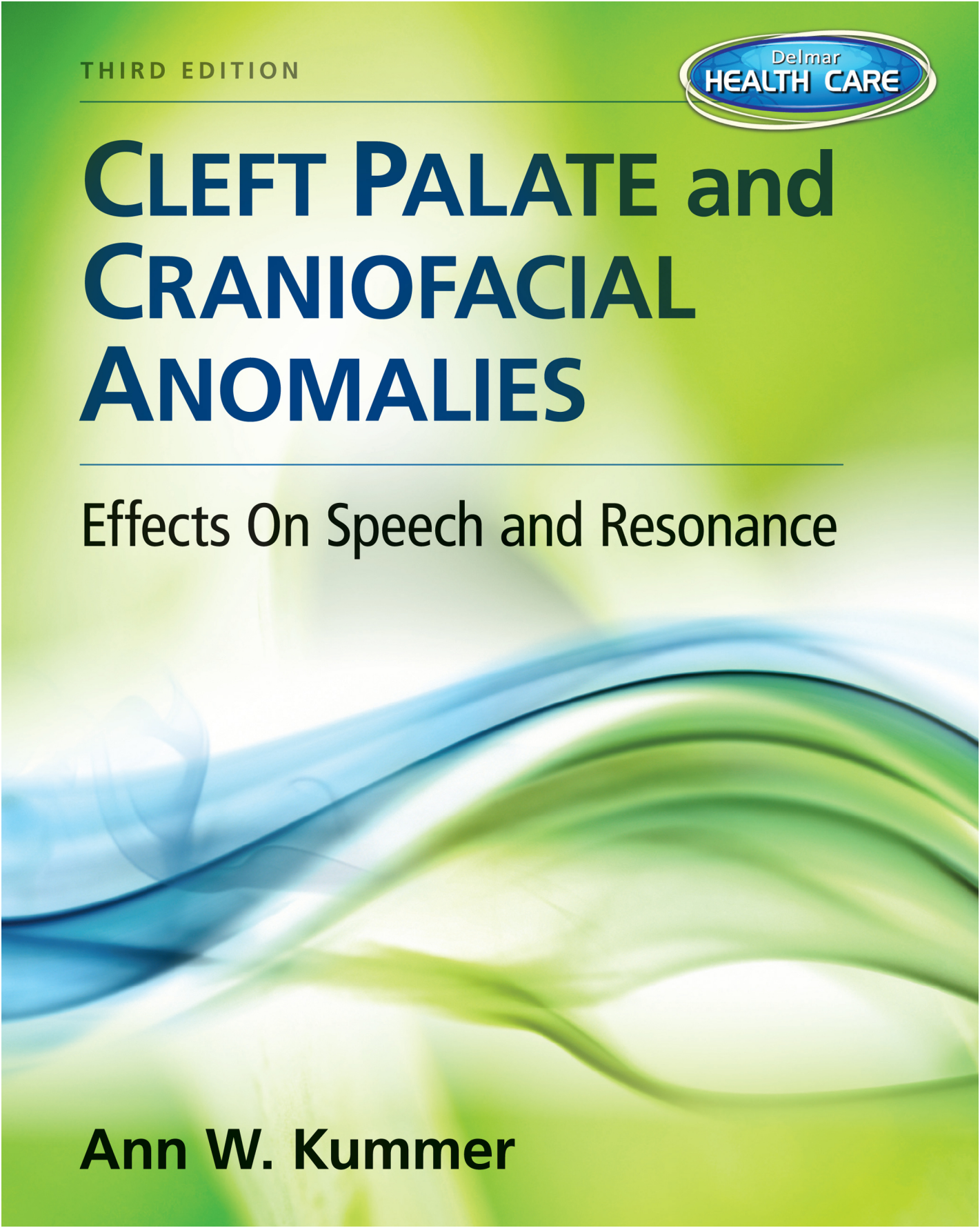
THIRD EDITION

Delmar HEALTH CARE

CLEFT PALATE and CRANIOFACIAL ANOMALIES

Effects On Speech and Resonance



Ann W. Kummer

CLEFT PALATE AND CRANIOFACIAL ANOMALIES

Effects on Speech and Resonance

THIRD EDITION

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Third Edition
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Dedication

This book is dedicated to the three people who have influenced me most in my life and have 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 third time.

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

The next dedication is to my mother, who is the kindest, most thoughtful, and most caring person that I have ever known. Mom, now that I am grown up, I strive to be more like you.

The final dedication is to my husband, who has supported me, encouraged me, and helped me to focus and succeed in my career. John, you have allowed me to spread my wings and fly. For that I will be eternally grateful!

With all my love, Ann

Contents

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 and/or cleft palate or other craniofacial anomalies, this is a true shock, especially because it involves the face. This can be a devastating blow to the family. 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 in order to really appreciate and bond with their newborn baby.

Cleft lip or palate is the fourth most common birth defect and the first most common facial birth defect. In fact, about 1 in every 600 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 physical impairments associated with craniofacial anomalies can be improved or even corrected with the help of a team of various professionals. To provide the type of care that these patients require, this group of professionals must be specialists within their field. For true quality care, they must have a thorough understanding of the current methods of evaluation and treatment of these patients.

Considering the prevalence of clefts and craniofacial anomalies in the general population, however, all health care 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, treatment, and appropriate referrals of individuals with these anomalies, 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 Book

The purpose of this book is to inform, educate, and excite students and professionals in speech-language pathology and in the medical and dental professions regarding the management of individuals with a history of cleft or craniofacial anomalies. This book is designed to be a textbook for graduate students and also a sourcebook for health care professionals who provide services in this area. My goal in writing this book 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 book a very practical "how-to" guide, as well as a source of didactic and theoretical information.

My ultimate goal with this book was 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 impact the quality of care provided to this population.

Organization

This book 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 clefts and craniofacial anomalies is discussed in subsequent chapters. The various causes of these anomalies, including the genetic bases, are reviewed. When the reader has completed the first section, there should be a firm understanding of normal and abnormal facial and velopharyngeal features and the potential causes of abnormalities.

Part 2 of this text includes chapters on the various problems associated with clefts and craniofacial anomalies. In particular, this section covers the effects of these anomalies on feeding, dentition, language, cognition, articulation, resonance, hearing, and psychosocial development. 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 anomalies. 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 are written to provide specific information for practicing clinicians who will be using these procedures.

Part 4 of this book discusses 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.

Part 5 of this book 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 necessitates interdisciplinary interaction and collaboration in the assessment and treatment of these patients.

FEATURES

- **Chapter outlines:** The outlines of each chapter help readers navigate through the content and find information quickly.
- **Illustrations:** This text includes *433 photos* and *94 line drawings* for a total of *527 illustrations*. These 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.
- **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. Professors can also use this section for class discussion, student homework, or for essay exams.
- **Definitions:** Selected *technical and medical terms* are presented in italics and defined at the first occurrence in the book.
- **Glossary:** There is a glossary of terms at the back of the book that defines all the medical and technical terms that were italicized in the individual chapters. The student may find that studying the glossary is helpful for learning much of the information in the book.

- **Appendices:** The appendices contain resource information for parents and guardians, and include a list of publications and parent support groups.
- **Videos:** There are many videos of various speech and resonance disorders and of diagnostic and treatment techniques.

New to This Edition

- **Chapter order:** The order of some of the chapters and sections has been changed for better flow.
- **Chapter outlines:** The outlines of all chapters were simplified and are more consistent between chapters.
- **New chapter:** Because the individual instrumental chapters are very detailed, there is now a new chapter entitled *Overview of Instrumental Procedures*. This chapter is designed for graduate students and other health care providers who need to know what instrumental procedures are available, but do not need the details of how to actually perform these procedures.
- **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.
- **New figures:** Almost *150 new figures* (photos and line art) were added to this edition.
- **Phonetic symbols:** In this edition, phonetic symbols, rather than letters, are used for speech sounds, as is done in other speech pathology texts. A key to these symbols is included for physicians and other professionals who are not familiar with phonetic symbols.
- **Glossary:** The glossary has been greatly expanded with many more word definitions.

Online Resources

- **Cleft Notes:** The *Cleft Notes* are basic summaries in table format and are provided for each chapter. There are some compare-and-contrast aspects of these tables to help the student 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/professors.

- **Handouts:** There are online handouts on a variety of topics that are covered in this book. 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. These can be printed and distributed as long as the heading, logo, and content are not altered.
- **Video Case Histories:** The many video case histories to illustrate the types of resonance disorders and speech errors that are described in the book. (More will be added online over time.) These cases included the medical and developmental histories, as appropriate, and a short video of the child speaking. Many cases include a video of the nasopharyngoscopy exam and/or videos of the nasometry exam. These videos are designed to help the viewer develop diagnostic and treatment skills. Because the videos are carefully edited, this is better than direct observation of a clinic.
- **PowerPoint® Presentations:** There are PowerPoint presentations for each chapter, which include important figures and photos.
- **Exam and Test Yourself Questions:** There are many multiple-choice questions for each chapter. These can be used by the instructor/professor for exams or can be given to the students to use for studying the material.
- **eBook:** This book is available as both a printed text and an ebook. It is now possible to purchase single chapters of the ebook.

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.

ACKNOWLEDGEMENTS

There are so many people for whom I would like to acknowledge for their help with this edition of the text. I am grateful for the work of several outstanding students, including Brooke Goodall, for her help in researching and updating the literature; Brooke Goodall, Vanessa Hardin, and Nicole Brenza, for help in compiling the video case studies; and Jennifer Hanson, for her work in developing the PowerPoint presentations for each chapter.

Many thanks go to the members of our Resonance Specialty Team at Cincinnati Children's, including Molly Hylton Dow, M.A.; Shyla Miller, M.A.; Allison Flynn, M.A.; Janet H. Middendorf, M.A.; and Meg Toner, M.A. They were very helpful in providing feedback, developing the Cleft Notes, and reviewing videos. In particular, I would like to thank Meg Toner for an excellent job in coordinating the Video Case Studies project. I would like to thank Mary Gilene, our division's project manager, for her invaluable help with EndNote, the handouts, PowerPoints, and many other miscellaneous things. I am indebted to my administrative assistants, Colleen Kinnard (who left me to attend graduate school in speech-language pathology) and Debbie Kleemeier. Both of them helped me in many ways, including editing, formatting, and tracking down permissions.

Thanks to Robert McClurkin, Director of Product Management and Marketing at KayPENTAX, for feedback regarding Chapters 14 and 17; to Sid Khosla, M.D., Assistant Professor in the Department of Otolaryngology–Head and Neck Surgery at the University of Cincinnati, for feedback regarding Chapter 7; and to Mackinnon Webster, Vice President, Strategic Partnerships and Program Development at The Smile Train, for feedback regarding Chapter 23. I especially want to thank the reviewers of this text for their time and efforts. Their comments and suggestions were very valuable.

Special thanks go to Janet H. Middendorf, M.A., who is my colleague and friend. She has helped me and covered patients and clinics for me on many occasions so that I could travel or work on this book! Finally, I'd like to thank the members of the Craniofacial Team at Cincinnati Children's Hospital Medical Center (CCHMC) for being such great colleagues, mentors, and friends! I have learned so much from all of them.

Finally, I would like to acknowledge my husband. This book consumed an enormous amount of my personal time and energy. I could not have done it without his support, encouragement, patience, and understanding.

FEEDBACK

I would like to encourage the readers of this text to contact me by e-mail (ann.kummer@cchmc.org) with suggestions or comments about this text. My goal is to constantly improve this text over time.

FINAL WORDS

Speaking for myself and for all the contributors, we are grateful for the opportunity to present this information to you. We are hopeful that you will be educated, enlightened, and inspired to provide superior clinical services for individuals with clefts or other craniofacial conditions.

Ann W. Kummer

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Key to Phonetic Symbols

(includes only those used in this book)

Vowels

Symbol	Examples
/i/	**bee,** s**ee**
/æ/	h**a**t, c**a**t
/ɑ/	f**a**ther, pot
/ɚ/	teach**er,** moth**er**

Consonants

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

About the Author

Ann W. Kummer, Ph.D., CCC-SLP, is Senior Director of the Division of Speech-Language Pathology at Cincinnati Children's Hospital Medical Center and Professor of Clinical Pediatrics, and Professor of Otolaryngology–Head and Neck Surgery at the University of Cincinnati Medical Center.

Under her direction, the Division of Speech-Language Pathology at Cincinnati Children's has grown to be the largest and one of the most respected programs in the country. Dr. Kummer gives frequent lectures on leadership and professional business practices in speech-language pathology. She is also one of the authors of the text *Business Practices: A Guide for Speech-Language Pathologists*, published by the American Speech-Language-Hearing Association (ASHA) in 2004. 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.)

As a clinician and researcher, Dr. Kummer specializes in speech and resonance disorders secondary to cleft palate, craniofacial anomalies, and velopharyngeal dysfunction. She is a long-term member of the Craniofacial Team at Cincinnati Children's and at Shriners Hospitals for Children in Cincinnati. She also provides services through the multidisciplinary VPI Clinic. She has worked with several international volunteer organizations for cleft palate, and is an active member of the American Cleft Palate–Craniofacial Association (ACPA) and the American Speech-Language Hearing Association (ASHA), serving on many committees.

Dr. Kummer has done several hundred lectures and seminars on a national and international level on cleft palate, craniofacial conditions, resonance disorders, and velopharyngeal dysfunction. She is the author of many professional articles, as well as over 20 book chapters in speech pathology and medical texts. In addition to this text, she is the co-author of the Simplified Nasometric Assessment Procedures (SNAP) Test (1996) and the author of the SNAP-R Test (2005) for the Nasometer II (KayPENTAX, Montvale, N.J.). She holds a patent on the Nasoscope device, which is marketed as the Oral & Nasal Listener (Super Duper, Inc.).

Dr. Kummer has received Honors of the Southwestern Ohio Speech-Language and Hearing Association (1995); Honors of the Ohio Speech-Language and Hearing Association (OSLHA) (1997); the Elwood Chaney Outstanding Clinician Award from the Ohio Speech-Language and Hearing Association (OSLHA) (2012); distinguished alumnus award from the Department of Communication Sciences and Disorders of the University of Cincinnati (1999); and the distinguished alumnus award from the College of Allied Health at the University of Cincinnati (2012). She was elected Fellow of the American Speech-Language-Hearing Association (ASHA) in 2002. She was named one of the top 25 most influential therapists in the United States by Therapy Times (2006); and named one of the 10 Most Inspiring Women in Cincinnati (2007).

Dr. Kummer received her bachelor's and master's degrees from Indiana University and her Ph.D. from the University of Cincinnati.

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Part 1

Normal Structures, Clefts, and Craniofacial Anomalies

CHAPTER

1

Anatomy and Physiology: Facial, Oral, and Velopharyngeal Structures

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 is important. In addition, knowledge about normal function of the oral structures and the velopharyngeal valve is essential before the speech-language pathologist will be able to effectively evaluate abnormal speech and velopharyngeal dysfunction.

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, 1975; Dickson & Dickson, 1972; Dickson, Grant, Sicher, Dubrul, & Paltan, 1974, 1975; Huang, Lee, & Rajendran, 1998; Kuehn, 1979; Maue-Dickson, 1977, 1979; Maue-Dickson & Dickson, 1980; Maue-Dickson, Dickson, & Rood, 1976; Moon & Kuehn, 1996, 1997, 2004; Perry, 2011; Seikel, King, & Drumright, 2005).

EAR

The *external ear* is comprised 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 is comprised of a collection of air cells within the temporal bone. Both the middle ear and mastoid cavities are lined with a *mucous membrane* (*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 three tiny bones in the middle ear are called the *ossicles*, and they include the malleus, incus, and stapes. The *malleus* (hammer) is firmly attached to the tympanic membrane. The *incus* (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* connects the middle ear with the nasopharynx. The end of this tube that terminates in the nasopharynx is closed at rest. During swallowing, the tensor veli palatini muscle contracts to open the Eustachian tube. This provides ventilation for the middle ear and mastoid cavities, and also results in equalization of air pressure between the middle ear and the environment (Cunsolo, Marchioni, Leo, Incorvaia, & Presutti, 2010; Licameli, 2002; Yoshida, Takahashi, Morikawa, & Kobayashi, 2007).

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 separate fluid-filled spaces. The *organ of Corti* is the site where mechanical energy introduced into the cochlea is converted into electrical stimulation 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.

A second function of the inner ear is 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.

FACIAL 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 1–1A and Figure 1–1B. The student is encouraged to identify the same structures on the photo of the normal infant face shown in Figure 1–1B.

Nose and Nasal Cavity

Starting with the nose, the *nasal root* is where the nose begins at the level of the eyes. The *nasal bridge*, also known as the *nasion*, is the bony structure that is located between the eyes and corresponds with the nasofrontal suture. The nostrils are separated by the *columella* (little column), which is the structure that supports the nasal tip and is between the nostrils. The columella is at the anterior end of the nasal septum and consists of epidermis, cartilage, and mucosa. Ideally, the columella is straight and backed by a straight nasal septum. It must also be long enough so that the nasal tip has an appropriate degree of projection.

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, which consists of cartilage. The alae are the two curved sides of the 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 *piriform aperture*, which literally means pear-shaped opening, is the opening to the nostril or nasal cavity. The *nasal vestibule* is the most anterior part of the nasal cavity and is enclosed by the cartilages of the nose.

The *nasal septum*, as can be seen in Figure 1–2, is in the midline and separates the nasal cavity into two halves. The *quadrangular cartilage* forms the anterior nasal septum and projects anteriorly to the columella. (The anterior nasal spine of the maxilla forms a base

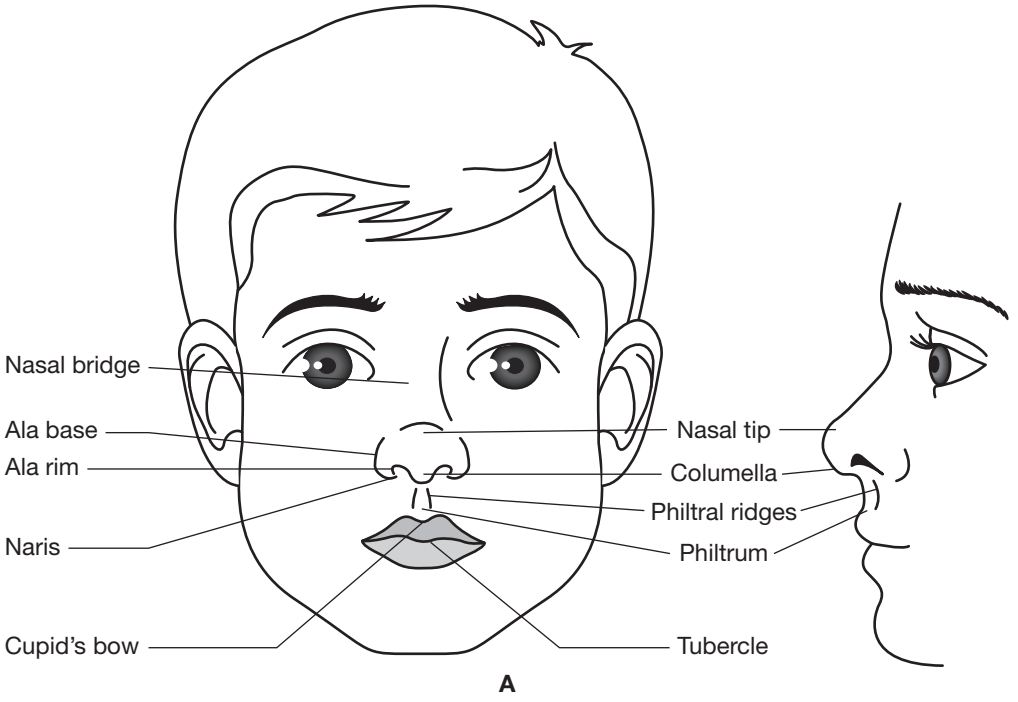

FIGURE 1–1A Normal facial landmarks. Note the structures on the diagram.

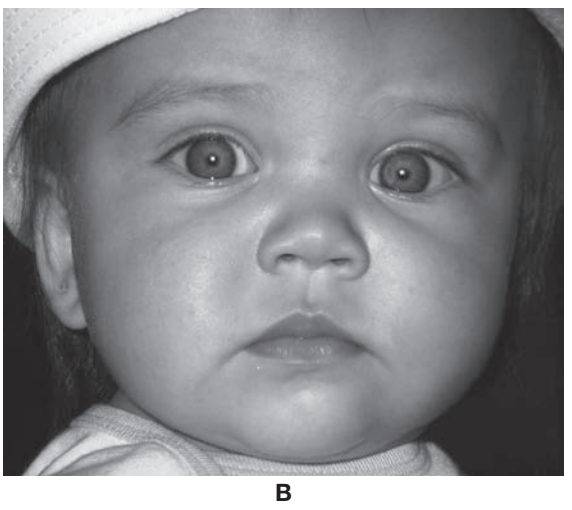

FIGURE 1–1B Normal face. Try to locate the same structures on this infant's face.

for the columella.) The *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 septum and nasal cavity, as well as the oral and pharyngeal cavities, are lined with a mucous membrane.

The *nasal turbinates*, also called *nasal conchae* (*concha*, singular), are paired shelf-like

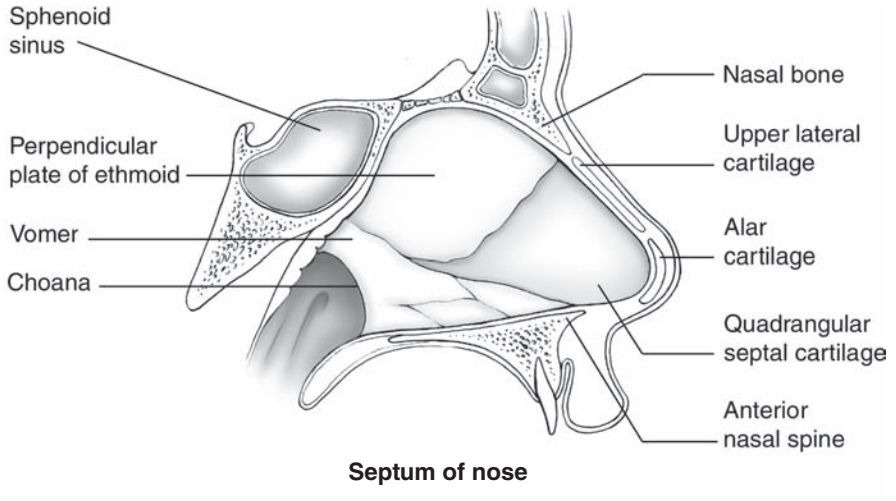

FIGURE 1–2 The nasal septum and related structures.

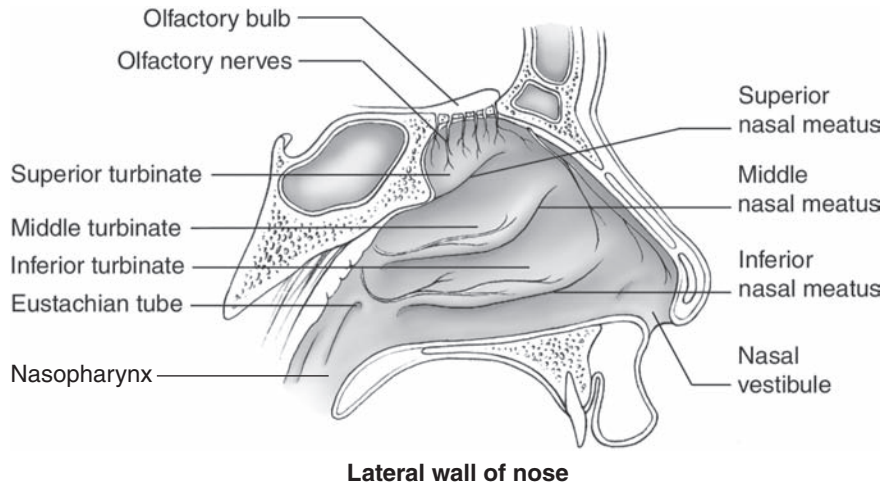

FIGURE 1–3 The lateral wall of the nose showing the turbinates.

bony structures that are attached to the lateral walls of the nose and protrude into the nasal cavity. They are long, narrow, and curled (Figure 1–3). The curled shape helps to create turbulent airflow (thus their name) within the nose to maximize contact of the inspired air with the nasal mucosa that covers the bones. The superior and middle turbinates are parts of the ethmoid bone. The inferior turbinates, which are largest, are separate and unique bones of their own.

The nasal turbinates within the nose have three distinct functions. First, the mucous blanket covering the nasal mucosa traps

particulate contaminants in order to filter inspired air of gross contaminants. Second, the turbinates warm and humidify the inspired air. This is done as nasal mucosa goes through alternating periods of vascular engorgement and decongestion. These periods alternate between sides every 90 minutes. The period of engorgement of the nasal lining promotes the warming and humidification of the inspired air. The third function of the turbinates is to 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 and are shown in Figure 8–5 as they would be seen through computed tomography. There are four pairs of paranasal sinuses: frontal sinuses (in the forehead area), maxillary sinuses (under the cheeks), ethmoid sinuses (between the eyes), and finally, sphenoid sinuses (deep in the skull). These sinuses are connected to the nose by a small opening called an *ostium* (*ostia*, plural).

Upper Lip

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.

The top of the upper lip is called the *Cupid's bow* due to its characteristic shape, which includes a rounded configuration with an indentation in the middle. The upper and lower lips are both highlighted by the *white roll*, which is border tissue surrounding the red portion of the lip, called the *vermilion*. On the upper lip, the inferior border of the midsection of the vermilion comes to a point and is somewhat prominent. Therefore, it is referred to as the *labial tubercle*. 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.

Oral Structures

Oral structures include the tongue, the faucial pillars, and the palate. The palate can be separated into two main parts: the hard palate and the soft palate (Figure 1–4). The *hard palate* is a bony structure that separates the oral cavity from the nasal cavity. The *velum*, frequently referred to as the *soft palate*, is the part of the palate that is muscular and is located in the back of the mouth, just posterior to the hard palate. At the posterior edge of the velum is the pendulous uvula. These structures are discussed in more 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

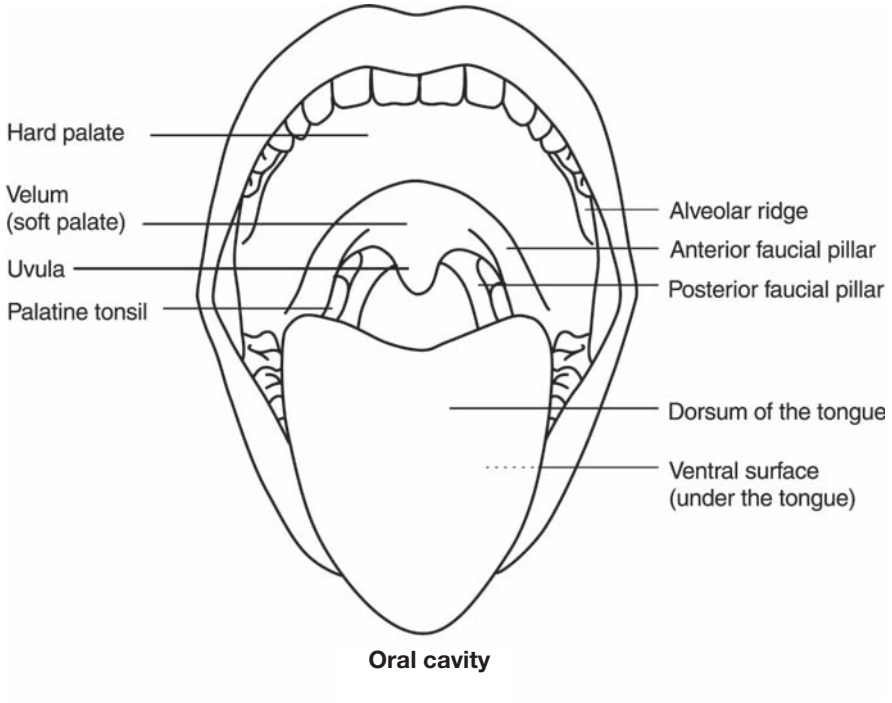

FIGURE 1–4 The structures of the oral cavity.

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

At the back of the oral cavity are bilateral paired (anterior and posterior) curtain-like structures called *faucial pillars* (Figure 1–4). As the velum curves downward toward the tongue on both sides, it forms the anterior faucial pillar. Just behind the anterior pillar is the posterior faucial pillar. These structures contain muscles that assist with velopharyngeal and lingual movement. The *palatine tonsils* (or simply the tonsils) consist of lymphoepithelial tissue and are found between the anterior and posterior faucial pillars on both sides. Although the tonsils are bilateral, differences in size are common, so it is not unusual for one tonsil to be larger than the other. The *lingual tonsils* are masses of lymphoid tissue that are located at the base of the tongue and extend to the epiglottis (Figure 1–5). The *oropharyngeal isthmus* is the opening from the oral cavity to the pharynx and is bordered superiorly by the velum, laterally by the faucial pillars, and inferiorly by the base of the tongue (see Chapter 8 for more information about tonsils and adenoids).

Hard Palate

The *hard palate* is a bony structure that separates the oral cavity from the nasal cavity. The hard palate forms a rounded dome on the

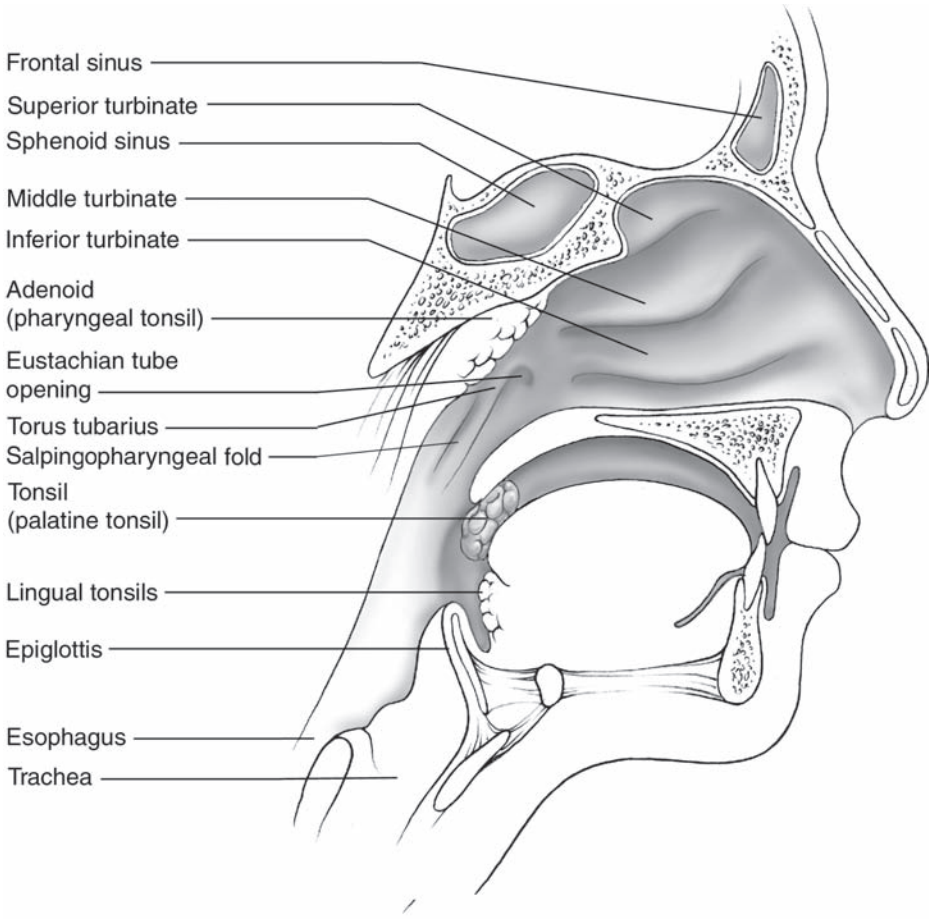

FIGURE 1–5 Lateral view of the nasal, oral, and pharyngeal cavities and the structures in these areas.

upper part of the oral cavity, called the *palatal vault*. In addition to serving as the roof of the mouth, it also serves as the floor of the nasal cavity. The outer portion of the hard palate is called the *alveolar ridge*, *alveolus*, or simply the gum ridge (see Figure 1–4). This ridge forms the base and the bony support for the teeth. The bony frame of the hard palate is covered by a mucoperiosteum. *Mucoperiosteum* consists of a mucous membrane and periosteum. *Periosteum* is a thick, fibrous tissue that covers the surface of bone. The mucosal covering of the hard palate has multiple ridges running transversely, which are called the *rugae*. There is a slight elevation of the mucosa in the middle of the anterior part of the hard palate, called the *incisive papilla*. A narrow seam-like ridge, called the *palatine raphe* (pronounced /ræfeɪ/), forms the midline of the hard palate and runs from the incisive papilla posteriorly over the entire length of the mucosa of the hard palate. At the junction of the hard and soft palate, bilateral midline depressions can often be seen, called the *foveae palati*, which are openings to minor salivary glands.