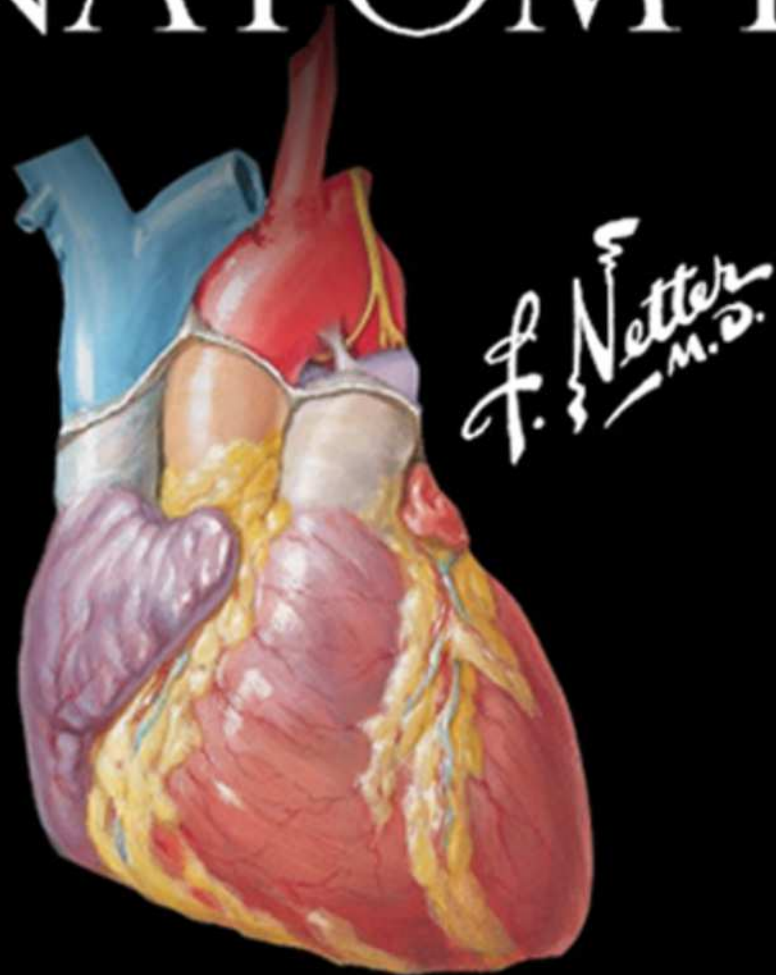


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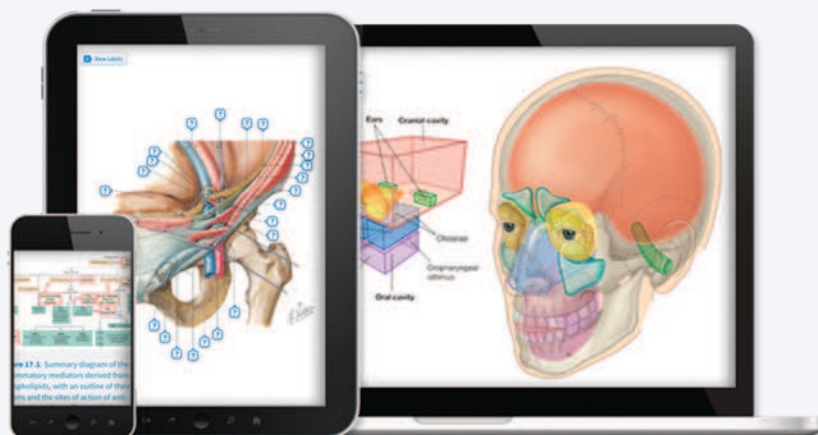
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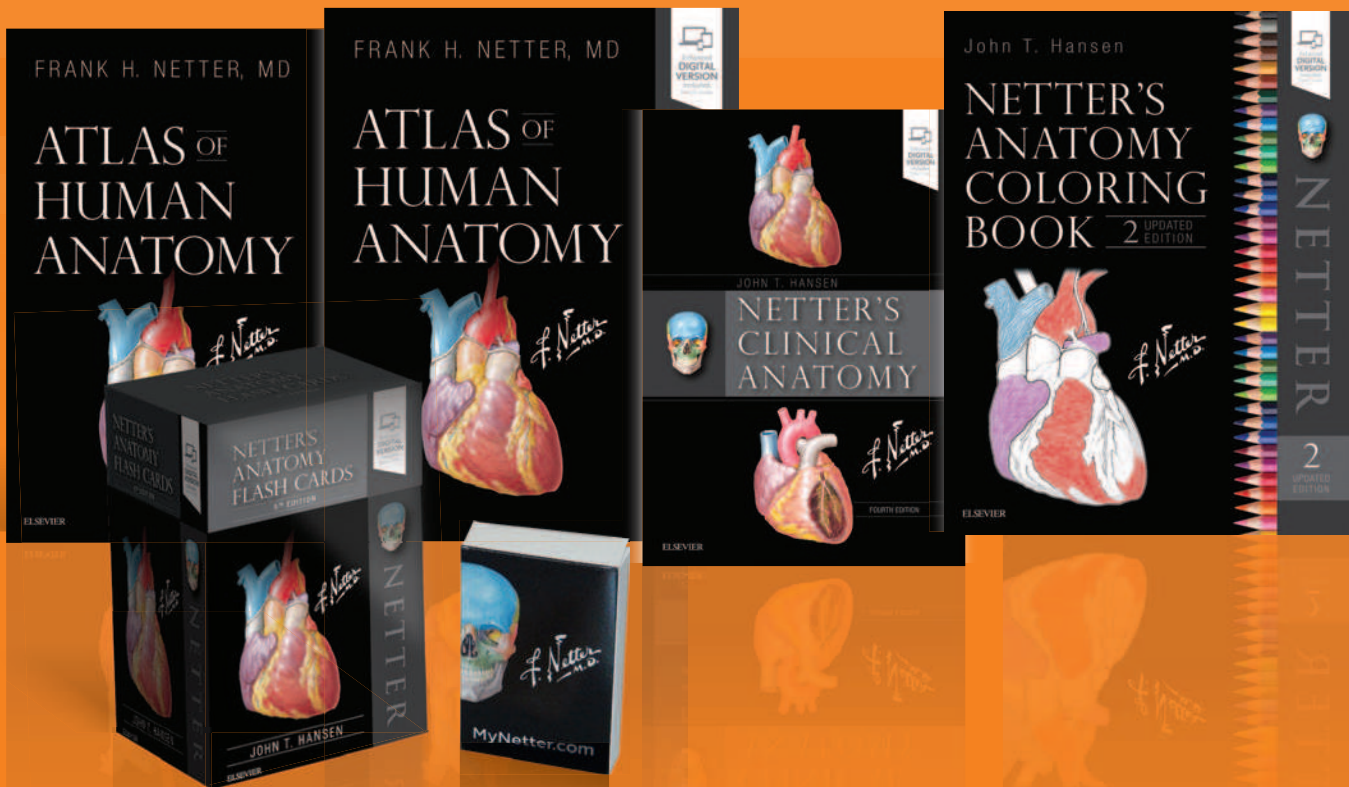
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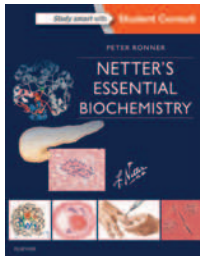
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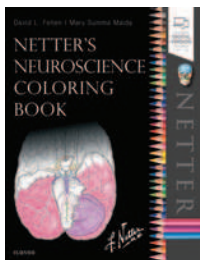
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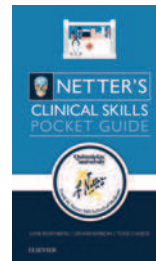
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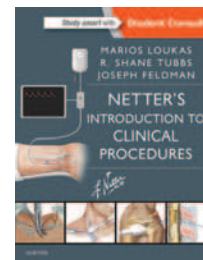


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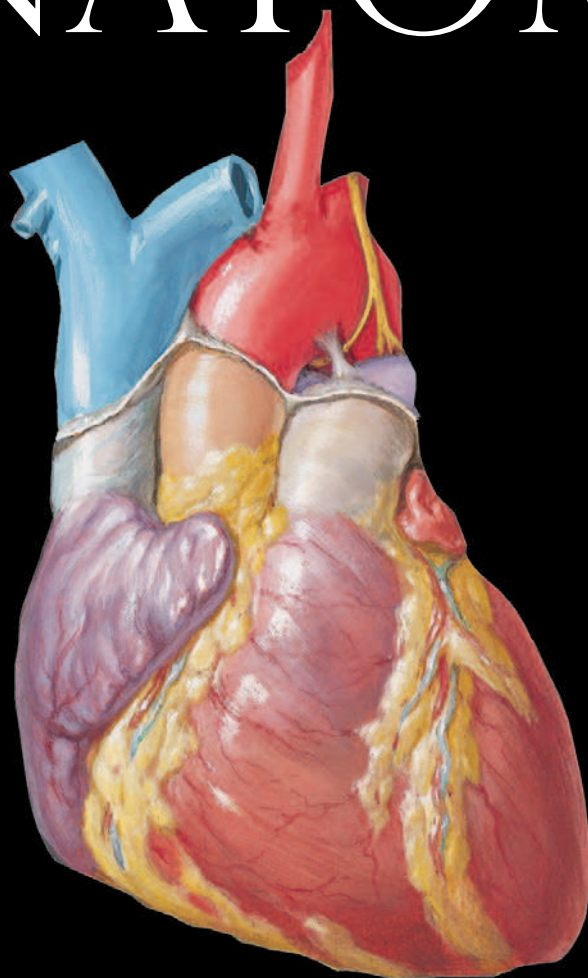
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NEW TO THIS EDITION

With your copy of the Frank H. Netter, MD, *Atlas of Human Anatomy*, you own a collection of some of the most well-known depictions of human anatomy in medicine and healthcare. In addition to the famous work of Dr. Netter, with your copy of this 7th edition, you also have access to nearly 100 painted pieces by Carlos A. G. Machado, MD, one of the foremost medical illustrators working today. Dr. Machado's contributions to the *Atlas* highlight important views of anatomy that have become more clinically relevant in recent years— anatomic views that have resulted from improved dissection techniques and modern imaging. In addition, you have access to more than 50 carefully selected radiologic images that help bridge the idealized illustrated anatomy with living anatomy viewed in the clinic.

While numerous updates have been made to the illustrated plates and tables to make them easier to learn from, the most significant changes to this edition include:

Introductory Section

To fulfill the requests from many students and fans of Netter's *Atlas*, we have added a new opening section containing several overview plates. These plates provide the very first head-to-toe views in the *Atlas of Human Anatomy*!

Clinical Tables

The *Atlas of Human Anatomy* is the only anatomy atlas illustrated by physicians. Dr. Netter was a surgeon and Dr. Machado is a cardiologist. The views of anatomy in this atlas have always reflected a clinical perspective. In line with this clinical focus, and in congruence with integrated curricula in health and medicine, tables at the end of each regional section highlight the most commonly injured structures, as well as other structures with high clinical significance and commonly covered in anatomy courses. The tables provide students with quick summaries, organized by body system, and note where to best view these key structures in the illustrated plates.

New Art Plates by Dr. Machado

For this edition alone, over 25 new illustrations have been painted by Dr. Machado. Suggestions for new plates of additional anatomic views and concepts are submitted by students, faculty, anatomists, physicians, and others. Sometimes suggestions are solicited at major anatomy conferences with a "What Should Carlos Paint Next?" idea box. Decisions around which new plates are prioritized and given space in a new edition come from discussions among consulting editors. The new plates for this edition are largely those that portray structures with clinical significance (Fascial Columns of the Neck, Deep Veins of the Leg, Hip Bursae, and Vasculature of the Prostate) or those that are difficult to visualize (Infratemporal Fossa)—and, of course, the new additions created for the introductory section.

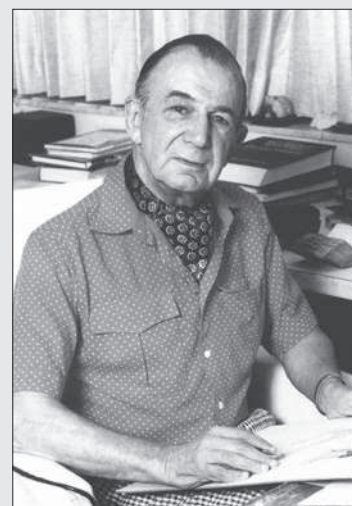
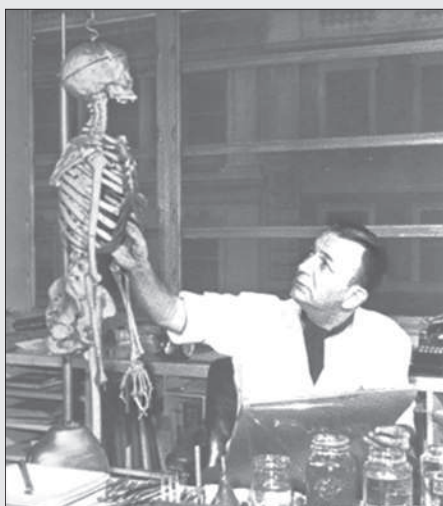
Terminology Updates

The *Atlas of Human Anatomy* uses terminology accepted (in Göttingen, Germany, on September 24, 2016) by the Federative International Programme on Anatomical Terminologies and published as updates to the 1998 *Terminologia Anatomica*. Numerous updates to terminology have been made, so in select cases, former terminology has been included within parentheses to assist with the transition.

New Radiologic Images

Over 50 radiologic images—some completely new views and others replacing existing views using newer imaging tools—are included in this edition. Images have been selected based on their utility to students studying gross anatomy.

Your *Atlas of Human Anatomy* content has been updated, created, and overseen by a team of dedicated and passionate consulting editors, with the help of a stellar international advisory board, and guided by the feedback of many students, educators, anatomists, and clinicians that love Netter's *Atlas*. Please feel free to comment on the Netter Images Facebook page or Twitter feeds or email us directly with your thoughts, suggestions, or questions at NetterAppFeedback@Elsevier.com.



PREFACE TO THE FIRST EDITION

I have often said that my career as a medical artist for almost 50 years has been a sort of “command performance” in the sense that it has grown in response to the desires and requests of the medical profession. Over these many years, I have produced almost 4,000 illustrations, mostly for *The CIBA* (now *Netter*) *Collection of Medical Illustrations* but also for *Clinical Symposia*. These pictures have been concerned with the varied subdivisions of medical knowledge such as gross anatomy, histology, embryology, physiology, pathology, diagnostic modalities, surgical and therapeutic techniques, and clinical manifestations of a multitude of diseases. As the years went by, however, there were more and more requests from physicians and students for me to produce an atlas purely of gross anatomy. Thus, this atlas has come about, not through any inspiration on my part but rather, like most of my previous works, as a fulfillment of the desires of the medical profession.

It involved going back over all the illustrations I had made over so many years, selecting those pertinent to gross anatomy, classifying them and organizing them by system and region, adapting them to page size and space, and arranging them in logical sequence. Anatomy of course does not change, but our understanding of anatomy and its clinical significance does change, as do anatomical terminology and nomenclature. This therefore required much updating of many of the older pictures and even

revision of a number of them in order to make them more pertinent to today’s ever-expanding scope of medical and surgical practice. In addition, I found that there were gaps in the portrayal of medical knowledge as pictorialized in the illustrations I had previously done, and this necessitated my making a number of new pictures that are included in this volume.

In creating an atlas such as this, it is important to achieve a happy medium between complexity and simplification. If the pictures are too complex, they may be difficult and confusing to read; if oversimplified, they may not be adequately definitive or may even be misleading. I have therefore striven for a middle course of realism without the clutter of confusing minutiae. I hope that the students and members of the medical and allied professions will find the illustrations readily understandable, yet instructive and useful.

At one point, the publisher and I thought it might be nice to include a foreword by a truly outstanding and renowned anatomist, but there are so many in that category that we could not make a choice. We did think of men like Vesalius, Leonardo da Vinci, William Hunter, and Henry Gray, who of course are unfortunately unavailable, but I do wonder what their comments might have been about this atlas.

Frank H. Netter, MD
(1906–1991)

FRANK H. NETTER, MD

Frank H. Netter was born in New York City in 1906. 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 Doctor of Medicine 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 1933, 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.

Icon Learning Systems acquired the Netter Collection in July 2000 and continued to update Dr. Netter’s original paintings and to add newly commissioned paintings by artists trained in the style of Dr. Netter. 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.

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 1989, presents the anatomic paintings from the Netter Collection. Now translated into 16 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 importantly, 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 subtly 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 make them so intellectually valuable.

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

ACKNOWLEDGMENTS

Carlos A. G. Machado, MD

I struck luck when joining this golden team of consulting editors exceedingly knowledgeable in the fields of clinical anatomy and medical education. It has been a great honor to work with and be under their guidance, as well as under the highly competent coordination of Elyse O'Grady and Marybeth Thiel, Elsevier's Executive Content Strategist and Senior Content Development Specialist, respectively.

This unique book would not exist without the genius of its creator, Dr. Frank Netter, to whom I owe special thanks, also in the name of generations of students and health professionals who, like myself, have learned so much from his incommensurable body of work.

I dedicate my work and express my most sincere thanks to my beloved parents, Carlos and Neide, who provided me with the foundation of my education; to my patient wife, Adriana, and talented daughter, Beatriz, for their love and support; to the students, teachers, and health professionals who rely on my work to learn and teach; to all the body donors and living friends that have respectively been the subjects of my studies and models of most of the illustrations I have created for the *Atlas*; and to my teachers Eugênio Cavalcante, Mário Fortes, and Paulo Carneiro for taking my interest in human/clinical anatomy much further.

John T. Hansen, PhD

At Elsevier I would like to thank Marybeth Thiel, Senior Content Development Specialist, Elyse O'Grady, Executive Content Strategist, John Casey, Senior Project Manager, Patricia Tannian, Publishing Services Manager, Julia Dummitt, Design Manager, Karen Giacomucci, Illustration Buyer, and Madelene Hyde, Publishing Director, for their continuous support and meticulous attention to detail during the development of this seventh edition of the *Atlas of Human Anatomy*. They, along with the entire editorial, production, design, and marketing teams at Elsevier have been a delight to work with and to know. I also wish to thank my consulting editors for their insightful and constructive suggestions as we strive to make every new edition of the *Atlas* better. I am also indebted to Carlos Machado for his superb artistic skill in producing and updating a number of plates that appear in this latest edition of the *Atlas*. His renderings of human anatomy are the perfect complement to the Netter images. In addition to my fellow editors, I wish to express my thanks to my faculty

colleagues at Rochester and to all my past and present students who have provided generous and constructive feedback and have enriched my life. Finally, I am indebted to my entire family for their continued support and especially to my wife, Paula. Their love and encouragement sustains me and is the source of all the happiness and joy I know.

Brion Benninger, MD, MSc

Every day I am thankful for my wife, Alison, and son, Jack, for the laughs we have as a family, often from my follies, which is such a tonic. I thank Elsevier, especially Marybeth Thiel, Elyse O'Grady, and Madelene Hyde for their professionalism and guidance, enabling John Hansen, Carlos Machado, and my fellow coeditors to work in a unique and dynamic environment. I thank those clinicians who trained me, especially my early gifted surgeon/anatomist/teacher mentors, Drs. Gerald Tressidor and Harold Ellis CBE (Cambridge & Guy's Hospital); Dr. S. Standing, who embodies professionalism and displays fortitude; Drs. P. Crone and J. Heatherington, and the University Board for their stellar support; my past and future students and patients; and clinical colleagues from all corners of the world who keep anatomy dynamic, fresh, and wanting more. Special thanks to Jim Diegel and Erik Szeto, friends, mentors and fellow visionaries who also see "outside the box," challenging status quo. A heartfelt tribute to my late mentors, friends, and sister, Jim McDaniel, Bill Bryan, and Gail Hendricks, all who represent what is good in teaching, caring, and healing. They made this world a wee bit better. Lastly, I thank my mother for her love of education and equality and my father for his inquisitive and creative mind.

Jennifer Brueckner-Collins, PhD

Many thanks to the Elsevier team, particularly Marybeth Thiel and Elyse O'Grady, for their guidance and expertise during our preparation of the seventh edition. It is always an honor to work with Carlos Machado, whose passion for and mastery of the art of clinical anatomy and medicine never cease to amaze me. I am forever indebted to Brian MacPherson, who has served as a teacher, mentor, and friend to me for more than 20 years....you showed me what it means to be a true educator and I have been so fortunate to have the opportunity to build a career based on those principles. To Kurt and Lincoln, you are my inspiration....my world...my life and I love you to the snow moon and back.

Todd M. Hoagland, PhD

It is a privilege to teach clinical human anatomy and I am eternally grateful to all the body donors and their families for enabling healthcare professionals to train in the dissection laboratory. It is my honor to work with outstanding medical students and colleagues at the Medical College of Wisconsin. I am grateful to John Hansen and the professionals of the Elsevier team for the opportunity to be a steward of the incomparable Netter's *Atlas*. Marybeth Thiel and Elyse O'Grady were especially helpful and a pleasure to work with. It was an honor to collaborate with the brilliant Carlos Machado and all the consulting editors. I thank Bill Swartz and Mark Moss for being outstanding mentors, and I thank all of the graduate students I've worked with, especially Rebecca Lufner. I am deeply appreciative of Stan Hillman and Jack O'Malley for inspiring me with masterful teaching and rigorous expectations. I am indebted to Gary Kolesari and Richard Hoyt Jr. for

helping me become a competent clinical anatomist, and to Rob Bouchie for his camaraderie. I am most grateful to my brother, Bill, for his unwavering optimism and gregarious nature. I thank my mother, Liz, for her dedication and love and for instilling a strong work ethic. Finally, I am humbled by my two awesome children, Ella and Caleb, for helping me redefine love, wonder, and joy.

R. Shane Tubbs, MS, PA-C, PhD

Elsevier and the Netter team have once again been a joy to work with. I thank Elyse O'Grady, Marybeth Thiel, and John Casey for their tremendous work on this edition. In addition, Carlos Machado has again added his expertise to bringing his anatomical images to life. As always, my work is inspired by my beautiful wife, Susan, and son, Isaiah. Lastly, I am indebted to my parents, Richard and Karon Tubbs, who supported me in my career to better understand the human body.

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- 439 Attachments of Muscles of Forearm: Anterior View
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- 443 Movements of Wrist
- 444 Ligaments of Wrist
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449	Wrist and Hand: Superficial Palmar Dissections
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451	Lumbrical Muscles and Bursae, Spaces, and Sheaths: Schema
452	Flexor Tendons, Arteries, and Nerves at Wrist
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456	Arteries and Nerves of Hand: Palmar Views
457	Wrist and Hand: Superficial Dissection
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BP100	Arteries of Arm and Proximal Forearm
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477 Hip Joint
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482 Muscles of Thigh: Anterior Views
483 Muscles of Thigh: Anterior Views (continued)
484 Muscles of Hip and Thigh: Lateral View
485 Muscles of Hip and Thigh: Posterior Views
486 Psoas and Iliacus Muscles
487 Lumbosacral and Coccygeal Plexuses
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490 Arteries and Nerves of Thigh: Anterior Views
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492 Arteries and Nerves of Thigh: Posterior View
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506	Attachments of Muscles of Leg
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513	Venous Drainage of Leg
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521	Muscles of Dorsum of Foot: Superficial Dissection
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523	Plantar Region of Foot: Superficial Dissection
524	Muscles of Plantar Region of Foot: First Layer
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- BP108 Arteries of Thigh and Knee
- BP109 Cross-Sectional Anatomy of Hip: Axial View
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- BP115 Cross-Sectional Anatomy of Ankle and Foot
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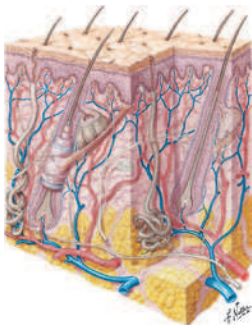
INTRODUCTION

1

Introduction

1-7

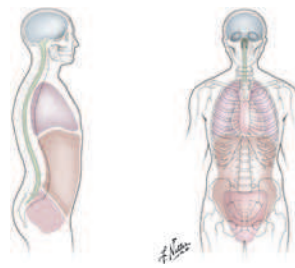
ELECTRONIC BONUS PLATES



BP 1 Cross Section of Skin



BP 2 Pilosebaceous Unit



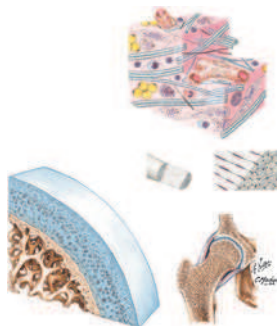
BP 3 Major Body Cavities



BP 4 Skeletal System:
Axial and Appendicular
Skeletons



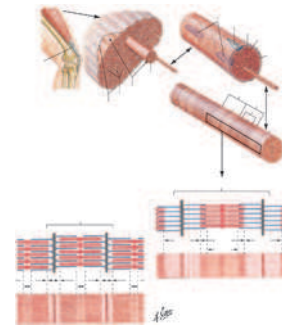
BP 5 Types of
Synovial Joints



BP 6 Joints: Connective
Tissues and Articular
Cartilage



BP 7 Architecture of Bone



BP 8 Muscular System

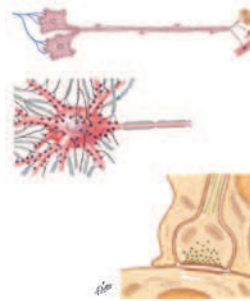
ELECTRONIC BONUS PLATES—*cont'd*



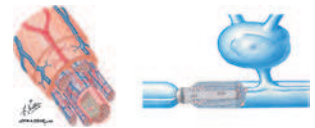
BP 9 Overview of the Gastrointestinal System



BP 10 Overview of the Endocrine System



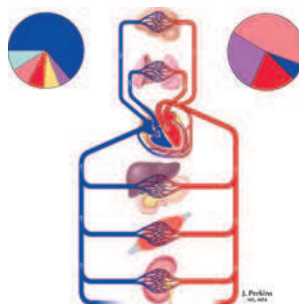
BP 11 Neurons and Synapses



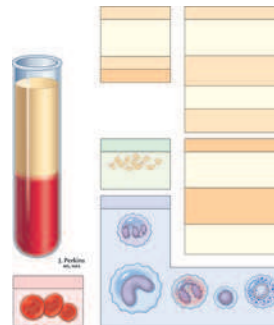
BP 12 Features of a Typical Peripheral Nerve



BP 13 Sites of Visceral Referred Pain



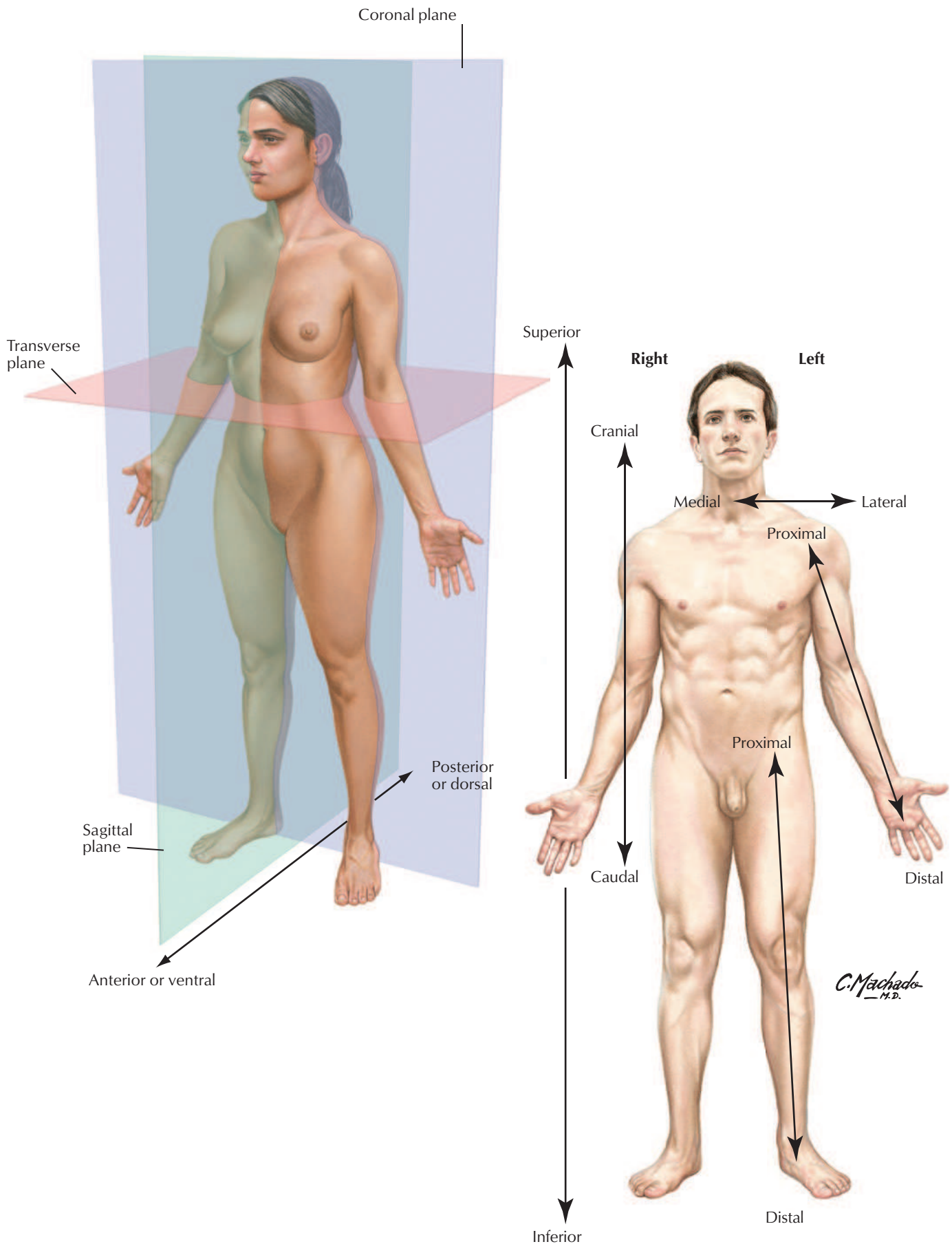
BP 14 General Organization of the Cardiovascular System



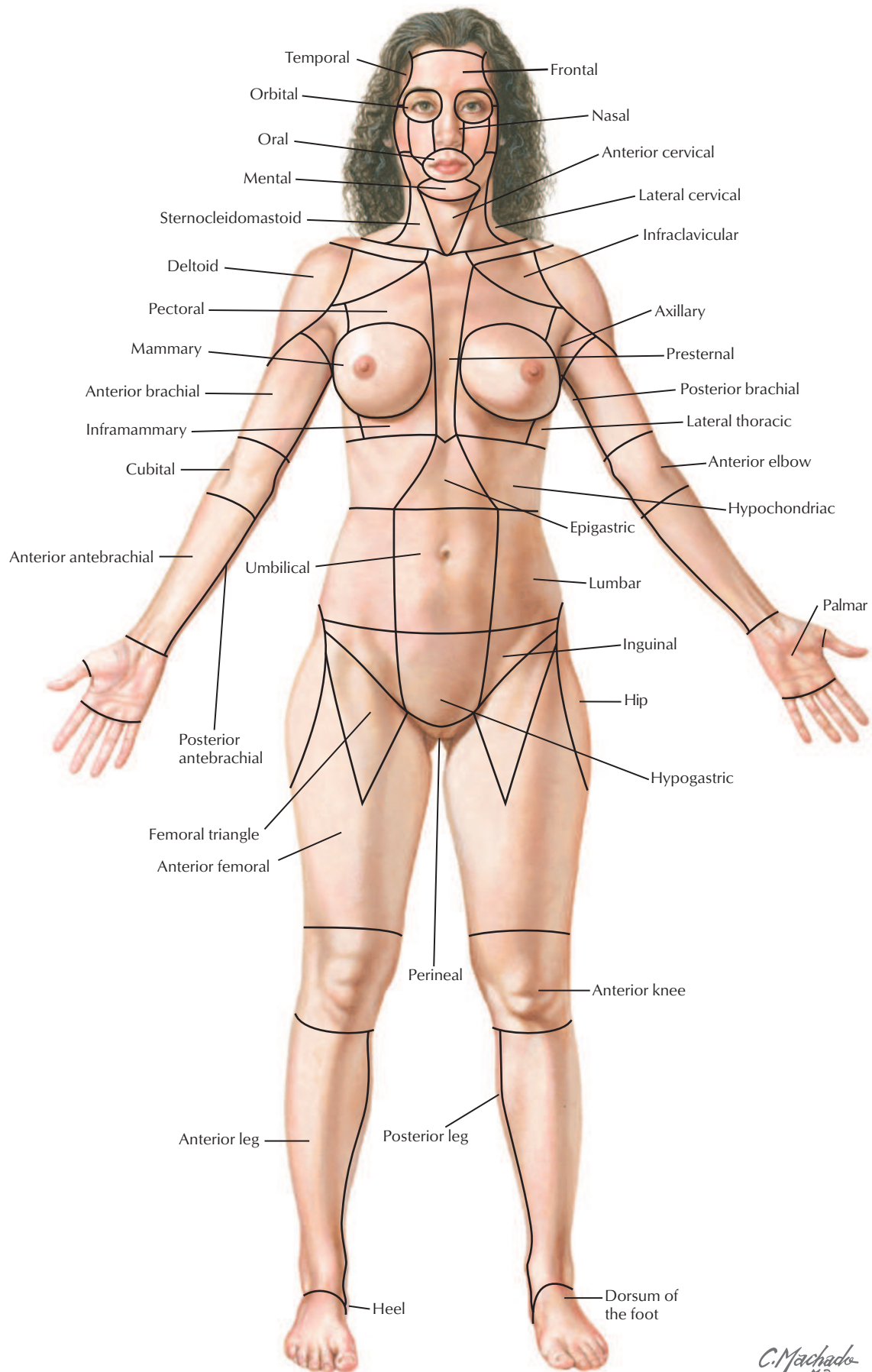
BP 15 Cardiovascular System: Composition of Blood



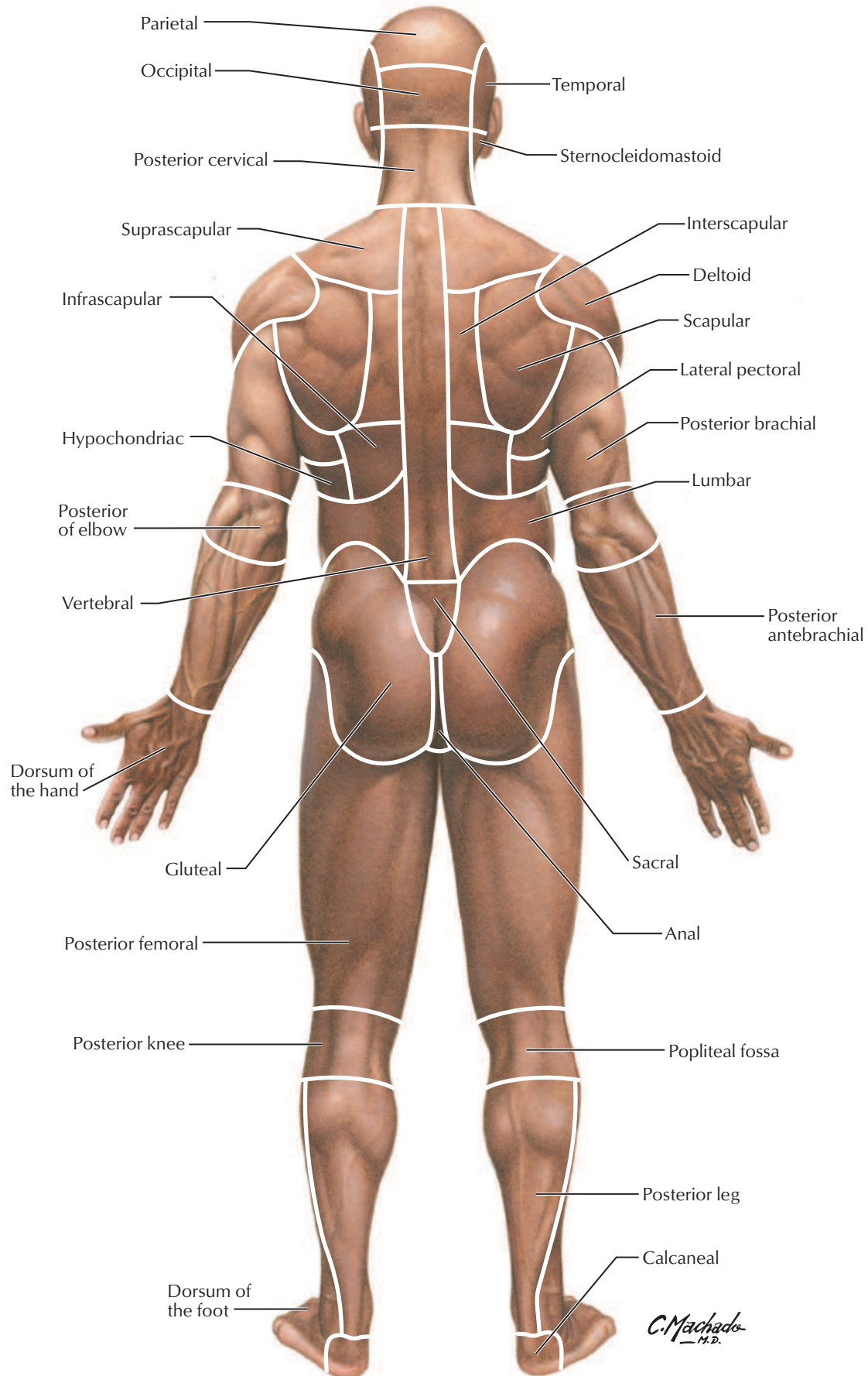
BP 16 Arterial Wall



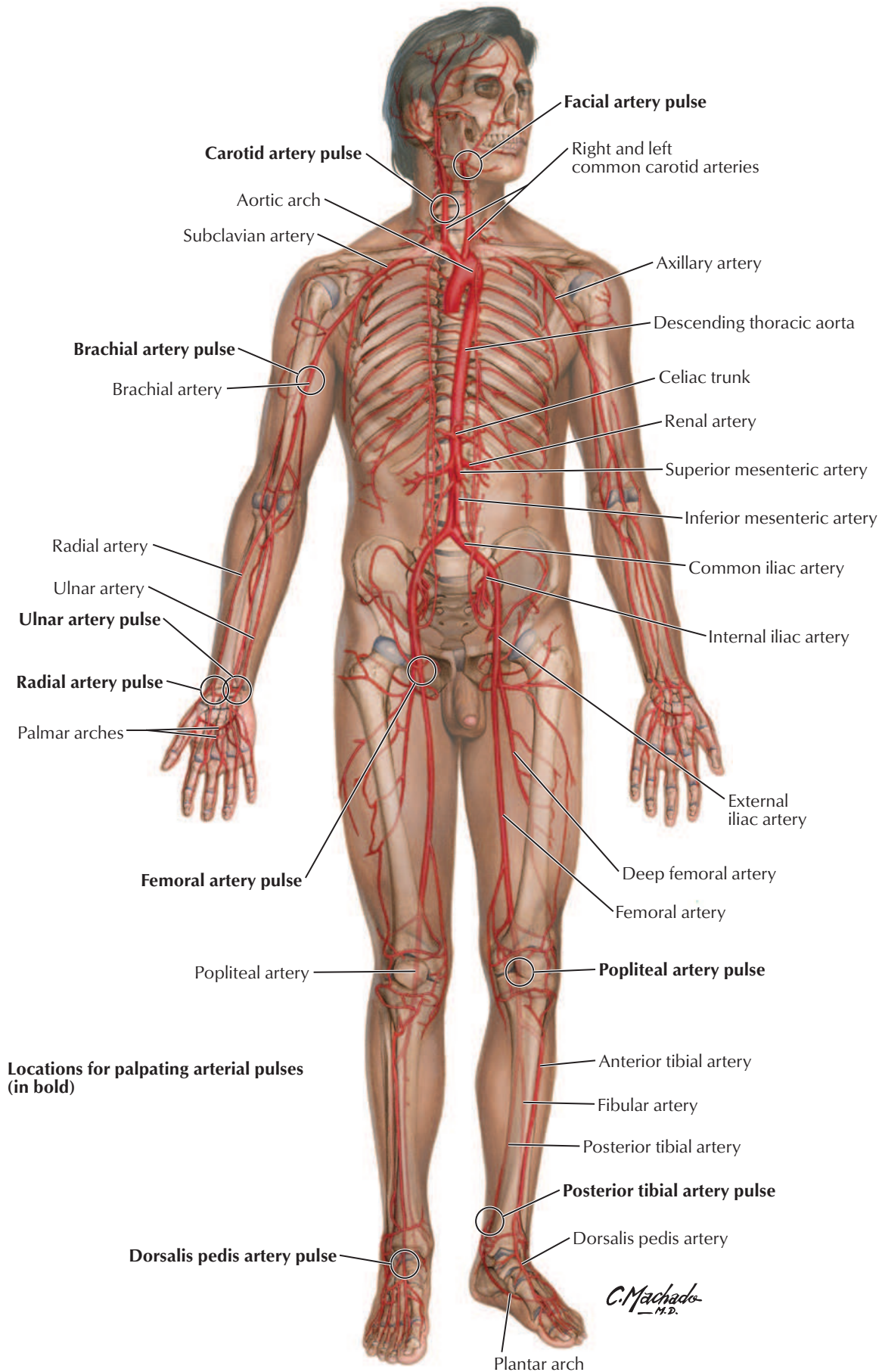
Surface Anatomy: Regions (Anterior View of Female)

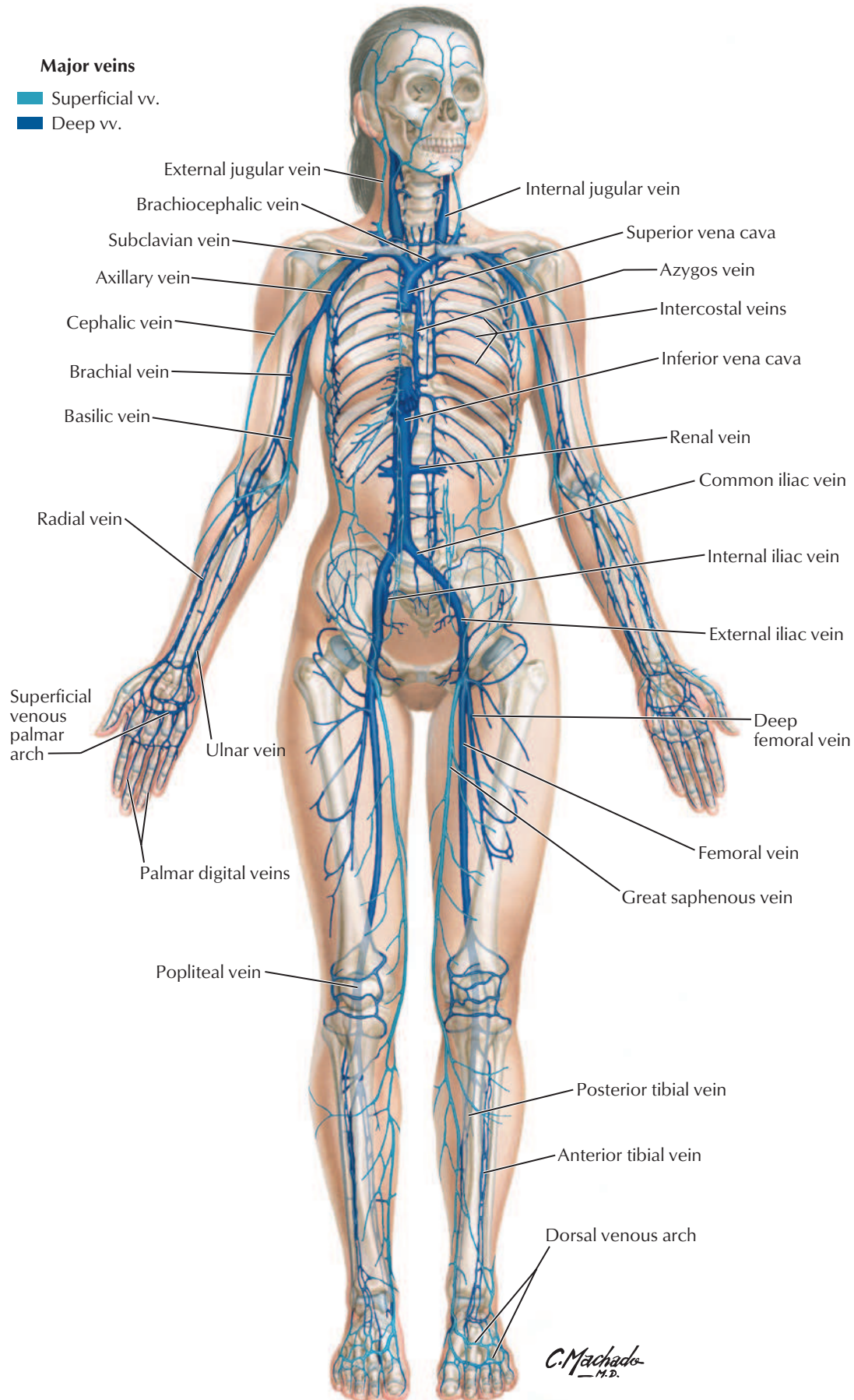


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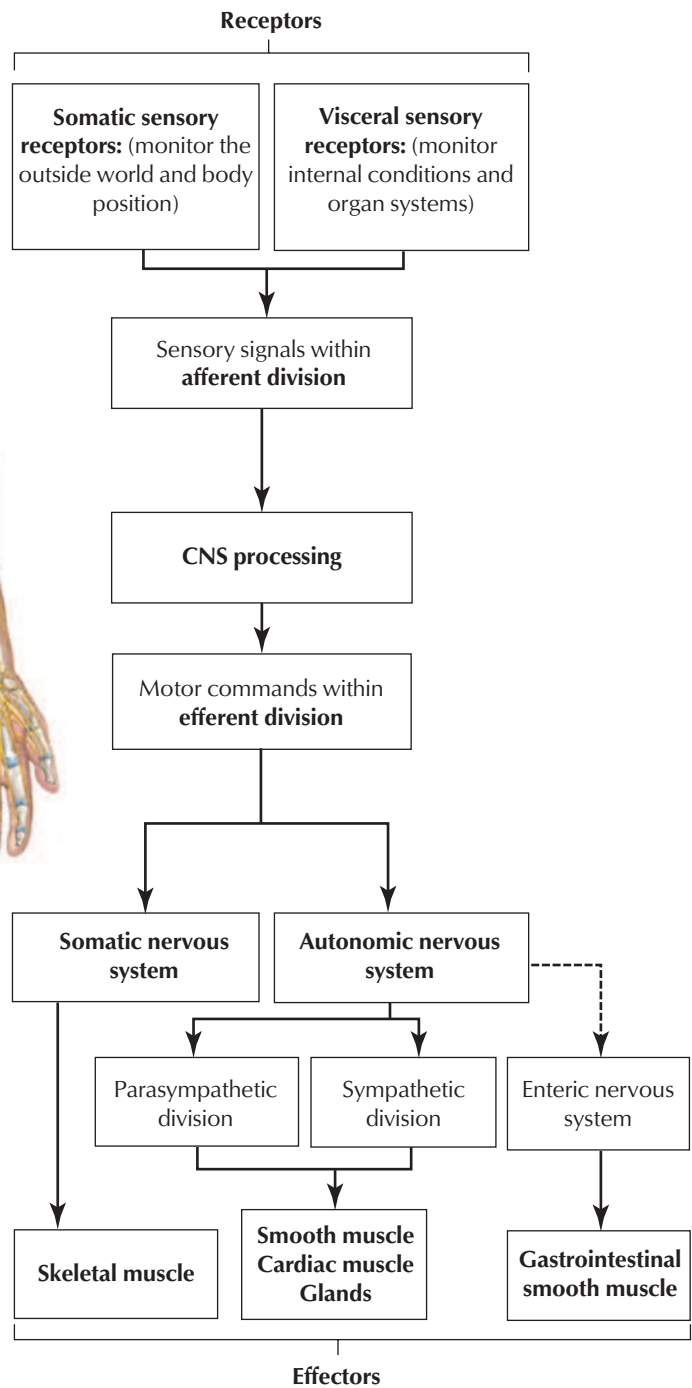
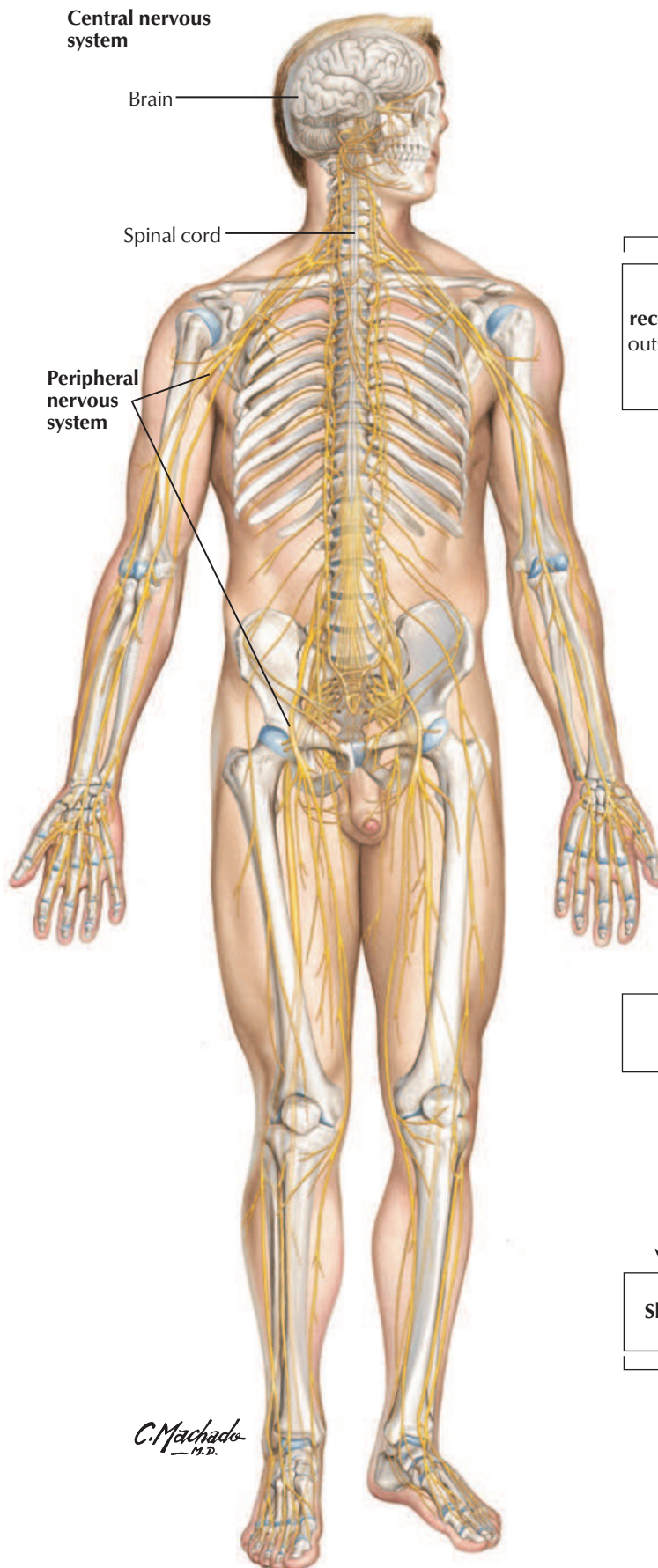


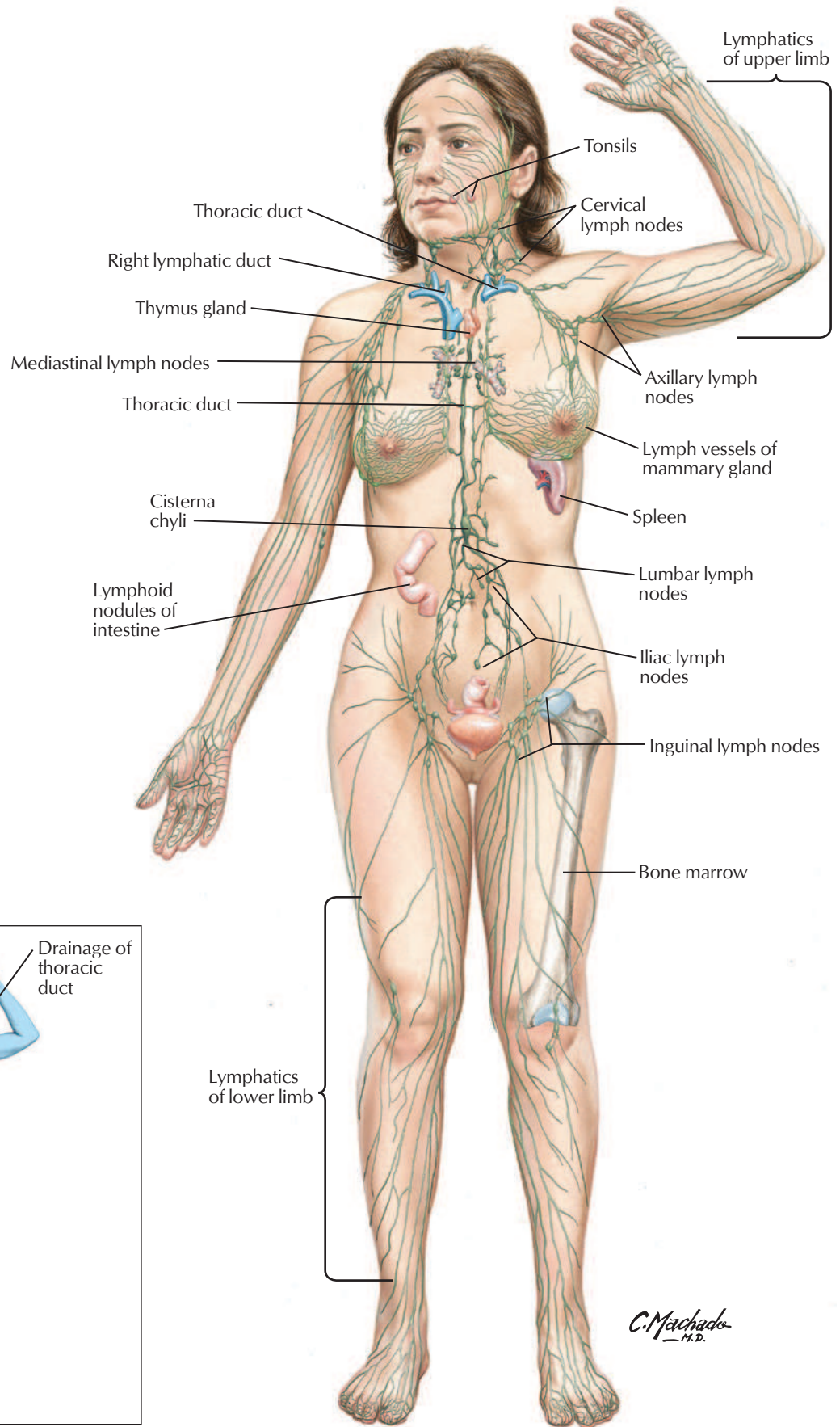
Major Arteries and Pulse Points

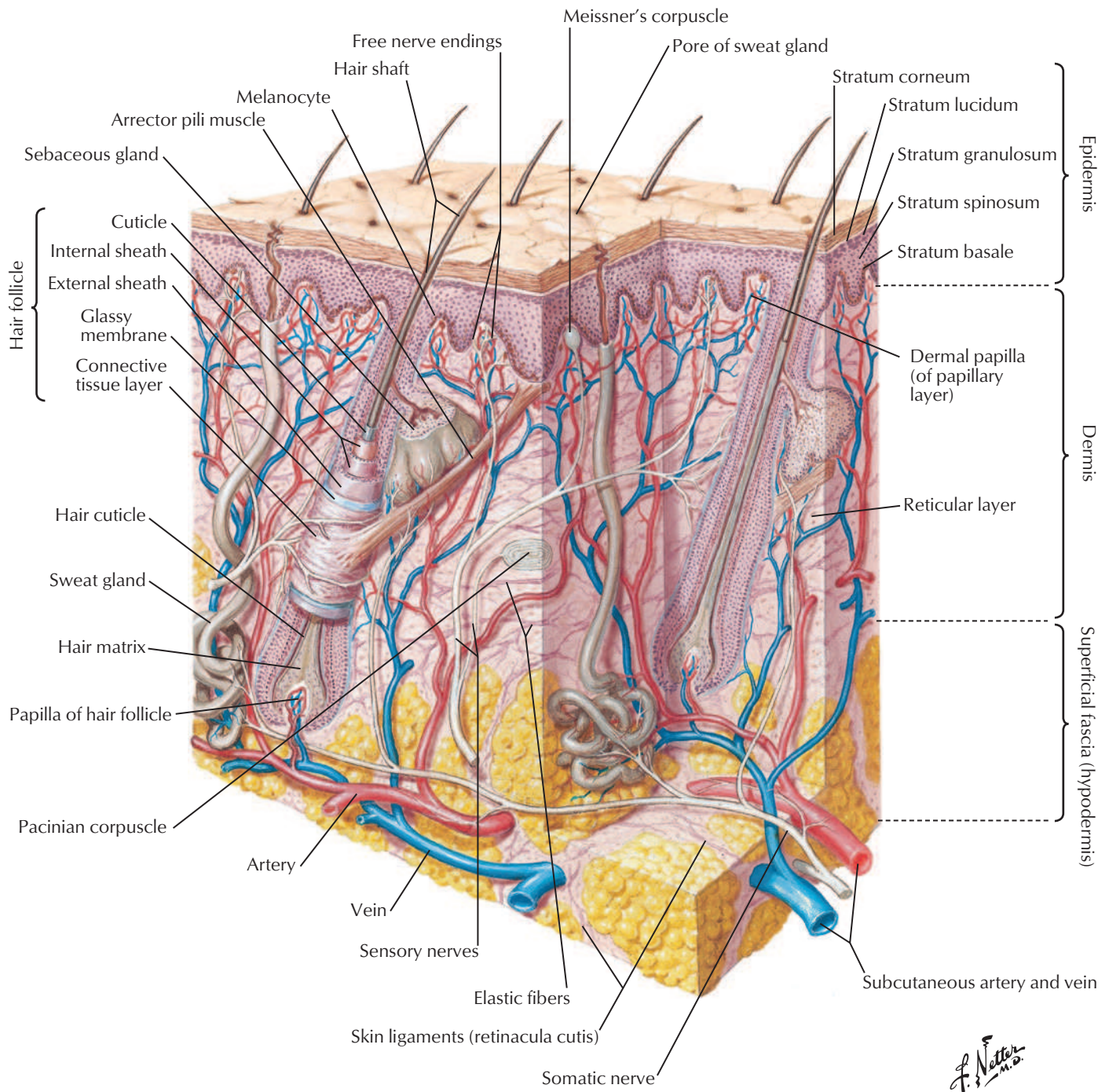


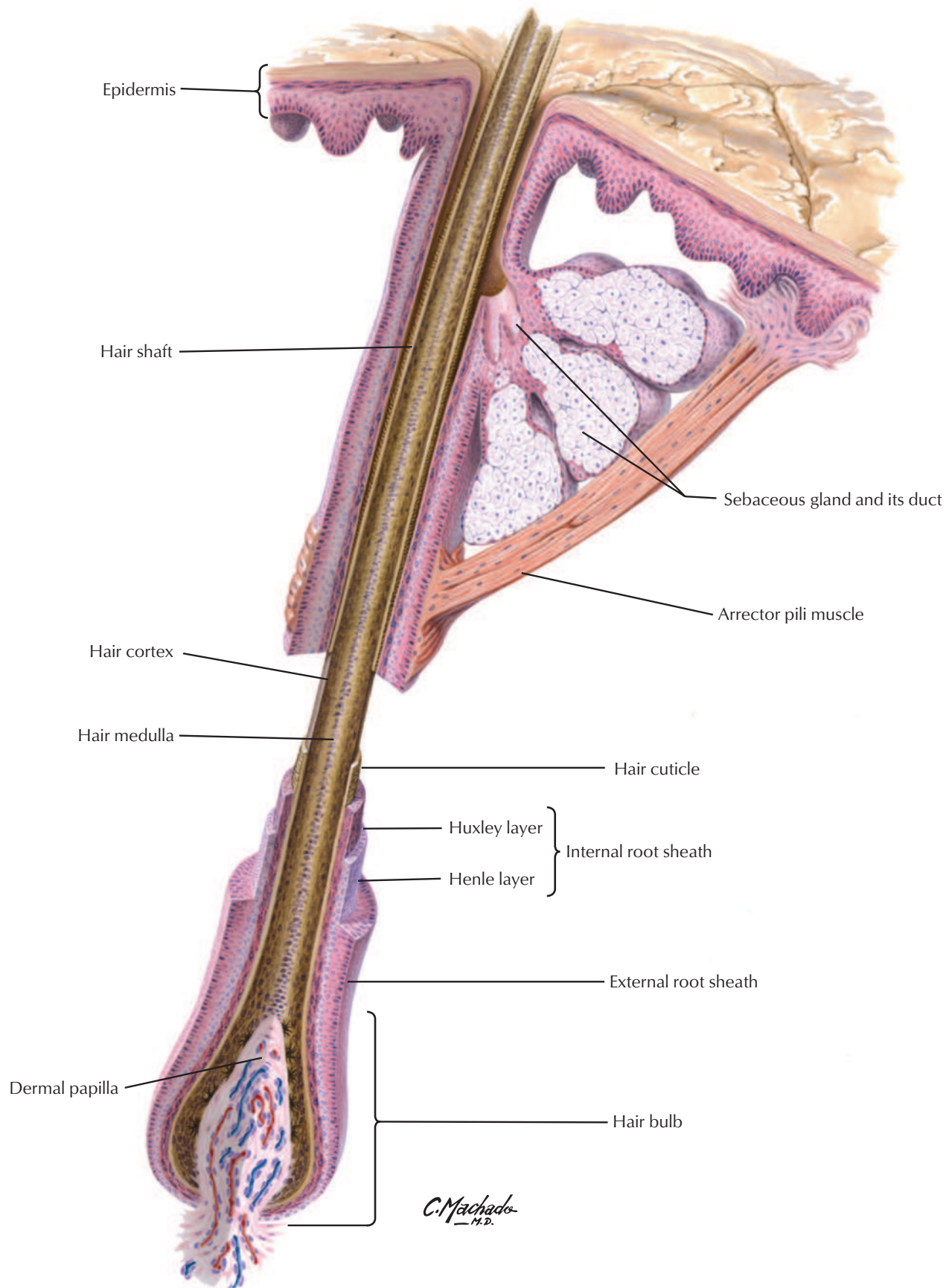


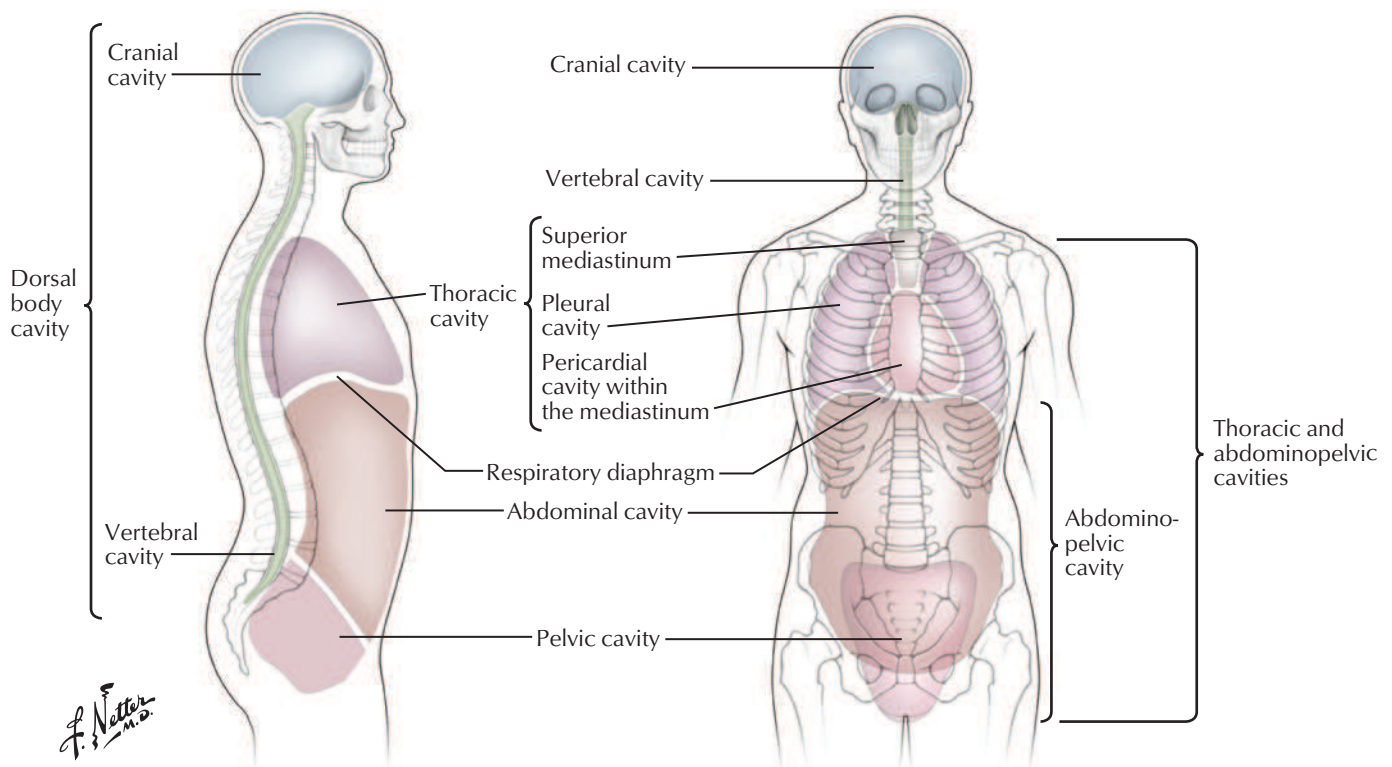
General Organization of the Nervous System



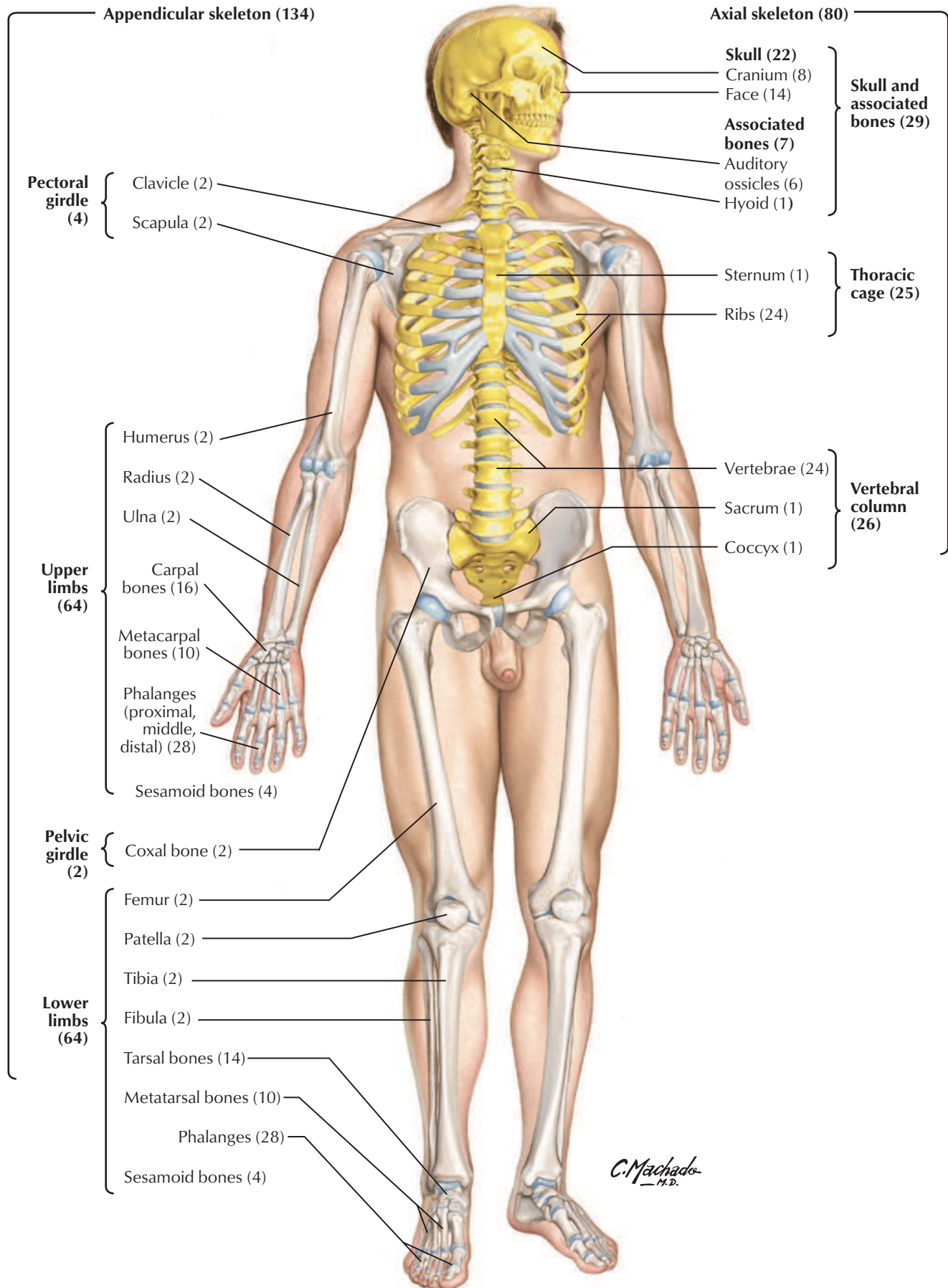




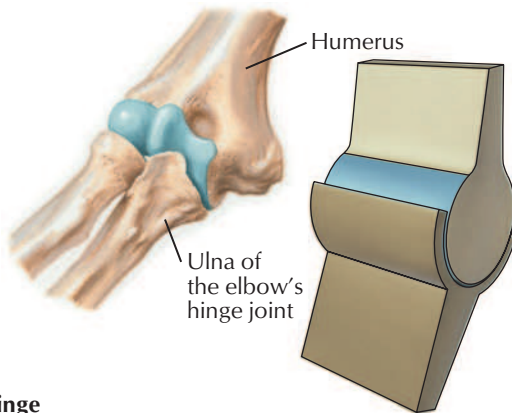
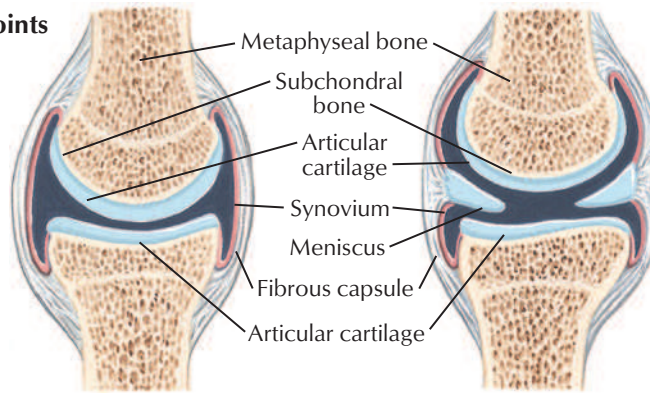




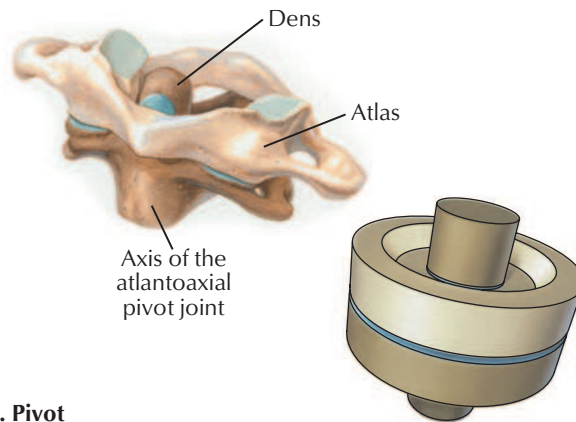
Skeletal System: Axial and Appendicular Skeletons



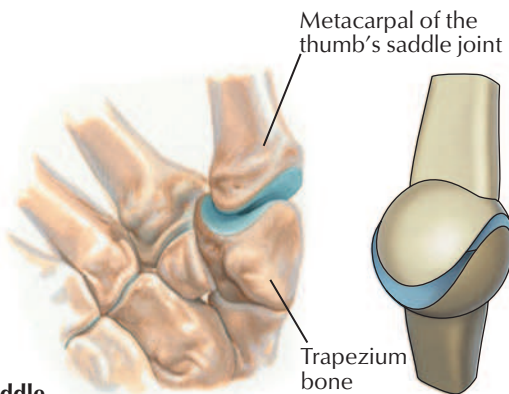
Structure of synovial joints



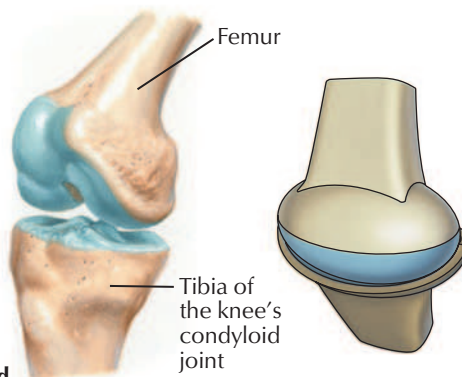
A. Hinge



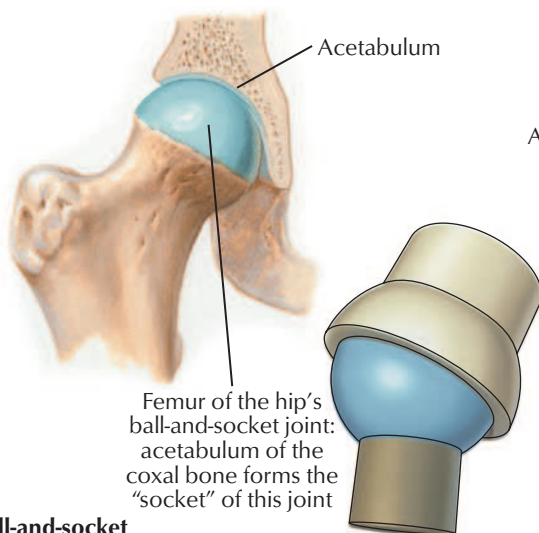
B. Pivot



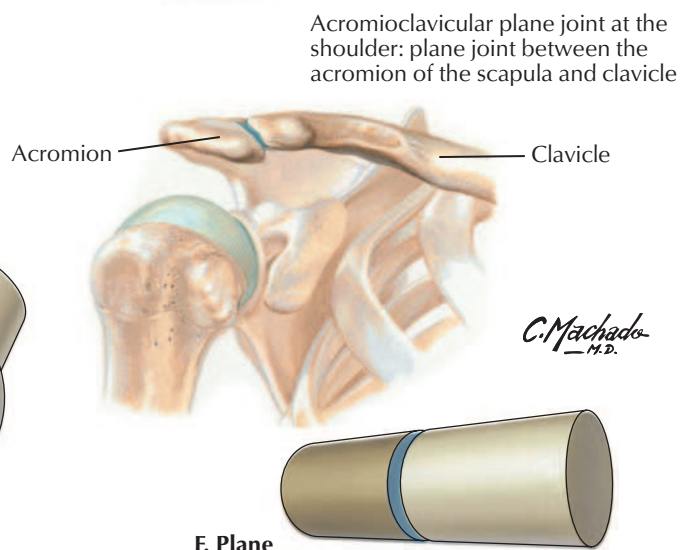
C. Saddle



D. Condyloid

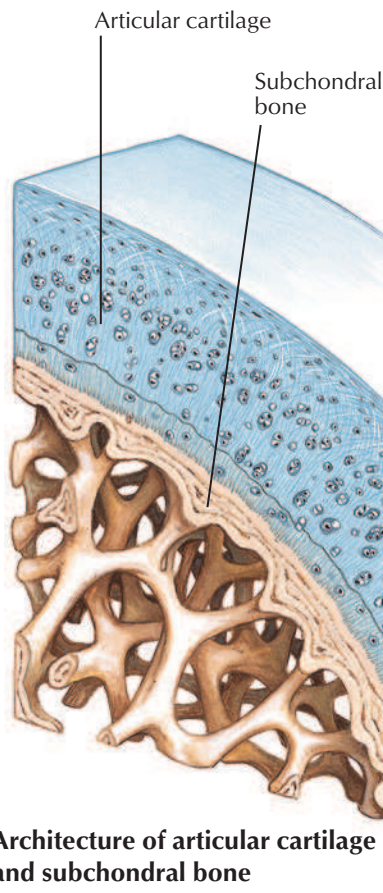
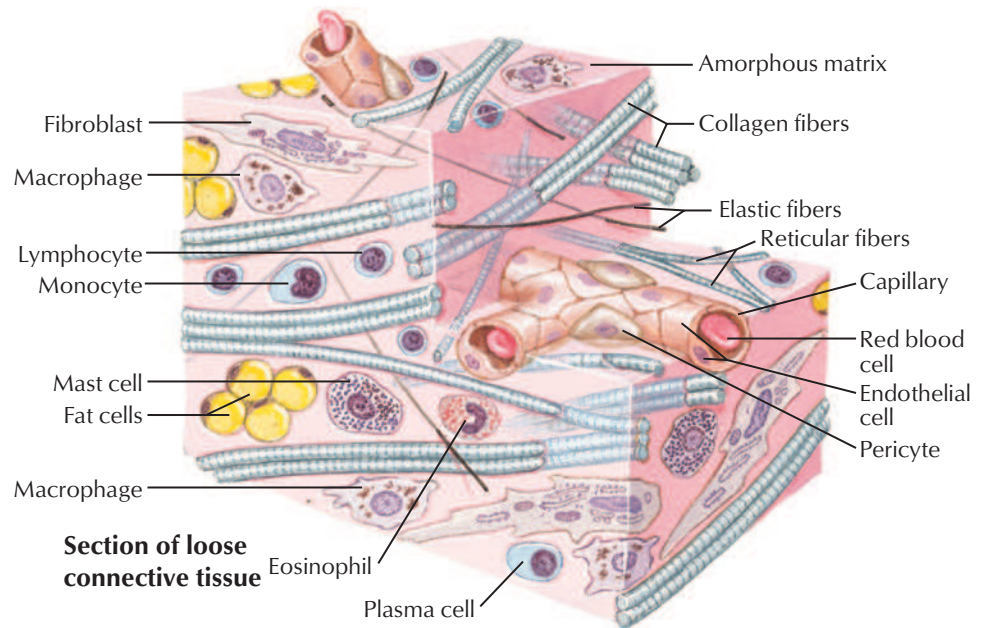


E. Ball-and-socket

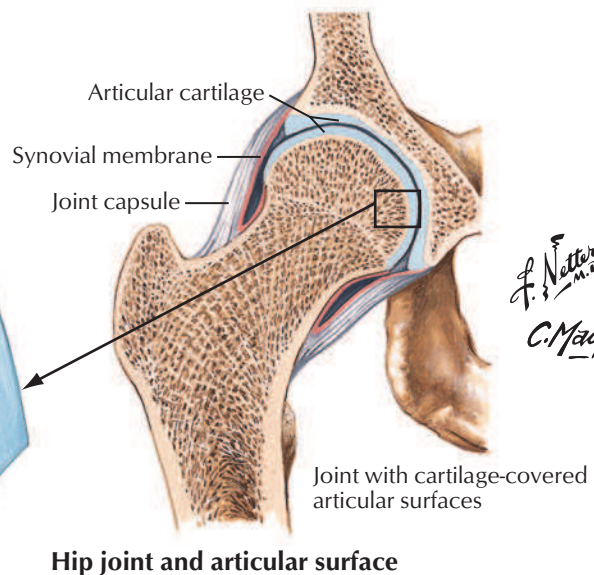
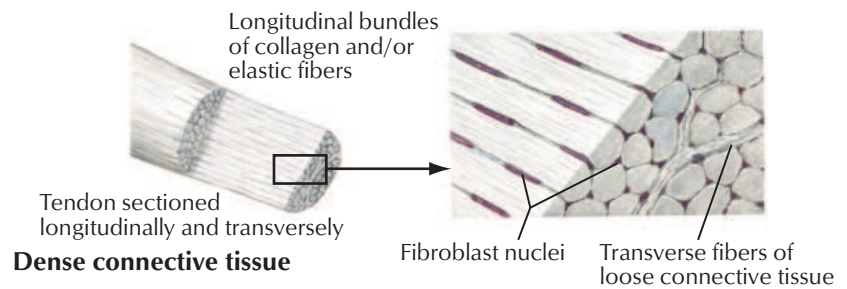


F. Plane

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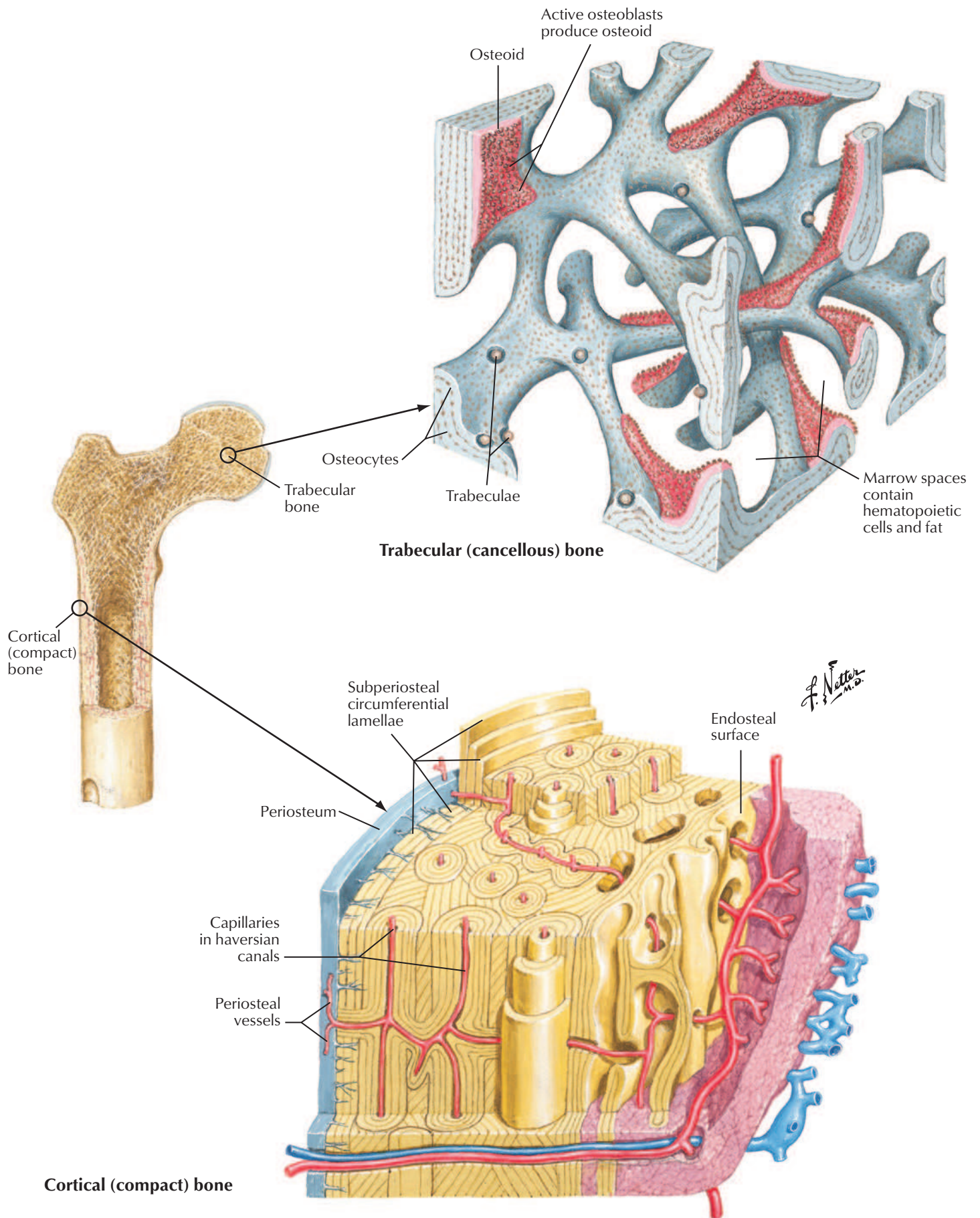


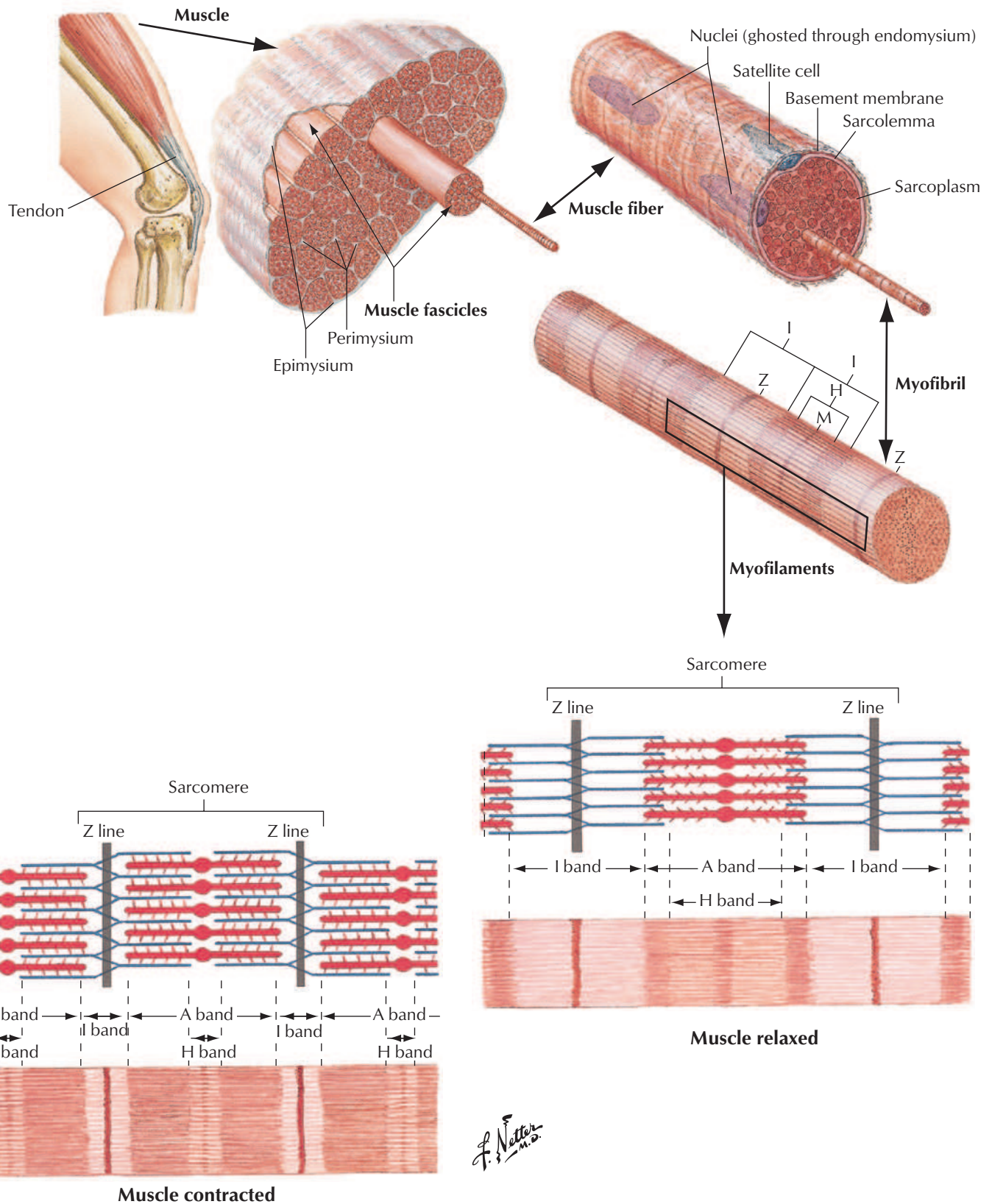
Architecture of articular cartilage and subchondral bone

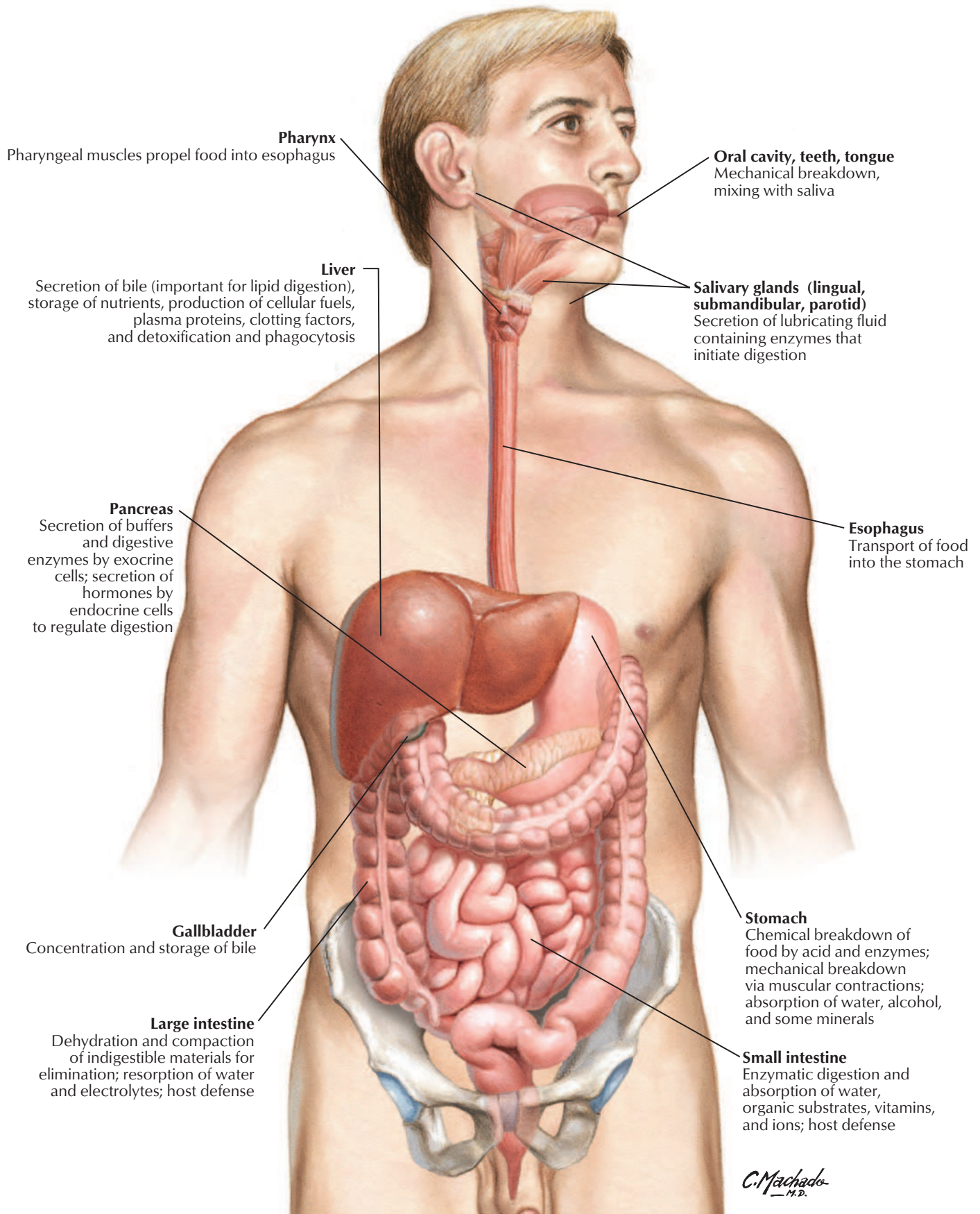


Hip joint and articular surface

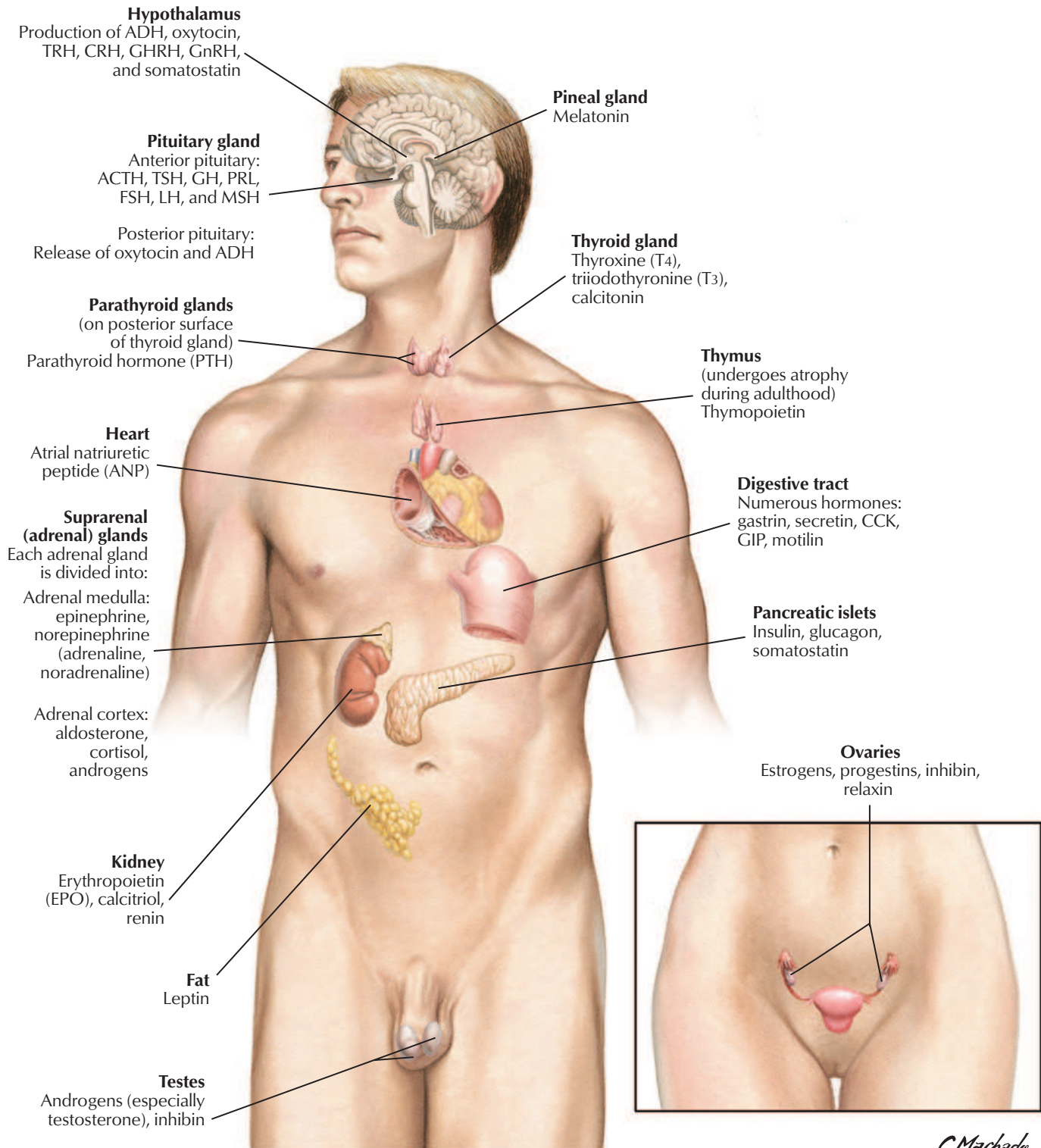
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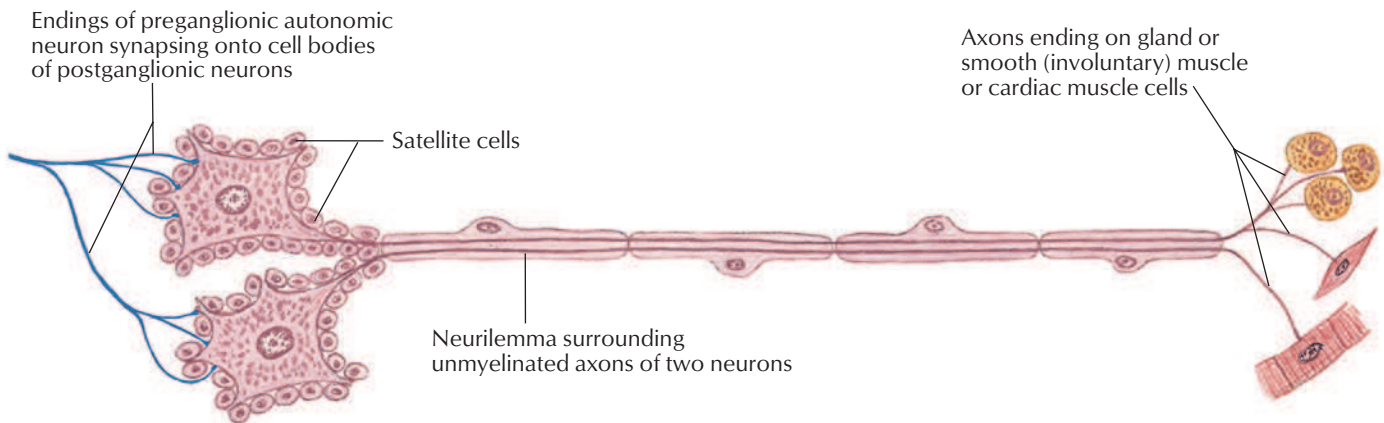




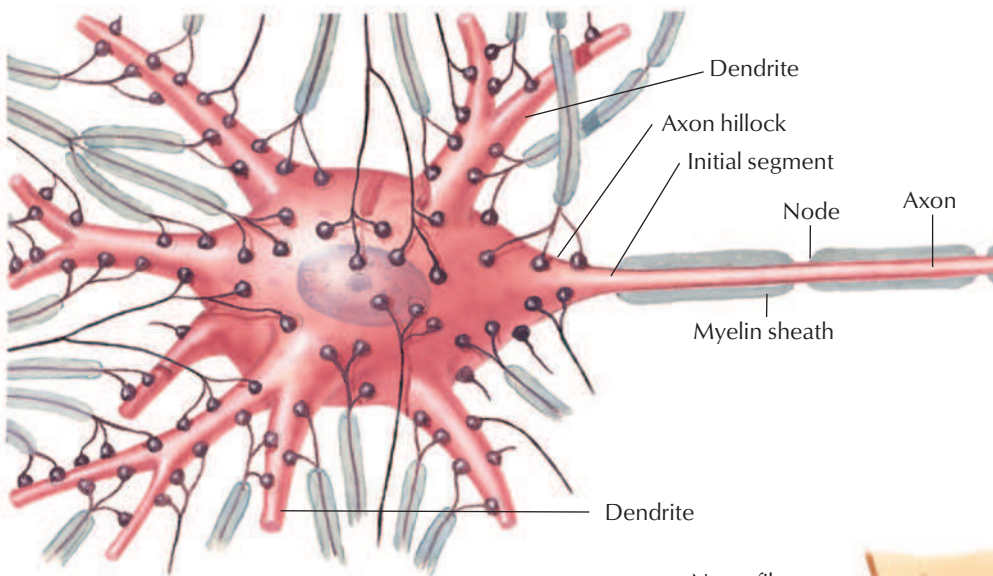


Overview of the Endocrine System



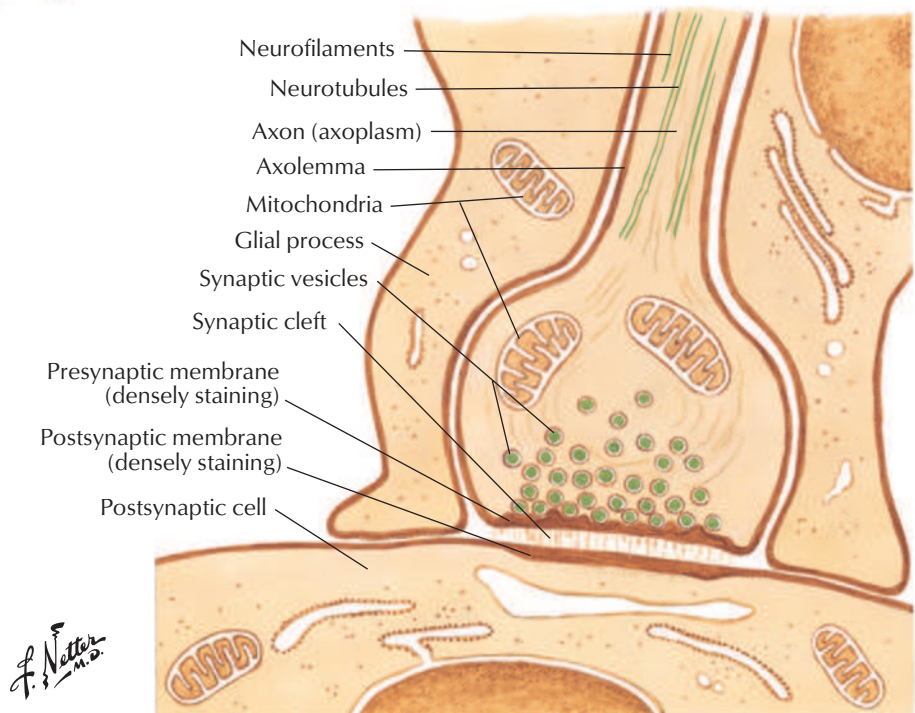


Two postganglionic autonomic neurons of a sympathetic or parasympathetic ganglion



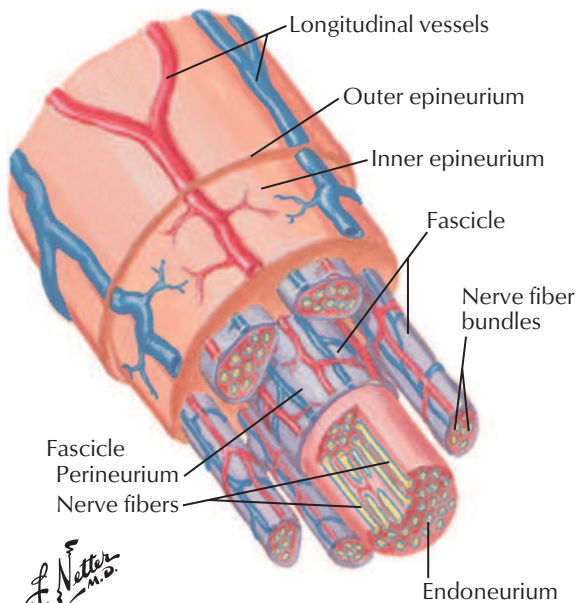
Schematic of synaptic endings

Numerous boutons (synaptic knobs) of presynaptic neurons terminating on a motor neuron and its dendrites

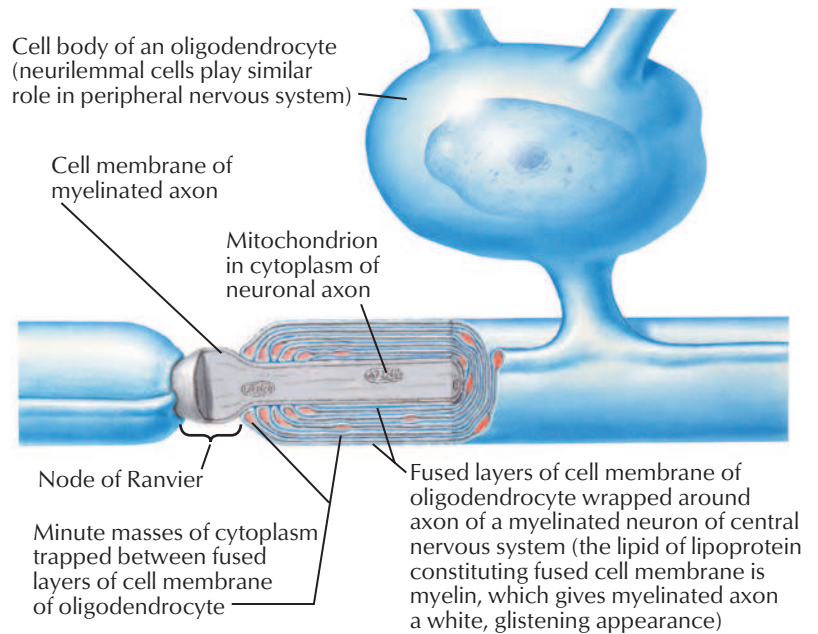


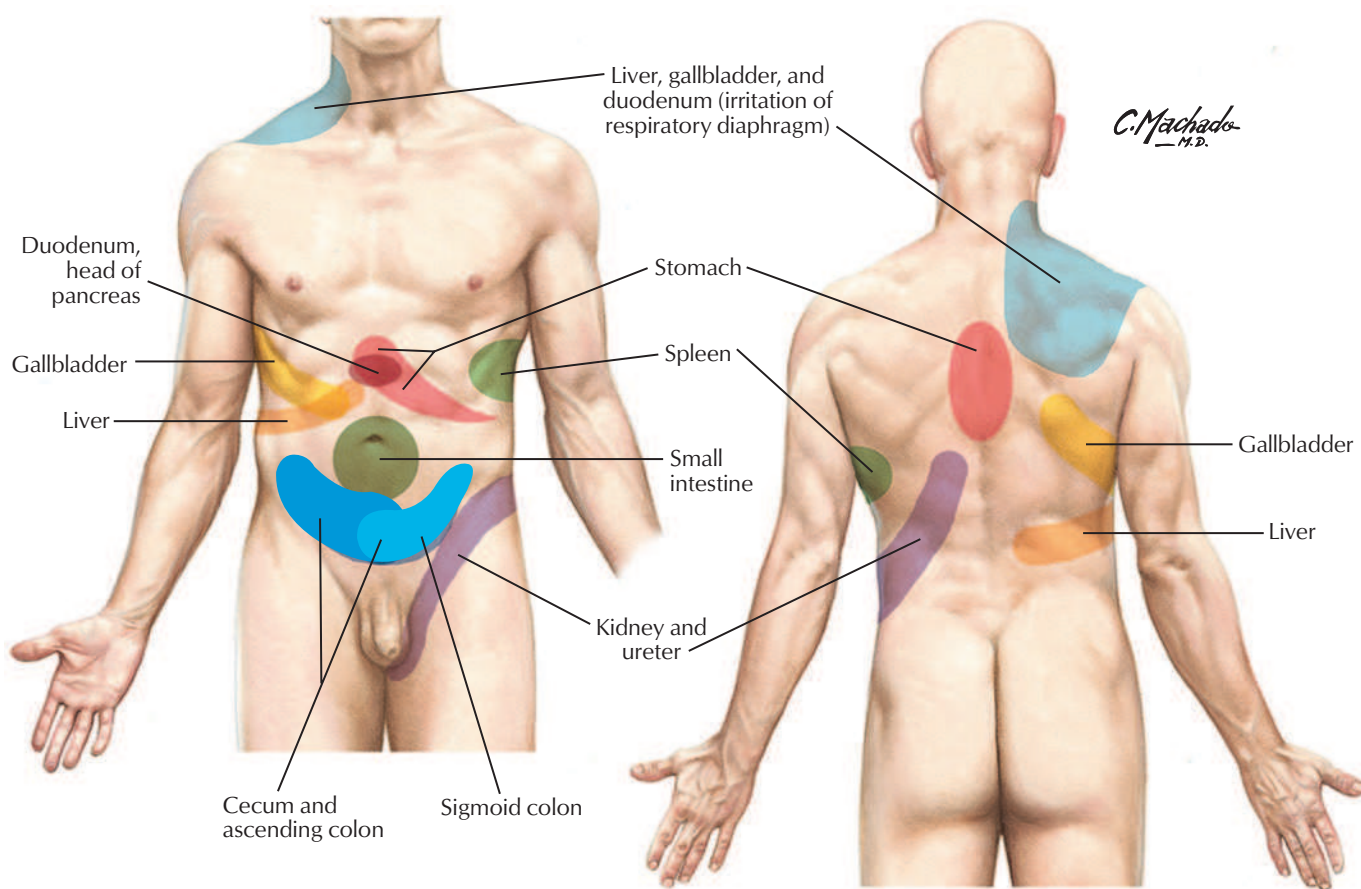
Enlarged section of bouton

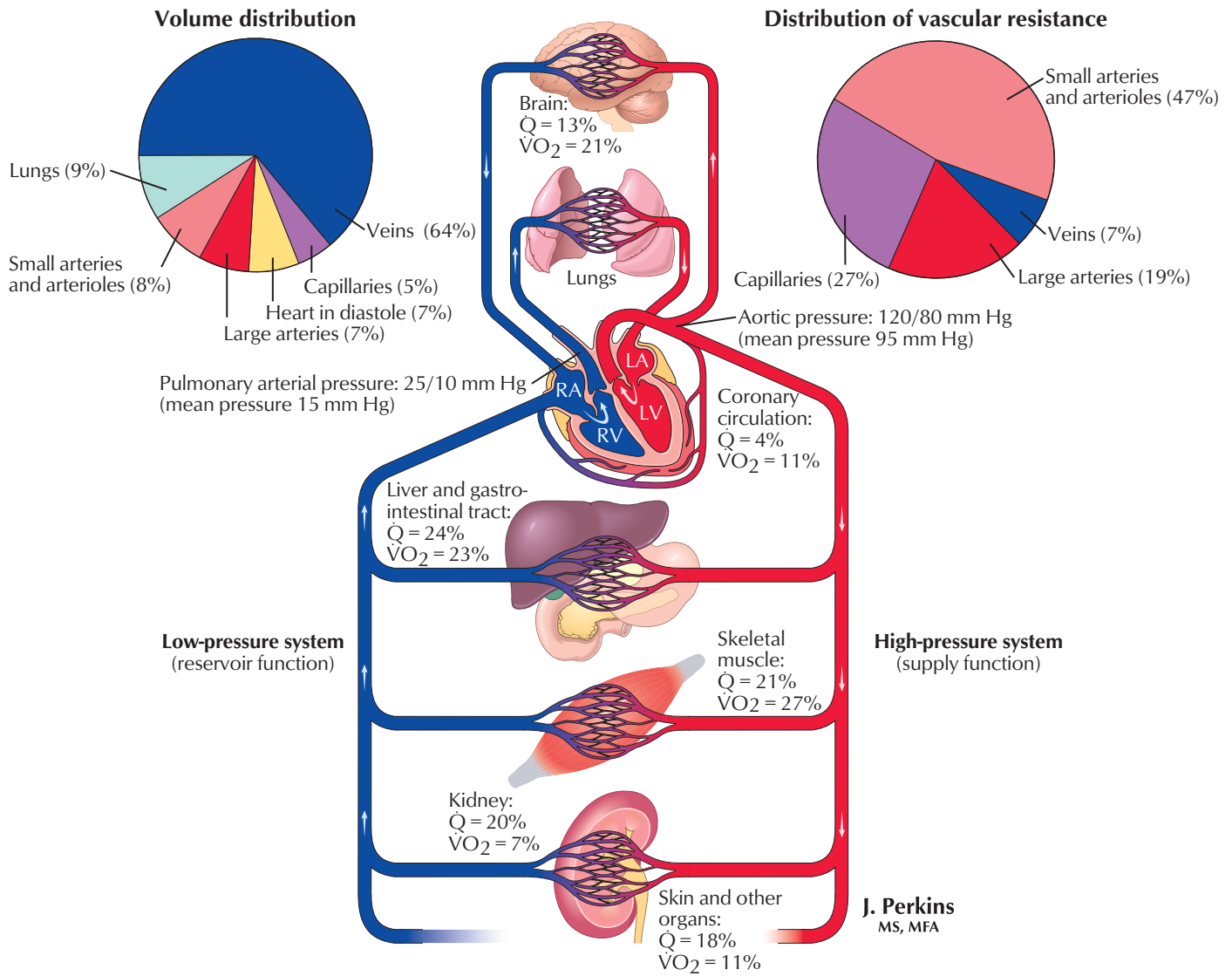
Features of a Typical Peripheral Nerve

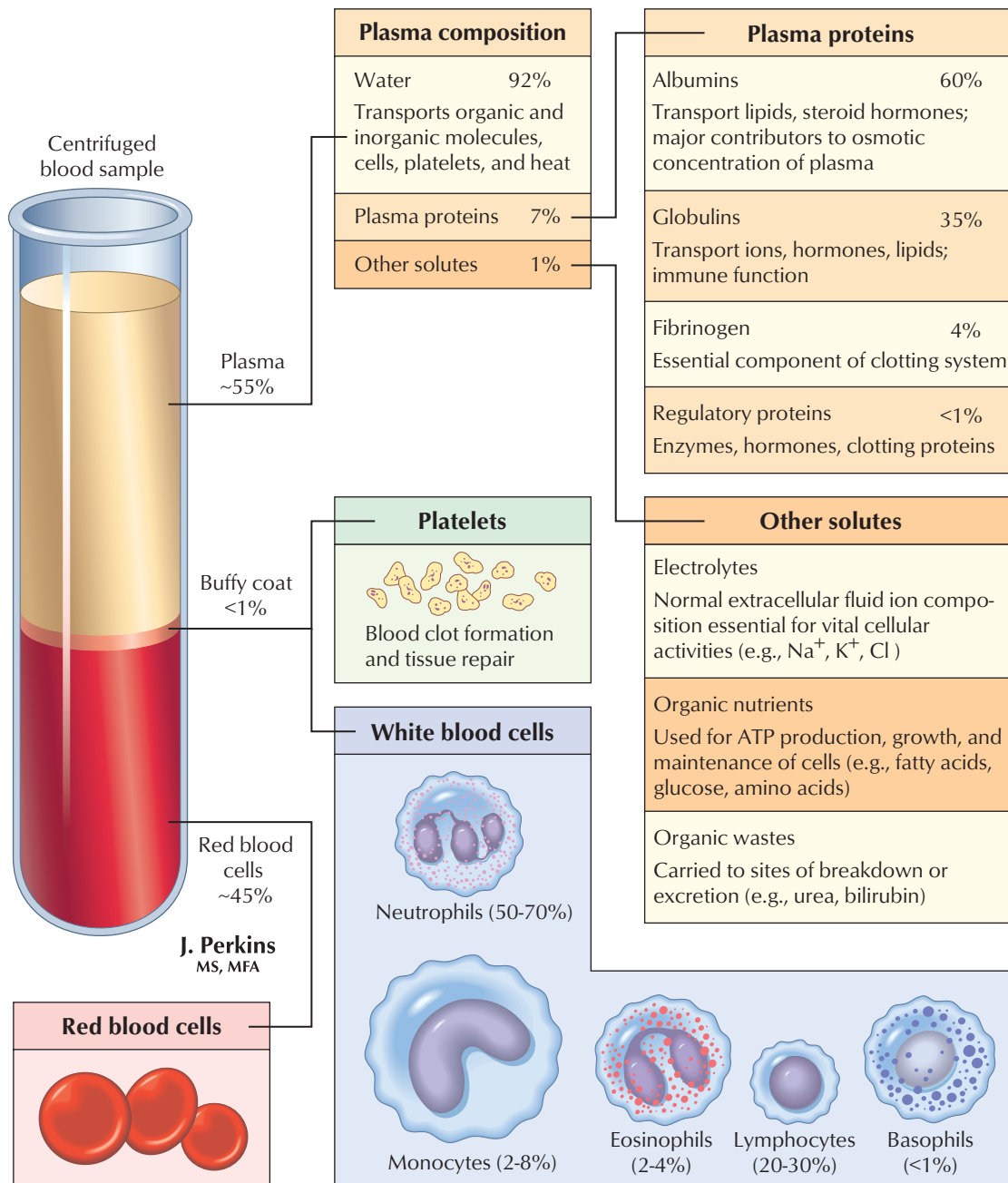


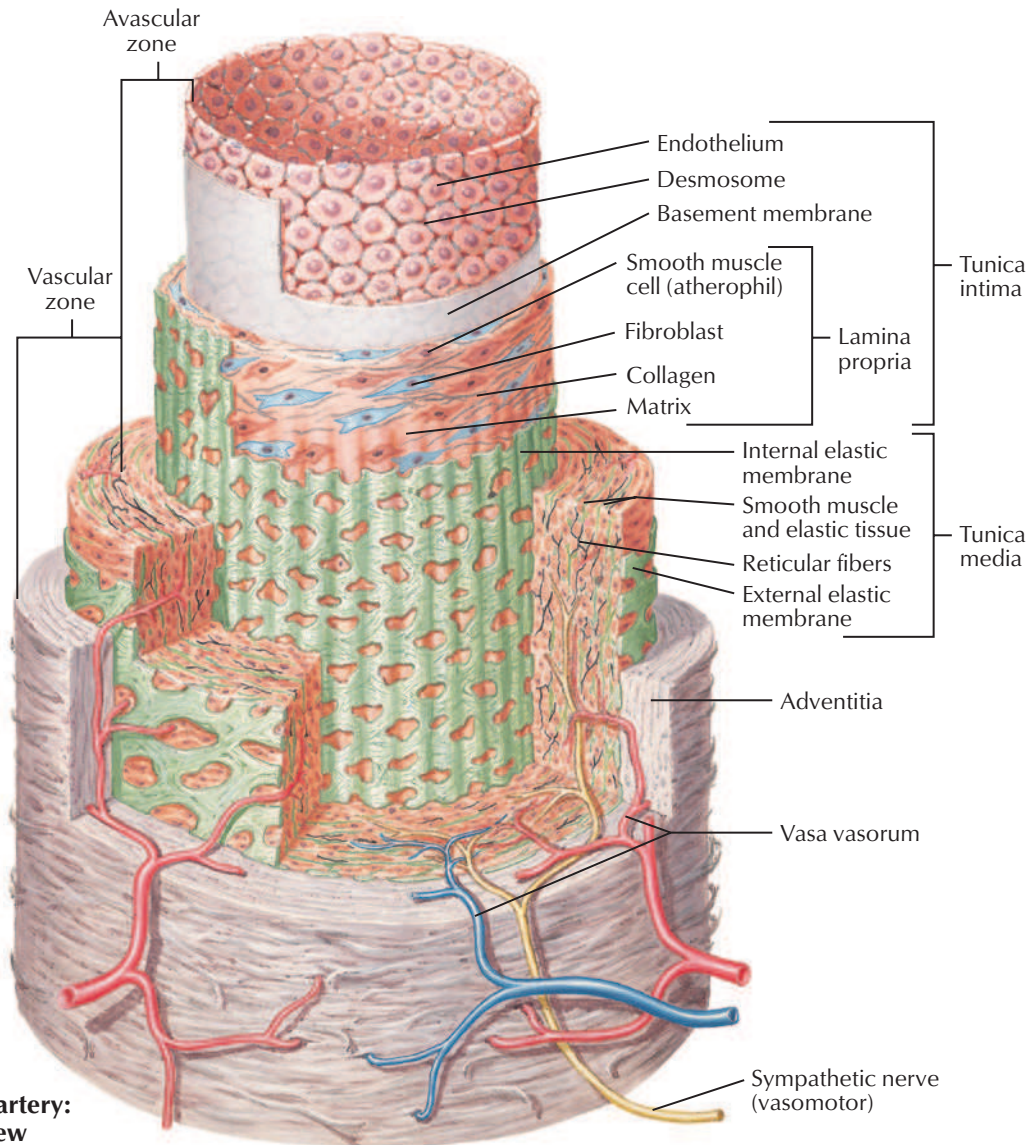
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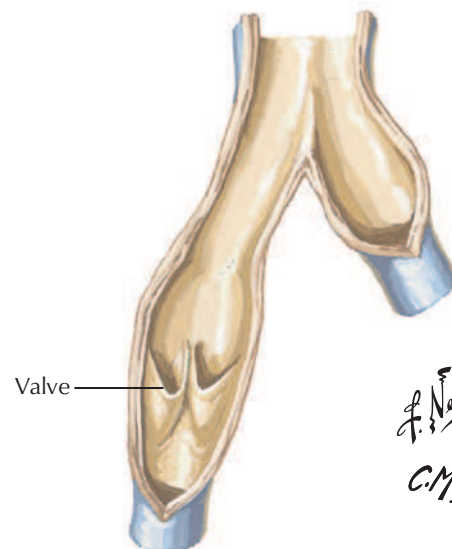




Wall of an artery:
cutaway view



Healthy artery



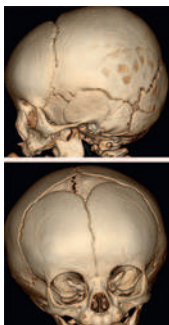
Healthy vein

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HEAD AND NECK 2

Surface Anatomy	8	Ear	105-110
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ELECTRONIC BONUS PLATES



BP17 3D Skull
Reconstruction CTs



BP18 Degenerative
Changes in Cervical
Vertebrae



BP19 Atlantooccipital
Junction



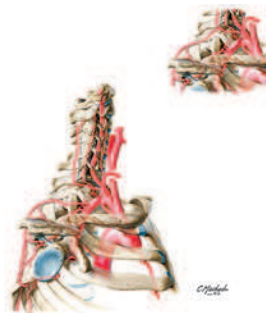
BP20 Muscles of Facial
Expression: Anterior View



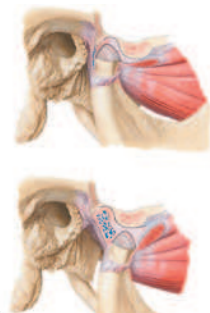
BP21 Musculature of Face



BP22 Paranasal Sinuses



BP23 Subclavian Artery



BP24 Opening of the
Mandible

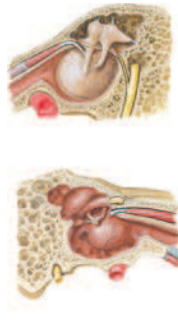
ELECTRONIC BONUS PLATES—*cont'd*



BP25 Afferent Innervation of Oral Cavity and Pharynx



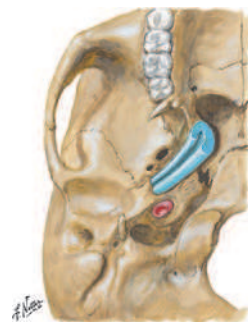
BP26 Fasciae of Orbit and Eyeball



BP27 Tympanic Cavity



BP28 Anatomy of the Pediatric Ear



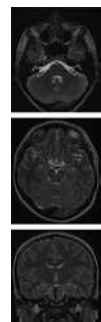
BP29 Auditory Tube (Eustachian)



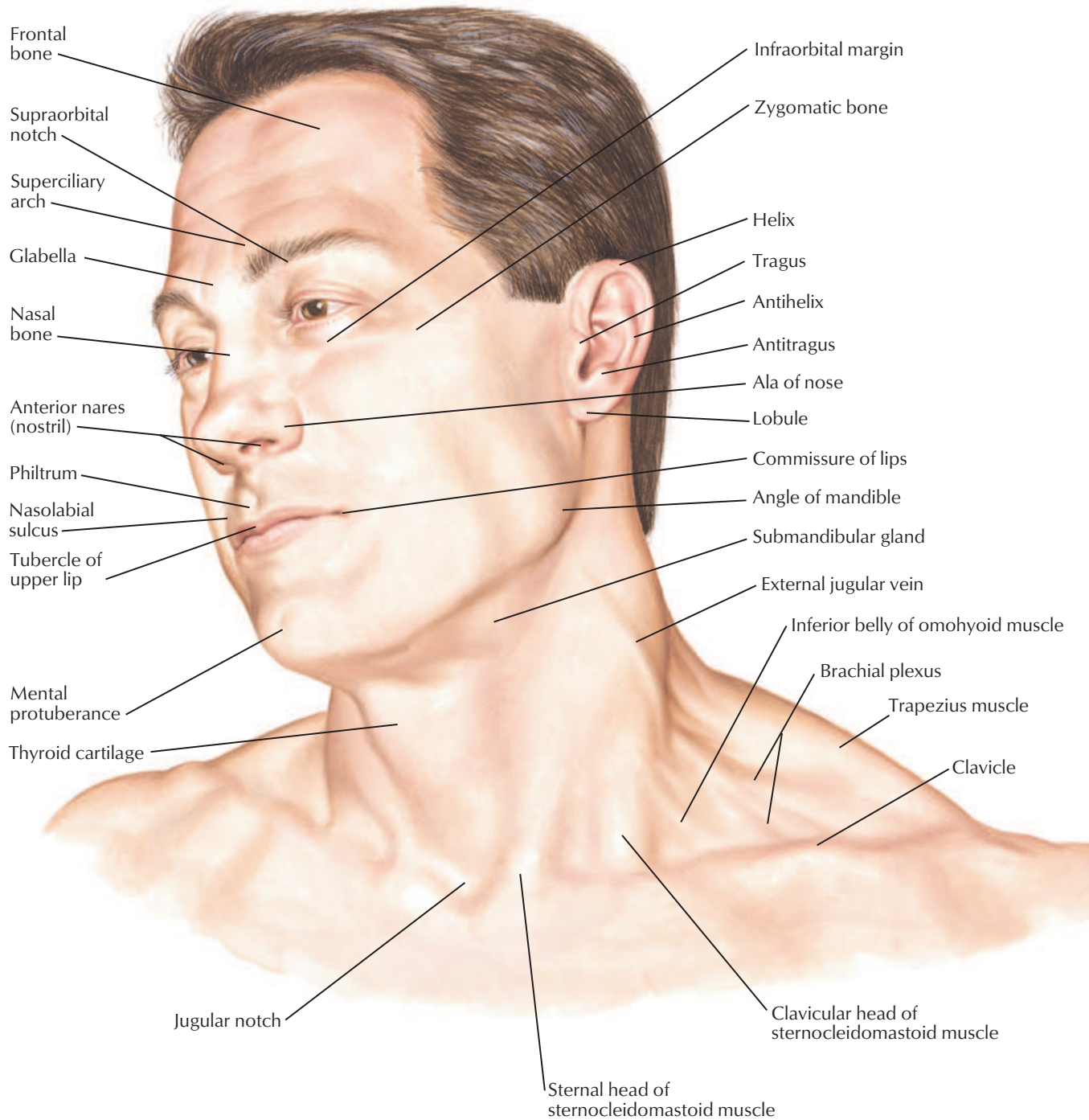
BP30 Arteries and Veins of Hypothalamus and Hypophysis



BP31 Cranial Imaging (MRV and MRA)



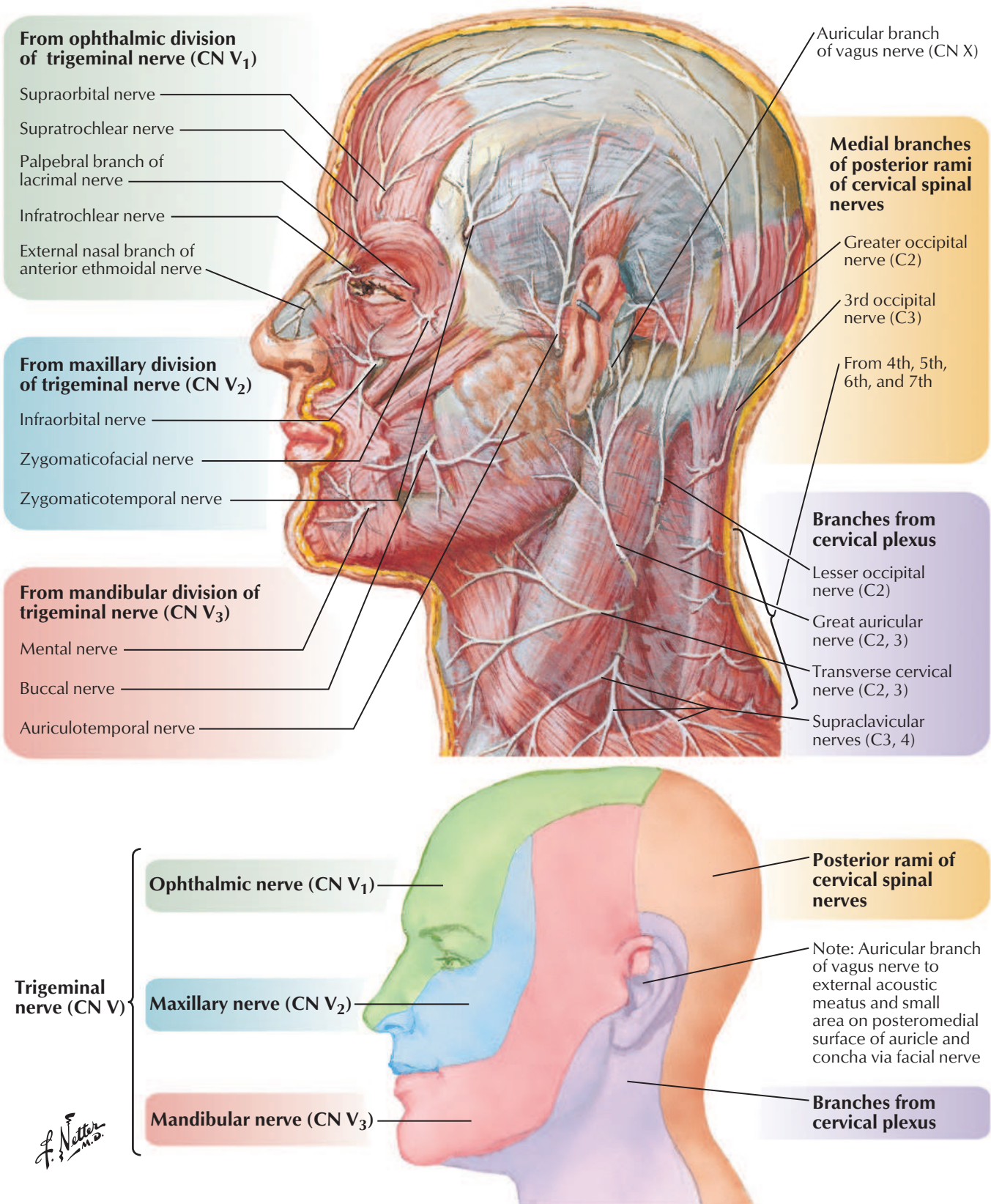
BP32 Axial and Coronal MRIs of Brain

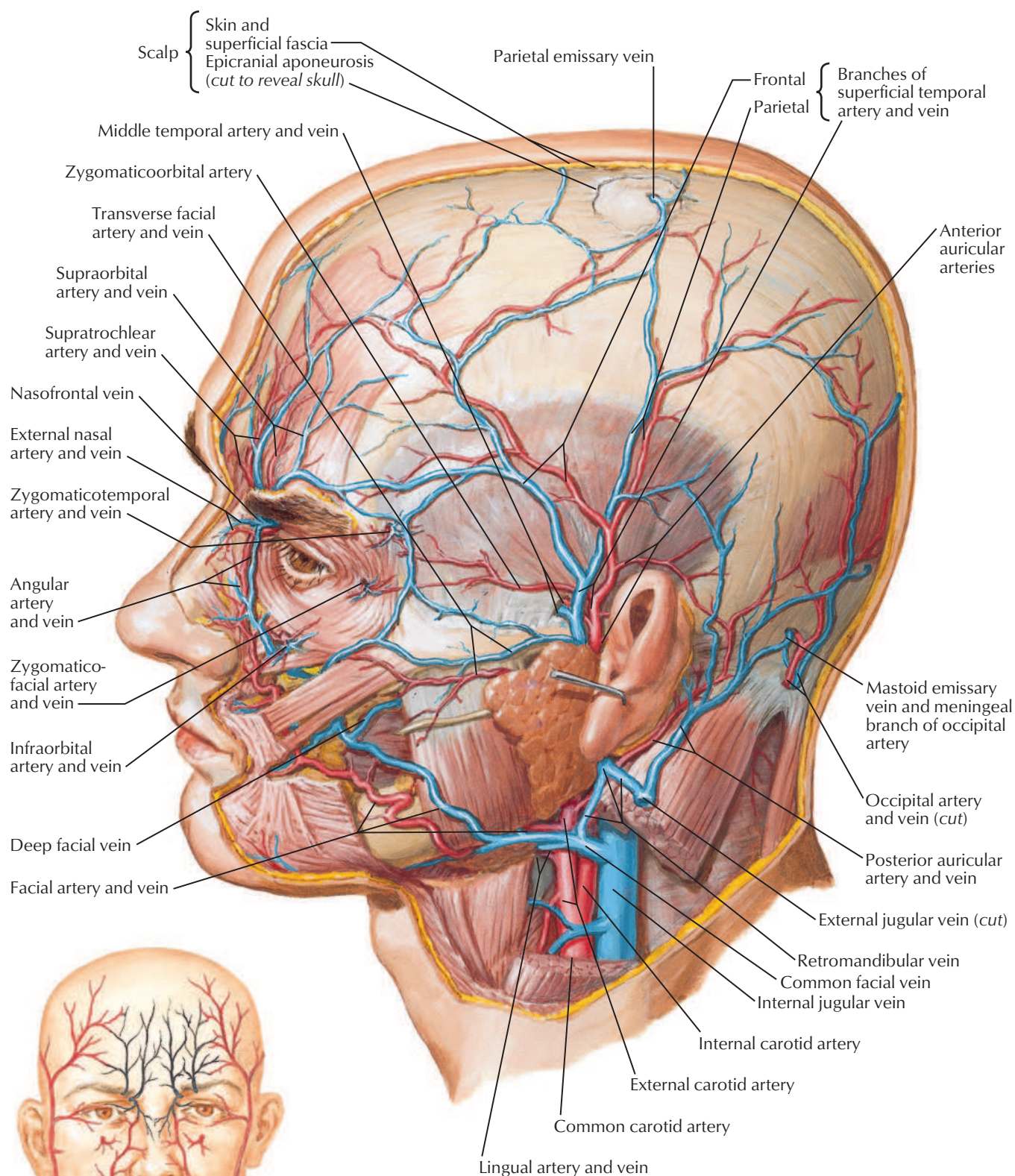


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Cutaneous Nerves of Head and Neck

See also [Plates 39, 42, 61](#)





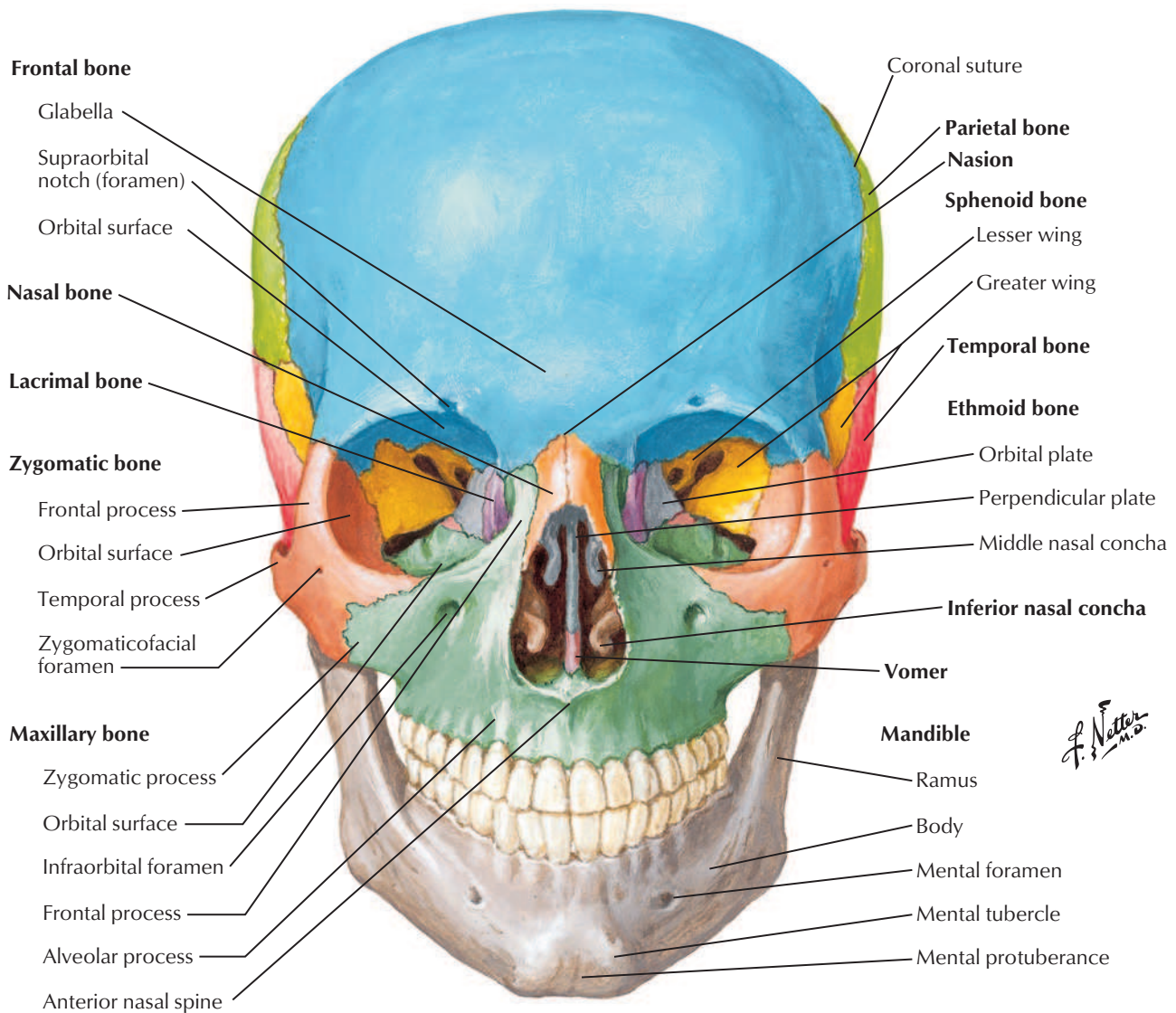
Sources of arterial supply of face

Black: from internal carotid artery (via ophthalmic artery)
Red: from external carotid artery

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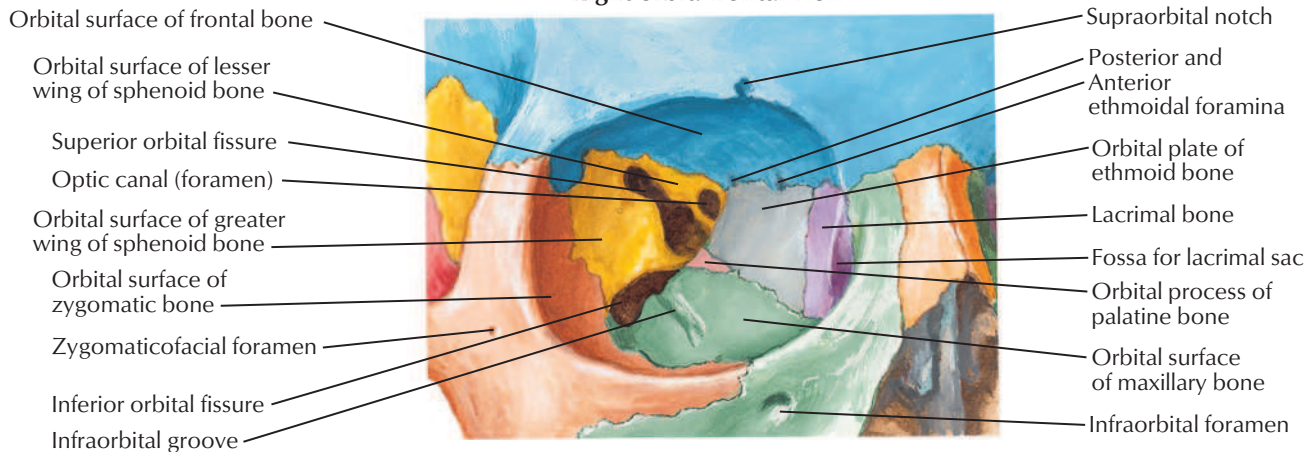
Skull: Anterior View

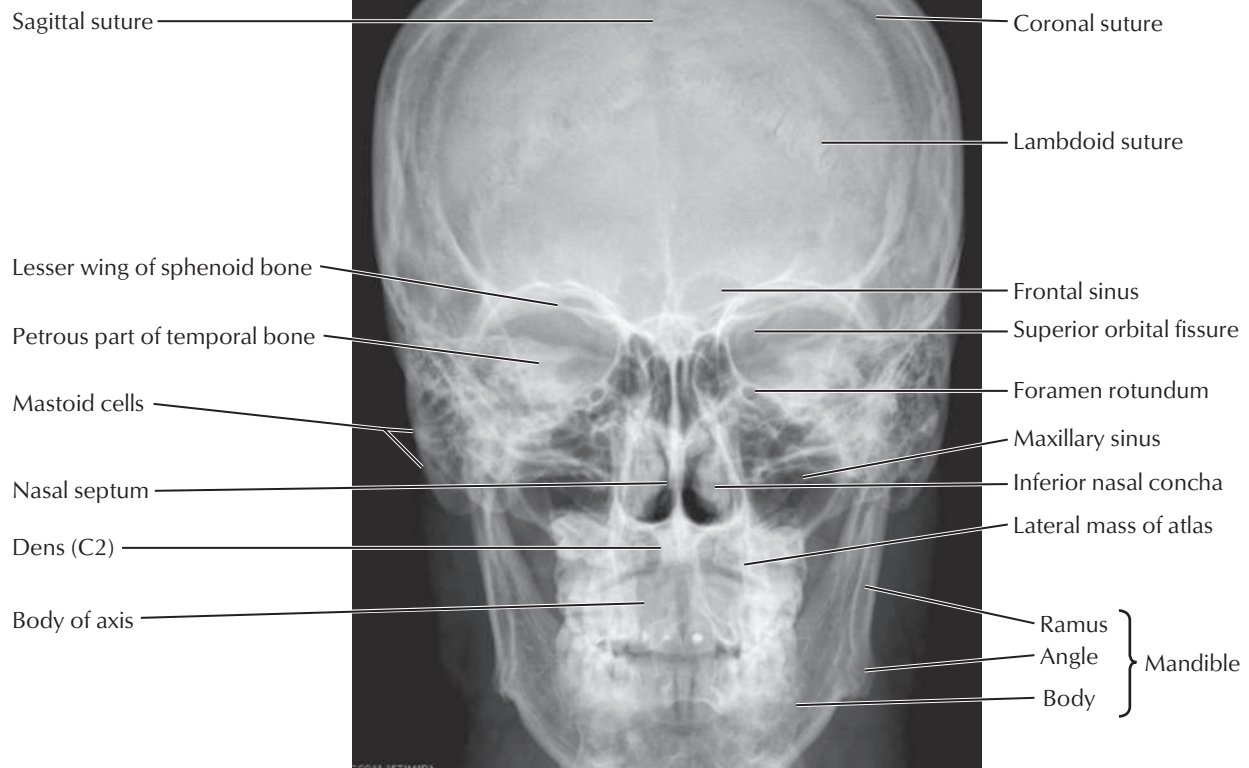
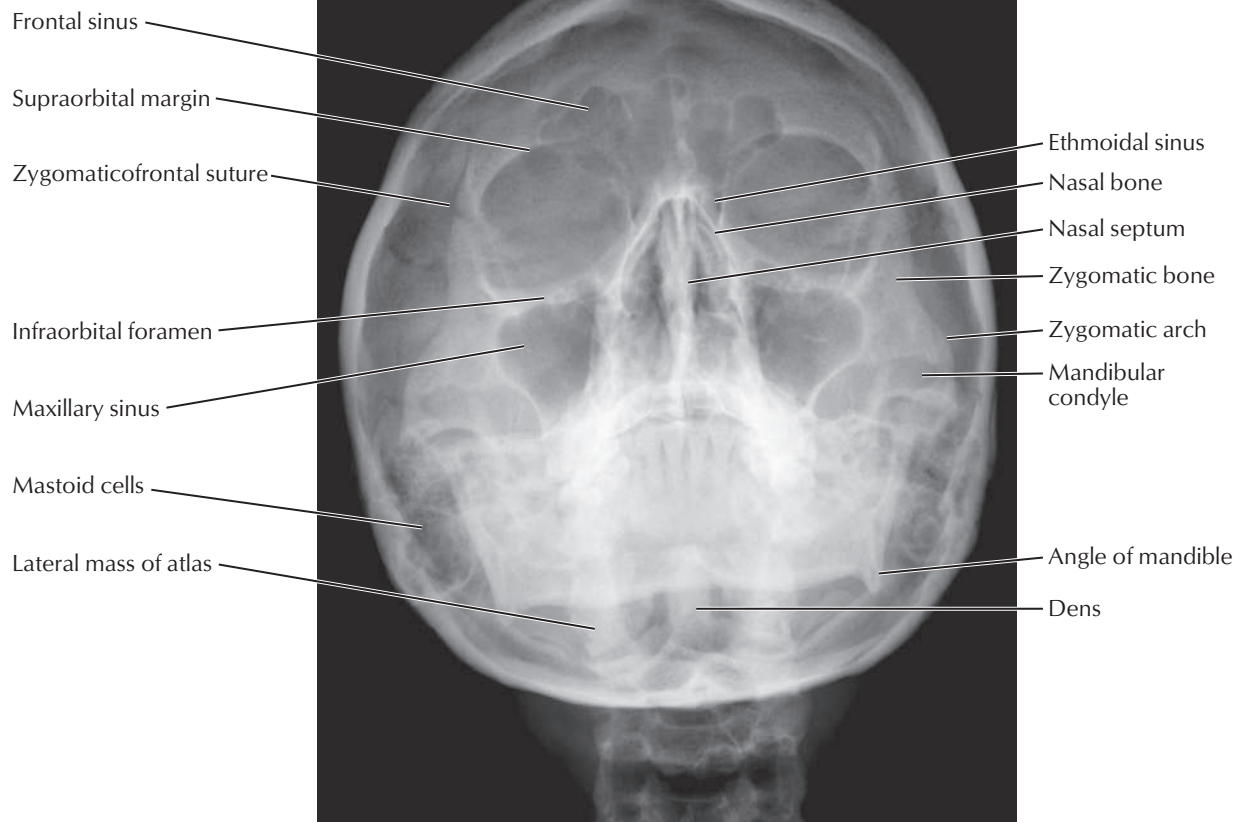
See also [Plate 13](#)



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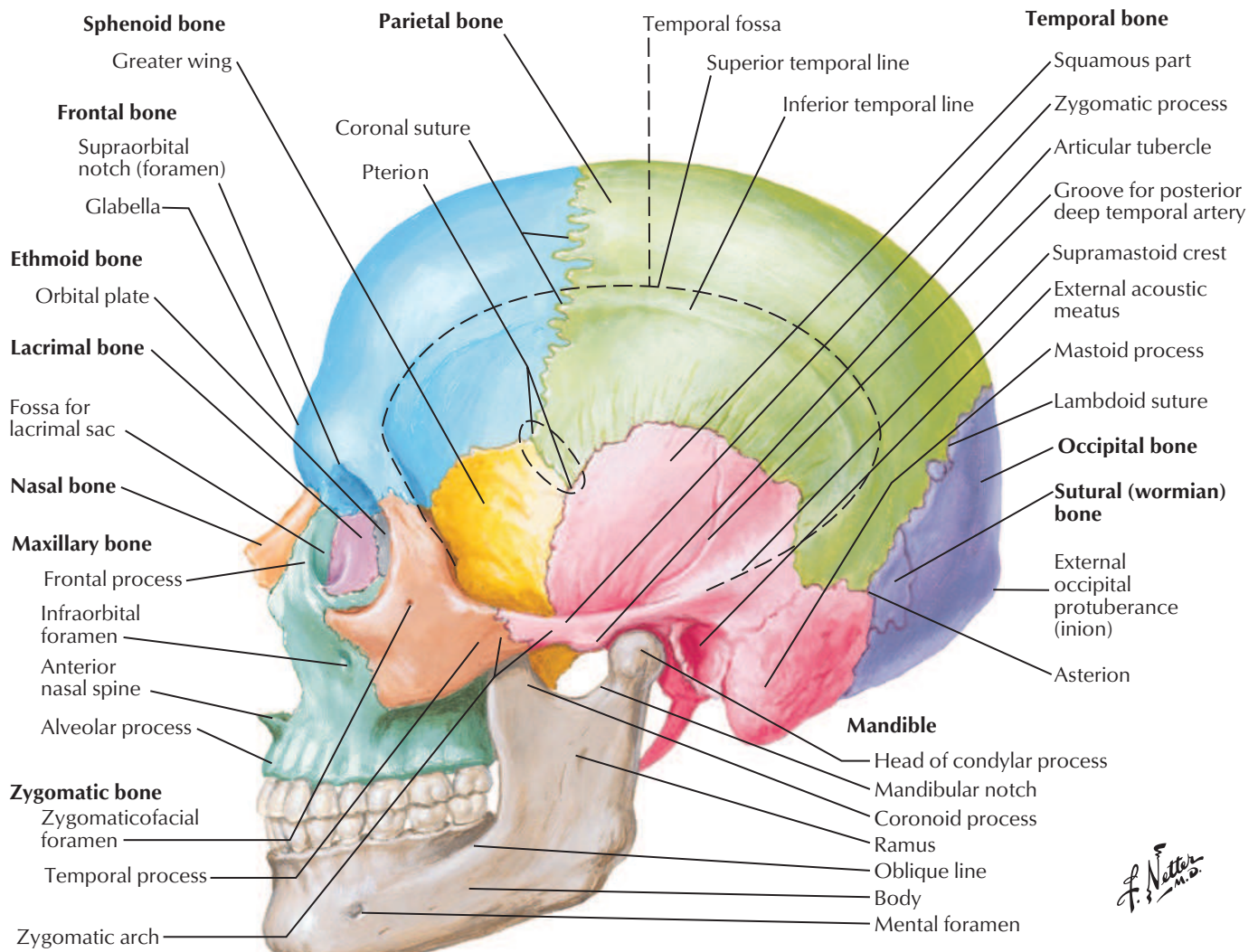
Right orbit: frontal view



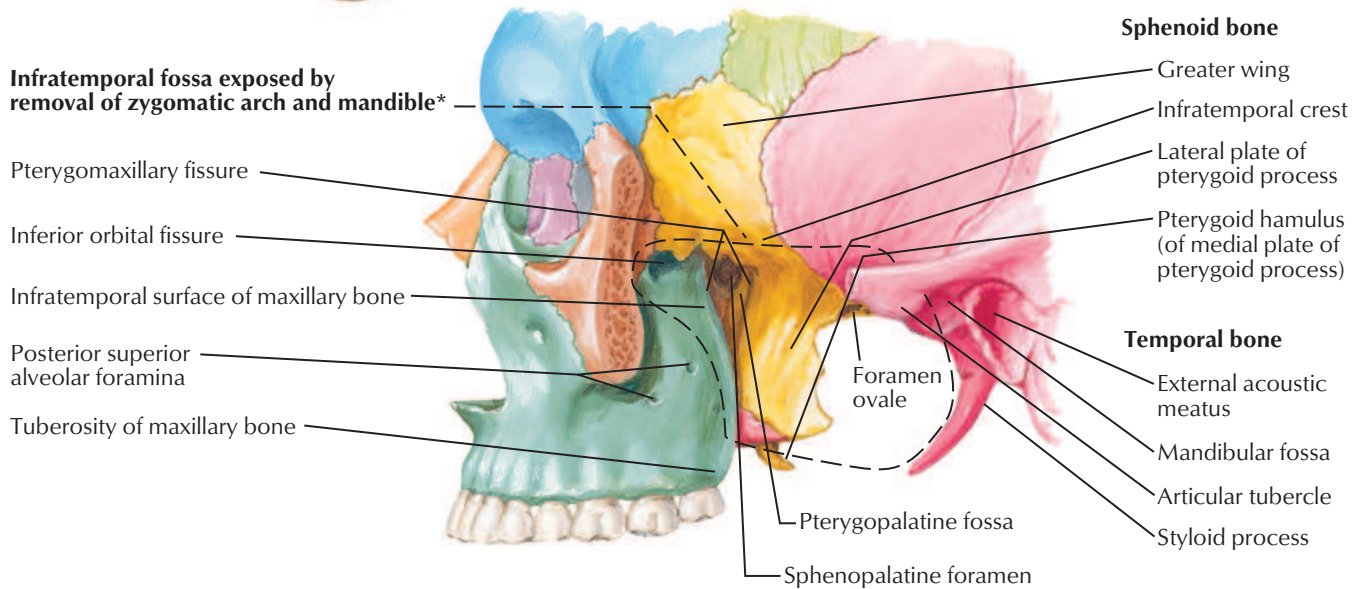
Posterior anterior view**Waters' view**

Skull: Lateral View

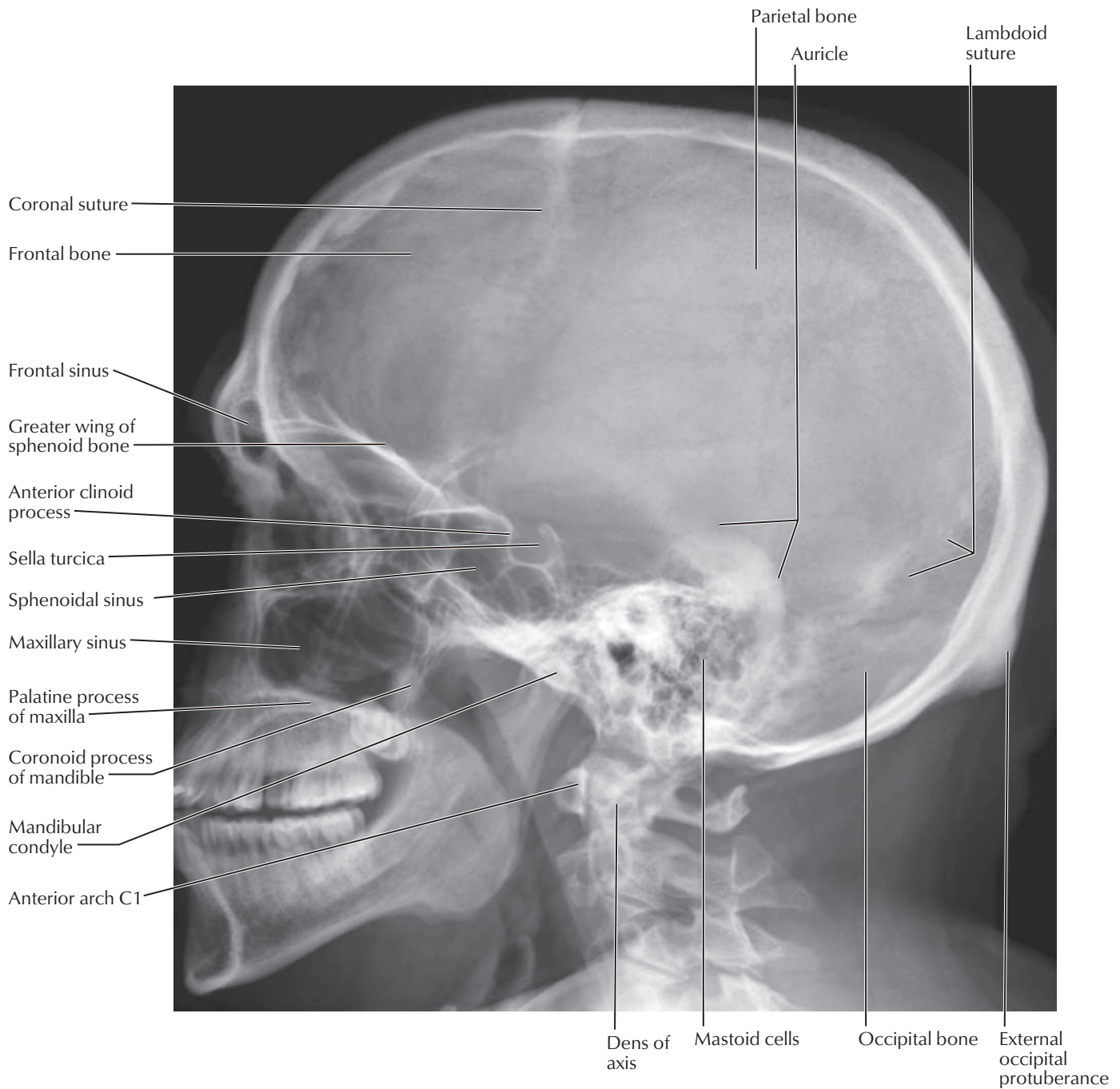
See also [Plates 14, 15, 22](#)



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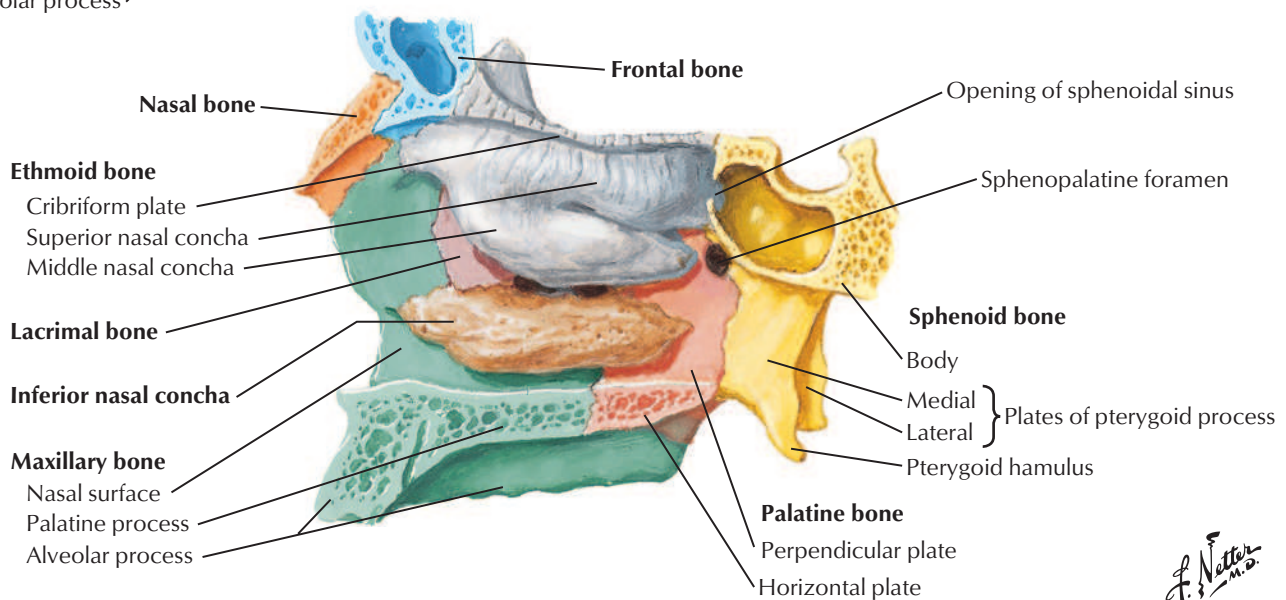
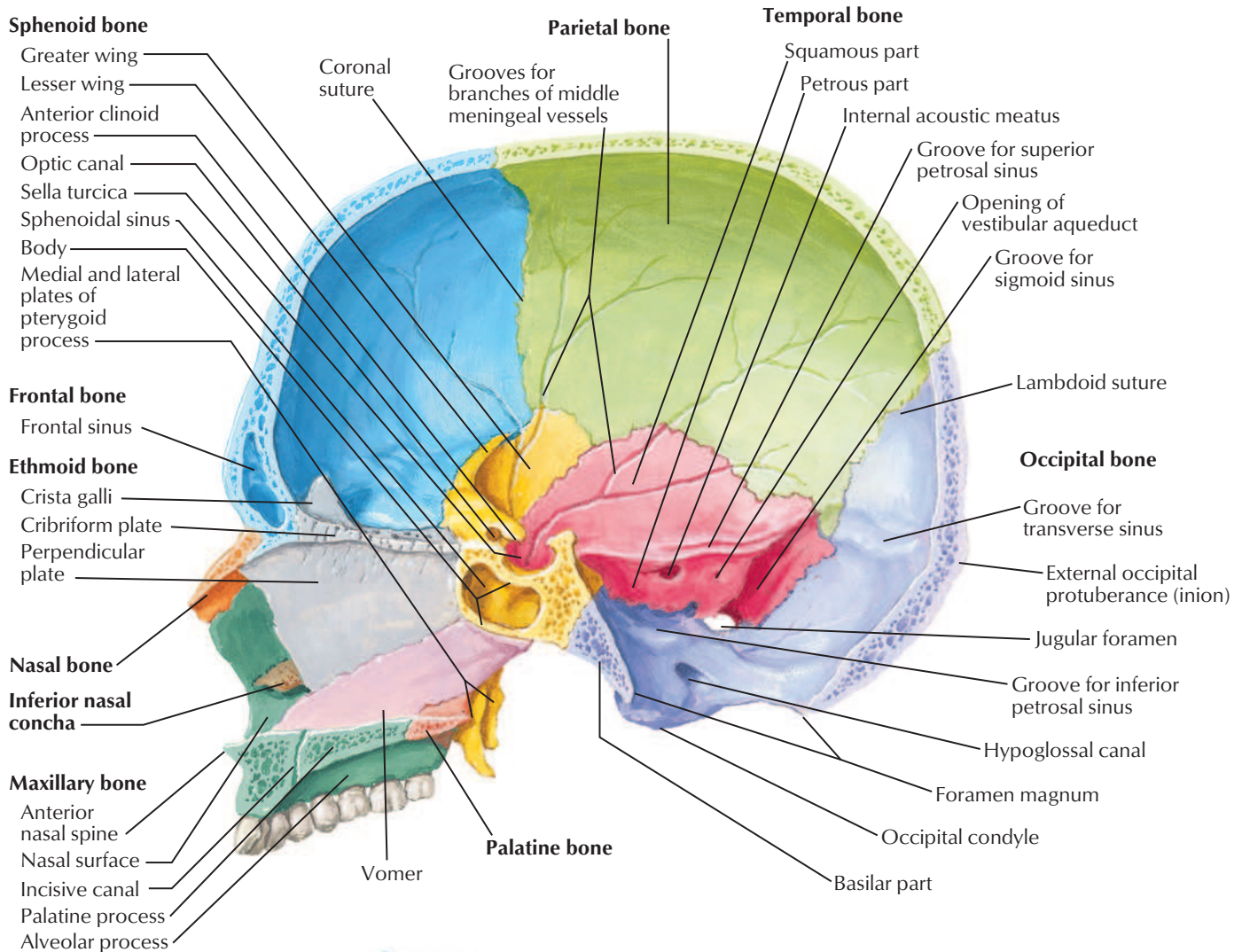


*Superficially, mastoid process forms posterior boundary.

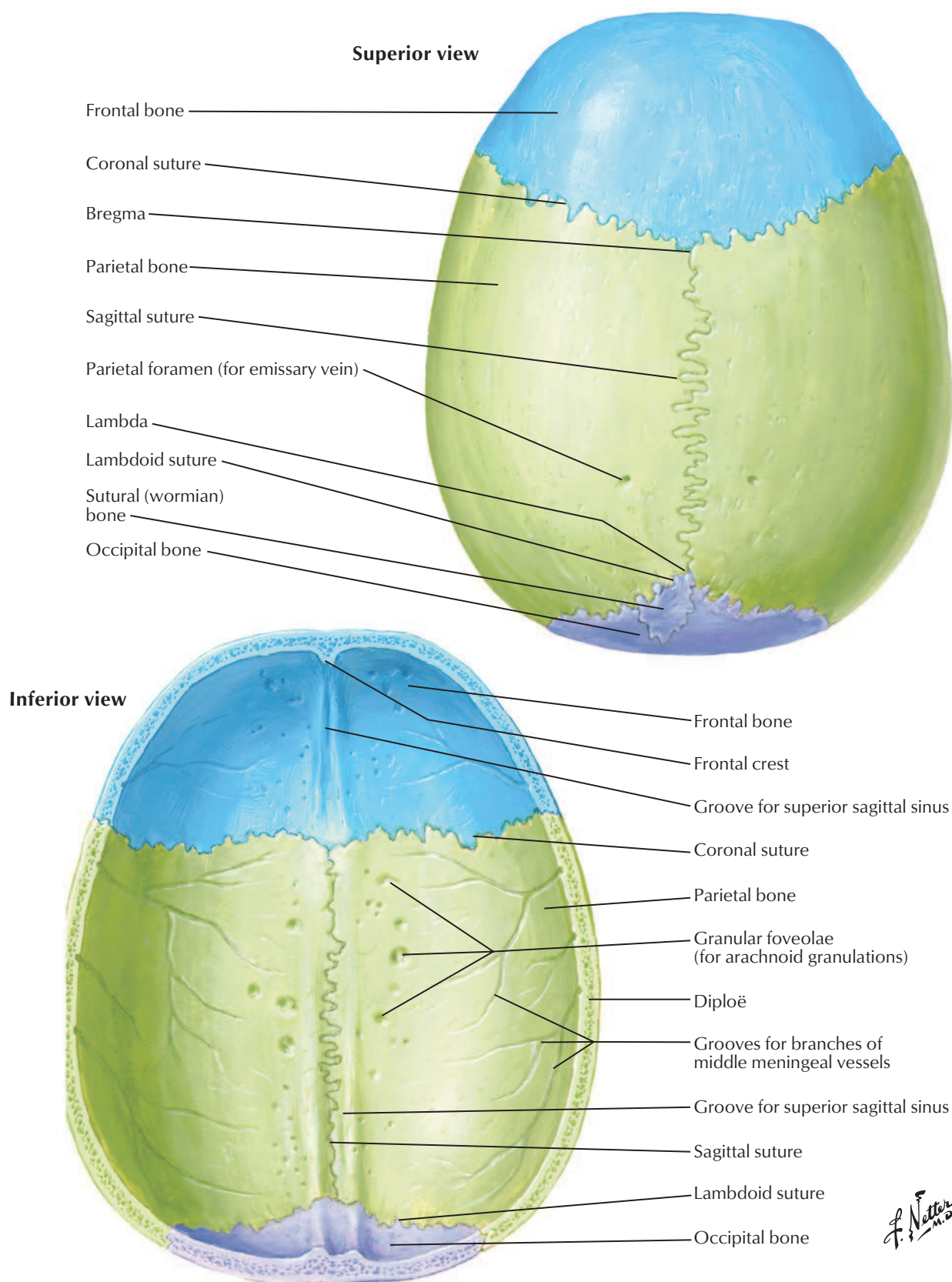


Skull: Midsagittal Section

See also [Plates 44, 46](#)

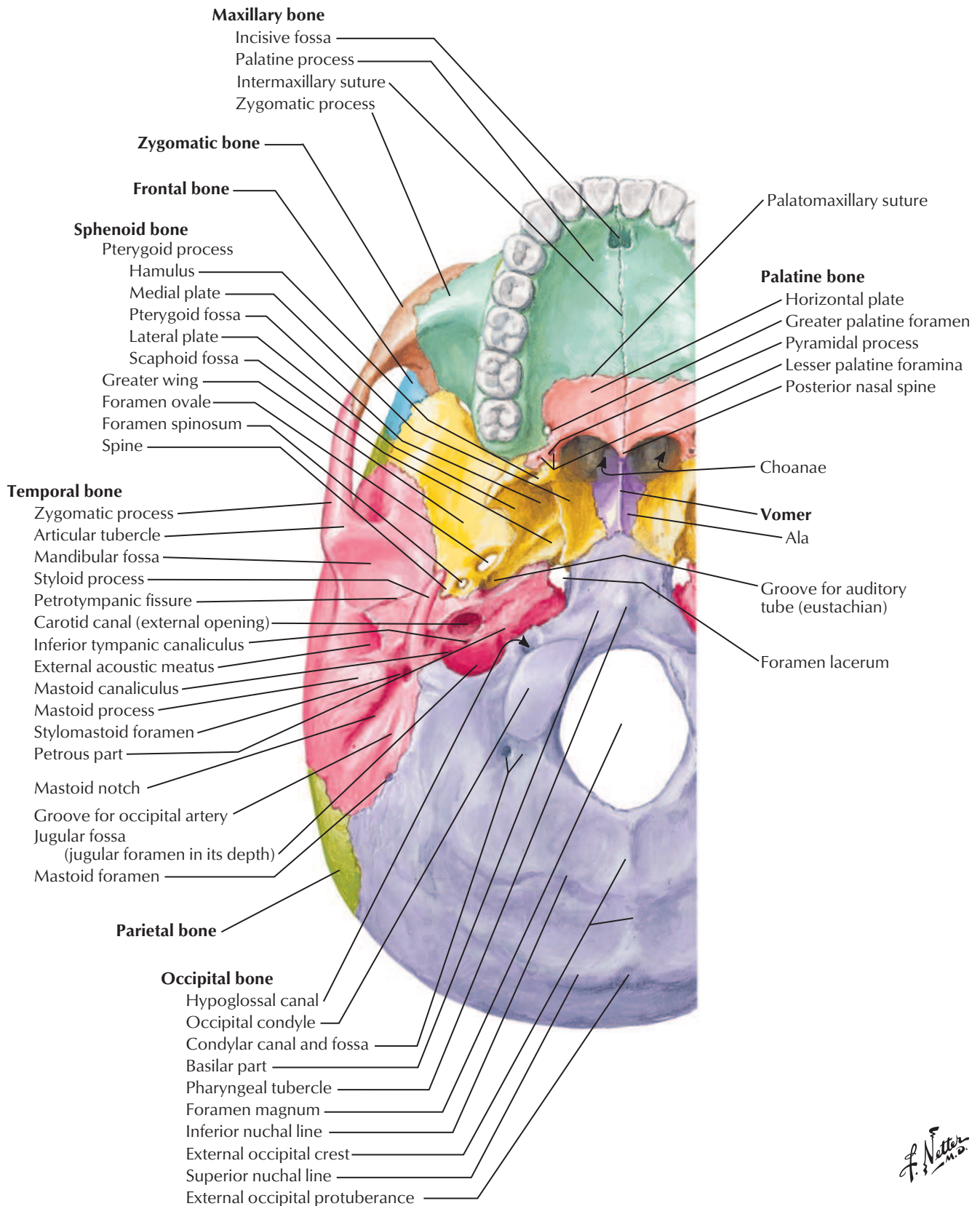


View of lateral nasal wall with nasal septum removed

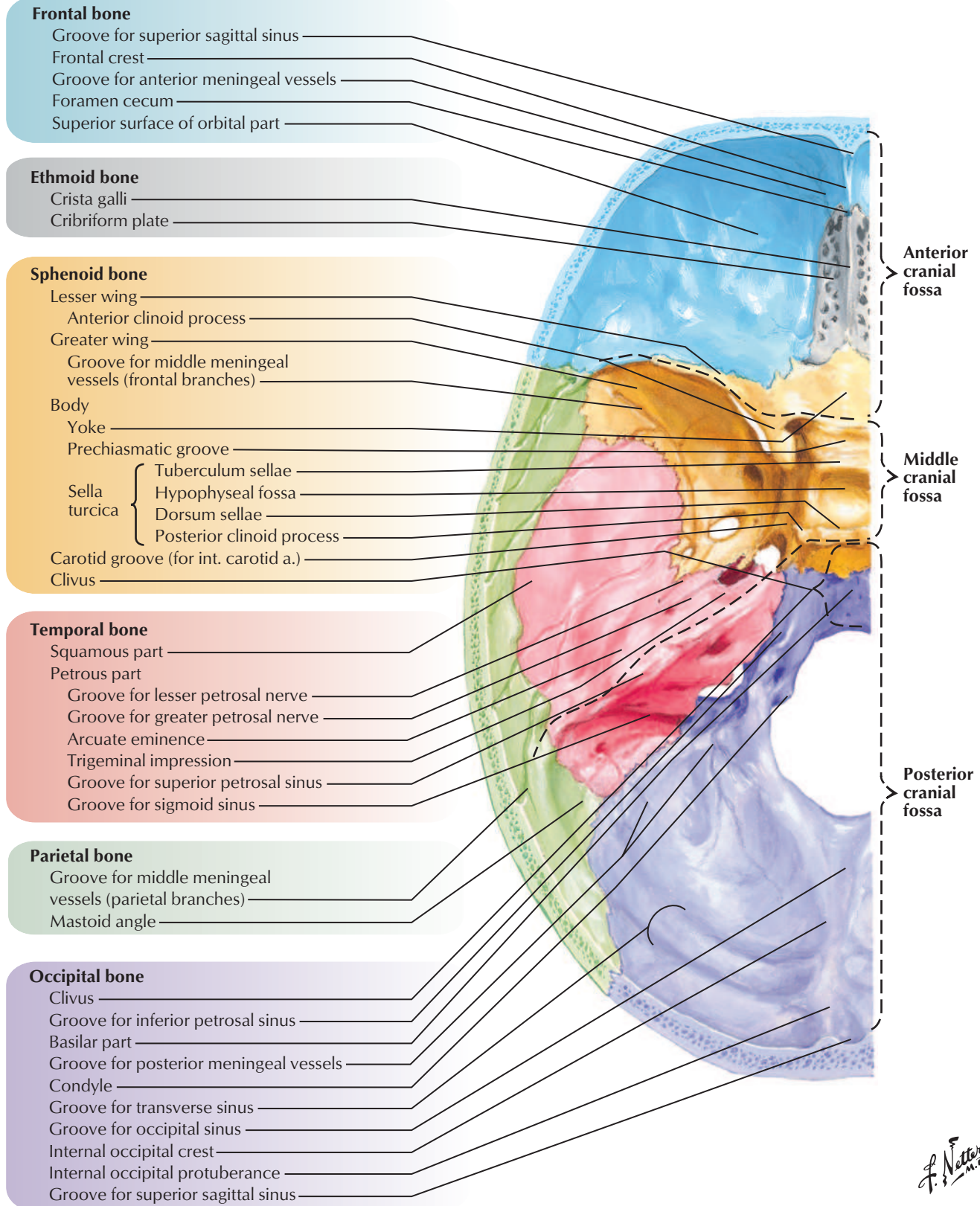


Cranial Base: Inferior View

See also [Plate 19](#)

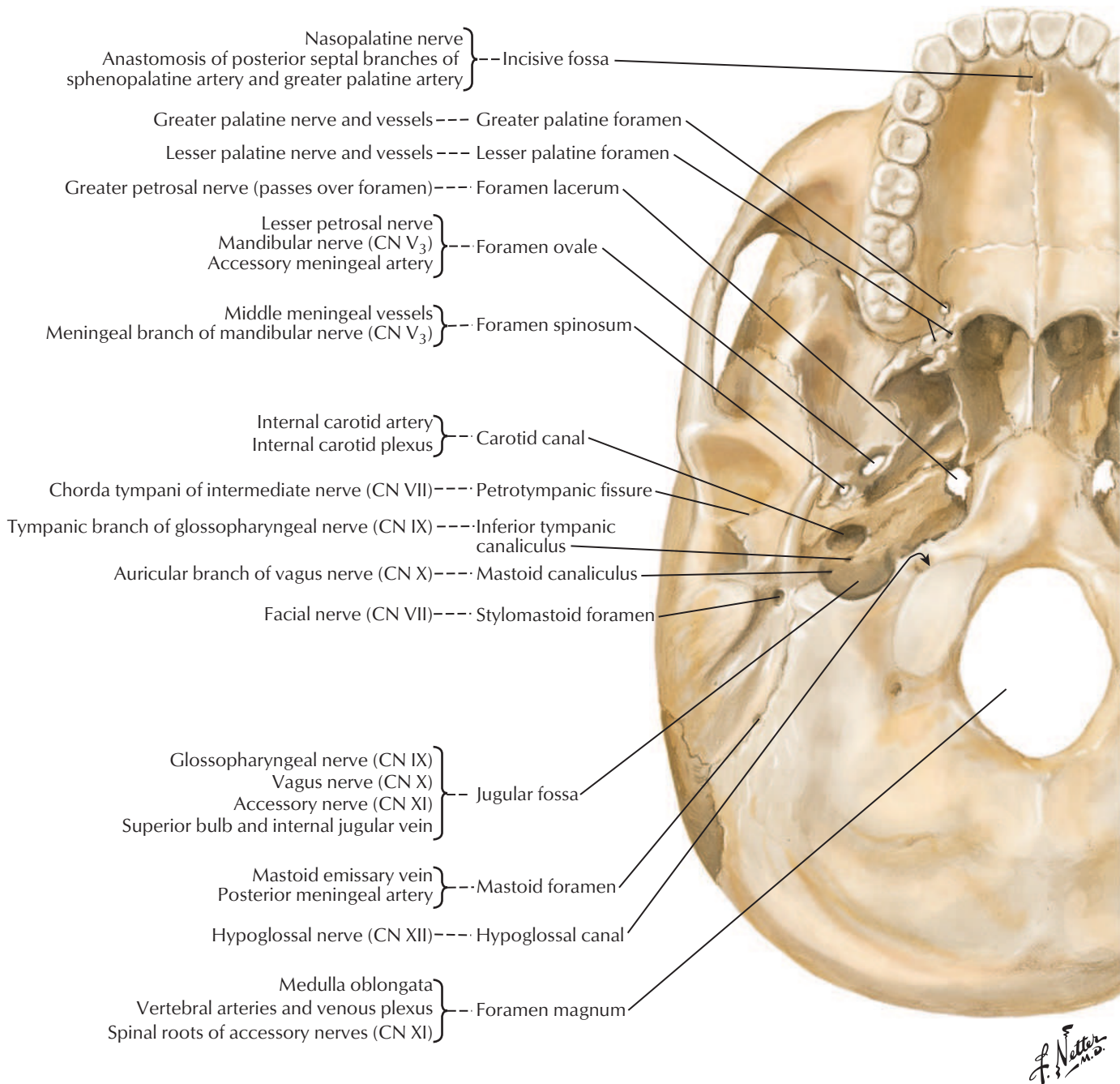


F. Netter M.D.

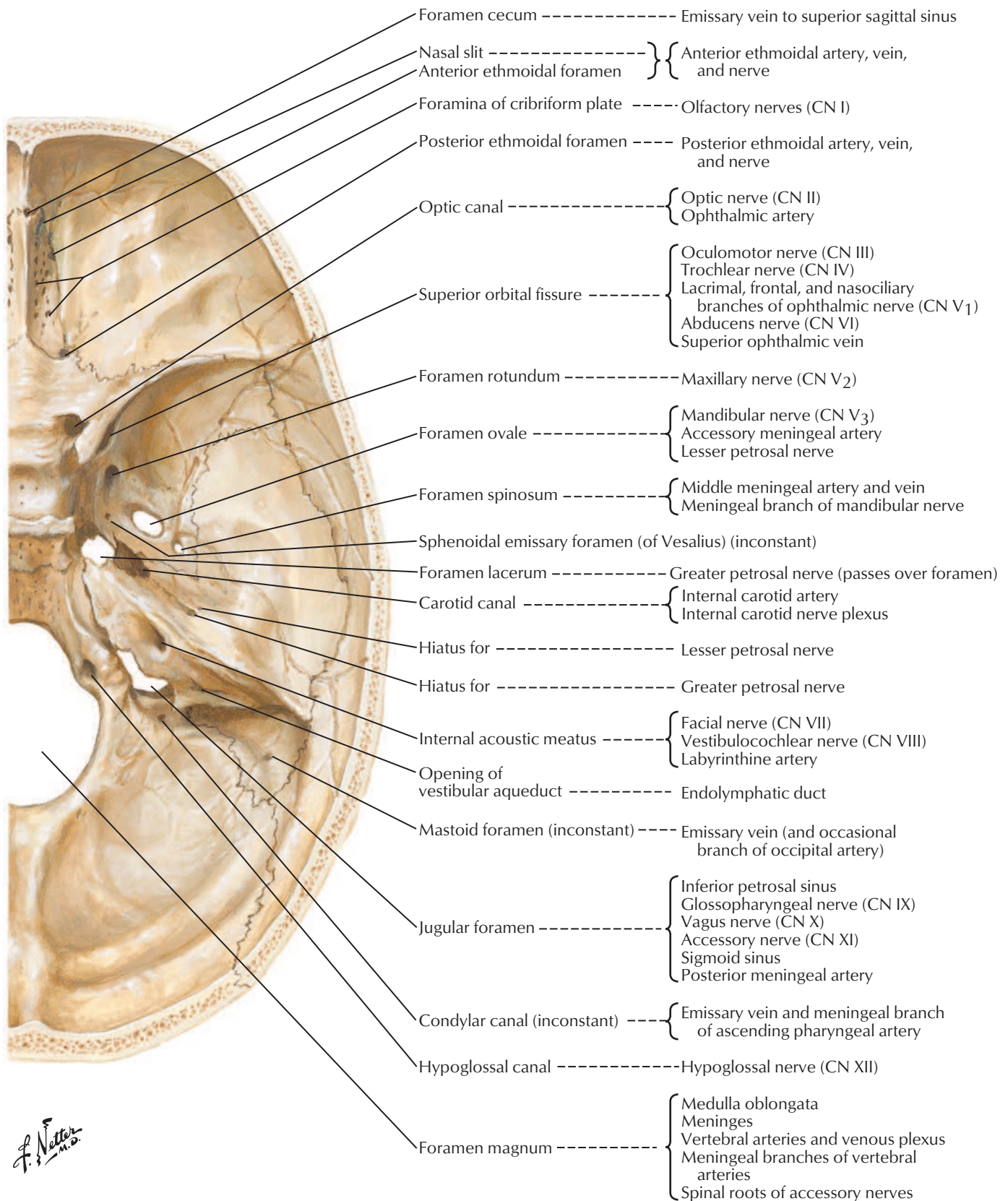


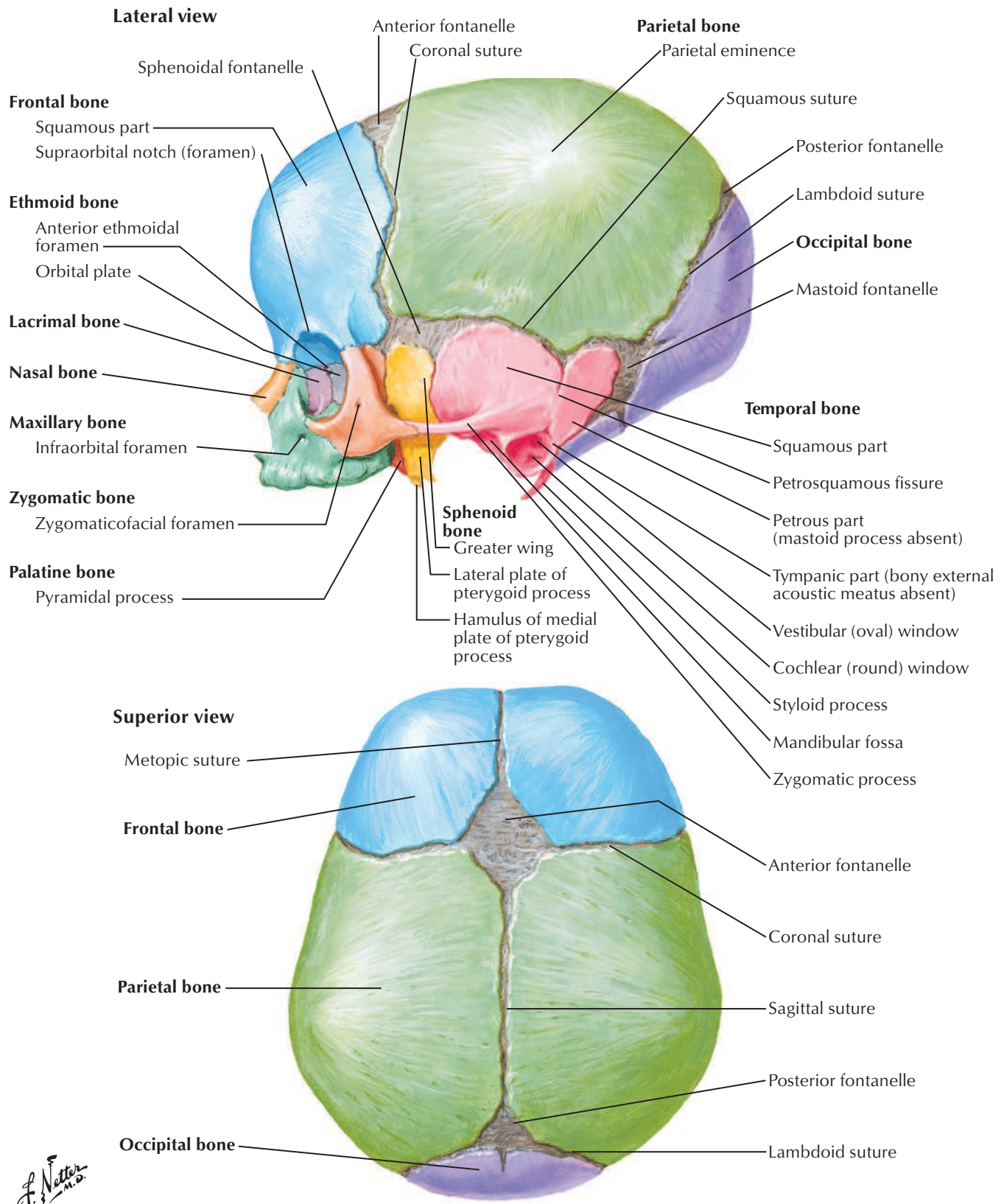
Foramina and Canals of Cranial Base: Inferior View

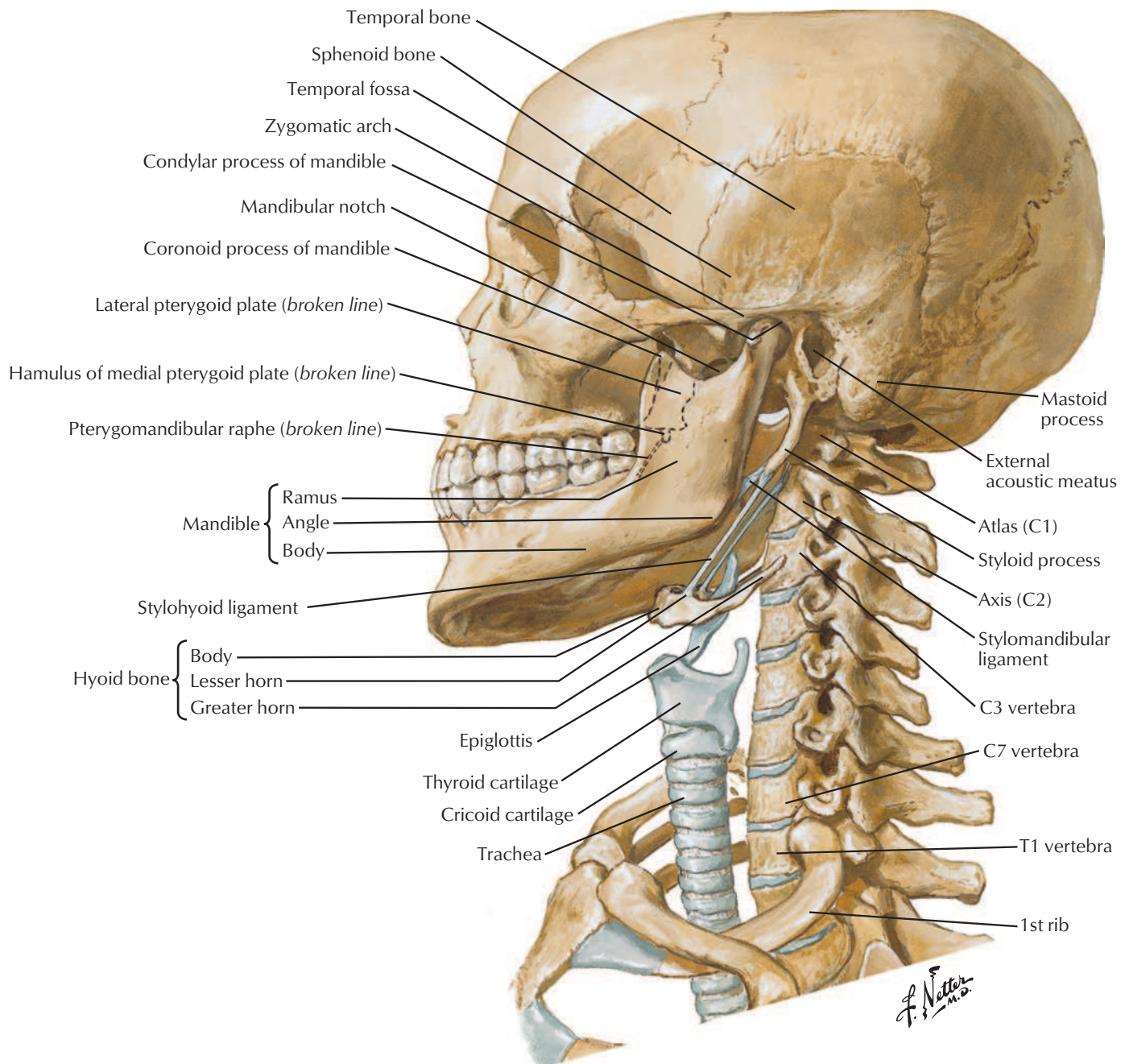
See also [Plate 17](#)



F. Netter M.D.



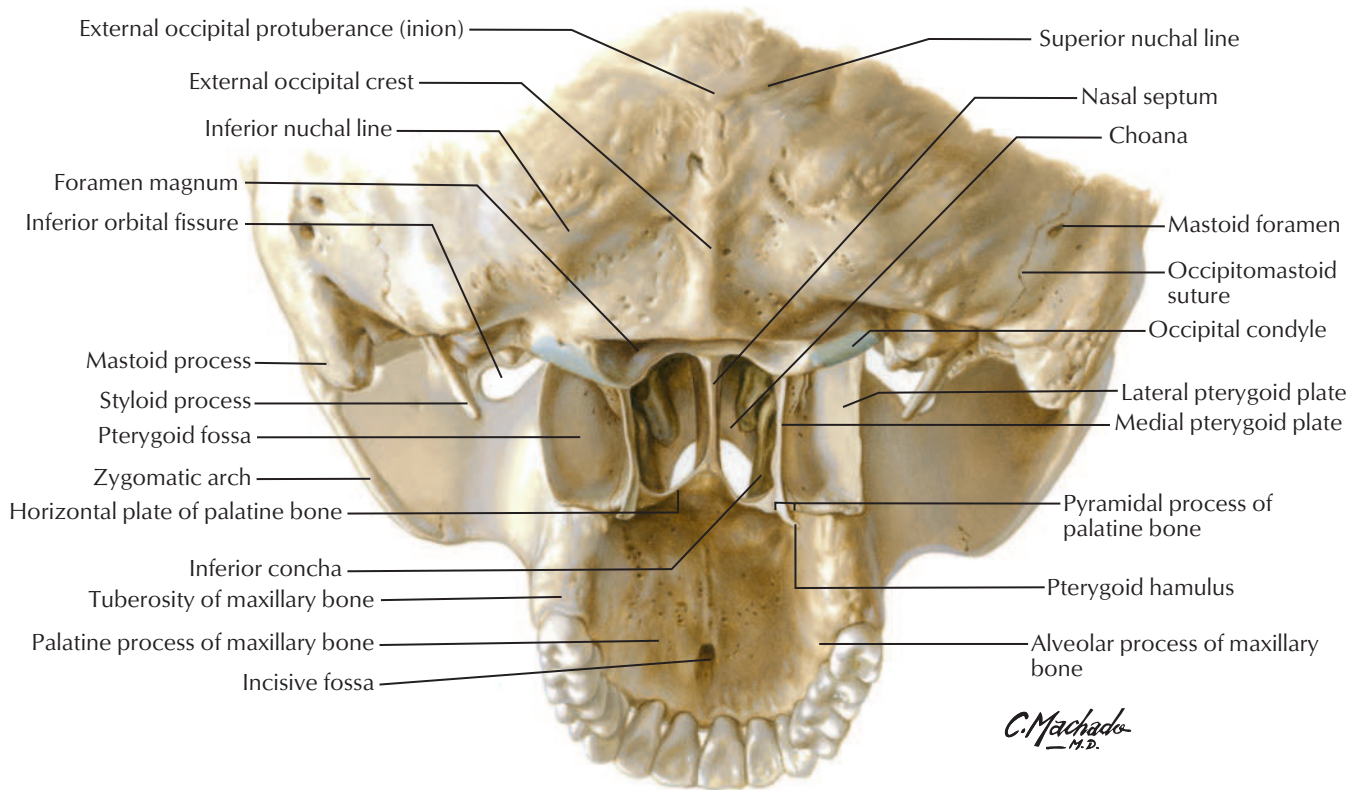




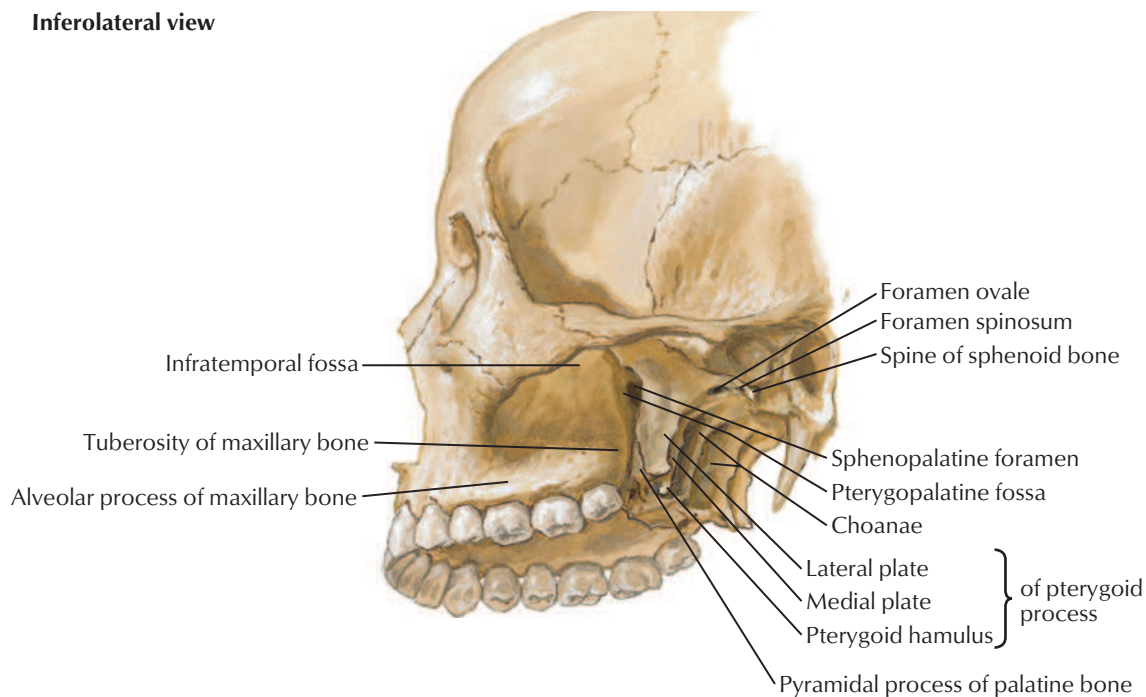
Pterygoid Fossae

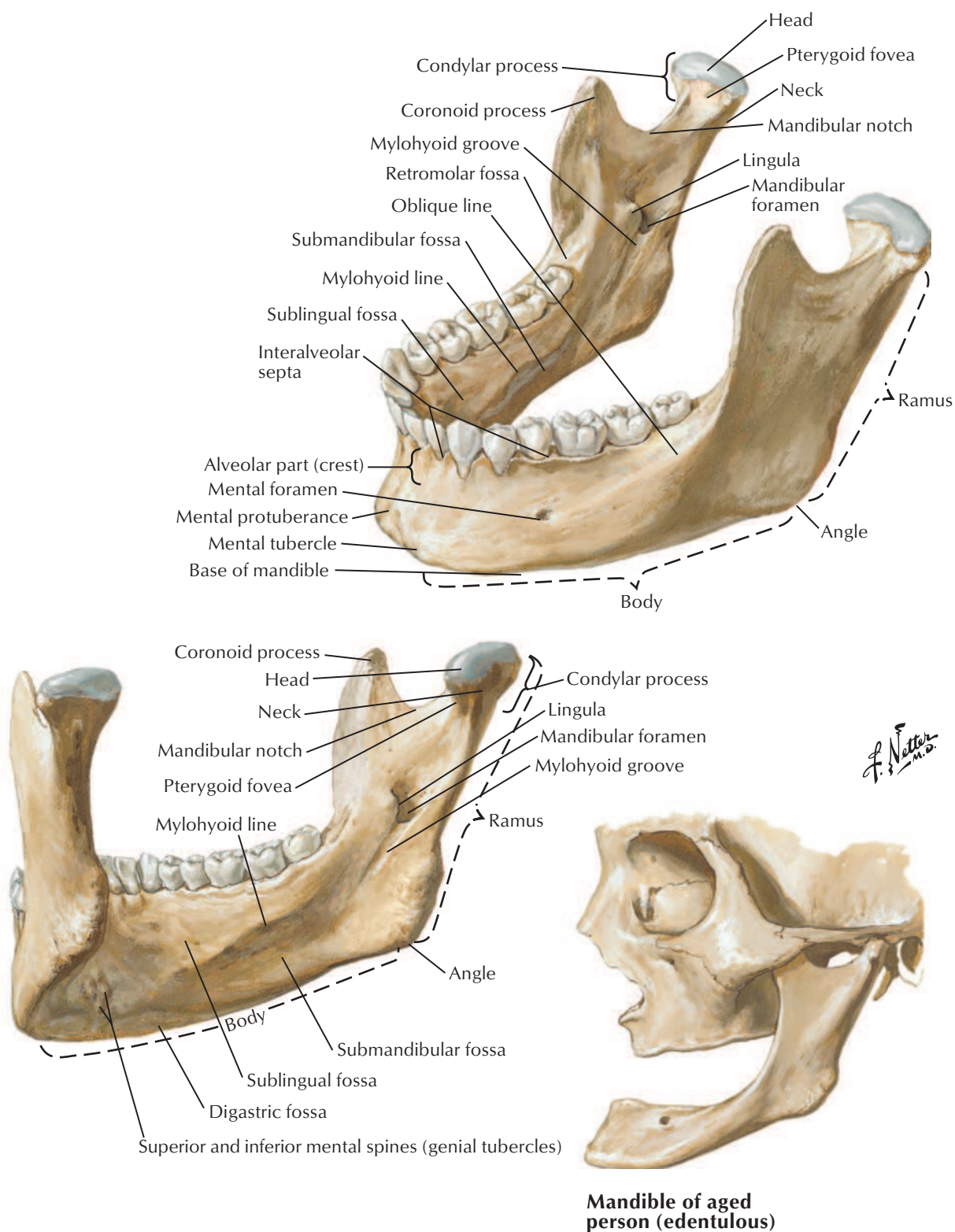
See also [Plates 46, 47, 48](#)

Posterior view



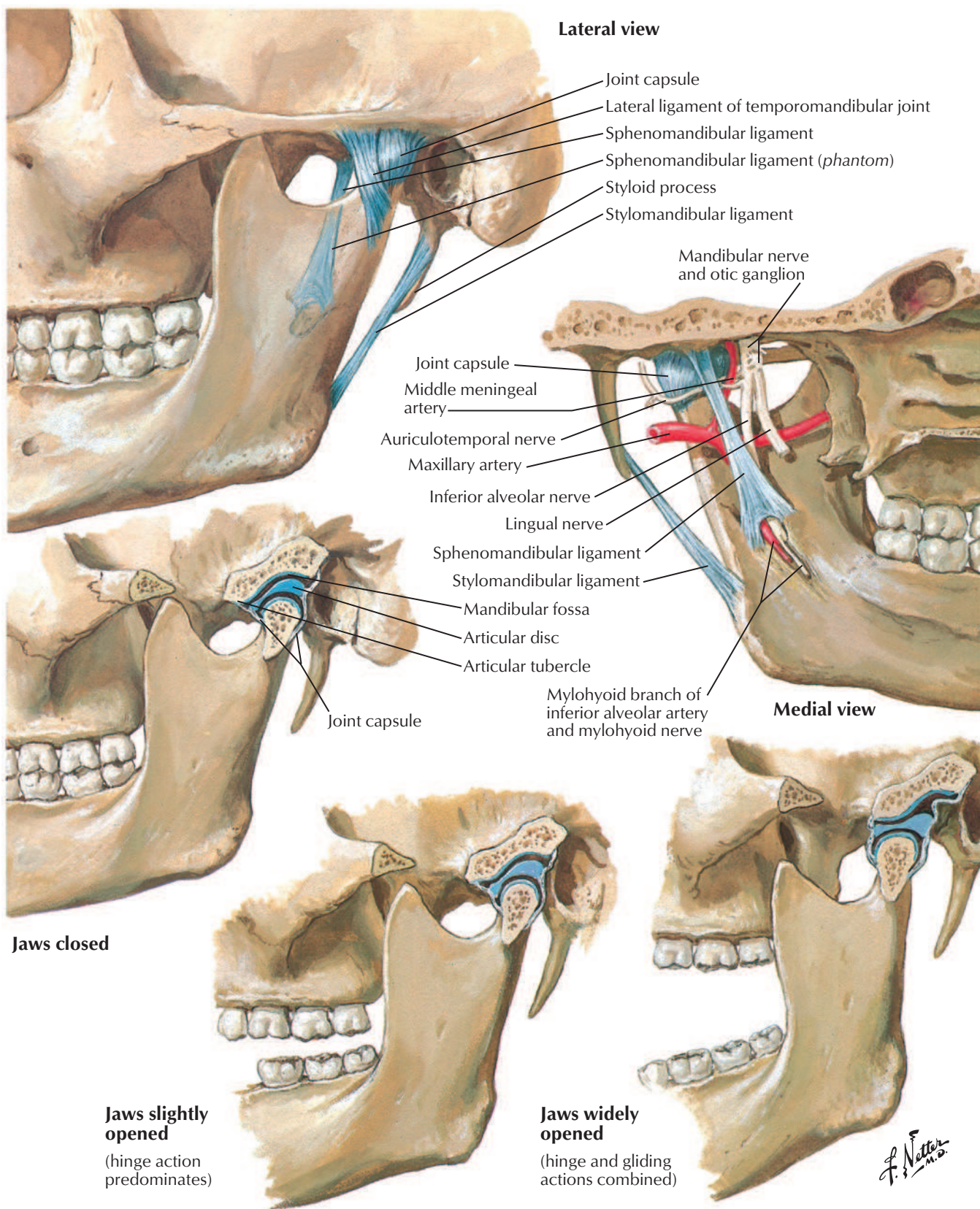
Inferolateral view

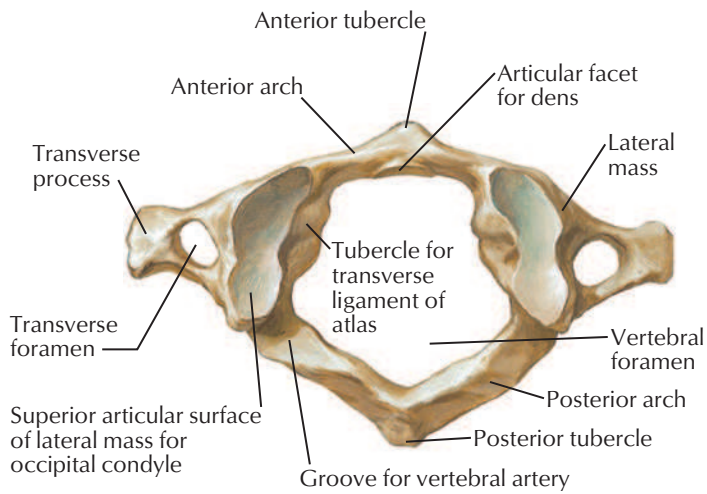




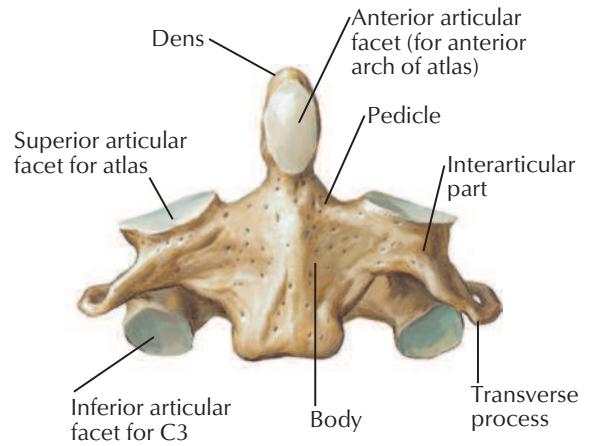
Temporomandibular Joint

See also [Plate 56](#)

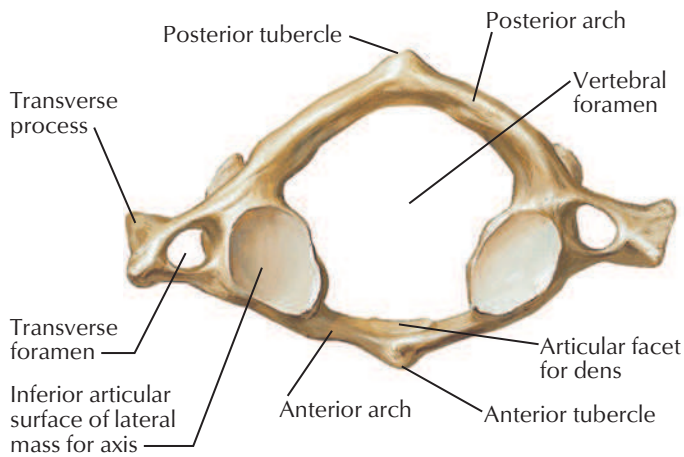




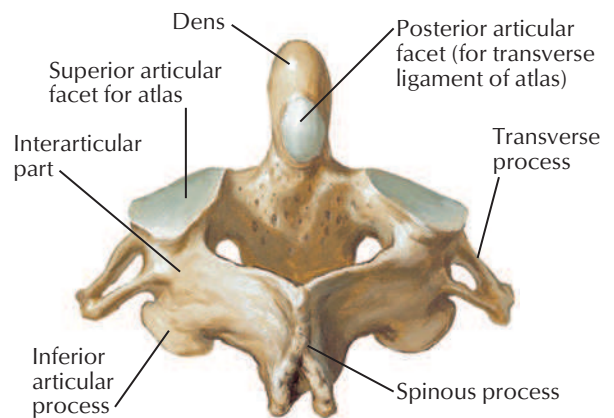
Atlas (C1): superior view



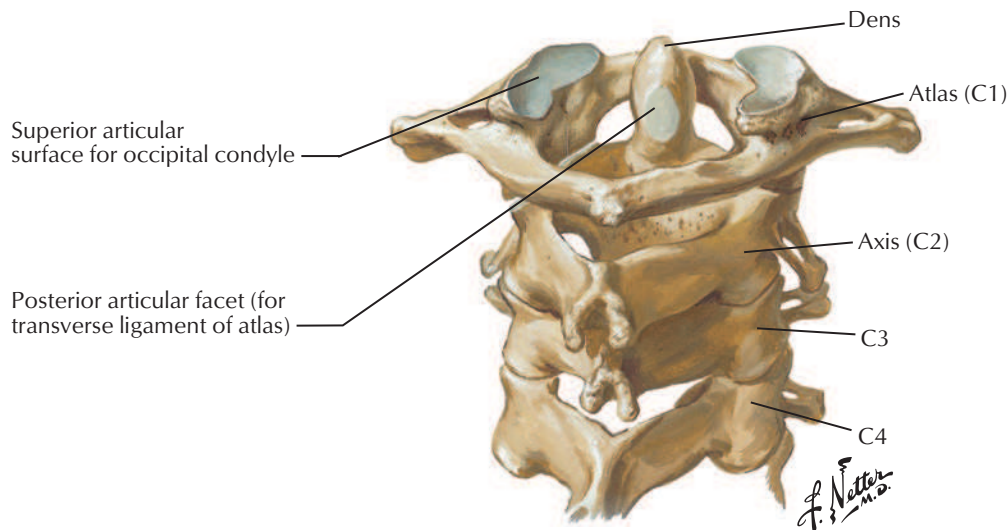
Axis (C2): anterior view



Atlas (C1): inferior view



Axis (C2): posterosuperior view

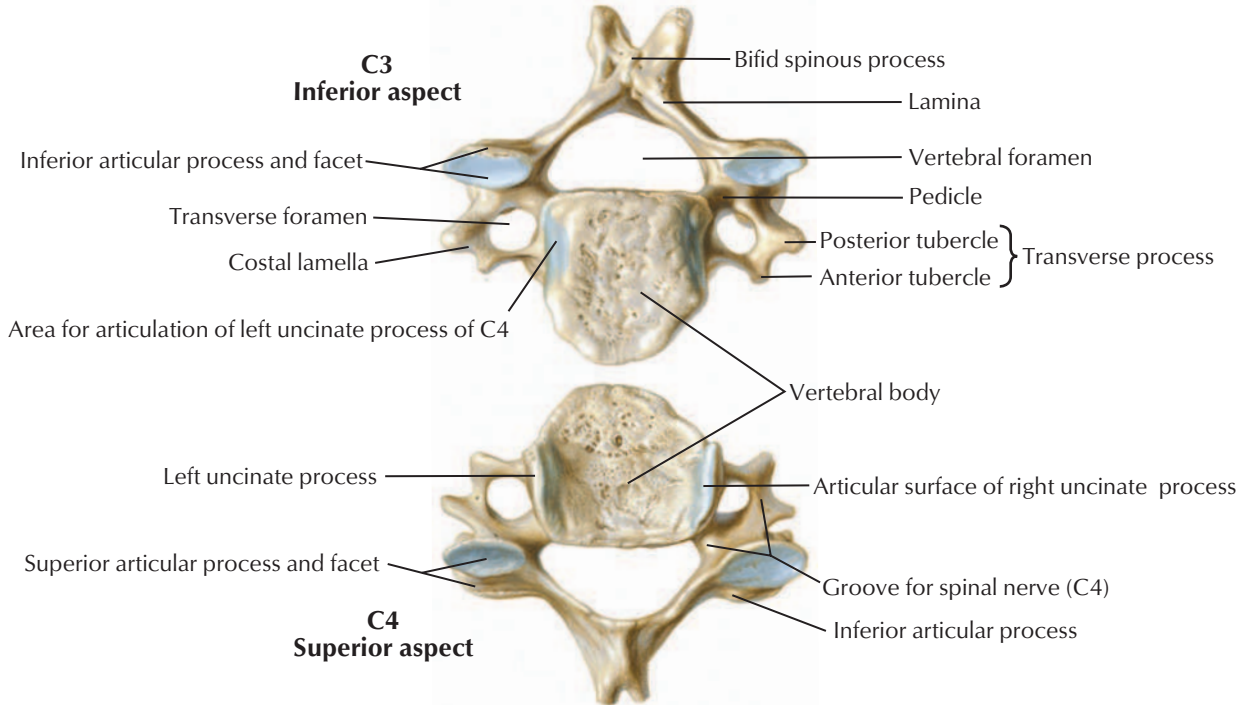


Upper cervical vertebrae, assembled: posterosuperior view

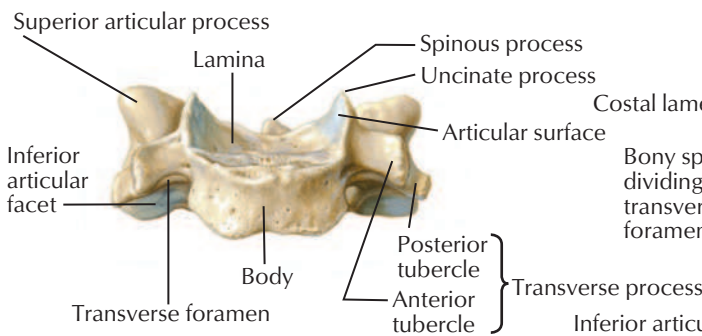
Cervical Vertebrae (continued)

See also [Plates 28, 29](#)

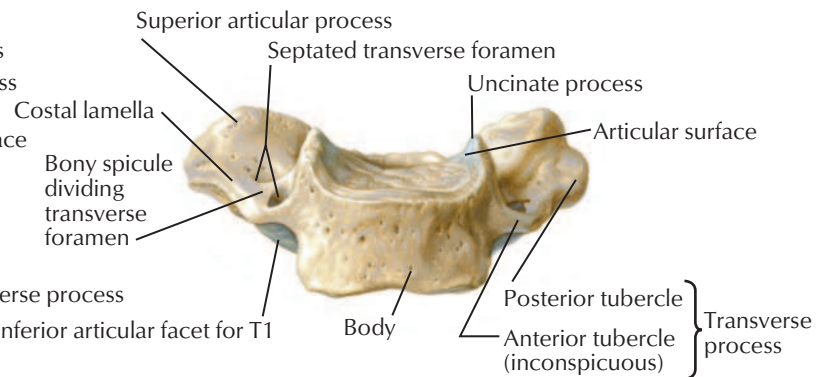
Inferior aspect of C3 and superior aspect of C4 showing the sites of the facet and uncovertebral articulations



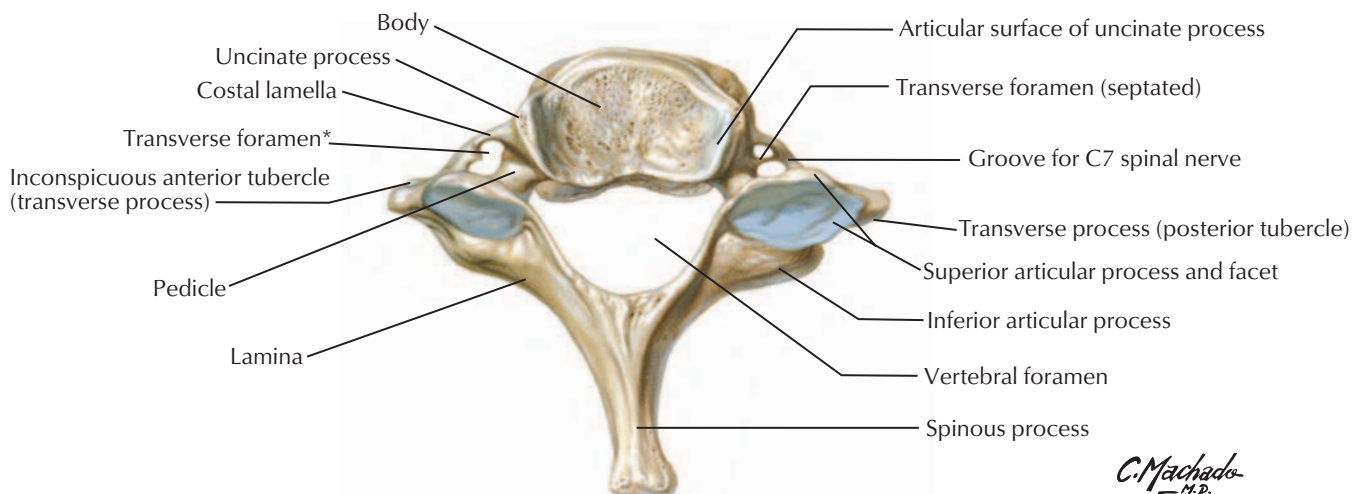
4th cervical vertebra: anterior view



7th cervical vertebra: anterior view

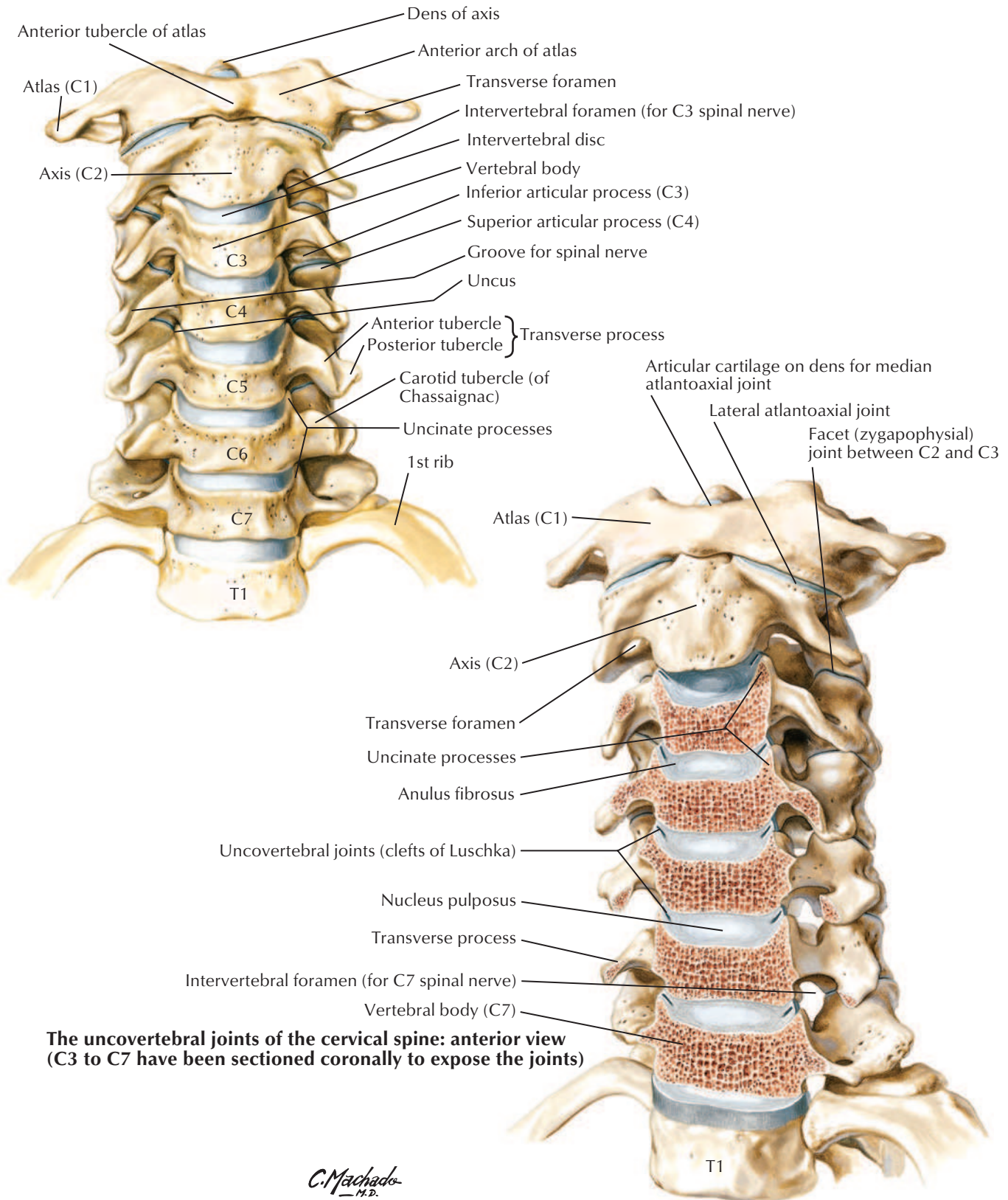


7th cervical vertebra (vertebra prominens): superior view



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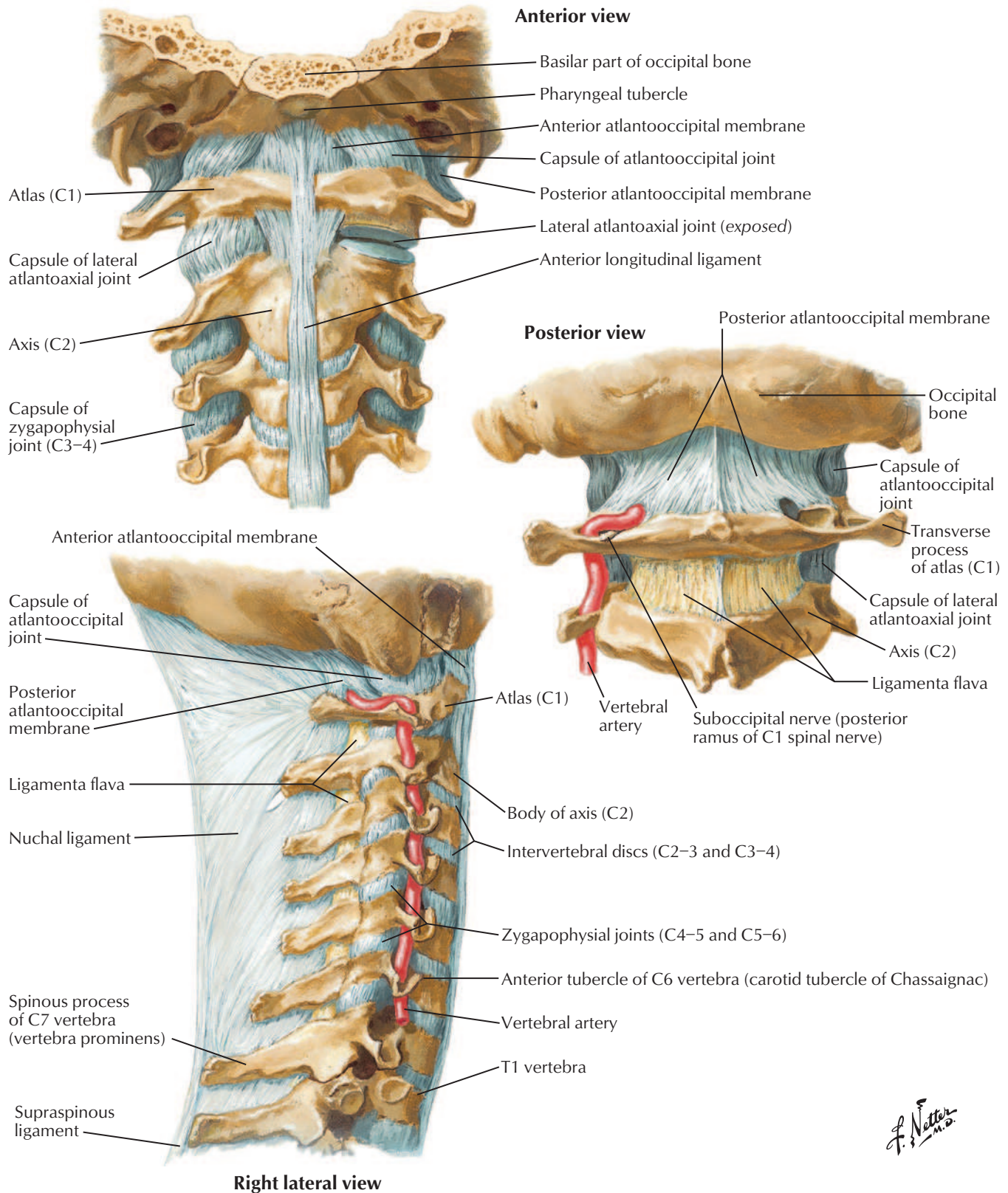
*The foramina transversaria of C7 transmit vertebral veins, but usually not the vertebral artery, and are asymmetrical in this specimen.

Cervical vertebrae: anterior view

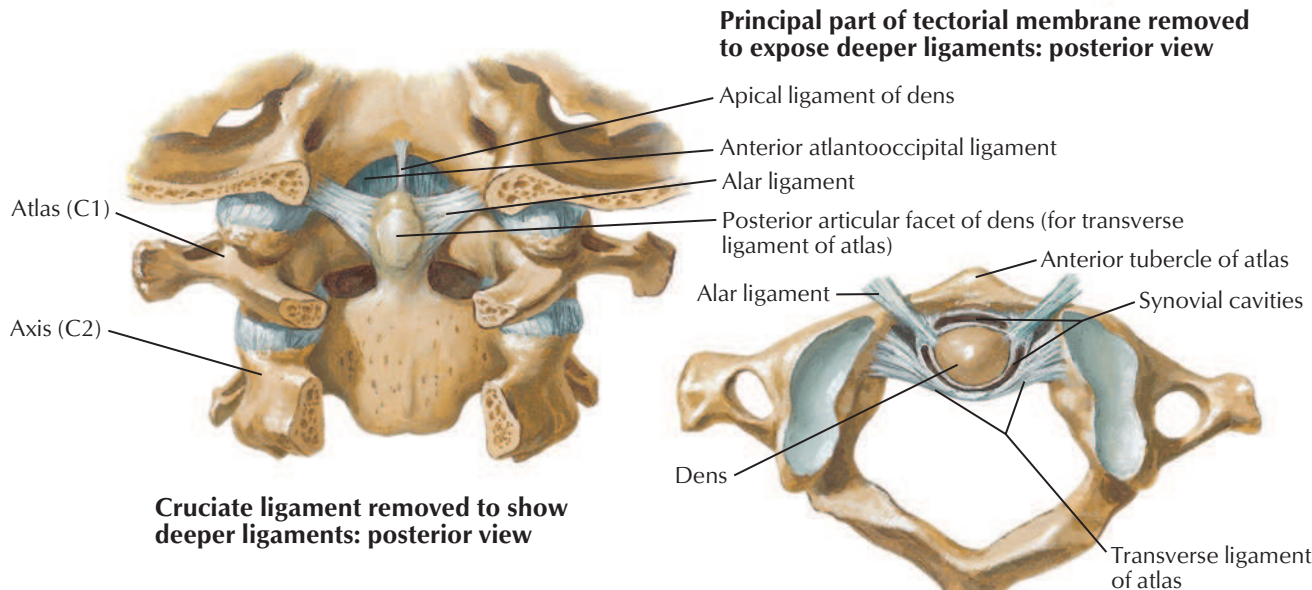
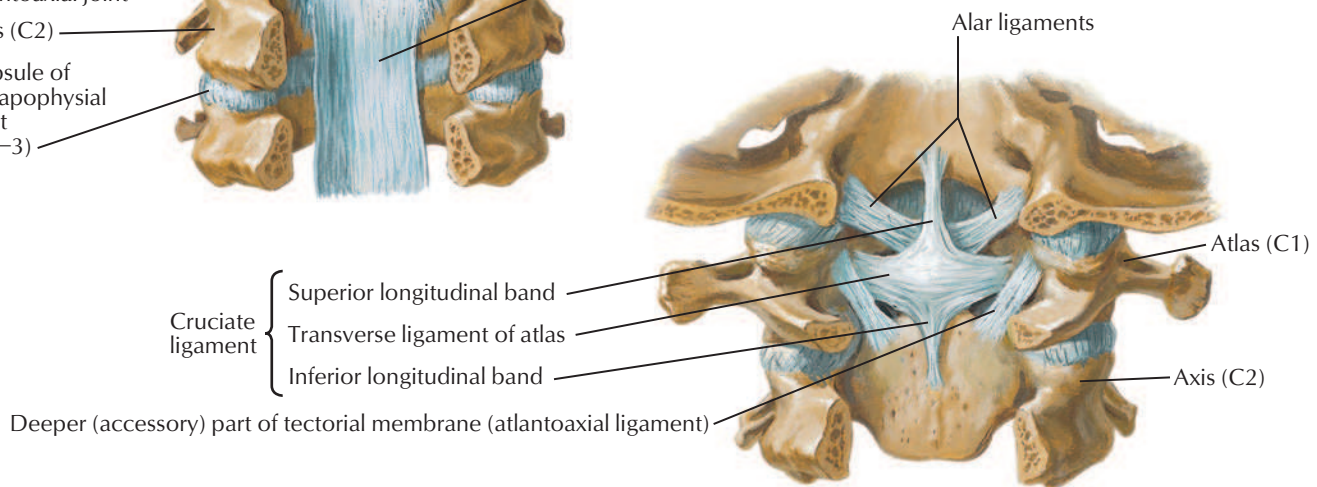
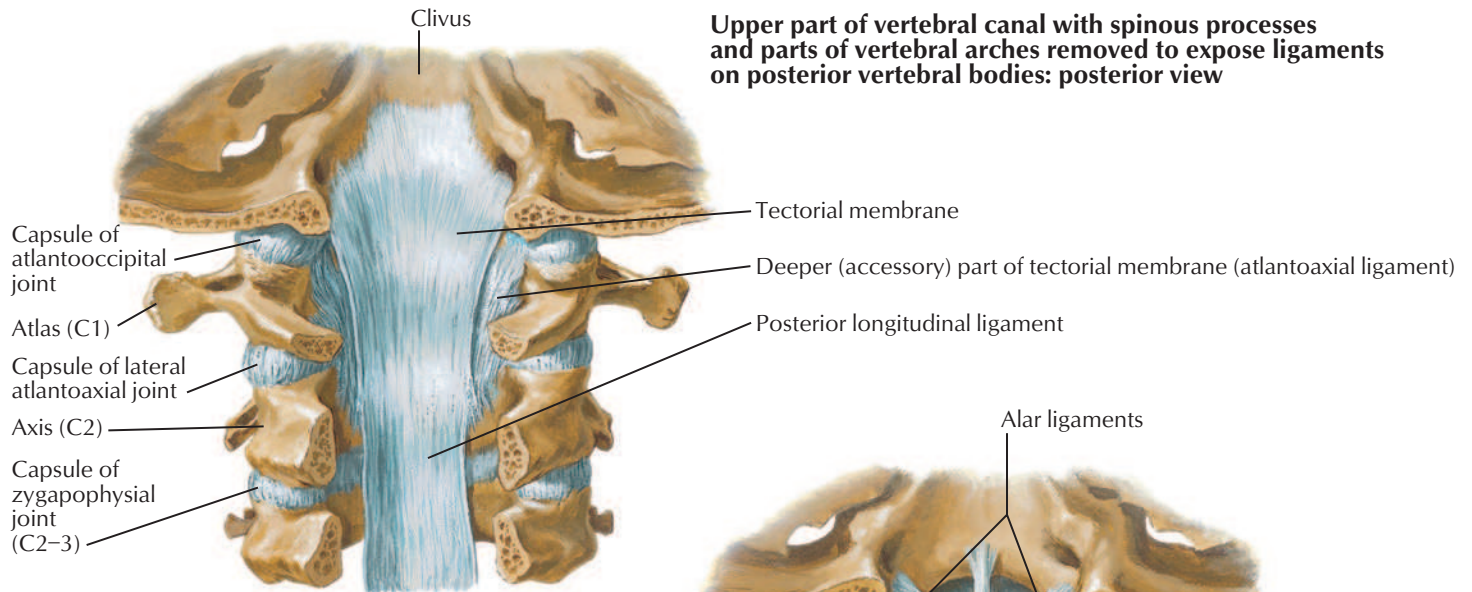
The uncovertebral joints of the cervical spine: anterior view
(C3 to C7 have been sectioned coronally to expose the joints)

C. Machado
— M.D. —

External Craniocervical Ligaments



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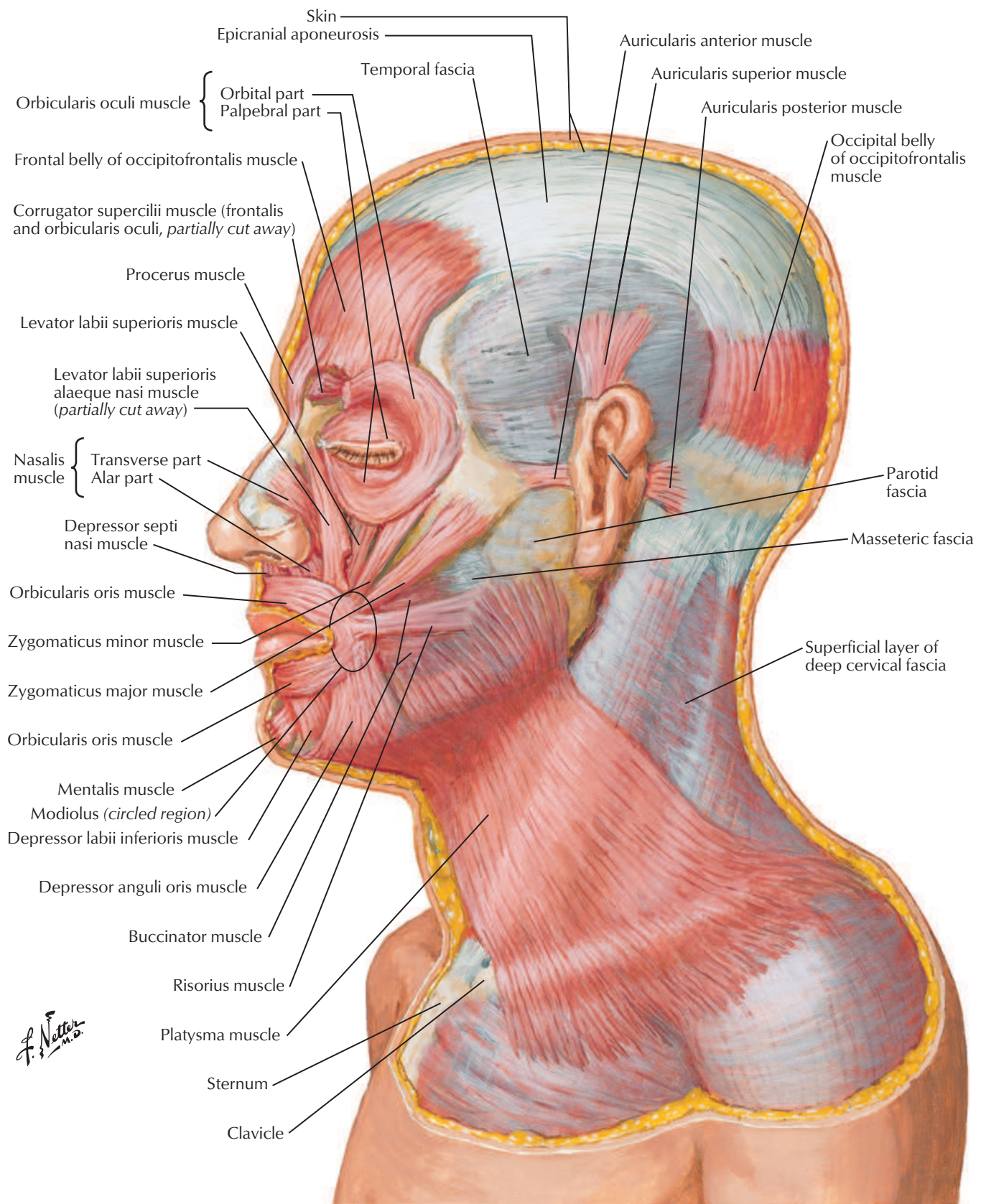


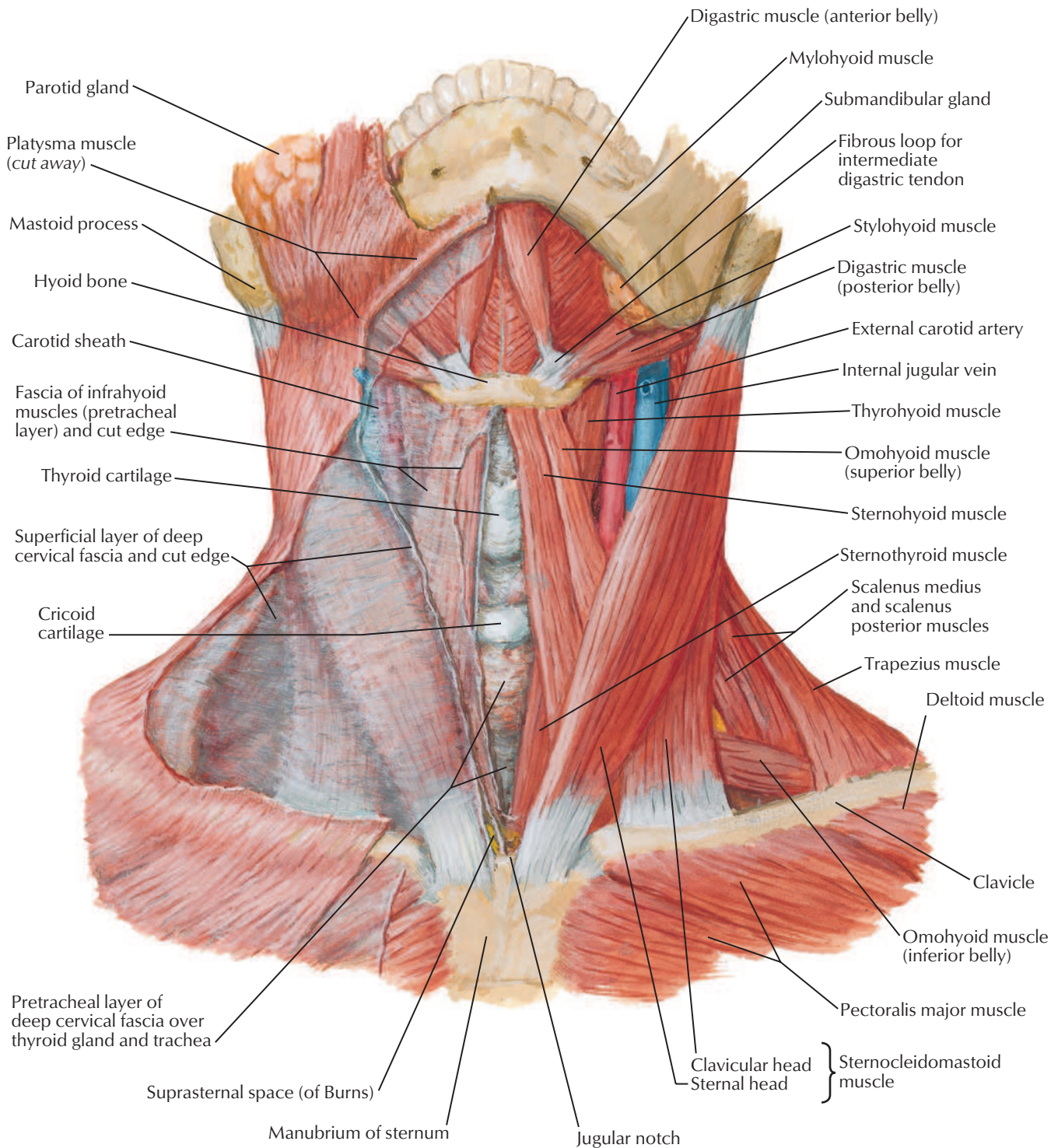
Median atlantoaxial joint: superior view

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Muscles of Facial Expression: Lateral View

See also [Plates 34, 55, 56](#)



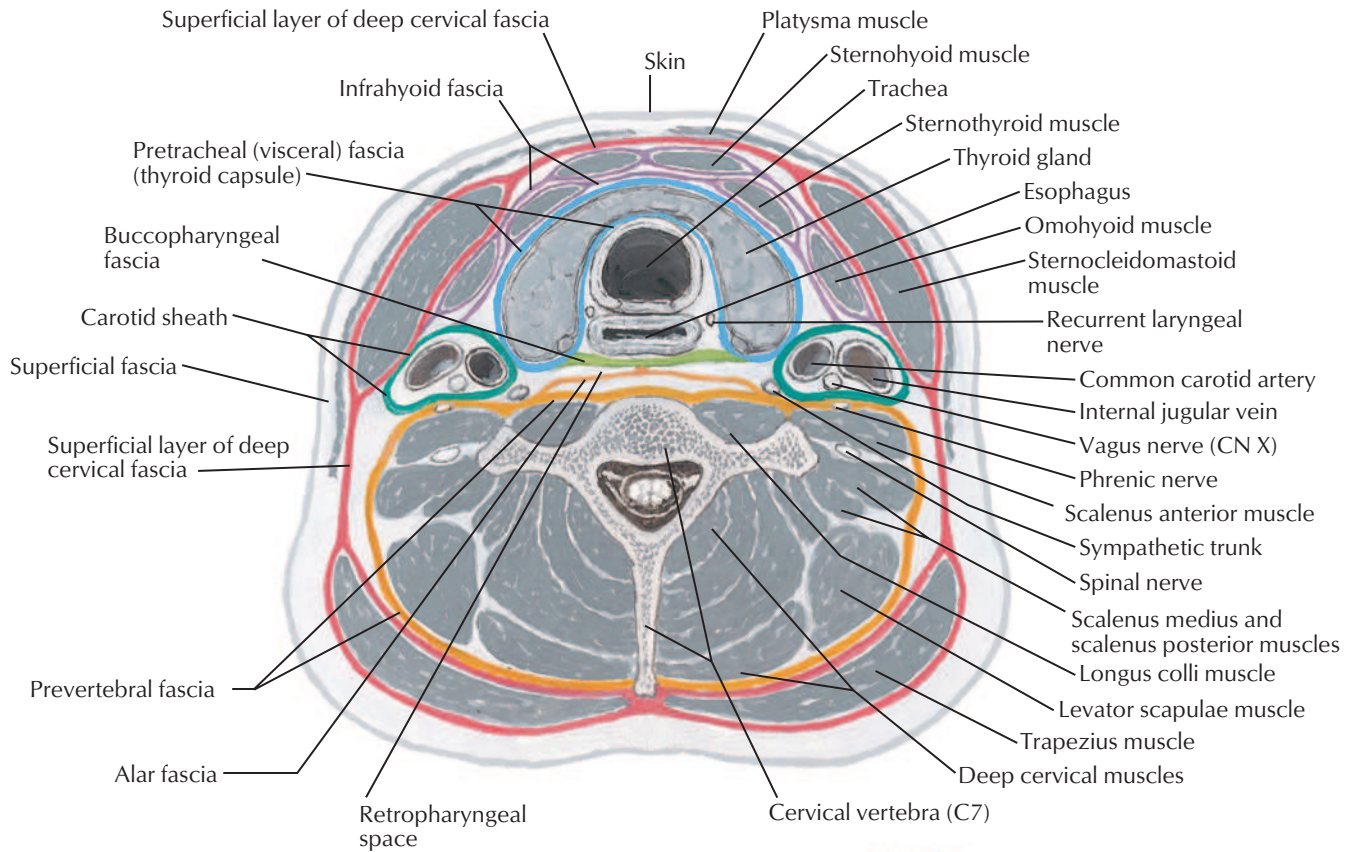


F. Netter M.D.

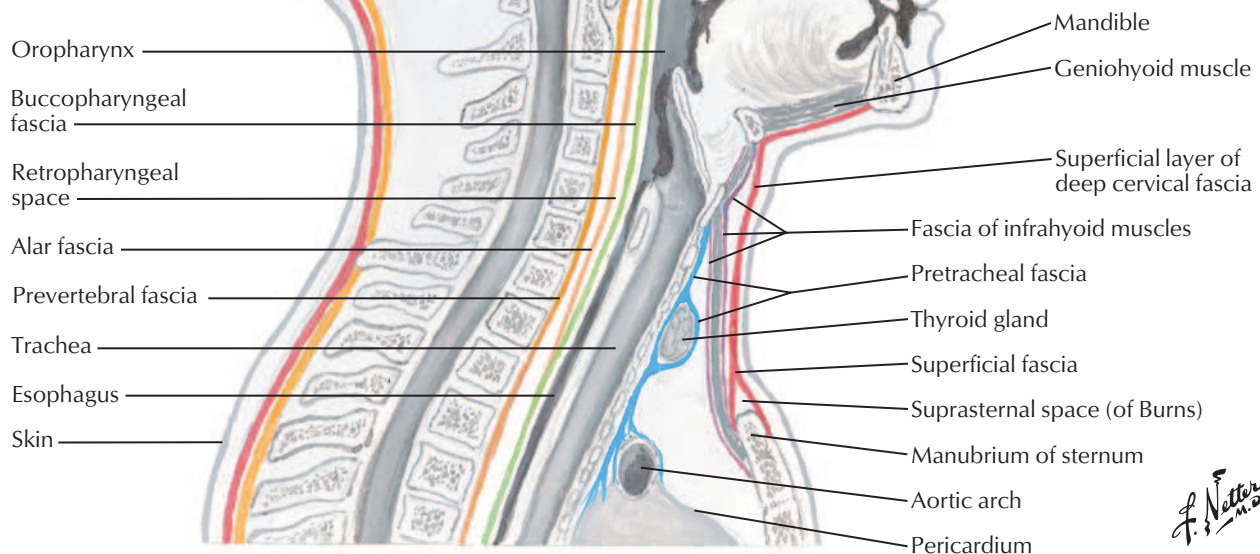
Fascial Layers of Neck

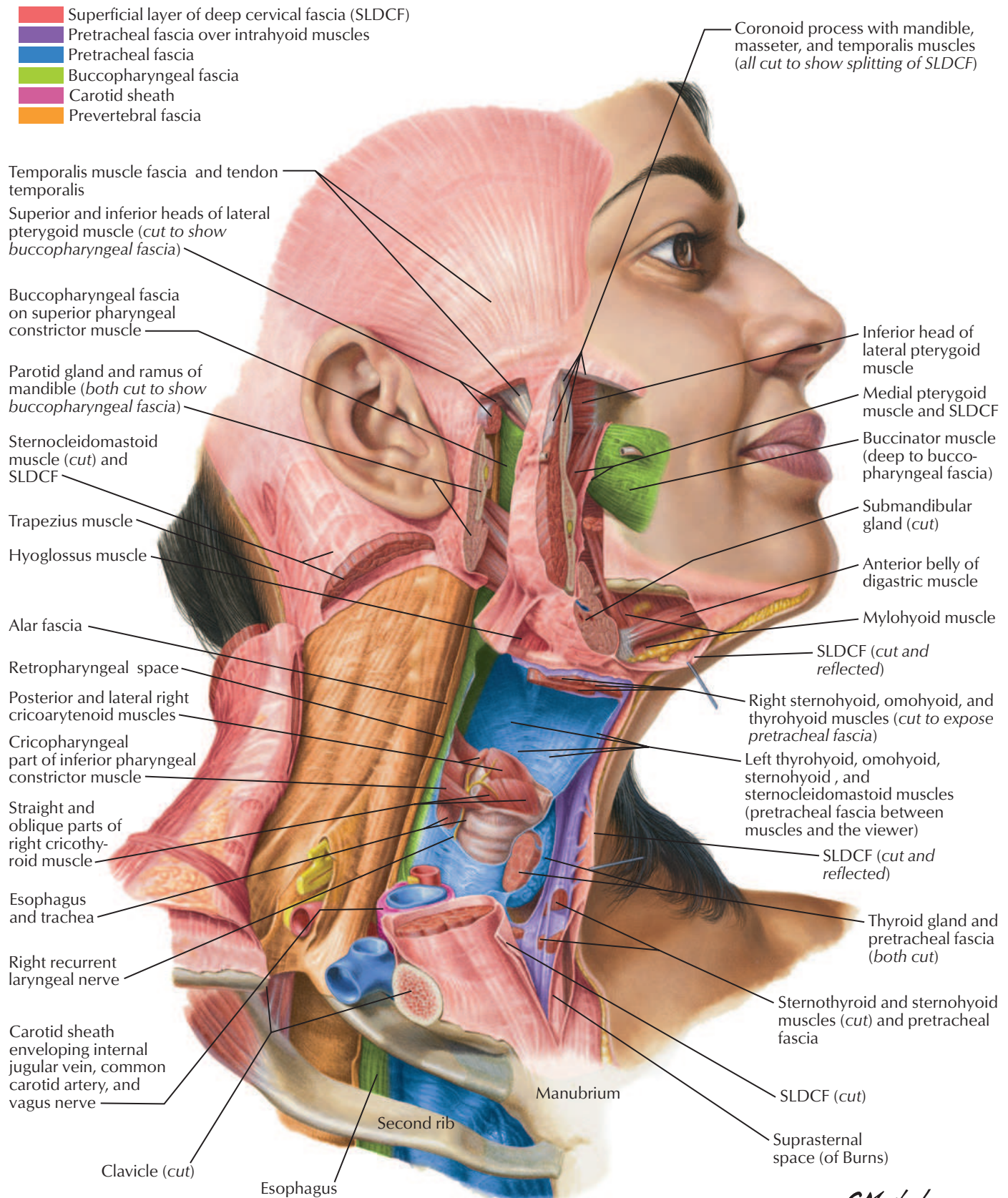
See also [Plate 32](#)

Cross section



Midsagittal section

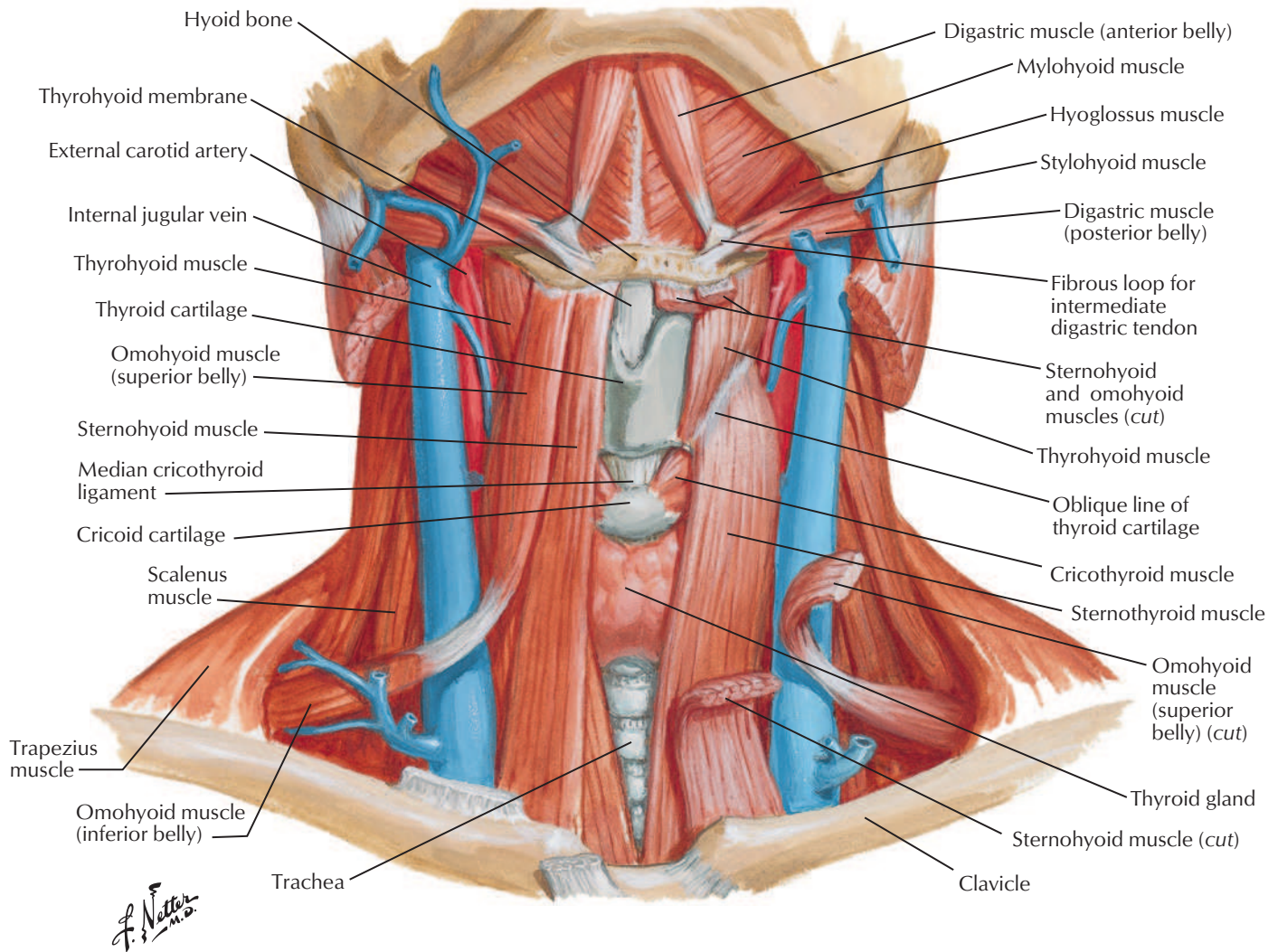


C. Machado
M.D.

SLDCF: Superficial layer of deep cervical fascia

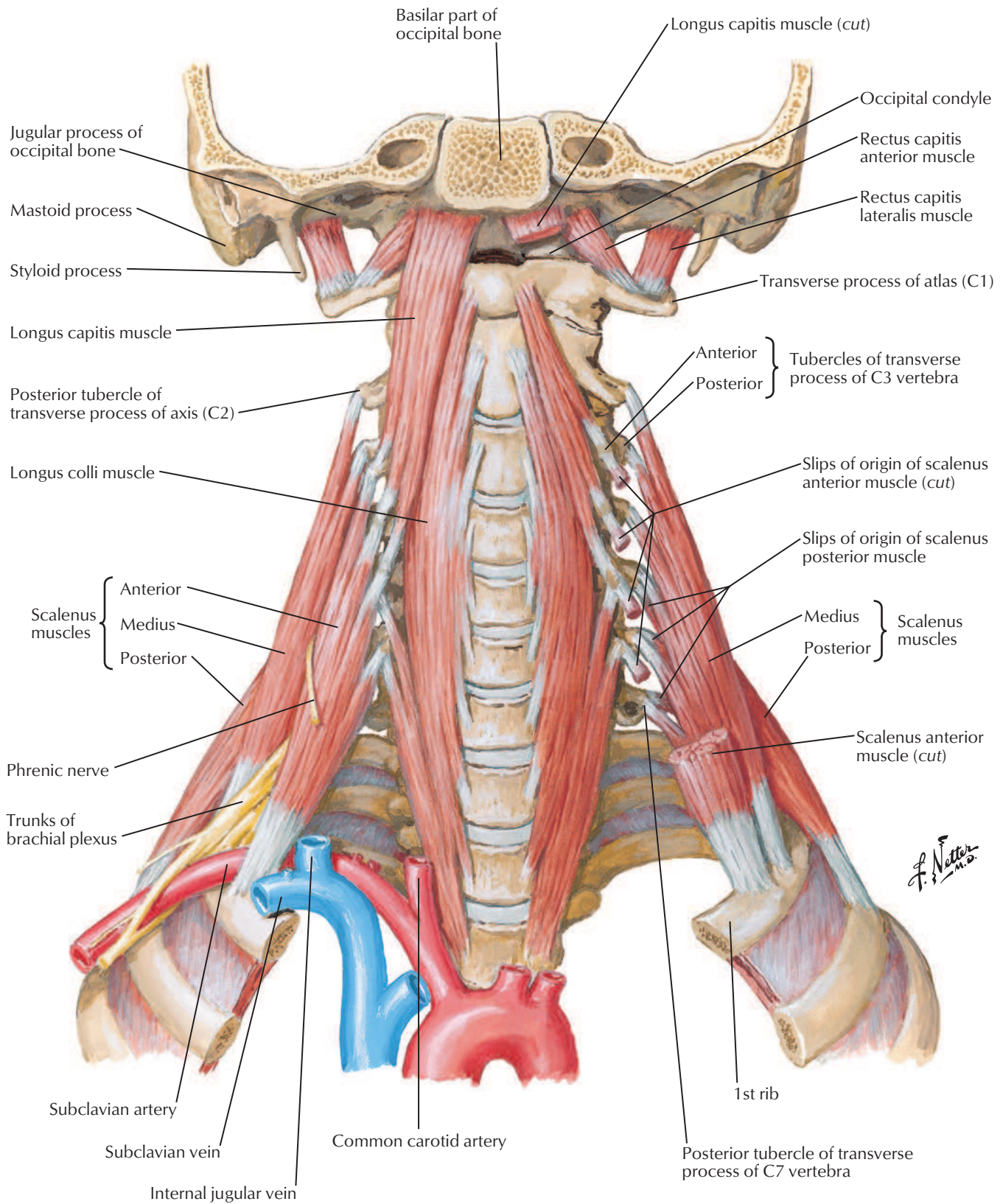
Infrahyoid and Suprahyoid Muscles

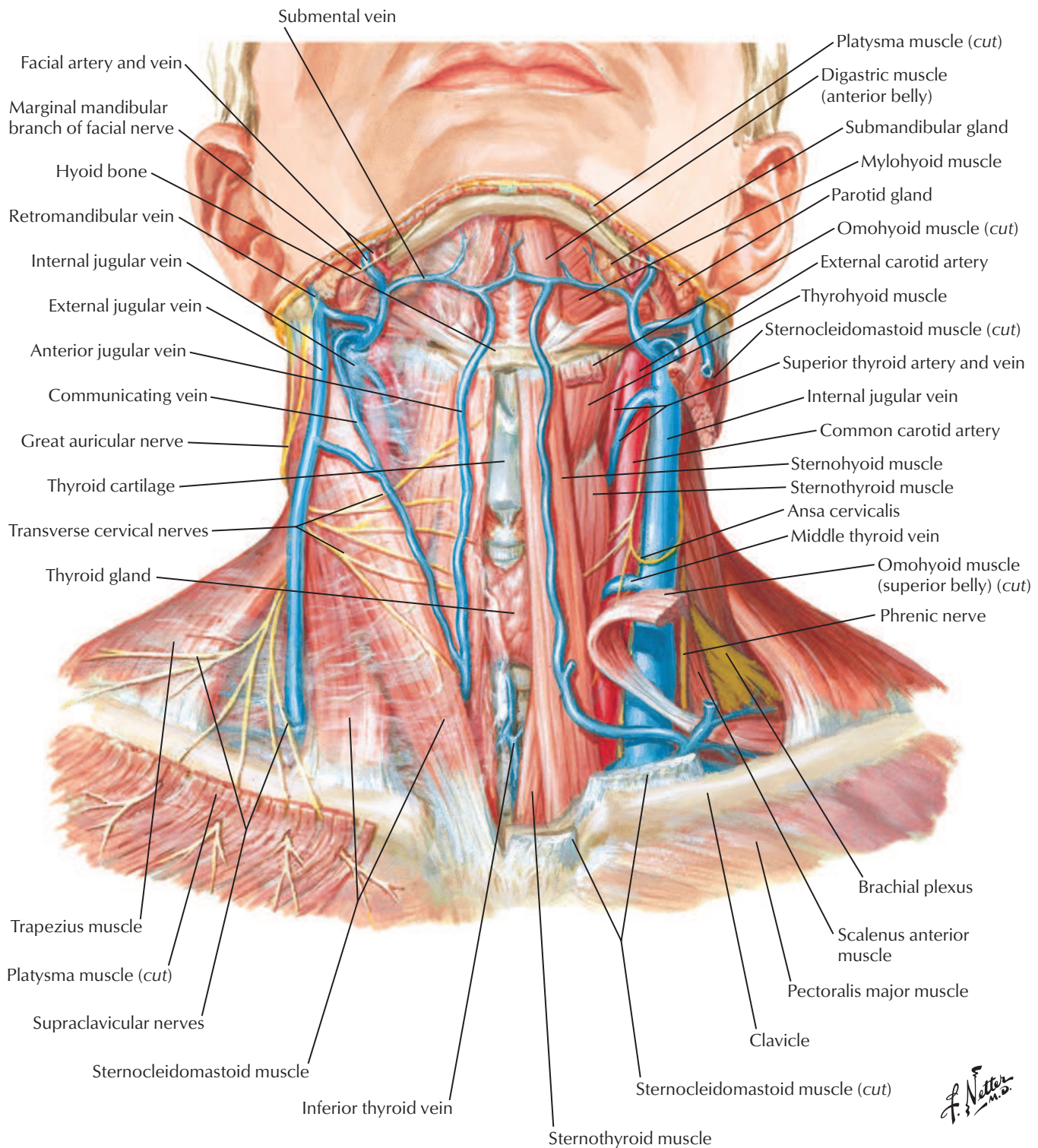
See also [Plates 32, 36, 69](#)





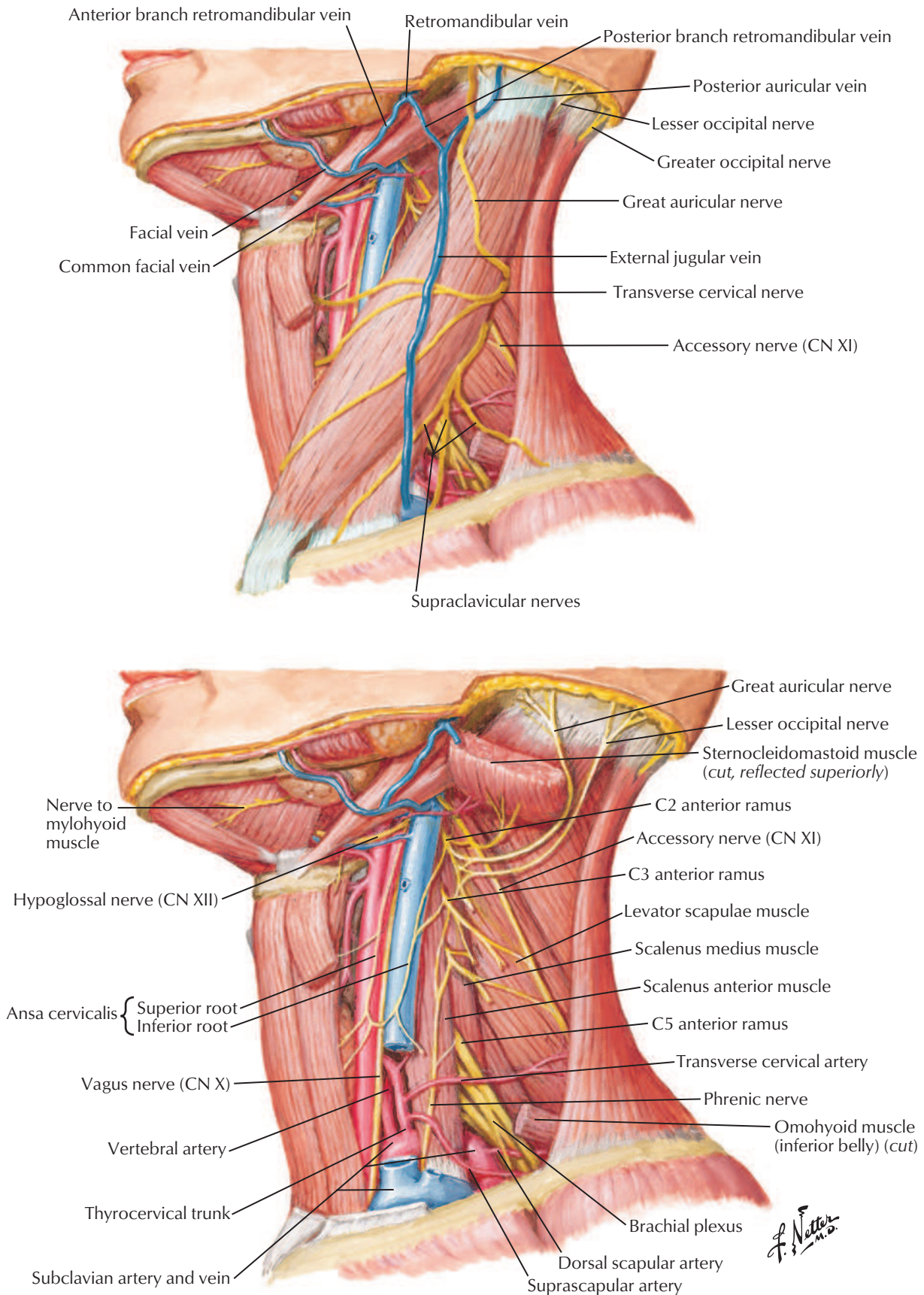
Anterior and Lateral Cervical Muscles





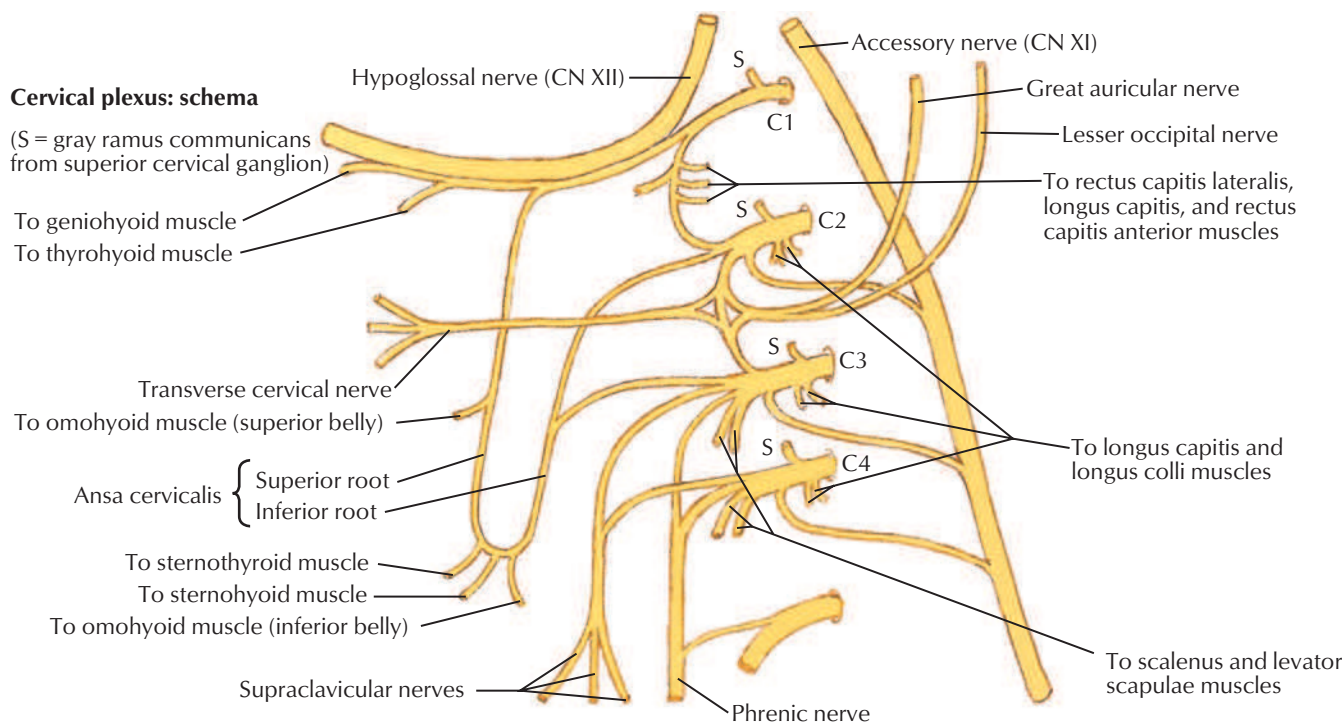
Nerves and Vessels of Neck

See also [Plates 138, 139, 140](#)

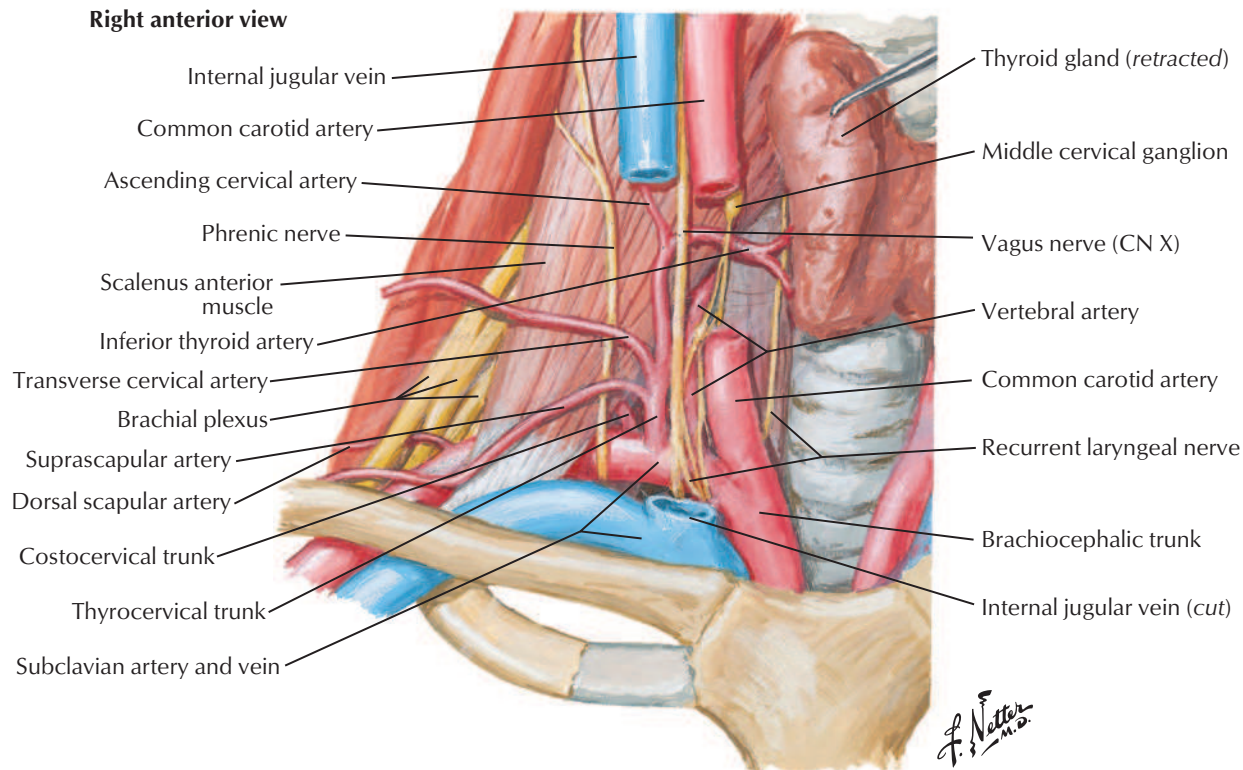


(S = gray ramus communicans from superior cervical ganglion)

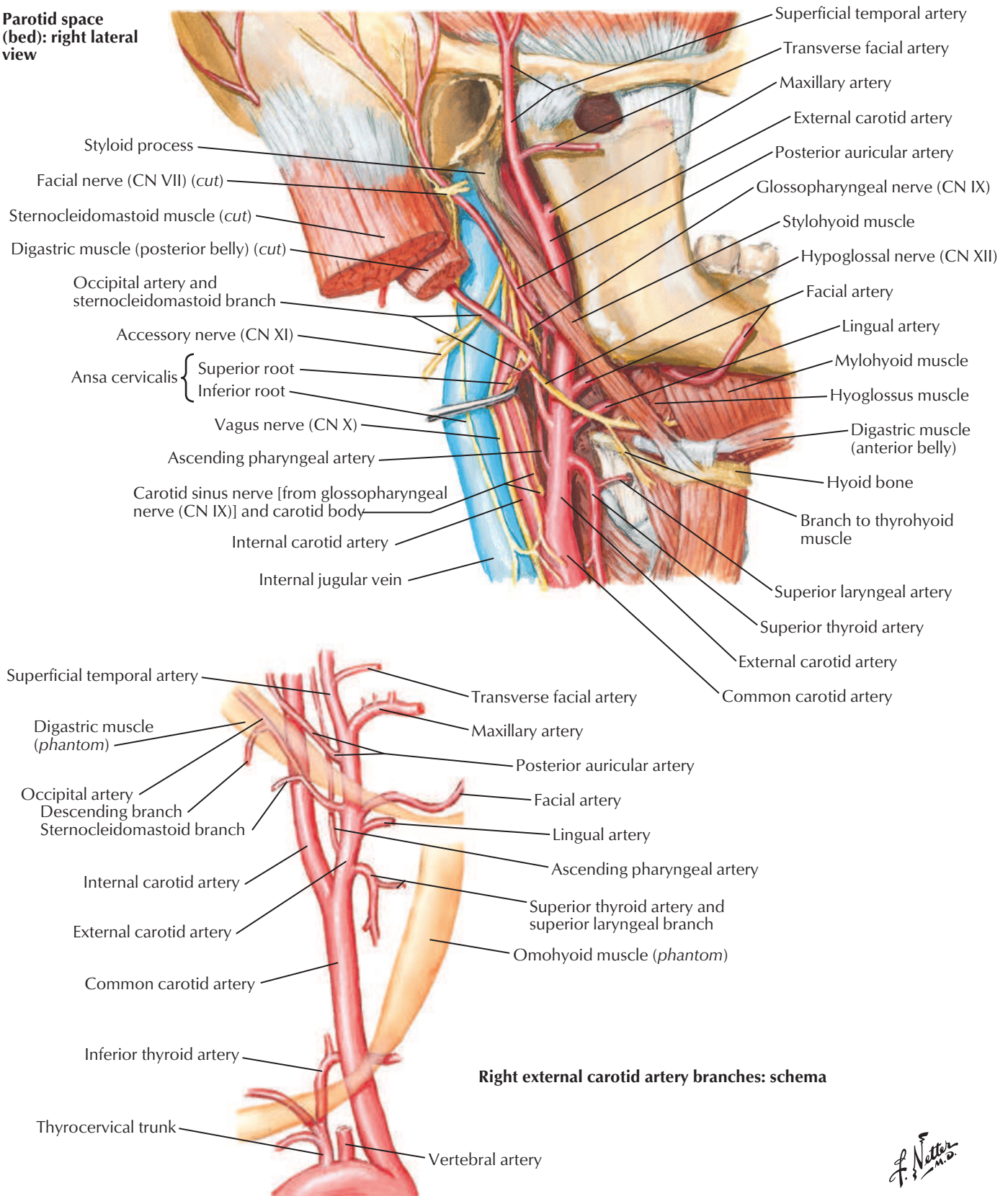
(S = gray ramus communicans from superior cervical ganglion)

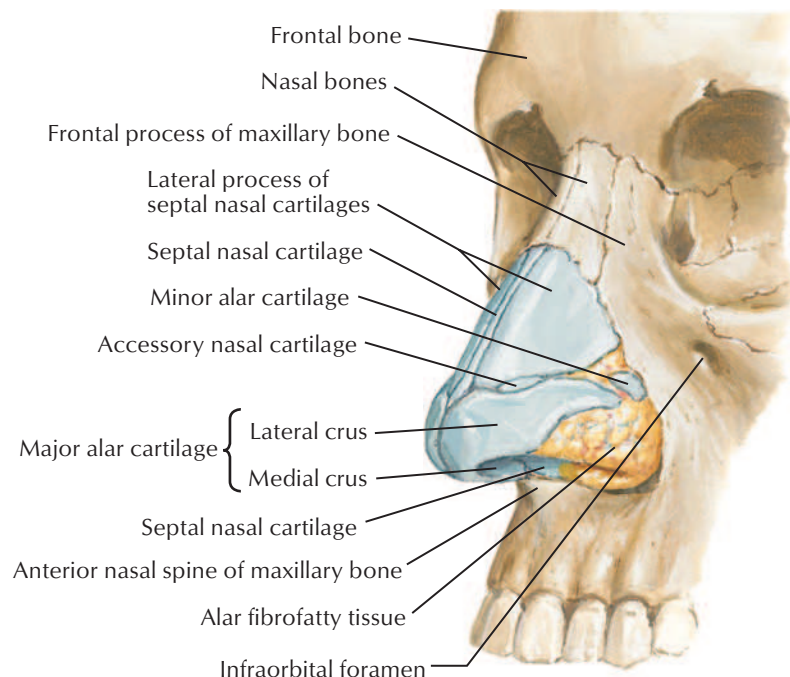
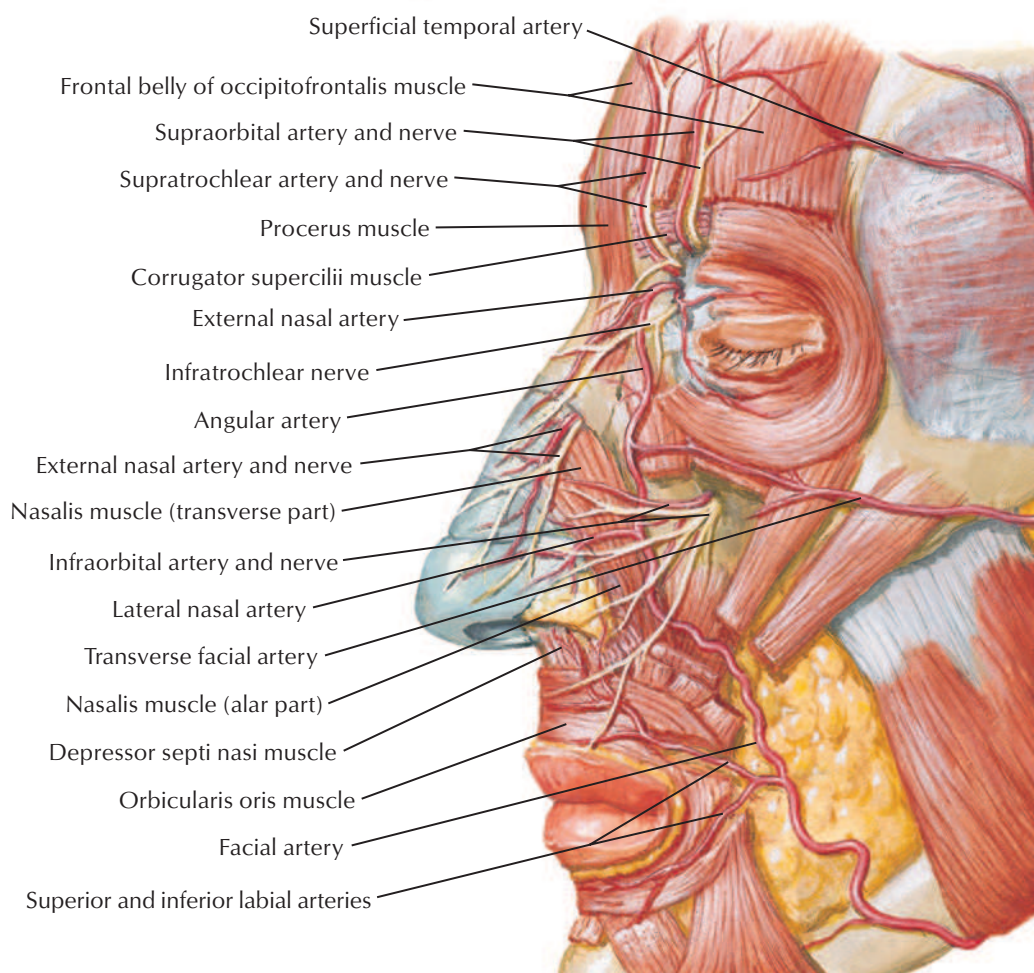
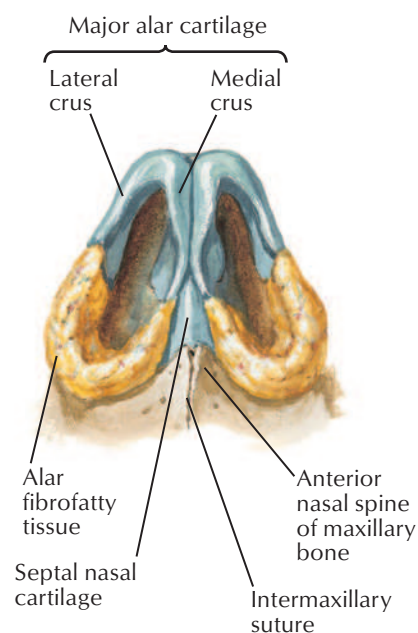


Right anterior view



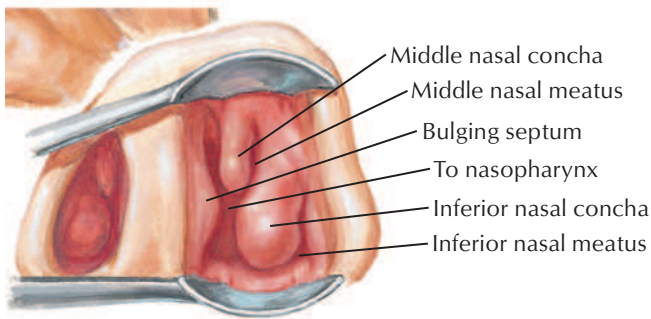
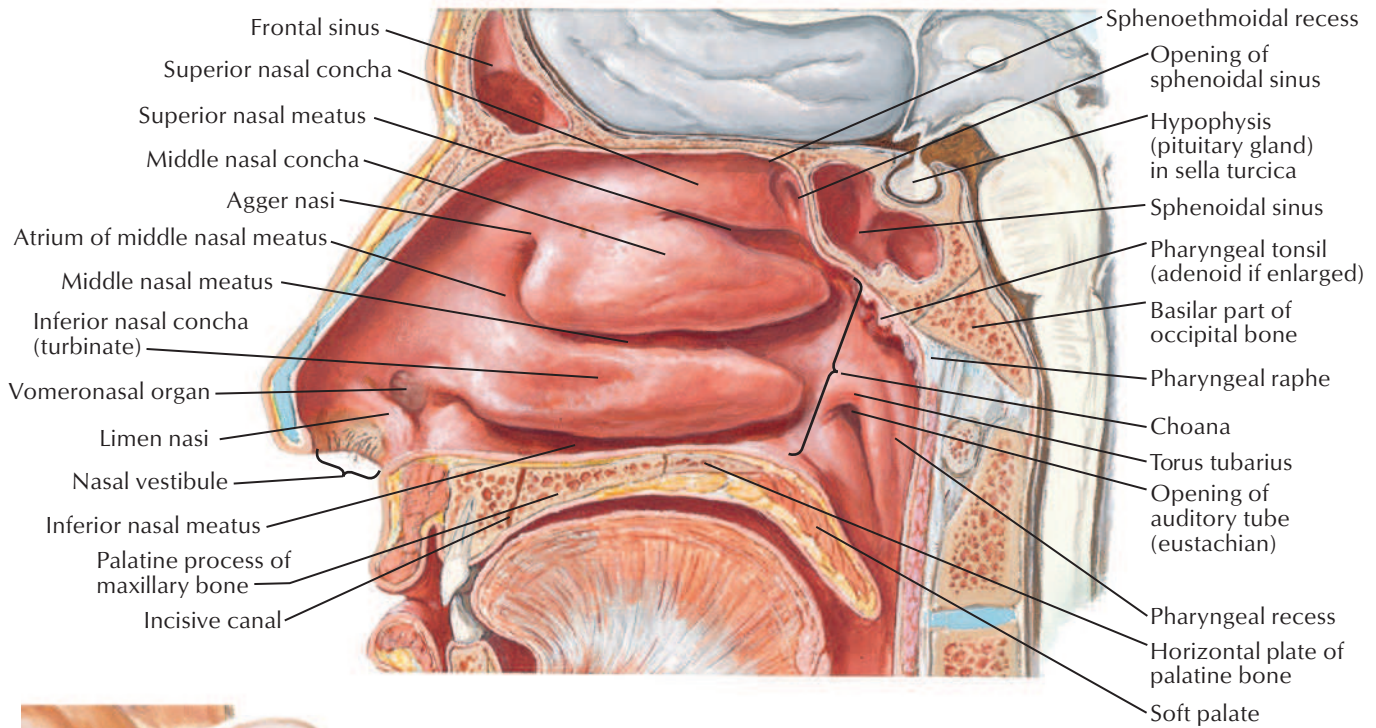
Parotid space (bed): right lateral view



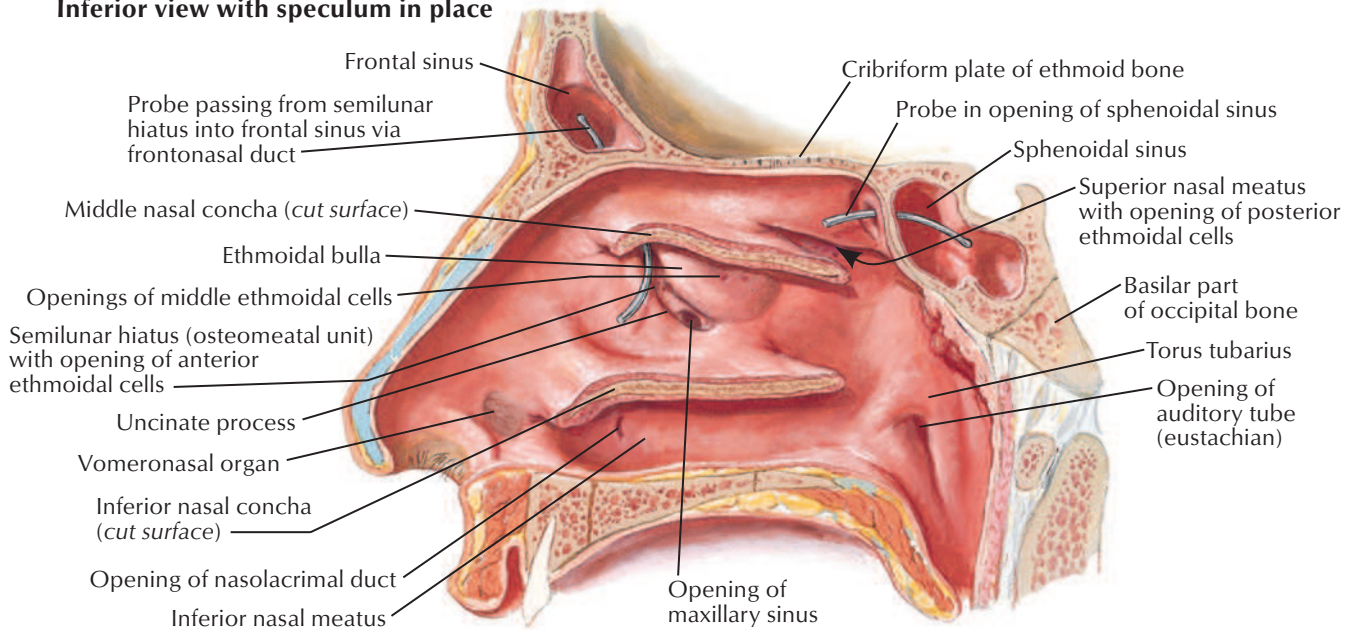
Anterolateral view**Inferior view**

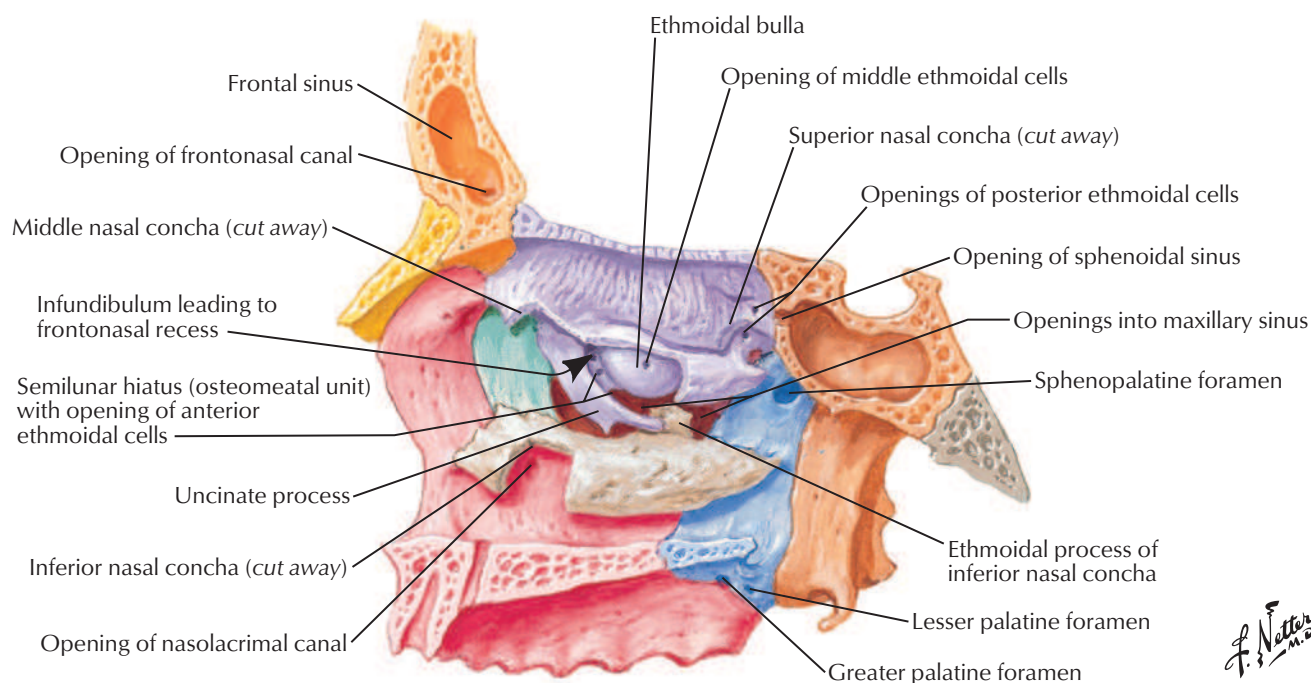
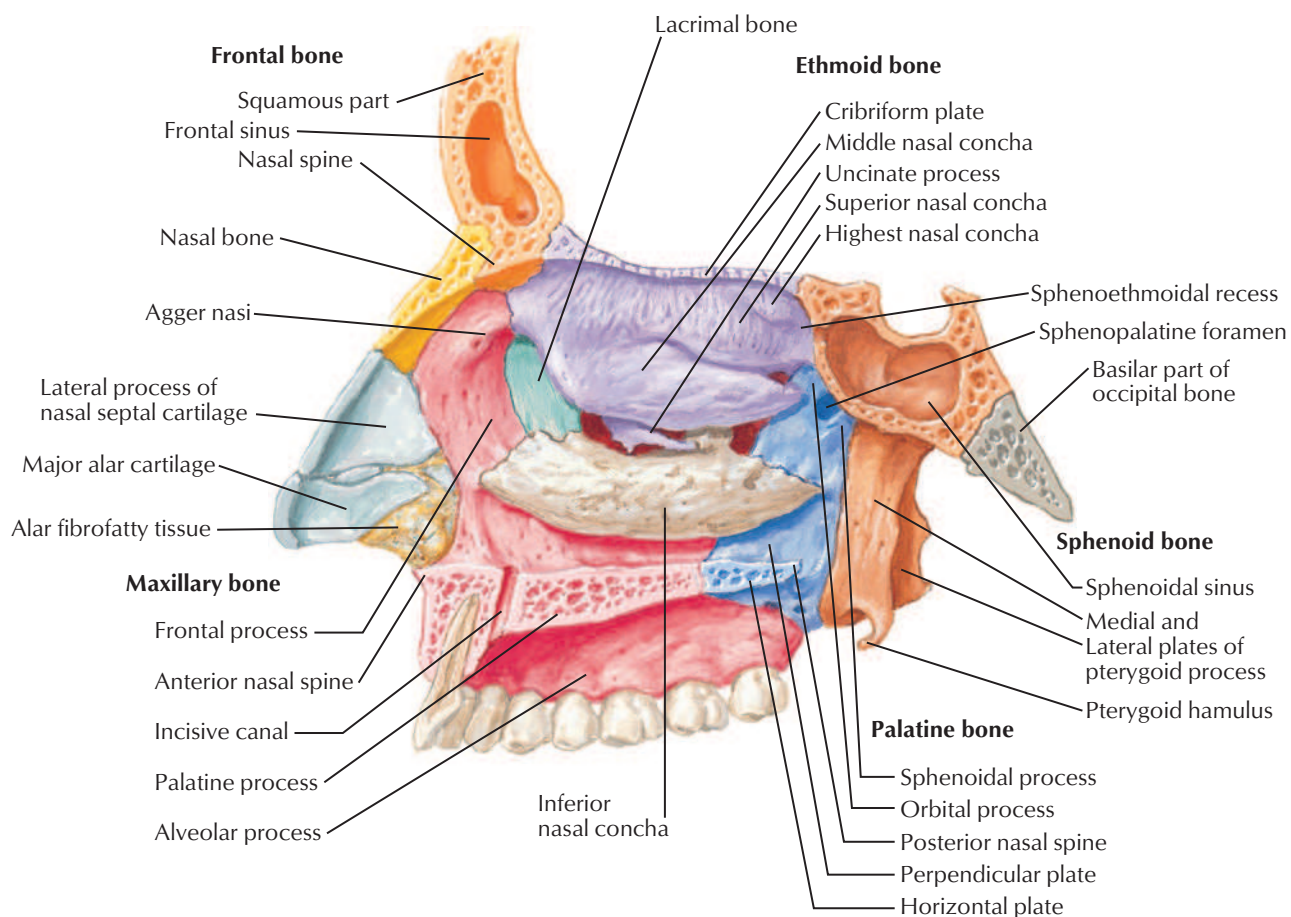
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Lateral Wall of Nasal Cavity



Inferior view with speculum in place





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