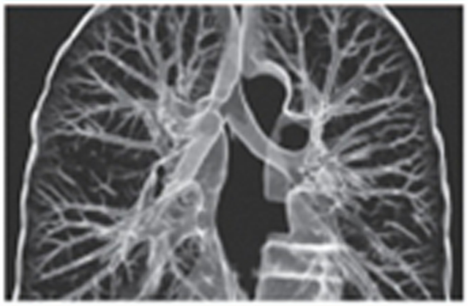
SECTIONAL ANATOMY



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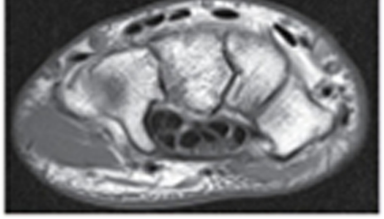

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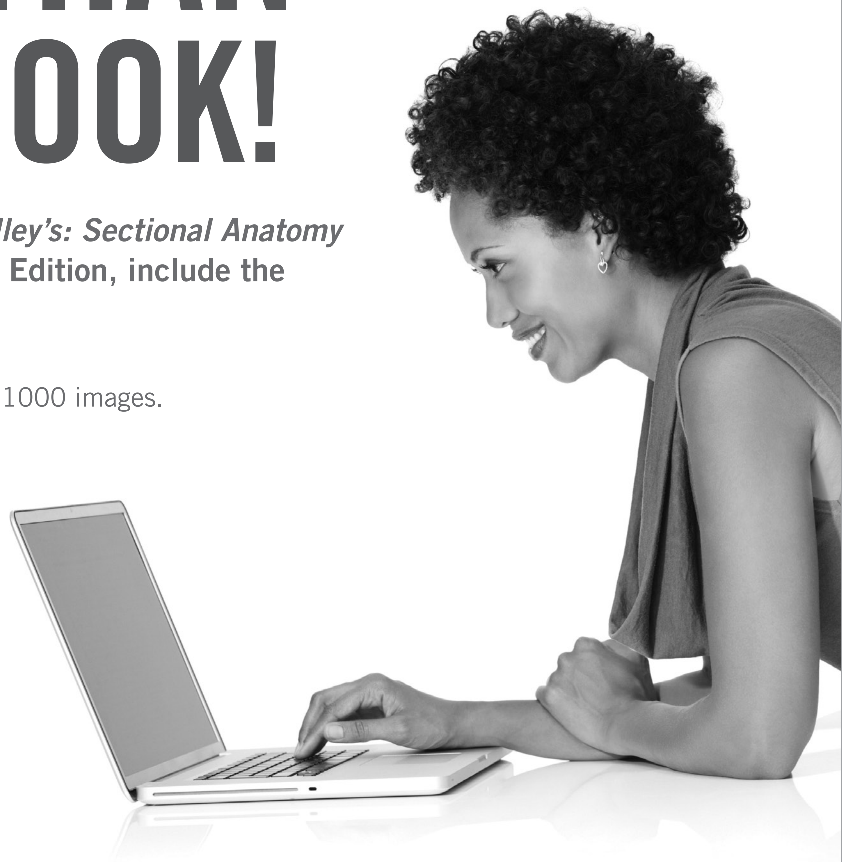

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SECTIONAL ANATOMY

For Imaging Professionals

FOURTH EDITION

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*Til **James,***
Min beste venn og evig ledsager. Jeg smil hver dag på grunn av deg.
Your strength sustains me, your
love elevates me, and your faith inspires me.

To my greatest treasures:
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Dean, Maren, Evelyn, McKenzie, Jakob, Anders, Alyssa, Margalit, and Porter
Your laughter brings me joy, your enthusiasm for learning is contagious,
and your support and love for each other is the grandest example of selfless service.
Thanks for reminding me to dream.

*To my parents, **Bill** and **Darhl Buchanan,***
for sharing your wisdom and encouragement
in ways that strengthen and inspire me.

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for your perseverance in collaborating with me
through four editions while keeping your sense of humor.

And to the many medical professionals who elevate their professions by serving with
humility, compassion, and a reverence for life.

LLK

Thank you to my family and friends whose guidance, love, and support carried me through
my most trying times.

I dedicate this book to:
*My family, **Mom, Dad, Brayden, Trinity, Grant, Scott, Kendra, Colton,** and **Jayden,***
who are my greatest blessings and who deeply enrich my life with laughter, joy, support,
and true love. When I need you most, you never fail to show up with a hug, smile, or words of
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And to the medical professionals who utilize this book in their pursuit of knowledge to improve patient
care and advance the field of radiologic sciences.

CMP

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Preface

This text was written to address the needs of today's practicing health professional. As technology in diagnostic imaging advances, so does the need to competently recognize and identify cross-sectional anatomy. Our goal was to create a clear, concise text that would demonstrate in an easy-to-use yet comprehensive format the anatomy the health professional is required to understand to optimize patient care. The text was purposely designed to be used both as a clinical reference manual and as an instructional text, either in a formal classroom environment or as a self-instructional volume.

Included are close to 1000 high-quality MR and CT images for every feasible plane of anatomy most commonly imaged. An additional 350 anatomic maps and line drawings related to the MR and CT images add to the learner's understanding of the anatomy being studied. In addition, pathology boxes describe common pathologies related to the anatomy presented, assisting the reader in making connections between the images in the text and common pathologies that will be encountered in clinical practice. Updated tables are used to summarize and organize key information in each chapter. For example, tables that summarize muscle group information include points of origin and insertion, as well as functions, for the muscle structures pertinent to the images the reader is studying.

NEW TO THIS EDITION

- Updated content to reflect the latest ARRT and ASRT curriculum guidelines
- Expanded images in the lymphatic system
- Second color added to the design to make difficult content easier to digest

CONTENT AND ORGANIZATION

The images include identification of vital anatomic structures to assist the health professional in locating and identifying the desired anatomy during actual clinical examinations. The narrative accompanying these images clearly and concisely describes the location and function of the anatomy in a format easily understood by health professionals. The text is divided into chapters by anatomic regions. Each chapter of the text contains an outline that provides an overview of the chapter's contents, pathology boxes that briefly describe common pathologies related to the anatomy being presented, tables designed to organize and summarize the anatomy contained in the chapter, and reference illustrations that provide the correct orientation for ease of locating the anatomy of interest.

ANCILLARIES

A Workbook and an Evolve site complement the text. When used together, these additional tools create a virtual learning system/reference resource.

Workbook: The Workbook provides practice opportunities for the user to identify specific anatomy. The Workbook includes learning objectives that focus on the key elements of each chapter, a variety of practice items to test the reader's knowledge of key concepts, labeling exercises to test the reader's knowledge of the anatomy, case studies to provide relevance for clinical applications, and answers to exercises.

Student Resources on Evolve: An image collection with approximately 1000 images.

Instructor Resources on Evolve: These resources include a test bank with approximately 500 questions and an image collection with approximately 1000 images.

Lorrie L. Kelley
Connie M. Petersen

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Acknowledgments

Many provided encouragement and direction as the compilation of this text commenced. Danielle Frazier and Manchu Mohan had the tiresome duty of encouraging us to meet deadlines, which they did with grace and patience. Sonya Seigafuse had the daunting task of strategically pulling it all together. We are indebted to them for their editorial assistance in seeing this project through completion. We wish to extend our gratitude to everyone who thought the first, second, and third editions had value and to those who took the time to provide constructive criticism and suggestions for further improvements and increased accuracy. And to the many students, peers, and colleagues for providing feedback so that we could see the text from many different perspectives.

The following individuals and institutions deserve special acknowledgment:

- Chris Hayden for his tremendous patience, knowledge, and time invested in helping us find and create all of the new CT images for the third edition. And St. Alphonsus Regional Medical Center for providing the CT images.
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We owe a debt of gratitude to Marie Dean who provided numerous new illustrations and revised many old drawings creating more accuracy and consistency in the visual presentation of the artwork throughout the text.

Lorrie L. Kelley
Connie M. Petersen

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Table of Contents

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CHAPTER

1

Introduction to Sectional Anatomy

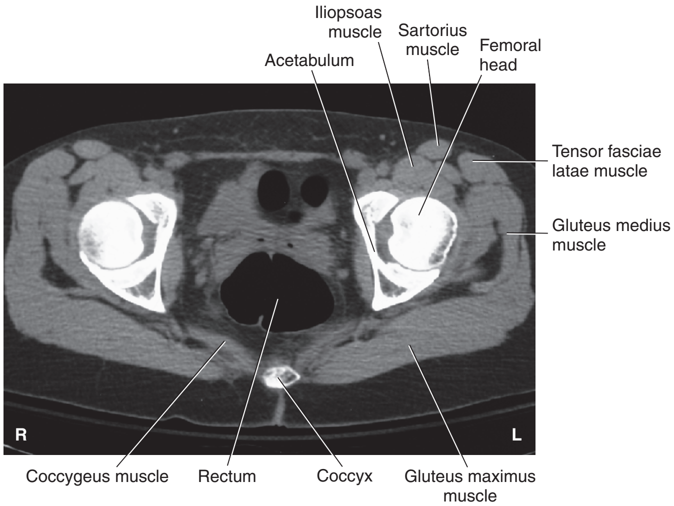

FIG. 1.1 Axial CT of hips.

Sectional anatomy has had a long history. Beginning as early as the 16th century, the great anatomist and artist Leonardo da Vinci was among the first to represent the body in anatomic sections. In the following centuries, numerous anatomists continued to provide illustrations of various body structures in sectional planes to gain greater understanding of the topographical relationships of the organs. The ability to see inside the body for medical purposes has been around since 1895, when Wilhelm Conrad Roentgen discovered x-rays. Since that time, medical imaging has evolved from the two-dimensional (2D) image of the first x-ray to the 2D cross-sectional images of computed tomography (CT) and magnetic resonance imaging (MRI), then to the three-dimensional (3D) imaging techniques used today. These changes warrant the need for medical professionals to understand and identify human anatomy in both 2D and 3D images.

Sectional anatomy emphasizes the physical relationship between internal structures. Prior knowledge of anatomy from drawings or radiographs may assist in understanding the location of specific structures on a sectional image. For example, it may be difficult to recognize all the internal anatomy of the pelvis in cross-section, but by identifying the femoral head on the image, it will be easier to recognize soft tissue structures adjacent to the hip (Fig. 1.1).

OBJECTIVES

- Define the four anatomic planes.
- Describe the relative position of specific structures within the body using directional and regional terminology.
- Identify commonly used external landmarks.
- Identify the location of commonly used internal landmarks.
- Describe the dorsal and ventral cavities of the body.
- List the structures located within the four abdominal quadrants.
- List the nine regions of the abdomen.
- Describe the gray scale used in CT and MR imaging.
- Describe MPR, CPR, SSD, MIP, and VR.
- Differentiate between 2D and 3D images.

OUTLINE

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ANATOMIC POSITIONS AND PLANES

For our purposes, sectional anatomy encompasses all the variations of viewing anatomy taken from an arbitrary angle through the body while in anatomic position.

In anatomic position, the body is standing erect, with the face and toes pointing forward and the arms at the side, with the palms facing forward. Sectional images are commonly acquired and displayed according to one of the four fundamental anatomic planes that pass through the body (Fig. 1.2). The four anatomic planes are defined as follows:

1. **Sagittal plane:** a vertical plane that passes through the body, dividing it into right and left portions
2. **Coronal plane:** a vertical plane that passes through the body, dividing it into anterior (ventral) and posterior (dorsal) portions
3. **Axial (transverse) plane:** a horizontal plane that passes through the body, dividing it into superior and inferior portions
4. **Oblique plane:** a plane that passes diagonally between the axes of two other planes

Medical images of sectional anatomy are, by convention, displayed in a specific orientation. Images are viewed with the right side of the image corresponding to the viewer's left side (Fig. 1.3).

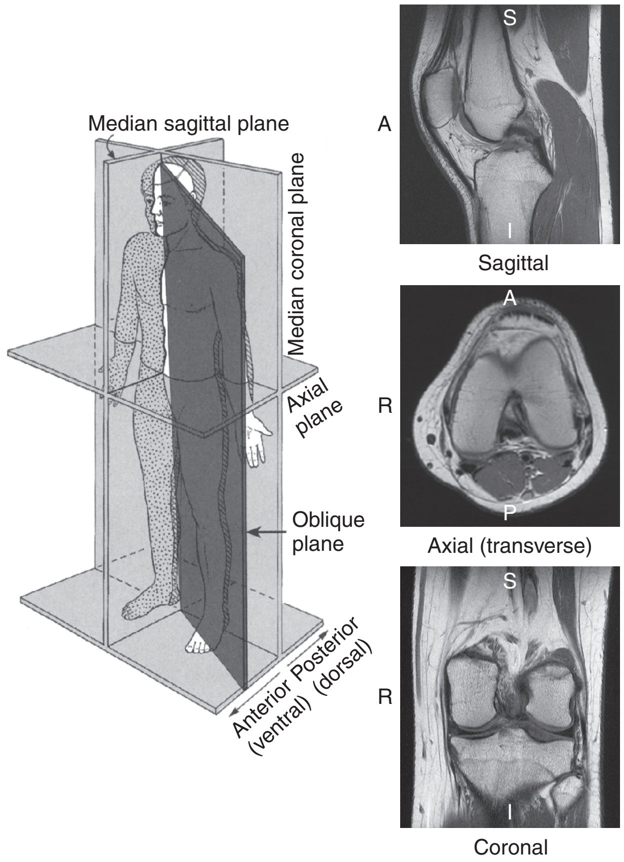

FIG. 1.2 Anatomic position and planes of the body.

TERMINOLOGY AND LANDMARKS

Directional and regional terminology is used to help describe the relative positions of specific structures within the body. Directional terms are defined in Table 1.1, and regional terms are defined in Table 1.2 and demonstrated in Fig. 1.4.

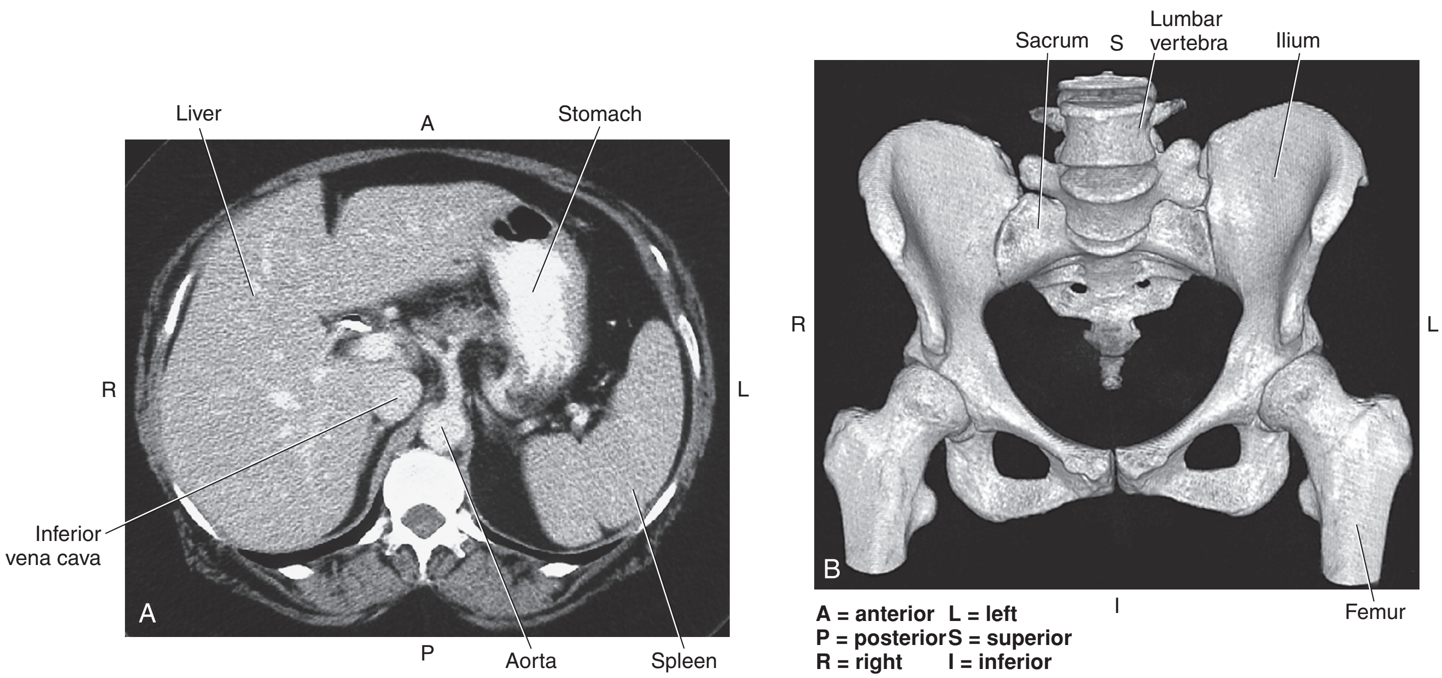

FIG. 1.3 (A) Axial CT of abdomen. (B) 3D CT of pelvis (anterior view).

TABLE 1.1 Directional Terminology

Direction	Definition
Superior	Above; at a higher level
Inferior	Below; at a lower level
Anterior/ventral	Toward the front or anterior surface of the body
Posterior/dorsal	Toward the back or posterior surface of the body
Medial	Toward the midsagittal plane
Lateral	Away from the midsagittal plane
Proximal	Toward a reference point or source within the body
Distal	Away from a reference point or source within the body
Superficial	Near the body surface
Deep	Farther into the body and away from the body surface
Cranial/cephalic	Toward the head
Caudal	Toward the feet
Rostral	Toward the nose
Ipsilateral	On the same side
Contralateral	On the opposite side
Thenar	The fleshy part of the hand at the base of the thumb
Volar	Pertaining to the palm of the hand or flexor surface of the wrist or the sole of the foot
Palmar	The front or palm of the hand
Plantar	The sole of the foot

TABLE 1.2 Regional Terminology

Direction	Definition
Abdominal	Abdomen
Antebrachial	Forearm
Antecubital	Front of elbow
Axillary	Armpit
Brachial	Upper arm
Buccal	Cheek
Carpal	Wrist
Cephalic	Head
Cervical	Neck
Costal	Ribs
Crural	Leg
Cubital	Posterior surface of elbow area of the arm
Cutaneous	Skin
Femoral	Thigh, upper portion of leg
Flank	Side of trunk adjoining the lumbar region
Frontal	Forehead
Gluteal	Buttock
Inguinal	Groin
Lumbar	Lower back between the ribs and hips
Occipital	Back of the head
Ophthalmic	Eye
Otic	Ear
Pectoral/mammary	Upper chest or breast
Pedal	Foot
Pelvic	Pelvis
Perineal	Perineum
Plantar	Sole of foot
Popliteal	Back of knee
Sacral	Sacrum
Sternal	Sternum
Sural	Calf
Tarsal	Ankle
Thoracic	Chest
Umbilical	Navel
Vertebral	Spine

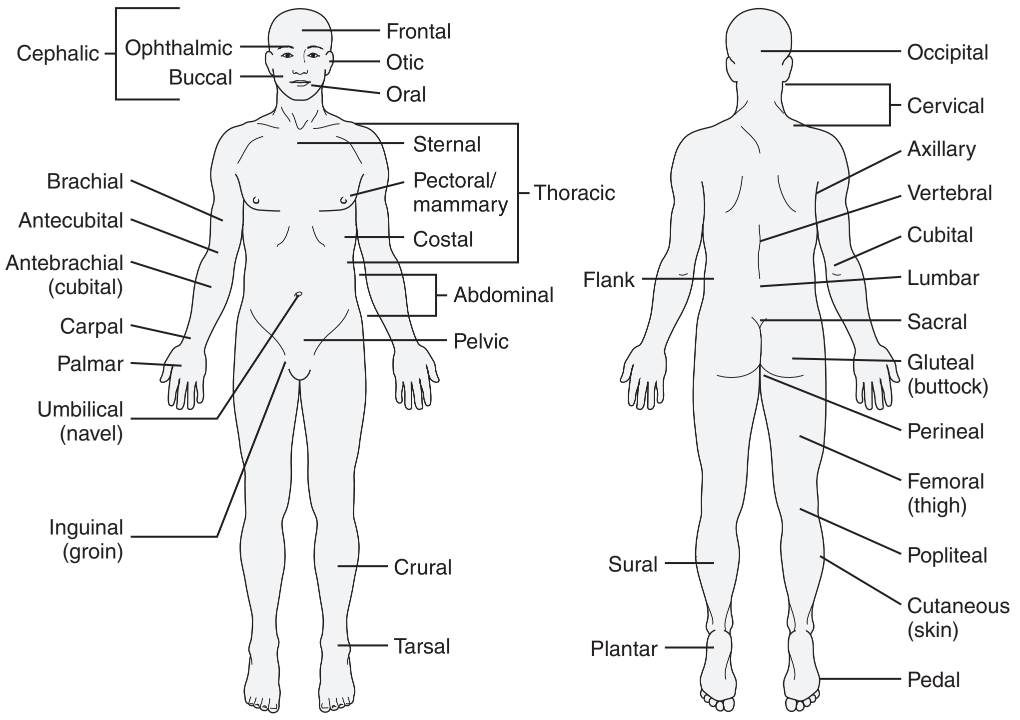

FIG. 1.4 Regional terminology of the body.

External Landmarks

External landmarks of the body are helpful in identifying the location of many internal structures. The commonly used external landmarks are shown in Figs. 1.5 and 1.6.

Internal Landmarks

Internal structures, in particular, vascular structures, can be located by referencing them to other identifiable regions or locations, such as organs or the skeleton (Table 1.3).

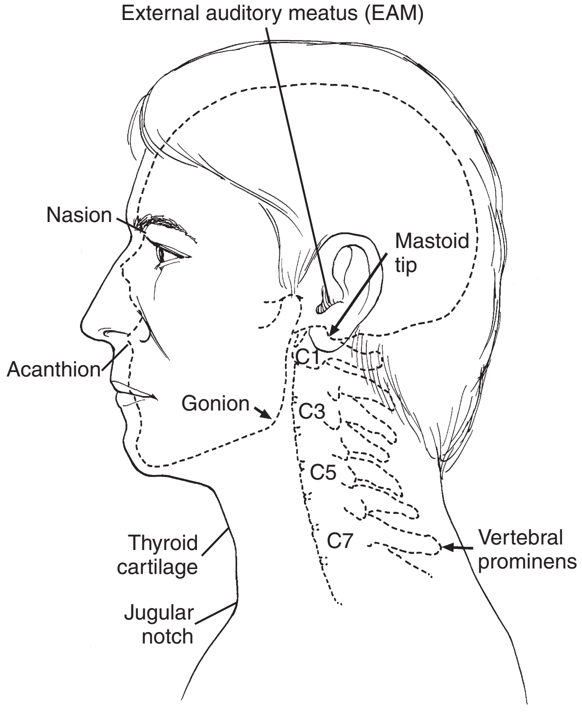

FIG. 1.5 External landmarks of the head and neck.

BODY CAVITIES

The body consists of two main cavities: the dorsal and ventral cavities. The dorsal cavity is located posteriorly and includes the cranial and spinal cavities. The ventral cavity, the largest body cavity, is subdivided into the thoracic and abdominopelvic cavities. The thoracic cavity is further subdivided into two lateral pleural cavities and a single, centrally located cavity called the mediastinum. The abdominopelvic cavity can be subdivided into the abdominal and pelvic cavities (Fig. 1.7). The structures located in each cavity are listed in Table 1.4.

ABDOMINAL AND PELVIC DIVISIONS

The abdomen is bordered superiorly by the diaphragm and inferiorly by the pelvic inlet. The abdomen can be divided into four quadrants or nine regions. These divisions are useful in identifying the general location of internal organs and provide descriptive terms for the location of pain or injury in a patient's history.

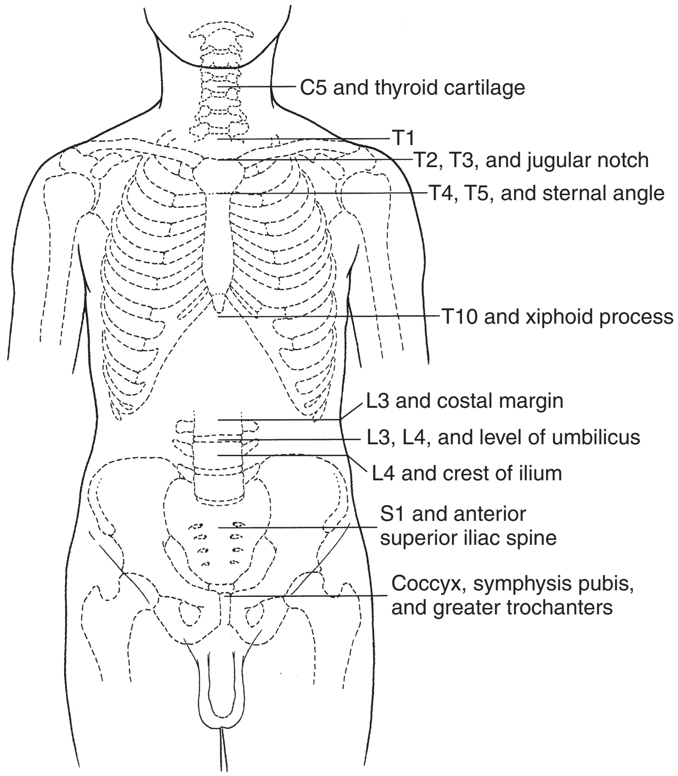

FIG. 1.6 External landmarks of the body.

TABLE 1.3 Internal Landmarks

Landmark	Location
Aortic arch	2.5 cm below jugular notch
Aortic bifurcation	L4–L5
Carina	T4–T5, sternal angle
Carotid bifurcation	Upper border of thyroid cartilage
Celiac trunk	4 cm above transpylоric plane
Circle of Willis	Suprasellar cistern
Common iliac vein bifurcation	Upper margin of sacroiliac joint
Conus medullaris	T12–L1, L2
Heart—apex	5th intercostal space, left midclavicular line
Heart—base	Level of 2nd and 3rd costal cartilages behind sternum
Inferior mesenteric artery	4 cm above bifurcation of abdominal aorta
Inferior vena cava	L5
Portal vein	Posterior to pancreatic neck
Renal arteries	Anterior to L1, inferior to superior mesenteric artery
Superior mesenteric artery	2 cm above transpyloric plane
Thyroid gland	Thyroid cartilage
Vocal cords	Midway between superior and inferior border of thyroid cartilage

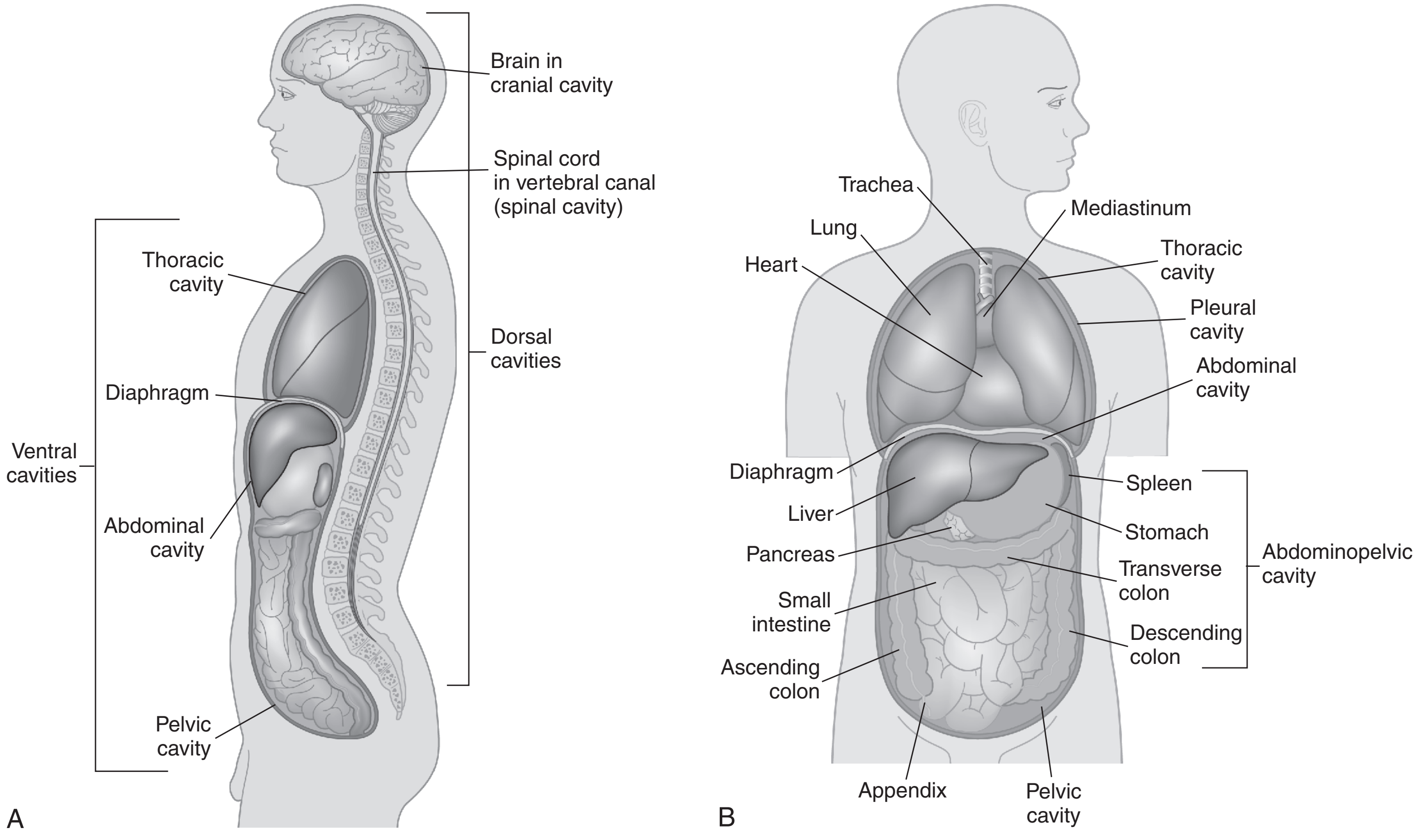

FIG. 1.7 (A) Lateral view of body cavities. (B) Anterior view of body cavities.

TABLE 1.4 Body Cavities

Main Body Cavities	Contents
Dorsal	
Cranial	• Brain
Spinal	• Spinal cord and vertebra
Ventral	
Thoracic	
• Mediastinum	• Thymus, heart, great vessels, trachea, esophagus, and pericardium
• Pleural	• Lungs, pleural membranes
Abdominopelvic	
• Abdominal	• Peritoneum, liver, gallbladder, pancreas, spleen, stomach, intestines, kidneys, ureters, and blood vessels
• Pelvic	• Rectum, urinary bladder, male and female reproductive system

Quadrants

The midsagittal and transverse planes intersect at the umbilicus to divide the abdomen into four quadrants (Fig. 1.8A):

Right upper quadrant (RUQ)
Right lower quadrant (RLQ)
Left upper quadrant (LUQ)
Left lower quadrant (LLQ)

For a description of the structures located within each quadrant, see Table 1.5.

Regions

The abdomen can be further divided by four planes into nine regions. The two transverse planes are the transpyloric and transtubercular planes. The transpyloric plane is found midway between the xiphisternal joint and the umbilicus, passing through the inferior border of the L1 vertebra. The transtubercular plane passes through the tubercles on the iliac crests, at the level of the L5 vertebral body. The two sagittal planes are the midclavicular lines. Each line runs inferiorly from the midpoint of the clavicle to the midinguinal point (Fig. 1.8B). The nine regions can be organized into three groups:

Superior
- Right hypochondrium
- Epigastrium
- Left hypochondrium

Middle
- Right lateral
- Umbilical
- Left lateral

Inferior
- Right inguinal
- Hypogastrium
- Left inguinal

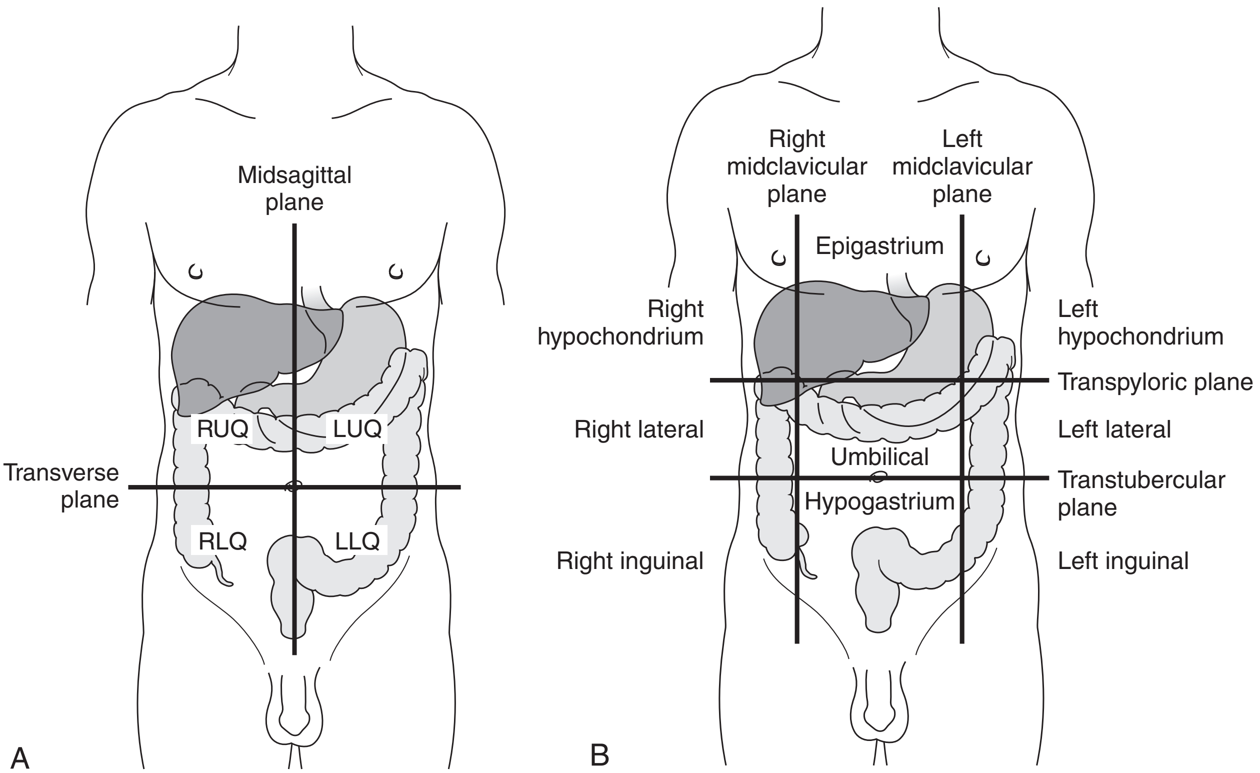

FIG. 1.8 (A) Four abdominal quadrants. (B) Nine abdominal regions.

TABLE 1.5 Organs Found Within Abdominopelvic Quadrants

Quadrant	Organs
Right upper quadrant (RUQ)	Right lobe of liver, gallbladder, right kidney, portions of stomach, small and large intestines
Left upper quadrant (LUQ)	Left lobe of liver, stomach, tail of the pancreas, left kidney, spleen, portions of large intestines
Right lower quadrant (RLQ)	Cecum, appendix, portions of small intestine, right ureter, right ovary, right spermatic cord
Left lower quadrant (LLQ)	Most of small intestine, portions of large intestine, left ureter, left ovary, left spermatic cord

IMAGE ACQUISITION

The images displayed in this text are acquired from MRI and CT scanners. MRI uses a strong magnetic field in conjunction with nonionizing radiofrequency (RF) energy to acquire images. CT uses ionizing radiation to acquire images. Both modalities are capable of creating 2D and 3D images.

IMAGE DISPLAY

Each digital image can be divided into individual regions called pixels or voxels that are then assigned a numerical value corresponding to a specific tissue property of the structure being imaged (Fig. 1.9). The numerical value of each voxel is assigned a shade of gray for image display. In CT, the numerical value (CT number) is referenced to a Hounsfield unit (HU), which represents the attenuating properties or density of each tissue. Water is used as the reference tissue and is given a value of zero. A CT number greater than zero will represent tissue that is denser than water and will appear in progressively lighter shades of gray to white. Tissues with a negative CT number will appear in progressively darker shades of gray to black (Fig. 1.10). In magnetic resonance (MR), the gray scale represents the specific tissue relaxation properties of T1, T2, and proton density. The gray scale in MR images can vary greatly because of inherent tissue properties and can appear different with each patient and across a series of images (Fig. 1.11).

The appearance of digital images can be altered to include more or fewer shades of gray by adjusting the gray scale, a process called windowing. Windowing is used to optimize visualization of specific tissues or lesions. Window width (WW) is a parameter that allows for the adjustment of the gray scale (number of shades of gray), and window level (WL) basically sets the density of the image or the center of the gray scale (Fig. 1.10).

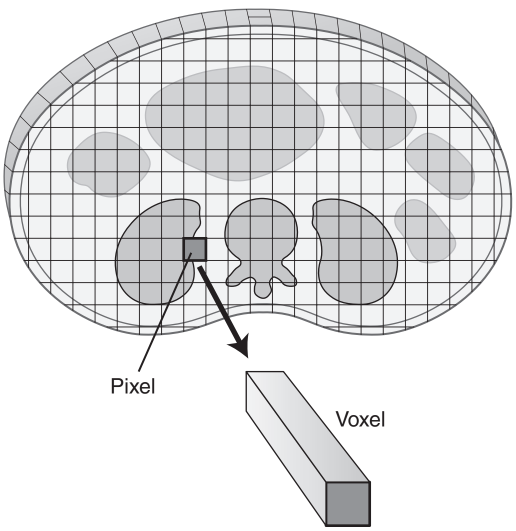

FIG. 1.9 Representation of a pixel and voxel.

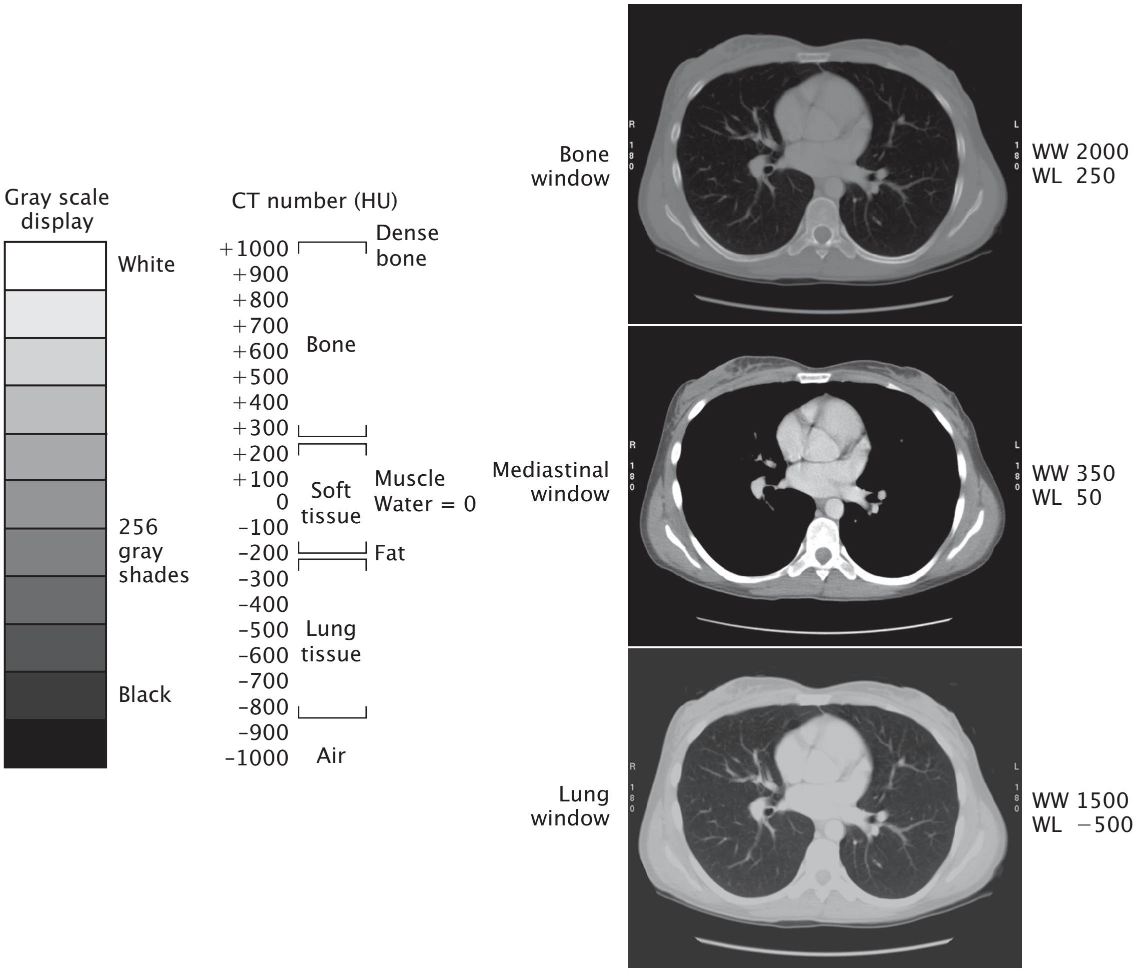

FIG. 1.10 CT numbers and windowing on axial CT of chest.

MULTIPLANAR REFORMATION AND 3D IMAGING

Several postprocessing techniques can be applied to the original 2D digital data to provide additional 3D information. All current postprocessing techniques depend on creating a digital data stack from the original 2D images, thereby generating a cube of digital information (Fig. 1.12).

Multiplanar Reformation (Reformat) (MPR)

Images reconstructed from data obtained along any projection through the cube result in a sagittal, coronal, axial, or oblique image (see Figs. 1.13 and 1.14).

Curved Planar Reformation (Reformat) (CPR)

Images are reconstructed from data obtained along an arbitrary curved projection through the cube (Fig. 1.15).

3D Imaging

All 3D algorithms use the principle of ray tracing in which imaginary rays are sent out from a camera viewpoint. The data are then rotated on an arbitrary axis, and the imaginary ray is passed through the data in specific increments. Depending on the method of reconstruction, unique information is projected onto the viewing plane (Fig. 1.16).

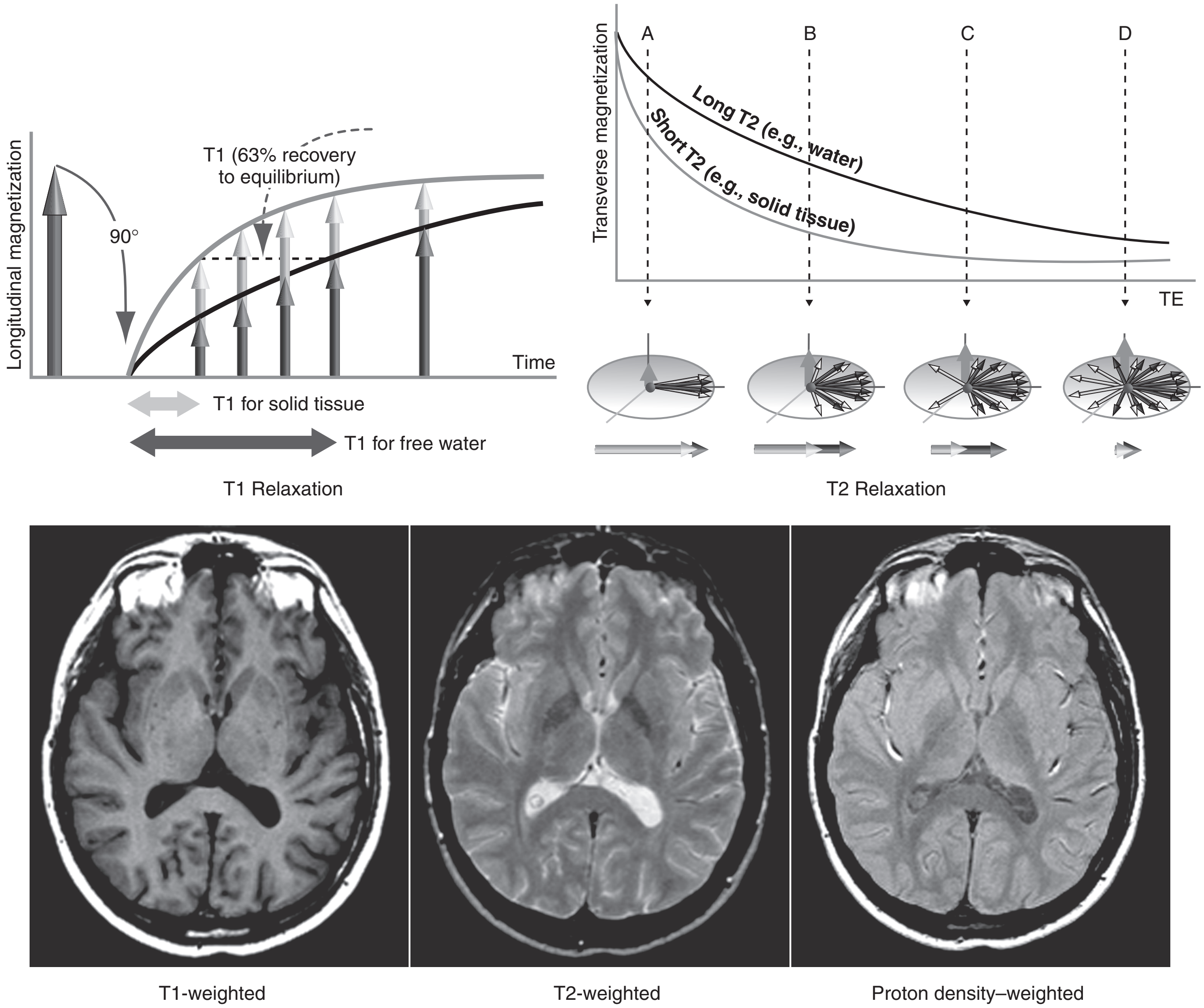

FIG. 1.11 MR tissue relaxation and image contrast.

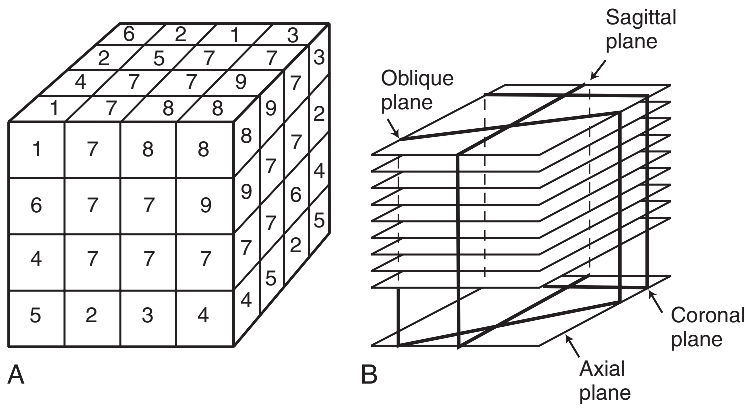

FIG. 1.12 (A) Digital cube. (B) Stack of axial image data.

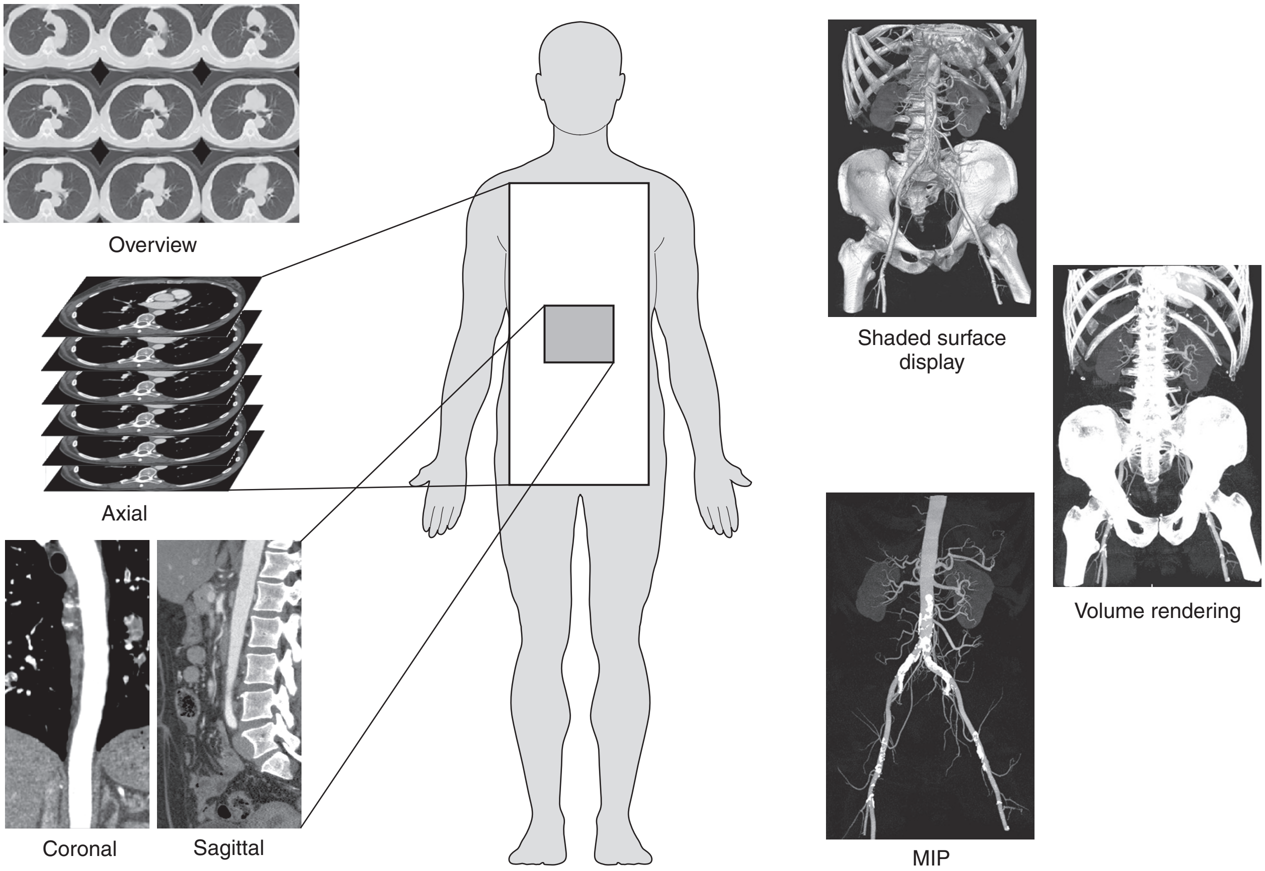

FIG. 1.13 Multiplanar reformation and 3D.

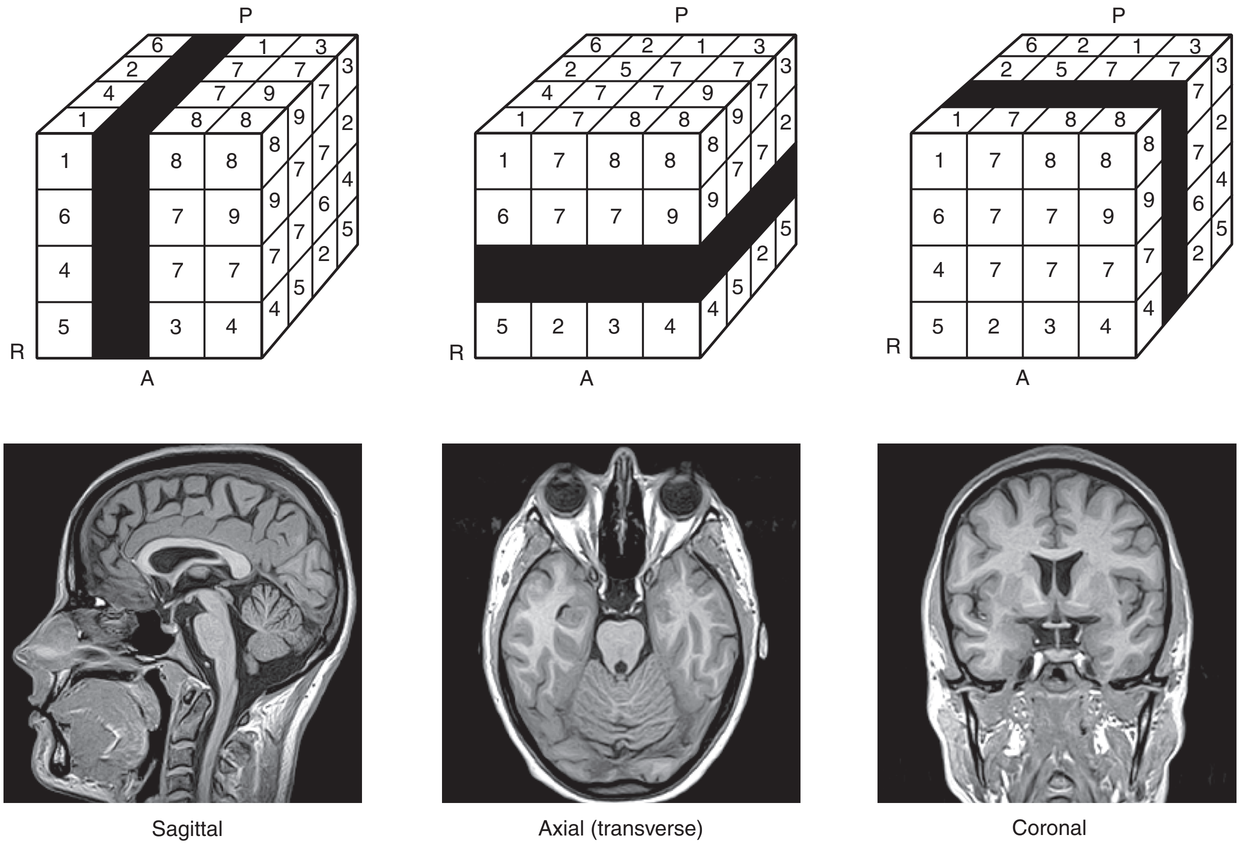

FIG. 1.14 Multiplanar reformations of brain.

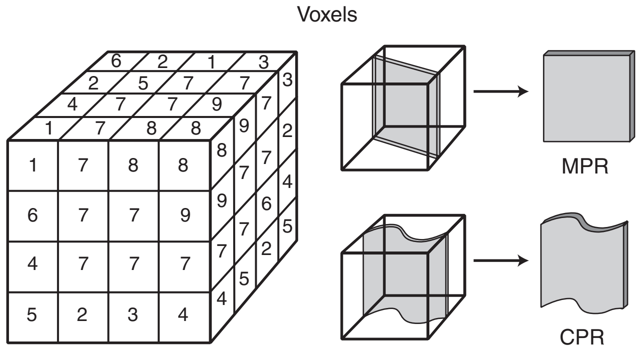

FIG. 1.15 Image reformation. *MPR,* Multiplanar reformation; *CPR,* curved planar reformation.

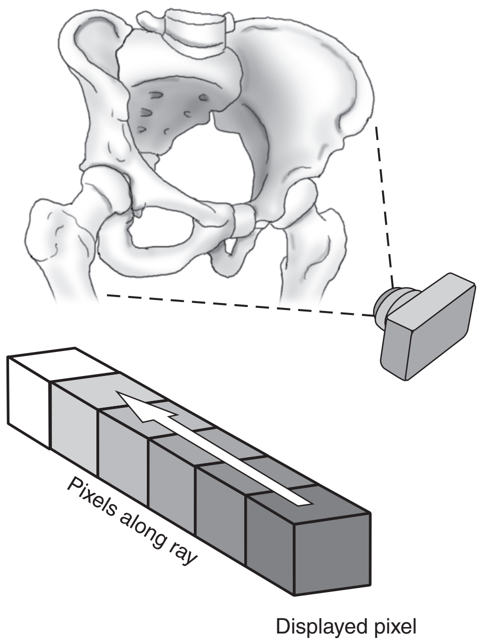

FIG. 1.16 Ray tracing.

Shaded Surface Display (SSD). A ray from the camera's viewpoint is directed to stop at a particular user-defined threshold value. With this method, every voxel with a value greater than the selected threshold is rendered opaque, creating a surface. That value is then projected onto the viewing screen (Fig. 1.17).

Maximum Intensity Projection (MIP). A ray from the camera's viewpoint is directed to stop at the voxel with the maximum signal intensity. With this method, only the brightest voxels will be mapped into the final image (Fig. 1.18).

Volume Rendering (VR). The contributions of each voxel are summed along the course of the ray from the camera's viewpoint. The process is repeated numerous times to determine each pixel value that will be displayed in the final image (Fig. 1.19).

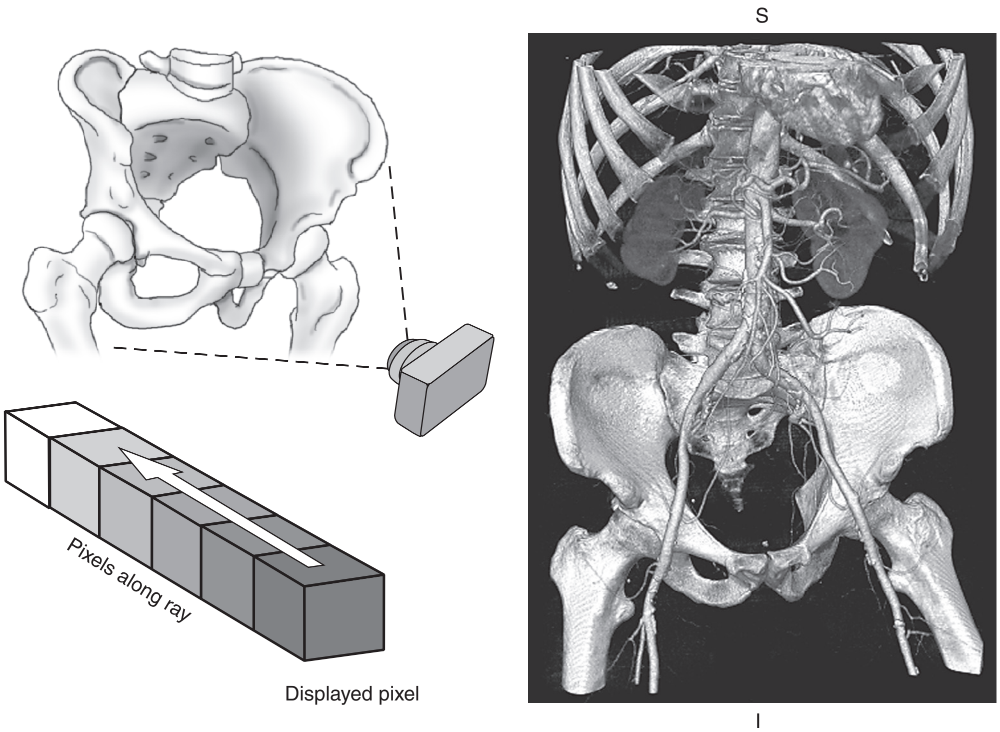

FIG. 1.17 Shaded surface display (SSD).

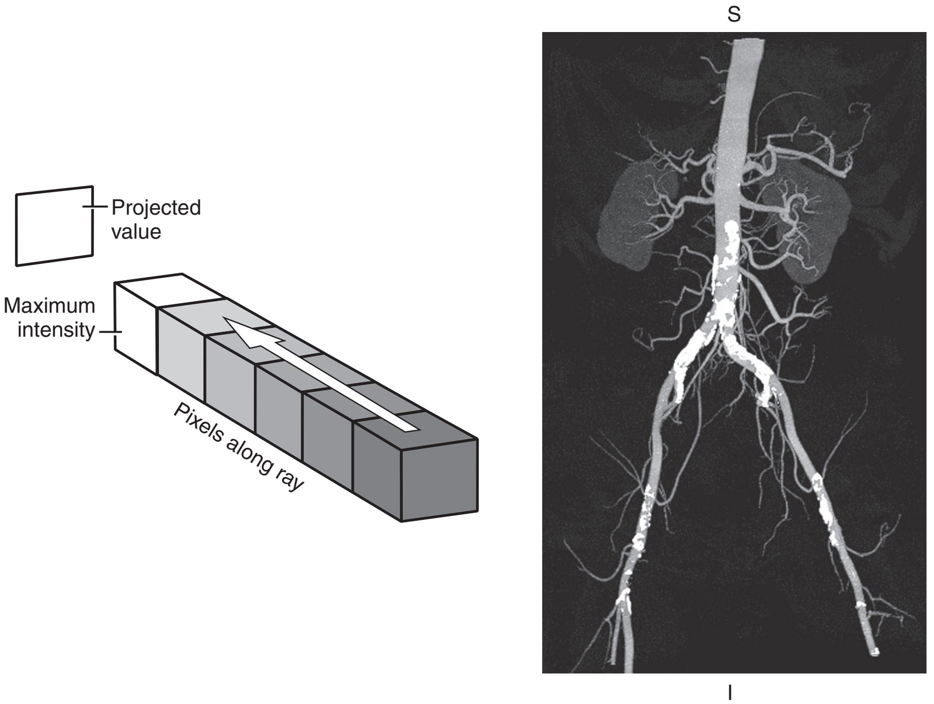

FIG. 1.18 Maximum intensity projection (MIP).

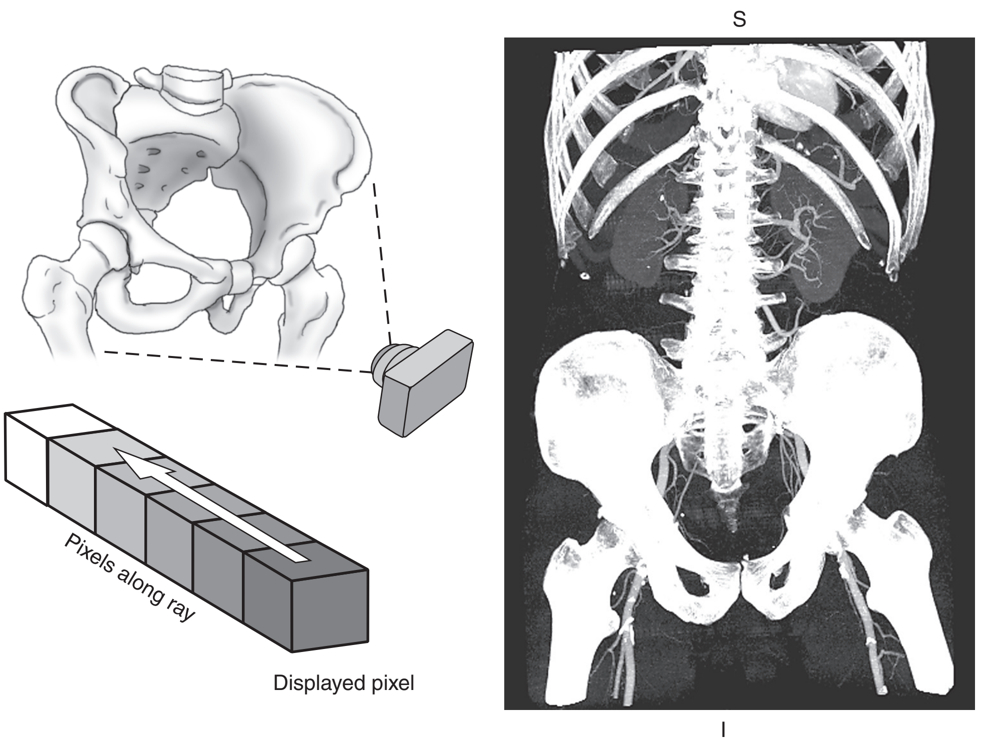

FIG. 1.19 Volume rendering (VR).

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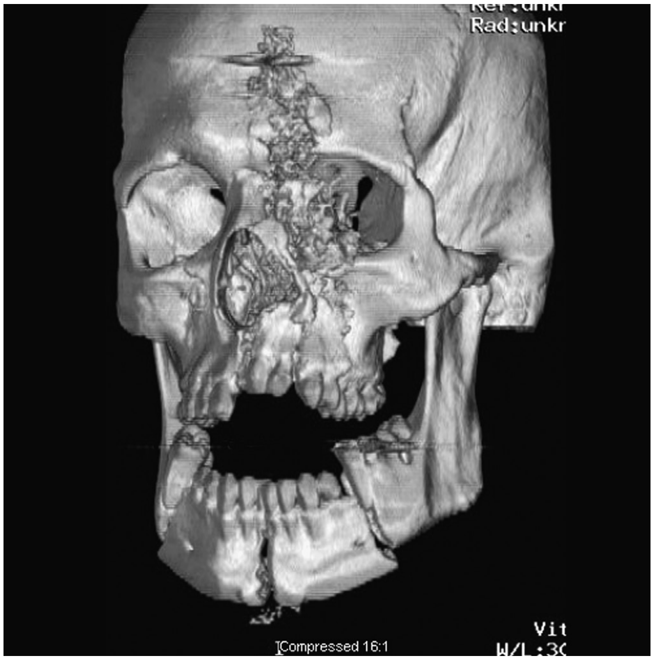
CHAPTER

2

Cranium and Facial Bones



Gentlemen, damn the sphenoid bone!

Oliver Wendell Holmes (1809–1894),
Opening of anatomy lectures at Harvard Medical School

The complex anatomy of the cranium and facial bones can be intimidating. However, with three-dimensional (3D) imaging and multiple imaging planes, the task of identifying these structures can be simplified. It is important to understand the normal sectional anatomy of the cranium and facial bones to identify pathologic disorders and injuries that may occur within this area (Fig. 2.1). This chapter demonstrates the sectional anatomy of the structures listed in the outline.

FIG. 2.1 **3D CT of skull.** Trauma resulting from a gunshot wound.

OBJECTIVES

- Differentiate between the three cranial fossae.
- Identify the location and unique structures of each cranial and facial bone.
- Identify the structures of the external, middle, and inner ear, and describe their functions.
- Identify the cranial sutures.
- Describe the six fontanels in the infant cranium.
- Describe the structures that constitute the temporomandibular joint.
- Identify the location of each paranasal sinus and the meatus into which it drains.
- Identify the structures of the osteomeatal unit.
- Identify the bones that form the orbit and their associated openings.
- Describe the structures that constitute the globe of the eye.
- List the muscles of the eye, and describe their functions and locations.

OUTLINE

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CRANIUM

The **cranium** is composed of eight bones that surround and protect the brain. These bones include the parietal (2), frontal (1), ethmoid (1), sphenoid (1), occipital (1), and temporal (2) (Figs. 2.2–2.5). The cranial bones are composed of two layers of compact tissue known as the internal (inner) and external (outer) tables. Located between the two tables is cancellous tissue or spongy bone called diploe (Figs. 2.6–2.9). The base of the cranium houses three fossae called the anterior, middle, and posterior cranial fossae. The **anterior cranial fossa** (frontal fossa) is composed primarily of the frontal bone, ethmoid bone, and lesser wing of the sphenoid bone and contains the frontal lobes of the brain. The **middle cranial fossa** (temporal fossa) is formed primarily by the body of the sphenoid and temporal bones and houses the pituitary gland, hypothalamus, and temporal lobes of the brain. The **posterior cranial fossa** (infratentorial fossa) is formed by the occipital and temporal bones and contains the cerebellum and brainstem (Figs. 2.6 and 2.7). For additional details of the contents found within

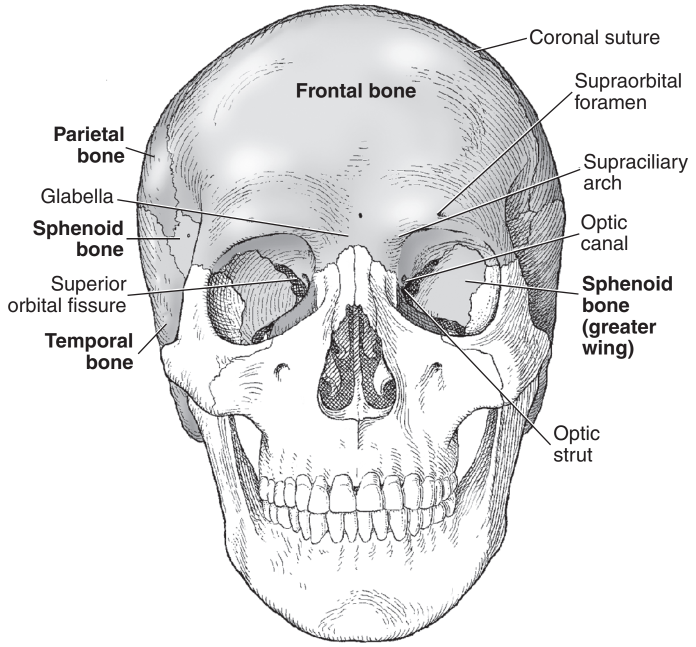


FIG. 2.2 Anterior view of skull.

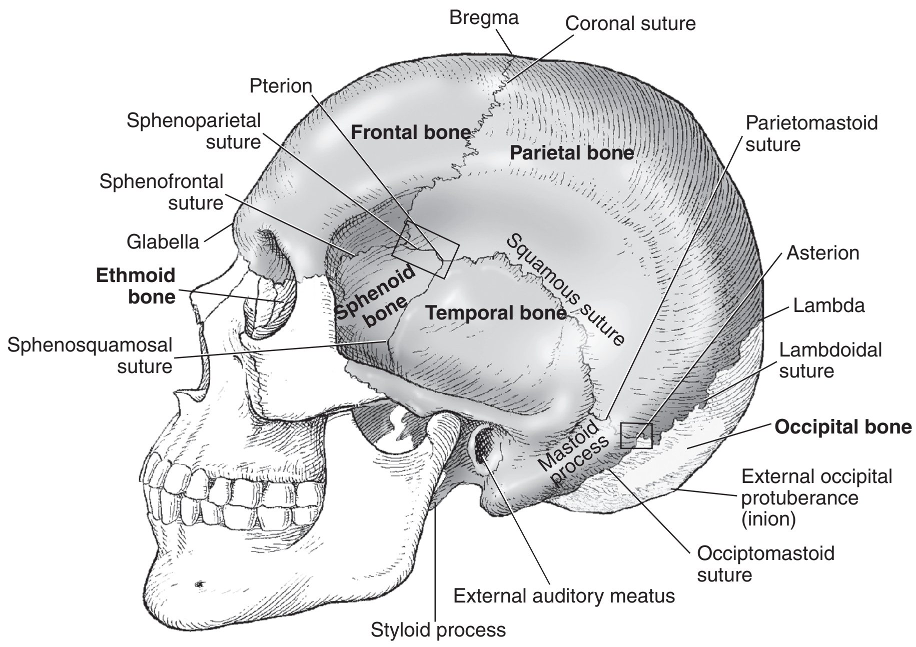


FIG. 2.3 Lateral view of skull.

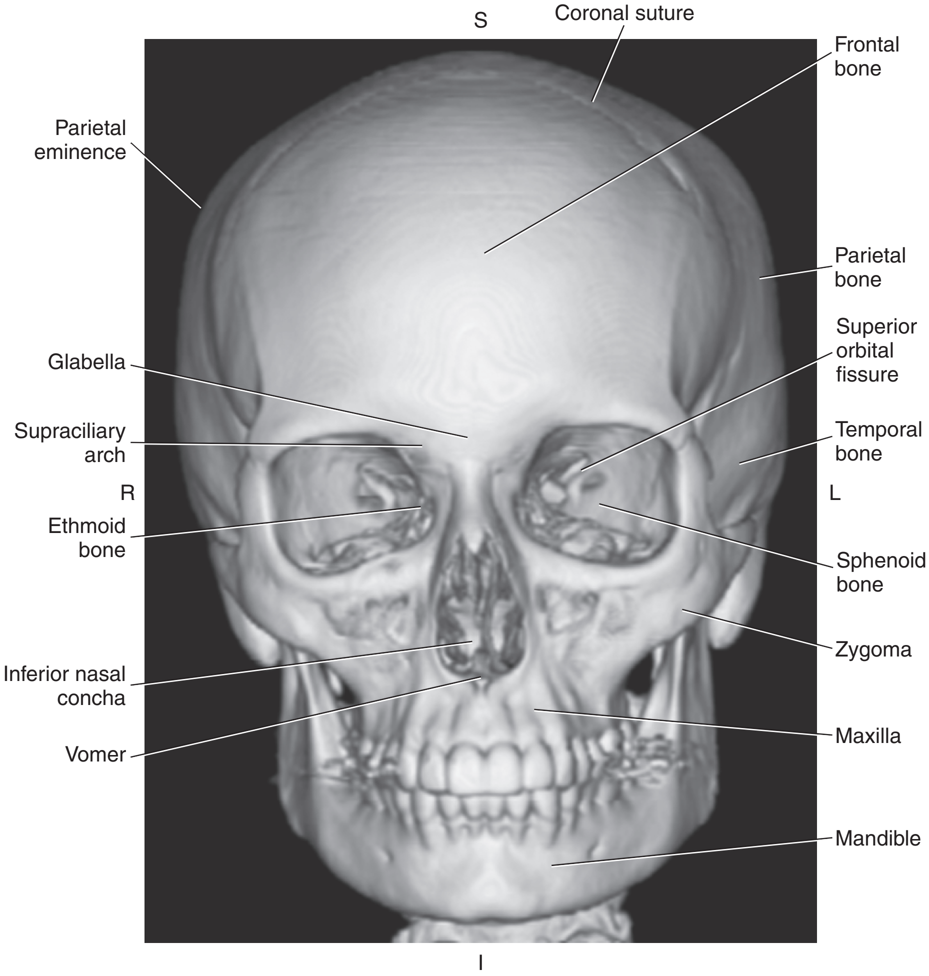


FIG. 2.4 3D CT of anterior skull.

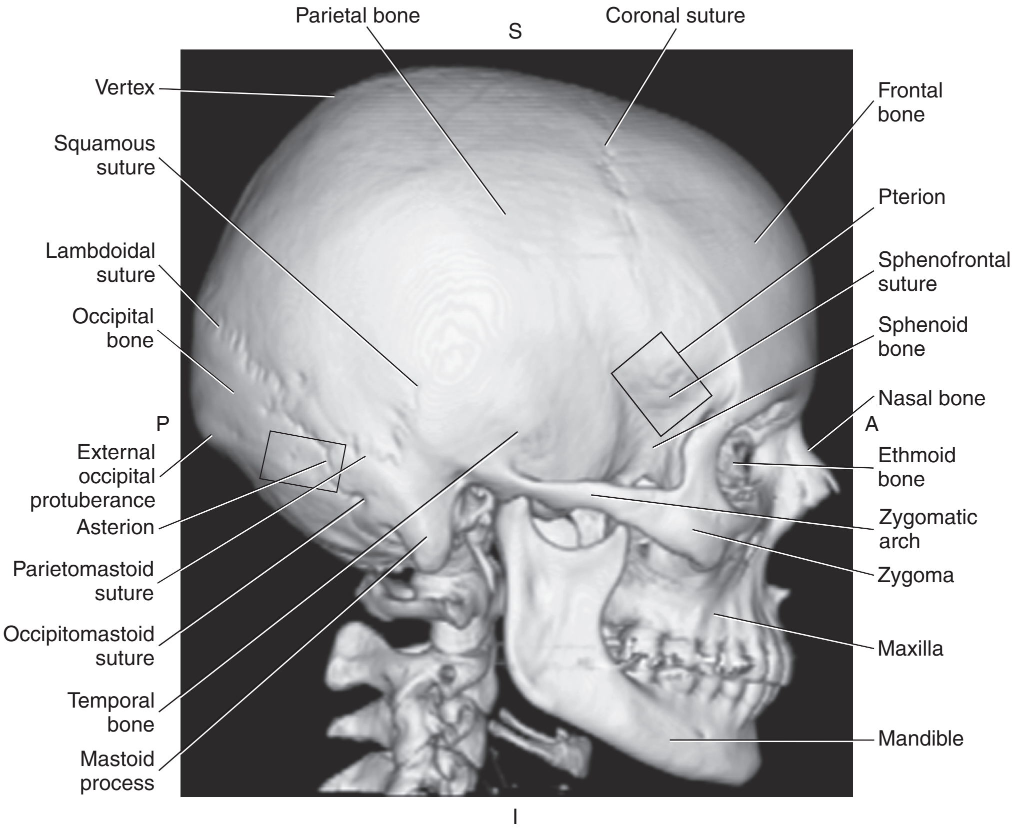


FIG. 2.5 3D CT of lateral skull.

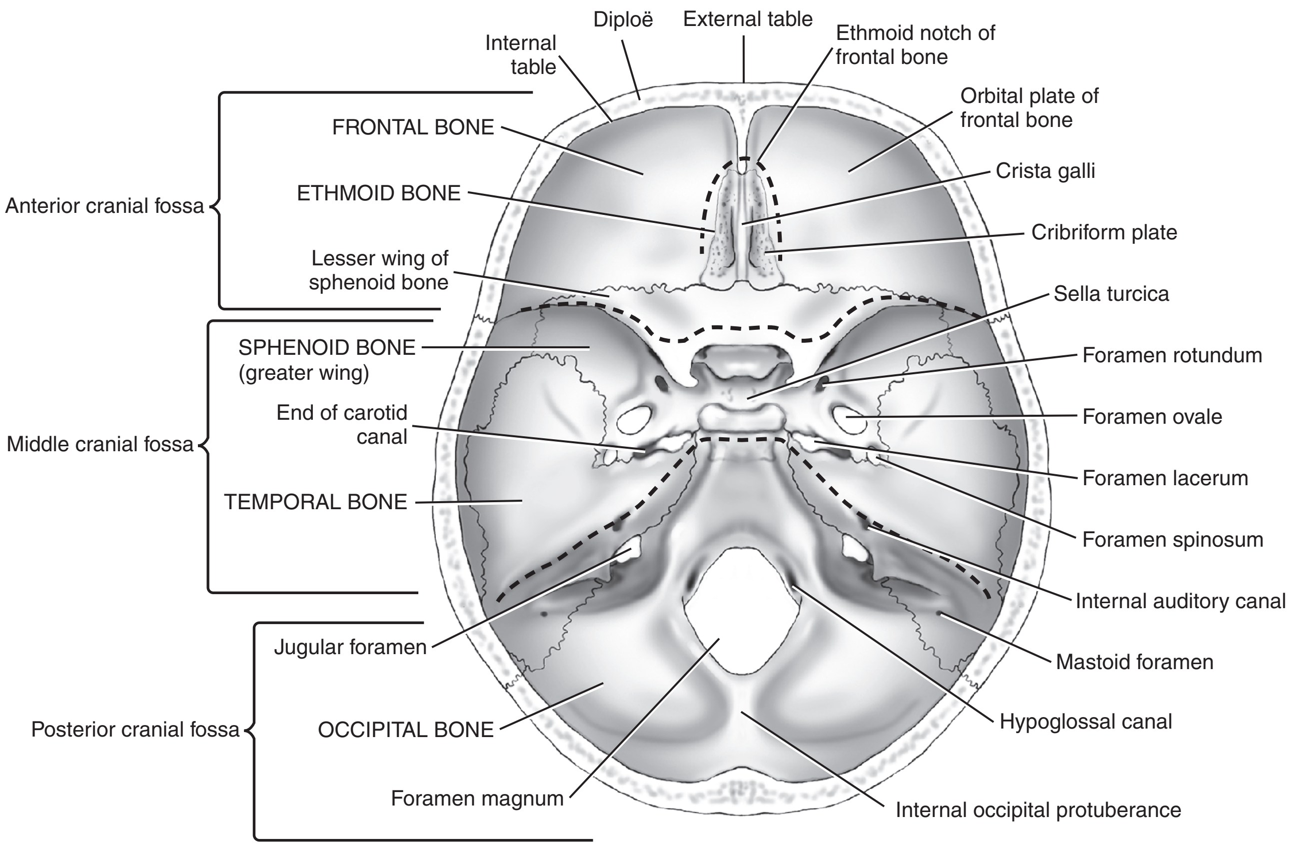


FIG. 2.6 Superior view of cranial fossae.

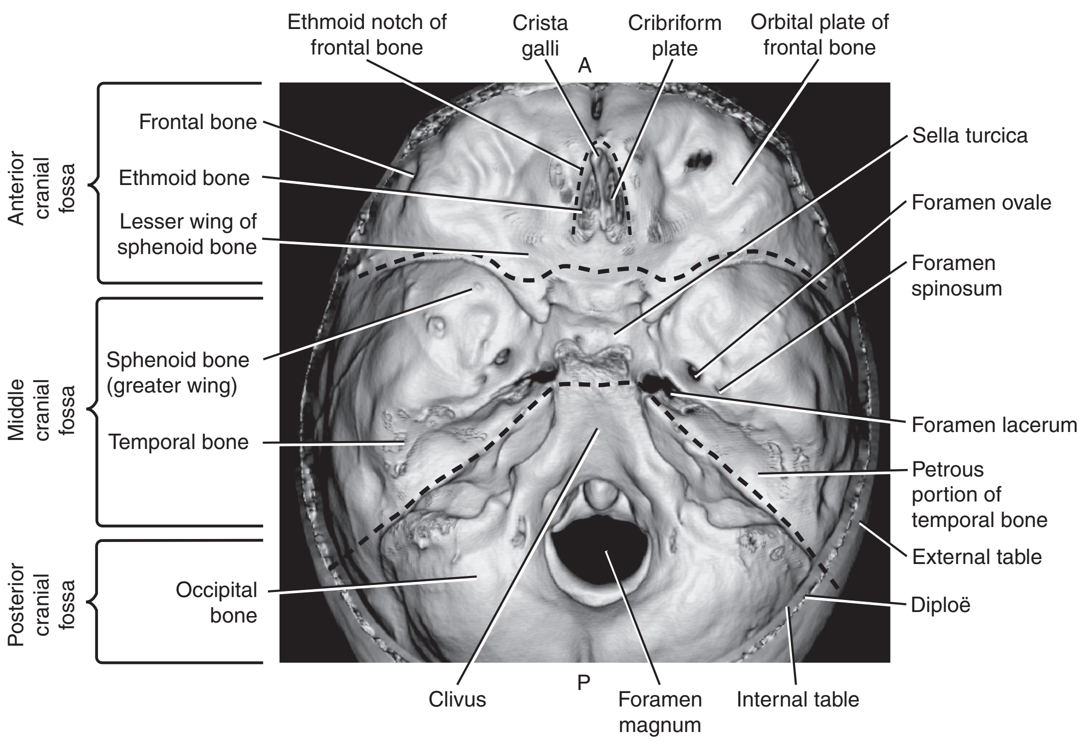


FIG. 2.7 3D CT of cranial fossae, superior view.

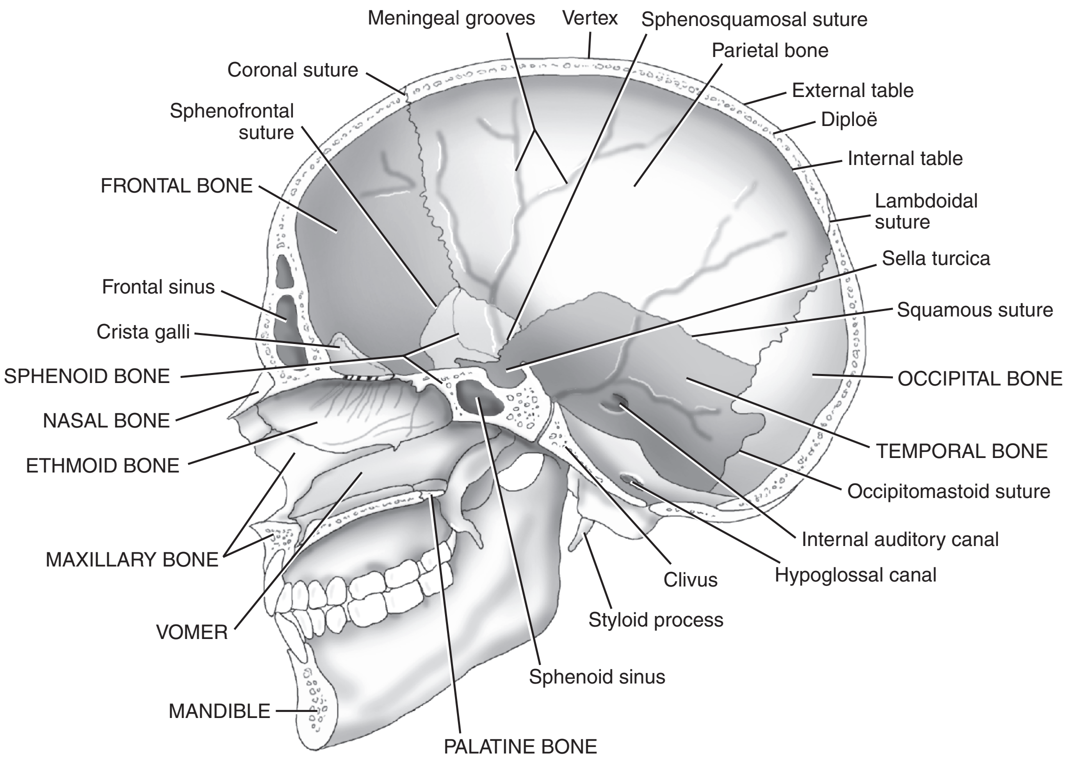


FIG. 2.8 Lateral view of inner skull.

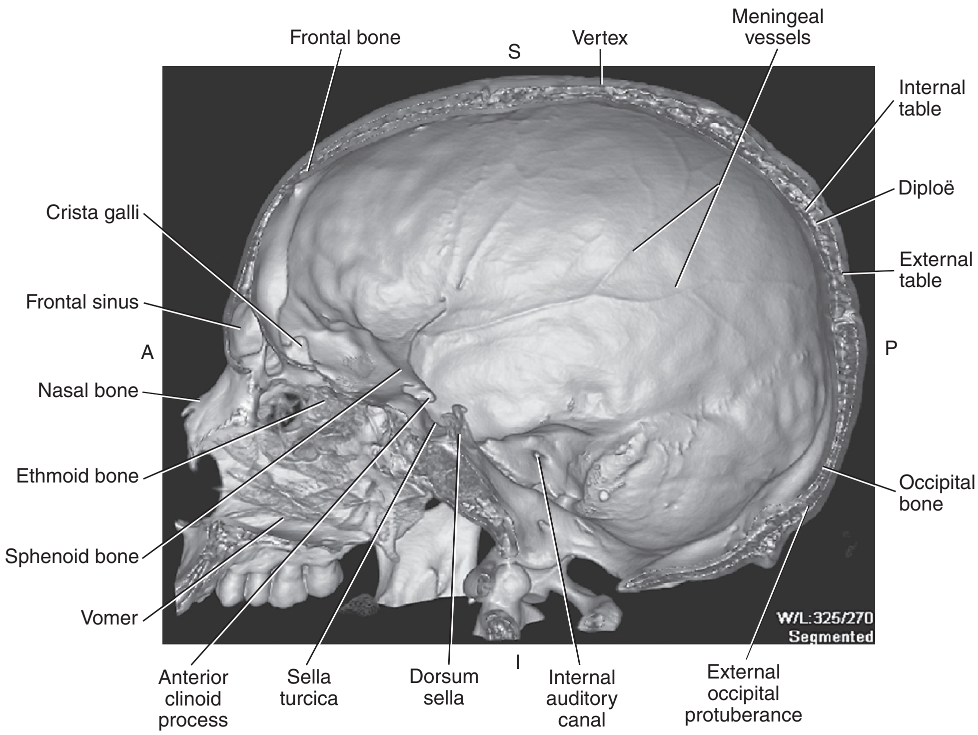


FIG. 2.9 3D CT of inner skull, lateral view.

TABLE 2.1 Contents of the Cranial Fossae

Fossa	Contents
Anterior cranial fossa	Frontal lobes of cerebrum; olfactory nerve (I)
Middle cranial fossa	Temporal lobes of cerebrum, pituitary gland, cavernous sinus, trigeminal ganglion, internal carotid artery, hypothalamus, and the following cranial nerves: optic nerves (II) and chiasm, oculomotor (III), trochlear (IV), trigeminal (V), abducens (VI)
Posterior cranial fossa	Cerebellum, pons, medulla oblongata, midbrain, and the following cranial nerves: facial (VII), vestibulocochlear (VIII), glossopharyngeal (IX), vagus (X), accessory (XI), hypoglossal (XII)

the cranial fossa, see Table 2.1. Each cranial bone is structurally unique, and thus identification of the physical components can be challenging.

Parietal Bone

The two **parietal bones** form a large portion of the sides of the cranium. Prominent markings and grooves that are found within the inner surface of the cranium are formed by corresponding meningeal vessels and cerebral gyri and sulci (Figs. 2.8 and 2.9). The parietal bones articulate with the frontal, occipital, temporal, and sphenoid bones. The superior point between the parietal bones is the **vertex,** which is the highest point of the cranium (Figs. 2.9 and 2.10). Each parietal bone has a central prominent bulge on its outer surface termed the **parietal eminence** (Fig. 2.4). The width of the cranium can be determined by measuring the distance between the two parietal eminences.

Frontal Bone

The **frontal bone** consists of a vertical and a horizontal portion. The **vertical** or **squamous portion** forms the forehead and anterior vault of the cranium (Figs. 2.2–2.5). The vertical portion contains the **frontal sinuses,** which lie on either side of the midsagittal plane (Figs. 2.8, 2.9, 2.11, and 2.12). Two elevated arches, the supraciliary arches, are joined to one another by a smooth area termed the **glabella** (Figs. 2.2 and 2.4). The **horizontal portion** forms the roof over each orbit, termed the **orbital plate,** and the majority of the anterior cranial fossa (Figs. 2.6, 2.7 and 2.13). Located in the superior portion of each orbit is the **supraorbital foramen,** or **notch,** which exists for the passage of the supraorbital nerve (Figs. 2.2 and 2.11). Between the orbital plates is an area termed the **ethmoid notch,** which receives the cribriform plate of the ethmoid bone (Figs. 2.6 and 2.7).

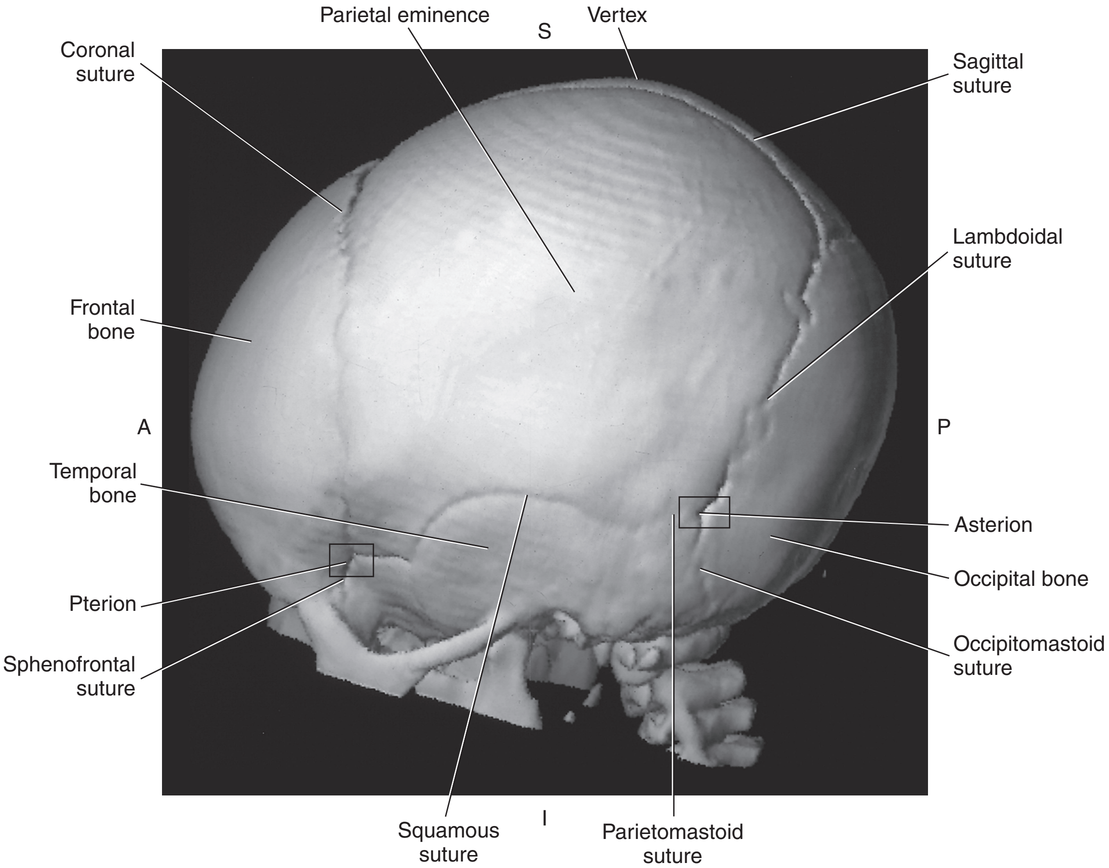


FIG. 2.10 3D CT of lateral surface of cranium.

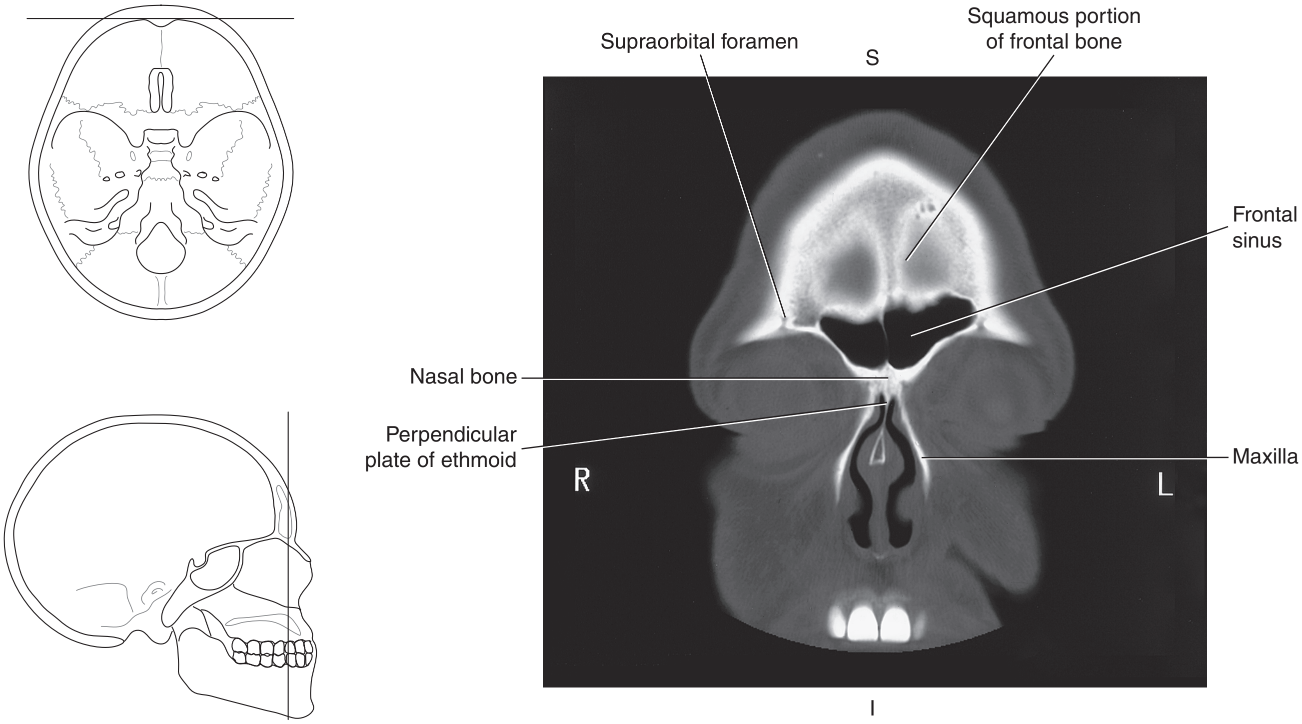


FIG. 2.11 Coronal CT of frontal bone.

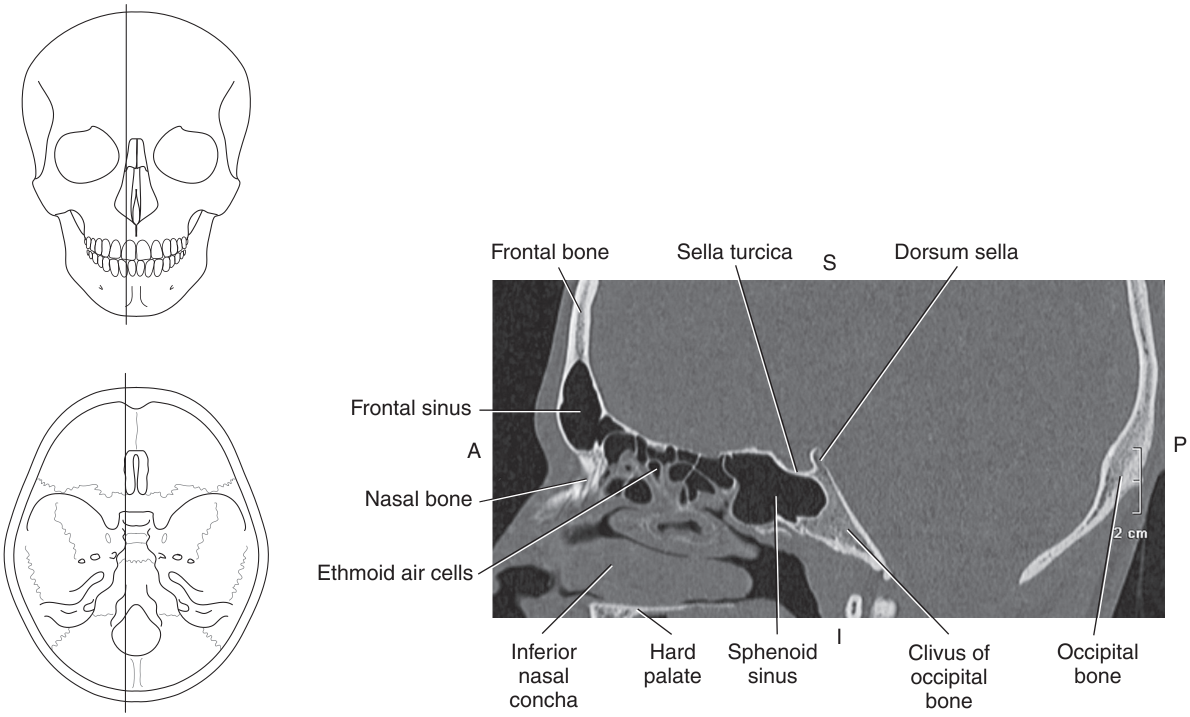
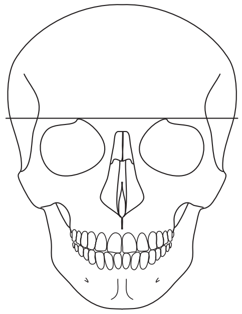
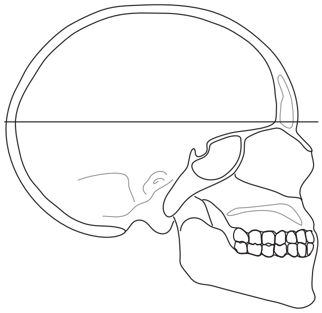


FIG. 2.12 Sagittal CT reformat of frontal sinus.





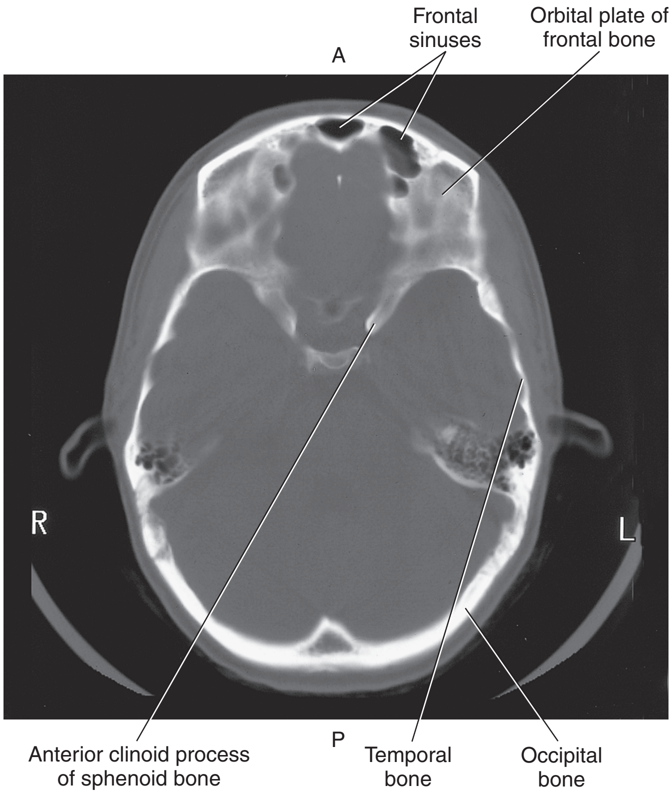


FIG. 2.13 Axial CT of orbital plates.

Ethmoid Bone

The **ethmoid bone** is the smallest of the cranial bones and is situated in the anterior cranial fossa. This cube-shaped bone can be divided into four parts: horizontal portion, vertical portion, and two lateral masses (labyrinths) (Figs. 2.14–2.17). The **horizontal portion,** called the **cribriform plate,** fits into the ethmoid notch of the frontal bone (Figs. 2.6 and 2.7). This plate contains many foramina for the passage of olfactory nerve fibers (Figs. 2.14 and 2.15). The **crista galli,** a bony projection stemming from the midline of the cribriform plate, projects superiorly to act as an attachment for the falx cerebri, which is the connective tissue that anchors the brain to the anterior cranial fossa (Figs. 2.16 and 2.17). The **vertical portion** of the ethmoid bone, called the **perpendicular plate,** projects inferiorly from the cribriform plate to form a portion of the bony nasal septum (Fig. 2.16). The **lateral masses (labyrinth)** incorporate thin-walled **orbital plates** (lamina papyracea), which create a portion of the medial orbit (Figs. 2.15 and 2.17). Contained within the lateral masses are many ethmoid air cells (**ethmoid sinuses**), one of the largest being the **ethmoid bulla** (Figs. 2.14–2.16). Projecting

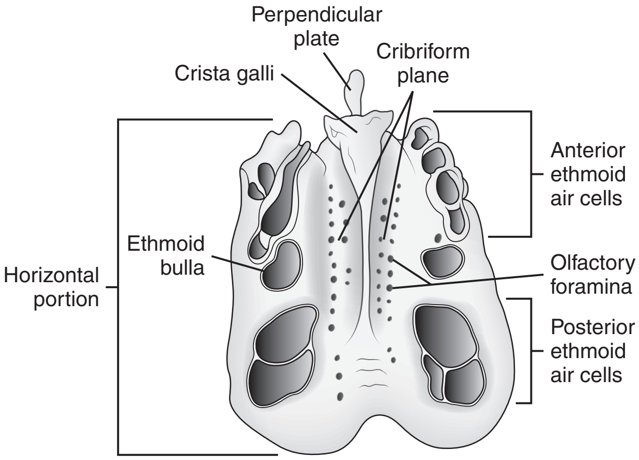


FIG. 2.14 Superior view of ethmoid bone.

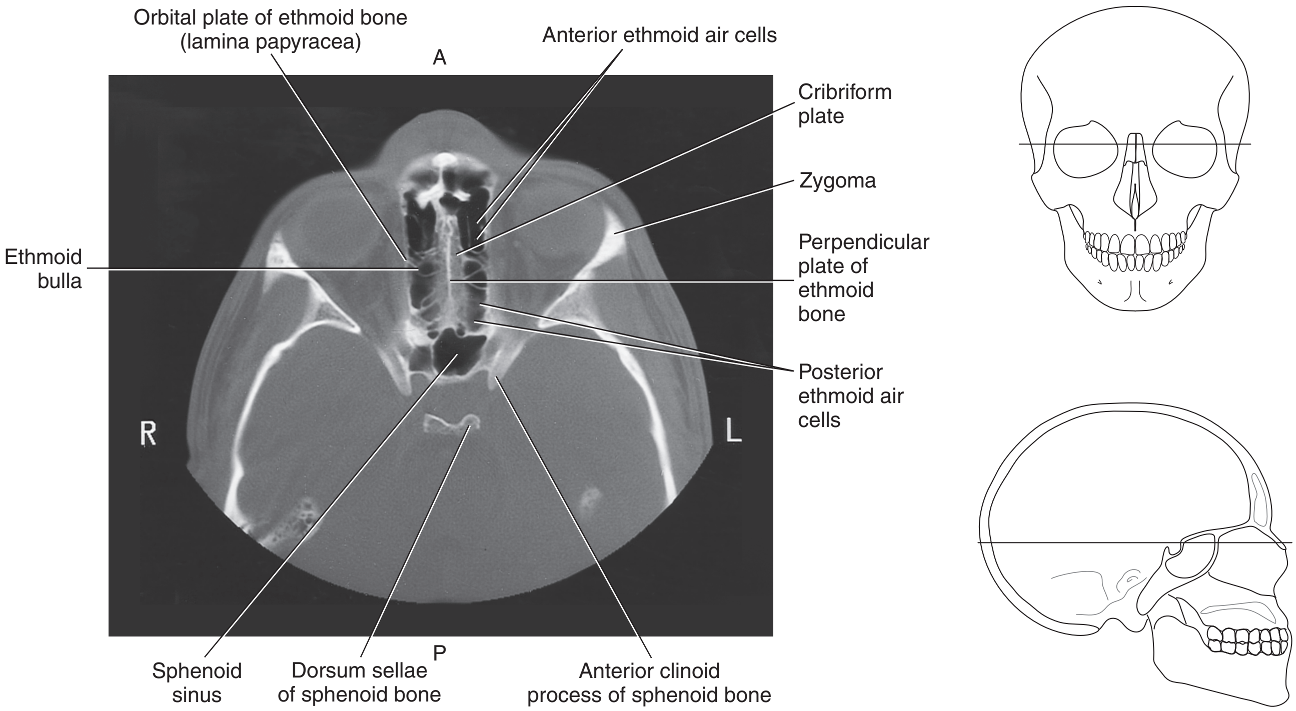


FIG. 2.15 Axial CT of ethmoid bone.

from the lateral masses are two scroll-shaped processes called the **superior** and **middle nasal conchae** (turbinates) and the **uncinate process.** Between the uncinate process and ethmoid bulla is a narrow groove called the **infundibulum,** which is an important landmark of the paranasal sinuses (Figs. 2.16 and 2.17).

The naso-orbitoethmoid (NOE) complex is the union of the ethmoid sinuses, frontal bone and sinuses, anterior cranial fossa, orbits, and nasal bones. Fractures of the NOE may cause symptoms that include nasal and forehead swelling, diplopia (double vision), and cerebrospinal fluid (CSF) rhinorrhea (leakage of CSF into the nose).

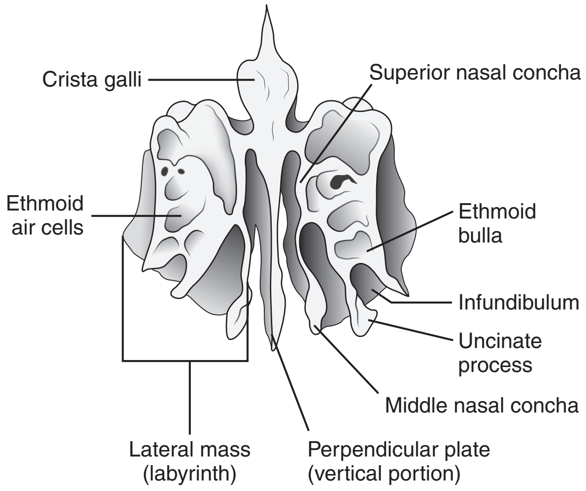


FIG. 2.16 Anterior view of ethmoid bone.

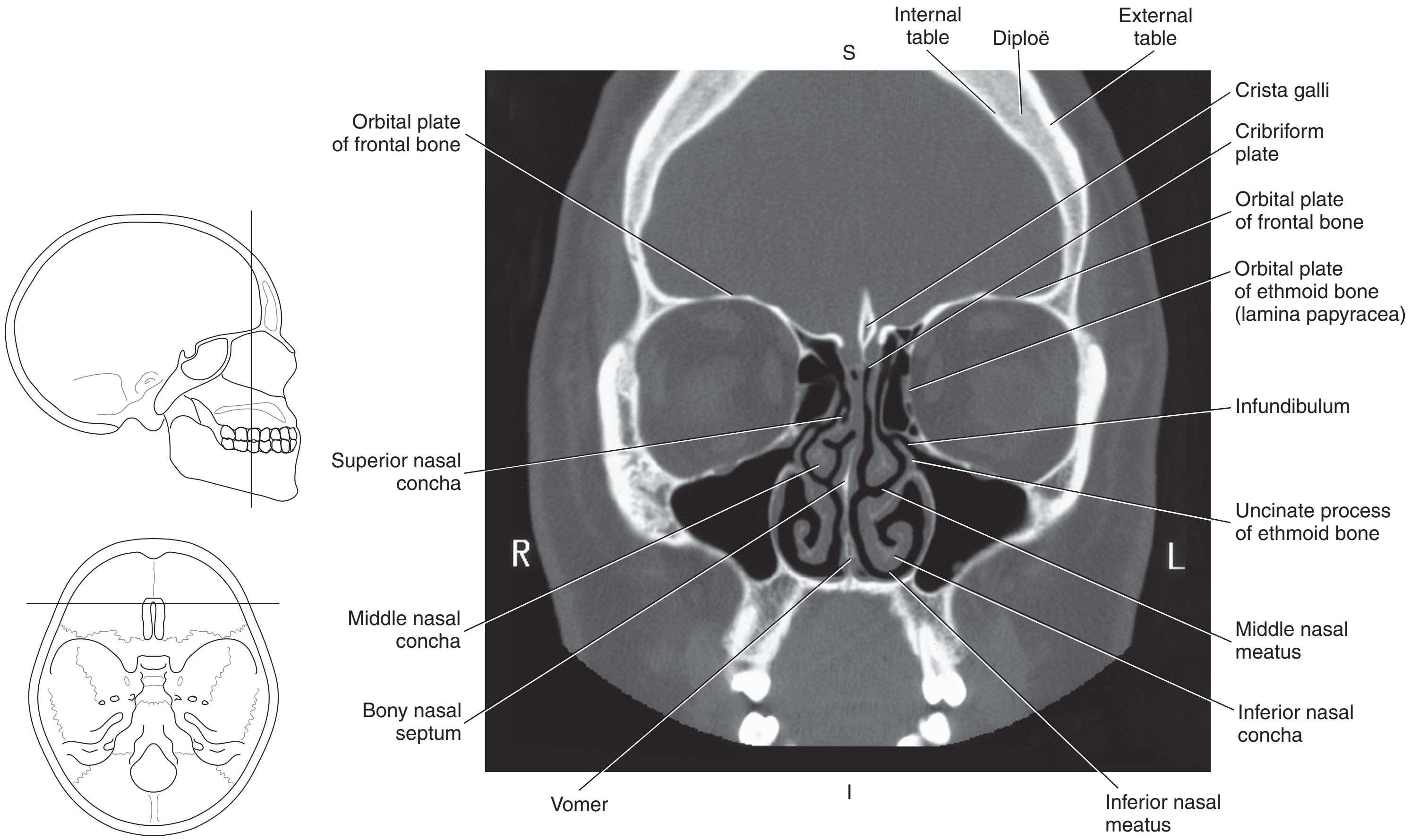


FIG. 2.17 Coronal CT of ethmoid bone with crista galli.

Sphenoid Bone

The butterfly-shaped **sphenoid bone** extends completely across the floor of the middle cranial fossa (Figs. 2.6 and 2.7). This bone forms the majority of the base of the skull and articulates with the occipital, temporal, parietal, frontal, and ethmoid bones. The main parts of the sphenoid bone are the body, lesser wings (2), and greater wings (2) (Fig. 2.18). Located within the **body** of the sphenoid bone is a deep depression called the **sella turcica,** which houses the hypophysis (pituitary gland). Directly below the sella turcica are two air-filled cavities termed **sphenoid sinuses** (Figs. 2.15 and 2.19). The anterior portion of the sella turcica is formed by the **tuberculum sellae,** and the posterior portion by the **dorsum sellae.** The dorsum sellae give rise to the **posterior clinoid processes** (Figs. 2.18 and 2.20–2.22). The triangular-shaped **lesser wings** attach to the superior aspect of the body and form two sharp points called **anterior clinoid processes,** which, along with the posterior clinoid processes, serve as attachment sites for the tentorium cerebelli (Figs. 2.18, 2.20, and 2.22). The **optic canal** is completely contained within the lesser wing and provides passage of the optic nerve and ophthalmic artery

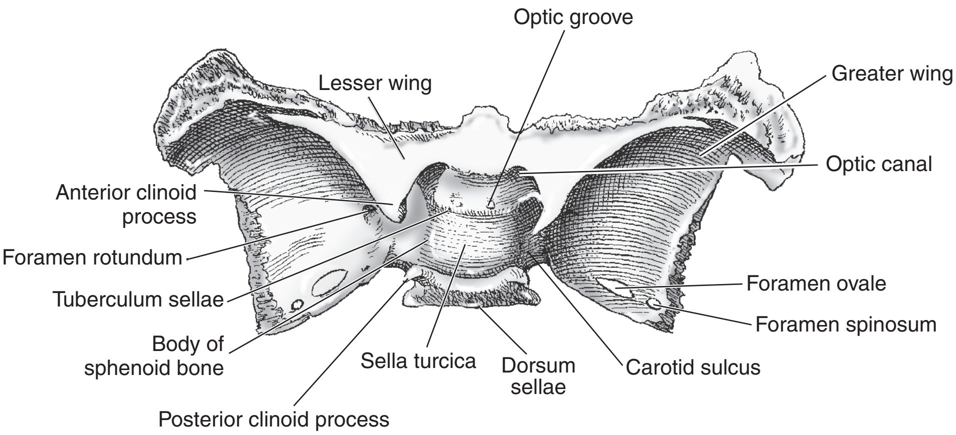


FIG. 2.18 Superior view of sphenoid bone.

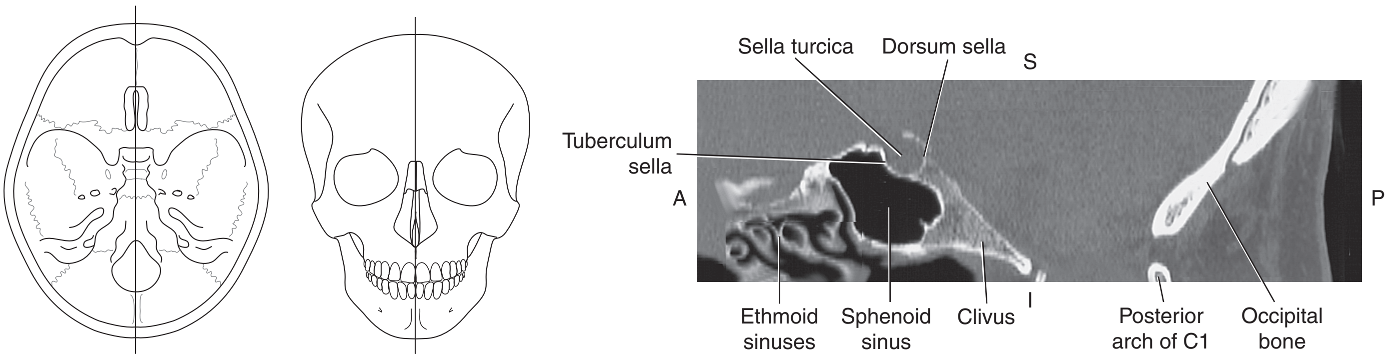


FIG. 2.19 Sagittal CT reformat of sella turcica.

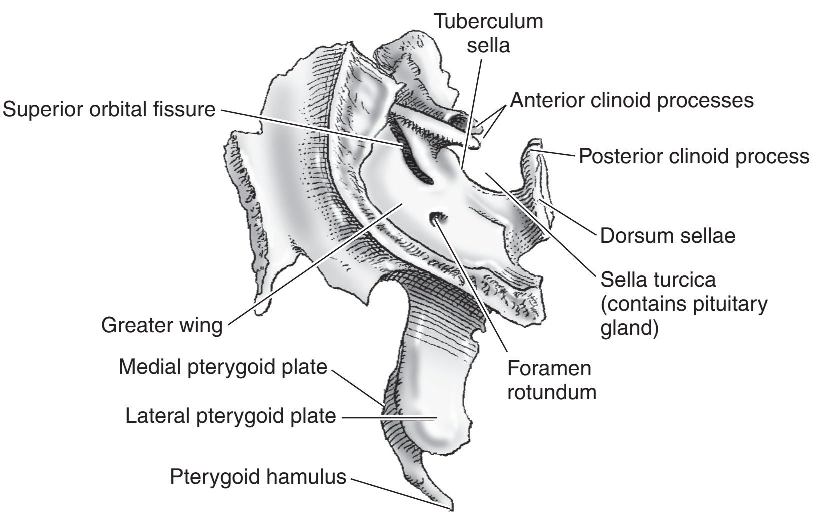


FIG. 2.20 Lateral view of sphenoid bone.