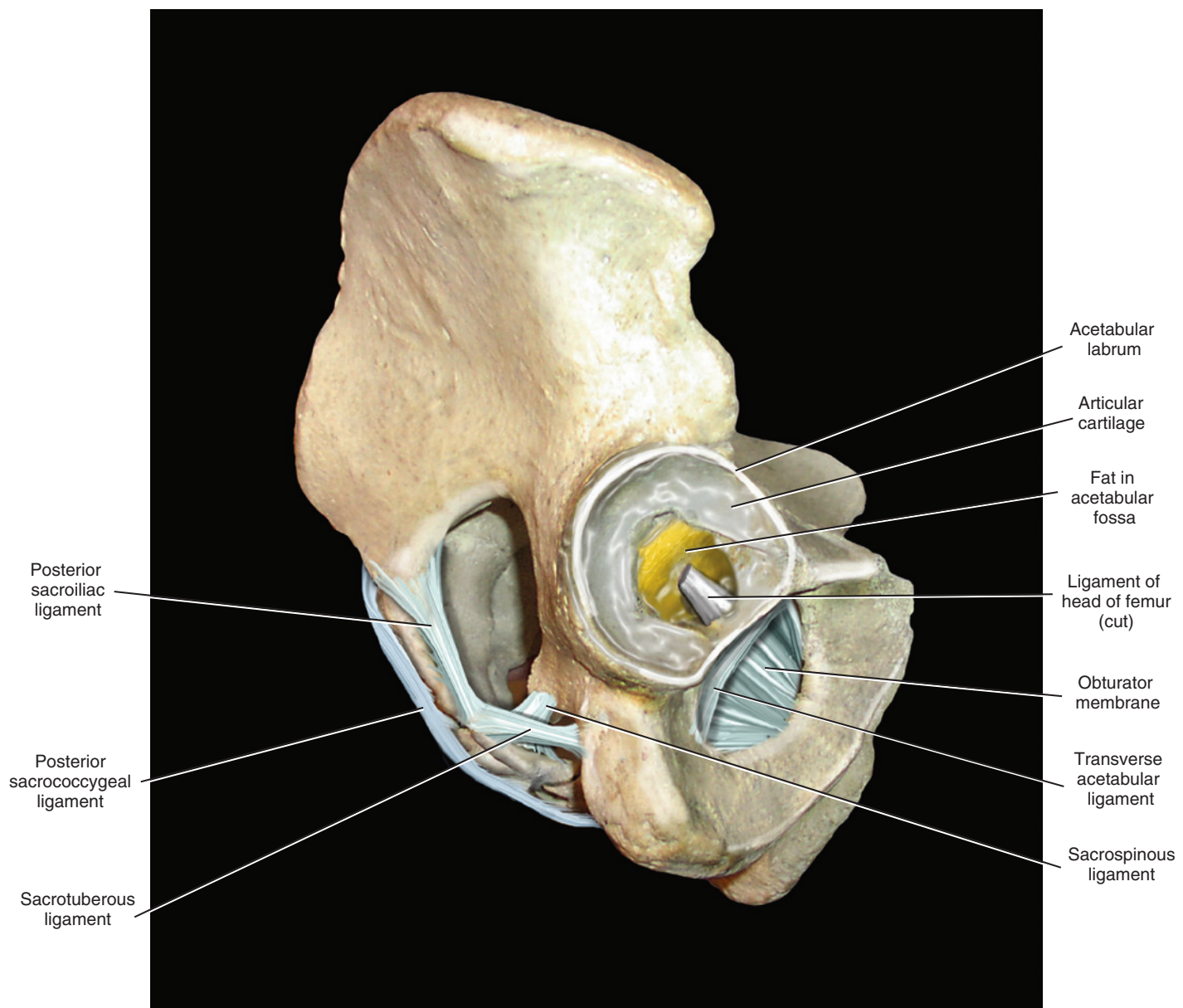


FIGURE 1-7 This side view displays the obturator membrane, as well as the sacrotuberous ligament. The latter begins on the ischial tuberosity and terminates on the lateral margin of the sacrum.

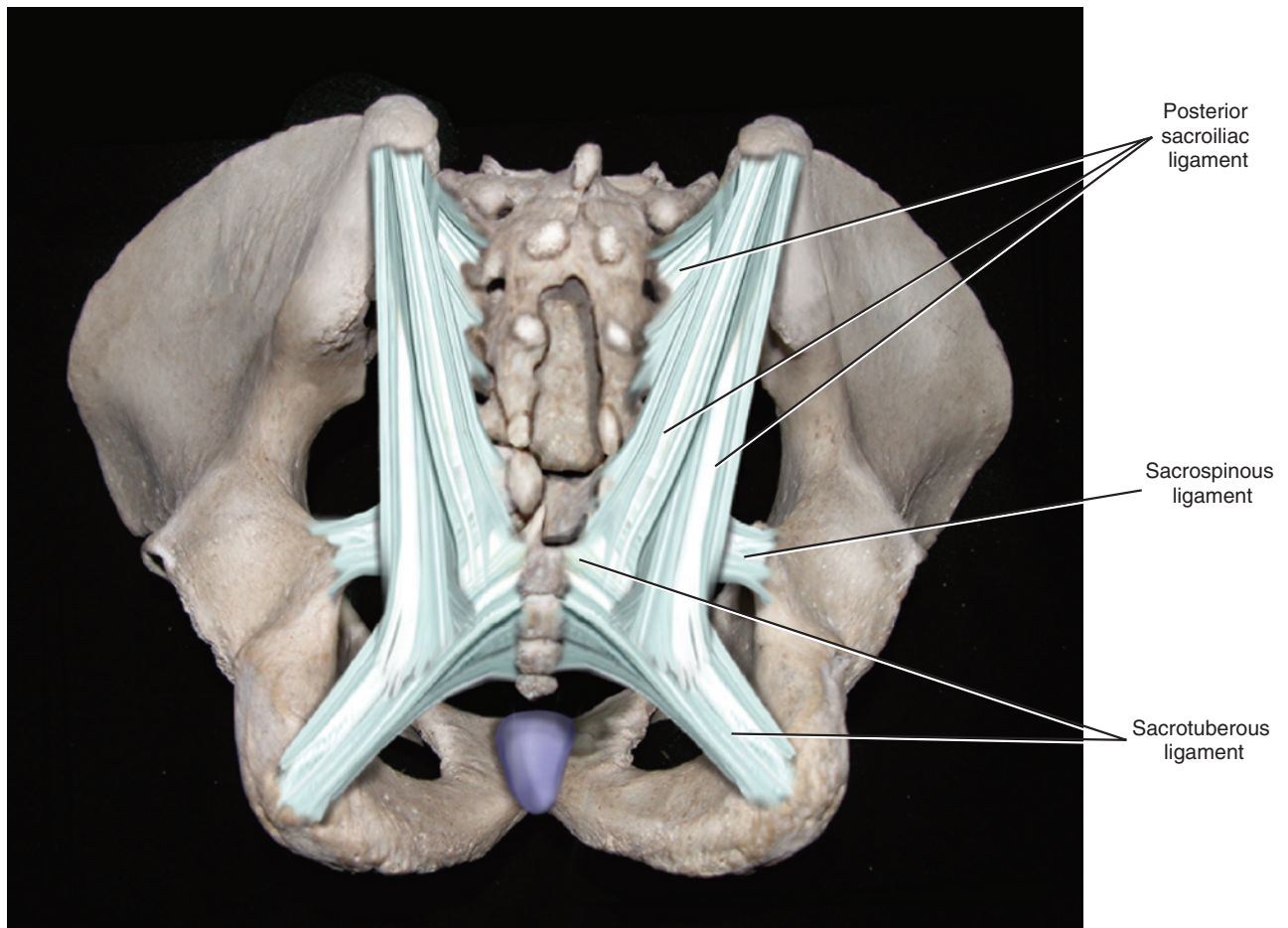


FIGURE 1-8 Posterior view combined with outlet view. The sacrotuberous ligament and the sacrospinous ligament cross.

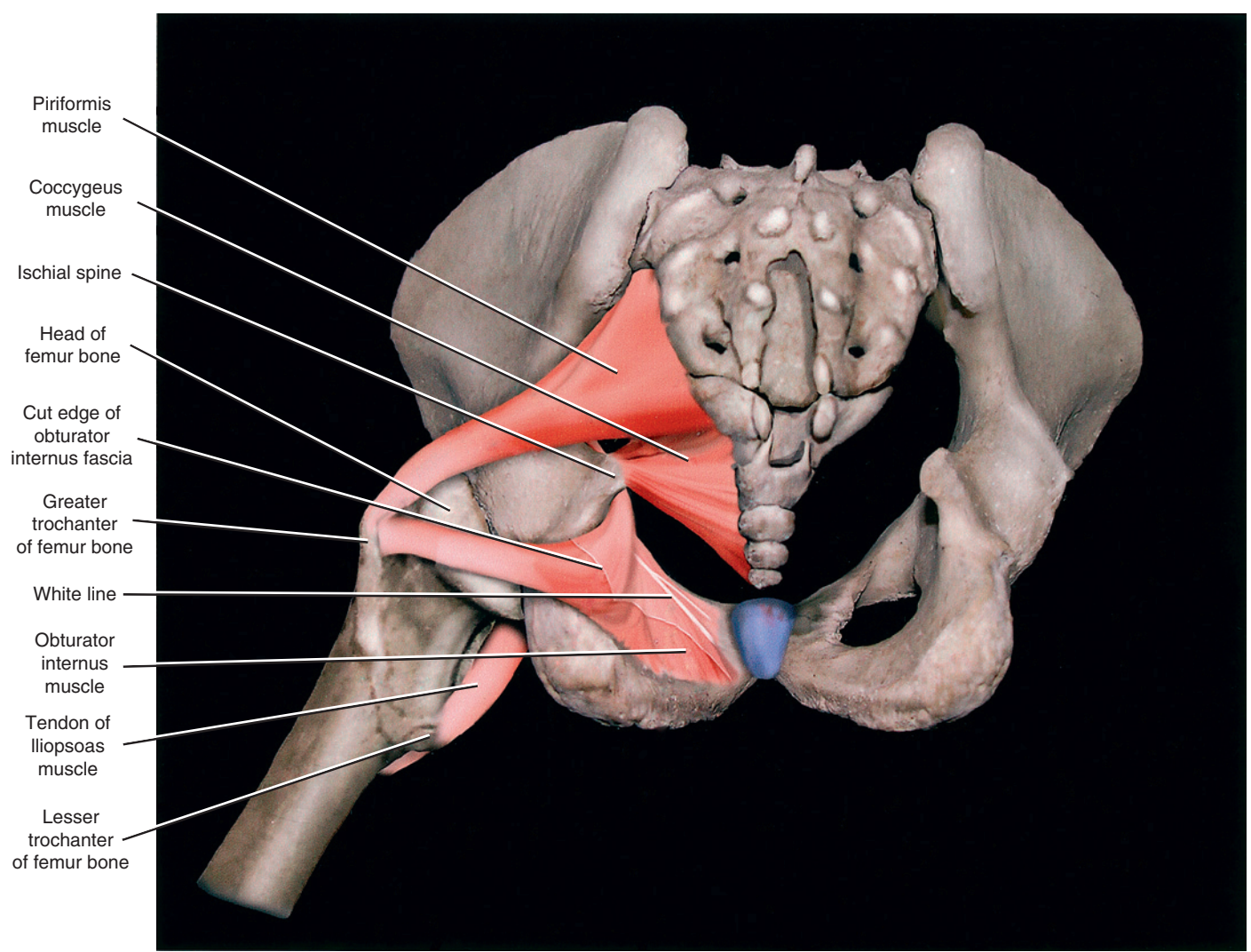


FIGURE 1-9 The ligaments have been eliminated. Views are through the pelvic outlet. The obturator internus, piriformis, and coccygeus are seen in sharp detail.

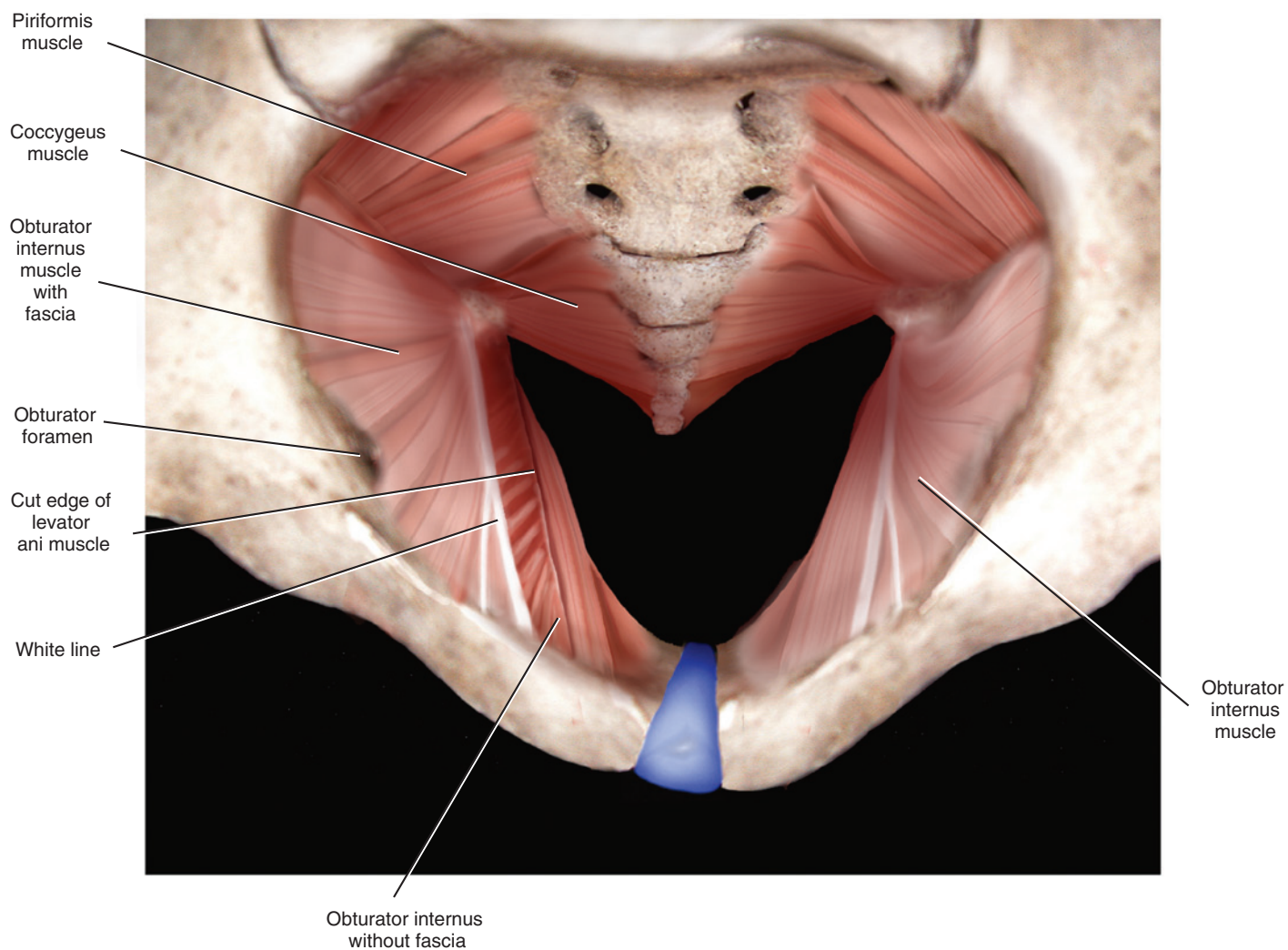


FIGURE 1-10 The large obturator internus muscle covered with tough obturator fascia forms the pelvic sidewall. The arcus tendineus, or white line, is produced by a thickened area of obturator fascia. The levator ani muscle arises from the arcus. The cut edge of the levator is shown on the patient's right side (*viewer's left side*). The left levator has been removed. The enclosure of the pelvis is completed by the piriformis and coccygeus muscles.

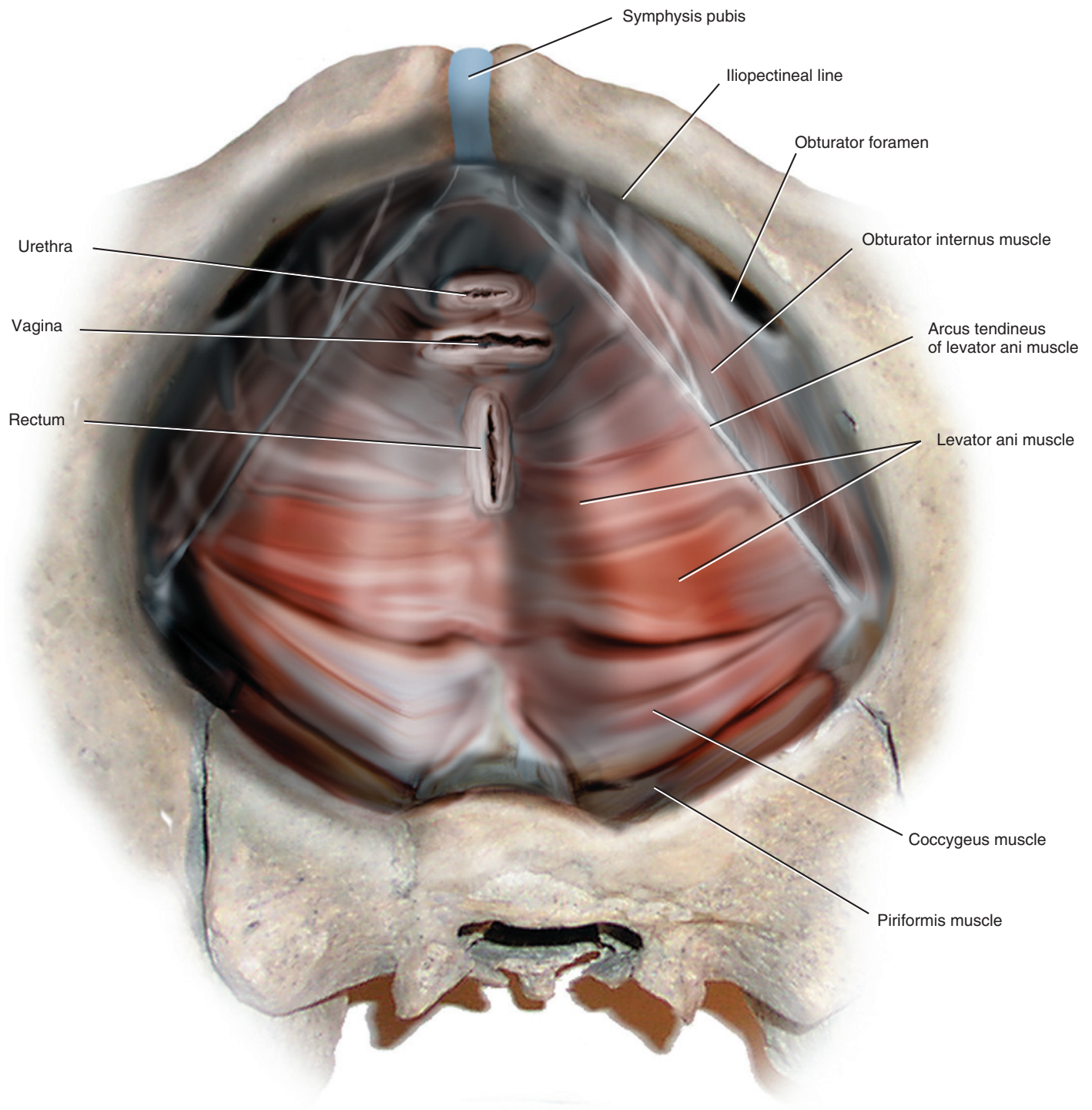


FIGURE 1-11 This view shows the intact levator ani muscle arising along the length of the arcus tendineus. Note the exposed retropubic space, together with the cut edges of the urethra and vagina.

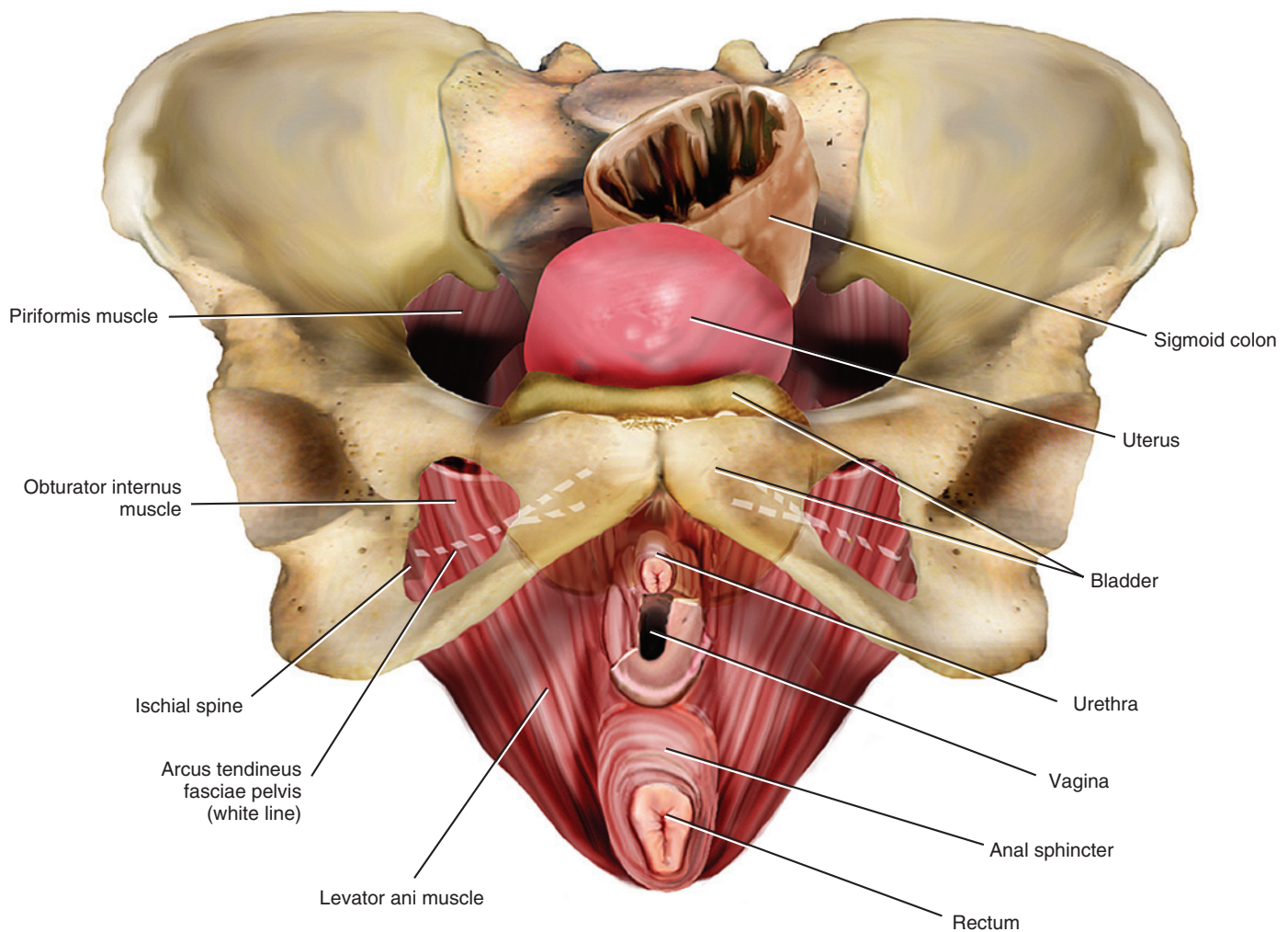


FIGURE 1-12 Frontal view of the funnel-like levator ani and its relationship to the vulva and superficial muscles of the perineum. The levator arises in part from the inferior margins of the pubic bone. The artist has superimposed the arcus tendineus (dashed white line) onto the obturator internus and pubic bone.

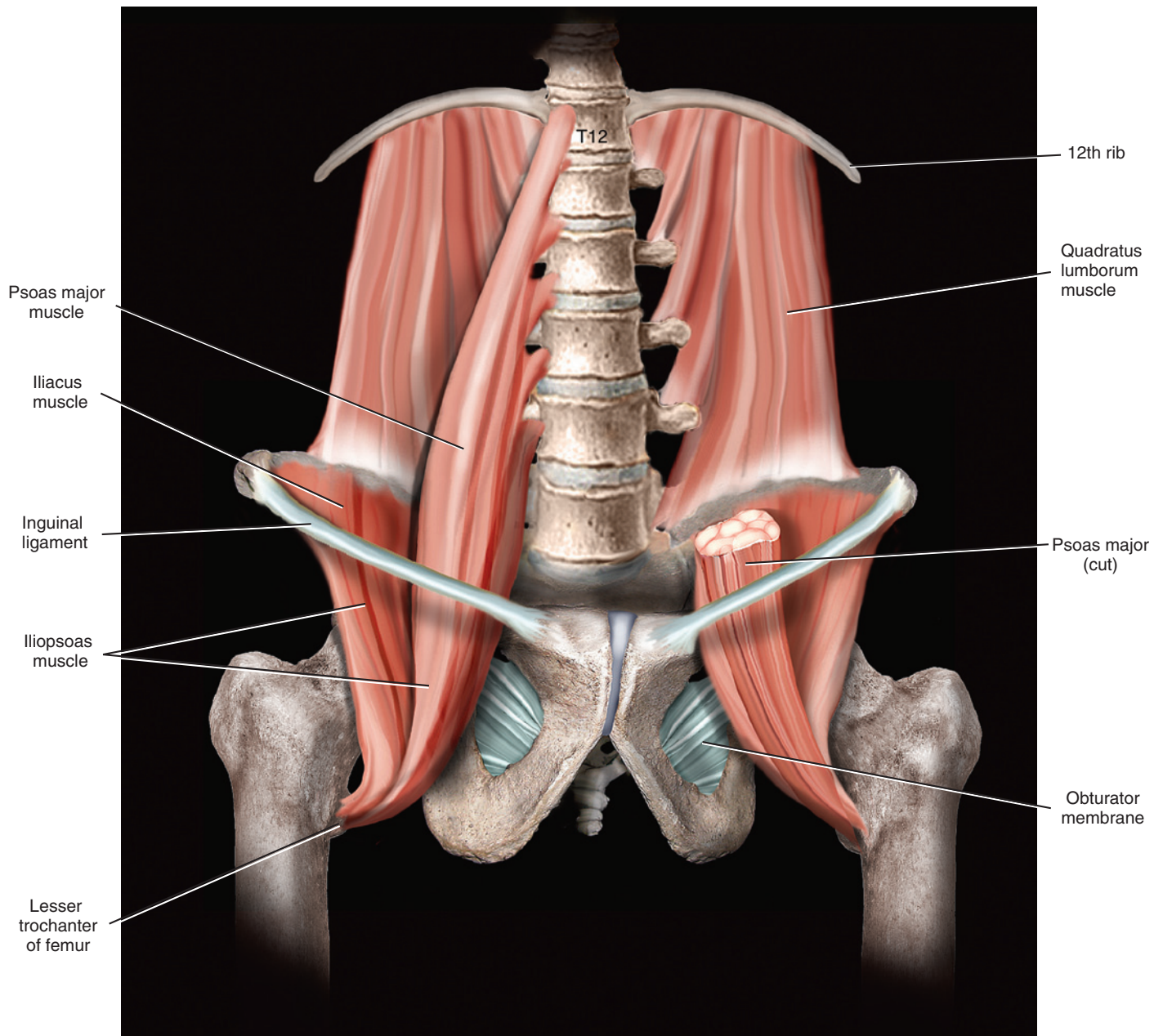


FIGURE 1-13 The large muscles of the retroperitoneum include the psoas major muscle, iliacus muscle, and quadratus lumborum muscle. The psoas and iliacus (iliopsoas) depart the abdomen and enter the thigh beneath the inguinal ligament.

The muscles of the thigh are in many cases relevant to pelvic anatomy. For example, the iliopsoas muscles leave the pelvis beneath the inguinal ligament with accompanying nerves to enter the thigh. The **sartorius muscle** is detached from the anterior superior iliac spine in radical vulvectomy surgery and transposed to cover the exposed femoral vessels. The **gracilis muscle** is used for pelvic reconstructive surgery as a myocutaneous graft. In addition to the muscles mentioned earlier, the gynecologist should be familiar with the **fascia lata, tensor fascia lata muscle, rectus femoris, vastus lateralis, vastus medialis, pectineus, and adductor longus muscles** (Figs. 1-14 and 1-15A and B).

The muscles and fascia of the abdominal wall are discussed in detail in [Chapter 8](#).

However, the schema of the **external oblique, internal oblique, rectus abdominis, and transversus abdominis muscles**, and inguinal ligament are convenient to view in a single picture ([Fig. 1-16](#)).

The **inferior epigastric vessels** are identified crossing the transversus abdominis fascia from their origin in the external iliac vessels. In this drawing, the left rectus abdominis muscle has been divided and the lower muscle belly has been reflected downward (caudal) to show the details of the inferior epigastric vessels, which lie on the post sheath of the rectus abdominis muscle and the transversus fascia. The triangle formed by the inferior epigastric vessels, the inguinal ligament, and the lateral border of the rectus is **Hesselbach's triangle** ([Fig. 1-17](#)). Indirect inguinal hernias most commonly develop here (Hesselbach's triangle).

When the lower abdomen is opened, the peritoneal cavity is seen to be filled with intestines. A fat pad, the **greater omentum**, which is attached cranially to the greater curvature of the **stomach** and the **transverse colon**, hangs like an apron over the small and large intestines. Lifting the omentum reveals the **large intestine** on the periphery surrounding coils of small bowel. The large bowel is anchored normally to the parietal peritoneum along the right and left gutters ([Fig. 1-18](#)). The pelvic colon, or **sigmoid colon**, is a mobile intraperitoneal structure that is suspended by a mesocolon. The pelvic colon ranges from 5 to 35 inches in length and usually lies under the ileum. The **rectum** is 5 to 6 inches in length. It begins at the third sacral vertebra and hugs the curve of the sacrum, terminating just beyond the end of the coccyx. The rectum is covered only partially with peritoneum, with its upper third having peritoneal covering on the front and sides and the lower two thirds lying largely retroperitoneally (middle third has peritoneum in front only). The large bowel consists of **cecum, ascending colon, transverse colon, descending colon, sigmoid colon, rectum, and anus**.

The blood supply to the large intestine emanates from the **superior mesenteric artery** (right colon and transverse colon) and the **inferior mesenteric artery** (left flexure, left colon sigmoid colon, upper two thirds of rectum), as well as the **internal pudendal artery** (anus and lower rectum). The venous drainage is to the **hypogastric veins** to a smaller extent and to the **splenic, or portal, vein** to a greater extent ([Fig. 1-19](#)).

Text continues on page 24.

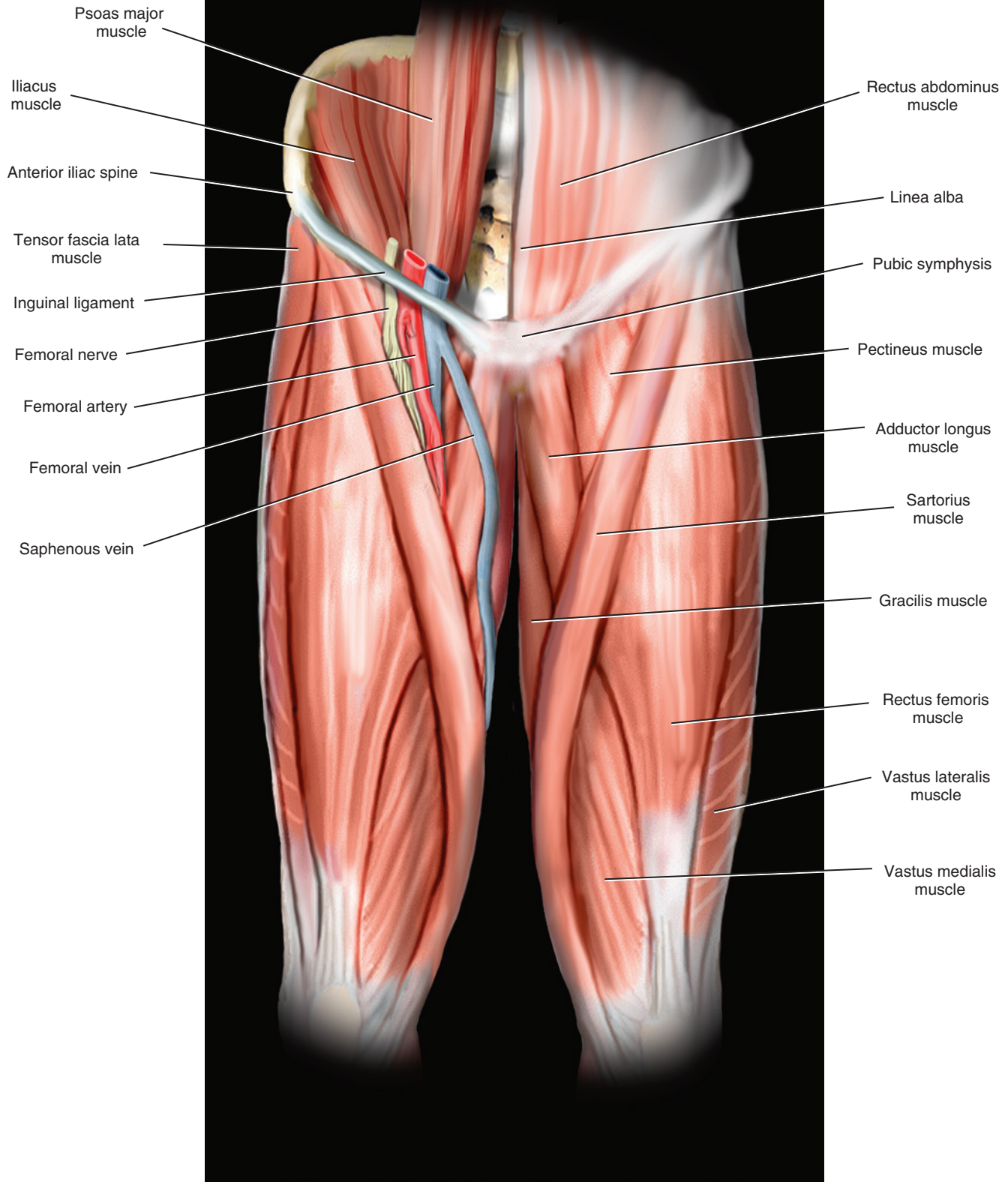


FIGURE 1-14 Muscles of the thigh are shown, together with their relationships to the saphenous vein, femoral vessels, and femoral nerve. Note that the saphenous vein lies in the fat (dissected away) overlying the adductor longus muscle. The femoral vein is directly superficial to the pectineus muscle. The femoral artery and nerve lie on the iliopsoas muscle(s).