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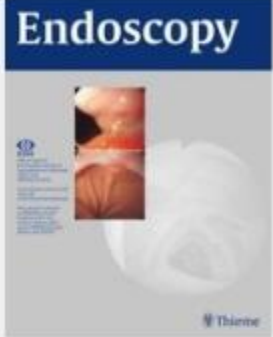
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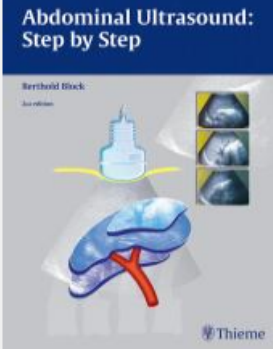
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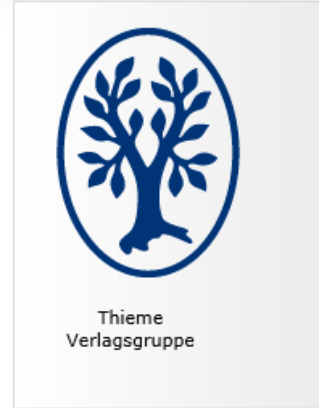
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LEARNING GOALS

- Locate the liver.
- Clearly delineate the liver from its surroundings.
- Survey the total liver volume in multiple planes.
- Recognize portions of the liver that are difficult to scan.

The liver is the dominant organ of the right upper abdomen. It is protected by ribs and is covered mainly by the right costal arch. These simple anatomical facts are widely known, but they have special significance and implications for ultrasound scanning.

1. The liver is so large that cannot be scanned adequately from one approach. A complete examination of the liver requires scanning from multiple angles and directions.
2. The liver cannot be scanned by the shortest route, but only from beneath the costal arch or between the ribs (Fig. 4.1). This means that while performing serial scans, you will view many sections of the liver more than once but are apt to miss blind spots if you are not fully familiar with the extent of the organ. Figure 4.2 illustrates this problem with an analogy.

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Fig. 4.1 Approaches for scanning the liver.

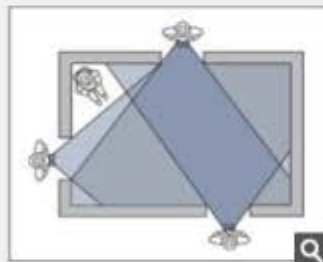


Fig. 4.2 Difficulties of liver scanning. In this analogy, an observer is looking into a room through three windows. Moving from window to window, he views the center of the room several times and sees corners a total of five times. Even so, he is unable to see the man sitting in one corner of the room.



Fig. 4.3 The liver (L) in upper abdominal transverse section.

# 7 Pancreas

## Organ Boundaries

### LEARNING GOALS

- Locate and identify the pancreas.
- Demonstrate the entire pancreas.

The pancreas is located in the retroperitoneum, bounded on each side by the duodenum and the spleen. It lies transversely in the epigastrium, its axis directed at a slight angle from lower right to upper left.

### Locating the pancreas

#### Barriers to scanning

The pancreas is often difficult to locate because of its posterior position. The main barrier to scanning the pancreas is gas in the stomach and bowel (Fig. 7.1).

#### Optimizing the scanning conditions

The pancreas, like the gallbladder, is best examined in the fasted patient. In some cases, visualization can be significantly improved by giving the patient an antigas medication. You can also apply local transducer pressure to push the gas aside. Of course, this should be done only after the other organs have been examined. Vision can be substantially improved by filling the stomach with water (500 ml, taken through a straw) (Fig. 7.2).

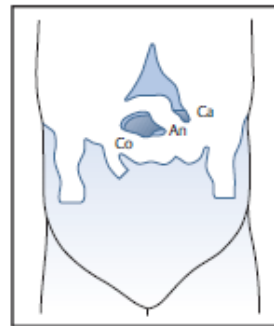
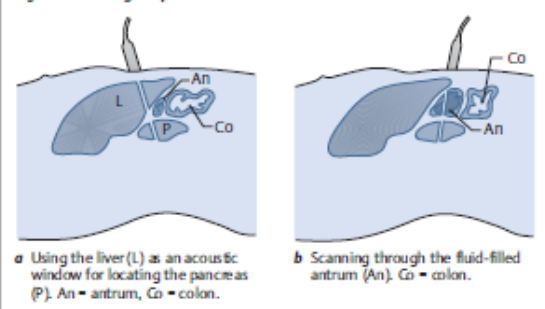


Fig. 7.1 The pancreas is obscured by the colon (Co), antrum (An), and costal arch (Ca).

Fig. 7.2 Locating the pancreas



a Using the liver (L) as an acoustic window for locating the pancreas (P). An = antrum, Co = colon.

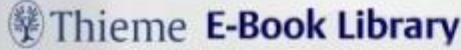
b Scanning through the fluid-filled antrum (An). Co = colon.



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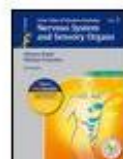
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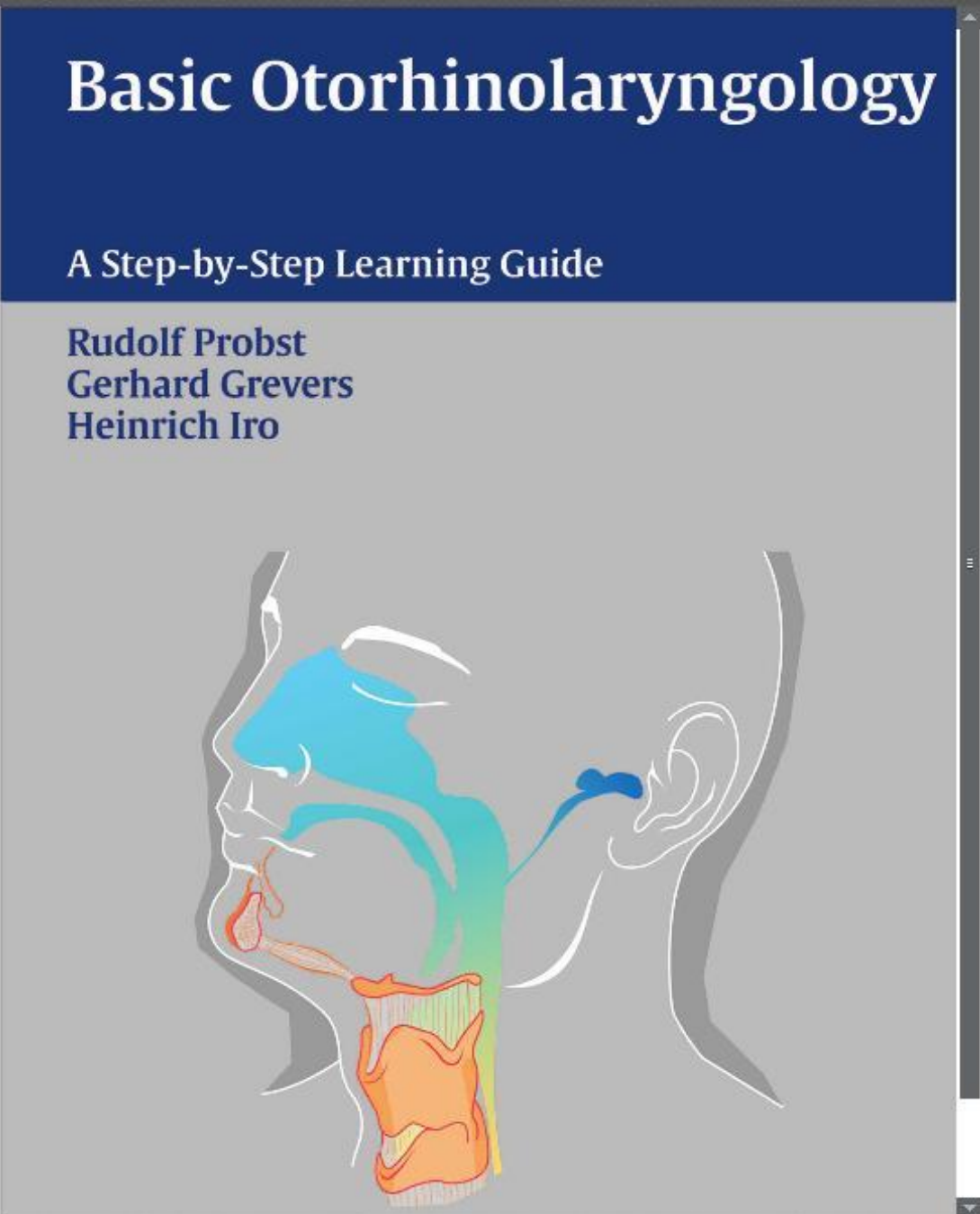
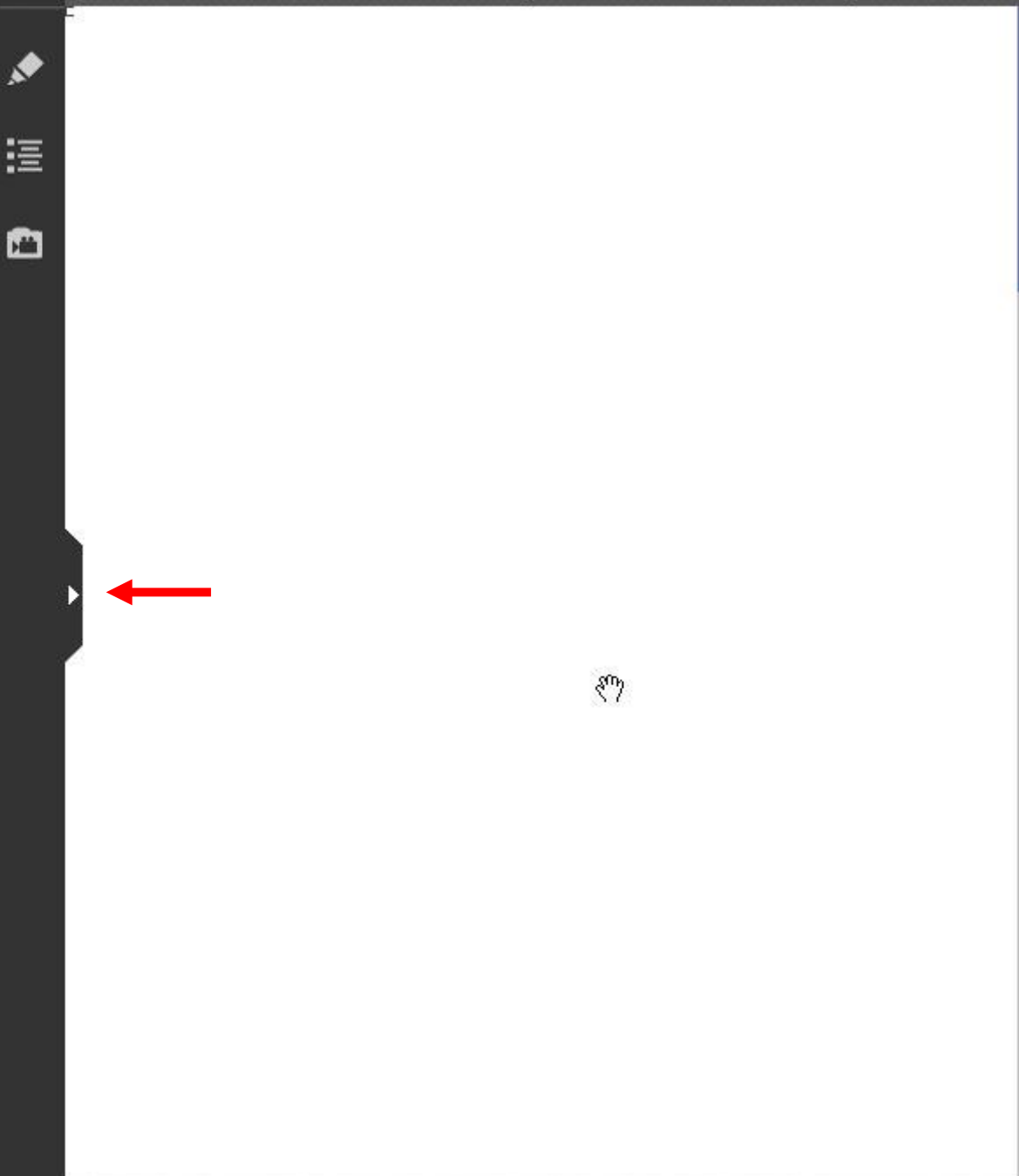
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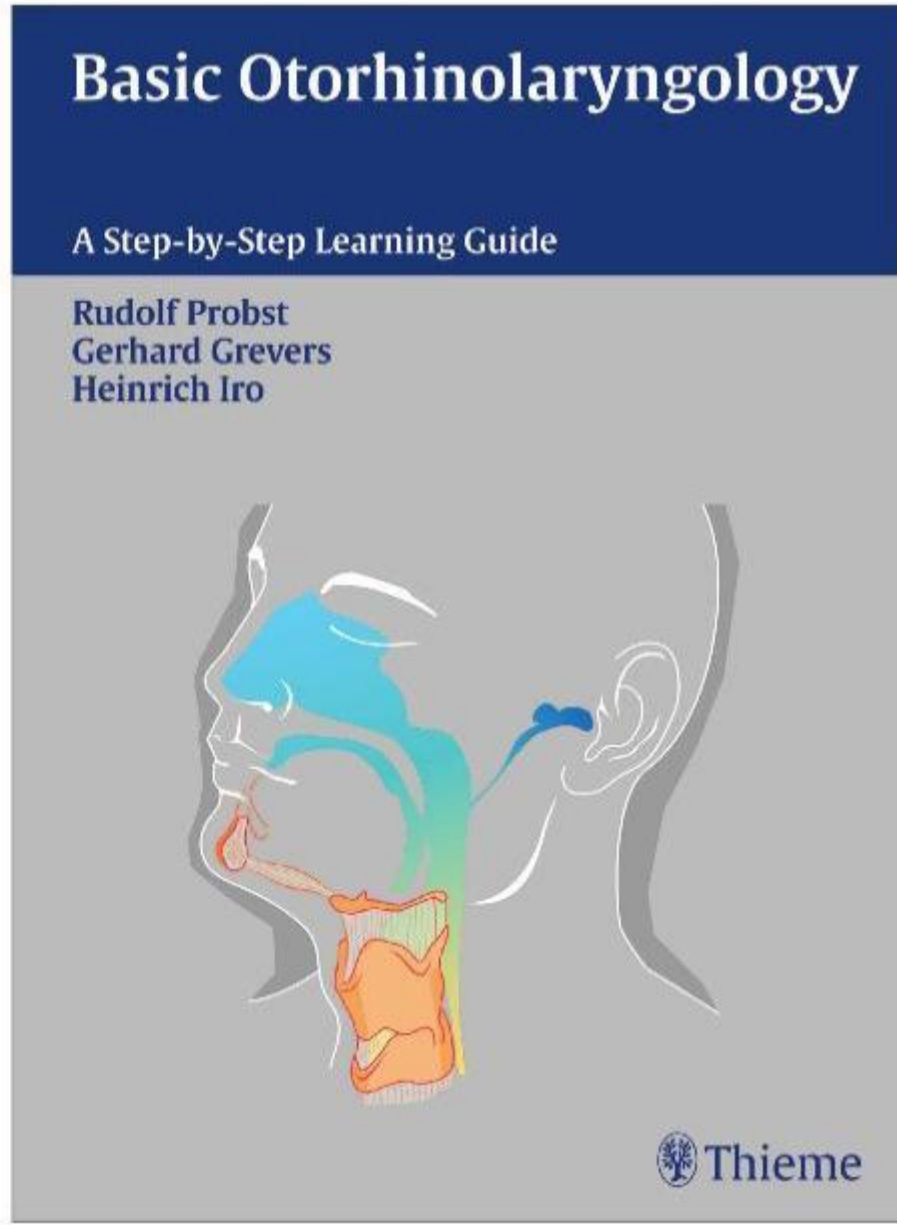



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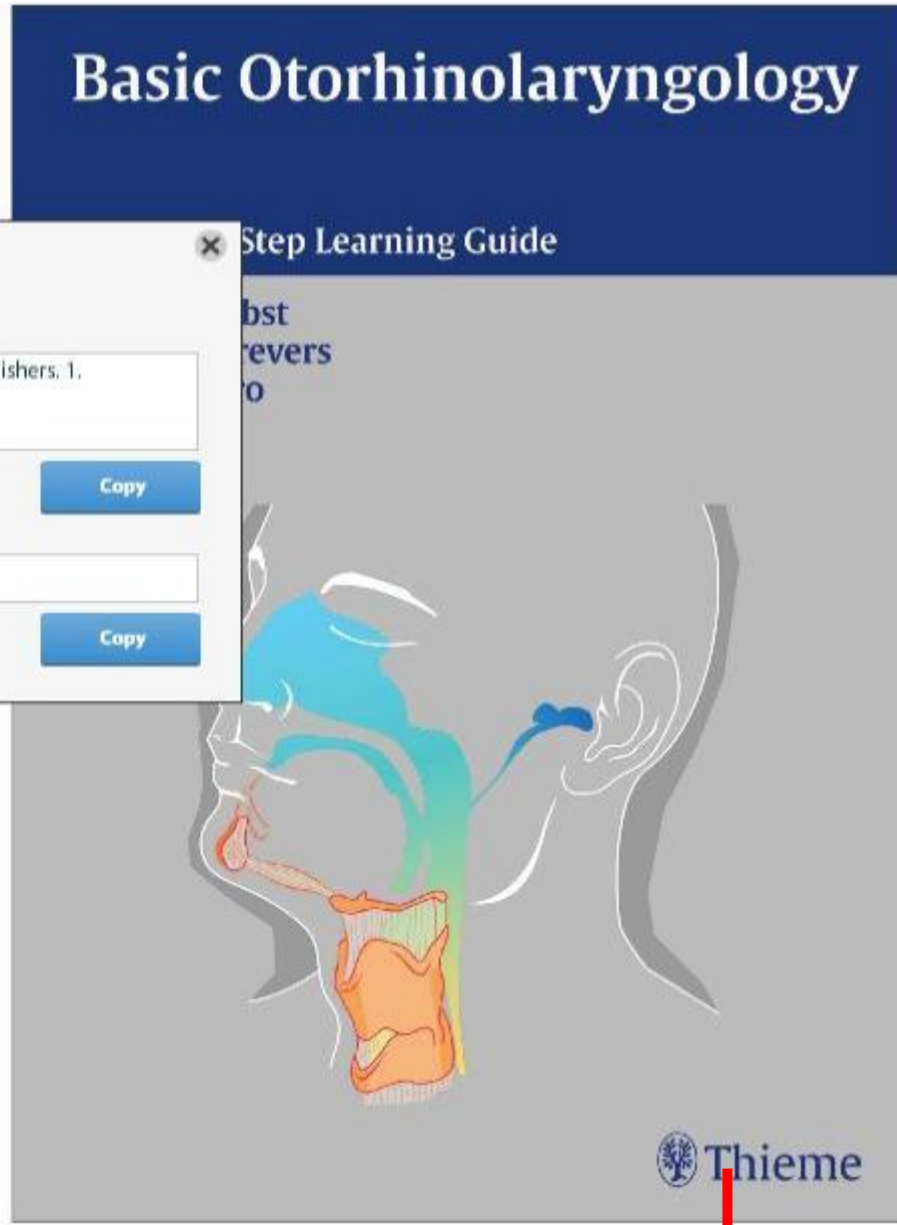


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6 I Nose, Paranasal Sinuses, and Face

Fig. 1.2 Paranasal sinuses

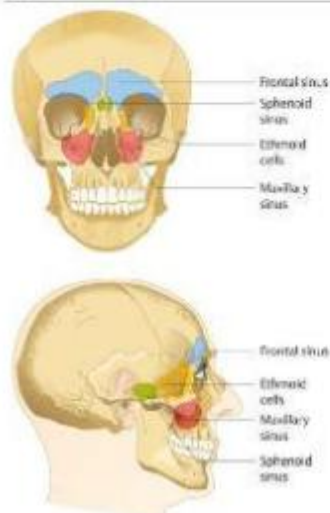


Diagram of the sinuses projected onto the cranial surface.

lary artery along with branches of the trigeminal nerve and autonomic nervous system. The floor of the maxillary sinus is closely related to the roots of the second premolar and first molar teeth. This creates a potential route for the spread of odontogenic infections, and a tooth extraction may create a communication between the oral cavity and maxillary sinus (oroantral fistula). Superior and medial to the maxillary sinus are the **ethmoid air cells**—a labyrinthine system of small, pneumatized sinus cavities that are separated from one another by thin bony walls and extend posteriorly between the middle turbinate (medial border) and orbit to the sphenoid sinus. The orbital plate of the ethmoid bone, called also the **lamina papyracea**, forms the lateral bony wall that separates the ethmoid air cells from the orbit. Paranasal sinus inflammations can spread through this lamina to involve the orbit (orbital complications). The posterior ethmoid cells are closely related to the optic nerve. The ethmoid roof and cribriform plate (Fig. 1.2) form the bony boundary that separates the ethmoid cells from the anterior cranial fossa. The surgeon who operates

in this region must have a detailed knowledge of the relations of these structures to the ethmoid labyrinth. The **sphenoid sinus** is located at the approximate center of the skull above the nasopharynx. Its posterior wall is formed by the **clivus**. It relates laterally to the  **cavernous sinus**, the **internal carotid artery**, and **cranial nerves II–VI**, and it is very closely related to the **optic canal**.

The **optic nerve** and **internal carotid artery** may run directly beneath the mucosa of the lateral wall of the sphenoid sinus, without a bony covering.

The **sphenoid sinus** is bordered superiorly by the **sella turcica** and **pituitary** and by the **anterior and middle cranial fossae**.

The **frontal sinus** is located in the frontal bone, its floor forming the medial portion of the orbital roof. The sinus, which is highly variable in its extent, is bounded behind by the **anterior cranial fossa**. Inflammations of the frontal sinus can give rise to serious complications because of its close proximity to the orbit and cranial cavity (orbital cellulitis, epidural or subdural abscess, meningitis).

Vascular Supply

The external nose derives most of its **blood supply** from the **facial artery**, which arises from the **external carotid artery**, and from the **ophthalmic artery**, which springs from the **internal carotid artery**. The **internal nose** receives blood from the territories of the external and internal carotid arteries: the terminal branches of the **sphenopalatine artery**, which arises from the maxillary artery, and the **anterior and posterior ethmoid arteries**, which arise from the ophthalmic artery. A detailed knowledge of the vascular supply is particularly important in the management of intractable epistaxis (nosebleed), which requires vascular ligation or angiographic embolization as a last recourse (see also Fig. 3.3, Epistaxis, p. 35). The **venous drainage** of the facial region is handled by the **facial vein**, **retromandibular vein**, and **internal jugular vein**.

The **regional lymphatic drainage** of the face and external nose is handled mainly by the **submandibular lymph nodes**, while the nasal cavity is additionally drained by the **retropharyngeal and deep cervical lymph nodes**.

Nerve Supply

The facial skin receives its **sensory innervation** from terminal branches of the **trigeminal nerve** that enter the facial region through the **supraorbital, infraorbital, and mental foramina** (Fig. 1.2). Only the skin over the **mandibular angle** and the lower portions of the auricle are supplied by the **great auricular nerve**. The facial muscles are classified as **mimetic or masticatory**, each of these groups receiving different motor innervation. While the mimetic muscles of the face develop from the blastema of the second branchial arch (the hyoid arch) and accordingly are supplied by the **facial nerve**, the masticatory muscles trace their embryonic development to the first branchial arch (the mandibular arch) and are therefore supplied by **mandibular nerve branches** arising from the **trigeminal nerve**.

7 1 Anatomy, Physiology, and Immunology of the Nose, Paranasal Sinuses, and Face

1.3 Anatomy of the ostiomeatal unit

The term "**ostiomeatal unit**" describes the area on the lateral nasal wall where the cells of the paranasal sinuses (except for the sphenoid sinus) open into the nasal cavity in a duct-like fashion. Even minor changes (e.g., anatomical variants, mucosal swelling) can hamper ventilation in this region, leading to pathologic sequelae in the paranasal sinuses (see below). The functionally significant anatomic structures of the ostiomeatal unit are the **uncinate process**, the **semilunar hiatus**, the **frontal recess**, the **ethmoid bulla**, the **ethmoid infundibulum**, and the **maxillary sinus ostium** (a coronal section is shown at right). The **frontal sinus** is connected to the ostiomeatal unit via the **frontal recess**, which has an hourglass-like shape. The **uncinate process** is a thin fibrous or bony process on the lateral nasal wall that arises slightly behind the anterior border of the middle turbinate and may narrow the passage from the nasal cavity to the ostiomeatal complex, depending on its degree of development. Located between the posterior border of the uncinate process and the first ethmoid cell (the **ethmoid bulla**) is another slitlike passage within the ostiomeatal complex, known as the **semilunar hiatus**. The space between the uncinate process, ethmoid bulla, and lamina papyracea of the ethmoid bone is called the **ethmoid infundibulum**.

The ostiomeatal unit is bounded medially (toward the nasal cavity) by the middle turbinate and laterally by the lamina papyracea. The main clinical significance of this region relates to the sites of narrowing in the ostiomeatal unit. For example, hyperemia

and swelling of the mucosa in the setting of a common cold can obstruct the narrow passages in the ostiomeatal unit, preventing adequate ventilation of the dependent paranasal sinus system and setting the stage for a rhinogenic inflammation of the paranasal sinuses (sinusitis).



Functional Anatomy of the Ostiomeatal Unit

The nose and paranasal sinuses are regarded as a functional unit. Many rhinologic disorders are transmitted from the nasal cavity into the paranasal sinus system. The ostiomeatal unit is the collective term for various anatomical structures located about the middle meatus. It represents the region on the lateral nasal wall that receives drainage from the anterior ethmoid cells, frontal sinus, and maxillary sinus (Fig. 1.3). It is important to know the anatomical details of this region in order to understand the pathophysiology of acute and especially chronic paranasal sinus inflammations and the surgical procedures that are used in the causal treatment of these conditions.



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Fig. 1.6 Paranasal sinuses

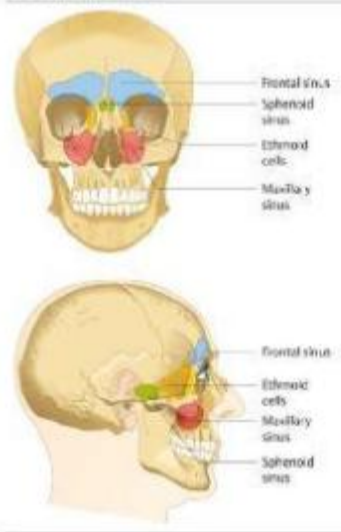


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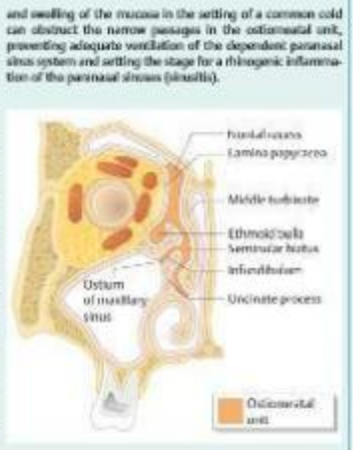
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7 | Anatomy, Physiology, and Immunology of the Nose, Paranasal Sinuses, and Face

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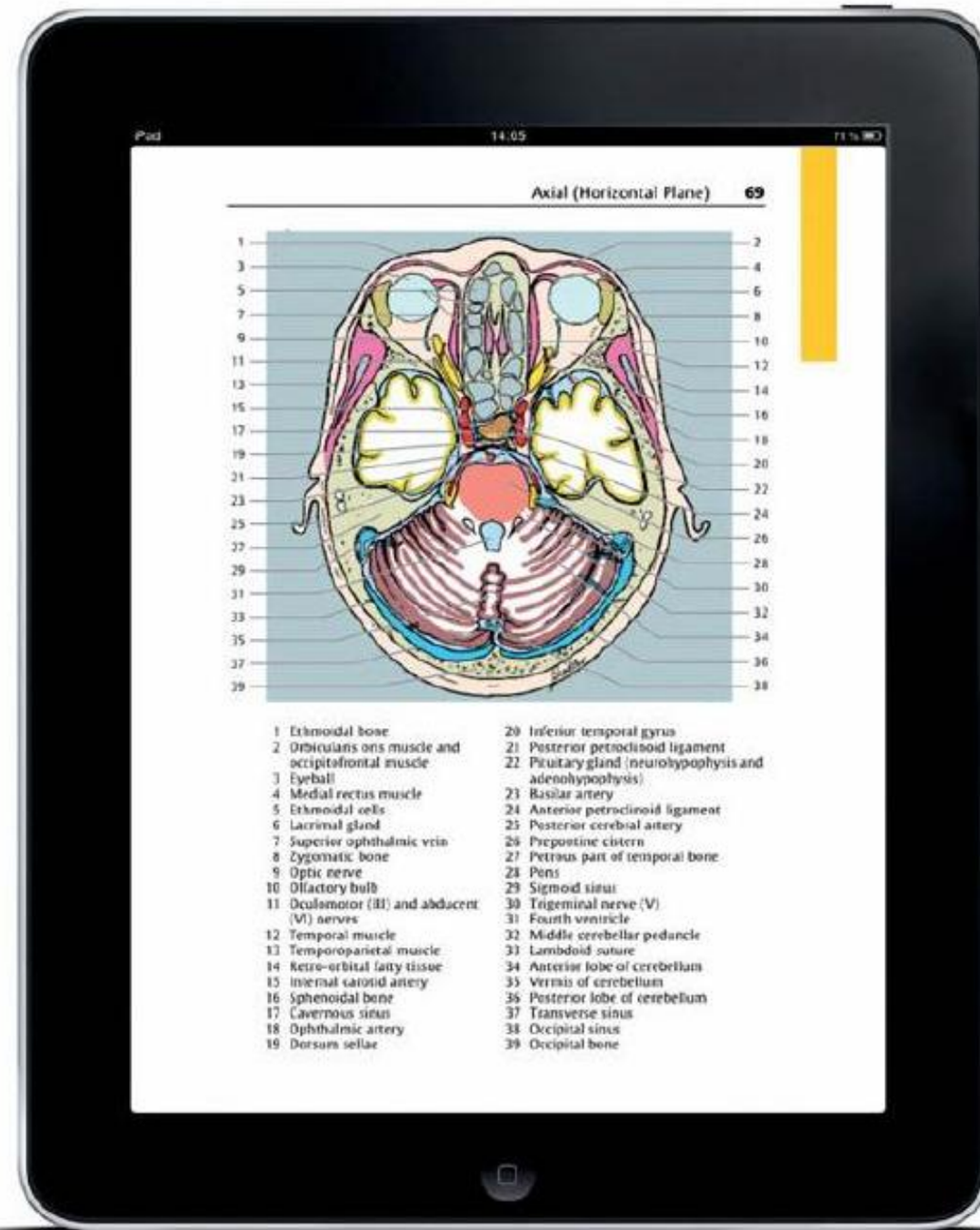
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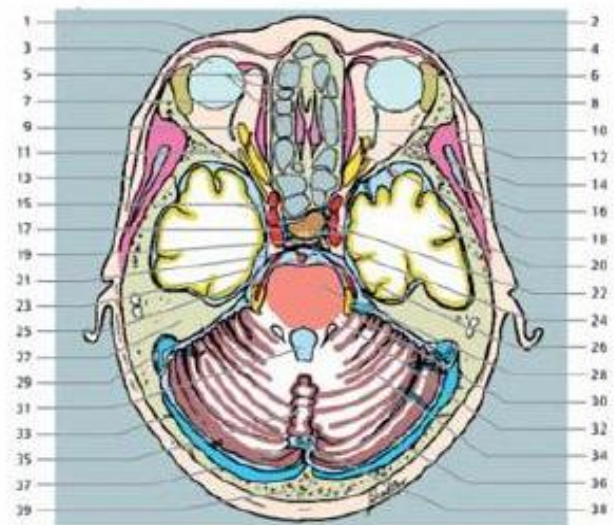
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Axial (Horizontal Plane) 69



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|--|--|
| 1 Ethmoidal bone                                     | 20 Inferior temporal gyrus                               |
| 2 Orbicularis oris muscle and occipitofrontal muscle | 21 Posterior petrosclerous ligament                      |
| 3 Eyeball  | 22 Pituitary gland (neurohypophysis and adenohypophysis) |
| 4 Medial rectus muscle                               | 23 Basilar artery  |
| 5 Ethmoidal cells                                    | 24 Anterior petrosclerous ligament                       |
| 6 Lacrimal gland                                     | 25 Posterior cerebral artery                             |
| 7 Superior ophthalmic vein                           | 26 Preoptine cistern                                     |
| 8 Zygomatic bone                                     | 27 Petrous part of temporal bone                         |
| 9 Optic nerve  | 28 Pons  |
| 10 Olfactory bulb                                    | 29 Sigmoid sinus   |
| 11 Oculomotor (III) and abducent (VI) nerves         | 30 Trigeminal nerve (V)                                  |
| 12 Temporal muscle                                   | 31 Fourth ventricle                                      |
| 13 Temporoparietal muscle                            | 32 Middle cerebellar peduncle                            |
| 14 Retro-orbital fatty tissue                        | 33 Lambdoid suture                                       |
| 15 Internal carotid artery                           | 34 Anterior lobe of cerebellum                           |
| 16 Sphenoidal bone                                   | 35 Vermis of cerebellum                                  |
| 17 Cavernous sinus                                   | 36 Posterior lobe of cerebellum                          |
| 18 Ophthalmic artery                                 | 37 Transverse sinus                                      |
| 19 Dorsum sellae                                     | 38 Occipital sinus                                       |
|  | 39 Occipital bone  |

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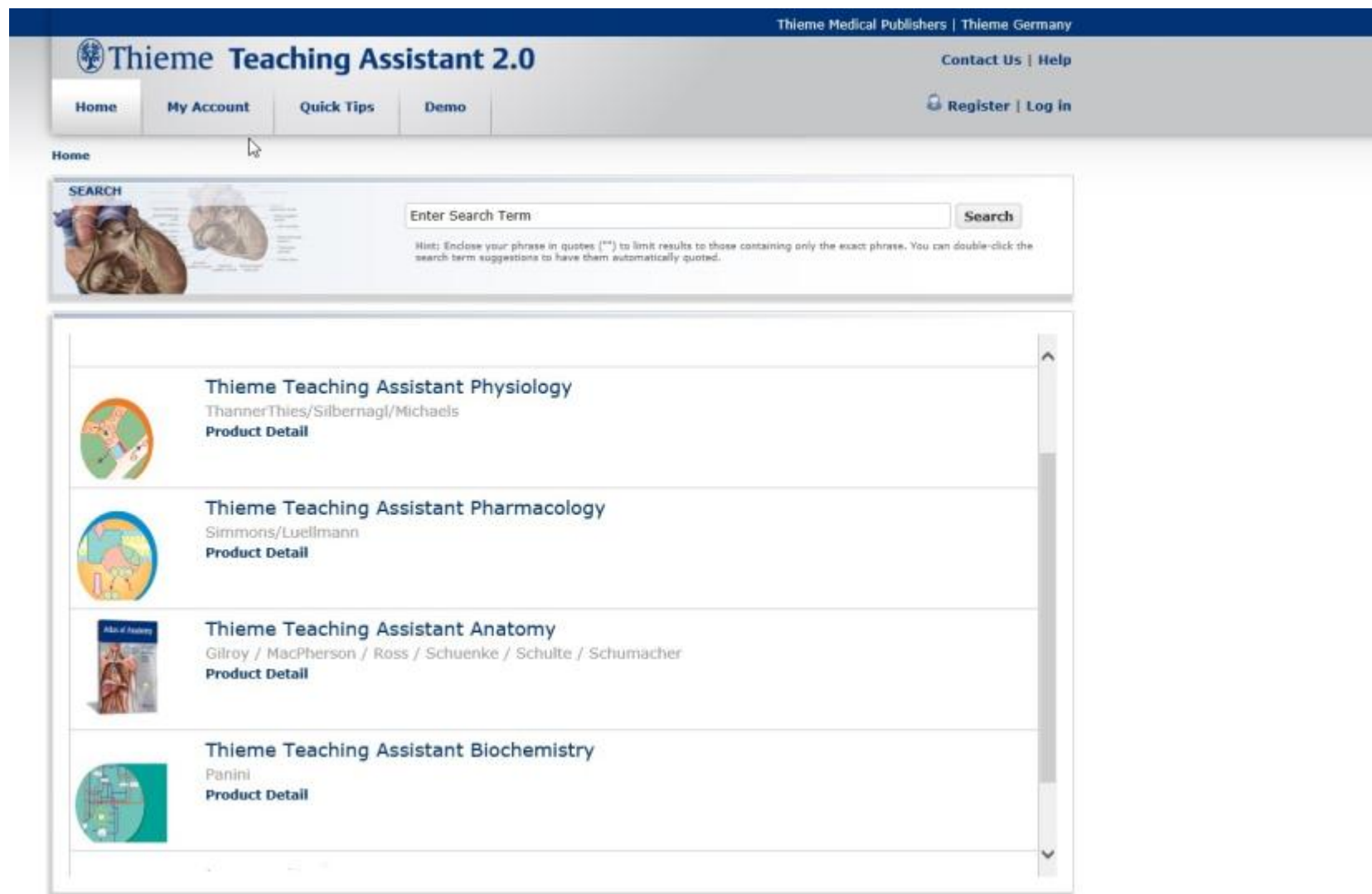
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The screenshot displays the homepage of the Thieme Teaching Assistant 2.0 website. At the top, a dark blue header contains the text "Thieme Medical Publishers | Thieme Germany" on the right. Below this, a light grey navigation bar features the Thieme logo and the title "Thieme Teaching Assistant 2.0" on the left, and links for "Contact Us | Help" and "Register | Log In" on the right. A secondary navigation bar includes "Home", "My Account", "Quick Tips", and "Demo".

The main content area begins with a "SEARCH" section on the left, featuring an anatomical illustration of a heart. To the right is a search input field labeled "Enter Search Term" with a "Search" button. A small hint below the field reads: "Hint: Enclose your phrase in quotes (\"'\") to limit results to those containing only the exact phrase. You can double-click the search term suggestions to have them automatically quoted."

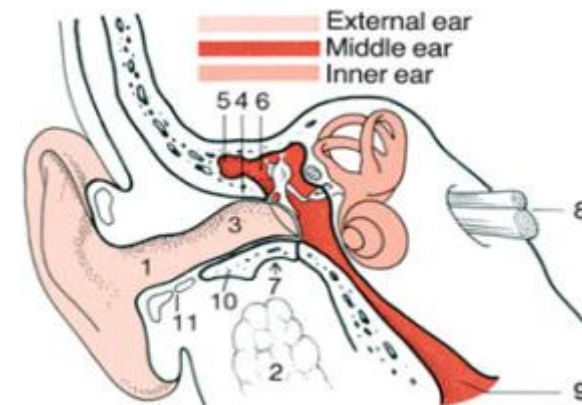
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