GRAY'S ANATOMY FOR STUDENTS

Richard L. Drake A. Wayne Vogl Adam W. M. Mitchell

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7 Upper limb

In the Clinic

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1 The Body

ADDITIONAL LEARNING RESOURCES for Chapter 1, The Body, CAN BE FOUND ON THE ACCOMPANYING EBOOK

- Short Questions—these are questions requiring short responses, Chapter 1

What is anatomy?

Anatomy includes those structures that can be seen grossly (without the aid of magnification) and microscopically (with the aid of magnification). Typically, when used by itself, the term *anatomy* tends to mean gross or macroscopic anatomy—that is, the study of structures that can be seen without using a microscope. Microscopic anatomy, also called histology, is the study of cells and tissues using a microscope.

Anatomy forms the basis for the practice of medicine. Anatomy leads the physician toward an understanding of a patient's disease, whether he or she is carrying out a physical examination or using the most advanced imaging techniques. Anatomy is also important for dentists, chiropractors, physical therapists, and all others involved in any aspect of patient treatment that begins with an analysis of clinical signs. The ability to interpret a clinical observation correctly is therefore the endpoint of a sound anatomical understanding.

Observation and visualization are the primary techniques a student should use to learn anatomy. Anatomy is much more than just memorization of lists of names. Although the language of anatomy is important, the network of information needed to visualize the position of physical structures in a patient goes far beyond simple memorization. Knowing the names of the various branches of the external carotid artery is not the same as being able to visualize the course of the lingual artery from its origin in the neck to its termination in the tongue. Similarly, understanding the organization of the soft palate, how it is related to the oral and nasal cavities, and how it moves during swallowing is very different from being able to recite the names of its individual muscles and nerves. An understanding of anatomy requires an understanding of the context in which the terminology can be remembered.

How can gross anatomy be studied?

The term *anatomy* is derived from the Greek word *temnein*, meaning "to cut." Clearly, therefore, the study of anatomy is linked, at its root, to dissection, although dissection of cadavers by students is now augmented, or even in some cases replaced, by viewing prosected (previously dissected) material and plastic models, or using computer teaching modules and other learning aids such as virtual and augmented reality experiences.

Anatomy can be studied following either a regional or a systemic approach.

- With a **regional approach**, each *region* of the body is studied separately and all aspects of that region are studied at the same time. For example, if the thorax is to be studied, all of its structures are examined. This includes the vasculature, the nerves, the bones, the muscles, and all other structures and organs located in the region of the body defined as the thorax. After studying this region, the other regions of the body (i.e., the abdomen, pelvis, lower limb, upper limb, back, head, and neck) are studied in a similar fashion.
- In contrast, in a **systemic approach**, each *system* of the body is studied and followed throughout the entire body. For example, a study of the cardiovascular system looks at the heart and all of the blood vessels in the body. When this is completed, the nervous system (brain, spinal cord, and all the nerves) might be examined in detail. This approach continues for the whole body until every system, including the nervous, skeletal, muscular, gastrointestinal, respiratory, lymphatic, and reproductive systems, has been studied.

Each of these approaches has benefits and deficiencies. The regional approach works very well if the anatomy course involves cadaver dissection but falls short when it comes to understanding the continuity of an entire system throughout the body. Similarly, the systemic approach fosters an understanding of an entire system throughout the body, but it is very difficult to coordinate this directly with a cadaver dissection or to acquire sufficient detail.

Important anatomical terms

The anatomical position

The anatomical position is the standard reference position of the body used to describe the location of structures (Fig. 1.1). The body is in the anatomical position when standing upright with feet together, hands by the side, and face looking forward. The mouth is closed and the facial expression is neutral. The rim of bone under the eyes is in the same horizontal plane as the top of the opening to the ear, and the eyes are open and focused on something in the distance. The palms of the hands face forward with the fingers straight and together and with the pad of the thumb turned 90 degrees to the pads of the fingers. The toes point forward.

Anatomical planes

Three major groups of planes pass through the body in the anatomical position (see Fig. 1.1).

- **Coronal planes** are oriented vertically and divide the body into anterior and posterior parts.
- **Sagittal planes** also are oriented vertically but are at right angles to the coronal planes and divide the body into right and left parts. The plane that passes through the center of the body dividing it into equal right and left halves is termed the **median sagittal plane.**

substance that attenuates X-rays more than bowel loops or arteries do normally. It is, however, extremely important that these substances are nontoxic. Barium sulfate, an insoluble salt, is a nontoxic, relatively high-density agent that is extremely useful in the examination of the gastrointestinal tract. When a **barium sulfate suspension** is ingested, it attenuates X-rays and can therefore be used to demonstrate the bowel lumen (Fig. 1.4). It is common to add air to the barium sulfate suspension by either ingesting "fizzy" granules or directly instilling air into the body cavity, as in a barium enema. This is known as a double-contrast (air/barium) study.

For some patients it is necessary to inject contrast agents directly into arteries or veins. In this case, iodine-based molecules are suitable contrast agents. **Iodine** is chosen because it has a relatively high atomic mass and so markedly attenuates X-rays, but also, importantly, it is naturally excreted via the urinary system. Intra-arterial and intravenous contrast agents are extremely safe and are well tolerated by most patients. Rarely, some patients have an anaphylactic reaction to intra-arterial or intravenous injections, so the necessary precautions must be taken. Intra-arterial and intravenous contrast agents not only help in visualizing the arteries and veins but, because they are excreted by the urinary system, can also be used to visualize the kidneys, ureter, and bladder in a process known as **intravenous urography.**

Subtraction angiography

During angiography it is often difficult to appreciate the contrast agent in the vessels through the overlying bony structures. To circumvent this, the technique of subtraction angiography has been developed. Simply, one or two images are obtained before the injection of contrast media. These images are inverted (such that a negative is created from the positive image). After injection of the contrast media into the vessels, a further series of images are obtained, demonstrating the passage of the contrast through the arteries into the veins and around the circulation. By adding the "negative precontrast image" to the positive postcontrast images, the bones and soft tissues are subtracted to produce a solitary image of contrast only. Before the advent of digital imaging this was a challenge, but now the use of computers has made this technique relatively straightforward and instantaneous (Fig. 1.5).

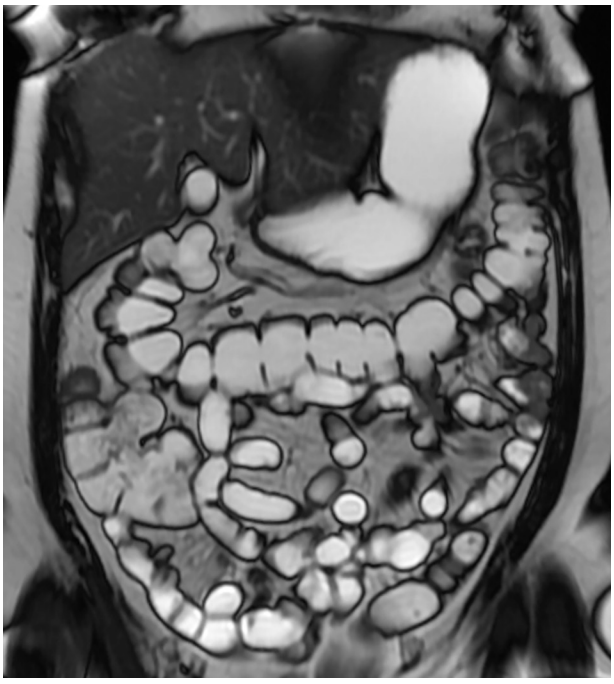

Fig. 1.4 Barium Sulfate Follow-Through. (MRE – magnetic resonance enterograph).

Fig. 1.5 Digital Subtraction Angiogram.

2 Back

ADDITIONAL LEARNING RESOURCES for Chapter 2, Back, CAN BE FOUND ON THE ACCOMPANYING EBOOK

- Self-Assessment—National Board–style multiple-choice questions, Chapter 2
- Short Questions—these are questions requiring short responses, Chapter 2
- Interactive Surface Anatomy—interactive surface animations, Chapter 2
- PT Case Studies, Chapter 2
  - Low back instability
  - Stenosis
  - Herniated nucleus pulposus
  - Atlanto-occipital dysfunction
  - Atlanto-axial dysfunction
  - Mid-cervical dysfunction
  - Cauda equina syndrome
  - Cervical degenerative joint disease
  - Cervical radiculopathy
- Clinical Cases, Chapter 2
  - Ankylosing spondylitis
  - Atlas fracture
  - Cervical facet syndrome
  - Dissecting thoracic aneurysm
  - Lumbar puncture
  - Psoas abscess
  - Sacral tumor
  - Spinal cord infarction

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- Anatomy modules 23 through 25

Conceptual overview

GENERAL DESCRIPTION

The back consists of the posterior aspect of the body and provides the musculoskeletal axis of support for the trunk. Bony elements consist mainly of the vertebrae, although proximal elements of the ribs, superior aspects of the pelvic bones, and posterior basal regions of the skull contribute to the back's skeletal framework (Fig. 2.1).

Associated muscles interconnect the vertebrae and ribs with each other and with the pelvis and skull. The back contains the spinal cord and proximal parts of the spinal nerves, which send and receive information to and from most of the body.

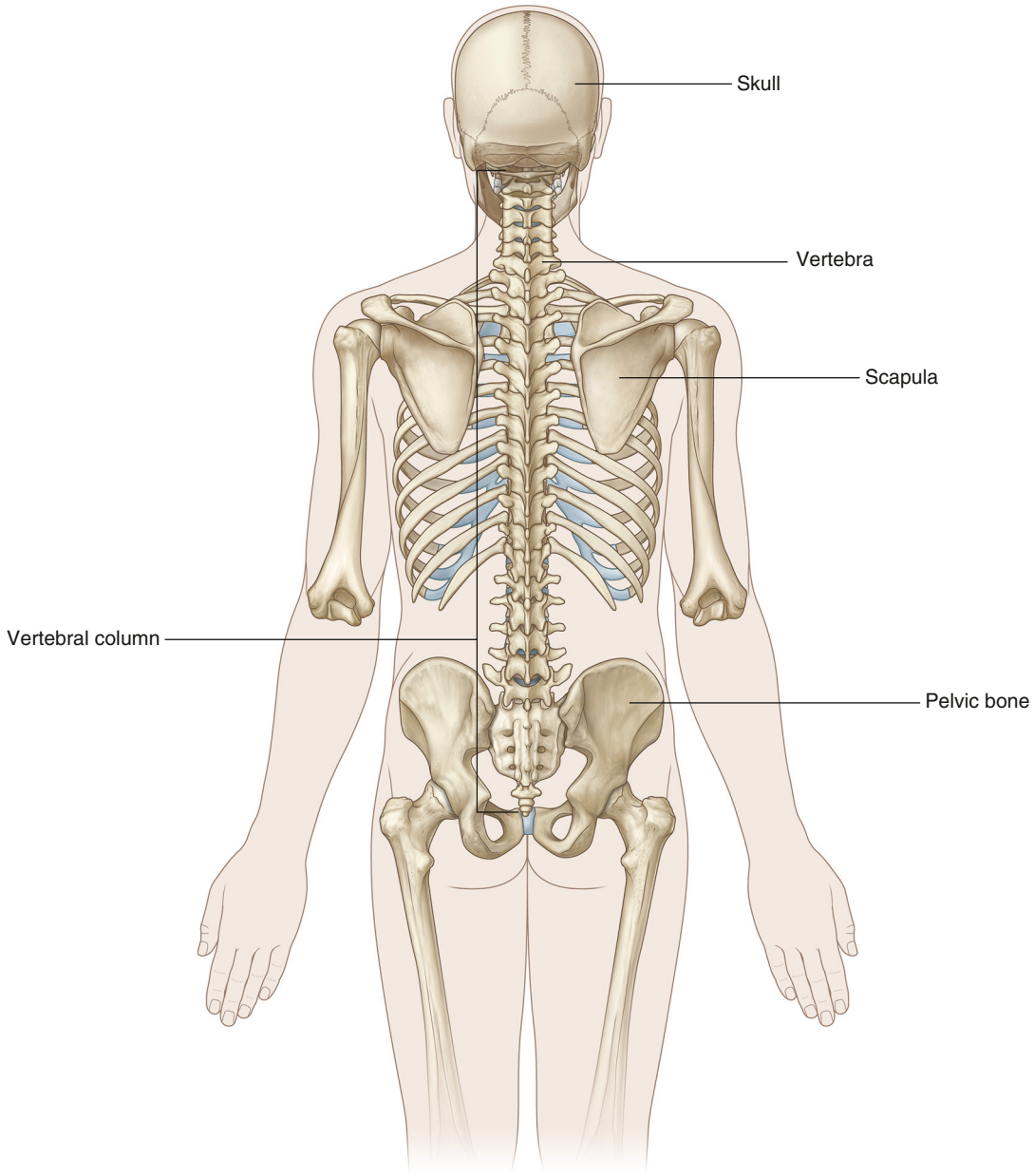

Fig. 2.1 Skeletal Framework of the Back.

3 Thorax

ADDITIONAL LEARNING RESOURCES for Chapter 3, Thorax, CAN BE FOUND ON THE ACCOMPANYING EBOOK

- Self-Assessment—National Board–style multiple-choice questions, Chapter 3
- Short Questions—these are questions requiring short responses, Chapter 3
- Interactive Surface Anatomy—interactive surface animations, Chapter 3
- Clinical Cases, Chapter 3
  - Aortic dissection
  - Broken pacemaker
  - Cardiac tamponade
  - Cervical rib
  - Chest wound
  - Coarctation of the aorta
  - Cystic fibrosis with bronchiectasis
  - Esophageal cancer
  - Lung cancer
  - Patent ductus arteriosus
  - Pneumonia
  - Sinus of Valsalva aneurysm
  - Subclavian steal syndrome
  - Venous access

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- Embryology modules 61 through 64

Conceptual overview

GENERAL DESCRIPTION

The **thorax** is an irregularly shaped cylinder with a narrow opening (superior thoracic aperture) superiorly and a relatively large opening (inferior thoracic aperture) inferiorly (Fig. 3.1). The superior thoracic aperture is open, allowing continuity with the neck; the inferior thoracic aperture is closed by the diaphragm.

The musculoskeletal wall of the thorax is flexible and consists of segmentally arranged vertebrae, ribs, and muscles and the sternum.

The **thoracic cavity** enclosed by the thoracic wall and the diaphragm is subdivided into three major compartments:

- a left and a right pleural cavity, each surrounding a lung, and
- the mediastinum.

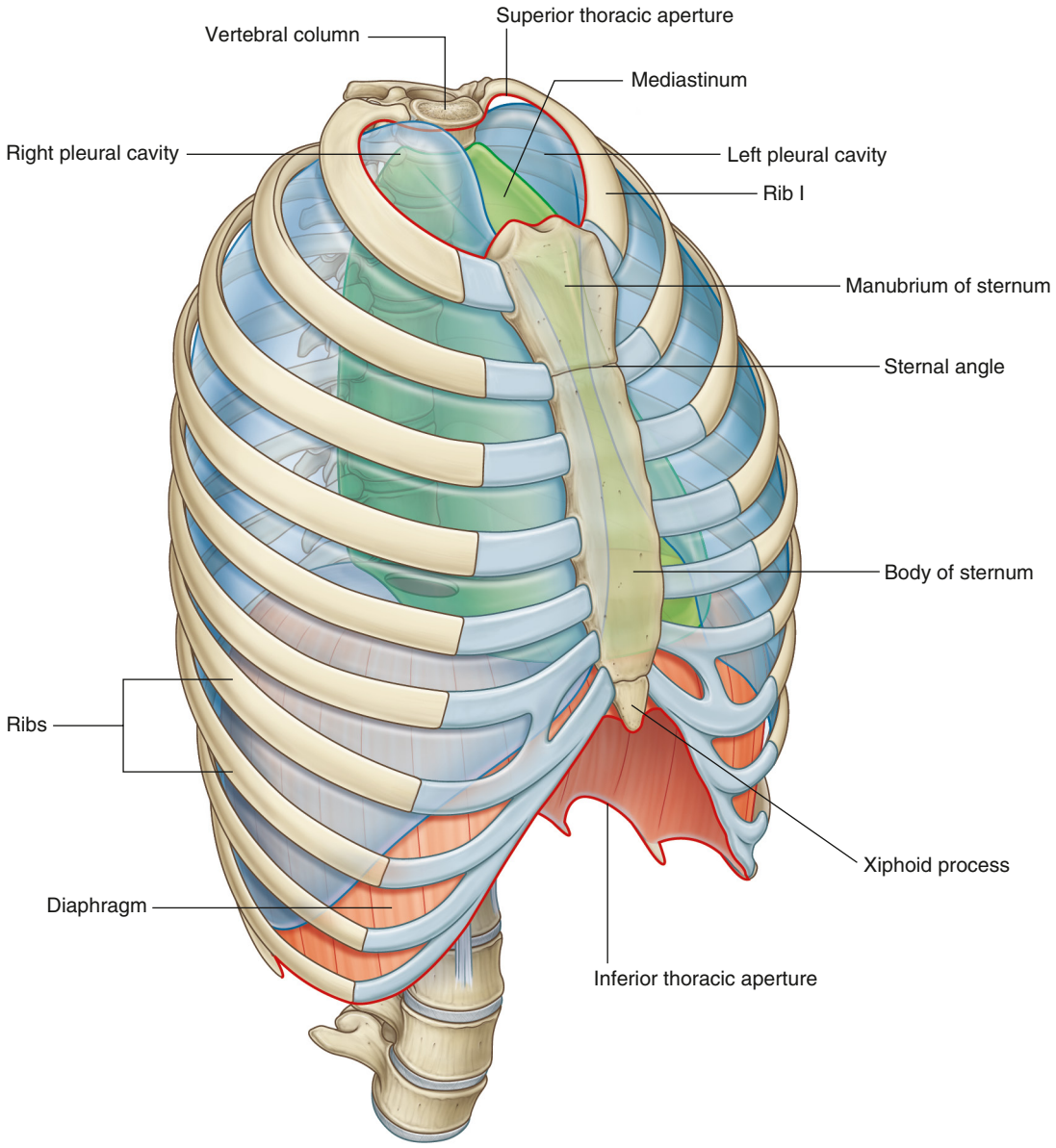

Fig. 3.1 Thoracic Wall and Cavity.

4

Abdomen

ADDITIONAL LEARNING RESOURCES for Chapter 4, Abdomen, CAN BE FOUND ON THE ACCOMPANYING EBOOK

- Self-Assessment—National Board–style multiple-choice questions, Chapter 4
- Short Questions—these are questions requiring short responses, Chapter 4
- Interactive Surface Anatomy—interactive surface animations, Chapter 4
- Clinical Cases, Chapter 4
  - Aorto-iliac occlusive disease
  - Caval obstruction
  - Colon cancer
  - Complications of an abdominoperineal resection
  - Diverticular disease
  - Endoleak after endovascular repair of abdominal aortic aneurysm
  - Hodgkin's lymphoma
  - Inguinal hernia
  - Intraabdominal abscess
  - Intussusception
  - Liver biopsy in patients with suspected liver cirrhosis
  - Ureteric stone
  - Zollinger-Ellison syndrome

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- Anatomy modules 10 through 17
- Embryology modules 65 and 66

Conceptual overview

GENERAL DESCRIPTION

The abdomen is a roughly cylindrical chamber extending from the inferior margin of the thorax to the superior margin of the pelvis and the lower limb (Fig. 4.1A).

The **inferior thoracic aperture** forms the superior opening to the abdomen and is closed by the diaphragm. Inferiorly, the deep abdominal wall is continuous with the pelvic wall at the **pelvic inlet**. Superficially, the inferior limit of the abdominal wall is the superior margin of the lower limb.

The chamber enclosed by the abdominal wall contains a single large **peritoneal cavity**, which freely communicates with the pelvic cavity.

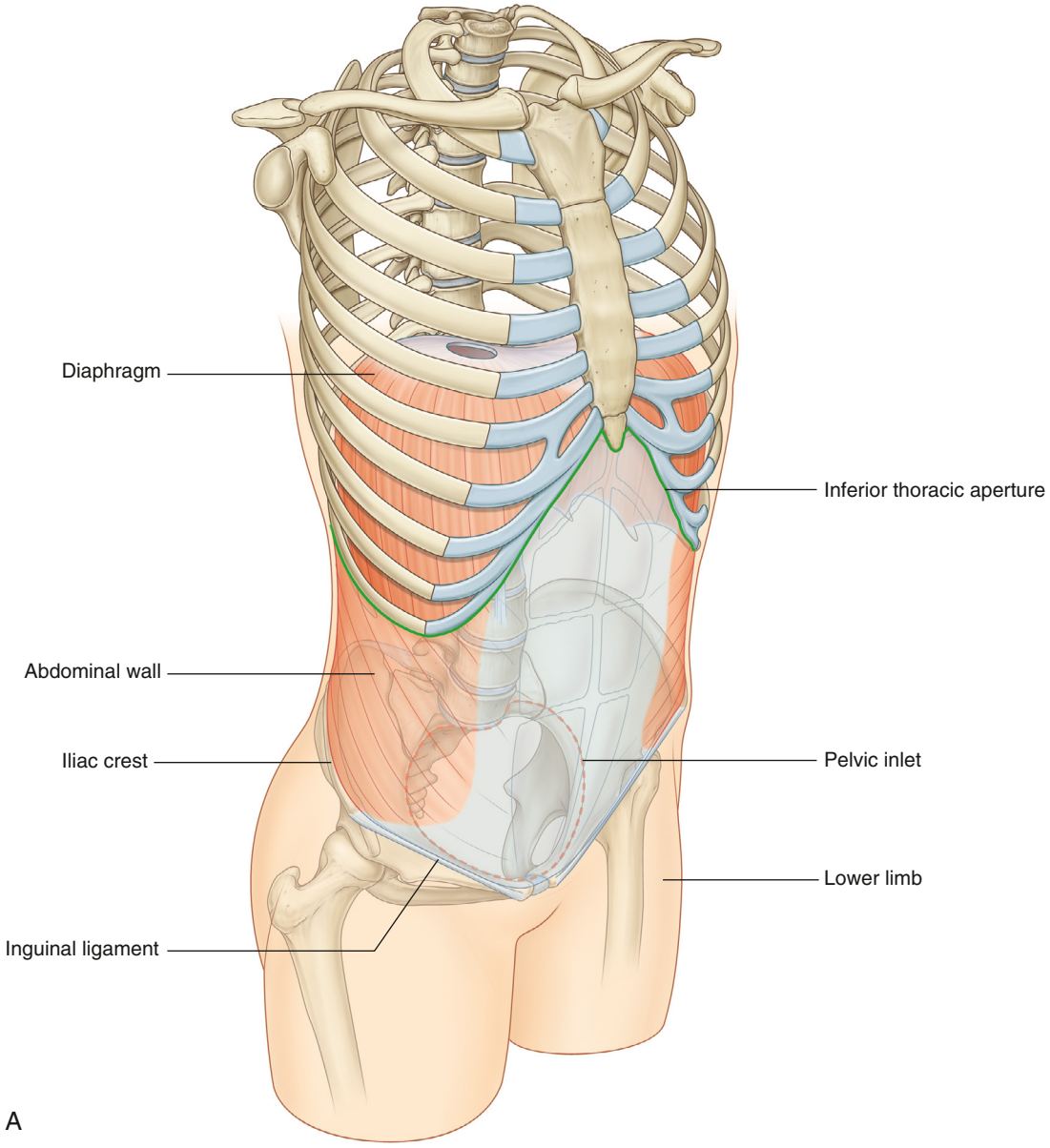

Fig. 4.1 Abdomen. (**A**) Boundaries.

5

Pelvis and Perineum

ADDITIONAL LEARNING RESOURCES for Chapter 5, Pelvis and Perineum, CAN BE FOUND ON THE ACCOMPANYING EBOOK

- Self-Assessment—National Board–style multiple-choice questions, Chapter 5
- Short Questions—these are questions requiring short responses, Chapter 5
- Interactive Surface Anatomy—interactive surface animations, Chapter 5
- Clinical Cases, Chapter 5
  - Ectopic pregnancy
  - Iatrogenic ureteric injury
  - Left common iliac artery obstruction
  - Ovarian torsion
  - Pelvic kidney
  - Sciatic nerve compression
  - Uterine fibroids
  - Uterine tumor
  - Varicocele

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- Anatomy modules 18 through 22
- Embryology modules 68 through 70

Conceptual overview

GENERAL DESCRIPTION

The pelvis and perineum are interrelated regions associated with the pelvic bones and terminal parts of the vertebral column. The pelvis is divided into two regions:

- The superior region related to upper parts of the pelvic bones and lower lumbar vertebrae is the **false pelvis** (**greater pelvis**) and is generally considered part of the abdominal cavity (Fig. 5.1).
- The **true pelvis** (**lesser pelvis**) is related to the inferior parts of the pelvic bones, sacrum, and coccyx, and has an inlet and an outlet.

The bowl-shaped **pelvic cavity** enclosed by the true pelvis consists of the pelvic inlet, walls, and floor. This cavity is continuous superiorly with the abdominal cavity and contains elements of the urinary, gastrointestinal, and reproductive systems.

The perineum (see Fig. 5.1) is inferior to the floor of the pelvic cavity; its boundaries form the **pelvic outlet**. The perineum contains the external genitalia and external openings of the genitourinary and gastrointestinal systems.

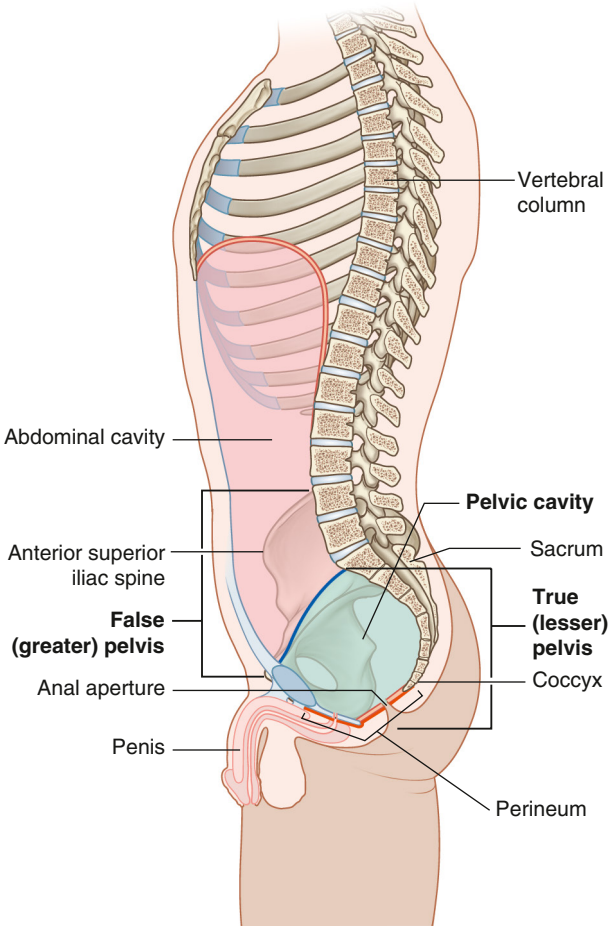

Fig. 5.1 Pelvis and Perineum.

FUNCTIONS

Contains and supports the bladder, rectum, anal canal, and reproductive tracts

Within the pelvic cavity, the bladder is positioned anteriorly and the rectum posteriorly in the midline.

As it fills, the bladder expands superiorly into the abdomen. It is supported by adjacent elements of the pelvic bone and by the pelvic floor. The urethra passes through the pelvic floor to the perineum, where, in women, it opens externally (Fig. 5.2A) and in men it enters the base of the penis (Fig. 5.2B).

Continuous with the sigmoid colon at the level of vertebra SIII, the rectum terminates at the anal canal, which penetrates the pelvic floor to open into the perineum. The anal canal is angled posteriorly on the rectum. This flexure is maintained by muscles of the pelvic floor and is relaxed during defecation. A skeletal muscle sphincter is associated with the anal canal and the urethra as each passes through the pelvic floor.

The pelvic cavity contains most of the reproductive tract in women and part of the reproductive tract in men.

- In women, the vagina penetrates the pelvic floor and connects with the uterus in the pelvic cavity. The uterus is positioned between the rectum and the bladder. A uterine (fallopian) tube extends laterally on each side toward the pelvic wall to open near the ovary.
- In men, the pelvic cavity contains the site of connection between the urinary and reproductive tracts. It also contains major glands associated with the reproductive system—the prostate and two seminal vesicles.

6 Lower Limb

ADDITIONAL LEARNING RESOURCES for Chapter 6, Lower Limb, CAN BE FOUND ON THE ACCOMPANYING EBOOK

- Self-Assessment—National Board–style multiple-choice questions, Chapter 6
- Short Questions—these are questions requiring short responses, Chapter 6
- Interactive Surface Anatomy—interactive surface animations, Chapter 6
- PT Case Studies, Chapter 6
  - Achilles tendinitis and tendinosis
  - Anterior lateral shin splints
  - Eversion ankle sprain
  - High ankle sprain
  - Patellofemoral pain syndrome
  - Plantar fasciitis
  - *See more PT Case Studies online*
- Clinical Cases, Chapter 6

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Anatomy modules 26 through 31
Embryology module 71

Conceptual overview

GENERAL DESCRIPTION

The lower limb is directly anchored to the axial skeleton by a sacroiliac joint and by strong ligaments, which link the pelvic bone to the sacrum. It is separated from the abdomen, back, and perineum by a continuous line (Fig. 6.1), which:

- joins the pubic tubercle with the anterior superior iliac spine (position of the inguinal ligament) and then continues along the iliac crest to the posterior superior iliac spine to separate the lower limb from the anterior and lateral abdominal walls;
- passes between the posterior superior iliac spine and along the dorsolateral surface of the sacrum to the coccyx to separate the lower limb from the muscles of the back; and
- joins the medial margin of the sacrotuberous ligament, the ischial tuberosity, the ischiopubic ramus, and the pubic symphysis to separate the lower limb from the perineum.

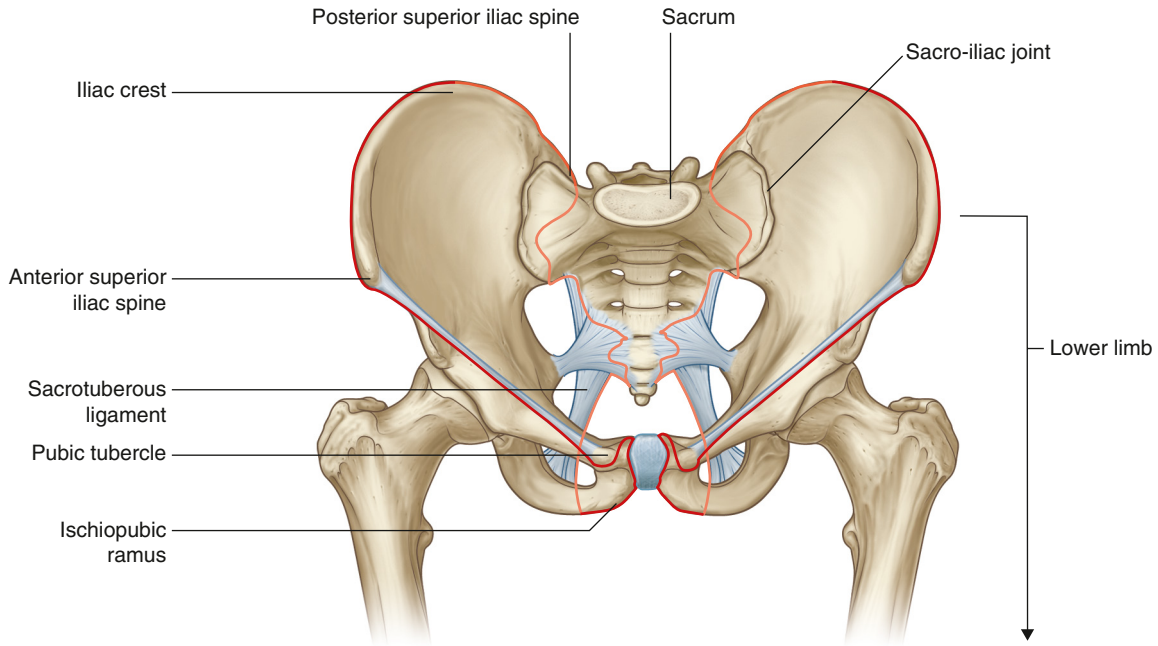

Fig. 6.1 Upper Margin of the Lower Limb.

ادامه دارد ...

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اقدام به تهیه آن نمایید.

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