FOURTH EDITION

Cleft Palate and Craniofacial Conditions

A Comprehensive Guide to Clinical Management

Ann W. Kummer

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14972-2

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Cover Design: Kristin E. Parker
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Media Development Editor: Troy Liston
Cover Image (Title Page, Part Opener, Chapter Opener):
© PeopleImages/Getty Images
Printing and Binding: LSC Communications
Cover Printing: LSC Communications

Library of Congress Cataloging-in-Publication Data

Names: Kummer, Ann W., author.
Title: Cleft palate and craniofacial conditions: a comprehensive guide to clinical management / Ann W. Kummer.
Other titles: Cleft palate and craniofacial anomalies
Description: Fourth edition. | Burlington, Massachusetts: Jones & Bartlett Learning, [2020] |
Preceded by Cleft palate and craniofacial anomalies / Ann W. Kummer. Third edition. 2014. |
Includes bibliographical references and index.
Identifiers: LCCN 2018005640 | ISBN 9781284149104 (pbk.)
Subjects: | MESH: Cleft Palate—complications | Speech Disorders—etiology |
Cleft Palate—therapy | Speech Disorders—therapy | Craniofacial
Abnormalities—complications | Craniofacial Abnormalities—therapy
Classification: LCC RJ496.S7 | NLM WV 440 | DDC 617.5/225—dc23
LC record available at https://lccn.loc.gov/2018005640

6048

Printed in the United States of America
22 21 20 19 18 10 9 8 7 6 5 4 3 2 1

DEDICATION

This book is dedicated to the three people who have influenced me most in my life and helped me to be the best that I can be. Without their love and support, I would never have had a career and certainly would not have had the opportunity to write this book . . . now for the fourth time.

The first dedication is to my father, who was a wonderful, caring, and talented otolaryngologist whom I always admired. I always wanted to be like my dad when I was growing up.

The next dedication is to my mother, who was the kindest, most thoughtful, and most caring person I have ever known. Once I grew up, I tried to be more like her. (I'm still trying.)

The final dedication is to my husband, who has loved me, supported me, encouraged me, and helped me to focus and succeed in my career. For that I will be eternally grateful!

Ann

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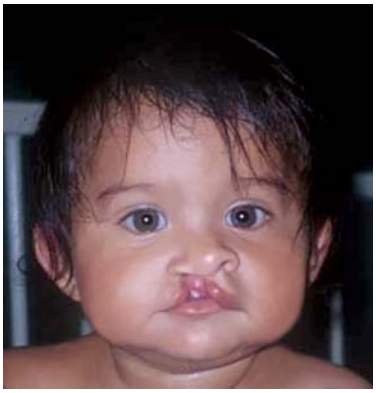
PREFACE



Anticipating the birth of a new baby is usually a very exciting time of life. The expectant couple does many things to prepare for the baby, including setting up a nursery, gathering baby clothes and diapers, and deciding on a name. The parents expect to have a normal baby, with 10 fingers, 10 toes, and an intact face. Usually, they are totally unprepared for the possibility of a different outcome.

Unfortunately, not all babies are born with perfect structures. When a child is born with cleft lip, cleft palate, or other craniofacial anomalies, this is a true shock, especially because it involves the face. What was expected to be a very happy and exciting time becomes a very stressful and emotional time for the parents and other family members. It may be impossible for the parents to see past the anomaly to really appreciate their newborn baby.

Cleft lip with or without cleft palate is the fourth most common birth defect and the first most common facial birth defect. In fact, about 1 in every 700 children born in the United States each year has a cleft of the lip and/or palate. About half of these children have other associated malformations. Cleft palate is a characteristic of well over 400 recognized syndromes.

Although current medical technology is not advanced enough to prevent the occurrence of these birth defects, most of the speech and functional impairments associated with craniofacial anomalies can be improved or even corrected with the help of a team of professionals. To provide the type of care that these patients require, this group of professionals must be specialists within their fields. For true quality care, they must have a thorough understanding of the current methods of evaluation and treatment of these patients.

Considering the incidence of clefts and craniofacial anomalies in the general population, however, all healthcare providers should have at least basic knowledge about the management of these patients and appropriate referrals. In particular, speech-language pathologists must be trained in the basic evaluation and treatment and appropriate referrals of individuals with these conditions, especially considering the fact that they often have a significant effect on speech. Certainly, school-based speech-language pathologists are very likely to have children on their caseloads with a history of cleft, craniofacial anomalies, or resonance disorders.

Purpose of This Text

The purpose of this text is to inform, educate, and excite students and professionals in speech-language pathology and the medical and dental professions regarding the management of individuals with clefts or craniofacial anomalies. This text is designed to be a textbook for graduate students and a sourcebook for healthcare professionals who provide services in this area. My goal in writing this text was to provide readers with a great deal of information but in a way that is both interesting and easy to read. As an active

clinician myself, my intent was to make this text a very practical how-to guide as well as a source of didactic and theoretical information.

My ultimate goal with this text is to improve the knowledge of treating professionals who work with individuals who are affected by a cleft or other craniofacial conditions. It is hoped that with this knowledge, they can positively affect the quality of care provided to this population.

Organization

This text was written in a purposeful sequence so that the information from each chapter builds on the information from previous chapters.

Part 1 of this text provides basic information on the normal anatomy of the orofacial structures and the normal physiology of the velopharyngeal valve. Once the normal structures and function are described, information on genetics and patterns of inheritance is covered. The rest of Part 1 consists of information about congenital and acquired craniofacial anomalies and craniofacial syndromes. Once the reader has completed the first section, the reader should have a firm understanding of normal and abnormal facial and velopharyngeal features and the potential causes of congenital and even acquired anomalies.

Part 2 of this text includes chapters on the various functional problems associated with clefts and craniofacial conditions. In particular, this section covers the effects of these anomalies on feeding, speech and language development, psychosocial function, and speech and resonance. After completing the second section, the reader will have an understanding of the number, types, and complexity of the problems that are secondary to clefts and craniofacial conditions. It will then be apparent to the reader that there is a need for multidisciplinary management of these patients in an interdisciplinary setting.

Part 3 of this text covers the various diagnostic methods for assessing speech, resonance, and velopharyngeal function. This section includes the perceptual examination of speech and resonance and the physical examination of the oral cavity and other orofacial structures. There is an overview chapter on instrumentation that is sufficient for graduate students. There are also individual chapters on the various types of instrumental procedures. These chapters are very detailed and written to provide specific information for practicing clinicians who will be using these procedures.

Part 4 of this text covers the treatment of speech and resonance disorders secondary to clefts, craniofacial anomalies, and velopharyngeal dysfunction. This section includes surgical management, prosthetic management, and speech therapy. The speech therapy chapter includes specific therapy strategies for achieving placement. In addition, there is a section on achieving carryover using motor learning and motor memory principles.

Part 5 of this text is short but important because it emphasizes the fact that many disciplines are needed to provide care for patients affected by clefts or craniofacial anomalies. The reader will complete this section with an understanding that quality patient care requires interdisciplinary interaction and collaboration in the assessment and treatment of these patients.

Features

- **Chapter outlines:** The outline of each chapter helps readers navigate through the content and find information quickly.
- **Figures:** This text includes almost 700 figures. These photos and illustrations are meant to enhance comprehension of information and concepts discussed in the chapters.
- **Case studies:** Several chapters include patient case studies to illustrate how chapter information applies to real-life situations.
- **Speech Notes:** Chapters regarding anomalies and surgeries have boxed sections called *Speech Notes*. These sections highlight how these anomalies or surgeries affect speech and resonance.

- **For Review and Discussion:** A list of questions and topics for discussion is included at the end of each chapter. The purpose of this section is to help the reader synthesize and apply information presented in the chapter. Instructors can also use this section for class discussion, student homework, or essay exams.
- **Definitions:** Selected technical and medical terms are presented in bold and defined within the text and in the glossary.
- **Glossary:** There is a glossary of terms at the end of the text that defines all the medical and technical terms that were bold in the individual chapters. The student may find that studying the glossary is helpful for learning much of the information in the text.

Online Resources

The following resources are available for students and instructors. For more information on how to access these resources, please visit go.jblearning.com/cleftpalate.

- **Cleft Notes:** The *Cleft Notes* are basic summaries in table format provided for each chapter. There are some compare-and-contrast aspects of these tables to help students assimilate the information. There are two versions of the Cleft Notes—a blank version for students to use when taking notes or studying, and a filled-out version for instructors. By completing the Cleft Notes, the students are engaged in more active learning and have a study guide for test preparation.
- **Handouts:** There are online handouts on a variety of topics that are covered in this text. These handouts are designed primarily for parents but can also be helpful to other professionals who are not familiar with the topic area. The handouts are designed so the user can print them directly from the website.
- **Videos:** There are 295 videos/animations/audio files online. These videos illustrate different types of speech and resonance disorders. There are videos of evaluation techniques, including nasopharyngoscopy, videofluoroscopy, and even nasometry studies. Finally, there are videos of speech therapy techniques that are effective with this population and also with other individuals with speech sound disorders. These videos are designed to help the viewer develop diagnostic and treatment skills by watching and listening to each video as many times as necessary. Because these videos are short and carefully edited, they facilitate better learning than direct observation in a clinic.
- **PowerPoint Presentations:** There are PowerPoint presentations, which include important figures and photos, for each chapter. These presentations can be used by the instructor for classroom teaching.
- **Testbank:** Assessment questions are available in a variety of different formats, including multiple choice, labeling, matching, and true/false.
- **Image Library:** The image library provides access to all the art in the textbook. This resource can be searched using keywords and subject areas.

New to This Edition

- **Photos:** Many new photos have been added, most of which are in color.
- **Drawings:** Anatomy figures have been rerendered for consistency and improved quality.
- **Tables:** Many chapters have information summarized in tables for easy learning. There are also tables of terms for normal and abnormal craniofacial, oral, dental, and pharyngeal structures and anomalies.
- **Chapter Text:** Chapters have been heavily edited with a focus on making the information clear, concise, and easy to read.
- **Chapter Order:** The chapter order has been reorganized for better flow.
- **Research Updates:** Information within the text and the references have been updated to reflect current research and literature.

Format Notes

Service providers must be sensitive to the emotional and psychological needs of the patient. Sensitivity to the feelings of the patient is often overlooked by well-meaning service providers. It is easy to forget that we deal with real people, not just interesting cases. This lack of sensitivity is sometimes reflected in the terminology that is used in the literature and in daily use. I recall listening to a speech given by an adult who was born with a cleft palate. As he described his childhood, he pointed out that being called a "cleft palate child" evoked very negative feelings. Fortunately, this type of phrase is becoming "politically incorrect," just as the term "harelip" has in the past. Using the anomaly as an adjective to describe the individual is certainly insensitive to the feelings of the person who was born with this anomaly. Therefore, it is preferable to use "patient-first" terminology as in "child with a cleft."

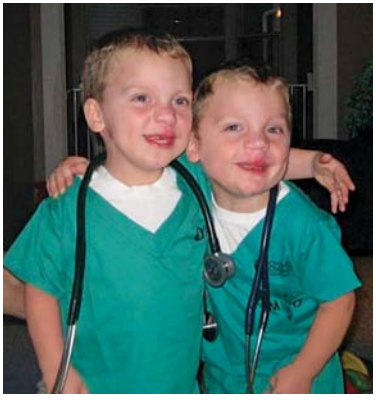
The reader will note that the word "child" is frequently used throughout the text for the individual with the anomaly. This is because the speech and resonance disorders secondary to cleft lip/palate and craniofacial anomalies are usually addressed during childhood. However, it should be understood that this information also applies to adults with the same anomalies.

Acknowledgments and Thanks

There are so many people that I would like to acknowledge for their help with this edition of the text. Many thanks go to the members of our VPI/Resonance Team at Cincinnati Children's, including Jenn Marshall, Shyla Miller, Cara Werner, Margaret (Meg) Wilson, and Sarah Woodhouse. They were very helpful in providing feedback, developing the Cleft Notes, and reviewing videos. Special thanks go to Cara Werner, who proofread the entire manuscript and online content. She also provided very valuable suggestions. I would like to thank the members of the Cleft and Craniofacial Center at Cincinnati Children's for being such great colleagues, mentors, and friends! I have learned so much through our professional interactions over the years. Finally, I'm very grateful to Laura Pagluica and her entire team at Jones & Bartlett including Rebecca Feeney, Vanessa Richards, Thais Miller, and Troy Liston. It was such a great experience working with them. I have been very impressed with the entire company and the quality of their products.

Final Words

I am very grateful for the opportunity to share with you what I have learned through my clinical practice over the years. I sincerely hope that through this text you will be educated, enlightened, and inspired to provide superior clinical services for individuals with clefts or other craniofacial conditions.



CREDITS

All photos courtesy of the Cleft and Craniofacial Center at Cincinnati Children's Hospital Medical Center.

KEY TO PHONETIC SYMBOLS

Vowels	
Symbol	**Examples**
/i/	b**ee**, s**ee**
/æ/	h**a**t, c**a**t
/ɑ/	f**a**ther, p**o**t
/ɚ/	teach**er**, moth**er**

Consonants		
Symbol	**Letters**	**Examples**
/ʔ/	glottal stop	bu**tt**on, mi**tt**en
/ʃ/,	sh	**sh**oe
/ʒ/	zh	meas**u**re
/ʧ/	ch	**ch**air
/ʤ/	j	**j**ump
/θ/	th	**th**in
/ð/	th	**th**en
/ŋ/	ng	si**ng**

Note: This key includes only the phonetic symbols used in this text.

ABOUT THE AUTHOR

Ann W. Kummer, PhD, CCC-SLP, FASHA, is the former senior director of the Division of Speech-Language Pathology at Cincinnati Children's. Under her direction of over 35 years, the speech-language pathology program at Cincinnati Children's became the largest pediatric program in the nation and one of the most respected. Dr. Kummer is professor of clinical pediatrics and professor of otolaryngology at the University of Cincinnati (UC), College of Medicine.

Dr. Kummer has done hundreds of national and international lectures and seminars in the areas of cleft palate and craniofacial anomalies, resonance disorders, velopharyngeal dysfunction, and business practices in speech-language pathology. She has taught the craniofacial anomalies course for five universities. She has also written numerous professional articles and 22 book chapters in speech pathology and medical texts. In addition to this text, she is one of the authors of the text *Business Practices: A Guide for Speech-Language Pathologists*. Dr. Kummer is the co-developer of the Simplified Nasometric Assessment Procedures (SNAP) test (1996) and author of the SNAP-R (2005), which is incorporated in the Nasometer™ equipment (PENTAX Medical). She holds a patent on the nasoscope, which is marketed as the Oral & Nasal Listener™ (Super Duper, Inc.). She was one of the main developers of workflow software that won the 1995 International Beacon Award through IBM/Lotus. (Derivative software is marketed by Chart Links.)

Dr. Kummer has received numerous honors, including Honors of the Southwestern Ohio Speech-Language-Hearing Association (1995); Honors of the Ohio Speech-Language-Hearing Association (OSLHA) (1997); Distinguished Alumnus Award from the Department of Communication Sciences and Disorders, University of Cincinnati (1999); Fellow of the American Speech-Language-Hearing Association (ASHA) (2002); named one of the top 25 most influential therapists in the United States by *Therapy Times* (2006); Honors for Distinguished Service, Department of Otolaryngology–Head and Neck Surgery, University of Cincinnati (2007); named one of the 10 Most Inspiring Women in Cincinnati (2007); inducted into the National Academy of Inventors, Cincinnati Chapter (2010); Distinguished Alumnus Award, College of Allied Health, University of Cincinnati (2012), Elwood Chaney Outstanding Clinician Award from the Ohio Speech-Language-Hearing Association (OSHLA) (2012); Annie Glenn National Leadership Award, Ohio School Speech Pathology Educational Audiology Coalition (OSSPEAC) (2014); and the Media Outreach Champion award from ASHA (2014). In 2017, she received Honors of the Association from ASHA, the highest award given by the association.

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It is with great appreciation that I would like to thank the various contributors to this edition. Their expertise was essential in making the contents of many of the chapters both accurate, current, and clinically relevant. I will be forever in their debt for their contributions.

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I would like to thank the reviewers who were kind enough to read through chapters and offer their advice. Their comments were greatly appreciated and most of their suggestions were incorporated in this edition.

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Karen Copple
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PART 1

Normal and Abnormal Craniofacial Structures

CHAPTER 1

Anatomy and Physiology

CHAPTER OUTLINE

INTRODUCTION

The nasal, oral, and pharyngeal structures are all very important for normal speech and resonance. Unfortunately, these are the structures that are commonly affected by cleft lip and palate and other craniofacial anomalies. Before the speech-language pathologist can fully understand the effects of oral and craniofacial anomalies on speech and resonance, a thorough understanding of normal structure (anatomy) and normal function (physiology) of the oral structures and the velopharyngeal valve is essential.

This chapter reviews the basic anatomy of the structures of the orofacial and velopharyngeal complex as they relate to speech production. The physiology of the subsystems of speech, including the velopharyngeal mechanism, is also described. For more detailed information on anatomy and physiology of the speech articulators, the interested reader is referred to other sources (Cassell & Elkadi, 1995; Cassell, Moon, & Elkadi, 1990; Dickson, 1972; Dickson, 1975; Dickson & Dickson, 1972; Dickson, Grant, Sicher, Dubrul, & Paltan, 1974; Dickson, Grant, Sicher, Dubrul, & Paltan, 1975; Huang, Lee, & Rajendran, 1998; Kuehn, 1979; Maue-Dickson, 1977; Maue-Dickson, 1979; Maue-Dickson & Dickson, 1980; Maue-Dickson, Dickson, & Rood, 1976; Moon & Kuehn, 1996; Moon & Kuehn, 1997; Moon & Kuehn, 2004; Perry, 2011; Seikel, King, & Drumright, 2005).

ANATOMY

Craniofacial Structures

Although the facial structures are familiar to all, some aspects of the face are important to point out for a thorough understanding of congenital anomalies and clefting. The normal facial landmarks can be seen on **FIGURE 1-1**. The reader is encouraged to identify the same structures on the photo of the normal infant face shown in Figure 1-1B.

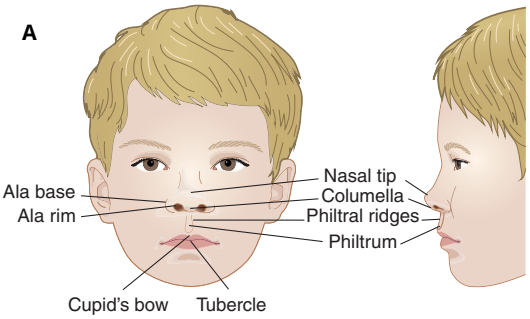

FIGURE 1-1 **(A)** Normal facial landmarks. Note the structures on the diagram. **(B)** Normal face. Try to locate the same structures on this infant's face.

Craniofacial Bones and Sutures

The bones of the cranium include the **frontal bones**, which cover the anterior portion of the brain; the **parietal bones**, which cover the top and sides of the cranium; the **temporal bones**, which form the sides and base of the skull; and finally, the **occipital bone**, which forms the back of the skull (**FIGURE 1-2**).

Each bone is bordered by an embryological suture line. The frontal bones are divided in midline by the **metopic suture** and bordered posteriorly by the coronal suture. The **coronal suture** is across the top of the skull horizontally (like a crown) and separates the frontal bones and parietal bones. The **sagittal suture** crosses the skull vertically and, therefore, divides the two parietal bones. Finally, the **lambdoid suture** is between the parietal, temporal, and occipital bones.

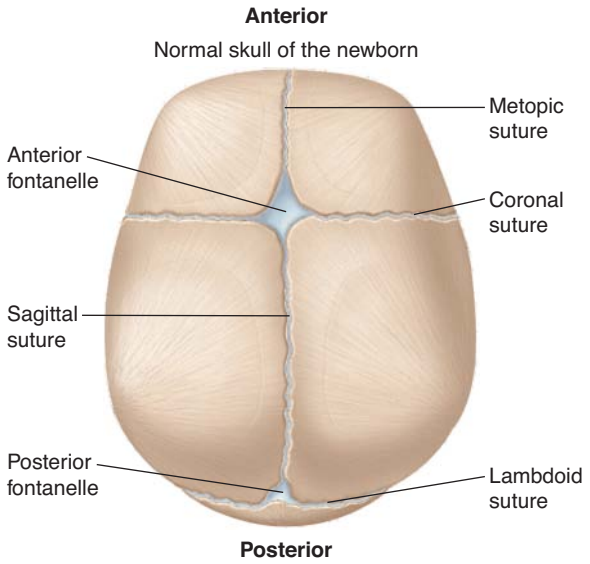

FIGURE 1-2 Cranial suture lines.

The **anterior fontanelle** ("soft spot" of an infant) is on the top of the skull at the junction of the frontal and the coronal sutures. The metopic suture closes between 3 and 9 months of age. The coronal, sagittal, and lambdoid sutures close between 22 and 39 months of age.

The facial bones include the **zygomatic bone** (also called **malar bone**), which forms the cheeks and the lateral walls of the orbits; the **maxilla**, which forms the upper jaw; and the **mandible**, which forms the lower jaw.

Ear

The ear has three distinct parts—the external ear, the middle ear, and the inner ear (**FIGURE 1-3**). A description of the anatomy of each part follows.

The **external ear** consists of the pinna and the external auditory canal. The **pinna** is the delicate cartilaginous framework of the external ear. It functions to direct sound energy into the **external auditory canal**, which is a skin-lined canal leading from the opening of the external ear to the eardrum.

The **middle ear** is a hollow space within the temporal bone. The **mastoid cavity** connects to the middle ear space posteriorly and consists of a collection of air cells within the temporal bone. Both the middle ear and mastoid cavities are lined with a **mucous membrane** (also known as **mucosa**), which consists of stratified squamous epithelium and lamina propria. (This should not be confused with **mucus**, which is the clear, viscid secretion from the mucous membranes.)

The **tympanic membrane**, also called the **eardrum**, is considered part of the middle ear. The tympanic membrane transmits sound energy through the ossicles to the inner ear. The **ossicles** are tiny bones within the middle ear and are called the malleus, incus, and stapes. The **malleus** (also known as the hammer) is firmly attached to the tympanic membrane. The **incus** (also known as the anvil) articulates with both the malleus and the stapes. The **stapes** acts as a piston to create pressure waves within the fluid-filled cochlea, which is part of the inner ear. The tympanic membrane and ossicles act to amplify the sound energy and efficiently introduce this energy into the liquid environment of the cochlea.

The **eustachian tube** (also known as the **auditory tube**) connects the middle ear with

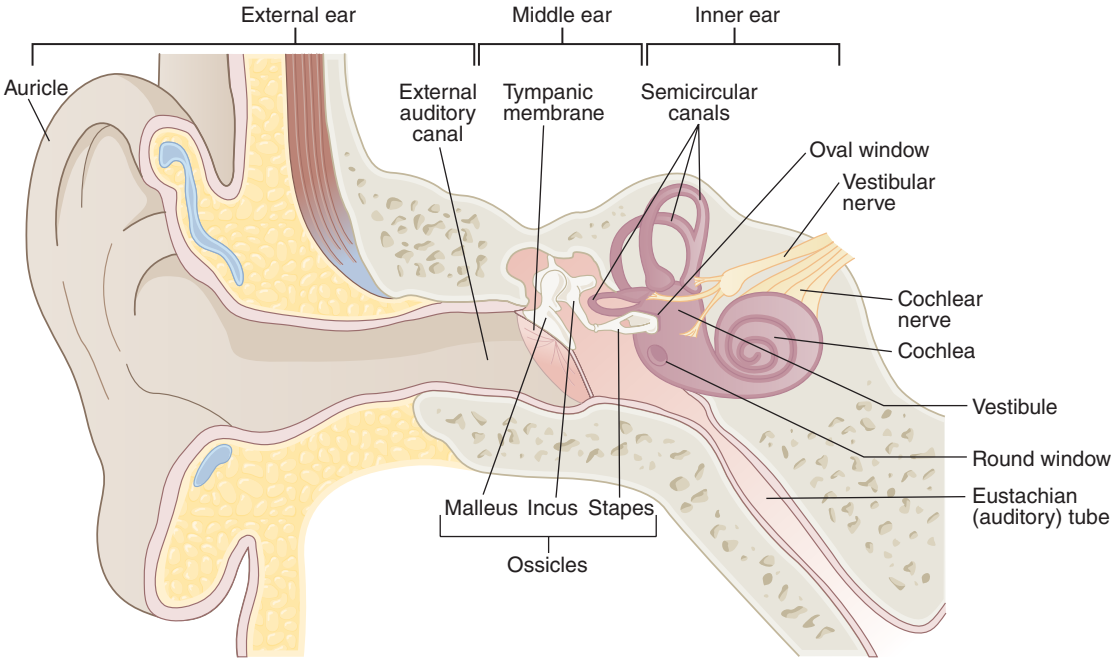

FIGURE 1-3 Ear showing external, middle, and inner ear structures and the eustachian tube.

the nasopharynx. The end of this tube, which terminates in the nasopharynx, is closed at rest but opens during swallowing. When it opens, it provides ventilation for the middle ear and mastoid cavities and results in equalization of air pressure between the middle ear and the environment (Cunsolo, Marchioni, Leo, Incorvaia, & Presutti, 2010; Licameli, 2002; Smith, Scoffings, & Tysome, 2016; Yoshida, Takahashi, Morikawa, & Kobayashi, 2007). It also allows drainage of fluids and debris from the middle ear space. (More information about the eustachian tube is noted in the Pharyngeal Structures section.)

The **inner ear** consists of the cochlea and semicircular canals. The **cochlea** is composed of a bony spiral tube that is shaped like a snail's shell. Within this bony tube are delicate membranes separating the canal into three fluid-filled spaces. The **organ of Corti** is the site where mechanical energy introduced into the cochlea is converted into electrical stimulation. This electrical impulse is conducted by the auditory nerves to the **auditory cortex**, which results in an awareness of sound. Inner and outer **hair cells** (sensory cells with hair-like properties) of the cochlea may be damaged by a variety of mechanisms, leading to sensorineural hearing loss.

In addition to hearing, the inner ear is responsible for balance. The **semicircular canals** are the loop-shaped tubular parts of the inner ear that provide a sense of spatial orientation. They are oriented in three planes at right angles to one another. The **saccule** and **utricle** are additional sensory organs within the inner ear. Hair cells within these organs have small calcium carbonate granules that respond to gravity, motion, and acceleration.

Nose and Nasal Cavity

The nose begins at the **nasal root**, which is the most depressed, superior part of the nose and at the level of the eyes. The **nasal bridge** is the saddle-shaped area that includes the nasal root and the lateral aspects of the nose. Finally, the **nasion** is a midline point just superior to the nasal root and overlying the nasofrontal suture.

The nostrils are separated externally by the **columella** (little column). The **anterior nasal spine** of the maxilla forms a base for the columella. The columella is like a supporting column in that it provides support for the nasal tip. The columella must be long enough so that the nasal tip has an appropriate degree of projection. Ideally, the columella is straight and backed by a straight nasal septum.

The nostrils are frequently referred to as **nares**, although an individual nostril is a **naris**. The **ala nasi** (ala is Latin for "wing") is the outside curved side of the nostril. The alae (plural version of ala) are the two curved sides of each nostril. The **alar rim** is the outside curved edge that surrounds the opening to the nostril on either side, and the **alar base** is the area where the ala meets the upper lip. The **nasal sill** is the base of the nostril opening. The **nasal vestibule** is the most anterior part of the nasal cavity and is enclosed by the cartilages of the nose.

The opening to the bony inside of the nose is called the **pyriform aperture** (also spelled as "piriform," means "pear shaped"). This pear-shaped opening (thus the name) is bordered by the nasal and maxillary bones (**FIGURE 1-4**).

The **nasal septum** is located in the midline of the nose and serves to separate the nasal cavity into two nostrils (**FIGURE 1-5**). It consists of both cartilage in the anterior portion of the nose and bone in the posterior portion. The **quadrangular cartilage** forms the anterior nasal septum and projects anteriorly to the columella. The bones of the septum include the maxillary crest, the vomer, and the perpendicular plate of the ethmoid. The

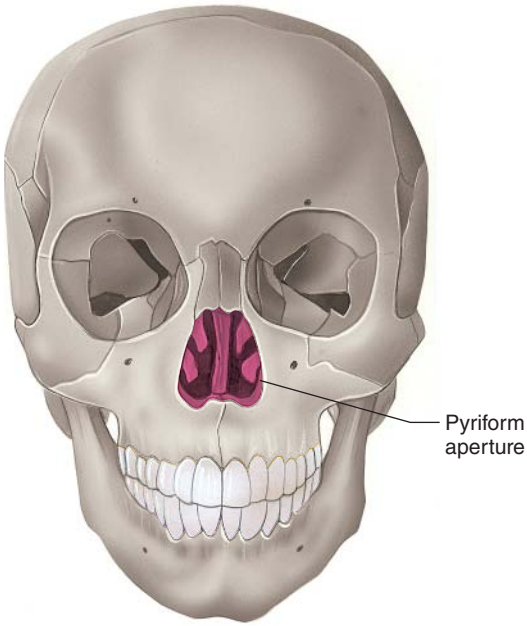

FIGURE 1-4 Pyriform aperture.

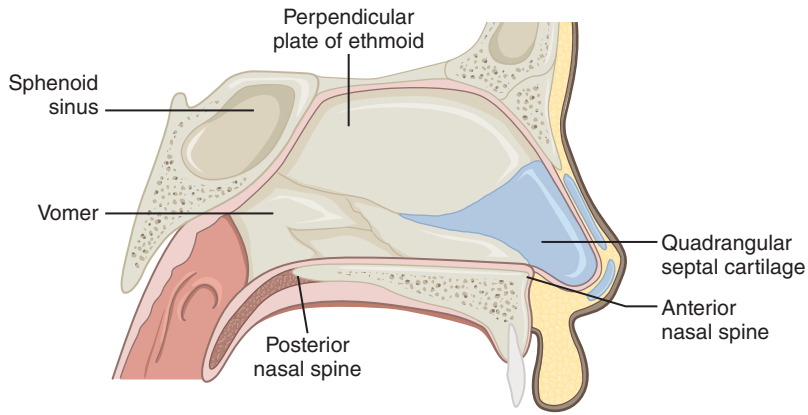

FIGURE 1-5 The nasal septum and related structures.

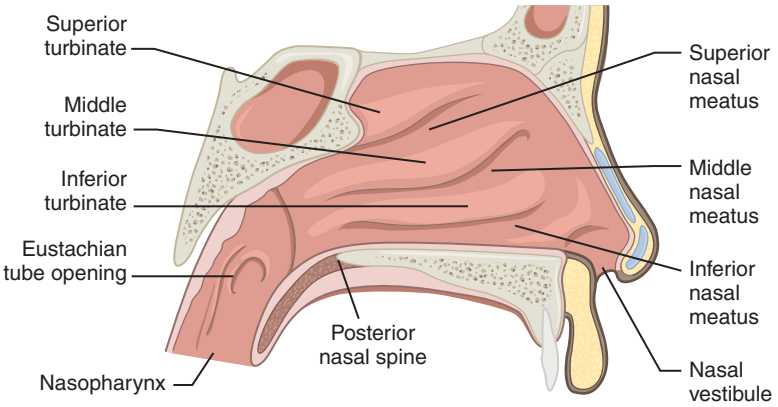

FIGURE 1-6 The lateral wall of the nose showing the turbinates.

vomer is a trapezoidal-shaped bone in the nasal septum. It is positioned perpendicular to the palate, and as such, the lower portion of the vomer fits in a groove formed by the median palatine suture line on the nasal aspect of the maxilla. The **perpendicular plate of the ethmoid** projects downward to join the vomer. It is not uncommon for the nasal septum to be less than perfectly straight, particularly in adults. The nasal septum is covered with mucous membrane, which is the lining tissue of the nasal cavity, oral cavity, and the pharynx.

The **nasal turbinates**, also called **nasal conchae** (concha, singular), are paired bony structures within the nose that are covered with mucosa (**FIGURE 1-6**). They are attached to the lateral walls of the nose and protrude medially into the nasal cavity. They are long, narrow, shelf-like, and curled in shape. As air flows underneath them, the curled shape helps to create turbulent airflow (thus the name "turbinate") to maximize contact of the inspired air with the nasal mucosa.

The nasal turbinates within the nose have three distinct functions. First, the mucus that covers the nasal mucosa filters inspired air of gross contaminants by trapping particulate contaminants. Second, the turbinates warm and humidify the inspired air. Finally, the turbinates deflect air superiorly in the nose in order to enhance the sense of smell.

Directly under the turbinates are the superior, middle, and inferior **nasal meatuses** (meatus, singular), which are the openings or passageways through which the air flows. At the back of the nasal cavity, on each side of the posterior part of the vomer, is a **choana** (choanae, plural), which is a funnel-shaped opening that leads to the nasopharynx.

Finally, the **paranasal sinuses** are air-filled spaces in the bones of the face and skull. These structures are each about the size of a walnut. There are four pairs of paranasal sinuses: frontal sinuses (in the forehead area), ethmoid sinuses (between the eyes), maxillary sinuses (under the cheeks), and sphenoid sinuses (deep in the skull). These sinuses are connected to the nose by a small opening called an **ostium** (ostia, plural). **FIGURE 1-7** shows the sinuses through computed tomography.

Lips

The features of the upper lip can be seen in Figure 1-1A. An examination of the upper lip reveals the **philtrum**, which is a long dimple or indentation that courses from the columella down to the upper lip. The philtrum is bordered by the **philtral ridges** on each side. These ridges are actually embryological suture lines that are formed as the segments of the upper lip fuse. The philtrum and philtral ridges course downward from the nose and terminate at the edge of the upper lip.

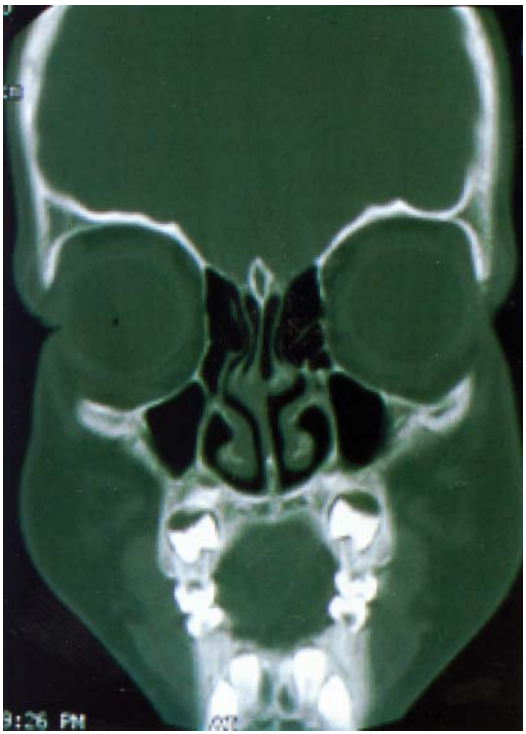

FIGURE 1-7 Radiograph of the nasal sinuses.

The top of the upper lip is called the **Cupid's bow** because of its characteristic shape of bilateral rounded peaks with a midline indentation. On the upper lip, the inferior border of the midsection of the vermilion is referred to as the **labial tubercle** because it comes to a slight point and can be somewhat prominent. The lips are surrounded by border tissue, called the **white roll**. The skin of the lips is called the **vermilion** because it is redder (and darker) than the skin of the rest of the face.

In its naturally closed position, the upper lip rests over and slightly in front of the lower lip, although the inferior border of the upper lip is inverted. Movement of the lips is primarily because of the orbicularis oris muscle. The **orbicularis oris** muscle is actually a complex of four independent quadrant muscles in the lips that encircle the mouth (**FIGURE 1-8**). This group of muscles is responsible for pursing and puckering of the lips for kissing and whistling.

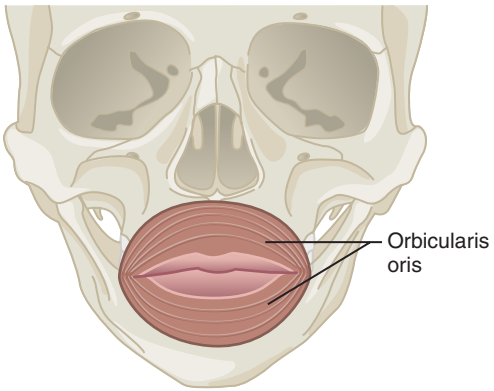

FIGURE 1-8 Orbicularis oris muscles, which circle the mouth.

Intraoral Structures

The intraoral structures include the tongue, faucial pillars, tonsils, hard palate, soft palate, uvula, and oropharyngeal isthmus (**FIGURE 1-9**). These structures are discussed in detail as follows.

Tongue

The tongue resides within the arch of the mandible and fills the oral cavity when the mouth is closed. With the mouth closed, the slight negative pressure within the oral cavity ensures that the tongue adheres to the palate and the tip rests against the alveolar ridge. The **dorsum** (dorsal surface) is the superior surface of the tongue and the **ventrum** (ventral surface) is the inferior surface of the tongue.

Faucial Pillars, Tonsils, and Oropharyngeal Isthmus

At the back of the oral cavity on both sides are the paired curtain-like structures called the **faucial pillars** (Figure 1-9). Both the anterior and posterior faucial pillars contain muscles that assist with velopharyngeal movement. (See section called *Muscles of the Velopharyngeal Valve*.)

Most people think of the **tonsils** as the tissue in the oral cavity that can become infected,