

Netter's Head and Neck Anatomy for Dentistry

2nd Edition

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- سرشناسه : هورتون، نیل اسکات
Horton, Neil Scott
عنوان و نام پدیدآور : Netter's head and neck anatomy for dentistry/illustrations by Frank ; contributing illustrators, H. Netter.; illustrations by Frank H. Netter ; [Carlos A.G. Machado ...] et al
مشخصات نشر : تهران: کتاب امیر، ۱۳۹۱-۱۲
مشخصات ظاهری : ۲۵۹ ص: (مصور (رنگی)، جدول، نمودار (بخشی رنگی)).
وضعیت فهرست : فبا
بومبسی :
پادداشت :
پادداشت :
بابومبسی عنوان :
موضوع :
موضوع :
موضوع :
شناسه گروه :
شناسه گروه :
شناسه :
رده برخط :
ردیف :
شماره کتابشناسی :
ملی :
انگلیسی :
اقتب از روی ویراست دوم : Saunders, an imprint of Elsevier Inc.
نشر هد :
دندانپزشکی -- اطلسها :
سر -- کالبدشناسی -- اطلسها :
گروه -- کالبدشناسی -- اطلسها :
نثر، فرانک هرری، ۱۹۰۴ - ۱۹۹۱ م :
Netter, Frank Henry :
ماشادو، کارلوس ا. جی. :
Machado, Carlos A. G. :
RKTAV/۸۸۲ ۱۳۹۱ :
۶۱۱۱ :
۳۹۲۲ :

Netter's HEAD AND NECK ANATOMY FOR DENTISTRY, 2e 2012

- نام کتاب :
زبان کتاب :
تجدید نظر :
مؤلف :
بازنشر :
نوبت چاپ :
تاریخ چاپ :
شمارگان :
چاپ :
نیل اسکات نورت
انگلیسی
دوم، ۱۲
نیل اسکات نورت
انتشارات کتاب امیر
اول
پاییز ۹۱
۱۰۰۰ نسخه
غزال

مرکز پیش: انتشارات کتب امیر - تهران - میدان انقلاب - روبروی درب اصلی دانشگاه تهران - مجتمع تجاری فروزنده

طبعة اول - واحد ۲۲۴ - نشانی: ۶۶۲۹۱۱۳۲ - ۶۶۲۹۱۲۵۹ - ۶۶۲۹۰۲۲۵ - ۶۶۲۹۰۲۲۳ - ۶۶۲۹۰۲۲۴ - ۶۶۲۹۰۲۲۵

1600 John F. Kennedy Blvd.
Ste 1800
Philadelphia, PA 19103-2899

NETTER'S HEAD AND NECK ANATOMY FOR DENTISTRY
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ISBN: 978-1-4377-2663-3

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Library of Congress Cataloging-in-Publication Data

Norton, Neil Scott.

Netter's head and neck anatomy for dentistry / Neil S. Norton ; illustrations by Frank H. Netter ; contributing illustrators, Carlos A.G. Machado ... [et al.].—2nd ed.
p. ; cm.

Head and neck anatomy for dentistry

Includes bibliographical references and index.

ISBN 978-1-4377-2663-3 (pbk. : alk. paper)

I. Netter, Frank H. (Frank Henry), 1906-1991. II. Title. III. Title: Head and neck anatomy for dentistry.

[DNLM] 1. Dentistry—Atlases. 2. Head—anatomy & histology—Atlases.
3. Neck—anatomy & histology—Atlases. WU 17]

LC Classification not assigned

611.01—dc23

2011029515

Acquisitions Editor: Elyse O'Grady
Developmental Editor: Marybeth Thiel
Publishing Services Manager: Catherine Jackson
Senior Project Manager: Carol O'Connell
Design Direction: Louis Forgiione

Printed in China

Last digit is the print number: 9 8 7 6 5 4 3 2 1

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I dedicate this book to the following influential people in my life,

To my mother Chari, who worked tirelessly and sacrificed everything throughout her life so that her children would not be without.

To Elizabeth, who made me a better man. I owe you everything for all that you have done for me.

To my brother John, who helped raise me.

To the late Father John G. Holbrook, S.J., who helped me appreciate the importance of service to others. He taught me the dedicated ways of *cura personalis* or care for the individual. I have tried to live by those words every day of my life.

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About the Author

Neil S. Norton, PhD, joined Creighton University in 1996 and is currently the Director of Admissions, Assistant Dean for Student Affairs, and Professor of Oral Biology in the School of Dentistry. After graduating Phi Beta Kappa from Randolph-Macon College with a BA in Biology he went on to receive his PhD training in Anatomy from the University of Nebraska Medical Center. Dr. Norton has been the recipient of numerous teaching awards including ten Outstanding Instructor of the Year Awards from the Freshman classes and eight Dr. Theodore J. Urban Pre-Clinical Awards, presented by graduating Senior classes for dedication and outstanding Basic Science instruction. Dr. Norton is the third professor in the history of the School of Dentistry to receive the prestigious Robert F. Kennedy Memorial Award for Teaching Achievement, the highest teaching recognition offered by the University. In 2007 Dr. Norton received the Caxo-Smith-Kline Sensodyne Teaching Award, the highest national teaching award given by the American Dental Education Association (ADEA). An active member of the School of Dentistry faculty, he was elected by colleagues to honorary membership in Omicron Kappa Upsilon, the Honor Dental Society whose regular membership is reserved for dentists. His teaching responsibilities include Head and Neck Anatomy, General Anatomy, Neuroscience, and Pain Control. Dr. Norton served four years as President of the University Faculty and chaired many committees, including the University Committee on Rank and Tenure and the University Committee on Academic Freedom and Responsibility. Currently he serves as the Faculty Athletic Representative for Creighton. He continues to actively publish on a variety of anatomical topics in addition to his administrative duties. He is an active member of the American Association of Clinical Anatomists (AACA) and has served as the Treasurer since 2006.

About the Artists

Frank H. Netter, MD

Frank H. Netter was born in 1906, in New York City. He studied art at the Art Students League and the National Academy of Design before entering medical school at New York University, where he received his MD degree in 1931. During his student years, Dr. Netter's notebook sketches attracted the attention of the medical faculty and other physicians, allowing him to augment his income by illustrating articles and textbooks. He continued illustrating as a sideline after establishing a surgical practice in 1935, but he ultimately opted to give up his practice in favor of a full-time commitment to art. After service in the United States Army during World War II, Dr. Netter began his long collaboration with the CIBA Pharmaceutical Company (now Novartis Pharmaceuticals). This 45-year partnership resulted in the production of the extraordinary collection of medical art so familiar to physicians and other medical professionals worldwide.

In 2005, Elsevier, Inc., purchased the Netter Collection and all publications from Icon Learning Systems. There are now over 50 publications featuring the art of Dr. Netter available through Elsevier, Inc. (in the United States: www.us.elsevierhealth.com/Netter and outside the United States: www.elsevierhealth.com).

Dr. Netter's works are among the finest examples of the use of illustration in the teaching of medical concepts. The 13-book *Netter Collection of Medical Illustrations*, which includes the greater part of the more than 20,000 paintings created by Dr. Netter, became and remains one of the most famous medical works ever published. *The Netter Atlas of Human Anatomy*, first published in 1929, presents the anatomical paintings from the Netter Collection. Now translated into 11 languages, it is the anatomy atlas of choice among medical and health professions students the world over.

The Netter illustrations are appreciated not only for their aesthetic qualities, but, more important, for their intellectual content. As Dr. Netter wrote in 1949, "... clarification of a subject is the aim and goal of illustration. No matter how beautifully painted, how delicately and safely rendered a subject may be, it is of little value as a *medical illustration* if it does not serve to make clear some medical point." Dr. Netter's planning, conception, point of view, and approach are what inform his paintings and what makes them so intellectually valuable.

Frank H. Netter, MD, physician and artist, died in 1991.

Learn more about the physician-artist whose work has inspired the Netter Reference collection at www.netterimages.com/artist/netter.htm.

Carlos Machado, MD

Carlos Machado was chosen by Novartis to be Dr. Netter's successor. He continues to be the main artist who contributes to the Netter collection of medical illustrations.

Self-taught in medical illustration, cardiologist Carlos Machado has contributed meticulous updates to some of Dr. Netter's original plates and has created many paintings of his own in the style of Netter as an extension of the Netter collection. Dr. Machado's photorealistic expertise and his keen insight into the physician/patient relationship inform his vivid and unforgettable visual style. His dedication to researching each topic and subject he paints places him among the premier medical illustrators at work today.

Learn more about his background and see more of his art at www.netterimages.com/artist/machado.htm.

Acknowledgments

The second edition of *Netter's Head & Neck Anatomy for Dentistry* book has been a labor of love. Like the 1st edition, it is the culmination of many hours of hard, but very satisfying, work. I am truly indebted to the help of many talented and dedicated individuals.

I started at the Creighton University School of Dentistry in 1996 and was overwhelmed by the comradery that existed at both the School and University level. I am grateful every day to be part of such a fine institution that is committed to the education of students. The support and assistance my fellow colleagues provided has been immeasurable. I would especially like to thank for their review of chapters, suggestions, and willingness to provide materials: Drs. W. Thomas Carroll, Paul Edwards, Terry Lanphier, Takanari Miyamoto, Cyndi Russell, Tarjit Saini, and Timon McVane. I owe a very special thanks to my Dean, Dr. Wayne W. Barkmeier. He was the person willing to give a young anatomist an opportunity at Creighton and gave my career to Dr. Barkmeier. It was he and Dr. Frank J. Ayers who pushed me and provided me the opportunity in Admissions and Student Affairs. For that, I'll always be grateful.

Additionally, I am grateful to Dr. Laura C. Barkmeier who was instrumental in the creation of the Development section of the book, as well as providing various suggestions in many other chapters. Another special thanks goes to my chair, Dr. Margaret A. Jergenson. Since 1996, Dr. Jergenson and I have taught general anatomy and head and neck anatomy to freshman dental students. As a dentist with a clinical background has been invaluable in helping me appreciate head and neck anatomy from a dental perspective. Together, we have enjoyed a great time working together as the anatomical team in the School of Dentistry. I could not ask for a better colleague with whom to teach anatomy.

My sincere appreciation to my Creighton colleagues. Creighton is a family, and I have been fortunate to spend my career at such a fine university. Over the years there are a few individuals who have helped me immensely. In particular, I owe a special acknowledgment of gratitude to Fr. Richard Hauser, S.J., and Thomas Shanahan, S.J. Last, a special thanks goes to Fr. John P. Schlegel, S.J. For eleven of my fifteen years at Creighton, Fr. Schlegel served as the President of Creighton University. In my previous role as President of the University Faculty, I worked with Fr. Schlegel on many issues and was always grateful to be working for a President committed to his students, staff, and faculty.

Thank you to the reviewers who examined the chapters in the first edition and provided excellent feedback: Drs. Robert Spears, Kathleen M. Klueber, and Brian R. Matherson, and Professor Cindy Evans. My sincere appreciation goes to friend and colleague Dr. Thomas Quinn, who offered helpful comments and words of encouragement throughout the textual writing and development of the art.

I enlisted the help of my dental students to make *Netter's Head and Neck Anatomy for Dentistry* more student-friendly. Special thanks go to Dr. Joseph Opack for providing excellent critiques on chapters and Dr. Ryan Dobbs for his assistance in keeping many of my chapters well organized and developed. Additional thanks go to Drs. Steve Midstokke and Paul Mendes for helping in the creation of some of the new pieces of art. A special thanks to Dr. Kyle D. Smith for helping select many of the new cone beam images that have been incorporated into the second edition.

This book would not be possible if not for the beautiful new artwork created by the incredible medical illustrators at Elsevier. Their hard work not only supplemented the illustrations of Dr. Frank Netter, Carlos Machado, MD, and John Craig, MD, seamlessly,

but also added to the vast Netter collection of anatomical pieces. Tiffany DaVanzo was instrumental in the creation of the new pieces in the second edition. I am very grateful to the work of Kip Carter, William Winn, and Andrew Swift. All of these illustrators helped put my vision into art. Their artistic interpretations are simply magnificent.

The Elsevier team deserves a special thanks for making this project happen, including Elyse O'Grady, Marybeth Thiel, Anne Lenehan, and Carol O'Connell. Additionally, I would like to acknowledge the work of those who helped me complete the first edition of the book: Jennifer Surich, Carolyn Kruse, and Jonathan Dimes.

A very special thanks goes to Paul Kelly. I have had the great honor and privilege of knowing Paul for the past 10 years. I remember many conversations with Paul over the years in which he encouraged me to put together an anatomical project for dentistry. I presented him with the rough outline and prospectus for a text/atlas that evolved into the first edition of this book.

Lastly, I thank all of the students whom I have instructed over my career. You have always served as a great inspiration to me. It has been an honor and privilege to be a part of your education. *Netter's Head and Neck Anatomy for Dentistry* is for you.

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Preface

Netter's Head and Neck Anatomy for Dentistry is a text/atlas written to help dental students and professionals learn and review head and neck anatomy. Designed for first-year dental students, it also serves to teach anatomy to students of dental hygiene as well as a review for the practicing clinician. The head and neck comprise the foundation for dental anatomical study. The many small, inter-related structures are not easily observable, which makes head and neck anatomy one of the most difficult disciplines for students to master.

This second edition has three major additions from the first edition. First, the inclusion of an introductory chapter on upper limb, thorax, and abdomen. These sections are included in dental school courses of gross anatomy and it was a goal to create one book that would fully cover head and neck anatomy but also provide the basic anatomy needed to successfully complete the upper limb, thorax and abdomen portions of an anatomy course. The second addition is the inclusion of over 20 radiographic images to complement the anatomy illustrations throughout the text. Radiology is an important part of the education of dental students and it is a natural addition to any anatomy text. The third addition is the inclusion of review questions that cover all of the chapters in the text. The multiple-choice questions are designed to serve as a review for the reader.

To understand the clinical significance of an anatomical concept is to understand the anatomy. It is with that in mind that a series of clinical correlates that relate to dentistry are provided at the end every chapter. Many anatomical topics covered in head and neck courses have been expanded especially for this text. A chapter has been dedicated to the temporomandibular joint. In the chapter on the oral cavity, more information has been provided for the reader on such topics as dentition. Chapters on the development of the head and neck and basic neuroscience are included to help connect with other related anatomical areas. A chapter on intraoral injections is included to help teach and reinforce an area often overlooked. The intent of these chapters is to provide the reader with a brief overview of important concepts related to head and neck anatomy.

A superb team of medical illustrators created new art to complement the anatomical illustrations of Dr. Frank H. Netter, which resulted in a more complete learning tool. Essential information is presented in tables and brief text that are integrated with the Netter art to help bridge gaps and augment the readers' knowledge of head and neck anatomy.

Netter's Head and Neck Anatomy for Dentistry is for those in all stages of the dental profession. My hope is that this book will provide an essential resource to readers in helping them to learn and appreciate the complex anatomy of the head and neck.

Netter's
HEAD AND NECK ANATOMY
FOR DENTISTRY

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CHAPTER 1

DEVELOPMENT OF THE HEAD AND NECK

Overview

Pharyngeal Arches

Pharyngeal Pouches, Membranes, and Clefts

Skull

Face

Palate

Tongue

Thyroid Gland

Clinical Correlates

Overview

GENERAL INFORMATION

3 major germ layers form the initial developing embryo:

- Ectoderm
- Mesoderm
- Endoderm

Mesoderm differentiates into:

- Paraxial mesoderm
- Intermediate mesoderm
- Lateral plate mesoderm

Ectoderm gives rise to 2 layers:

- Neuroectoderm
- Neural crest

The head and neck are formed by:

- Paraxial mesoderm
- Lateral plate mesoderm
- Neural crest
- Ectodermal placodes

Most of the head and neck is formed from the pharyngeal arches

