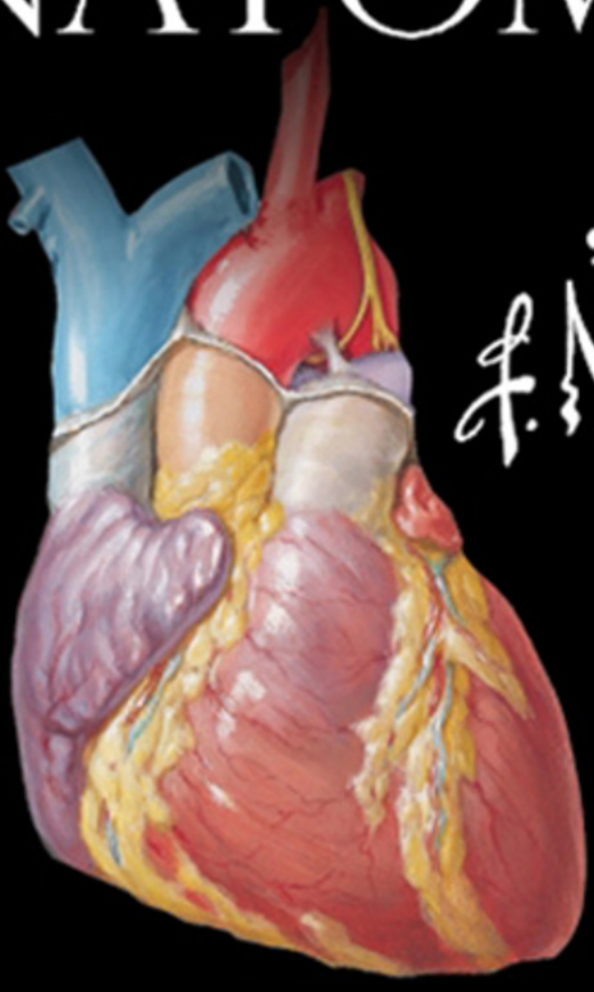
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ATLAS OF HUMAN ANATOMY





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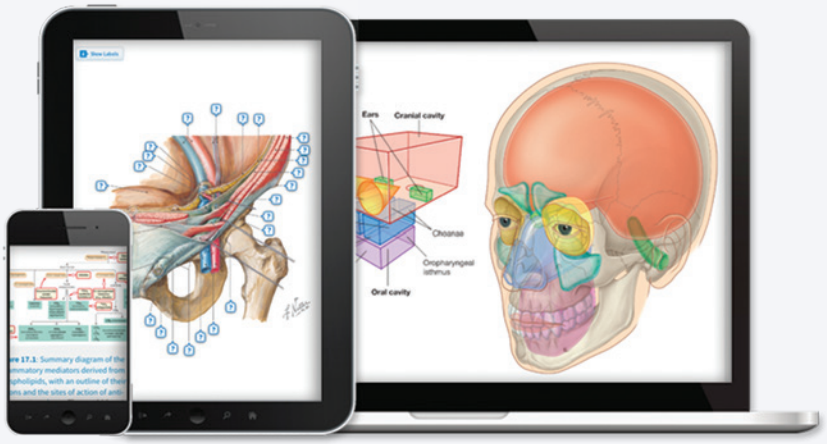
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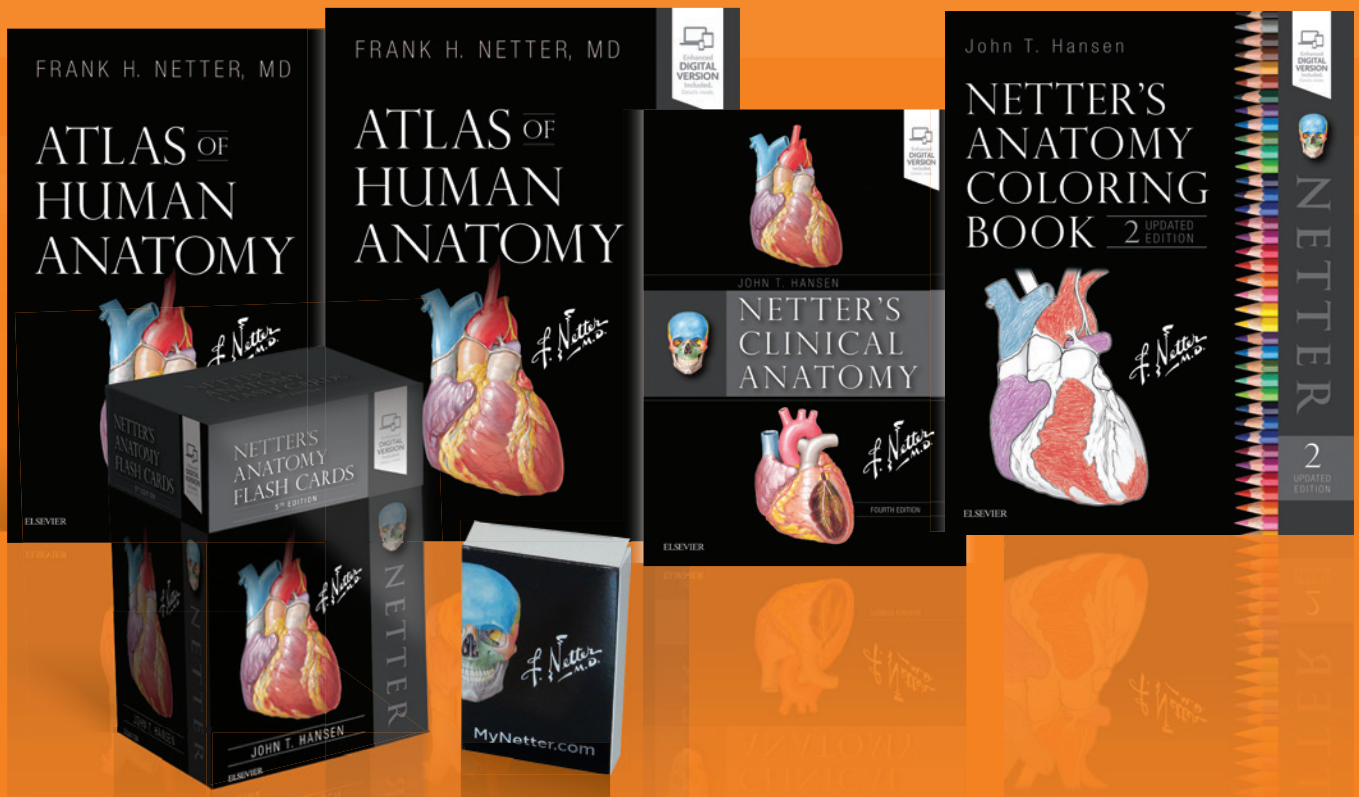
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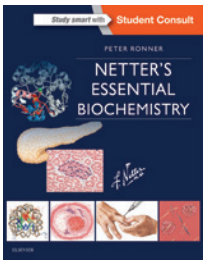
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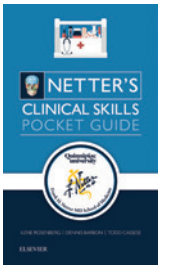
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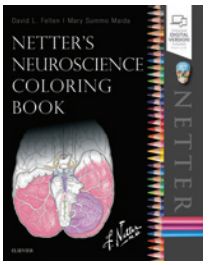


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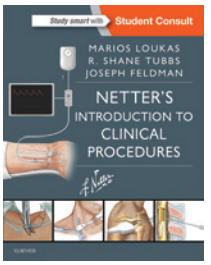


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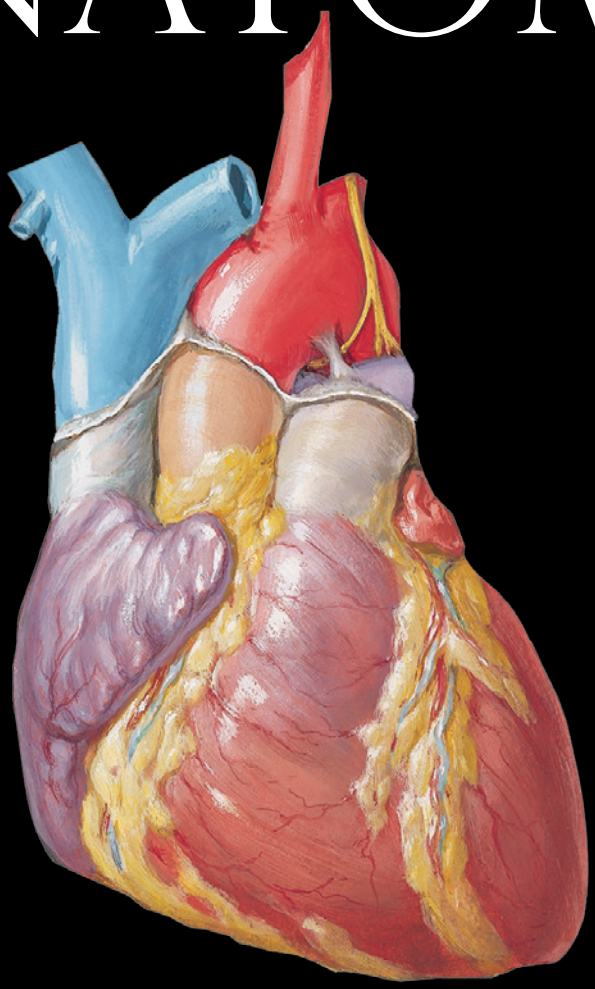
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NEW TO THIS EDITION

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

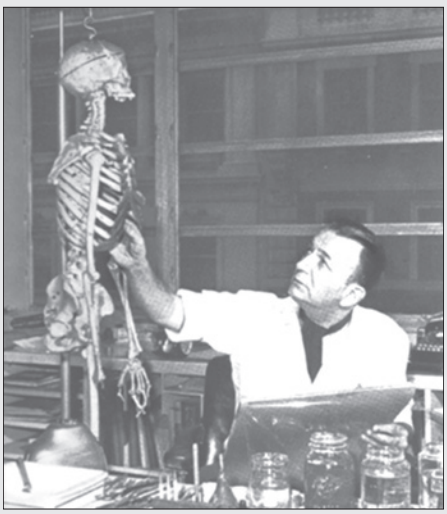
The *Atlas of Human Anatomy* uses terminology accepted (in Göttingen, Germany, on September 24, 2016) by the Federative International Programme on Anatomical Terminologies and published as updates to the 1998 *Terminologia Anatomica*. Numerous updates to terminology have been made, so in select cases,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

New Radiologic Images

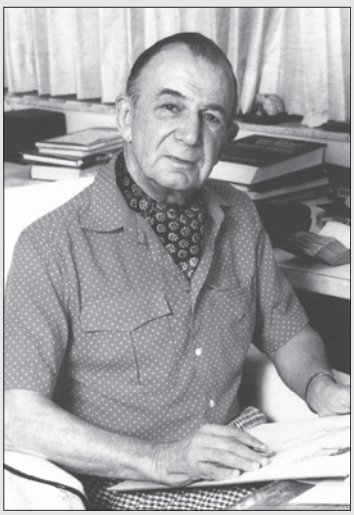
Over 50 radiologic images—some completely new views and others replacing existing views using newer imaging tools—are included in this edition. Images have been selected based on their utility to students studying gross anatomy.

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.









To my dear wife, Vera

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. Standring, 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

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Todd M. Hoagland, PhD

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434 Muscles of Forearm (Superficial Layer): Posterior View
435 Muscles of Forearm (Deeper Layer): Posterior View
436 Muscles of Forearm (Superficial Layer): Anterior View
437 Muscles of Forearm (Intermediate Layer): Anterior View
438 Muscles of Forearm (Deep Layer): Anterior View
439 Attachments of Muscles of Forearm: Anterior View
440 Attachments of Muscles of Forearm: Posterior View
441 Forearm: Serial Cross Sections, Anterior View

Wrist and Hand • Plates 442-461

442 Carpal Bones
443 Movements of Wrist
444 Ligaments of Wrist
445 Ligaments of Wrist (continued)
446 Bones of Wrist and Hand

447 Wrist and Hand: Radiographs
448 Metacarpophalangeal and Interphalangeal Ligaments
449 Wrist and Hand: Superficial Palmar Dissections
450 Wrist and Hand: Deeper Palmar Dissections
451 Lumbrical Muscles and Bursae, Spaces, and Sheaths: Schema
452 Flexor Tendons, Arteries, and Nerves at Wrist
453 Bursae, Spaces, and Tendon Sheaths of Hand
454 Flexor and Extensor Tendons in Fingers
455 Intrinsic Muscles of Hand
456 Arteries and Nerves of Hand: Palmar Views
457 Wrist and Hand: Superficial Dissection
458 Wrist and Hand: Superficial Dorsal Dissection
459 Nerves and Arteries of Dorsal Hand and Wrist
460 Extensor Tendons at Wrist
461 Fingers

Neurovasculature • Plates 462-469

462 Cutaneous Innervation of Wrist and Hand
463 Arteries and Nerves of Upper Limb: Anterior View
464 Nerves of Upper Limb
465 Musculocutaneous Nerve: Anterior View
466 Median Nerve
467 Ulnar Nerve
468 Radial Nerve in Arm and Nerves of Posterior Shoulder: Posterior View
469 Radial Nerve in Forearm and Hand

Regional Imaging • Plate 470

470 Shoulder MRI and CT Scan

Structures with High Clinical Significance • Tables 7.1-7.2

Muscle Tables • Tables 7.3-7.6

Electronic Bonus Plates • Plates BP99-BP106

BP99 Veins of Upper Limb
BP100 Arteries of Arm and Proximal Forearm
BP101 Arteries of Forearm and Hand
BP102 Ligaments of Wrist
BP103 Flexor and Extensor Zones of Hand
BP104 Section Through Metacarpal and Distal Carpal Bones
BP105 Cross Section of Hand: Axial View
BP106 Cross Section of Hand: Axial View (continued)

SECTION 8 LOWER LIMB • Plates 471-535

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471 Lower Limb: Surface Anatomy

Cutaneous Anatomy • Plates 472-475

472 Dermatomes of Lower Limb and Segmental Nerve Function
473 Superficial Nerves and Veins of Lower Limb: Anterior View
474 Superficial Nerves and Veins of Lower Limb: Posterior View
475 Lymph Vessels and Nodes of Lower Limb

Hip and Thigh • Plates 476-496

476 Coxal Bone
477 Hip Joint
478 Hip Joint: Anteroposterior Radiograph
479 Femur
480 Bony Attachments of Muscles of Hip and Thigh: Anterior View
481 Bony Attachments of Muscles of Hip and Thigh: Posterior View
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
488 Lumbar Plexus
489 Sacral and Coccygeal Plexuses
490 Arteries and Nerves of Thigh: Anterior Views
491 Arteries and Nerves of Thigh: Anterior Views (continued)
492 Arteries and Nerves of Thigh: Posterior View
493 Nerves of Hip and Buttock
494 Hip Bursae: Posterior and Anterolateral Views
495 Arteries of Femoral Head and Neck
496 Thigh: Serial Cross Sections

Knee • Plates 497-503

497 Knee: Medial and Lateral Views
498 Knee: Anterior Views
499 Knee: Interior Views
500 Knee: Cruciate and Collateral Ligaments
501 Knee: Anteroposterior Radiograph and Posterior View
502 Knee: Posterior and Sagittal Views
503 Arteries of Lower Limb: Schema

Leg • Plates 504-514

504 Tibia and Fibula
505 Tibia and Fibula (continued)
506 Attachments of Muscles of Leg
507 Muscles of Leg (Superficial Dissection): Posterior View
508 Muscles of Leg (Intermediate Dissection): Posterior View
509 Muscles of Leg (Deep Dissection): Posterior View
510 Muscles of Leg: Lateral View
511 Muscles of Leg (Superficial Dissection): Anterior View
512 Muscles of Leg (Deep Dissection): Anterior View
513 Venous Drainage of Leg
514 Leg: Cross Sections and Fascial Compartments

Ankle and Foot • Plates 515-528

515 Bones of Foot
516 Bones of Foot (continued)
517 Calcaneus
518 Ligaments and Tendons of Ankle
519 Ligaments and Tendons of Foot: Plantar View
520 Tendon Sheaths of Ankle
521 Muscles of Dorsum of Foot: Superficial Dissection
522 Dorsum of Foot: Deep Dissection
523 Plantar Region of Foot: Superficial Dissection
524 Muscles of Plantar Region of Foot: First Layer
525 Muscles of Plantar Region of Foot: Second Layer
526 Muscles of Plantar Region of Foot: Third Layer
527 Interosseous Muscles and Deep Arteries of Foot
528 Interosseous Muscles of Foot

Neurovasculature • Plates 529-533

529 Femoral Nerve and Lateral Femoral Cutaneous Nerve
530 Obturator Nerve
531 Sciatic Nerve and Posterior Femoral Cutaneous Nerve
532 Tibial Nerve
533 Common Fibular Nerve

Regional Imaging • Plates 534-535

534 Hip MRI and 3D CT
535 Ankle: Radiographs

Structures with High Clinical Significance • Tables 8.1-8.2

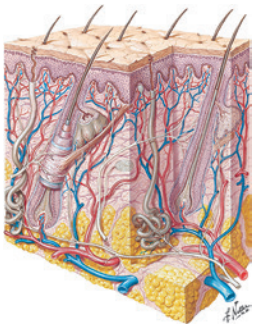
Muscle Tables • Tables 8.3-8.6

Electronic Bonus Plates • Plates BP107-BP117

BP107 Veins of Lower Limb
BP108 Arteries of Thigh and Knee
BP109 Cross-Sectional Anatomy of Hip: Axial View
BP110 Arteries of Knee and Foot
BP111 Leg: Serial Cross Sections
BP112 Osteology of Knee
BP113 Knee Radiograph: Lateral View
BP114 Anatomy of Foot: Nerves and Arteries
BP115 Cross-Sectional Anatomy of Ankle and Foot
BP116 Cross-Sectional Anatomy of Ankle and Foot (continued)
BP117 Anatomy of Toenail

INTRODUCTION 1

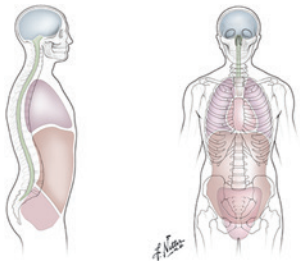
ELECTRONIC BONUS PLATES



BP 1 Cross Section of Skin



BP 2 Pilosebaceous Unit



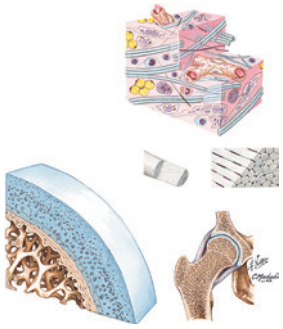
BP 3 Major Body Cavities



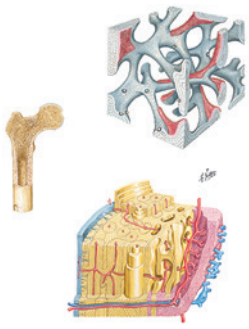
BP 4 Skeletal System: Axial and Appendicular Skeletons



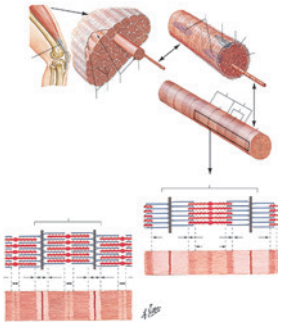
BP 5 Types of Synovial Joints



BP 6 Joints: Connective Tissues and Articular Cartilage

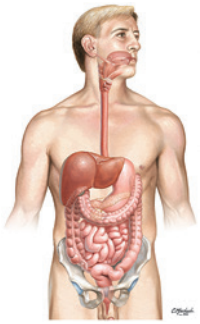


BP 7 Architecture of Bone

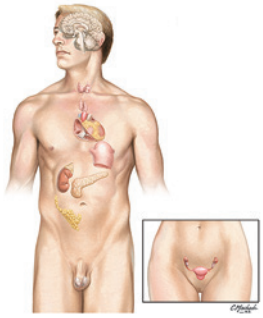


BP 8 Muscular System

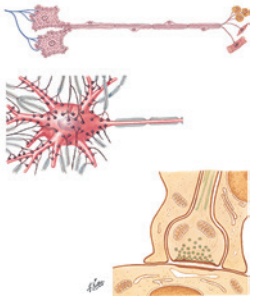
ELECTRONIC BONUS PLATES—*cont'd*



BP 9 Overview of the Gastrointestinal System



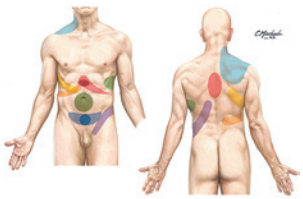
BP 10 Overview of the Endocrine System



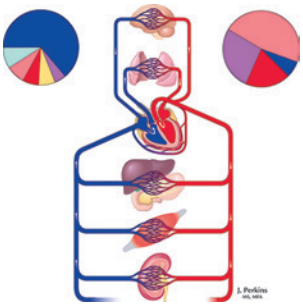
BP 11 Neurons and Synapses



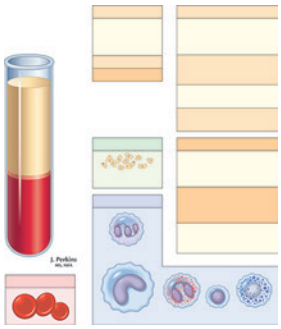
BP 12 Features of a Typical Peripheral Nerve



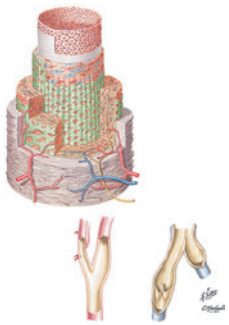
BP 13 Sites of Visceral Referred Pain



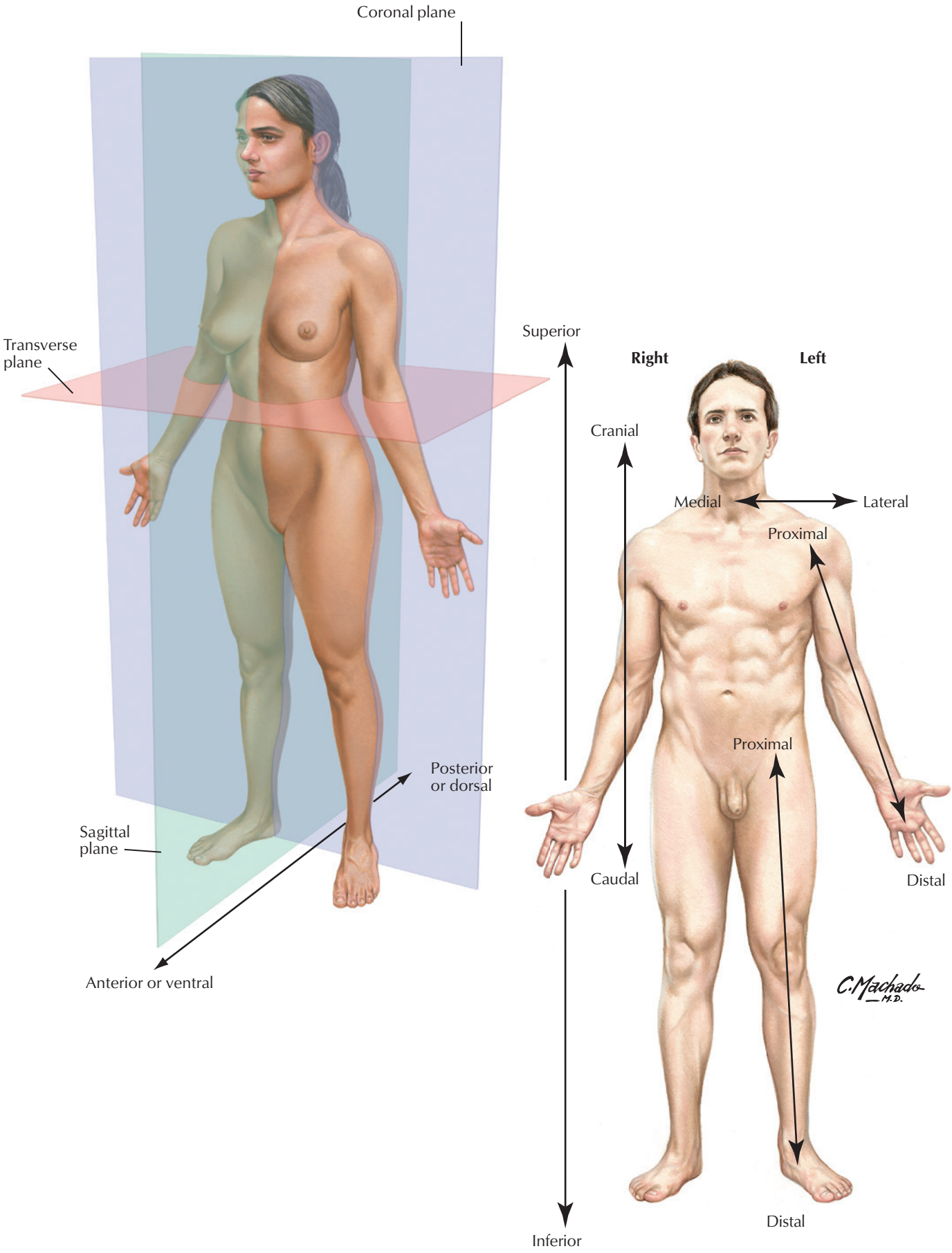
BP 14 General Organization of the Cardiovascular System

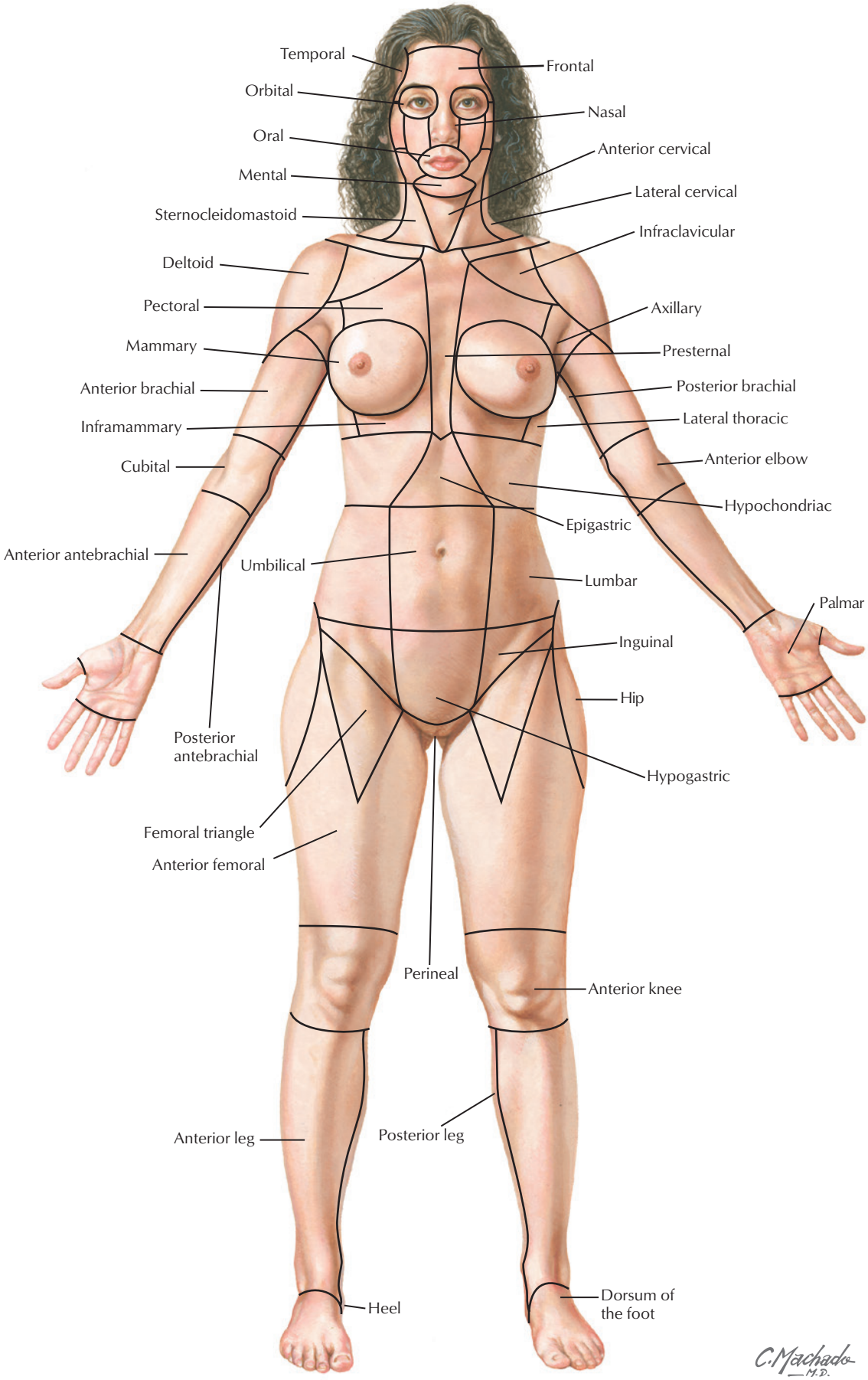


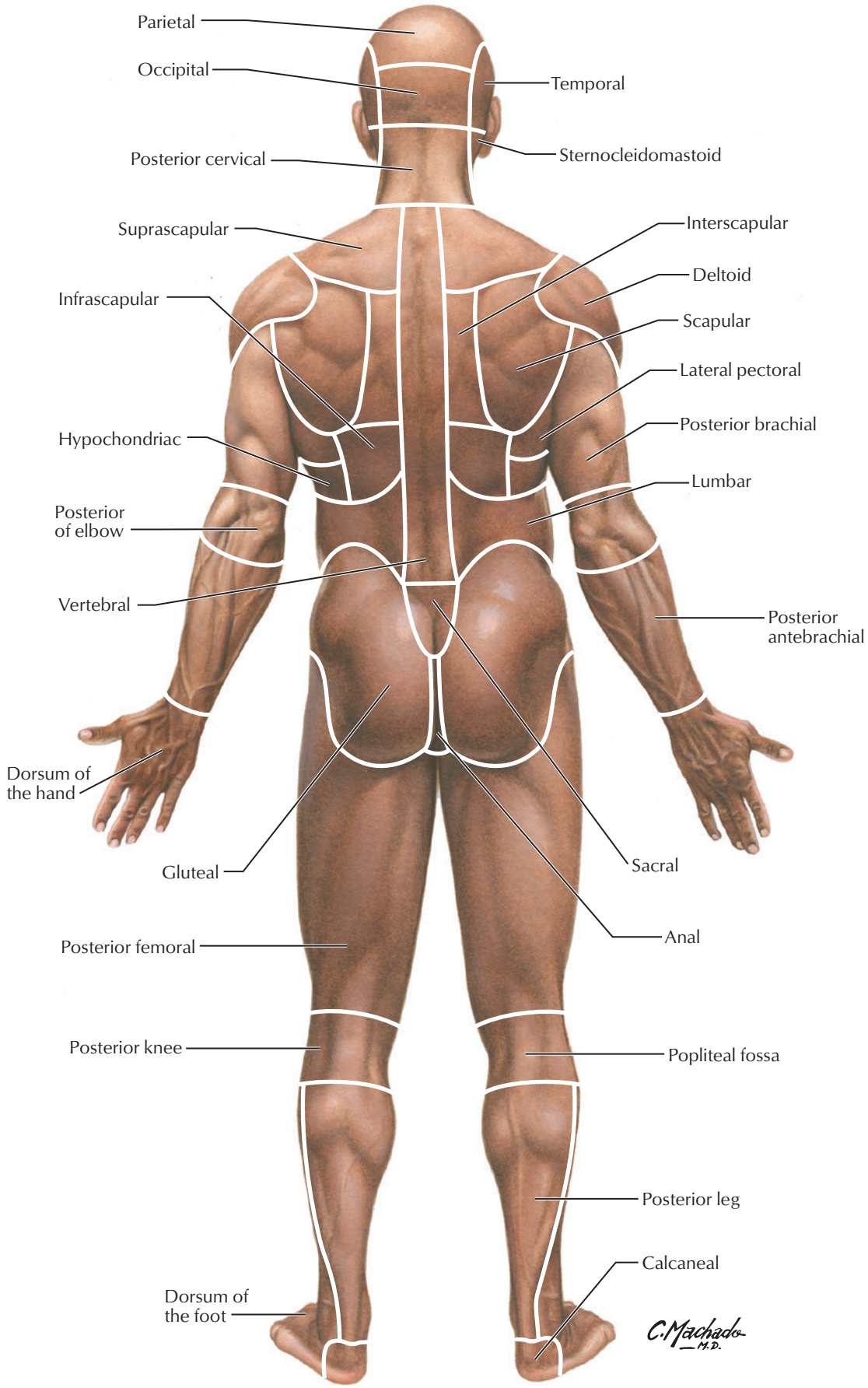
BP 15 Cardiovascular System: Composition of Blood

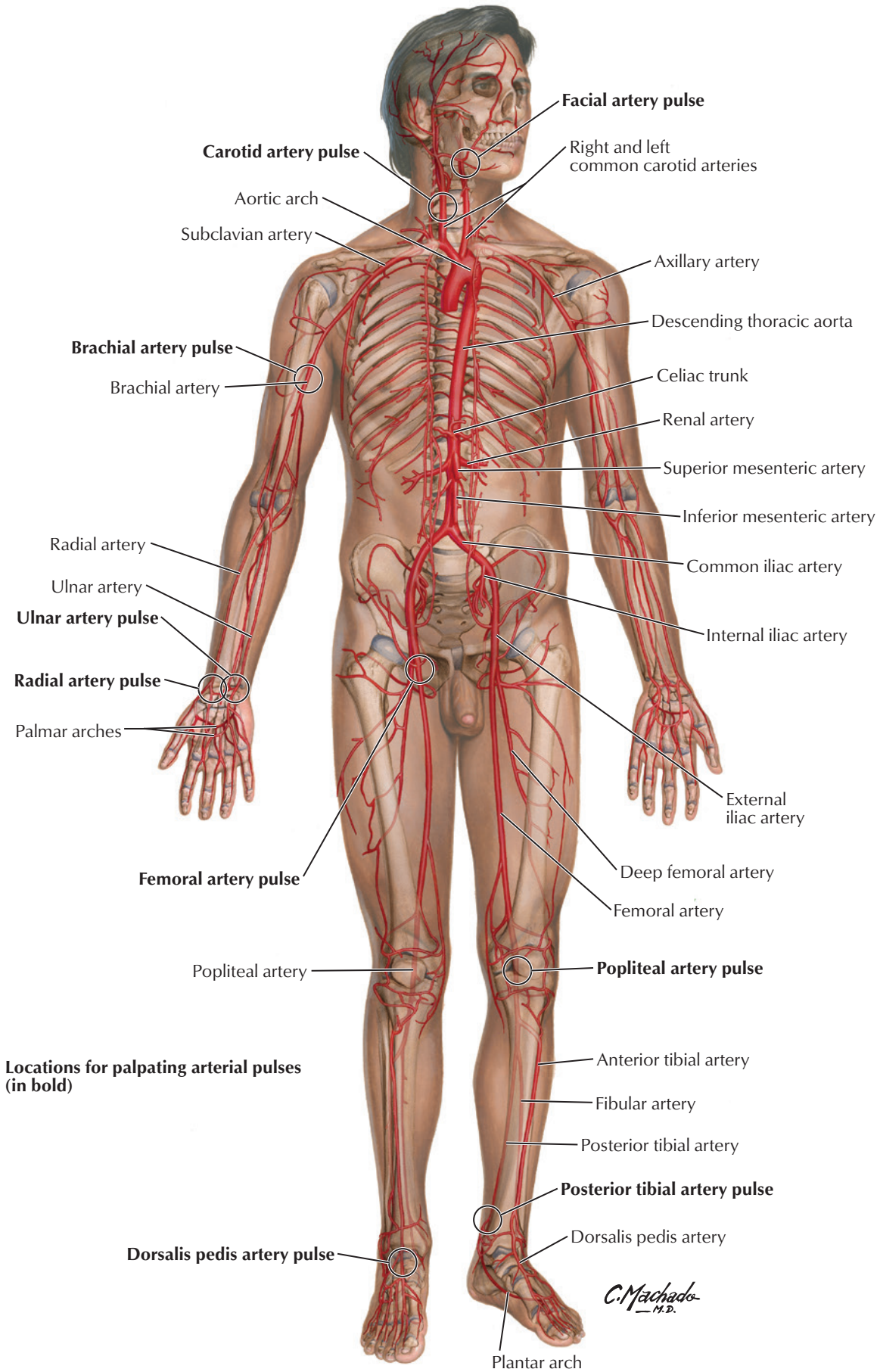


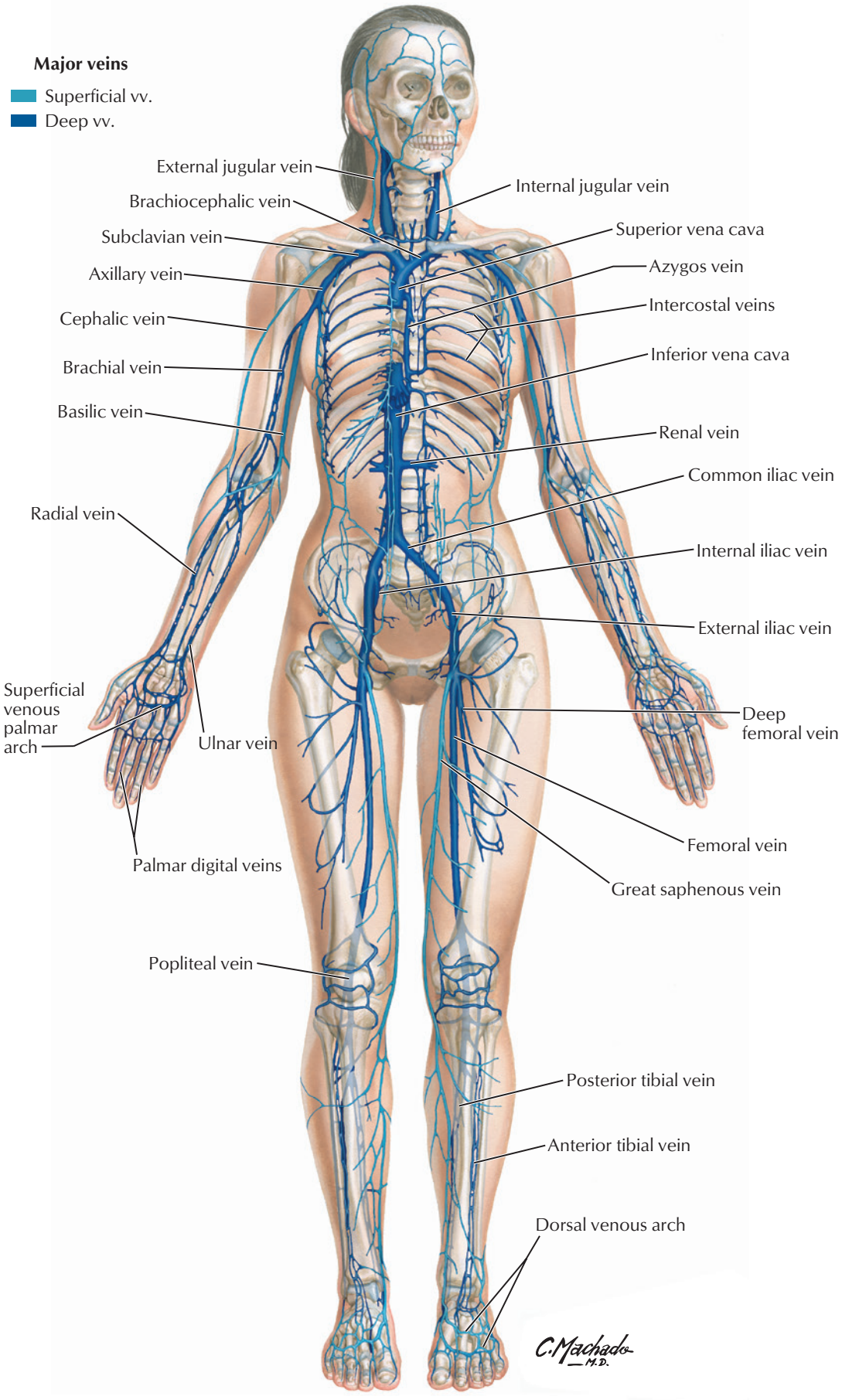
BP 16 Arterial Wall

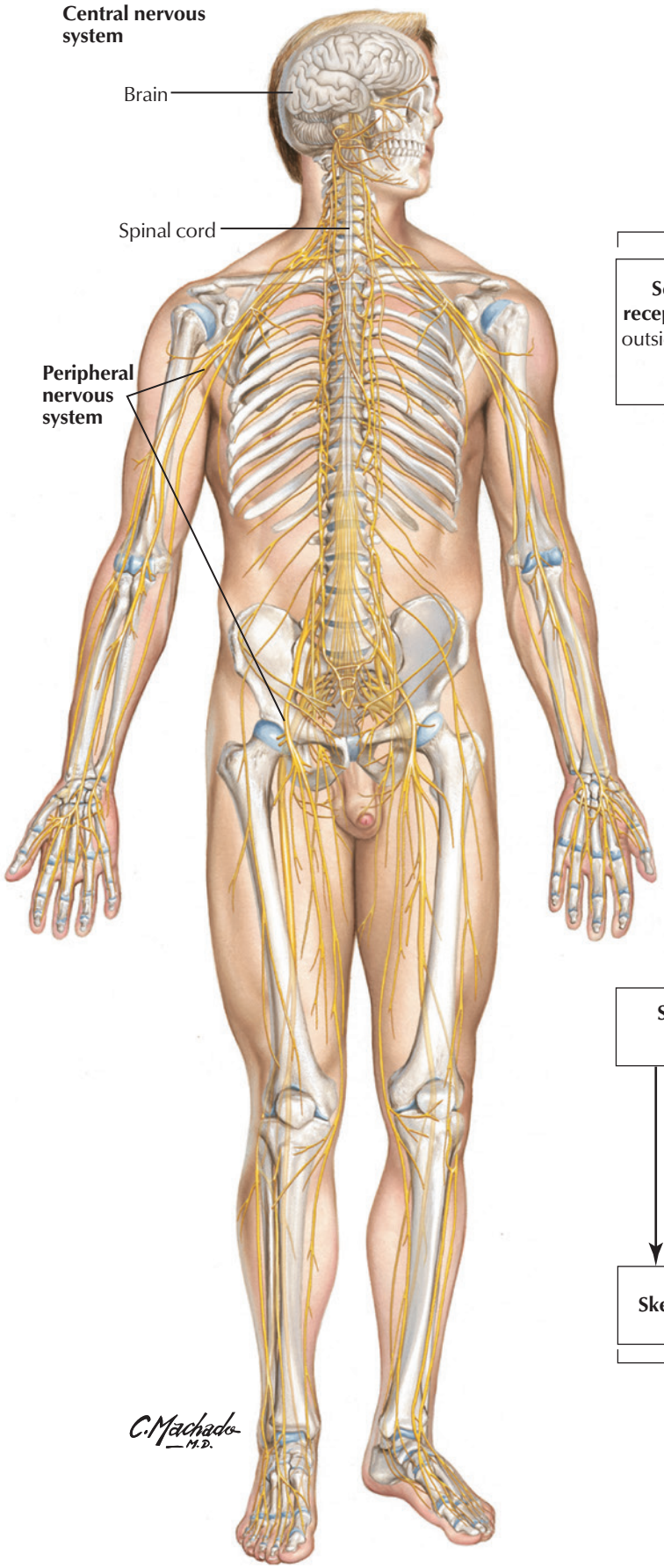

Coronal plane
Transverse plane
Sagittal plane
Posterior or dorsal
Anterior or ventral
Superior
Inferior
Right
Left
Cranial
Caudal
Medial
Lateral
Proximal
Distal
Proximal
Distal
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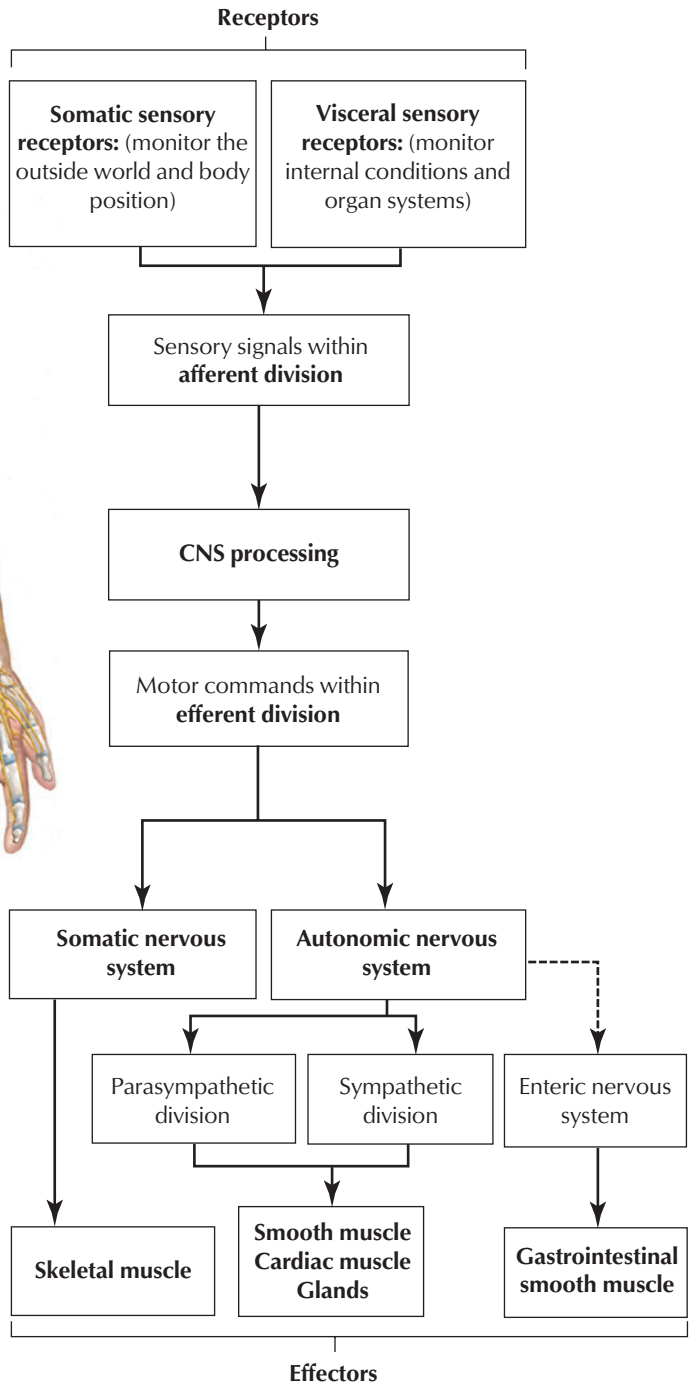

Temporal
Frontal
Orbital
Nasal
Oral
Anterior cervical
Mental
Lateral cervical
Sternocleidomastoid
Infraclavicular
Deltoid
Pectoral
Axillary
Mammary
Presternal
Anterior brachial
Posterior brachial
Inframammary
Lateral thoracic
Cubital
Anterior elbow
Hypochondriac
Epigastric
Anterior antebrachial
Umbilical
Lumbar
Palmar
Inguinal
Hip
Posterior antebrachial
Hypogastric
Femoral triangle
Anterior femoral
Perineal
Anterior knee
Anterior leg
Posterior leg
Heel
Dorsum of the foot
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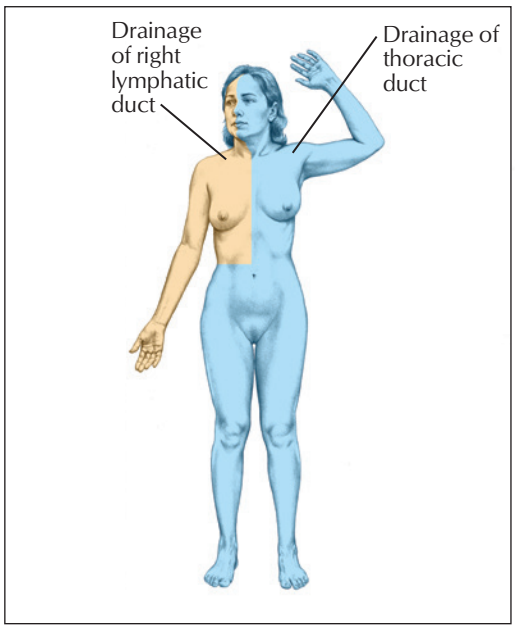

Parietal
Occipital
Temporal
Posterior cervical
Sternocleidomastoid
Suprascapular
Interscapular
Deltoid
Infrascapular
Scapular
Lateral pectoral
Posterior brachial
Hypochondriac
Lumbar
Posterior of elbow
Vertebral
Posterior antebrachial
Dorsum of the hand
Gluteal
Sacral
Anal
Posterior femoral
Posterior knee
Popliteal fossa
Posterior leg
Calcaneal
Dorsum of the foot
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Facial artery pulse
Carotid artery pulse
Right and left common carotid arteries
Aortic arch
Subclavian artery
Axillary artery
Descending thoracic aorta
Brachial artery pulse
Brachial artery
Celiac trunk
Renal artery
Superior mesenteric artery
Inferior mesenteric artery
Radial artery
Common iliac artery
Ulnar artery
Ulnar artery pulse
Internal iliac artery
Radial artery pulse
Palmar arches
External iliac artery
Deep femoral artery
Femoral artery pulse
Femoral artery
Popliteal artery
Popliteal artery pulse
Locations for palpating arterial pulses (in bold)
Anterior tibial artery
Fibular artery
Posterior tibial artery
Posterior tibial artery pulse
Dorsalis pedis artery
Dorsalis pedis artery pulse
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Plantar arch

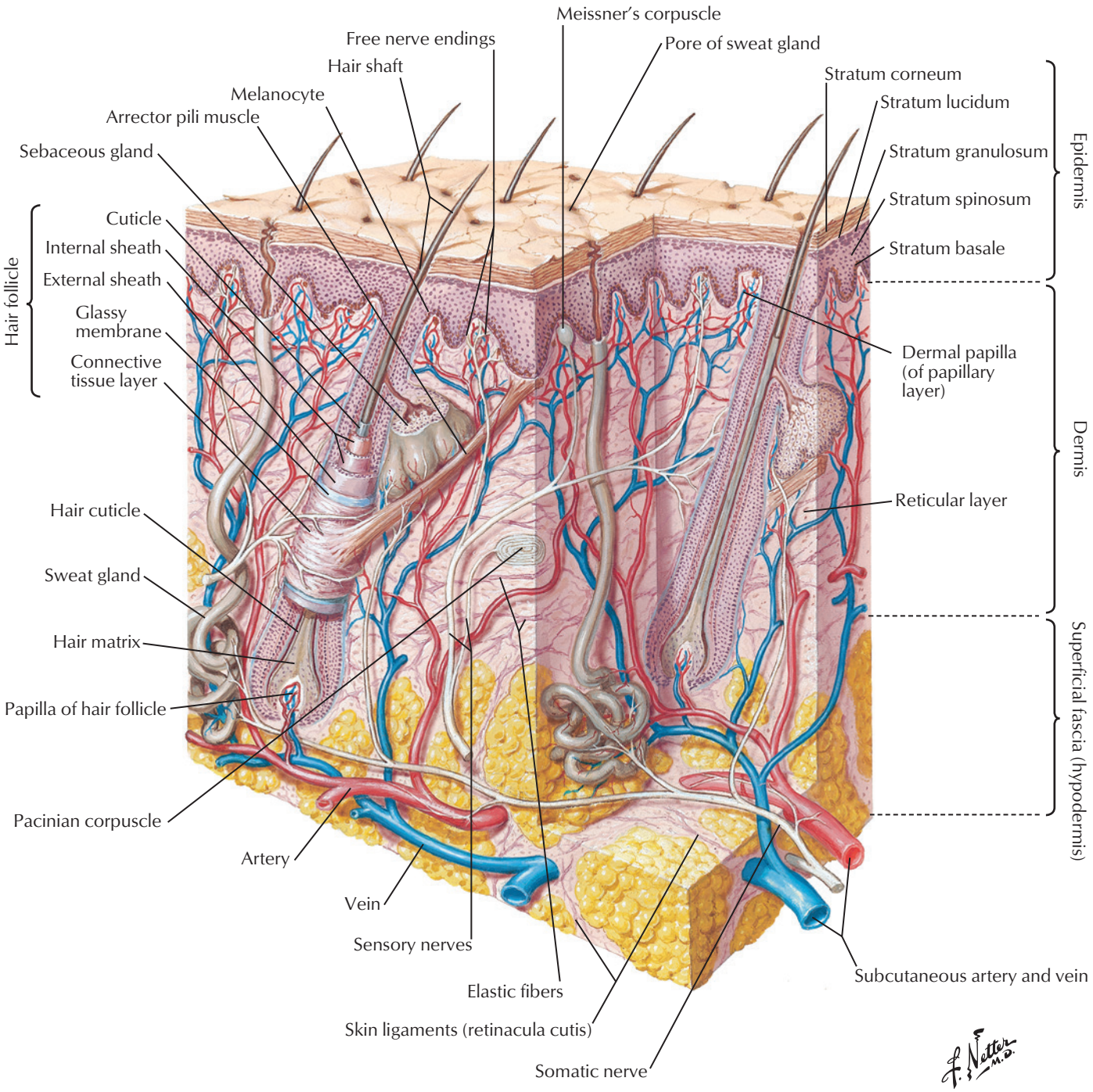

Major veins
Superficial vv.
Deep vv.
External jugular vein
Internal jugular vein
Brachiocephalic vein
Subclavian vein
Superior vena cava
Axillary vein
Azygos vein
Cephalic vein
Intercostal veins
Brachial vein
Inferior vena cava
Basilic vein
Renal vein
Common iliac vein
Radial vein
Internal iliac vein
External iliac vein
Superficial venous palmar arch
Ulnar vein
Deep femoral vein
Palmar digital veins
Femoral vein
Great saphenous vein
Popliteal vein
Posterior tibial vein
Anterior tibial vein
Dorsal venous arch
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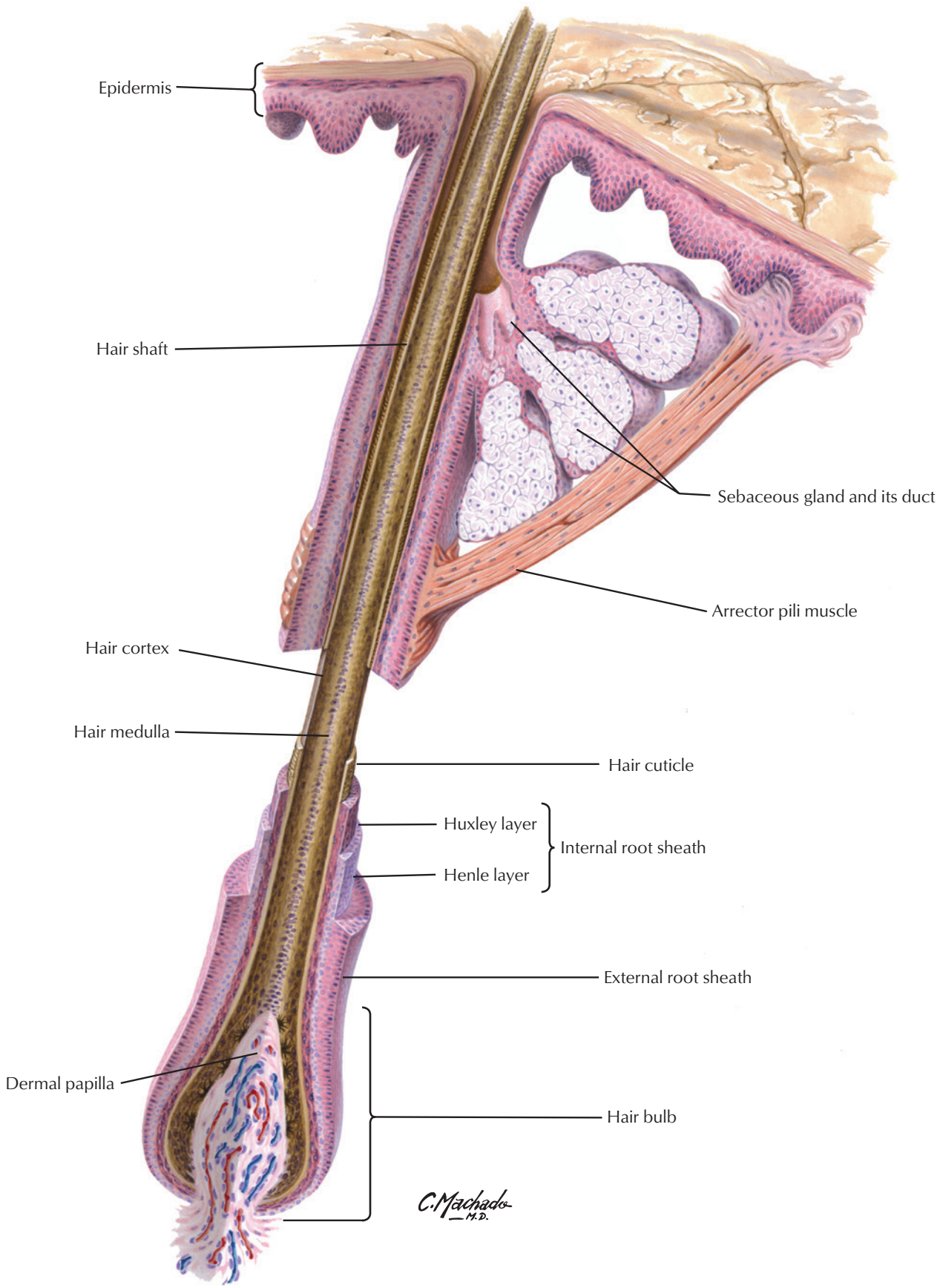

Central nervous system
Brain
Spinal cord
Peripheral nervous system
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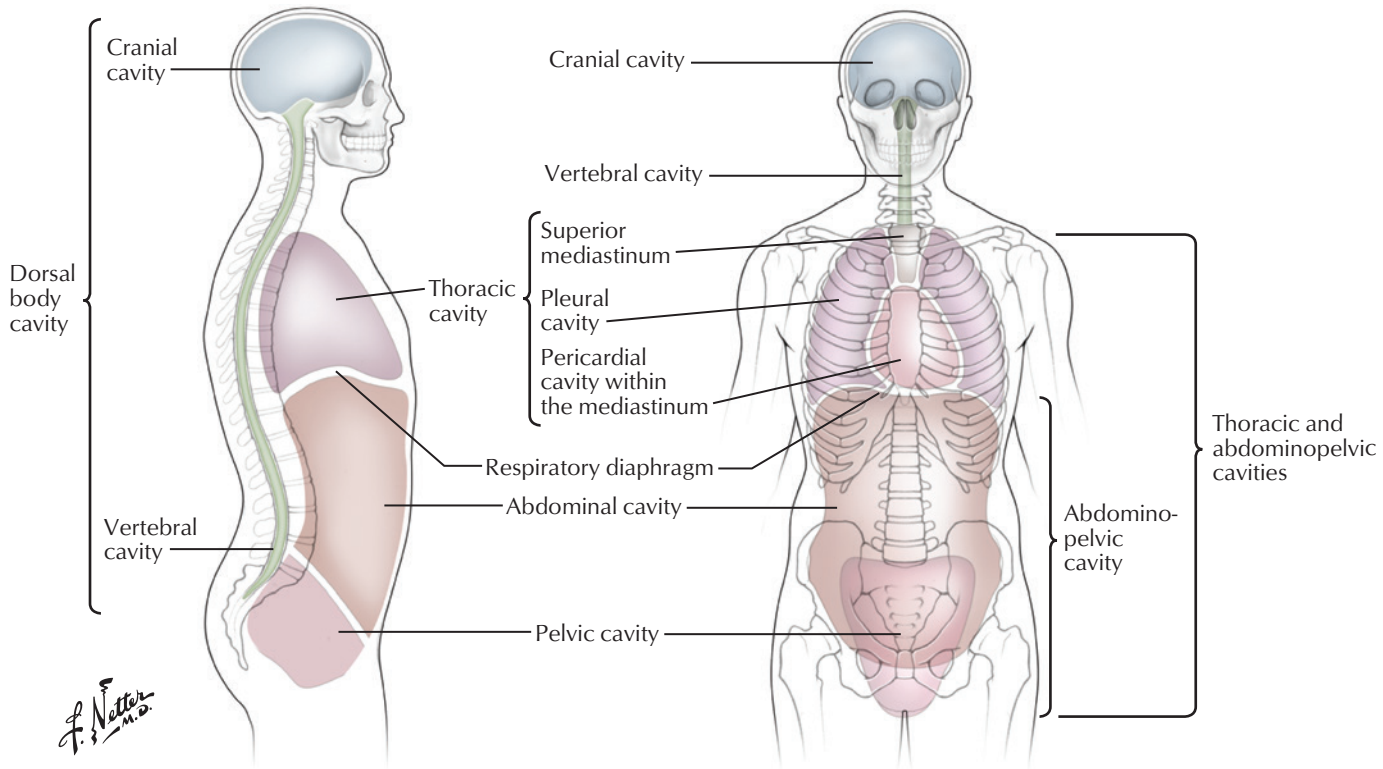

Receptors
Somatic sensory receptors: (monitor the outside world and body position)
Visceral sensory receptors: (monitor internal conditions and organ systems)
Sensory signals within afferent division
CNS processing
Motor commands within efferent division
Somatic nervous system
Autonomic nervous system
Parasympathetic division
Sympathetic division
Enteric nervous system
Skeletal muscle
Smooth muscle
Cardiac muscle
Glands
Gastrointestinal smooth muscle
Effectors

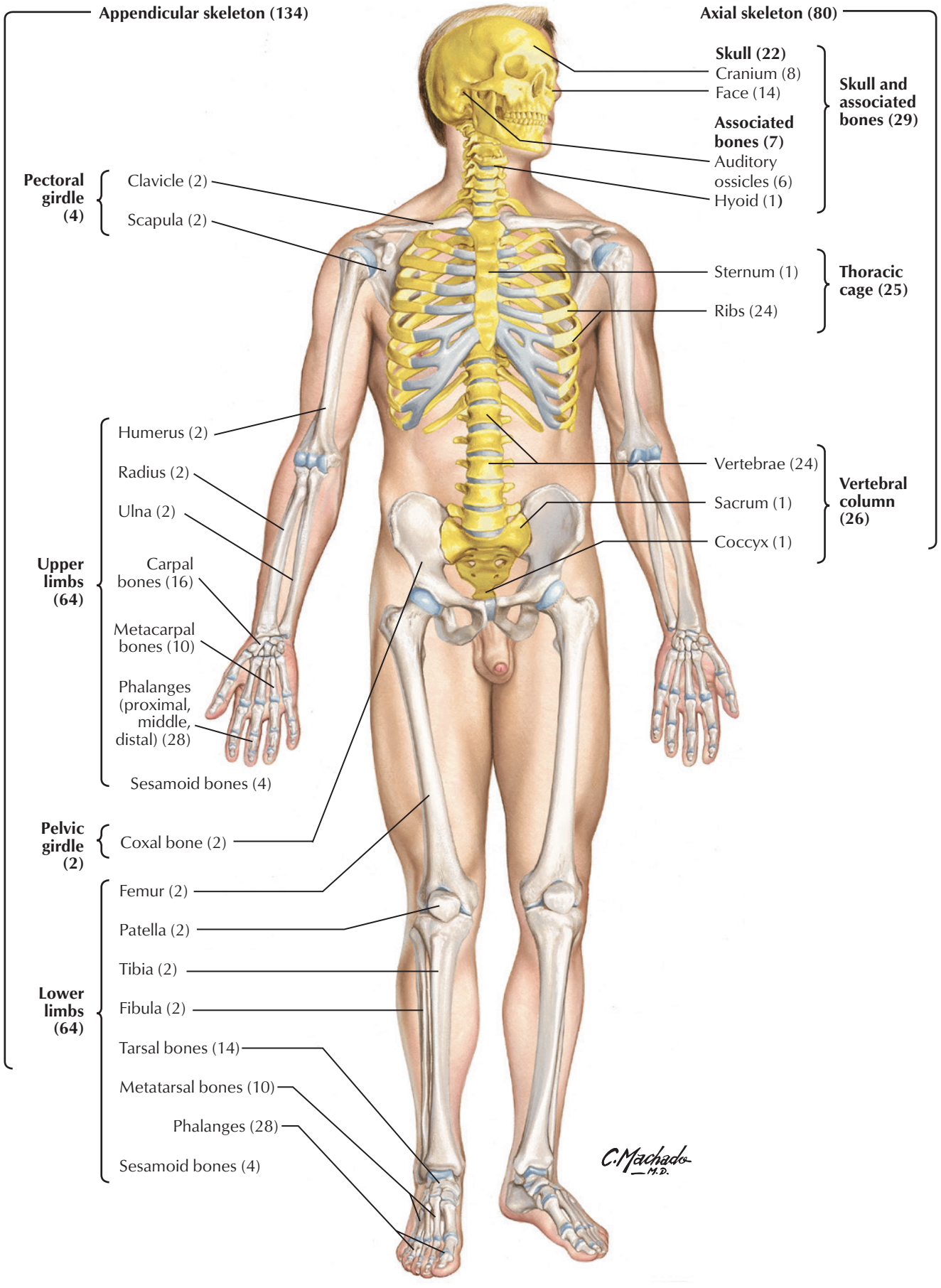


Lymphatics of upper limb
Tonsils
Cervical lymph nodes
Thoracic duct
Right lymphatic duct
Thymus gland
Mediastinal lymph nodes
Thoracic duct
Axillary lymph nodes
Lymph vessels of mammary gland
Cisterna chyli
Spleen
Lumbar lymph nodes
Lymphoid nodules of intestine
Iliac lymph nodes
Inguinal lymph nodes
Bone marrow
Lymphatics of lower limb
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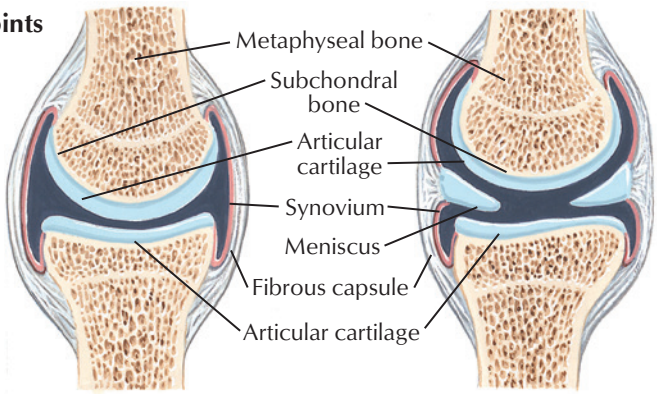

Meissner's corpuscle
Free nerve endings
Pore of sweat gland
Hair shaft
Stratum corneum
Melanocyte
Stratum lucidum
Arrector pili muscle
Stratum granulosum
Sebaceous gland
Stratum spinosum
Cuticle
Stratum basale
Internal sheath
External sheath
Glassy membrane
Connective tissue layer
Hair follicle
Epidermis
Dermal papilla (of papillary layer)
Dermis
Hair cuticle
Reticular layer
Sweat gland
Hair matrix
Superficial fascia (hypodermis)
Papilla of hair follicle
Pacinian corpuscle
Artery
Vein
Sensory nerves
Elastic fibers
Subcutaneous artery and vein
Skin ligaments (retinacula cutis)
Somatic nerve
F. Netter M.D.

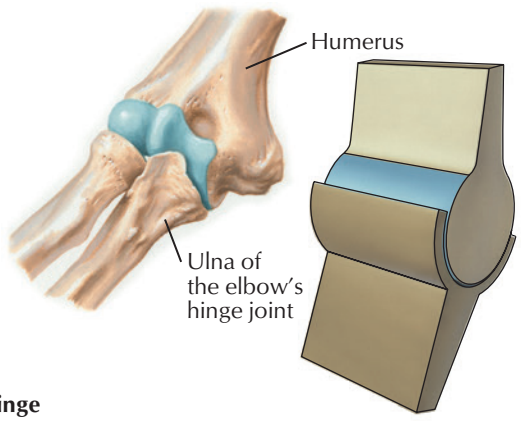

Epidermis
Hair shaft
Sebaceous gland and its duct
Arrector pili muscle
Hair cortex
Hair medulla
Hair cuticle
Huxley layer
Henle layer
Internal root sheath
External root sheath
Dermal papilla
Hair bulb
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Cranial cavity
Dorsal body cavity
Thoracic cavity
Vertebral cavity
Cranial cavity
Vertebral cavity
Superior mediastinum
Pleural cavity
Pericardial cavity within the mediastinum
Respiratory diaphragm
Abdominal cavity
Pelvic cavity
Abdomino-pelvic cavity
Thoracic and abdominopelvic cavities

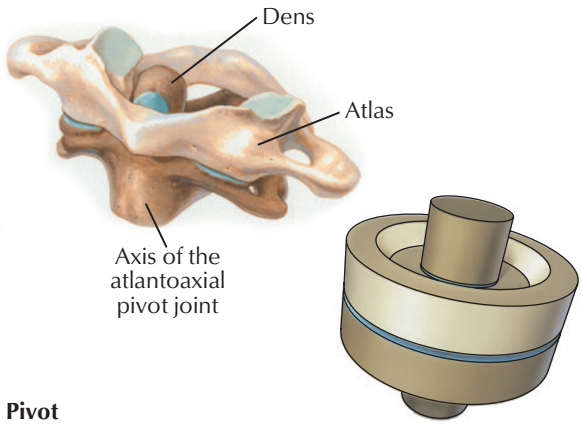

Appendicular skeleton (134)
Axial skeleton (80)
Skull (22)
Cranium (8)
Face (14)
Associated bones (7)
Auditory ossicles (6)
Hyoid (1)
Skull and associated bones (29)
Pectoral girdle (4)
Clavicle (2)
Scapula (2)
Sternum (1)
Ribs (24)
Thoracic cage (25)
Humerus (2)
Radius (2)
Ulna (2)
Carpal bones (16)
Metacarpal bones (10)
Phalanges (proximal, middle, distal) (28)
Sesamoid bones (4)
Upper limbs (64)
Vertebrae (24)
Sacrum (1)
Coccyx (1)
Vertebral column (26)
Pelvic girdle (2)
Coxal bone (2)
Femur (2)
Patella (2)
Tibia (2)
Fibula (2)
Tarsal bones (14)
Metatarsal bones (10)
Phalanges (28)
Sesamoid bones (4)
Lower limbs (64)
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Structure of synovial joints

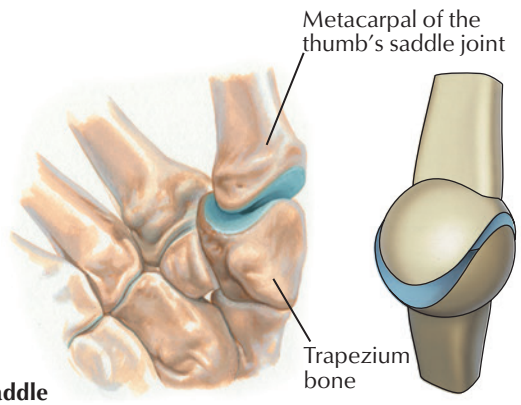




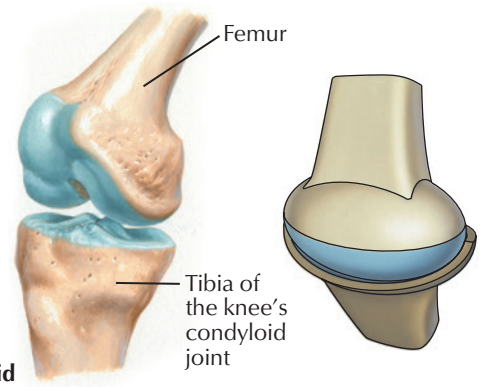
A. Hinge



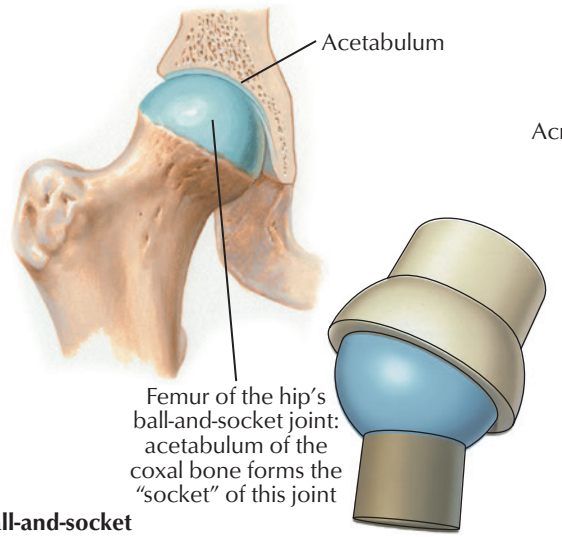
B. Pivot



C. Saddle

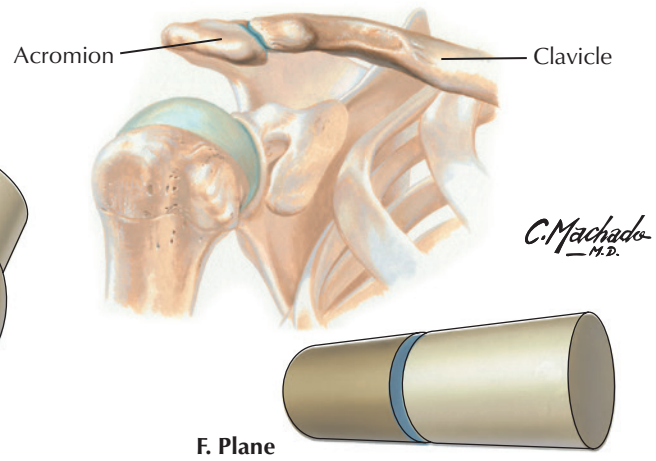


D. Condyloid

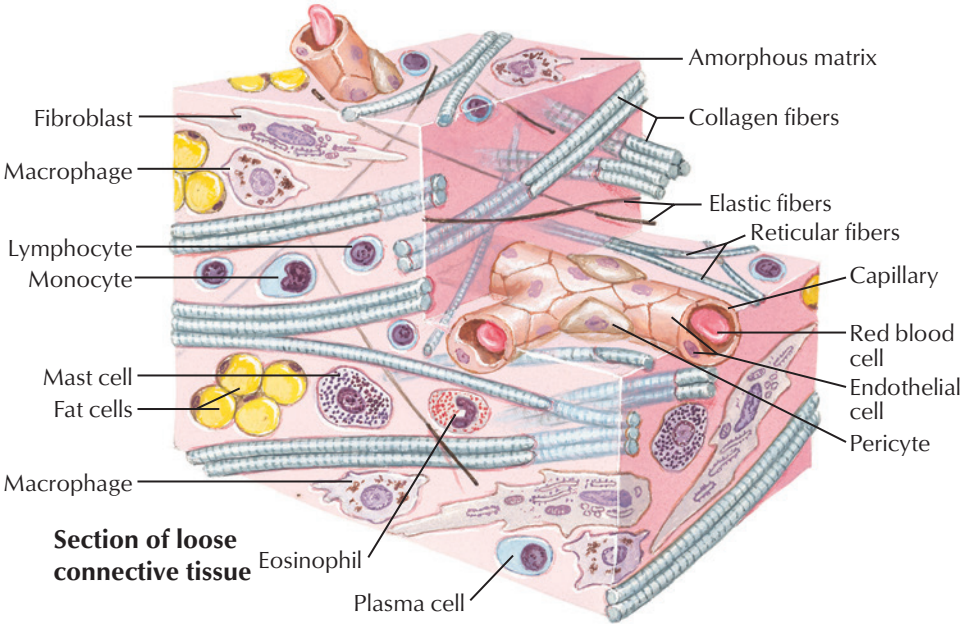


E. Ball-and-socket

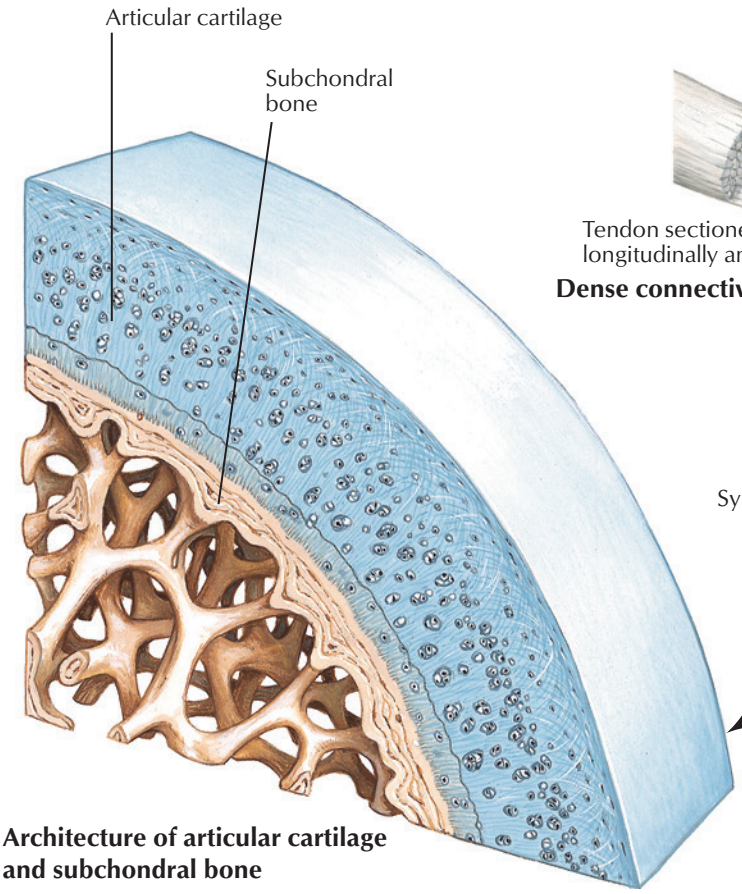
Acromioclavicular plane joint at the shoulder: plane joint between the acromion of the scapula and clavicle



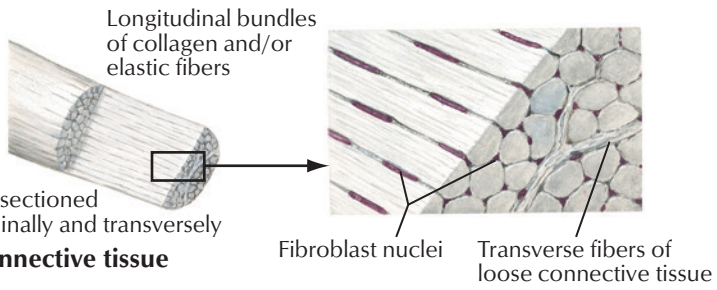
F. Plane



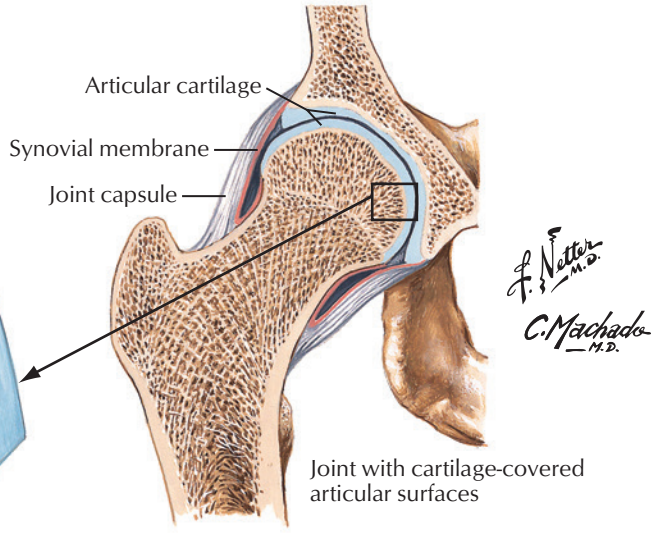
Section of loose connective tissue



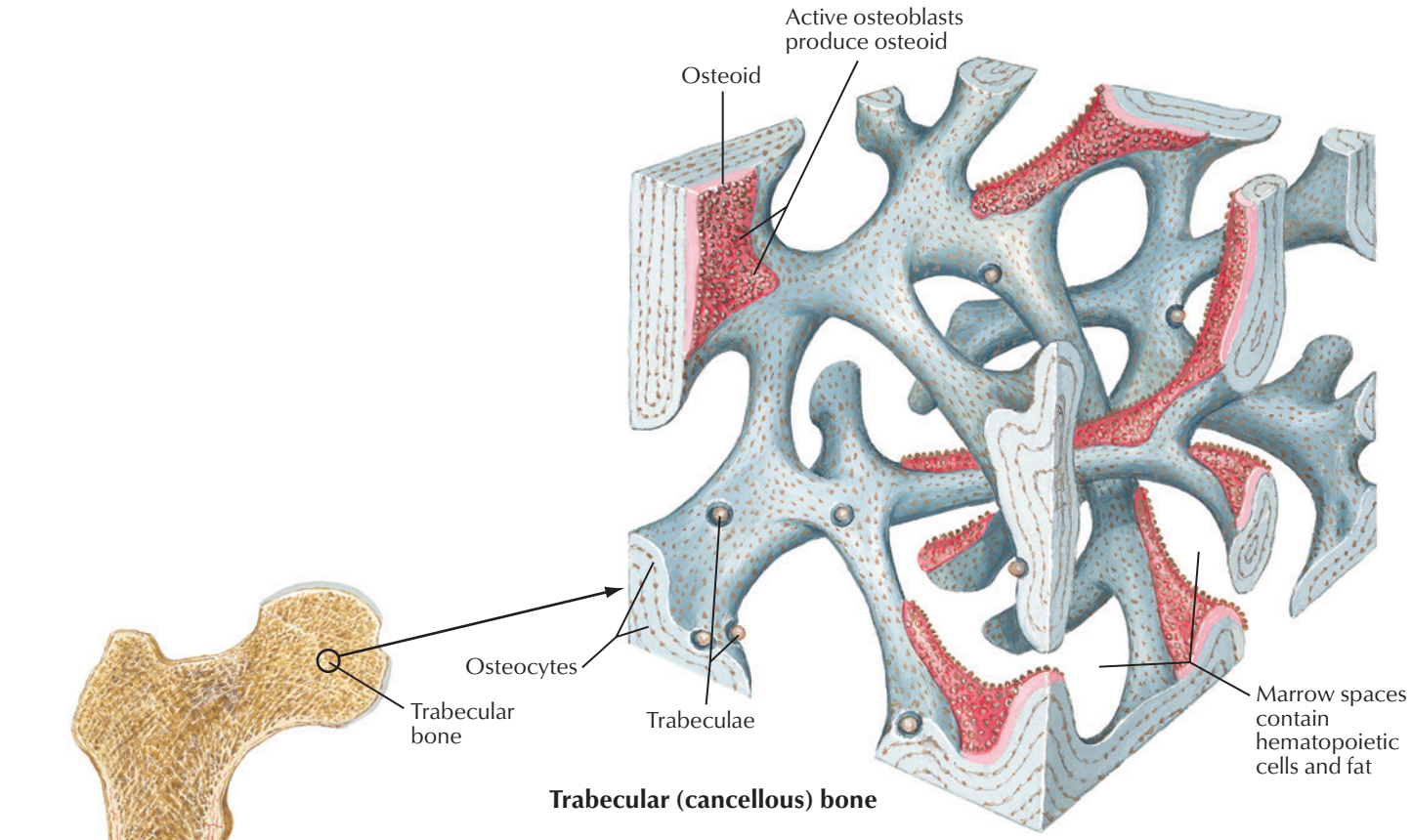
Architecture of articular cartilage and subchondral bone



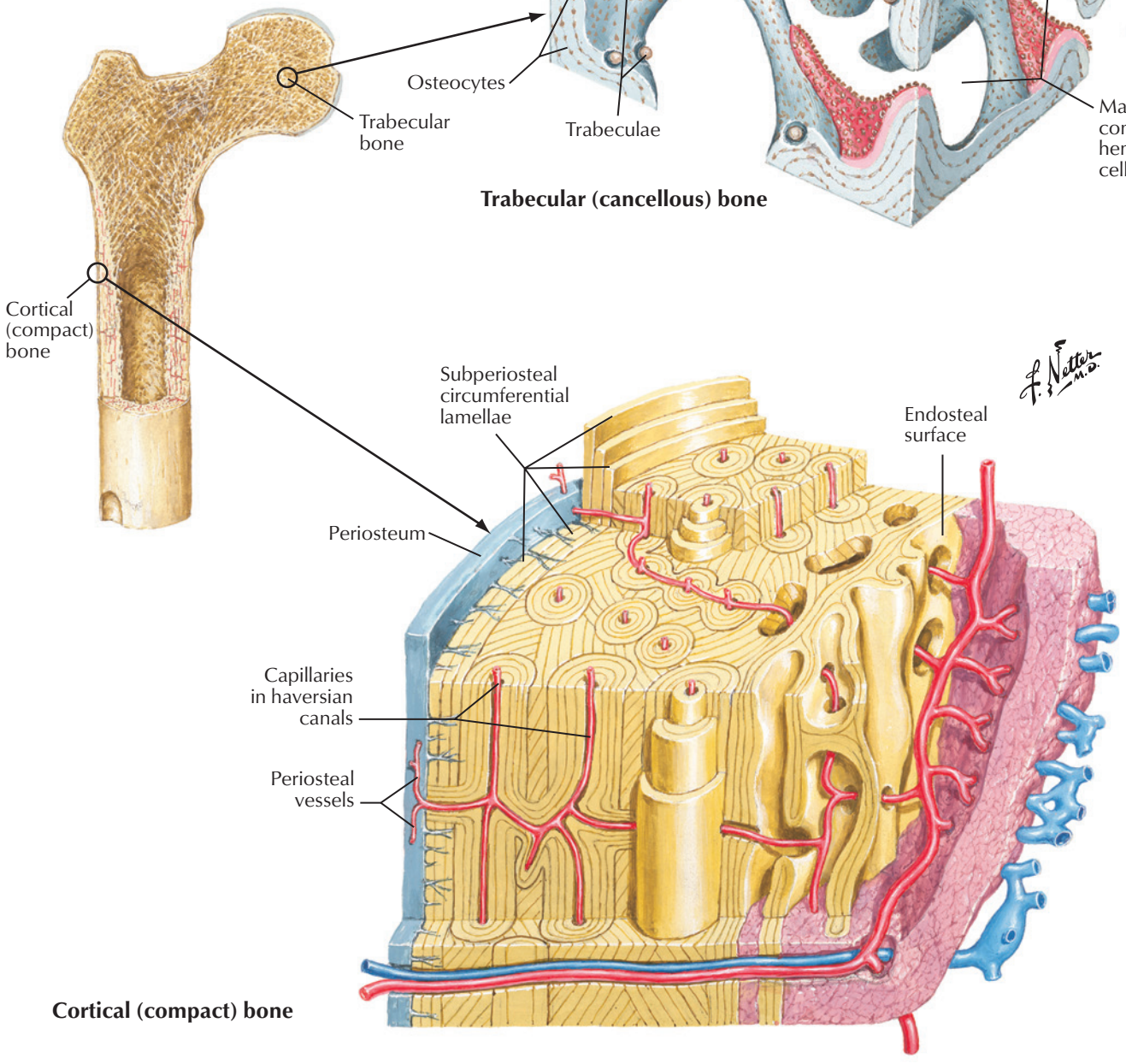
Dense connective tissue



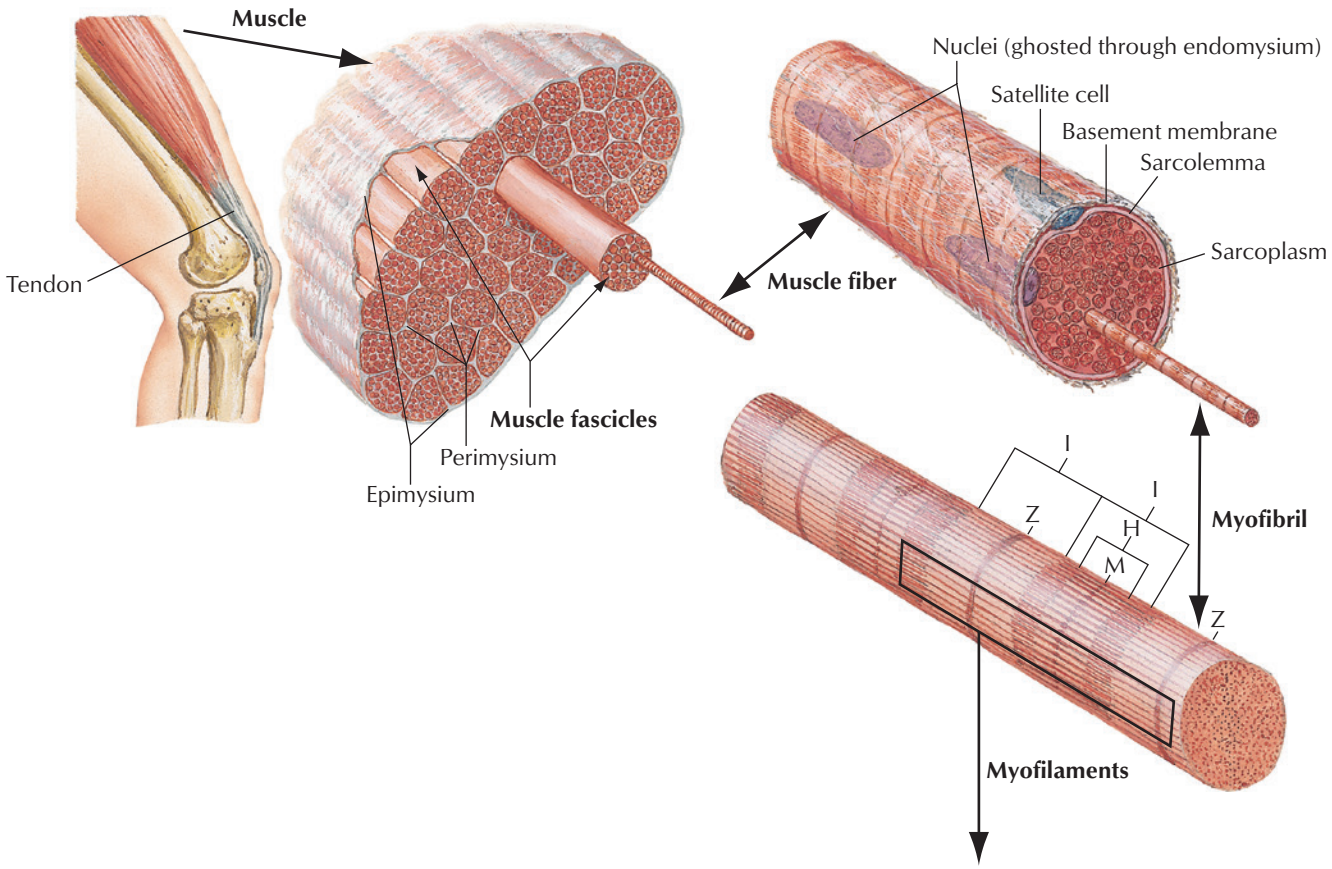
Hip joint and articular surface

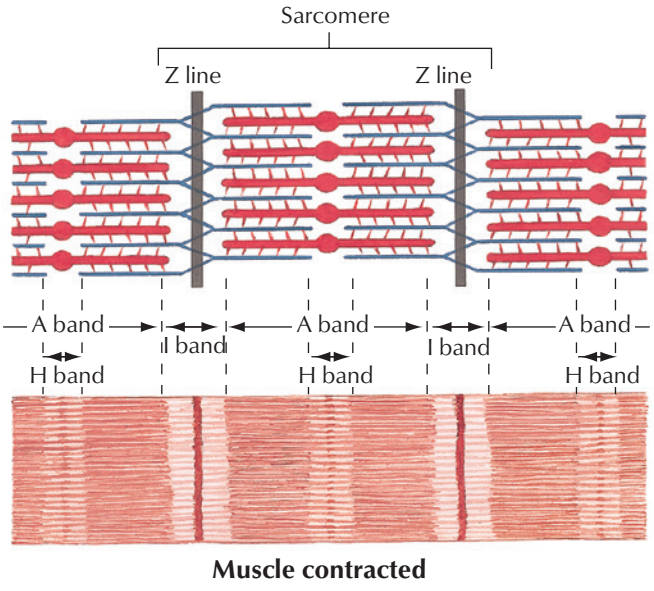


Trabecular (cancellous) bone

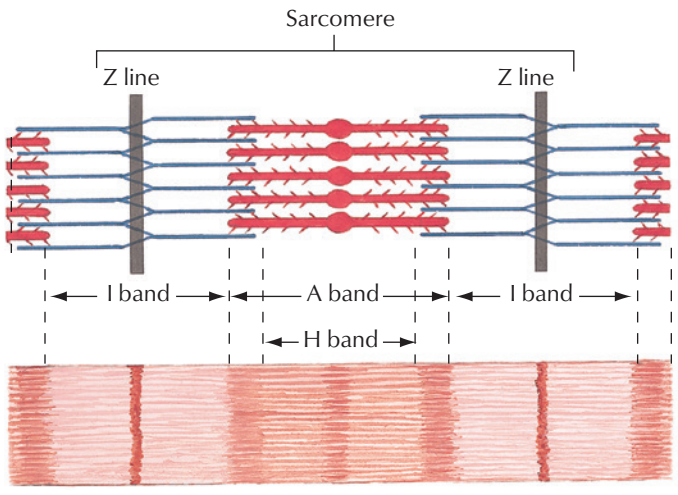


Cortical (compact) bone

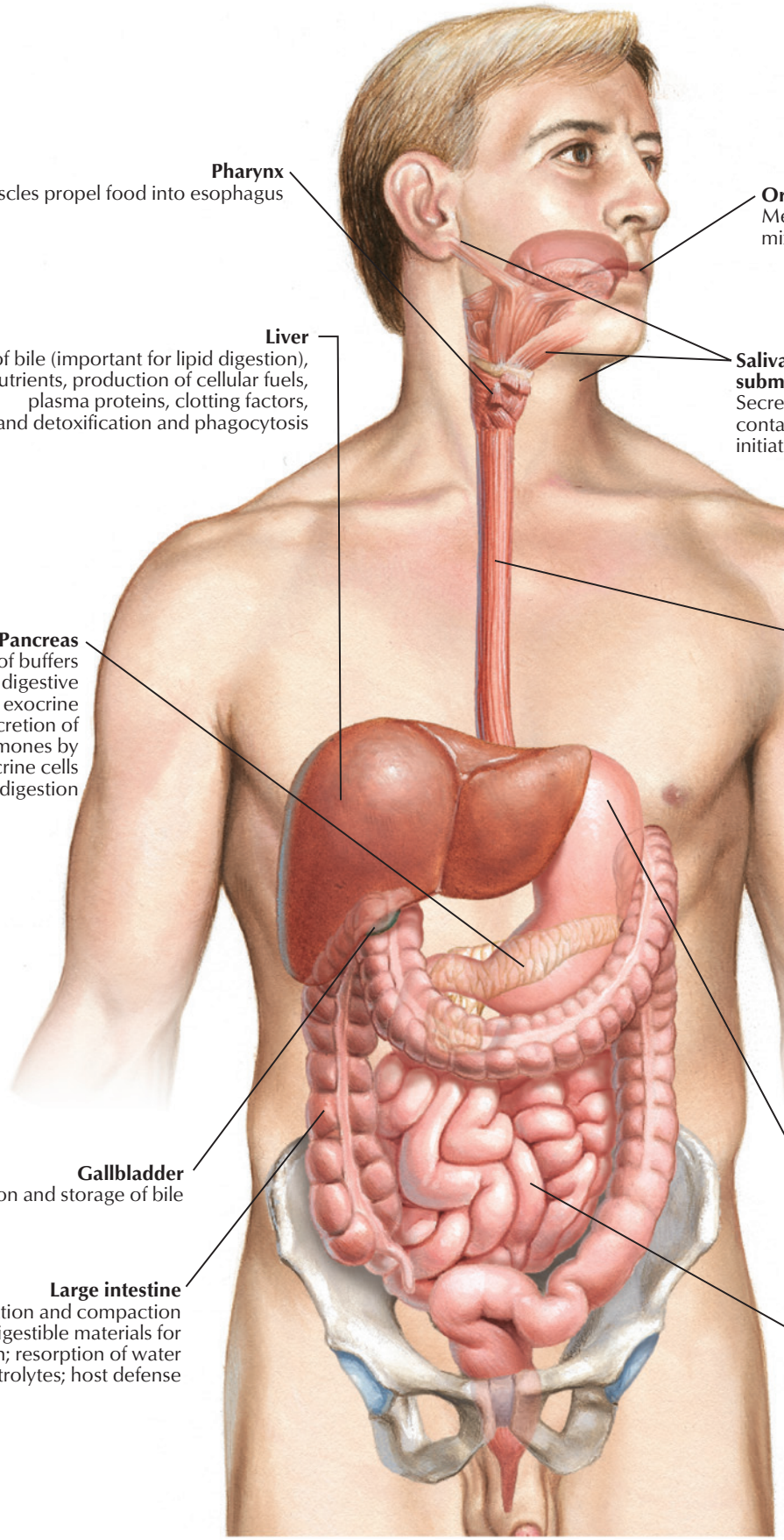




Muscle contracted



Muscle relaxed



Pharynx
Pharyngeal muscles propel food into esophagus

Oral cavity, teeth, tongue
Mechanical breakdown, mixing with saliva

Liver
Secretion of bile (important for lipid digestion), storage of nutrients, production of cellular fuels, plasma proteins, clotting factors, and detoxification and phagocytosis

Salivary glands (lingual, submandibular, parotid)
Secretion of lubricating fluid containing enzymes that initiate digestion

Pancreas
Secretion of buffers and digestive enzymes by exocrine cells; secretion of hormones by endocrine cells to regulate digestion

Esophagus
Transport of food into the stomach

Gallbladder
Concentration and storage of bile

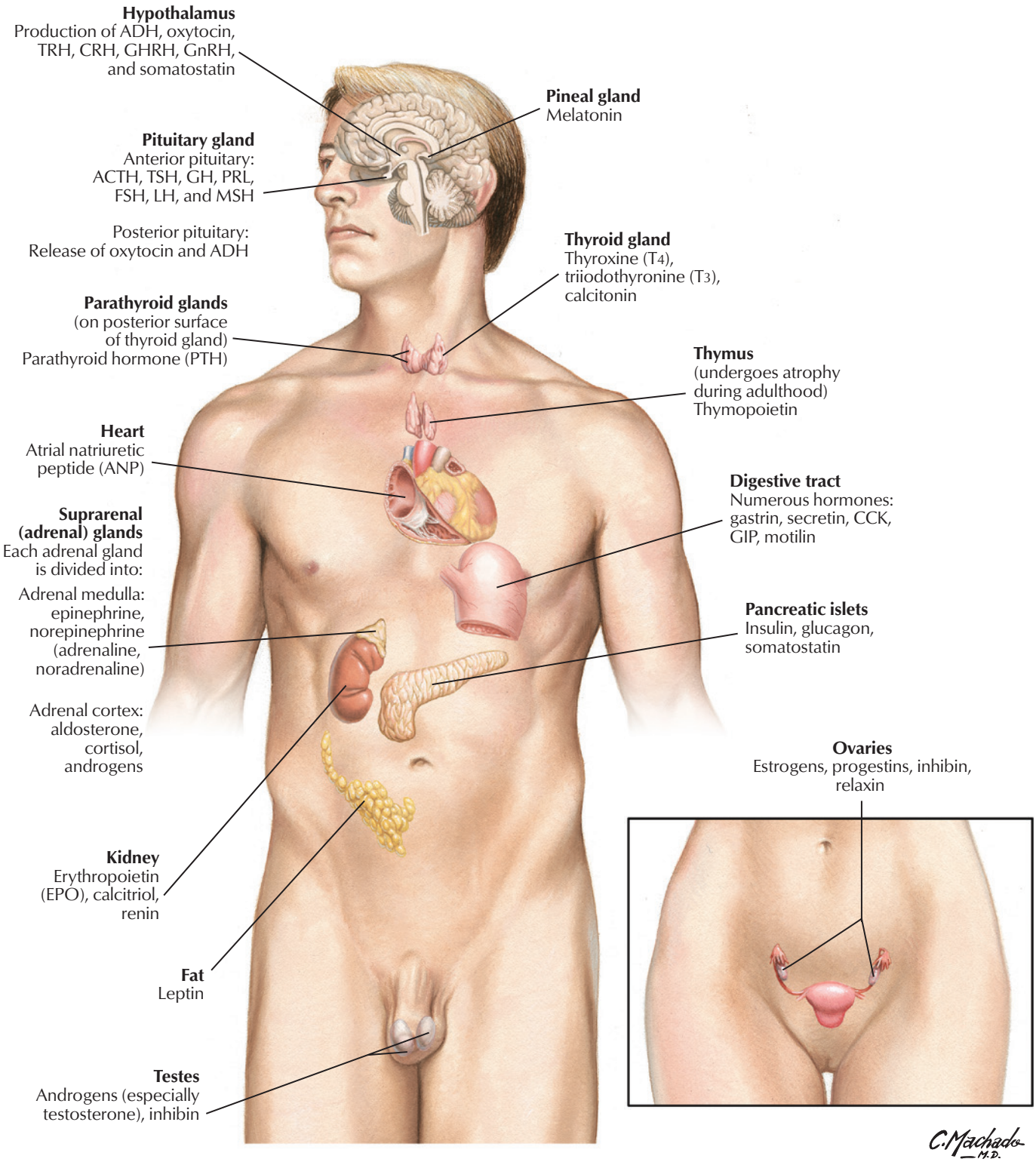
Stomach
Chemical breakdown of food by acid and enzymes; mechanical breakdown via muscular contractions; absorption of water, alcohol, and some minerals

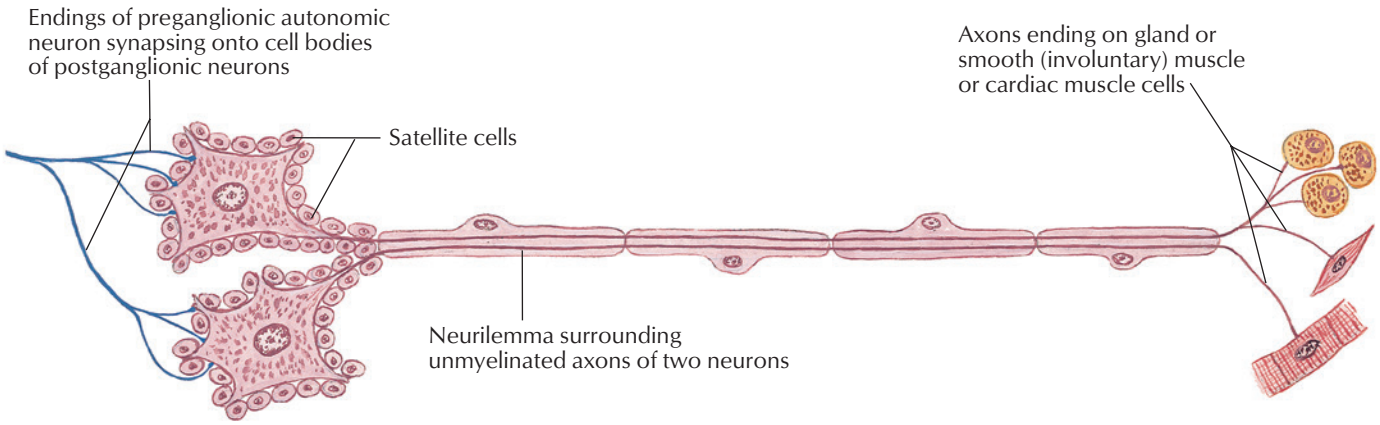
Large intestine
Dehydration and compaction of indigestible materials for elimination; resorption of water and electrolytes; host defense

Small intestine
Enzymatic digestion and absorption of water, organic substrates, vitamins, and ions; host defense

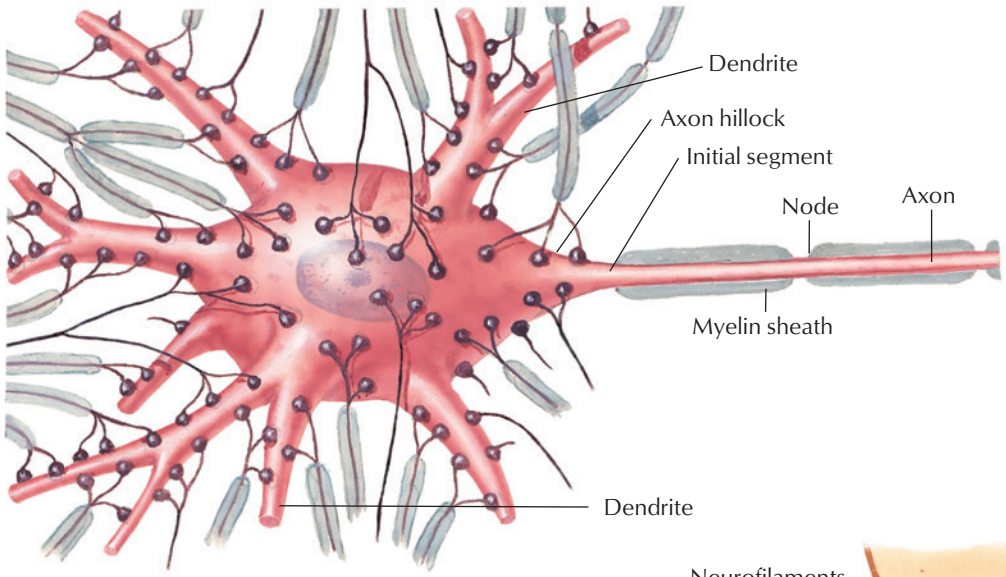
C. Machado M.D.

Overview of the Endocrine System



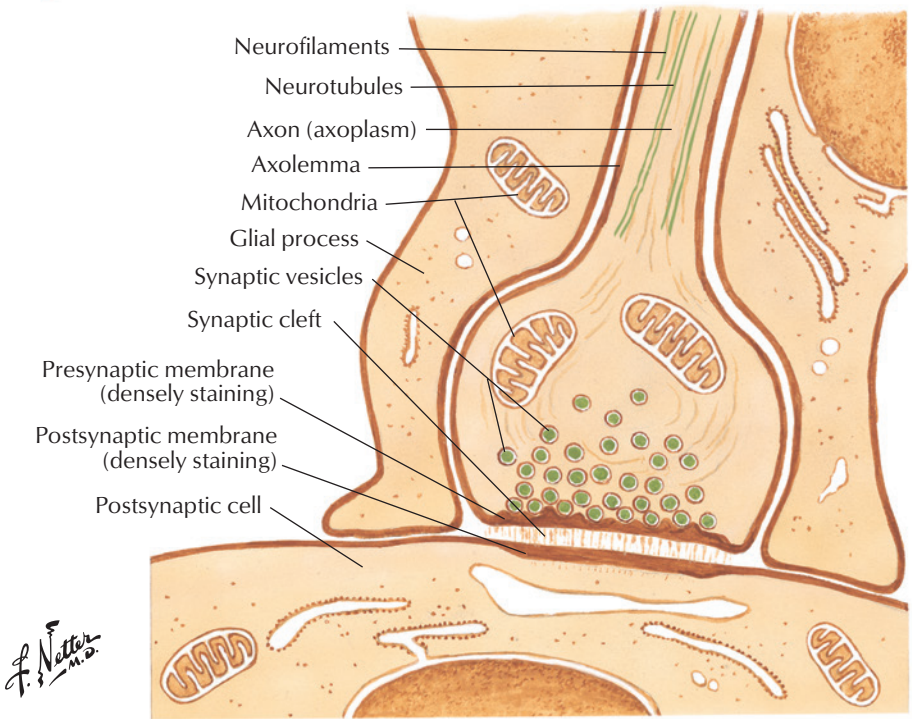


Two postganglionic autonomic neurons of a sympathetic or parasympathetic ganglion

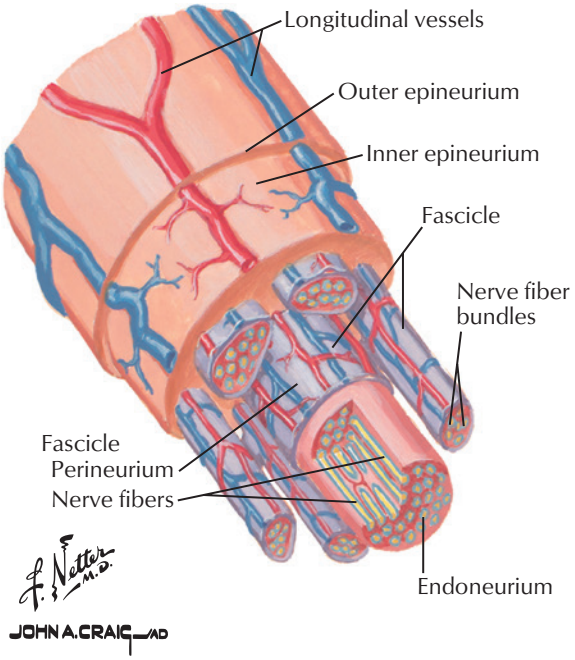


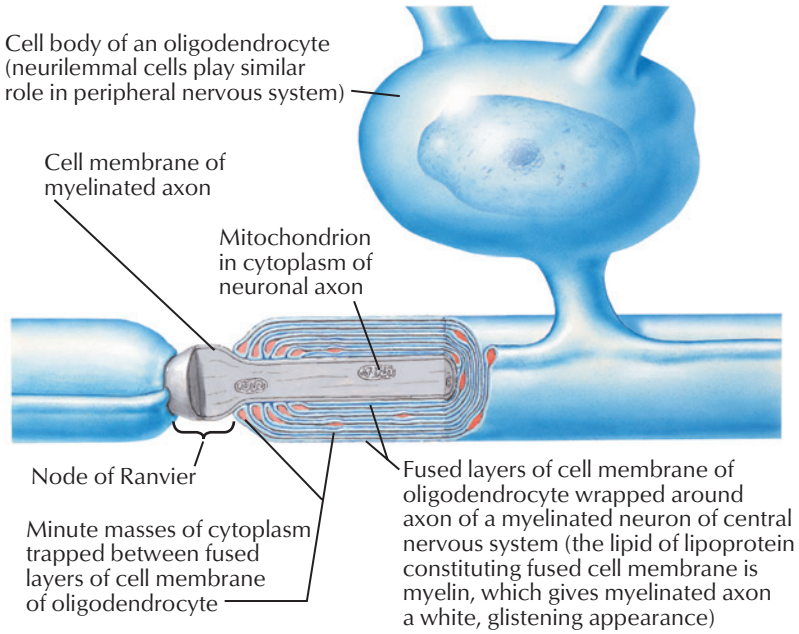
Schematic of synaptic endings

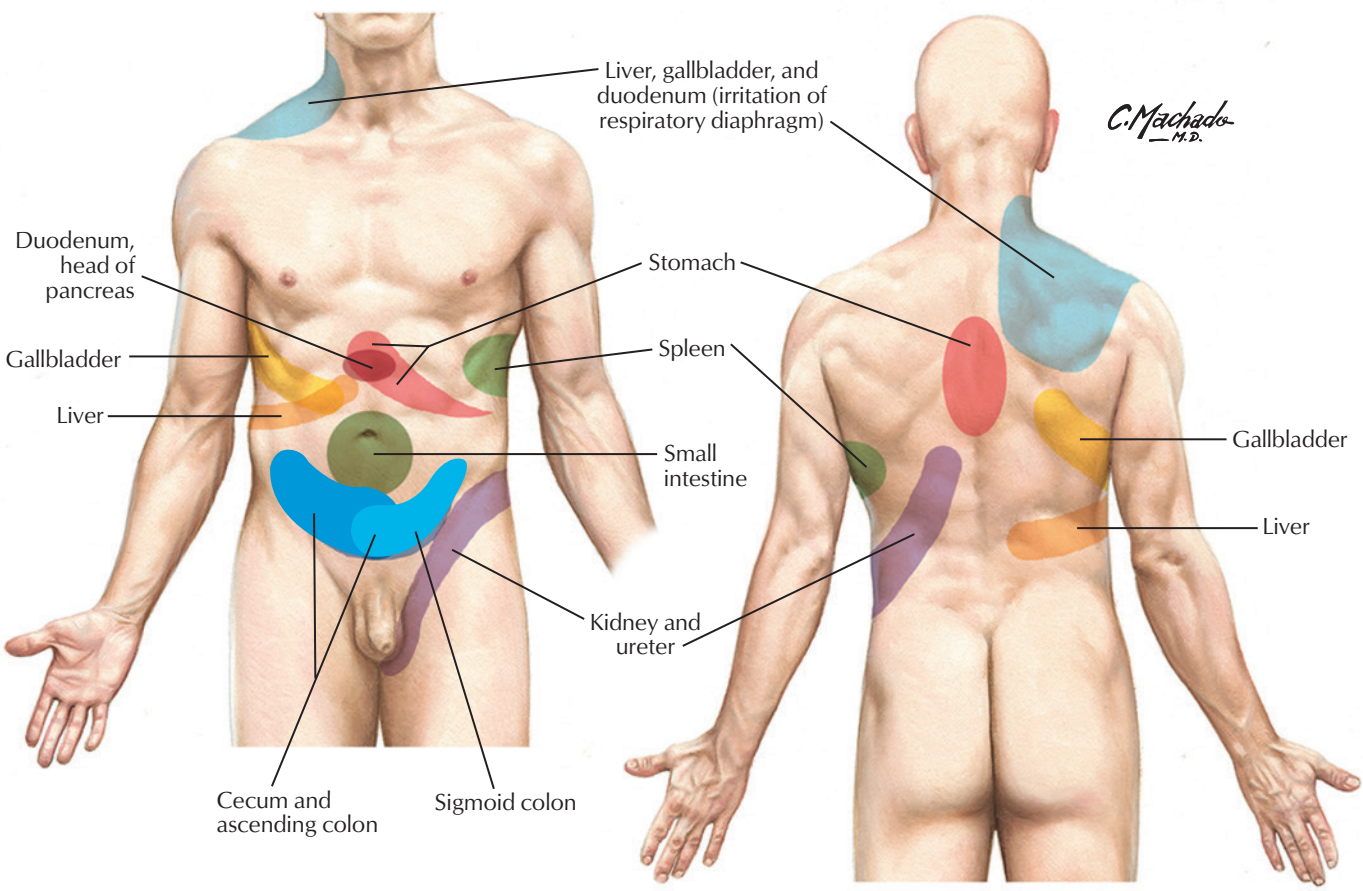
Numerous boutons (synaptic knobs) of presynaptic neurons terminating on a motor neuron and its dendrites

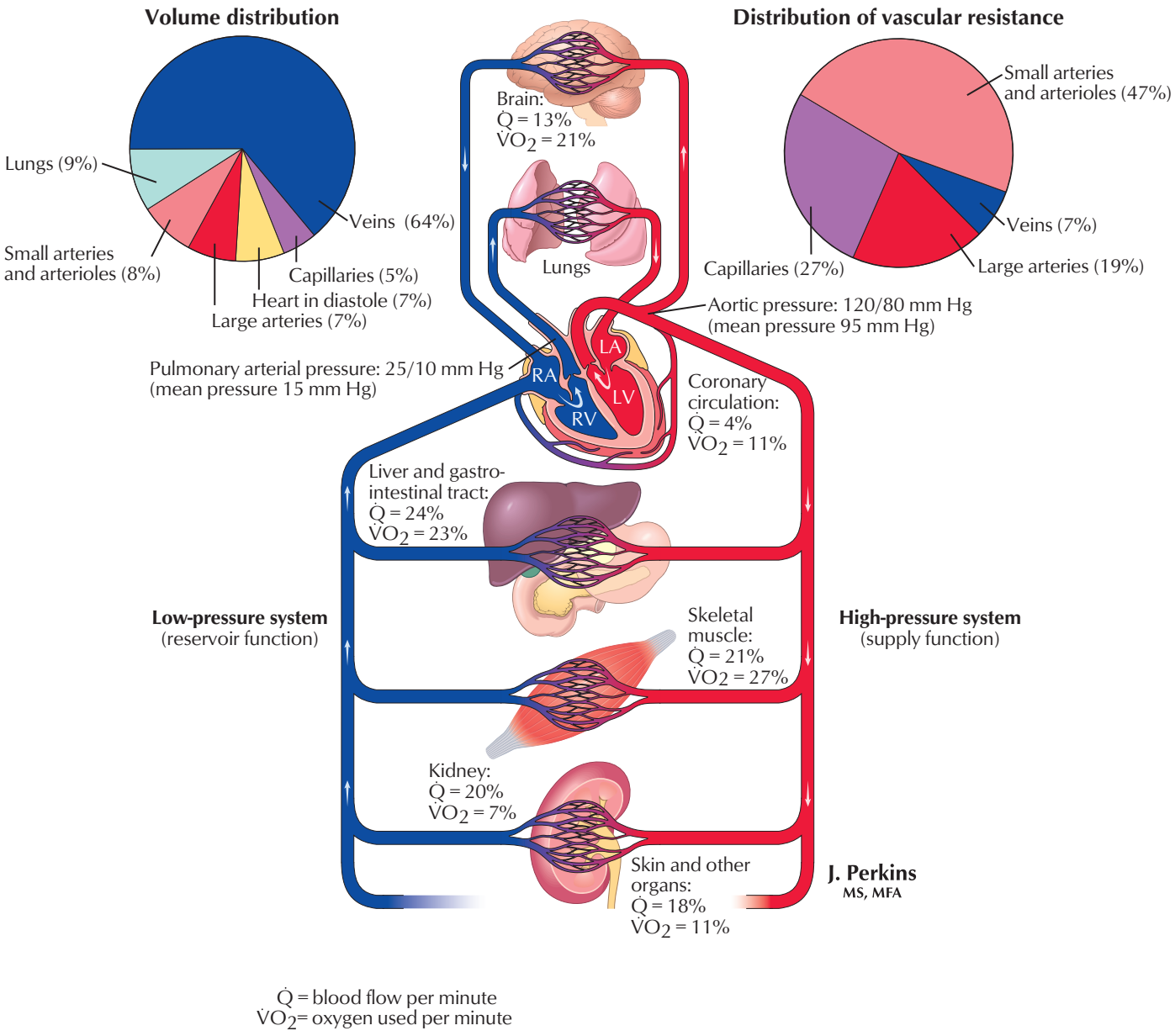


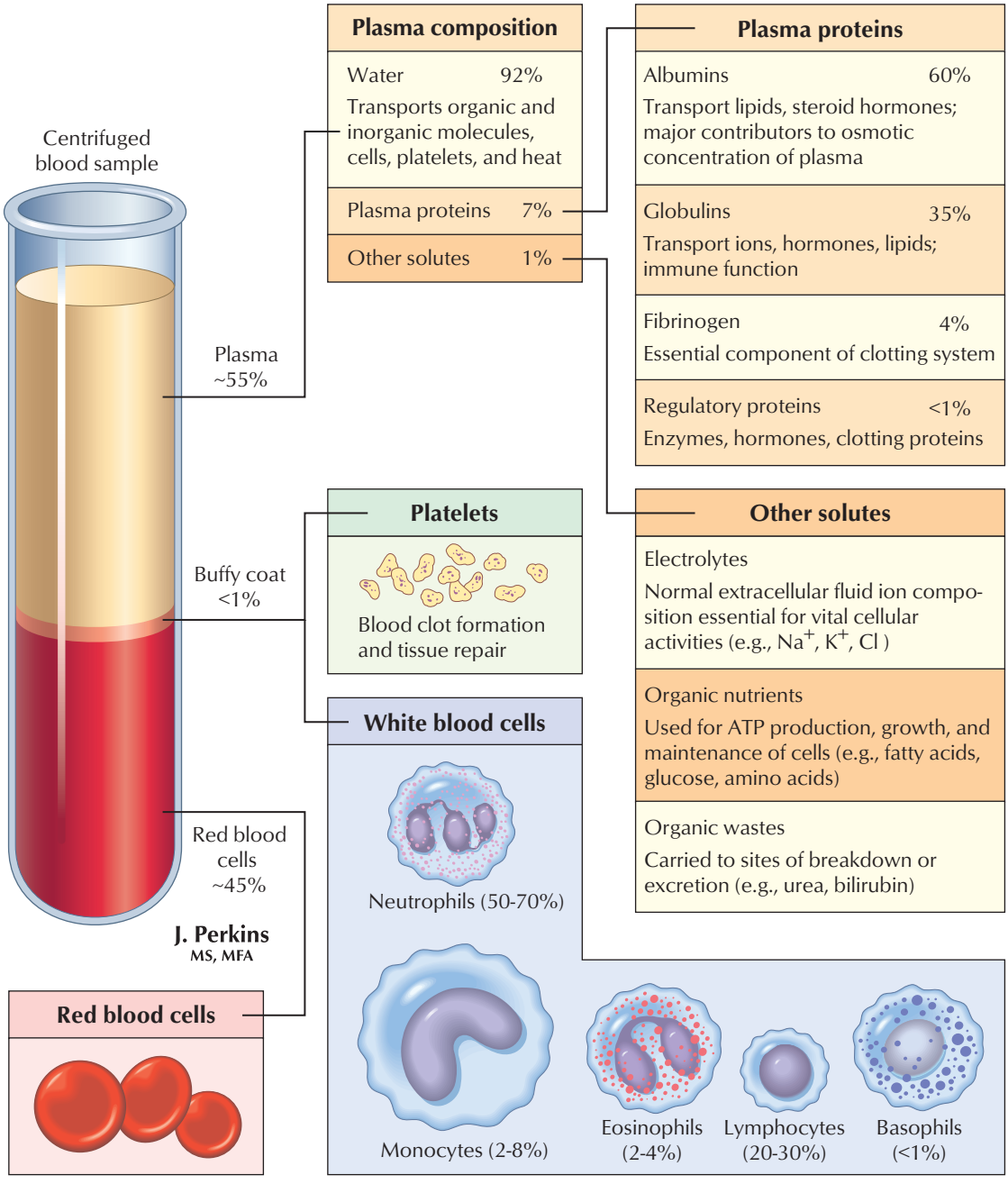
Enlarged section of bouton

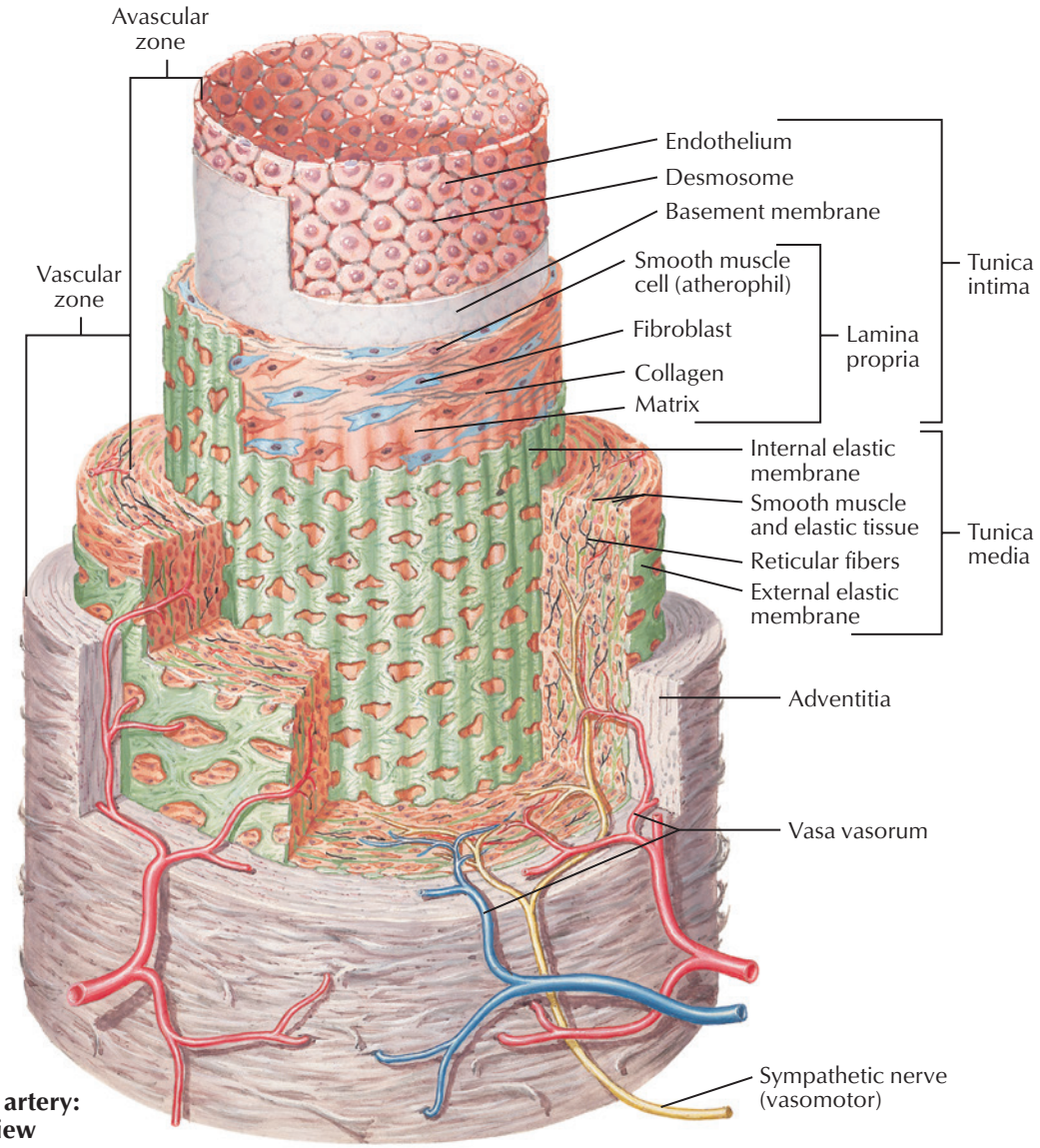

Longitudinal vessels
Outer epineurium
Inner epineurium
Fascicle
Nerve fiber bundles
Fascicle
Perineurium
Nerve fibers
Endoneurium
JOHN A. CRAIG, MD


Cell body of an oligodendrocyte (neurilemmal cells play similar role in peripheral nervous system)
Cell membrane of myelinated axon
Mitochondrion in cytoplasm of neuronal axon
Node of Ranvier
Minute masses of cytoplasm trapped between fused layers of cell membrane of oligodendrocyte
Fused layers of cell membrane of oligodendrocyte wrapped around axon of a myelinated neuron of central nervous system (the lipid of lipoprotein constituting fused cell membrane is myelin, which gives myelinated axon a white, glistening appearance)

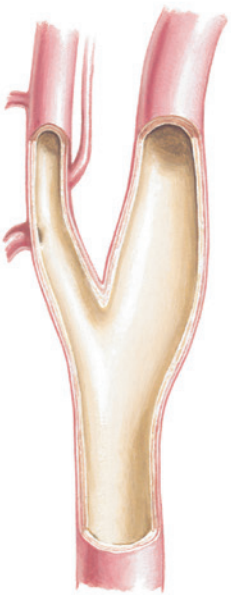

Liver, gallbladder, and duodenum (irritation of respiratory diaphragm)
C. Machado M.D.
Duodenum, head of pancreas
Stomach
Gallbladder
Spleen
Liver
Small intestine
Gallbladder
Liver
Kidney and ureter
Cecum and ascending colon
Sigmoid colon


Volume distribution
Lungs (9%)
Veins (64%)
Small arteries and arterioles (8%)
Capillaries (5%)
Heart in diastole (7%)
Large arteries (7%)
Distribution of vascular resistance
Small arteries and arterioles (47%)
Veins (7%)
Capillaries (27%)
Large arteries (19%)
Brain:
Q̇ = 13%
V̇O2 = 21%
Lungs
Aortic pressure: 120/80 mm Hg
(mean pressure 95 mm Hg)
Pulmonary arterial pressure: 25/10 mm Hg
(mean pressure 15 mm Hg)
RA
LA
LV
RV
Coronary circulation:
Q̇ = 4%
V̇O2 = 11%
Liver and gastro-intestinal tract:
Q̇ = 24%
V̇O2 = 23%
Low-pressure system
(reservoir function)
Skeletal muscle:
Q̇ = 21%
V̇O2 = 27%
High-pressure system
(supply function)
Kidney:
Q̇ = 20%
V̇O2 = 7%
Skin and other organs:
Q̇ = 18%
V̇O2 = 11%
J. Perkins
MS, MFA
Q̇ = blood flow per minute
V̇O2 = oxygen used per minute

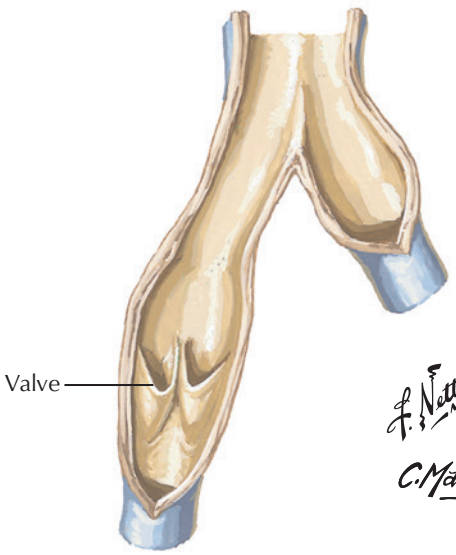

Centrifuged blood sample
Plasma ~55%
Buffy coat <1%
Red blood cells ~45%
J. Perkins
MS, MFA
Red blood cells
Plasma composition
Water 92%
Transports organic and inorganic molecules, cells, platelets, and heat
Plasma proteins 7%
Other solutes 1%
Plasma proteins
Albumins 60%
Transport lipids, steroid hormones; major contributors to osmotic concentration of plasma
Globulins 35%
Transport ions, hormones, lipids; immune function
Fibrinogen 4%
Essential component of clotting system
Regulatory proteins <1%
Enzymes, hormones, clotting proteins
Platelets
Blood clot formation and tissue repair
Other solutes
Electrolytes
Normal extracellular fluid ion composition essential for vital cellular activities (e.g., Na+, K+, Cl)
Organic nutrients
Used for ATP production, growth, and maintenance of cells (e.g., fatty acids, glucose, amino acids)
Organic wastes
Carried to sites of breakdown or excretion (e.g., urea, bilirubin)
White blood cells
Neutrophils (50-70%)
Monocytes (2-8%)
Eosinophils (2-4%)
Lymphocytes (20-30%)
Basophils (<1%)



Wall of an artery: cutaway view



Healthy artery

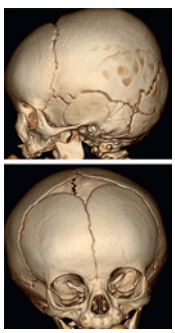


Healthy vein

HEAD AND NECK 2

Surface Anatomy	8	**Ear**	105-110
Superficial Head and Neck	9-10	**Meninges and Brain**	111-126
Bones and Ligaments	11-30	**Cranial and Cervical Nerves**	127-146
Neck	31-41	**Cerebral Vasculature**	147-158
Nasal Region	42-64	**Regional Imaging**	159-160
Oral Region	65-74	**Structures with High Clinical Significance**	Tables 2.1-2.3
Pharynx	75-86	**Muscle Tables**	Tables 2.4-2.9
Thyroid Gland and Larynx	87-93	**Electronic Bonus Plates**	BP17-BP32
Orbit and Contents	94-104		

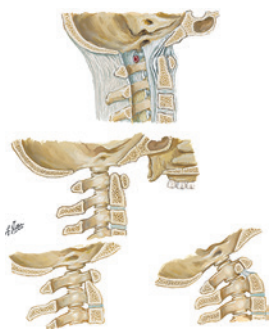
ELECTRONIC BONUS PLATES



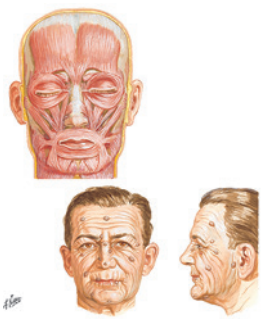
BP17 3D Skull Reconstruction CTs



BP18 Degenerative Changes in Cervical Vertebrae



BP19 Atlantooccipital Junction



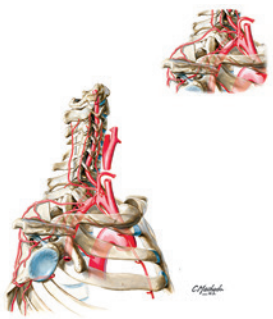
BP20 Muscles of Facial Expression: Anterior View



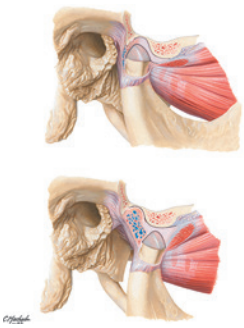
BP21 Musculature of Face



BP22 Paranasal Sinuses

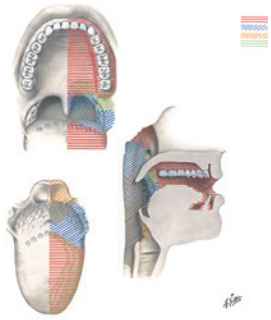


BP23 Subclavian Artery

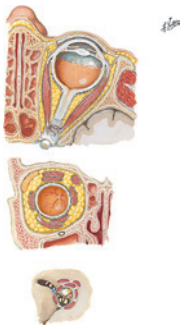


BP24 Opening of the Mandible

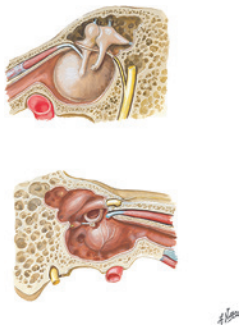
ELECTRONIC BONUS PLATES—*cont'd*



BP25 Afferent Innervation of Oral Cavity and Pharynx



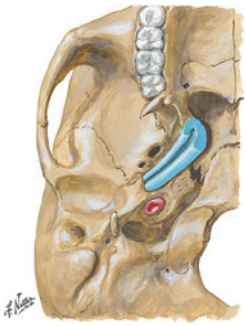
BP26 Fasciae of Orbit and Eyeball



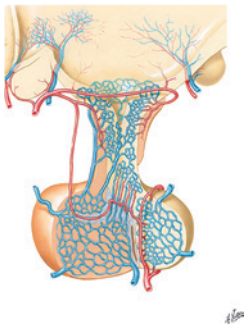
BP27 Tympanic Cavity



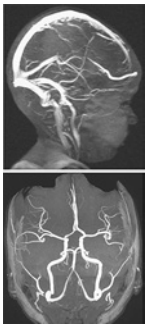
BP28 Anatomy of the Pediatric Ear



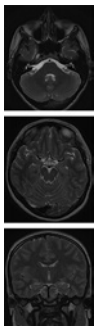
BP29 Auditory Tube (Eustachian)



BP30 Arteries and Veins of Hypothalamus and Hypophysis

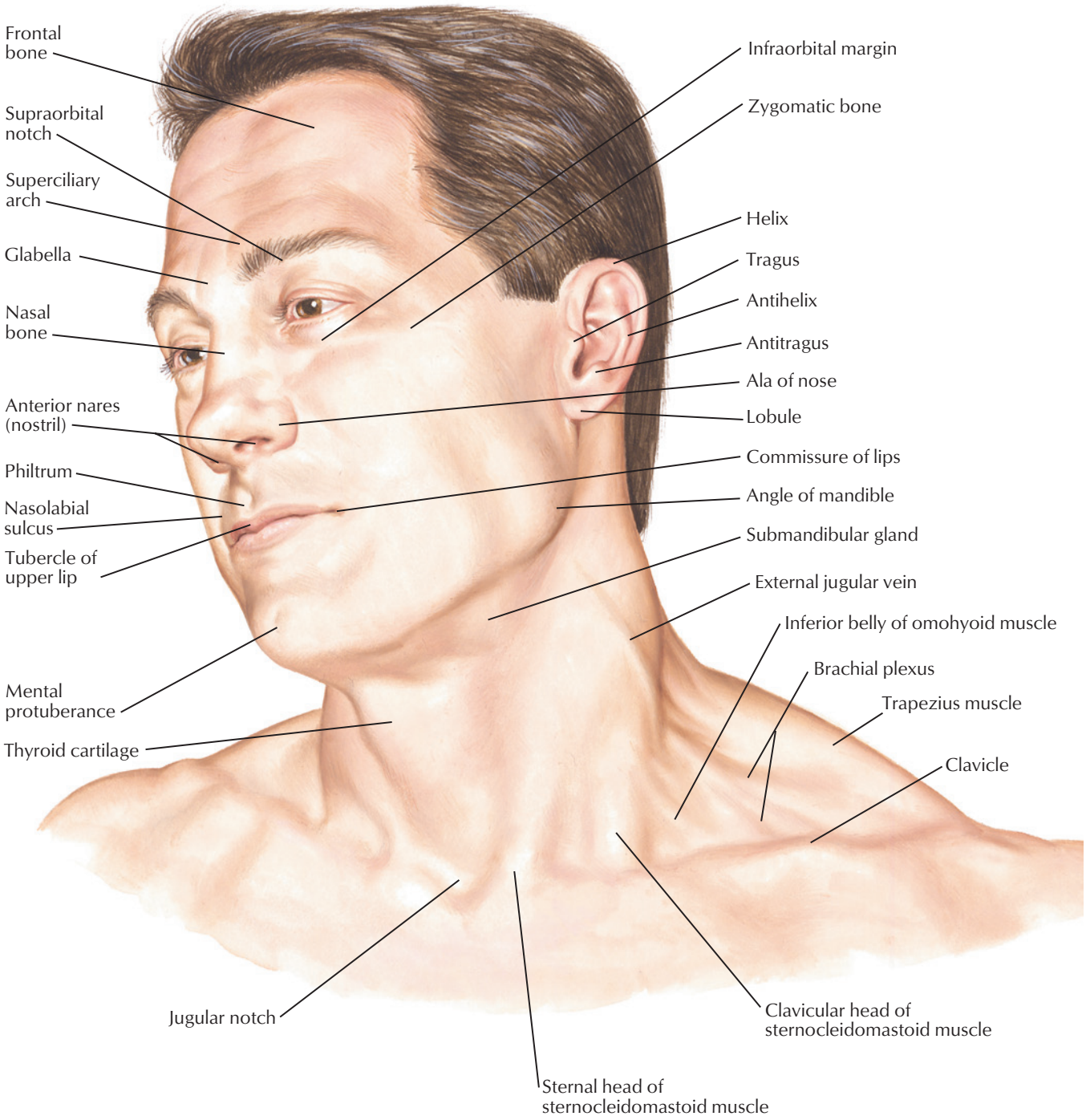


BP31 Cranial Imaging (MRV and MRA)



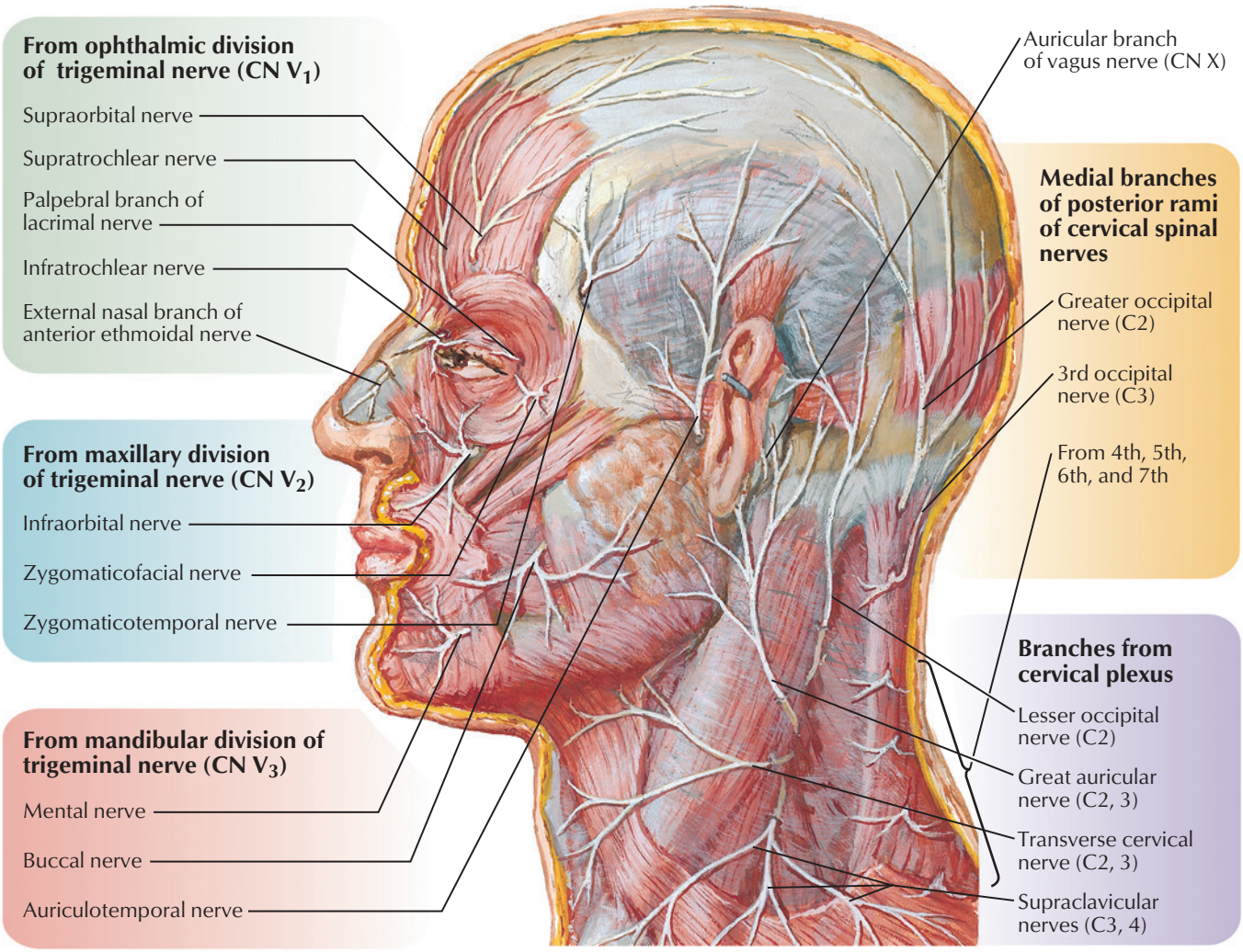
BP32 Axial and Coronal MRIs of Brain

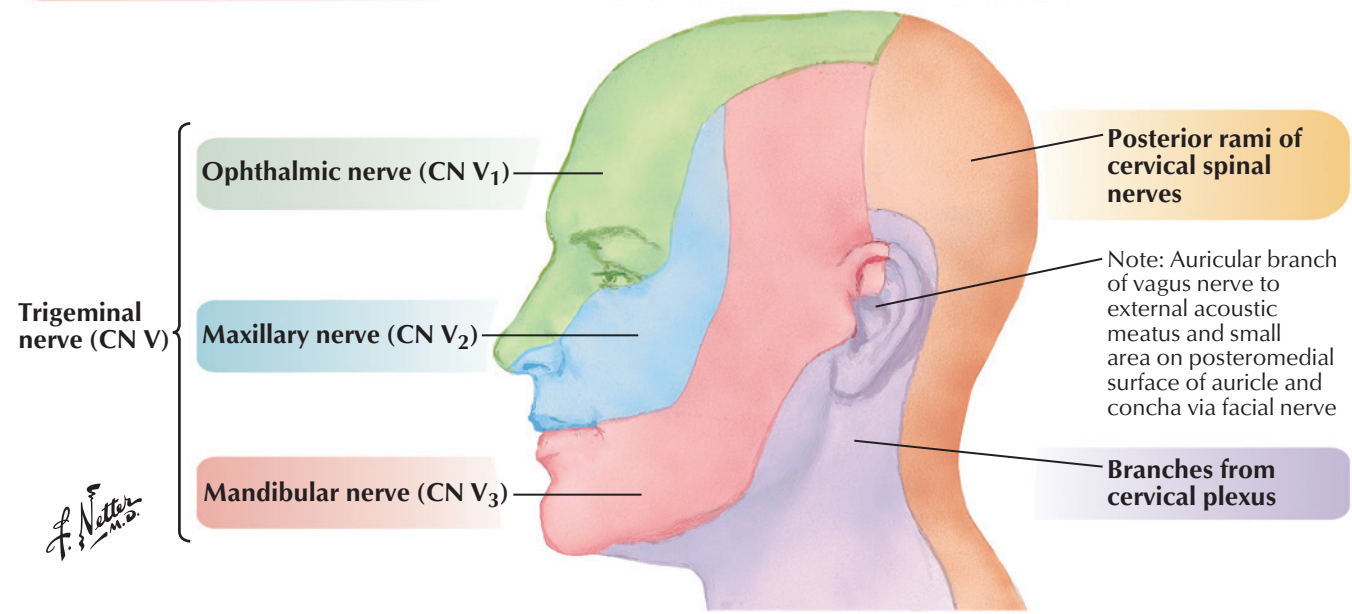
See also Plate 171



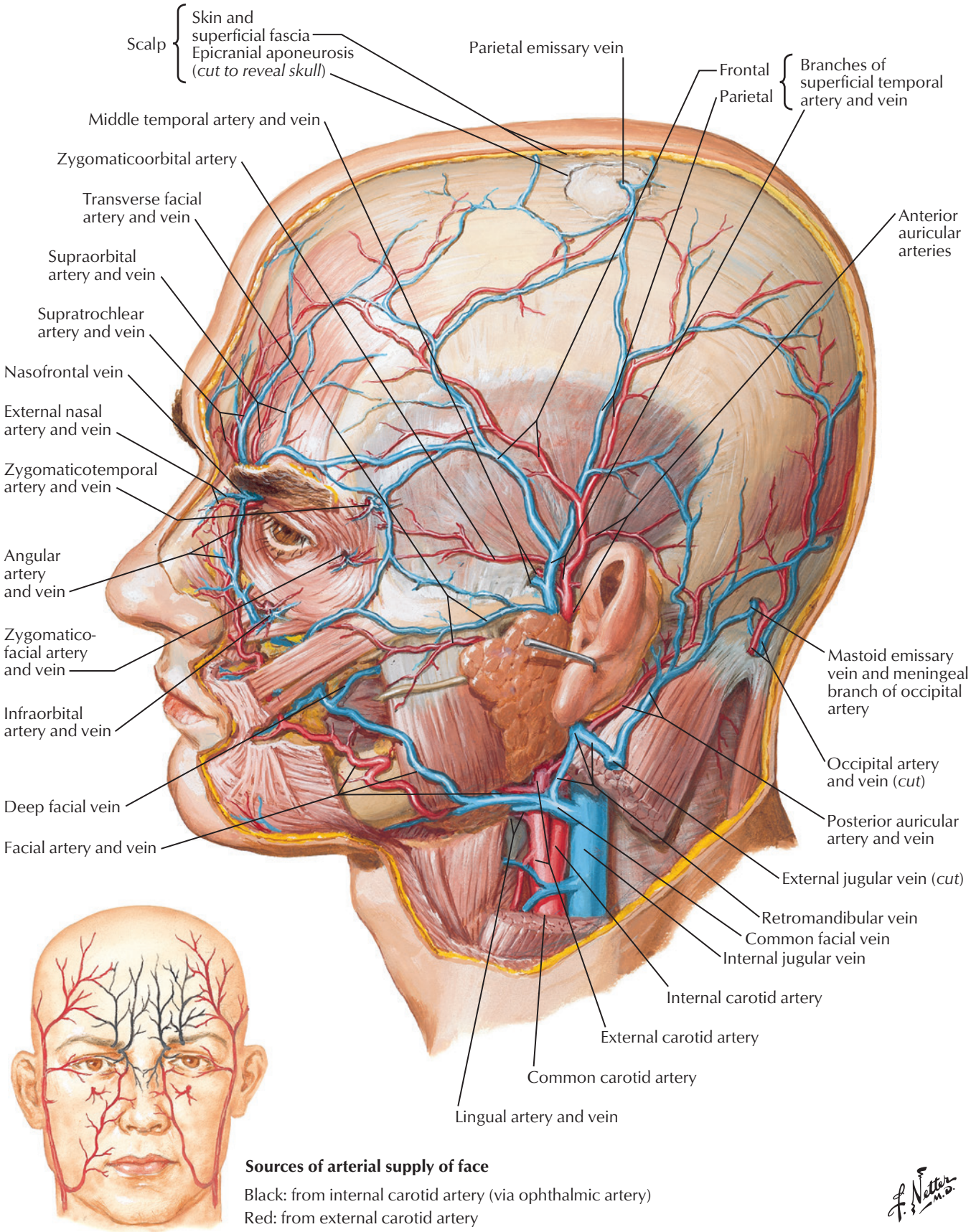
C. Machado M.D.

See also Plates 39, 42, 61





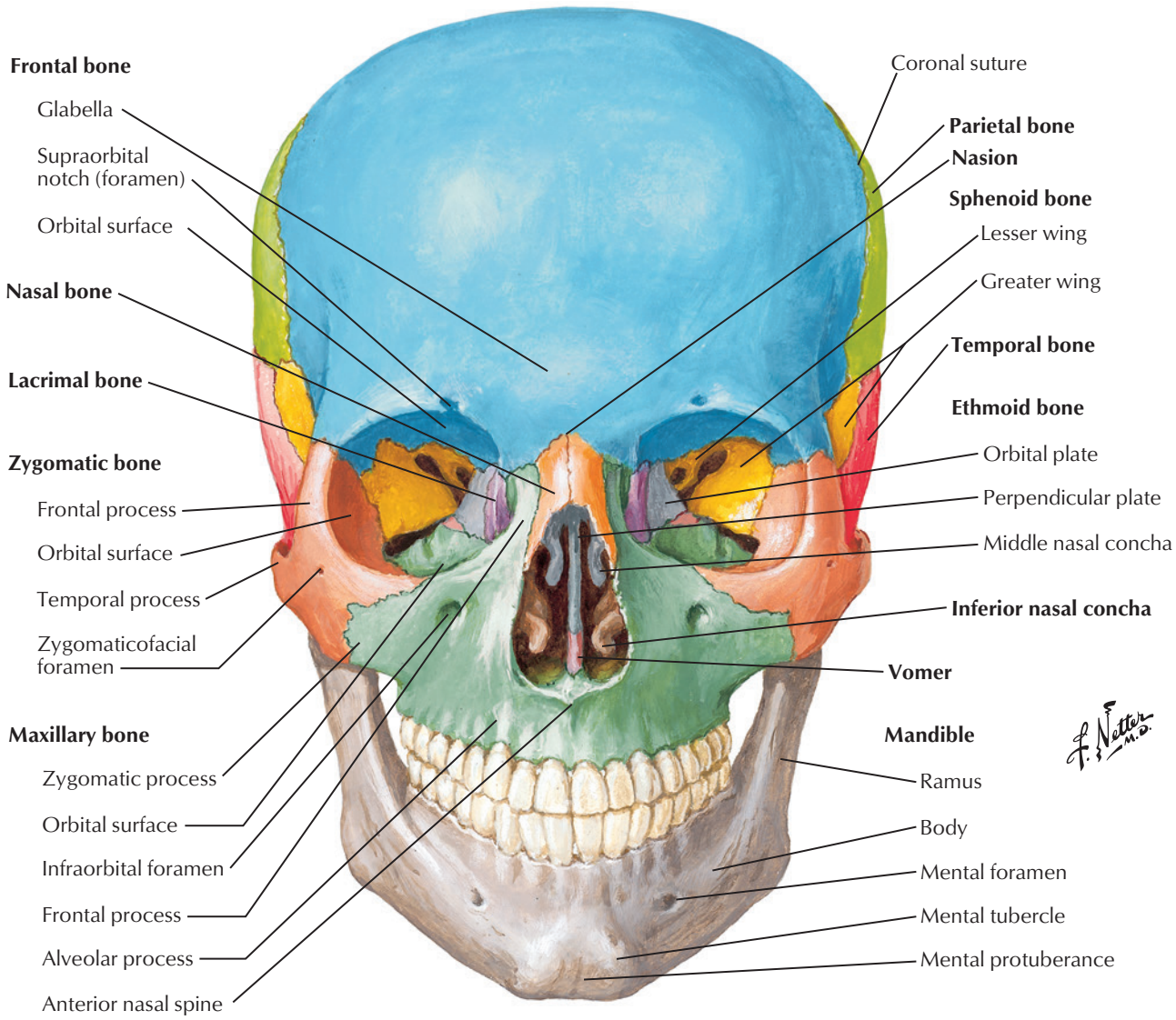
See also Plates 57, 83, 84



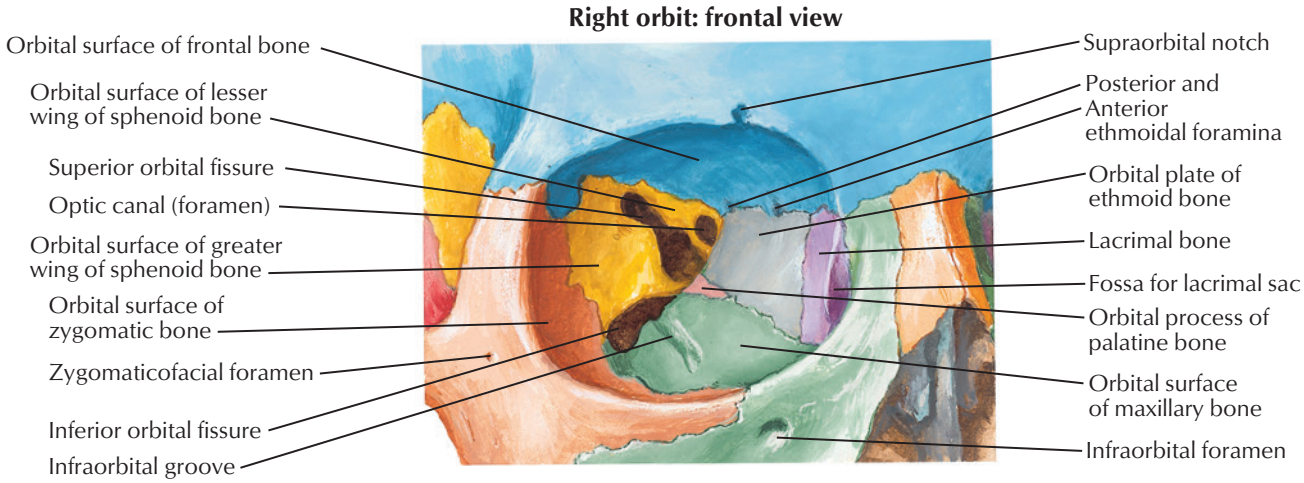
Sources of arterial supply of face

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

See also Plate 13

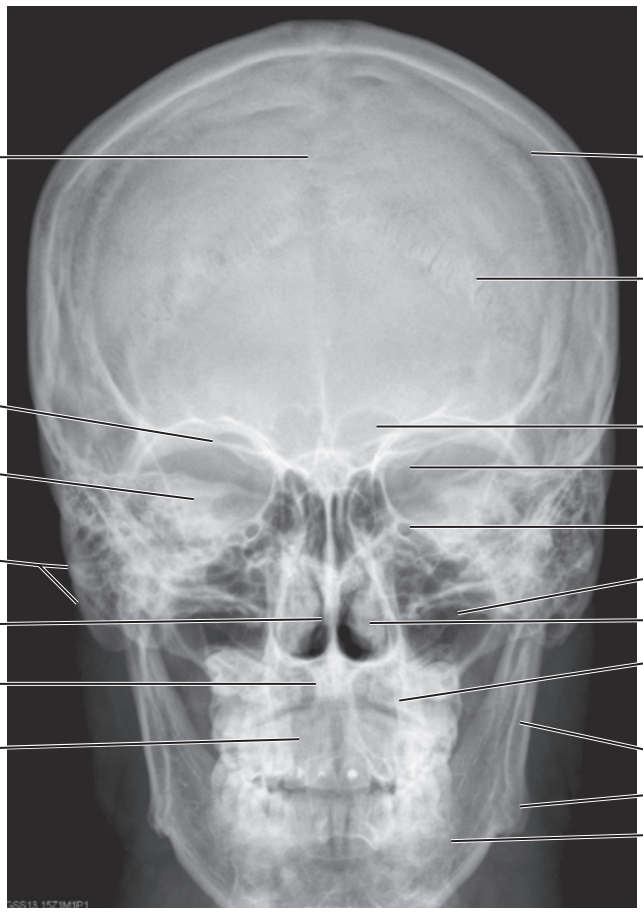


Right orbit: frontal view



See also Plate 11

Posterior anterior view

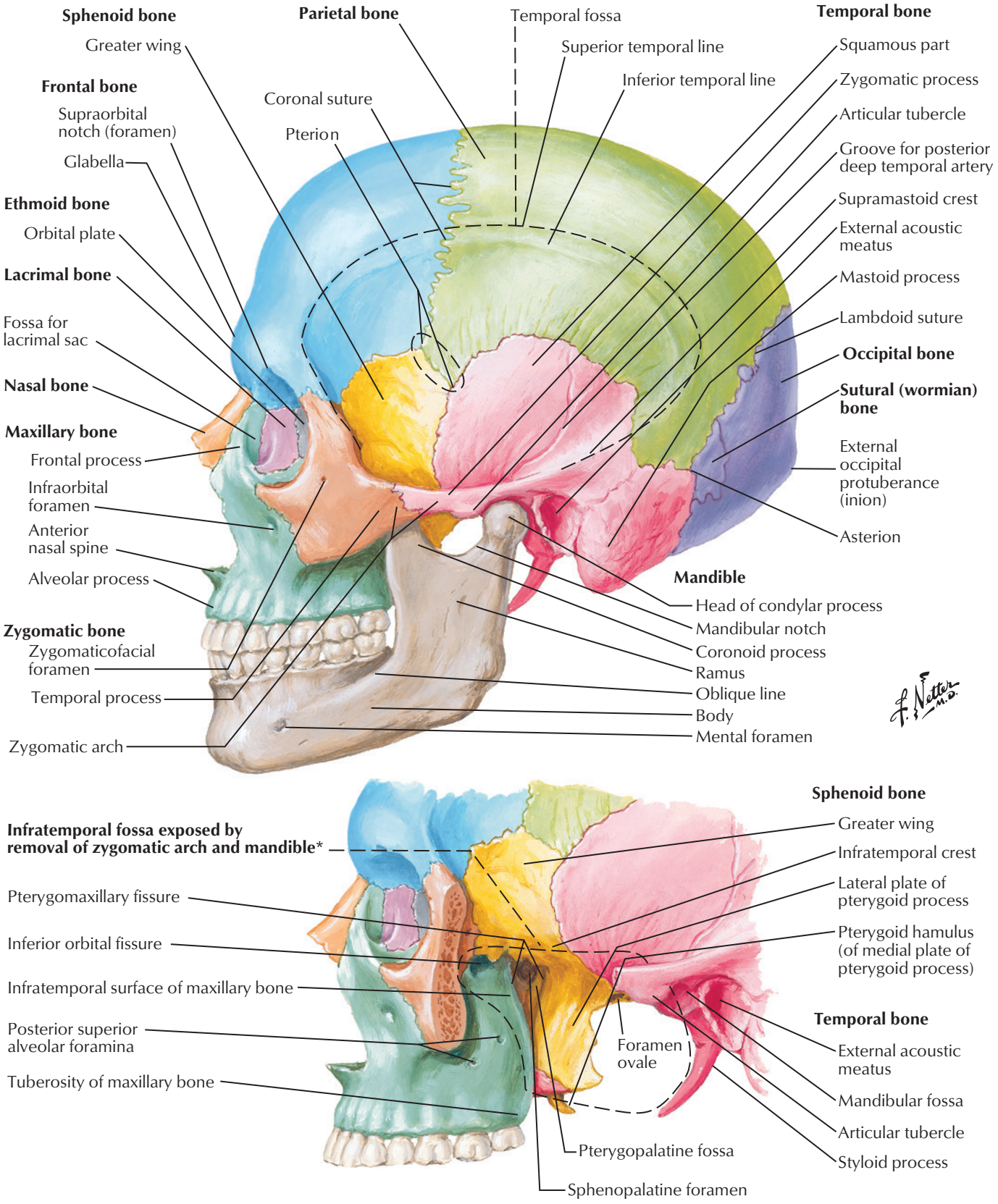


Waters' view



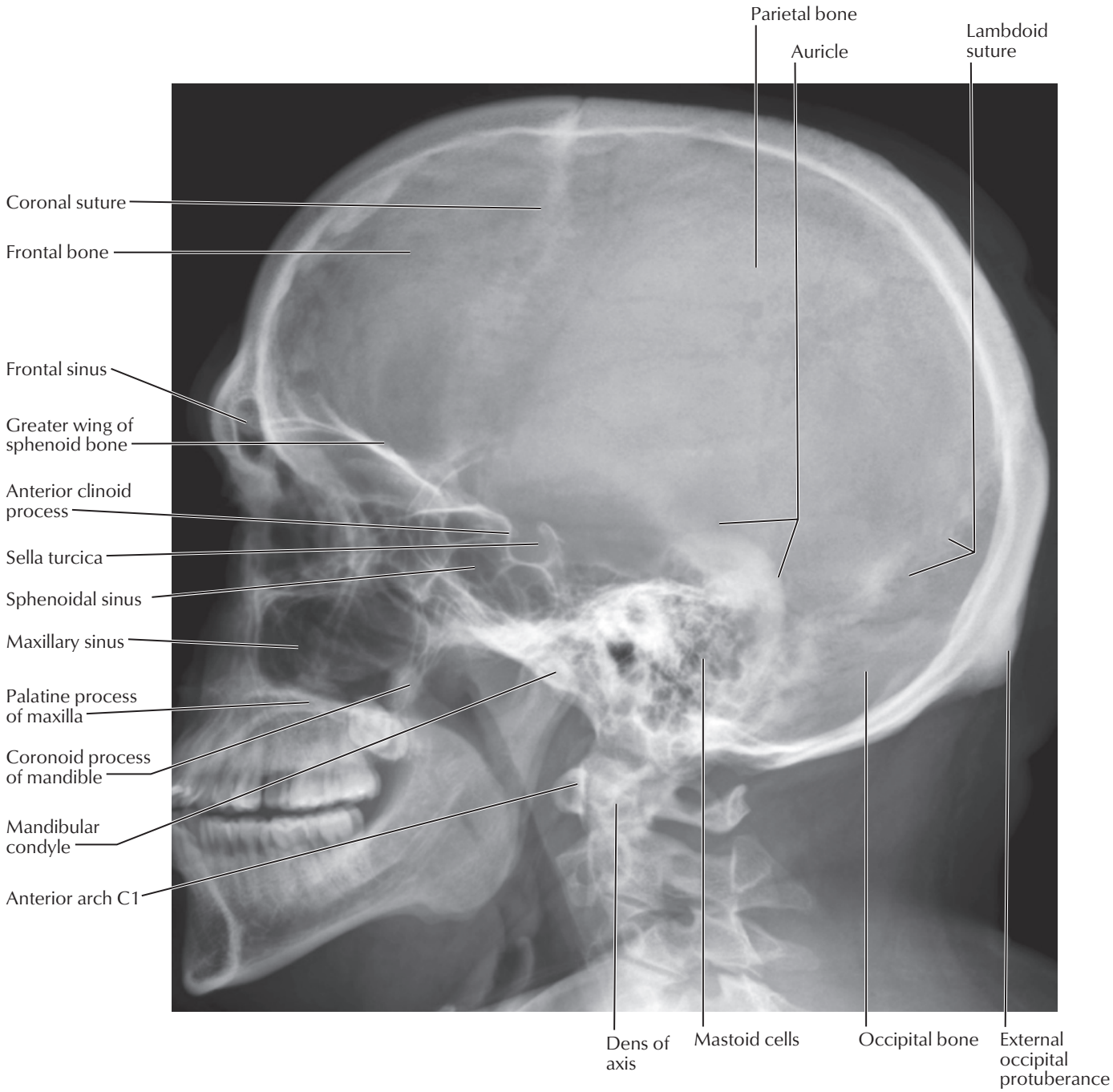
Skull: Lateral View

See also Plates 14, 15, 22

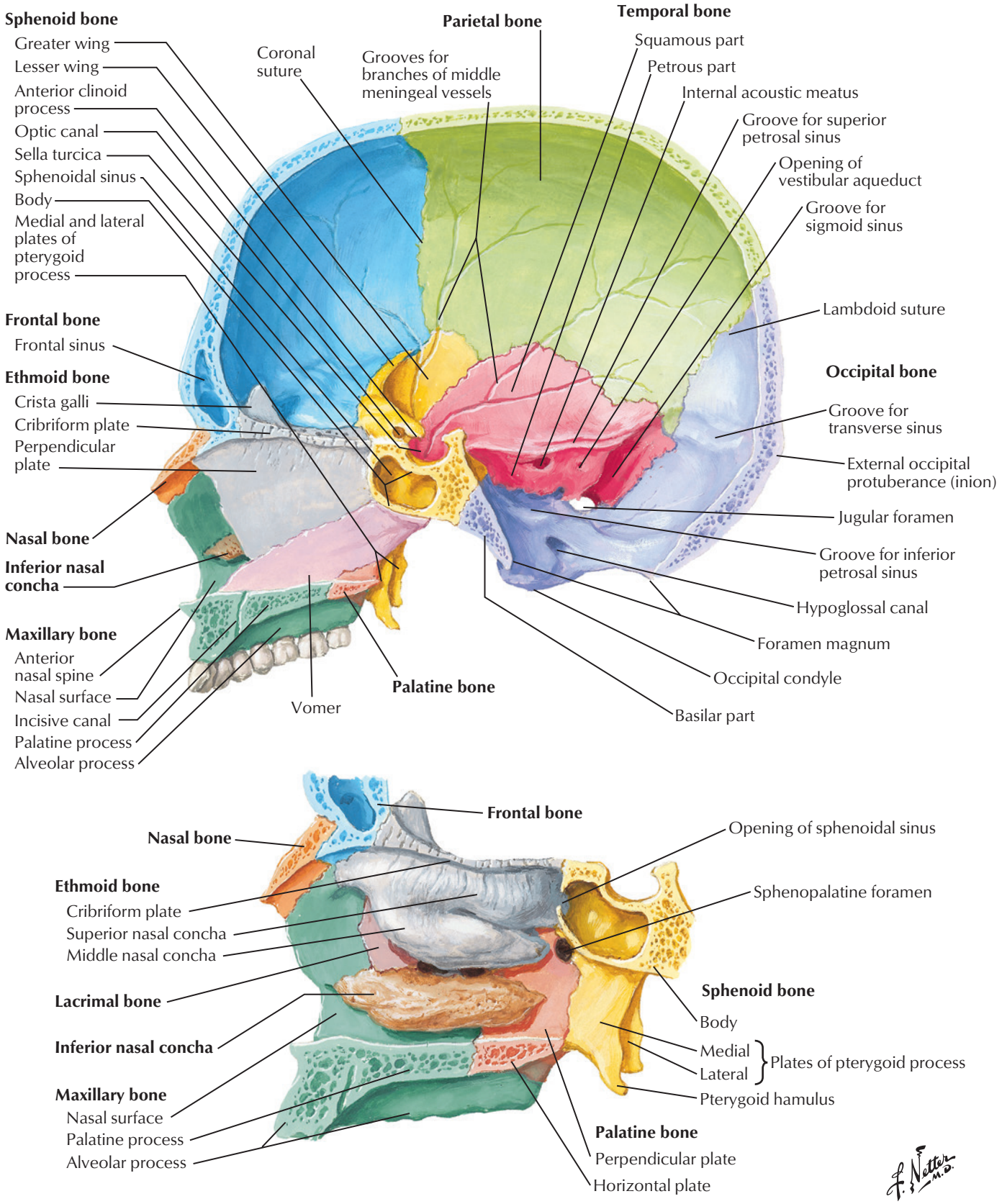


*Superficially, mastoid process forms posterior boundary.

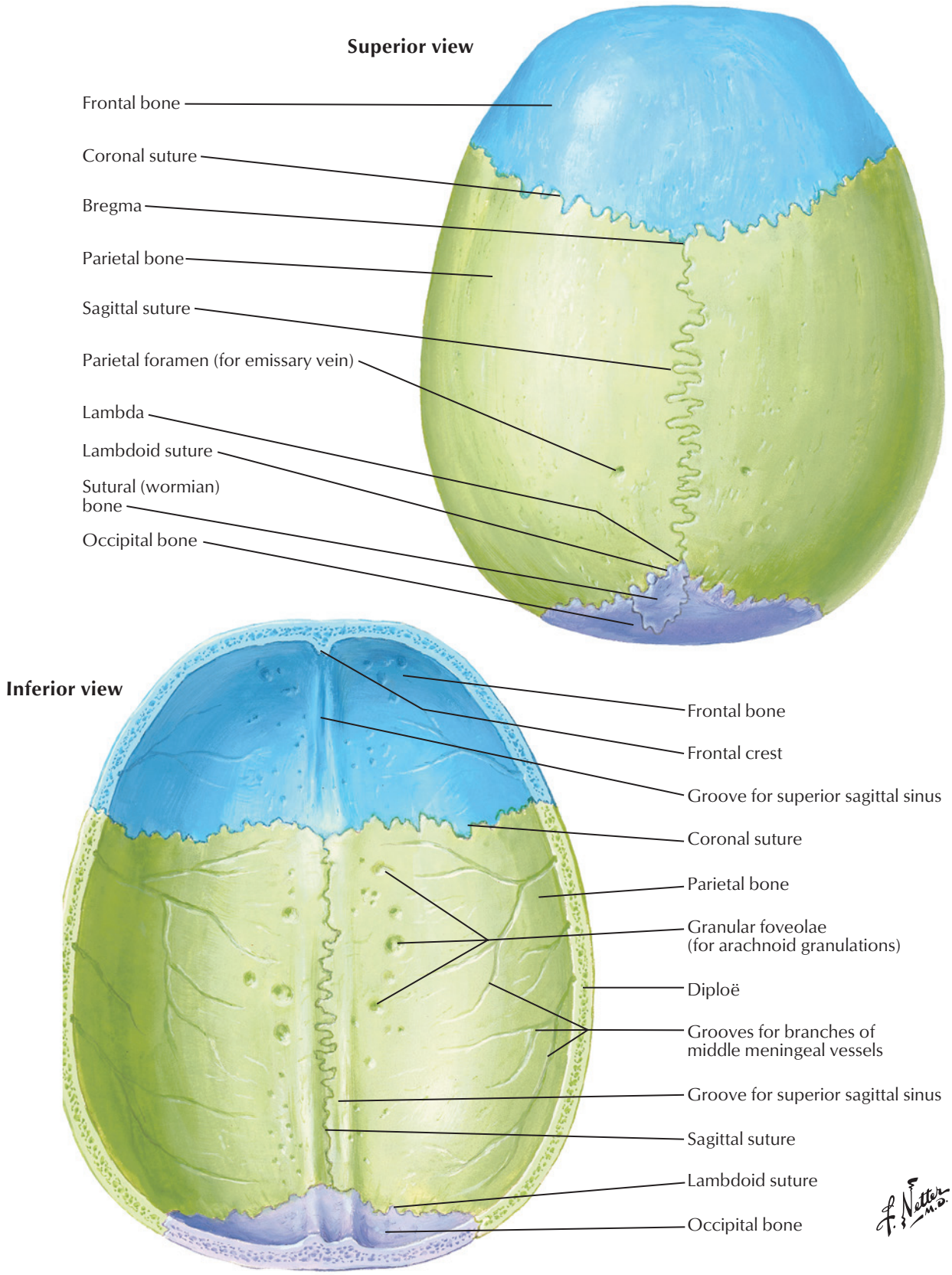
See also Plate 15



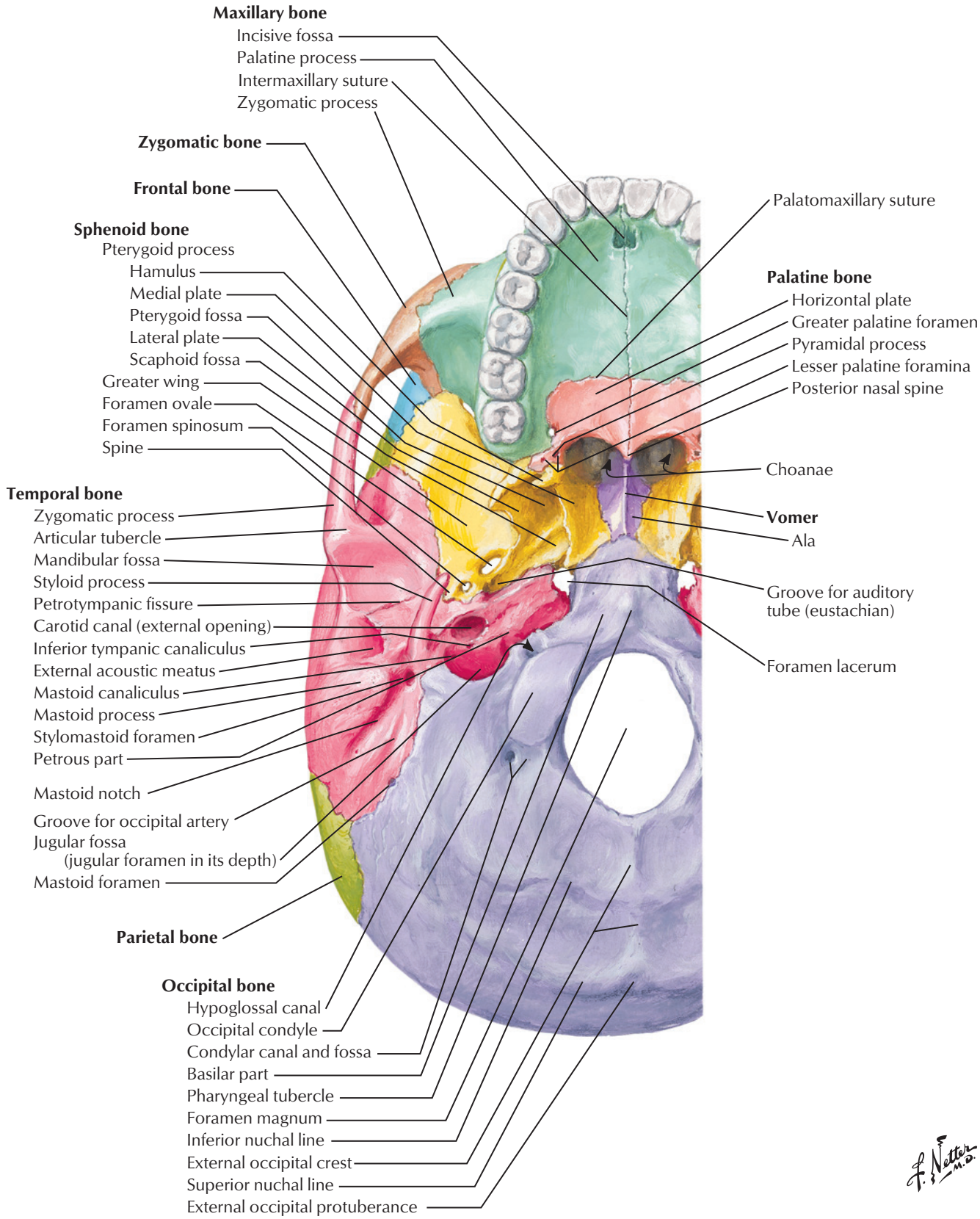
See also Plates 44, 46



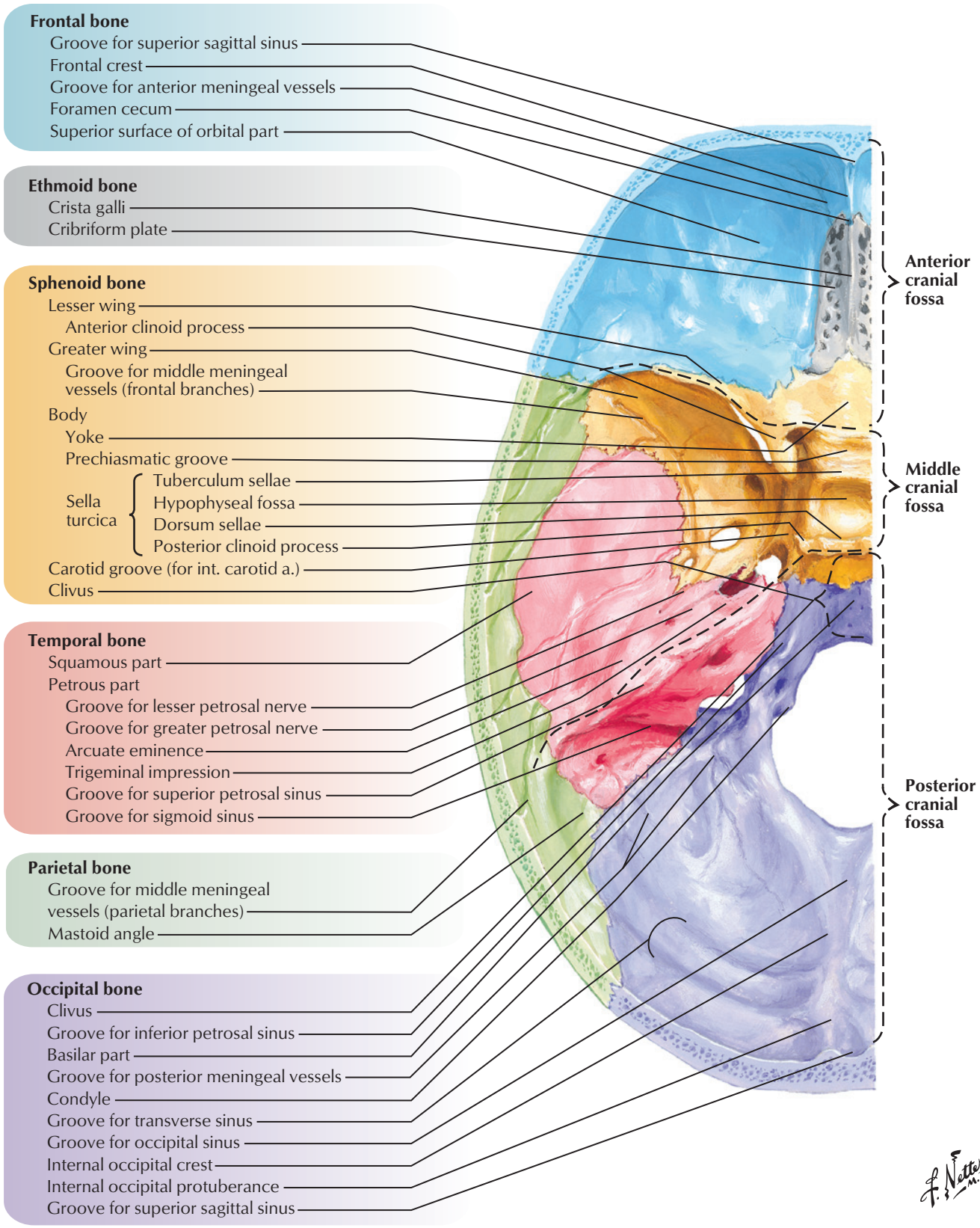
View of lateral nasal wall with nasal septum removed


Superior view
Frontal bone
Coronal suture
Bregma
Parietal bone
Sagittal suture
Parietal foramen (for emissary vein)
Lambda
Lambdoid suture
Sutural (wormian) bone
Occipital bone
Inferior view
Frontal bone
Frontal crest
Groove for superior sagittal sinus
Coronal suture
Parietal bone
Granular foveolae (for arachnoid granulations)
Diploë
Grooves for branches of middle meningeal vessels
Groove for superior sagittal sinus
Sagittal suture
Lambdoid suture
Occipital bone

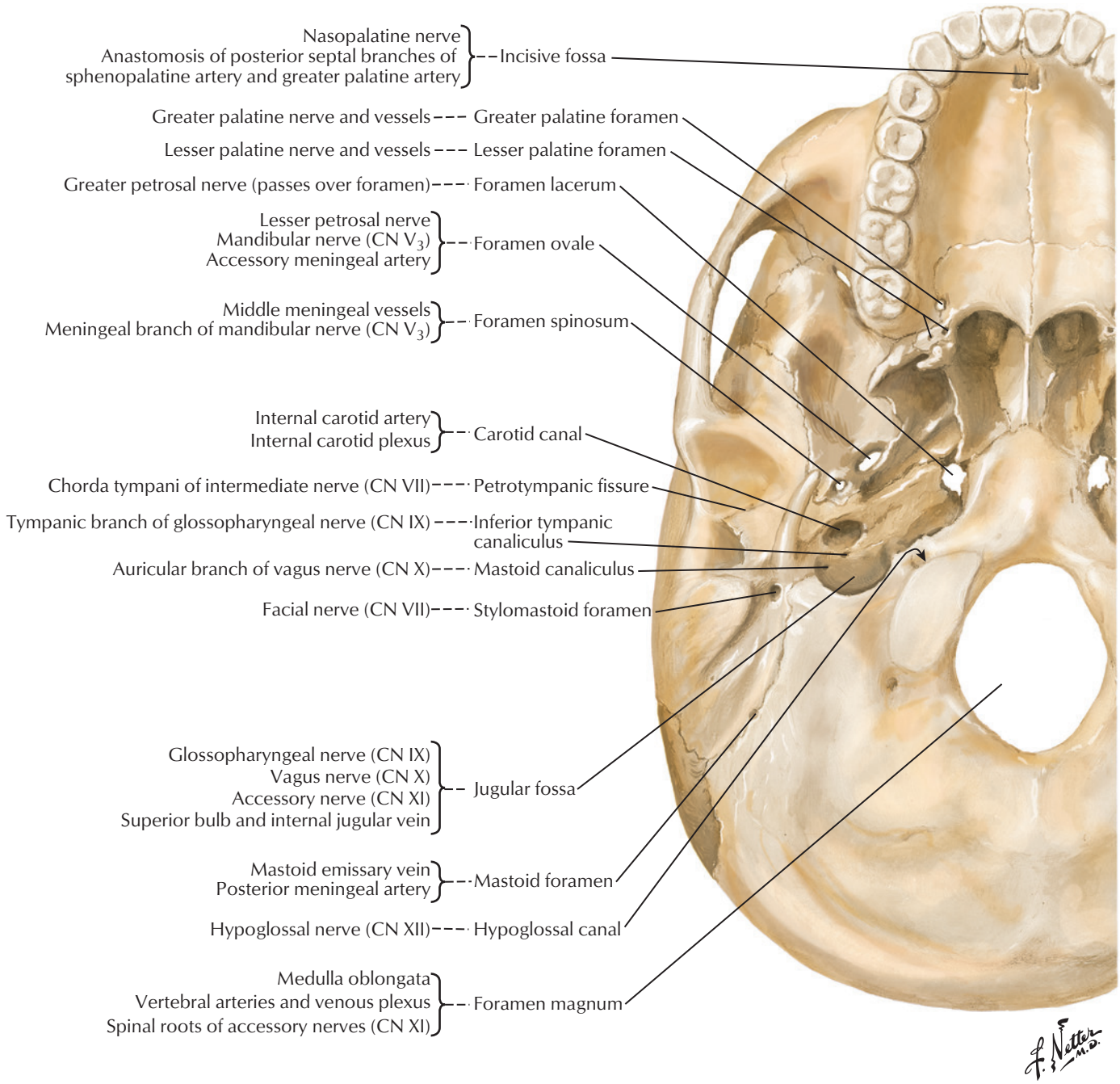
See also Plate 19



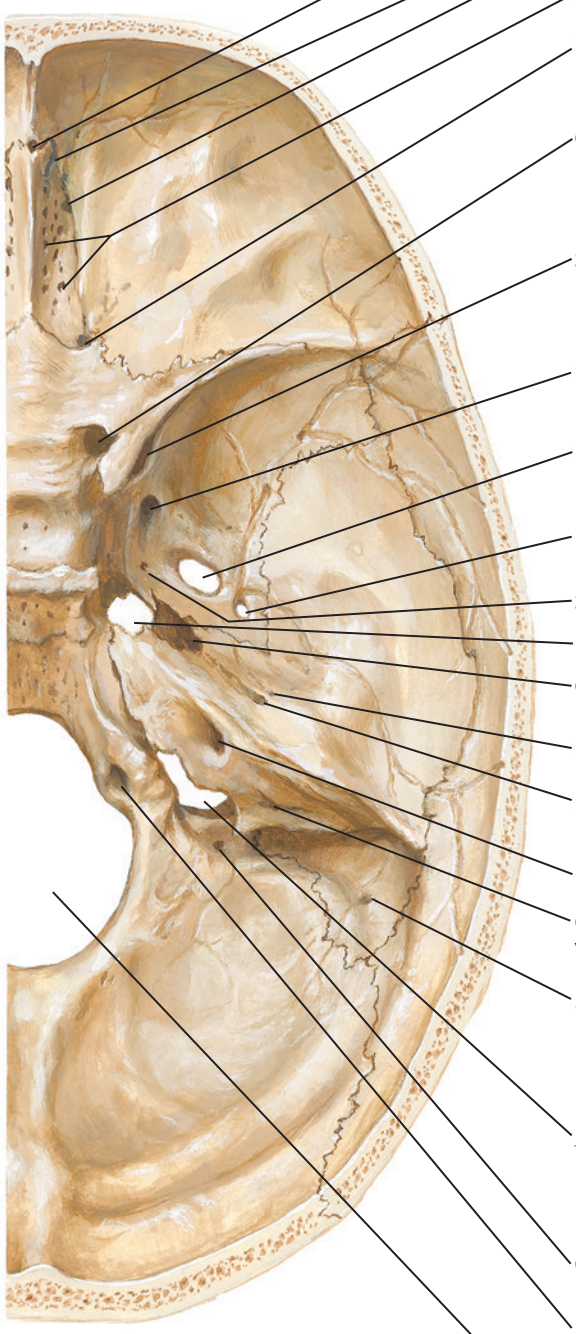
See also Plates 20, 115



See also Plate 17

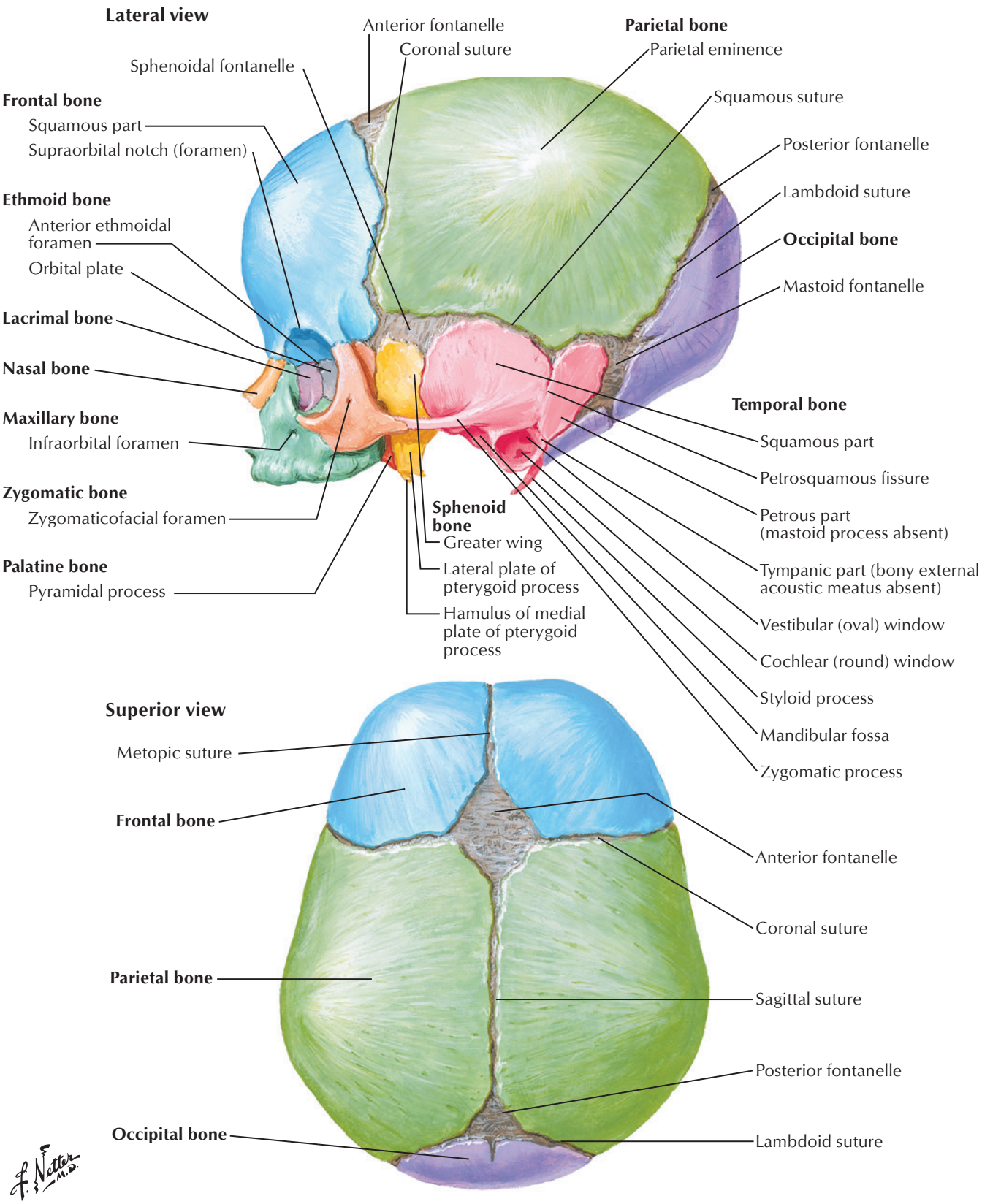


See also Plates 18, 115

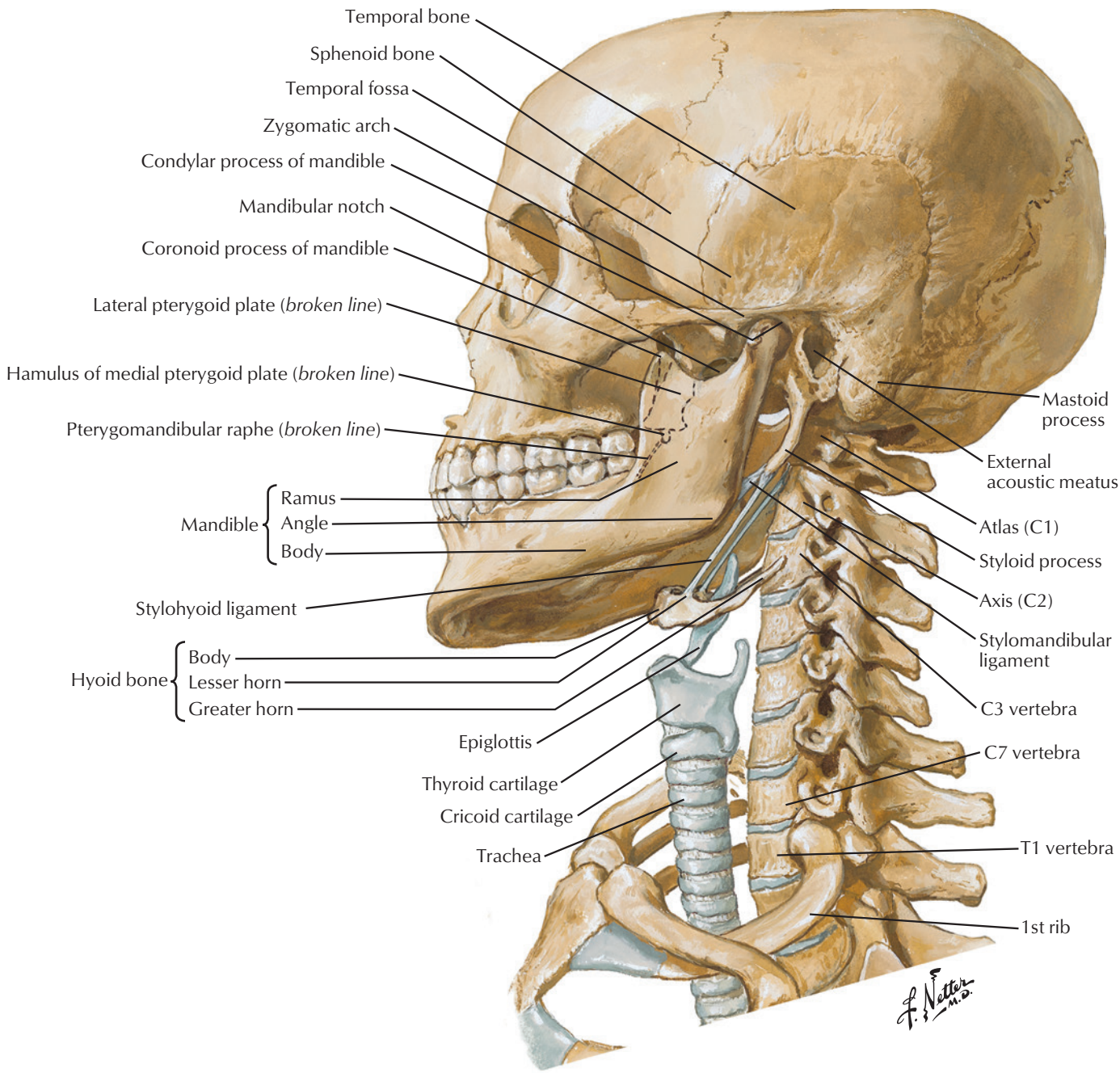


- Foramen cecum — Emissary vein to superior sagittal sinus
- Nasal slit, Anterior ethmoidal foramen — Anterior ethmoidal artery, vein, and nerve
- Foramina of cribriform plate — Olfactory nerves (CN I)
- Posterior ethmoidal foramen — Posterior ethmoidal artery, vein, and nerve
- Optic canal — Optic nerve (CN II); Ophthalmic artery
- Superior orbital fissure — Oculomotor nerve (CN III); Trochlear nerve (CN IV); Lacrimal, frontal, and nasociliary branches of ophthalmic nerve (CN V_1); Abducens nerve (CN VI); Superior ophthalmic vein
- Foramen rotundum — Maxillary nerve (CN V_2)
- Foramen ovale — Mandibular nerve (CN V_3); Accessory meningeal artery; Lesser petrosal nerve
- Foramen spinosum — Middle meningeal artery and vein; Meningeal branch of mandibular nerve
- Sphenoidal emissary foramen (of Vesalius) (inconstant)
- Foramen lacerum — Greater petrosal nerve (passes over foramen)
- Carotid canal — Internal carotid artery; Internal carotid nerve plexus
- Hiatus for — Lesser petrosal nerve
- Hiatus for — Greater petrosal nerve
- Internal acoustic meatus — Facial nerve (CN VII); Vestibulocochlear nerve (CN VIII); Labyrinthine artery
- Opening of vestibular aqueduct — Endolymphatic duct
- Mastoid foramen (inconstant) — Emissary vein (and occasional branch of occipital artery)
- Jugular foramen — Inferior petrosal sinus; Glossopharyngeal nerve (CN IX); Vagus nerve (CN X); Accessory nerve (CN XI); Sigmoid sinus; Posterior meningeal artery
- Condylar canal (inconstant) — Emissary vein and meningeal branch of ascending pharyngeal artery
- Hypoglossal canal — Hypoglossal nerve (CN XII)
- Foramen magnum — Medulla oblongata; Meninges; Vertebral arteries and venous plexus; Meningeal branches of vertebral arteries; Spinal roots of accessory nerves

See also Plates 13, 16

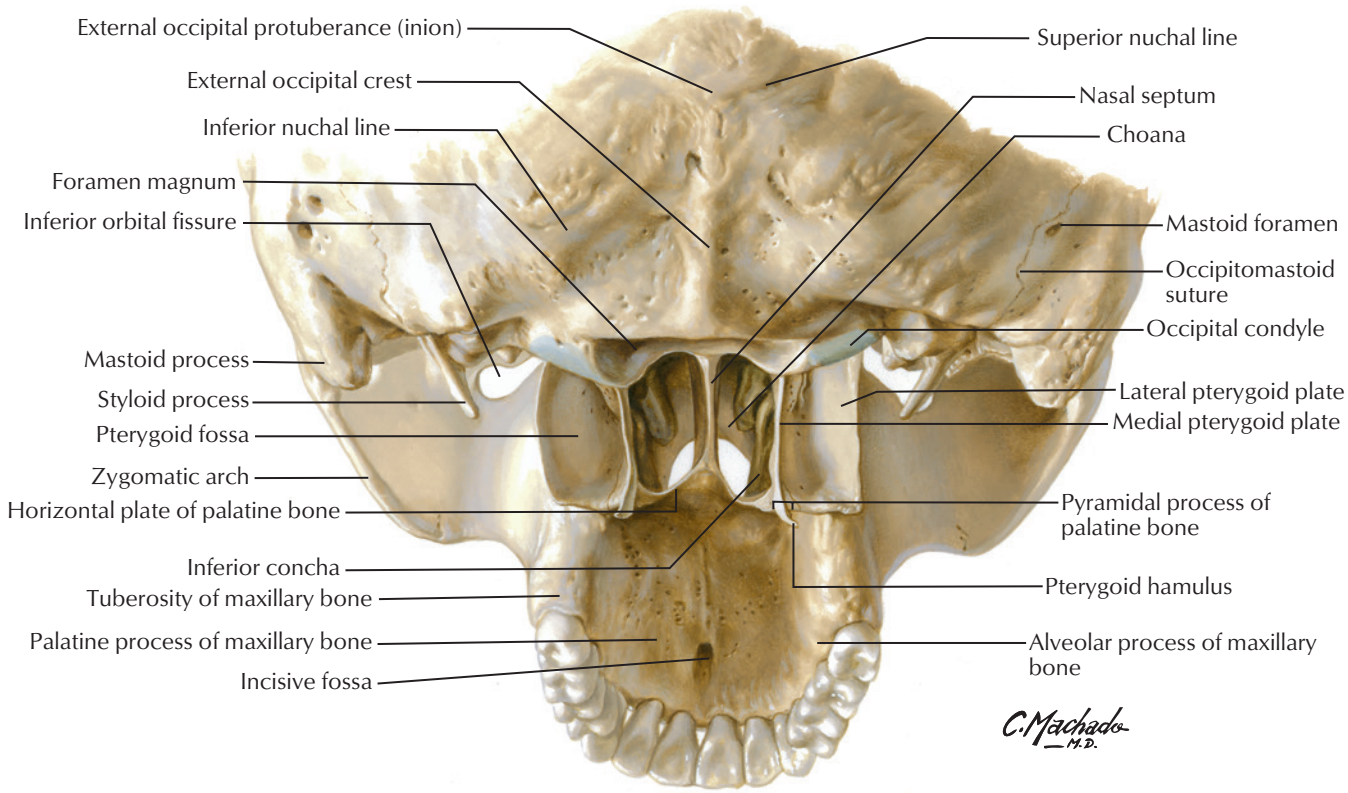


See also Plates 13, 26

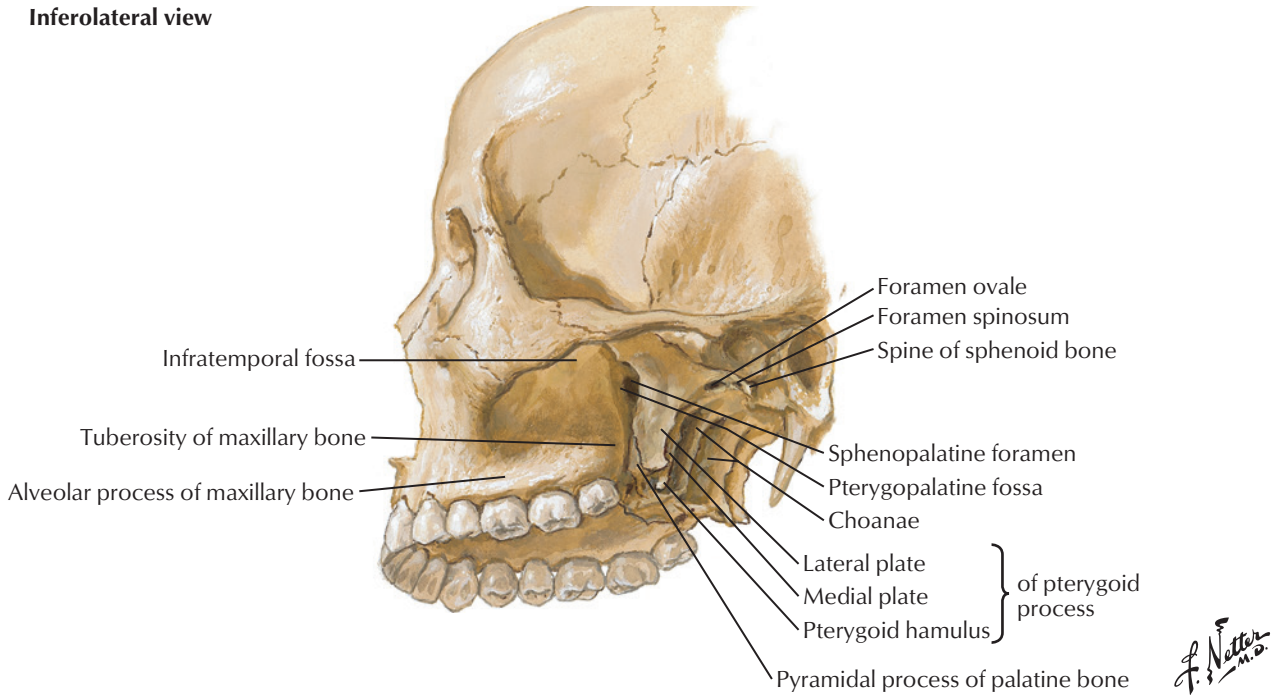


See also Plates 46, 47, 48

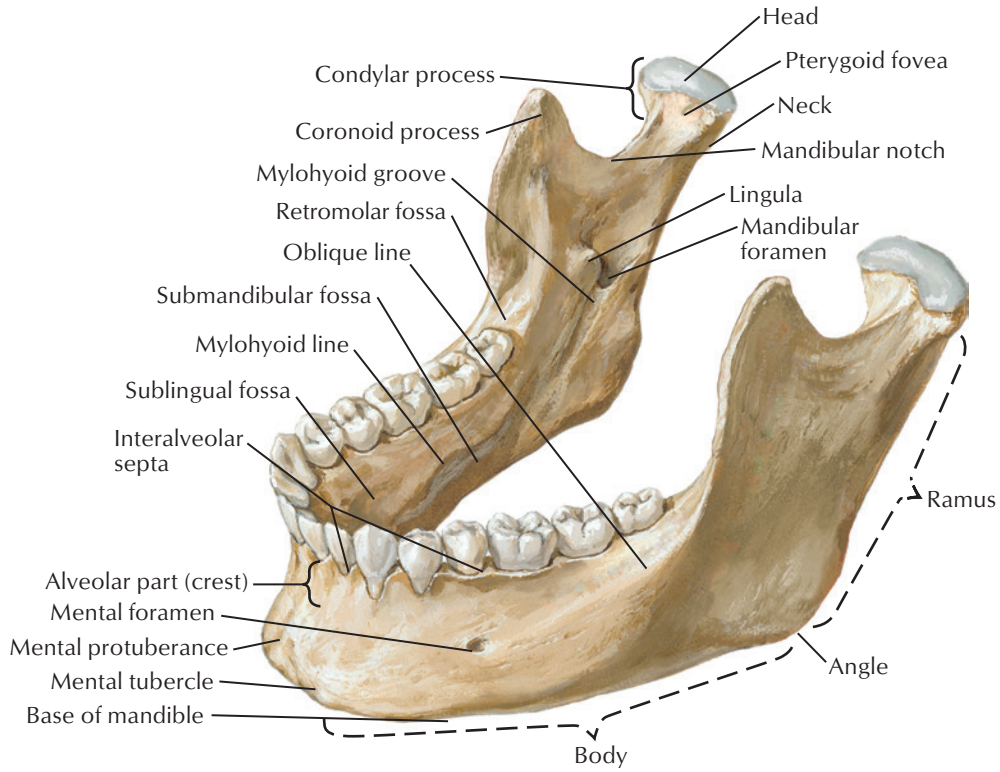
Posterior view

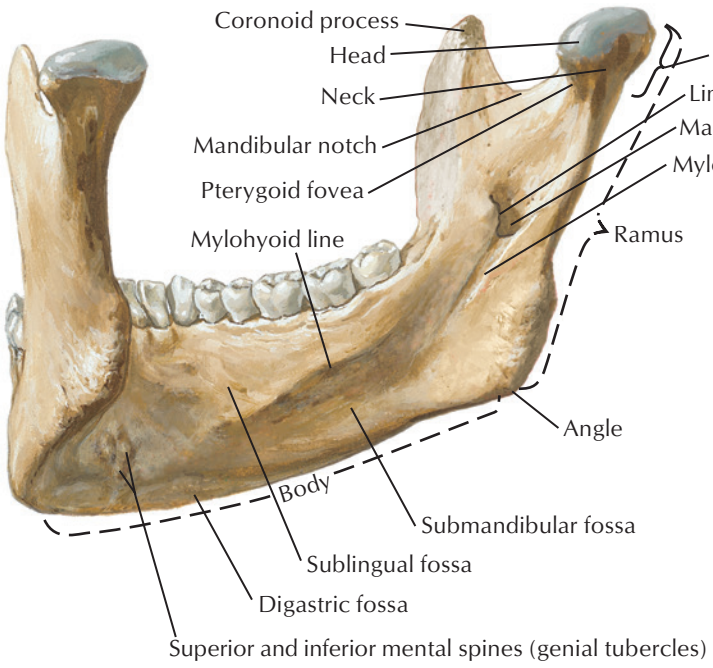


Inferolateral view



See also Plates 55, 56

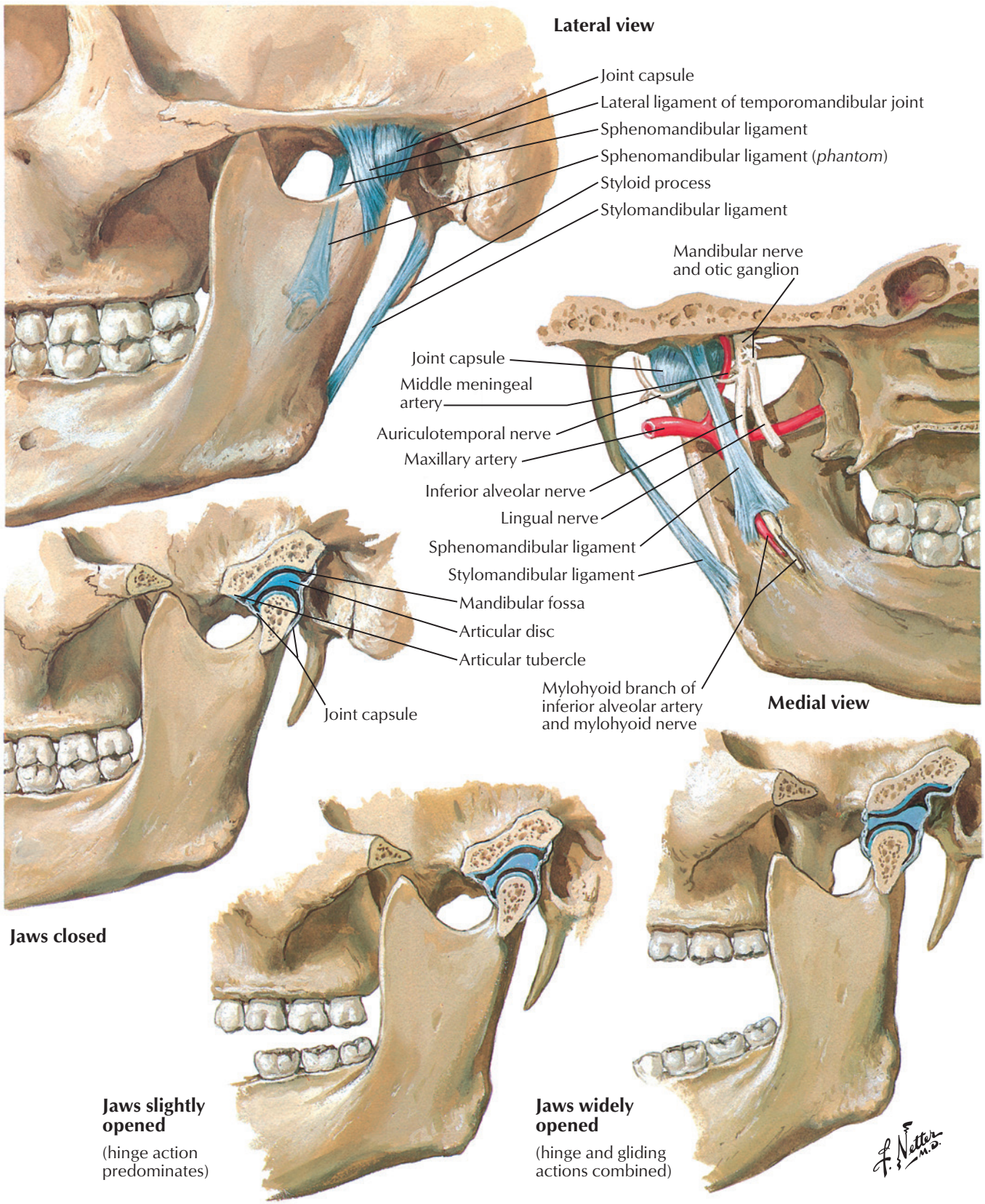


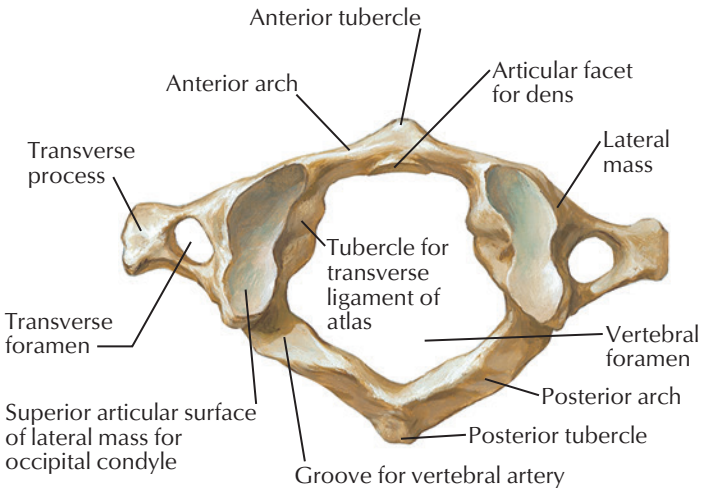




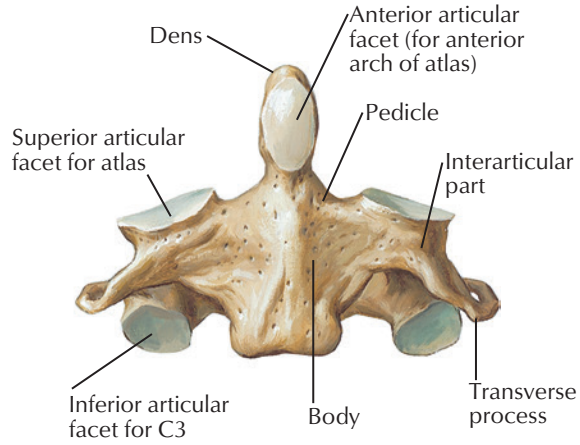
Mandible of aged person (edentulous)

See also Plate 56

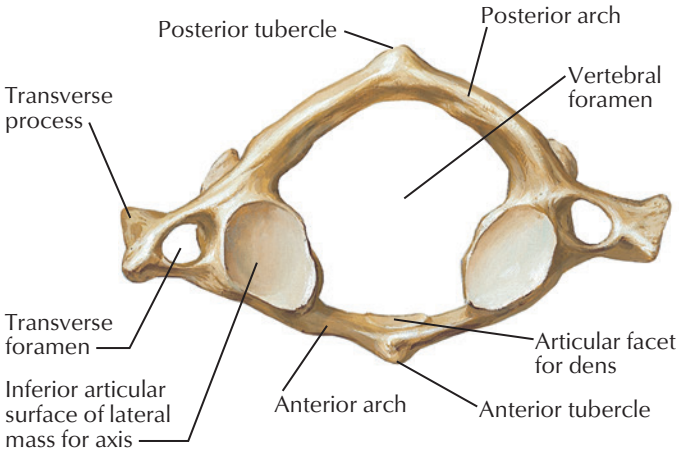




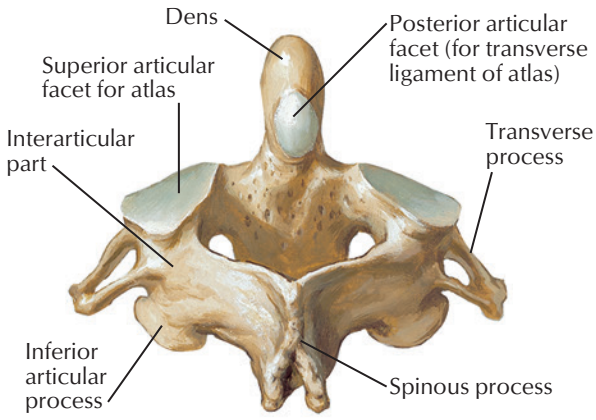
Atlas (C1): superior view



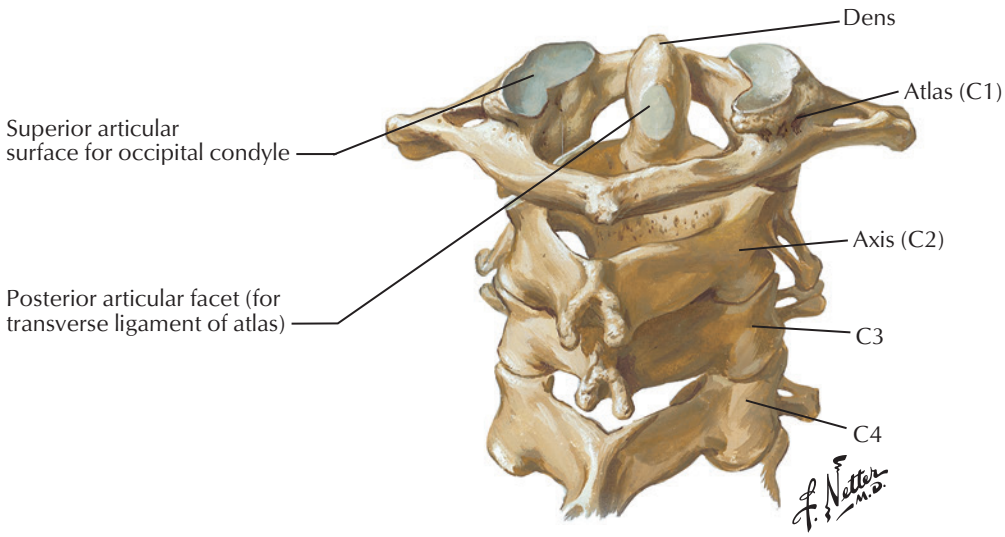
Axis (C2): anterior view



Atlas (C1): inferior view

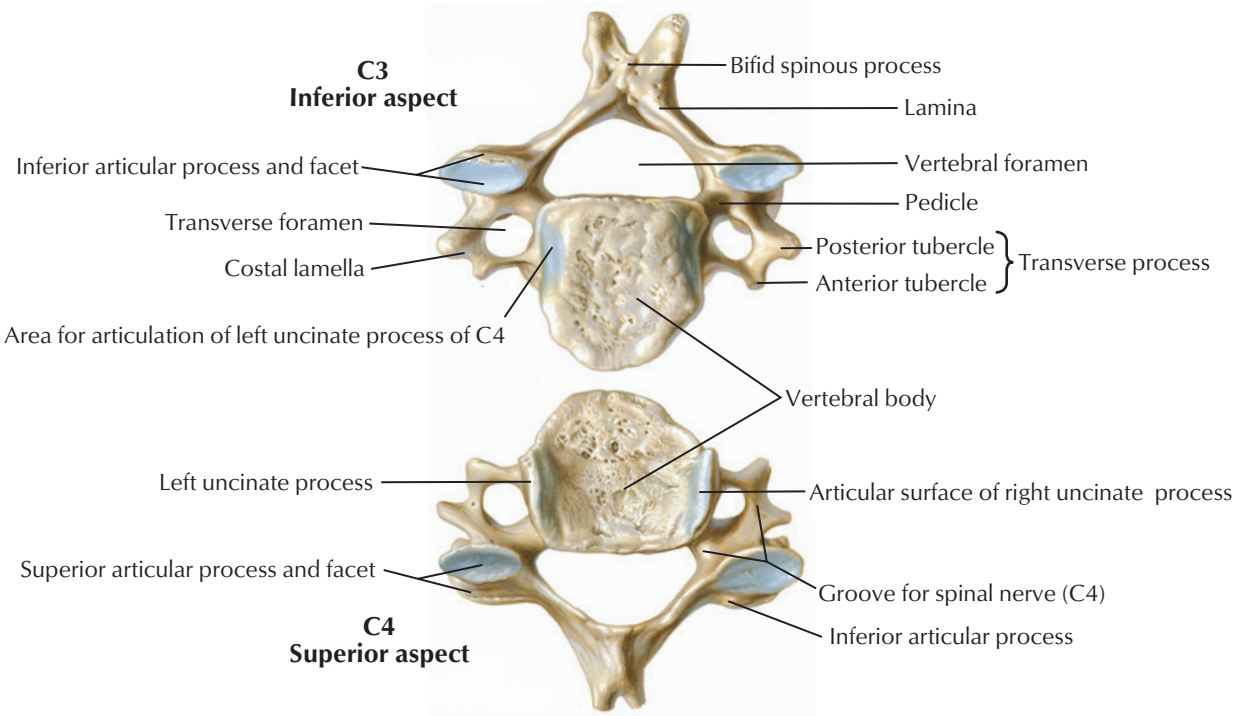


Axis (C2): posterosuperior view

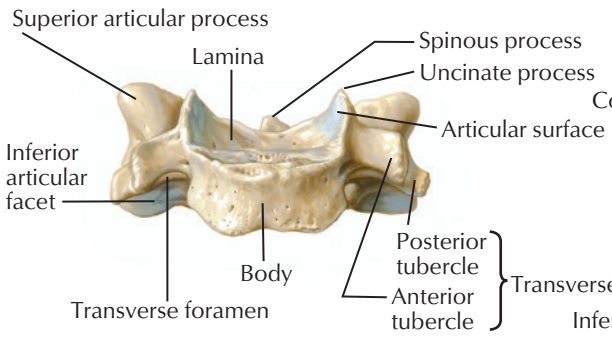


Upper cervical vertebrae, assembled: posterosuperior view

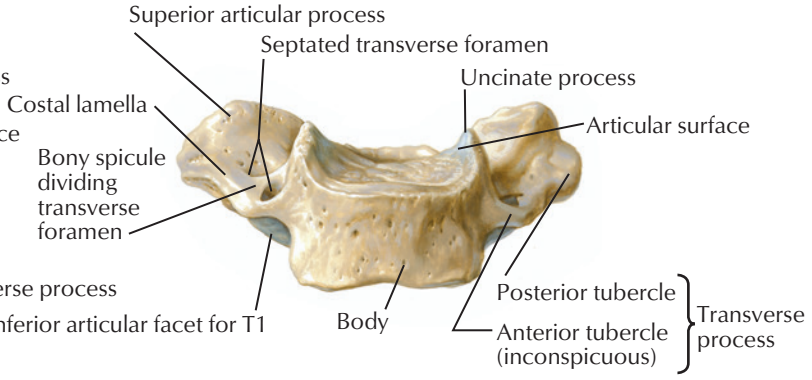
Inferior aspect of C3 and superior aspect of C4 showing the sites of the facet and uncovertebral articulations



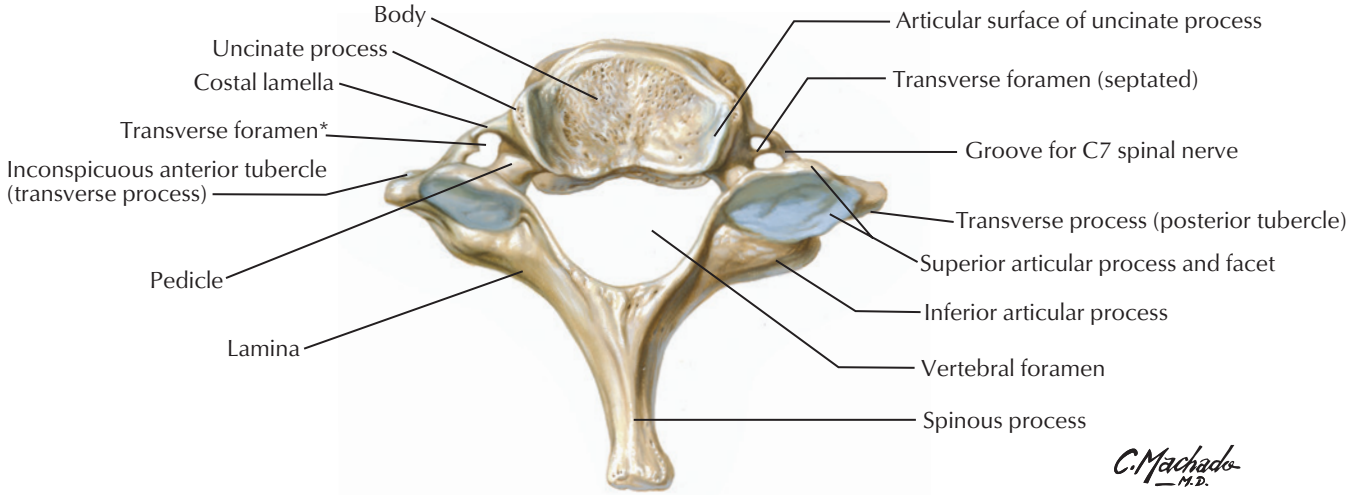
4th cervical vertebra: anterior view



7th cervical vertebra: anterior view

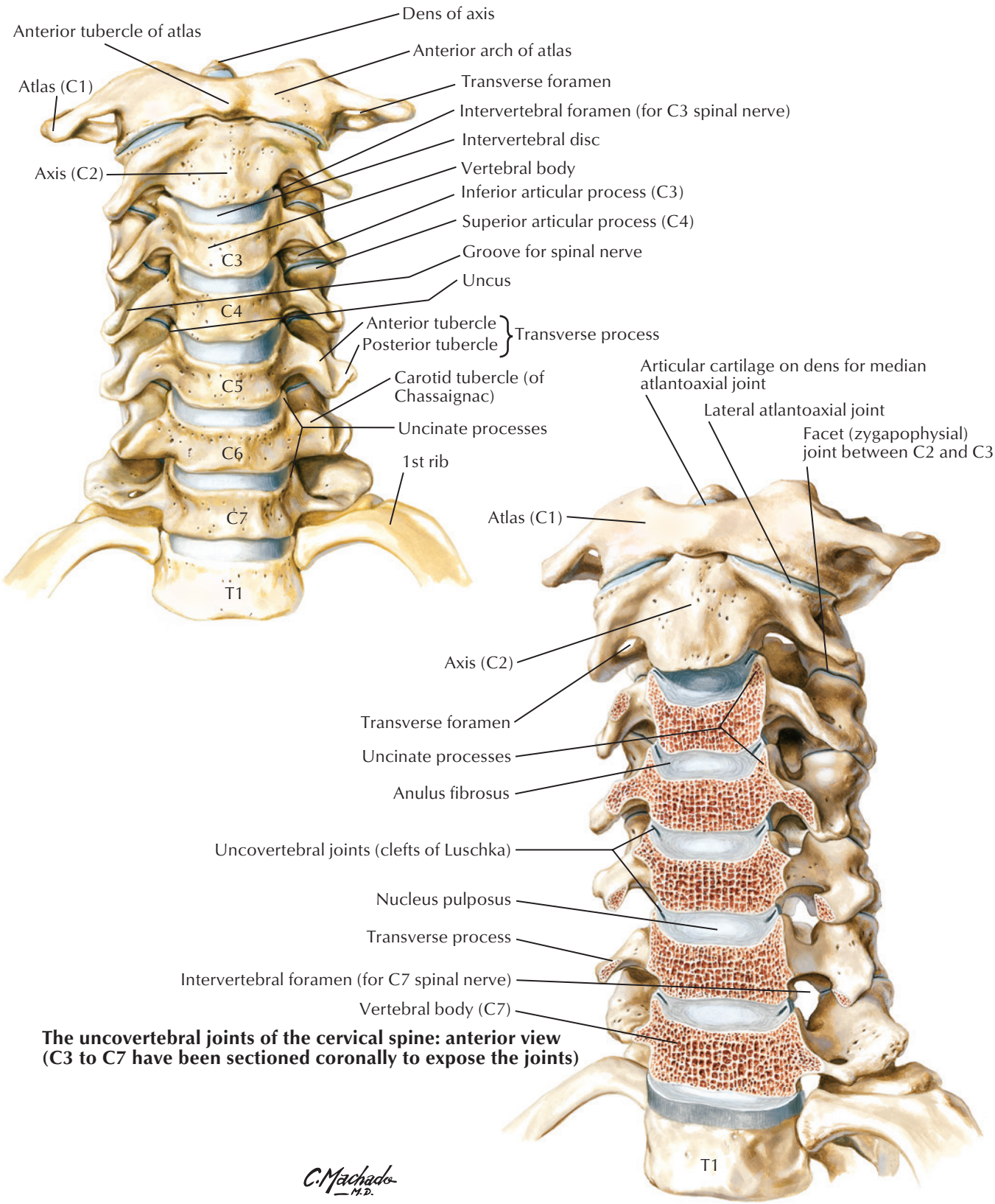


7th cervical vertebra (vertebra prominens): superior view



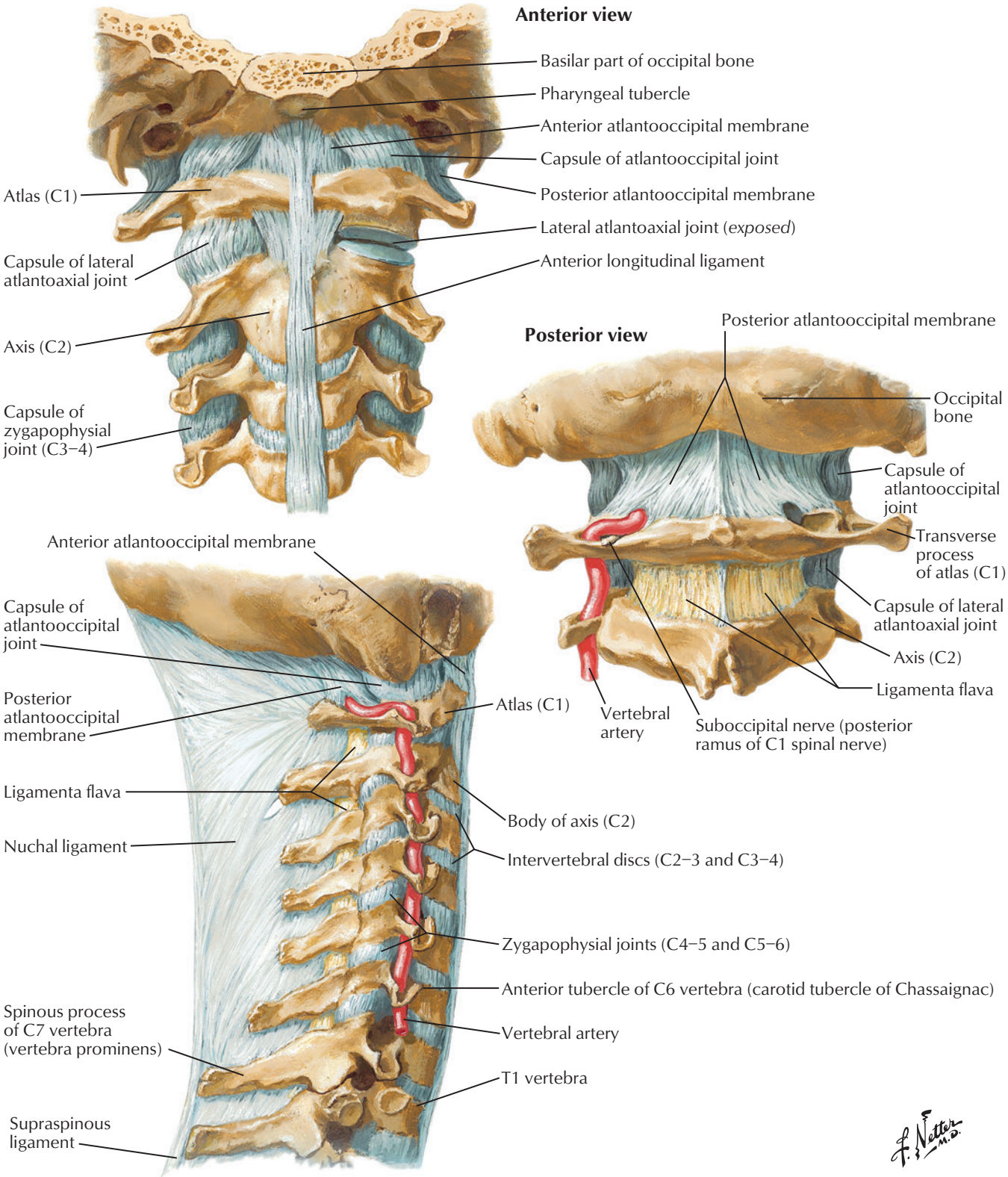
**The foramina transversaria of C7 transmit vertebral veins, but usually not the vertebral artery, and are asymmetrical in this specimen.*

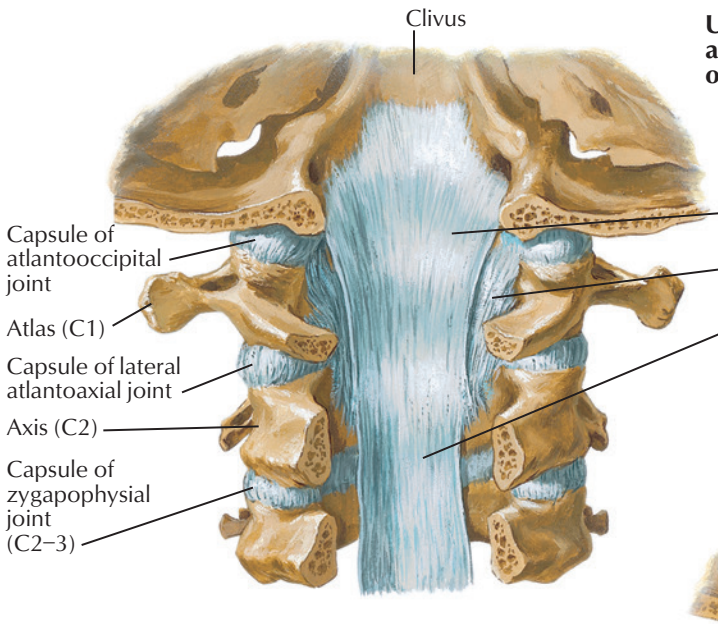
Cervical vertebrae: anterior view



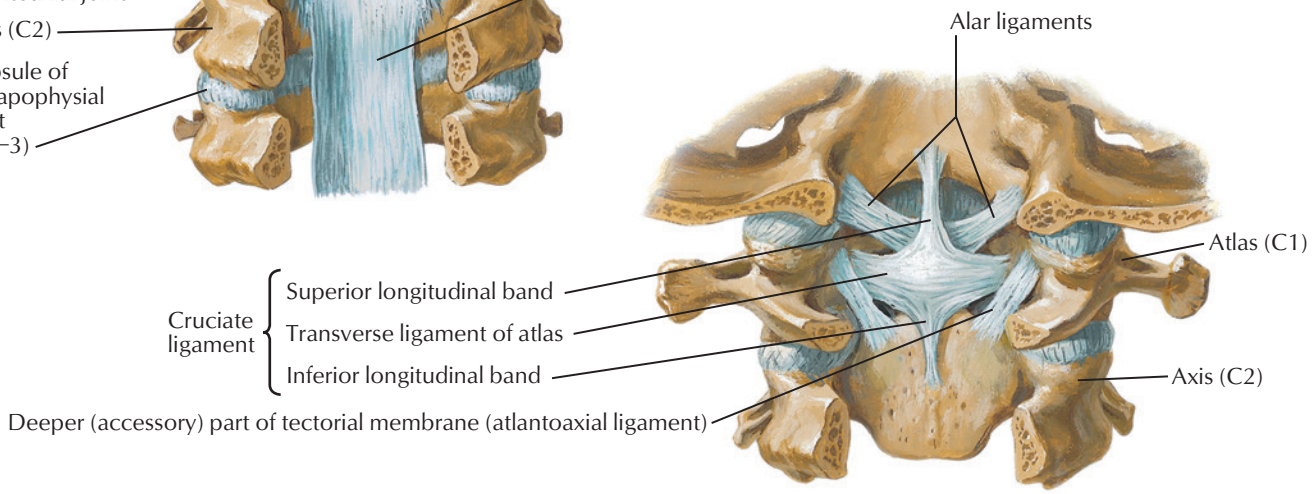
The uncovertebral joints of the cervical spine: anterior view (C3 to C7 have been sectioned coronally to expose the joints)

C. Machado M.D.

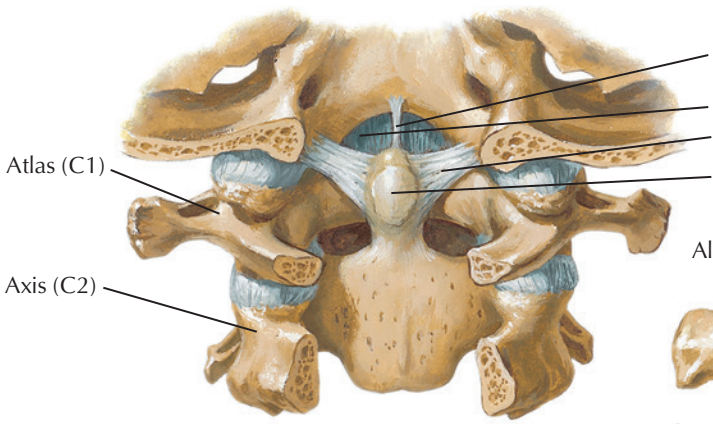

Anterior view
Basilar part of occipital bone
Pharyngeal tubercle
Anterior atlantooccipital membrane
Capsule of atlantooccipital joint
Posterior atlantooccipital membrane
Lateral atlantoaxial joint (exposed)
Anterior longitudinal ligament
Atlas (C1)
Capsule of lateral atlantoaxial joint
Axis (C2)
Capsule of zygapophysial joint (C3–4)
Posterior view
Posterior atlantooccipital membrane
Occipital bone
Capsule of atlantooccipital joint
Transverse process of atlas (C1)
Capsule of lateral atlantoaxial joint
Axis (C2)
Ligamenta flava
Vertebral artery
Suboccipital nerve (posterior ramus of C1 spinal nerve)
Anterior atlantooccipital membrane
Capsule of atlantooccipital joint
Posterior atlantooccipital membrane
Atlas (C1)
Ligamenta flava
Nuchal ligament
Body of axis (C2)
Intervertebral discs (C2–3 and C3–4)
Zygapophysial joints (C4–5 and C5–6)
Anterior tubercle of C6 vertebra (carotid tubercle of Chassaignac)
Vertebral artery
T1 vertebra
Spinous process of C7 vertebra (vertebra prominens)
Supraspinous ligament
Right lateral view



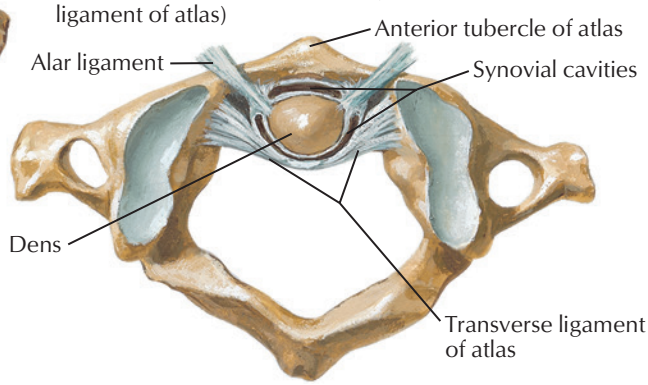
Upper part of vertebral canal with spinous processes and parts of vertebral arches removed to expose ligaments on posterior vertebral bodies: posterior view



Principal part of tectorial membrane removed to expose deeper ligaments: posterior view

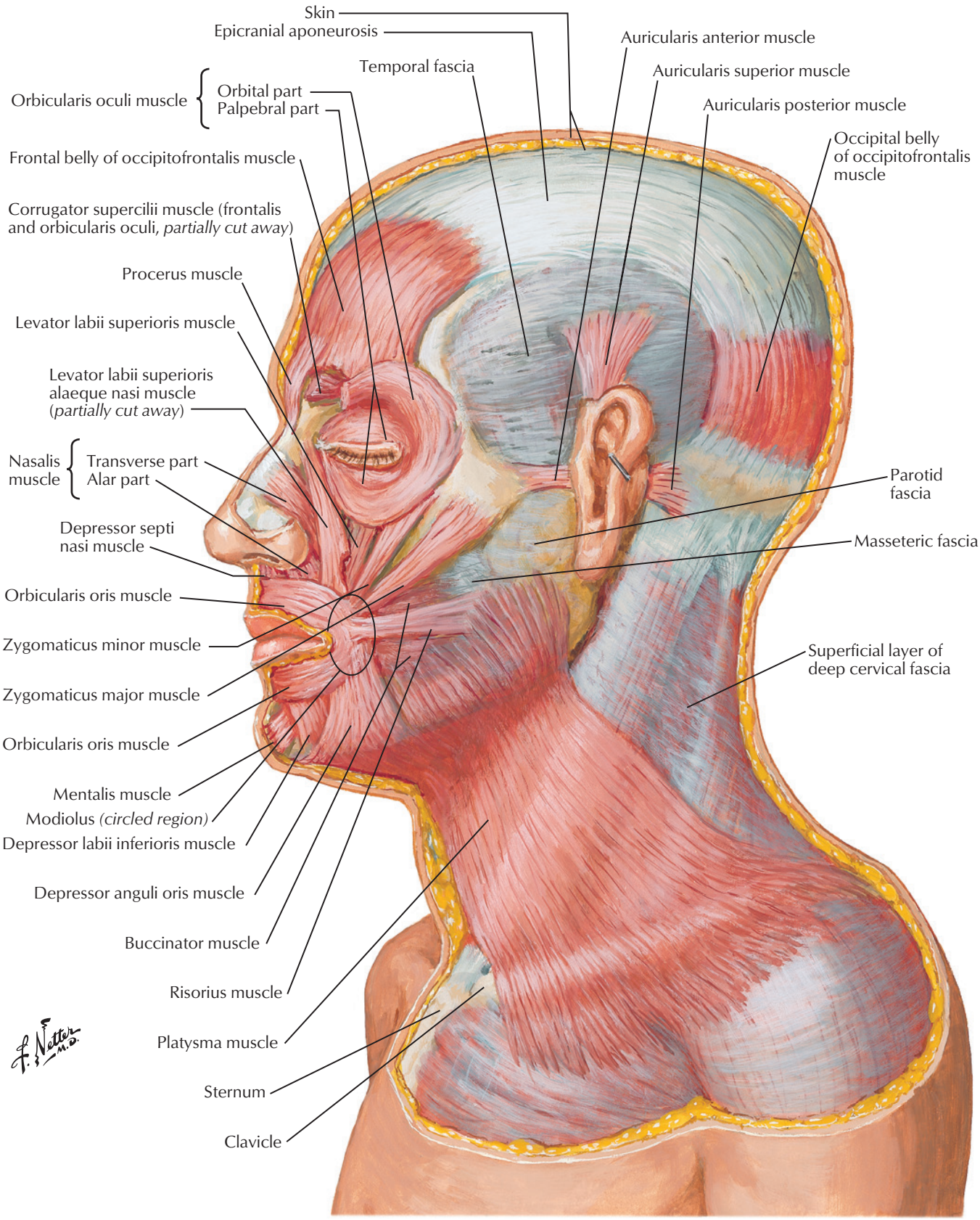


Cruciate ligament removed to show deeper ligaments: posterior view

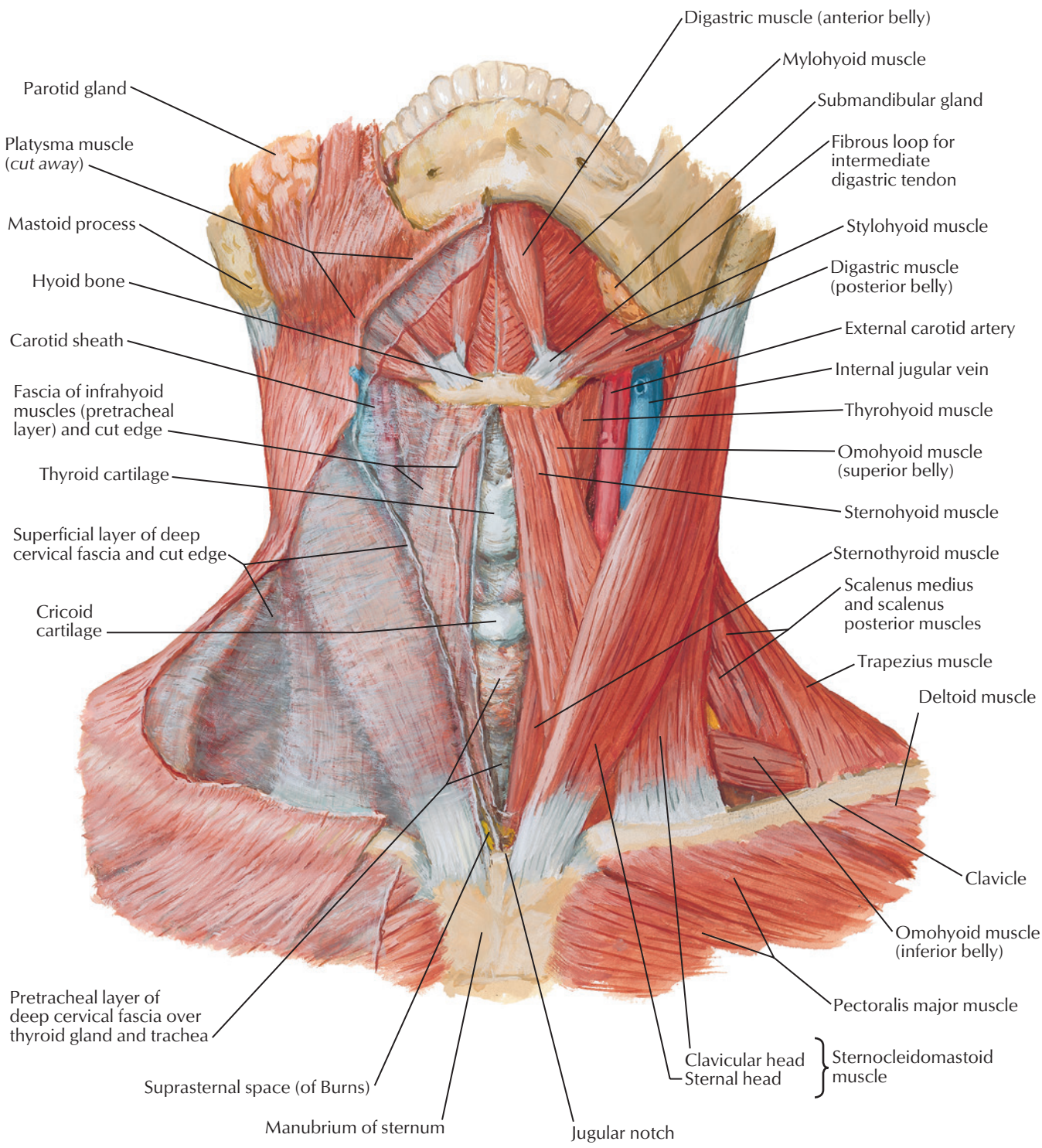


Median atlantoaxial joint: superior view

See also Plates 34, 55, 56

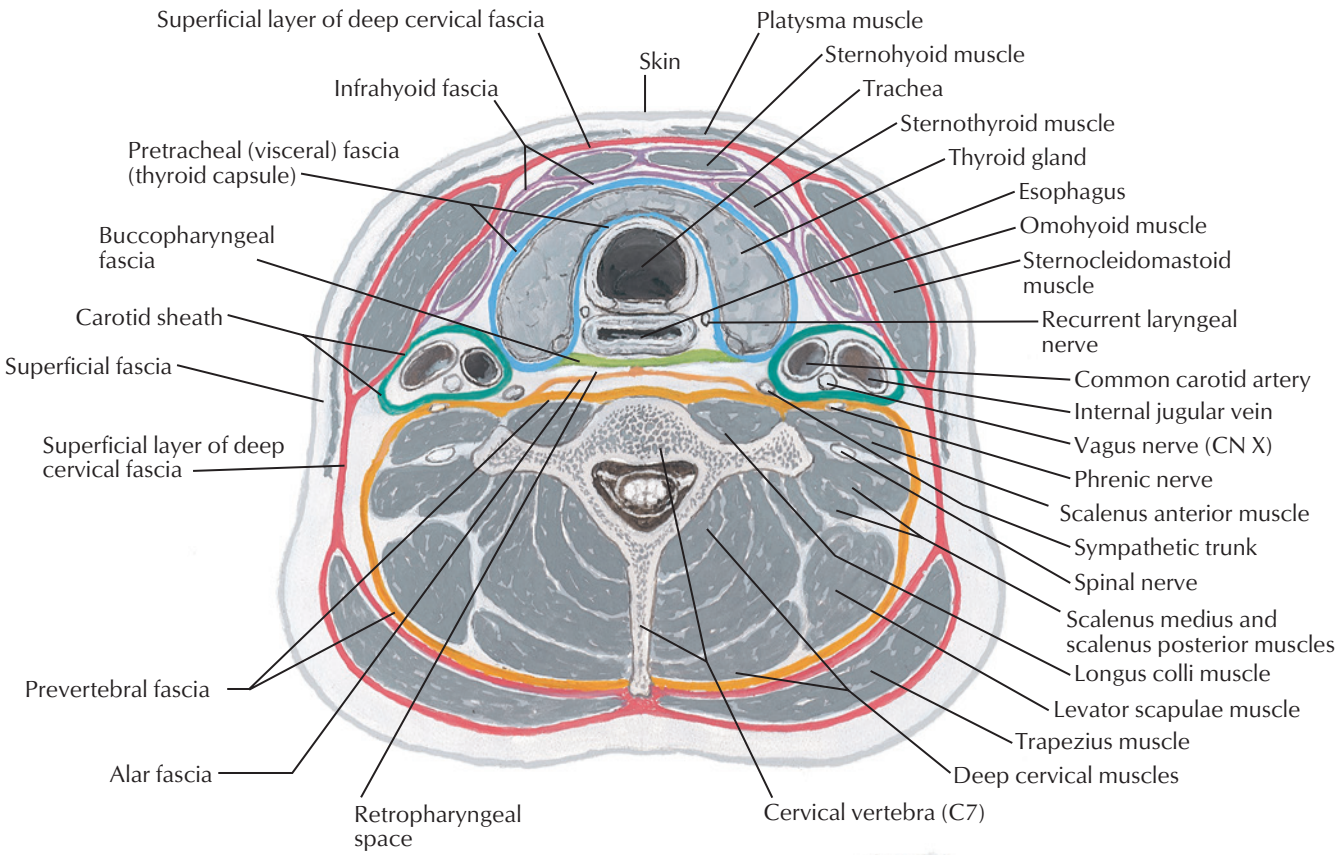


See also Plates 33, 35, 38

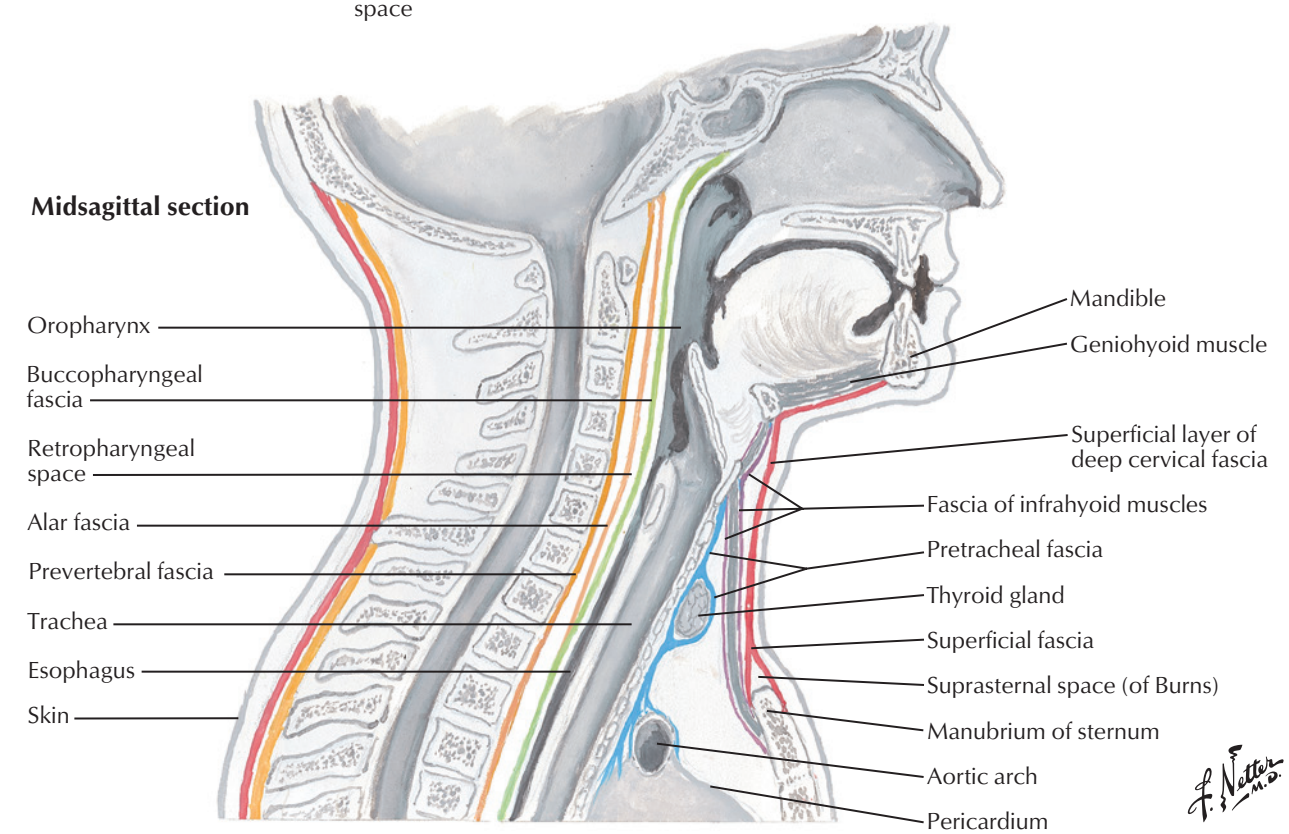


See also Plate 32

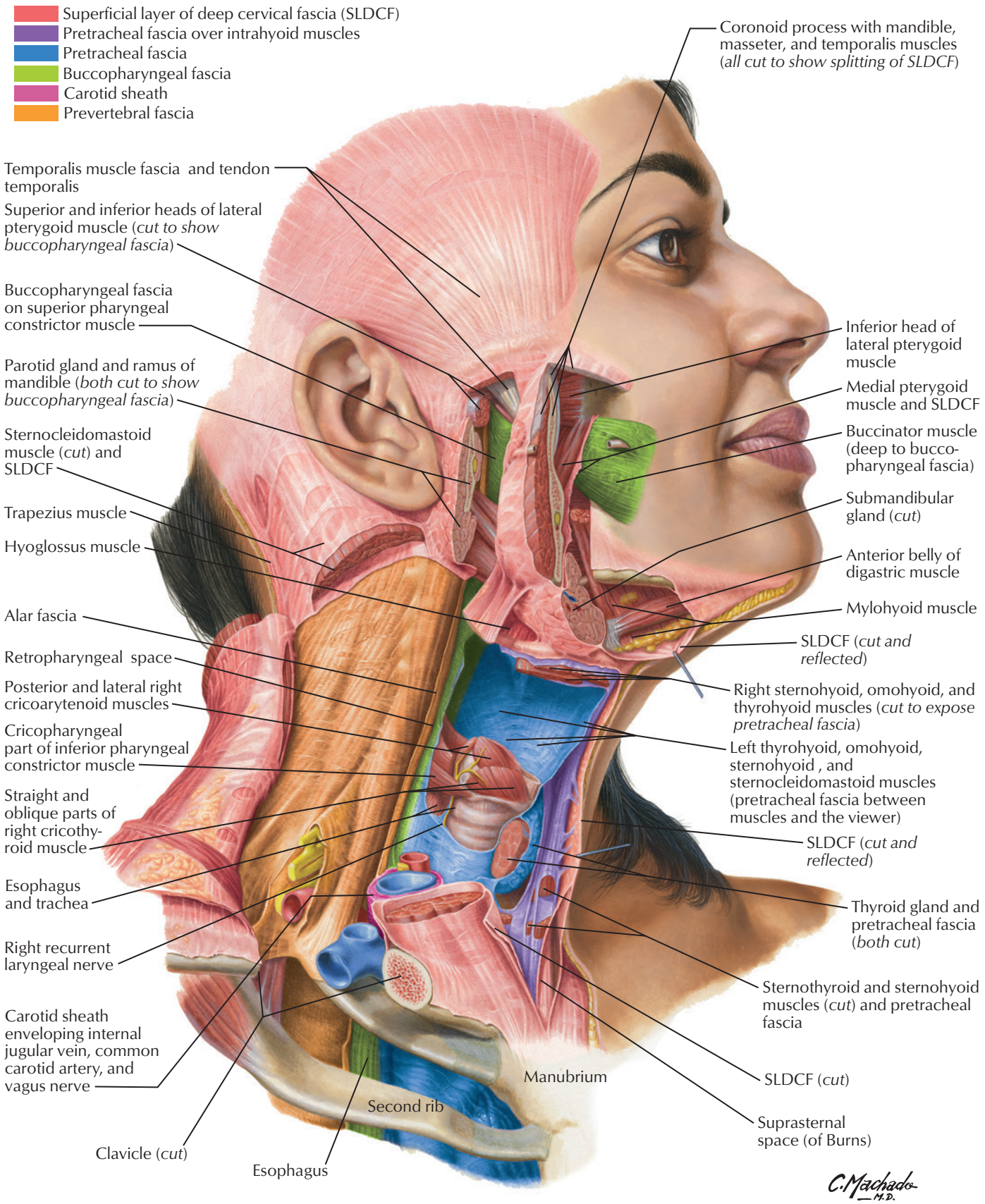
Cross section



Midsagittal section

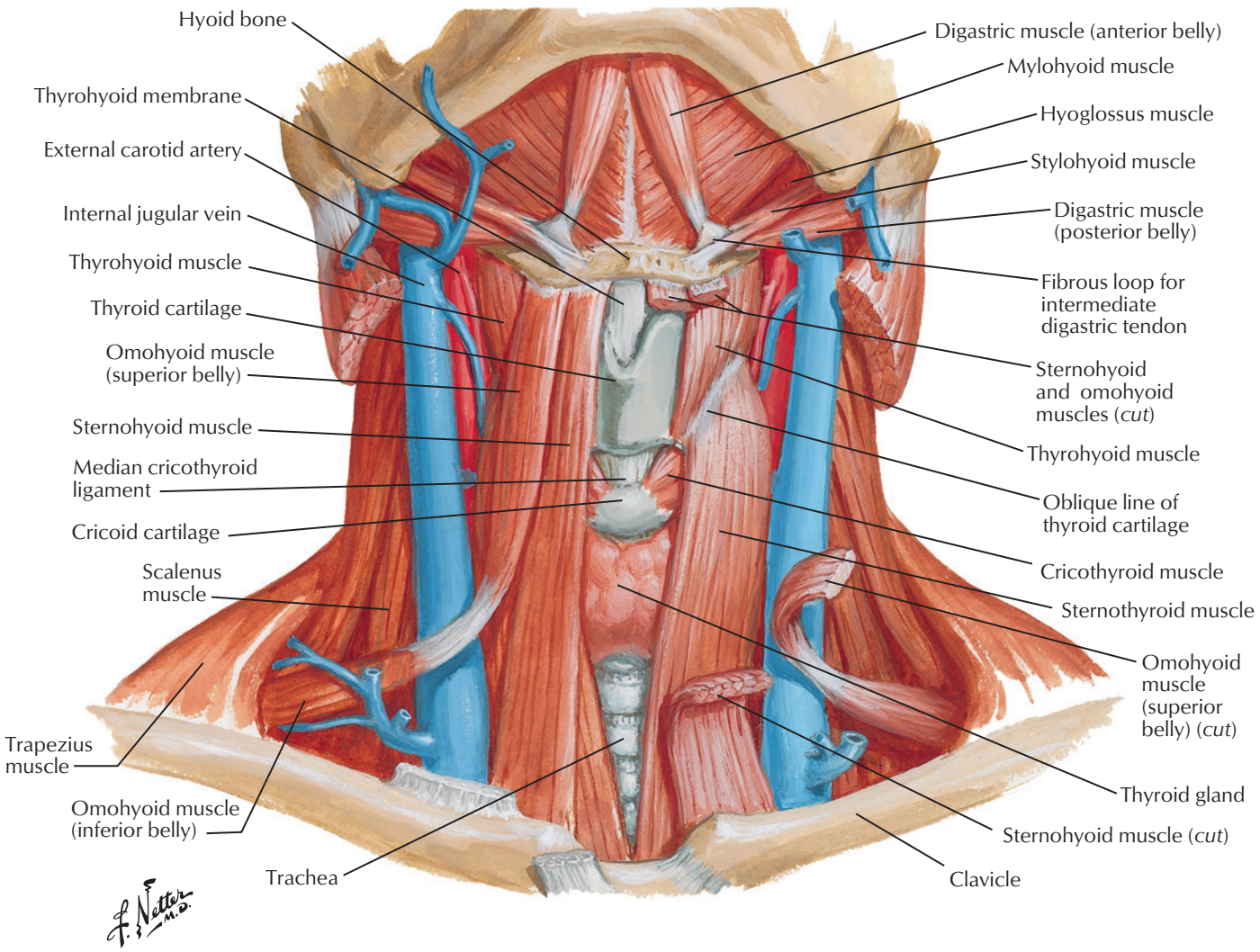


See also Plates 32, 33, 38

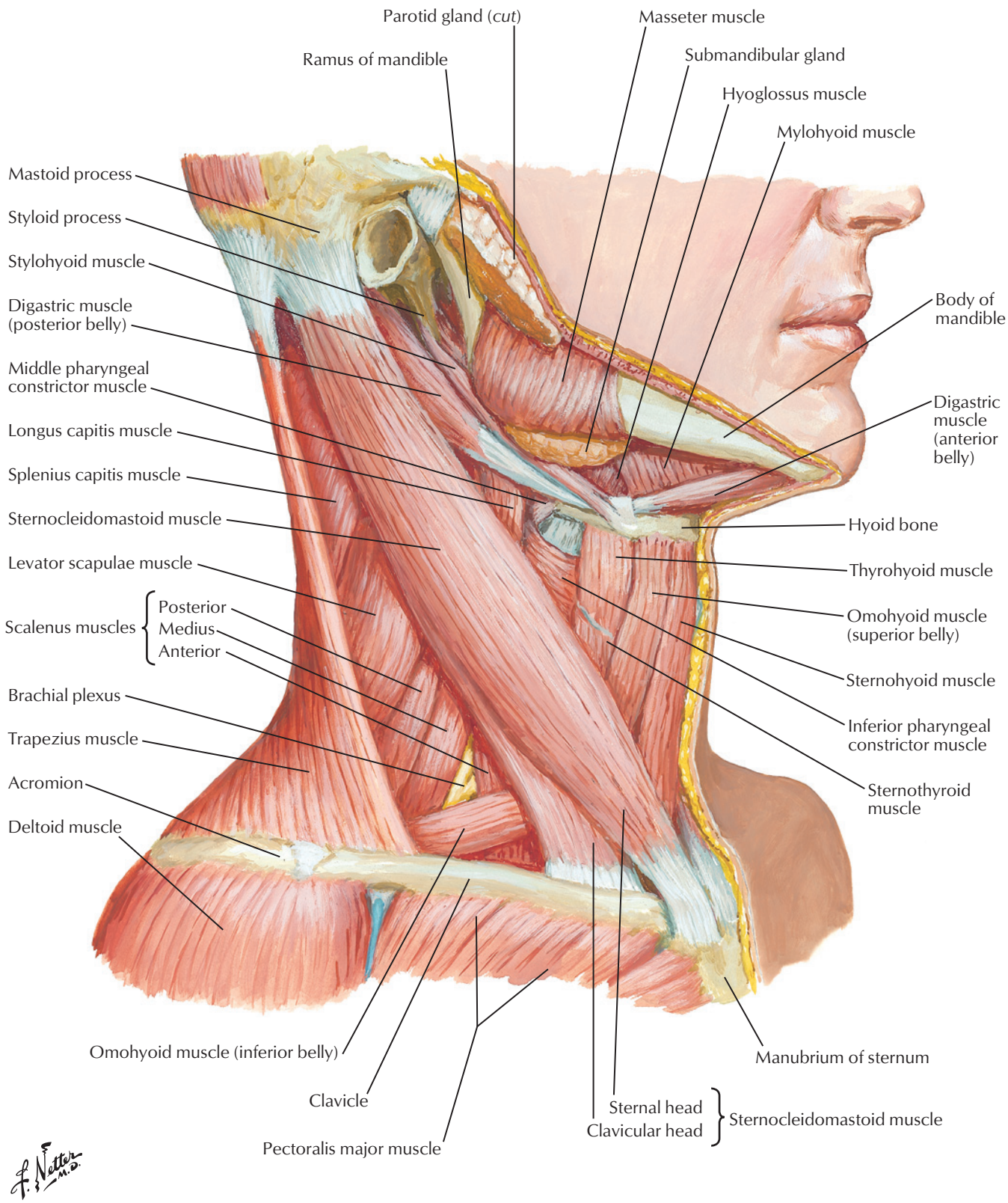


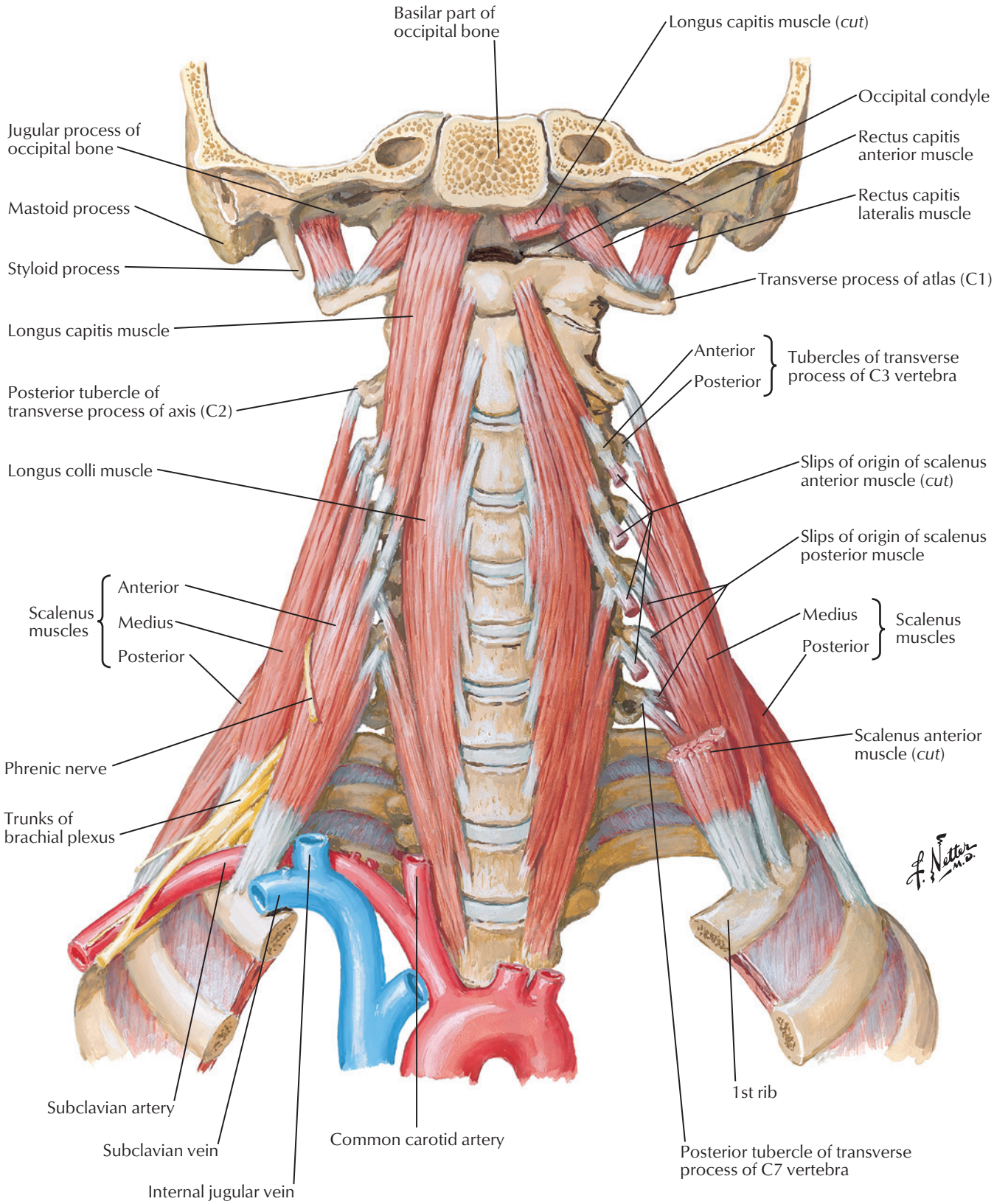
SLDCF: Superficial layer of deep cervical fascia

See also Plates 32, 36, 69

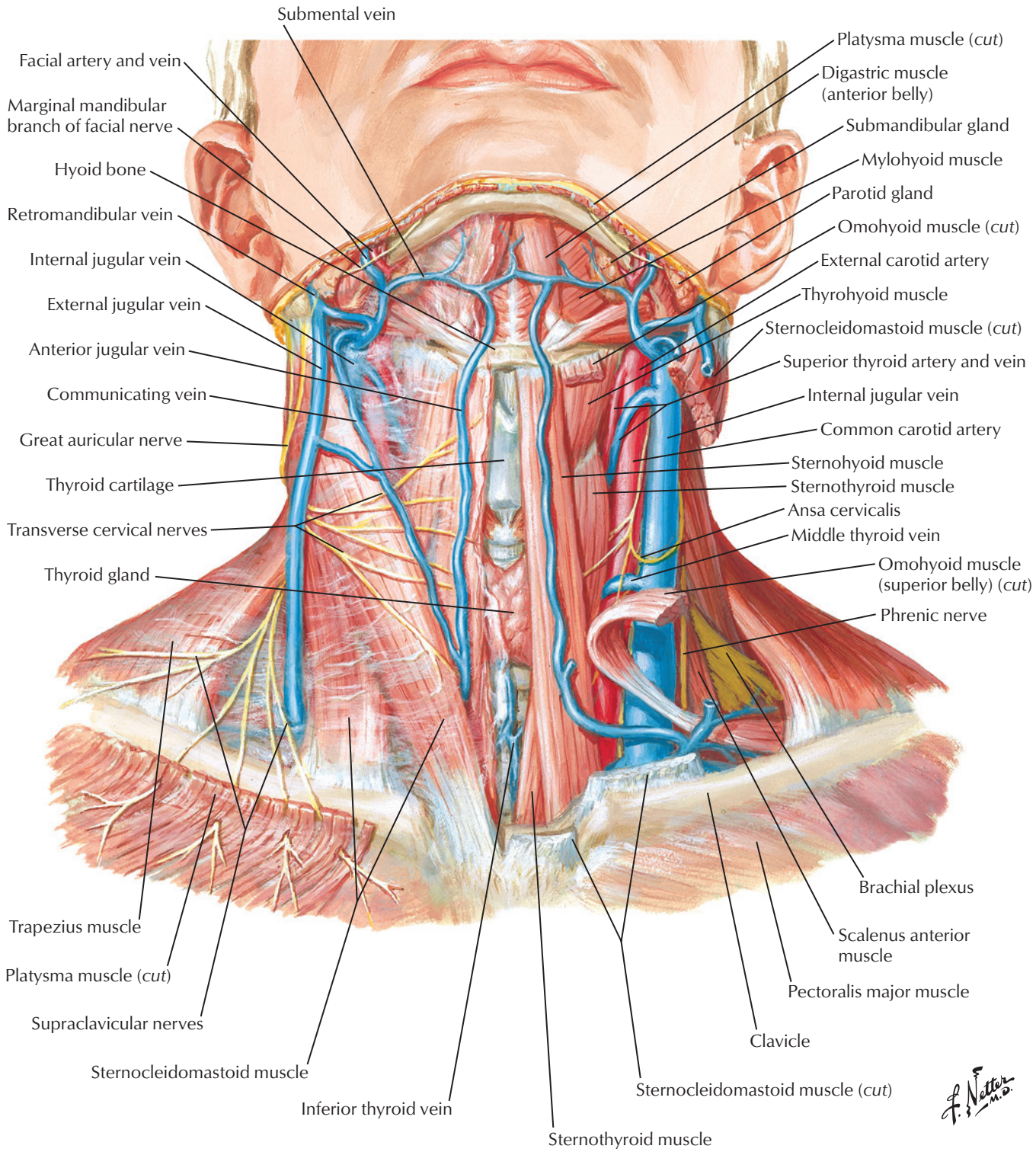


See also Plates 32, 35, 38

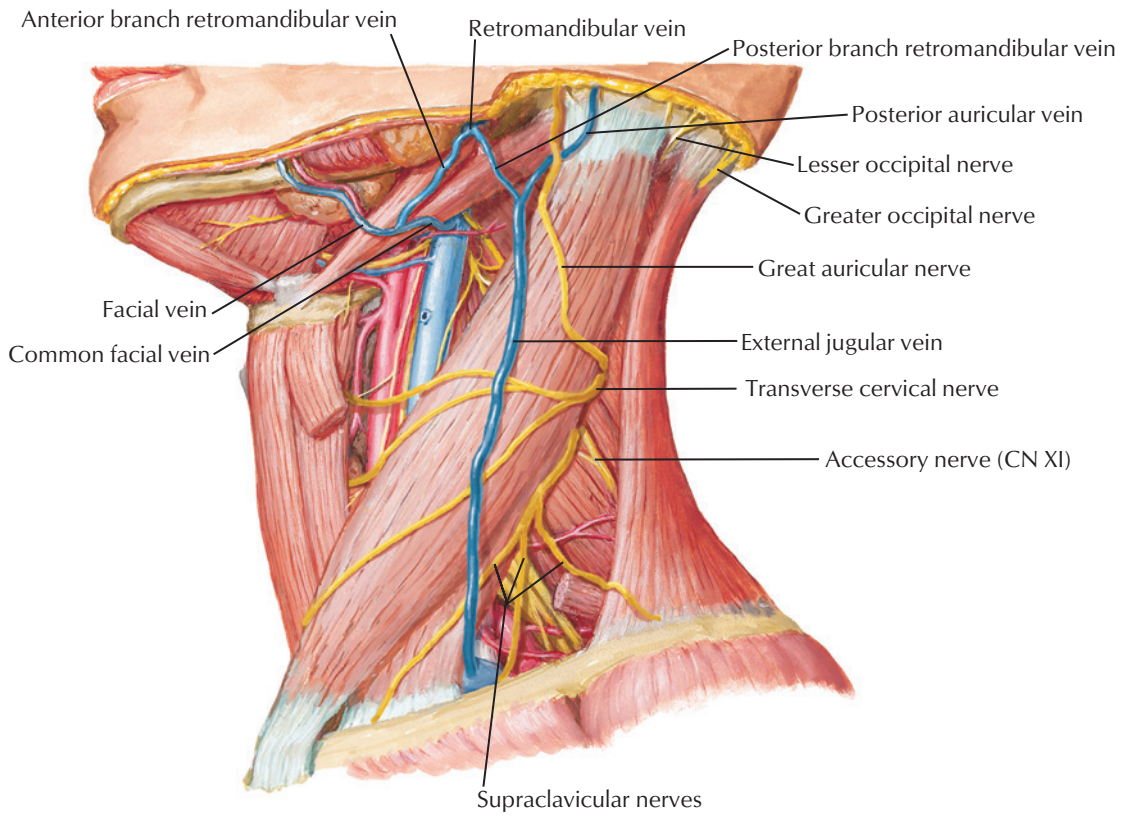


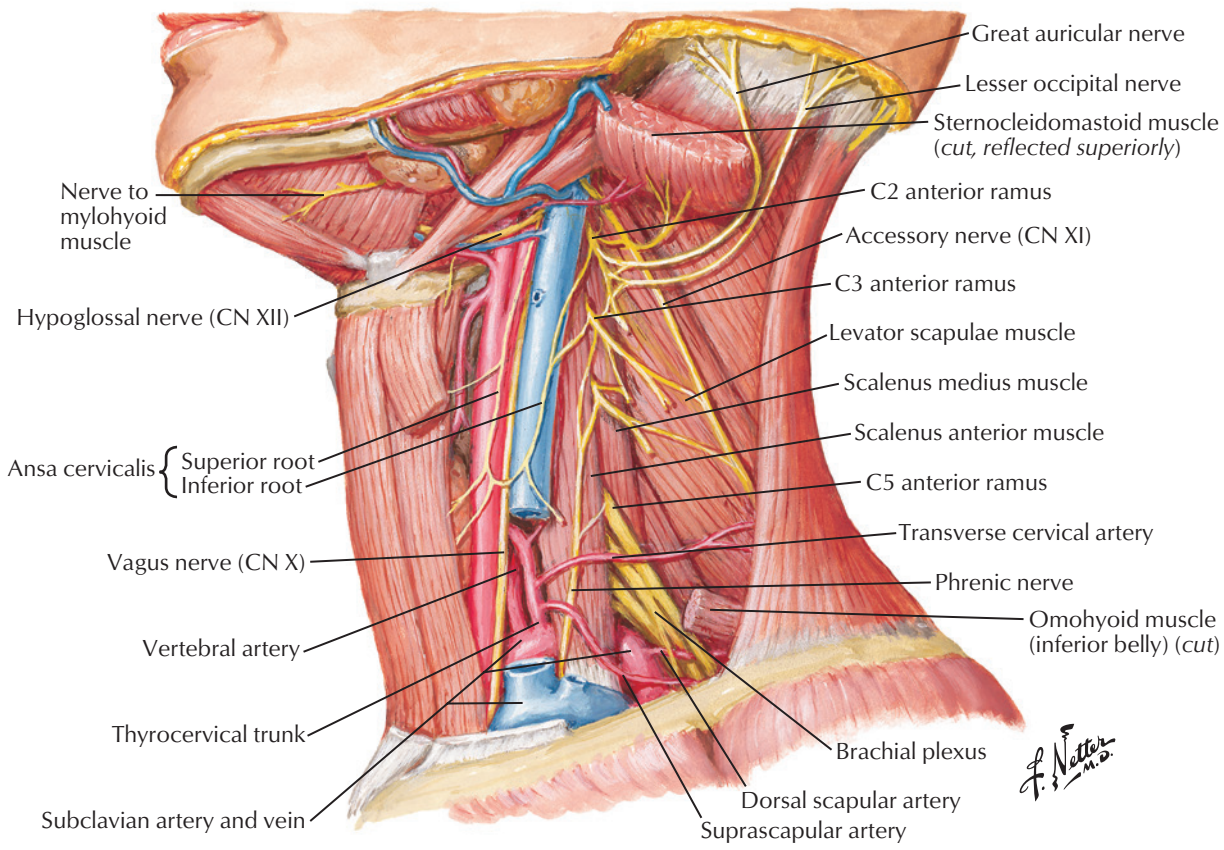

Basilar part of occipital bone
Longus capitis muscle (*cut*)
Occipital condyle
Jugular process of occipital bone
Rectus capitis anterior muscle
Mastoid process
Rectus capitis lateralis muscle
Styloid process
Transverse process of atlas (C1)
Longus capitis muscle
Anterior
Posterior
Tubercles of transverse process of C3 vertebra
Posterior tubercle of transverse process of axis (C2)
Longus colli muscle
Slips of origin of scalenus anterior muscle (*cut*)
Slips of origin of scalenus posterior muscle
Scalenus muscles
Anterior
Medius
Posterior
Medius
Posterior
Scalenus muscles
Scalenus anterior muscle (*cut*)
Phrenic nerve
Trunks of brachial plexus
Subclavian artery
Subclavian vein
Internal jugular vein
Common carotid artery
1st rib
Posterior tubercle of transverse process of C7 vertebra

For deep veins of neck see Plate 84



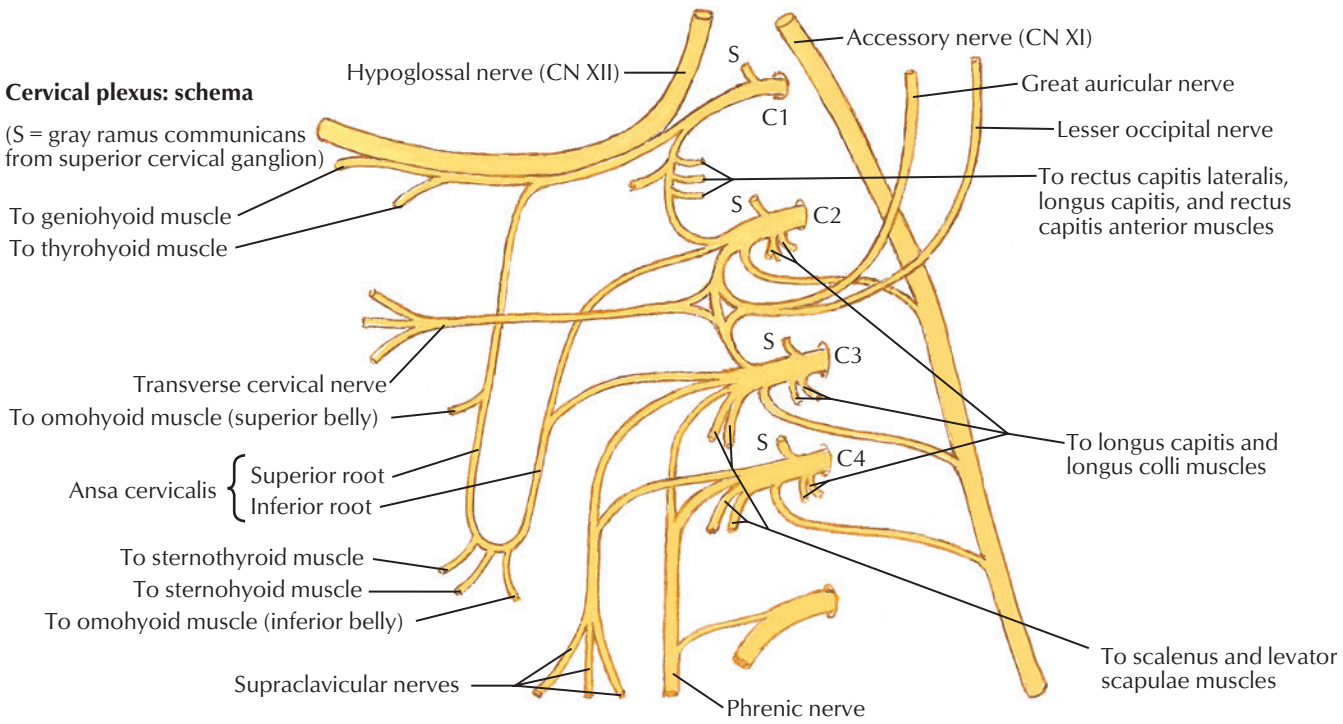
See also Plates 138, 139, 140



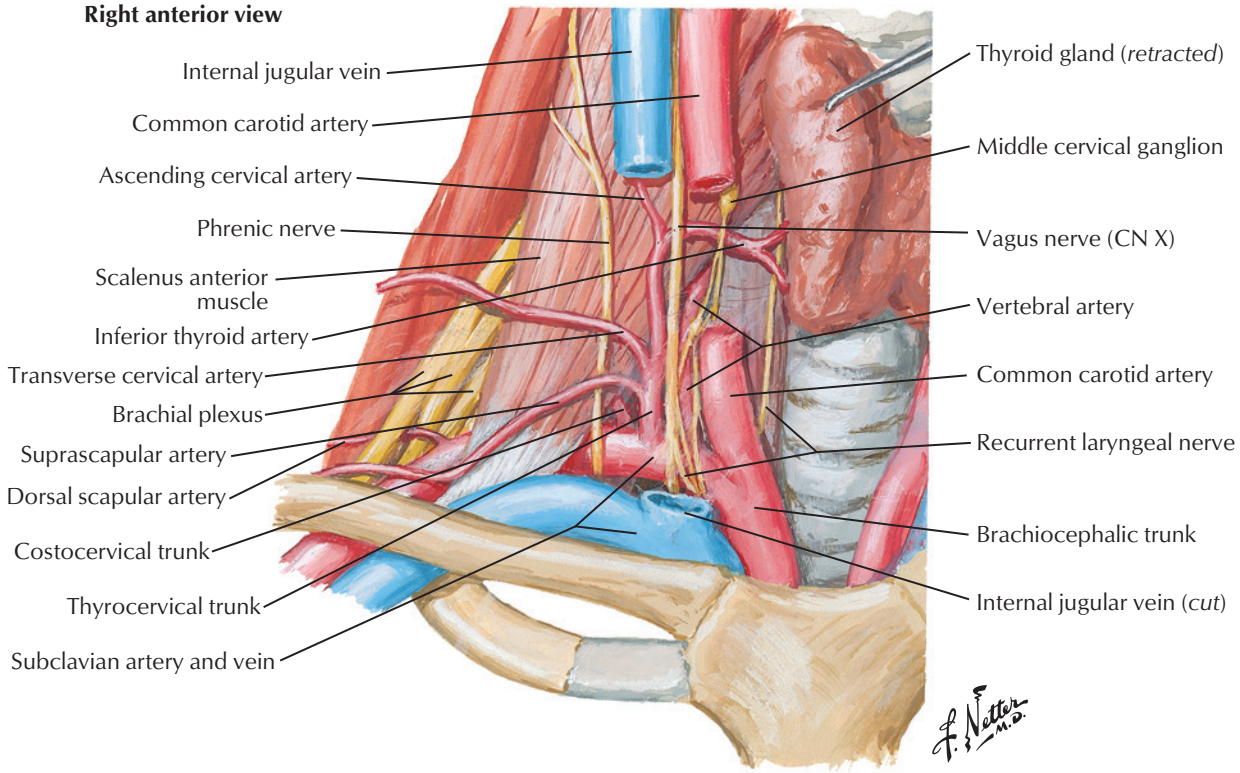


See also Plate 140

Cervical plexus: schema

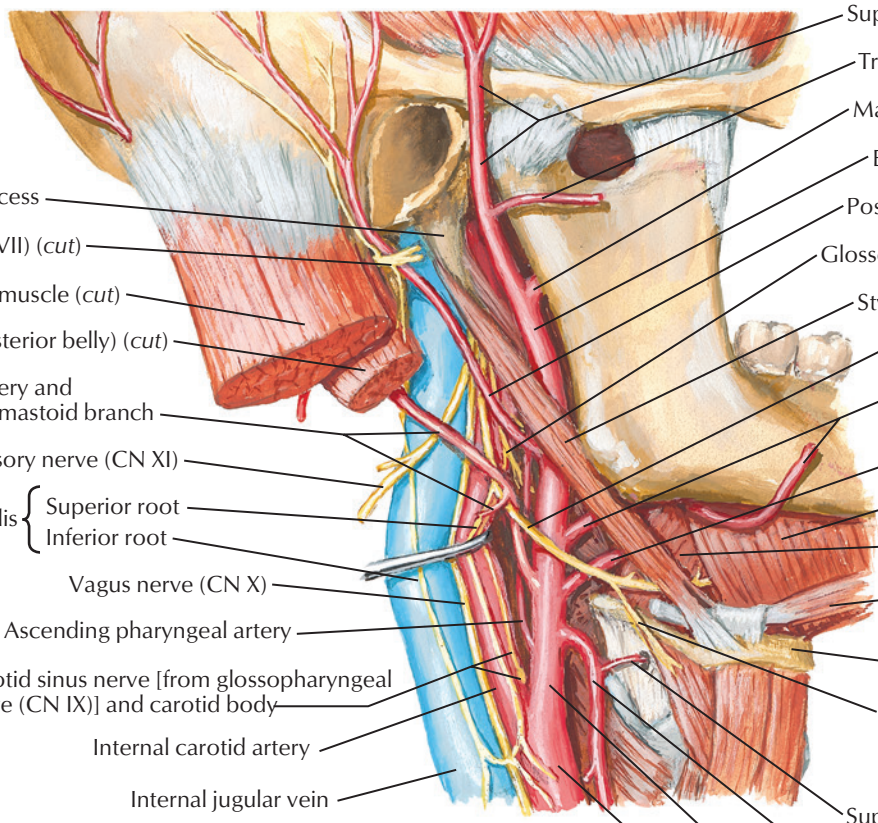


Right anterior view

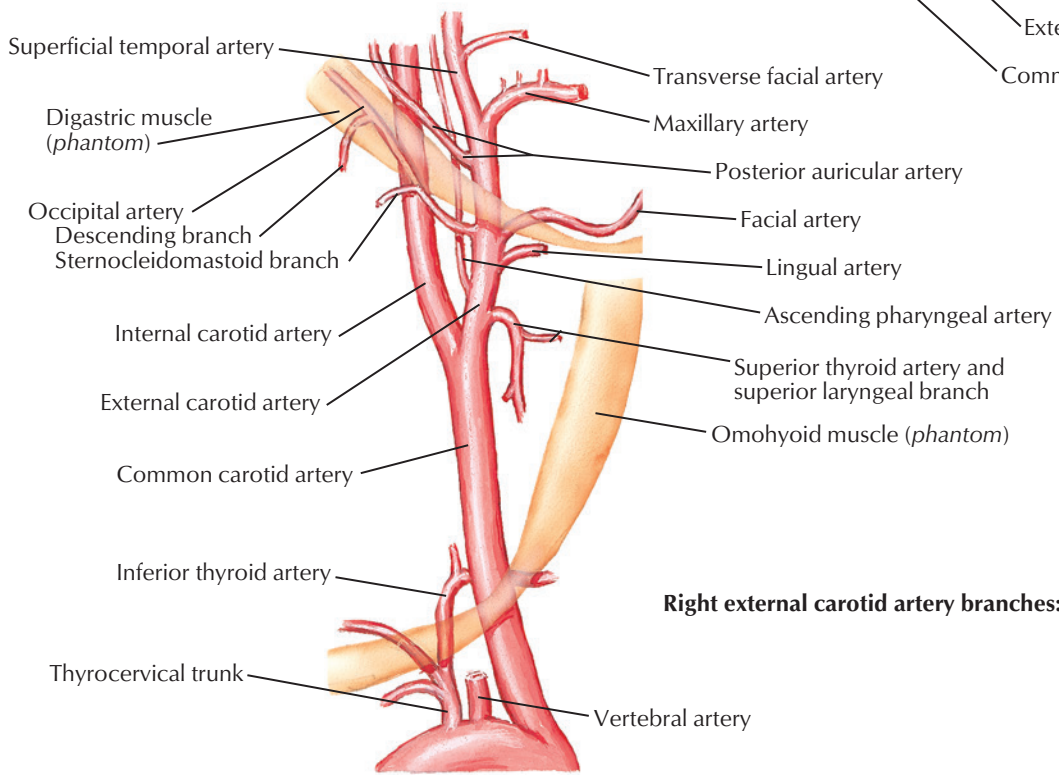


See also Plates 147, 149

Parotid space (bed): right lateral view



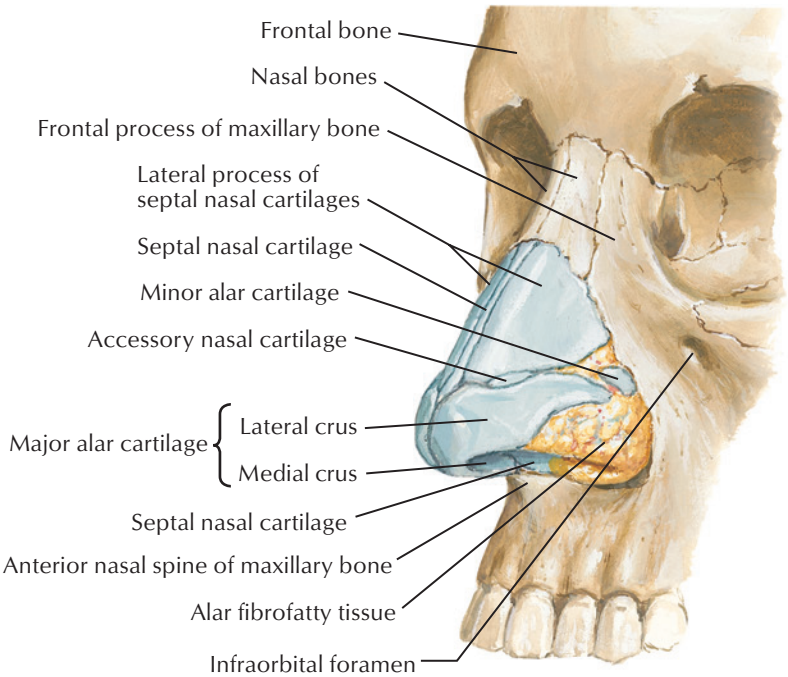
Superficial temporal artery
Transverse facial artery
Maxillary artery
External carotid artery
Posterior auricular artery
Glossopharyngeal nerve (CN IX)
Stylohyoid muscle
Hypoglossal nerve (CN XII)
Facial artery
Lingual artery
Mylohyoid muscle
Hyoglossus muscle
Digastric muscle (anterior belly)
Hyoid bone
Branch to thyrohyoid muscle
Superior laryngeal artery
Superior thyroid artery
External carotid artery
Common carotid artery
Styloid process
Facial nerve (CN VII) (*cut*)
Sternocleidomastoid muscle (*cut*)
Digastric muscle (posterior belly) (*cut*)
Occipital artery and sternocleidomastoid branch
Accessory nerve (CN XI)
Ansa cervicalis
Superior root
Inferior root
Vagus nerve (CN X)
Ascending pharyngeal artery
Carotid sinus nerve [from glossopharyngeal nerve (CN IX)] and carotid body
Internal carotid artery
Internal jugular vein



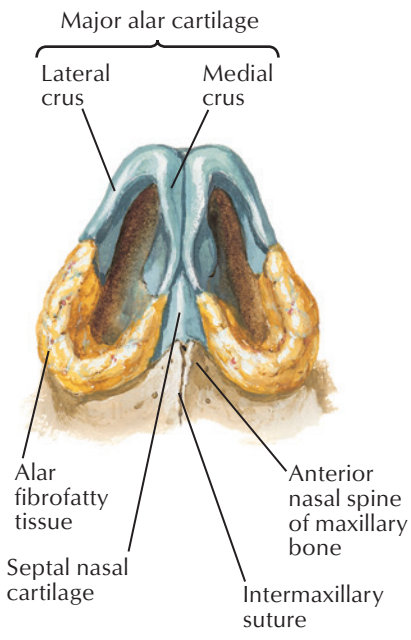
Superficial temporal artery
Transverse facial artery
Digastric muscle (*phantom*)
Maxillary artery
Posterior auricular artery
Occipital artery
Descending branch
Sternocleidomastoid branch
Facial artery
Lingual artery
Ascending pharyngeal artery
Internal carotid artery
Superior thyroid artery and superior laryngeal branch
External carotid artery
Omohyoid muscle (*phantom*)
Common carotid artery
Inferior thyroid artery
Thyrocervical trunk
Vertebral artery

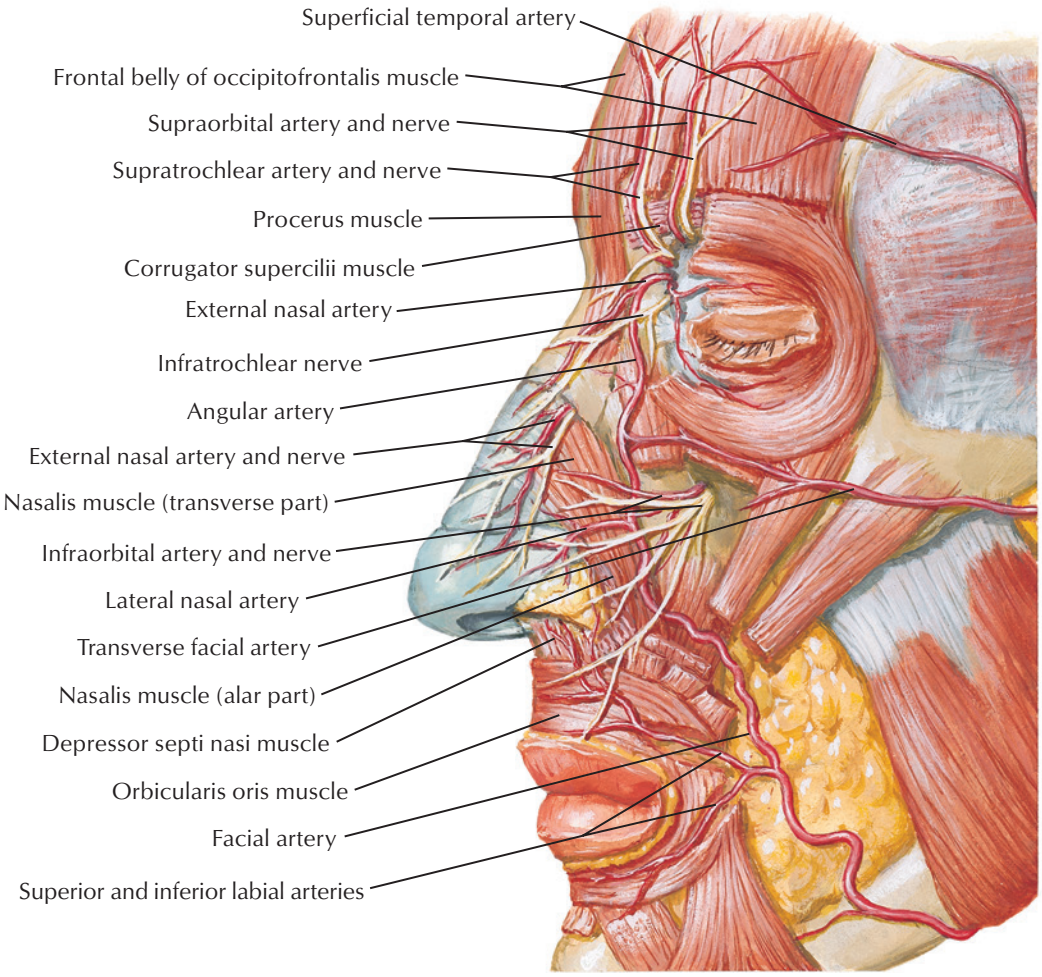
Right external carotid artery branches: schema

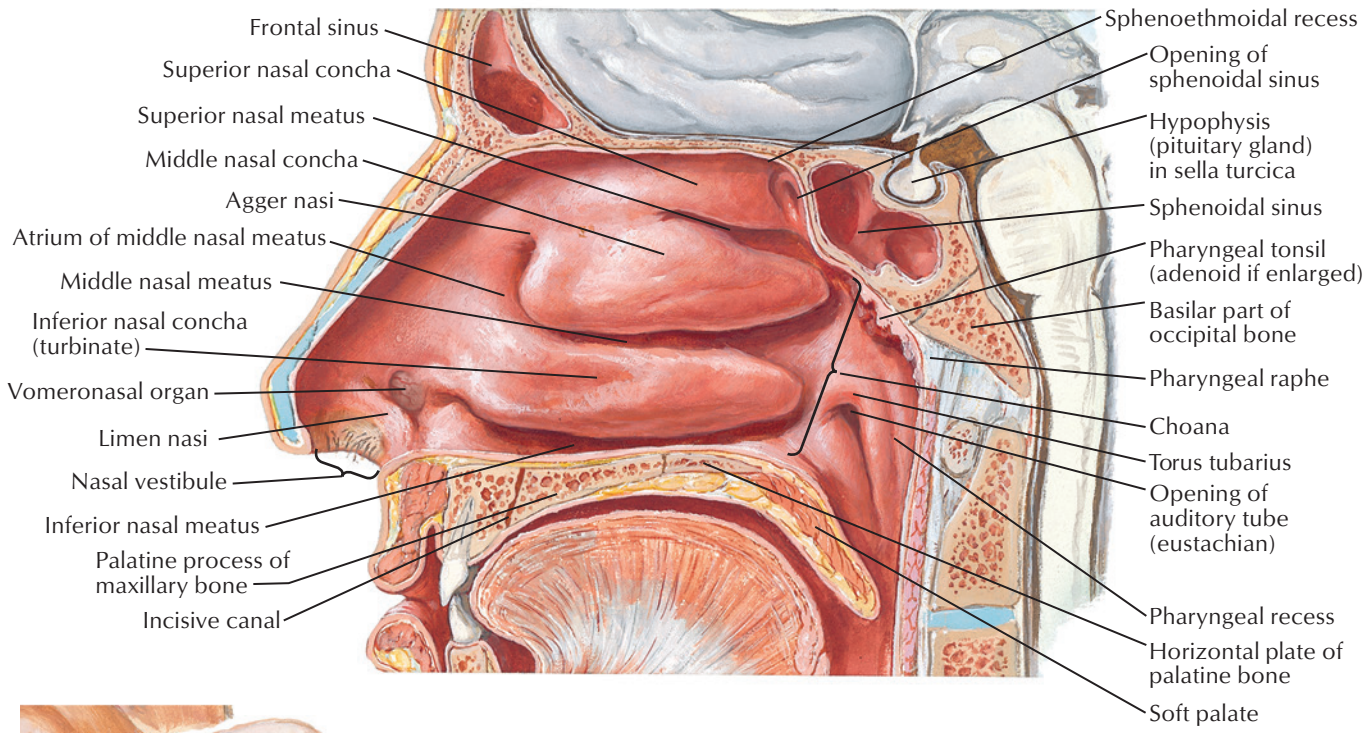
Anterolateral view

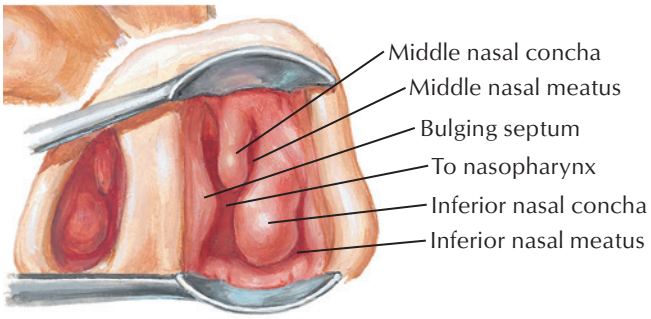


Inferior view

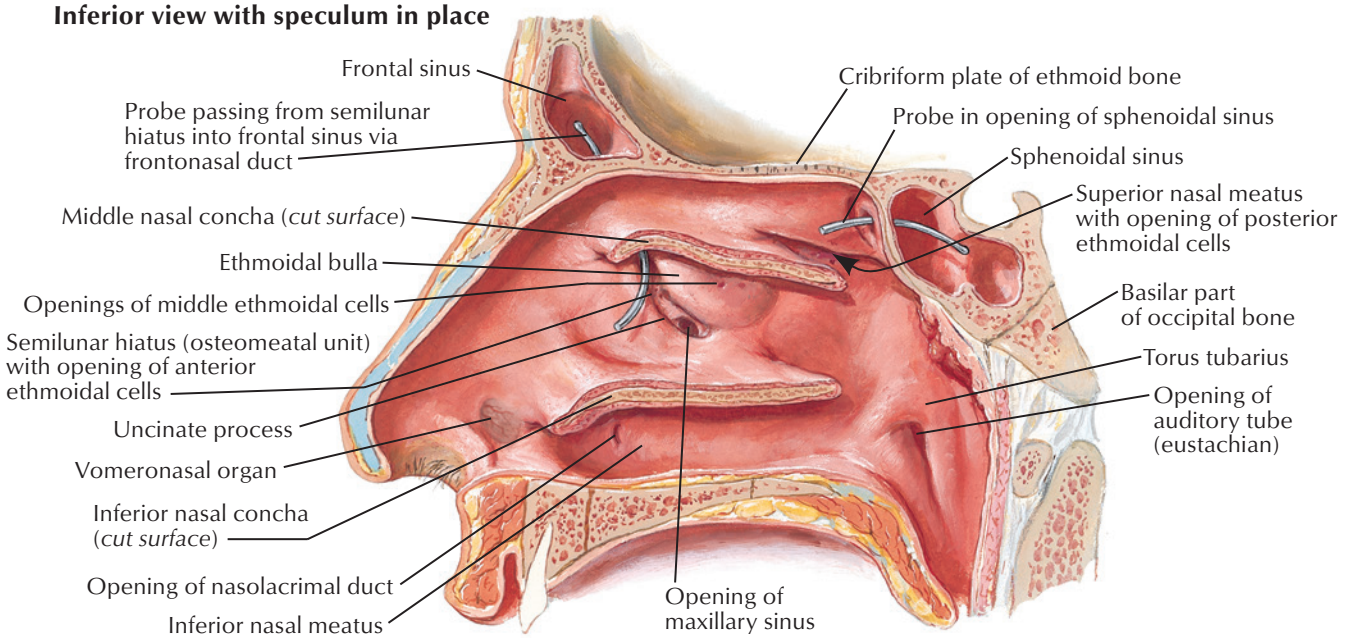




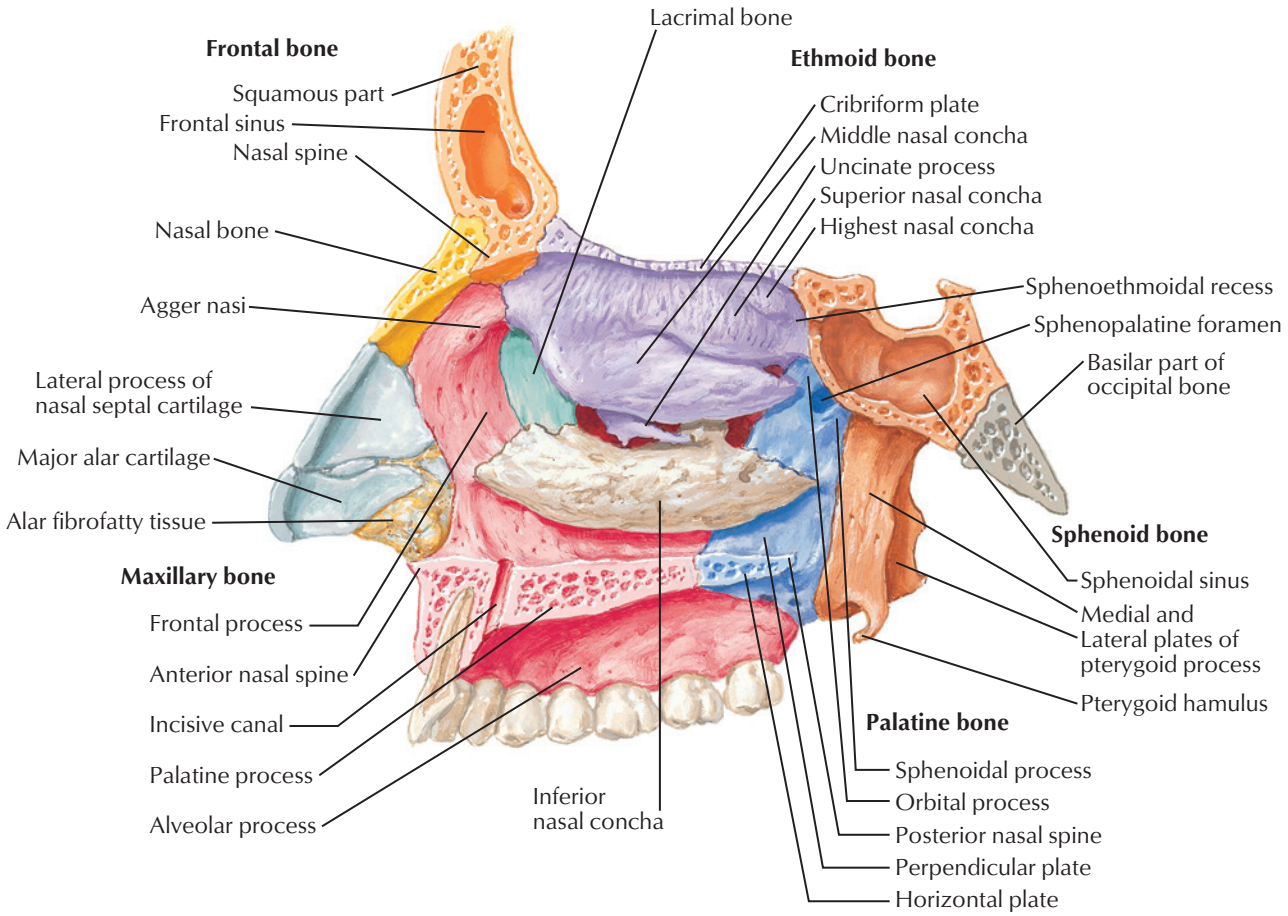


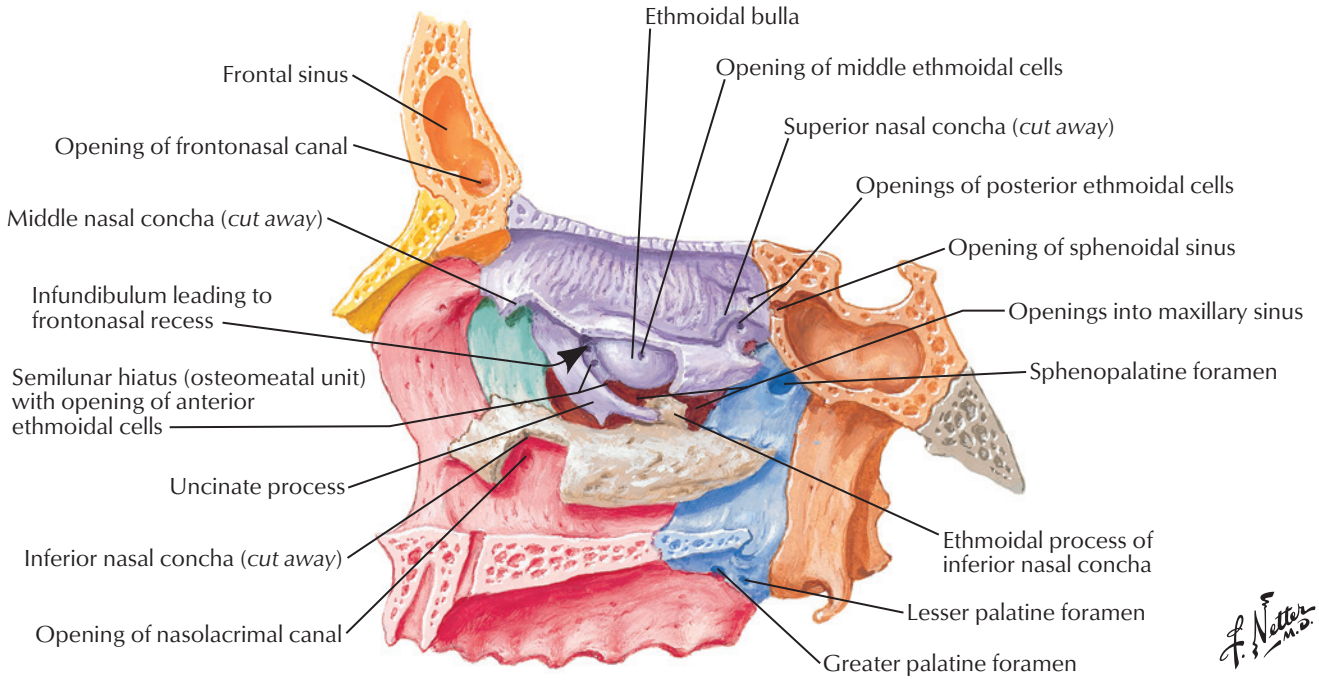


Inferior view with speculum in place

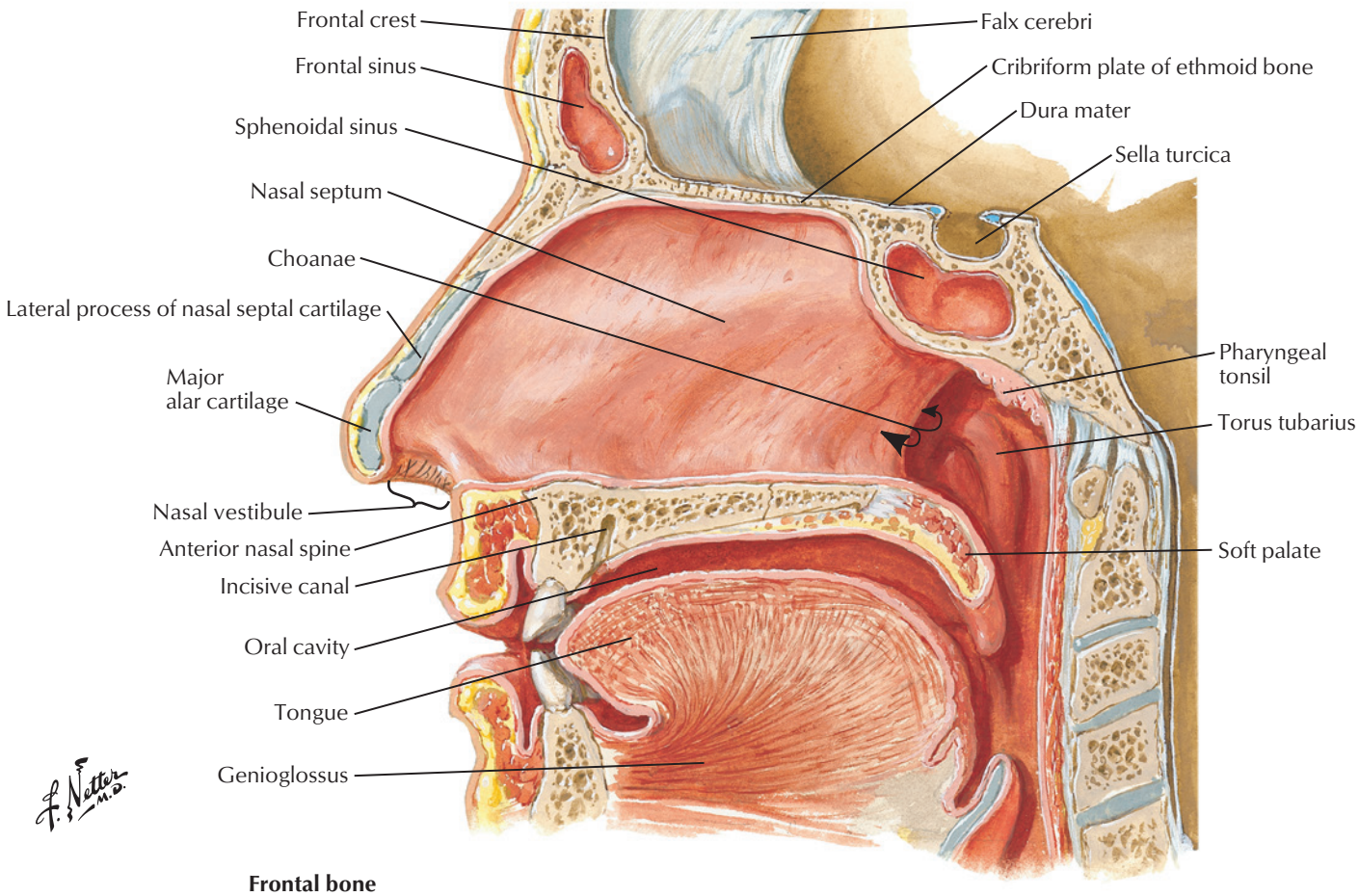


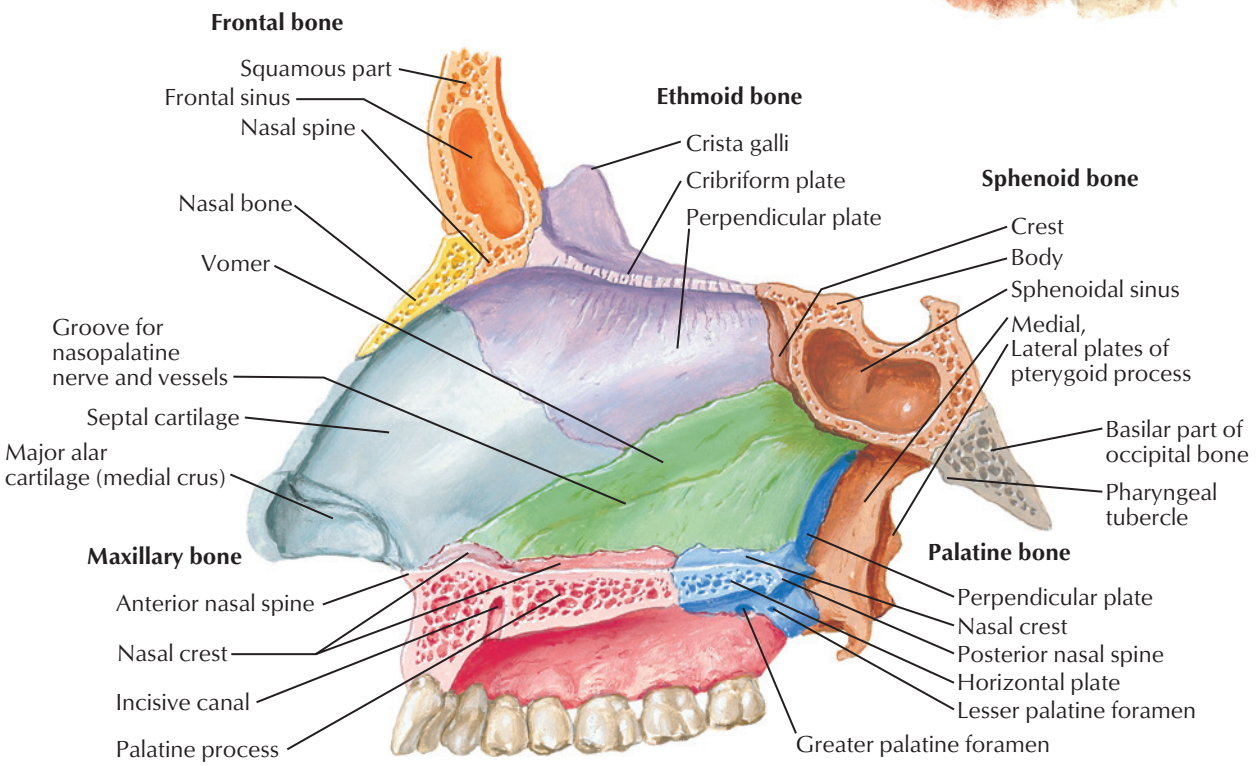
See also Plates 43, 45

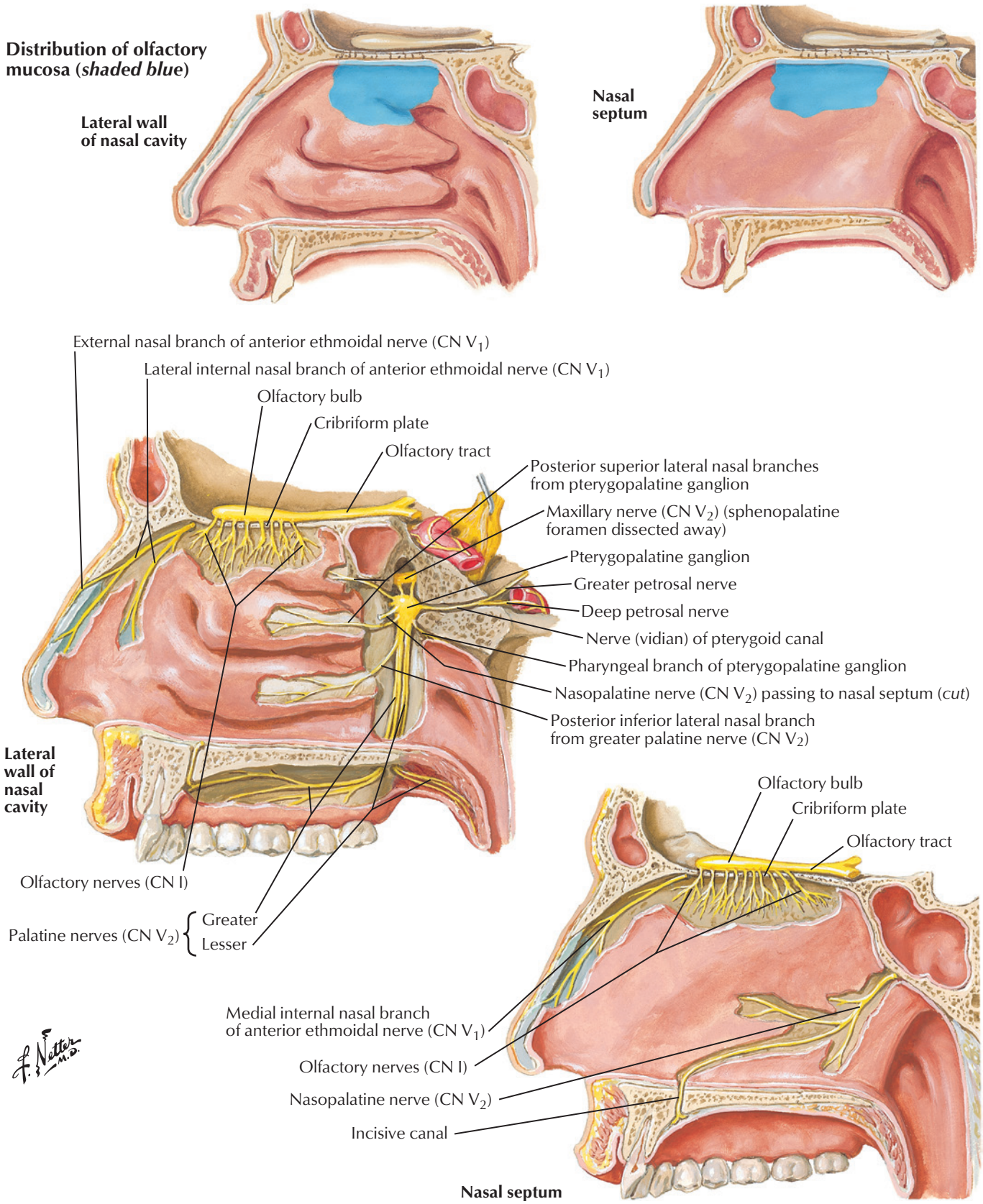




See also Plate 15

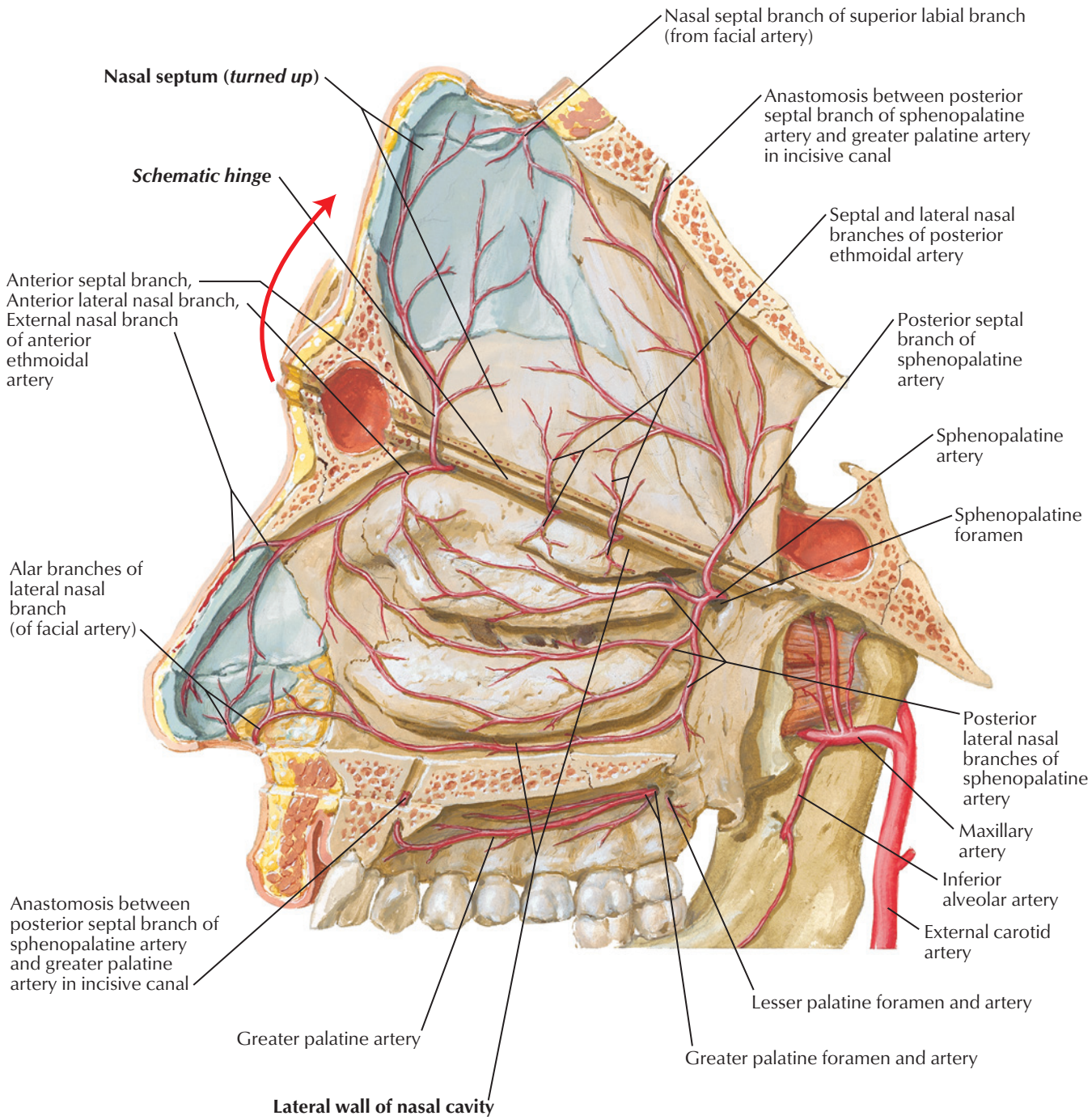




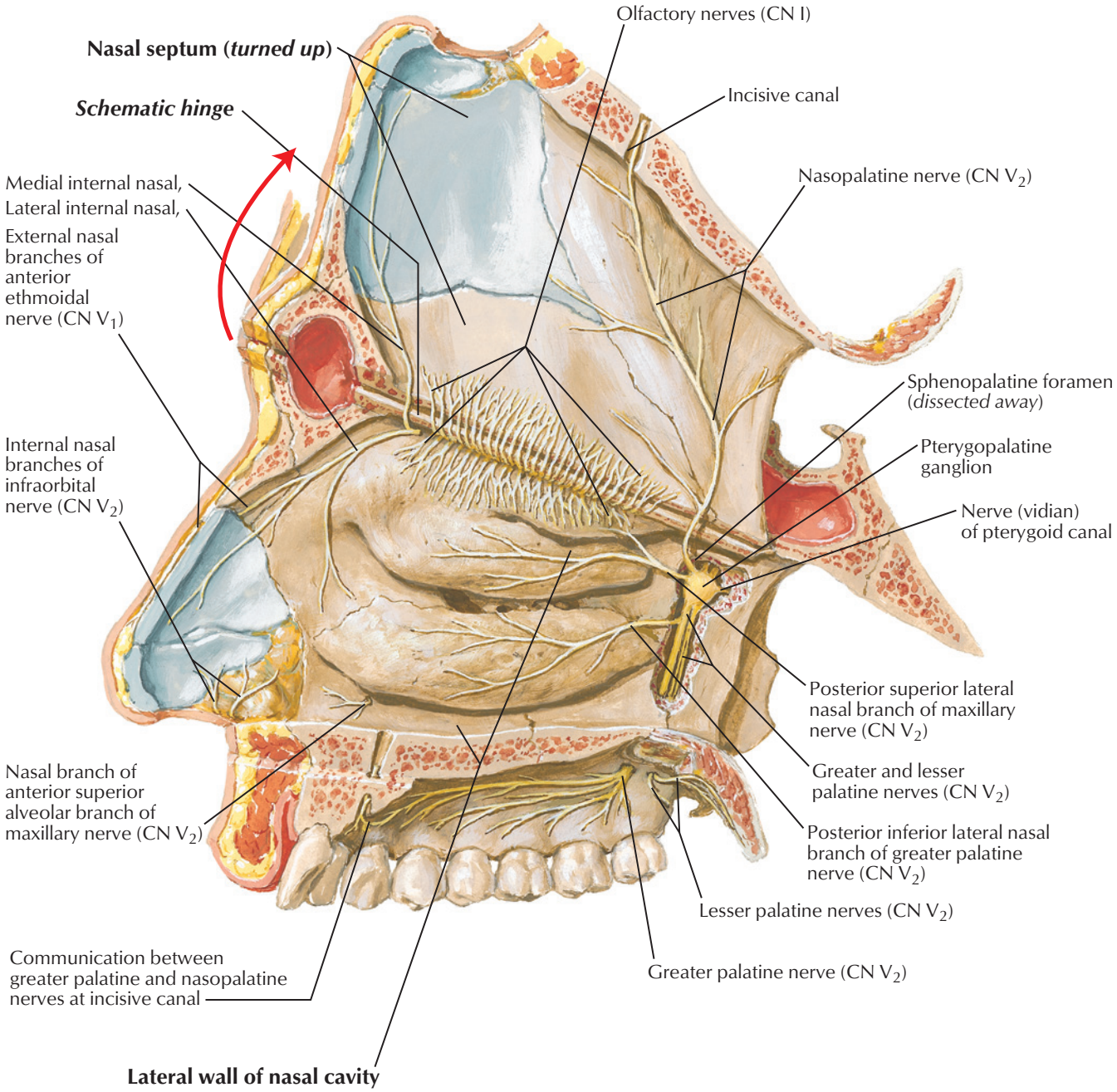

Distribution of olfactory mucosa (*shaded blue*)
Lateral wall of nasal cavity
Nasal septum
External nasal branch of anterior ethmoidal nerve (CN V1)
Lateral internal nasal branch of anterior ethmoidal nerve (CN V1)
Olfactory bulb
Cribriform plate
Olfactory tract
Posterior superior lateral nasal branches from pterygopalatine ganglion
Maxillary nerve (CN V2) (sphenopalatine foramen dissected away)
Pterygopalatine ganglion
Greater petrosal nerve
Deep petrosal nerve
Nerve (vidian) of pterygoid canal
Pharyngeal branch of pterygopalatine ganglion
Nasopalatine nerve (CN V2) passing to nasal septum (*cut*)
Posterior inferior lateral nasal branch from greater palatine nerve (CN V2)
Lateral wall of nasal cavity
Olfactory nerves (CN I)
Palatine nerves (CN V2)
Greater
Lesser
Olfactory bulb
Cribriform plate
Olfactory tract
Medial internal nasal branch of anterior ethmoidal nerve (CN V1)
Olfactory nerves (CN I)
Nasopalatine nerve (CN V2)
Incisive canal
Nasal septum

Arteries of Nasal Cavity: Bony Nasal Septum Turned Up

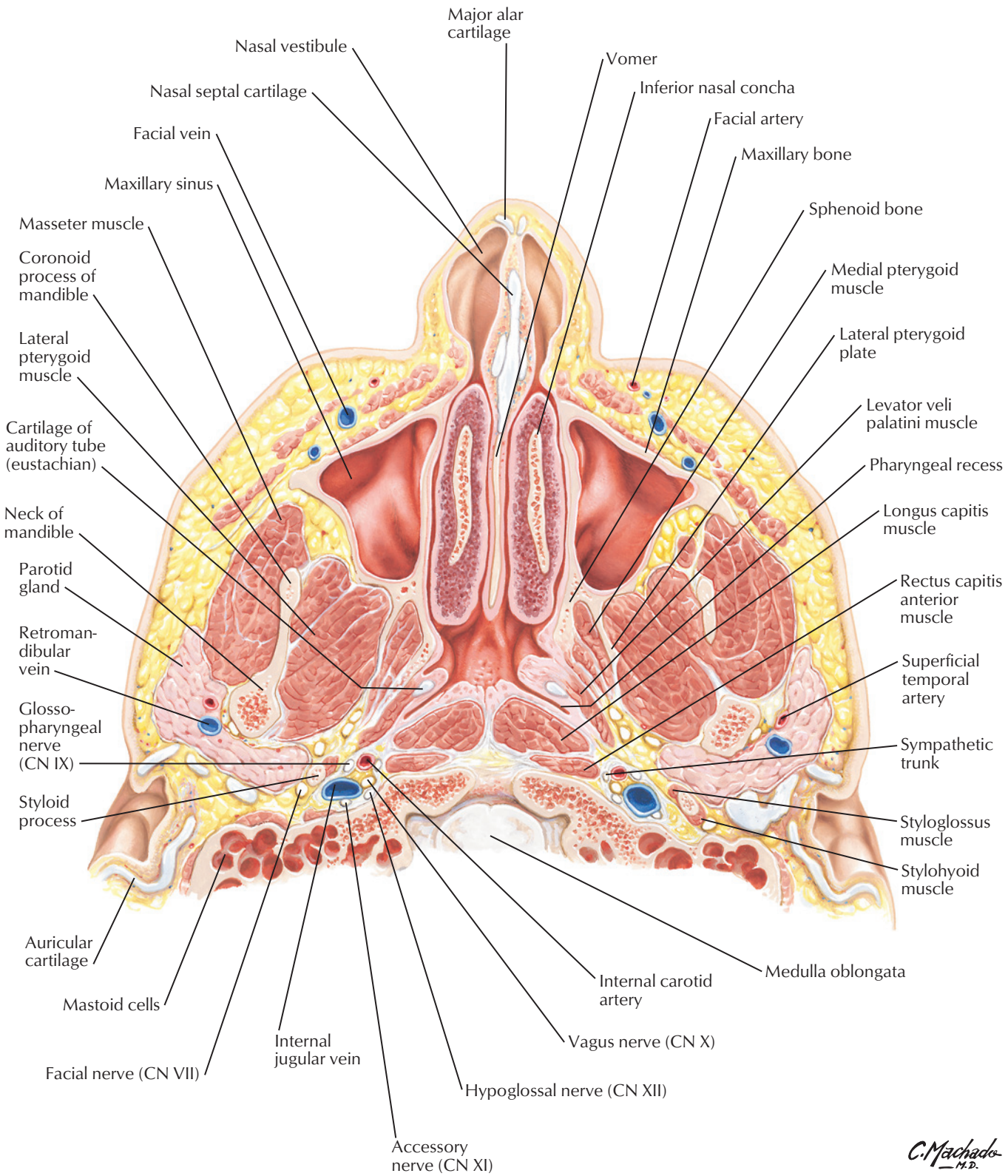
See also Plates 57, 63



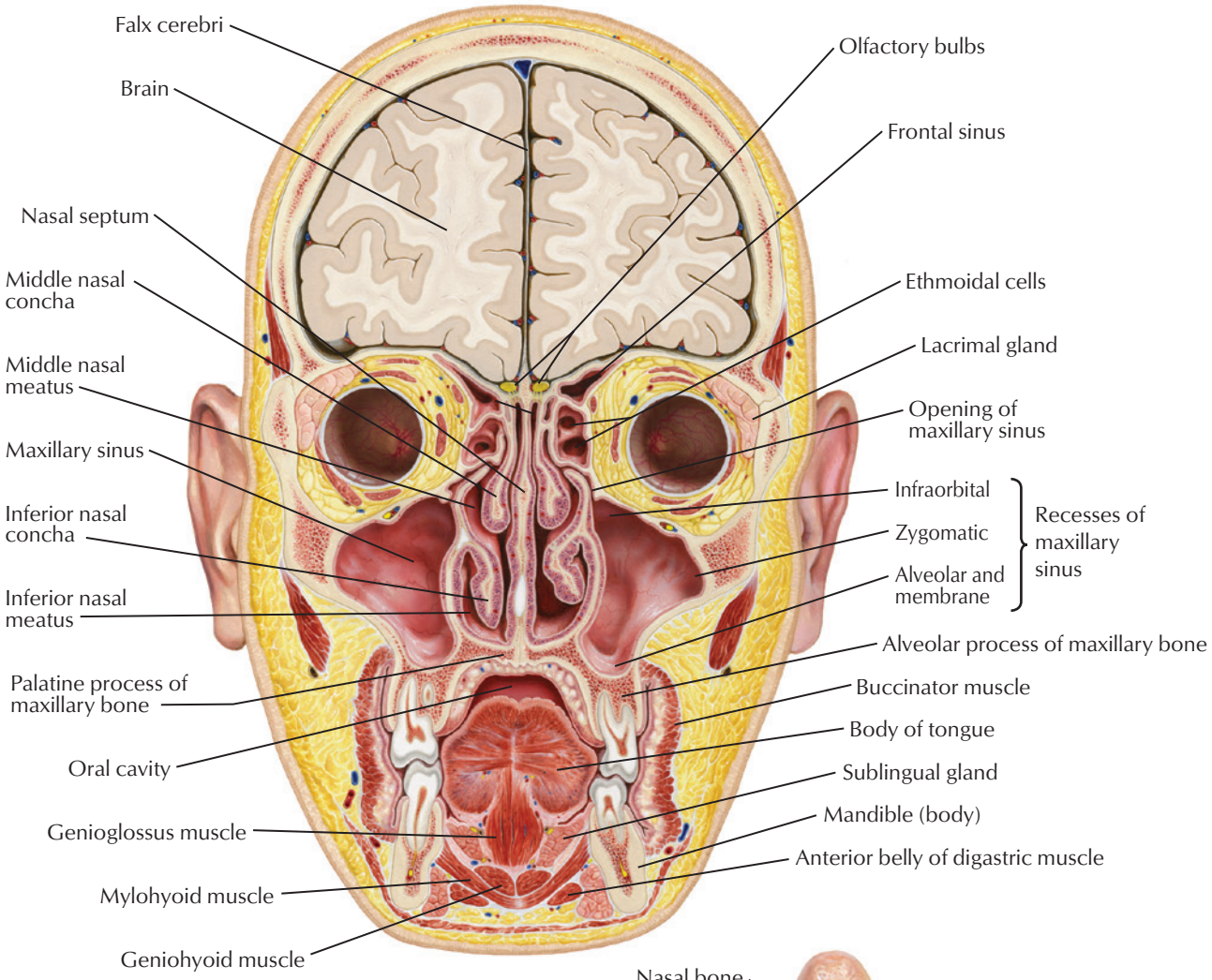
See also Plate 62



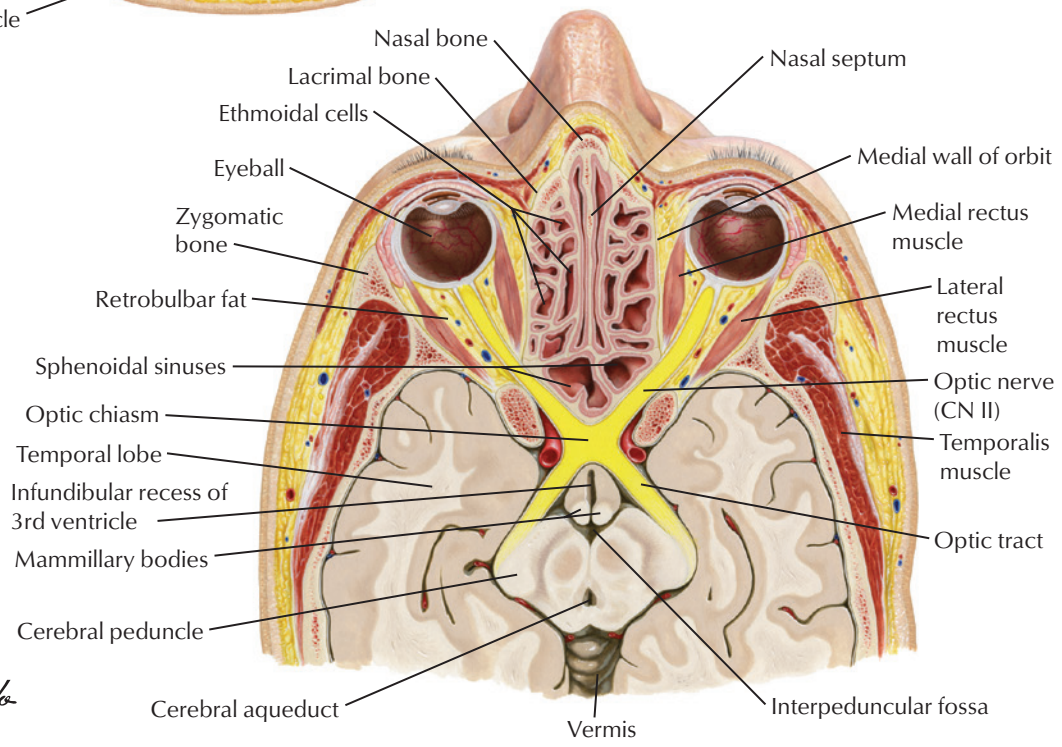
Nose and Maxillary Sinus: Transverse Section



Coronal section



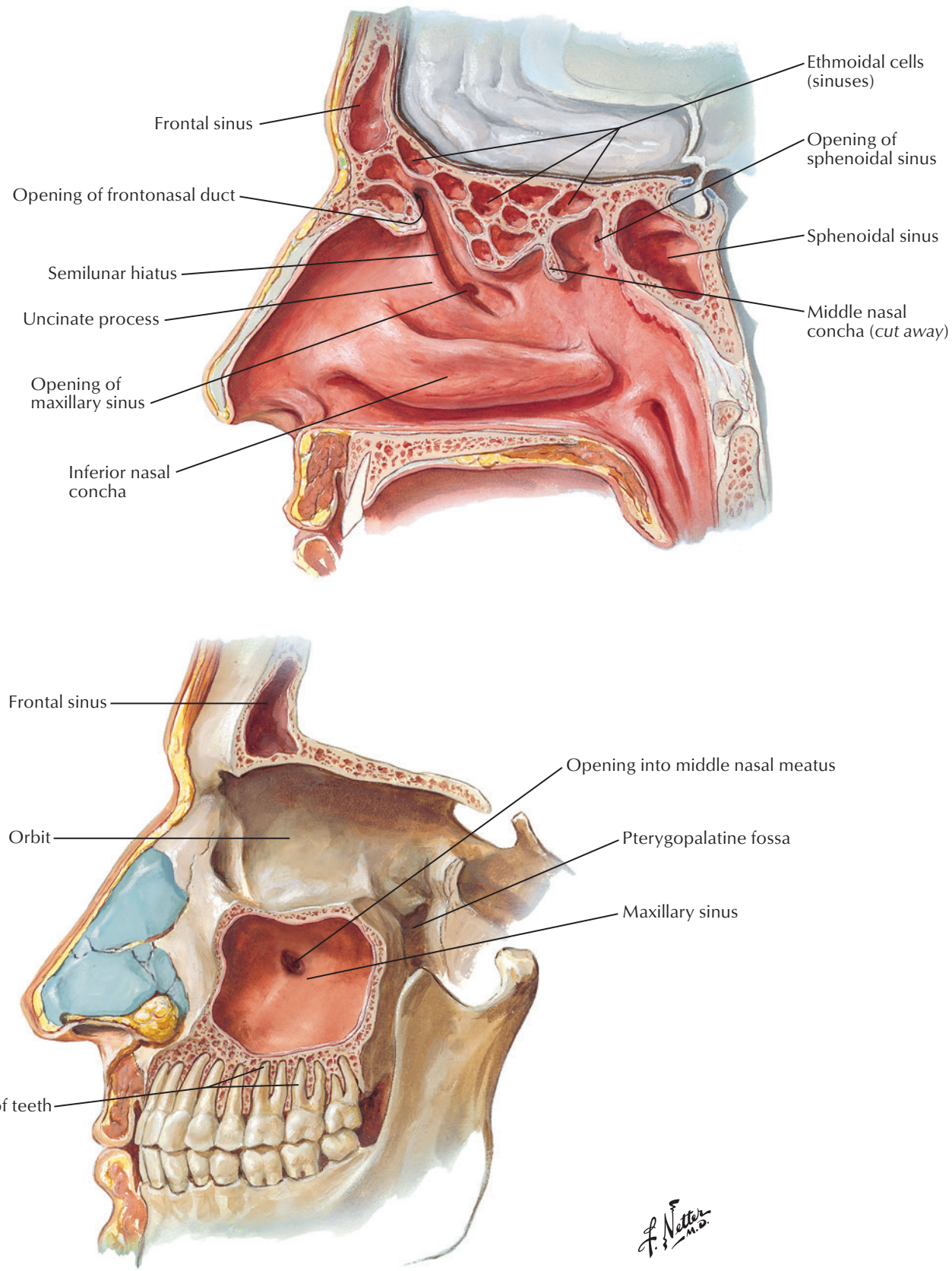
Transverse section



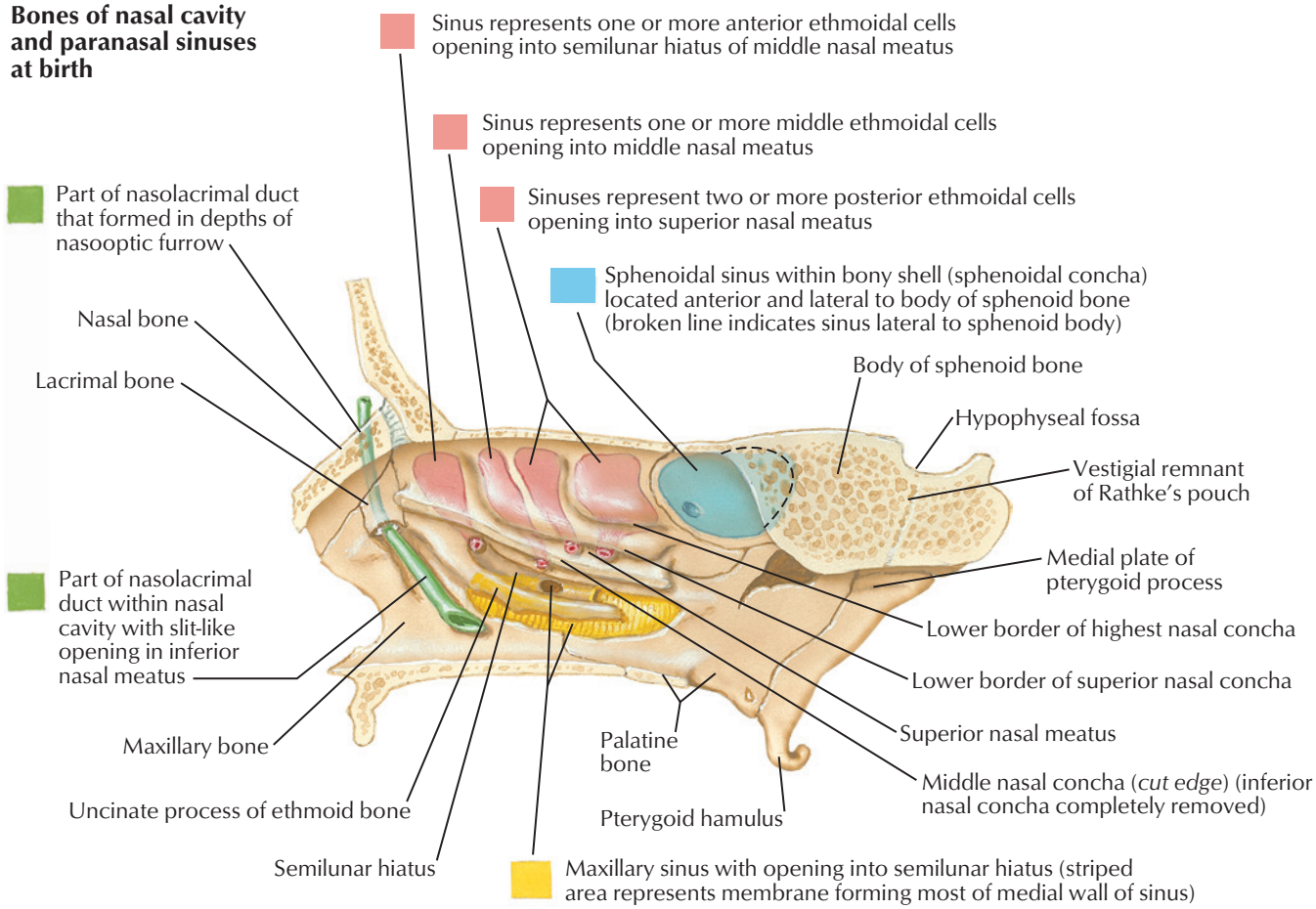
C. Machado M.D.

Paranasal Sinuses: Parasagittal Views

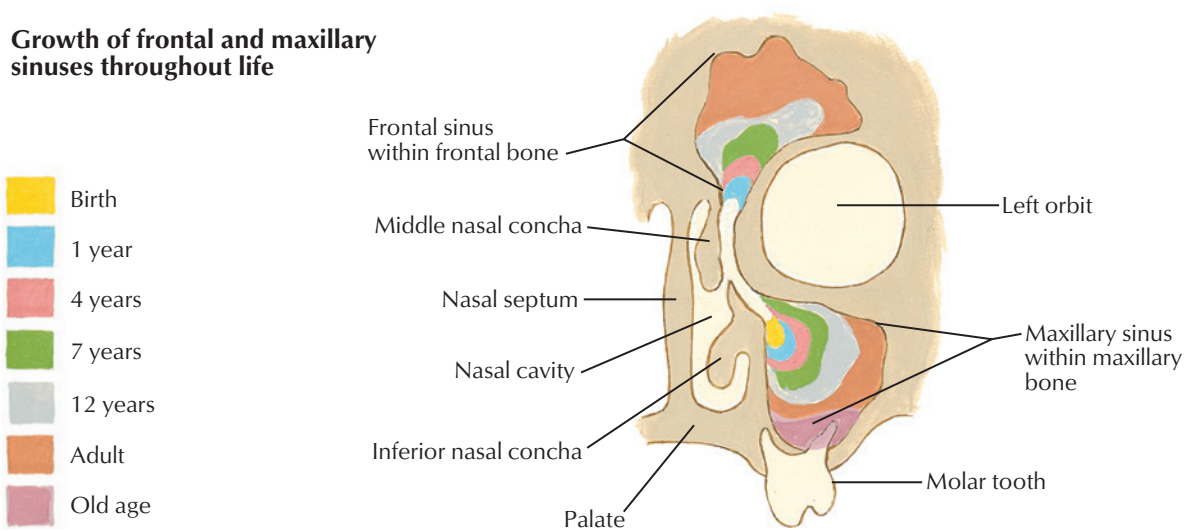
See also Plate 43



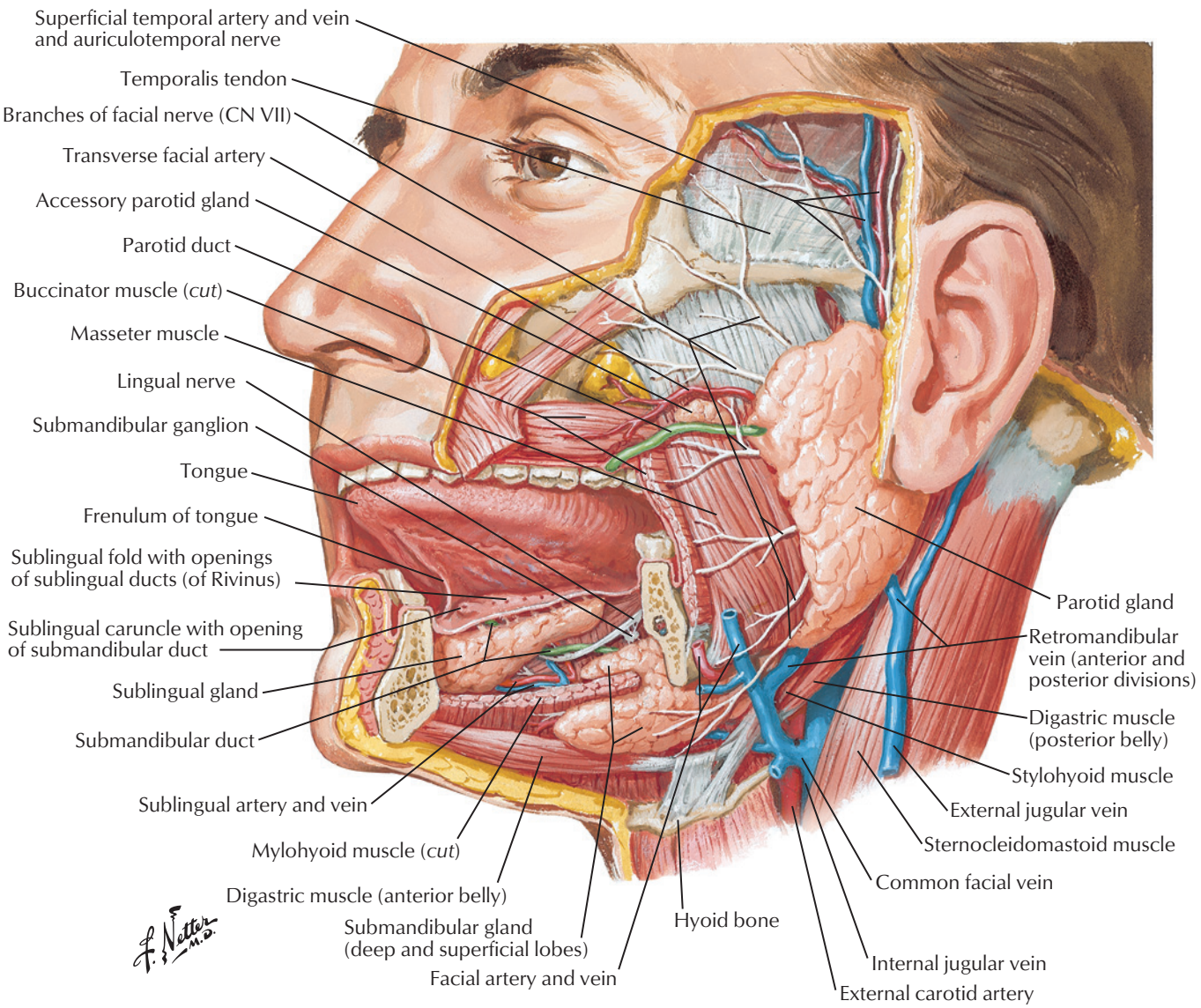
Bones of nasal cavity and paranasal sinuses at birth



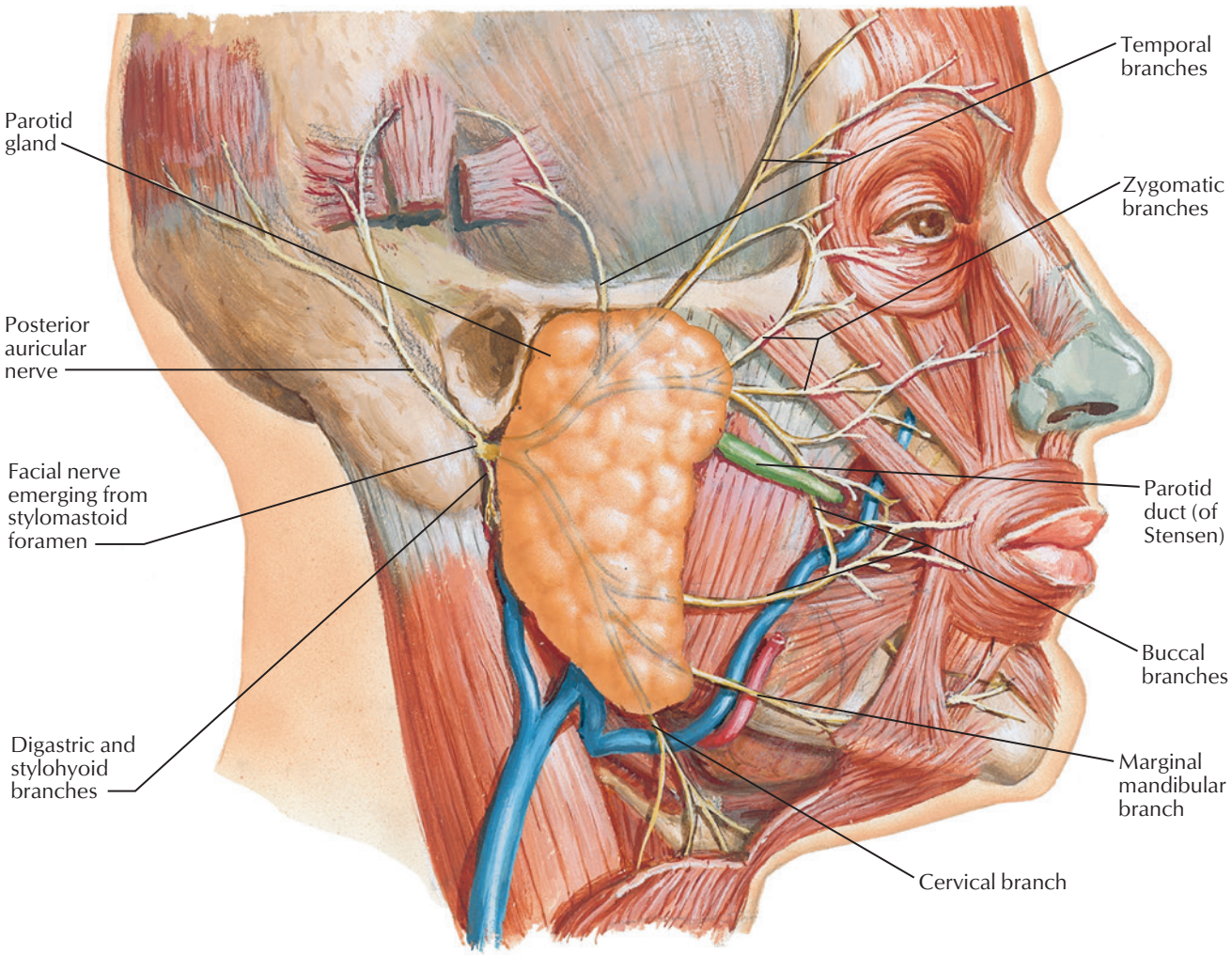
Growth of frontal and maxillary sinuses throughout life

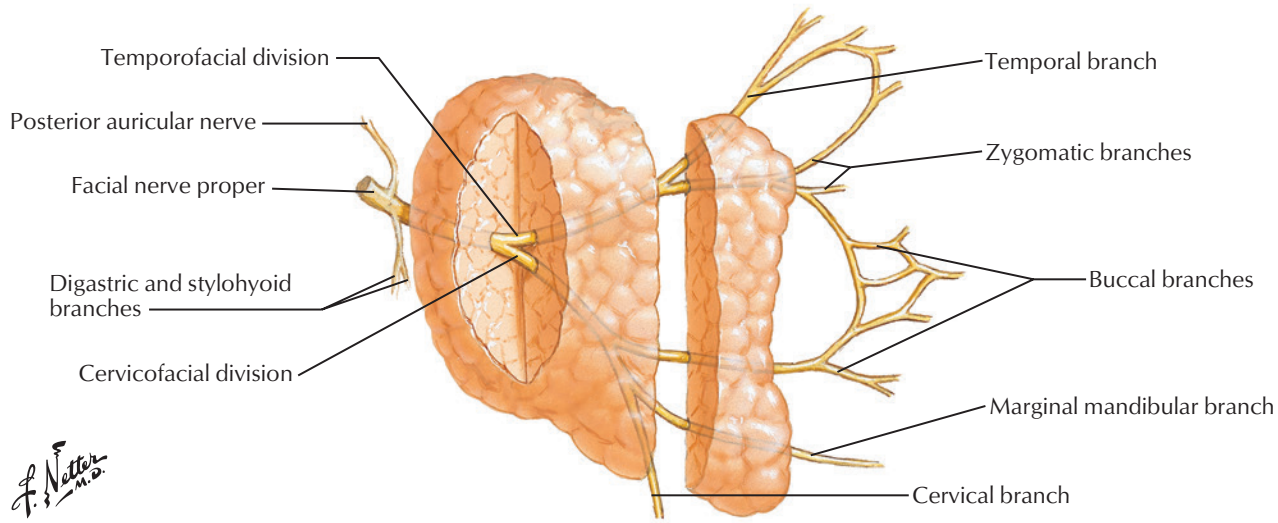


See also Plates 54, 144, 145



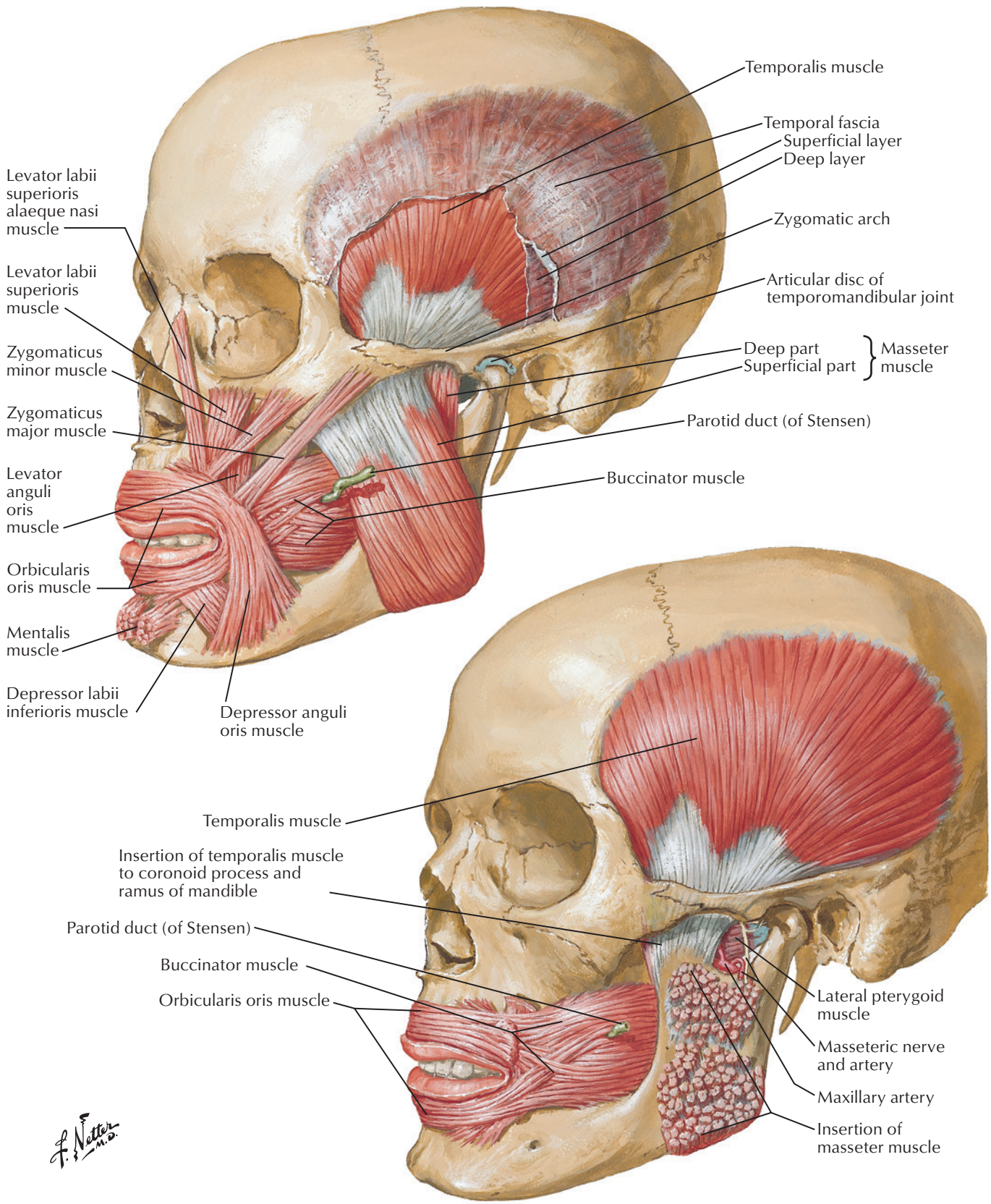
See also Plates 53, 134





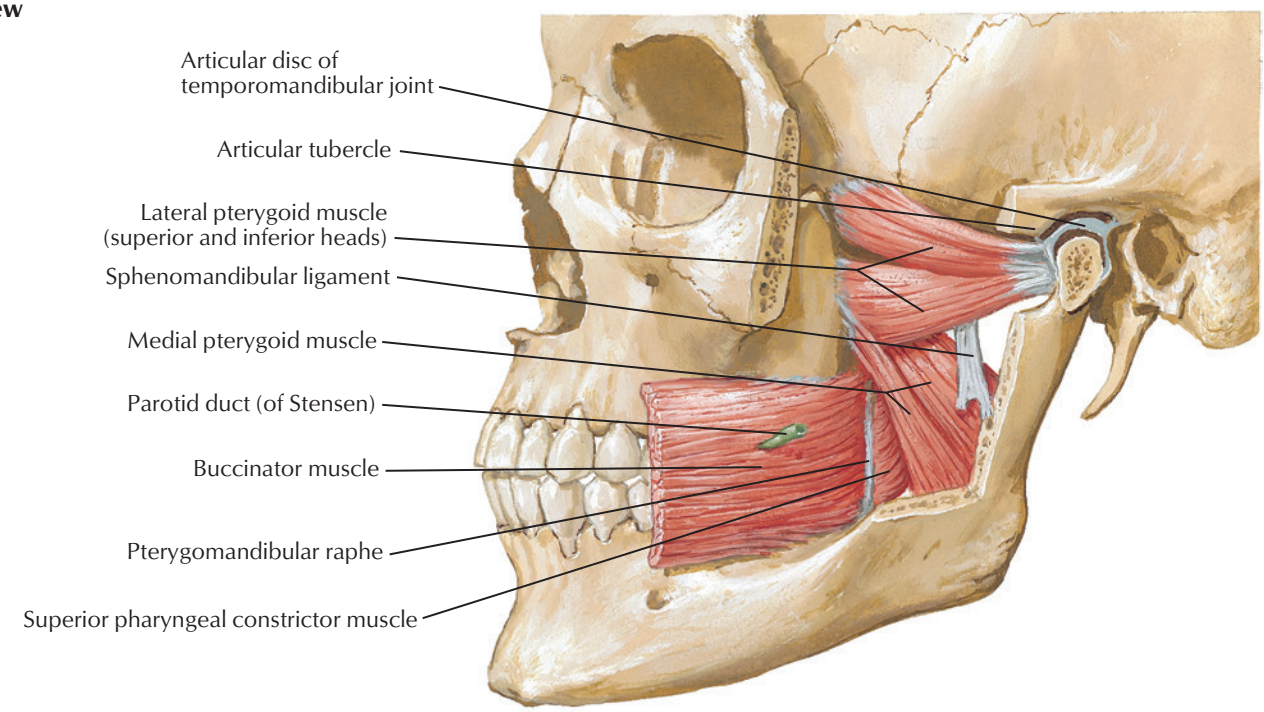
Muscles Involved in Mastication

For facial muscles see Plate 31

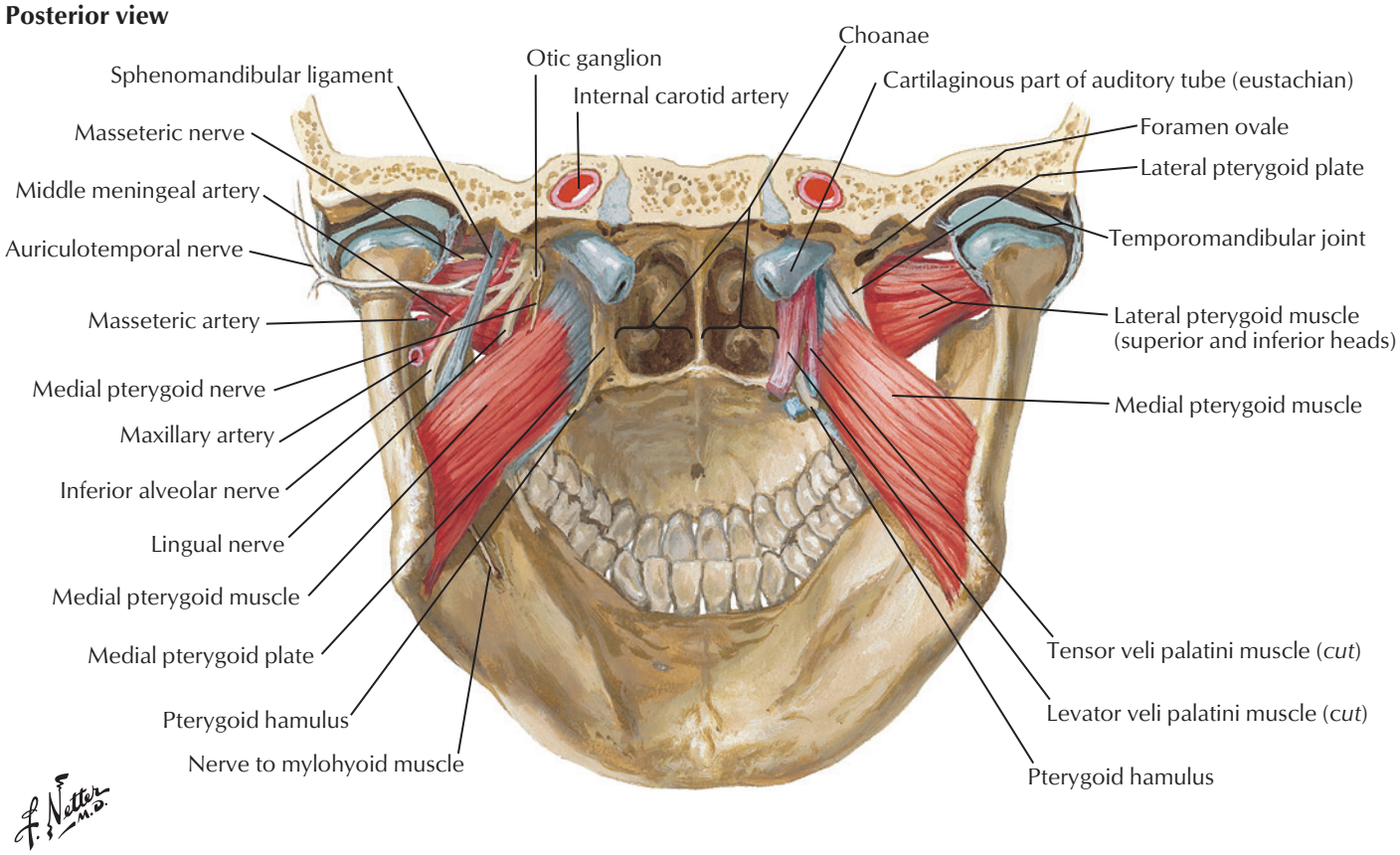


See also Plates 55, 59

Lateral view

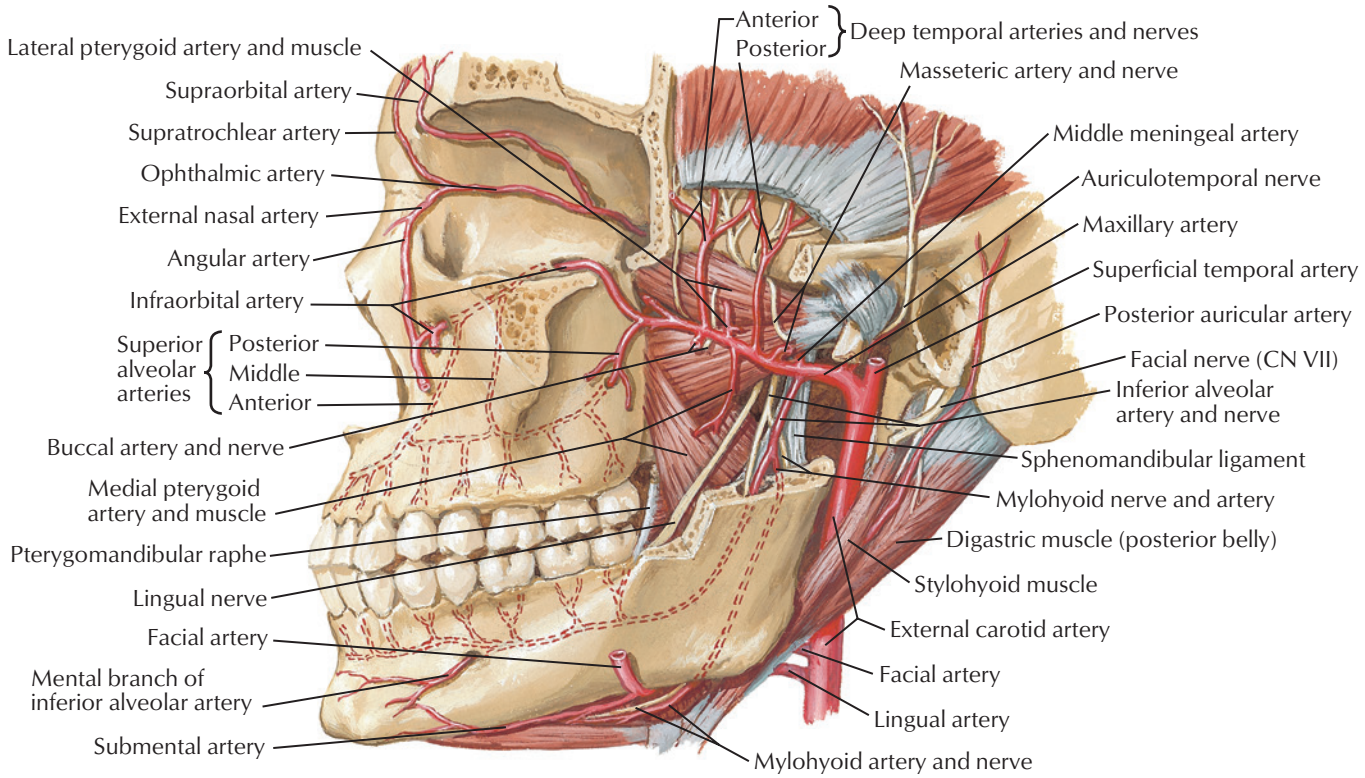


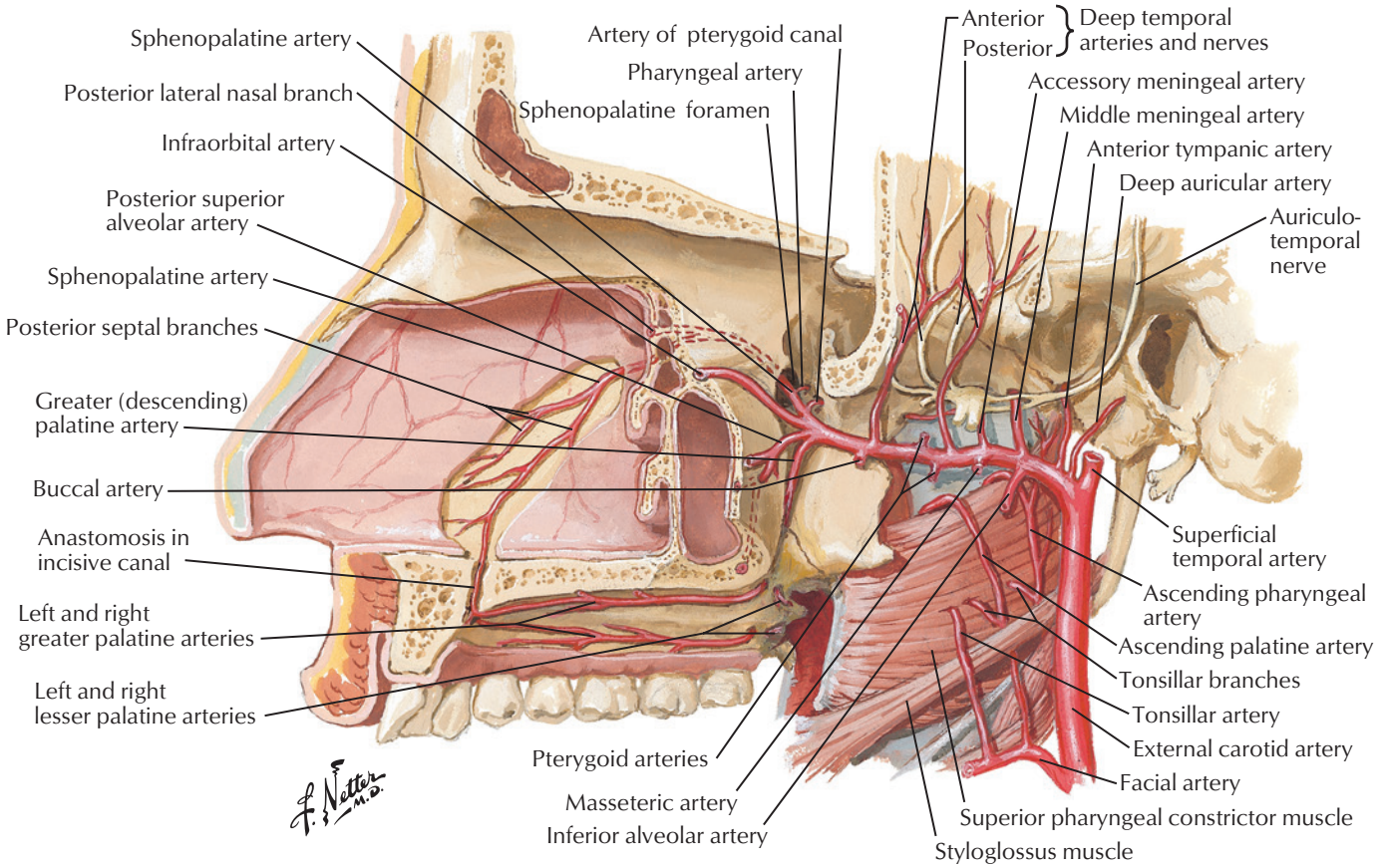
Posterior view



Maxillary Artery

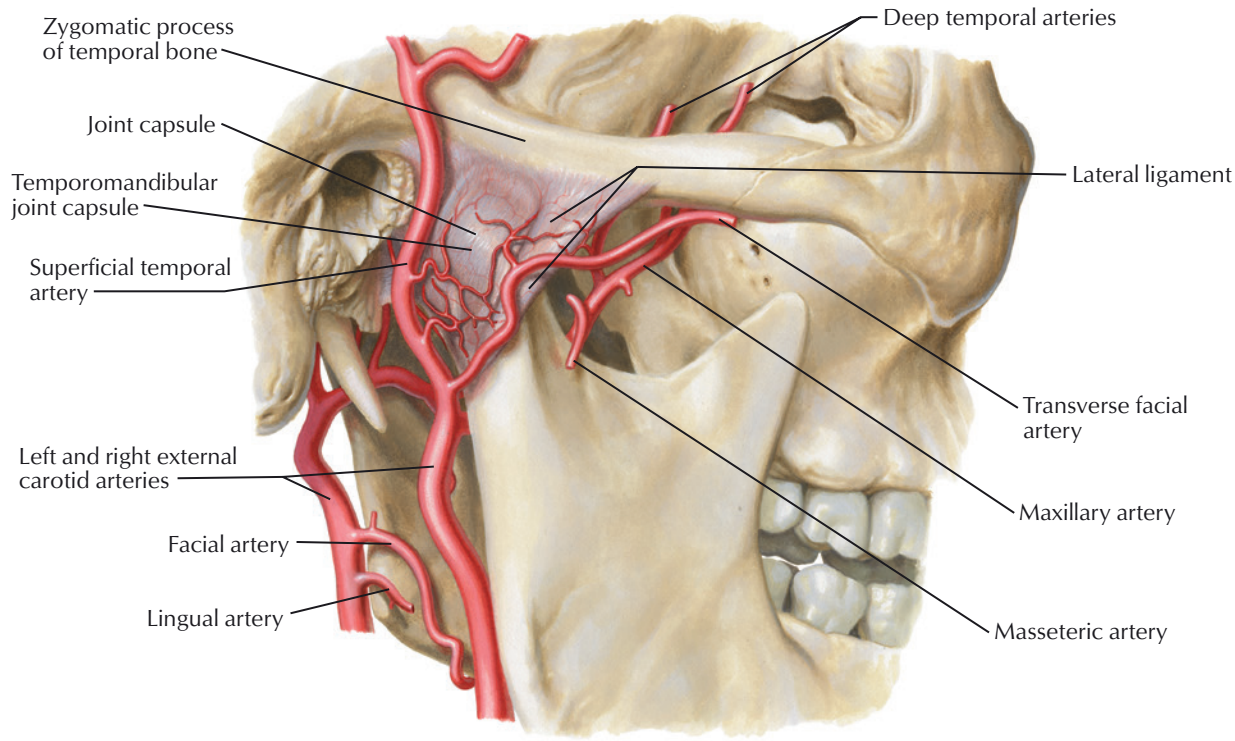
See also Plates 63, 83



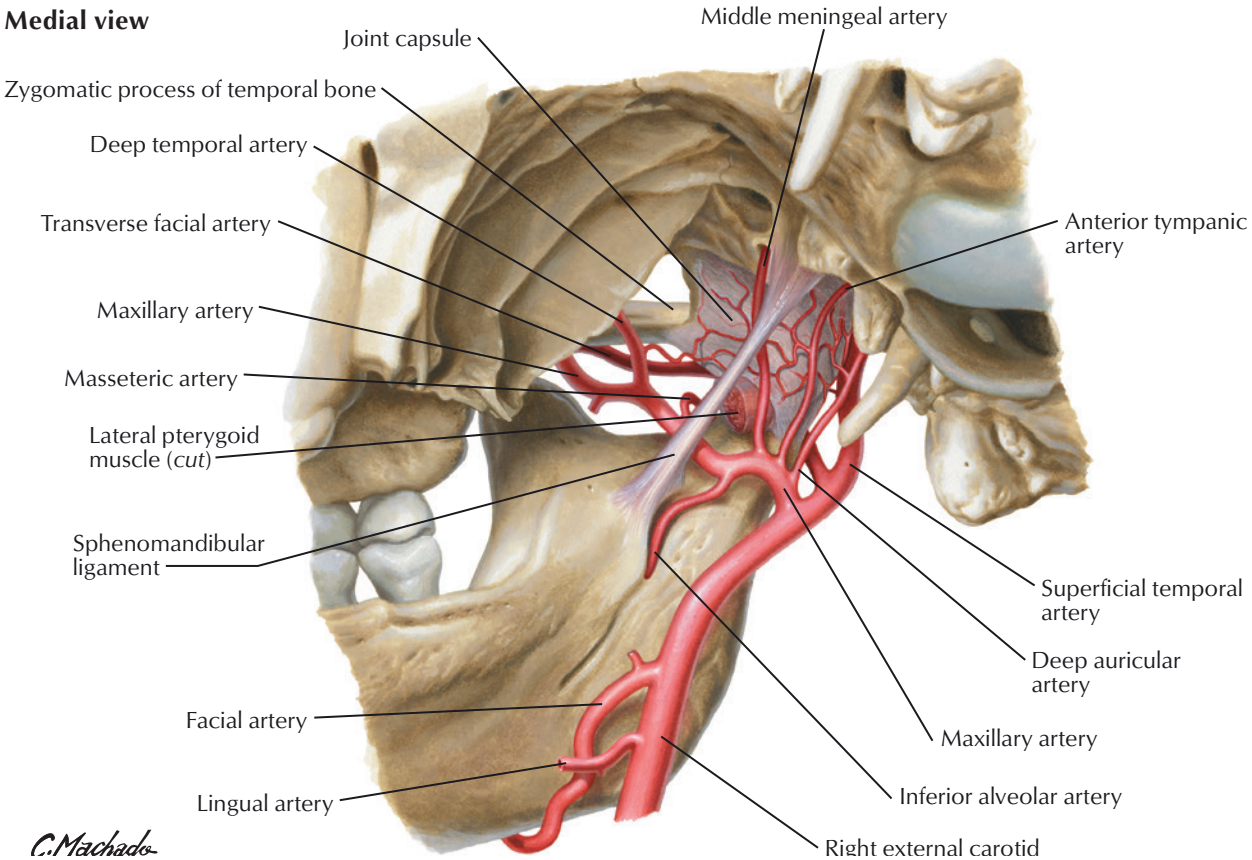


See also Plates 57, 59, 63

Lateral view



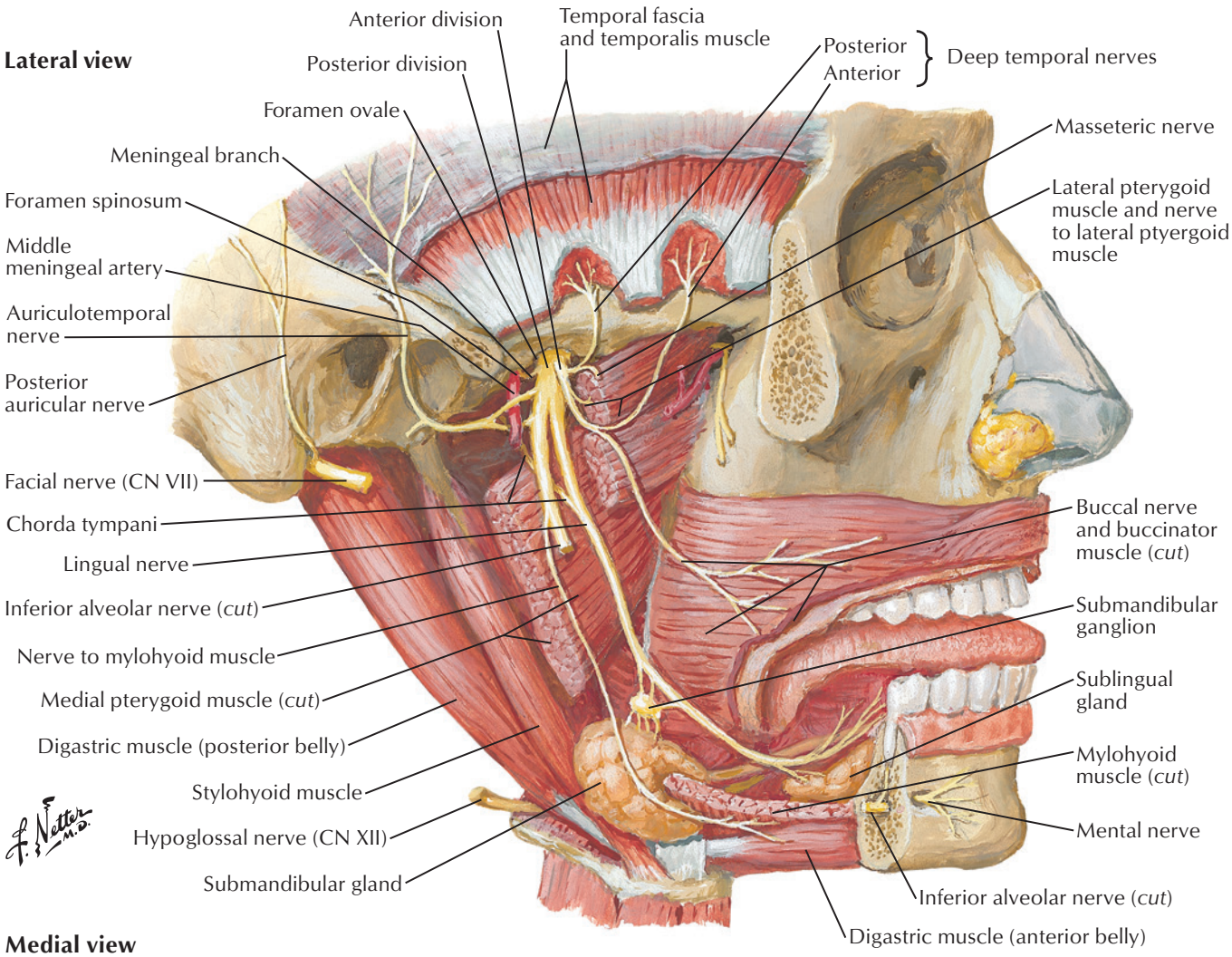
Medial view



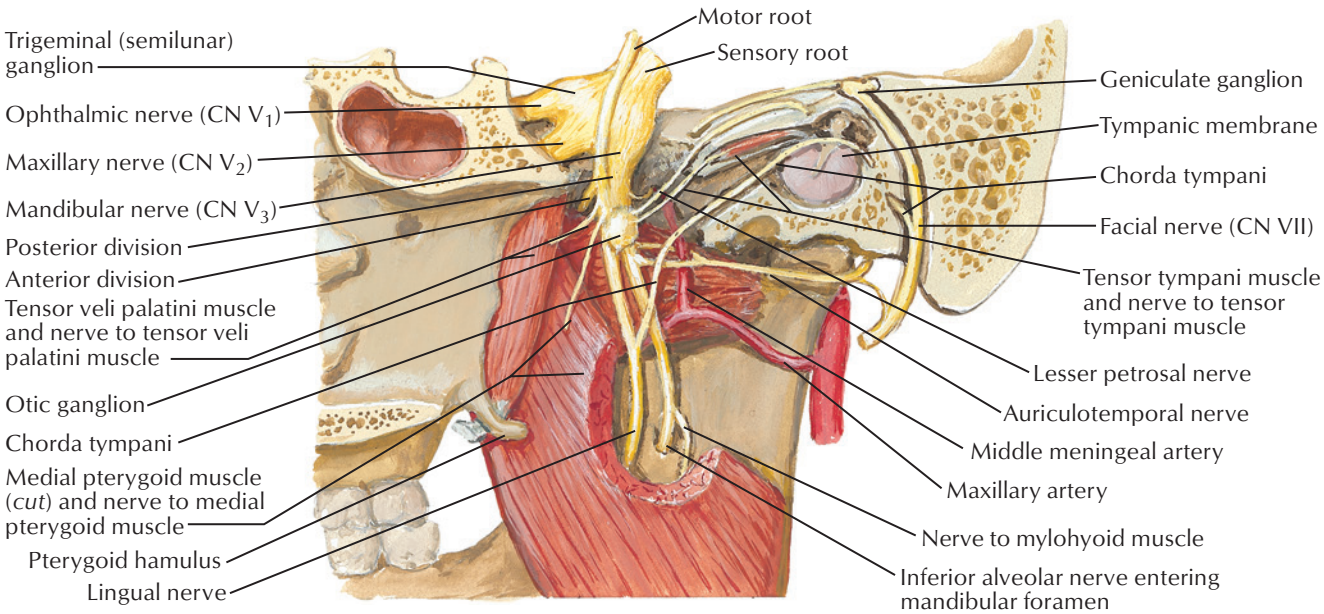
C. Machado

See also Plates 82, 133

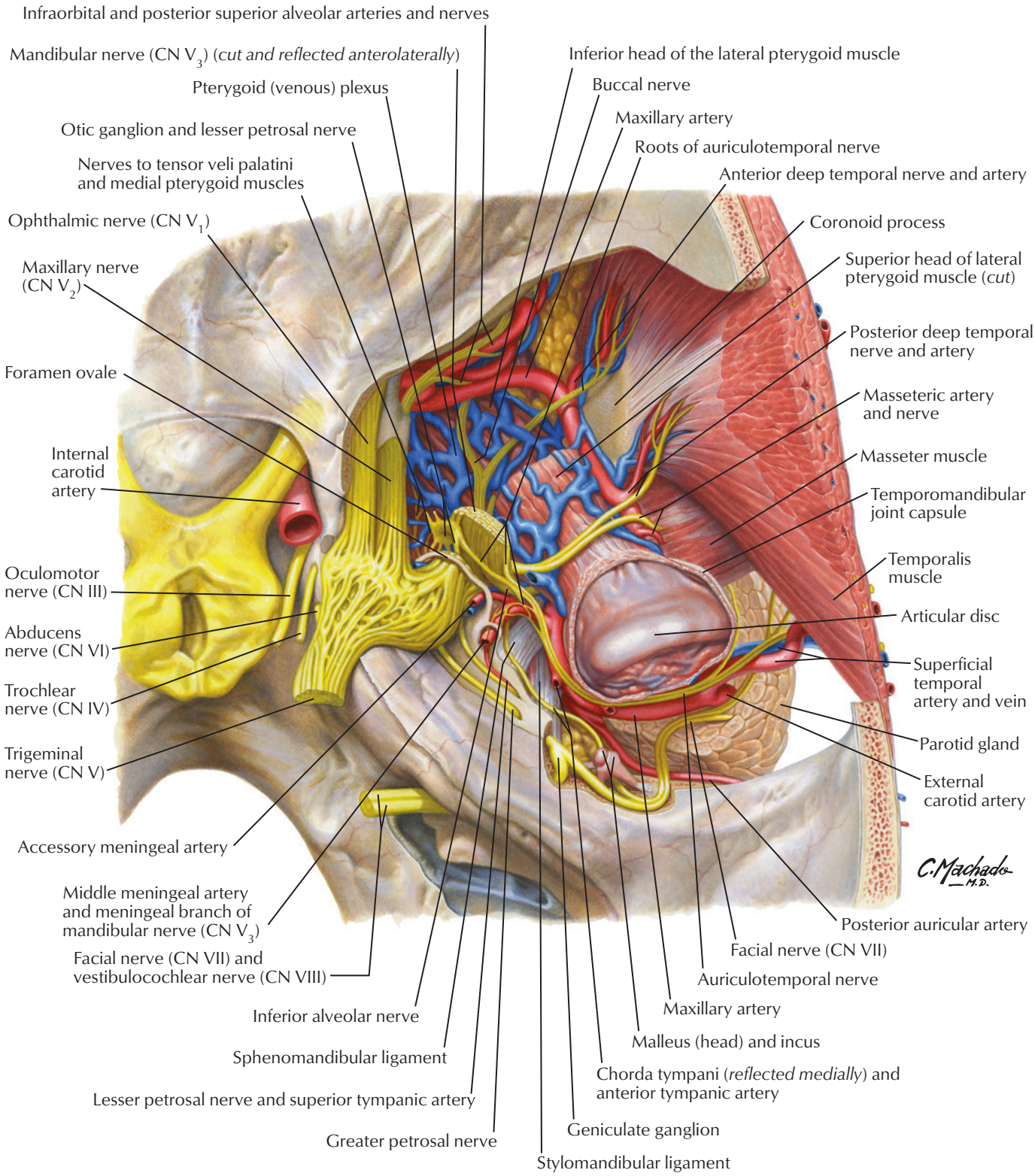
Lateral view



Medial view

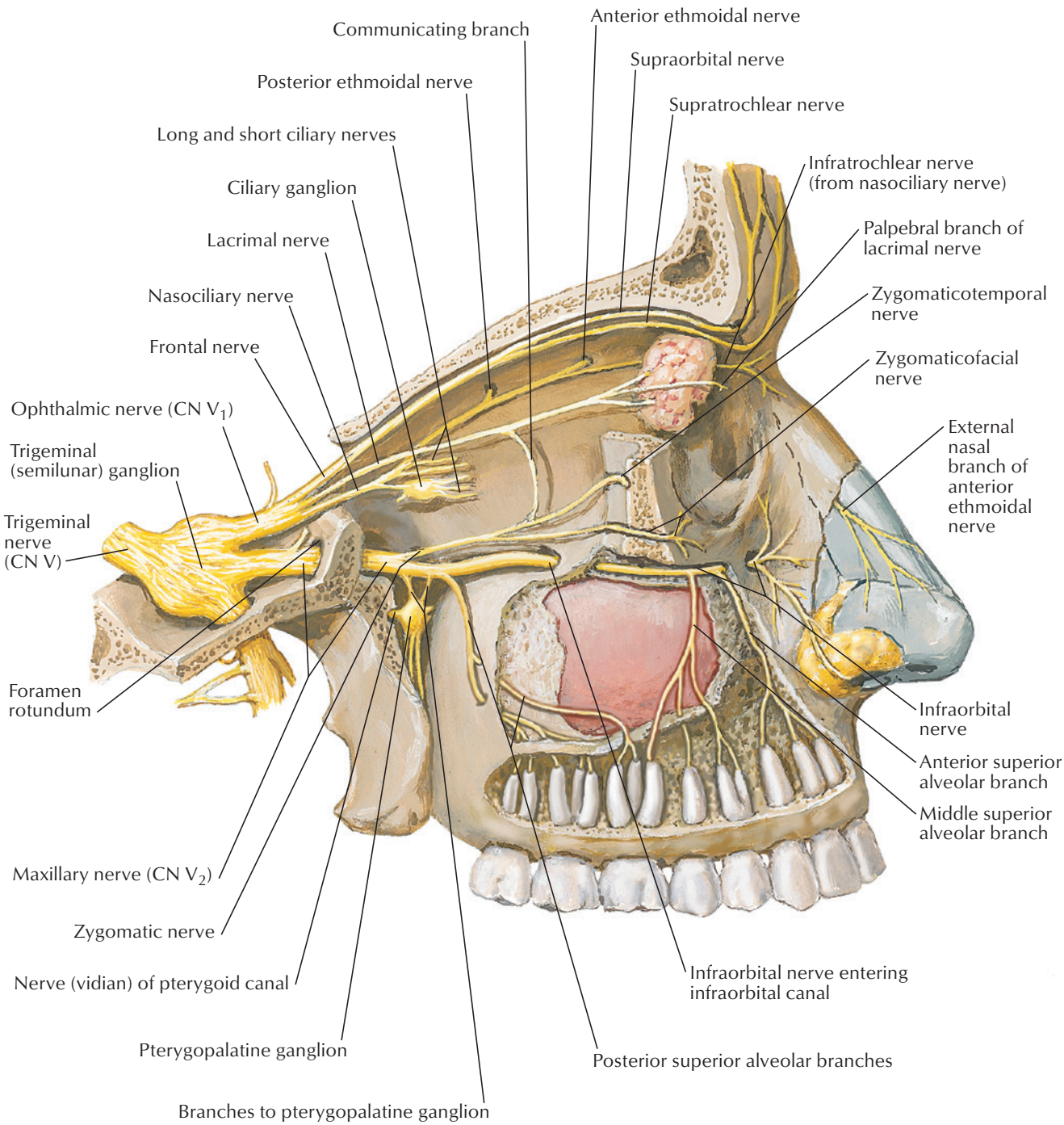


See also Plates 57-59, 63, 64, 115

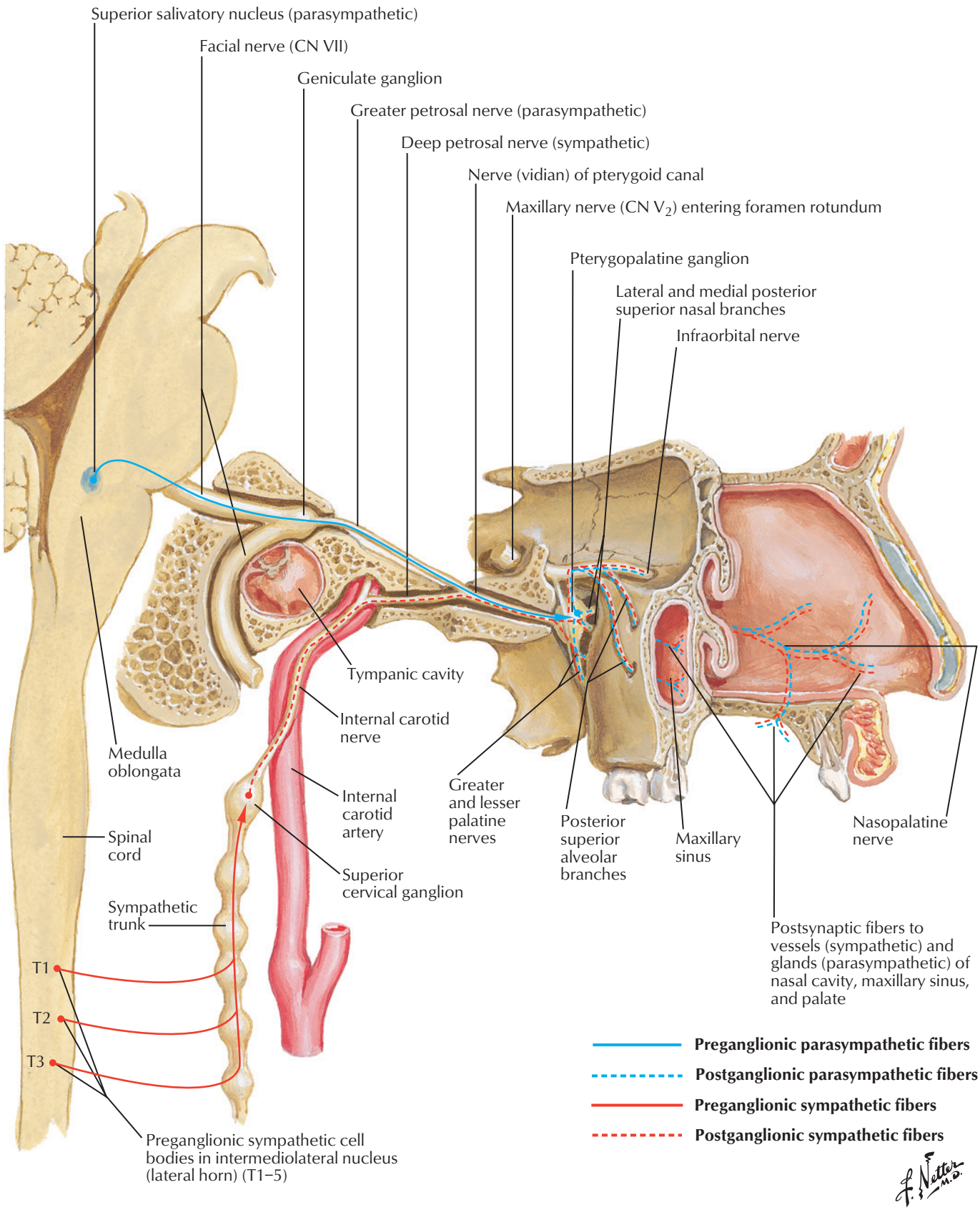


Ophthalmic (CN V_1) and Maxillary (CN V_2) Nerves

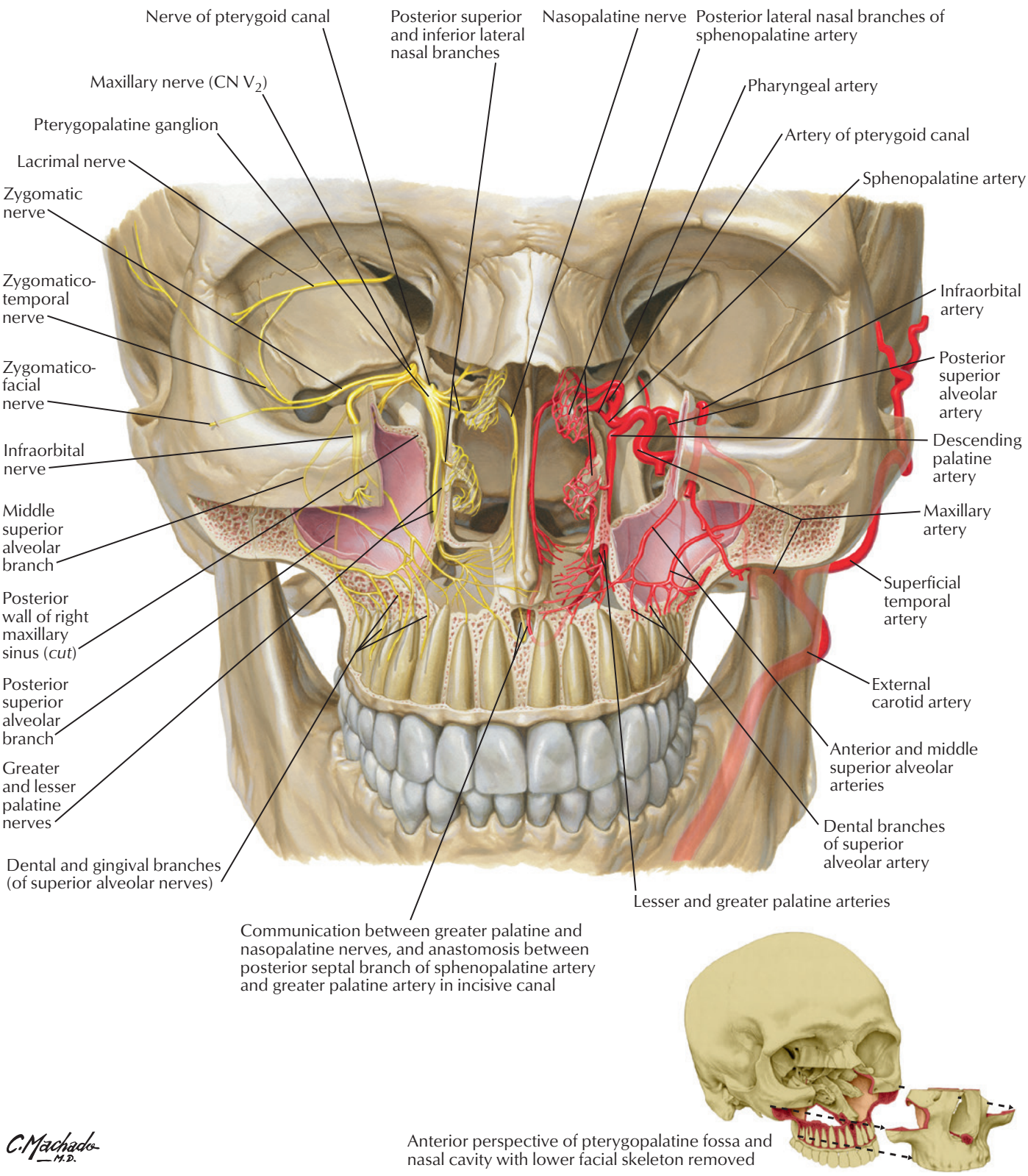
See also Plates 63, 66



See also Plates 133, 142, 144

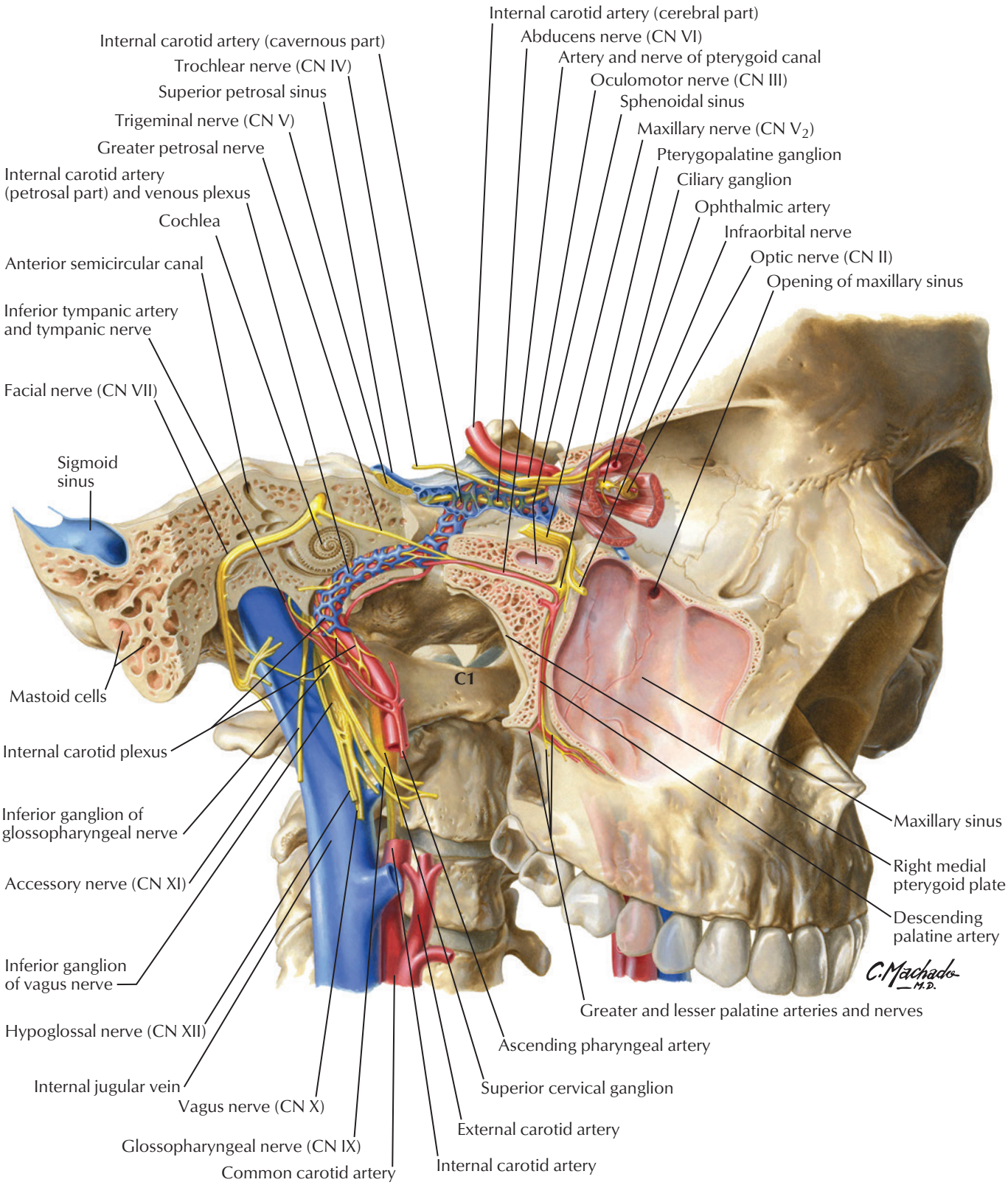


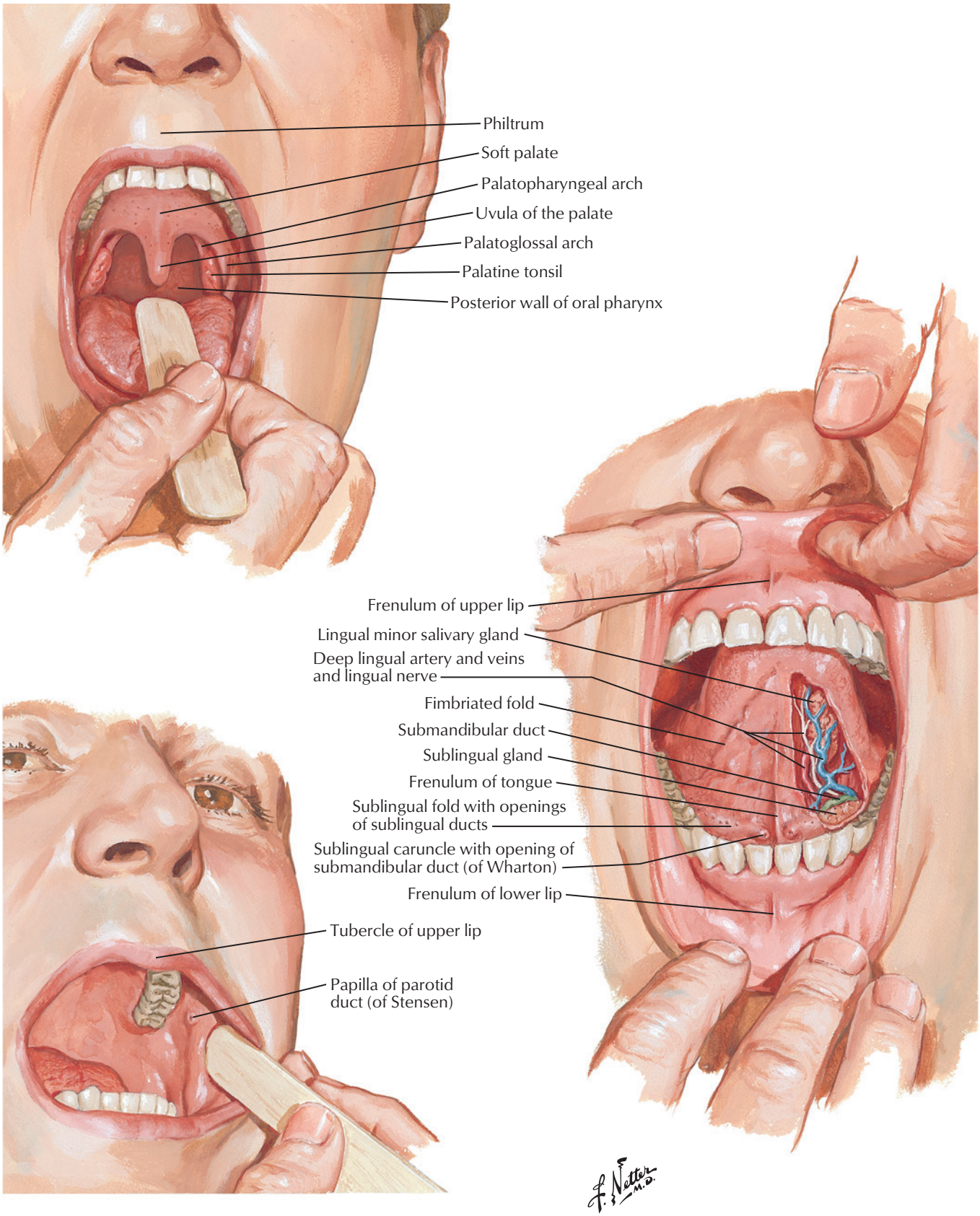
See also Plates 46, 48, 61



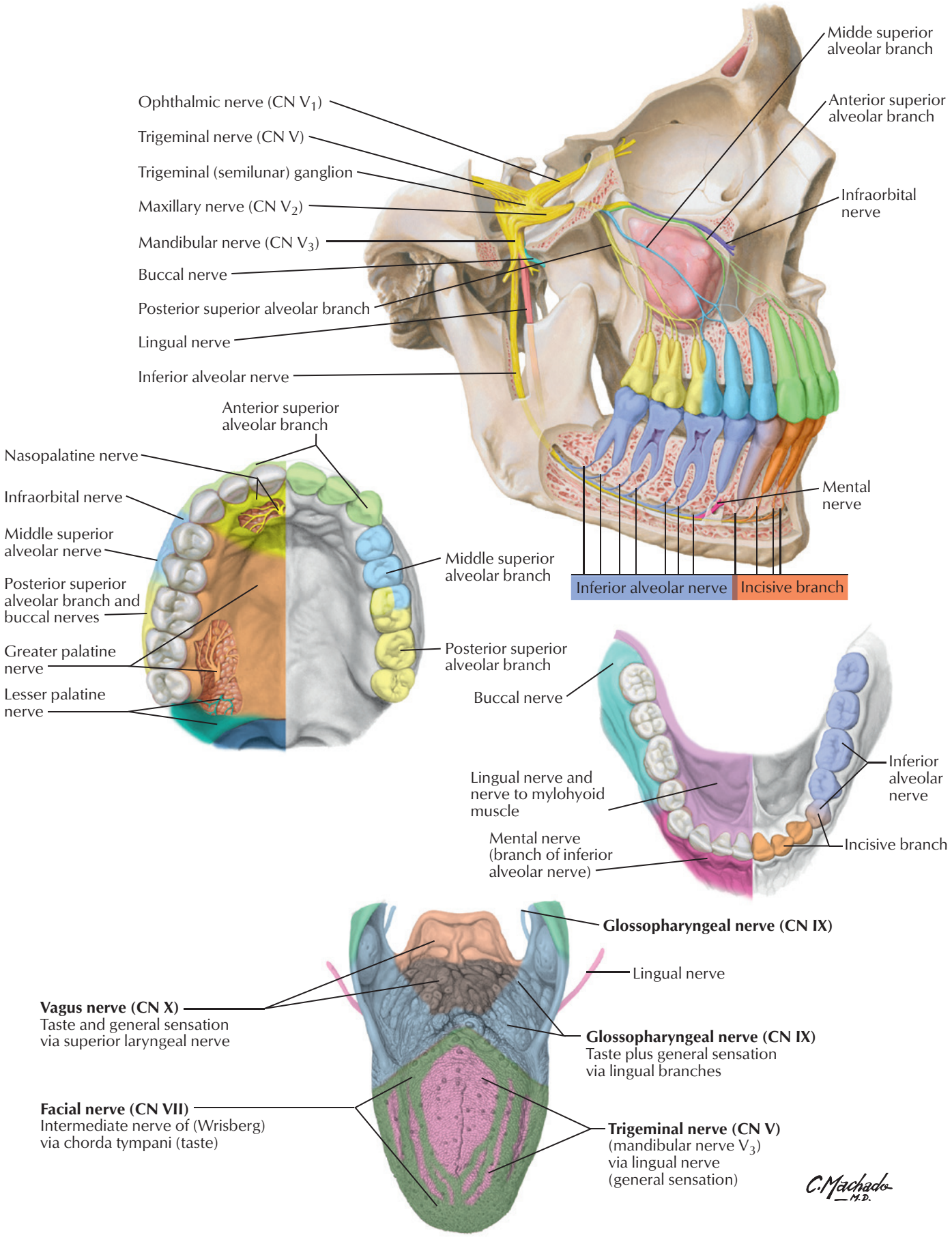
Anterior perspective of pterygopalatine fossa and nasal cavity with lower facial skeleton removed

See also Plates 115, 142, 147

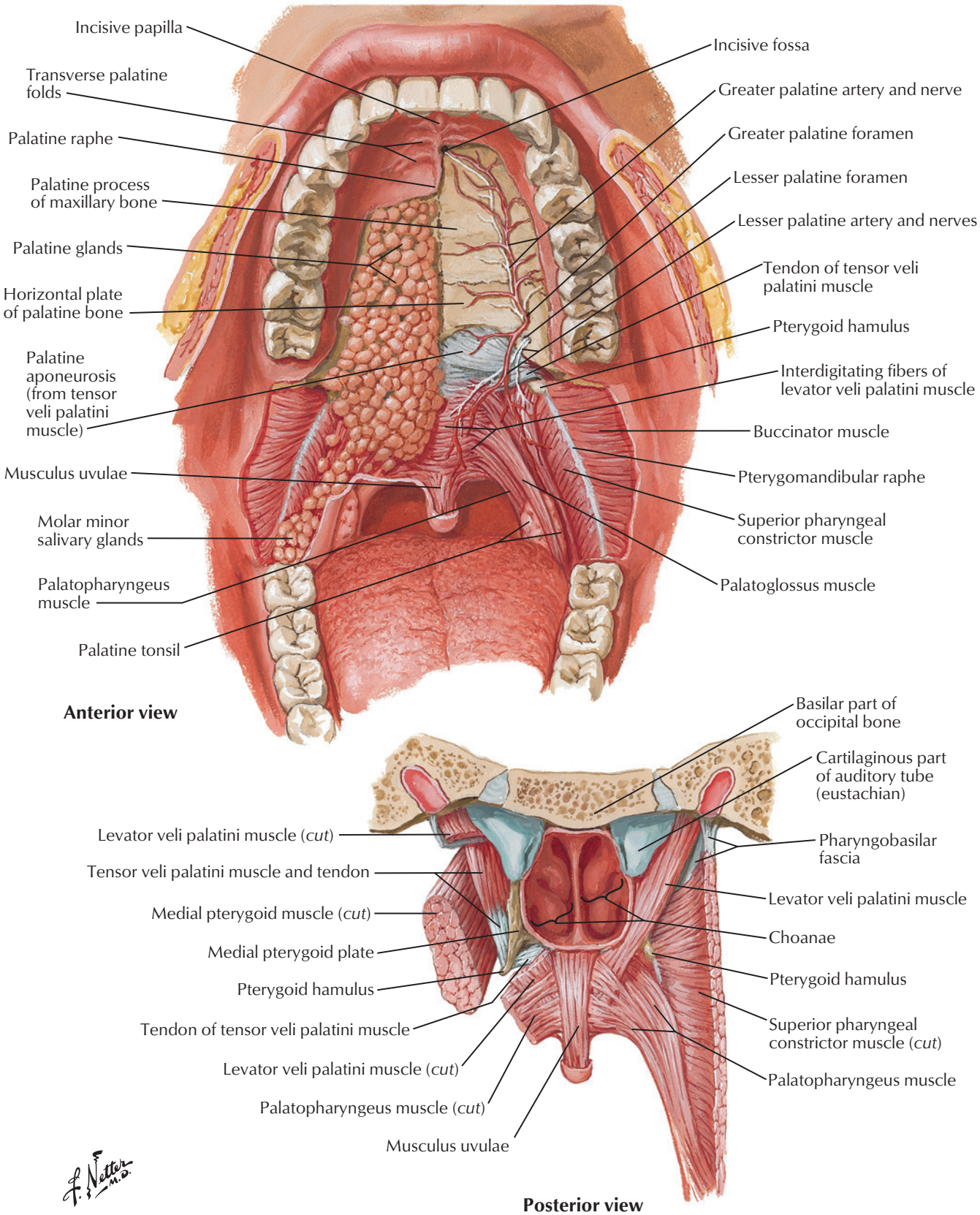



Philtrum
Soft palate
Palatopharyngeal arch
Uvula of the palate
Palatoglossal arch
Palatine tonsil
Posterior wall of oral pharynx
Frenulum of upper lip
Lingual minor salivary gland
Deep lingual artery and veins and lingual nerve
Fimbriated fold
Submandibular duct
Sublingual gland
Frenulum of tongue
Sublingual fold with openings of sublingual ducts
Sublingual caruncle with opening of submandibular duct (of Wharton)
Frenulum of lower lip
Tubercle of upper lip
Papilla of parotid duct (of Stensen)

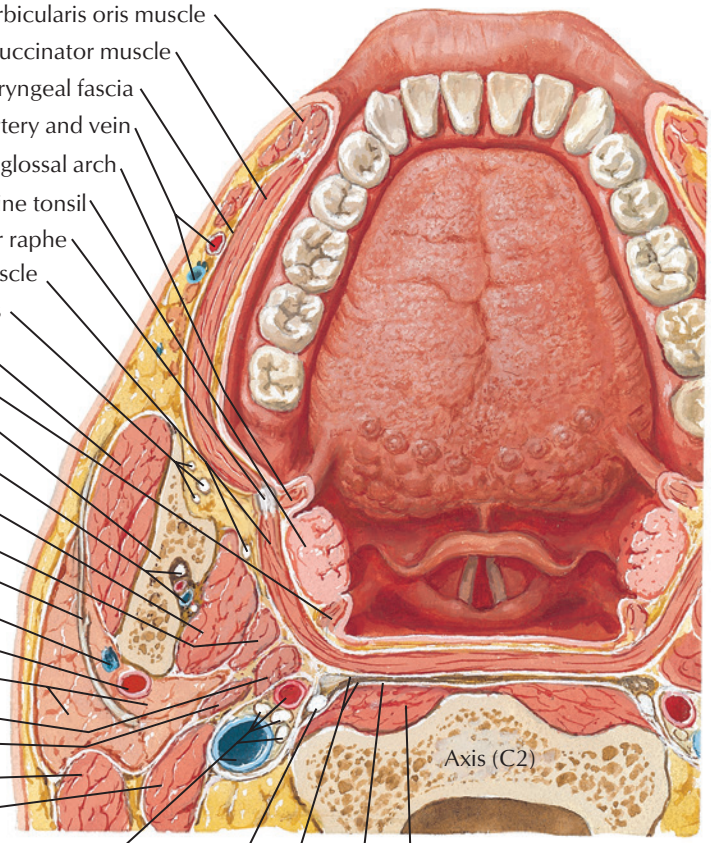
See also Plates 144, 146

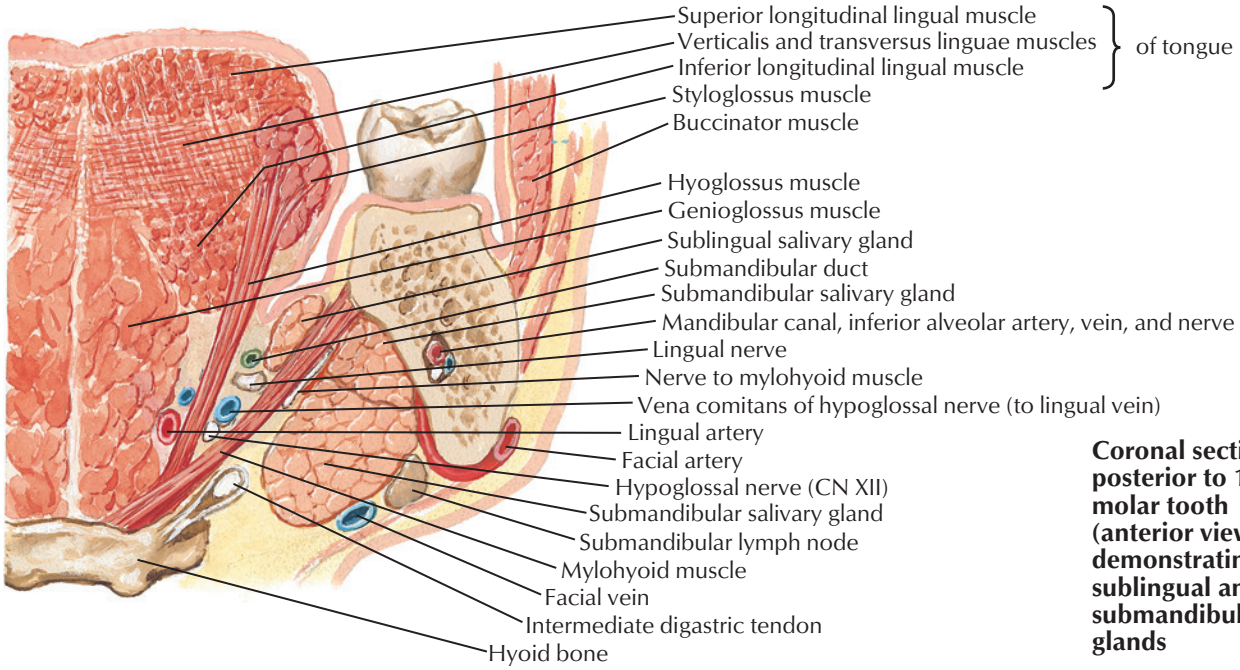


See also Plate 48



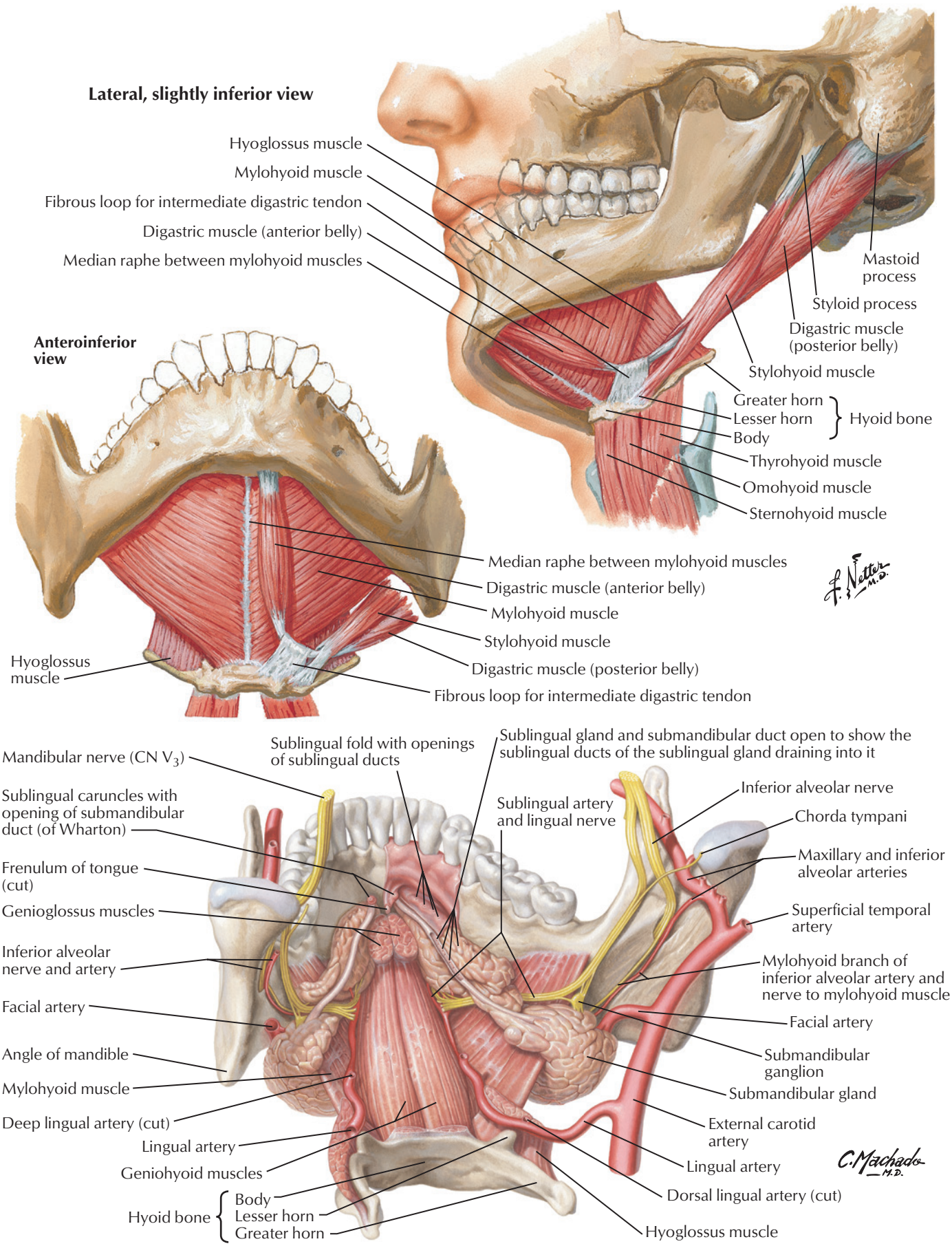
Horizontal section below lingula of mandible (superior view) demonstrating bed of parotid gland

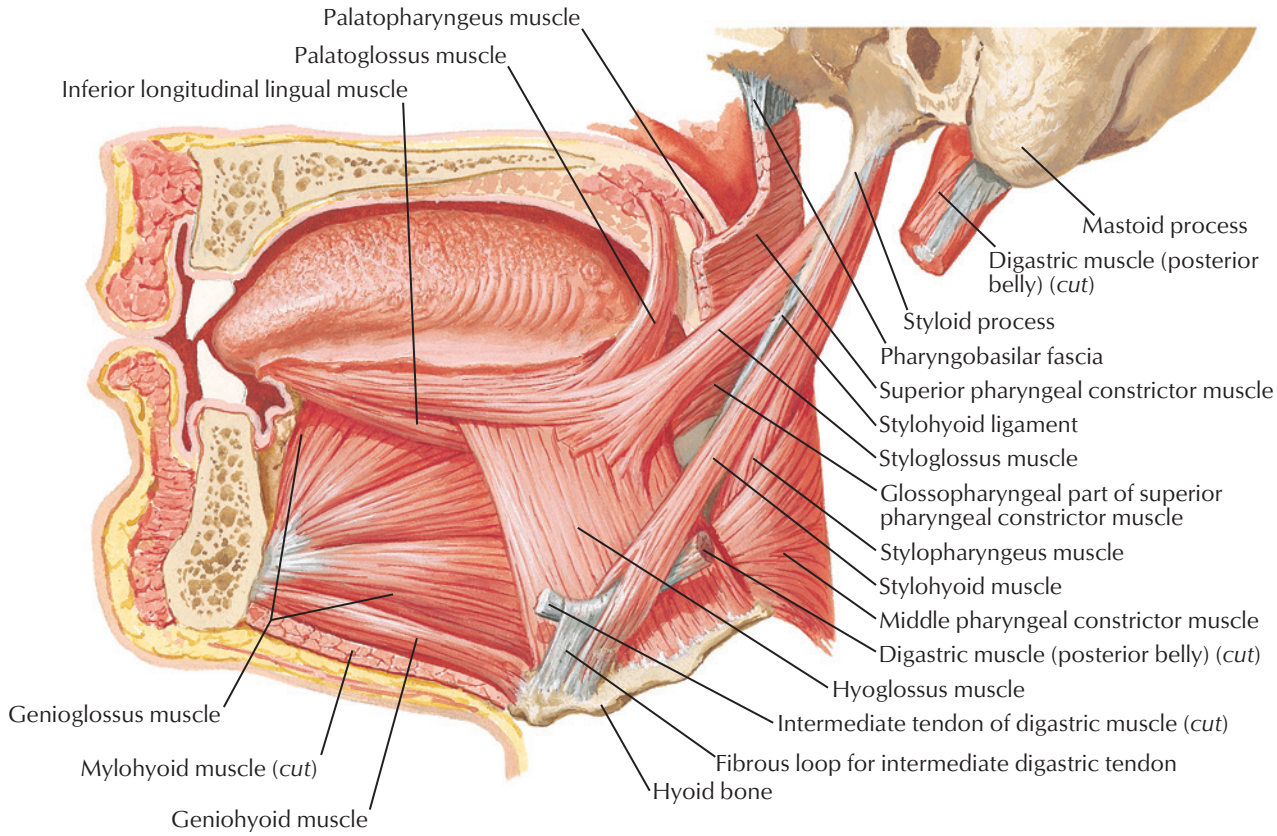




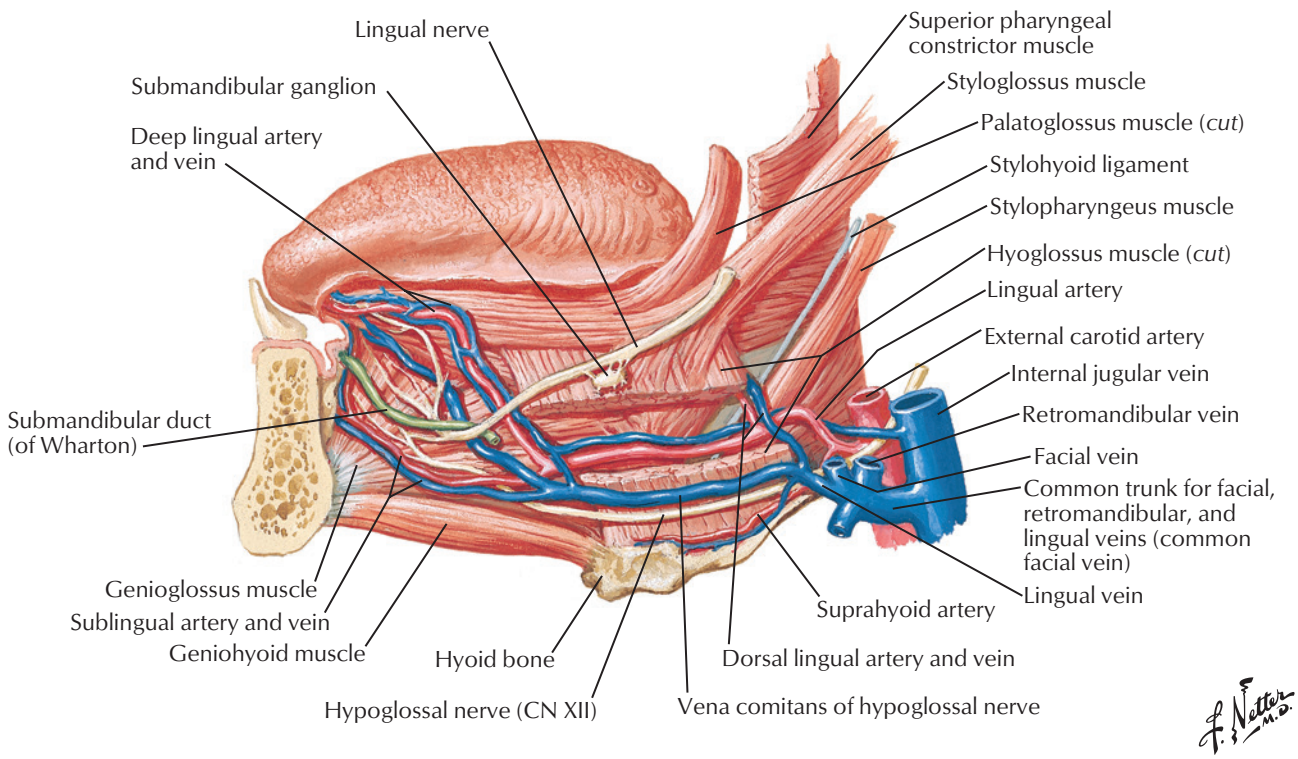
Coronal section posterior to 1st molar tooth (anterior view) demonstrating sublingual and submandibular glands

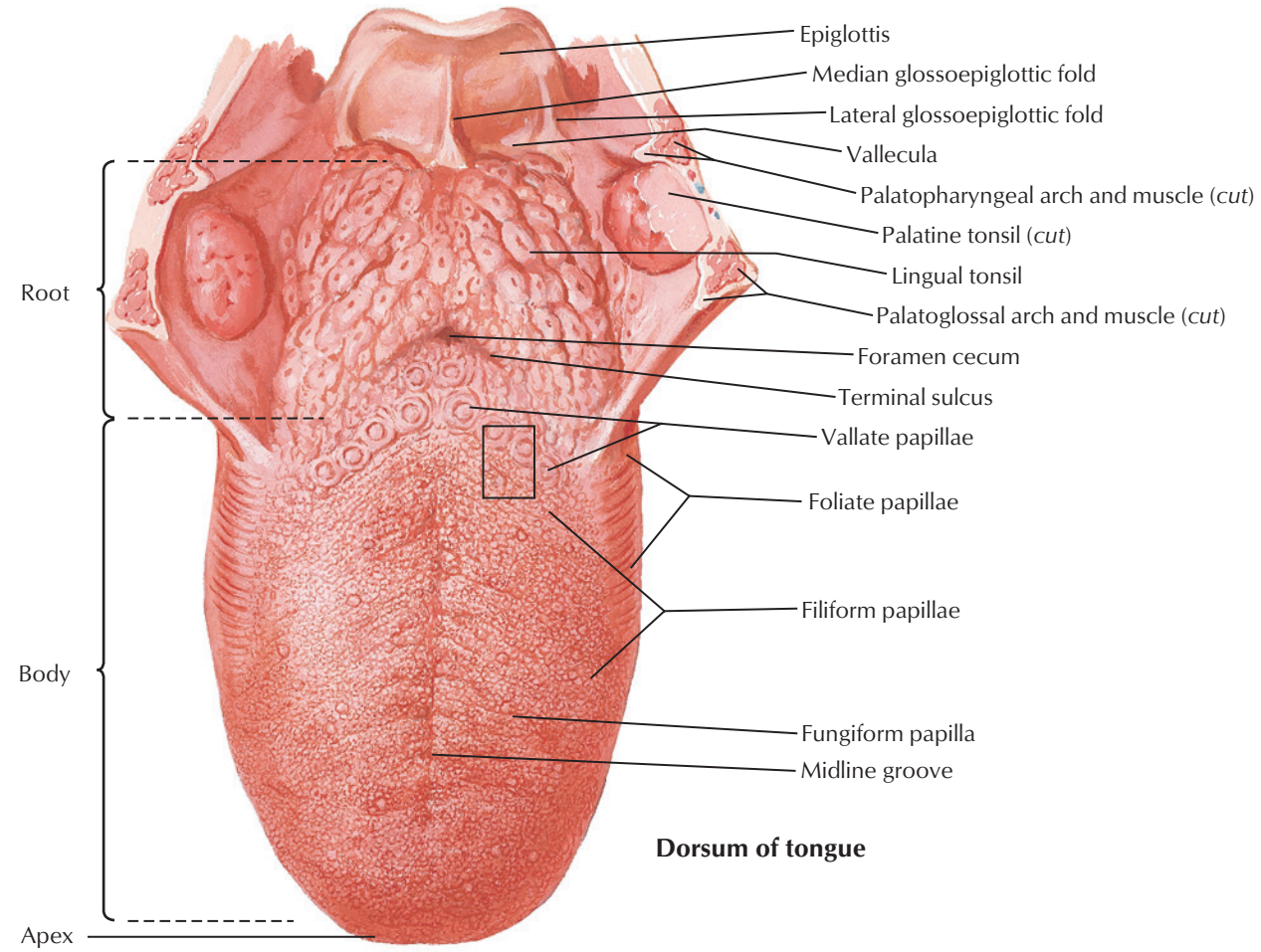
See also Plate 35



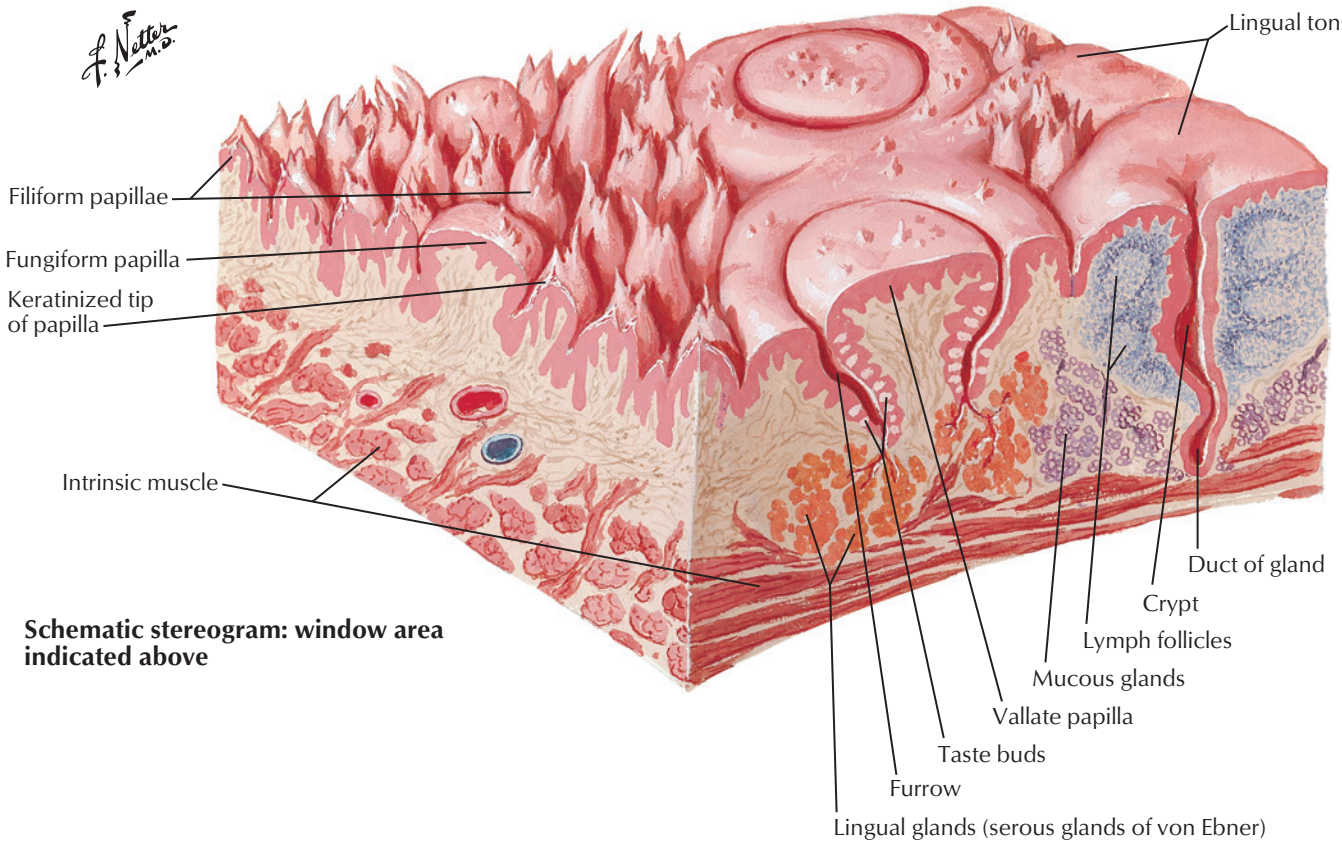


Lateral view (left side of mandible removed)



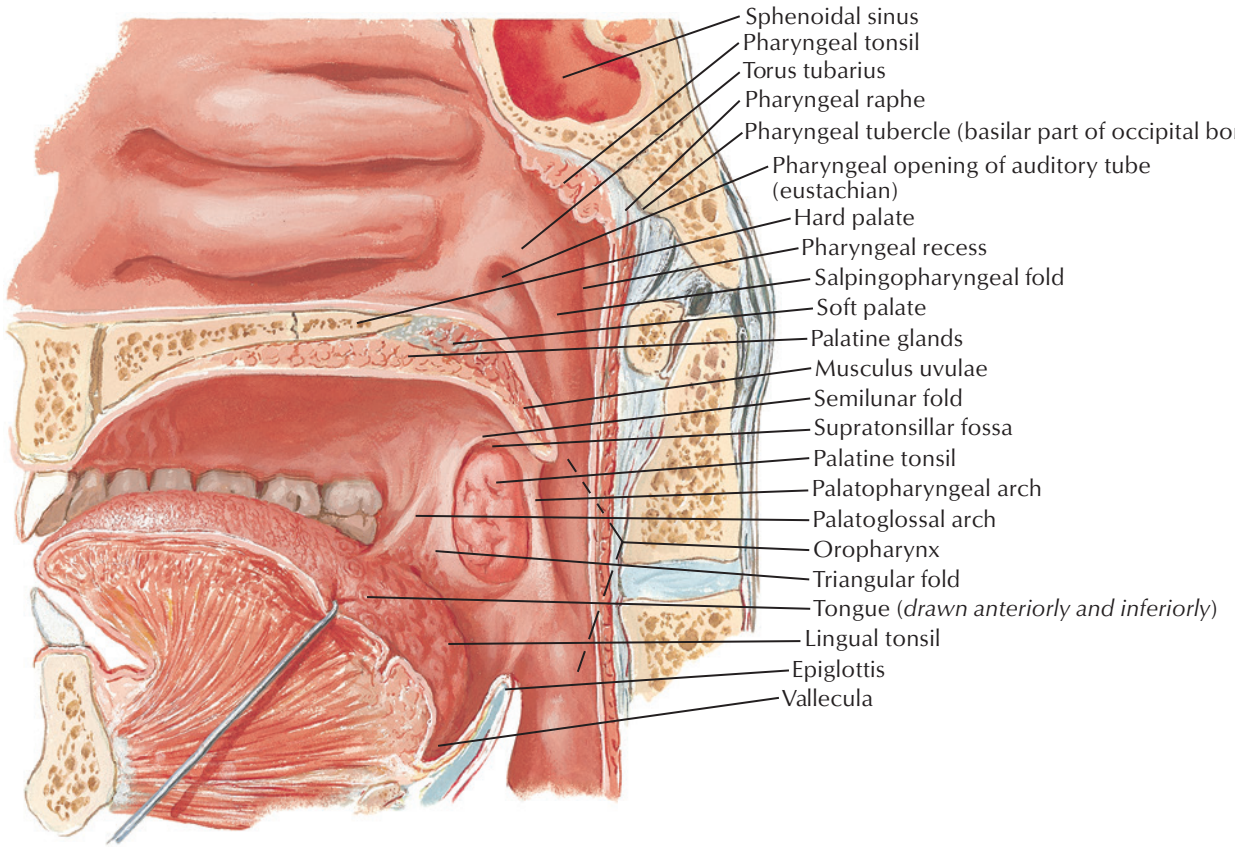


Dorsum of tongue

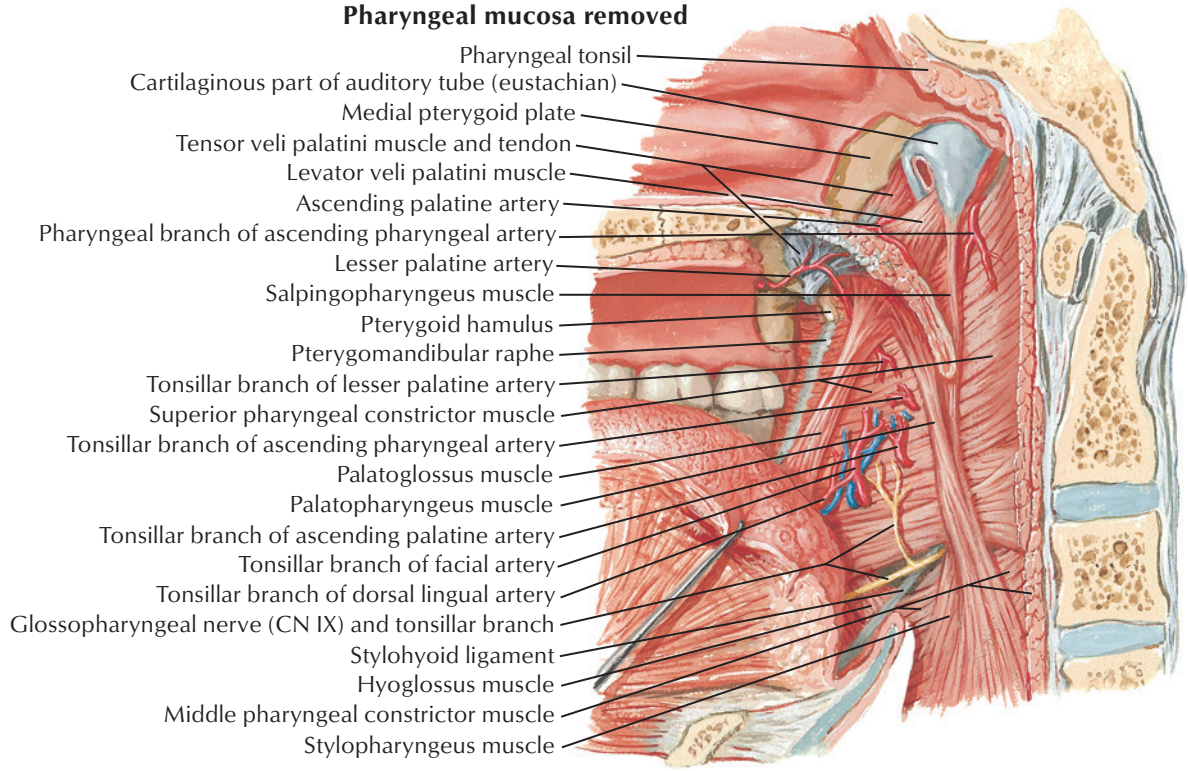


Schematic stereogram: window area indicated above

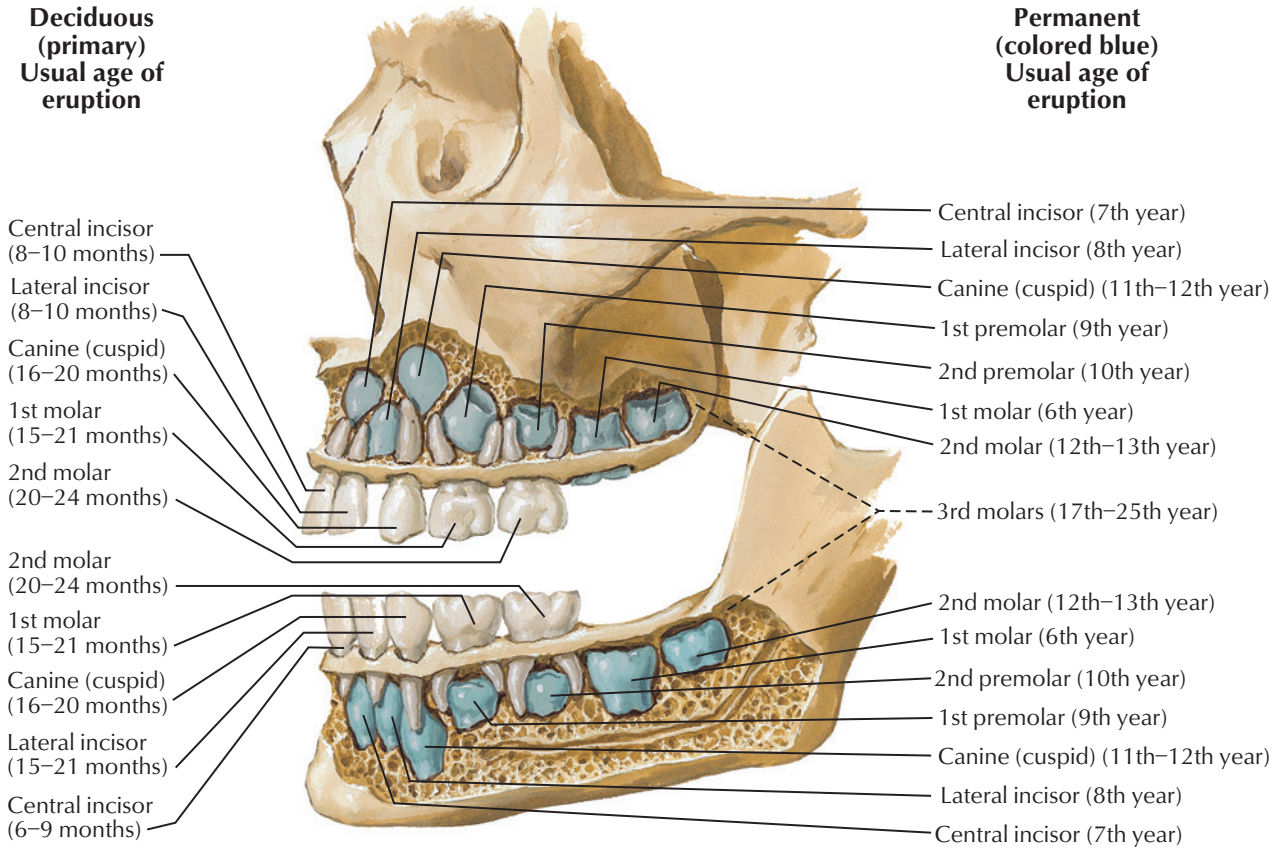
Medial view
sagittal section

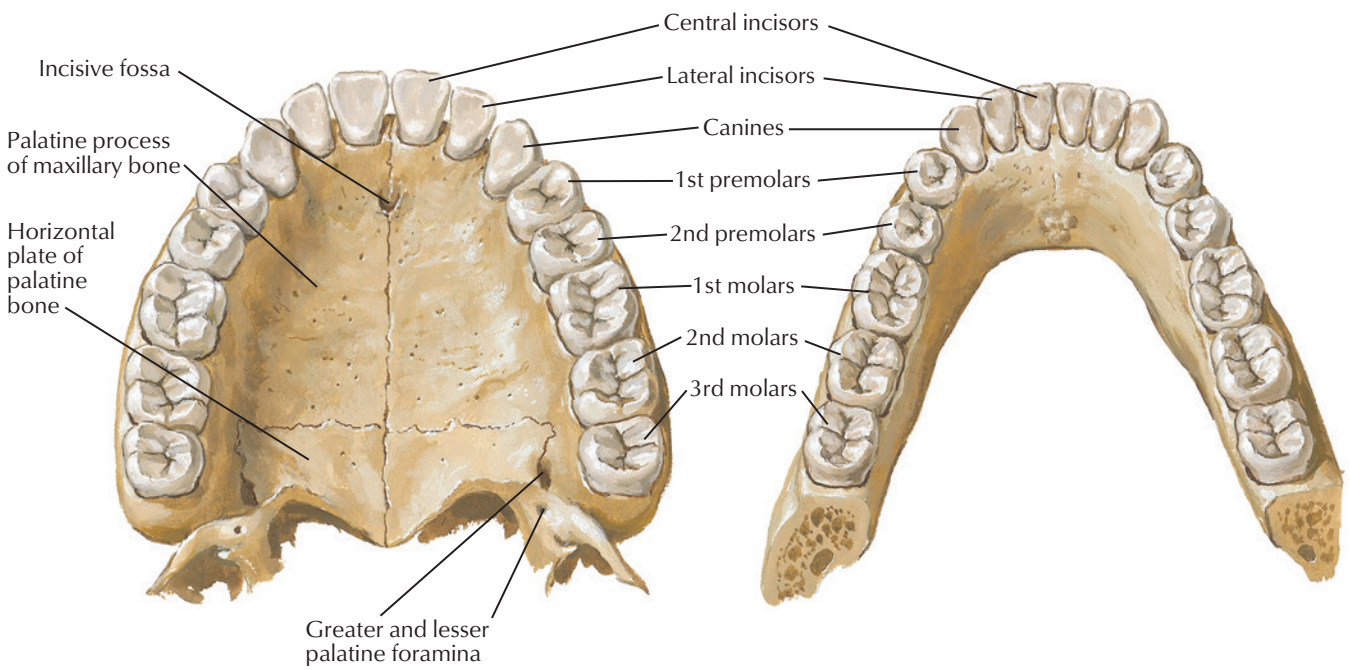


Pharyngeal mucosa removed



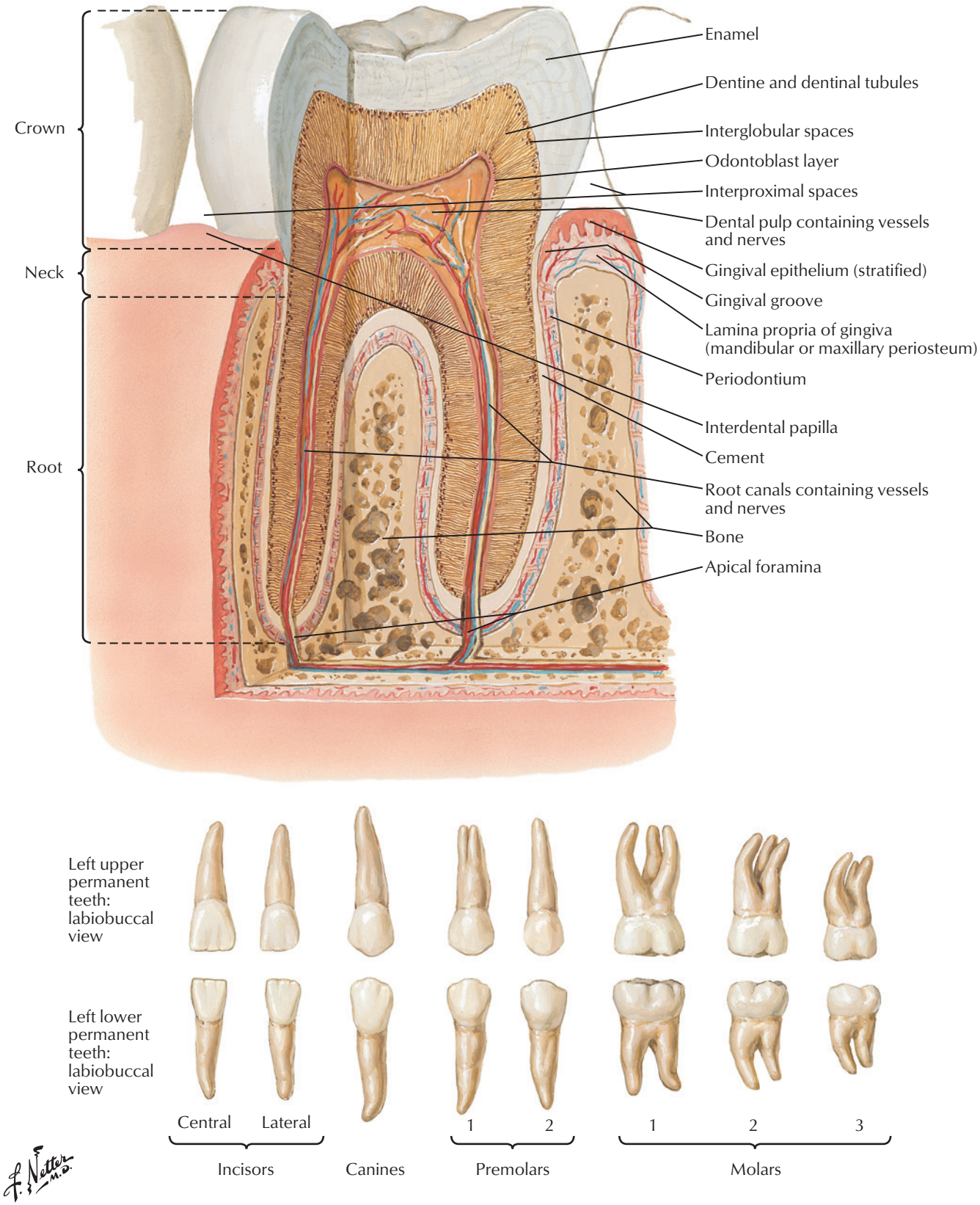
See also Plate 67





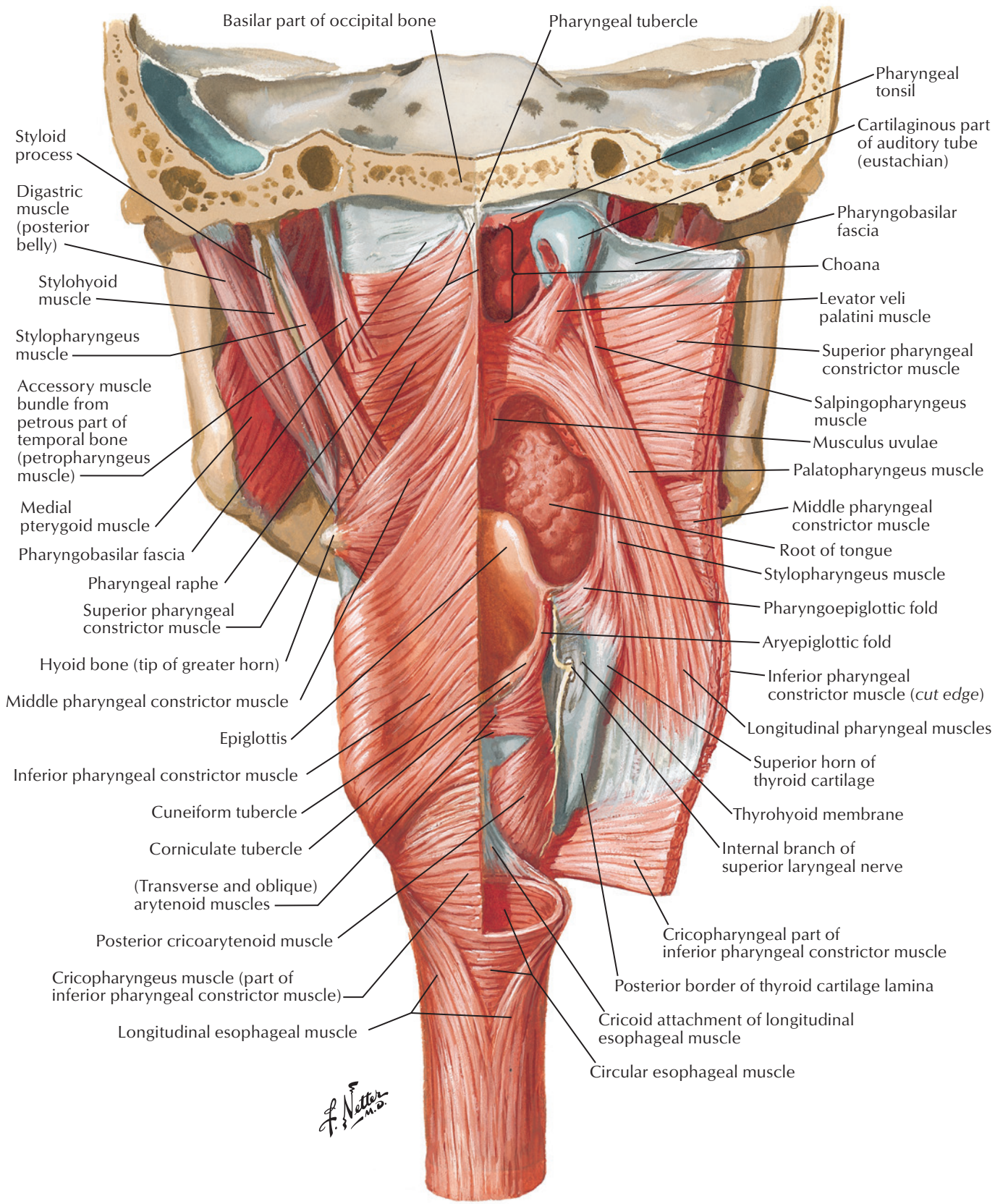
Upper permanent teeth

Lower permanent teeth

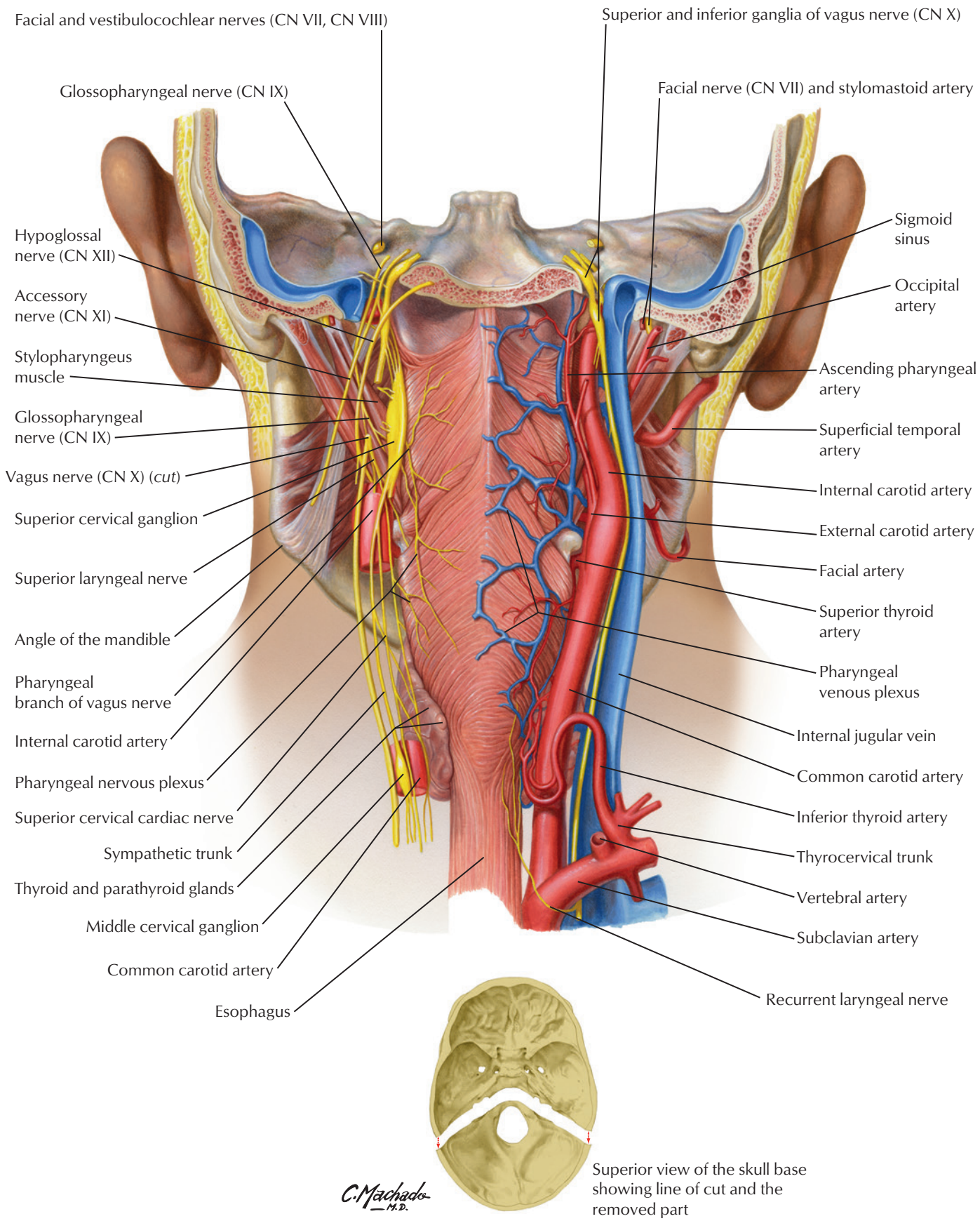

Crown
Neck
Root
Enamel
Dentine and dentinal tubules
Interglobular spaces
Odontoblast layer
Interproximal spaces
Dental pulp containing vessels and nerves
Gingival epithelium (stratified)
Gingival groove
Lamina propria of gingiva (mandibular or maxillary periosteum)
Periodontium
Interdental papilla
Cement
Root canals containing vessels and nerves
Bone
Apical foramina
Left upper permanent teeth: labiobuccal view
Left lower permanent teeth: labiobuccal view
Central
Lateral
1
2
1
2
3
Incisors
Canines
Premolars
Molars

Muscles of Pharynx: Partially Opened Posterior View

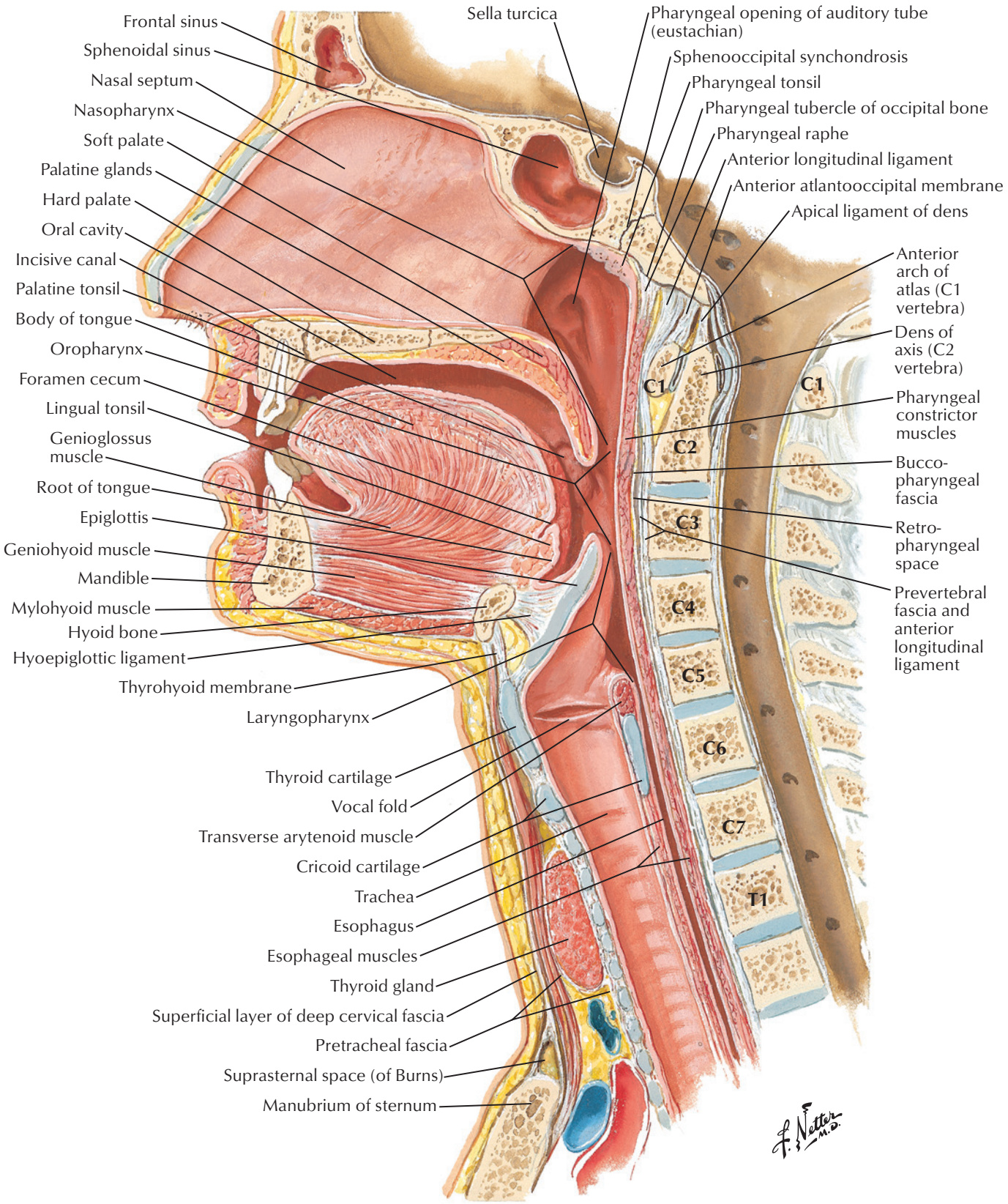
See also Plates 76, 81



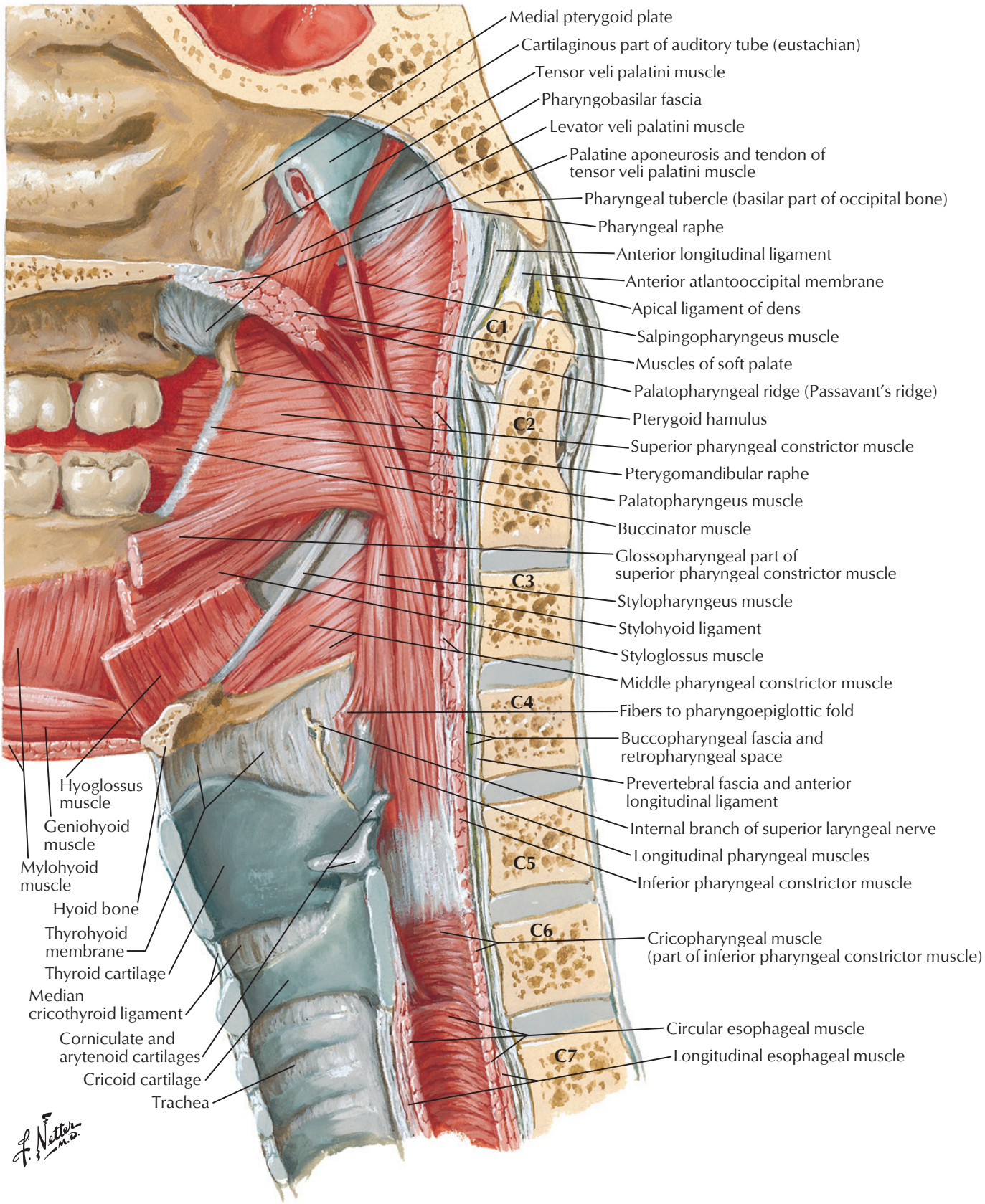
See also Plates 75, 79, 82, 83

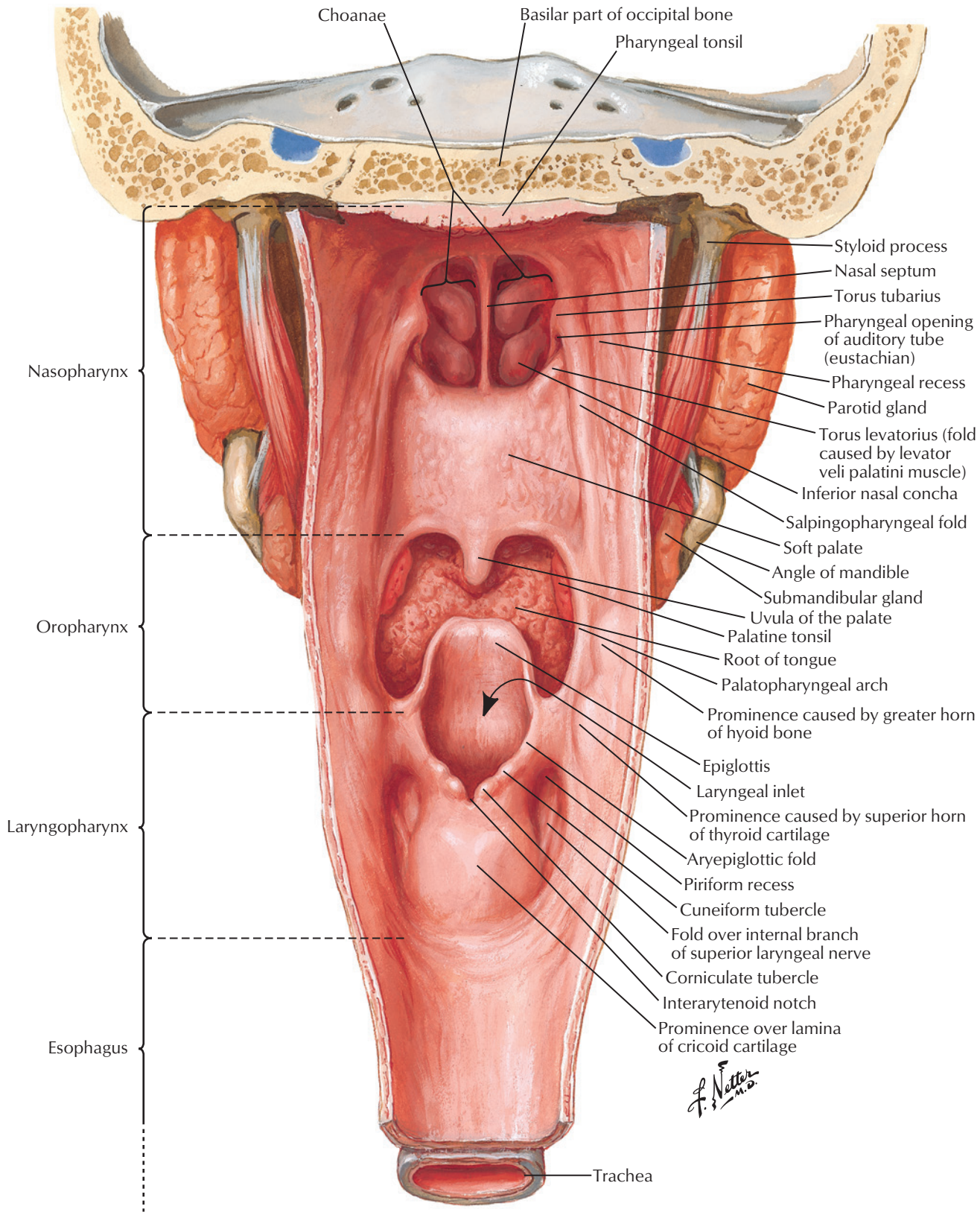


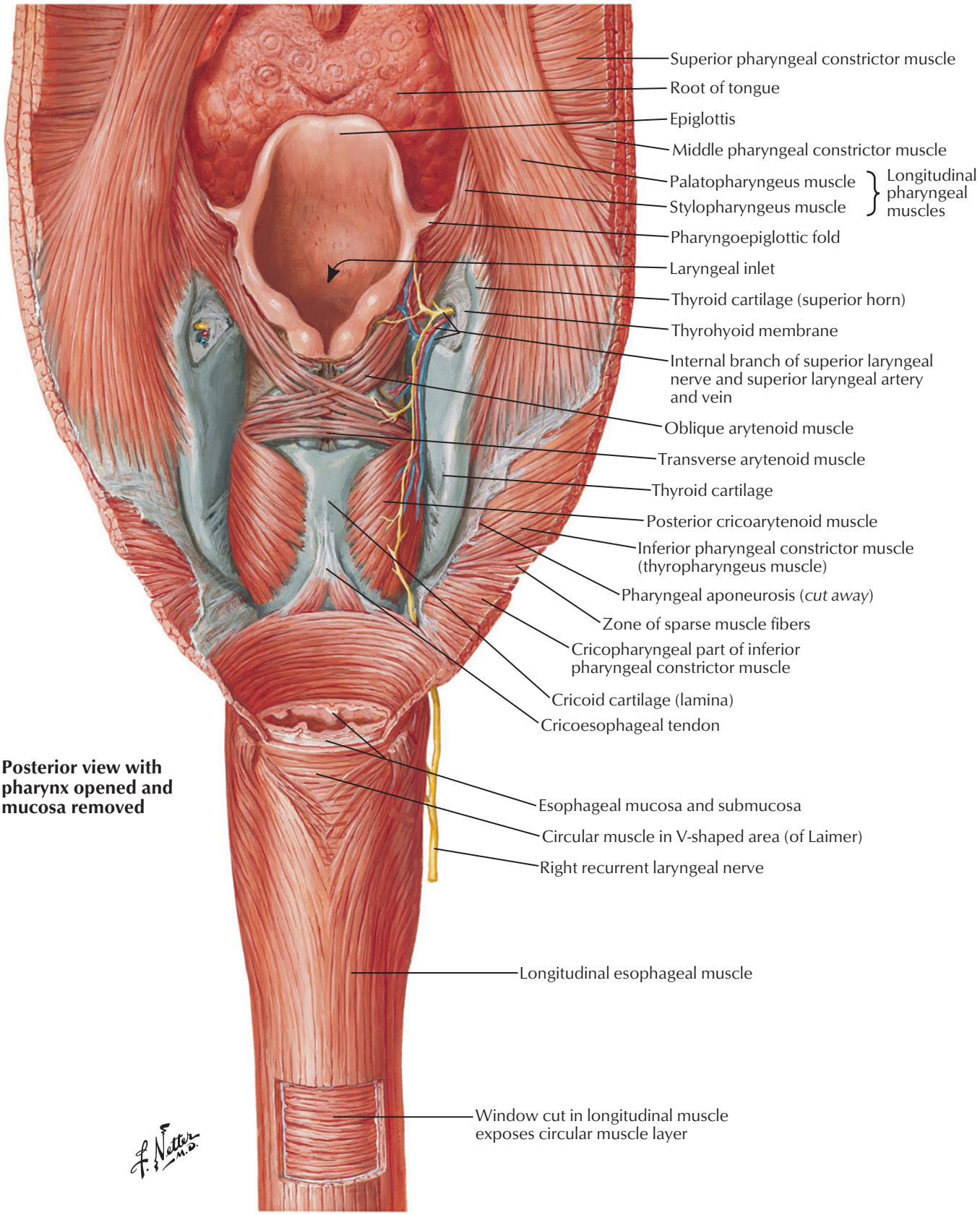
Superior view of the skull base showing line of cut and the removed part


Frontal sinus
Sphenoidal sinus
Nasal septum
Nasopharynx
Soft palate
Palatine glands
Hard palate
Oral cavity
Incisive canal
Palatine tonsil
Body of tongue
Oropharynx
Foramen cecum
Lingual tonsil
Genioglossus muscle
Root of tongue
Epiglottis
Geniohyoid muscle
Mandible
Mylohyoid muscle
Hyoid bone
Hyoepiglottic ligament
Thyrohyoid membrane
Laryngopharynx
Thyroid cartilage
Vocal fold
Transverse arytenoid muscle
Cricoid cartilage
Trachea
Esophagus
Esophageal muscles
Thyroid gland
Superficial layer of deep cervical fascia
Pretracheal fascia
Suprasternal space (of Burns)
Manubrium of sternum
Sella turcica
Pharyngeal opening of auditory tube (eustachian)
Sphenooccipital synchondrosis
Pharyngeal tonsil
Pharyngeal tubercle of occipital bone
Pharyngeal raphe
Anterior longitudinal ligament
Anterior atlantooccipital membrane
Apical ligament of dens
Anterior arch of atlas (C1 vertebra)
Dens of axis (C2 vertebra)
C1
C1
Pharyngeal constrictor muscles
C2
Bucco-pharyngeal fascia
C3
Retro-pharyngeal space
Prevertebral fascia and anterior longitudinal ligament
C4
C5
C6
C7
T1

See also Plate 72



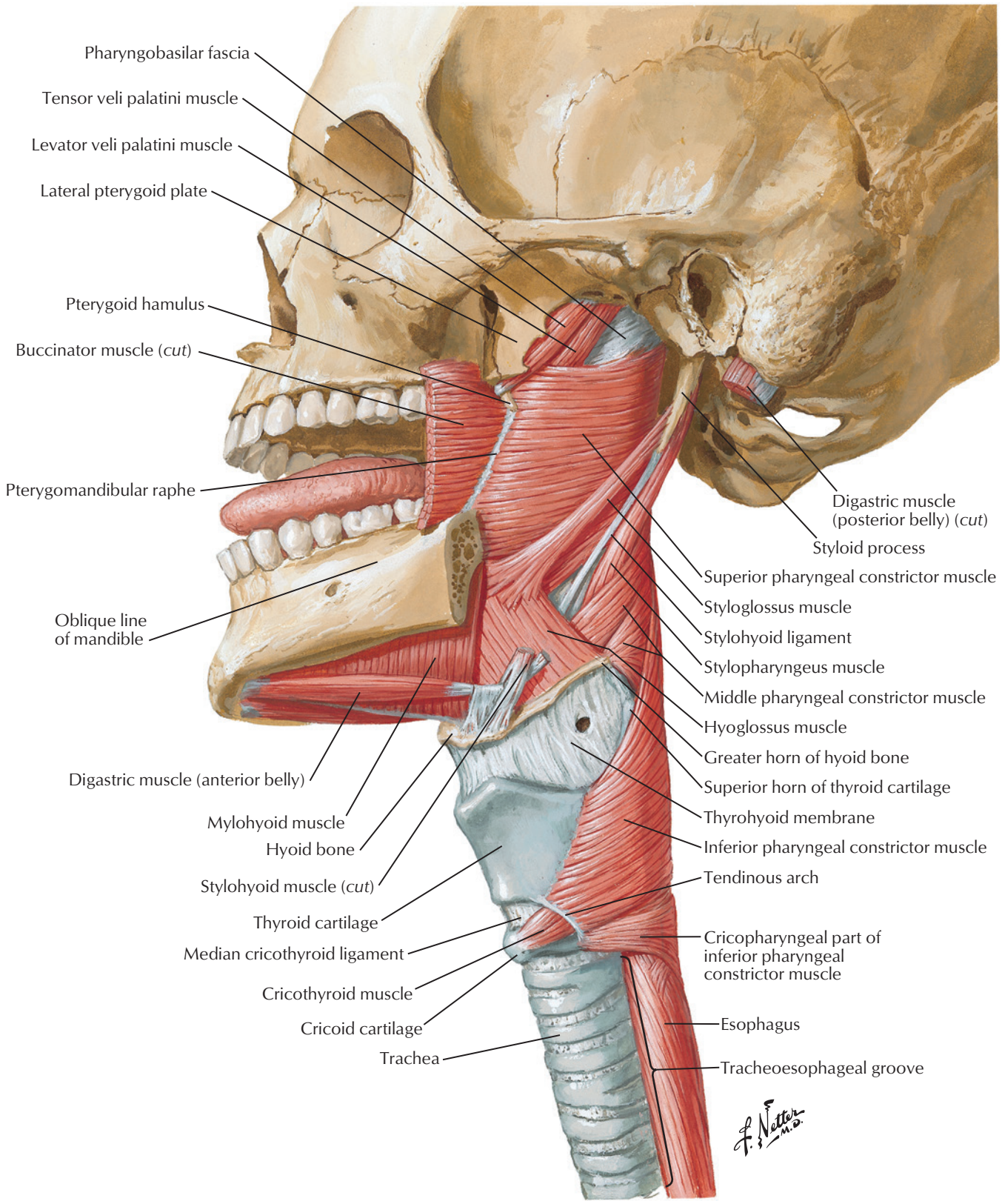

Choanae
Basilar part of occipital bone
Pharyngeal tonsil
Styloid process
Nasal septum
Torus tubarius
Pharyngeal opening of auditory tube (eustachian)
Pharyngeal recess
Parotid gland
Torus levatorius (fold caused by levator veli palatini muscle)
Inferior nasal concha
Salpingopharyngeal fold
Soft palate
Angle of mandible
Submandibular gland
Uvula of the palate
Palatine tonsil
Root of tongue
Palatopharyngeal arch
Prominence caused by greater horn of hyoid bone
Epiglottis
Laryngeal inlet
Prominence caused by superior horn of thyroid cartilage
Aryepiglottic fold
Piriform recess
Cuneiform tubercle
Fold over internal branch of superior laryngeal nerve
Corniculate tubercle
Interarytenoid notch
Prominence over lamina of cricoid cartilage
Nasopharynx
Oropharynx
Laryngopharynx
Esophagus
Trachea



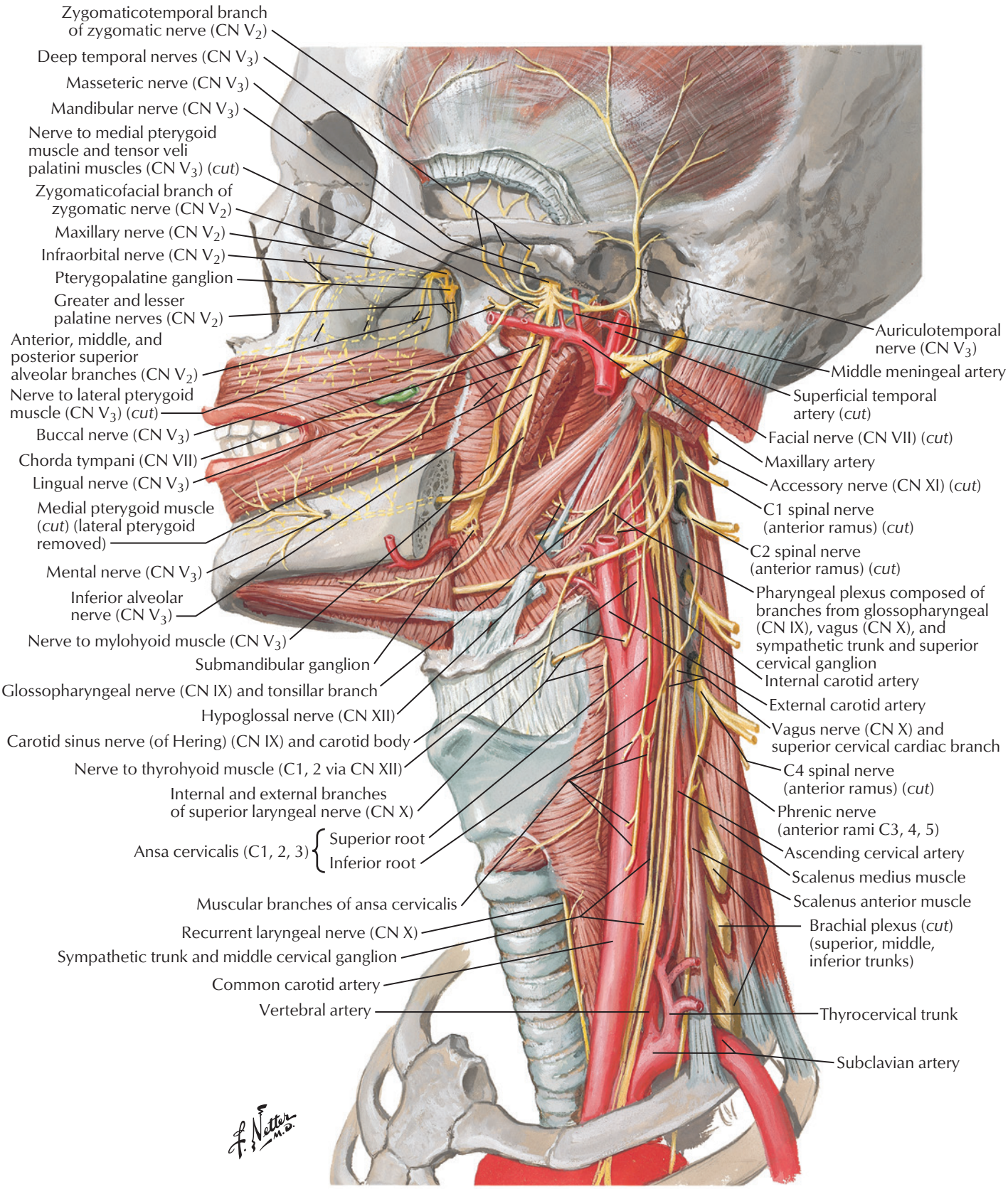
Posterior view with pharynx opened and mucosa removed

Muscles of Pharynx: Lateral View

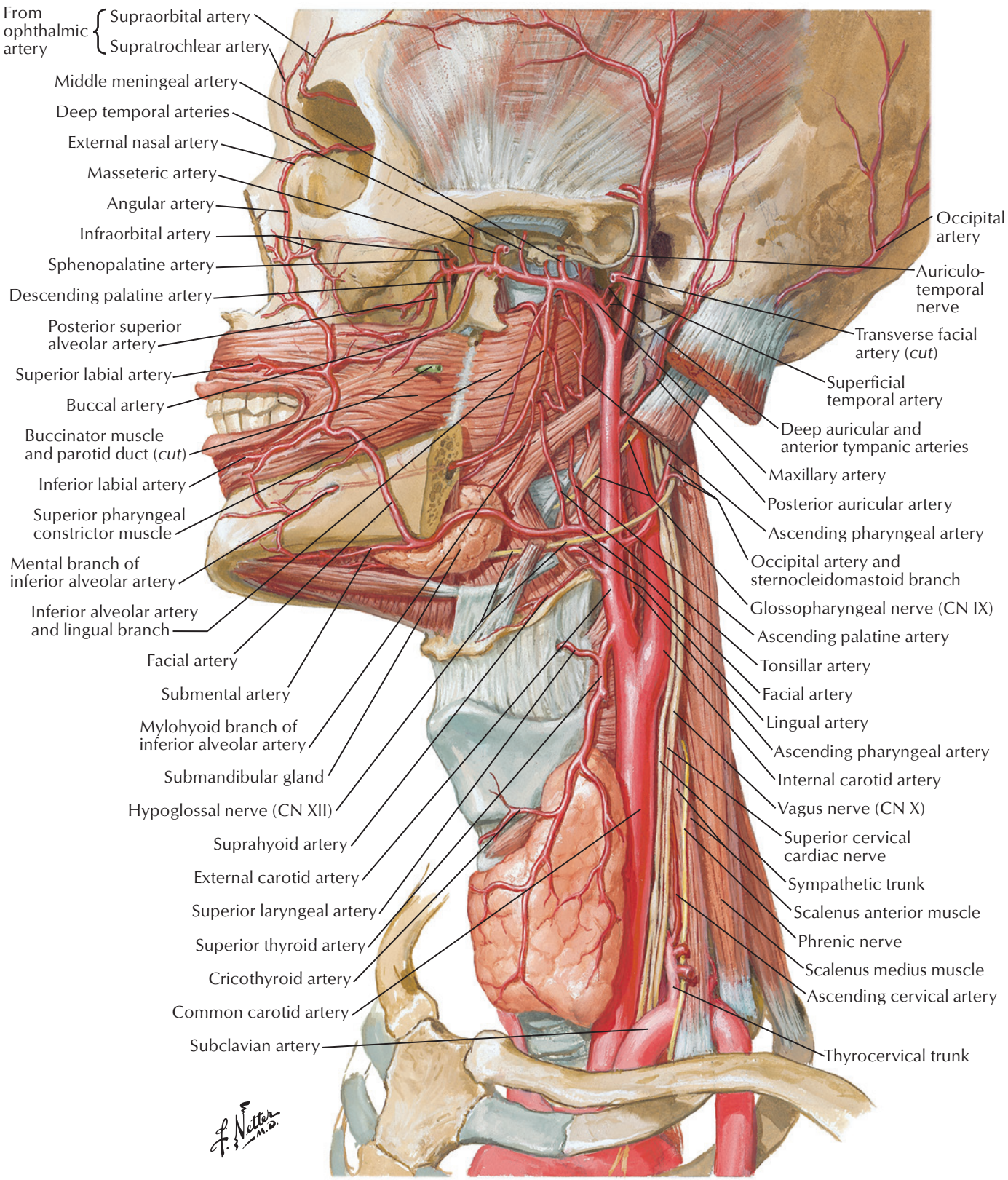
See also Plate 75



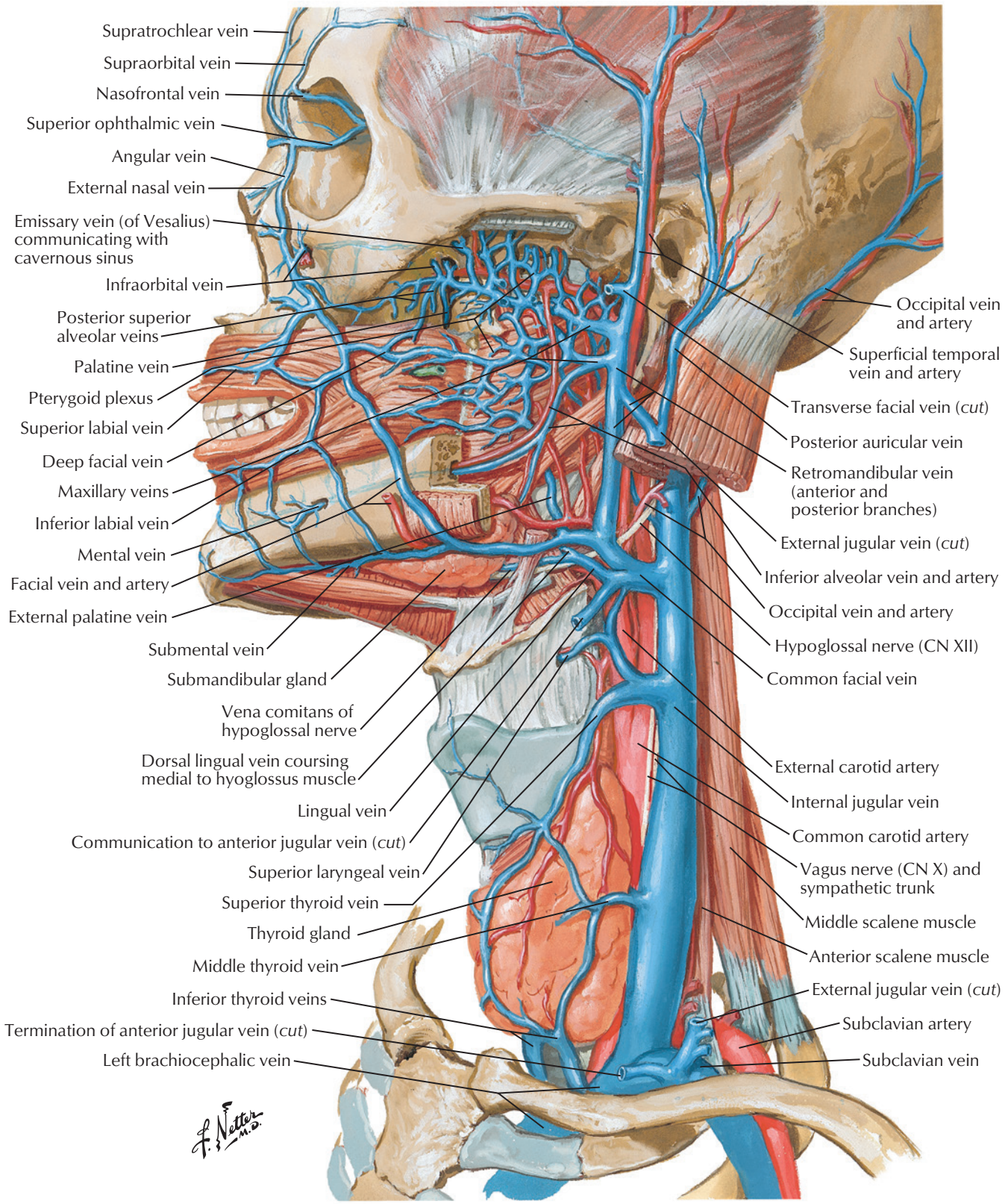
See also Plates 59, 133, 136



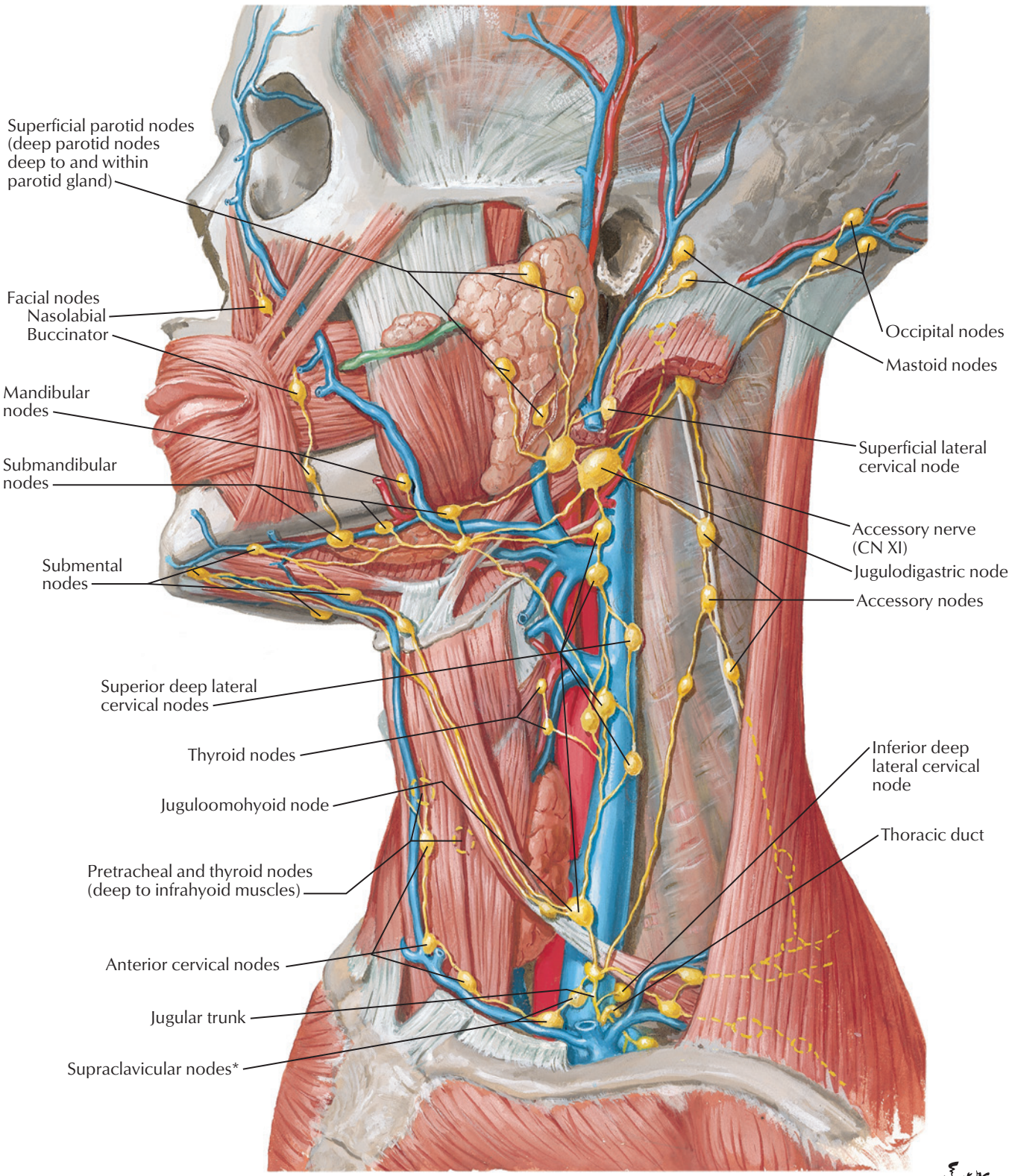
See also Plates 41, 57



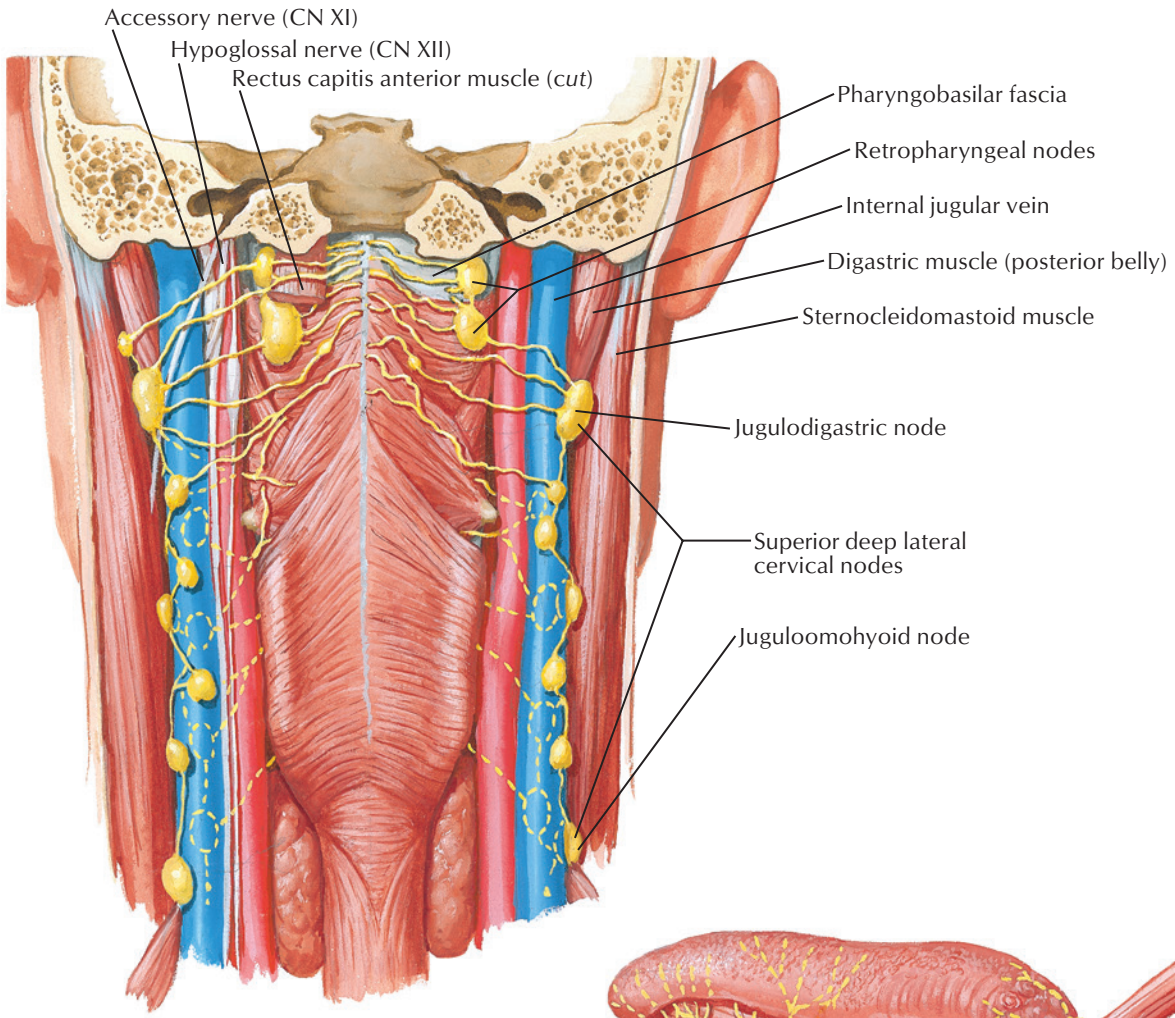
See also Plate 85



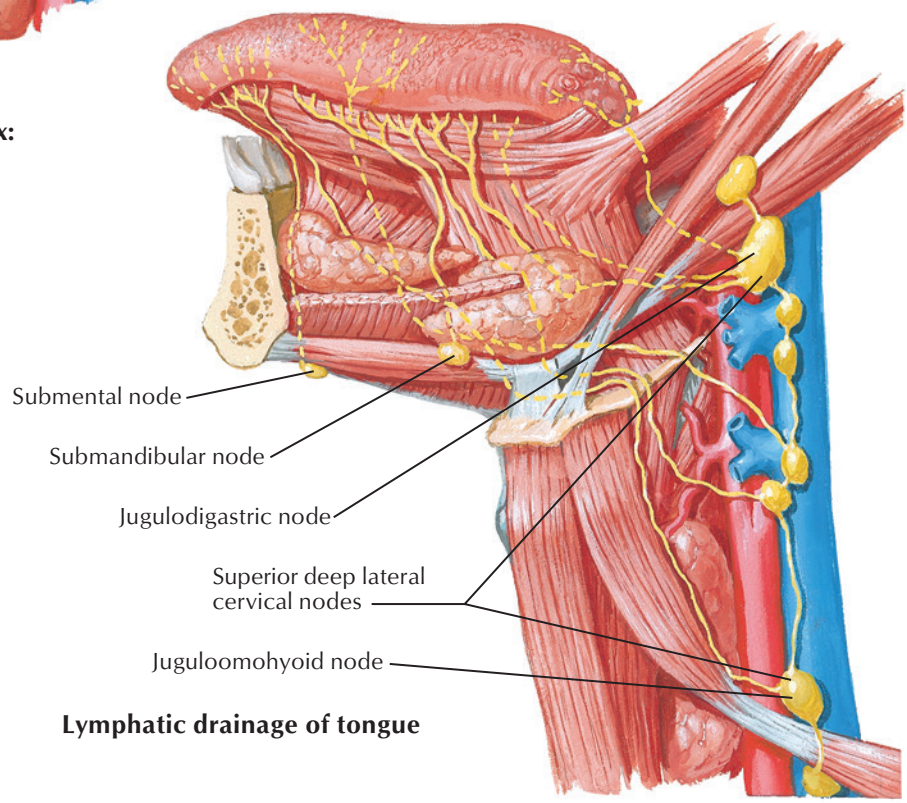
See also Plate 242



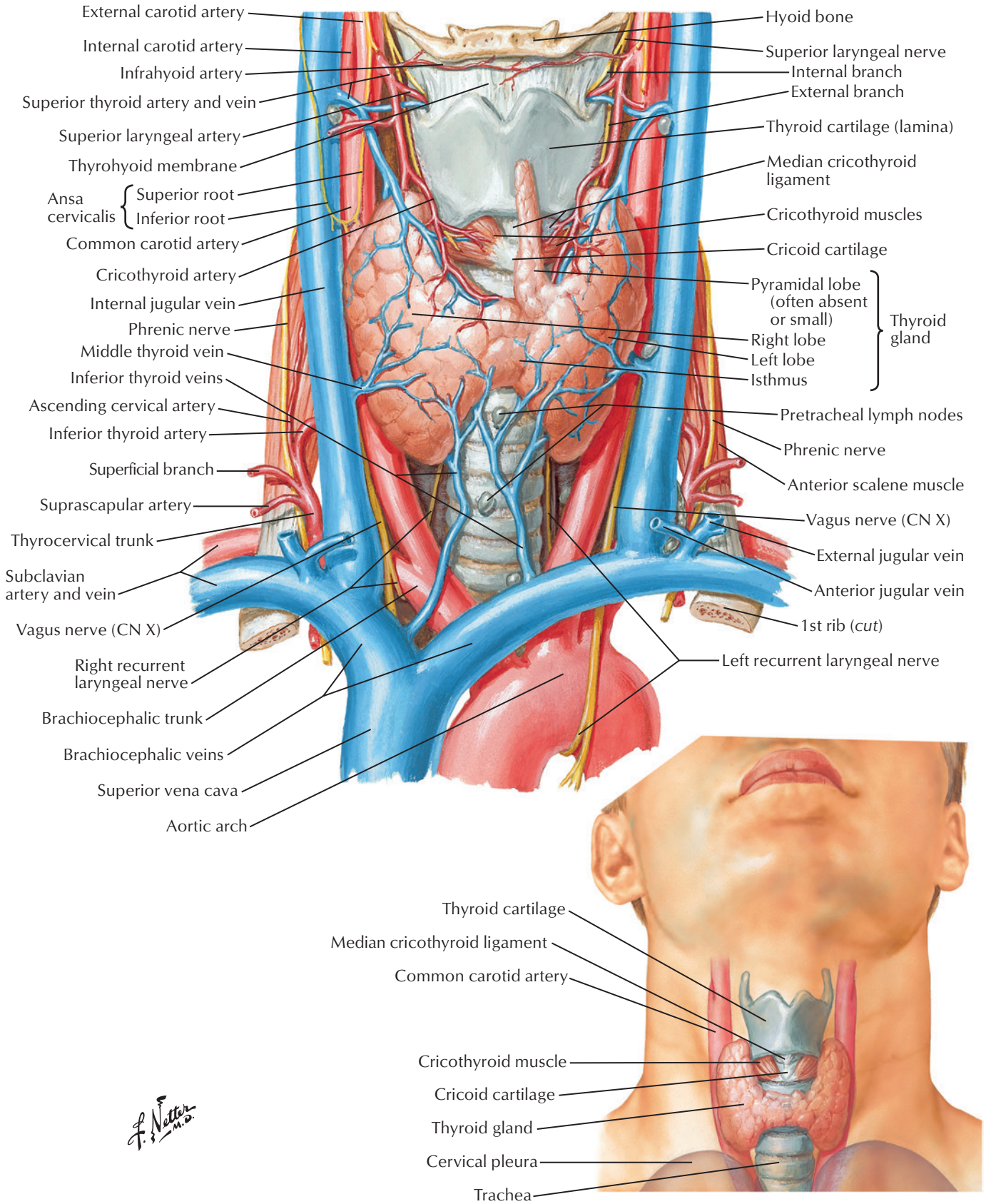
*The supraclavicular group of nodes, especially on the left, are also sometimes referred to as the signal or sentinel lymph nodes of Virchow or Troisier, especially when sufficiently enlarged and palpable. These nodes (or a single node) are so termed because they may be the first recognized presumptive evidence of malignant disease in the viscera.



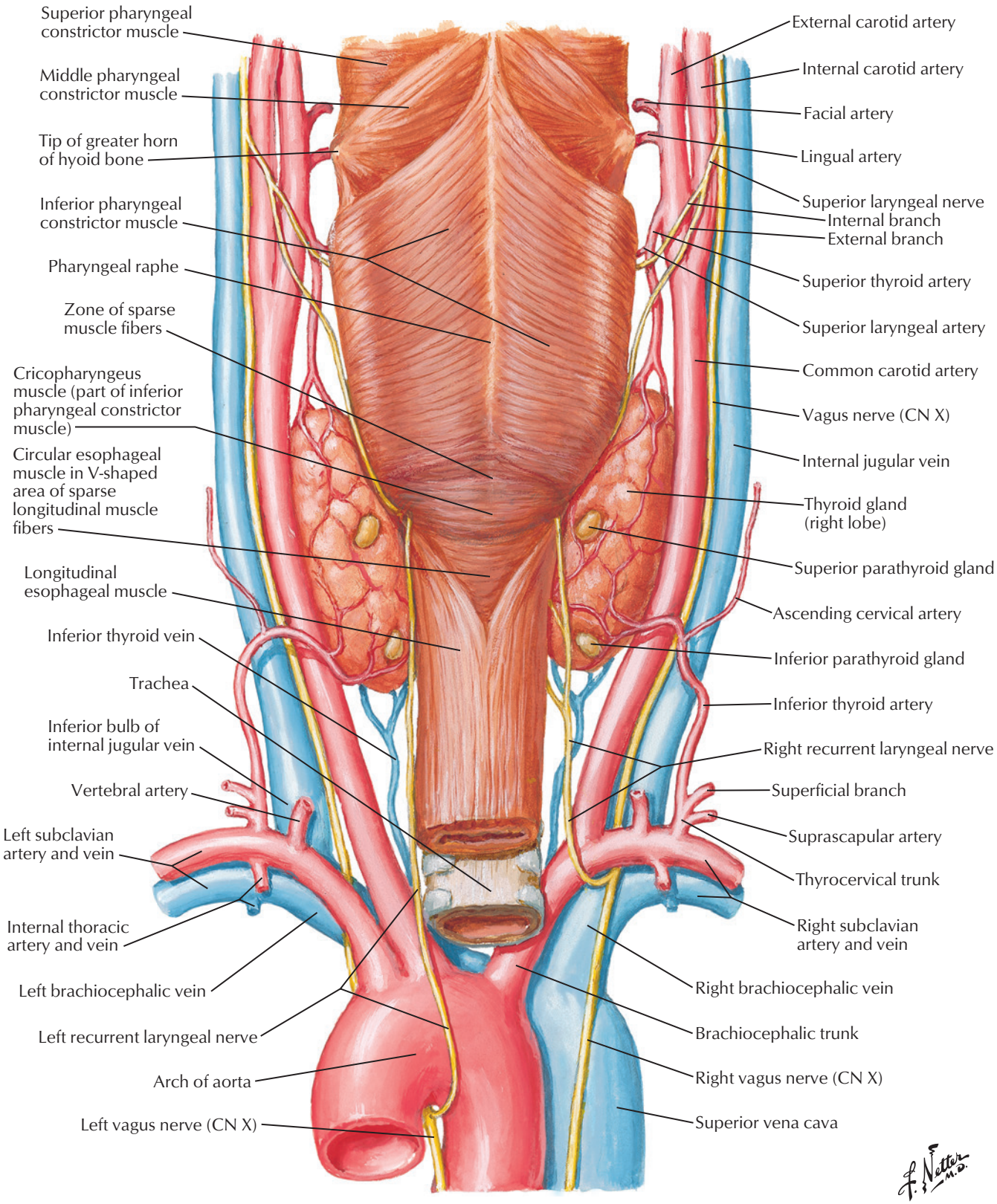
Lymphatic drainage of pharynx: posterior view



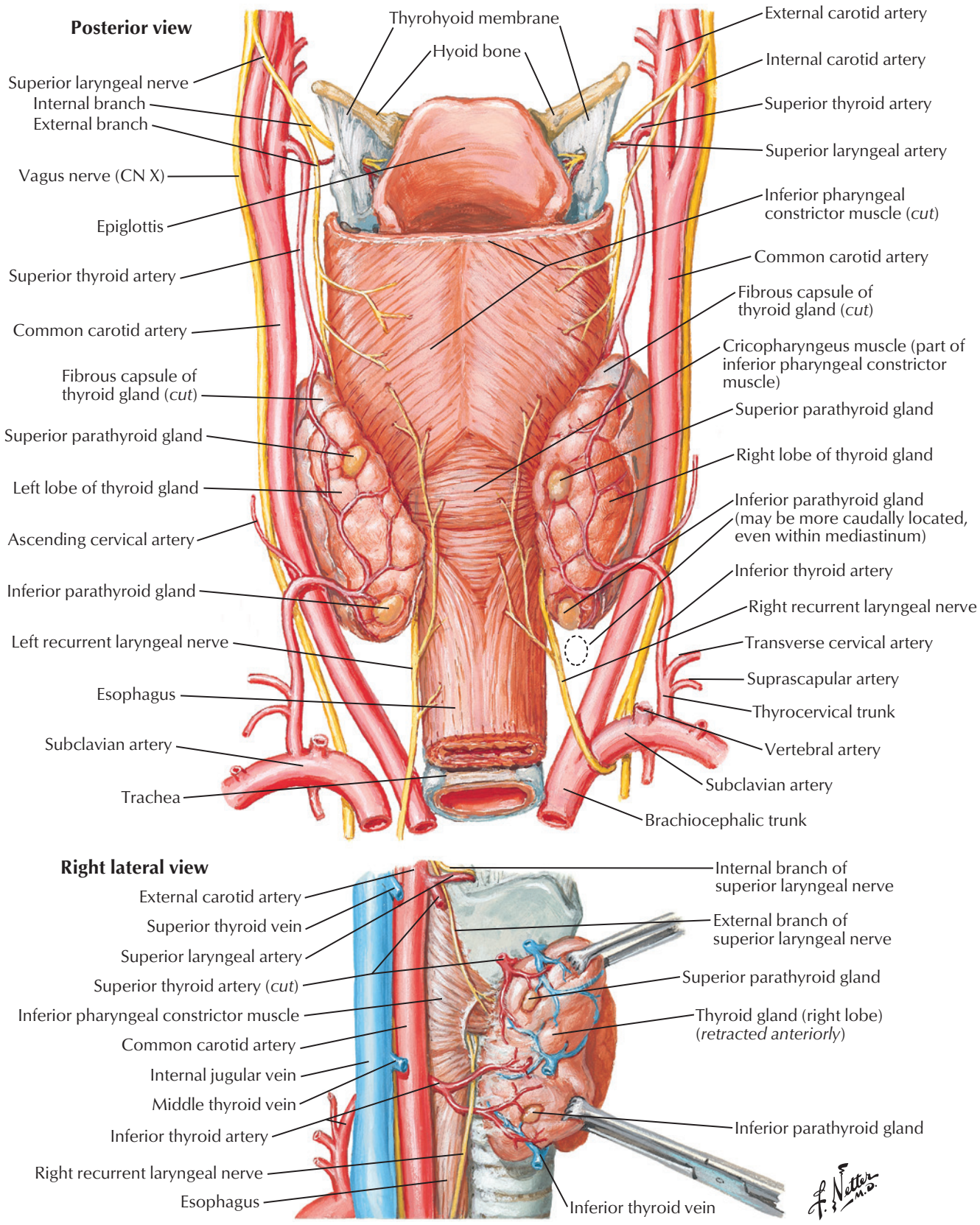
Lymphatic drainage of tongue

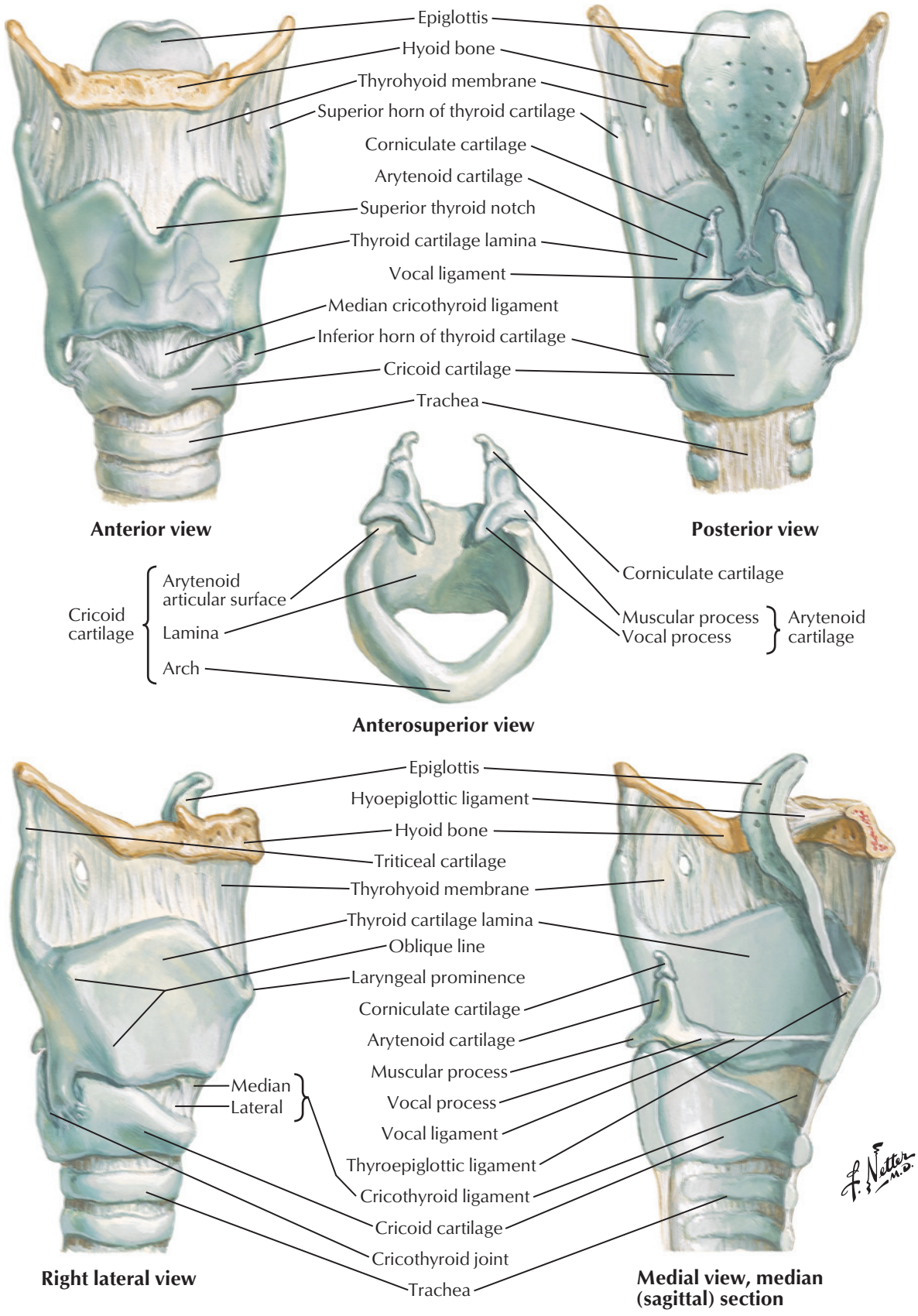

External carotid artery
Internal carotid artery
Infrahyoid artery
Superior thyroid artery and vein
Superior laryngeal artery
Thyrohyoid membrane
Ansa cervicalis
Superior root
Inferior root
Common carotid artery
Cricothyroid artery
Internal jugular vein
Phrenic nerve
Middle thyroid vein
Inferior thyroid veins
Ascending cervical artery
Inferior thyroid artery
Superficial branch
Suprascapular artery
Thyrocervical trunk
Subclavian artery and vein
Vagus nerve (CN X)
Right recurrent laryngeal nerve
Brachiocephalic trunk
Brachiocephalic veins
Superior vena cava
Aortic arch
Hyoid bone
Superior laryngeal nerve
Internal branch
External branch
Thyroid cartilage (lamina)
Median cricothyroid ligament
Cricothyroid muscles
Cricoid cartilage
Pyramidal lobe (often absent or small)
Right lobe
Left lobe
Isthmus
Thyroid gland
Pretracheal lymph nodes
Phrenic nerve
Anterior scalene muscle
Vagus nerve (CN X)
External jugular vein
Anterior jugular vein
1st rib (cut)
Left recurrent laryngeal nerve
Thyroid cartilage
Median cricothyroid ligament
Common carotid artery
Cricothyroid muscle
Cricoid cartilage
Thyroid gland
Cervical pleura
Trachea

See also Plate 89

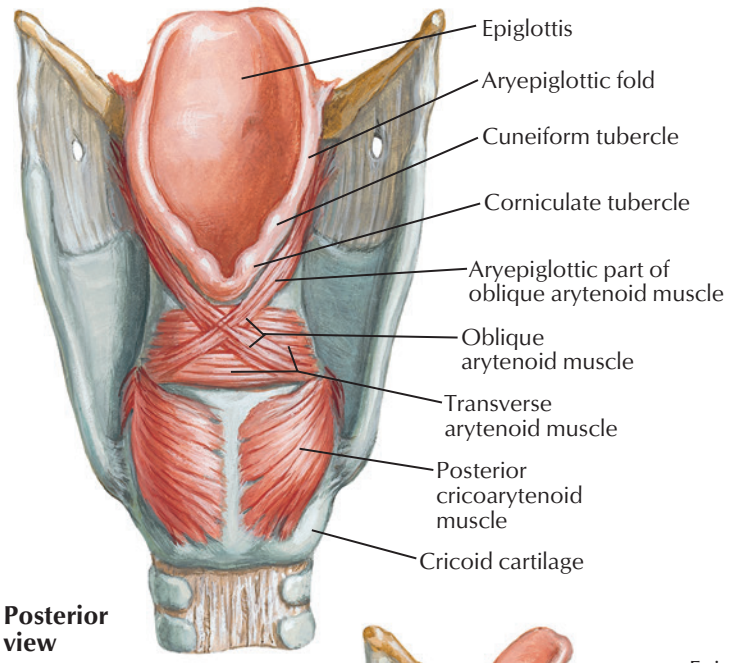


See also Plates 80, 88, 92

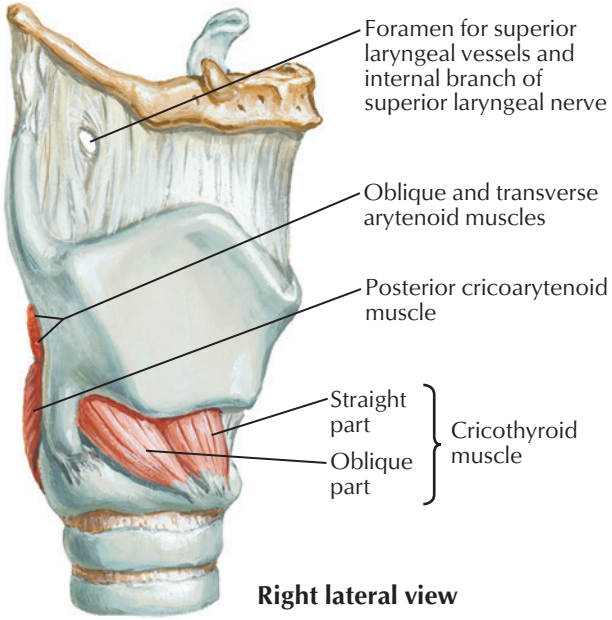



Epiglottis
Hyoid bone
Thyrohyoid membrane
Superior horn of thyroid cartilage
Corniculate cartilage
Arytenoid cartilage
Superior thyroid notch
Thyroid cartilage lamina
Vocal ligament
Median cricothyroid ligament
Inferior horn of thyroid cartilage
Cricoid cartilage
Trachea
Anterior view
Posterior view
Cricoid cartilage
Arytenoid articular surface
Lamina
Arch
Corniculate cartilage
Muscular process
Vocal process
Arytenoid cartilage
Anterosuperior view
Epiglottis
Hyoepiglottic ligament
Hyoid bone
Triticeal cartilage
Thyrohyoid membrane
Thyroid cartilage lamina
Oblique line
Laryngeal prominence
Median
Lateral
Corniculate cartilage
Arytenoid cartilage
Muscular process
Vocal process
Vocal ligament
Thyroepiglottic ligament
Cricothyroid ligament
Cricoid cartilage
Cricothyroid joint
Trachea
Right lateral view
Medial view, median (sagittal) section

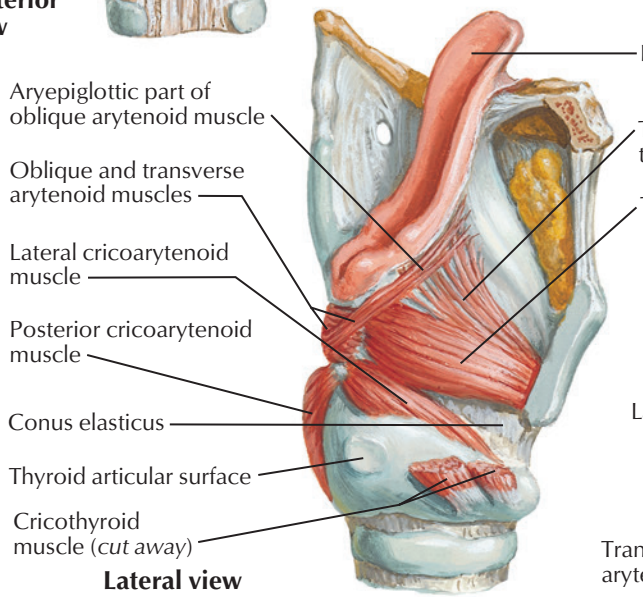
See also Plates 90, 92, 93



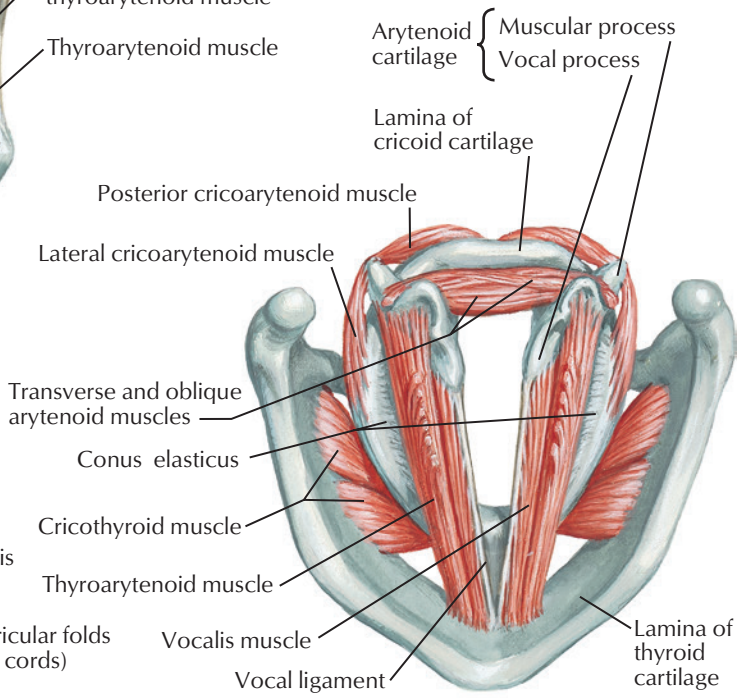
Posterior view



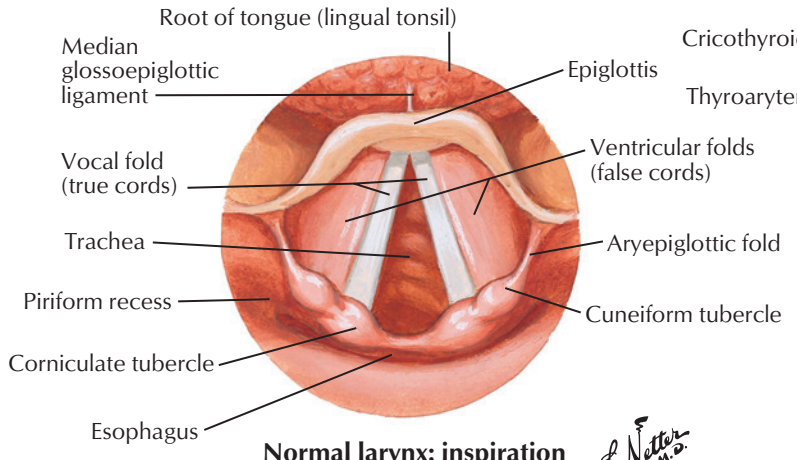
Right lateral view



Lateral view

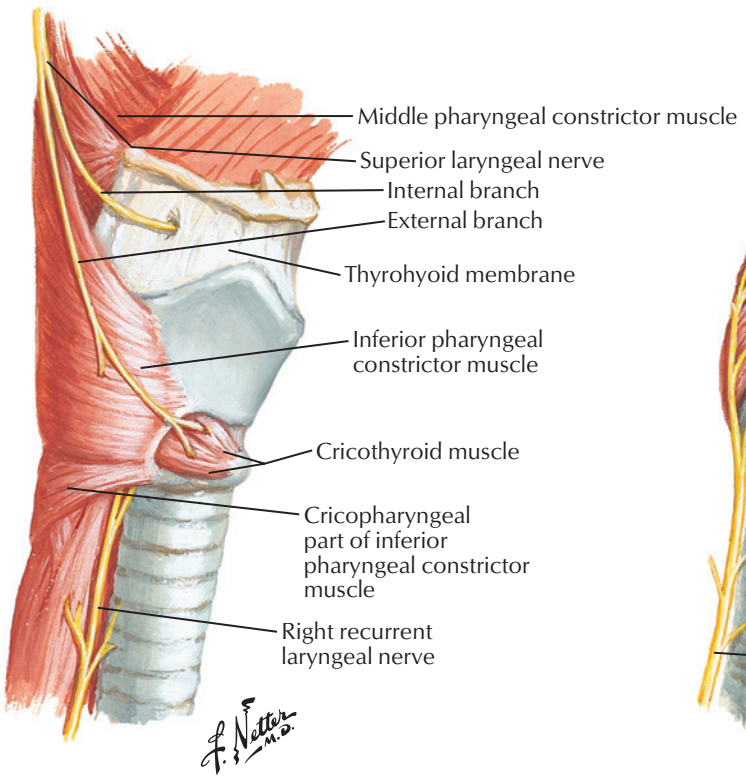


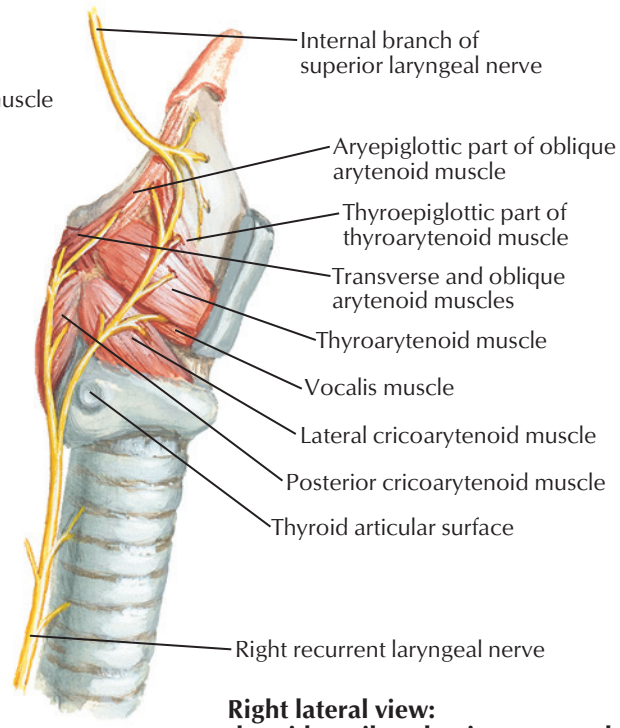
Superior view



Normal larynx: inspiration

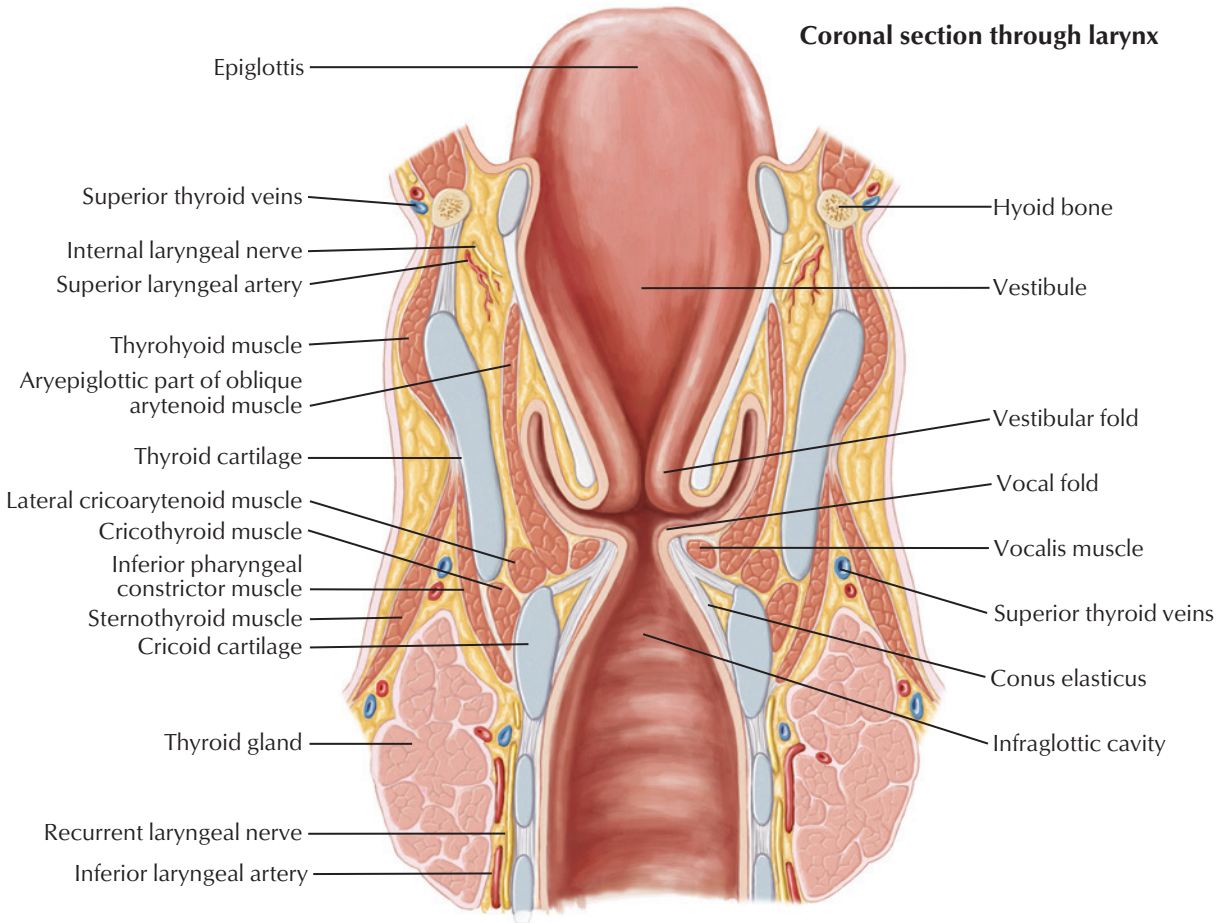
See also Plates 90, 91, 93





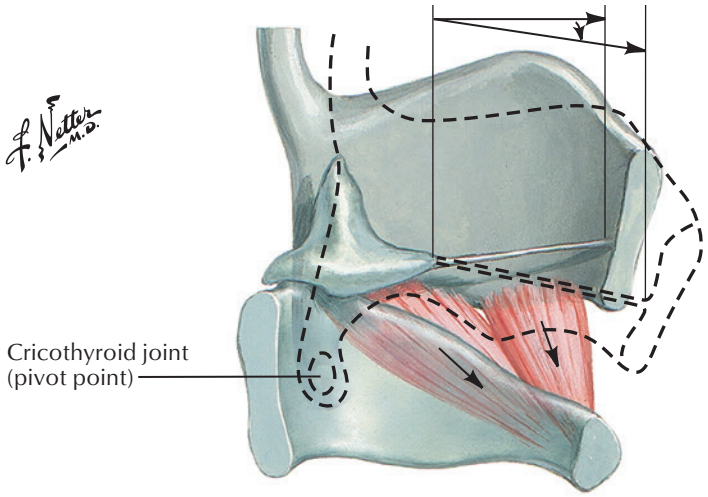
Right lateral view: thyroid cartilage lamina removed

Coronal section through larynx

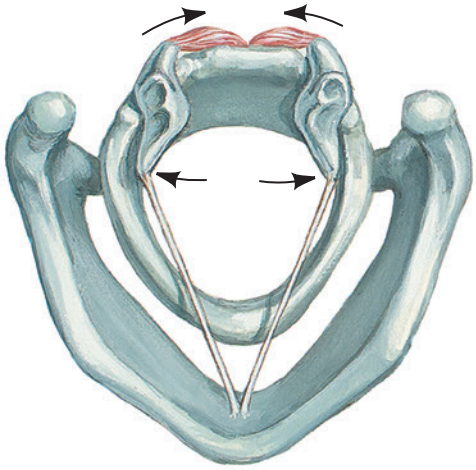


Action of Intrinsic Muscles of Larynx

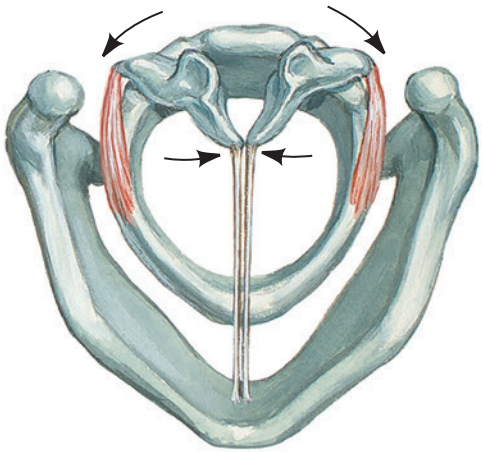
See also Plates 90, 91, 92



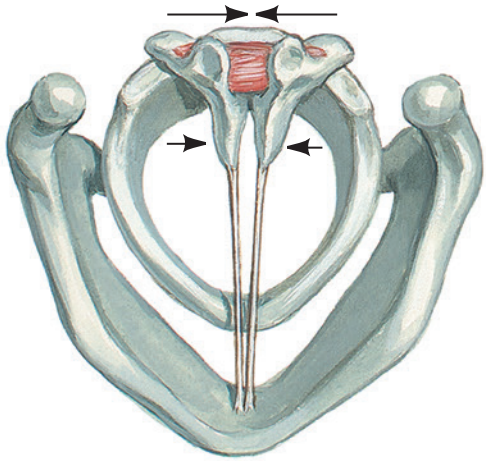
Action of cricothyroid muscles
Lengthening (increasing tension) of vocal ligaments



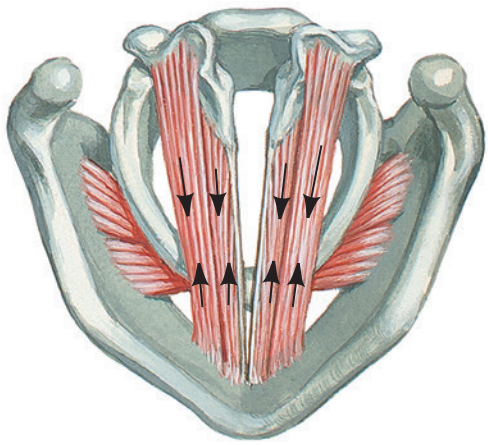
Action of posterior cricoarytenoid muscles
Abduction of vocal ligaments



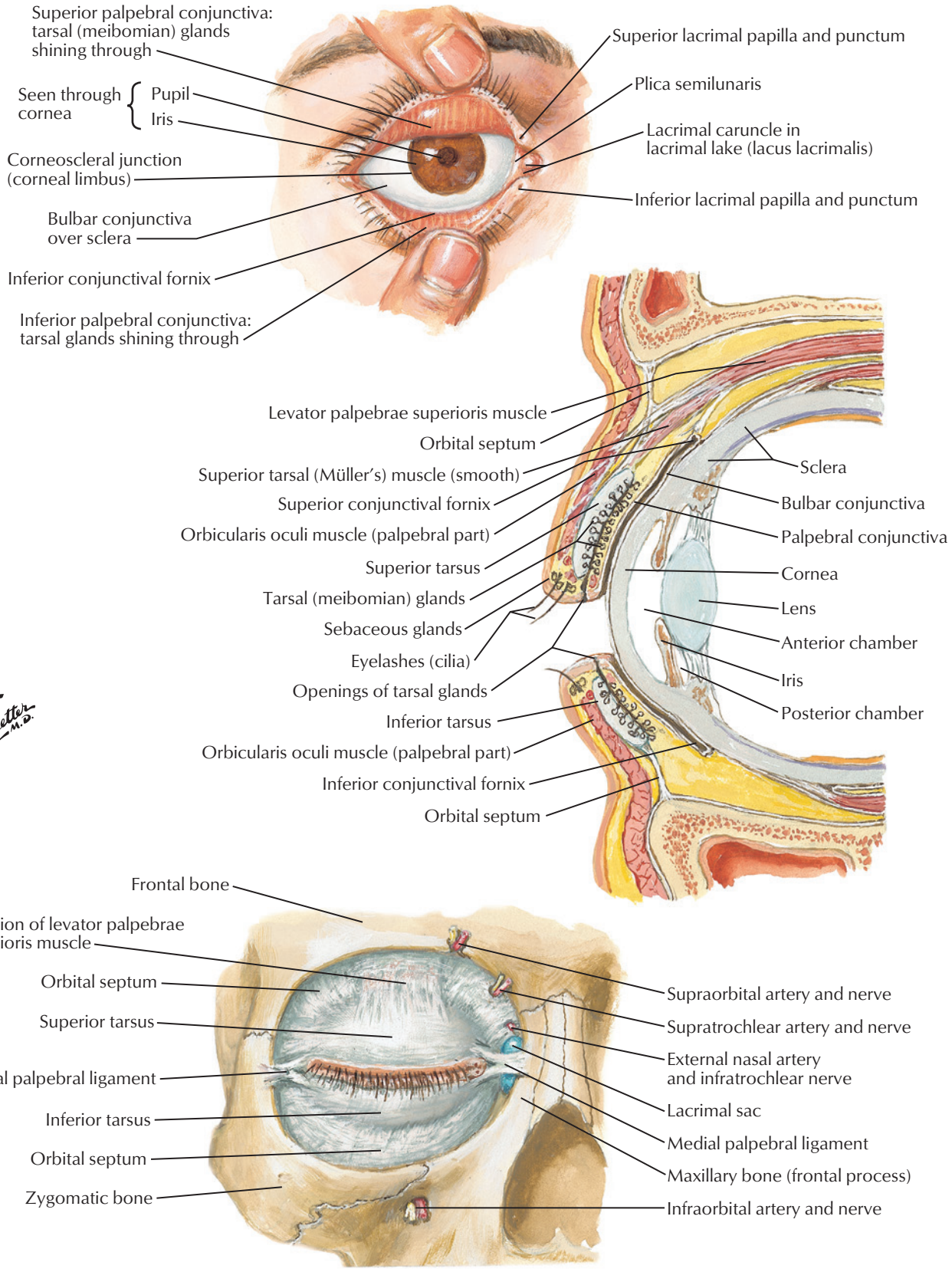
Action of lateral cricoarytenoid muscles
Adduction of vocal ligaments



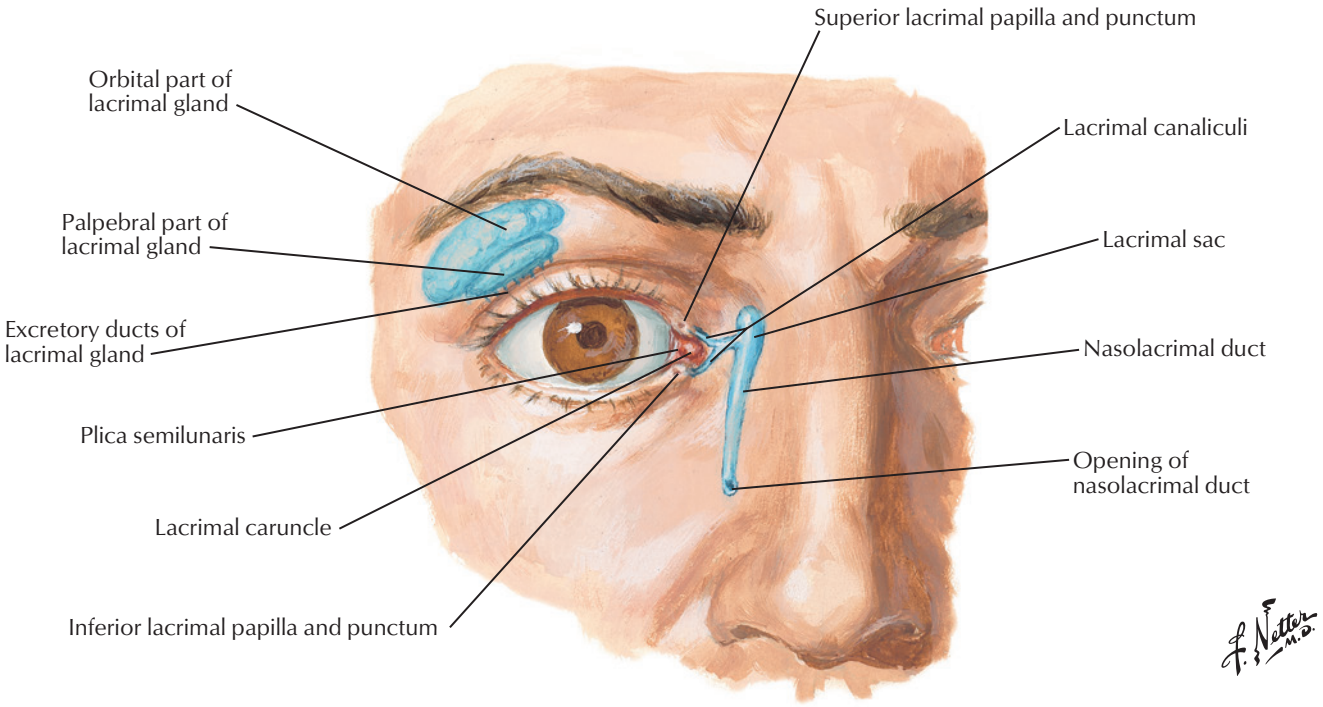
Action of transverse and oblique arytenoid muscles
Adduction of vocal ligaments

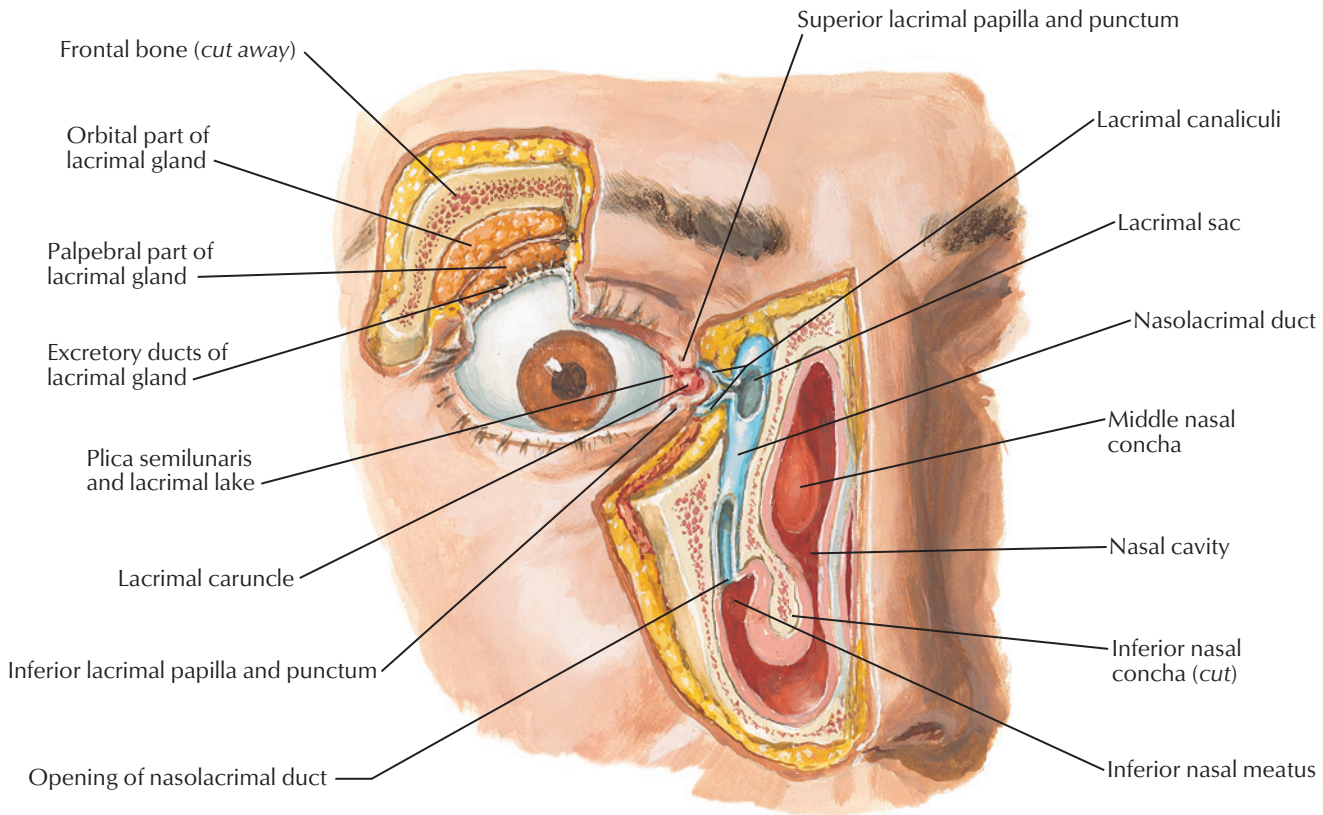


Action of vocalis and thyroarytenoid muscles
Shortening (relaxation) of vocal ligaments


Superior palpebral conjunctiva: tarsal (meibomian) glands shining through
Seen through cornea
Pupil
Iris
Corneoscleral junction (corneal limbus)
Bulbar conjunctiva over sclera
Inferior conjunctival fornix
Inferior palpebral conjunctiva: tarsal glands shining through
Superior lacrimal papilla and punctum
Plica semilunaris
Lacrimal caruncle in lacrimal lake (lacus lacrimalis)
Inferior lacrimal papilla and punctum
Levator palpebrae superioris muscle
Orbital septum
Superior tarsal (Müller's) muscle (smooth)
Superior conjunctival fornix
Orbicularis oculi muscle (palpebral part)
Superior tarsus
Tarsal (meibomian) glands
Sebaceous glands
Eyelashes (cilia)
Openings of tarsal glands
Inferior tarsus
Orbicularis oculi muscle (palpebral part)
Inferior conjunctival fornix
Orbital septum
Sclera
Bulbar conjunctiva
Palpebral conjunctiva
Cornea
Lens
Anterior chamber
Iris
Posterior chamber
F. Netter M.D.
Frontal bone
Insertion of levator palpebrae superioris muscle
Orbital septum
Superior tarsus
Lateral palpebral ligament
Inferior tarsus
Orbital septum
Zygomatic bone
Supraorbital artery and nerve
Supratrochlear artery and nerve
External nasal artery and infratrochlear nerve
Lacrimal sac
Medial palpebral ligament
Maxillary bone (frontal process)
Infraorbital artery and nerve

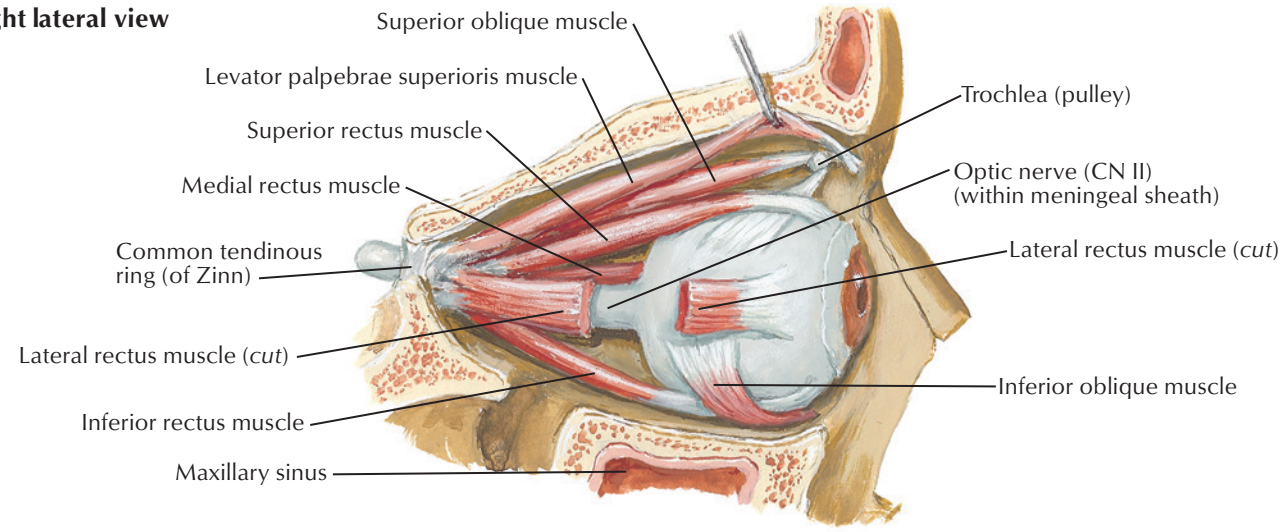
See also Plate 144



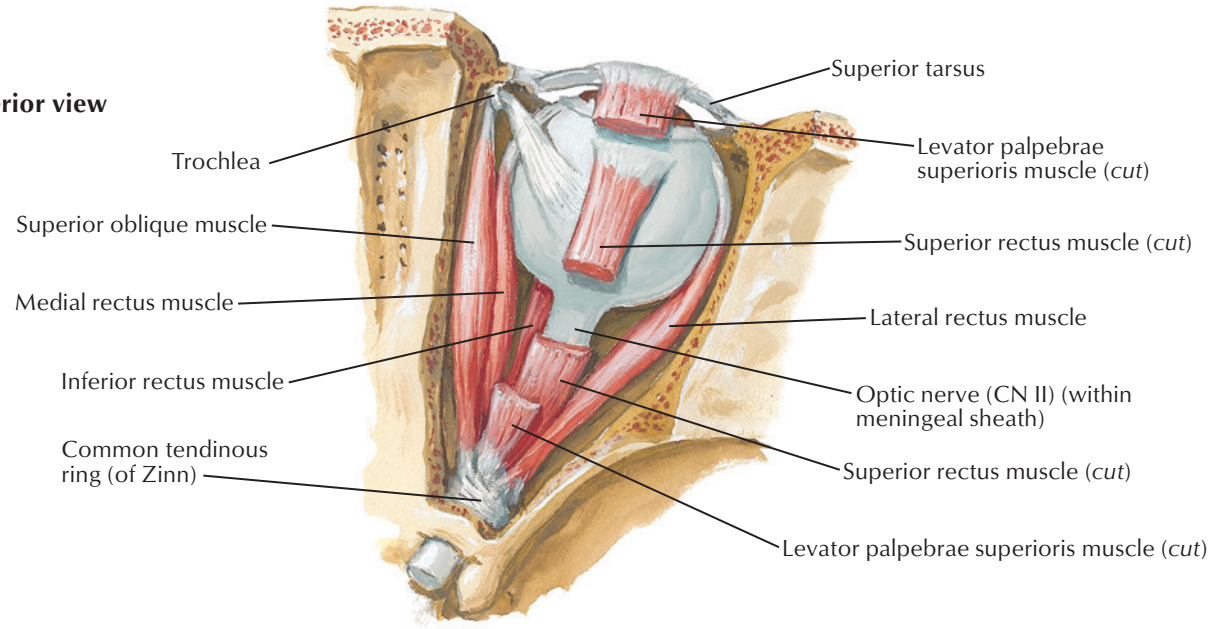


See also Plate 97

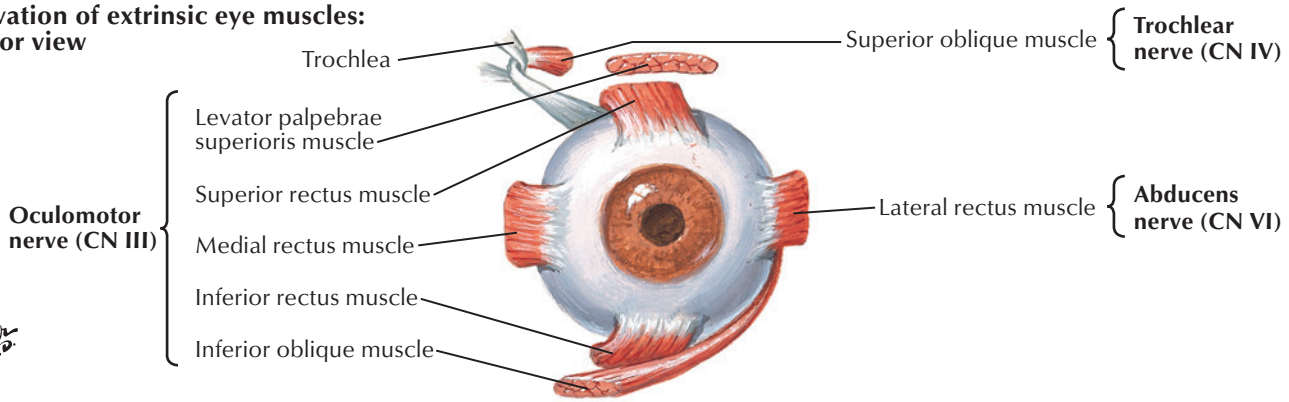
Right lateral view



Superior view

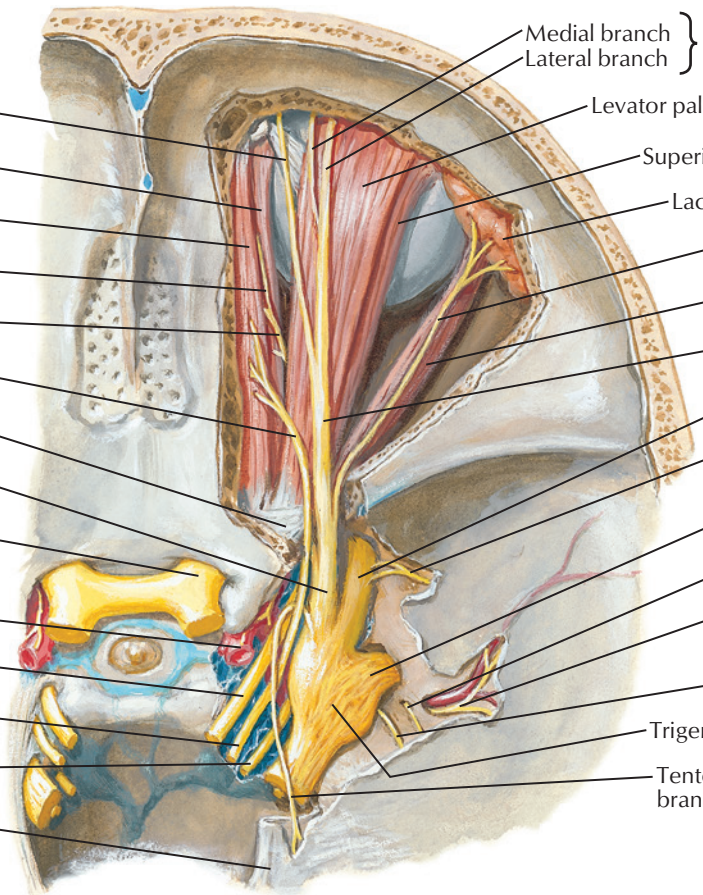


Innervation of extrinsic eye muscles: anterior view

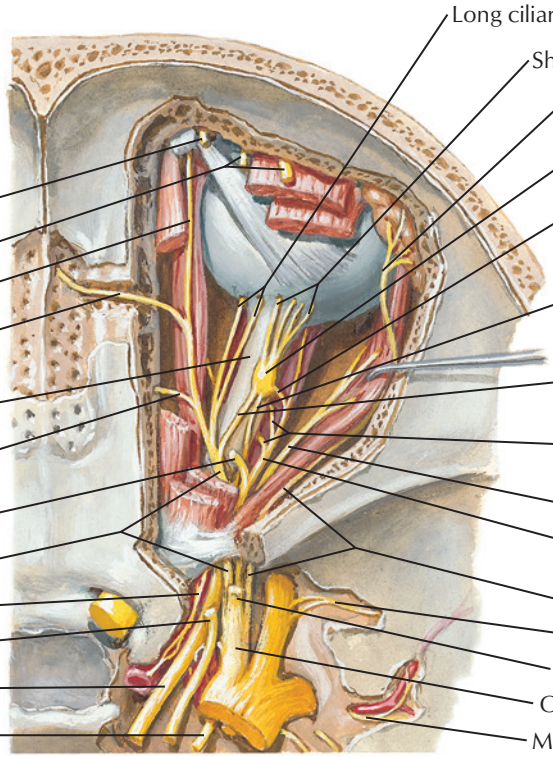


See also Plates 61, 132, 133

Superior view

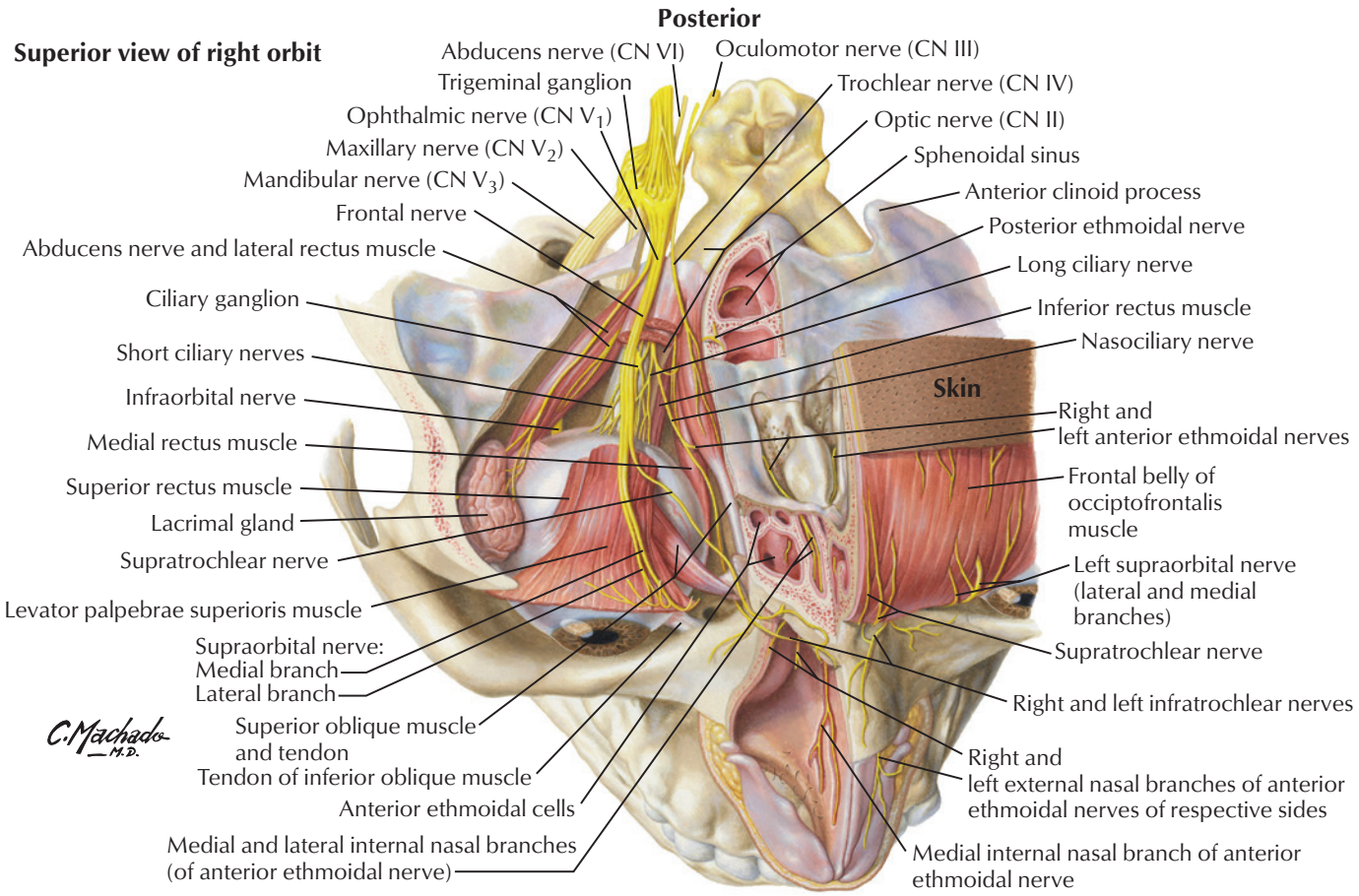


Superior view:
levator palpebrae superioris, superior rectus, and superior oblique muscles partially cut away

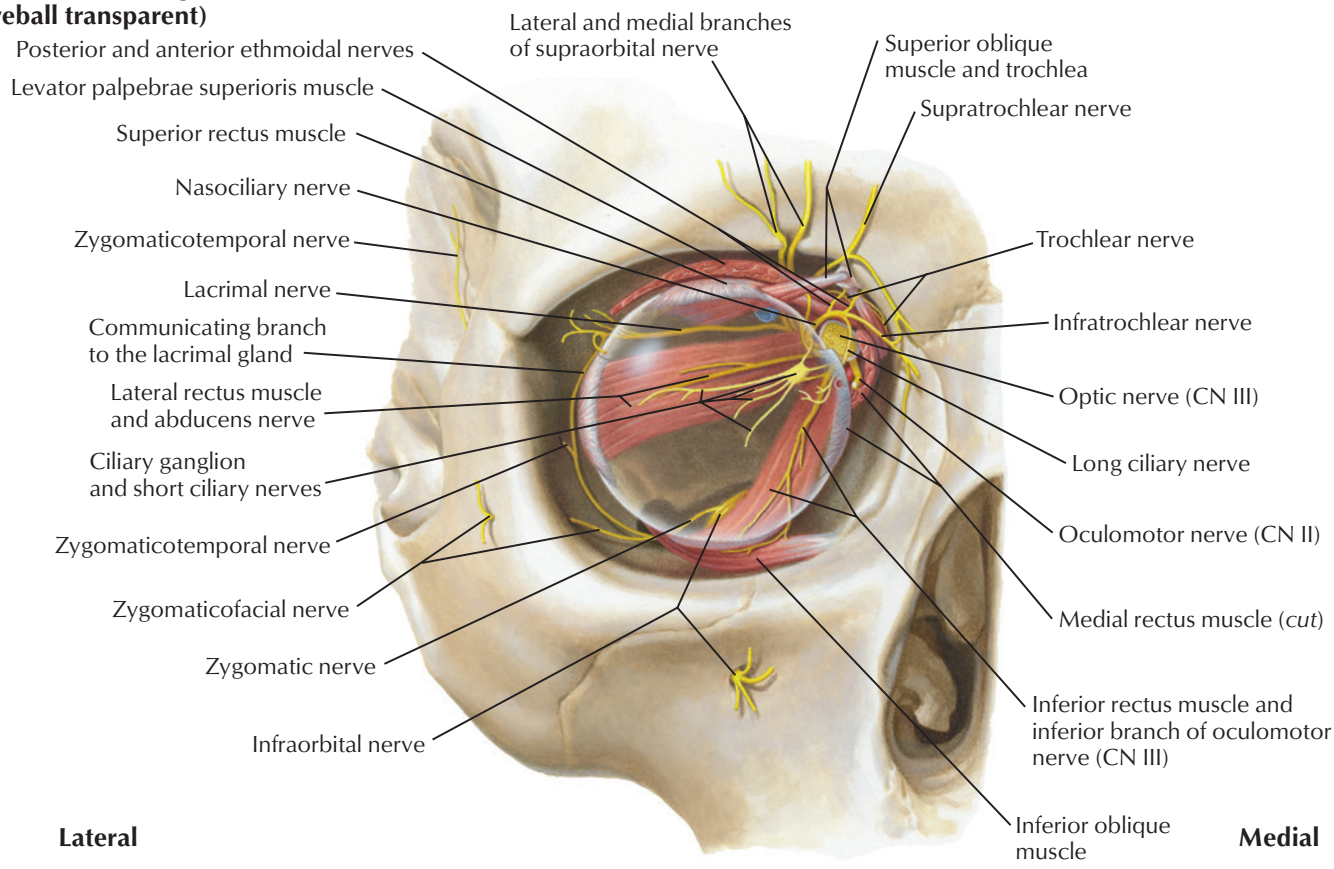


See also Plates 96, 97

Superior view of right orbit

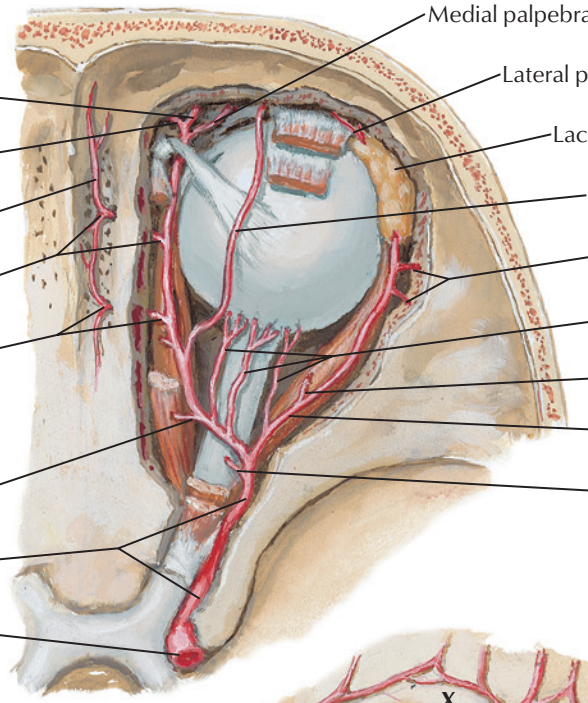


Anterior view of right orbit (eyeball transparent)

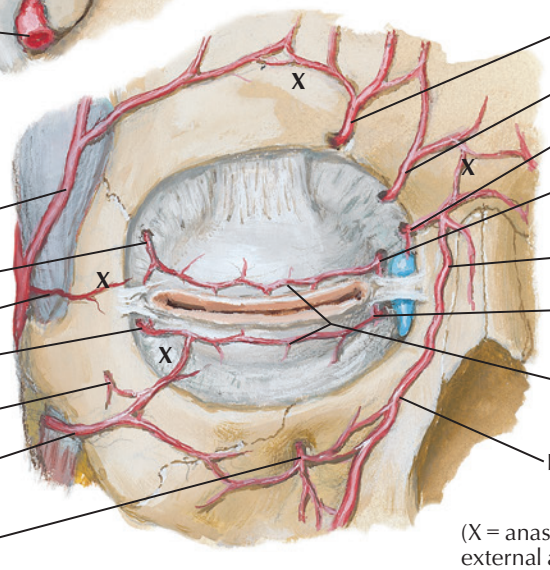


See also Plates 10, 84

Superior view

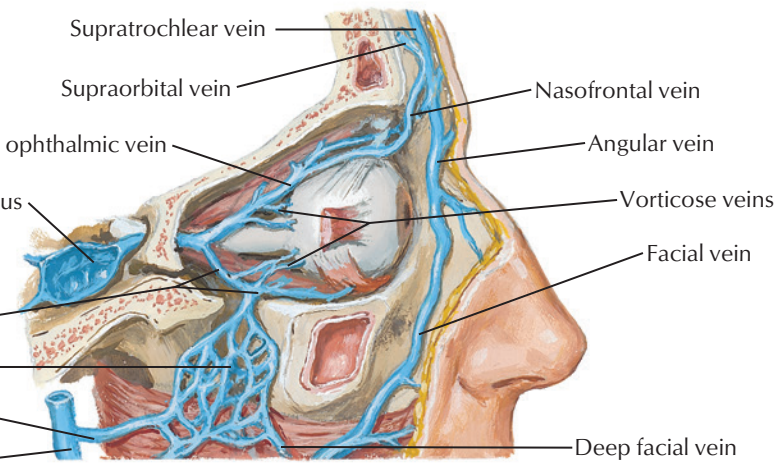


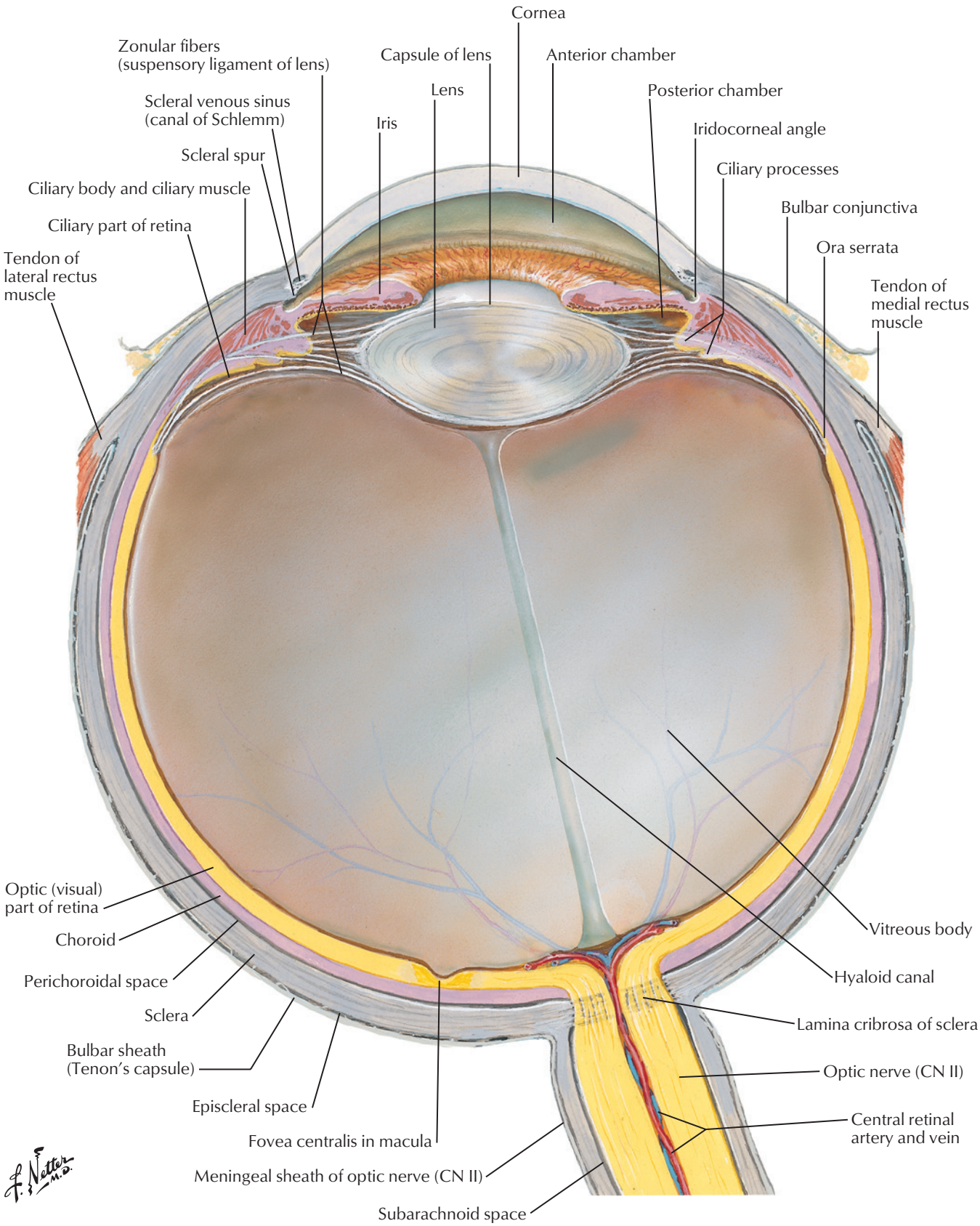
Anterior view

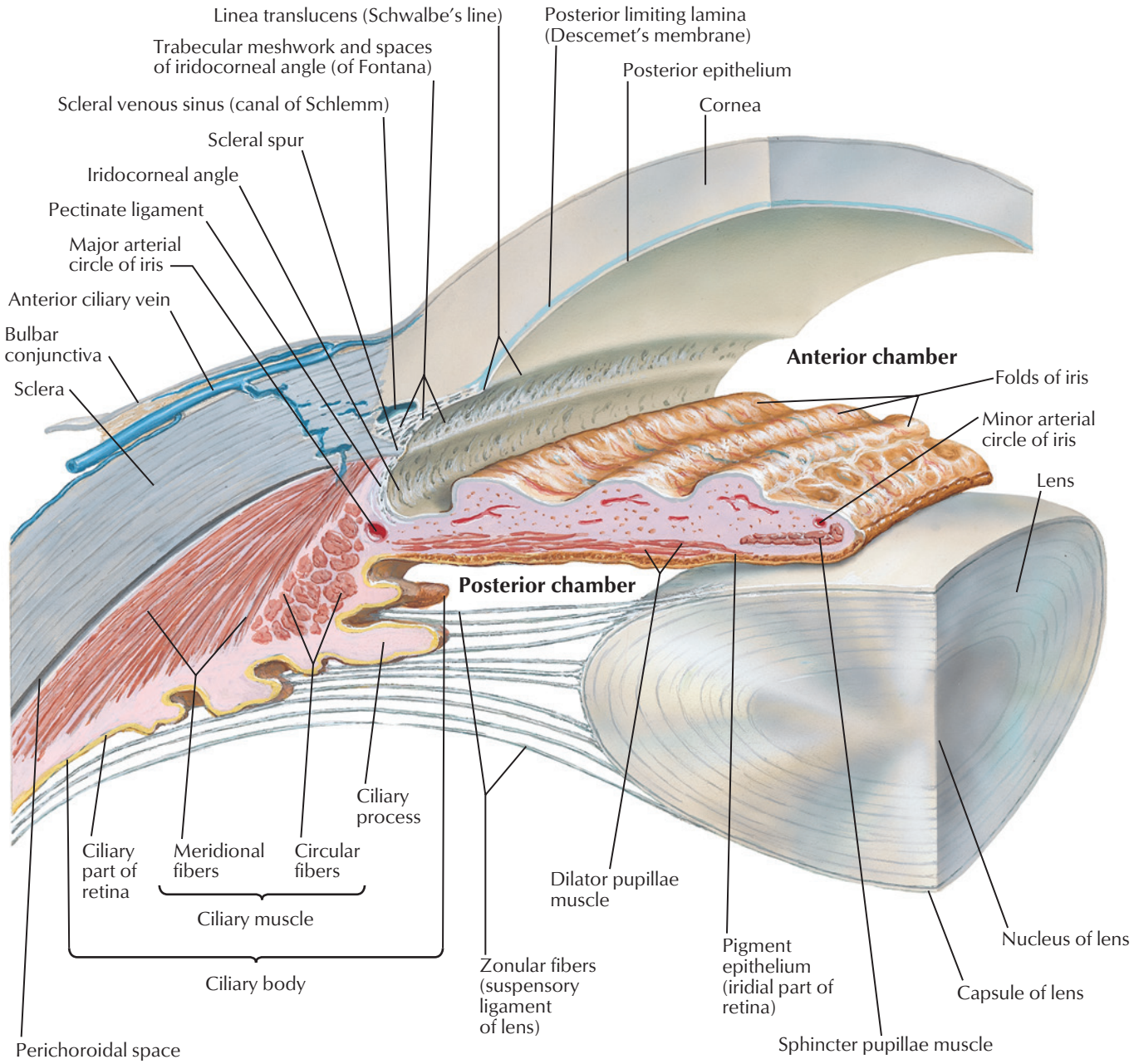


(X = anastomosis of vessels from external and internal carotid arteries)

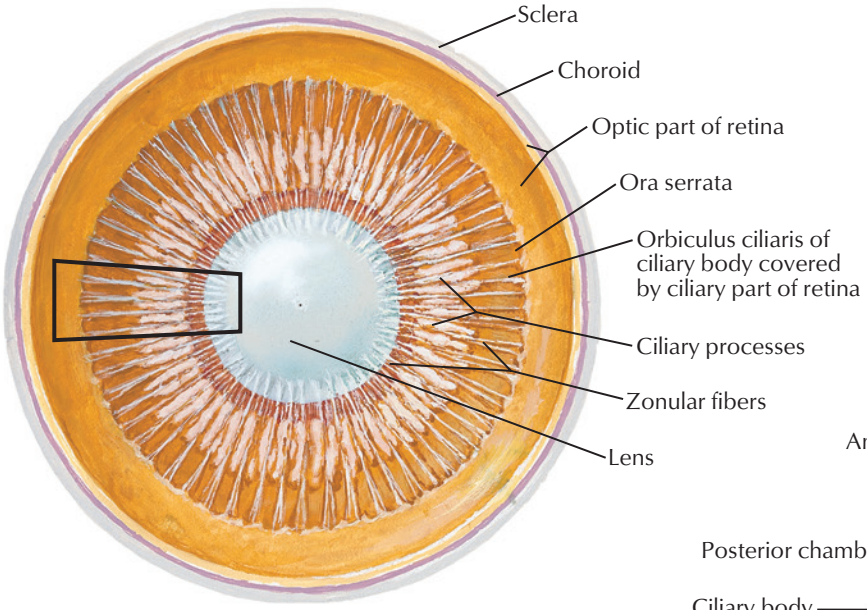
Lateral view



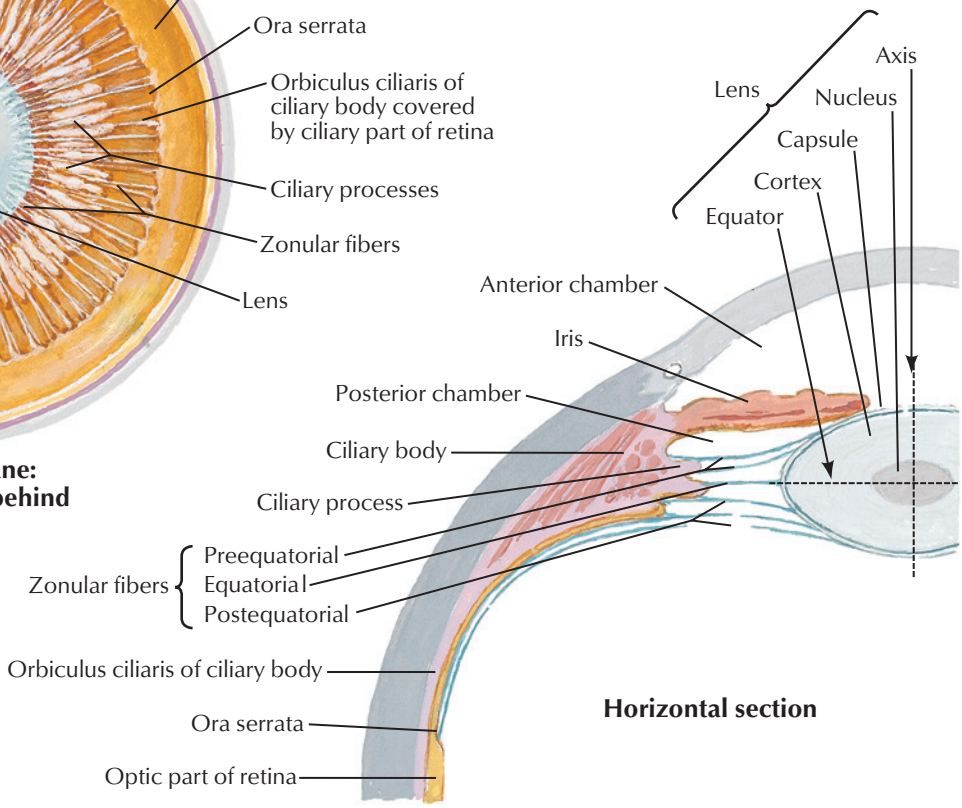

Cornea
Zonular fibers
(suspensory ligament of lens)
Capsule of lens
Anterior chamber
Scleral venous sinus
(canal of Schlemm)
Lens
Posterior chamber
Iris
Iridocorneal angle
Scleral spur
Ciliary processes
Ciliary body and ciliary muscle
Bulbar conjunctiva
Ciliary part of retina
Ora serrata
Tendon of
lateral rectus
muscle
Tendon of
medial rectus
muscle
Optic (visual)
part of retina
Vitreous body
Choroid
Hyaloid canal
Perichoroidal space
Lamina cribrosa of sclera
Sclera
Optic nerve (CN II)
Bulbar sheath
(Tenon's capsule)
Central retinal
artery and vein
Episcleral space
Fovea centralis in macula
Meningeal sheath of optic nerve (CN II)
Subarachnoid space



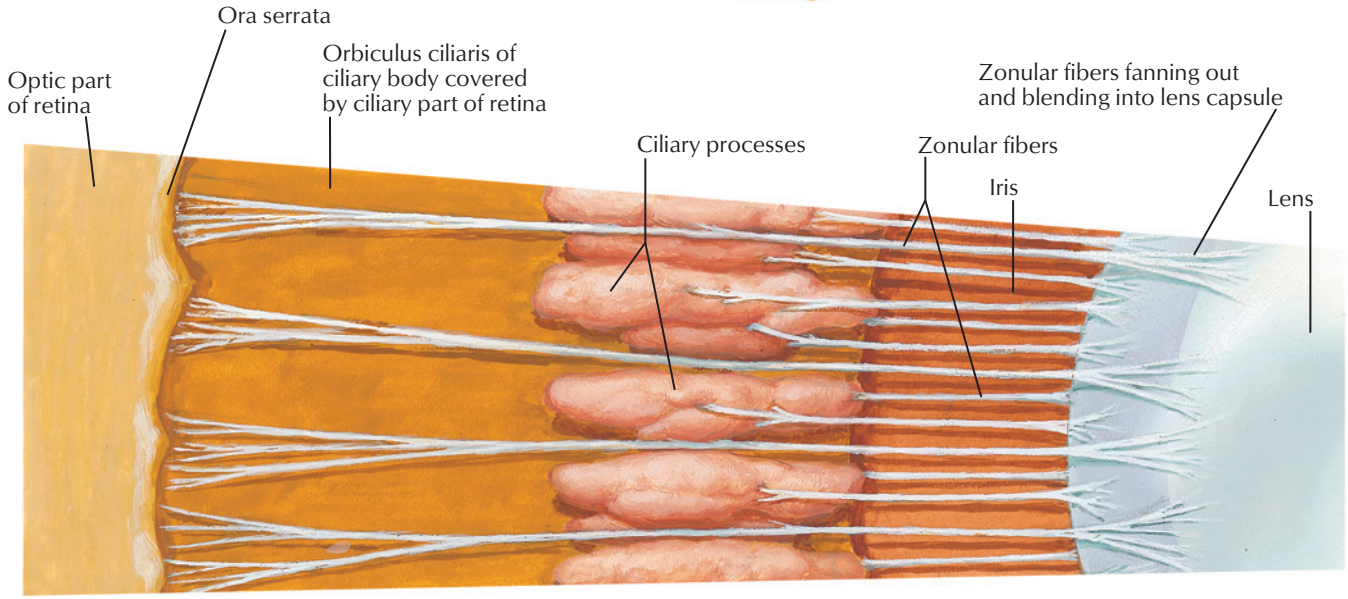
Note: For clarity, only single plane of zonular fibers shown; actually, fibers surround entire circumference of lens.



Eyeball sectioned in coronal plane: anterior segment viewed from behind

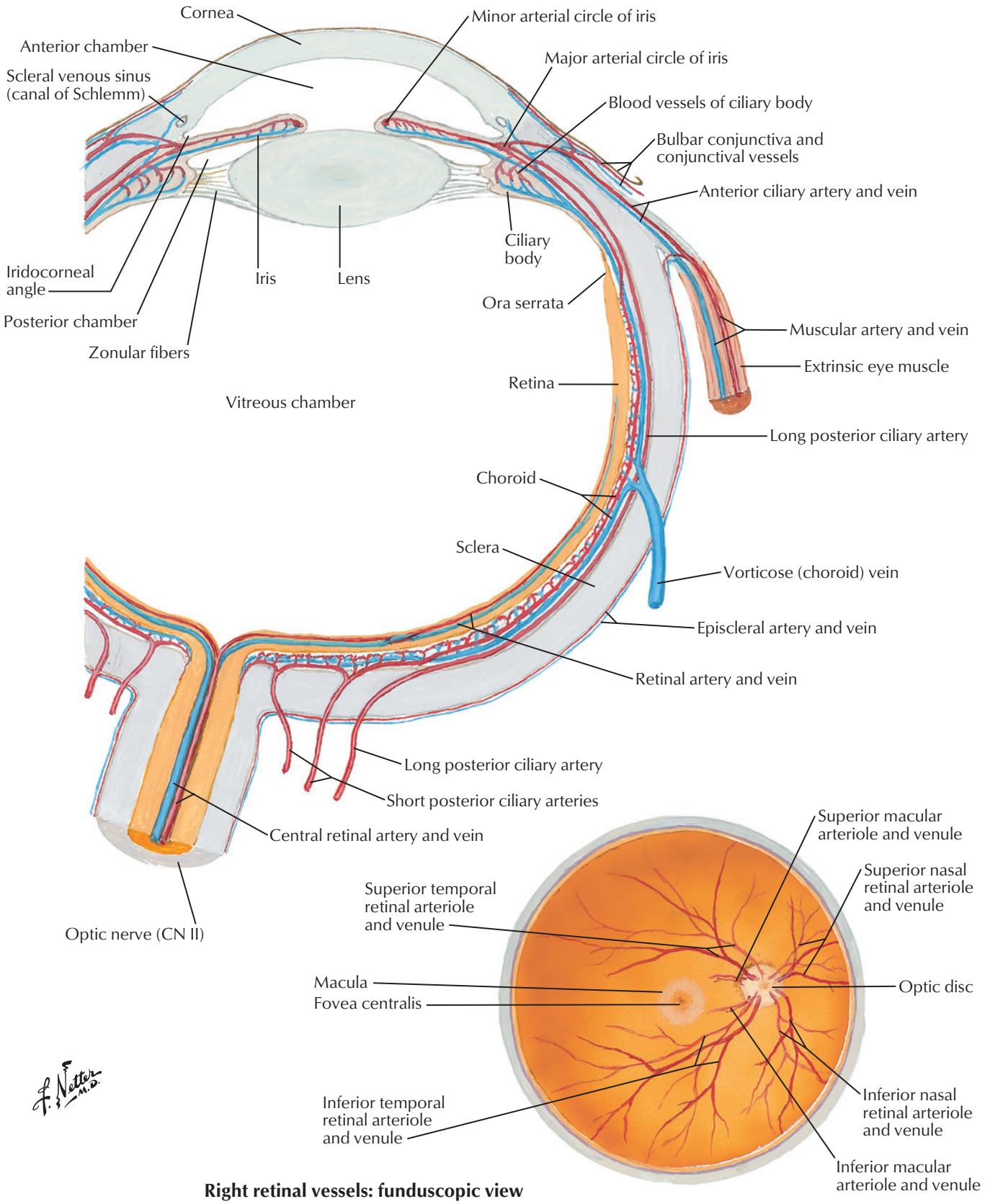


Horizontal section



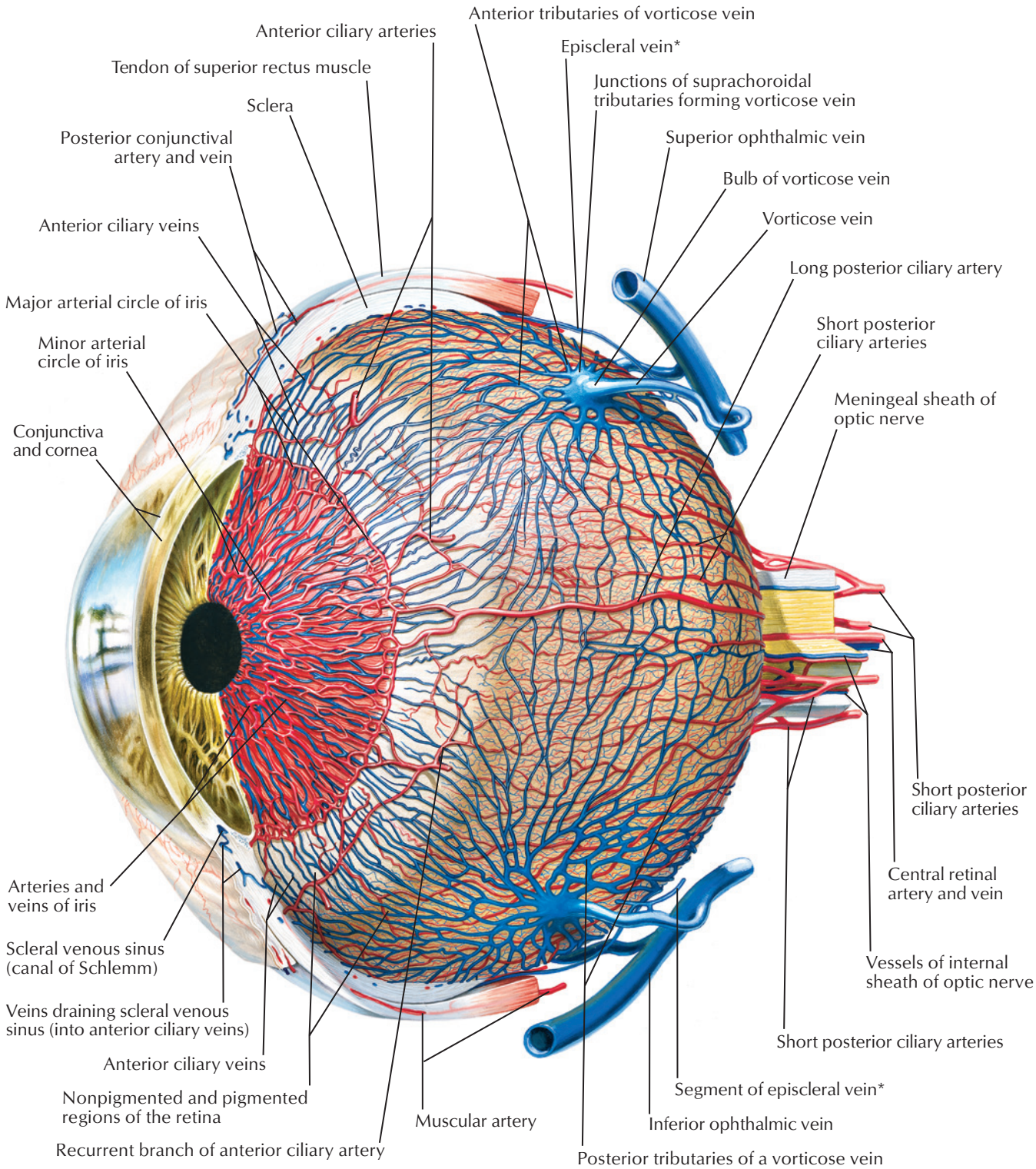
Enlargement of segment outlined in top illustration (semischematic)

See also Plate 104



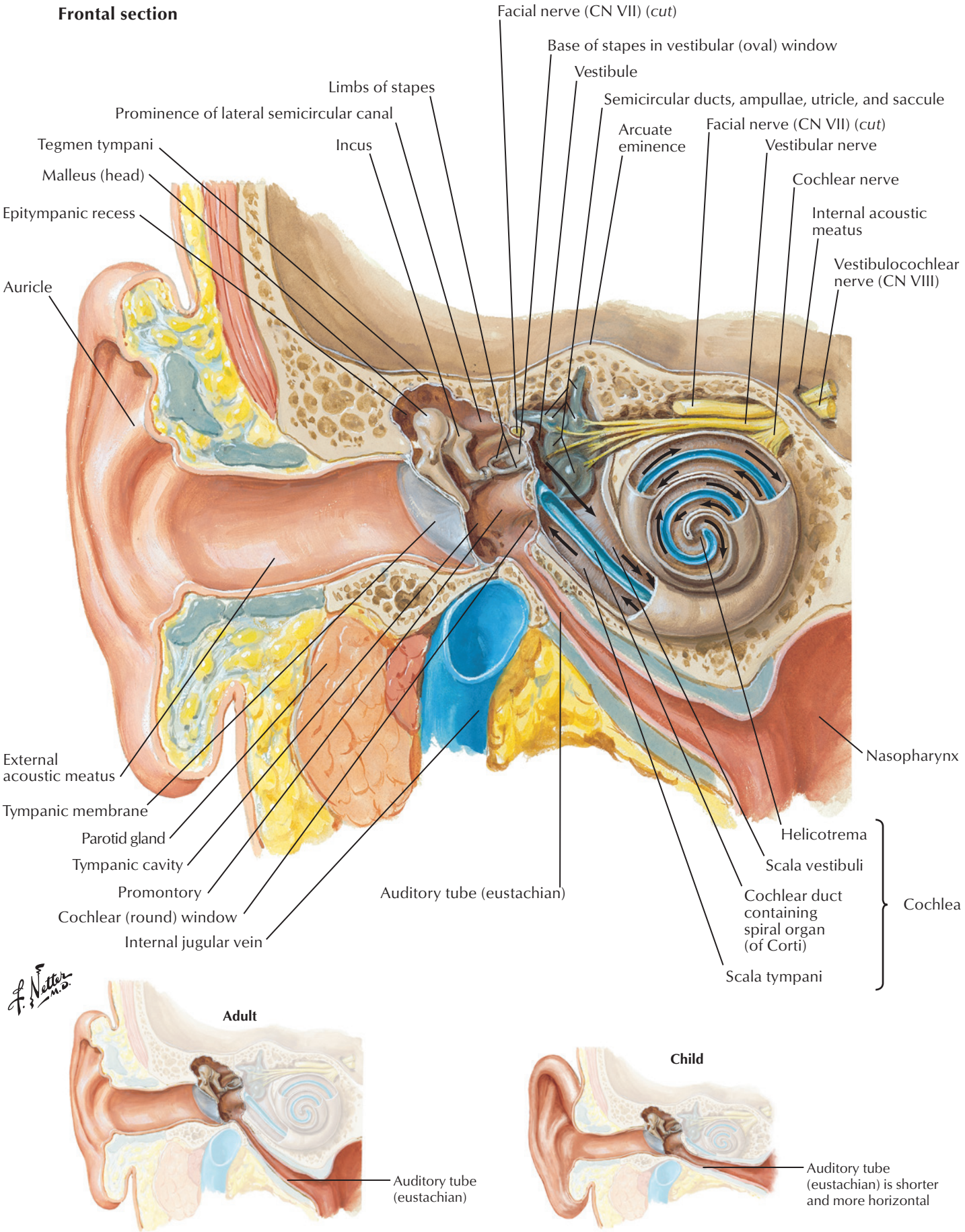
Right retinal vessels: funduscopic view

Vascular arrangements within the choroid (vascular tunic) of the eyeball

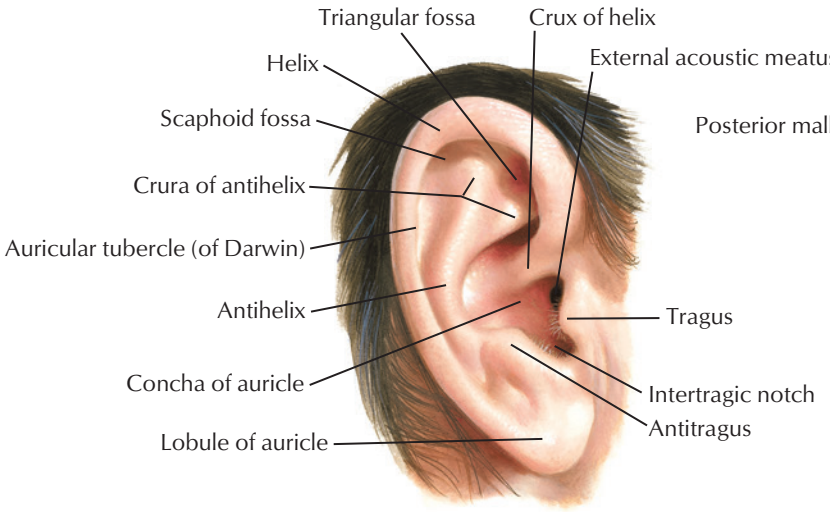


*The episcleral veins are shown here anastomosing with the vorticose veins, which they do; however, they also drain into the anterior ciliary veins.

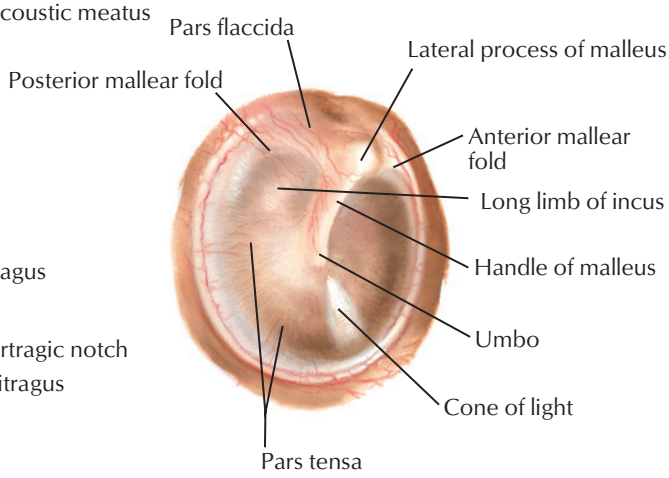
C. Machado M.D.


Frontal section
Facial nerve (CN VII) (cut)
Base of stapes in vestibular (oval) window
Vestibule
Limbs of stapes
Semicircular ducts, ampullae, utricle, and saccule
Prominence of lateral semicircular canal
Arcuate eminence
Facial nerve (CN VII) (cut)
Tegmen tympani
Incus
Vestibular nerve
Malleus (head)
Cochlear nerve
Epitympanic recess
Internal acoustic meatus
Vestibulocochlear nerve (CN VIII)
Auricle
Nasopharynx
External acoustic meatus
Tympanic membrane
Helicotrema
Parotid gland
Scala vestibuli
Tympanic cavity
Promontory
Auditory tube (eustachian)
Cochlear duct containing spiral organ (of Corti)
Cochlea
Cochlear (round) window
Internal jugular vein
Scala tympani
Adult
Auditory tube (eustachian)
Child
Auditory tube (eustachian) is shorter and more horizontal

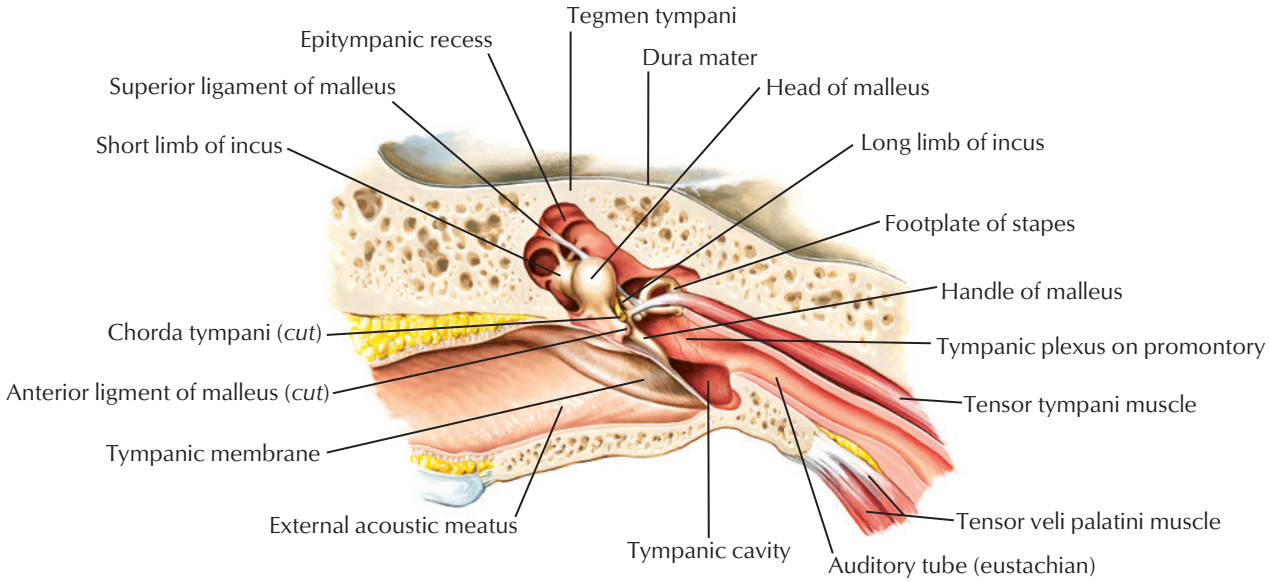
Right auricle (pinna)



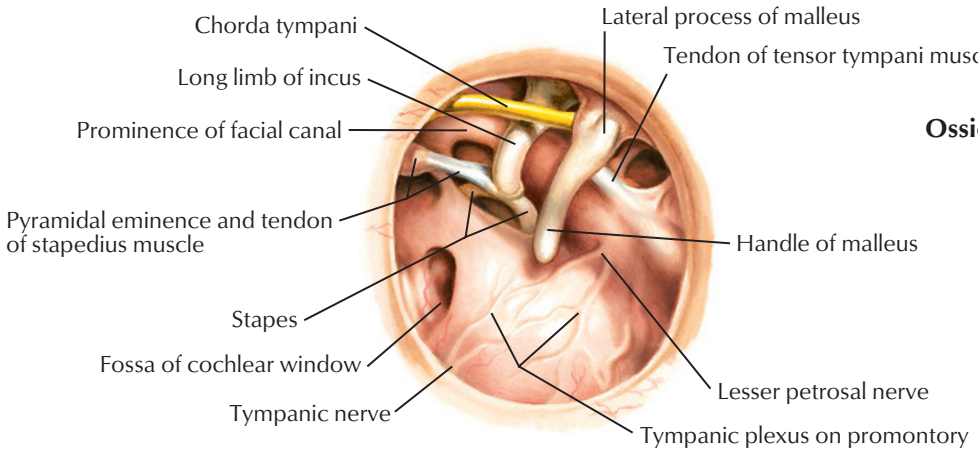
Otoscopic view of right tympanic membrane



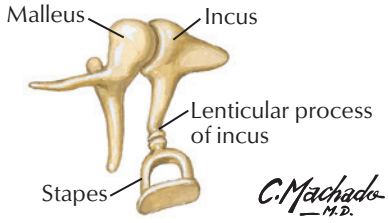
Coronal oblique section of external acoustic meatus and middle ear (tympanic cavity)



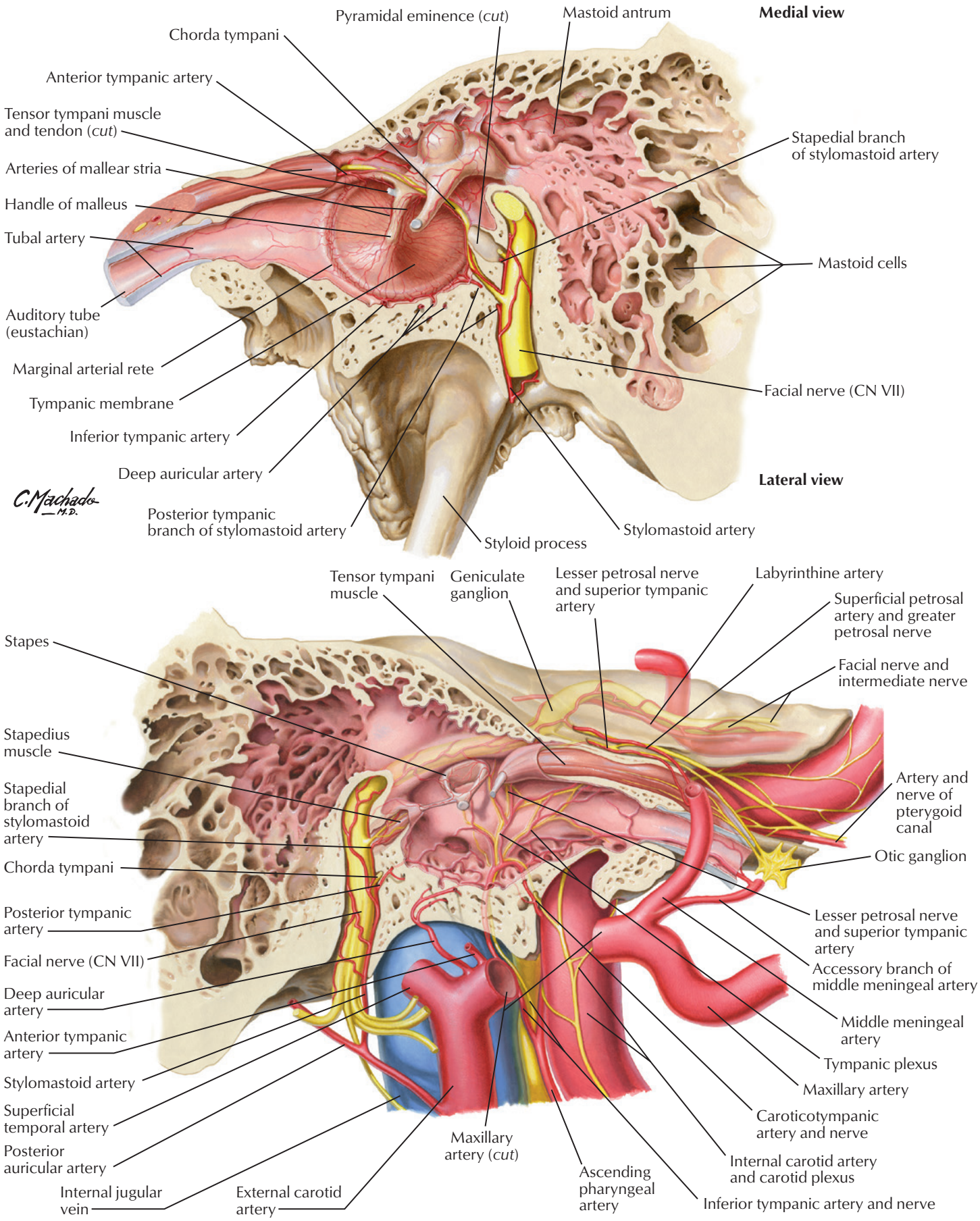
Right tympanic cavity after removal of tympanic membrane (lateral view)



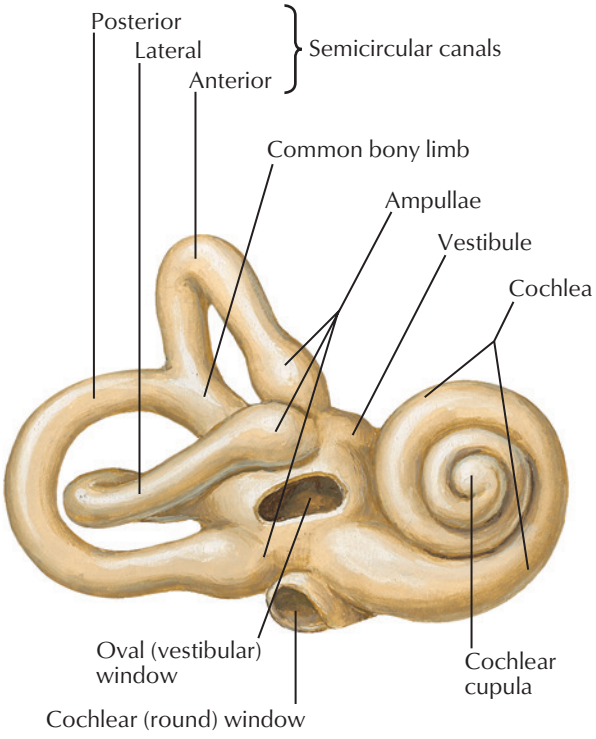
Ossicles articulated: medial view



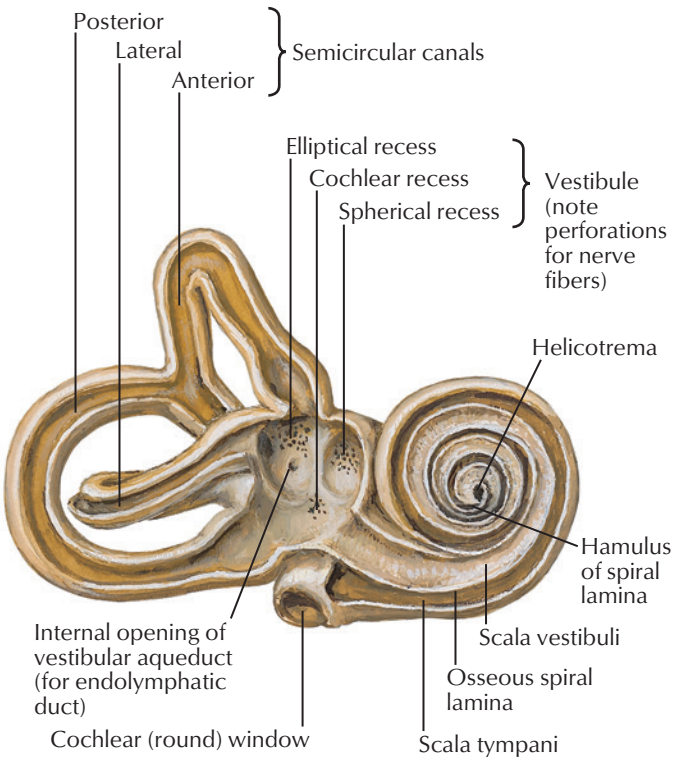
See also Plates 59, 146



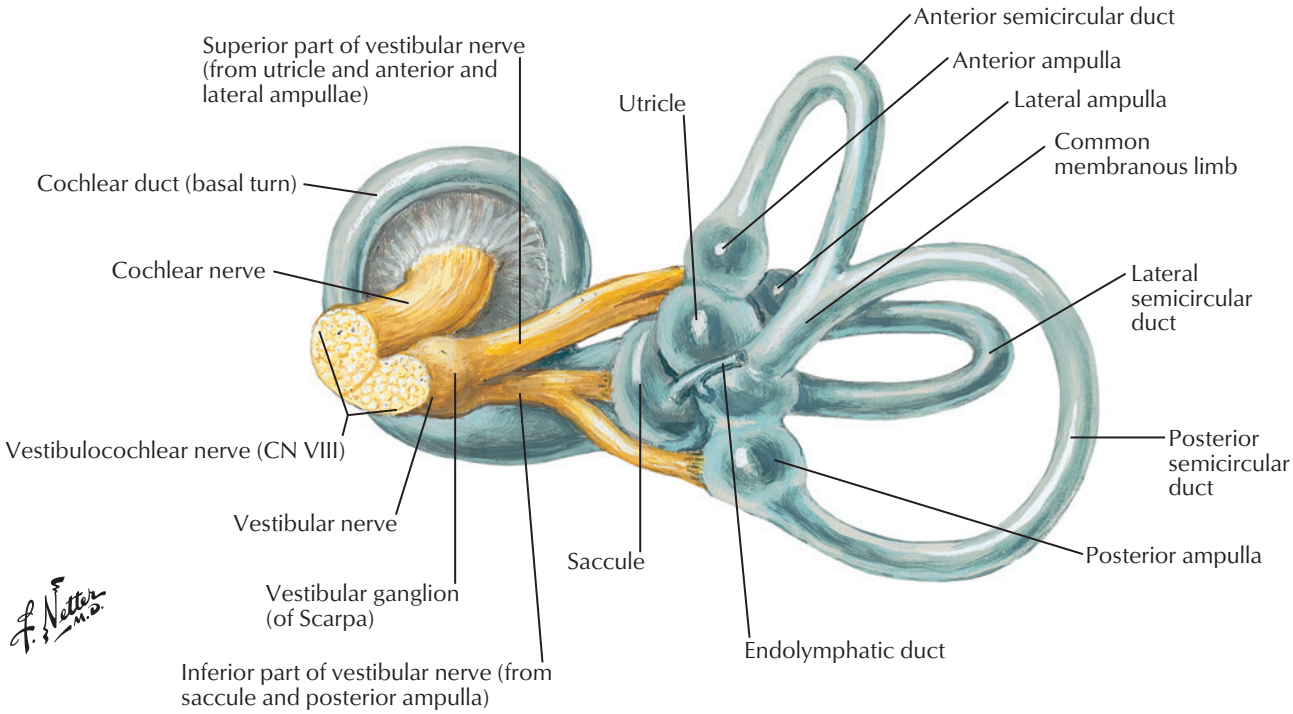
Right bony labyrinth (otic capsule), anterolateral view: surrounding cancellous bone removed



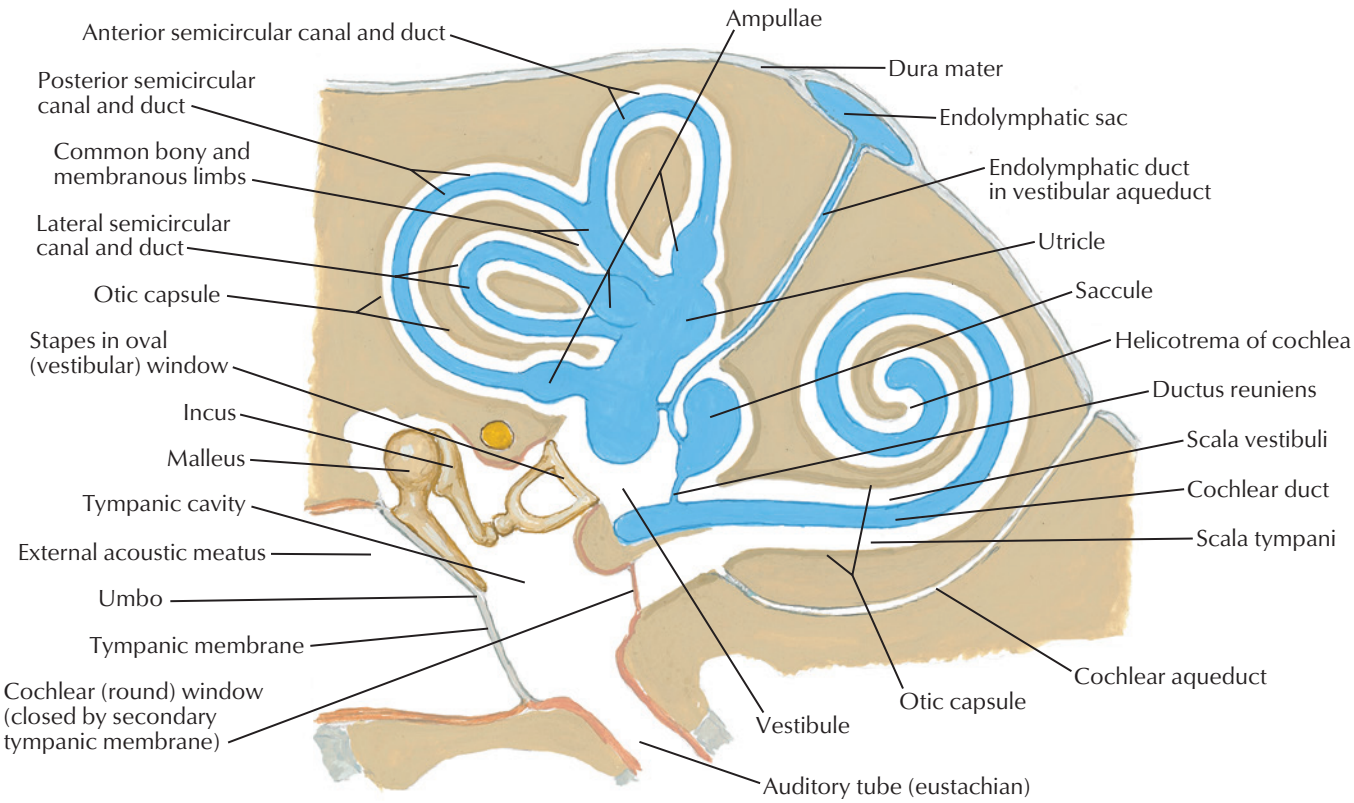
Dissected right bony labyrinth (otic capsule): membranous labyrinth removed



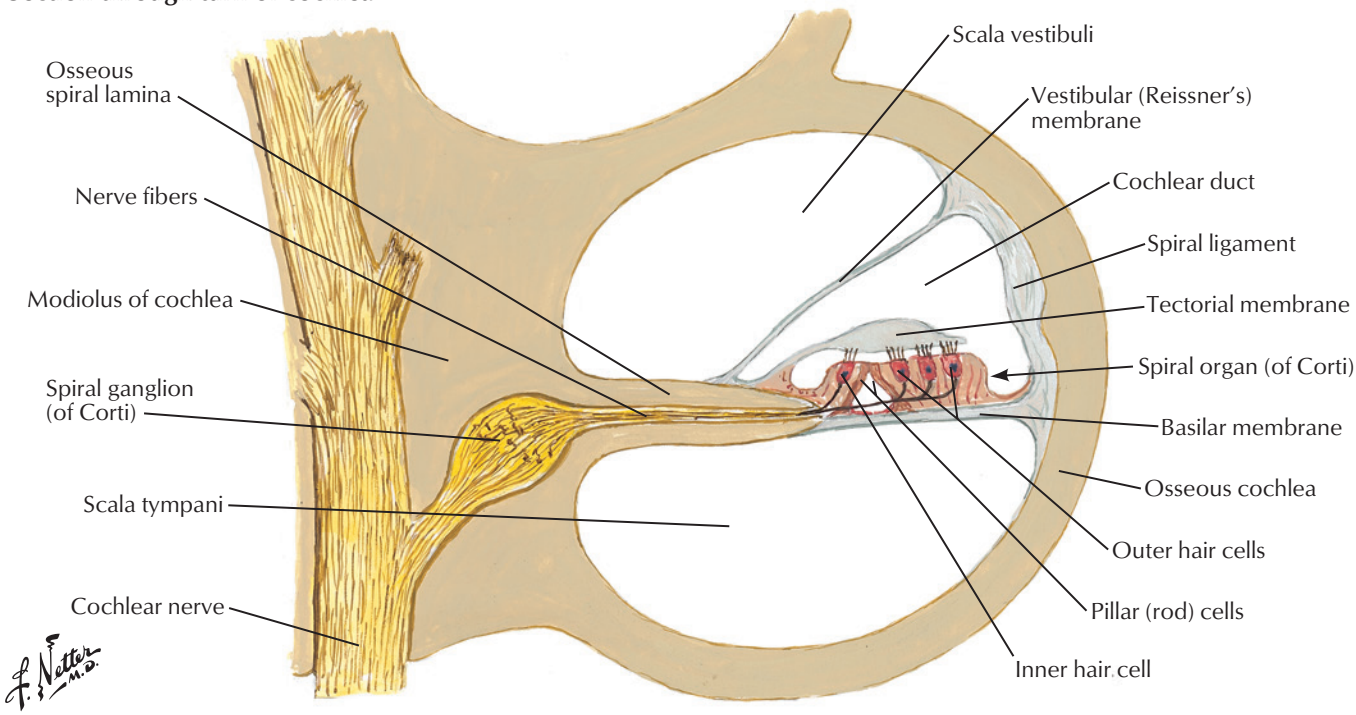
Right membranous labyrinth with nerves: medial view



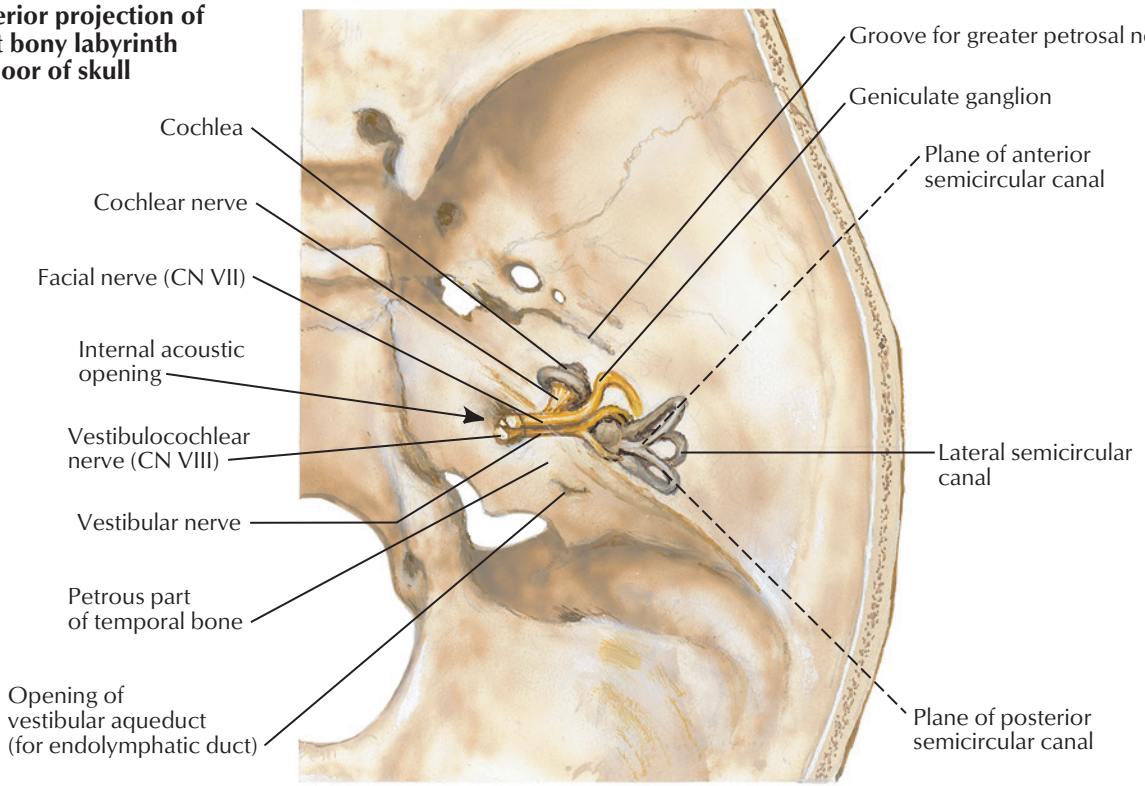
Bony and membranous labyrinths: schema



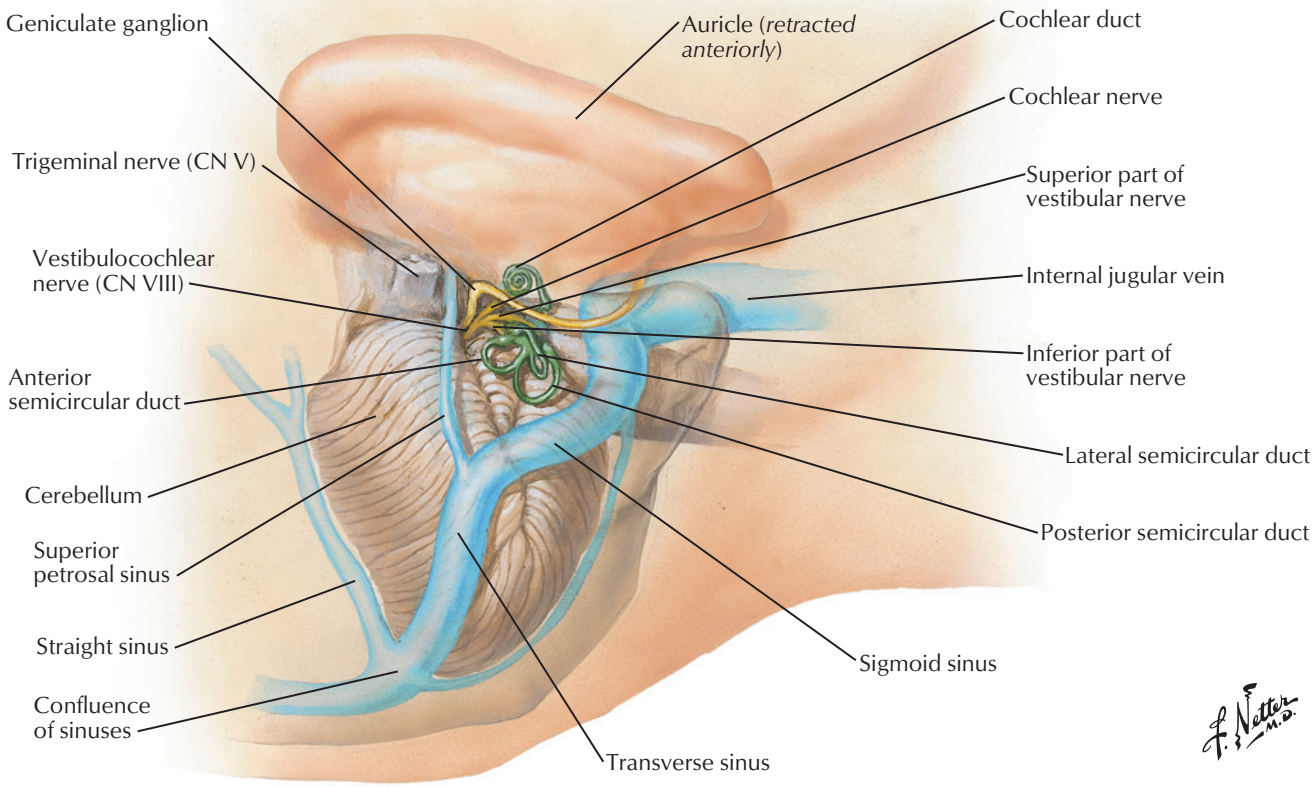
Section through turn of cochlea



Superior projection of right bony labyrinth on floor of skull

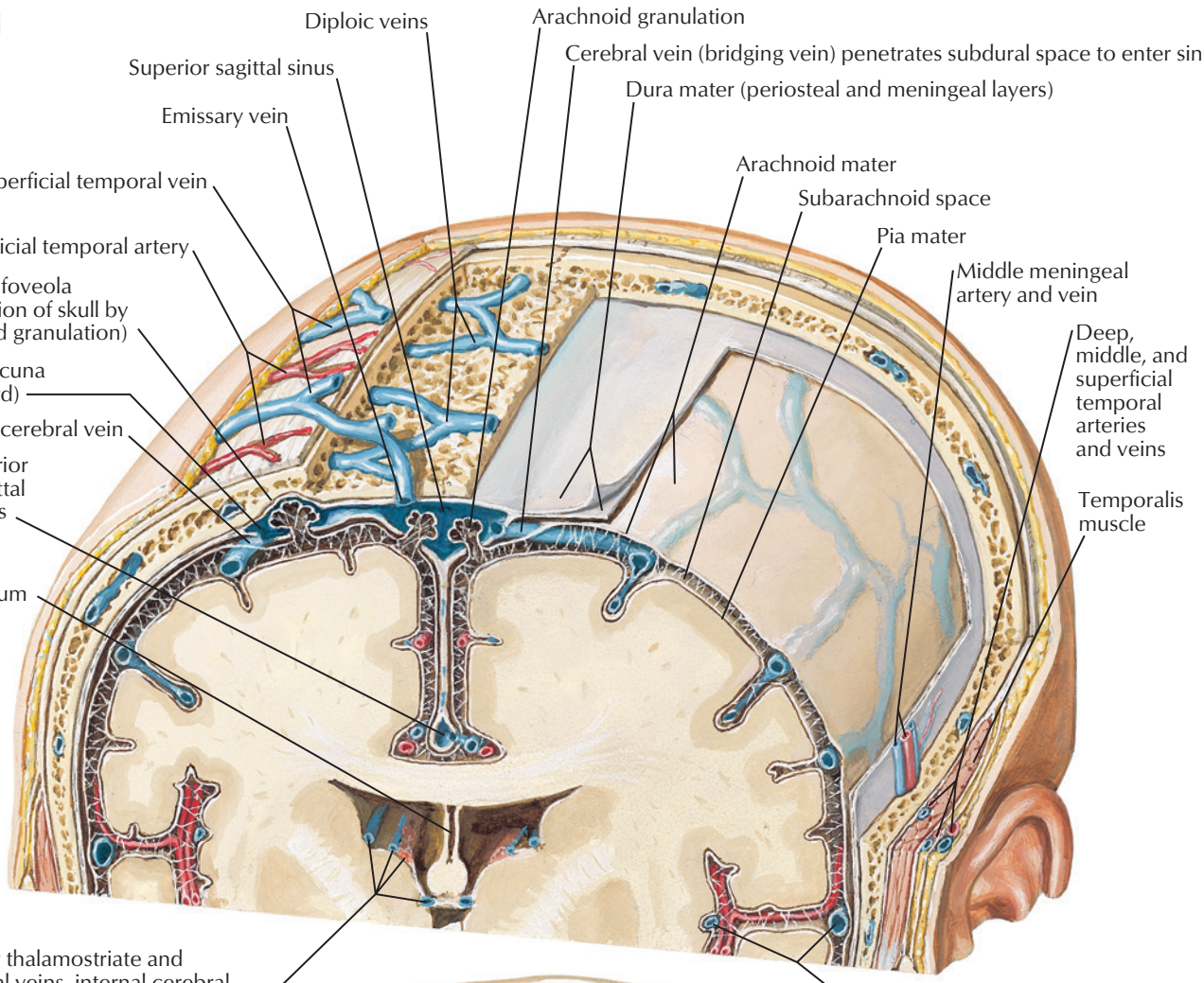


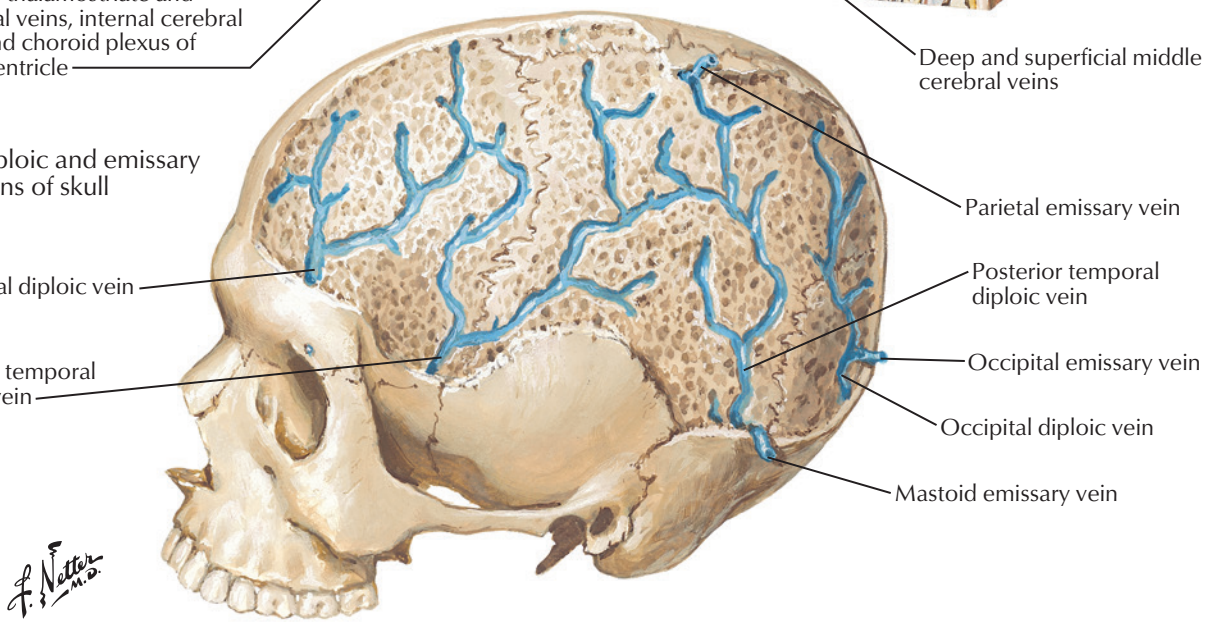
Lateral projection of right membranous labyrinth



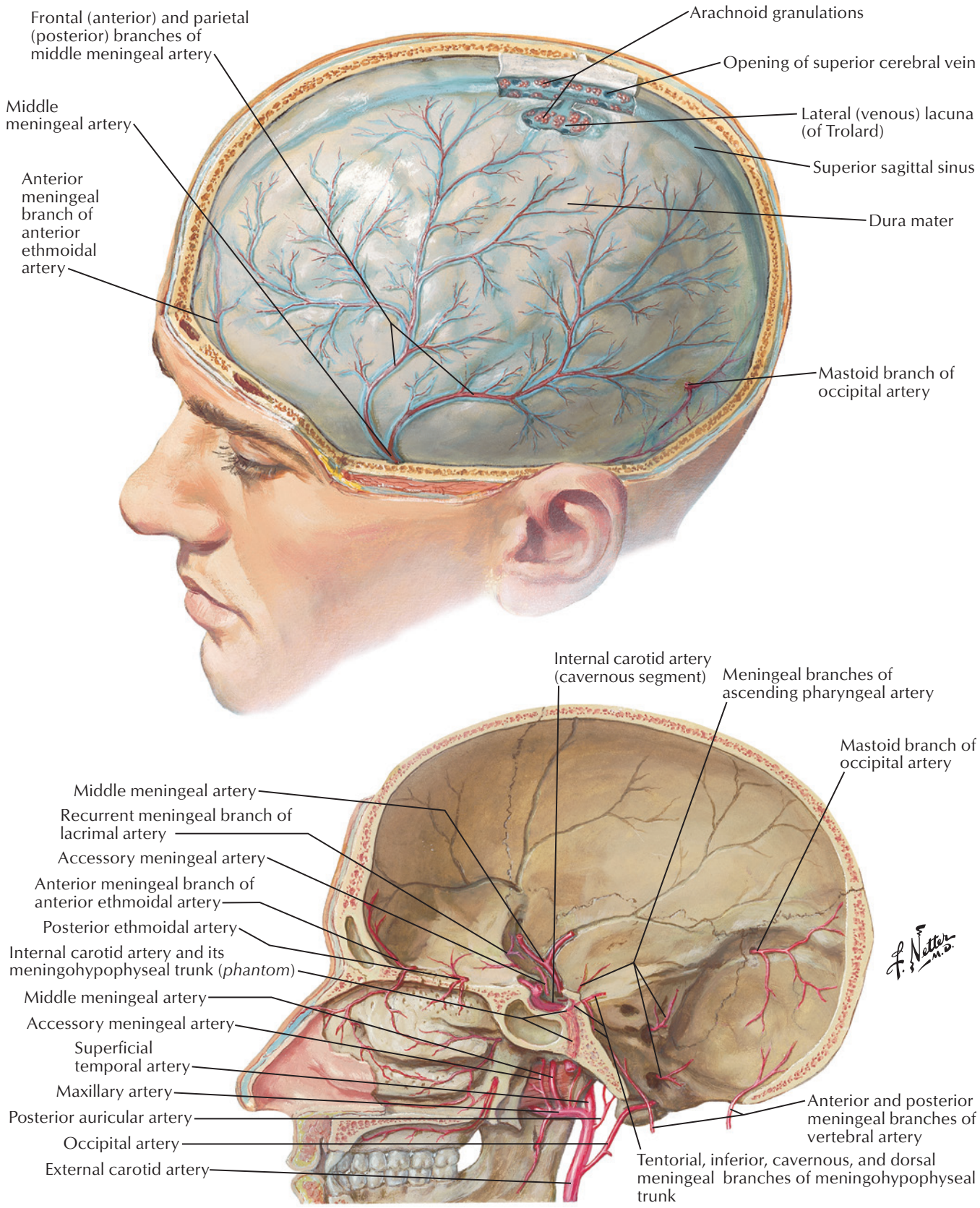
See also Plate 10

Coronal view



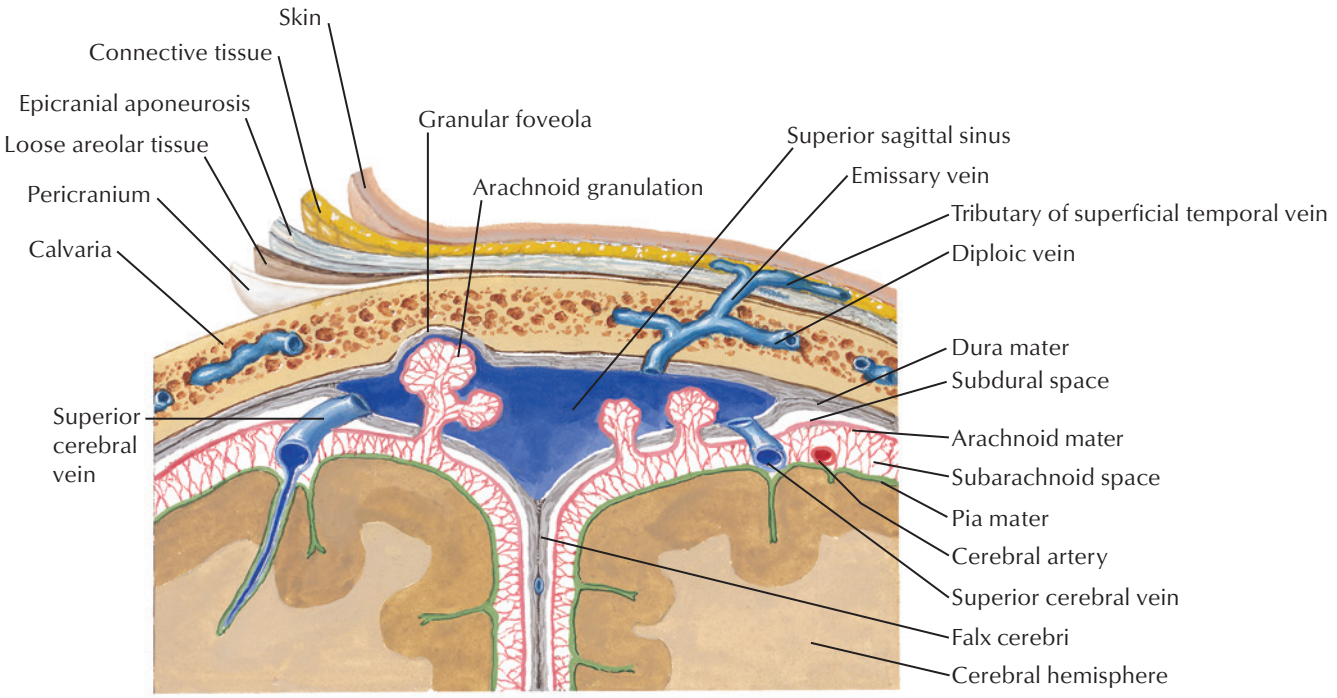


See also Plate 147

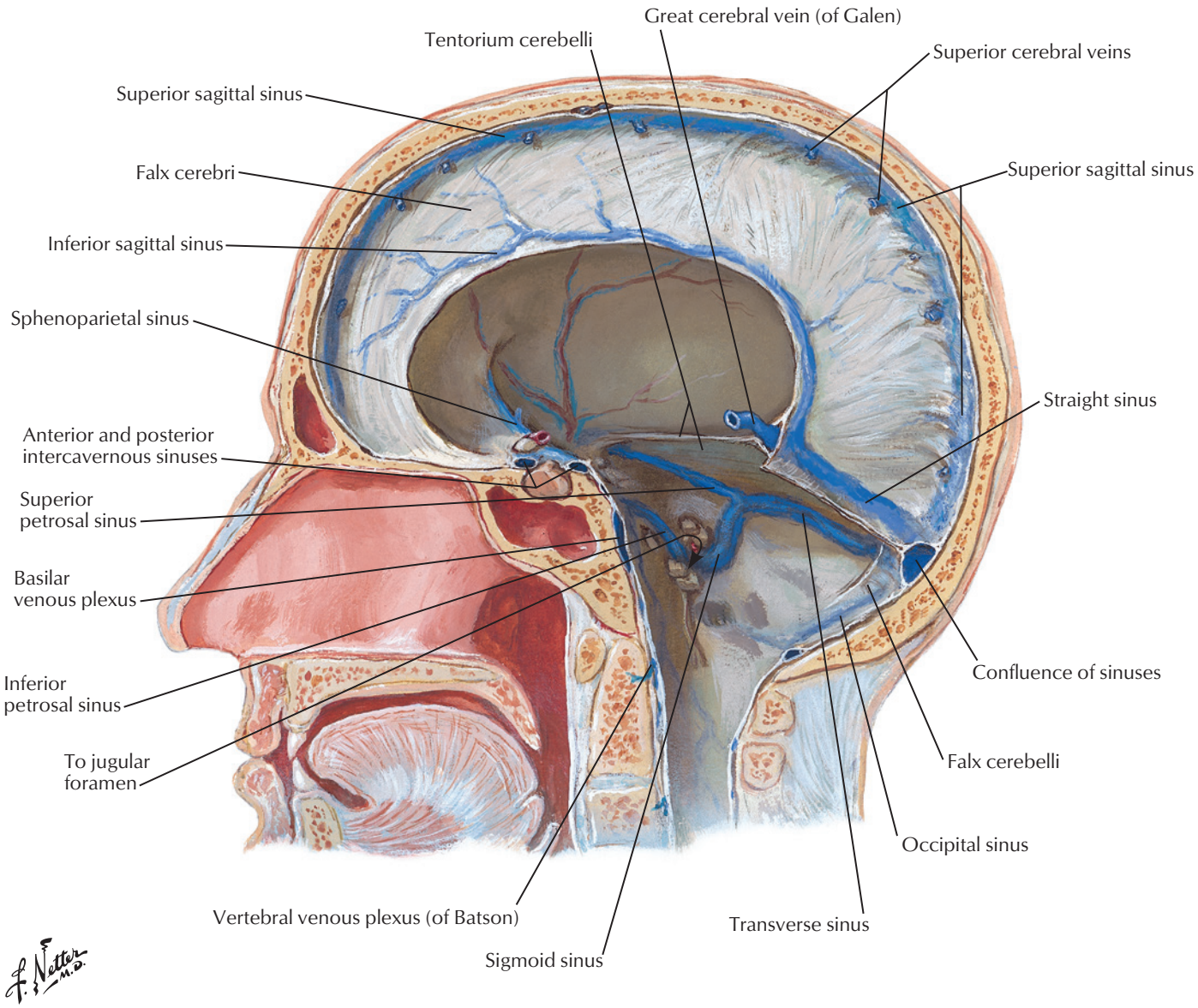


Meninges and Superficial Cerebral Veins

For deep veins of brain see Plate 156

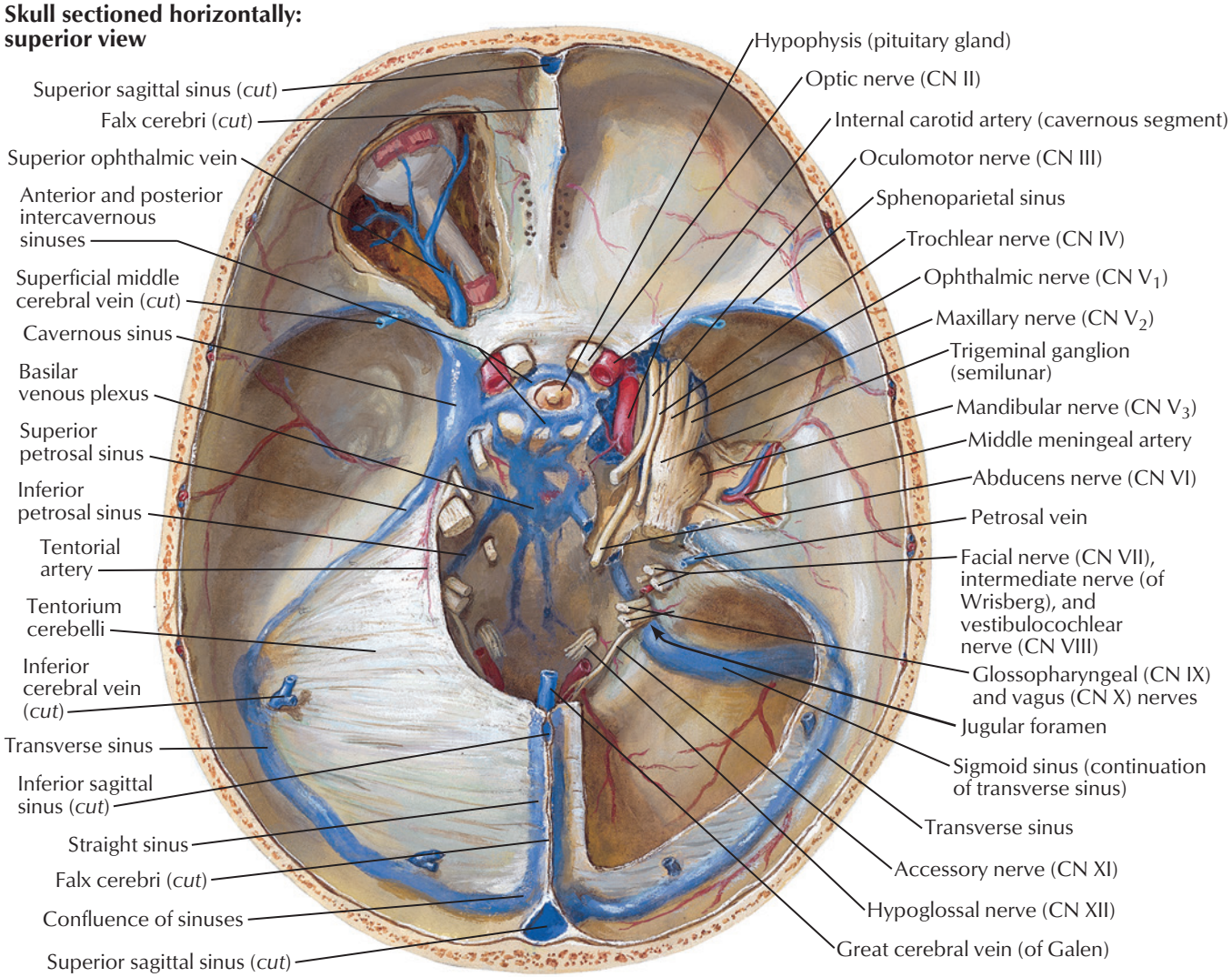


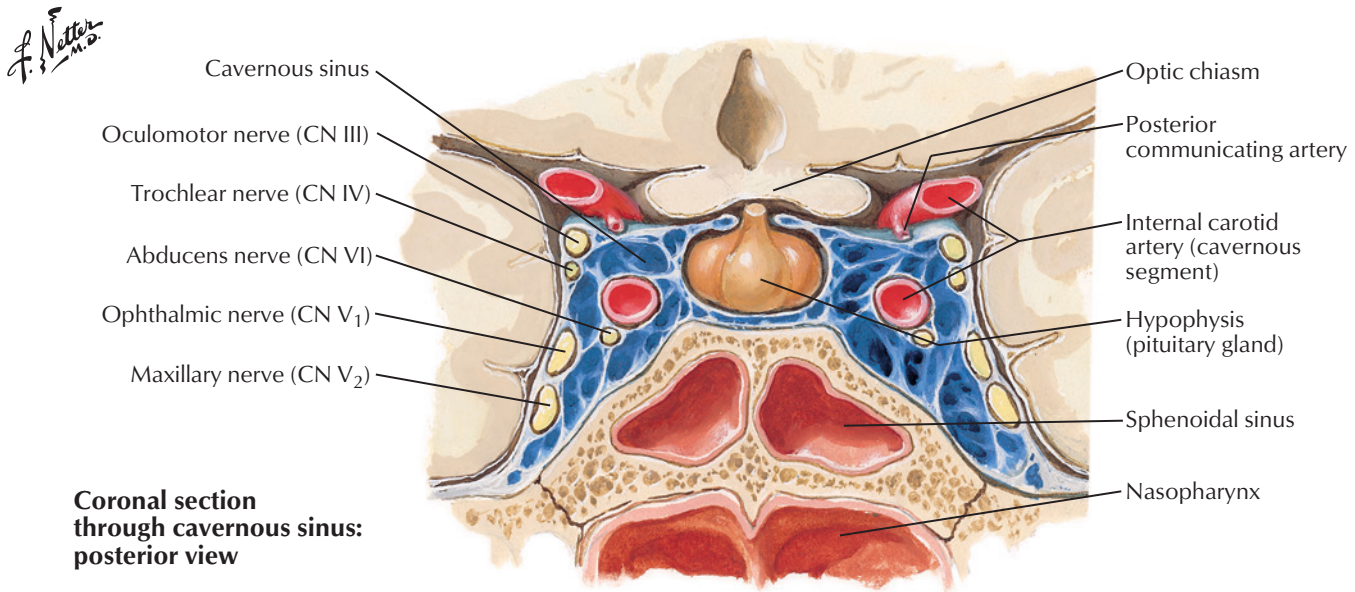
See also Plates 111, 117



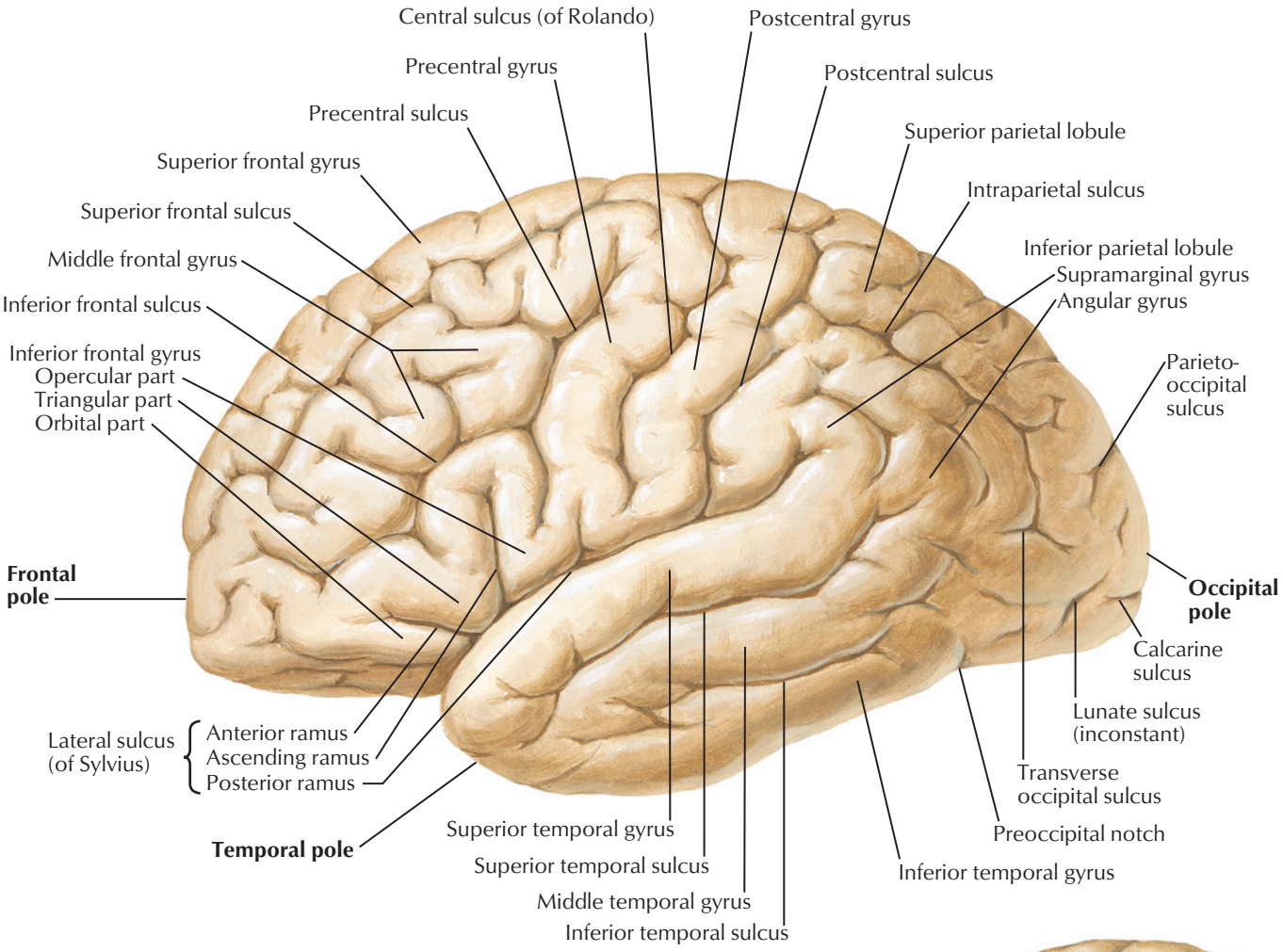
See also Plates 64, 97

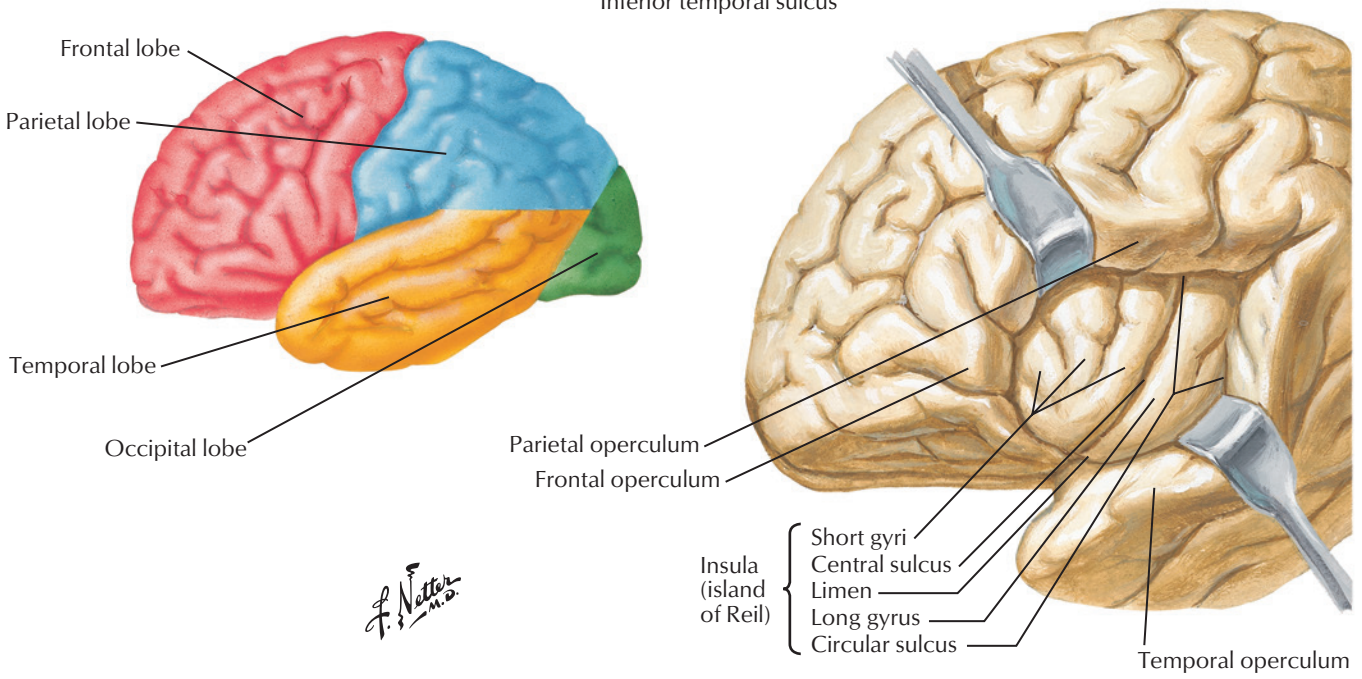
Skull sectioned horizontally: superior view





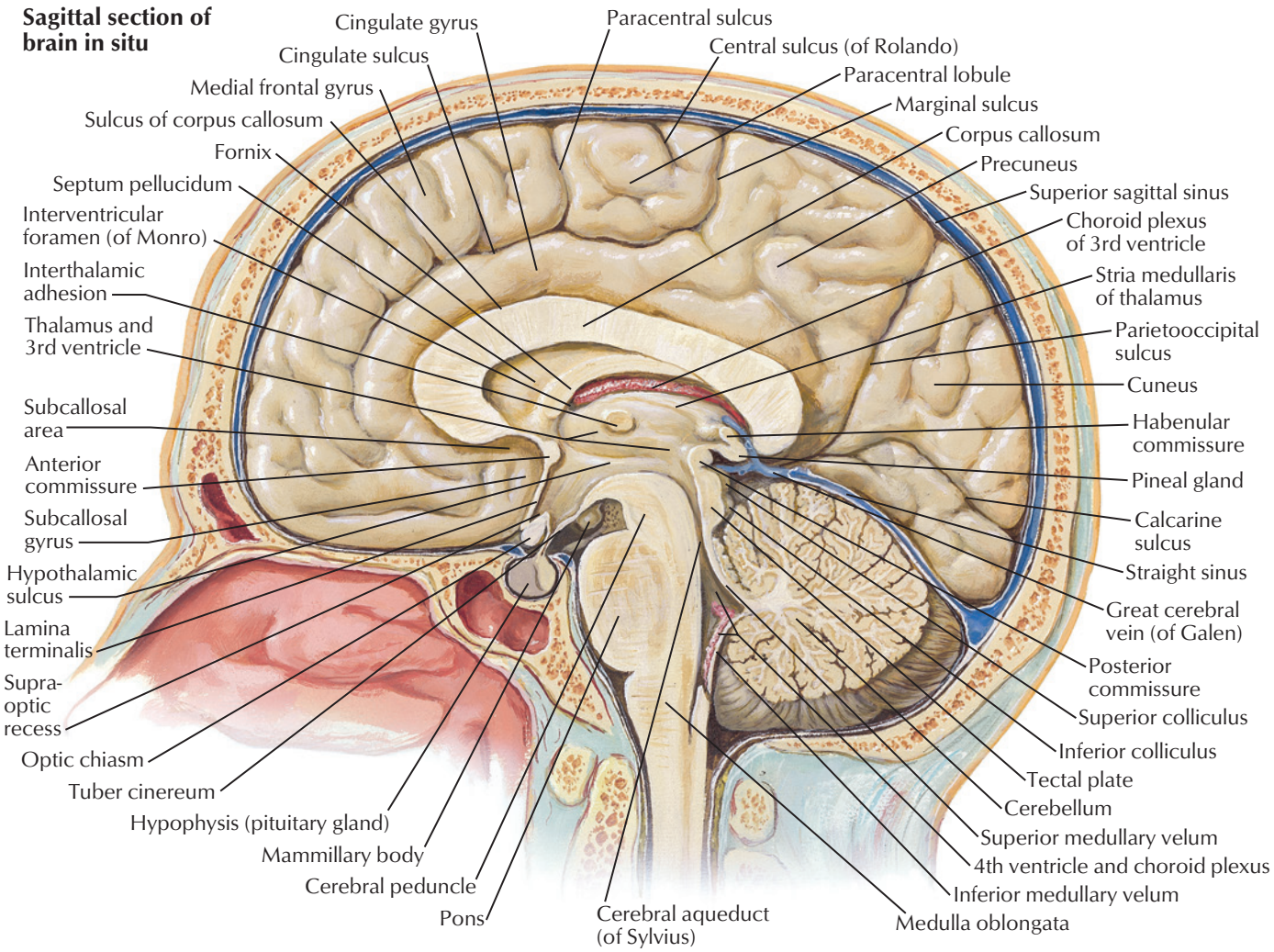
Coronal section through cavernous sinus: posterior view


Central sulcus (of Rolando)
Postcentral gyrus
Precentral gyrus
Postcentral sulcus
Precentral sulcus
Superior parietal lobule
Superior frontal gyrus
Intraparietal sulcus
Superior frontal sulcus
Inferior parietal lobule
Middle frontal gyrus
Supramarginal gyrus
Inferior frontal sulcus
Angular gyrus
Inferior frontal gyrus
Opercular part
Triangular part
Orbital part
Parieto-occipital sulcus
Frontal pole
Occipital pole
Calcarine sulcus
Lateral sulcus (of Sylvius)
Anterior ramus
Ascending ramus
Posterior ramus
Lunate sulcus (inconstant)
Transverse occipital sulcus
Temporal pole
Superior temporal gyrus
Preoccipital notch
Superior temporal sulcus
Inferior temporal gyrus
Middle temporal gyrus
Inferior temporal sulcus

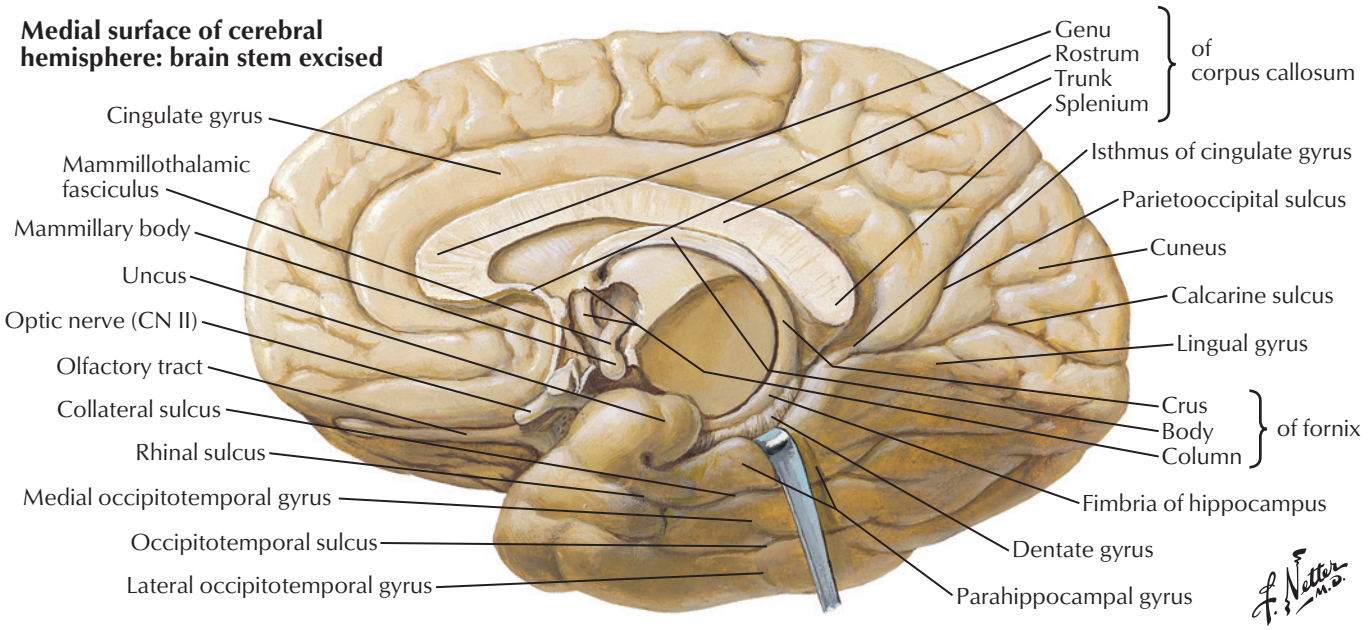

Frontal lobe
Parietal lobe
Temporal lobe
Occipital lobe
Parietal operculum
Frontal operculum
Insula (island of Reil)
Short gyri
Central sulcus
Limen
Long gyrus
Circular sulcus
Temporal operculum

See also Plate 158

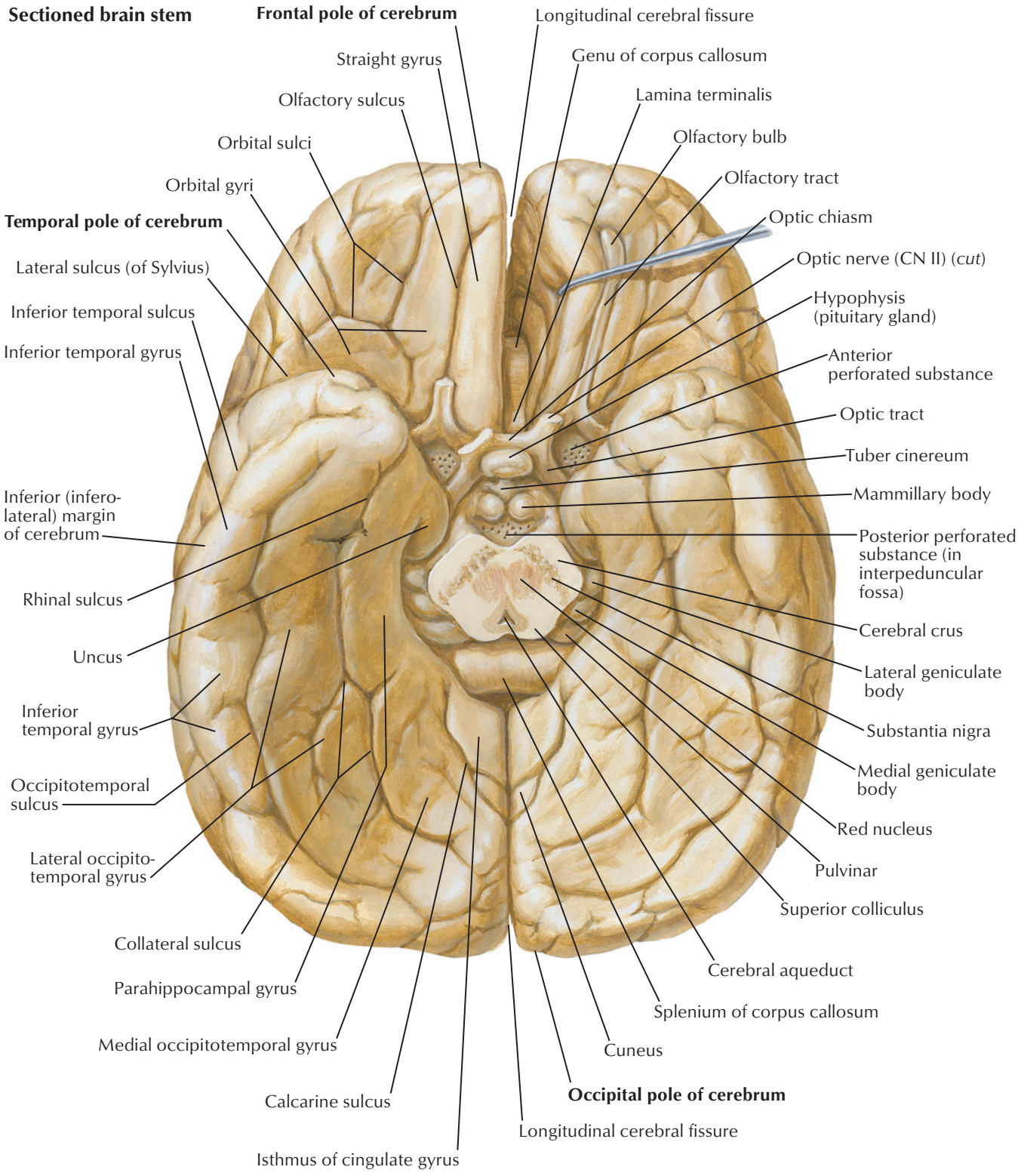
Sagittal section of brain in situ

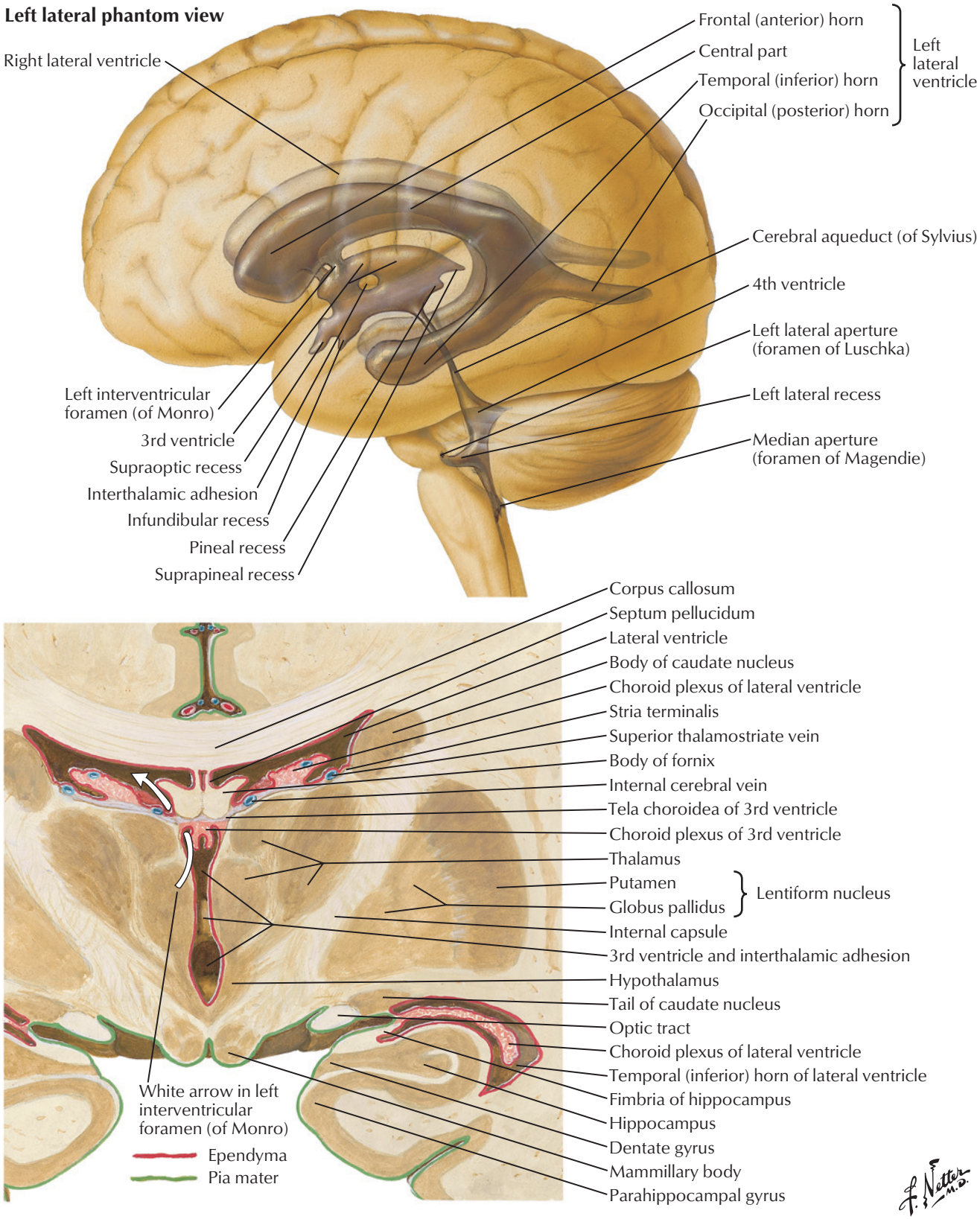


Medial surface of cerebral hemisphere: brain stem excised



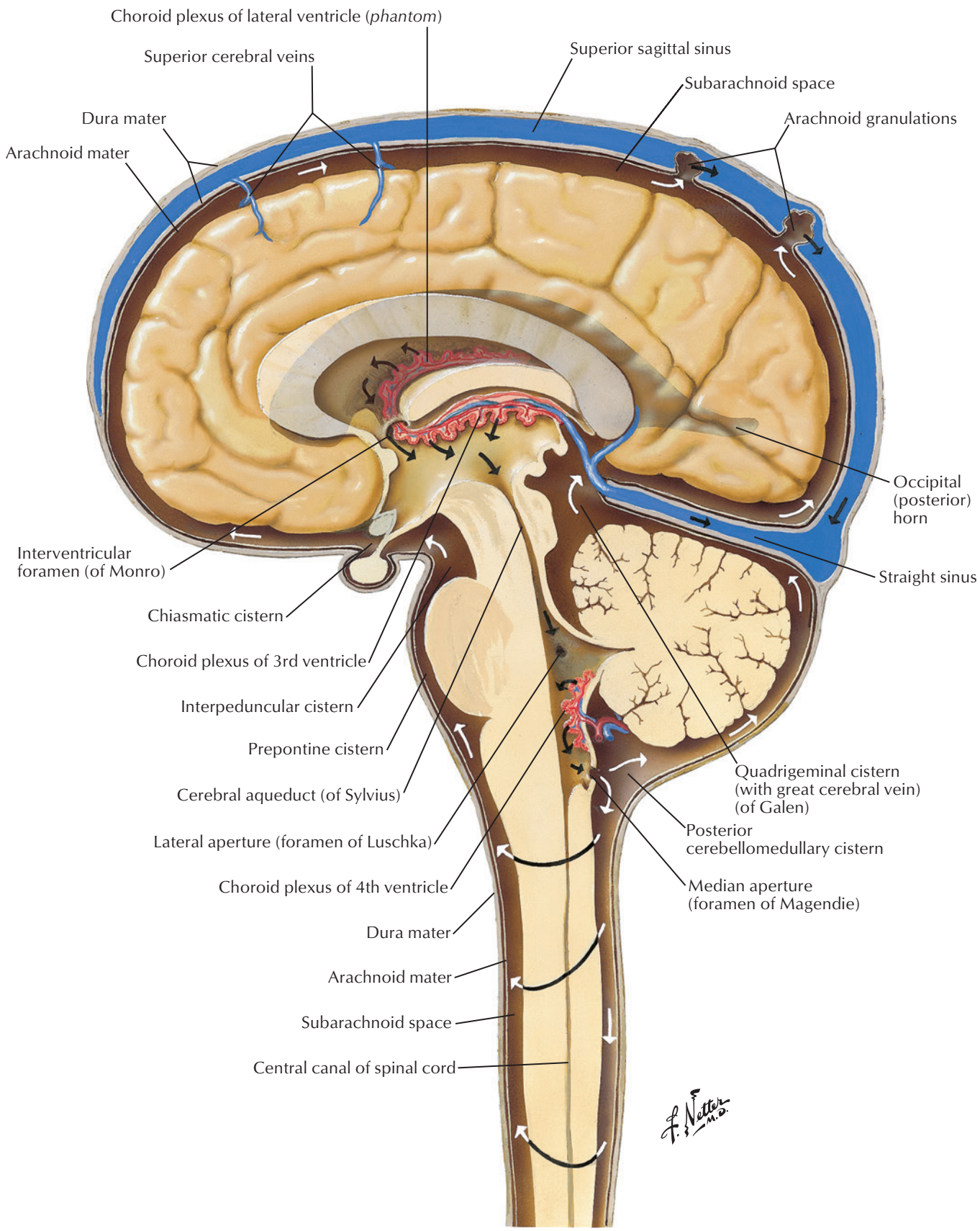
See also Plate 117



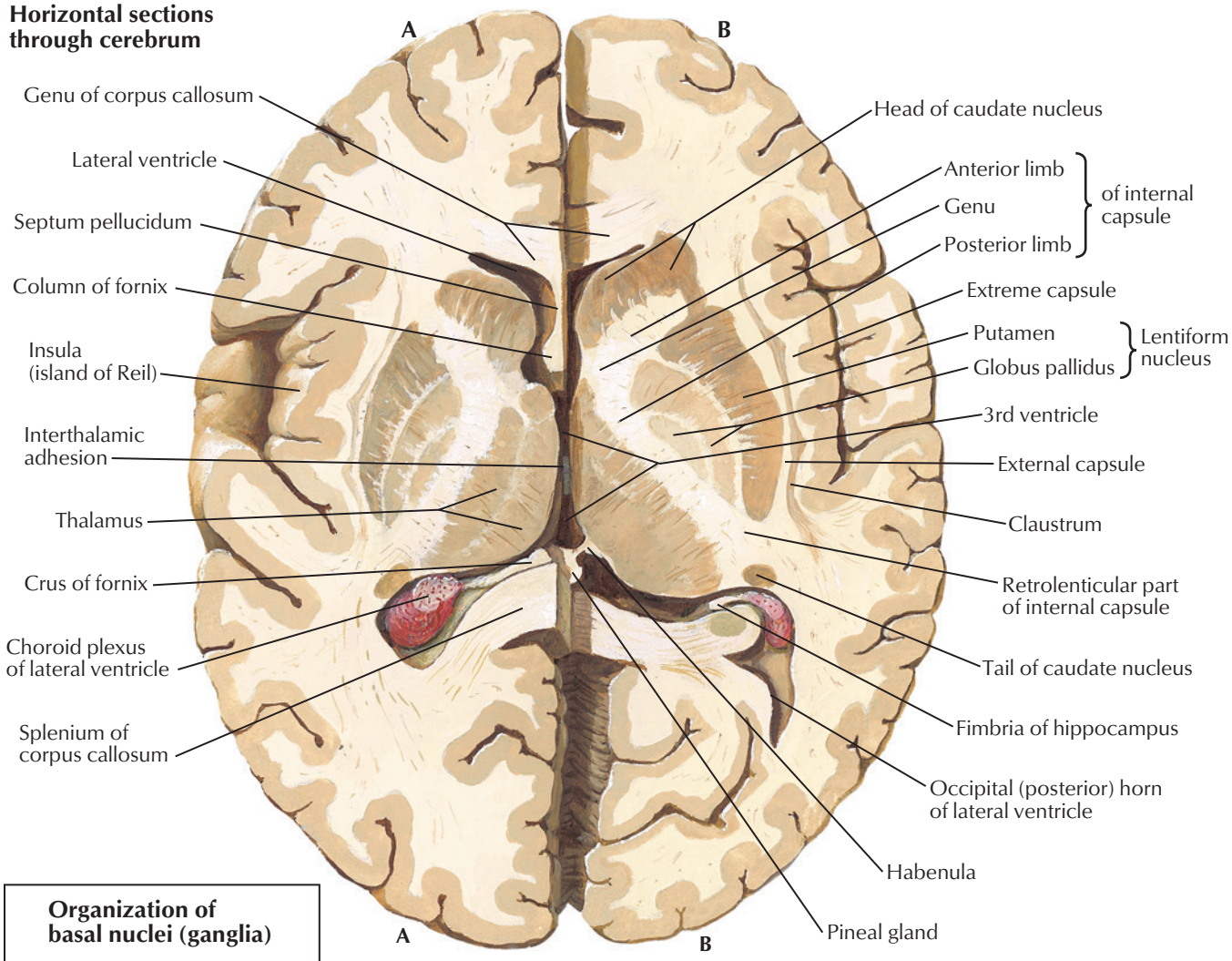


Coronal section of brain: posterior view

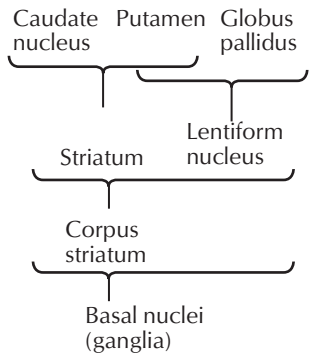
See also Plates 119, 157

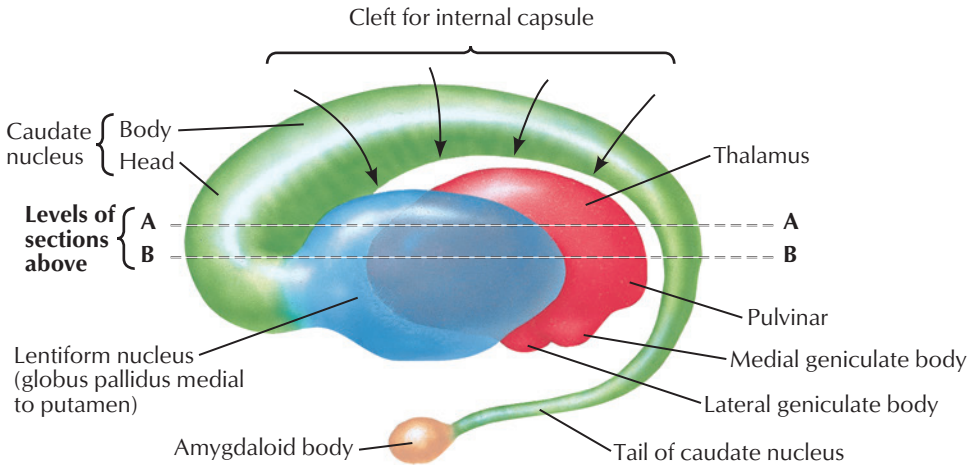


Horizontal sections through cerebrum

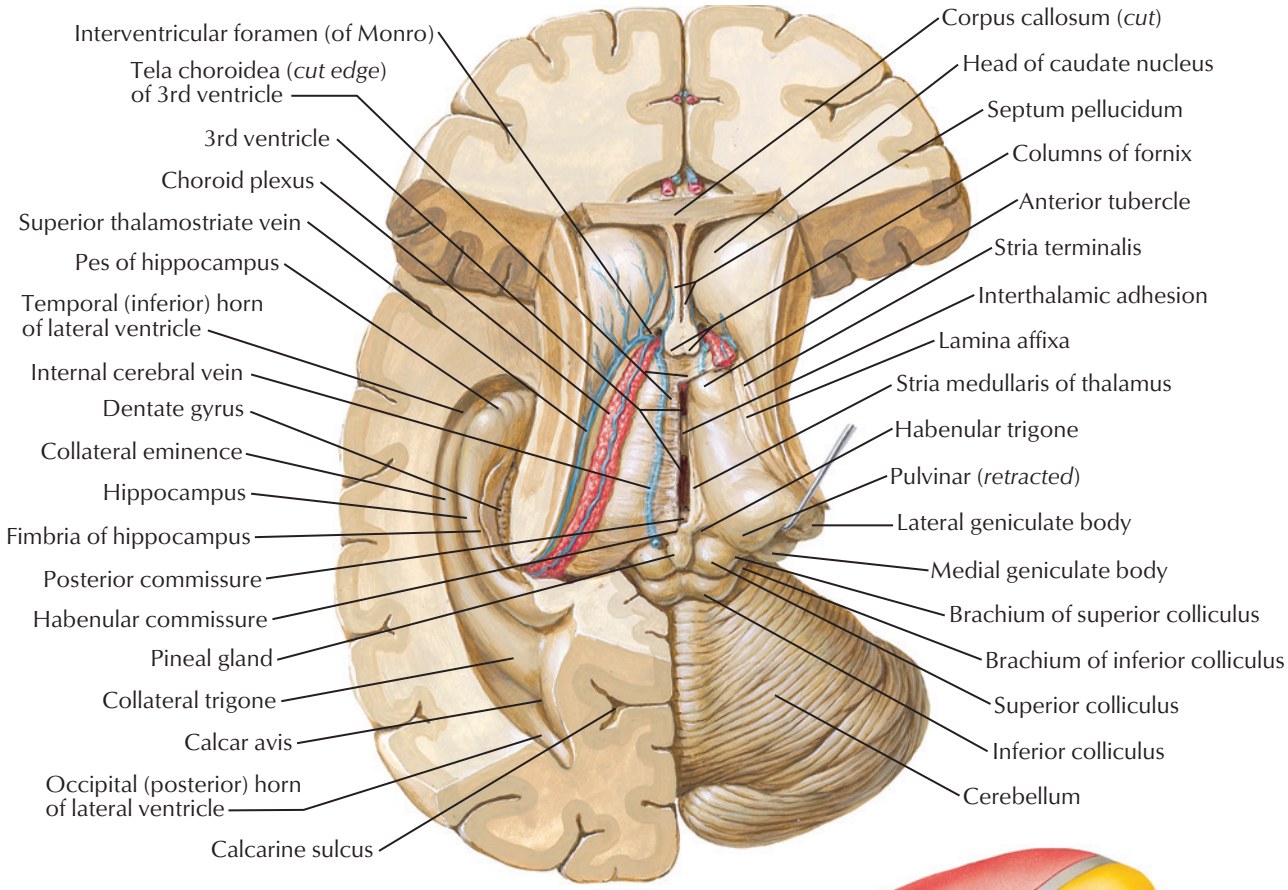


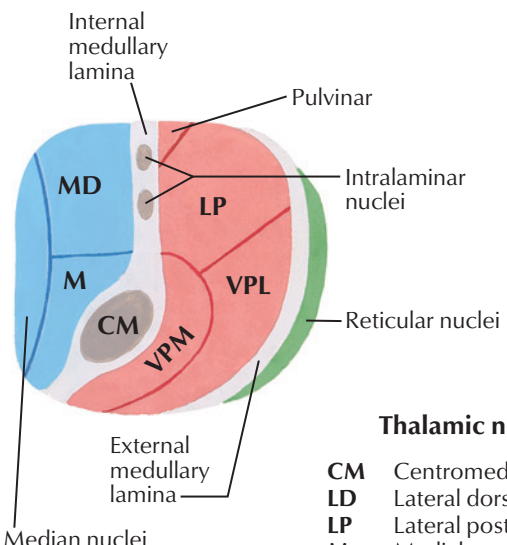
Organization of basal nuclei (ganglia)





Interrelationship of thalamus, lentiform nucleus, caudate nucleus, and amygdaloid body (schema): left lateral view

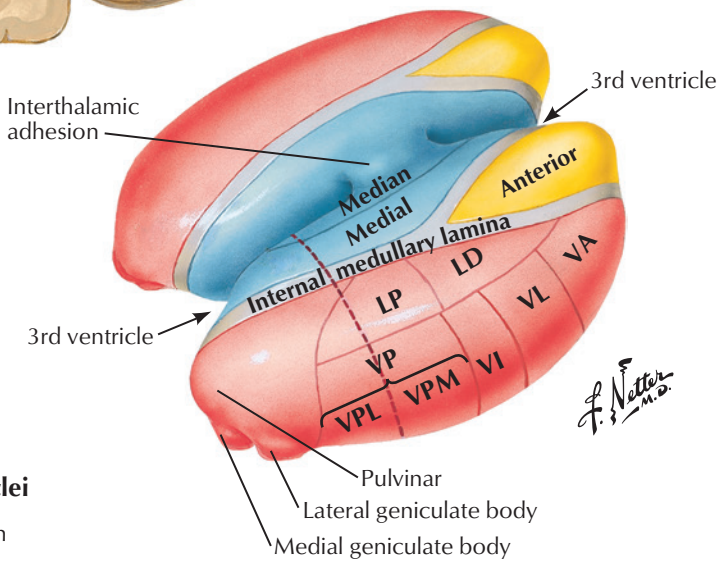




Schematic section through thalamus
(at level of broken line shown in figure at right)

Thalamic nuclei

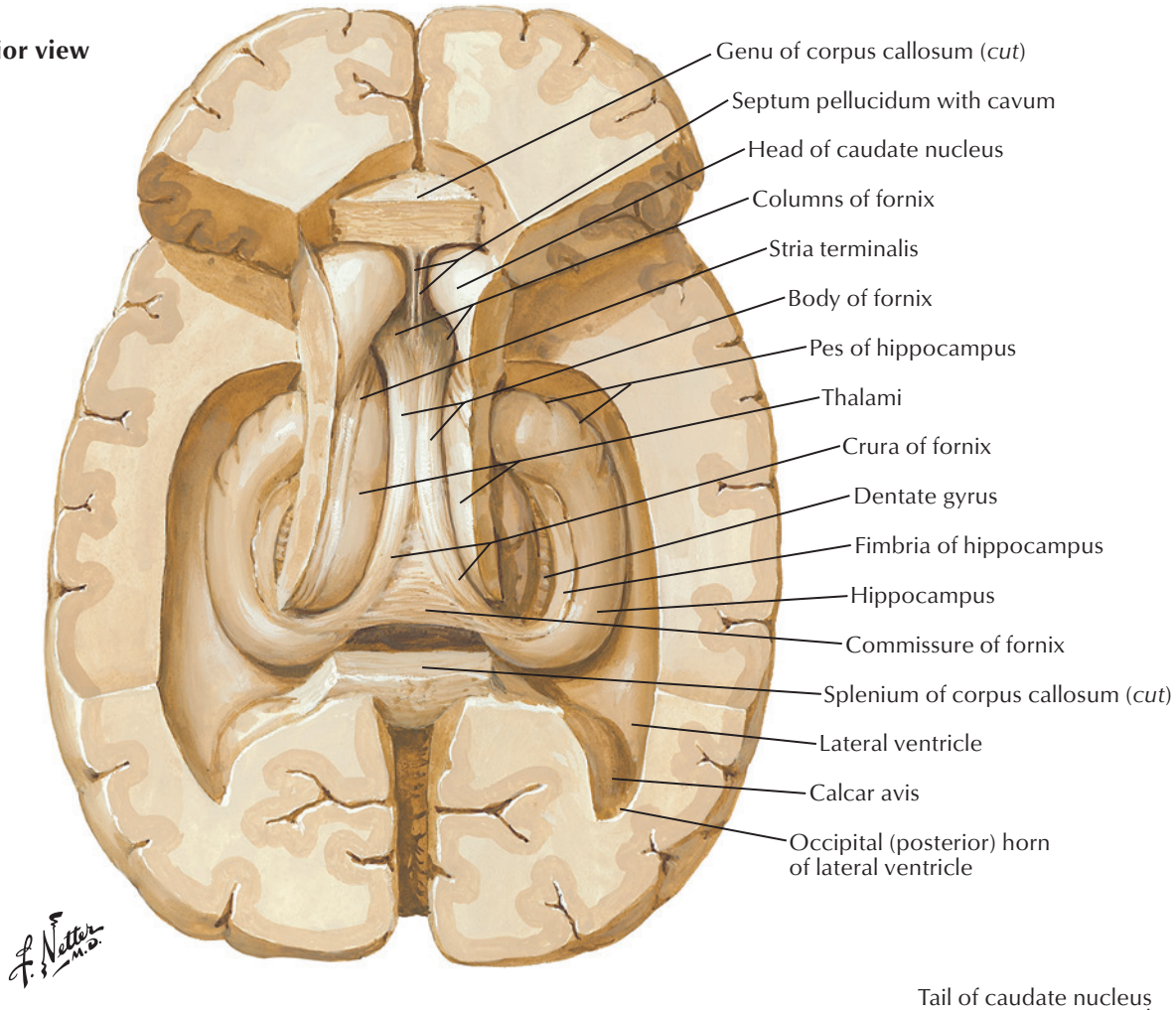
CM	Centromedian
LD	Lateral dorsal
LP	Lateral posterior
M	Medial group
MD	Medial dorsal
VA	Ventral anterior
VI	Ventral intermedial
VL	Ventral lateral
VP	Ventral posterior (ventrodorsal)
VPL	Ventral posterolateral
VPM	Ventral posteromedial

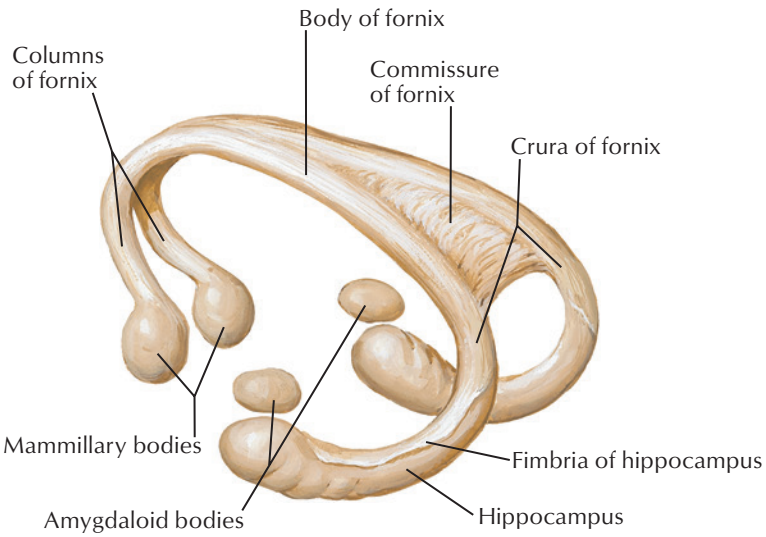


Schematic representation of thalamus
(external medullary lamina and reticular nuclei removed)

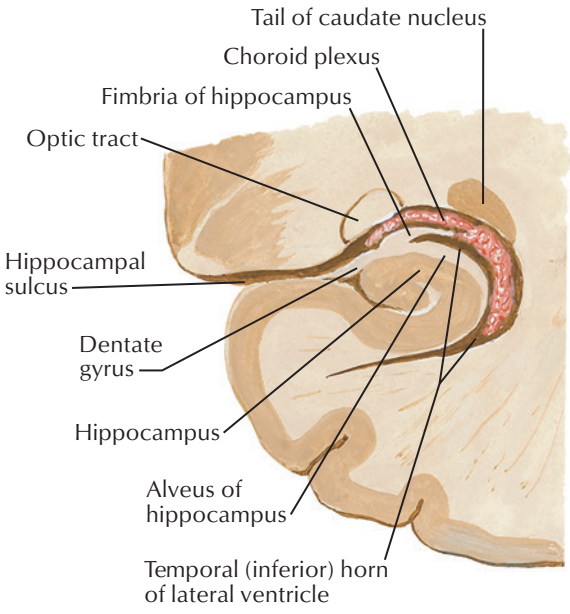
Lateral cell mass
Medial and median cell mass
Anterior cell mass

Superior view

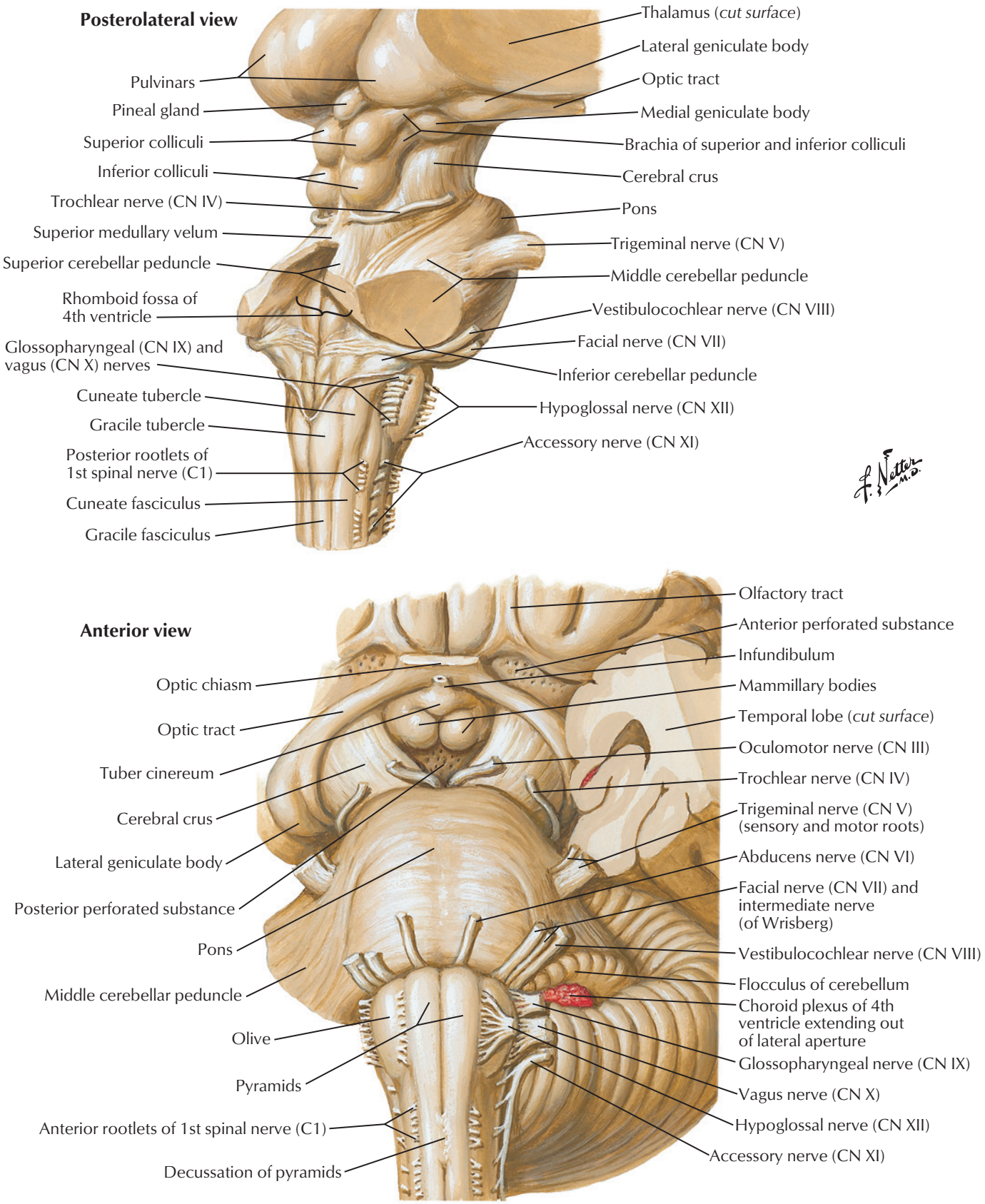




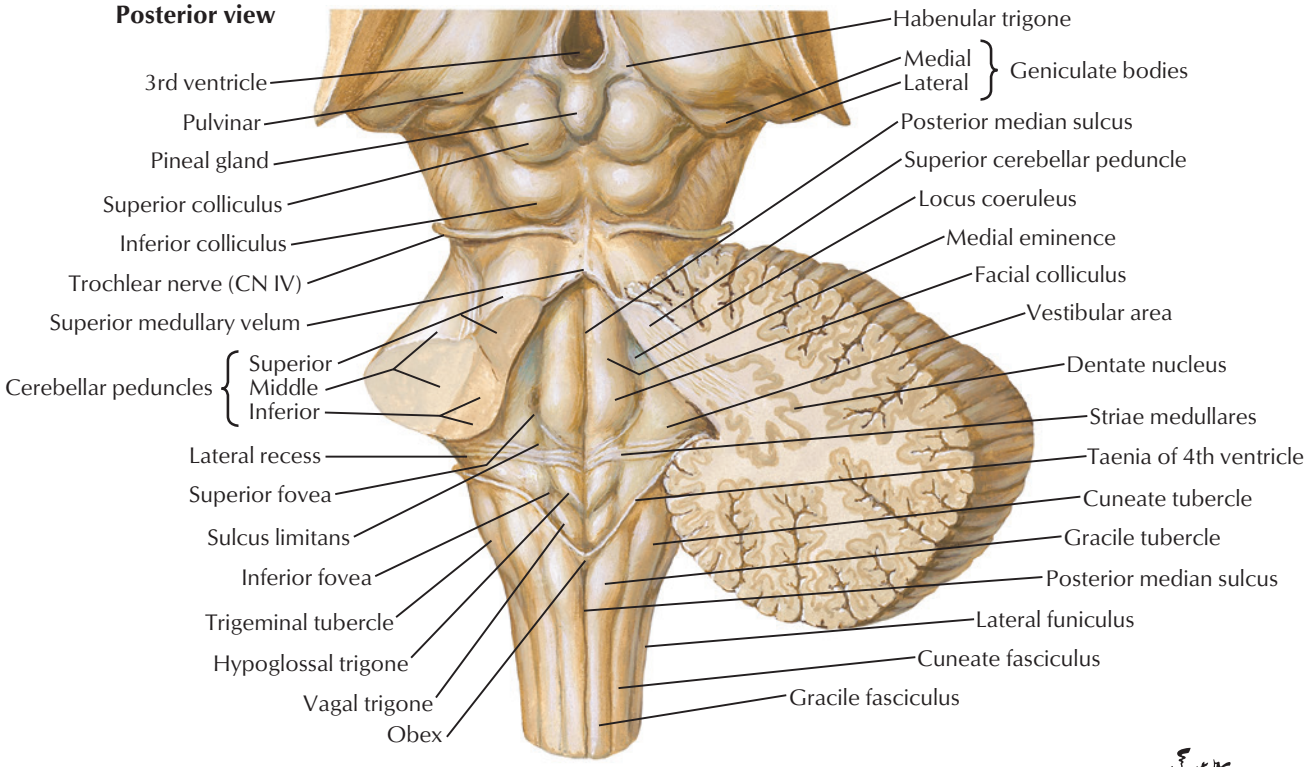
Fornix: schema



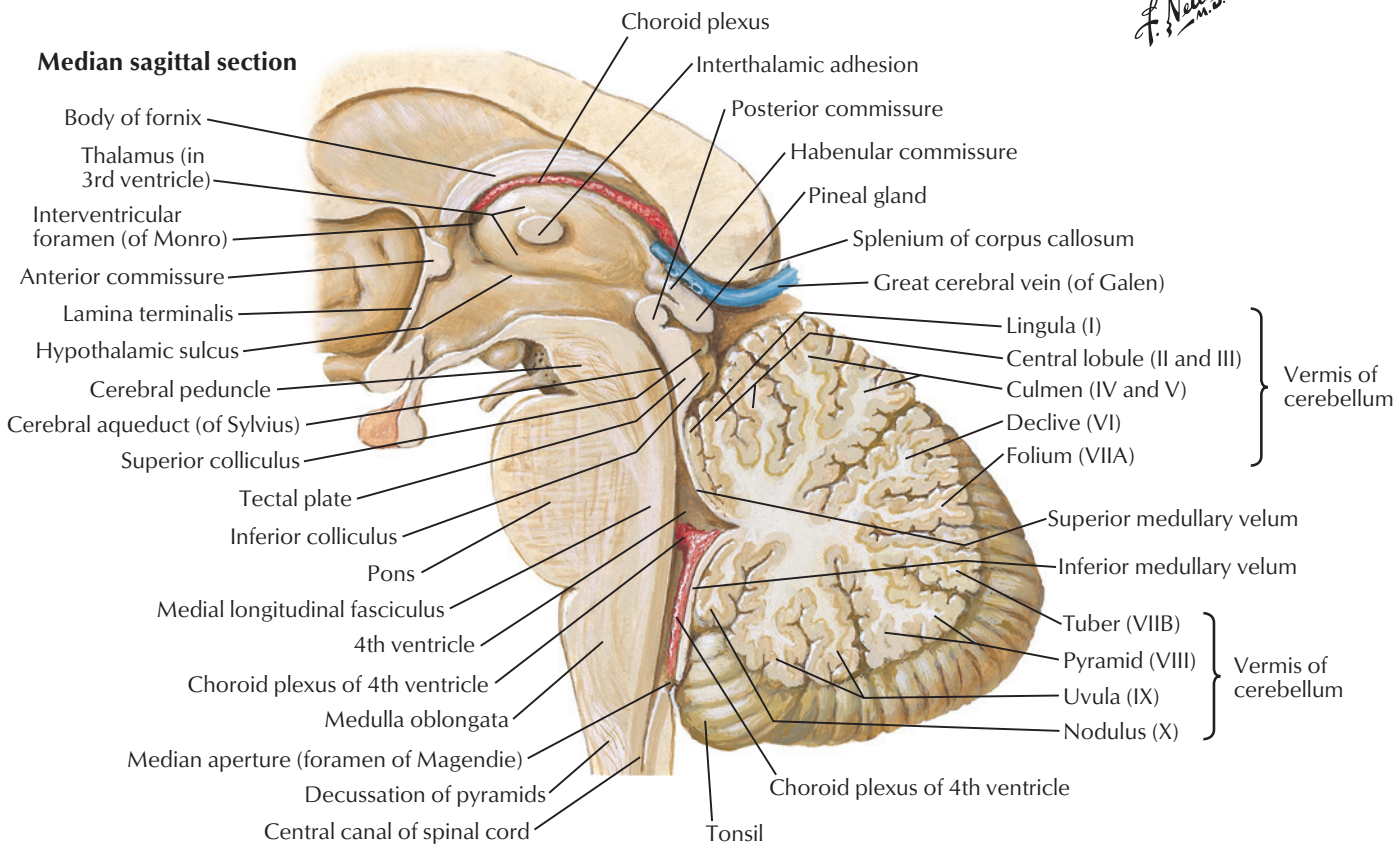
Coronal section: posterior view

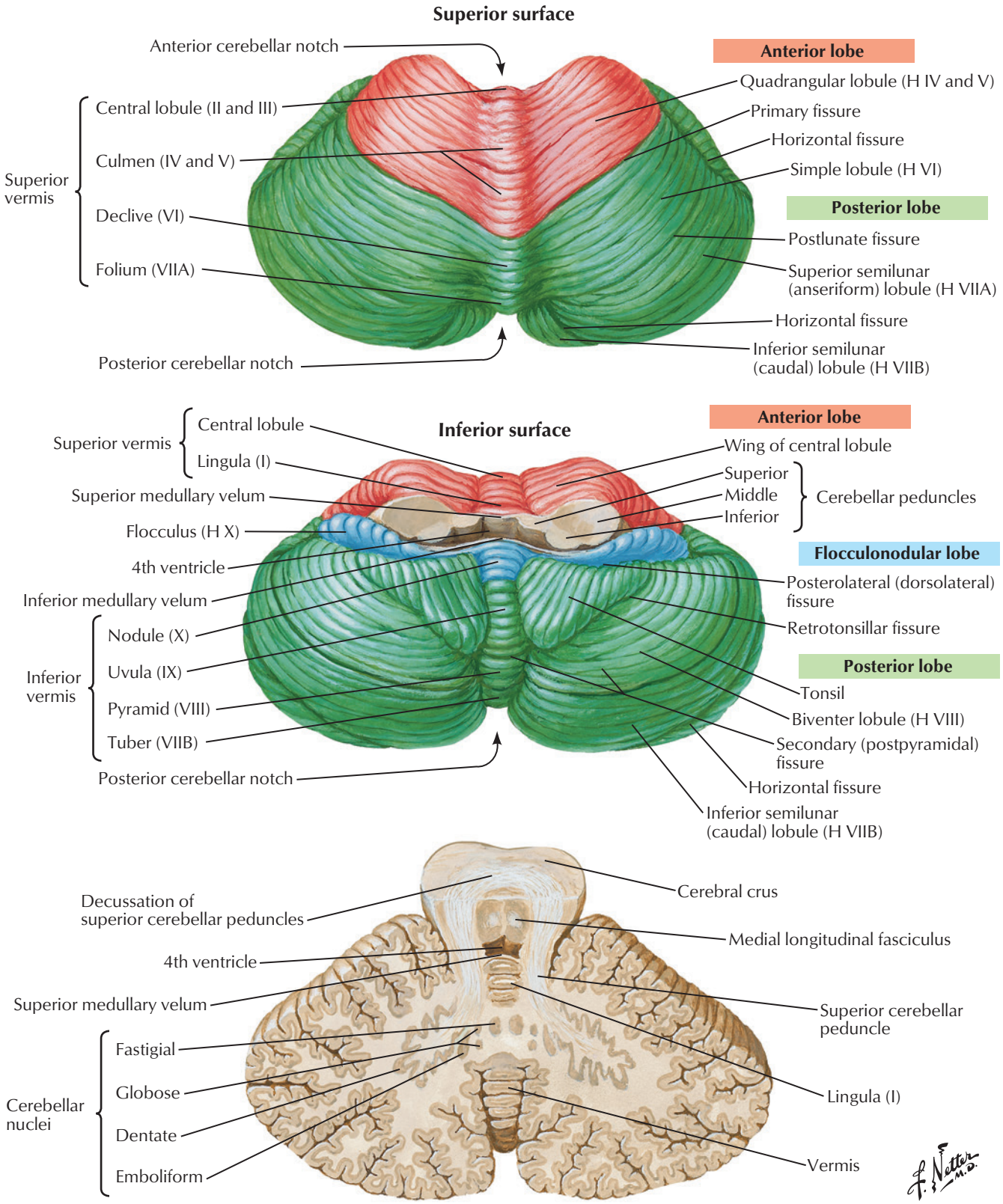

Posterolateral view
Thalamus (cut surface)
Lateral geniculate body
Optic tract
Medial geniculate body
Brachia of superior and inferior colliculi
Cerebral crus
Pons
Trigeminal nerve (CN V)
Middle cerebellar peduncle
Vestibulocochlear nerve (CN VIII)
Facial nerve (CN VII)
Inferior cerebellar peduncle
Hypoglossal nerve (CN XII)
Accessory nerve (CN XI)
Pulvinars
Pineal gland
Superior colliculi
Inferior colliculi
Trochlear nerve (CN IV)
Superior medullary velum
Superior cerebellar peduncle
Rhomboid fossa of 4th ventricle
Glossopharyngeal (CN IX) and vagus (CN X) nerves
Cuneate tubercle
Gracile tubercle
Posterior rootlets of 1st spinal nerve (C1)
Cuneate fasciculus
Gracile fasciculus
Anterior view
Olfactory tract
Anterior perforated substance
Infundibulum
Mammillary bodies
Temporal lobe (cut surface)
Oculomotor nerve (CN III)
Trochlear nerve (CN IV)
Trigeminal nerve (CN V) (sensory and motor roots)
Abducens nerve (CN VI)
Facial nerve (CN VII) and intermediate nerve (of Wrisberg)
Vestibulocochlear nerve (CN VIII)
Flocculus of cerebellum
Choroid plexus of 4th ventricle extending out of lateral aperture
Glossopharyngeal nerve (CN IX)
Vagus nerve (CN X)
Hypoglossal nerve (CN XII)
Accessory nerve (CN XI)
Optic chiasm
Optic tract
Tuber cinereum
Cerebral crus
Lateral geniculate body
Posterior perforated substance
Pons
Middle cerebellar peduncle
Olive
Pyramids
Anterior rootlets of 1st spinal nerve (C1)
Decussation of pyramids

Posterior view

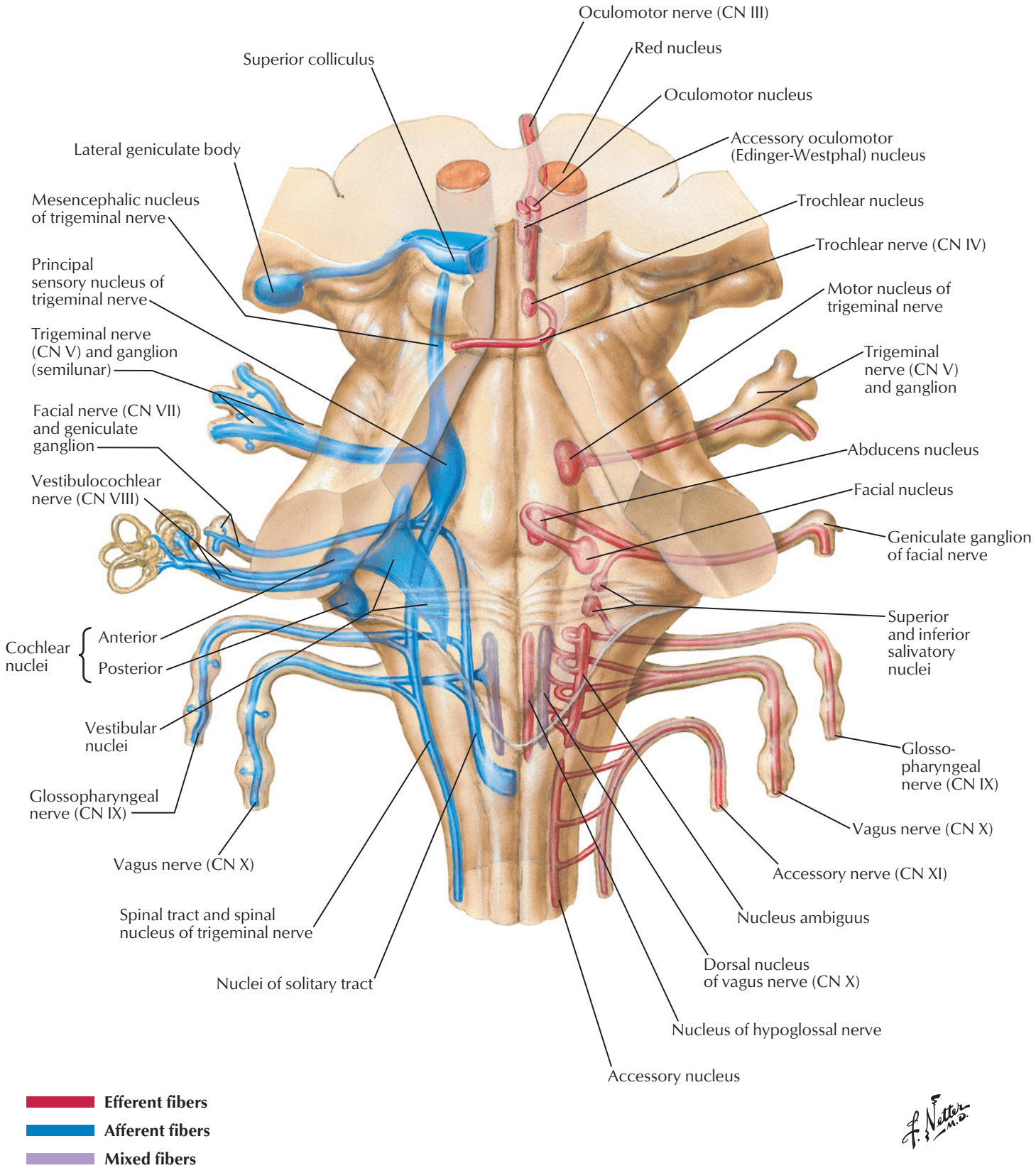


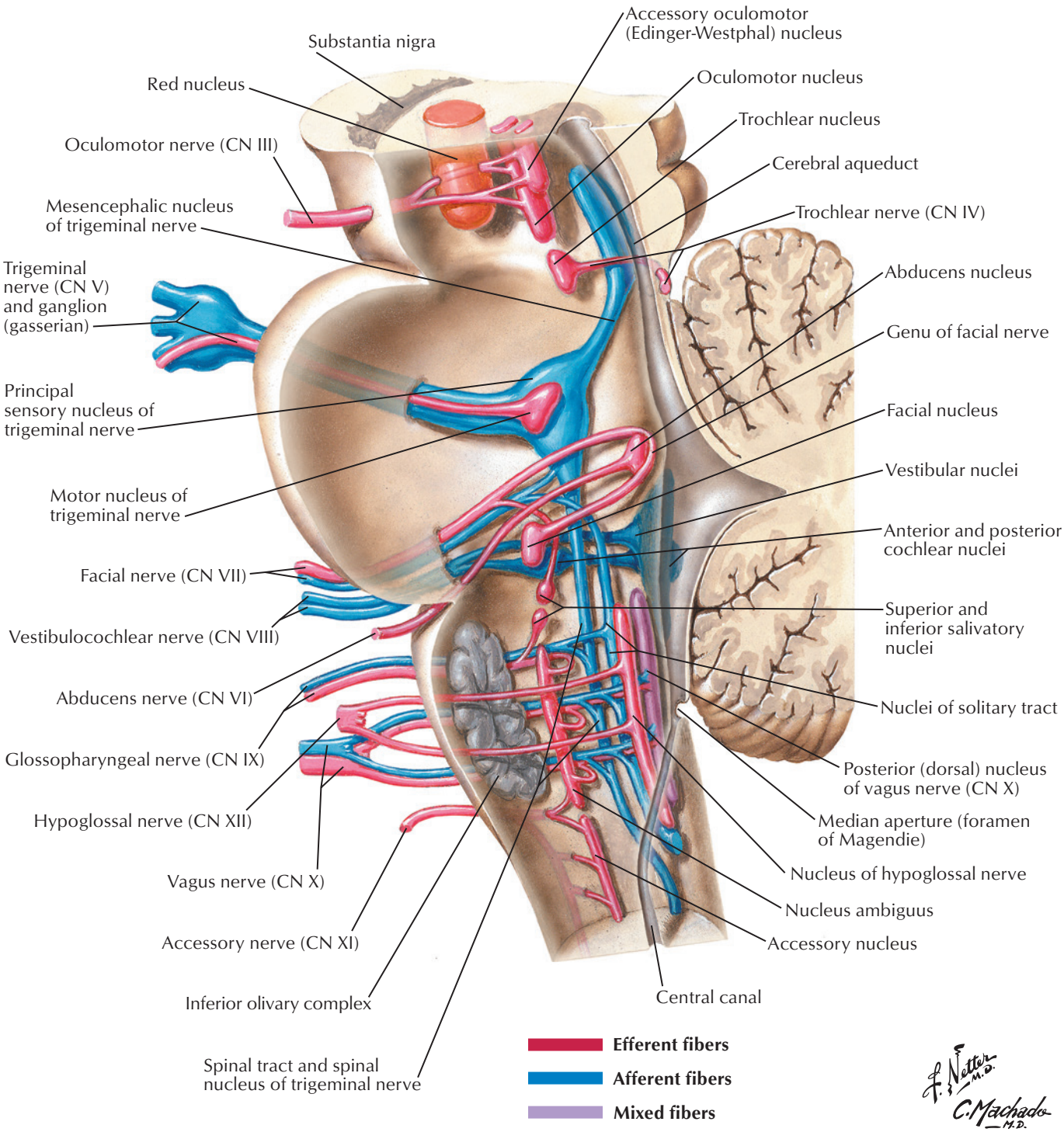
Median sagittal section

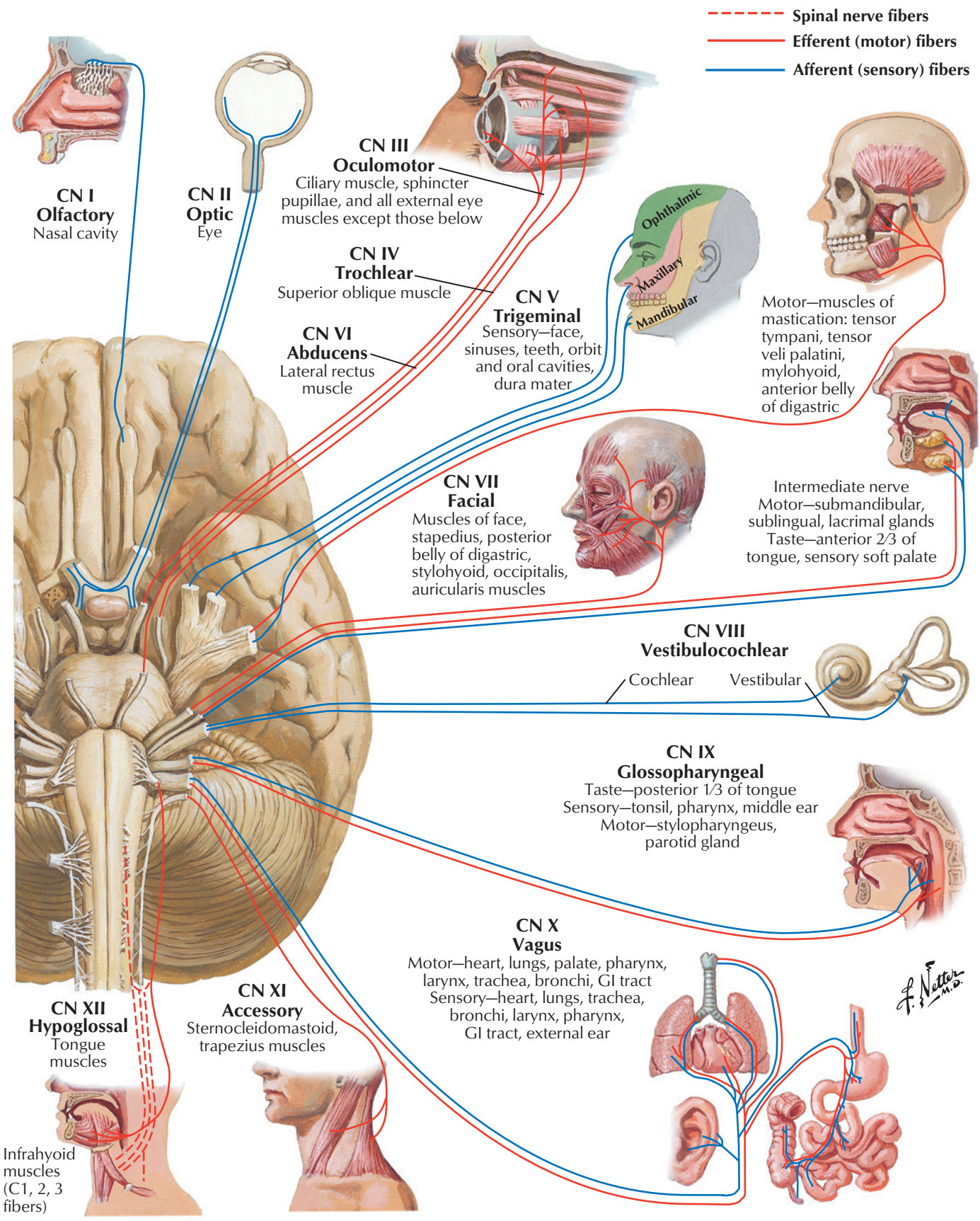


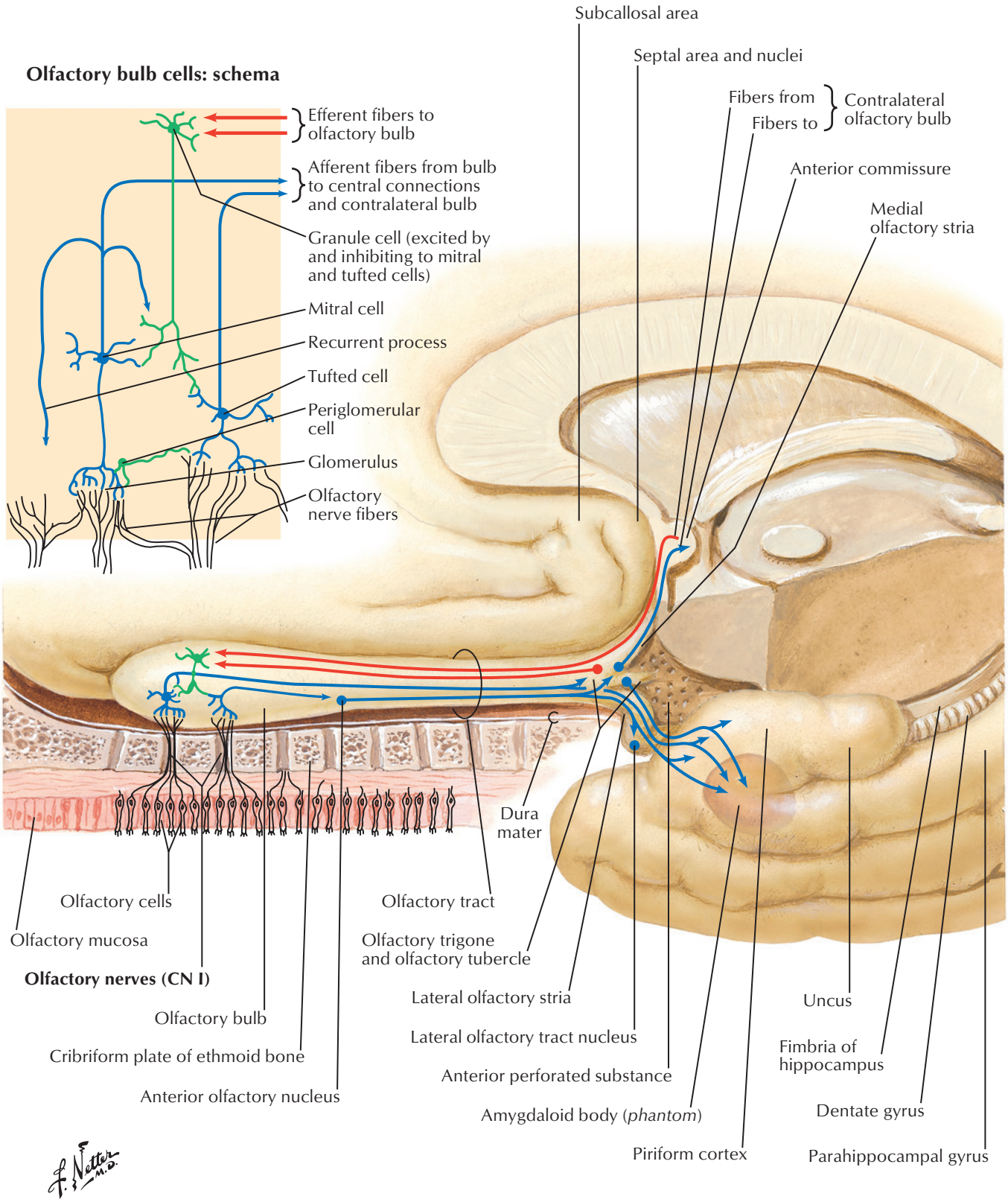


Section in plane of superior cerebellar peduncle


Oculomotor nerve (CN III)
Red nucleus
Superior colliculus
Oculomotor nucleus
Lateral geniculate body
Accessory oculomotor (Edinger-Westphal) nucleus
Mesencephalic nucleus of trigeminal nerve
Trochlear nucleus
Trochlear nerve (CN IV)
Principal sensory nucleus of trigeminal nerve
Motor nucleus of trigeminal nerve
Trigeminal nerve (CN V) and ganglion (semilunar)
Trigeminal nerve (CN V) and ganglion
Facial nerve (CN VII) and geniculate ganglion
Abducens nucleus
Vestibulocochlear nerve (CN VIII)
Facial nucleus
Geniculate ganglion of facial nerve
Cochlear nuclei
Anterior
Posterior
Superior and inferior salivatory nuclei
Vestibular nuclei
Glosso-pharyngeal nerve (CN IX)
Glossopharyngeal nerve (CN IX)
Vagus nerve (CN X)
Vagus nerve (CN X)
Accessory nerve (CN XI)
Spinal tract and spinal nucleus of trigeminal nerve
Nucleus ambiguus
Dorsal nucleus of vagus nerve (CN X)
Nuclei of solitary tract
Nucleus of hypoglossal nerve
Accessory nucleus
Efferent fibers
Afferent fibers
Mixed fibers


Substantia nigra
Red nucleus
Oculomotor nerve (CN III)
Mesencephalic nucleus of trigeminal nerve
Trigeminal nerve (CN V) and ganglion (gasserian)
Principal sensory nucleus of trigeminal nerve
Motor nucleus of trigeminal nerve
Facial nerve (CN VII)
Vestibulocochlear nerve (CN VIII)
Abducens nerve (CN VI)
Glossopharyngeal nerve (CN IX)
Hypoglossal nerve (CN XII)
Vagus nerve (CN X)
Accessory nerve (CN XI)
Inferior olivary complex
Spinal tract and spinal nucleus of trigeminal nerve
Accessory oculomotor (Edinger-Westphal) nucleus
Oculomotor nucleus
Trochlear nucleus
Cerebral aqueduct
Trochlear nerve (CN IV)
Abducens nucleus
Genu of facial nerve
Facial nucleus
Vestibular nuclei
Anterior and posterior cochlear nuclei
Superior and inferior salivatory nuclei
Nuclei of solitary tract
Posterior (dorsal) nucleus of vagus nerve (CN X)
Median aperture (foramen of Magendie)
Nucleus of hypoglossal nerve
Nucleus ambiguus
Accessory nucleus
Central canal
Efferent fibers
Afferent fibers
Mixed fibers
F. Netter M.D.
C. Machado M.D.


Spinal nerve fibers
Efferent (motor) fibers
Afferent (sensory) fibers
CN I
Olfactory
Nasal cavity
CN II
Optic
Eye
CN III
Oculomotor
Ciliary muscle, sphincter pupillae, and all external eye muscles except those below
CN IV
Trochlear
Superior oblique muscle
CN V
Trigeminal
Sensory—face, sinuses, teeth, orbit and oral cavities, dura mater
Ophthalmic
Maxillary
Mandibular
Motor—muscles of mastication: tensor tympani, tensor veli palatini, mylohyoid, anterior belly of digastric
CN VI
Abducens
Lateral rectus muscle
CN VII
Facial
Muscles of face, stapedius, posterior belly of digastric, stylohyoid, occipitalis, auricularis muscles
Intermediate nerve
Motor—submandibular, sublingual, lacrimal glands
Taste—anterior 2/3 of tongue, sensory soft palate
CN VIII
Vestibulocochlear
Cochlear
Vestibular
CN IX
Glossopharyngeal
Taste—posterior 1/3 of tongue
Sensory—tonsil, pharynx, middle ear
Motor—stylopharyngeus, parotid gland
CN X
Vagus
Motor—heart, lungs, palate, pharynx, larynx, trachea, bronchi, GI tract
Sensory—heart, lungs, trachea, bronchi, larynx, pharynx, GI tract, external ear
CN XI
Accessory
Sternocleidomastoid, trapezius muscles
CN XII
Hypoglossal
Tongue muscles
Infrahyoid muscles (C1, 2, 3 fibers)

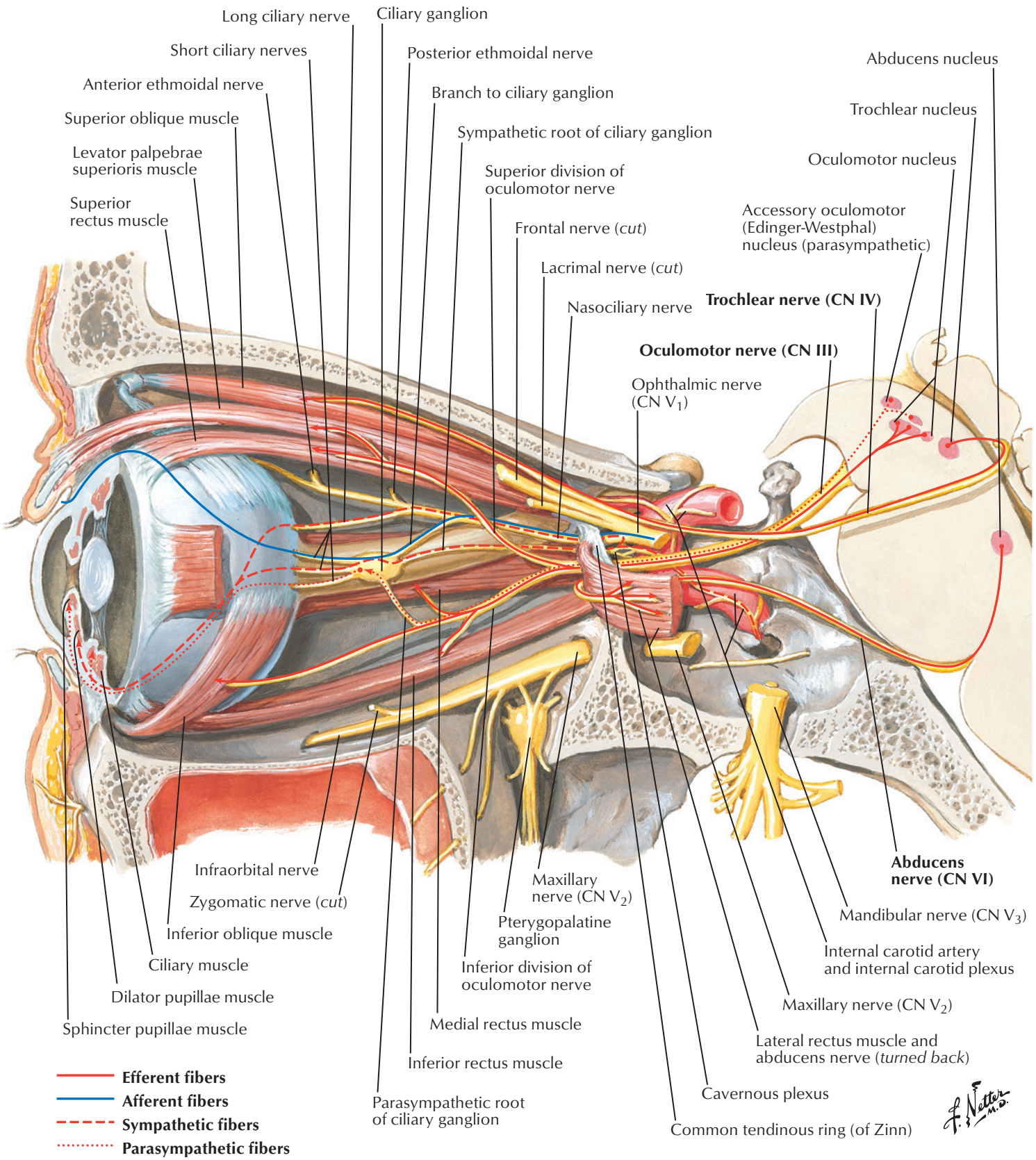

Olfactory bulb cells: schema
Efferent fibers to olfactory bulb
Afferent fibers from bulb to central connections and contralateral bulb
Granule cell (excited by and inhibiting to mitral and tufted cells)
Mitral cell
Recurrent process
Tufted cell
Periglomerular cell
Glomerulus
Olfactory nerve fibers
Subcallosal area
Septal area and nuclei
Fibers from
Fibers to
Contralateral olfactory bulb
Anterior commissure
Medial olfactory stria
Dura mater
Olfactory cells
Olfactory mucosa
Olfactory nerves (CN I)
Olfactory bulb
Cribriform plate of ethmoid bone
Anterior olfactory nucleus
Olfactory tract
Olfactory trigone and olfactory tubercle
Lateral olfactory stria
Lateral olfactory tract nucleus
Anterior perforated substance
Amygdaloid body (phantom)
Piriform cortex
Uncus
Fimbria of hippocampus
Dentate gyrus
Parahippocampal gyrus



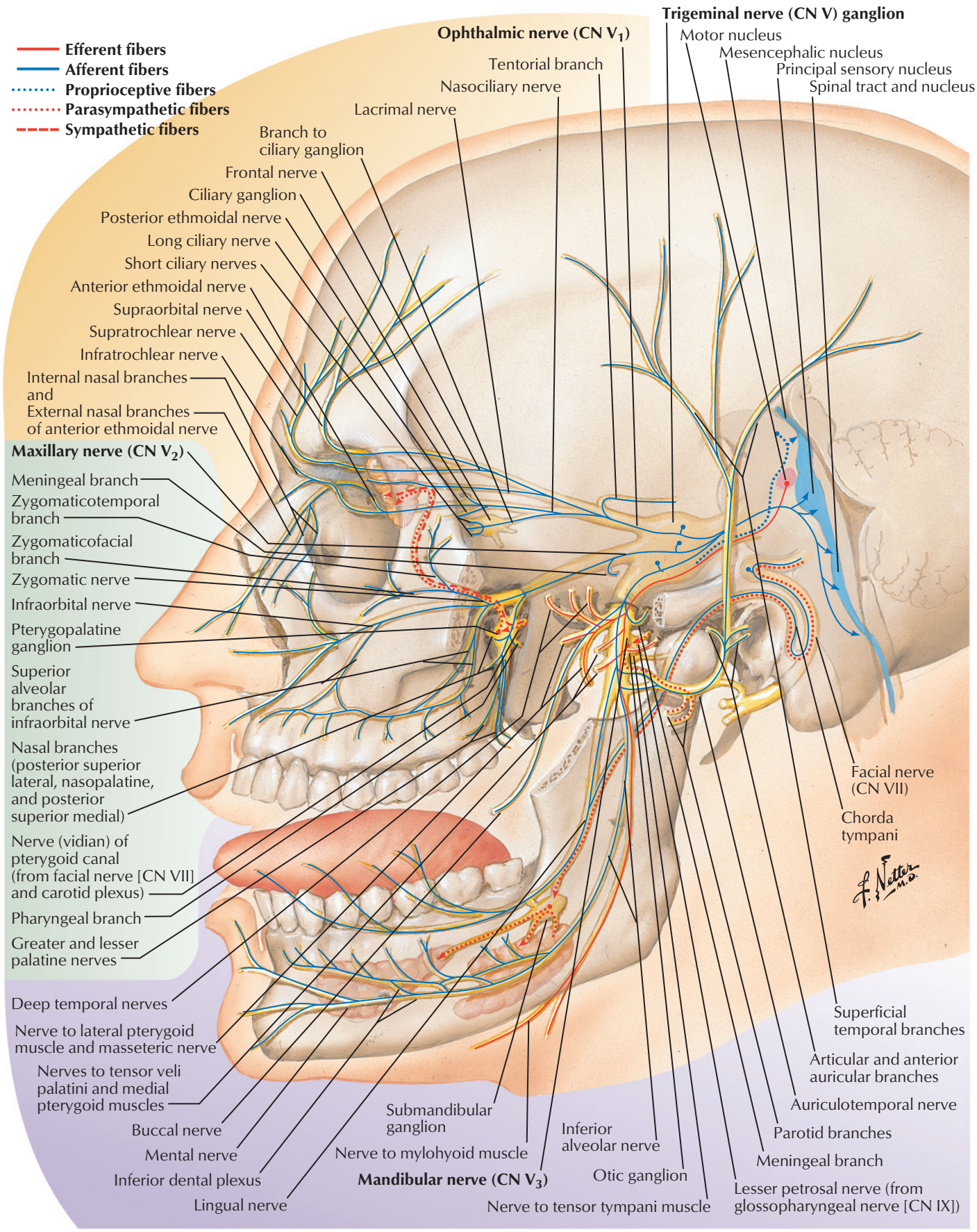
Structure of retina: schema

- **A** Amacrine cells
- **B** Bipolar cells
- **C** Cones
- **G** Ganglion cells
- **H** Horizontal cells
- **P** Pigment cells
- **R** Rods

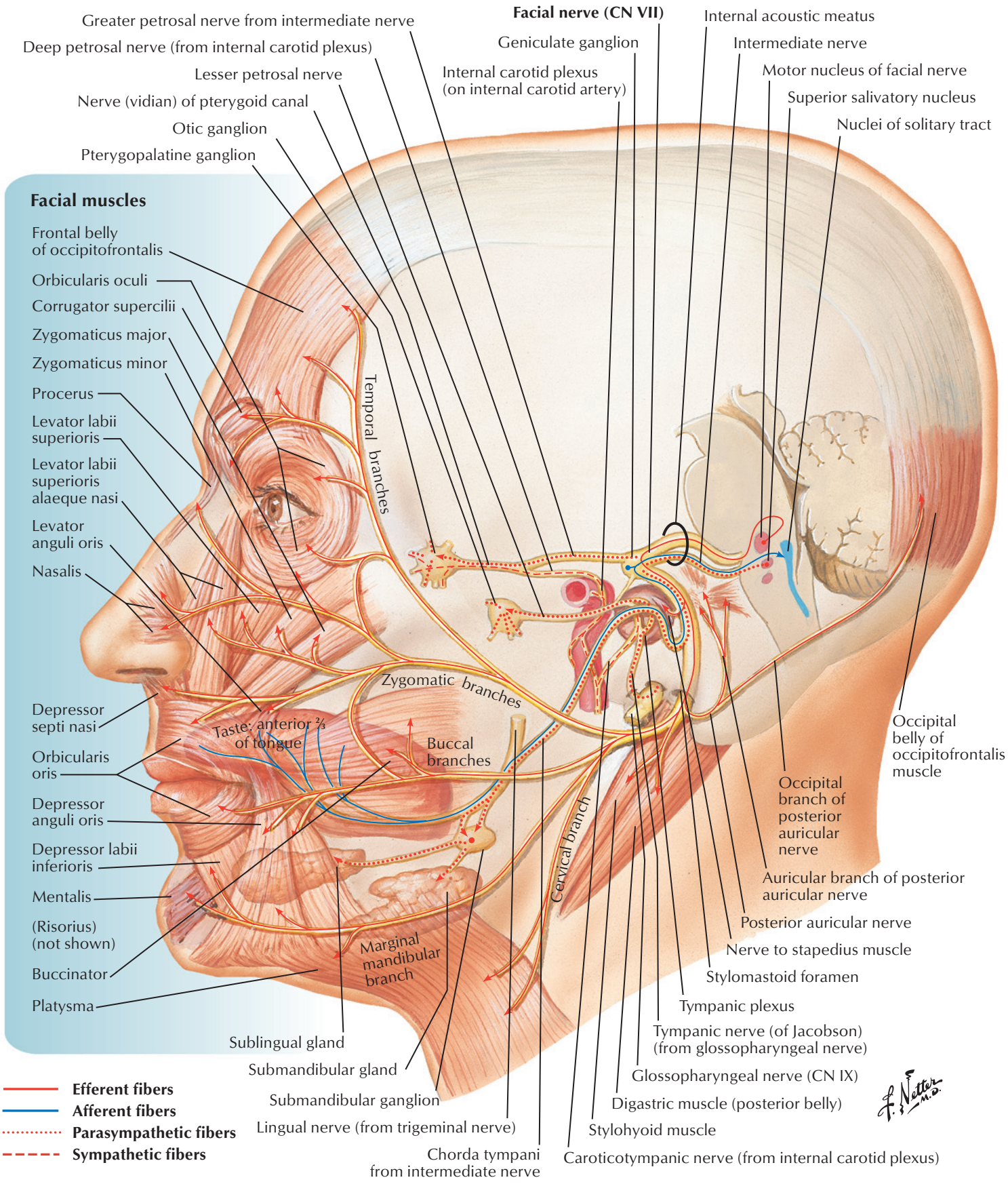
See also Plates 97, 143

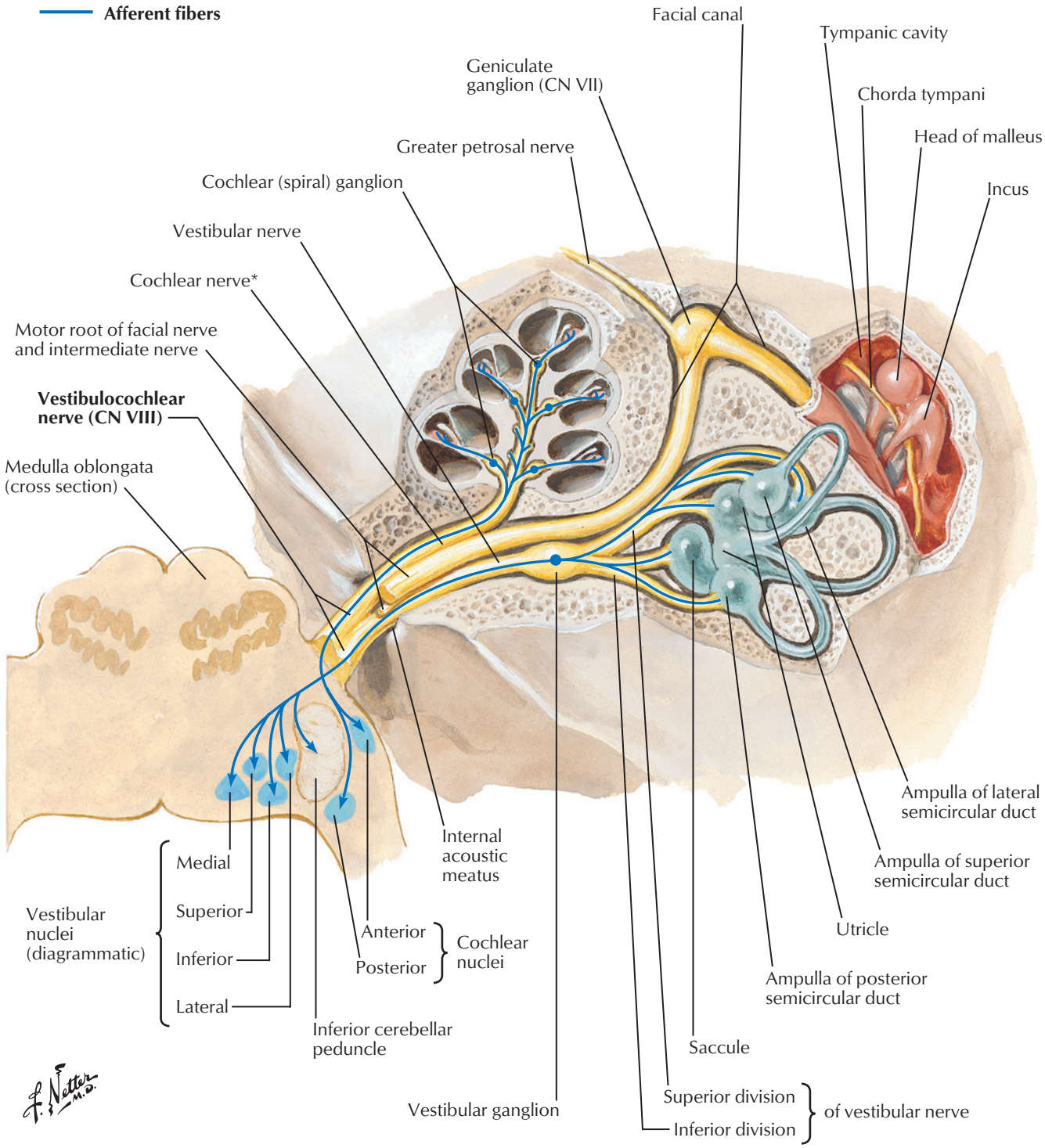


See also Plates 9, 59, 61

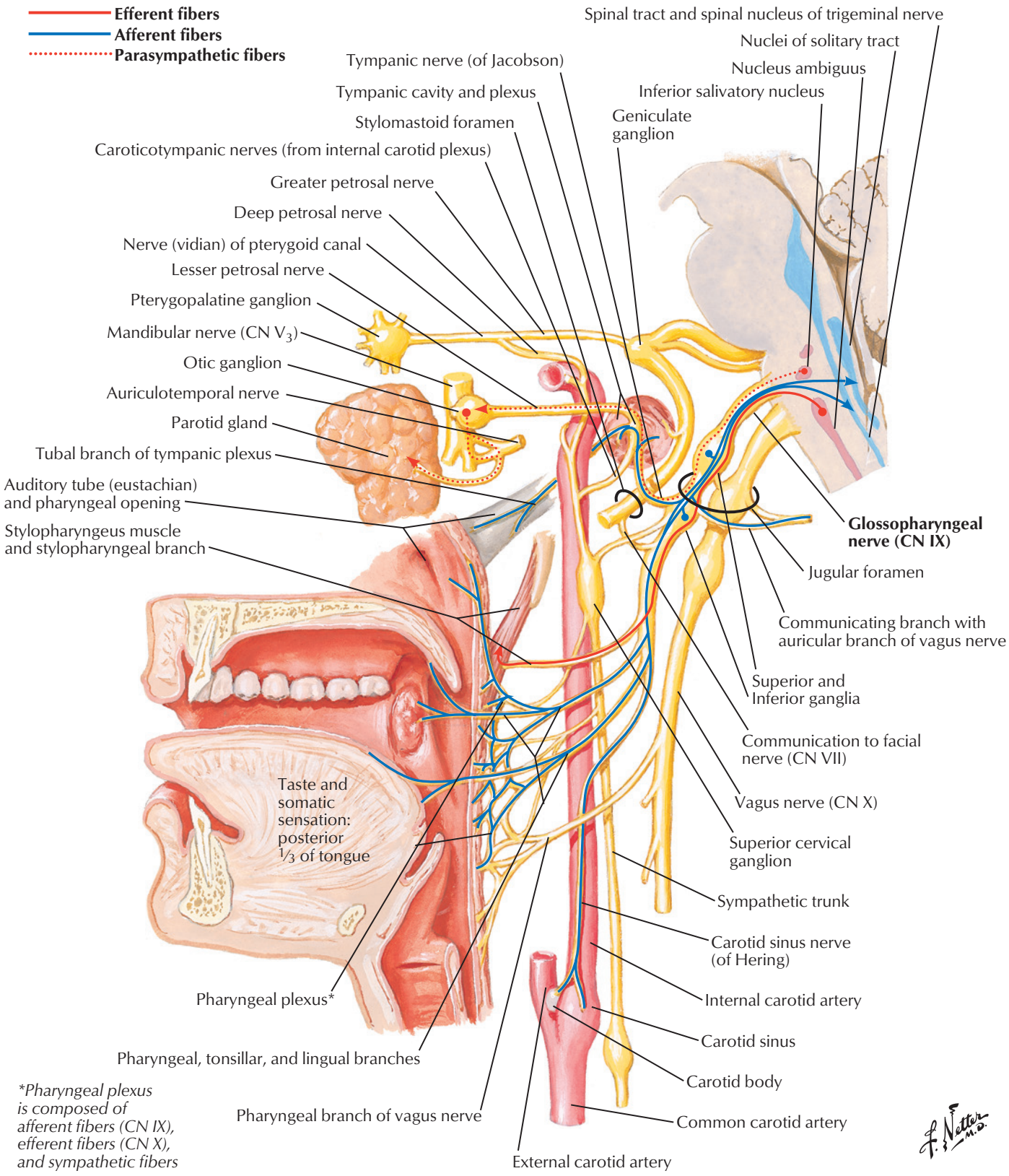


See also Plate 54

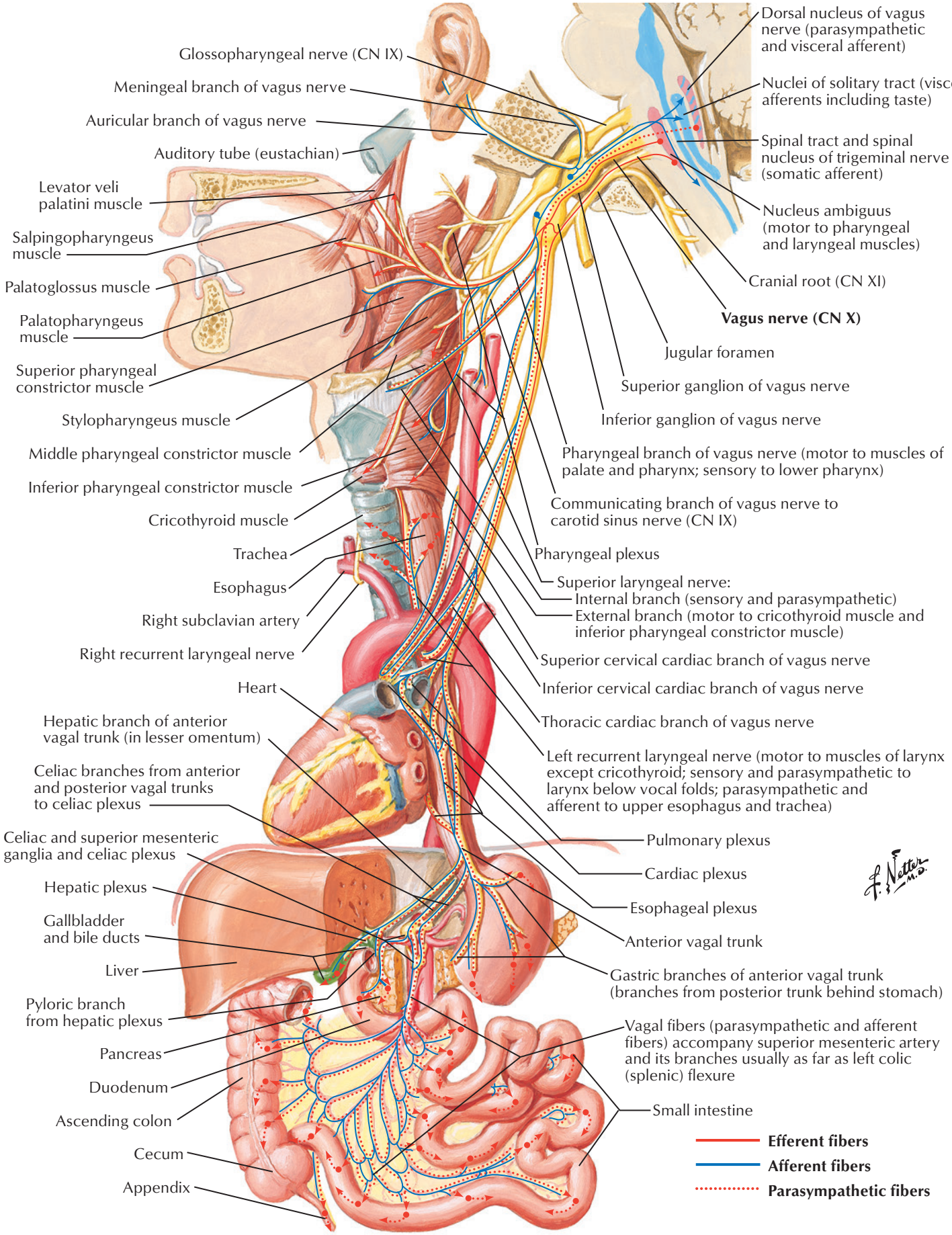




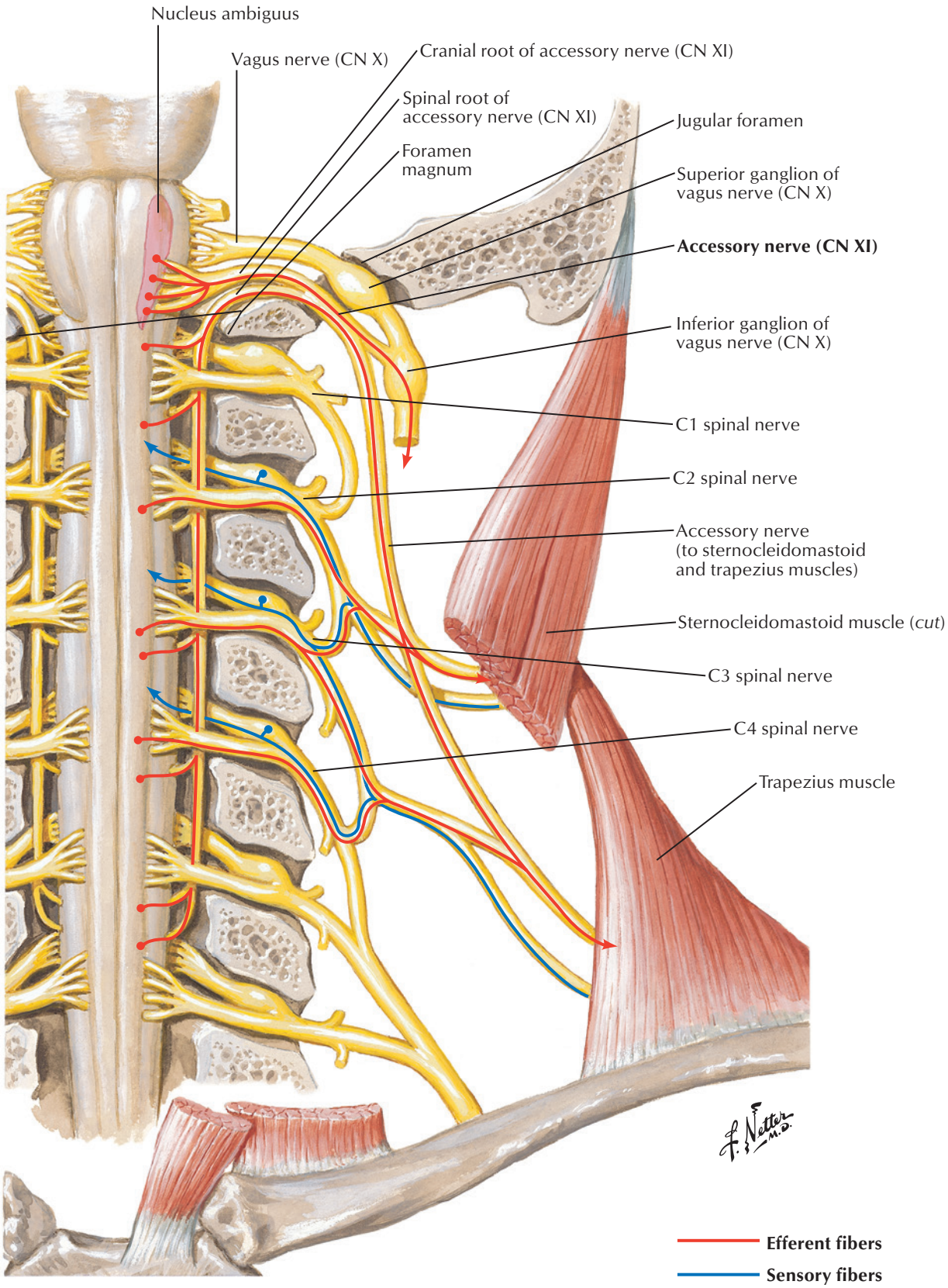
*Note: The cochlear nerve also contains efferent fibers to the sensory epithelium. These fibers are derived from the vestibular nerve while in the internal acoustic meatus.


Efferent fibers
Afferent fibers
Parasympathetic fibers
Spinal tract and spinal nucleus of trigeminal nerve
Nuclei of solitary tract
Nucleus ambiguus
Inferior salivatory nucleus
Geniculate ganglion
Tympanic nerve (of Jacobson)
Tympanic cavity and plexus
Stylomastoid foramen
Caroticotympanic nerves (from internal carotid plexus)
Greater petrosal nerve
Deep petrosal nerve
Nerve (vidian) of pterygoid canal
Lesser petrosal nerve
Pterygopalatine ganglion
Mandibular nerve (CN V3)
Otic ganglion
Auriculotemporal nerve
Parotid gland
Tubal branch of tympanic plexus
Auditory tube (eustachian) and pharyngeal opening
Stylopharyngeus muscle and stylopharyngeal branch
Glossopharyngeal nerve (CN IX)
Jugular foramen
Communicating branch with auricular branch of vagus nerve
Superior and Inferior ganglia
Communication to facial nerve (CN VII)
Vagus nerve (CN X)
Superior cervical ganglion
Sympathetic trunk
Carotid sinus nerve (of Hering)
Internal carotid artery
Carotid sinus
Carotid body
Common carotid artery
External carotid artery
Taste and somatic sensation: posterior 1/3 of tongue
Pharyngeal plexus*
Pharyngeal, tonsillar, and lingual branches
Pharyngeal branch of vagus nerve
*Pharyngeal plexus is composed of afferent fibers (CN IX), efferent fibers (CN X), and sympathetic fibers

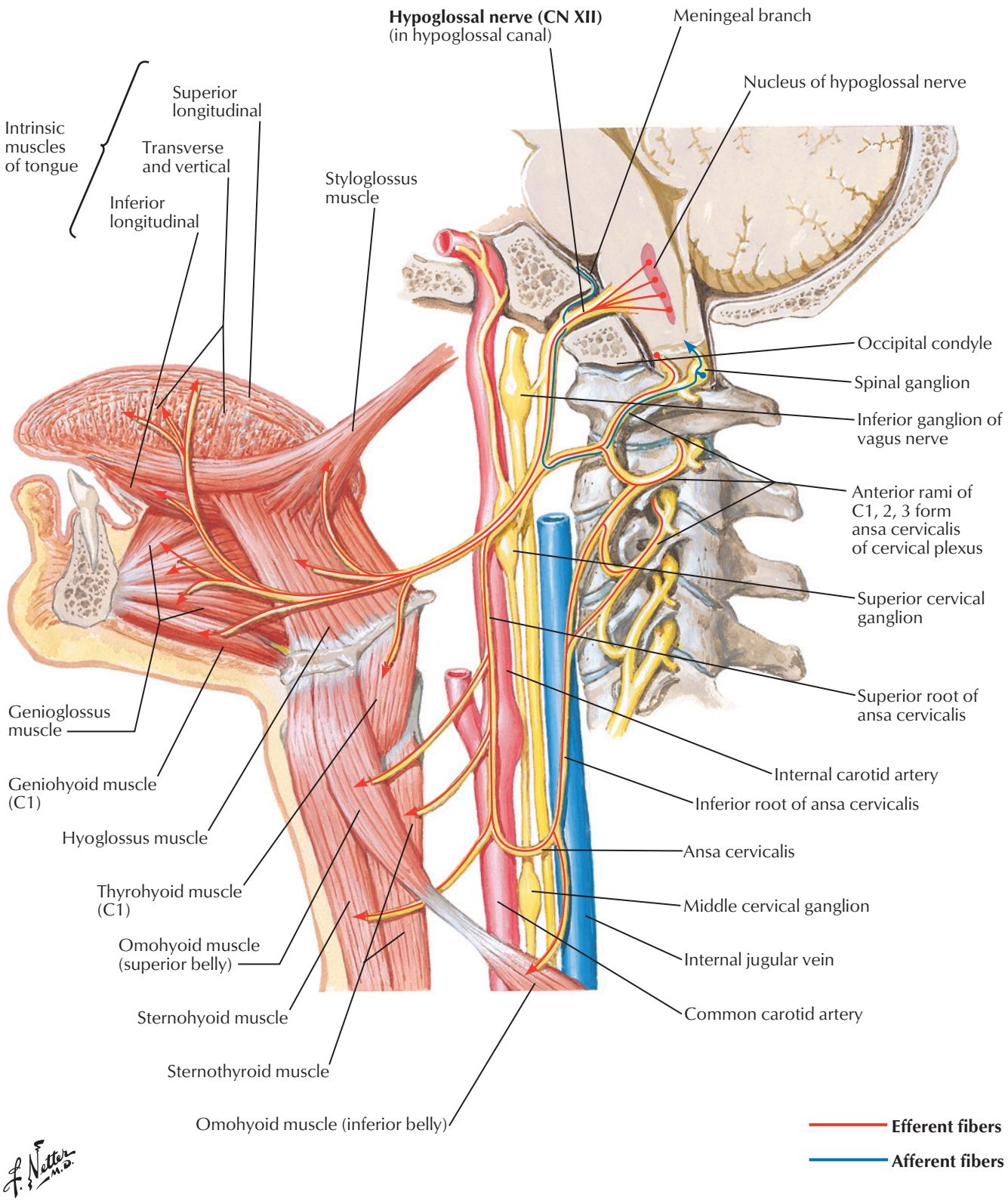
Vagus Nerve (CN X): Schema



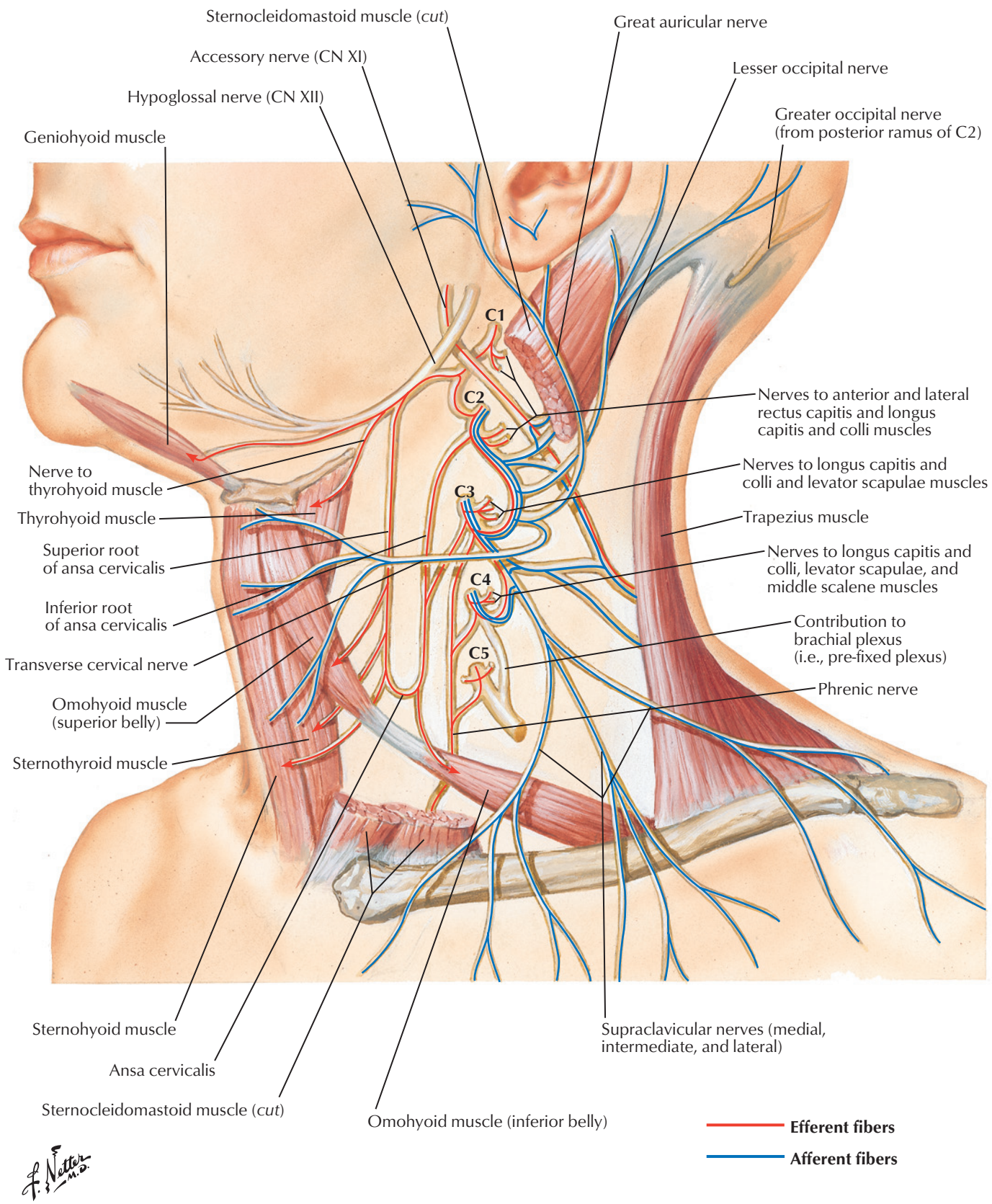
See also Plate 39



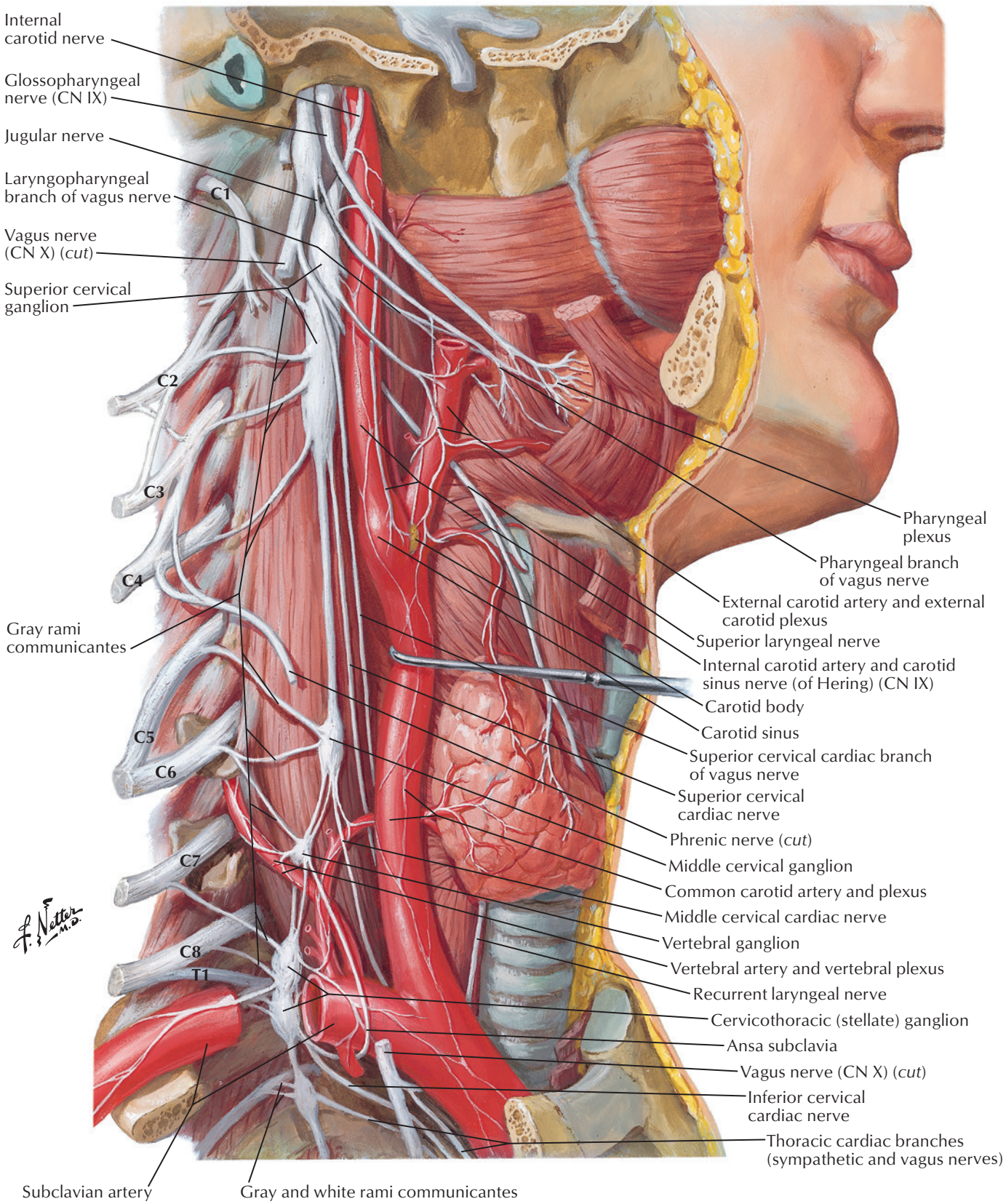
See also Plate 39



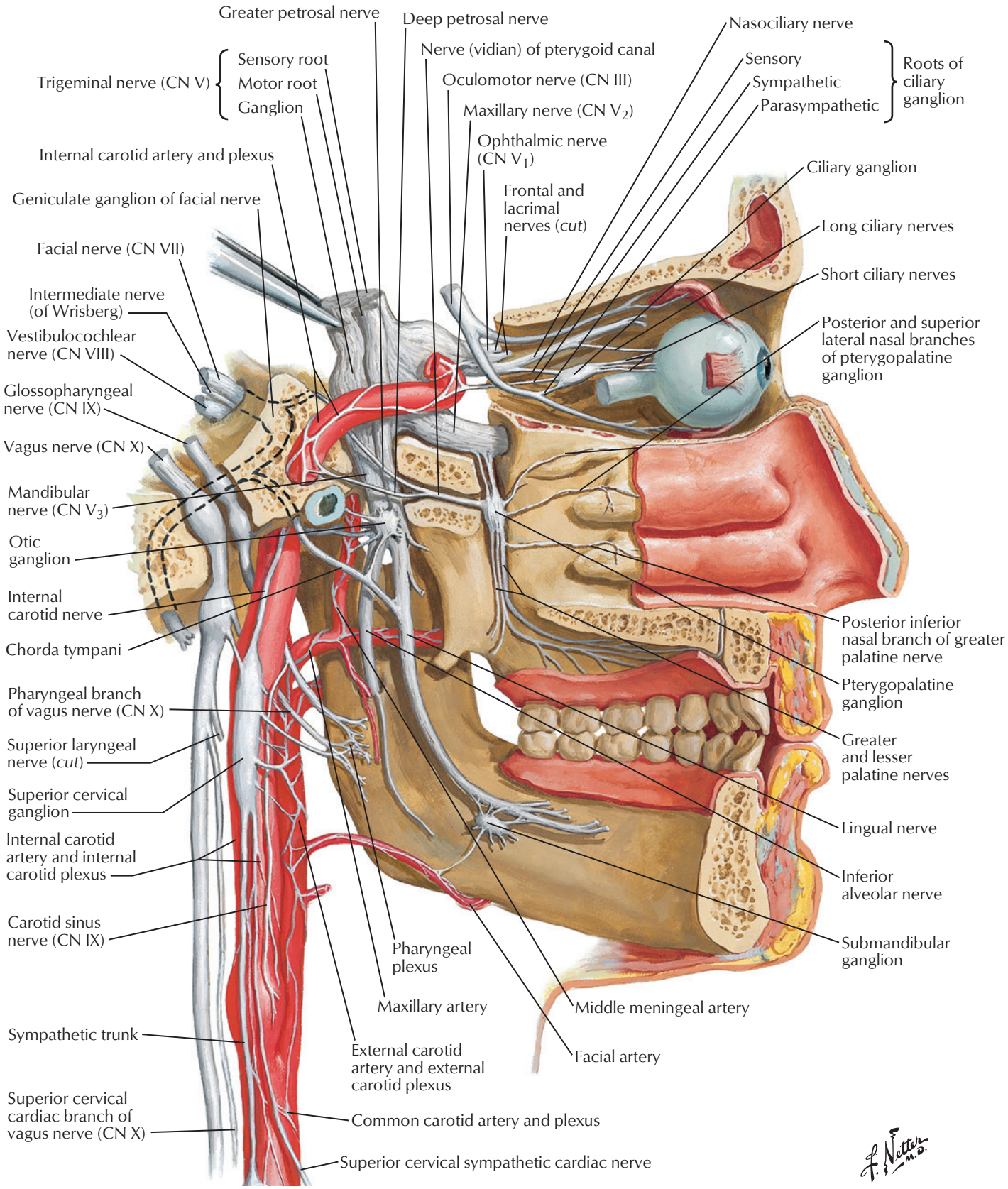
See also Plates 39, 40



See also Plate 136

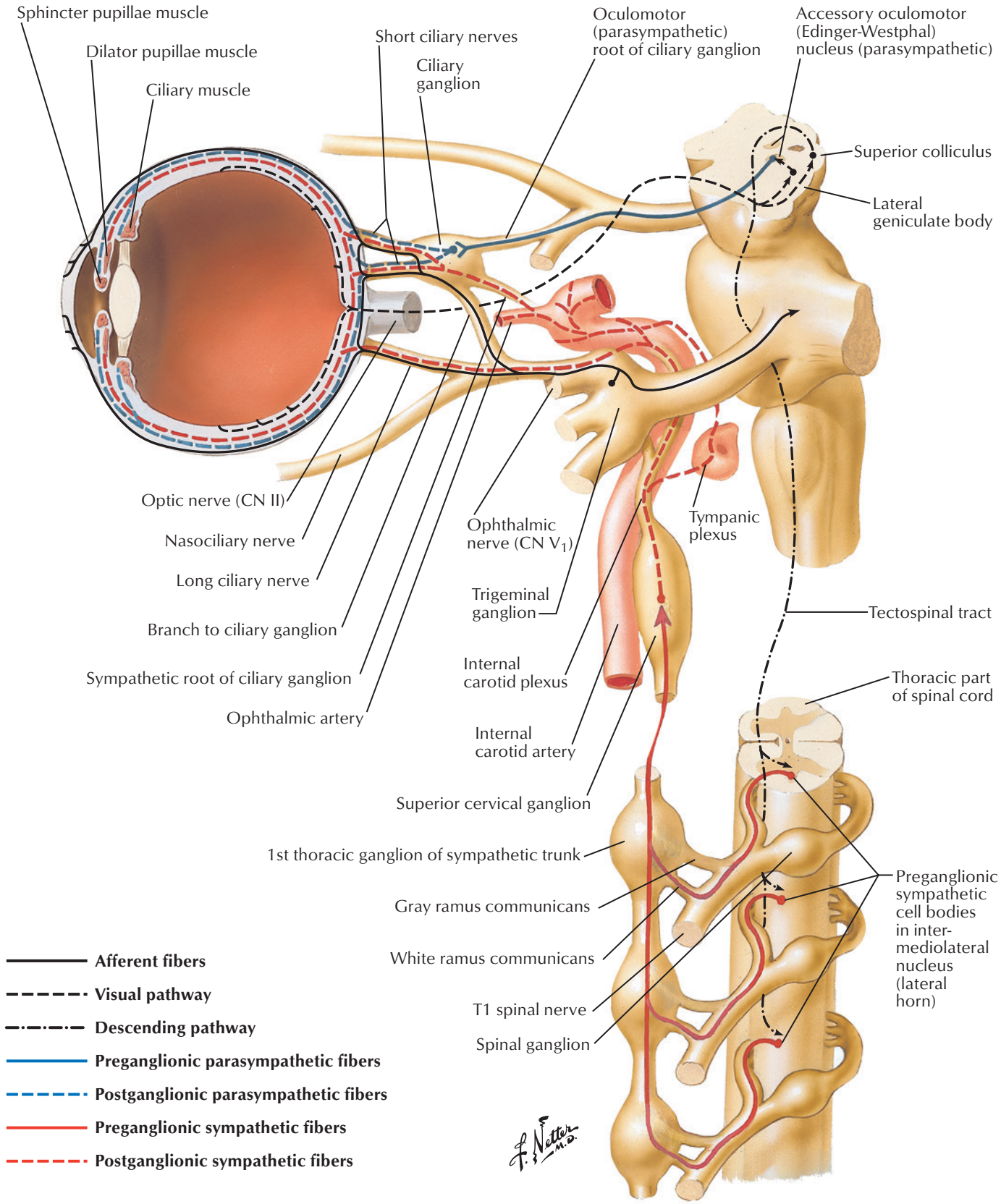


See also Plates 62, 133, 144

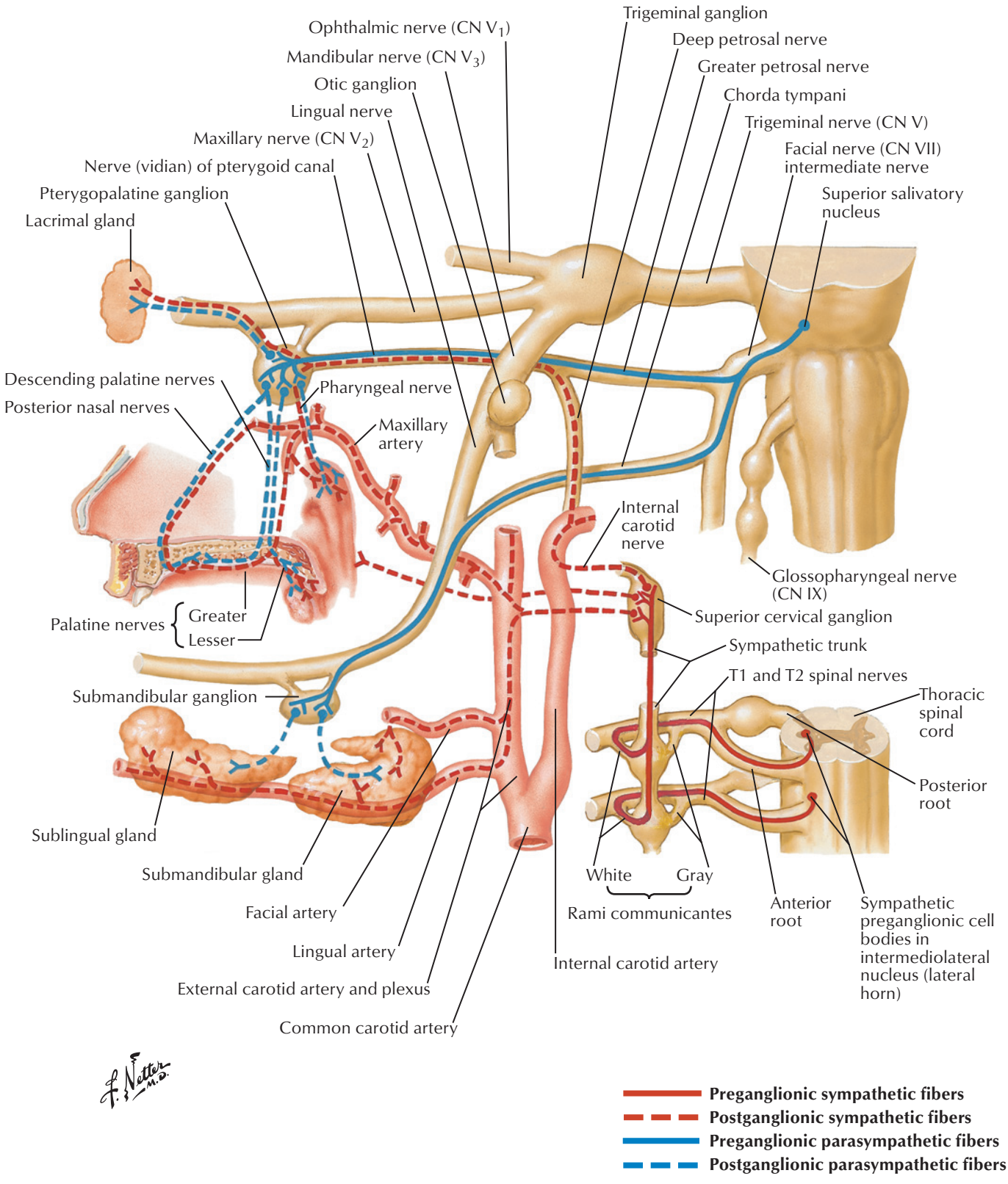


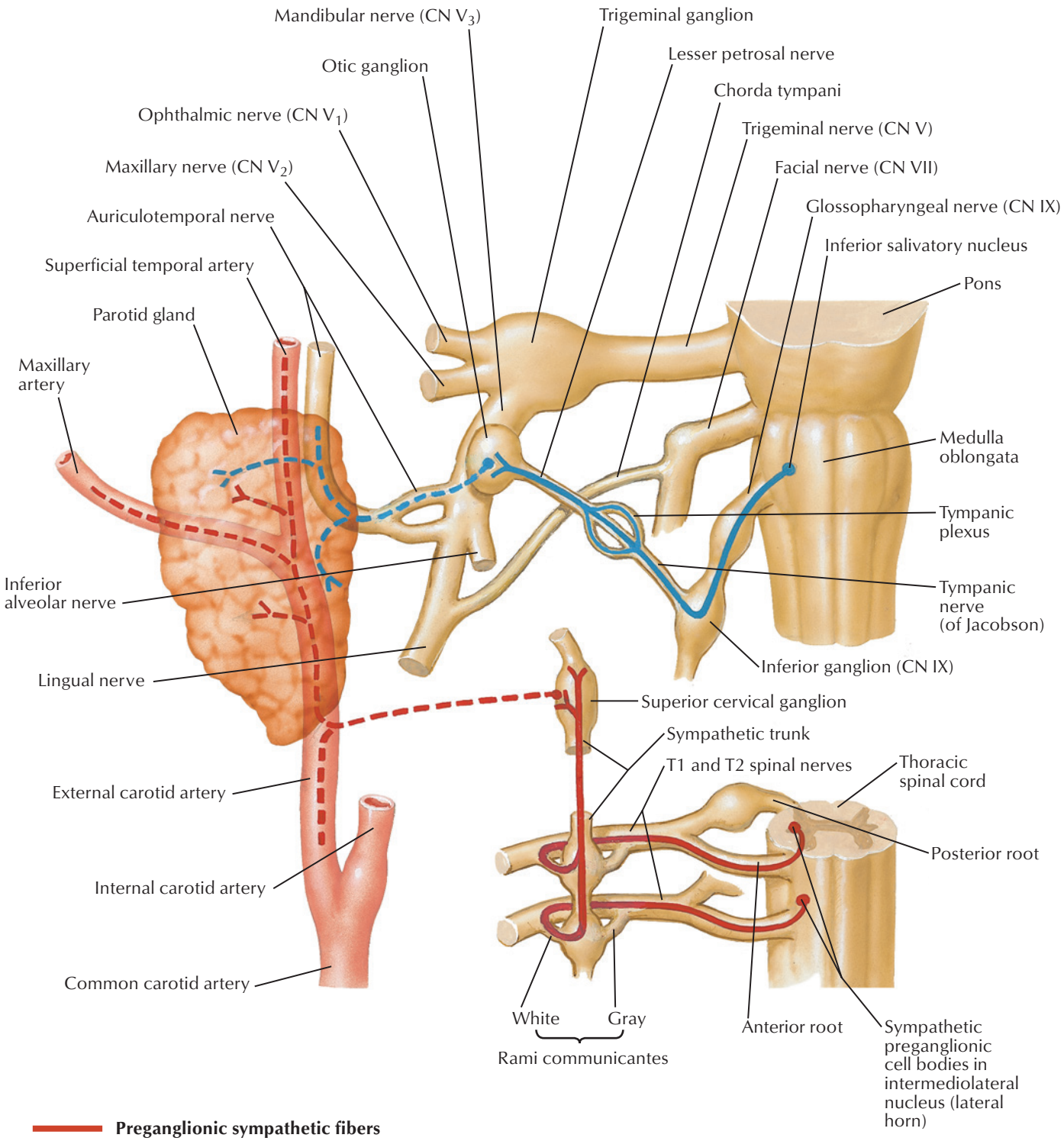
Ciliary Ganglion: Schema

See also Plate 62

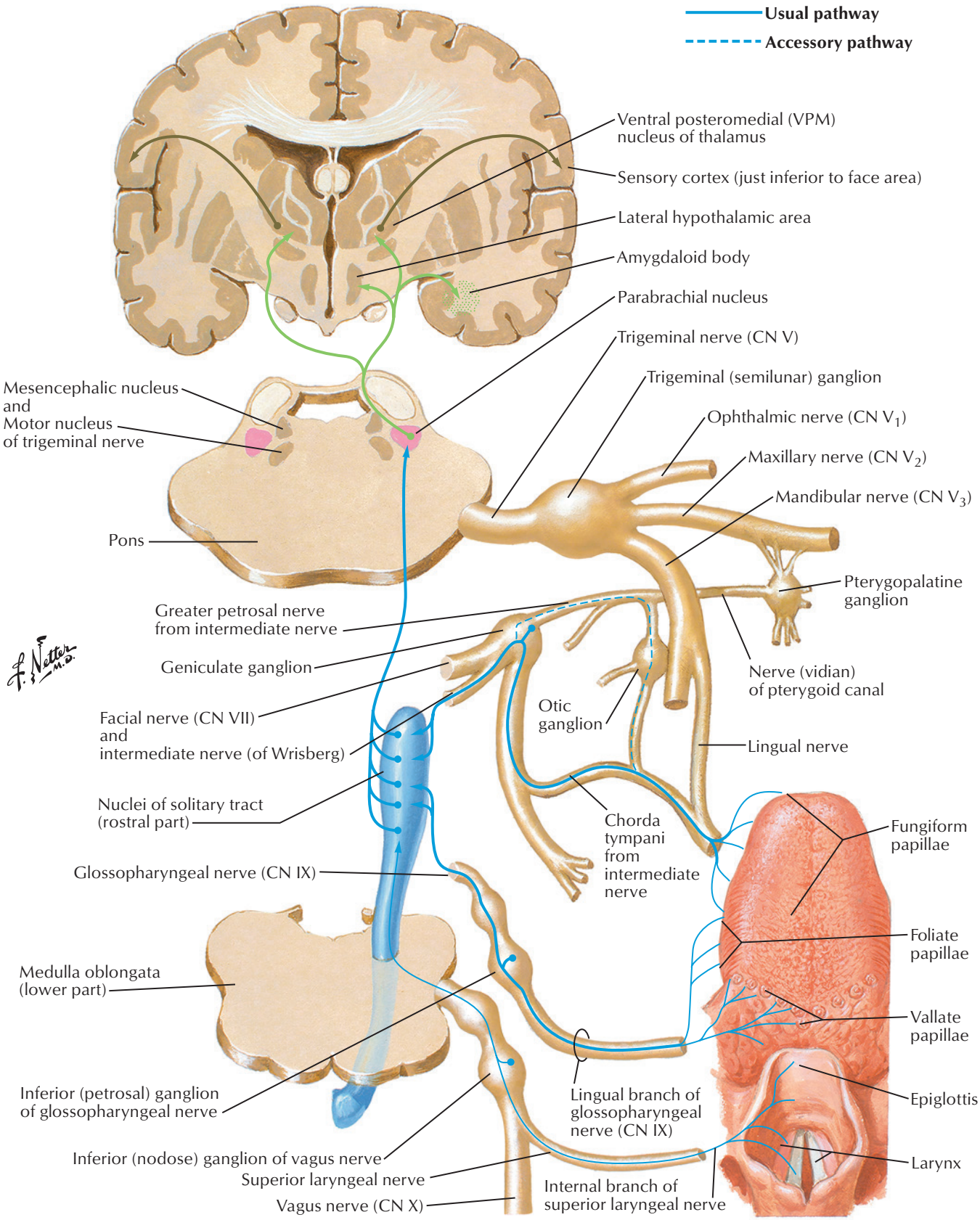


See also Plate 95

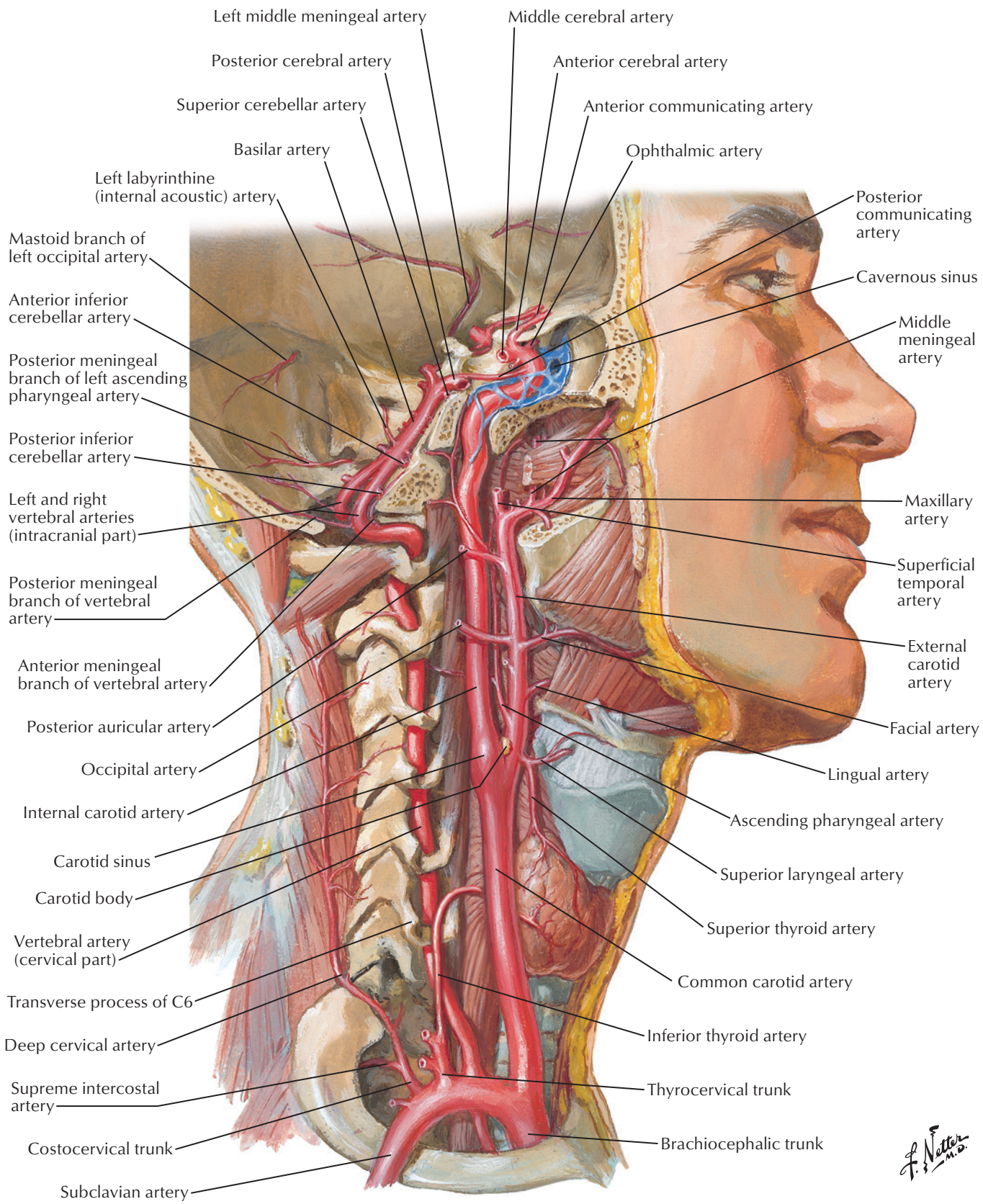



Mandibular nerve (CN V3)
Trigeminal ganglion
Lesser petrosal nerve
Otic ganglion
Chorda tympani
Ophthalmic nerve (CN V1)
Trigeminal nerve (CN V)
Maxillary nerve (CN V2)
Facial nerve (CN VII)
Glossopharyngeal nerve (CN IX)
Auriculotemporal nerve
Inferior salivatory nucleus
Superficial temporal artery
Pons
Parotid gland
Maxillary artery
Medulla oblongata
Tympanic plexus
Inferior alveolar nerve
Tympanic nerve (of Jacobson)
Lingual nerve
Inferior ganglion (CN IX)
Superior cervical ganglion
Sympathetic trunk
T1 and T2 spinal nerves
Thoracic spinal cord
External carotid artery
Posterior root
Internal carotid artery
Common carotid artery
White
Gray
Anterior root
Rami communicantes
Sympathetic preganglionic cell bodies in intermediolateral nucleus (lateral horn)
Preganglionic sympathetic fibers
Postganglionic sympathetic fibers
Preganglionic parasympathetic fibers
Postganglionic parasympathetic fibers

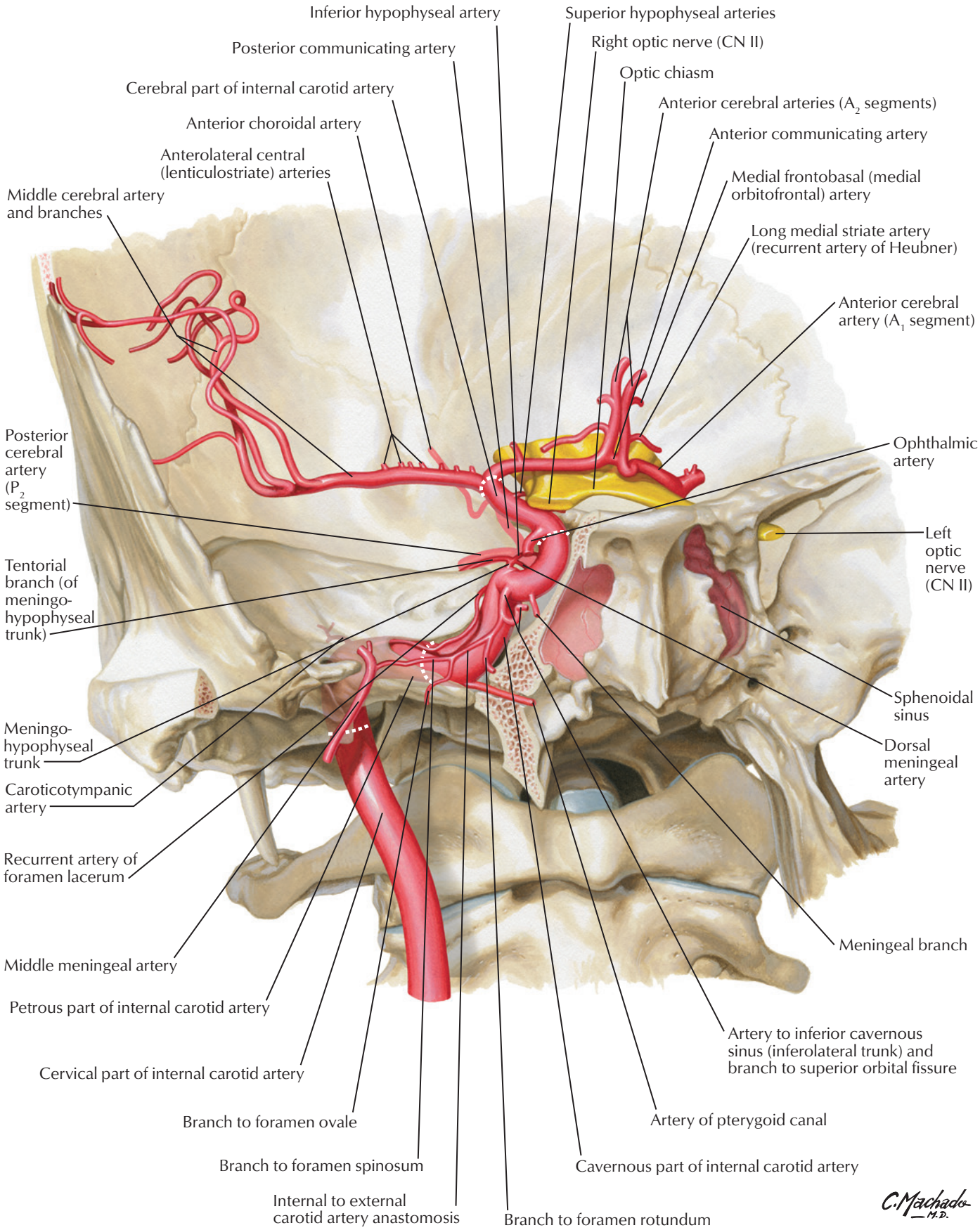
See also Plates 134, 136

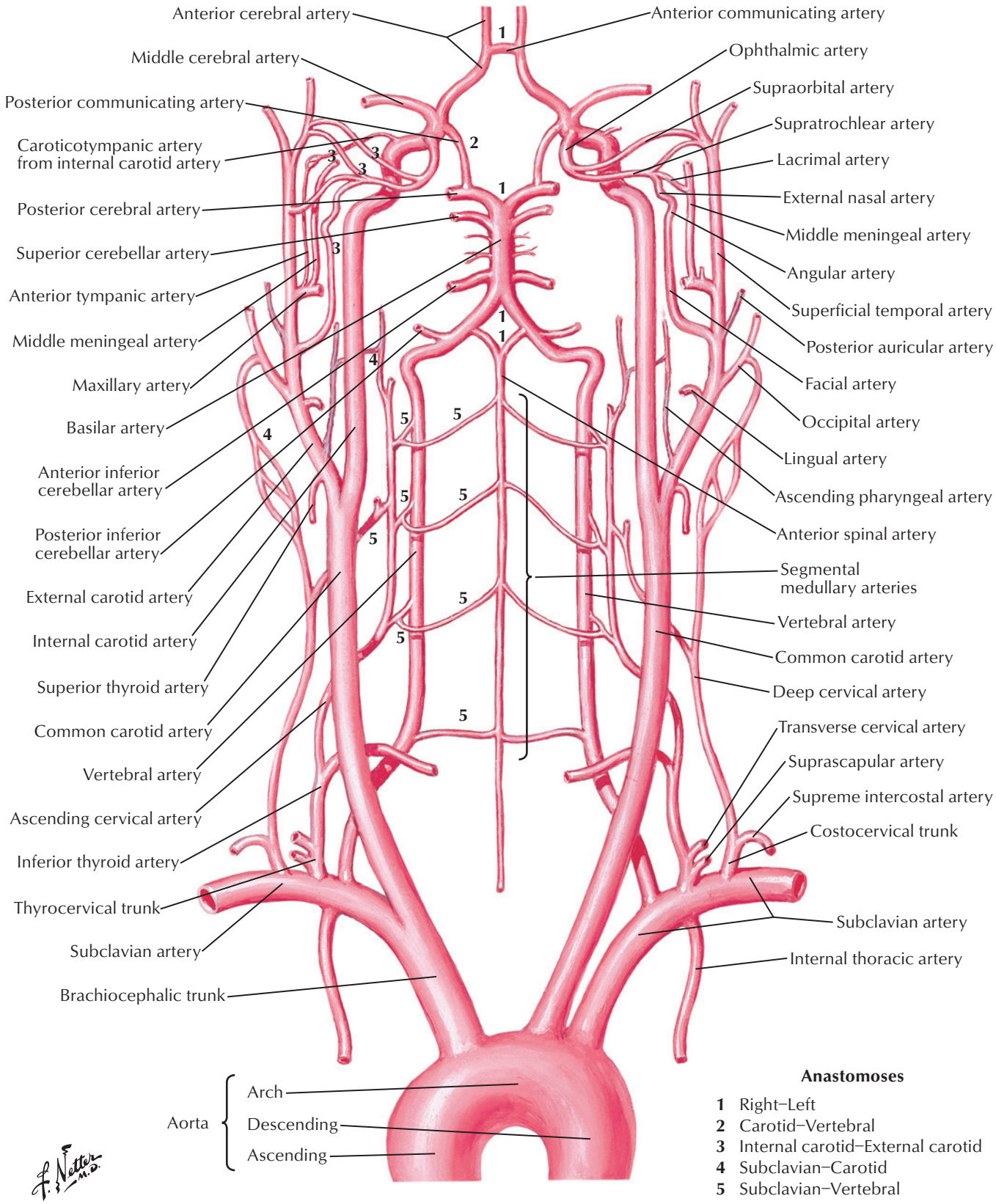


See also Plates 41, 64, 148

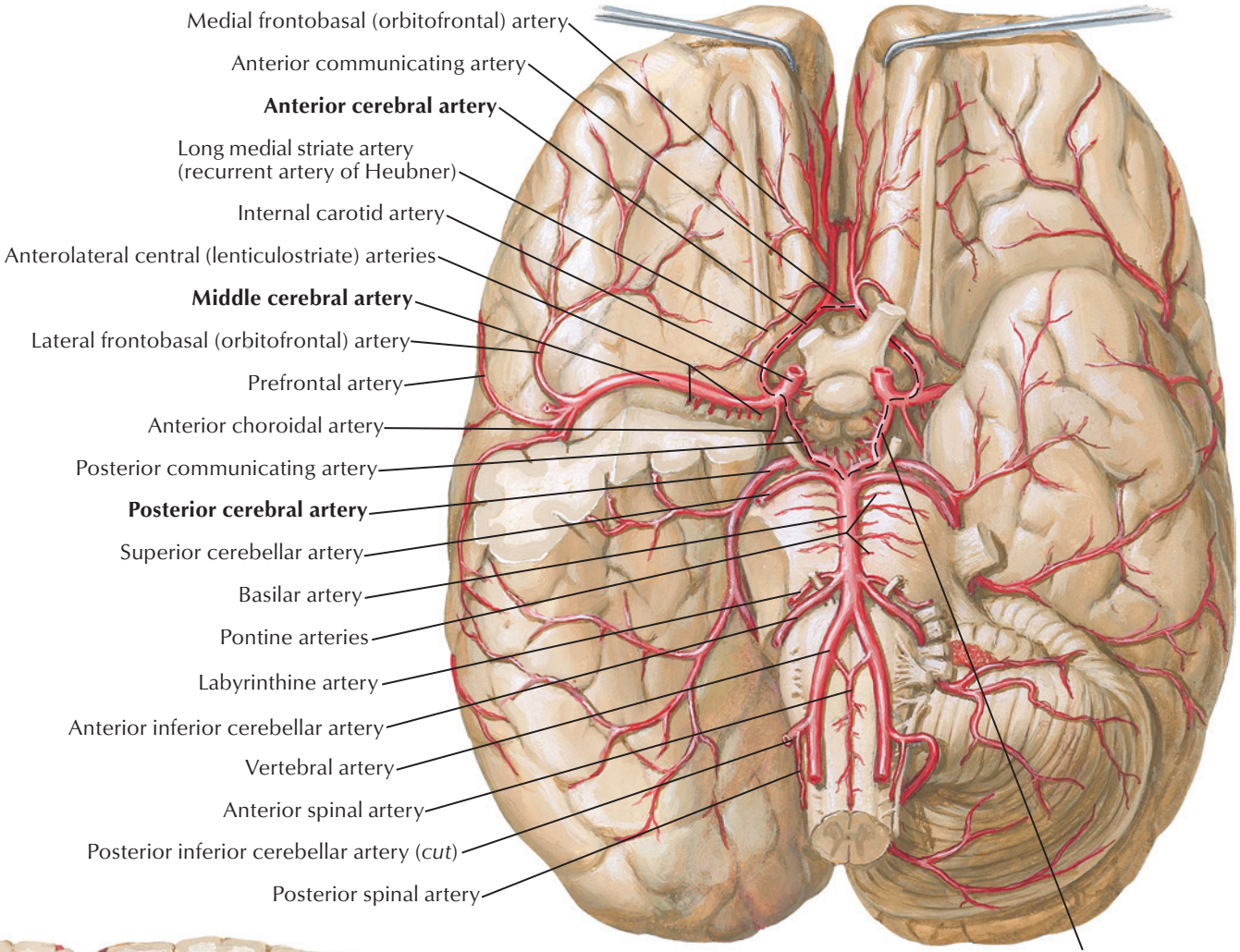


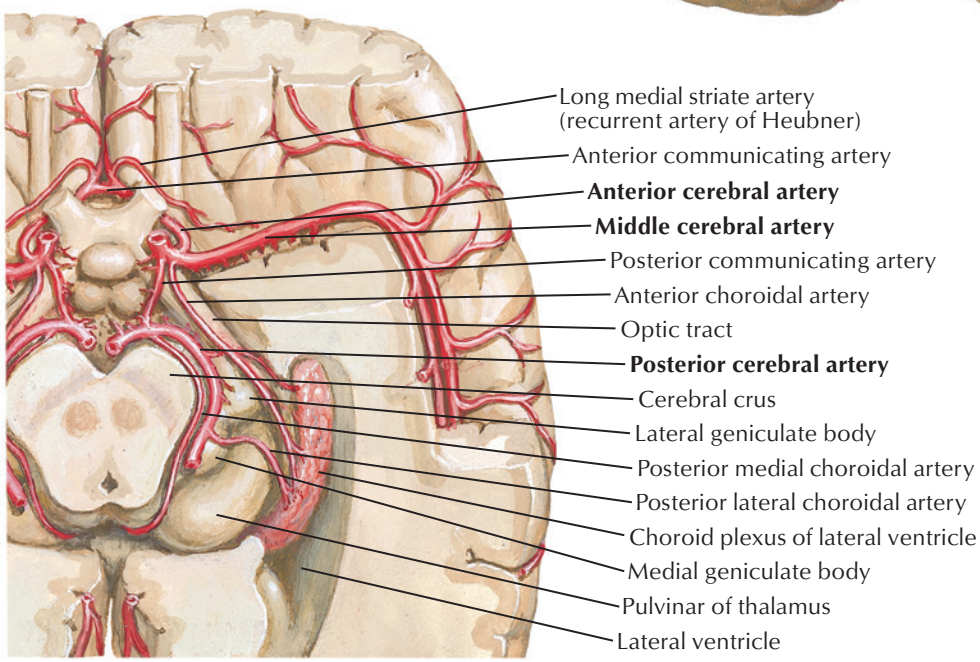
See also Plates 147, 150



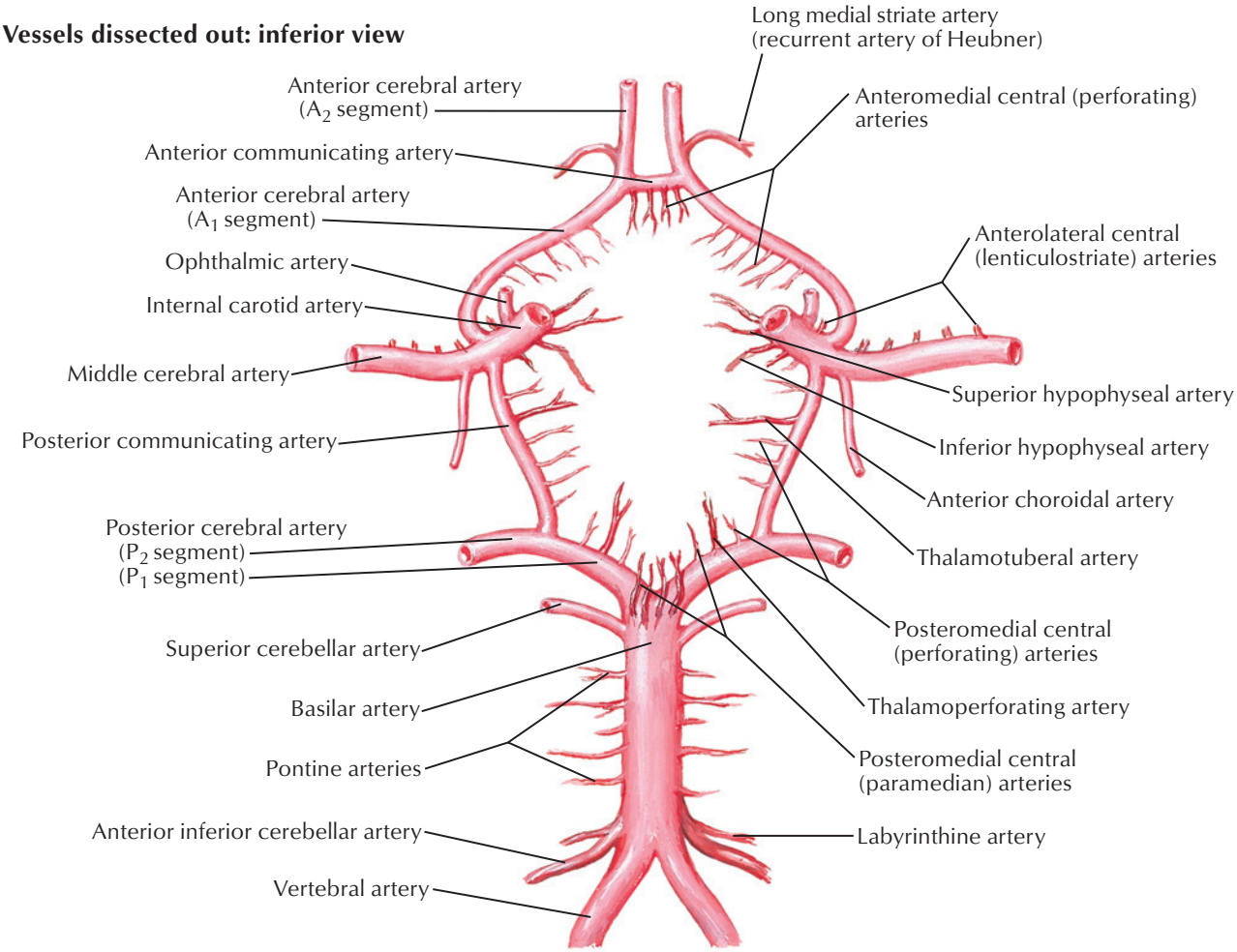

Anterior cerebral artery
Middle cerebral artery
Posterior communicating artery
Caroticotympanic artery from internal carotid artery
Posterior cerebral artery
Superior cerebellar artery
Anterior tympanic artery
Middle meningeal artery
Maxillary artery
Basilar artery
Anterior inferior cerebellar artery
Posterior inferior cerebellar artery
External carotid artery
Internal carotid artery
Superior thyroid artery
Common carotid artery
Vertebral artery
Ascending cervical artery
Inferior thyroid artery
Thyrocervical trunk
Subclavian artery
Brachiocephalic trunk
Aorta
Arch
Descending
Ascending
Anterior communicating artery
Ophthalmic artery
Supraorbital artery
Supratrochlear artery
Lacrimal artery
External nasal artery
Middle meningeal artery
Angular artery
Superficial temporal artery
Posterior auricular artery
Facial artery
Occipital artery
Lingual artery
Ascending pharyngeal artery
Anterior spinal artery
Segmental medullary arteries
Vertebral artery
Common carotid artery
Deep cervical artery
Transverse cervical artery
Suprascapular artery
Supreme intercostal artery
Costocervical trunk
Subclavian artery
Internal thoracic artery
1
2
3
4
5
Anastomoses
1 Right–Left
2 Carotid–Vertebral
3 Internal carotid–External carotid
4 Subclavian–Carotid
5 Subclavian–Vertebral

See also Plate 148

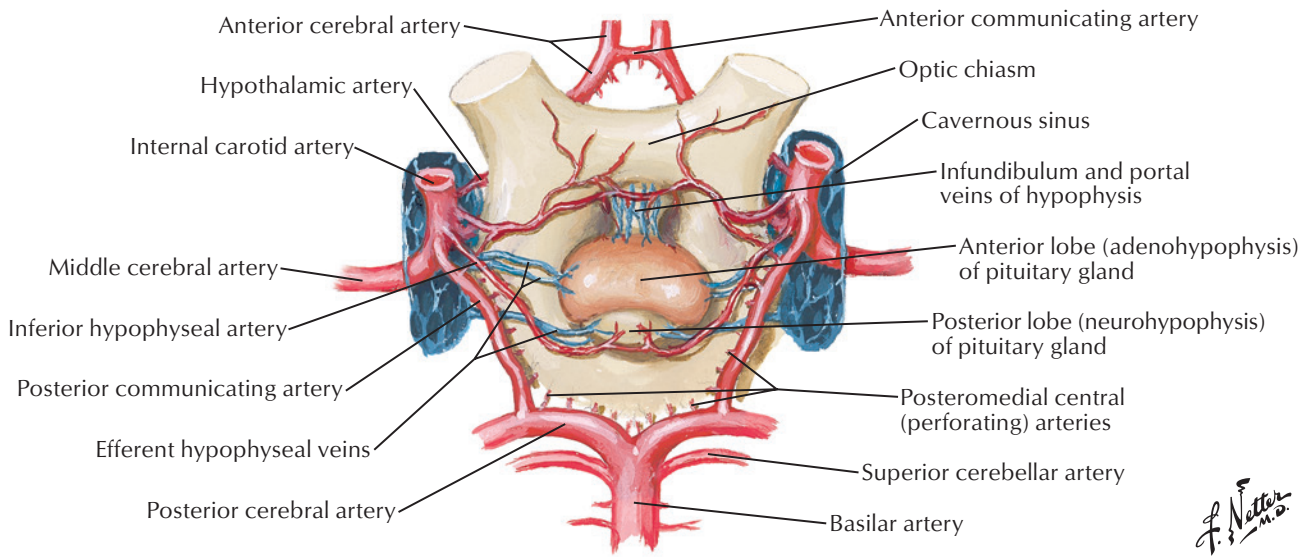


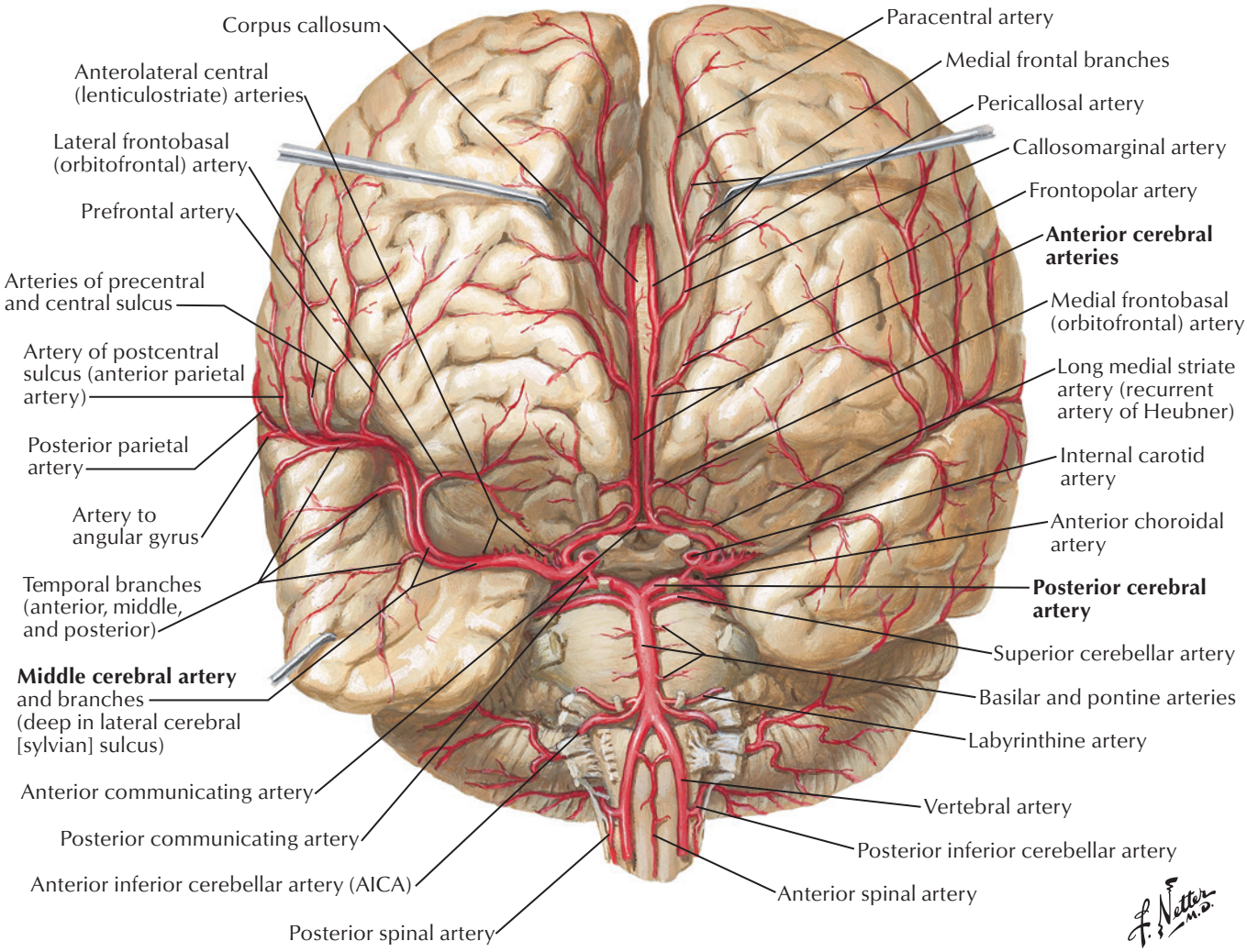


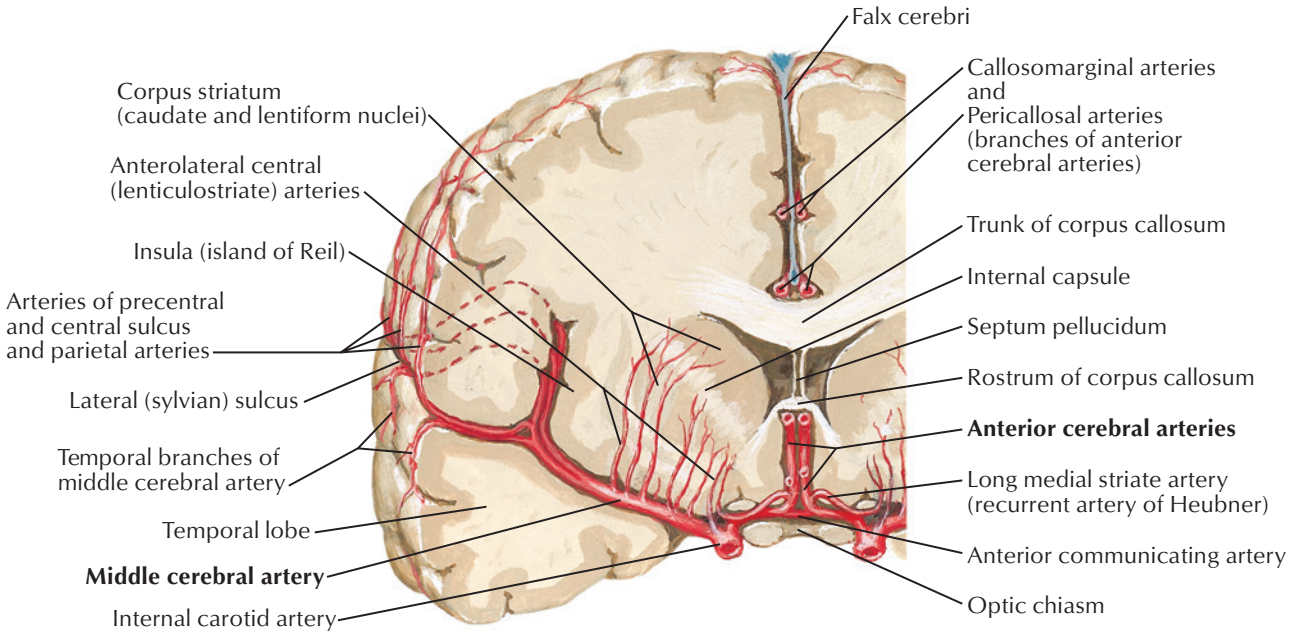
Vessels dissected out: inferior view

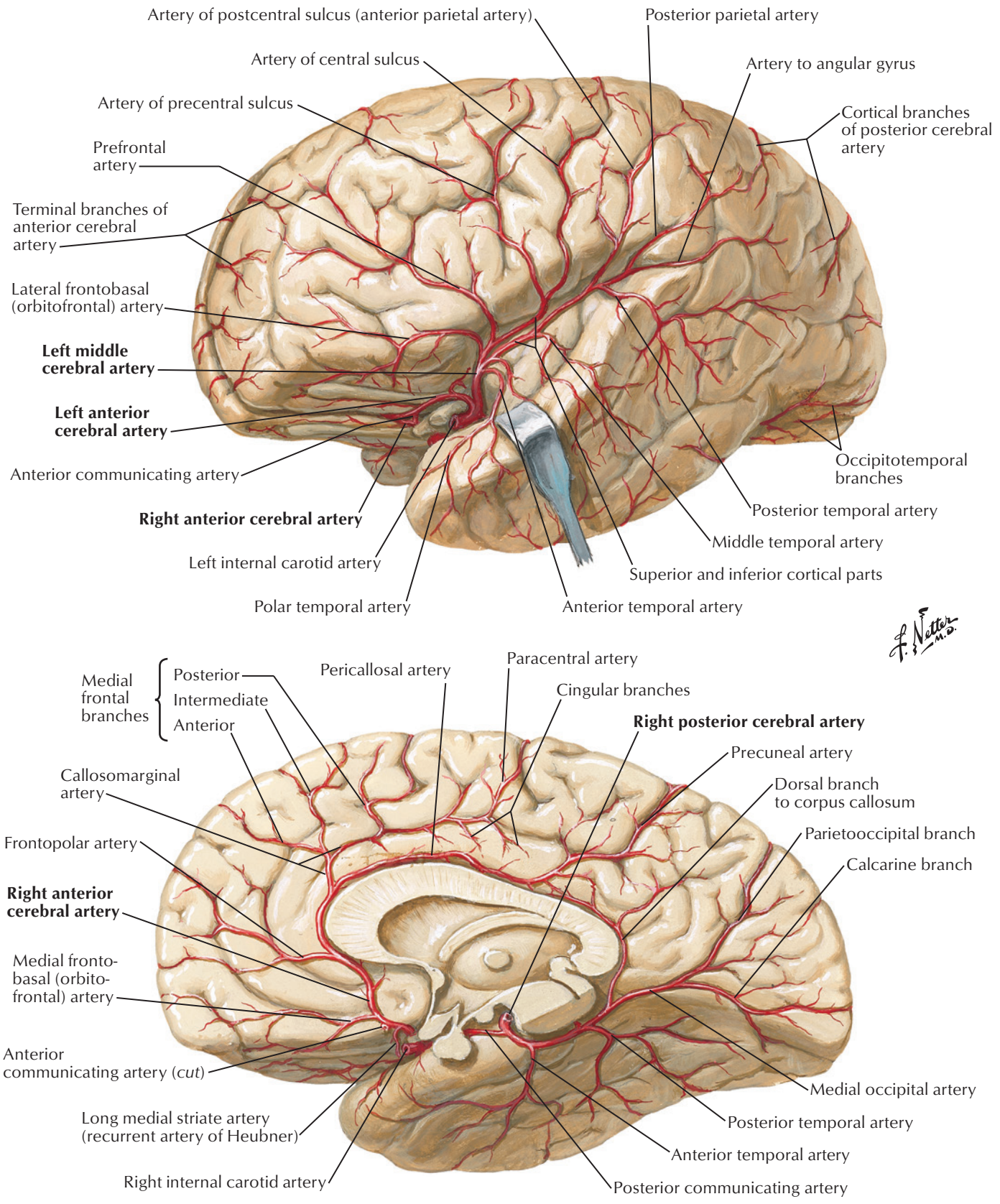


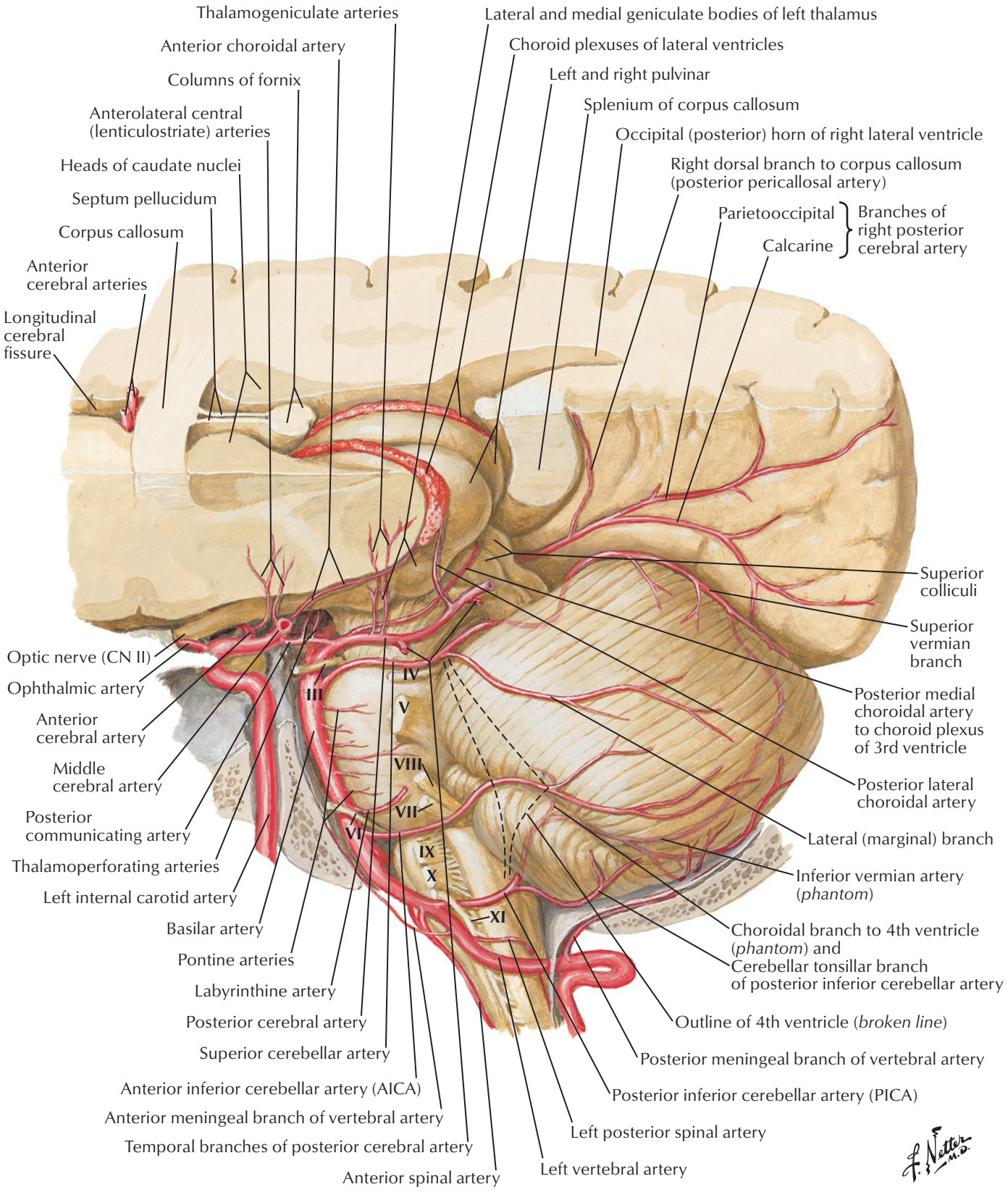
Vessels in situ: inferior view

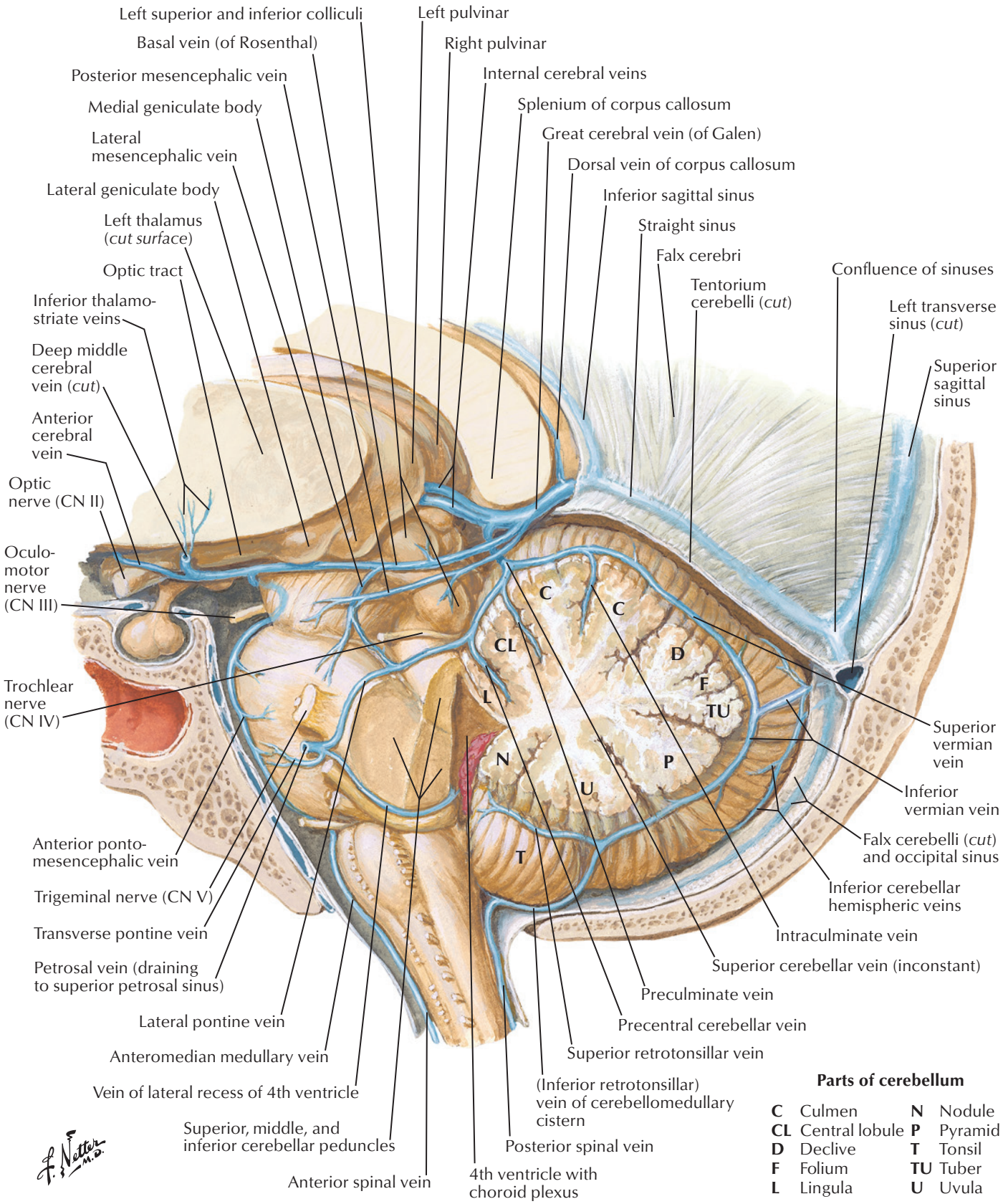



Corpus callosum
Anterolateral central (lenticulostriate) arteries
Lateral frontobasal (orbitofrontal) artery
Prefrontal artery
Arteries of precentral and central sulcus
Artery of postcentral sulcus (anterior parietal artery)
Posterior parietal artery
Artery to angular gyrus
Temporal branches (anterior, middle, and posterior)
Middle cerebral artery and branches (deep in lateral cerebral [sylvian] sulcus)
Anterior communicating artery
Posterior communicating artery
Anterior inferior cerebellar artery (AICA)
Posterior spinal artery
Paracentral artery
Medial frontal branches
Pericallosal artery
Callosomarginal artery
Frontopolar artery
Anterior cerebral arteries
Medial frontobasal (orbitofrontal) artery
Long medial striate artery (recurrent artery of Heubner)
Internal carotid artery
Anterior choroidal artery
Posterior cerebral artery
Superior cerebellar artery
Basilar and pontine arteries
Labyrinthine artery
Vertebral artery
Posterior inferior cerebellar artery
Anterior spinal artery


Falx cerebri
Corpus striatum (caudate and lentiform nuclei)
Anterolateral central (lenticulostriate) arteries
Insula (island of Reil)
Arteries of precentral and central sulcus and parietal arteries
Lateral (sylvian) sulcus
Temporal branches of middle cerebral artery
Temporal lobe
Middle cerebral artery
Internal carotid artery
Callosomarginal arteries and Pericallosal arteries (branches of anterior cerebral arteries)
Trunk of corpus callosum
Internal capsule
Septum pellucidum
Rostrum of corpus callosum
Anterior cerebral arteries
Long medial striate artery (recurrent artery of Heubner)
Anterior communicating artery
Optic chiasm


Artery of postcentral sulcus (anterior parietal artery)
Posterior parietal artery
Artery of central sulcus
Artery to angular gyrus
Artery of precentral sulcus
Cortical branches of posterior cerebral artery
Prefrontal artery
Terminal branches of anterior cerebral artery
Lateral frontobasal (orbitofrontal) artery
Left middle cerebral artery
Left anterior cerebral artery
Anterior communicating artery
Occipitotemporal branches
Right anterior cerebral artery
Posterior temporal artery
Middle temporal artery
Left internal carotid artery
Superior and inferior cortical parts
Polar temporal artery
Anterior temporal artery
Medial frontal branches
Posterior
Intermediate
Anterior
Pericallosal artery
Paracentral artery
Cingular branches
Right posterior cerebral artery
Precuneal artery
Callosomarginal artery
Dorsal branch to corpus callosum
Parietooccipital branch
Frontopolar artery
Calcarine branch
Right anterior cerebral artery
Medial fronto-basal (orbito-frontal) artery
Anterior communicating artery (cut)
Medial occipital artery
Posterior temporal artery
Long medial striate artery (recurrent artery of Heubner)
Anterior temporal artery
Right internal carotid artery
Posterior communicating artery

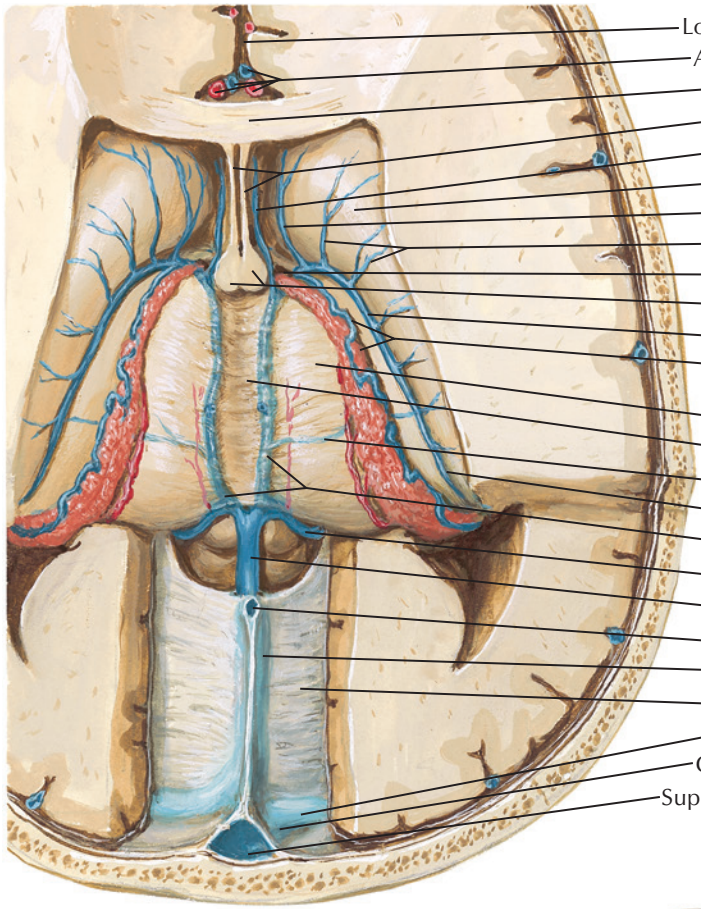

Thalamogeniculate arteries
Anterior choroidal artery
Columns of fornix
Anterolateral central (lenticulostriate) arteries
Heads of caudate nuclei
Septum pellucidum
Corpus callosum
Anterior cerebral arteries
Longitudinal cerebral fissure
Lateral and medial geniculate bodies of left thalamus
Choroid plexuses of lateral ventricles
Left and right pulvinar
Splenium of corpus callosum
Occipital (posterior) horn of right lateral ventricle
Right dorsal branch to corpus callosum (posterior pericallosal artery)
Parietooccipital
Calcarine
Branches of right posterior cerebral artery
Superior colliculi
Superior vermian branch
Posterior medial choroidal artery to choroid plexus of 3rd ventricle
Posterior lateral choroidal artery
Lateral (marginal) branch
Inferior vermian artery (phantom)
Choroidal branch to 4th ventricle (phantom) and Cerebellar tonsillar branch of posterior inferior cerebellar artery
Outline of 4th ventricle (broken line)
Posterior meningeal branch of vertebral artery
Posterior inferior cerebellar artery (PICA)
Left posterior spinal artery
Left vertebral artery
Anterior spinal artery
Optic nerve (CN II)
Ophthalmic artery
Anterior cerebral artery
Middle cerebral artery
Posterior communicating artery
Thalamoperforating arteries
Left internal carotid artery
Basilar artery
Pontine arteries
Labyrinthine artery
Posterior cerebral artery
Superior cerebellar artery
Anterior inferior cerebellar artery (AICA)
Anterior meningeal branch of vertebral artery
Temporal branches of posterior cerebral artery
III
IV
V
VI
VII
VIII
IX
X
XI



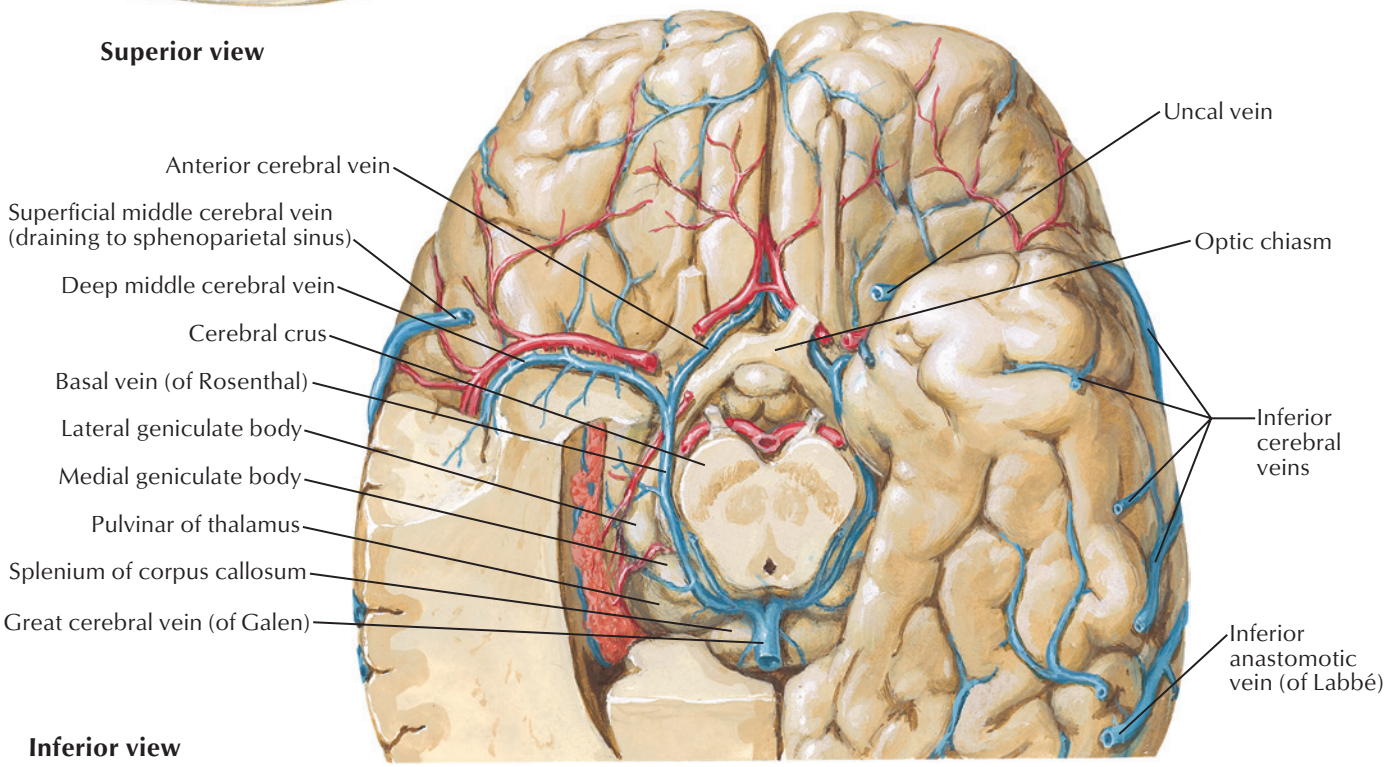
Parts of cerebellum

C	Culmen	**N**	Nodule
CL	Central lobule	**P**	Pyramid
D	Declive	**T**	Tonsil
F	Folium	**TU**	Tuber
L	Lingula	**U**	Uvula

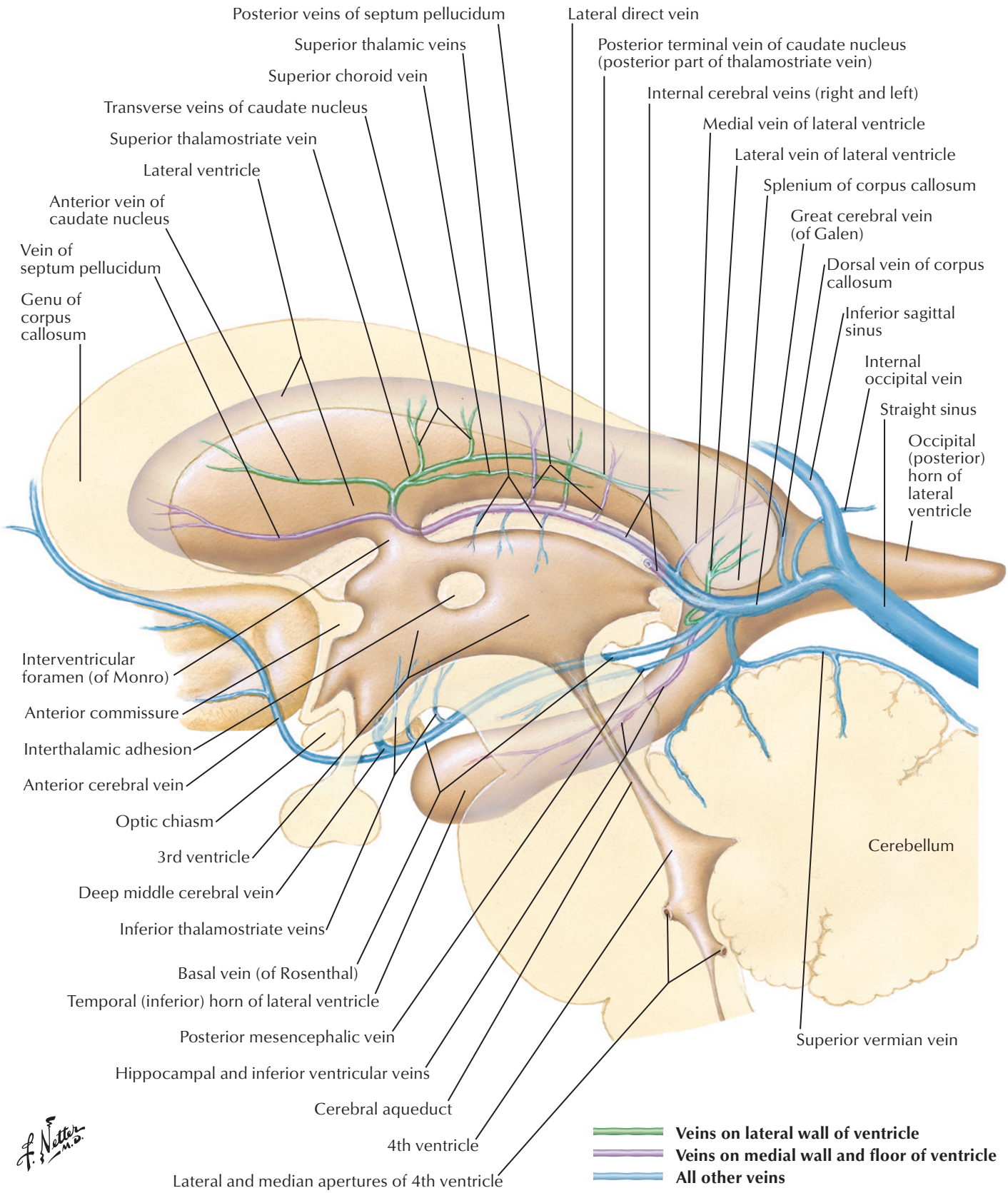
For superficial veins of brain see Plate 122



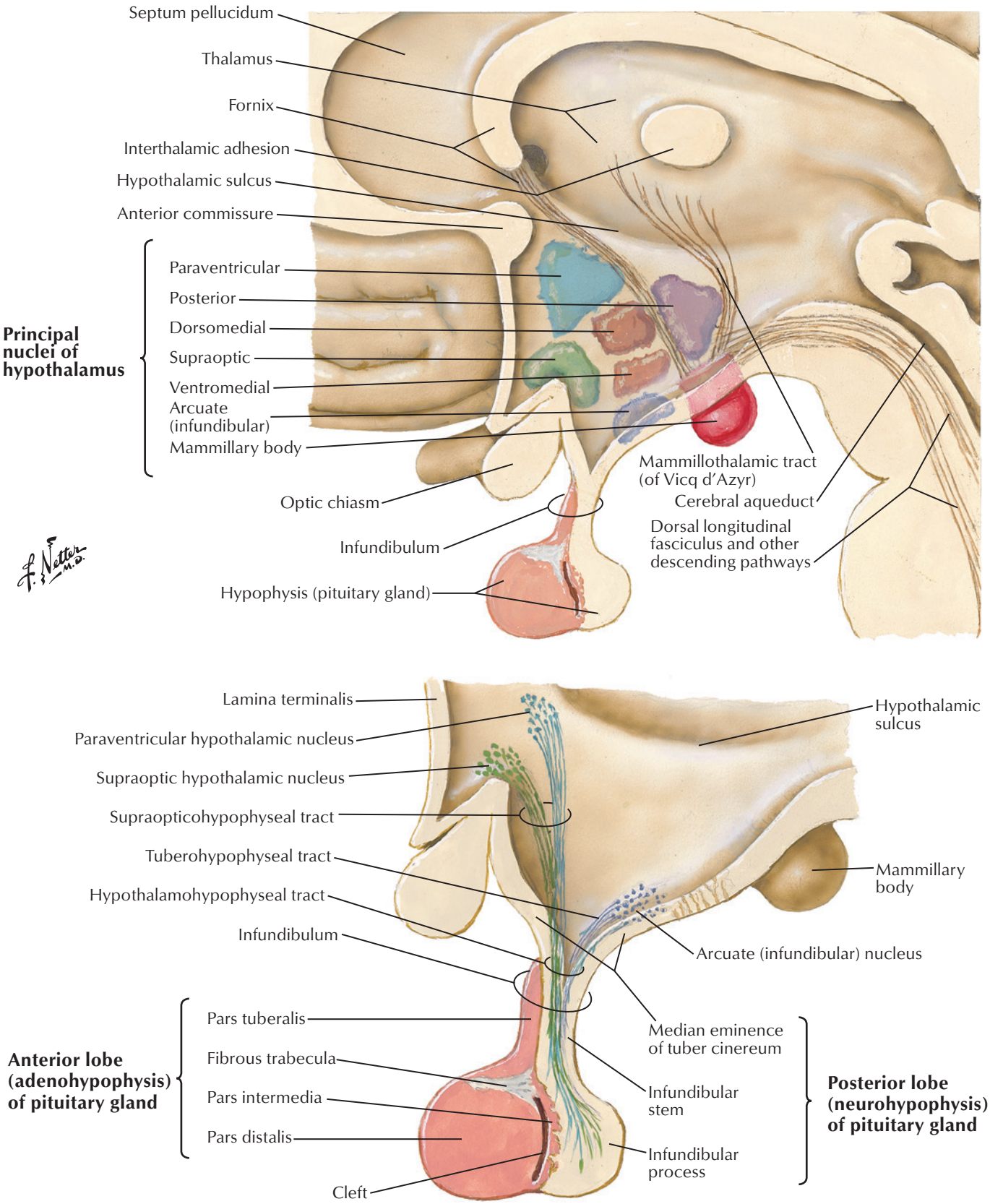
Superior view



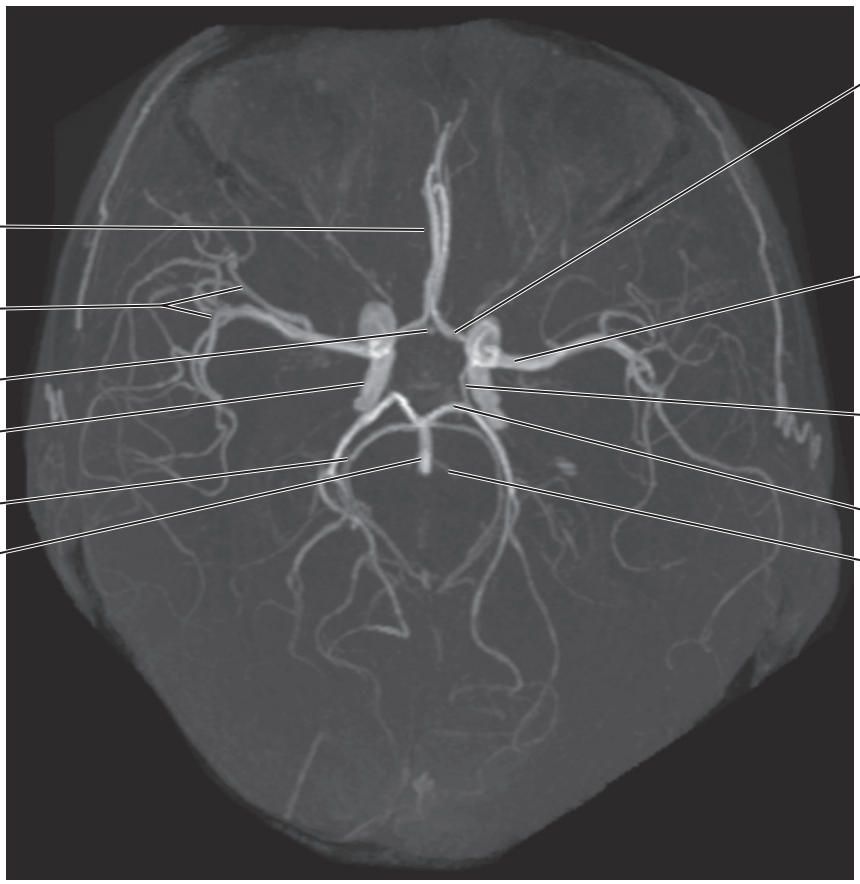
Inferior view


Posterior veins of septum pellucidum
Superior thalamic veins
Superior choroid vein
Transverse veins of caudate nucleus
Superior thalamostriate vein
Lateral ventricle
Anterior vein of caudate nucleus
Vein of septum pellucidum
Genu of corpus callosum
Lateral direct vein
Posterior terminal vein of caudate nucleus (posterior part of thalamostriate vein)
Internal cerebral veins (right and left)
Medial vein of lateral ventricle
Lateral vein of lateral ventricle
Splenium of corpus callosum
Great cerebral vein (of Galen)
Dorsal vein of corpus callosum
Inferior sagittal sinus
Internal occipital vein
Straight sinus
Occipital (posterior) horn of lateral ventricle
Interventricular foramen (of Monro)
Anterior commissure
Interthalamic adhesion
Anterior cerebral vein
Optic chiasm
3rd ventricle
Deep middle cerebral vein
Inferior thalamostriate veins
Basal vein (of Rosenthal)
Temporal (inferior) horn of lateral ventricle
Posterior mesencephalic vein
Hippocampal and inferior ventricular veins
Cerebral aqueduct
4th ventricle
Lateral and median apertures of 4th ventricle
Cerebellum
Superior vermian vein
Veins on lateral wall of ventricle
Veins on medial wall and floor of ventricle
All other veins

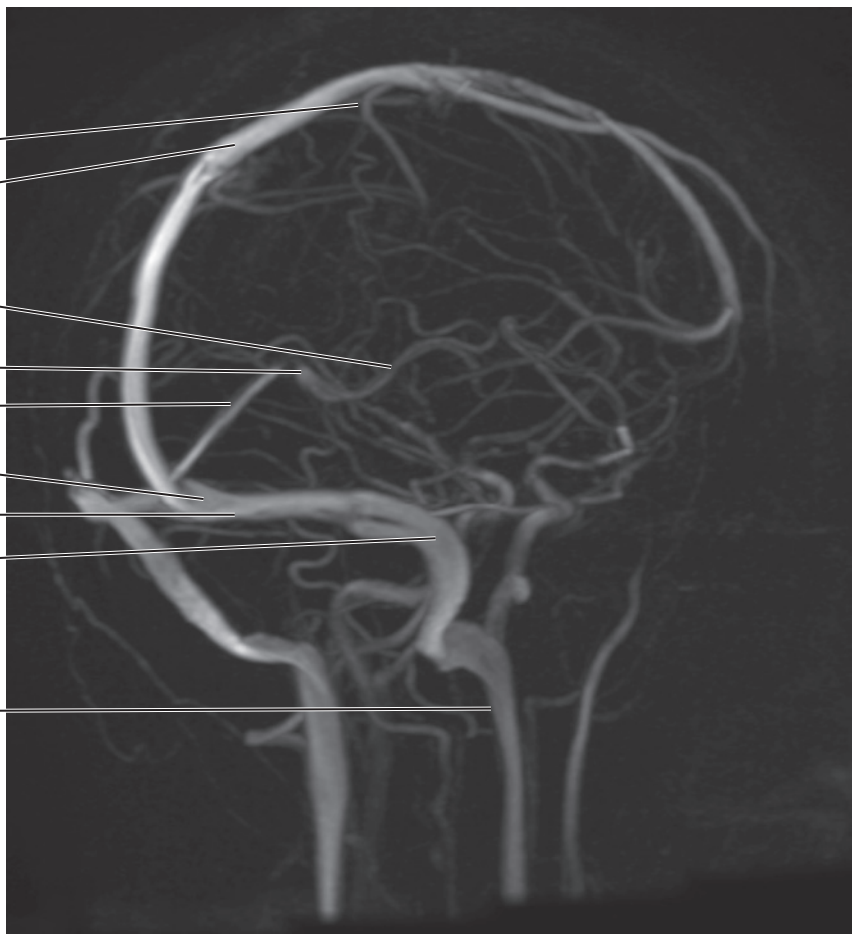
See also Plate 117



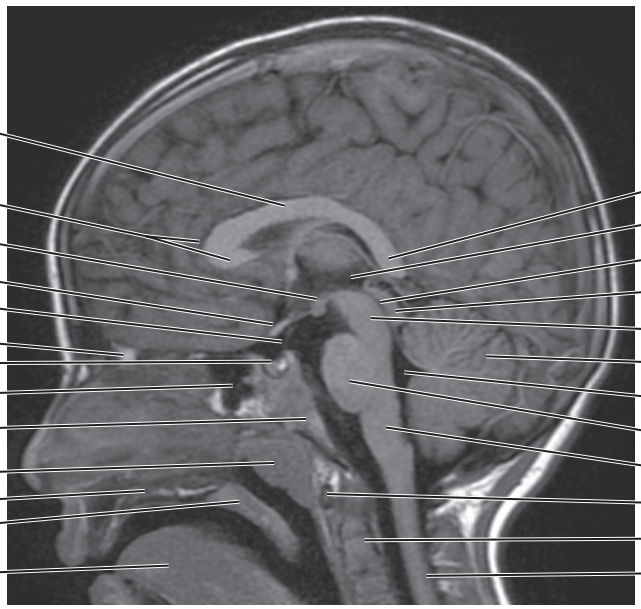
Magnetic resonance angiography (MRA) at level of circle of Willis (3D time-of-flight image without contrast)



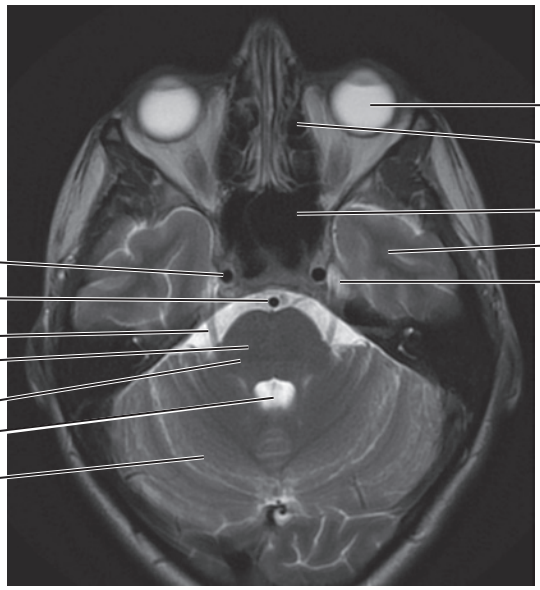
Magnetic resonance venography (MRV) (2D time-of-flight image without contrast)

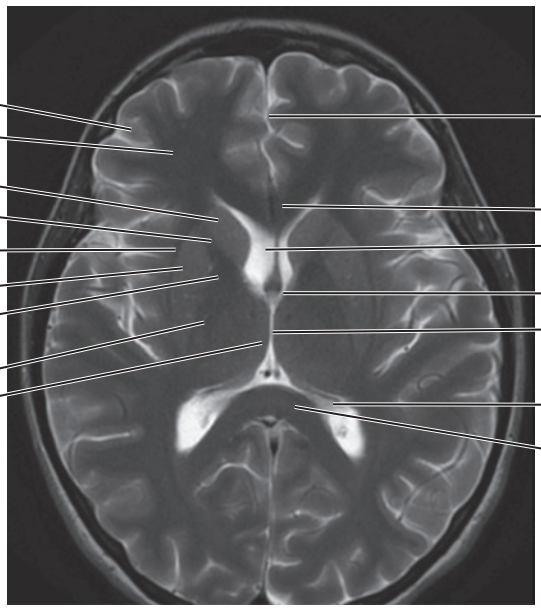


T1-weighted MRI, sagittal view



T2-weighted, MRI axial views without contrast





ANATOMIC STRUCTURES	CLINICAL IMPORTANCE	PLATE NUMBERS
SKELETAL SYSTEM		
Orbit	Direct trauma to eye may result in "blowout" fracture; margin remains intact, but medial and/or inferior walls of orbit have fractured	11, 50
Pterion	Weak area of skull that is common site of fracture	13
Temporomandibular joint	Temporomandibular disorders are common source of pain and joint dysfunction	25
Cervical vertebrae	Degenerative changes cause narrowing of intervertebral foramina that may cause cervical radiculopathy	26–28
Cervical vertebrae	Bilateral fracture of pars interarticularis of C2 (spondylolysis) results from hyperextension of head on neck and results in spondylolisthesis of C2 (hangman's fracture); fractures (common) are due to motor vehicle, snowmobile, and all-terrain vehicle accidents	26
Thyroid cartilage, cricoid cartilage	Palpable landmarks used for cricothyrotomy and tracheostomy	87, 90
Ear ossicles	Pathologic conditions involving ossicles (e.g., otosclerosis) can cause conductive hearing loss	105, 106
MUSCULAR SYSTEM		
Muscles of facial expression	Used to assess function of CN VII during cranial nerve examination; may become weak or paralyzed with CN VII dysfunction (e.g., Bell's palsy)	31, 134
Sternocleidomastoid muscle	Palpated to identify "nerve point of neck" for administration of anesthesia to cervical plexus	39
Sternocleidomastoid, trapezius muscles	Used to assess function of CN XI during cranial nerve examination	39, 138
Muscles of mastication	Used to assess function of CN V (V_3) during cranial nerve examination	55, 56
Levator veli palatini, musculus uvulae	Used to assess function of CN X during cranial nerve examination; contralateral deviation of uvula during elevation indicates CN X dysfunction	67
Genioglossus muscle	Used to assess CN XII function during cranial nerve examination; deviates to side of lesion when protruded following CN XII injury	70, 139
Levator palpebrae superioris, superior tarsal muscles	Muscles responsible for elevating eyelid; ptosis indicates pathologic change in CN III or sympathetics (superior tarsal muscle)	94, 96
Eye muscles	Used to assess function of CN III, CN IV, and CN VI during cranial nerve examination	96, 98
Dilator pupillae muscle	Important in assessment of sympathetic function in head; lack of dilation indicates interruption in sympathetic outflow (e.g., Horner's syndrome)	101, 132
Sphincter pupillae muscle	Involved in pupillary light reflex and accommodation reflex	101, 132
RESPIRATORY SYSTEM		
Paranasal sinuses	Cavities in skull; prone to mucosal inflammation due to bacterial or viral infection	49, 50
DIGESTIVE SYSTEM		
Parotid gland	Swelling of gland due to infection (e.g., mumps) may compress branches of facial nerve, producing facial muscle weakness	53, 54

ANATOMIC STRUCTURES	CLINICAL IMPORTANCE	PLATE NUMBERS
ENDOCRINE SYSTEM		
Thyroid gland	Common site of cancer; removed with thyroidectomy	87
NERVOUS SYSTEM		
Accessory nerve (CN XI)	Lymph node biopsy in posterior cervical triangle can cause iatrogenic injury of CN XI	39
Cervical plexus	Cervical plexus blocks are performed for neck procedures	39, 40
Trigeminal nerve (CN V)	Branches of CN V are anesthetized for procedures on face or anterior scalp	42, 133
Olfactory nerve (CN I)	One of most commonly injured cranial nerves; can be avulsed at cribriform plate following falls	46, 130
Facial nerve (CN VII)	Idiopathic unilateral facial nerve palsy (Bell's palsy) can result in inability to fully close eye and result in desiccated cornea ipsilaterally	54
Recurrent laryngeal nerve	May be compressed or damaged by procedures in neck (e.g., thyroidectomy), aortic arch aneurysm, or lung cancer, producing hoarseness of voice	88, 89
Oculomotor nerve (CN III), trochlear nerve (CN IV), and abducens nerve (CN VI)	Cavernous sinus thrombosis can result in dysfunction of extraocular muscles caused by compression of one, two, or all three nerves	115
Superior colliculus and cerebral aqueduct	Tumor of midbrain can result in compression of cerebral aqueduct, with resultant hydrocephalus	120
Optic nerve (CN II)	One early sign of growing pituitary gland mass is bitemporal hemianopsia	131, 151
Optic nerve (CN II)	One of first signs of ophthalmic artery aneurysm is visual loss due to compression of overlying optic nerve	148
CARDIOVASCULAR SYSTEM		
Right internal and external jugular veins	Examined to assess jugular venous pulse; internal jugular vein is preferred because it is in line with superior vena cava; external jugular vein may be used instead as the internal jugular vein is very difficult to visualize	38
Internal jugular vein, subclavian vein	Used to obtain venous access via insertion of central venous catheter	38, 84
Inferior thyroid artery	At risk during thyroidectomy; must be preserved to maintain blood supply to parathyroid glands	40, 88
Common carotid artery	Palpated in neck to assess carotid pulse; prone to atherosclerotic thickening of vessel wall	41
Anterior ethmoidal, sphenopalatine, and facial arteries	Anastomosis site of these vessels in nasal vestibule is common site of nosebleed (epistaxis)	47
Pterygoid venous plexus	Common route for spread of infection due to connections between face, orbit, and venous sinuses	84, 99
Ophthalmic artery	Primary source of blood to retina; blindness may occur if artery is occluded	99, 103
Arteries of scalp	Lacerations bleed profusely owing to rich blood supply; vessels do not retract in dense connective tissue layer of scalp	111
Superior cerebral veins	May be torn from their junction with superior sagittal sinus, producing subdural hematoma	112, 113, 114, 120

ANATOMIC STRUCTURES	CLINICAL IMPORTANCE	PLATE NUMBERS
CARDIOVASCULAR SYSTEM—Continued		
Middle meningeal artery	Trauma to skull can tear middle meningeal artery, causing epidural hematoma	112
Dural venous sinuses	Infections in head may spread to sinuses, causing dural sinus thrombosis; cavernous sinus is most common site	114, 115
Cavernous sinus	Fistula (anastomosis) between internal carotid artery and cavernous sinus may form, especially following trauma	115, 151
Carotid sinus	Compressed during carotid sinus massage	141
Cerebral arterial circle of Willis	Common site of aneurysms; rupture produces subarachnoid hemorrhage	150
LYMPHATIC SYSTEM		
Thoracic duct	May be injured in neck at junction of internal jugular and subclavian veins	85
Superior and inferior deep nodes	Palpated during neck examination to assess size	85, 86

*Selections were based largely on clinical data and commonly discussed clinical correlations in gross anatomy courses.

MUSCLE	MUSCLE GROUP	PROXIMAL ATTACHMENT (ORIGIN)	DISTAL ATTACHMENT (INSERTION)	INNERVATION	BLOOD SUPPLY	MAIN ACTIONS
Auricularis anterior	External ear	Temporal fascia, epicranial aponeurosis	Anterior part of medial surface of helix of ear	Posterior auricular and temporal branches of facial nerve	Auricular branch of posterior auricular artery, parietal branch of superficial temporal artery	Elevates and draws auricle forward
Auricularis posterior	External ear	Base of mastoid process	Lower part of cranial surface of auricle	Posterior auricular and temporal branches of facial nerve	Auricular branch of posterior auricular artery, parietal branch of superficial temporal artery	Retracts and elevates auricle
Auricularis superior	External ear	Temporal fascia, epicranial aponeurosis	Upper part of medial surface of auricle	Posterior auricular and temporal branches of facial nerve	Auricular branch of posterior auricular artery, parietal branch of superficial temporal artery	Retracts and elevates auricle
Buccinator	Facial expression	Posterior portion of alveolar process of maxillary bone and mandible opposite sockets of molar teeth, anterior border of pterygomandibular raphe	Angle of mouth	Buccal branches of facial nerve	Muscular branches of facial artery, buccal branch of maxillary artery	Compresses cheeks, expels air between lips, aids in mastication
Ciliary	Intrinsic eye	Corneoscleral junction	Ciliary body	Parasympathetic fibers via short ciliary nerves (CN III)	Ophthalmic artery	Constricts ciliary body and lens rounds up (accommodation)
Corrugator supercilii	Facial expression	Medial part of supraorbital margin	Skin of medial half of eyebrow	Zygomatic and temporal branches of facial nerve	Zygomatic and anterior branches of superficial temporal artery	Draws eyebrows downward and medially, produces vertical wrinkles of skin between eyebrows
Cricothyroid	Laryngeal	Anterior cricoid cartilage	Inferior border of thyroid cartilage and its inferior horn	External branch of superior laryngeal nerve	Superior and inferior thyroid arteries	Lengthens and tenses vocal ligaments
Depressor anguli oris	Facial expression	Continuous with platysma muscle on oblique line of mandible	Angle of mouth into orbicularis oris muscle and skin	Mandibular and buccal branches of facial nerve	Inferior labial artery of facial artery	Depresses angle of mouth
Depressor labii inferioris	Facial expression	Lateral surface of mandible between symphysis and mental foramen deep to depressor anguli oris	Skin to lower lip, mingling with orbicularis oris muscle, medial fibers joining those of opposite side	Mandibular and buccal branches of facial nerve	Inferior labial artery of facial artery	Depresses lower lip and draws it lateralward
Depressor septi nasi	Facial expression	Incisive fossa of maxillary bone	Septum and posterior part of ala of nose	Zygomatic and buccal branches of facial nerve	Superior labial artery of facial artery	Narrows nostril, draws septum downward
Digastric	Suprahyoid	*Anterior belly:* digastric fossa of mandible *Posterior belly*: mastoid notch of temporal bone	Intermediate tendon attached to body of hyoid	*Anterior belly:* nerve to mylohyoid muscle *Posterior belly:* facial nerve	*Anterior belly:* branches of submental artery *Posterior belly:* muscular branches of posterior auricular artery, muscular branches of occipital artery	Raises hyoid bone and base of tongue, steadies hyoid bone, opens mouth by lowering mandible
Dilator pupillae	Intrinsic eye	Radial fibers in iris	Blends with sphincter pupillae fibers	Sympathetic fibers from superior cervical ganglion	Ophthalmic artery	Dilates pupil
Frontal belly of occipitofrontalis	Facial expression	Epicranial aponeurosis at level of coronal suture	Skin of frontal region, epicranial aponeurosis	Temporal branches of facial nerve	Frontal branch of superficial temporal artery	Horizontally wrinkles skin of forehead, raises eyebrows
Genioglossus	Extrinsic tongue	Mental spine of mandible	Dorsum of tongue, hyoid bone	Hypoglossal nerve (CN XII)	Sublingual and submental arteries	Depresses and protrudes tongue

Variations in spinal nerve contributions to the innervation of muscles, their arterial supply, their attachments, and their actions are common themes in human anatomy. Therefore, expect differences between texts and realize that anatomical variation is normal.

MUSCLE	MUSCLE GROUP	PROXIMAL ATTACHMENT (ORIGIN)	DISTAL ATTACHMENT (INSERTION)	INNERVATION	BLOOD SUPPLY	MAIN ACTIONS
Geniohyoid	Suprahyoid	Inferior genial tubercle on back of symphysis of mandible	Anterior surface of body of hyoid bone	Branch of C1 through hypoglossal nerve (CN XII)	Sublingual branch of lingual artery	Elevates hyoid bone and depresses mandible
Hyoglossus	Extrinsic tongue	Body and greater horn of hyoid bone	Lateral and inferior aspect of tongue	Hypoglossal nerve (CN XII)	Sublingual and submental arteries	Depresses and retracts tongue
Inferior longitudinal lingual muscle	Intrinsic tongue	Under surface of tongue between genioglossus and hyoglossus	Apex of tongue blending with styloglossus	Hypoglossal nerve (CN XII)	Deep lingual branch of lingual artery, branches from facial artery	Shortens tongue, turns tip and sides downward
Inferior oblique	Extraocular; eyelid	Anterior floor of orbit lateral to nasolacrimal canal	Lateral sclera deep to lateral rectus muscle	Oculomotor nerve (CN III), inferior division	Ophthalmic artery	Abducts, elevates, and laterally rotates eyeball
Inferior pharyngeal constrictor	Circular pharyngeal	Oblique line of thyroid cartilage and cricoid cartilage	Median raphe of pharynx	Vagus nerve via pharyngeal plexus	Ascending pharyngeal artery, branches of superior thyroid artery	Constricts wall of pharynx during swallowing
Inferior rectus	Extraocular; eyelid	Common tendinous ring	Inferior aspect of eyeball, posterior to corneoscleral junction	Oculomotor nerve (CN III), inferior division	Ophthalmic artery	Depresses, adducts, and laterally rotates eyeball
Lateral cricoarytenoid	Laryngeal	Arch of cricoid cartilage	Muscular process of arytenoid cartilage	Recurrent laryngeal nerve	Superior and inferior thyroid arteries	Adducts vocal folds
Lateral pterygoid	Mastication	*Superior head:* infratemporal surface of greater wing of sphenoid bone *Inferior head:* lateral pterygoid plate	Pterygoid fovea, capsule of temporomandibular joint, articular disc	Mandibular nerve (CN V_3)	Muscular branches of maxillary artery	*Bilaterally:* protrudes mandible *Unilaterally and alternately:* produces side-to-side grinding
Lateral rectus	Extraocular; eyelid	Common tendinous ring	Lateral aspect of eyeball, posterior to corneoscleral junction	Abducens nerve (CN VI)	Ophthalmic artery	Abducts eyeball
Levator anguli oris	Facial expression	Canine fossa of maxillary bone immediately below infra-orbital foramen and under cover of zygomatic head of levator labii superioris	Angle of mouth; fibers intermingle with orbicularis oris, depressor anguli oris, zygomaticus	Zygomatic and buccal branches of facial nerve	Superior labial artery of facial artery	Elevates angle of mouth
Levator labii superioris alaeque nasi	Facial expression	Upper part of frontal process of maxillary bone	Into major alar cartilage, skin of nose, lateral upper lip	Zygomatic and buccal branches of facial nerve	Superior labial artery and angular branches of facial artery	Elevates upper lip and dilates nostril
Levator labii superioris	Facial expression	Maxillary bone above infraorbital foramen	Skin of upper lip	Zygomatic and buccal branches of facial nerve	Superior labial artery and angular branches of facial artery	Elevates upper lip, dilates nares
Levator palpebrae superioris	Extraocular; eyelid	Lesser wing of sphenoid bone, anterior to optic canal	Superior tarsal plate	Oculomotor nerve (CN III), superior division	Ophthalmic artery	Raises upper eyelid
Levator veli palatini	Palatal	Temporal bone (petrous portion) and auditory tube	Palatine aponeurosis	Vagus nerve via pharyngeal plexus	Ascending palatine artery branch of facial artery, descending palatine artery branch of maxillary artery	Elevates soft palate during swallowing

MUSCLE	MUSCLE GROUP	PROXIMAL ATTACHMENT (ORIGIN)	DISTAL ATTACHMENT (INSERTION)	INNERVATION	BLOOD SUPPLY	MAIN ACTIONS
Longus capitis	Anterior vertebral	Anterior tubercles of transverse processes of C3–C6	Inferior surface of basilar part of occipital bone	Anterior rami of cervical nerves (C1–C3)	Ascending cervical branch of inferior thyroid artery, ascending pharyngeal artery, muscular branches of vertebral artery	Flexes head
Longus colli	Anterior vertebral	*Vertical portion:* C5–T3 vertebrae *Inferior oblique portion:* T1–T3 vertebrae *Superior oblique portion*: anterior tubercles of transverse processes of C3–C5 vertebrae	*Vertical portion:* into C2–C4 vertebrae *Inferior oblique portion*: on anterior tubercles of transverse processes of C3–C6 vertebrae *Superior oblique portion:* tubercle of anterior arch of atlas	Anterior primary rami of cervical nerves (C2–C8)	Prevertebral branches of ascending pharyngeal artery, muscular branches of ascending cervical and vertebral arteries	*Bilaterally*: flex and assist in rotating cervical vertebrae and head *Unilaterally:* flexes vertebral column laterally
Masseter	Mastication	Zygomatic arch	Ramus of mandible, coronoid process	Mandibular nerve (CN V_3), via masseteric nerve	Transverse facial artery; masseteric branch of maxillary and facial arteries	Elevates and protrudes mandible; deep fibers retract it
Medial pterygoid	Mastication	Medial surface of lateral plate of pterygoid, pyramidal process of palatine bone, maxillary tuberosity	Medial surface of ramus and angle of mandible inferior to mandibular foramen	Mandibular nerve (V_3), nerve to medial pterygoid muscle	Facial and maxillary arteries	*Bilaterally:* protrudes and elevates mandible *Unilaterally and alternately:* produces side-to-side movements
Medial rectus	Extraocular; eyelid	Common tendinous ring	Medial aspect of eyeball, posterior to corneoscleral junction	Oculomotor nerve (CN III), inferior division	Ophthalmic artery	Adducts eyeball
Mentalis	Facial expression	Incisive fossa of mandible	Skin of chin	Marginal mandibular branch of facial nerve	Inferior labial artery of facial artery	Raises and protrudes lower lip
Middle pharyngeal constrictor	Circular pharyngeal	Stylohyoid ligament and horns of hyoid bone	Median raphe of pharynx	Vagus nerve via pharyngeal plexus	Ascending pharyngeal artery, ascending palatine and tonsillar branches of facial artery, dorsal lingual branches of lingual artery	Constricts wall of pharynx during swallowing
Musculus uvulae	Palatal	Nasal spine, palatine aponeurosis	Mucosa of uvula of the palate	Vagus nerve via pharyngeal plexus	Ascending palatine artery branch of facial artery, descending palatine artery branch of maxillary artery	Shortens, elevates, and retracts uvula of the palate
Mylohyoid	Suprahyoid	Mylohyoid line of mandible	Median raphe and body of hyoid bone	Nerve to mylohyoid muscle	Sublingual branch of lingual artery, submental branch of facial artery	Elevates hyoid bone, base of tongue, floor of mouth; depresses mandible
Nasalis	Facial expression	Canine eminence above and lateral to incisive fossa of maxillary bone	Aponeurosis on nasal cartilages	Zygomatic and buccal branches of facial nerve	Superior labial, septal, and lateral nasal branches of facial artery	Draws ala of nose toward nasal septum, compresses nostrils; alar part opens nostrils
Occipital belly (occipitofrontalis) muscle	Facial expression	Lateral 2/3 of superior nuchal line and mastoid process	Skin of occipital region, epicranial aponeurosis	Posterior auricular nerve of facial nerve	Occipital branch of posterior auricular artery, descending branch of occipital artery	Moves scalp backward

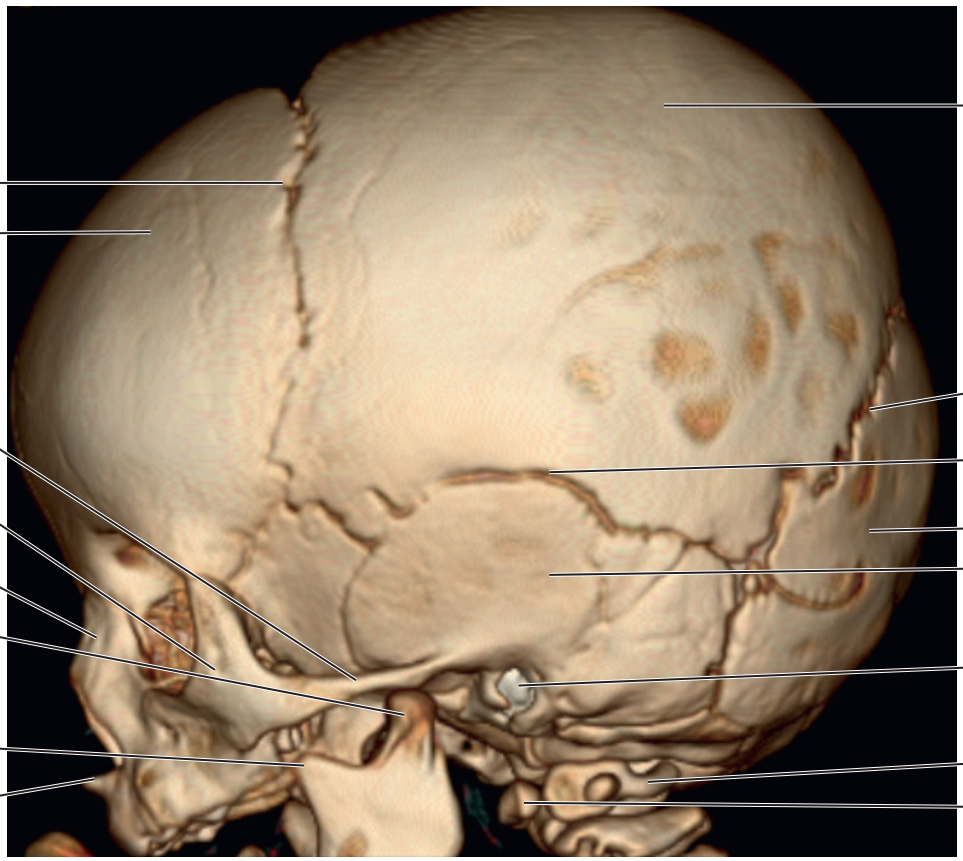
MUSCLE	MUSCLE GROUP	PROXIMAL ATTACHMENT (ORIGIN)	DISTAL ATTACHMENT (INSERTION)	INNERVATION	BLOOD SUPPLY	MAIN ACTIONS
Omohyoid	Infrahyoid	*Inferior belly:* from upper border of scapula and superior transverse scapular ligament, ending in intermediate tendon *Superior belly:* from this tendon	*Inferior belly:* to intermediate tendon *Superior belly:* to body of hyoid bone	Ansa cervicalis	Hyoid branch of lingual artery, sternocleidomastoid branch of superior thyroid artery	Steadies hyoid bone and depresses hyoid
Orbicularis oculi	Facial expression	Medial orbital margin, palpebral ligament, lacrimal bone	Skin around orbit, palpebral ligament, upper and lower eyelids	Facial nerve (CN VII)	Facial and superficial temporal arteries	Closes eyelids
Orbicularis oris	Facial expression	Maxillary bone above incisor teeth	Skin around lips	Zygomatic, buccal, and mandibular branches of facial nerve	Inferior and superior labial branches of facial artery	Compression, contraction, and protrusion of lips
Palatoglossus	Palatal	Palatine aponeurosis of soft palate	Lateral aspect of tongue	Vagus nerve via pharyngeal plexus	Ascending pharyngeal arteries, palatine branches of facial and maxillary arteries	Elevates posterior tongue, depresses palate
Palatopharyngeus	Longitudinal pharyngeal	Hard palate, superior palatine aponeurosis	Lateral pharyngeal wall	Vagus nerve via pharyngeal plexus	Ascending palatine artery branch of facial artery, descending palatine artery branch of maxillary artery	Tenses soft palate; pulls walls of pharynx superiorly, anteriorly, and medially during swallowing
Platysma	Facial expression	Skin below clavicle, upper thorax	Mandible, oral muscles	Facial nerve	Submental and suprascapular arteries	Tenses skin of neck
Posterior cricoarytenoid	Laryngeal	Posterior surface of lamina of cricoid cartilage	Muscular process of arytenoid cartilage	Recurrent laryngeal nerve	Superior and inferior thyroid arteries	Abducts vocal folds
Procerus	Facial expression	Fascia covering lower parts of nasal bone and upper part of lateral nasal cartilage	Skin between and above eyebrows	Temporal and zygomatic branches of facial nerve	Angular and lateral nasal branches of facial artery	Draws down medial angle of eyebrows, produces transverse wrinkles over bridge of nose
Rectus capitis anterior	Anterior vertebral	Lateral mass of atlas	Base of occipital bone in front of foramen magnum	Anterior rami of cervical nerves (C1–C2)	Muscular branches of vertebral artery, ascending pharyngeal artery	Flexes head
Rectus capitis lateralis	Anterior vertebral	Upper surface of transverse process of atlas	Inferior surface of jugular process of occipital bone	Anterior rami of cervical nerves (C1–C2)	Muscular branches of vertebral artery, occipital artery, ascending pharyngeal artery	Flexes head laterally to same side
Risorius	Facial expression	Fascia over masseter muscle superficial to platysma muscle	Skin at angle of mouth	Zygomatic and buccal branches of facial nerve	Superior labial artery of facial artery	Retracts angle of mouth
Salpingopharyngeus	Longitudinal pharyngeal	Pharyngotympanic (auditory, eustachian) tube	Side of pharyngeal wall	Vagus nerve via pharyngeal plexus	Pharyngeal branch of ascending pharyngeal artery	Elevates pharynx and larynx during swallowing and speaking
Scalenus anterior	Lateral vertebral	Anterior tubercles of transverse processes of C3–C6	Scalene tubercle on 1st rib	Anterior rami of cervical nerves (C5–C8)	Ascending cervical branch of inferior thyroid artery	Elevates 1st rib, bends neck
Scalenus medius	Lateral vertebral	Posterior tubercles of transverse processes of C2–C7	Upper surface of 1st rib (behind subclavian groove)	Anterior rami of cervical nerves (C3–C7)	Muscular branches of ascending cervical artery	Elevates 1st rib, bends neck
Scalenus posterior	Lateral vertebral	Posterior tubercles of transverse processes of C4–C6	Outer surface of 2nd rib	Anterior rami of cervical nerves (C5–C8)	Muscular branches of ascending cervical division of inferior thyroid artery, superficial branch of transverse cervical artery	Elevates 2nd rib, bends neck

Table 2.7

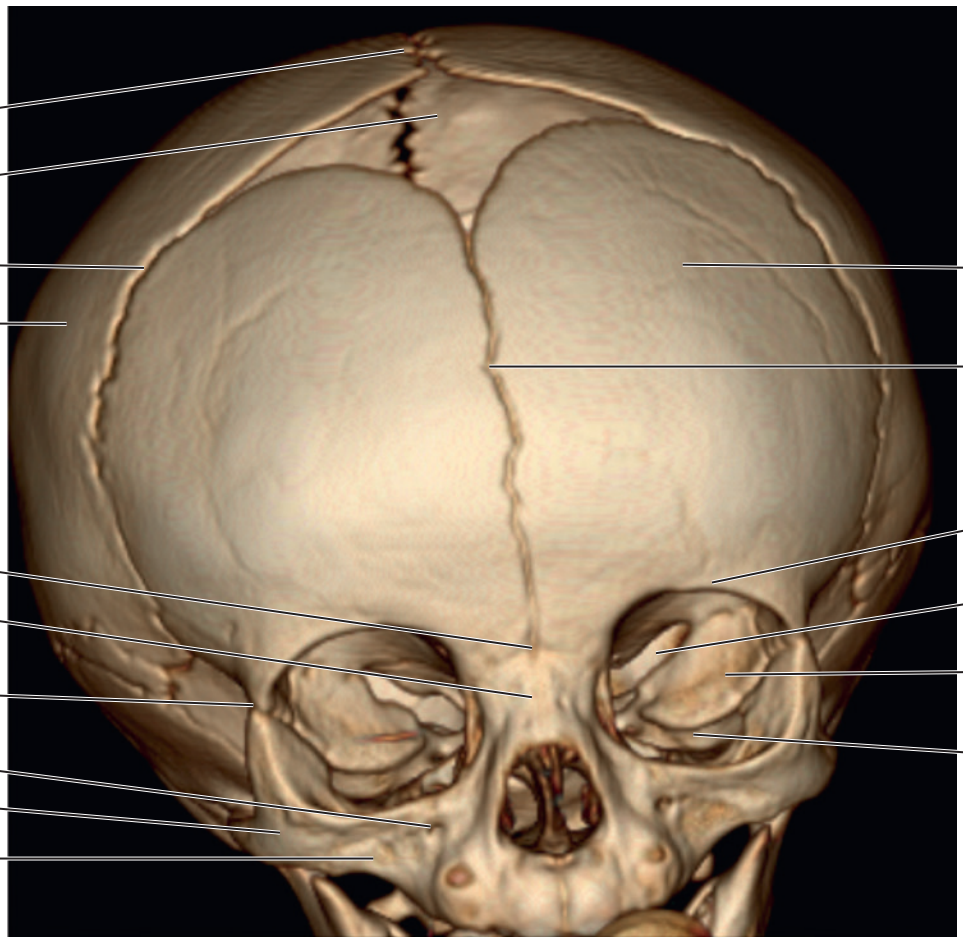
MUSCLE	MUSCLE GROUP	PROXIMAL ATTACHMENT (ORIGIN)	DISTAL ATTACHMENT (INSERTION)	INNERVATION	BLOOD SUPPLY	MAIN ACTIONS
Sphincter pupillae	Intrinsic eye	Circular smooth muscle of iris that passes around pupil	Blends with dilator pupillae fibers	Parasympathetic fibers via oculomotor nerve (CN III)	Ophthalmic artery	Constricts pupil
Stapedius	Middle ear	Pyramidal eminence of temporal bone	Stapes	Facial nerve	Posterior auricular, anterior tympanic, and middle meningeal arteries	Pulls stapes posteriorly to lessen oscillation of tympanic membrane
Sternocleidomastoid	Neck	*Sternal head:* anterior surface of manubrium *Clavicular head:* upper surface of medial 1/3 of clavicle	Lateral surface of mastoid process; lateral half of superior nuchal line of occipital bone	Accessory nerve (CN XI)	Sternocleidomastoid branch of superior thyroid and occipital arteries, muscular branch of suprascapular artery, occipital branch of posterior auricular artery	*Bilaterally:* flexes head, raises thorax *Unilaterally:* turns face toward opposite side
Sternohyoid	Infrahyoid	Posterior surface of manubrium sterni, posterior sternoclavicular ligament, medial end of clavicle	Medial part of lower border of body of hyoid bone	Ansa cervicalis	Sternocleidomastoid and hyoid branches of superior thyroid artery, hyoid branch of lingual artery	Depresses larynx and hyoid bone, steadies hyoid bone
Sternothyroid	Infrahyoid	Posterior surface of manubrium sterni below and deep to origin of sternohyoid, edge of 1st costal cartilage	Oblique line on lamina of thyroid cartilage	Ansa cervicalis	Cricothyroid branch of superior thyroid artery	Depresses larynx and thyroid cartilage
Styloglossus	Extrinsic tongue	Styloid process and stylohyoid ligament	Lateral and inferior aspect of tongue	Hypoglossal nerve (CN XII)	Sublingual artery	Retracts tongue and draws it up for swallowing
Stylohyoid	Suprahyoid	Posterior border of styloid process	Body of hyoid bone at junction with greater horn	Facial nerve	Muscular branches of facial artery, muscular branches of occipital artery	Elevates and retracts hyoid bone
Stylopharyngeus	Longitudinal pharyngeal	Medial aspect of styloid process	Pharyngeal wall and posterior border of thyroid cartilage	Glossopharyngeal nerve (CN IX)	Ascending pharyngeal artery, ascending palatine and tonsillar branches of facial artery, dorsal branches of lingual artery	Elevates pharynx and larynx during swallowing and speaking
Subclavius	Shoulder	Upper border of 1st rib and its cartilage	Inferior surface of middle third of clavicle	Nerve to subclavius muscle	Clavicular branch of thoracoacromial artery	Anchors and depresses clavicle
Superior longitudinal lingual muscle	Intrinsic tongue	Submucous fibers at back of tongue	Apex of tongue; unites with muscle of opposite side	Hypoglossal nerve (CN XII)	Deep lingual branch of lingual artery, branches from facial artery	Shortens tongue, turns tip and sides upward
Superior oblique	Extraocular; eyelid	Body of sphenoid bone (above optic canal), medial to origin of superior rectus	Passes through trochlea, attaches to superior sclera between superior and lateral recti muscles	Trochlear nerve (CN IV)	Ophthalmic artery	Abducts, depresses, and medially rotates eyeball
Superior pharyngeal constrictor	Circular pharyngeal	Hamulus, pterygomandibular raphe, mylohyoid line of mandible	Median raphe of pharynx	Vagus nerve via pharyngeal plexus	Ascending pharyngeal artery, ascending palatine and tonsillar branches of facial artery, dorsal branches of lingual artery	Constricts wall of pharynx during swallowing
Superior rectus	Extraocular; eyelid	Common tendinous ring	Superior aspect of eyeball, posterior to the corneoscleral junction	Oculomotor nerve (CN III), superior division	Ophthalmic artery	Elevates, adducts, and medially rotates eyeball

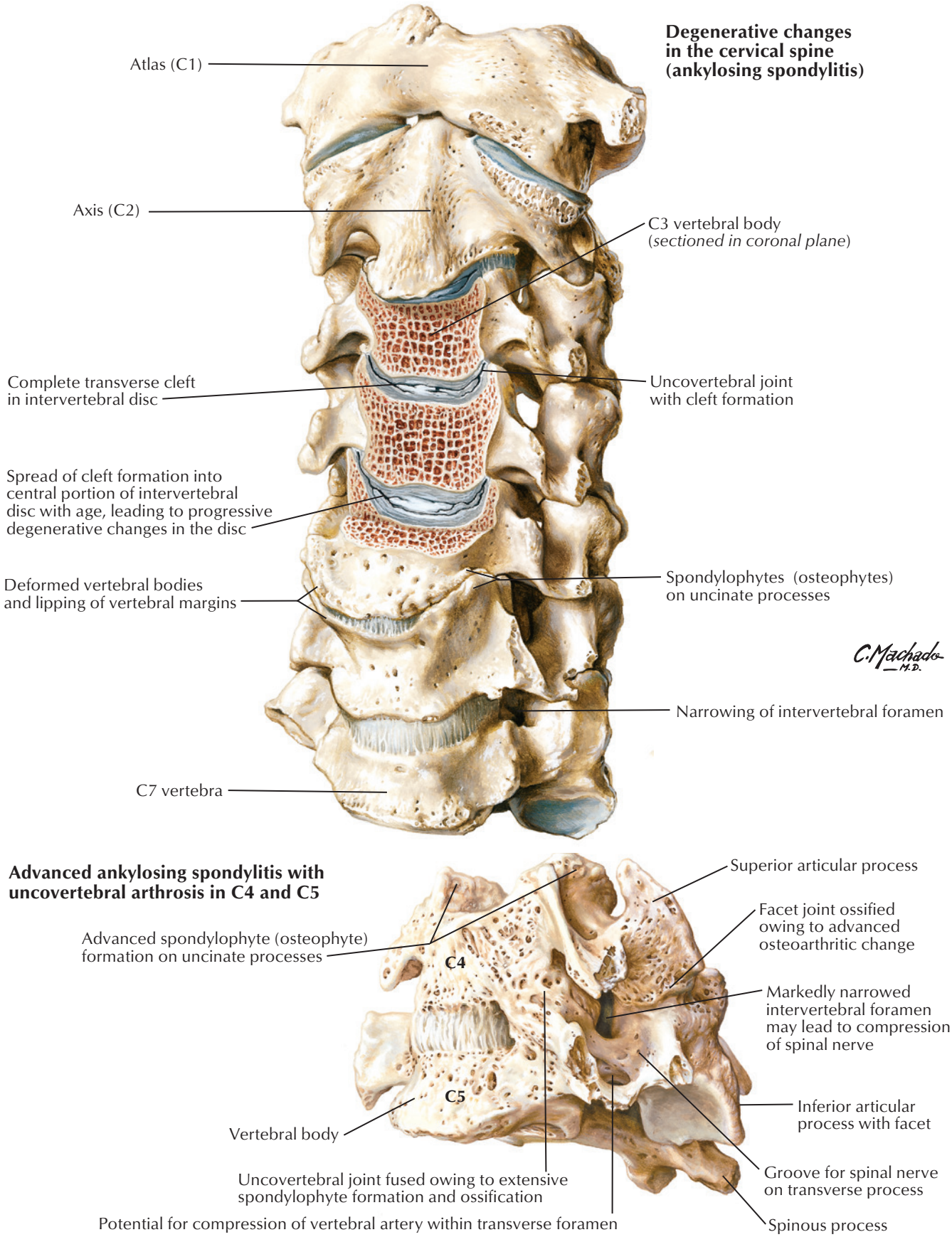
MUSCLE	MUSCLE GROUP	PROXIMAL ATTACHMENT (ORIGIN)	DISTAL ATTACHMENT (INSERTION)	INNERVATION	BLOOD SUPPLY	MAIN ACTIONS
Temporalis	Mastication	Floor of temporal fossa, deep temporal fascia	Coronoid process and ramus of mandible	Mandibular nerve (CN V_3), deep temporal nerves	Superficial temporal and maxillary arteries, middle, anterior, and posterior deep temporal arteries	Elevates mandible; posterior fibers retract mandible
Tensor tympani	Middle ear	Cartilage of pharyngotympanic (auditory, eustachian) tube	Handle of malleus	Mandibular branch of trigeminal nerve (CN V_3)	Superior tympanic branch of middle meningeal division of maxillary artery	Tenses tympanic membrane by drawing it medially
Tensor veli palatini	Palatal	Scaphoid fossa of medial pterygoid plate, spine of sphenoid bone, pharyngotympanic (auditory, eustachian) tube	Palatine aponeurosis	Mandibular nerve	Ascending palatine artery branch of facial artery, descending palatine artery branch of maxillary artery	Tenses soft palate, opens pharyngotympanic (auditory, eustachian) tube during swallowing and yawning
Thyroarytenoid	Laryngeal	Posterior aspect of thyroid cartilage	Muscular process of arytenoid cartilage	Recurrent laryngeal nerve	Superior and inferior thyroid arteries	Shortens and relaxes vocal cords, sphincter of vestibule
Thyrohyoid	Infrahyoid	Oblique line on lamina of thyroid cartilage	Lower border of body and greater horn of hyoid bone	Thyrohyoid branch of C1 nerve via hypoglossal nerve (CN XII)	Hyoid branch of superior thyroid artery	Depresses larynx and hyoid bone, elevates larynx when hyoid bone is fixed
Transverse and oblique arytenoid	Laryngeal	Arytenoid cartilage	Opposite arytenoid cartilage	Recurrent laryngeal nerve	Superior and inferior thyroid arteries	Closes intercartilaginous portion of rima glottides
Transverse (tongue)	Intrinsic tongue	Median fibrous septum of tongue	Dorsum and sides of tongue	Hypoglossal nerve (CN XII)	Deep lingual branch of lingual artery, branches from facial artery	Narrows and elongates tongue
Vertical (tongue)	Intrinsic tongue	Mucous membrane on dorsum of forepart of tongue	Fibers extend from dorsum to undersurface of tongue	Hypoglossal nerve (CN XII)	Deep lingual branch of lingual artery, branches from facial artery	Flattens and broadens tongue
Vocalis	Laryngeal	Vocal process of arytenoid cartilage	Vocal ligament	Recurrent laryngeal nerve	Superior and inferior thyroid arteries	Tenses anterior vocal ligament, relaxes posterior vocal ligament
Zygomaticus major	Facial expression	Zygomatic arch	Angle of mouth	Zygomatic and buccal branches of facial nerve	Superior labial artery of facial artery	Draws angle of mouth backward and upward
Zygomaticus minor	Facial expression	Zygomatic arch	Angle of mouth, upper lip	Zygomatic and buccal branches of facial nerve	Superior labial artery of facial artery	Elevates upper lip

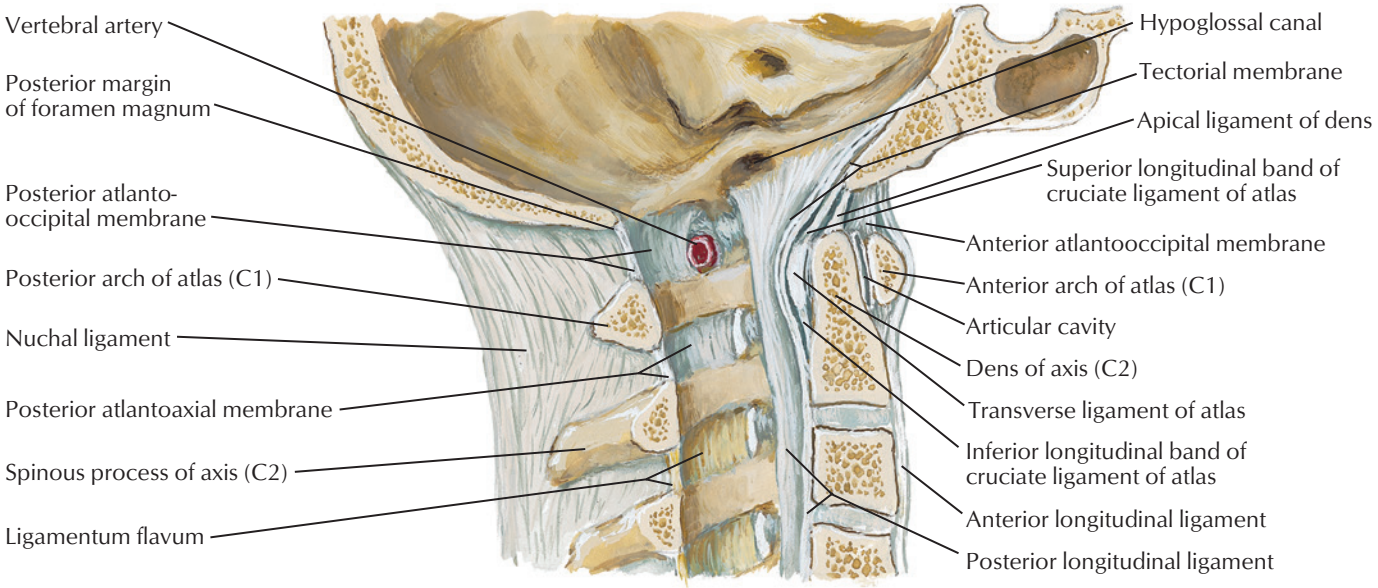
CT 3D child skull reconstruction, lateral view

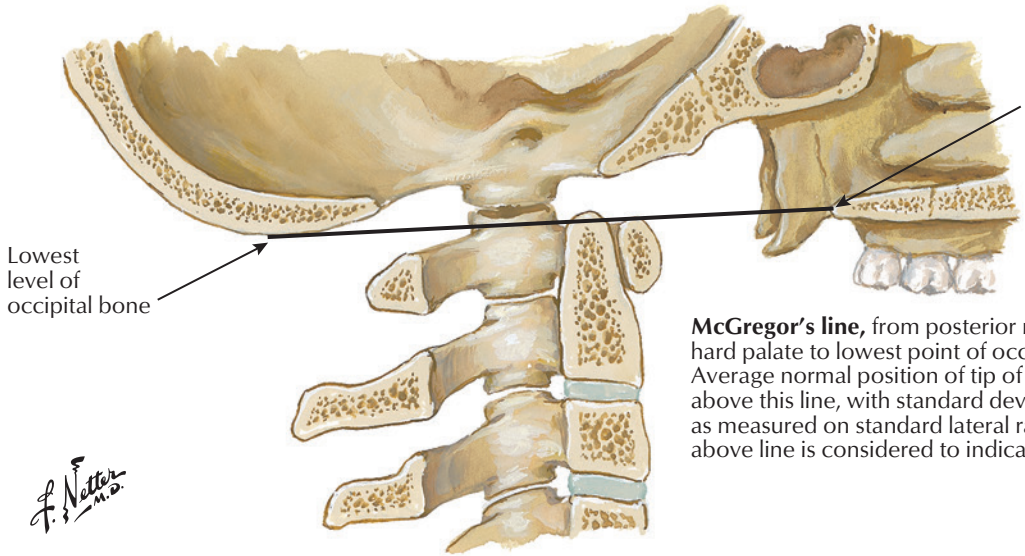


CT 3D child skull reconstruction, frontal view




Degenerative changes in the cervical spine (ankylosing spondylitis)
Atlas (C1)
Axis (C2)
C3 vertebral body (sectioned in coronal plane)
Complete transverse cleft in intervertebral disc
Uncovertebral joint with cleft formation
Spread of cleft formation into central portion of intervertebral disc with age, leading to progressive degenerative changes in the disc
Deformed vertebral bodies and lipping of vertebral margins
Spondylophytes (osteophytes) on uncinate processes
C.Machado M.D.
Narrowing of intervertebral foramen
C7 vertebra
Advanced ankylosing spondylitis with uncovertebral arthrosis in C4 and C5
Superior articular process
Facet joint ossified owing to advanced osteoarthritic change
Advanced spondylophyte (osteophyte) formation on uncinate processes
C4
Markedly narrowed intervertebral foramen may lead to compression of spinal nerve
C5
Inferior articular process with facet
Vertebral body
Groove for spinal nerve on transverse process
Uncovertebral joint fused owing to extensive spondylophyte formation and ossification
Potential for compression of vertebral artery within transverse foramen
Spinous process



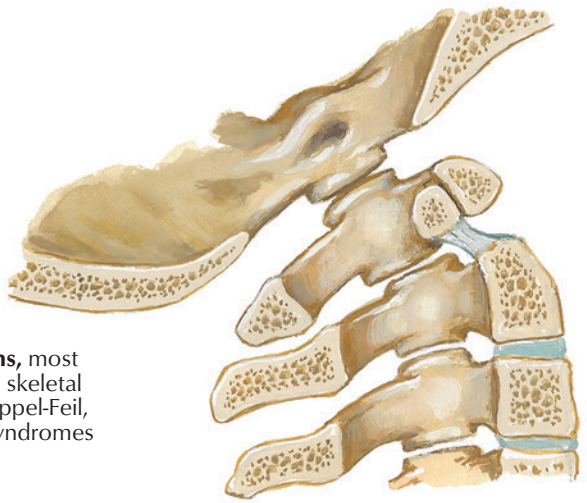


McGregor's line, from posterior nasal spine of hard palate to lowest point of occipital bone. Average normal position of tip of dens is 1.32 mm above this line, with standard deviation of ±2.6 mm as measured on standard lateral radiograph. Tip >4.5 mm above line is considered to indicate basilar impression.

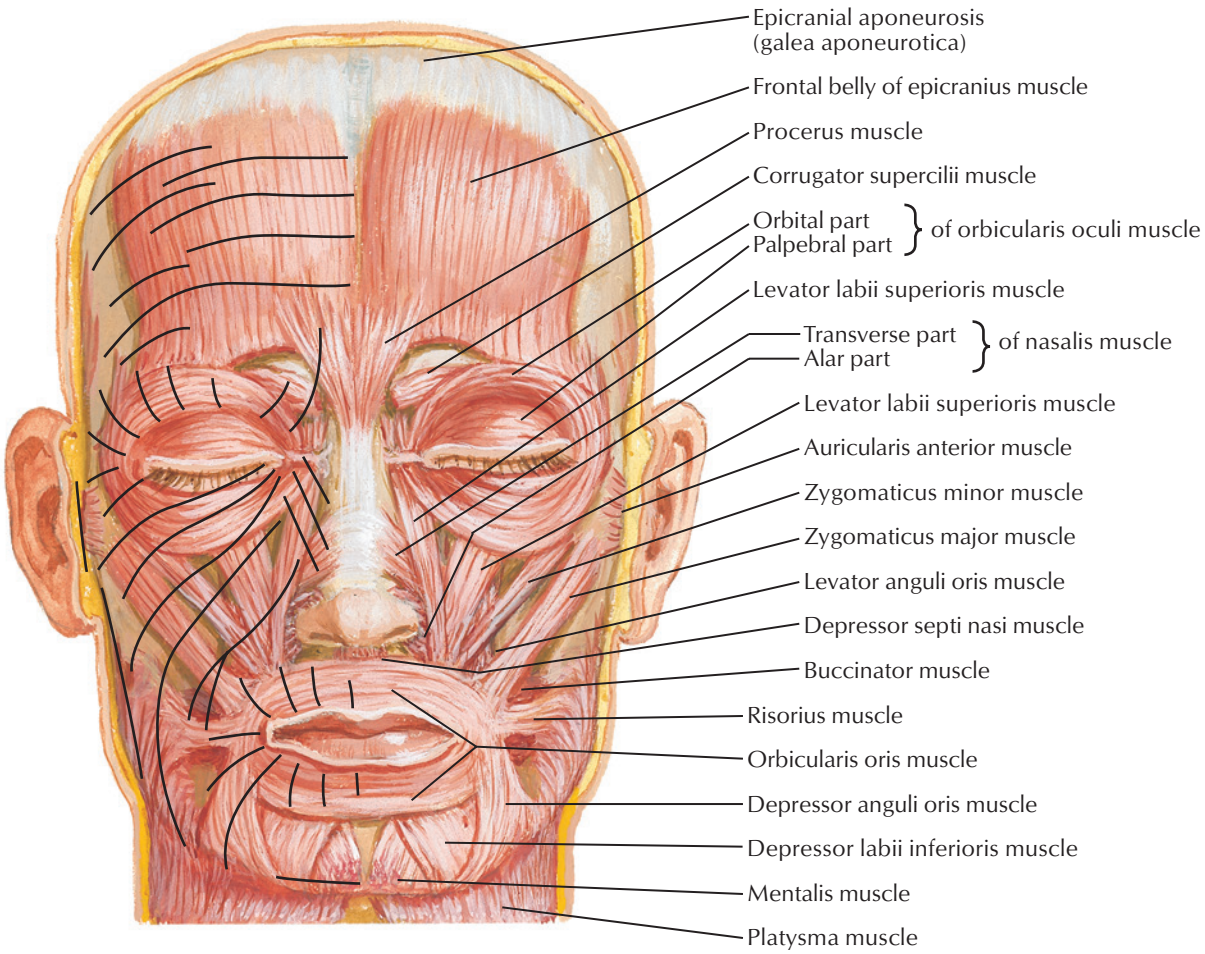


Hypoplastic dens

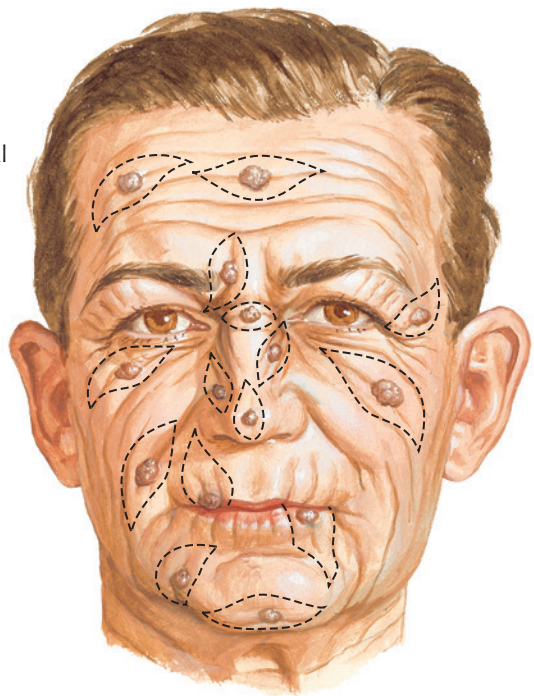
Abnormalities of dens, most often associated with skeletal dysplasias such as Klippel-Feil, Down, or Morquio syndromes

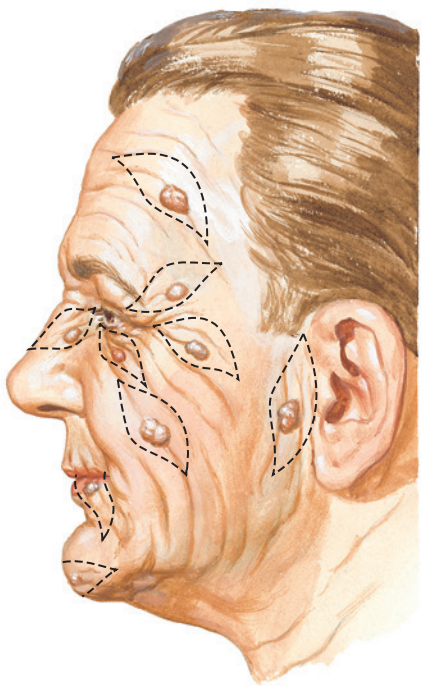


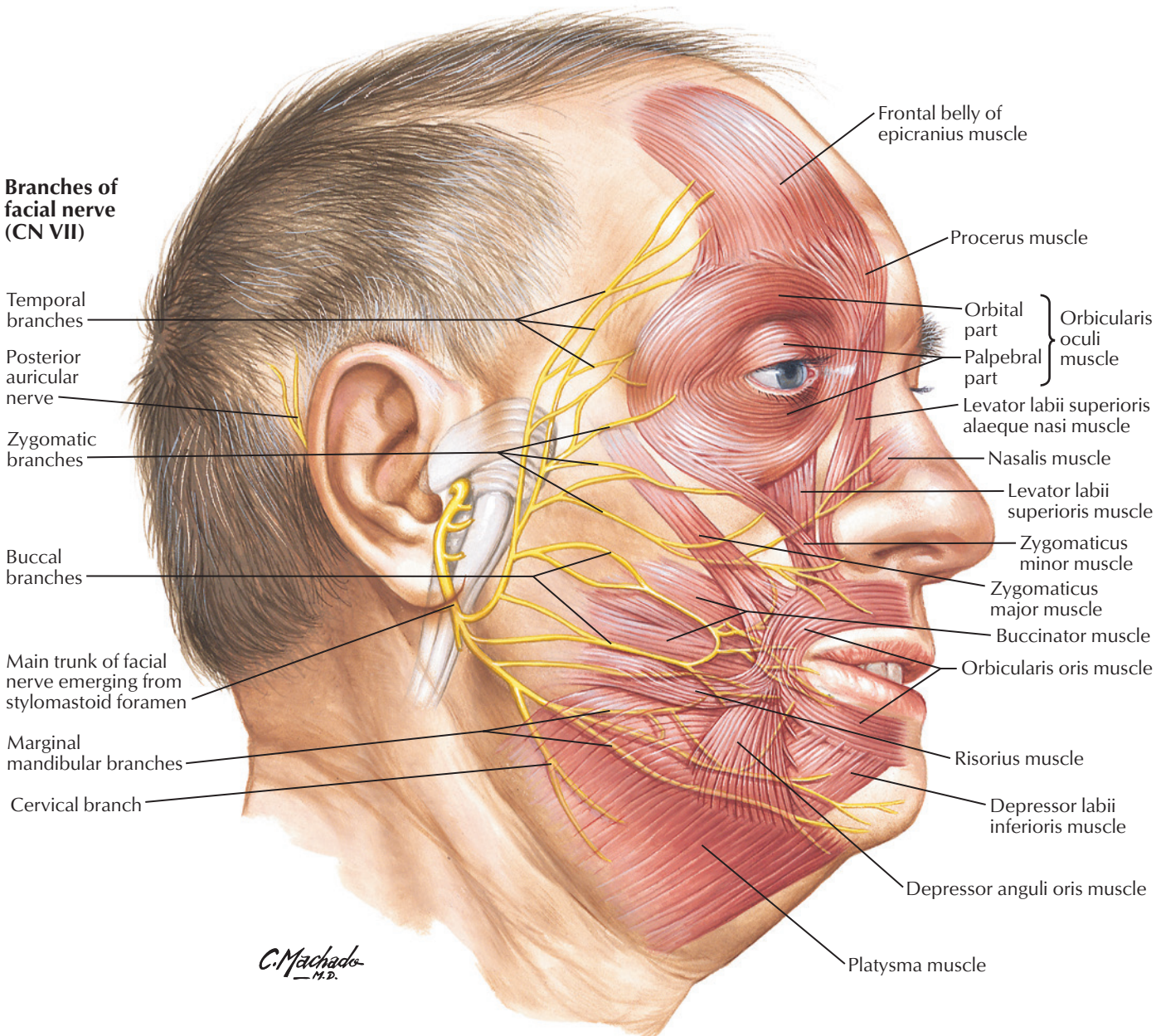
Os odontoideum with fibrous union and narrowing of vertebral canal with head in extension

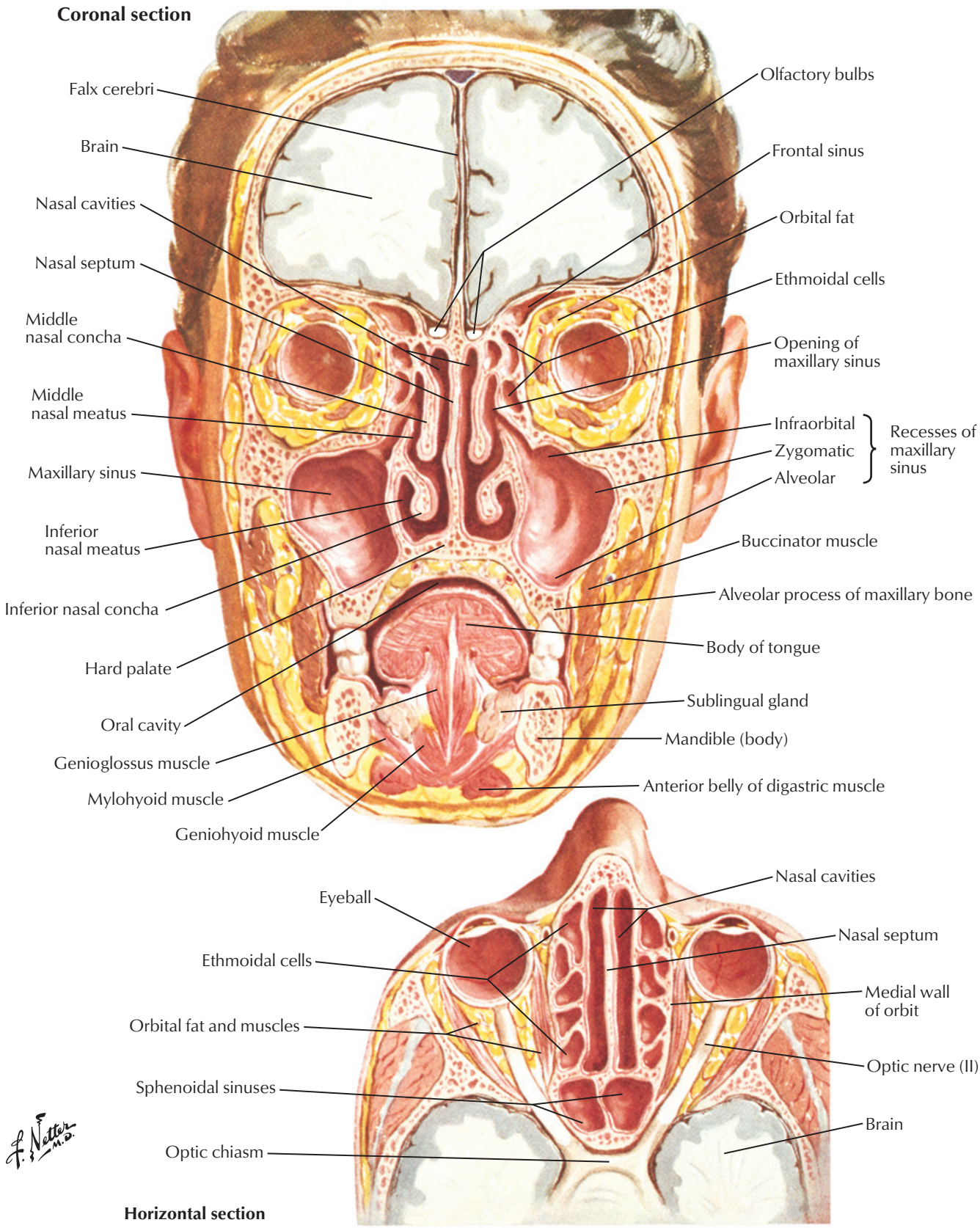


Course of wrinkle lines (Langer's lines) of skin is transverse to fiber direction of facial muscles. Elliptical incisions for removal of skin tumors conform to direction of wrinkle lines.

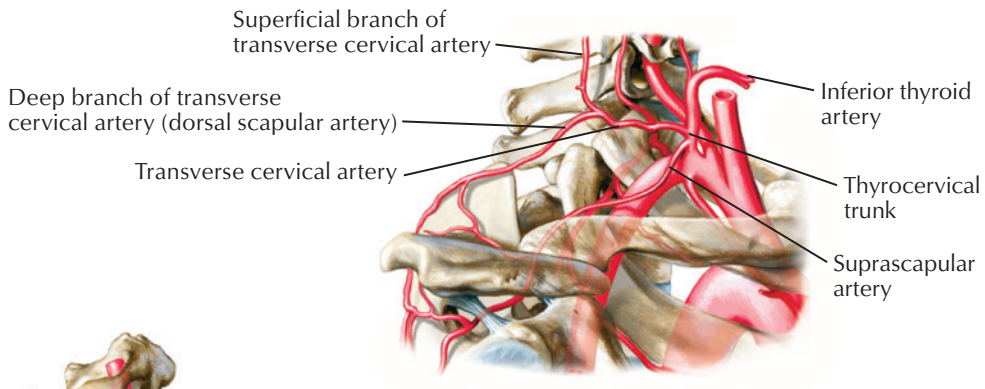




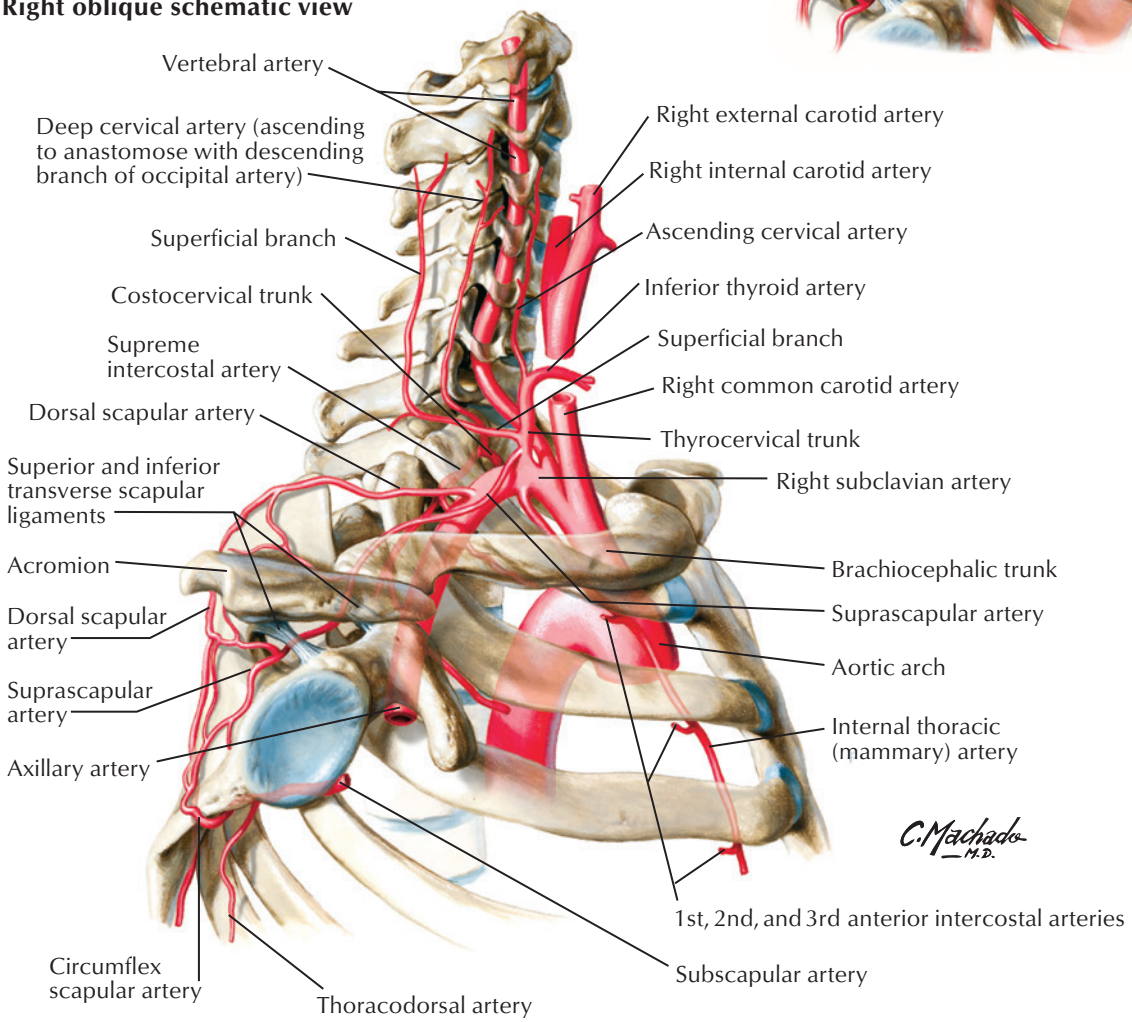

Branches of facial nerve (CN VII)
Temporal branches
Posterior auricular nerve
Zygomatic branches
Buccal branches
Main trunk of facial nerve emerging from stylomastoid foramen
Marginal mandibular branches
Cervical branch
Frontal belly of epicranius muscle
Procerus muscle
Orbital part
Palpebral part
Orbicularis oculi muscle
Levator labii superioris alaeque nasi muscle
Nasalis muscle
Levator labii superioris muscle
Zygomaticus minor muscle
Zygomaticus major muscle
Buccinator muscle
Orbicularis oris muscle
Risorius muscle
Depressor labii inferioris muscle
Depressor anguli oris muscle
Platysma muscle
C. Machado M.D.

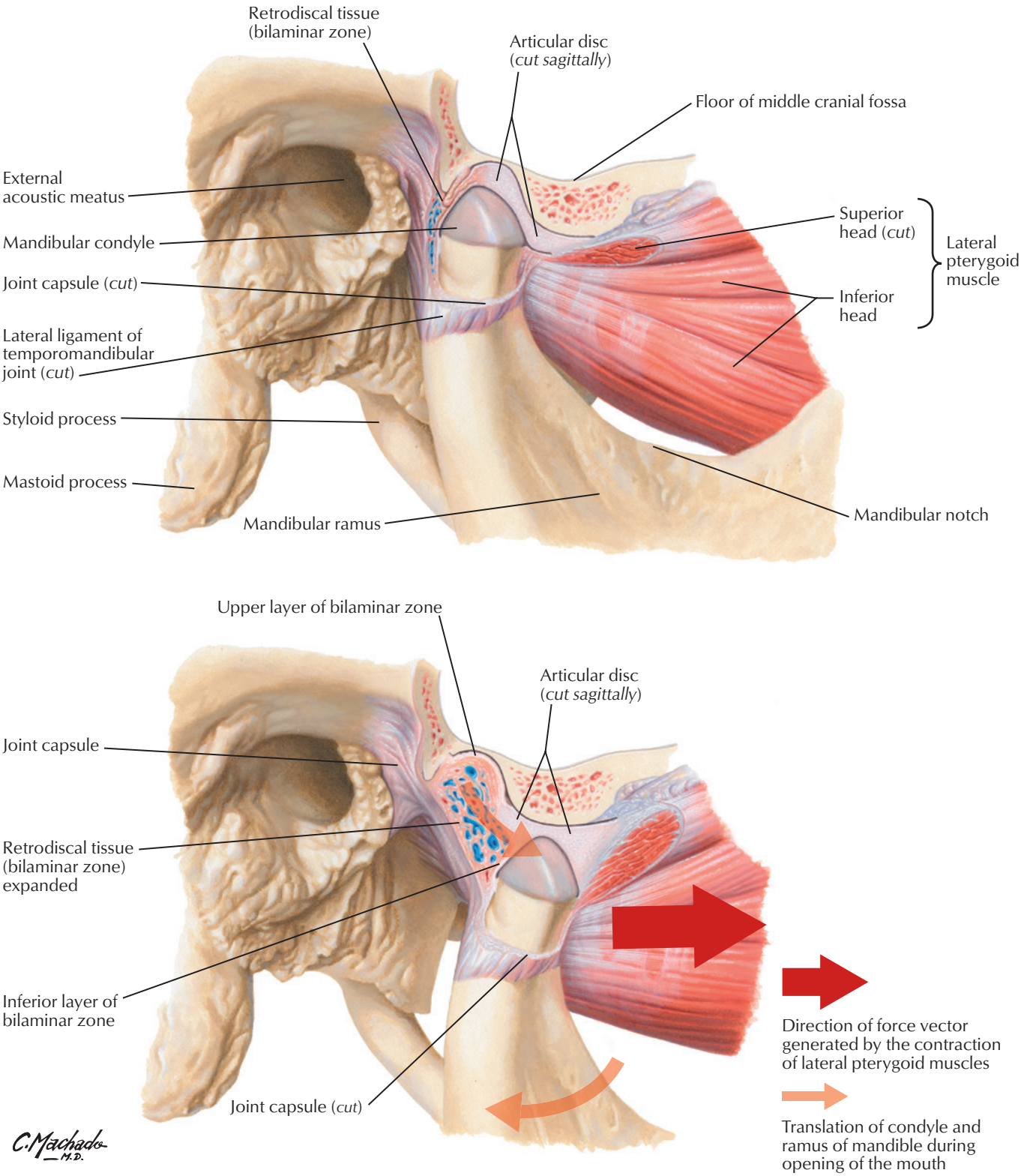

Coronal section
Falx cerebri
Brain
Nasal cavities
Nasal septum
Middle nasal concha
Middle nasal meatus
Maxillary sinus
Inferior nasal meatus
Inferior nasal concha
Hard palate
Oral cavity
Genioglossus muscle
Mylohyoid muscle
Geniohyoid muscle
Olfactory bulbs
Frontal sinus
Orbital fat
Ethmoidal cells
Opening of maxillary sinus
Infraorbital
Zygomatic
Alveolar
Recesses of maxillary sinus
Buccinator muscle
Alveolar process of maxillary bone
Body of tongue
Sublingual gland
Mandible (body)
Anterior belly of digastric muscle
Eyeball
Ethmoidal cells
Orbital fat and muscles
Sphenoidal sinuses
Optic chiasm
Nasal cavities
Nasal septum
Medial wall of orbit
Optic nerve (II)
Brain
Horizontal section

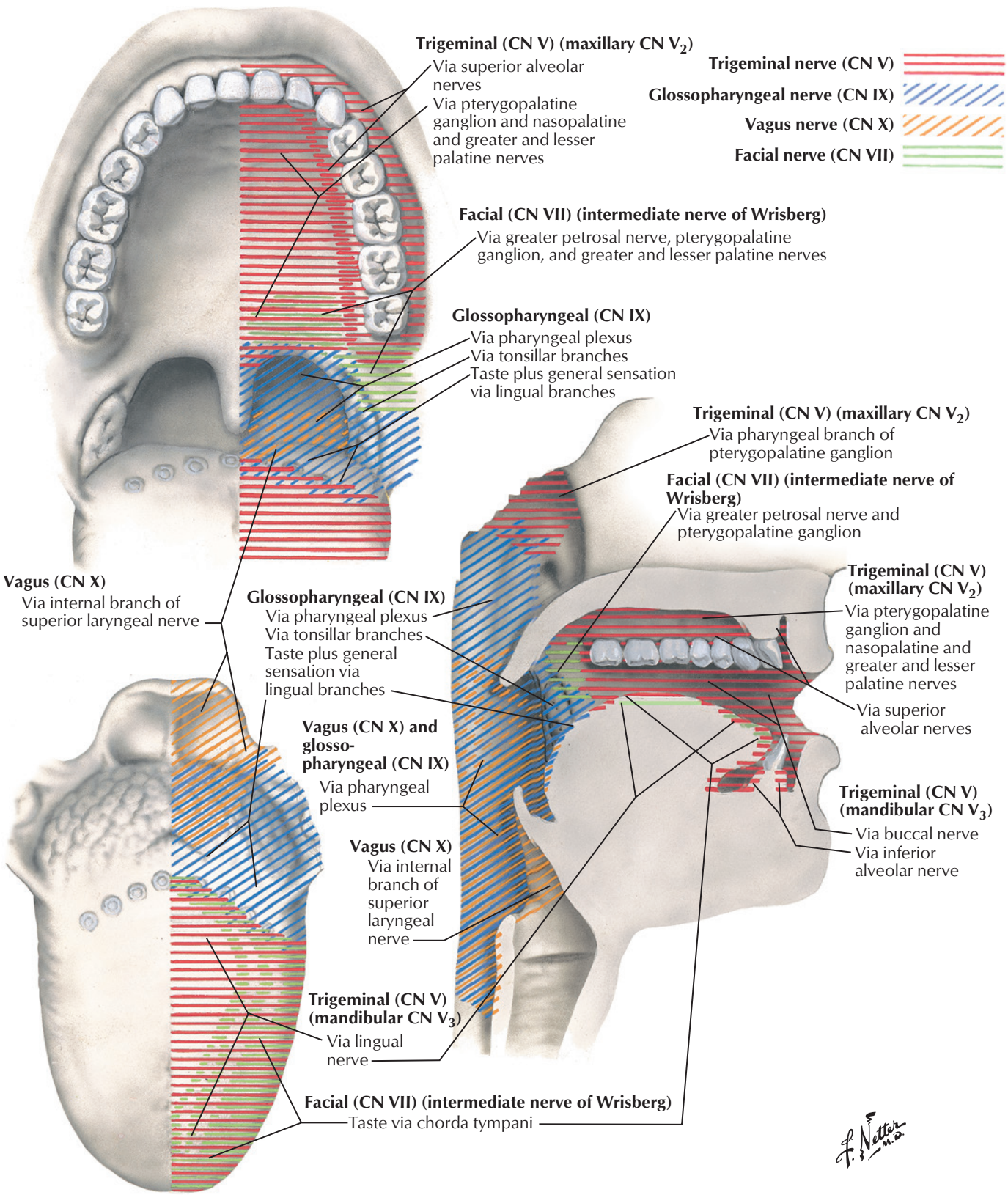
Common origin of superficial cervical and dorsal scapular arteries from transverse cervical artery (~30%)



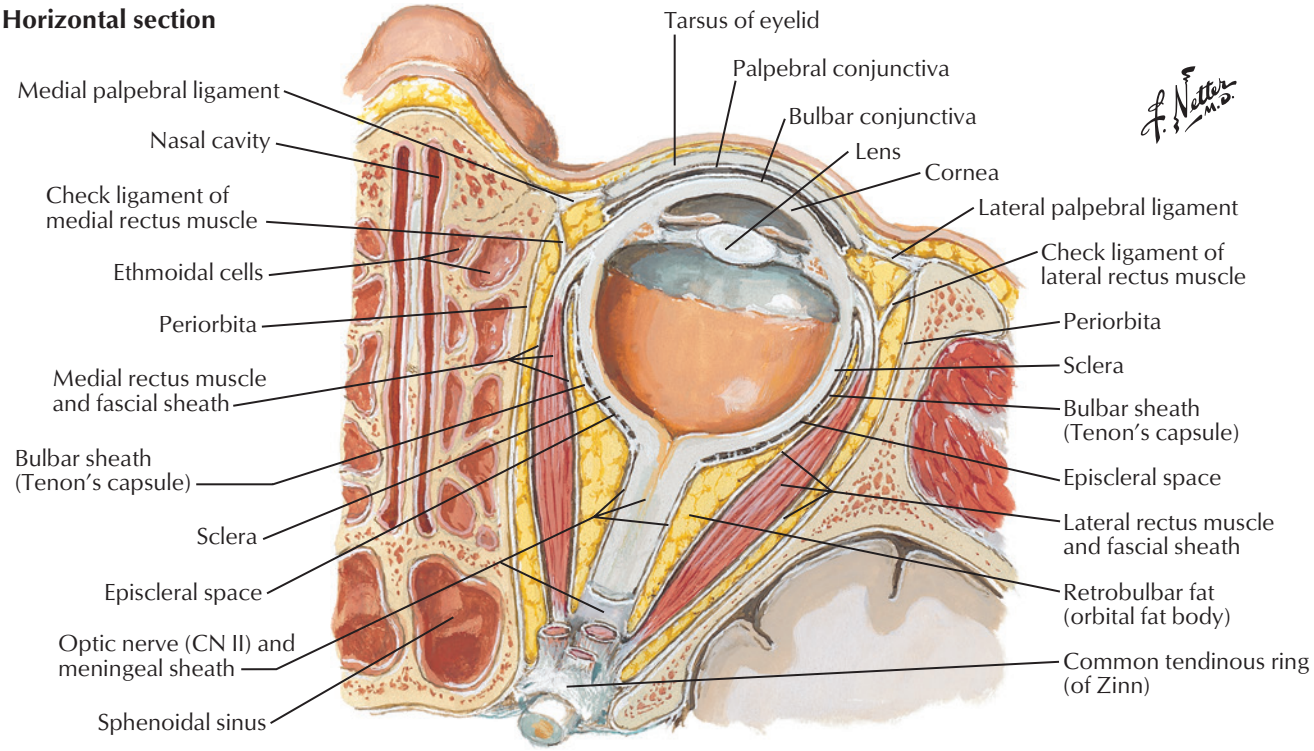
Right oblique schematic view



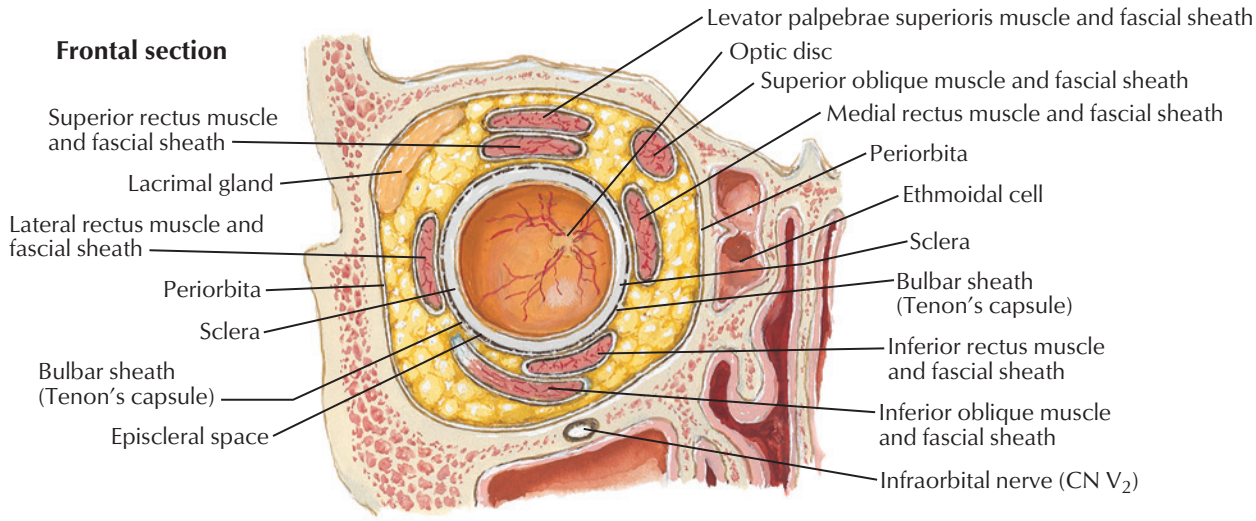

Retrodiscal tissue (bilaminar zone)
Articular disc (cut sagittally)
Floor of middle cranial fossa
External acoustic meatus
Mandibular condyle
Joint capsule (cut)
Lateral ligament of temporomandibular joint (cut)
Styloid process
Mastoid process
Mandibular ramus
Superior head (cut)
Inferior head
Lateral pterygoid muscle
Mandibular notch
Upper layer of bilaminar zone
Articular disc (cut sagittally)
Joint capsule
Retrodiscal tissue (bilaminar zone) expanded
Inferior layer of bilaminar zone
Joint capsule (cut)
Direction of force vector generated by the contraction of lateral pterygoid muscles
Translation of condyle and ramus of mandible during opening of the mouth
C. Machado M.D.


Trigeminal (CN V) (maxillary CN V2)
Via superior alveolar nerves
Via pterygopalatine ganglion and nasopalatine and greater and lesser palatine nerves
Trigeminal nerve (CN V)
Glossopharyngeal nerve (CN IX)
Vagus nerve (CN X)
Facial nerve (CN VII)
Facial (CN VII) (intermediate nerve of Wrisberg)
Via greater petrosal nerve, pterygopalatine ganglion, and greater and lesser palatine nerves
Glossopharyngeal (CN IX)
Via pharyngeal plexus
Via tonsillar branches
Taste plus general sensation via lingual branches
Trigeminal (CN V) (maxillary CN V2)
Via pharyngeal branch of pterygopalatine ganglion
Facial (CN VII) (intermediate nerve of Wrisberg)
Via greater petrosal nerve and pterygopalatine ganglion
Vagus (CN X)
Via internal branch of superior laryngeal nerve
Glossopharyngeal (CN IX)
Via pharyngeal plexus
Via tonsillar branches
Taste plus general sensation via lingual branches
Trigeminal (CN V) (maxillary CN V2)
Via pterygopalatine ganglion and nasopalatine and greater and lesser palatine nerves
Via superior alveolar nerves
Vagus (CN X) and glosso-pharyngeal (CN IX)
Via pharyngeal plexus
Trigeminal (CN V) (mandibular CN V3)
Via buccal nerve
Via inferior alveolar nerve
Vagus (CN X)
Via internal branch of superior laryngeal nerve
Trigeminal (CN V) (mandibular CN V3)
Via lingual nerve
Facial (CN VII) (intermediate nerve of Wrisberg)
Taste via chorda tympani
F. Netter M.D.

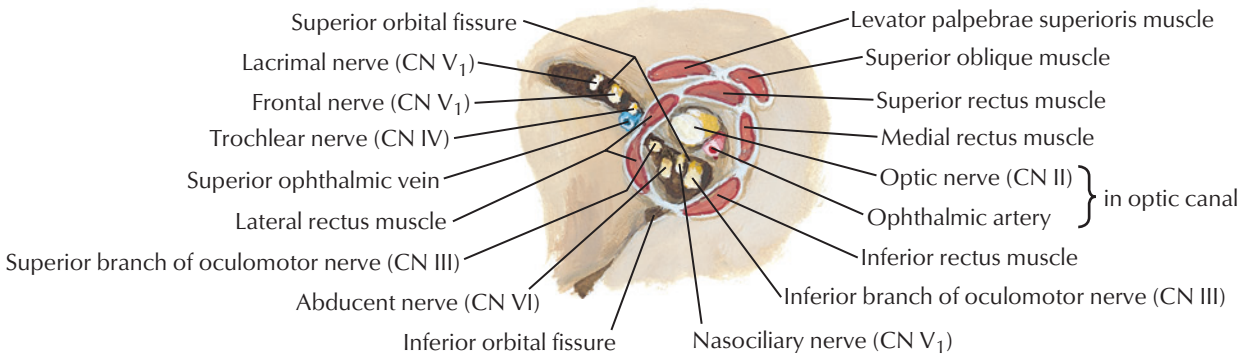
Horizontal section



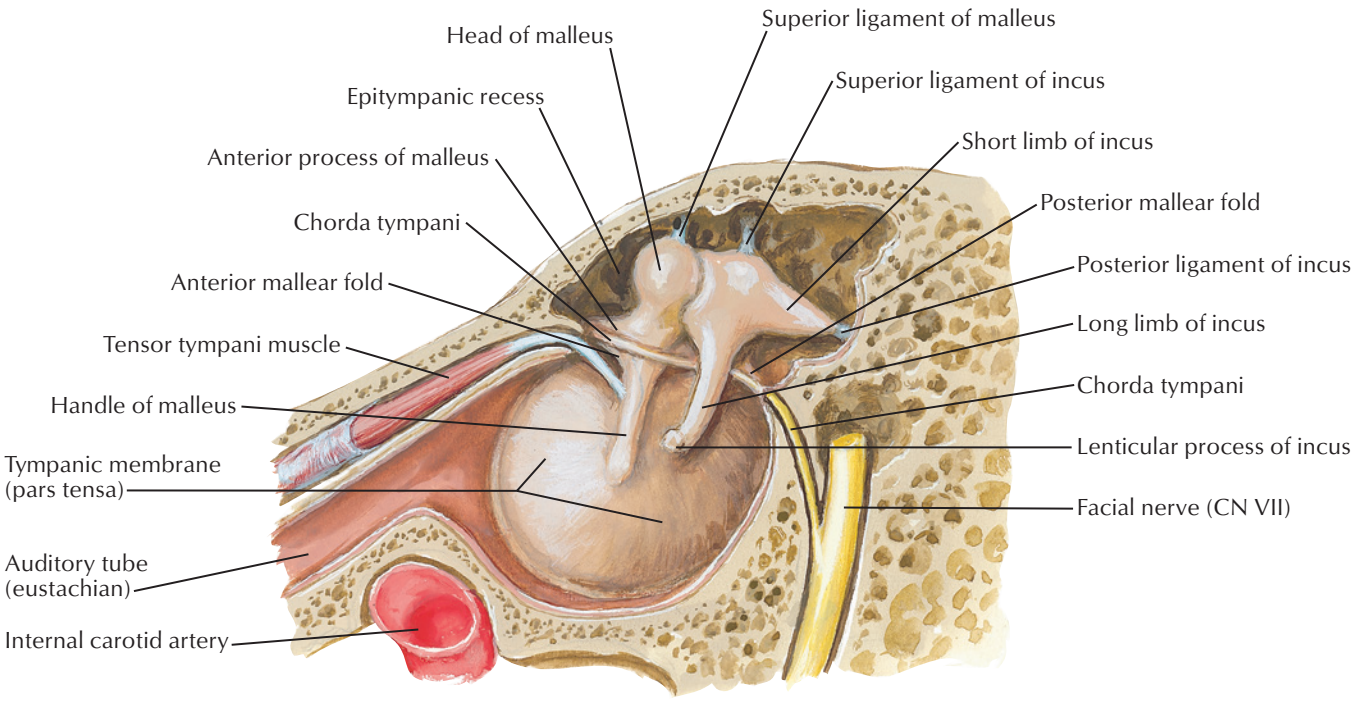
Frontal section



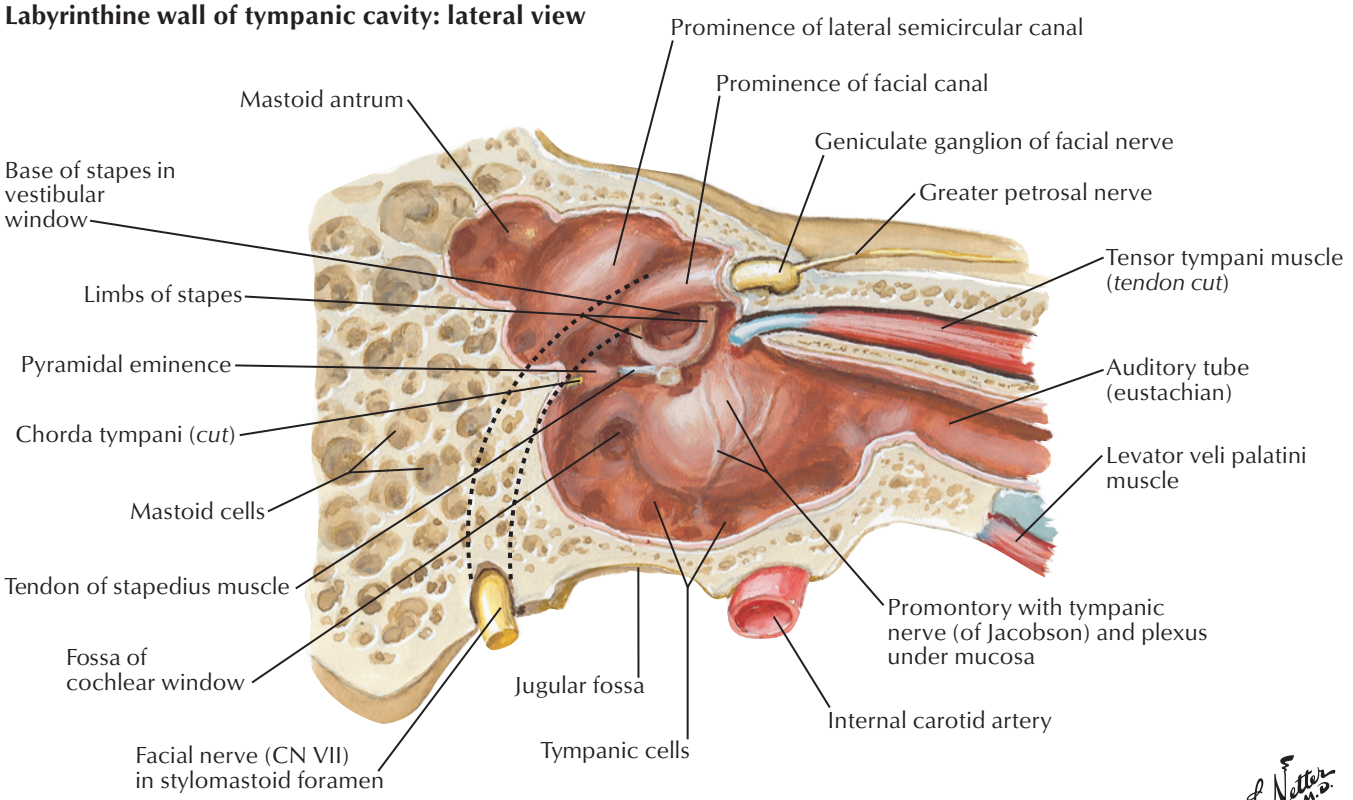
Muscle attachments and nerves and vessels entering orbit



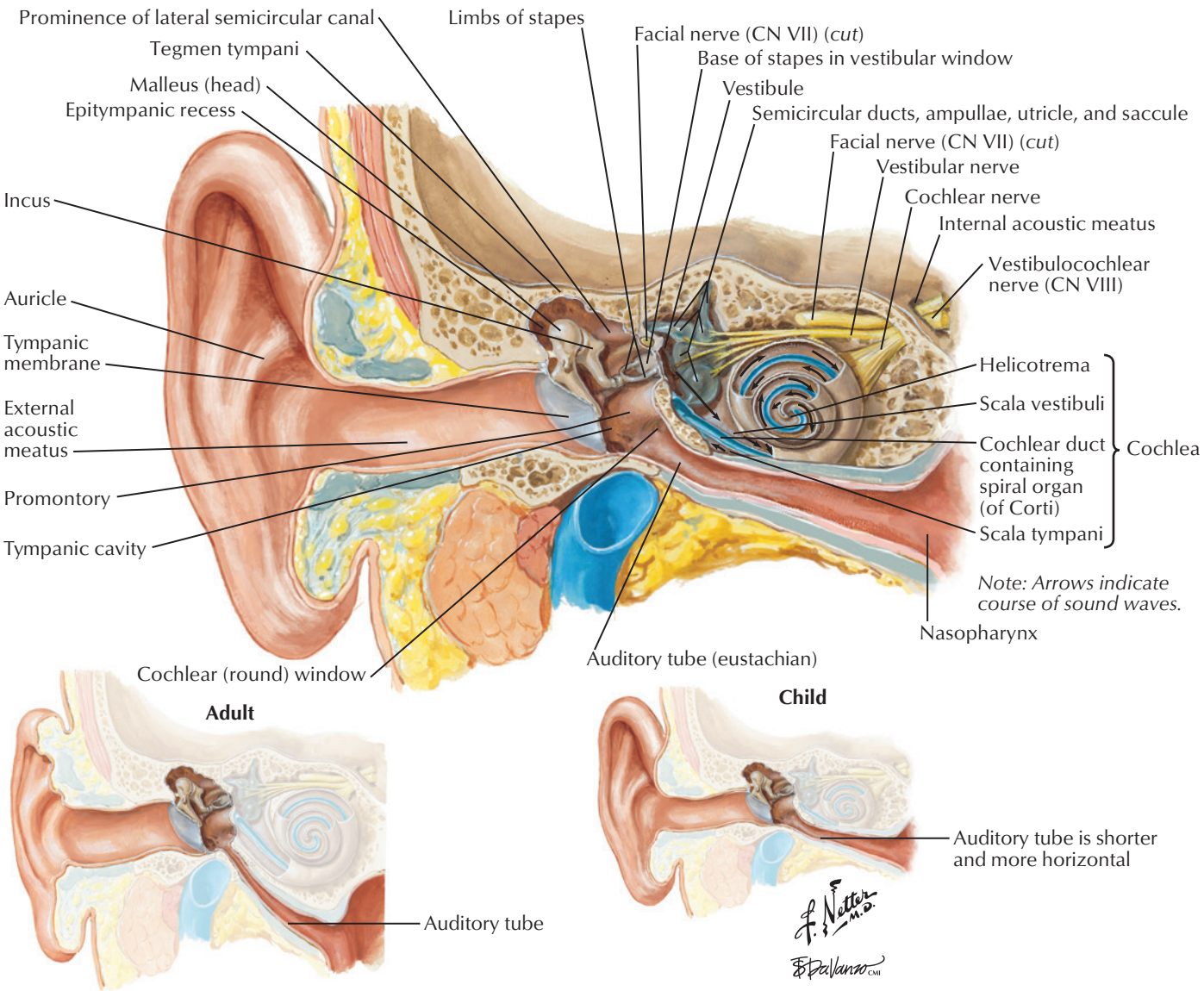
Lateral wall of tympanic cavity: medial (internal) view



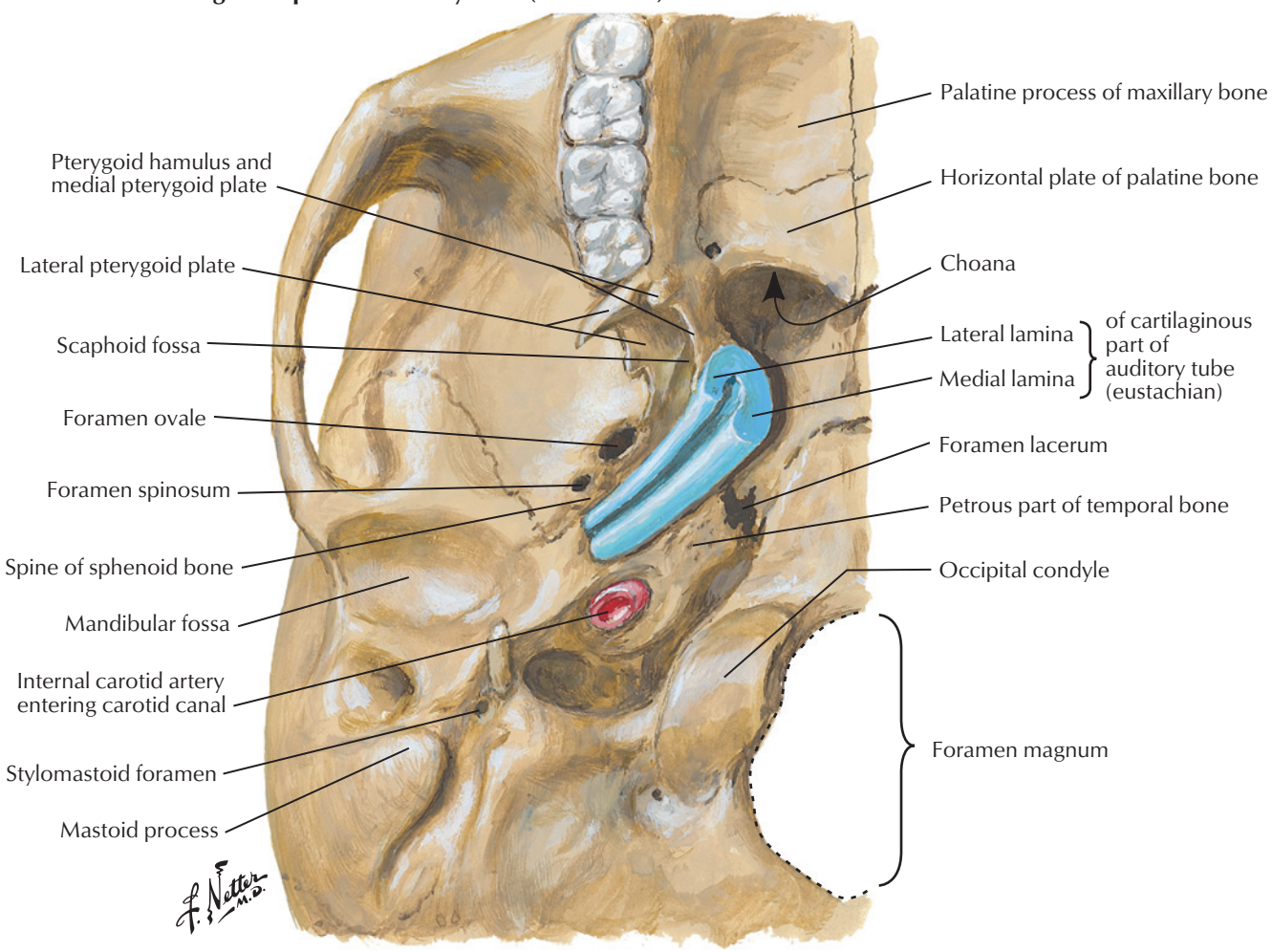
Labyrinthine wall of tympanic cavity: lateral view

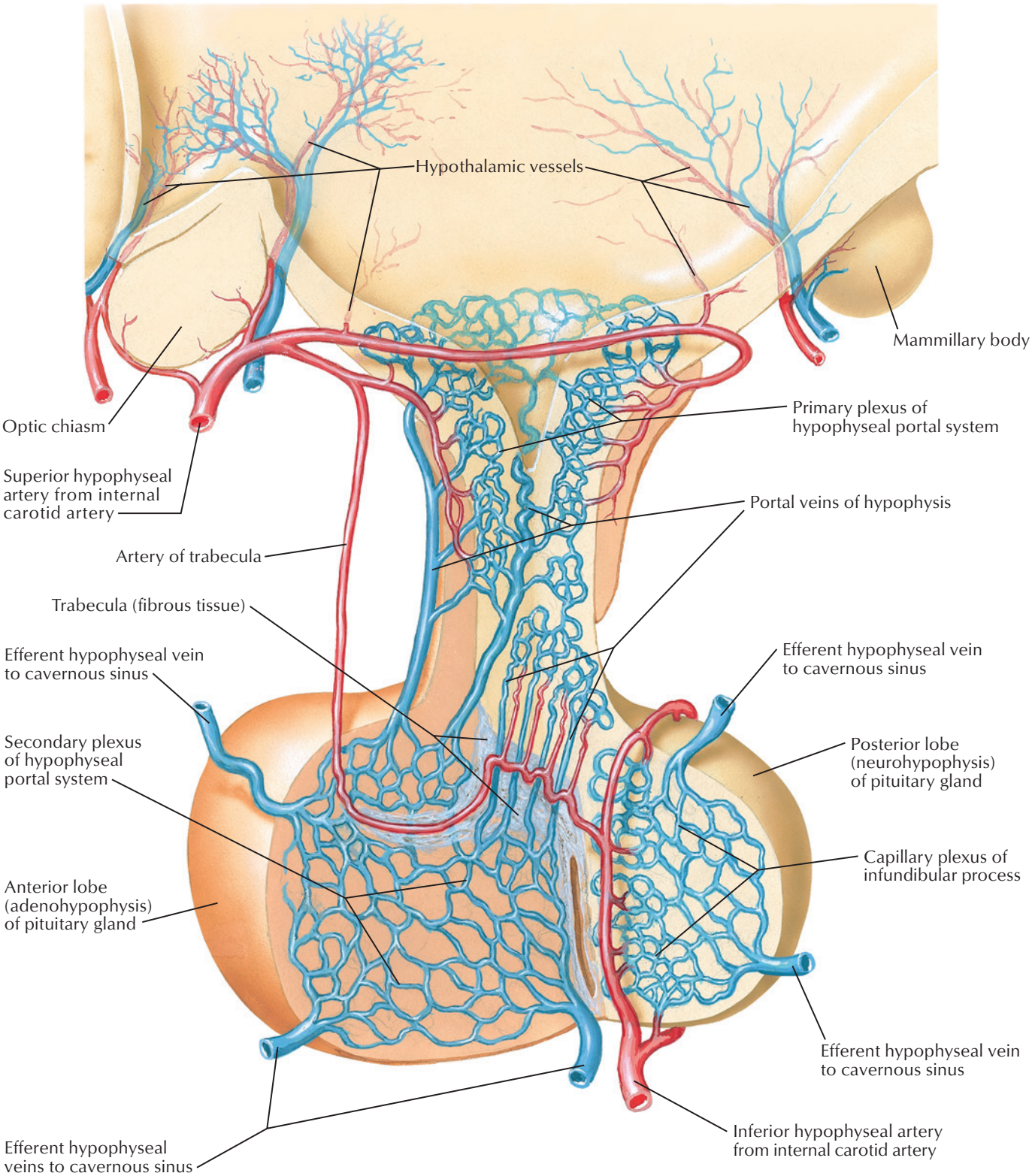


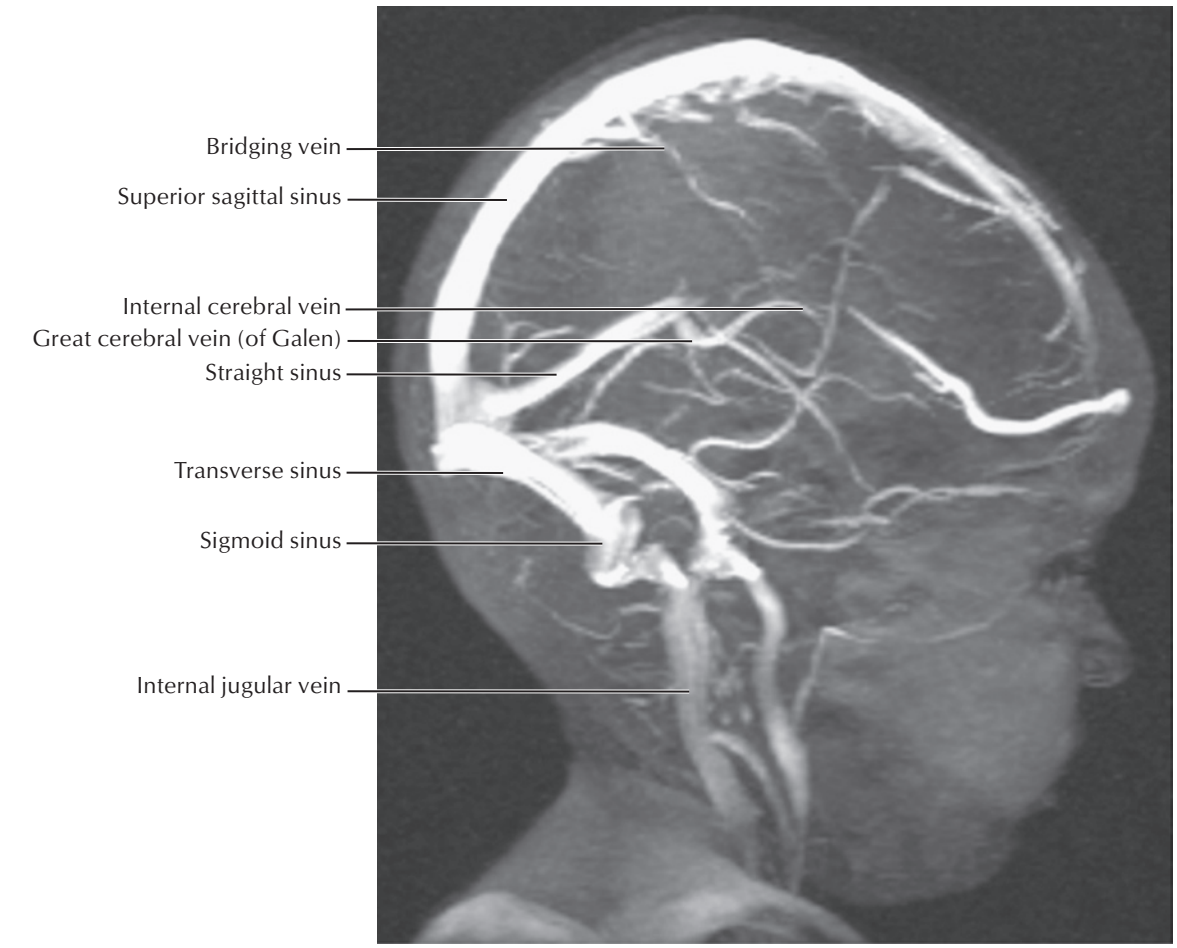
Pediatric ear: frontal section

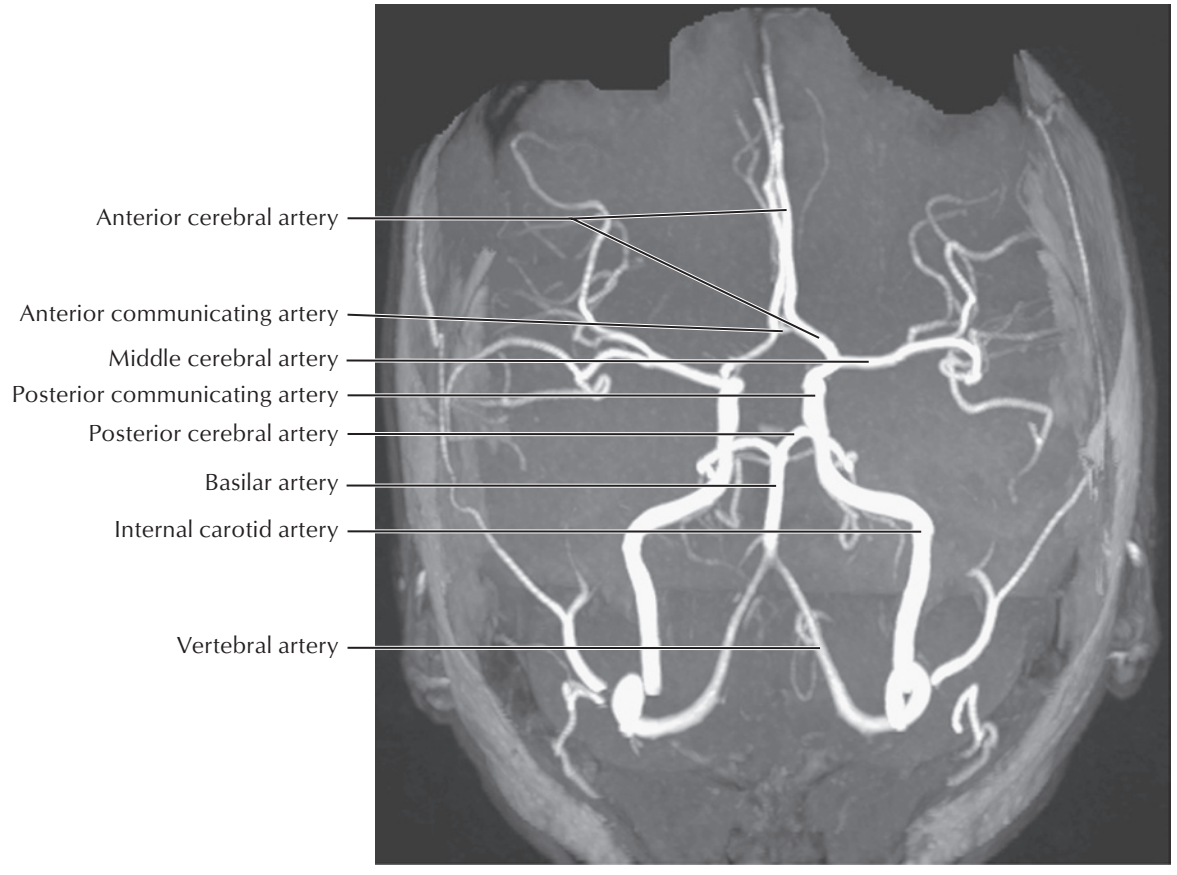


Cartilaginous part of auditory tube (eustachian) at base of skull: inferior view




Hypothalamic vessels
Mammillary body
Optic chiasm
Primary plexus of hypophyseal portal system
Superior hypophyseal artery from internal carotid artery
Portal veins of hypophysis
Artery of trabecula
Trabecula (fibrous tissue)
Efferent hypophyseal vein to cavernous sinus
Efferent hypophyseal vein to cavernous sinus
Secondary plexus of hypophyseal portal system
Posterior lobe (neurohypophysis) of pituitary gland
Capillary plexus of infundibular process
Anterior lobe (adenohypophysis) of pituitary gland
Efferent hypophyseal vein to cavernous sinus
Inferior hypophyseal artery from internal carotid artery
Efferent hypophyseal veins to cavernous sinus

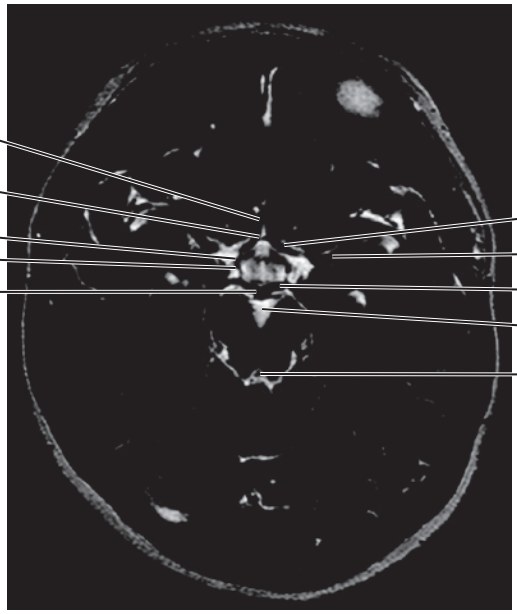

Bridging vein
Superior sagittal sinus
Internal cerebral vein
Great cerebral vein (of Galen)
Straight sinus
Transverse sinus
Sigmoid sinus
Internal jugular vein


Anterior cerebral artery
Anterior communicating artery
Middle cerebral artery
Posterior communicating artery
Posterior cerebral artery
Basilar artery
Internal carotid artery
Vertebral artery

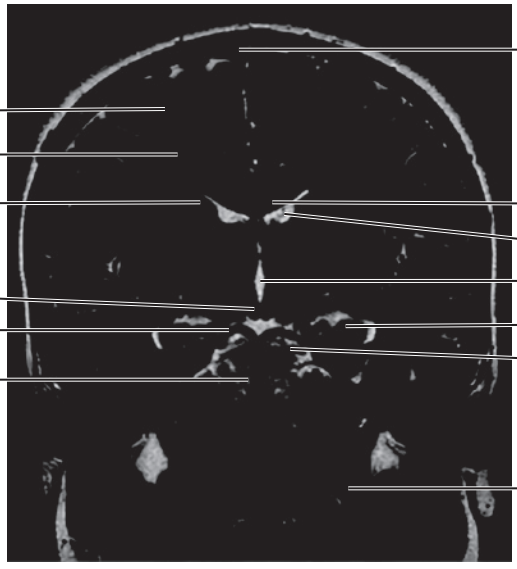
T2-weighted axial brain MRI without contrast



T2-weighted axial brain MRI without contrast



T2-weighted coronal brain MRI without contrast



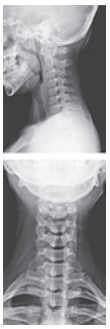
BACK AND SPINAL CORD 3

Surface Anatomy	161	**Structures With High Clinical Significance**	Table 3.1
Bones and Ligaments	162-168	**Muscle Tables**	Tables 3.2-3.3
Spinal Cord	169-179	**Electronic Bonus Plates**	BP33-BP43
Muscles and Nerves	180-184		
Cross-Sectional Anatomy	185-186		

ELECTRONIC BONUS PLATES



BP33 Vertebral Ligaments



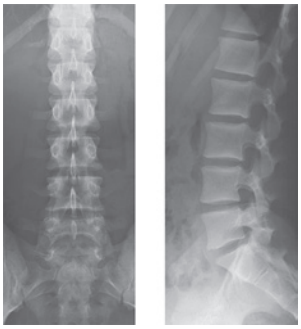
BP34 Cervical Spine: Radiographs



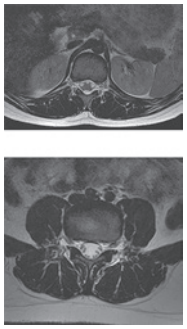
BP35 Cervical Spine: MRI and Radiograph



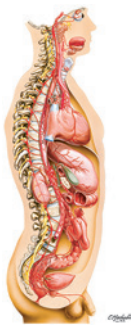
BP36 Thoracolumbar Spine: Lateral Radiograph



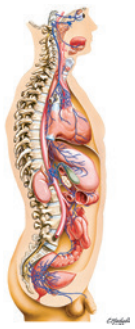
BP37 Lumbar Vertebrae: Radiographs



BP38 Lumbar Spine: MRIs

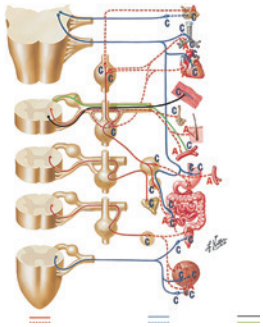


BP39 Sympathetic Nervous System: General Topography



BP40 Parasympathetic Nervous System: General Topography

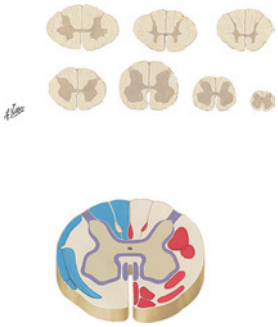
ELECTRONIC BONUS PLATES—*cont'd*



BP41 Cholinergic and Adrenergic Synapses: Schema

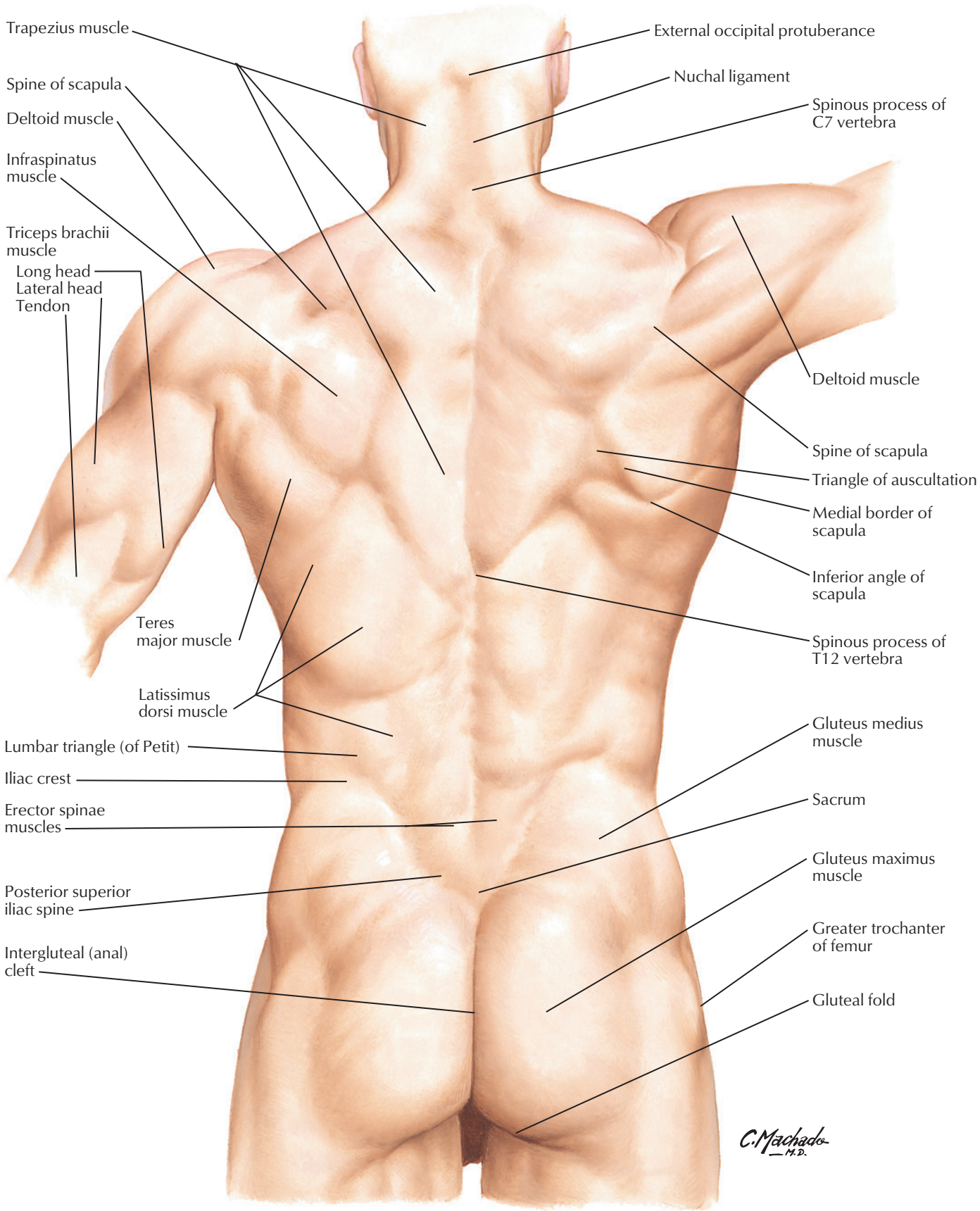


BP42 Vertebral Veins: Detail Showing Venous Communications

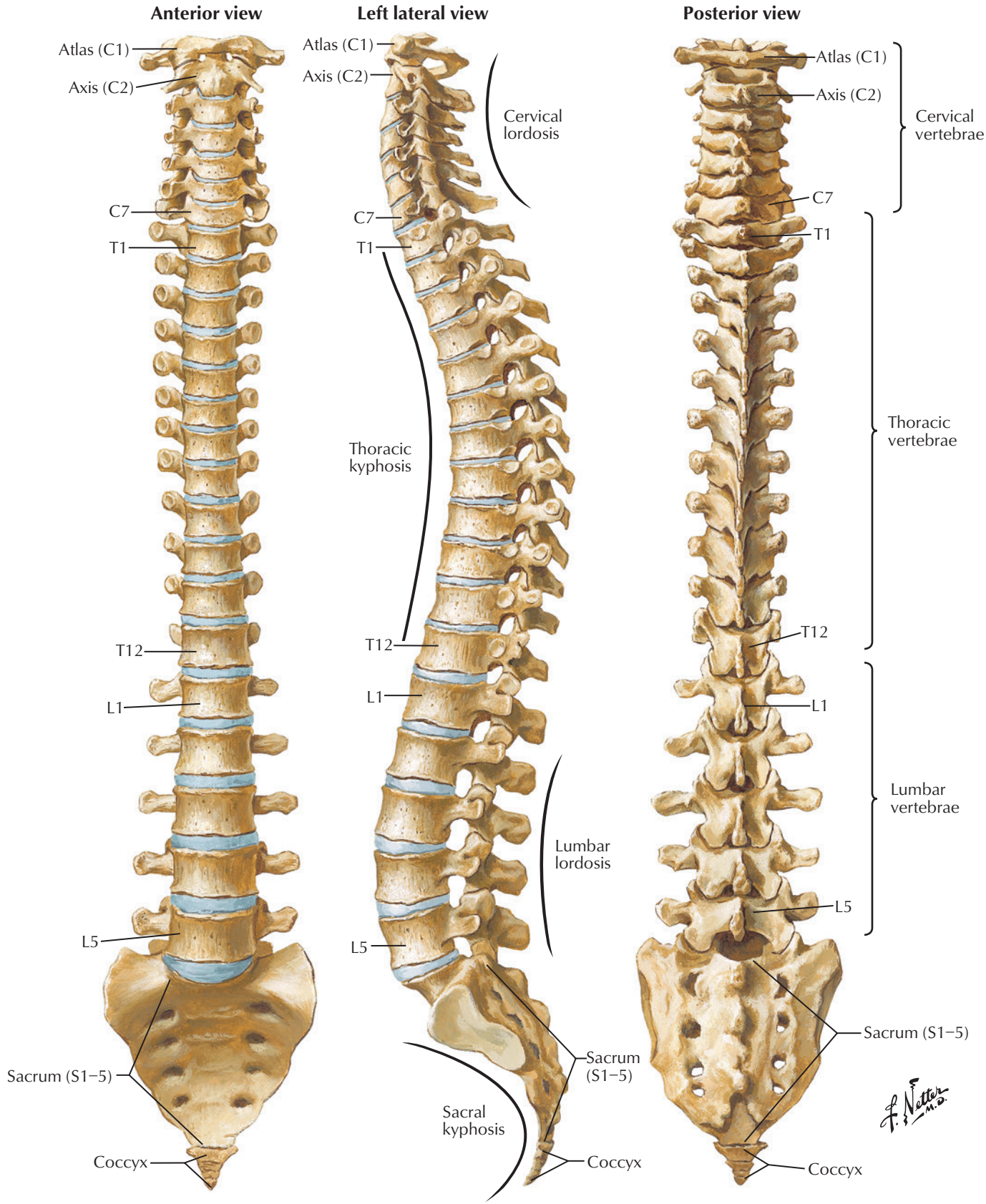


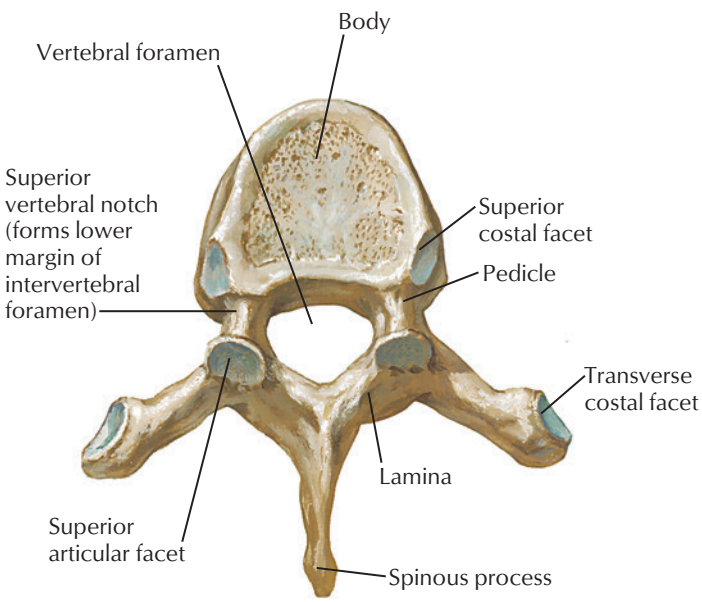
BP43 Spinal Cord Cross Sections: Fiber Tracts

See also Plates 162, 171, 180

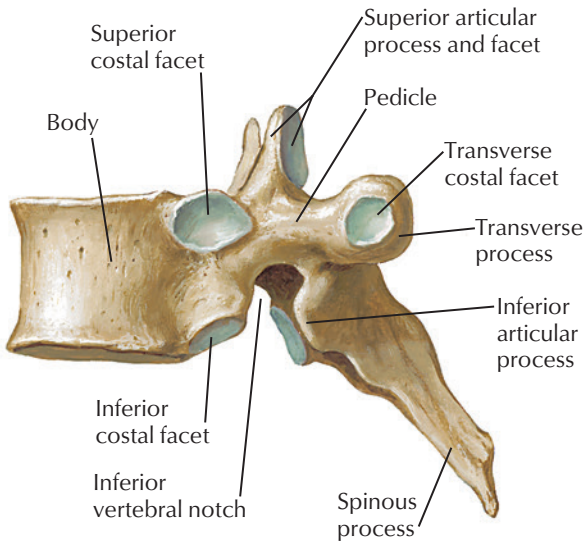


See also Plates 28, 192, 250

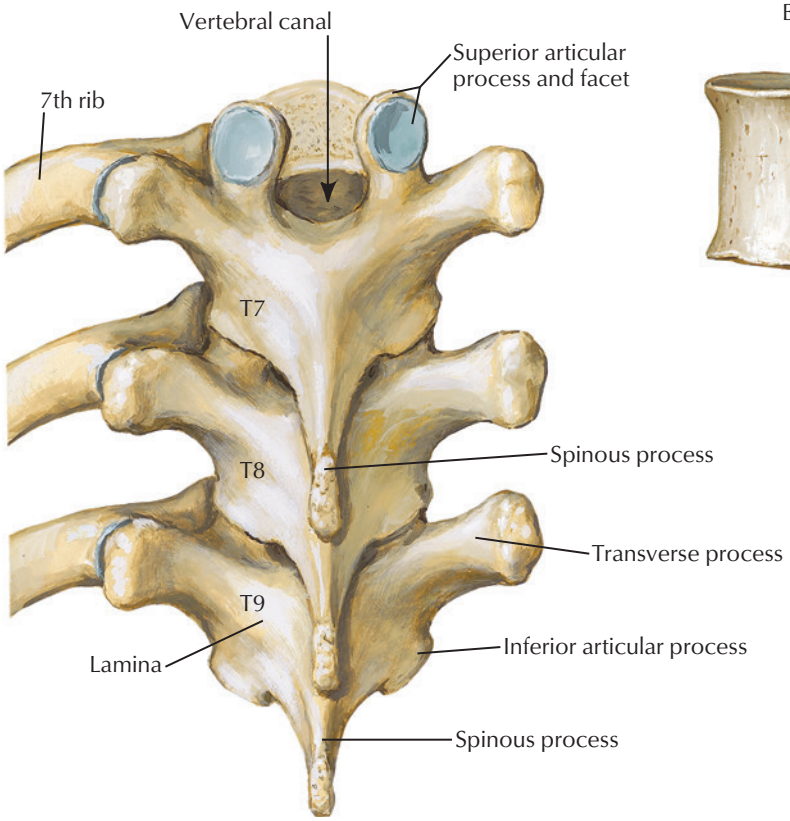




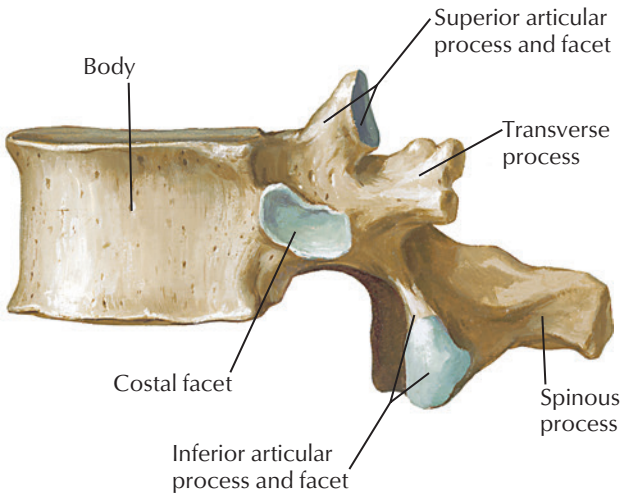
T6 vertebra: superior view



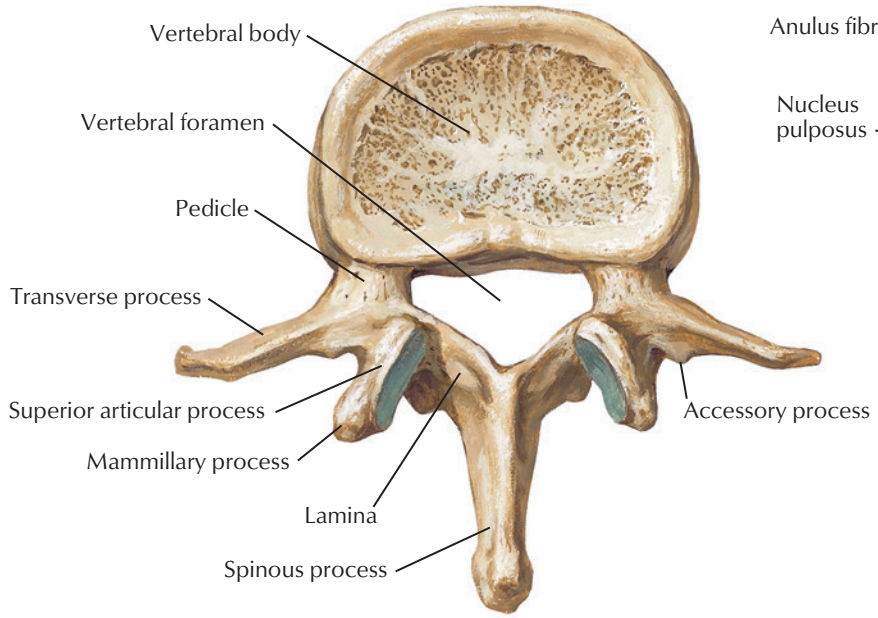
T6 vertebra: lateral view



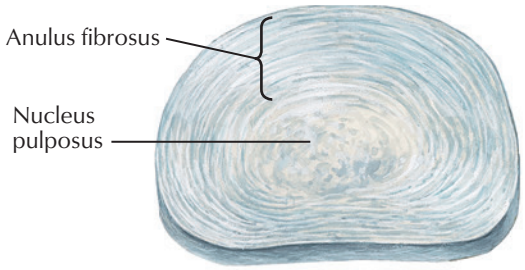
T7, T8, and T9 vertebrae: posterior view



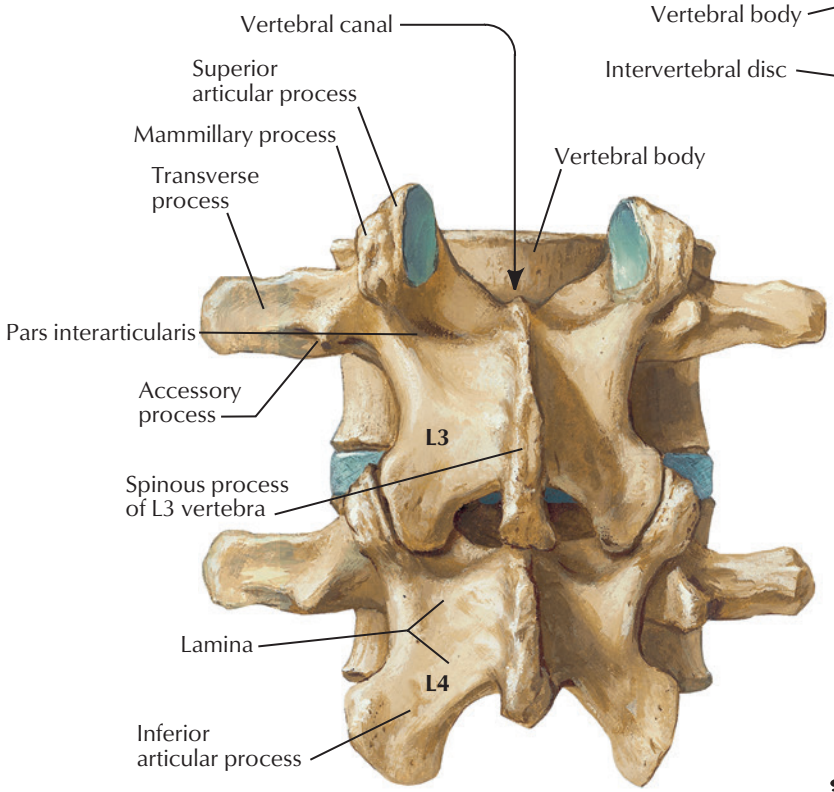
T12 vertebra: lateral view



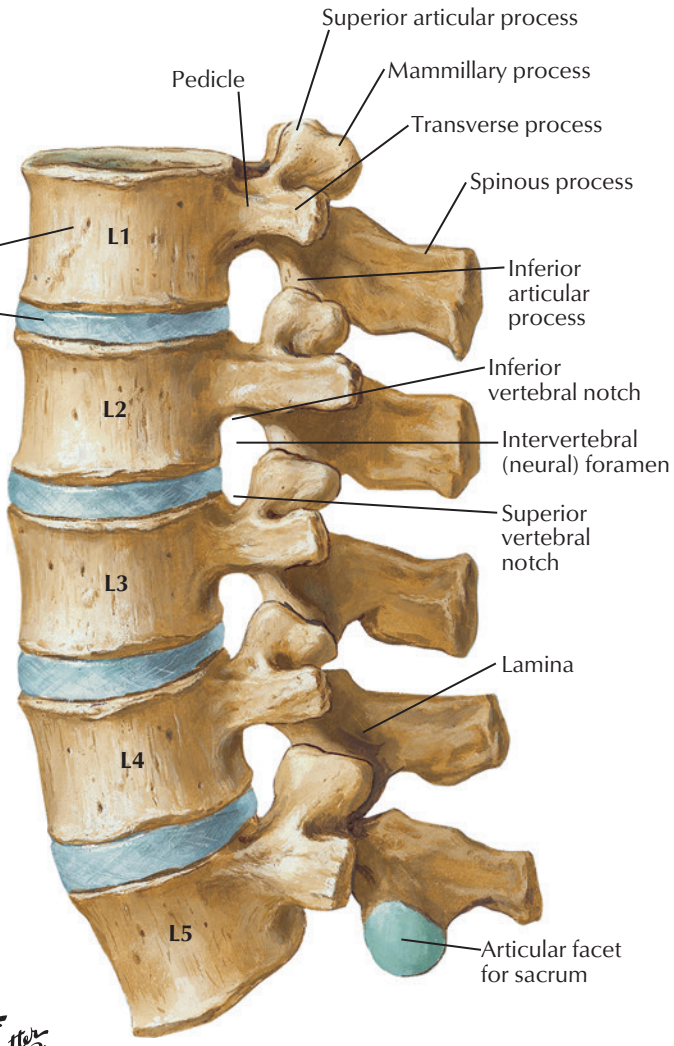
L2 vertebra: superior view



Intervertebral disc



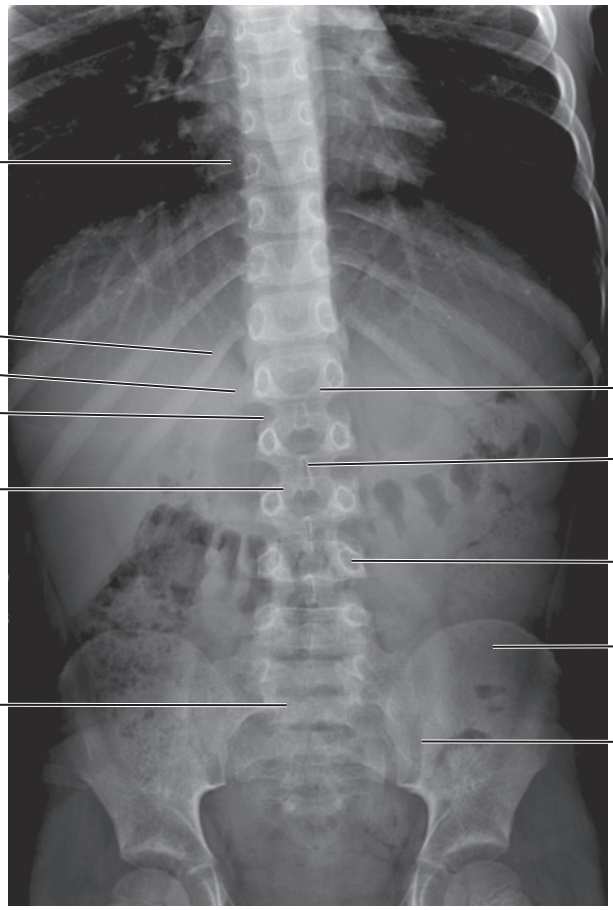
L3 and L4 vertebrae: posterior view



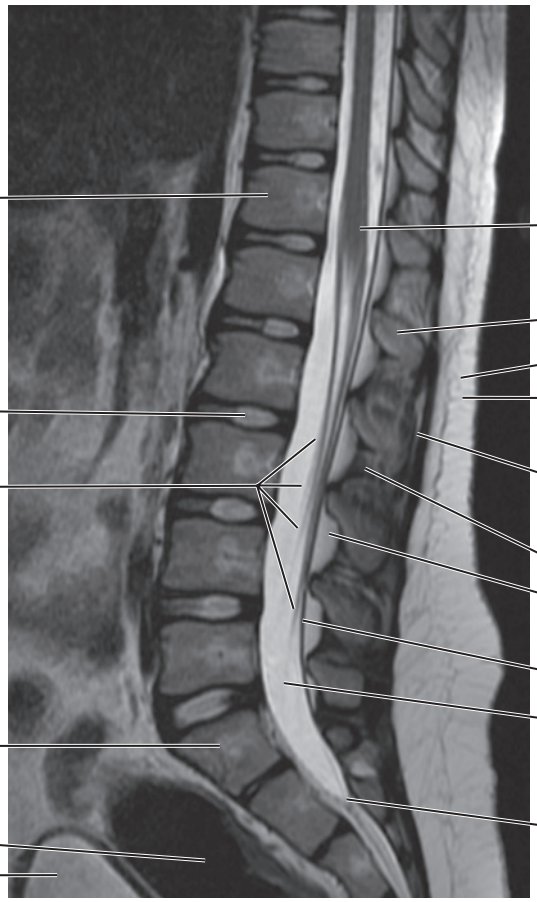
Lumbar vertebrae, articulated: left lateral view

See also Plates 162, 250

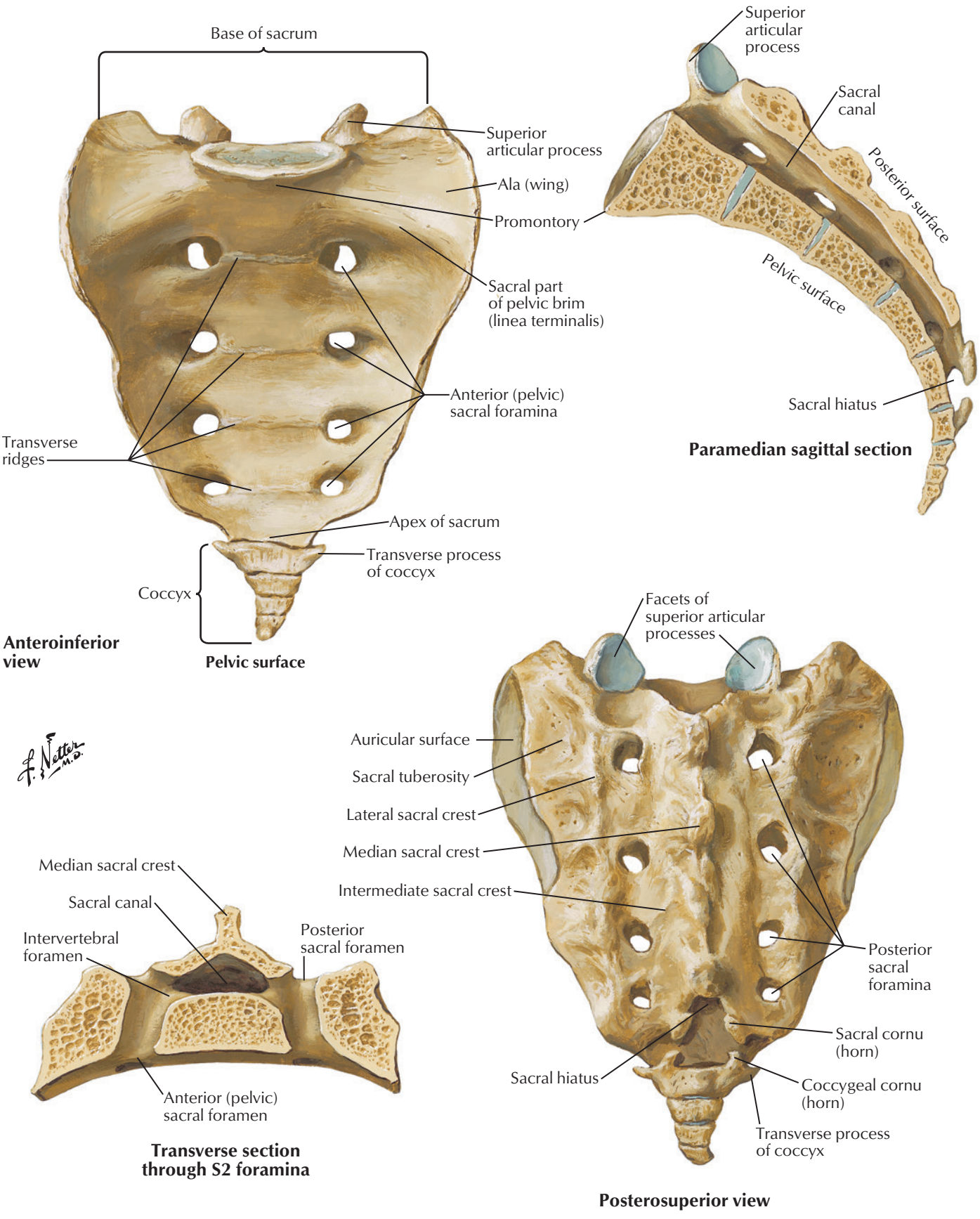
Anteroposterior radiograph of thoracolumbar spine

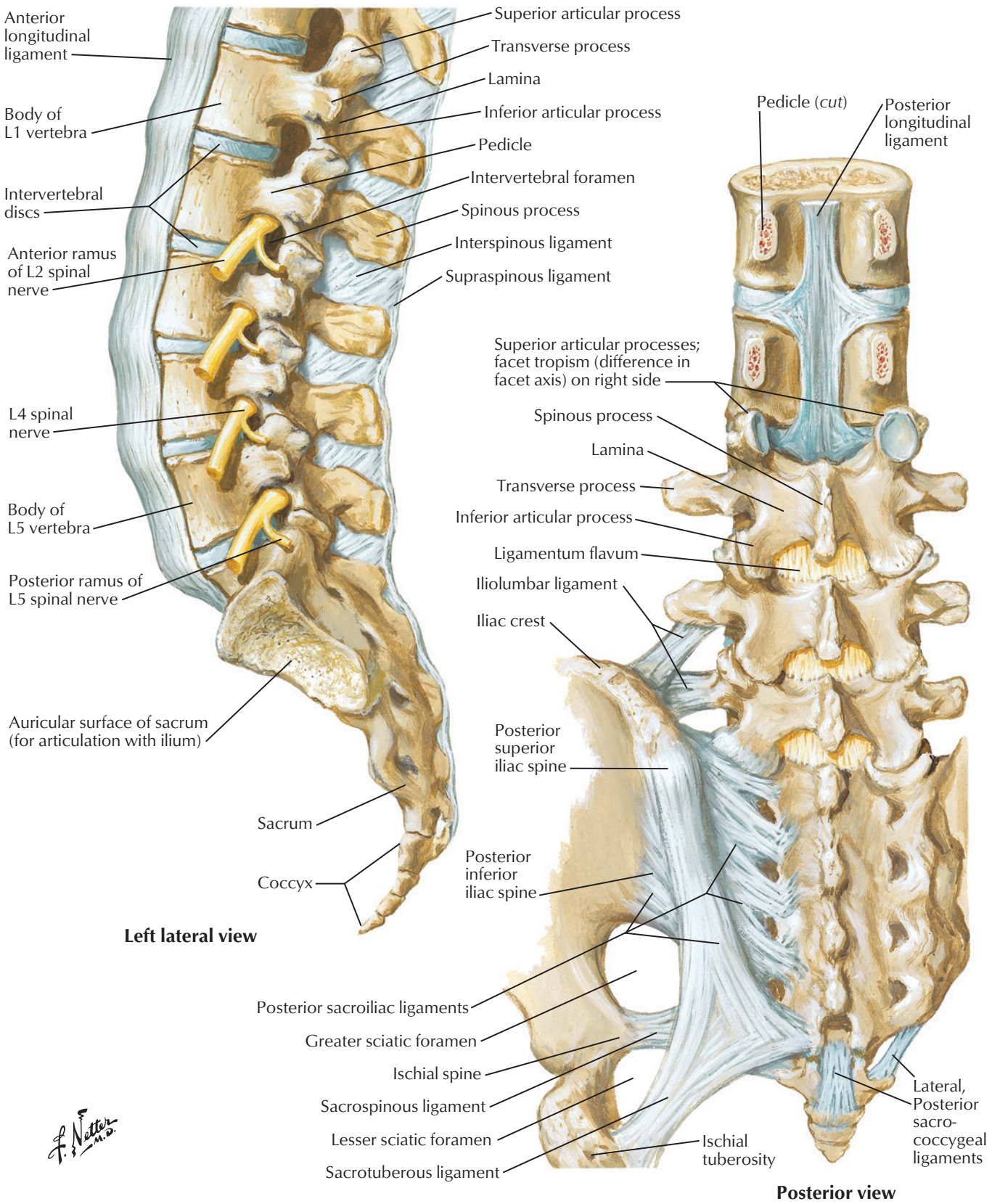


T2-weighted sagittal MRI of lumbar spine

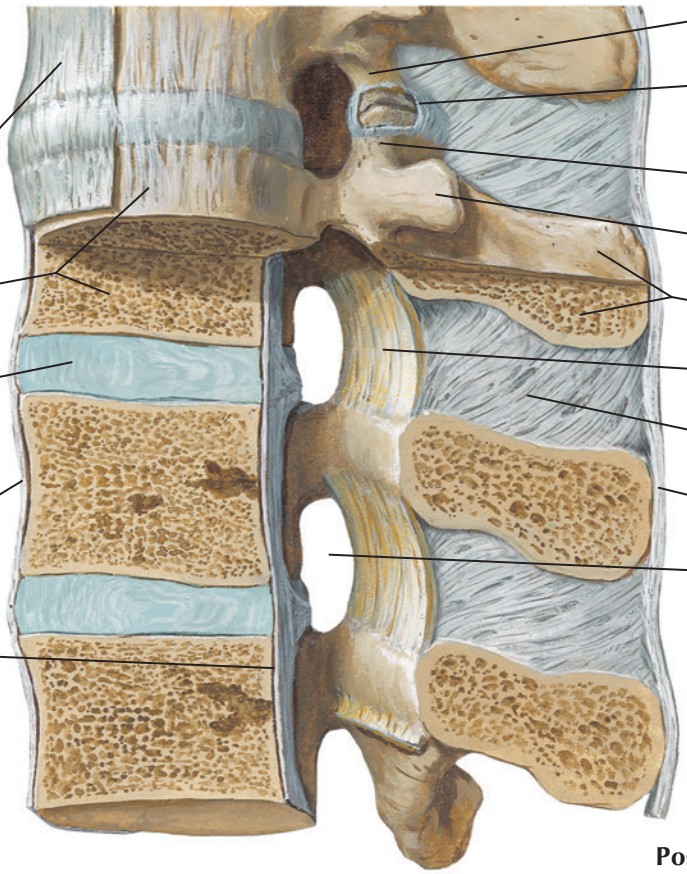


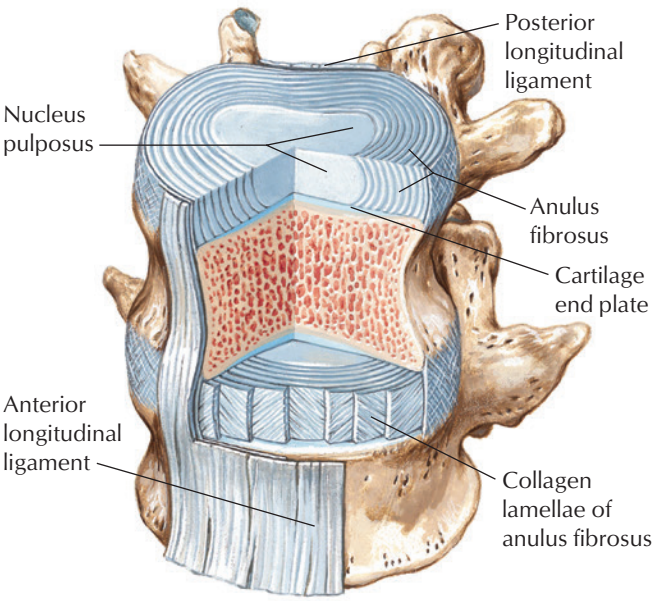
See also Plates 334, 338




Anterior longitudinal ligament
Body of L1 vertebra
Intervertebral discs
Anterior ramus of L2 spinal nerve
L4 spinal nerve
Body of L5 vertebra
Posterior ramus of L5 spinal nerve
Auricular surface of sacrum (for articulation with ilium)
Sacrum
Coccyx
Superior articular process
Transverse process
Lamina
Inferior articular process
Pedicle
Intervertebral foramen
Spinous process
Interspinous ligament
Supraspinous ligament
Left lateral view
Pedicle (cut)
Posterior longitudinal ligament
Superior articular processes; facet tropism (difference in facet axis) on right side
Spinous process
Lamina
Transverse process
Inferior articular process
Ligamentum flavum
Iliolumbar ligament
Iliac crest
Posterior superior iliac spine
Posterior inferior iliac spine
Posterior sacroiliac ligaments
Greater sciatic foramen
Ischial spine
Sacrospinous ligament
Lesser sciatic foramen
Sacrotuberous ligament
Ischial tuberosity
Lateral, Posterior sacro-coccygeal ligaments
Posterior view

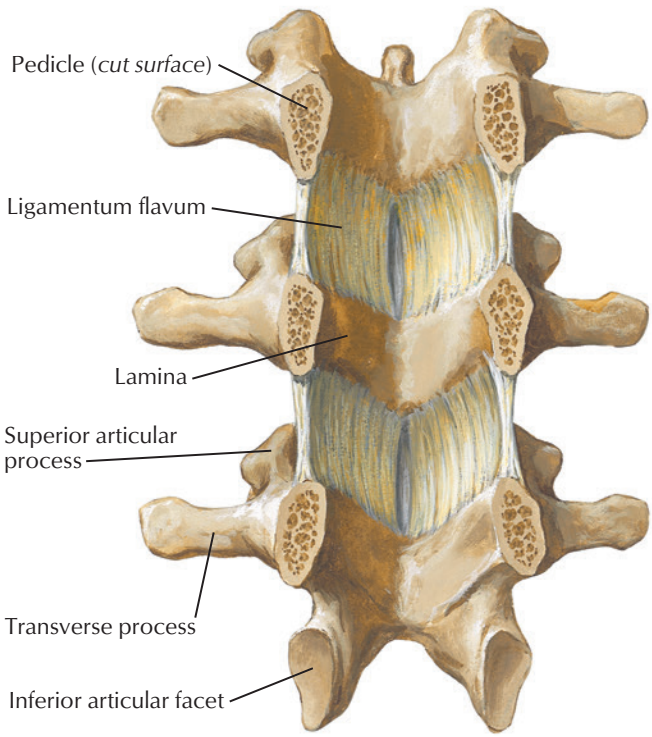
Left lateral view (*partially sectioned in median plane*)

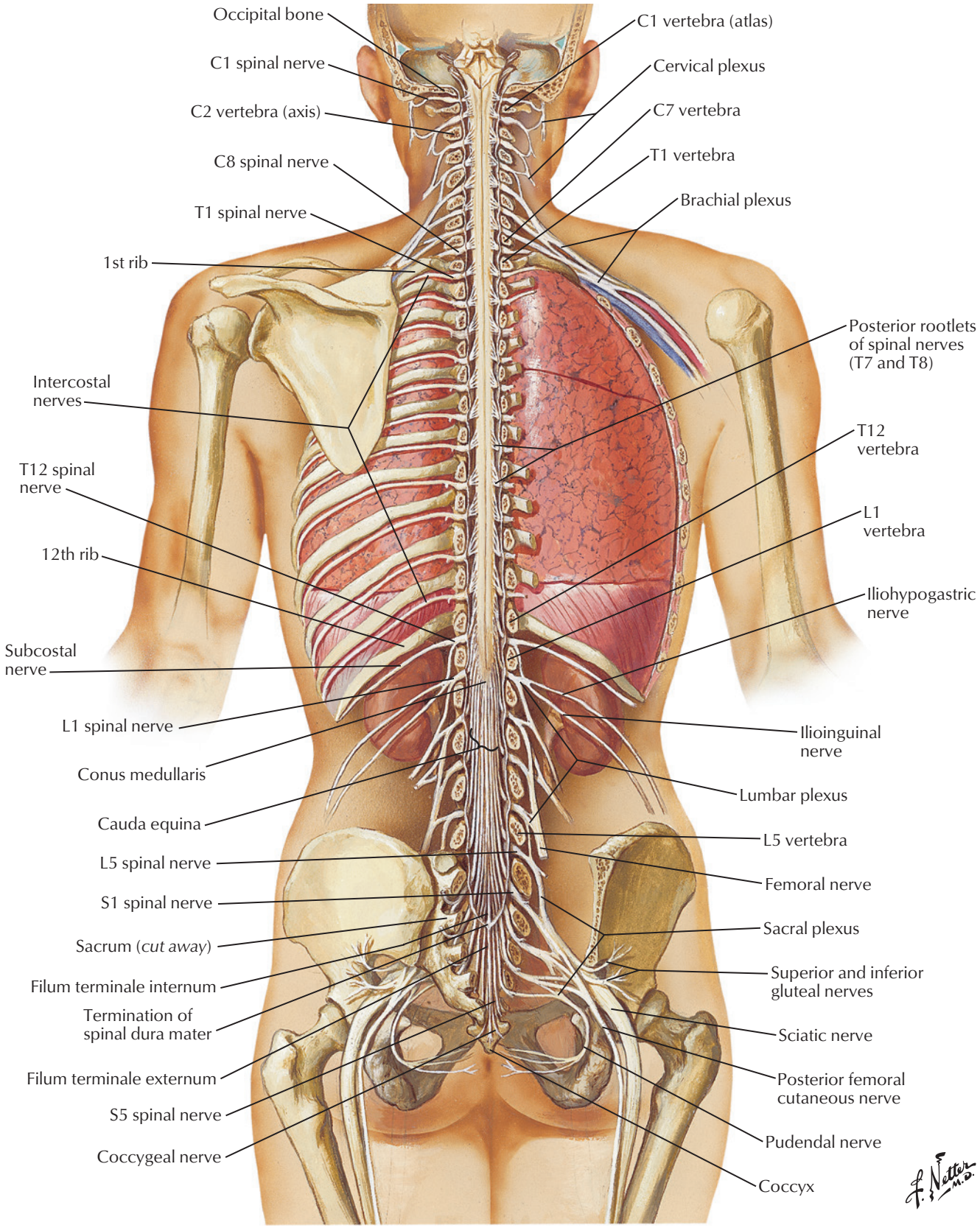


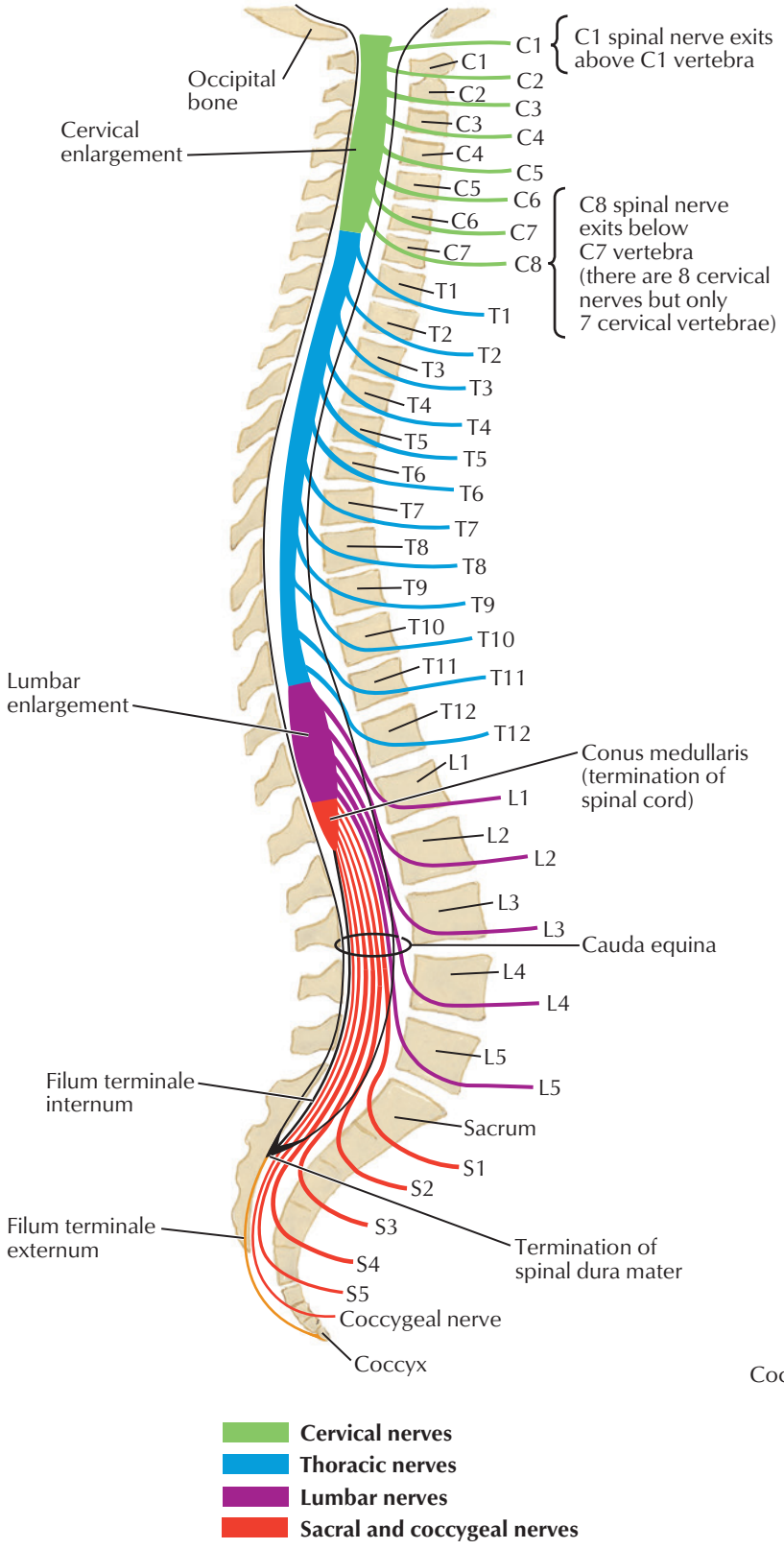


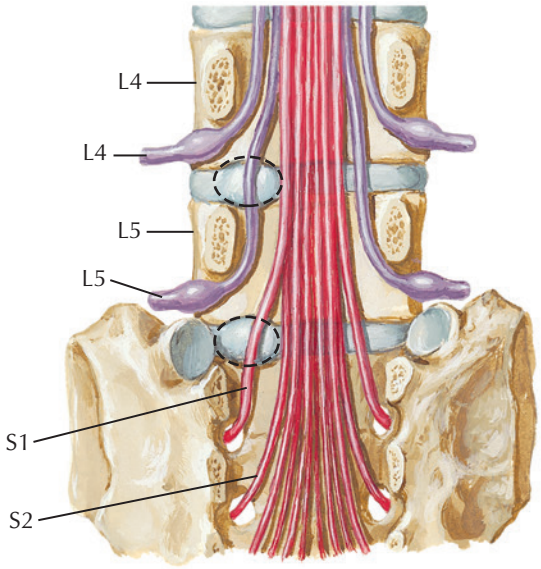
Intervertebral disc composed of central nuclear zone of collagen and hydrated proteoglycans surrounded by concentric lamellae of collagen fibers

Posterior vertebral arches: anterior view

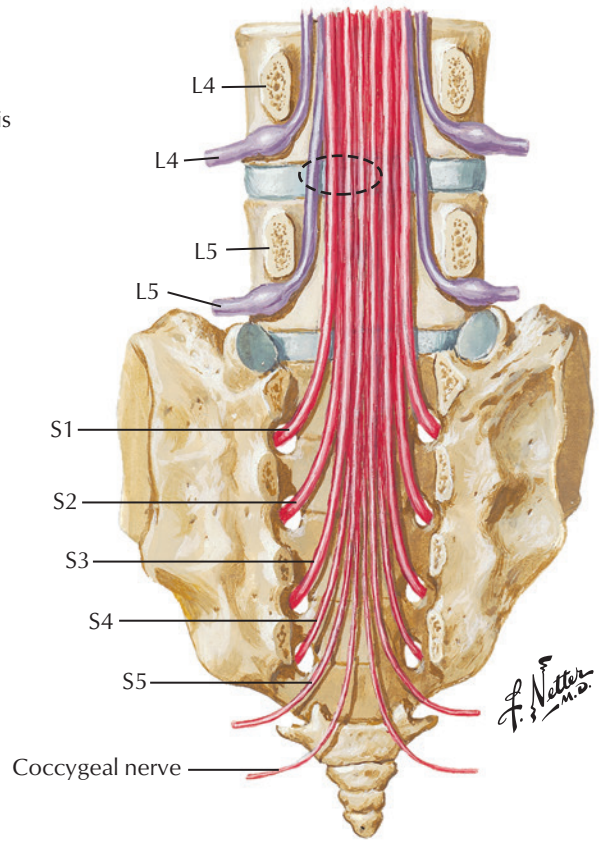



Occipital bone
C1 spinal nerve
C2 vertebra (axis)
C8 spinal nerve
T1 spinal nerve
1st rib
Intercostal nerves
T12 spinal nerve
12th rib
Subcostal nerve
L1 spinal nerve
Conus medullaris
Cauda equina
L5 spinal nerve
S1 spinal nerve
Sacrum (*cut away*)
Filum terminale internum
Termination of spinal dura mater
Filum terminale externum
S5 spinal nerve
Coccygeal nerve
C1 vertebra (atlas)
Cervical plexus
C7 vertebra
T1 vertebra
Brachial plexus
Posterior rootlets of spinal nerves (T7 and T8)
T12 vertebra
L1 vertebra
Iliohypogastric nerve
Ilioinguinal nerve
Lumbar plexus
L5 vertebra
Femoral nerve
Sacral plexus
Superior and inferior gluteal nerves
Sciatic nerve
Posterior femoral cutaneous nerve
Pudendal nerve
Coccyx
F. Netter M.D.

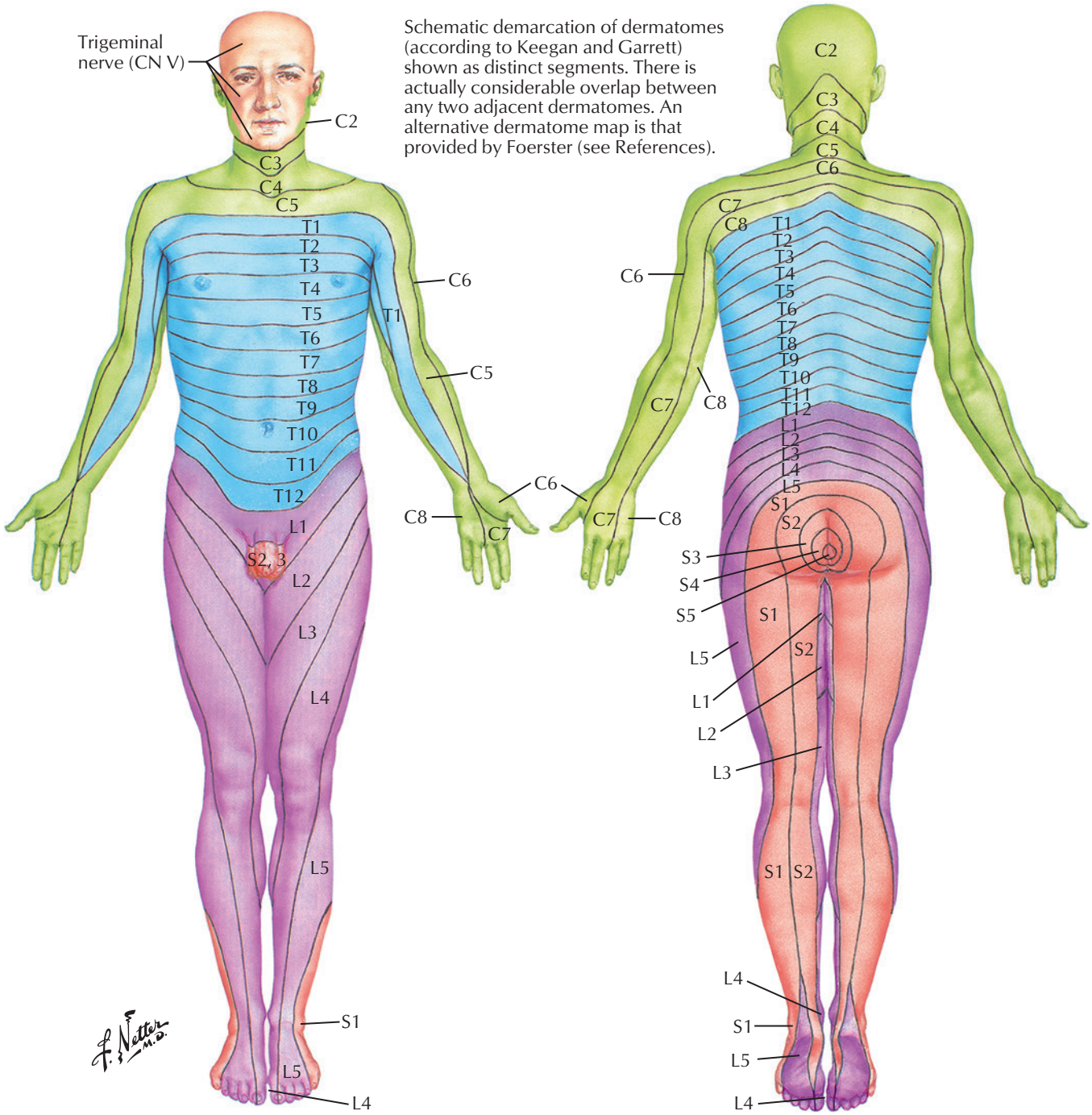




Lumbar disc protrusion (*dashed ovals*) does not usually affect nerve exiting above disc. Lateral protrusion at disc level L4–5 affects L5 spinal nerve, not L4 spinal nerve. Protrusion at disc level L5–S1 affects S1 spinal nerve, not L5 spinal nerve.



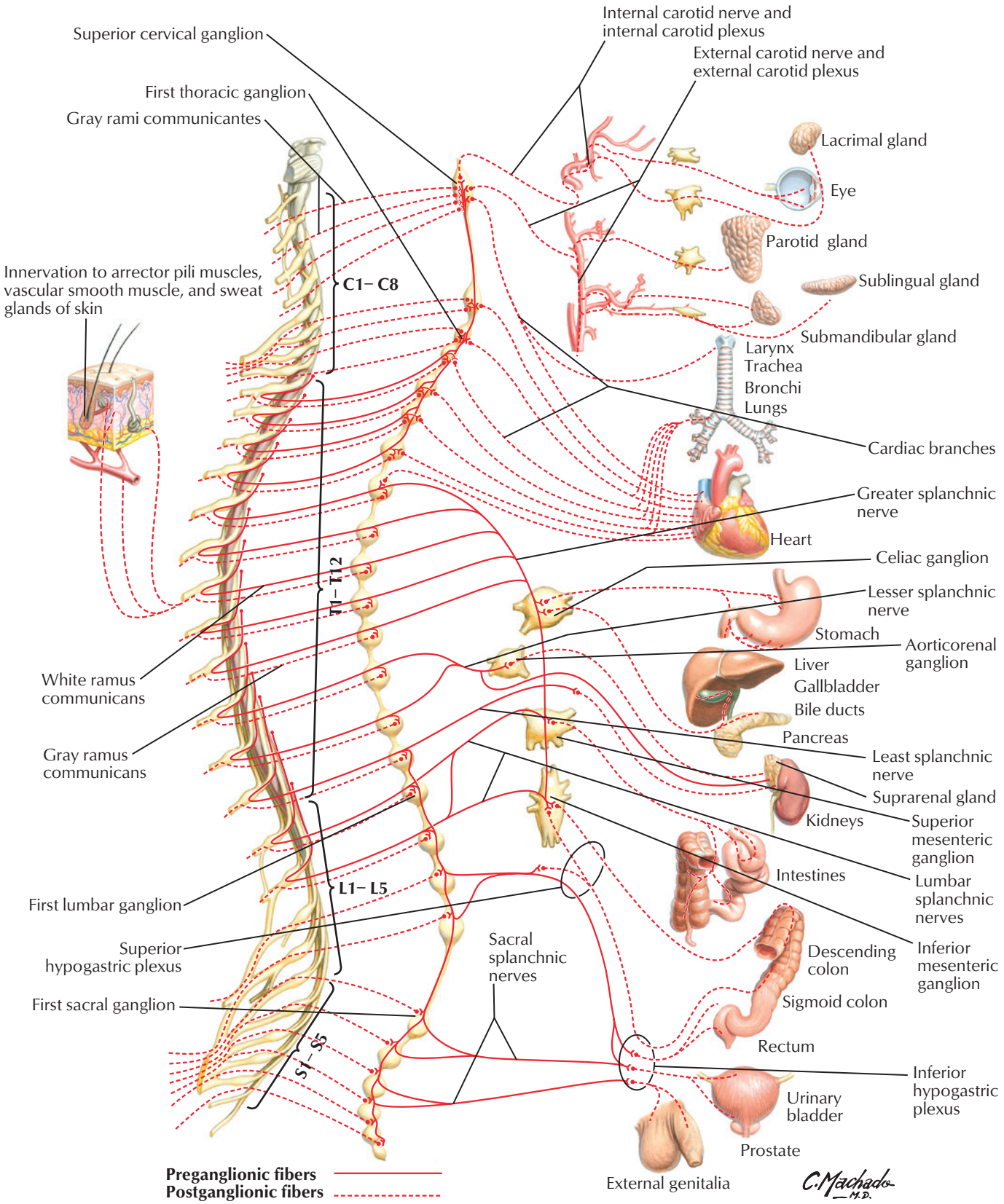
Medial protrusion at disc level L4–5 (*dashed oval*) rarely affects L4 spinal nerve but might affect L5 spinal nerve and sometimes S1–4 spinal nerves.



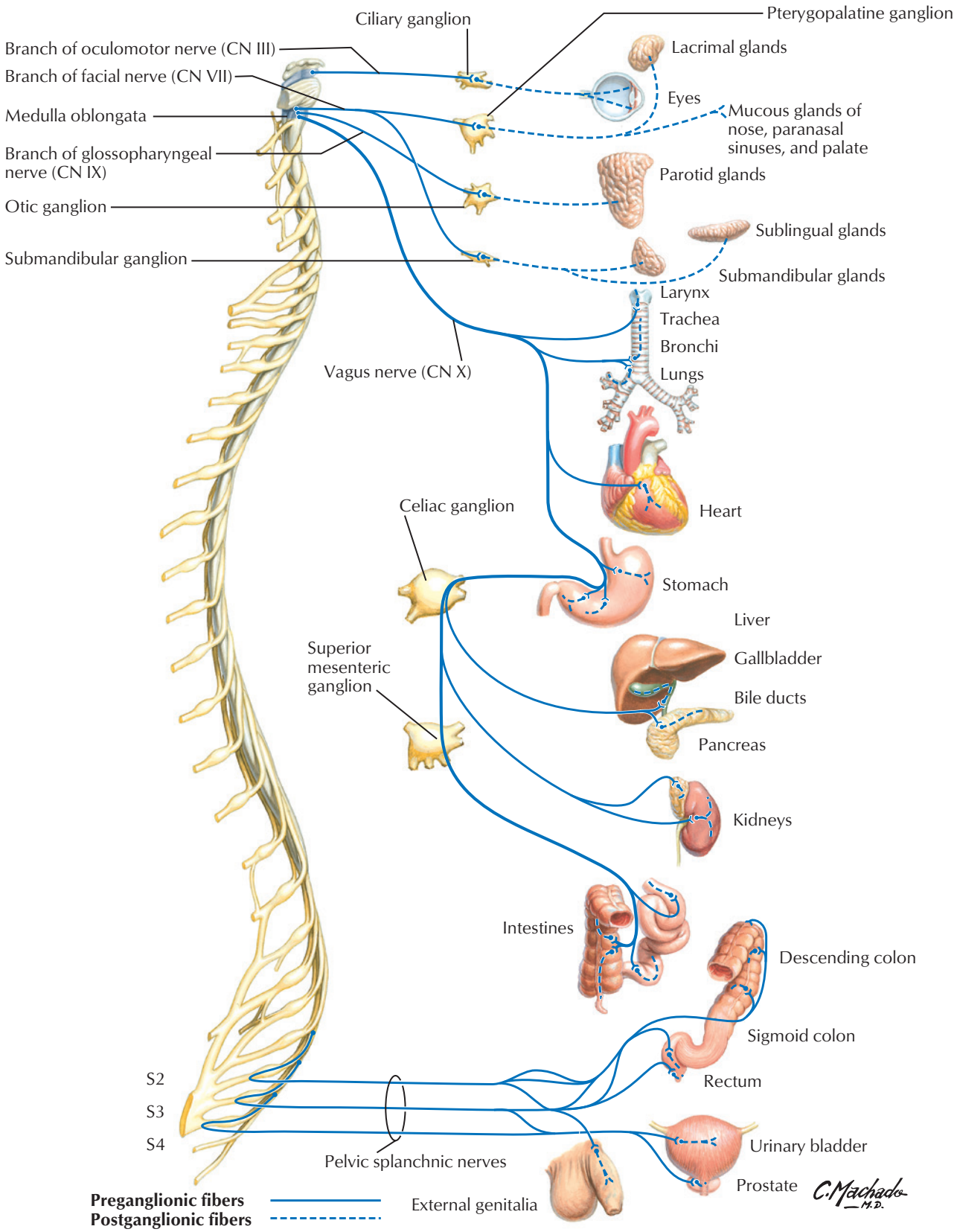
Levels of principal dermatomes

C5	Level of clavicles
C5, 6	Lateral sides of upper limbs
C8, T1	Medial sides of upper limbs
C6	Digit I (thumb)
C6, 7, 8	Hand
C8	Digits IV and V (ring and little fingers)
T4	Level of nipples
T10	Level of umbilicus
L1	Inguinal region
L1, 2, 3, 4	Anterior and medial surfaces of lower limbs
L4, 5, S1	Foot
L4	Medial side digit I (great toe)
L5, S1, 2	Lateral and posterior surfaces of lower limbs
S1	Lateral margin of foot and digit V (little toe)
S2, 3, 4	Perineum

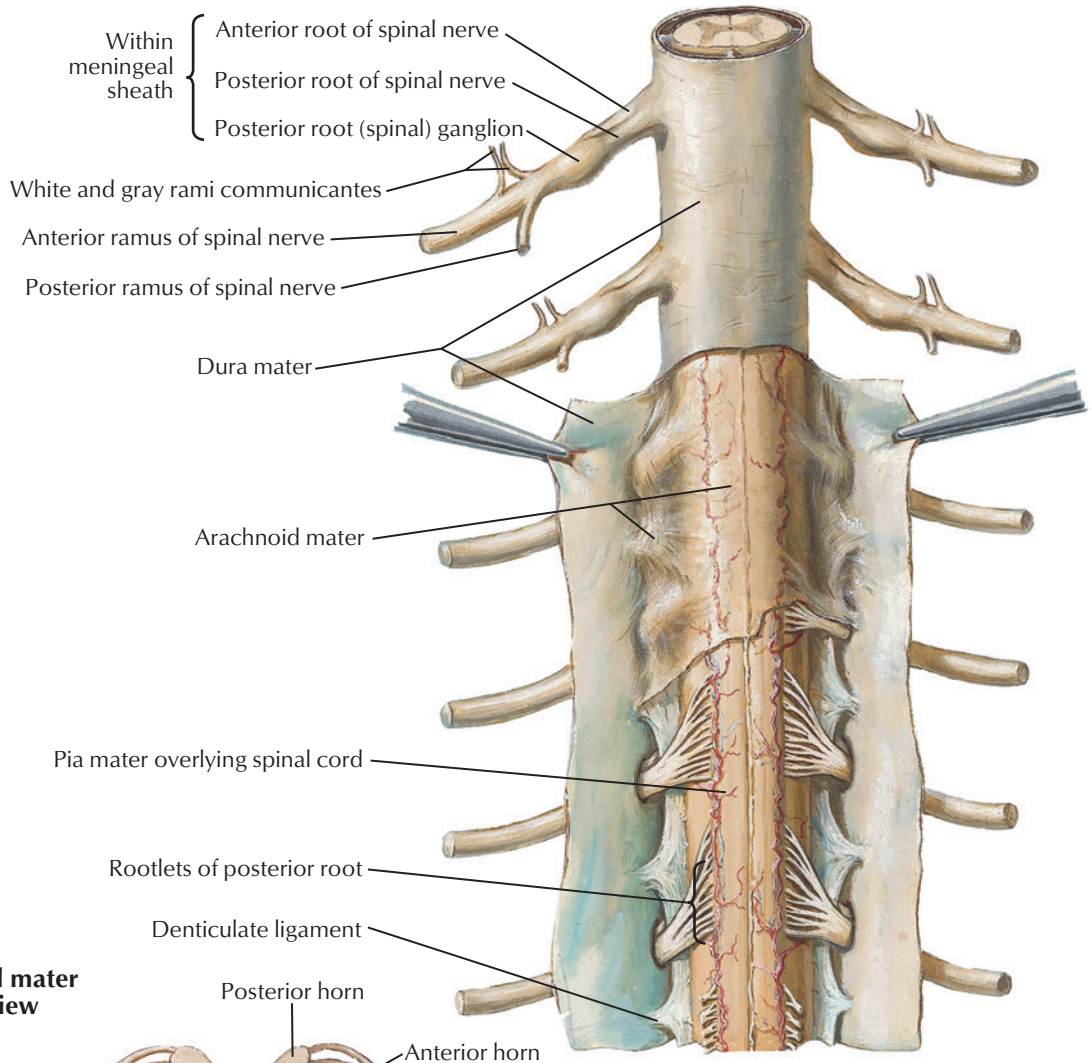
See also Plates 213, 320, 322



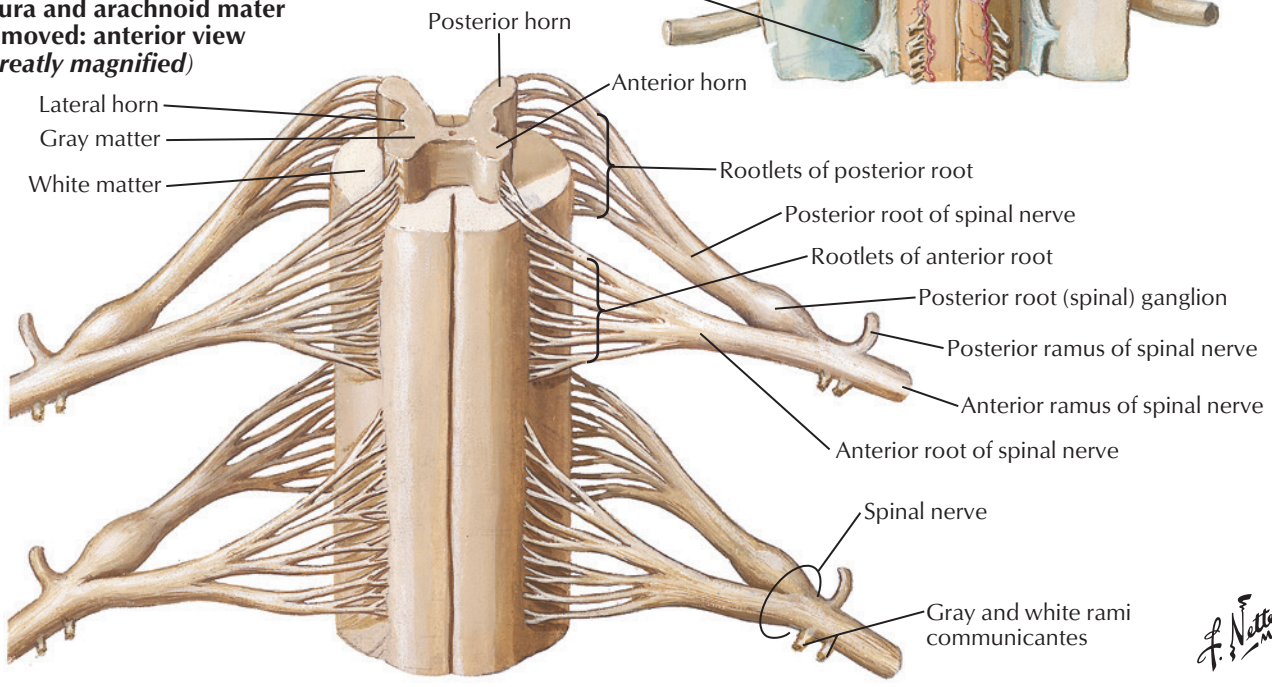
See also Plates 306, 394



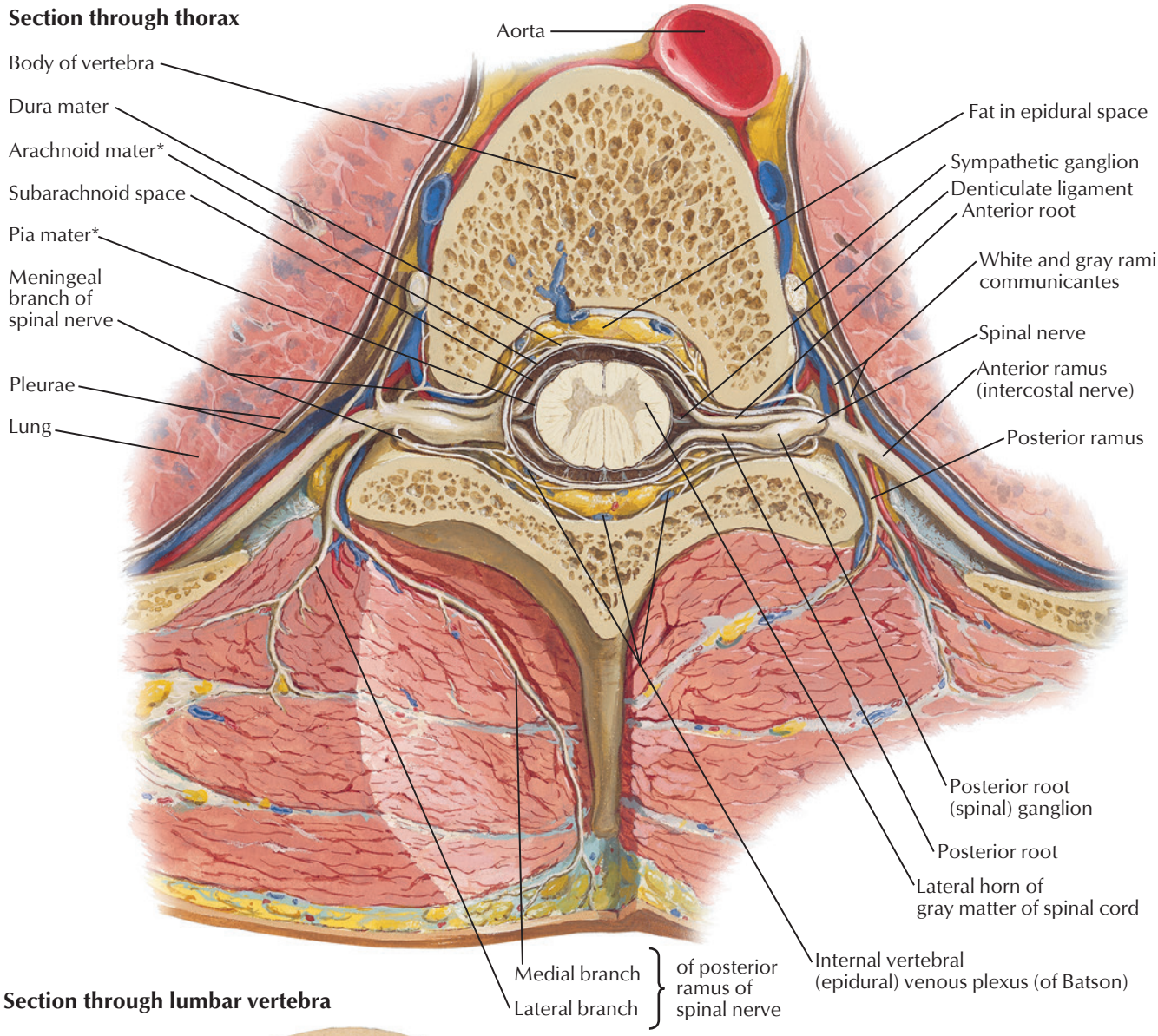
Posterior view



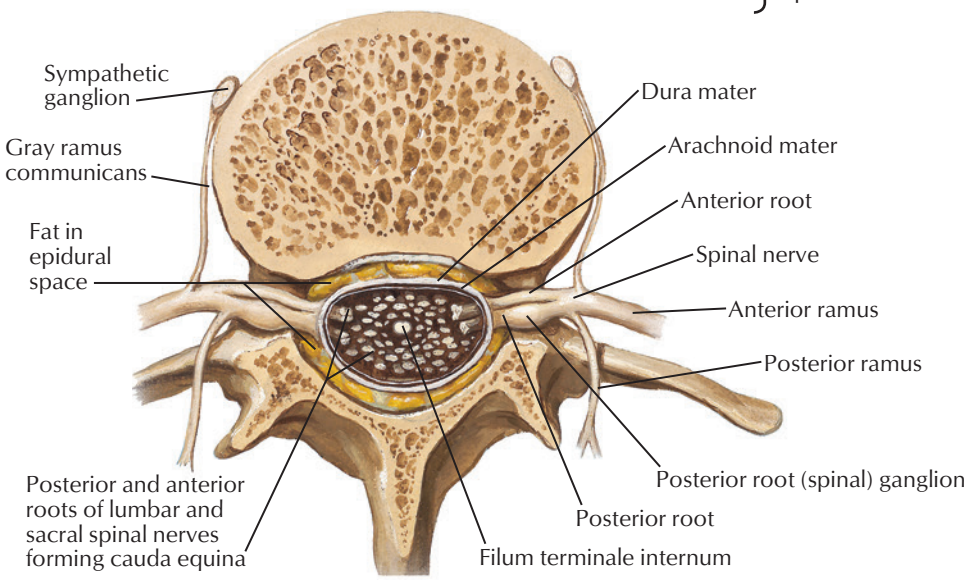
Dura and arachnoid mater removed: anterior view (*greatly magnified*)



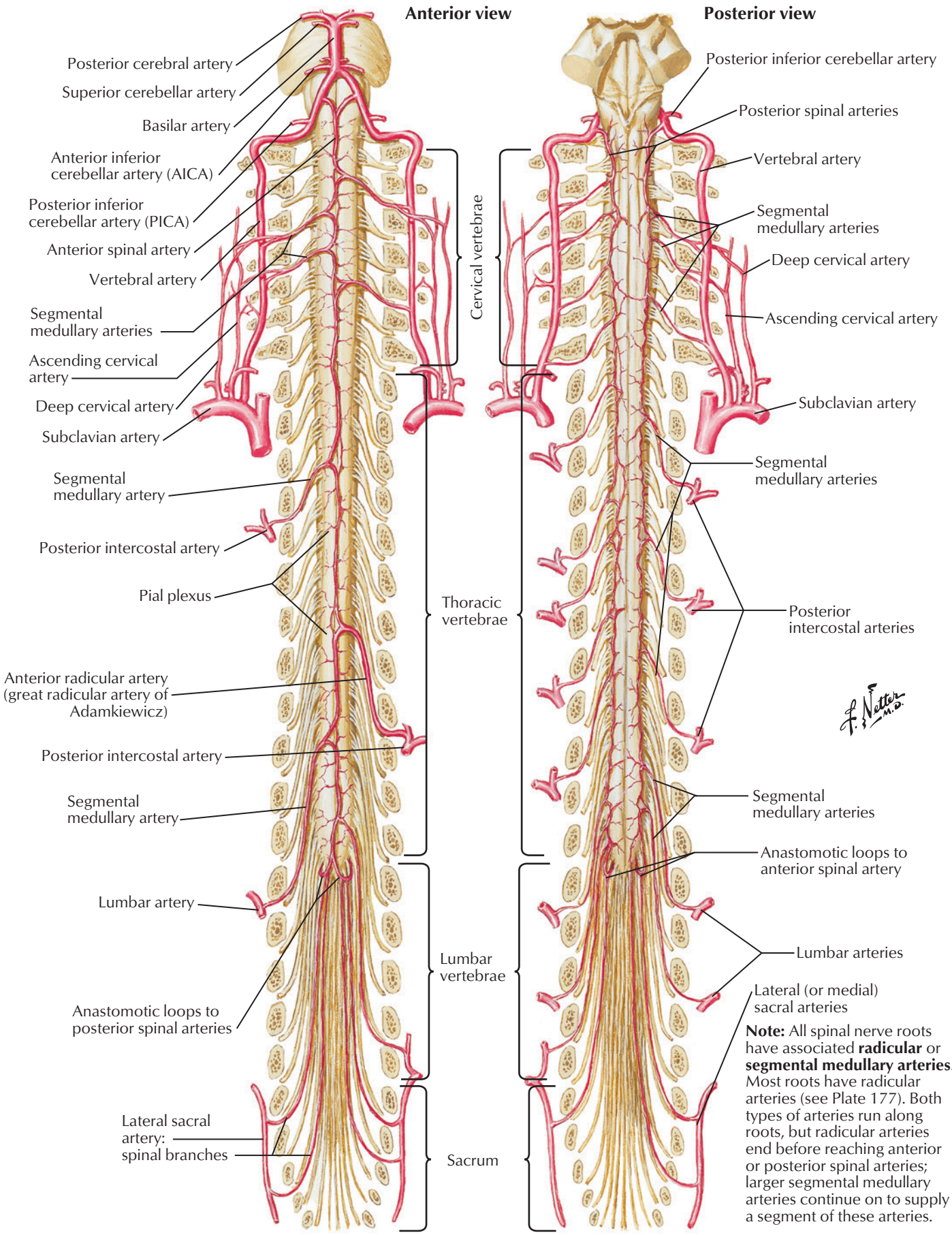
Section through thorax



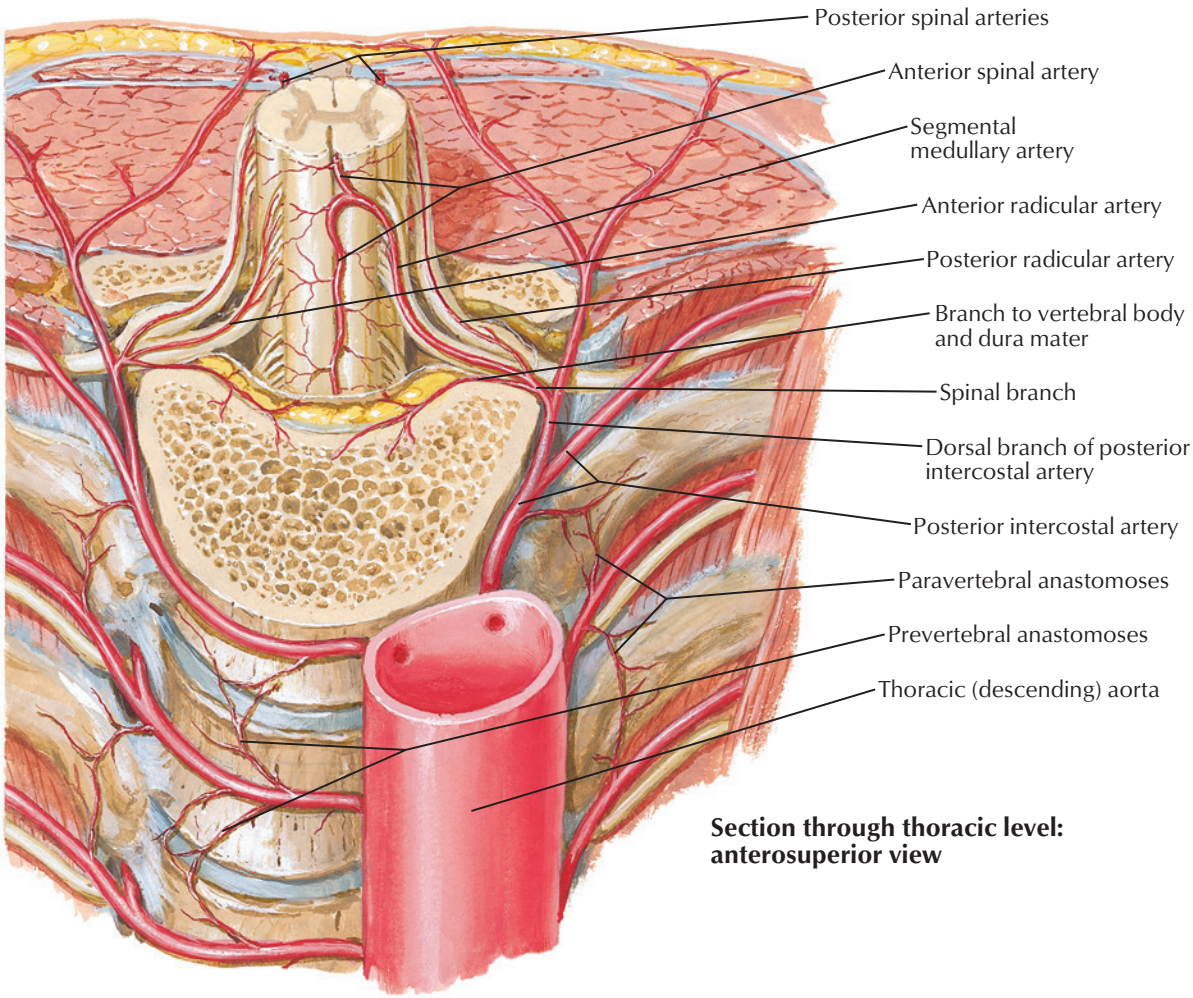
Section through lumbar vertebra



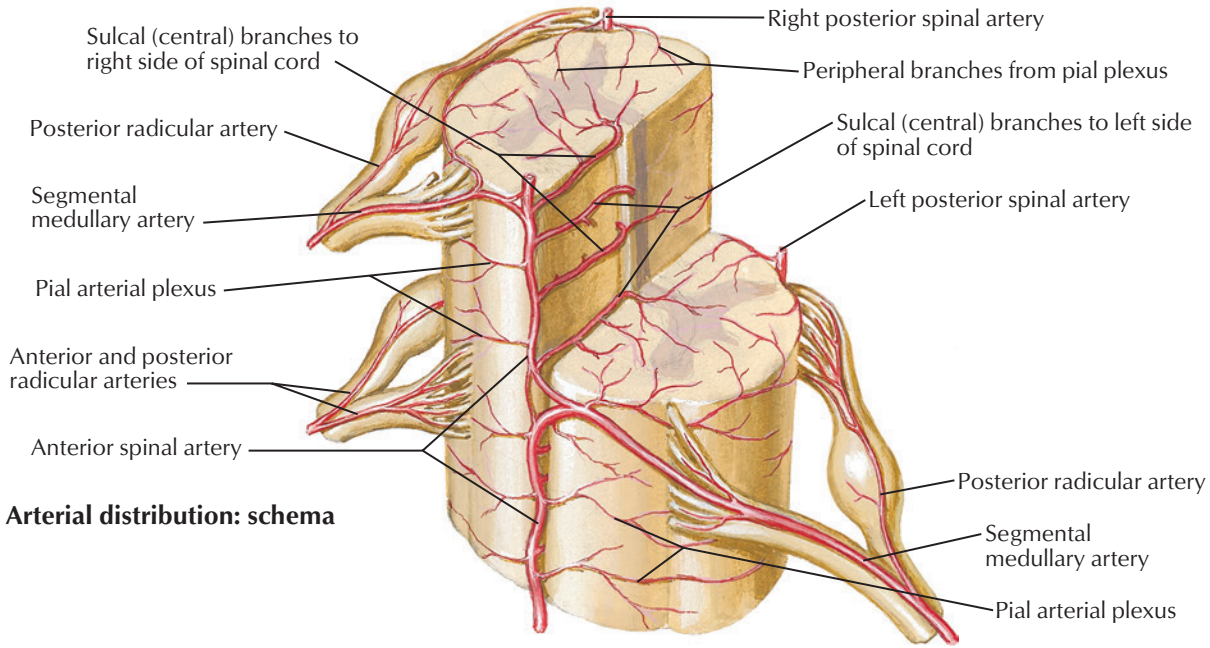
*Leptomeninges



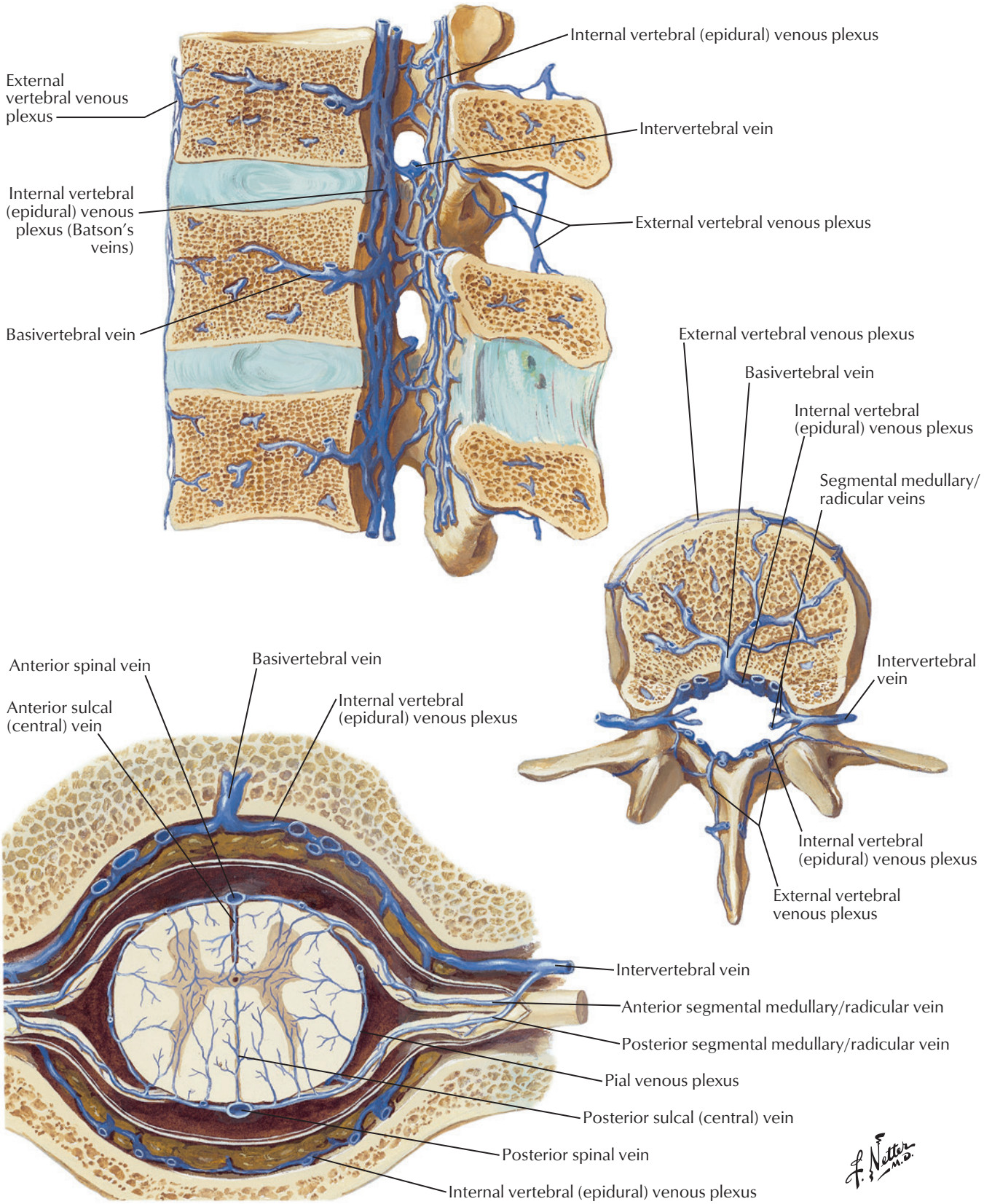
Note: All spinal nerve roots have associated **radicular** or **segmental medullary arteries**. Most roots have radicular arteries (see Plate 177). Both types of arteries run along roots, but radicular arteries end before reaching anterior or posterior spinal arteries; larger segmental medullary arteries continue on to supply a segment of these arteries.

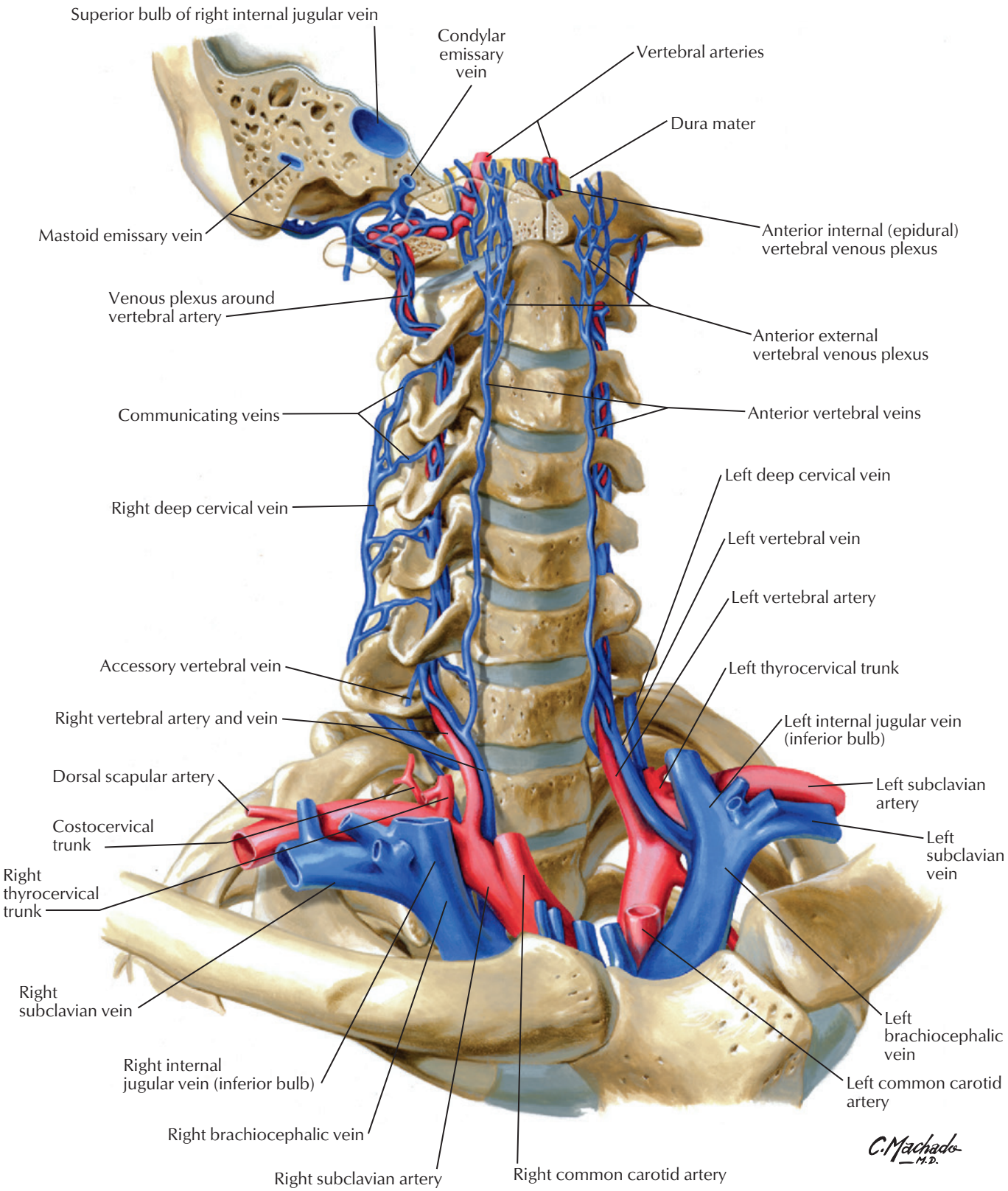


Section through thoracic level: anterosuperior view

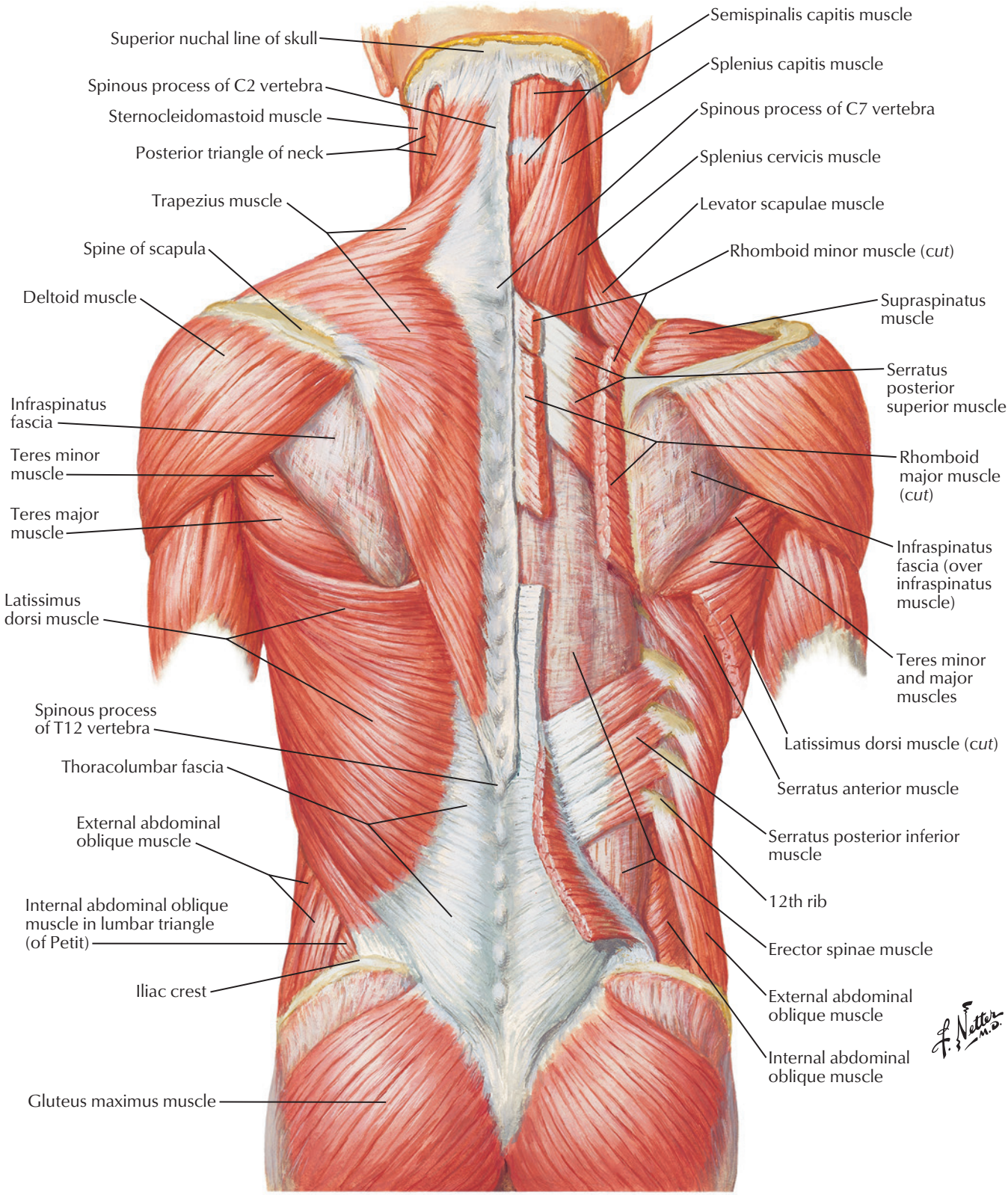


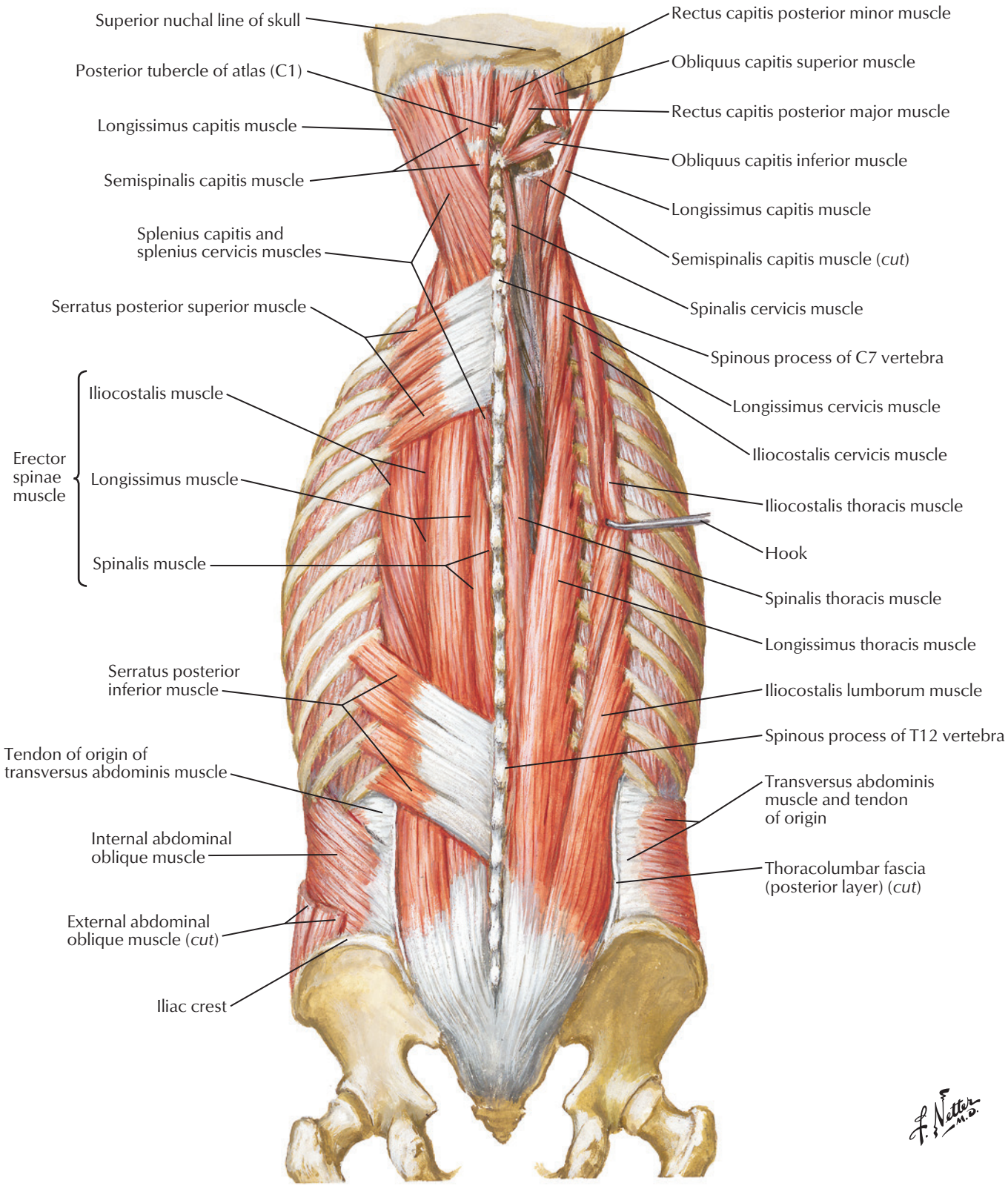
Arterial distribution: schema

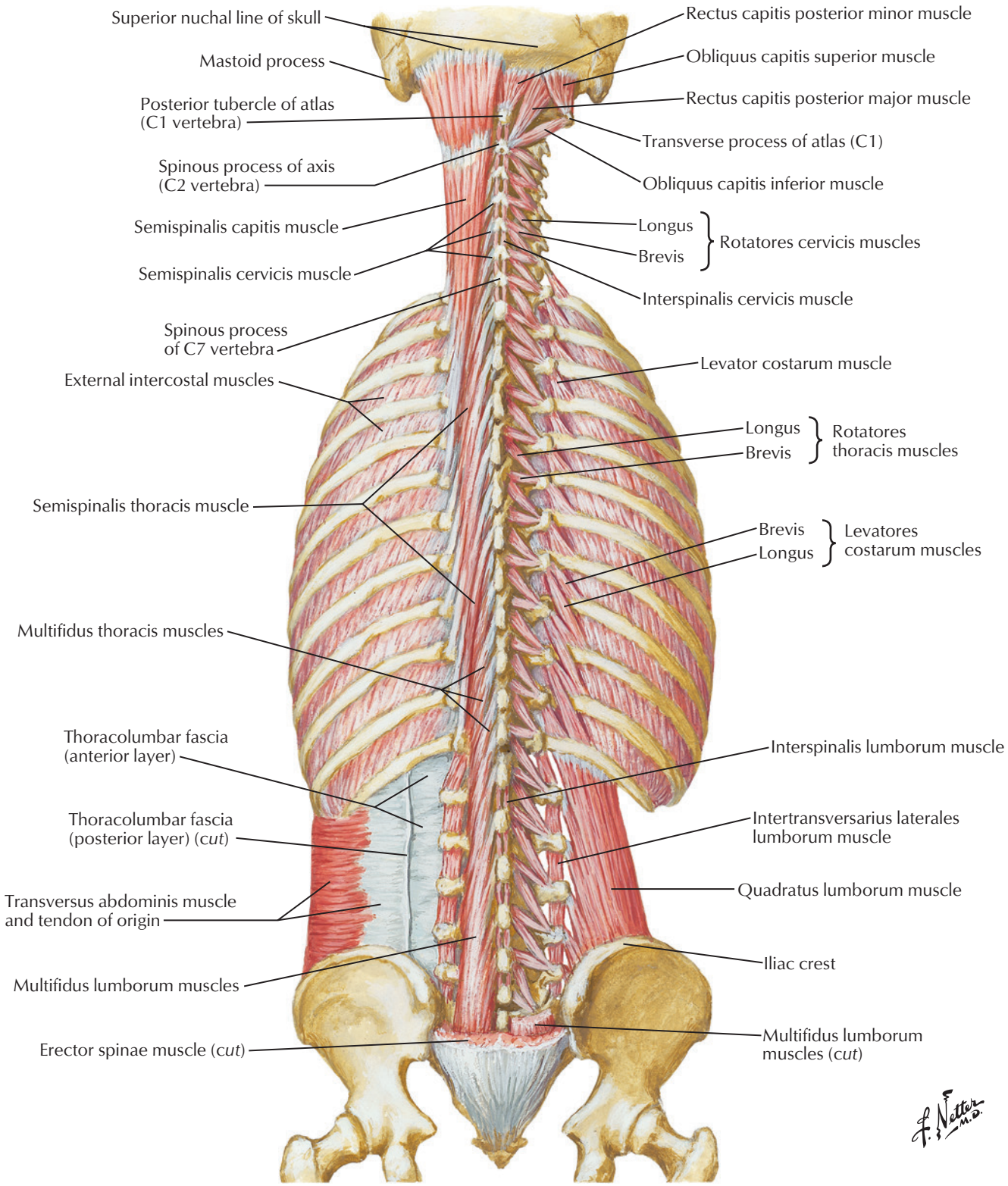

Internal vertebral (epidural) venous plexus
External vertebral venous plexus
Intervertebral vein
Internal vertebral (epidural) venous plexus (Batson's veins)
External vertebral venous plexus
Basivertebral vein
External vertebral venous plexus
Basivertebral vein
Internal vertebral (epidural) venous plexus
Segmental medullary/ radicular veins
Intervertebral vein
Anterior spinal vein
Basivertebral vein
Anterior sulcal (central) vein
Internal vertebral (epidural) venous plexus
Internal vertebral (epidural) venous plexus
External vertebral venous plexus
Intervertebral vein
Anterior segmental medullary/radicular vein
Posterior segmental medullary/radicular vein
Pial venous plexus
Posterior sulcal (central) vein
Posterior spinal vein
Internal vertebral (epidural) venous plexus

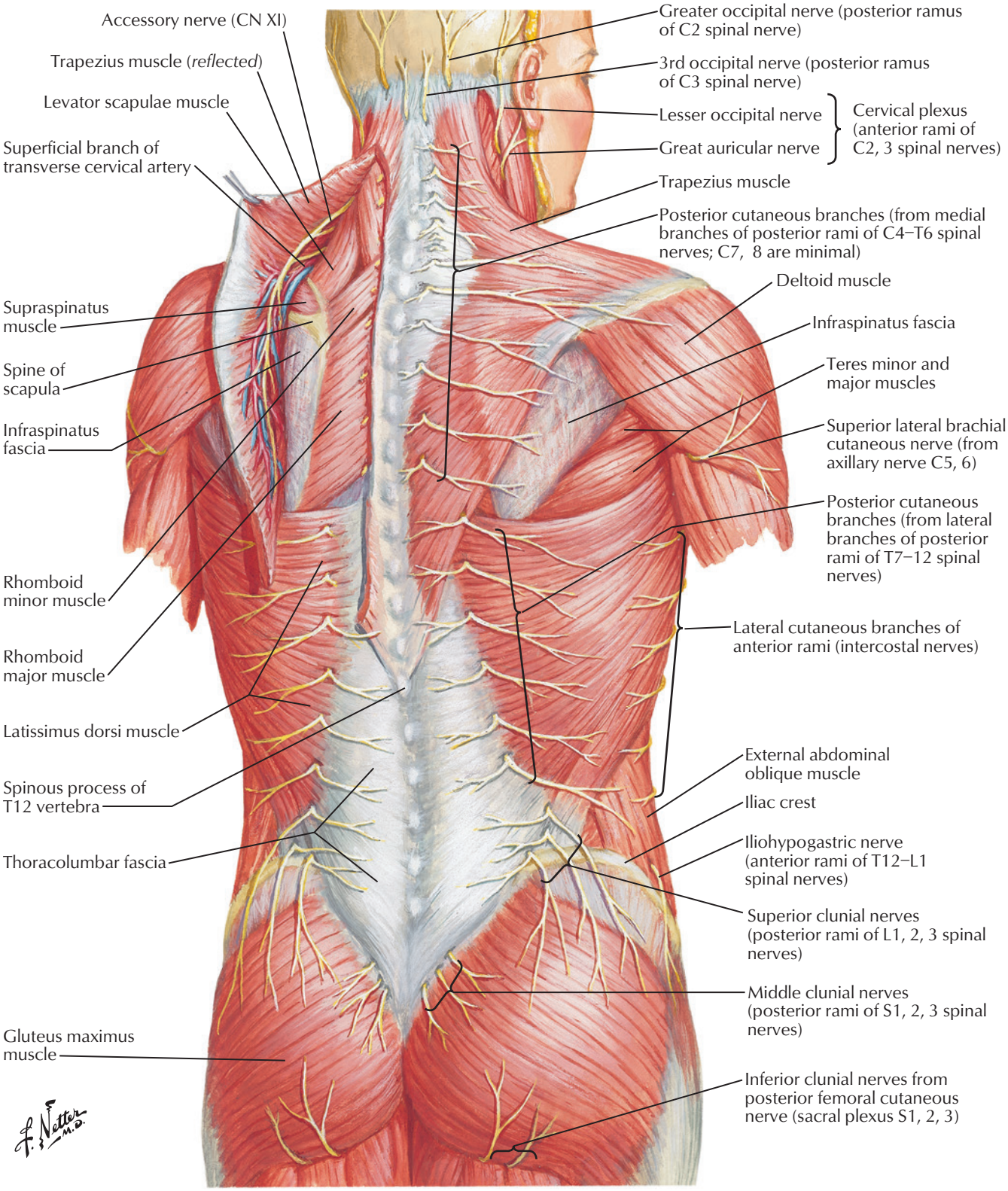

Superior bulb of right internal jugular vein
Condylar emissary vein
Vertebral arteries
Dura mater
Mastoid emissary vein
Anterior internal (epidural) vertebral venous plexus
Venous plexus around vertebral artery
Anterior external vertebral venous plexus
Communicating veins
Anterior vertebral veins
Left deep cervical vein
Right deep cervical vein
Left vertebral vein
Left vertebral artery
Accessory vertebral vein
Left thyrocervical trunk
Right vertebral artery and vein
Left internal jugular vein (inferior bulb)
Dorsal scapular artery
Left subclavian artery
Costocervical trunk
Left subclavian vein
Right thyrocervical trunk
Right subclavian vein
Left brachiocephalic vein
Right internal jugular vein (inferior bulb)
Left common carotid artery
Right brachiocephalic vein
Right subclavian artery
Right common carotid artery
C. Machado M.D.

See also Plates 36, 257

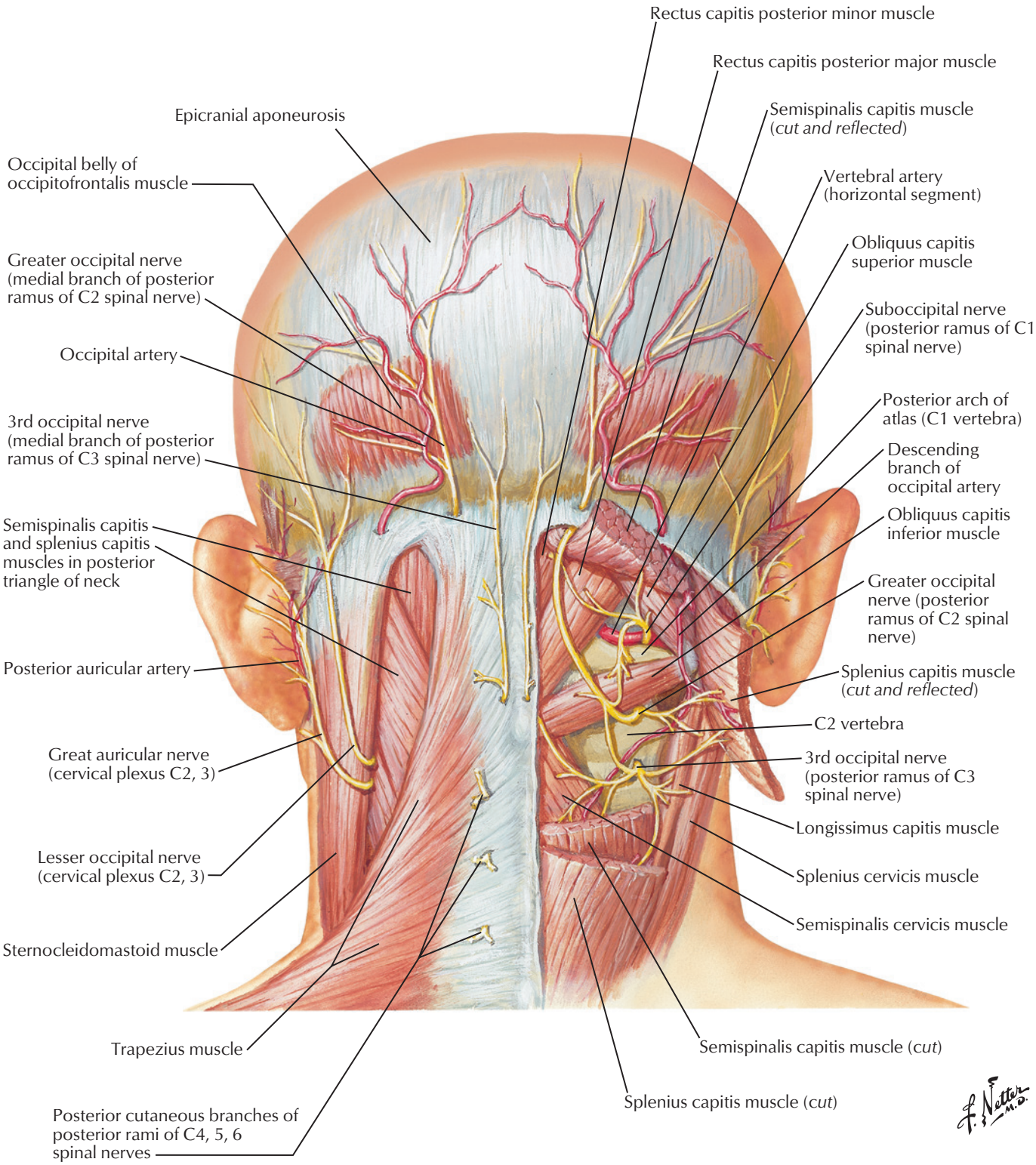



Superior nuchal line of skull
Posterior tubercle of atlas (C1)
Longissimus capitis muscle
Semispinalis capitis muscle
Splenius capitis and splenius cervicis muscles
Serratus posterior superior muscle
Erector spinae muscle
Iliocostalis muscle
Longissimus muscle
Spinalis muscle
Serratus posterior inferior muscle
Tendon of origin of transversus abdominis muscle
Internal abdominal oblique muscle
External abdominal oblique muscle (cut)
Iliac crest
Rectus capitis posterior minor muscle
Obliquus capitis superior muscle
Rectus capitis posterior major muscle
Obliquus capitis inferior muscle
Longissimus capitis muscle
Semispinalis capitis muscle (cut)
Spinalis cervicis muscle
Spinous process of C7 vertebra
Longissimus cervicis muscle
Iliocostalis cervicis muscle
Iliocostalis thoracis muscle
Hook
Spinalis thoracis muscle
Longissimus thoracis muscle
Iliocostalis lumborum muscle
Spinous process of T12 vertebra
Transversus abdominis muscle and tendon of origin
Thoracolumbar fascia (posterior layer) (cut)

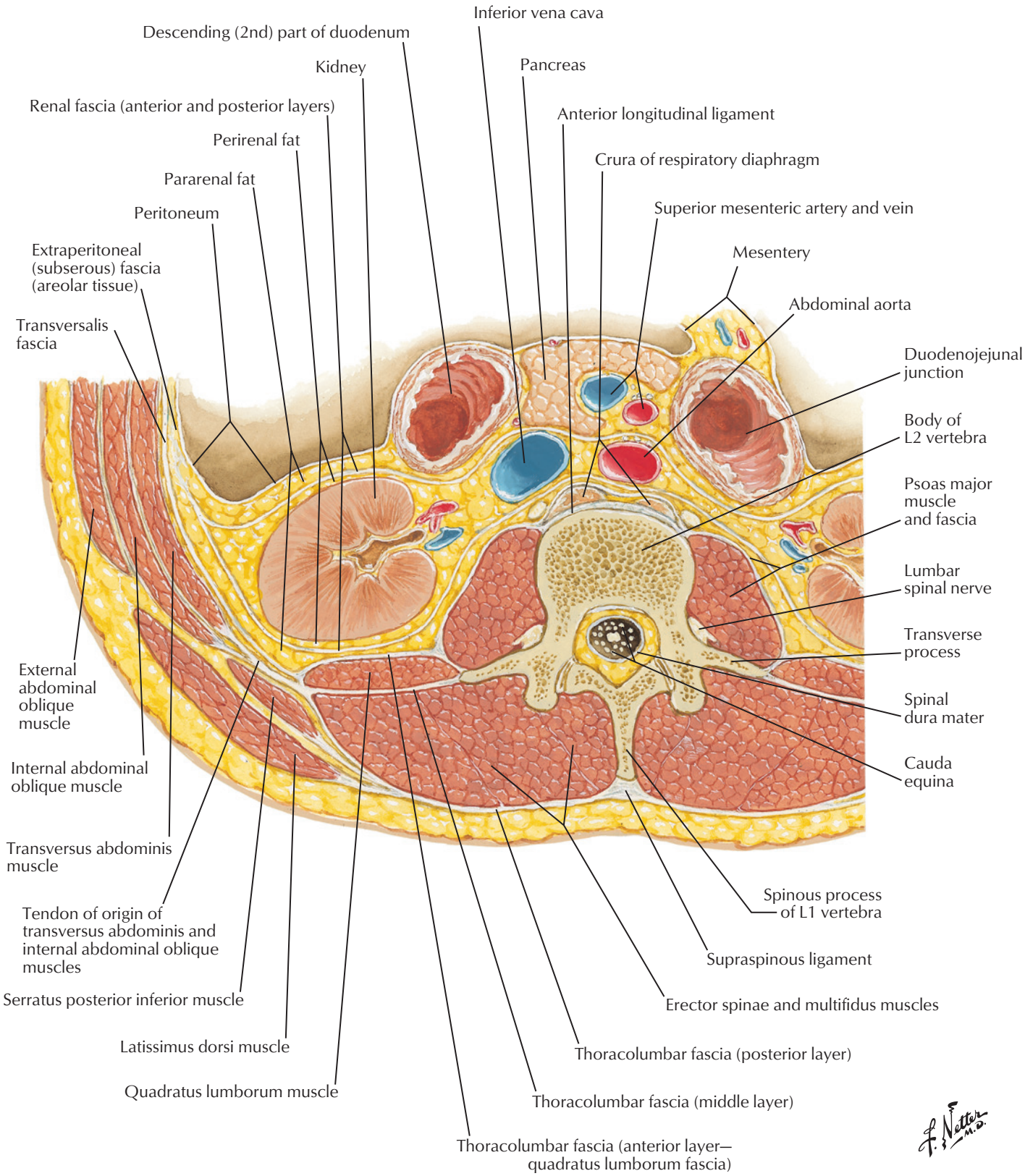

Superior nuchal line of skull
Mastoid process
Posterior tubercle of atlas (C1 vertebra)
Spinous process of axis (C2 vertebra)
Semispinalis capitis muscle
Semispinalis cervicis muscle
Spinous process of C7 vertebra
External intercostal muscles
Semispinalis thoracis muscle
Multifidus thoracis muscles
Thoracolumbar fascia (anterior layer)
Thoracolumbar fascia (posterior layer) (cut)
Transversus abdominis muscle and tendon of origin
Multifidus lumborum muscles
Erector spinae muscle (cut)
Rectus capitis posterior minor muscle
Obliquus capitis superior muscle
Rectus capitis posterior major muscle
Transverse process of atlas (C1)
Obliquus capitis inferior muscle
Longus
Brevis
Rotatores cervicis muscles
Interspinalis cervicis muscle
Levator costarum muscle
Longus
Brevis
Rotatores thoracis muscles
Brevis
Longus
Levatores costarum muscles
Interspinalis lumborum muscle
Intertransversarius laterales lumborum muscle
Quadratus lumborum muscle
Iliac crest
Multifidus lumborum muscles (cut)


Accessory nerve (CN XI)
Trapezius muscle (*reflected*)
Levator scapulae muscle
Superficial branch of transverse cervical artery
Supraspinatus muscle
Spine of scapula
Infraspinatus fascia
Rhomboid minor muscle
Rhomboid major muscle
Latissimus dorsi muscle
Spinous process of T12 vertebra
Thoracolumbar fascia
Gluteus maximus muscle
Greater occipital nerve (posterior ramus of C2 spinal nerve)
3rd occipital nerve (posterior ramus of C3 spinal nerve)
Lesser occipital nerve
Great auricular nerve
Cervical plexus (anterior rami of C2, 3 spinal nerves)
Trapezius muscle
Posterior cutaneous branches (from medial branches of posterior rami of C4–T6 spinal nerves; C7, 8 are minimal)
Deltoid muscle
Infraspinatus fascia
Teres minor and major muscles
Superior lateral brachial cutaneous nerve (from axillary nerve C5, 6)
Posterior cutaneous branches (from lateral branches of posterior rami of T7–12 spinal nerves)
Lateral cutaneous branches of anterior rami (intercostal nerves)
External abdominal oblique muscle
Iliac crest
Iliohypogastric nerve (anterior rami of T12–L1 spinal nerves)
Superior clunial nerves (posterior rami of L1, 2, 3 spinal nerves)
Middle clunial nerves (posterior rami of S1, 2, 3 spinal nerves)
Inferior clunial nerves from posterior femoral cutaneous nerve (sacral plexus S1, 2, 3)

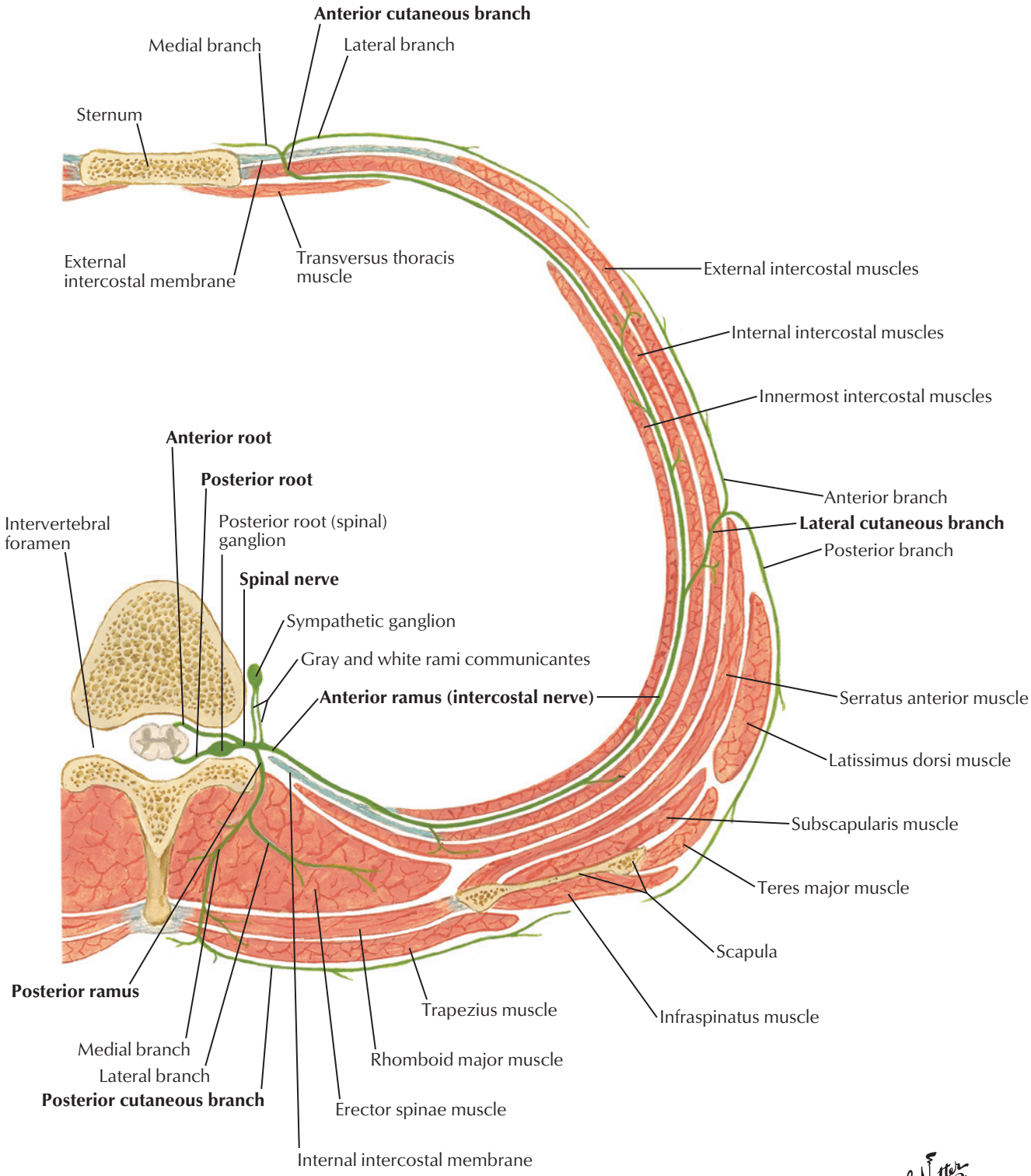
See also Plates 36, 39



See also Plates 312, 318



See also Plate 261



Note: *In lower thoracic region, lateral branch of posterior ramus is longer, motor, and cutaneous; medial branch is shorter and motor only.*

ANATOMIC STRUCTURES	CLINICAL IMPORTANCE	PLATE NUMBERS
SKELETAL SYSTEM		
Spinous processes	Palpable landmarks used to assess spinal curvatures and determine location of spinal cord for procedures such as lumbar puncture and injection of spinal anesthesia	161, 180
C7 spinous process	Most prominent spinous process (vertebra prominens); often used to begin counting vertebrae	161, 163
Intervertebral disc	Age-related changes may produce herniation of nucleus pulposus, causing back pain; occurs most commonly in lower lumbar regions of vertebral column	164, 170
Lamina	Surgically removed in laminectomy to gain access to vertebral canal and spinal cord	164
Intervertebral foramen	May become narrowed by age-related changes (e.g., osteophyte formation) or changes in intervertebral disc height, producing compression of its contents	164, 167, 168
Sacral hiatus	Provides access to epidural space to administer caudal epidural anesthesia	166
5th lumbar vertebra	Spondylolysis is clinical condition in which vertebral body separates from the part of its vertebral arch bearing inferior articulating process; if this occurs bilaterally, L5 body and transverse process may slide forward over sacrum, giving rise to spondylolisthesis	167
L5/S1 vertebrae	Most common level of intervertebral disc herniation	167, 170
Vertebral foramen	May become narrowed by arthritic changes in lumbar vertebrae, resulting in spinal stenosis; can lead to back pain, sciatica, numbness or tingling, and weakness in lower limbs	163, 164
MUSCULAR SYSTEM		
Trapezius muscle	Responsible for holding scapula against thoracic wall against gravity; drooping of shoulder indicates weakness of or injury to accessory nerve	180
Intrinsic back muscles	Microscopic stretching or tearing of muscle fibers produces back strain, a common cause of low back pain	181, 182
NERVOUS SYSTEM		
Conus medullaris	Indicates inferior limit of spinal cord; it is necessary to locate this point in procedures such as lumbar puncture	169
Cauda equina	Lumbar and sacral nerve roots may be anesthetized with anesthesia injected into subarachnoid space (spinal block)	169, 170
Spinal meninges	Access to epidural and subarachnoid spaces is necessary for clinical procedures such as epidural anesthesia and lumbar puncture	165, 175
CARDIOVASCULAR SYSTEM		
Segmental medullary arteries	Narrowing or damage to these arteries caused by atherosclerosis, vertebral fractures, or vertebral dislocations may cause ischemia of spinal cord	176
Vertebral venous plexuses	Venous conduits for metastasis of cancer cells to spine, lungs, and brain	178

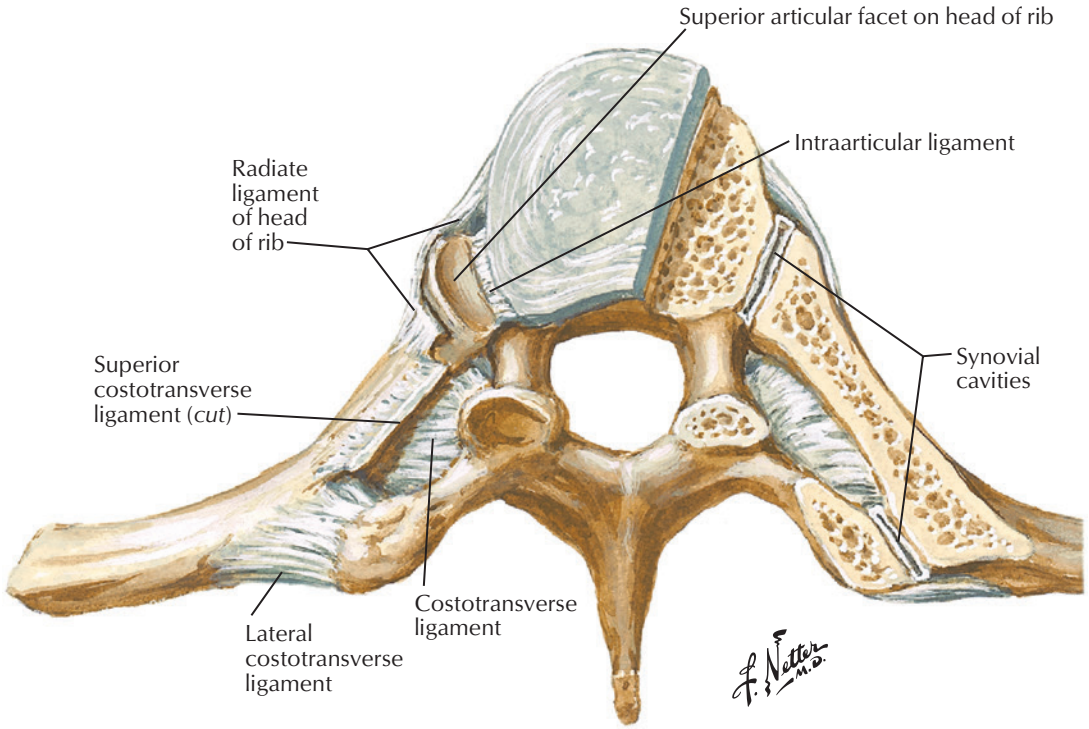
*Selections were based largely on clinical data as well as commonly covered clinical correlations in gross anatomy courses.

MUSCLE	MUSCLE GROUP	PROXIMAL ATTACHMENT (ORIGIN)	DISTAL ATTACHMENT (INSERTION)	INNERVATION	BLOOD SUPPLY	MAIN ACTIONS
Erector spinae	Sacrospinalis	Posterior sacrum, iliac crest, sacrospinous ligament, supraspinous ligament, spinous processes of lower lumbar vertebrae and sacrum	*Iliocostalis:* angles of lower ribs, cervical transverse processes *Longissimus:* between tubercles and angles of ribs, transverse processes of thoracic and cervical vertebrae, mastoid process *Spinalis:* spinous processes of upper thoracic and midcervical vertebrae	Posterior rami of each region	*Cervical portions:* occipital, deep cervical, and vertebral arteries *Thoracic portions:* dorsal branches of posterior intercostal, subcostal, and lumbar arteries *Sacral portions:* dorsal branches of lateral sacral arteries	Extends and laterally bends vertebral column and head
Interspinales (cervical, thoracic, lumbar)	Segmental	Spinous process	Adjacent spinous process	Posterior rami of spinal nerves	*Cervical portions:* occipital, deep cervical, and vertebral arteries *Thoracic portions:* dorsal branches of posterior intercostal arteries *Lumbar portions:* dorsal branches of lumbar arteries	Aid in extension of vertebral column
Intertransversarii (cervical, thoracic, lumbar)	Segmental	Extend between adjacent transverse processes of vertebrae	Extend between adjacent transverse processes of vertebrae	Posterior rami of spinal nerves	*Cervical portions:* occipital, deep cervical, and vertebral arteries *Thoracic portions:* dorsal branches of posterior intercostal, subcostal, and lumbar arteries *Lumbar portions:* dorsal branches of lateral lumbar arteries	Assist in lateral flexion of vertebral column
Latissimus dorsi	Superficial back	Spinous processes of T7–L5, thoracolumbar fascia, iliac crest, and last three ribs	Intertubercular sulcus of humerus	Thoracodorsal nerve	Thoracodorsal artery, dorsal perforating branches of 9th, 10th, and 11th posterior intercostal, subcostal, and first three lumbar arteries	Extends, adducts, and medially rotates humerus
Levator scapulae	Superficial back	Posterior tubercles of transverse processes of C1–C4	Medial border of scapula from superior angle to spine	Anterior rami of C3–C4 and dorsal scapular nerve	Dorsal scapular artery, transverse cervical artery, ascending cervical artery	Elevates scapula medially, inferiorly rotates glenoid fossa
Multifidus	Transversospinales	Sacrum, ilium, transverse processes of T1–T12, and articular processes of C4–C7	Spinous processes of vertebrae above, spanning two to four segments	Posterior rami of each region	*Cervical portions:* occipital, deep cervical, and vertebral arteries *Thoracic portions:* dorsal branches of posterior intercostal, subcostal, and lumbar arteries *Sacral portions:* dorsal branches of lateral sacral arteries	Stabilizes spine
Obliquus capitis inferior	Suboccipital	Spine of axis	Transverse process of atlas	Suboccipital nerve	Vertebral artery, descending branch of occipital artery	Rotates atlas to turn face to same side
Obliquus capitis superior	Suboccipital	Transverse process of atlas	Occipital bone	Suboccipital nerve	Vertebral artery, descending branch of occipital artery	Extends and bends head laterally
Rectus capitis posterior major	Suboccipital	Spine of axis	Inferior nuchal line	Suboccipital nerve	Vertebral artery, descending branch of occipital artery	Extends and rotates head to same side

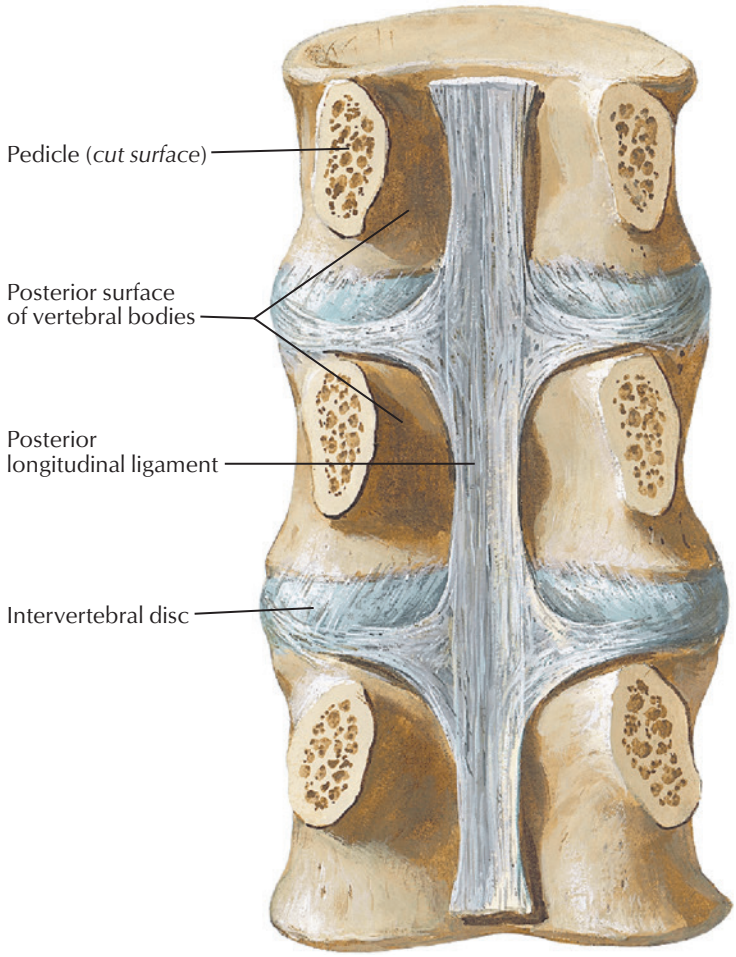
Variations in spinal nerve contributions to the innervation of muscles, their arterial supply, their attachments, and their actions are common themes in human anatomy. Therefore, expect differences between texts and realize that anatomical variation is normal.

MUSCLE	MUSCLE GROUP	PROXIMAL ATTACHMENT (ORIGIN)	DISTAL ATTACHMENT (INSERTION)	INNERVATION	BLOOD SUPPLY	MAIN ACTIONS
Rectus capitis posterior minor	Suboccipital	Tubercle of posterior arch of atlas	Median inferior nuchal line	Suboccipital nerve	Vertebral artery, descending branch of occipital artery	Extends head
Rhomboid major	Superficial back	Spinous processes of T2–T5 vertebrae	Medial border of scapula below base of spine of scapula	Dorsal scapular nerve	Dorsal scapular *OR* deep branch of transverse cervical artery, dorsal perforating branches of upper five or six posterior intercostal arteries	Fixes scapula to thoracic wall and retracts and rotates it to depress glenoid cavity
Rhomboid minor	Superficial back	Nuchal ligament, spines of C7 and T1 vertebrae	Medial border of scapula at spine of scapula	Dorsal scapular nerve	Dorsal scapular *OR* deep branch of transverse cervical artery, dorsal perforating branches of upper five or six posterior intercostal arteries	Fixes scapula to thoracic wall and retracts and rotates it to depress glenoid cavity
Rotatores	Transversospinales	Transverse processes of cervical, thoracic, and lumbar regions	Lamina and transverse process of spine above, spanning one or two segments	Posterior rami of spinal nerves	Dorsal branches of segmental arteries	Stabilizes, extends, and rotates spine
Semispinalis	Transversospinales	Transverse processes of C4–T12	Spinous processes of cervical and thoracic regions	Posterior rami of spinal nerves	*Cervical portions:* occipital, deep cervical, and vertebral arteries *Thoracic portions:* dorsal branches of posterior intercostal arteries	Extends head, neck, and thorax and rotates them to opposite side
Serratus posterior inferior	Intermediate back	Spinous processes of T11–L2	Inferior aspect of ribs 9–12	Anterior rami of lower thoracic nerves	Posterior intercostal arteries	Depresses ribs
Serratus posterior superior	Intermediate back	Nuchal ligament, spinous processes of C7–T3	Superior aspect of ribs 2–5	Anterior rami of upper thoracic nerves	Posterior intercostal arteries	Elevates ribs
Splenius capitis	Spinotransverse	Nuchal ligament, spinous processes of C7–T4	Mastoid process of temporal bone, lateral third of superior nuchal line	Posterior rami of middle cervical nerves	Descending branch of occipital artery, deep cervical artery	*Bilaterally:* extends head *Unilaterally*: laterally bends (flexes) and rotates face to same side
Splenius cervicis	Spinotransverse	Spinous processes of T3–T6	Transverse processes (C1–C3)	Posterior rami of lower cervical nerves	Descending branch of occipital artery, deep cervical artery	*Bilaterally*: extends neck *Unilaterally:* laterally bends (flexes) and rotates neck toward same side
Trapezius	Superficial back	Superior nuchal line, external occipital protuberance, nuchal ligament, spinous processes of C7–T12	Lateral third of clavicle, acromion, spine of scapula	Accessory nerve (CN XI)	Transverse cervical artery, dorsal perforating branches of posterior intercostal arteries	Elevates, retracts, and rotates scapula; lower fibers depress scapula

Thoracic vertebrae, transverse section: superior view



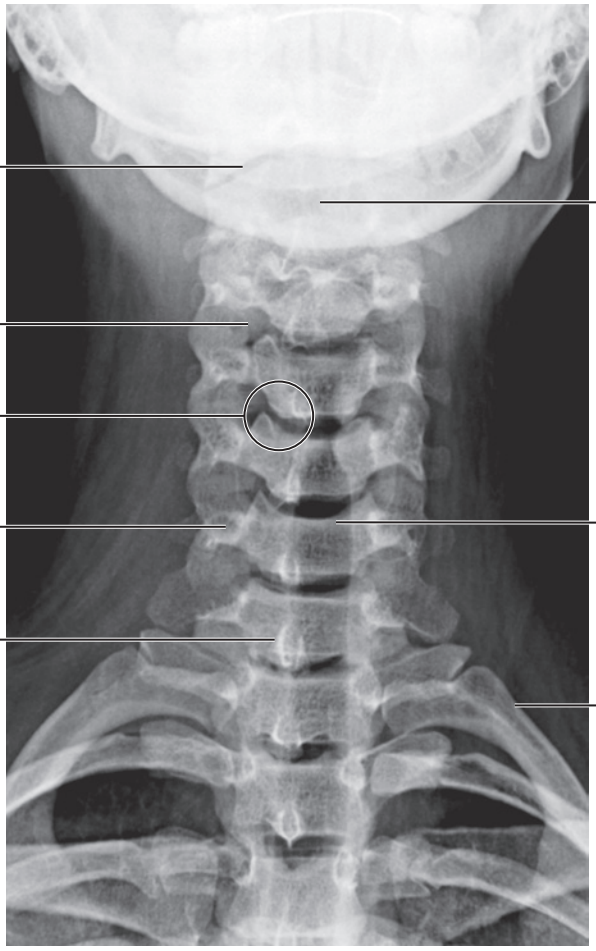
Lumbar anterior vertebral segments: posterior view (*pedicles sectioned*)



Lateral view



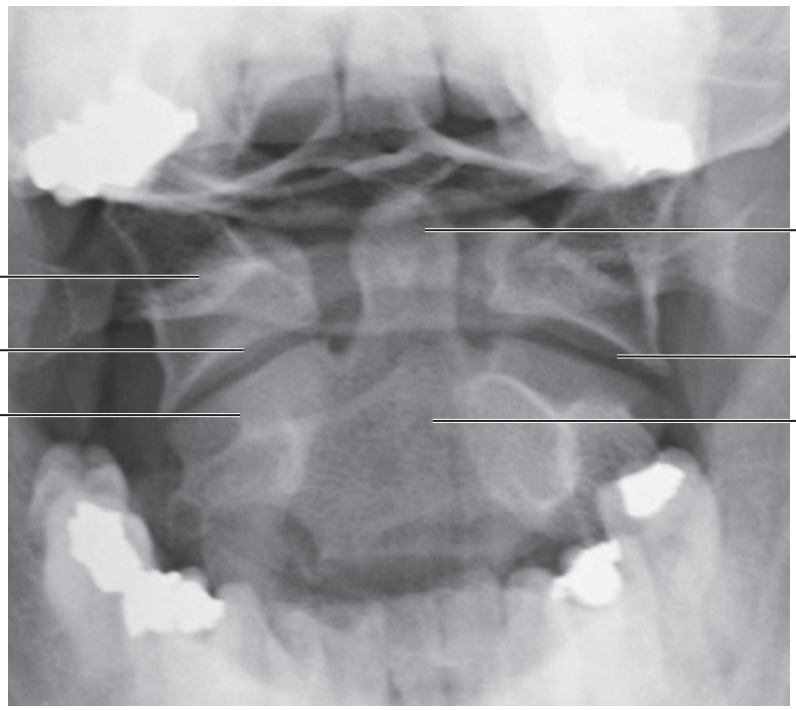
Anteroposterior view



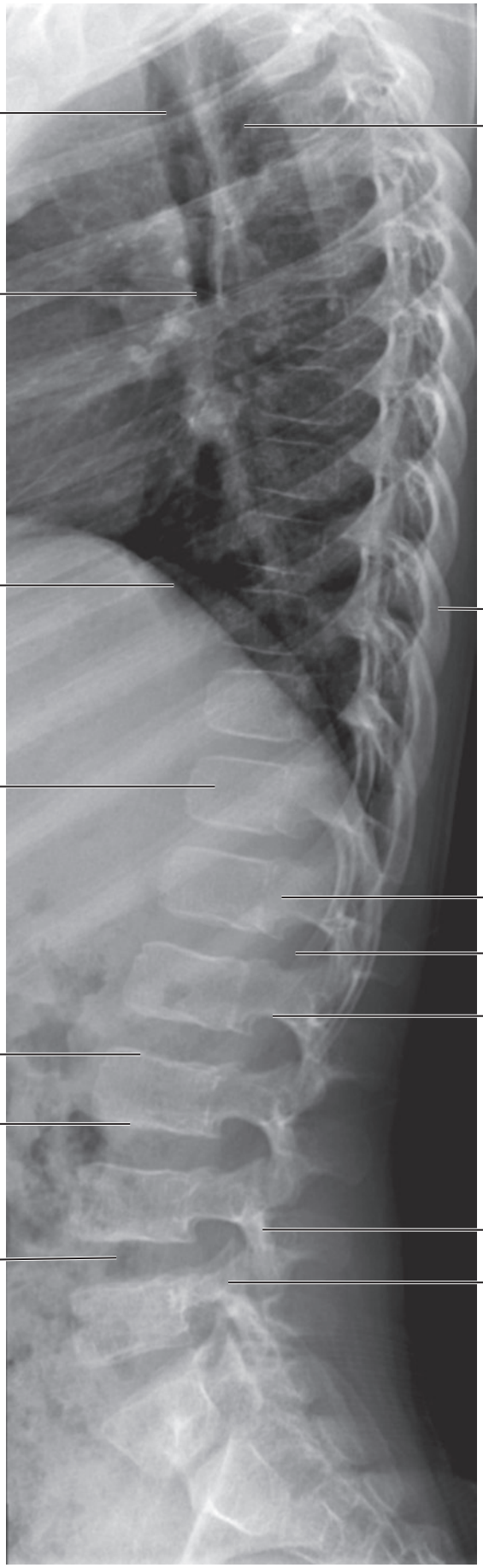
Sagittal T2-weighted MRI of cervical spine, without contrast



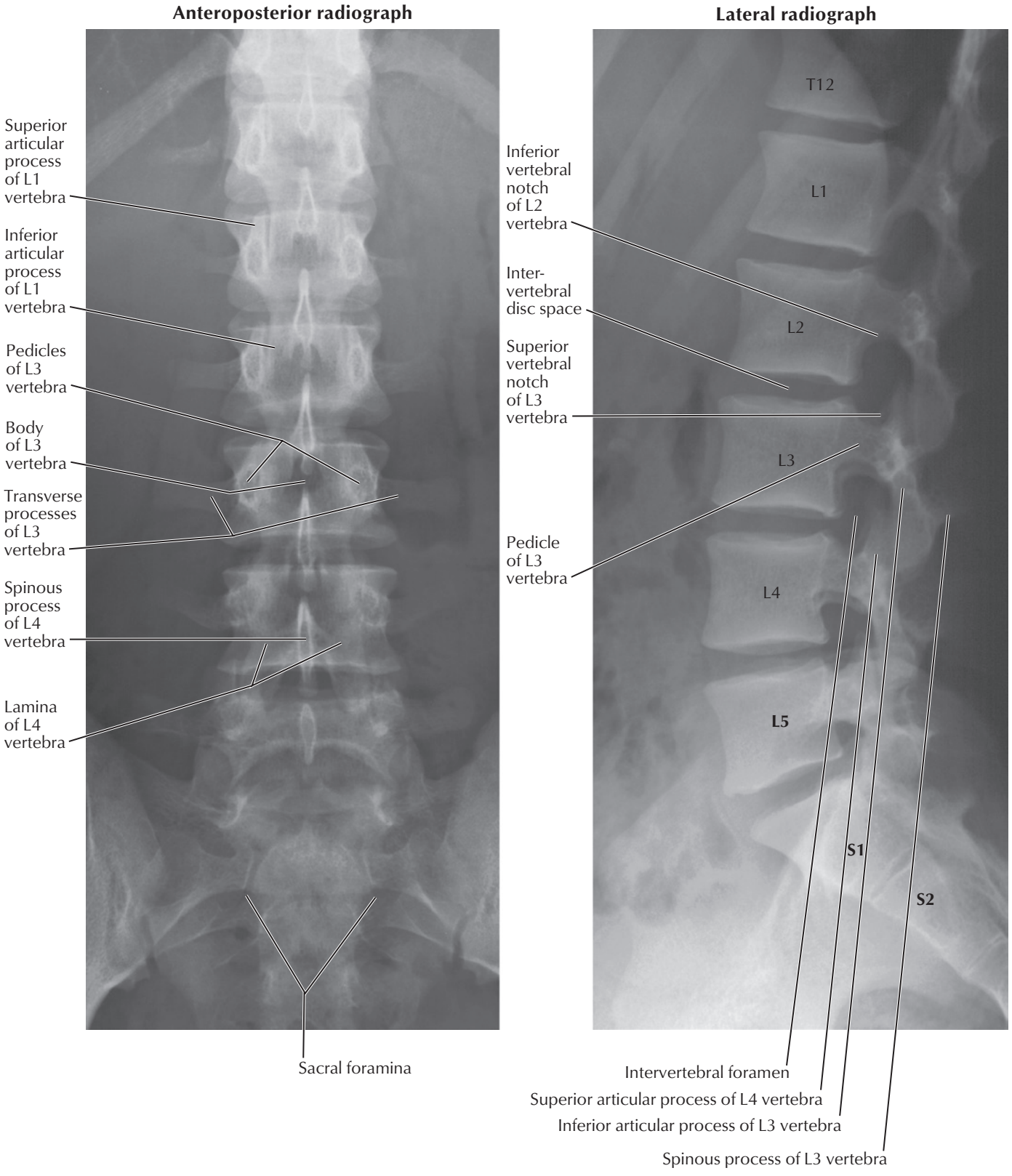
Open-mouth radiograph of cervical spine



Lateral radiograph of thoracolumbar spine

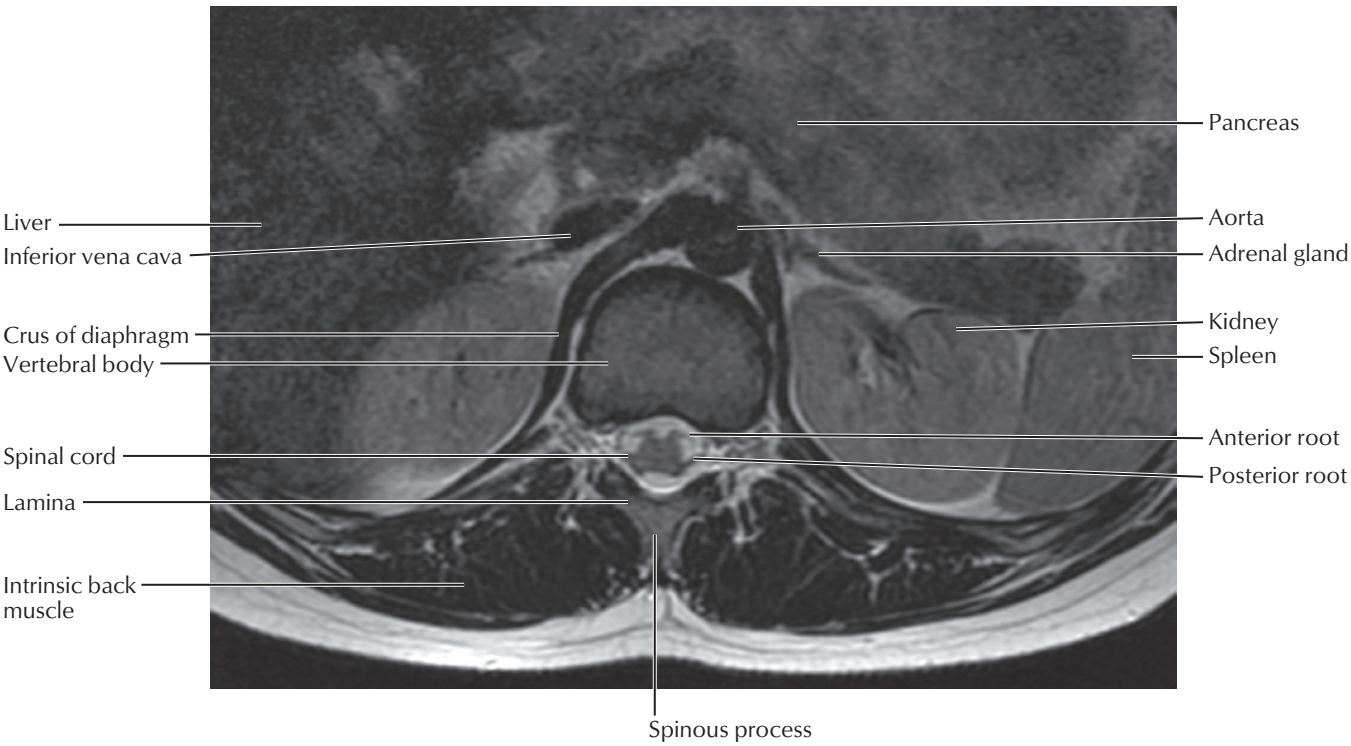


Radiographs of lumbar vertebrae

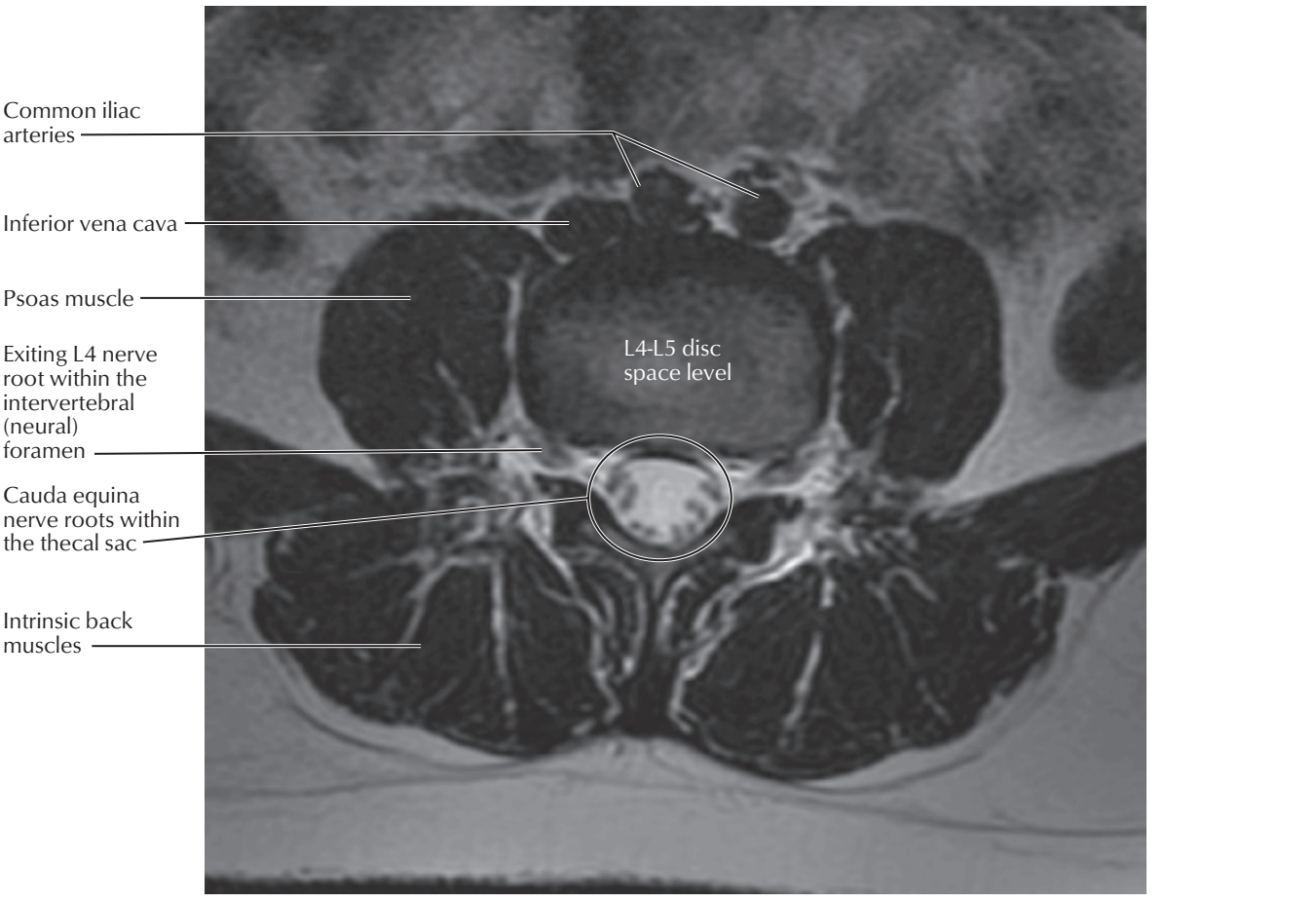


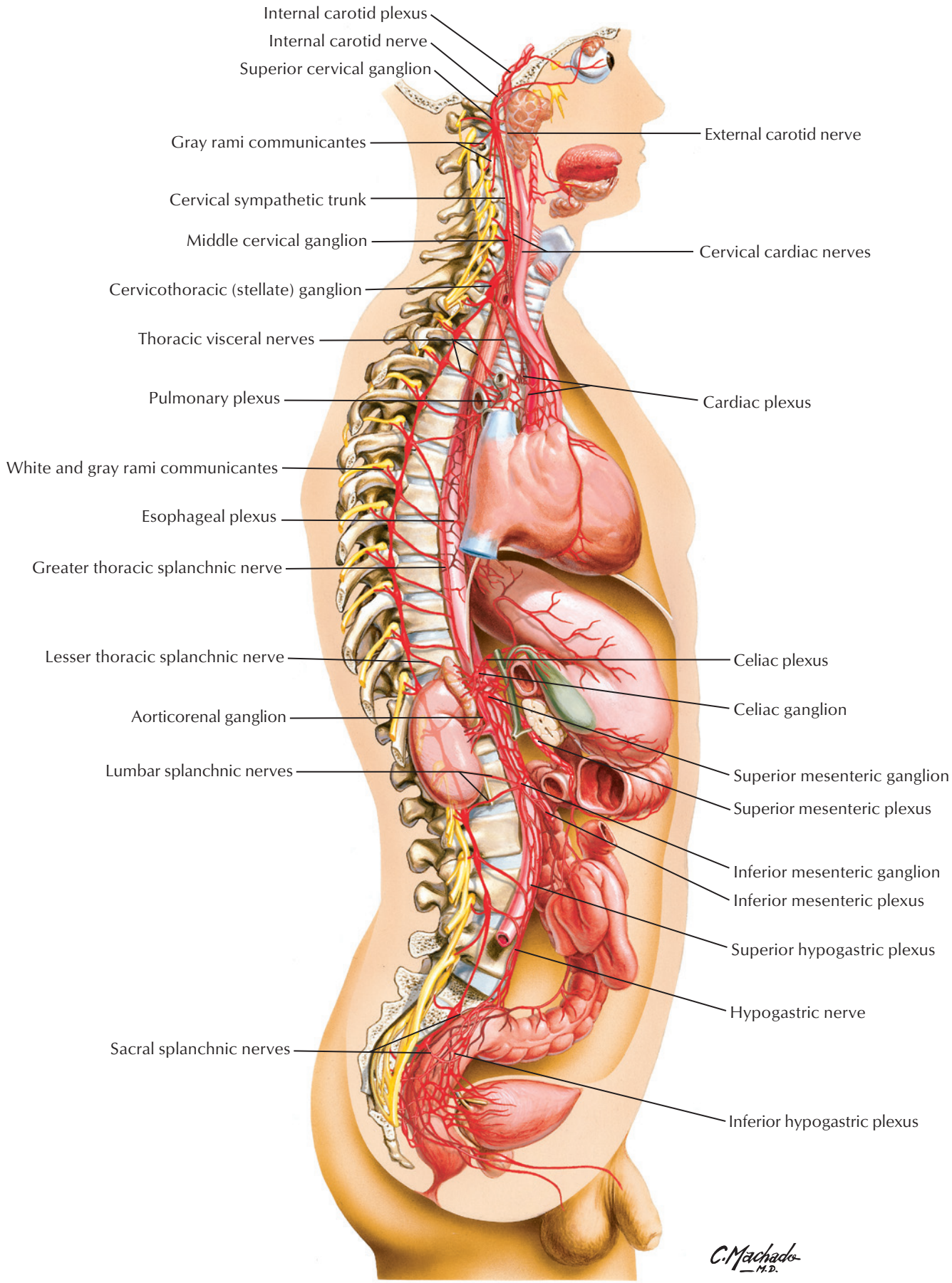
Note: *The vertebral bodies are numbered.*

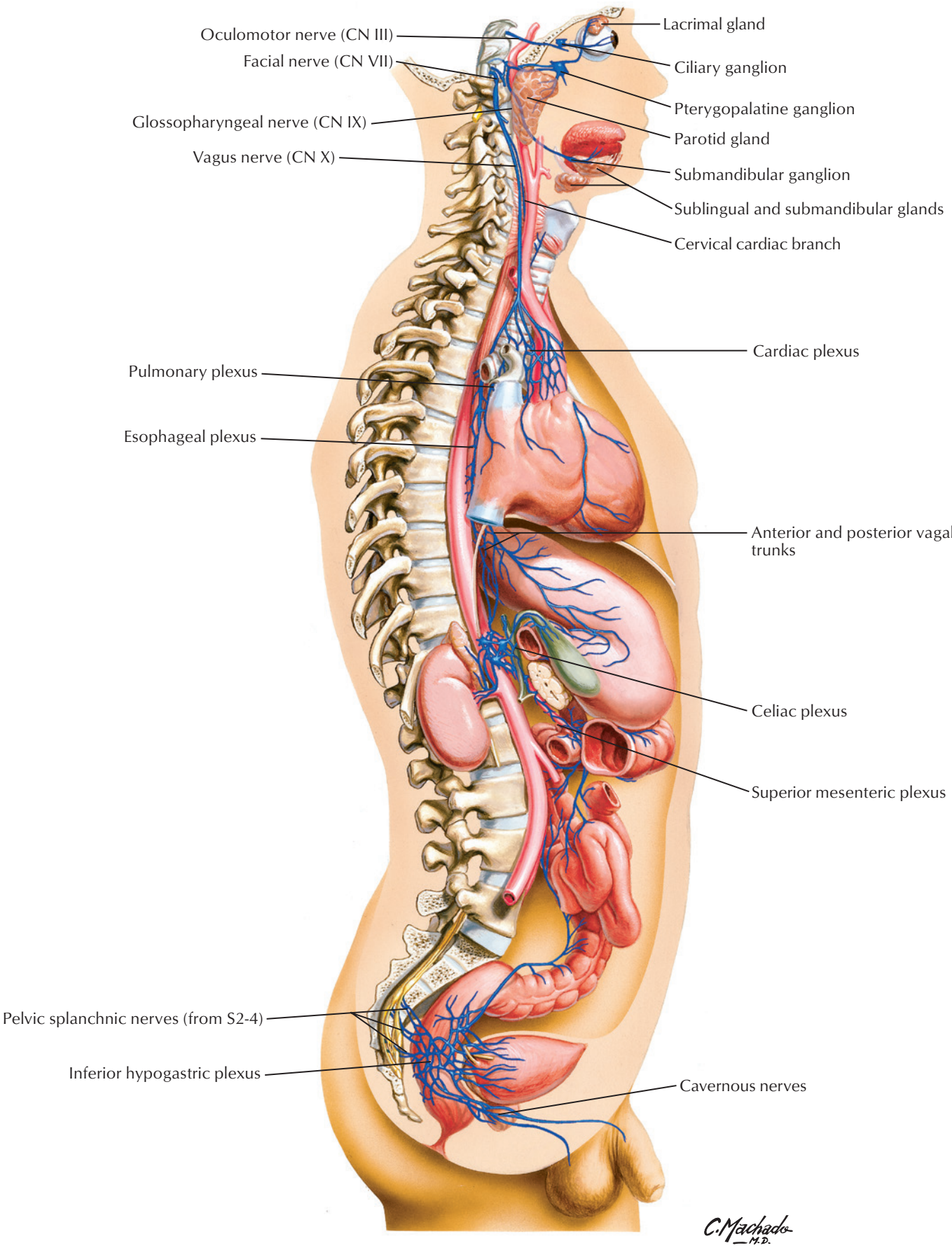
Axial T2-weighted MRI section through upper lumbar level, without contrast

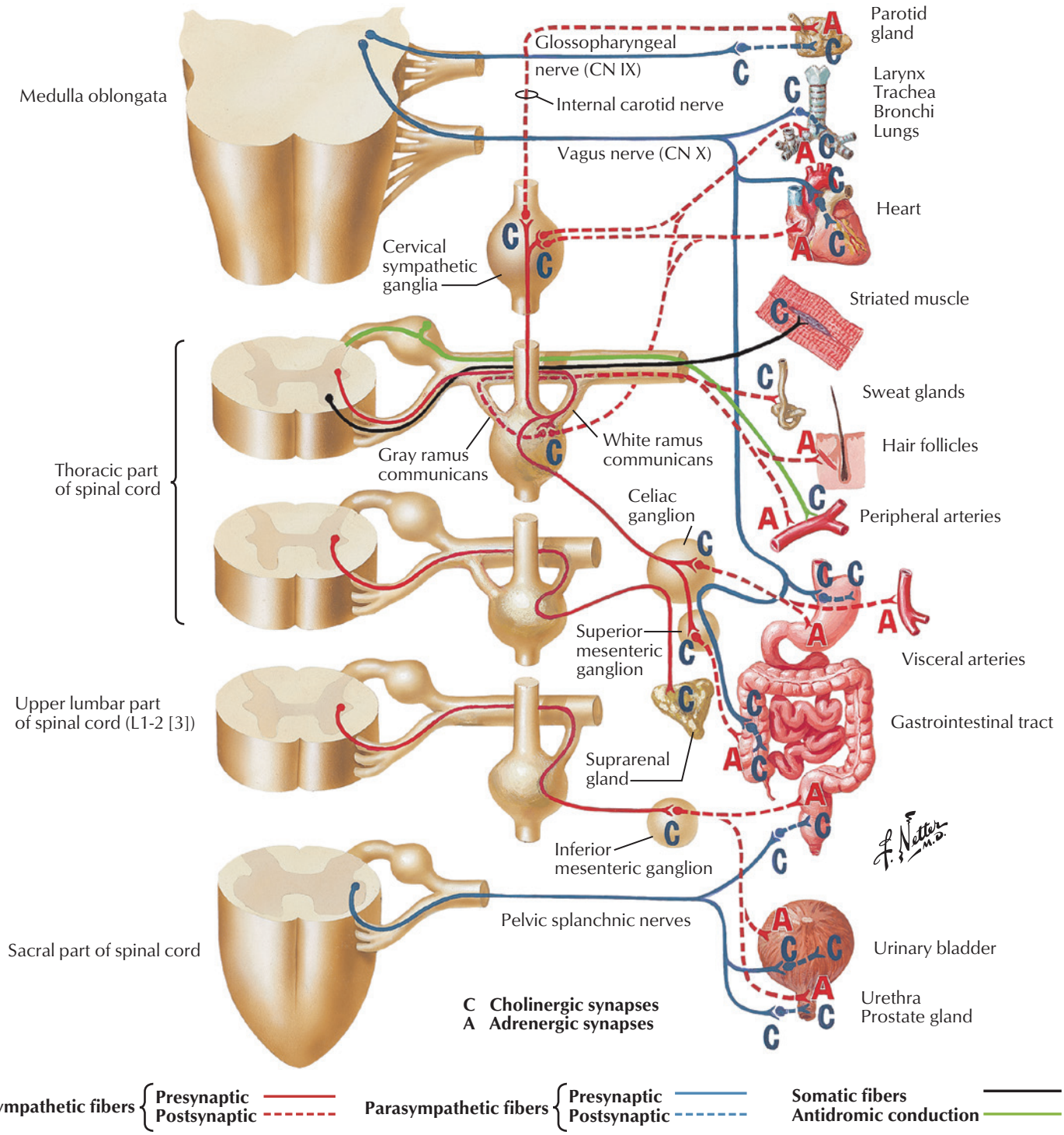


Axial T2-weighted MRI section through lower lumbar level, without contrast

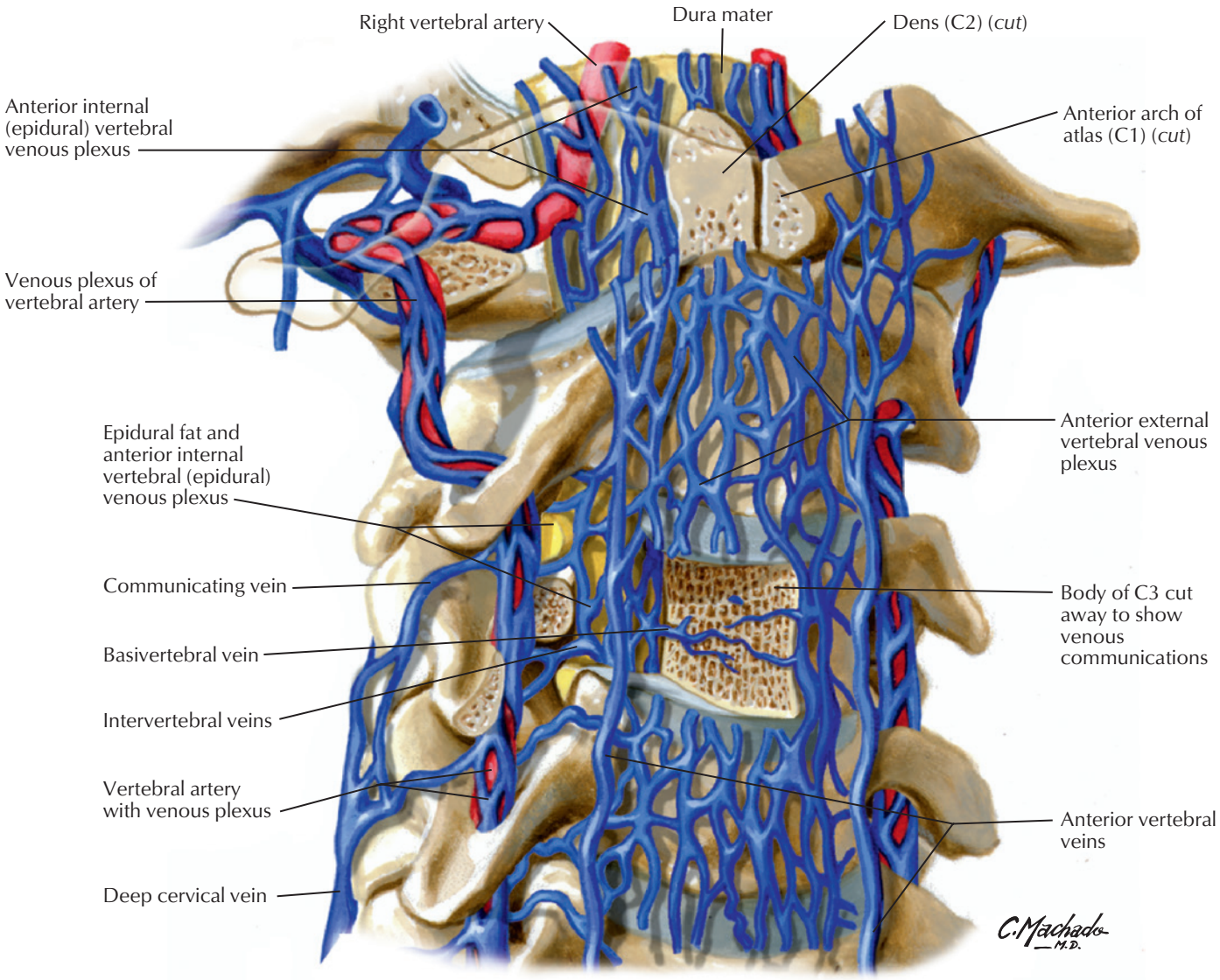



Internal carotid plexus
Internal carotid nerve
Superior cervical ganglion
Gray rami communicantes
Cervical sympathetic trunk
Middle cervical ganglion
Cervicothoracic (stellate) ganglion
Thoracic visceral nerves
Pulmonary plexus
White and gray rami communicantes
Esophageal plexus
Greater thoracic splanchnic nerve
Lesser thoracic splanchnic nerve
Aorticorenal ganglion
Lumbar splanchnic nerves
Sacral splanchnic nerves
External carotid nerve
Cervical cardiac nerves
Cardiac plexus
Celiac plexus
Celiac ganglion
Superior mesenteric ganglion
Superior mesenteric plexus
Inferior mesenteric ganglion
Inferior mesenteric plexus
Superior hypogastric plexus
Hypogastric nerve
Inferior hypogastric plexus
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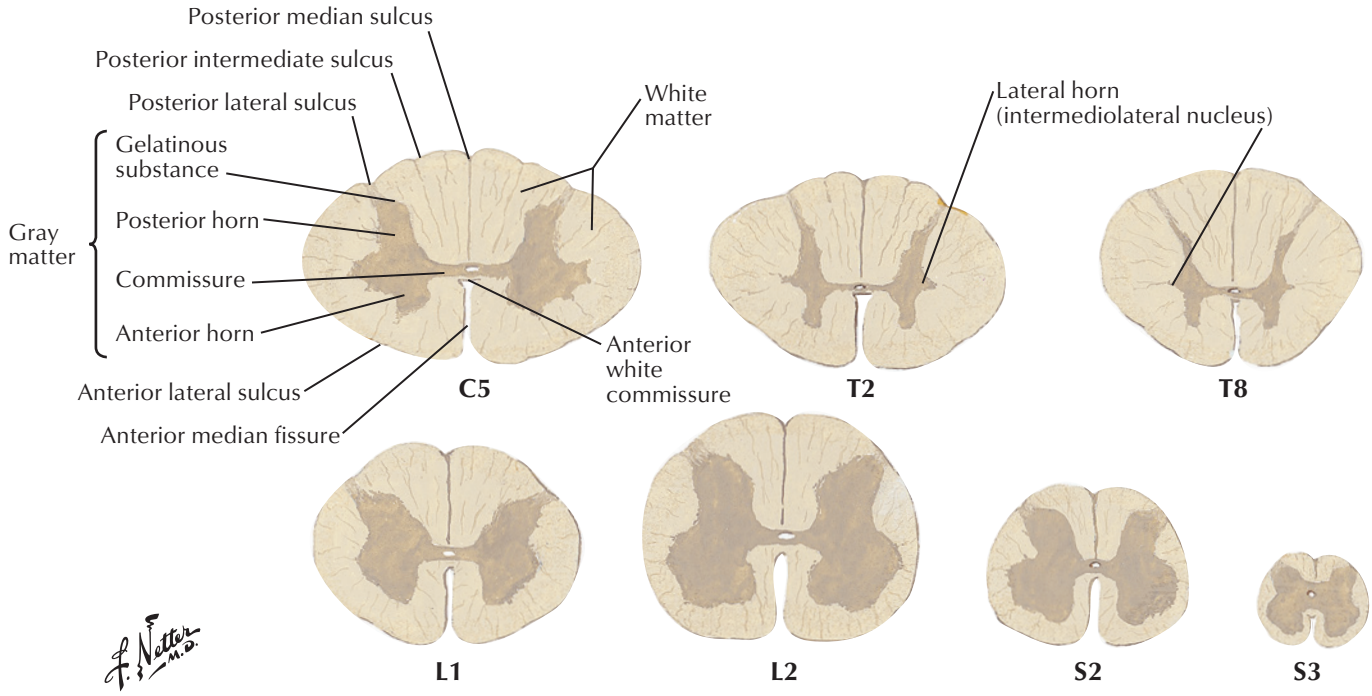

Oculomotor nerve (CN III)
Facial nerve (CN VII)
Glossopharyngeal nerve (CN IX)
Vagus nerve (CN X)
Lacrimal gland
Ciliary ganglion
Pterygopalatine ganglion
Parotid gland
Submandibular ganglion
Sublingual and submandibular glands
Cervical cardiac branch
Cardiac plexus
Pulmonary plexus
Esophageal plexus
Anterior and posterior vagal trunks
Celiac plexus
Superior mesenteric plexus
Pelvic splanchnic nerves (from S2-4)
Inferior hypogastric plexus
Cavernous nerves
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Medulla oblongata
Glossopharyngeal nerve (CN IX)
Internal carotid nerve
Vagus nerve (CN X)
Parotid gland
Larynx
Trachea
Bronchi
Lungs
Heart
Cervical sympathetic ganglia
Striated muscle
Sweat glands
Hair follicles
Peripheral arteries
Gray ramus communicans
White ramus communicans
Thoracic part of spinal cord
Celiac ganglion
Superior mesenteric ganglion
Visceral arteries
Gastrointestinal tract
Upper lumbar part of spinal cord (L1-2 [3])
Suprarenal gland
Inferior mesenteric ganglion
Pelvic splanchnic nerves
Sacral part of spinal cord
Urinary bladder
Urethra
Prostate gland
C Cholinergic synapses
A Adrenergic synapses
Sympathetic fibers
Presynaptic
Postsynaptic
Parasympathetic fibers
Presynaptic
Postsynaptic
Somatic fibers
Antidromic conduction

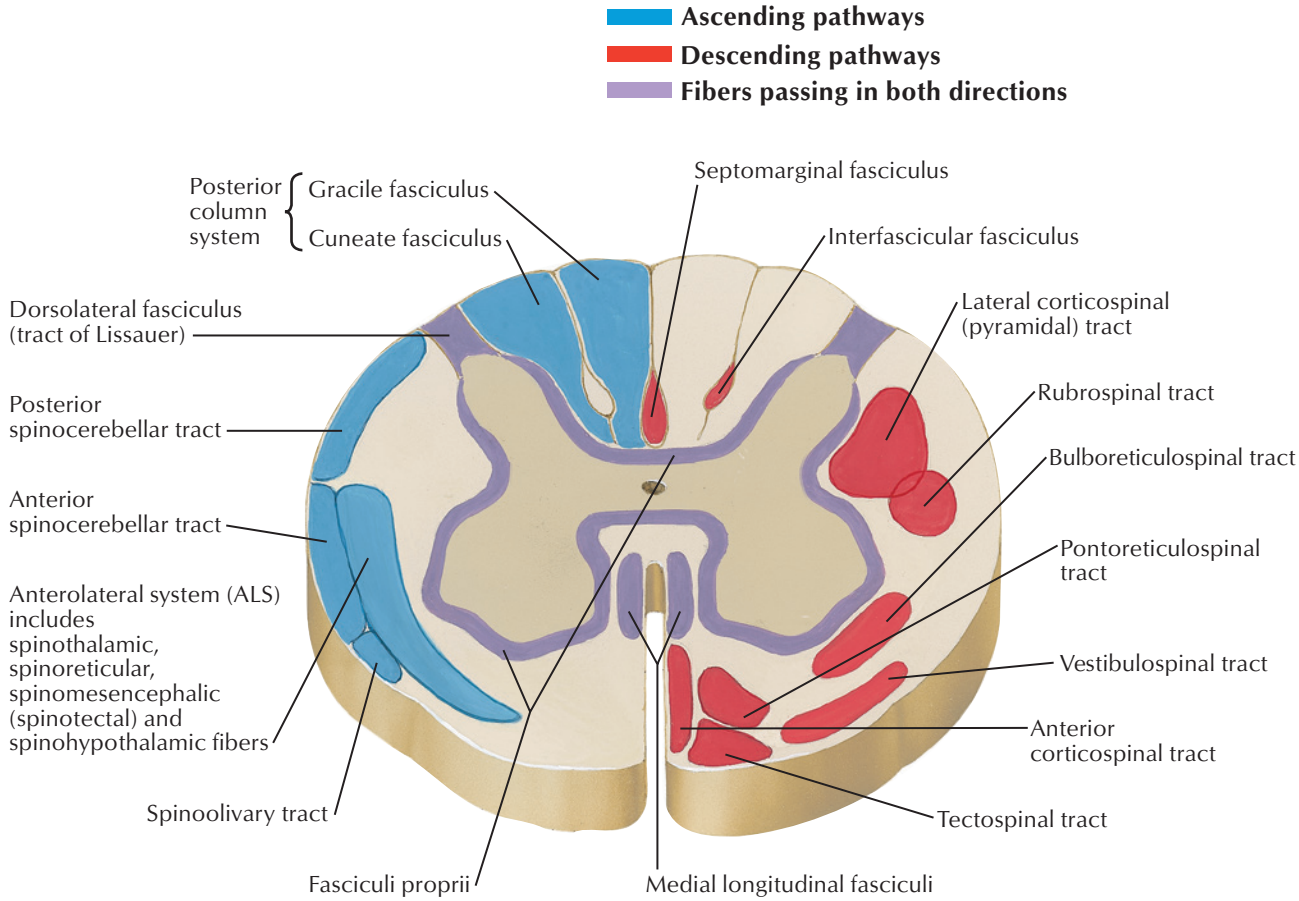
Vertebral Veins: Detail Showing Venous Communications



Sections through spinal cord at various levels



Principal fiber tracts of spinal cord

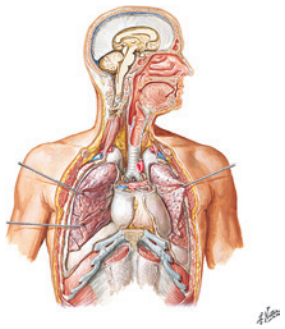


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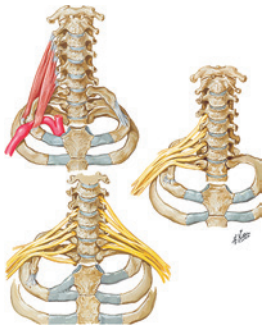
THORAX 4

Surface Anatomy	187	**Regional Scans**	244
Mammary Gland	188-191	**Cross-Sectional Anatomy**	245-248
Body Wall	192-201	**Structures with High Clinical Significance**	Tables 4.1-4.2
Lungs	202-214	**Muscle Table**	Table 4.3
Heart	215-233	**Electronic Bonus Plates**	BP44-BP57
Mediastinum	234-243		

ELECTRONIC BONUS PLATES



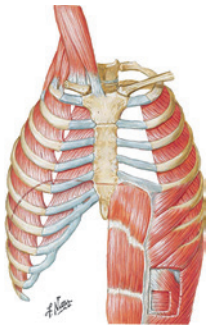
BP44 Respiratory System



BP45 Cervical Ribs and Related Anomalies



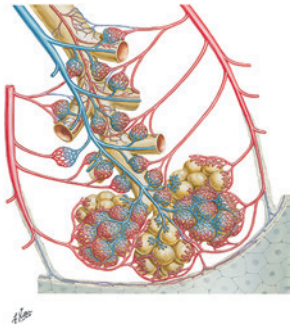
BP46 Muscle Attachments of Ribs



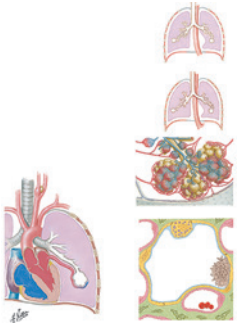
BP47 Muscles of Respiration



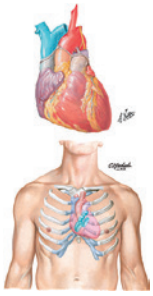
BP48 Intrapulmonary Airways: Schema



BP49 Intrapulmonary Blood Circulation: Schema

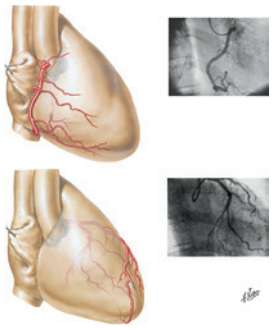


BP50 Gas Exchange

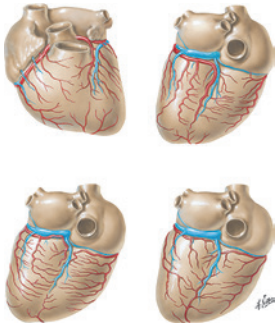


BP51 Anterior Aspect of Heart

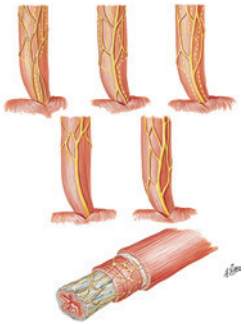
ELECTRONIC BONUS PLATES—*cont'd*



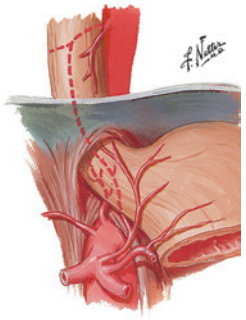
BP52 Coronary Arteries: Right Anterior Oblique Views with Arteriograms



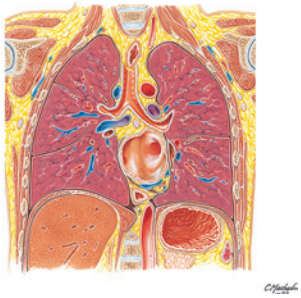
BP53 Coronary Arteries and Cardiac Veins: Variations



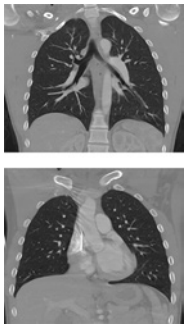
BP54 Intrinsic Nerves and Variations in Nerves of Esophagus



BP55 Arteries of Esophagus: Variations

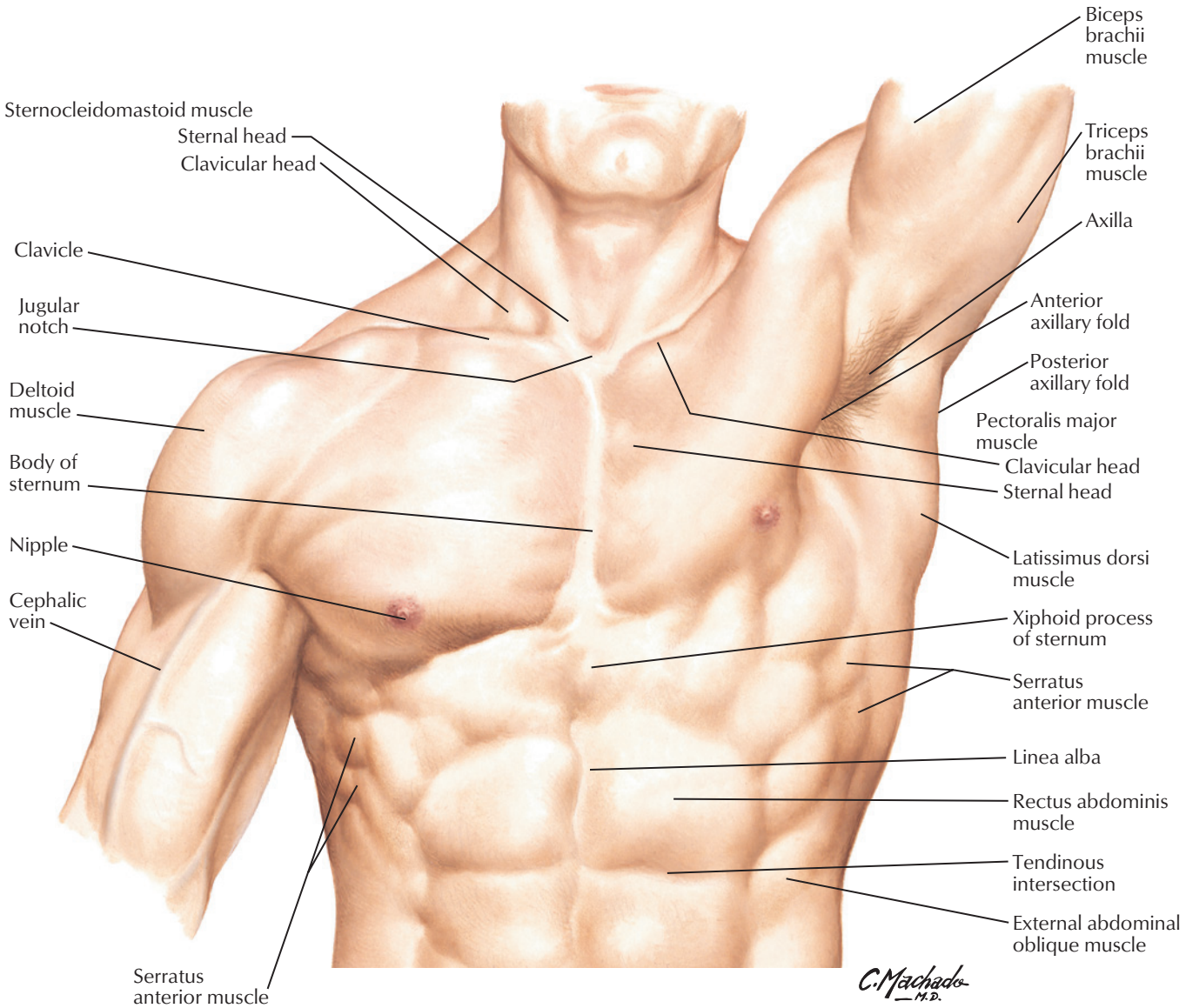


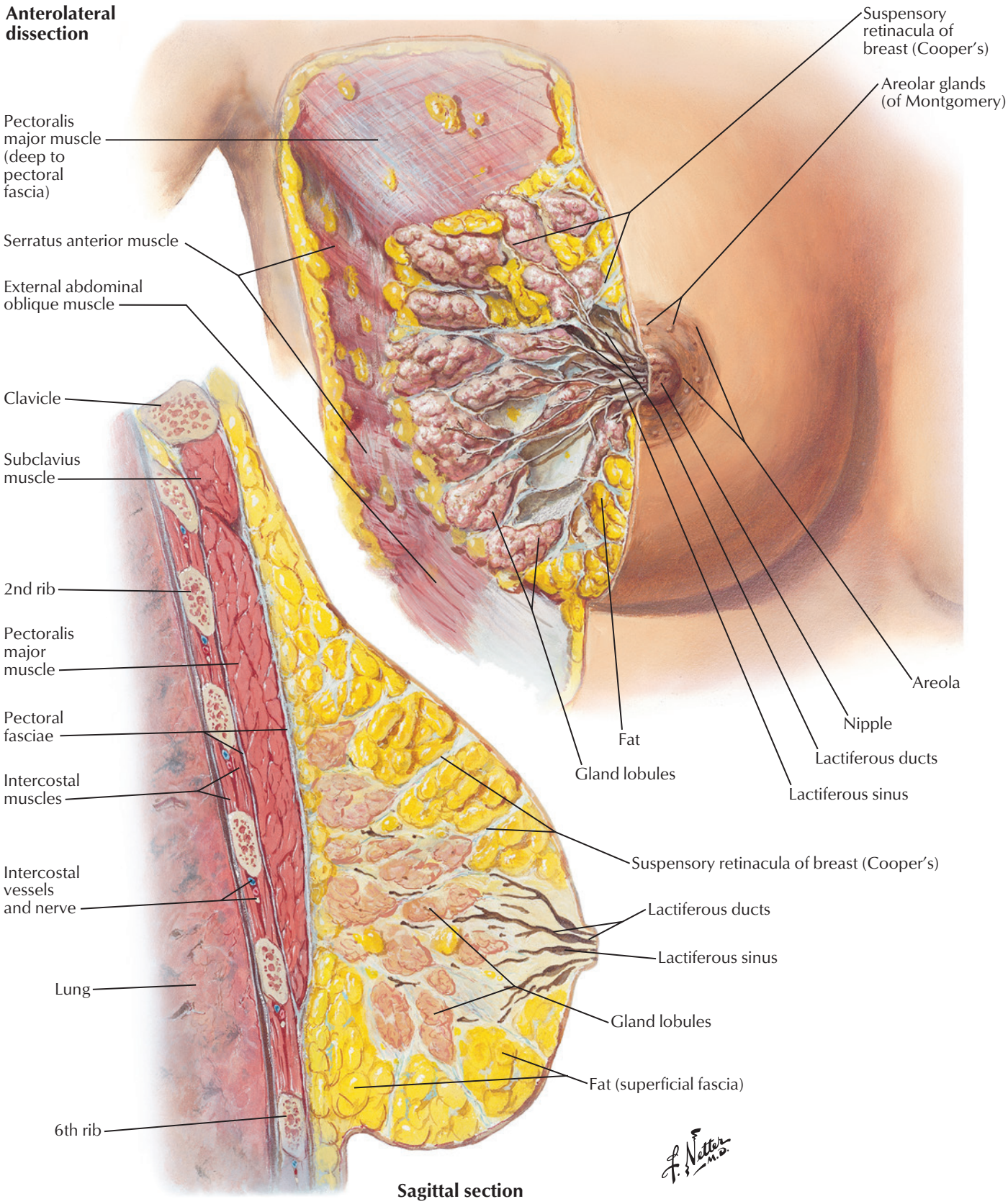
BP56 Thorax: Coronal Section (Midaxillary Line, Tracheal Bifurcation, Left Atrium)

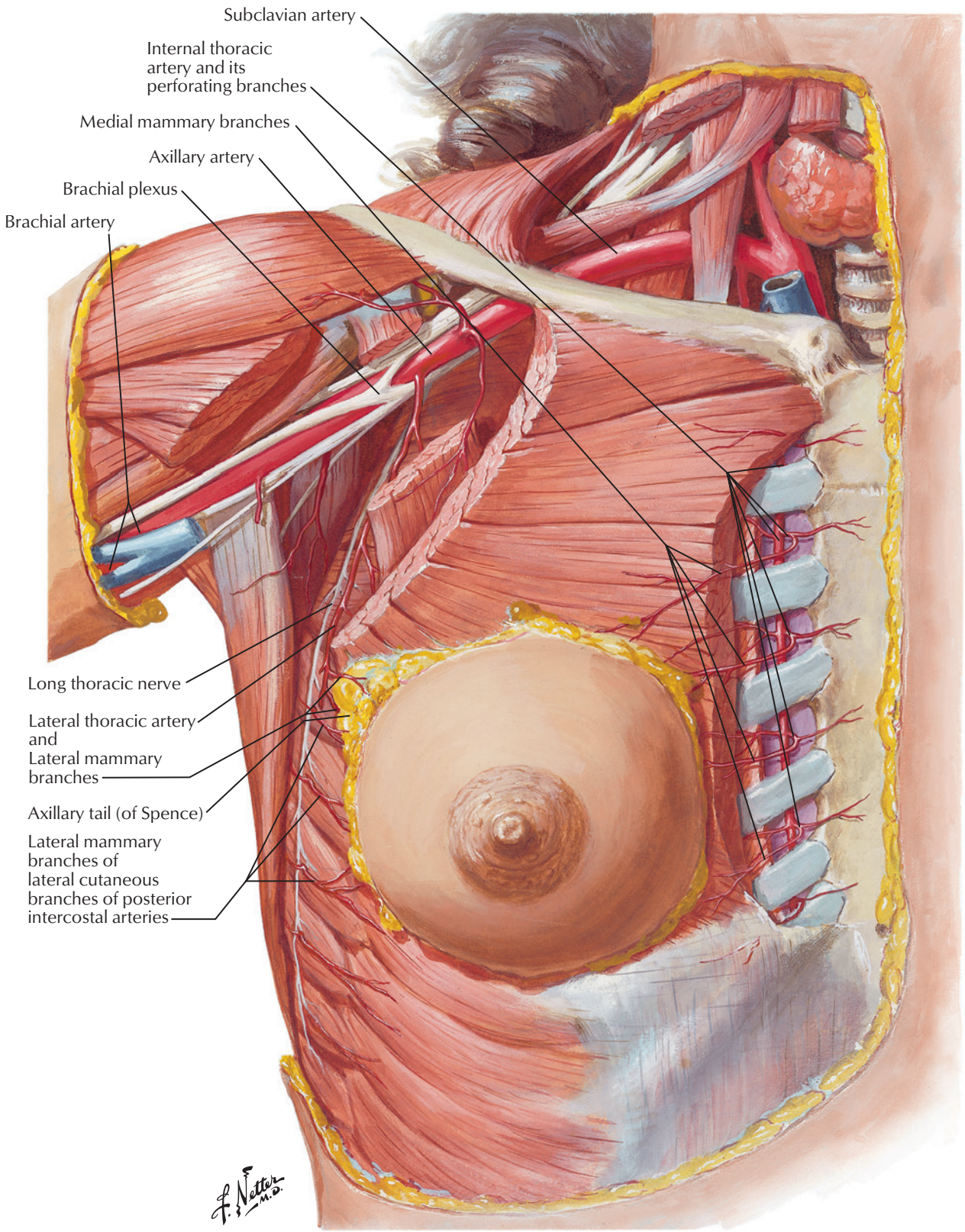


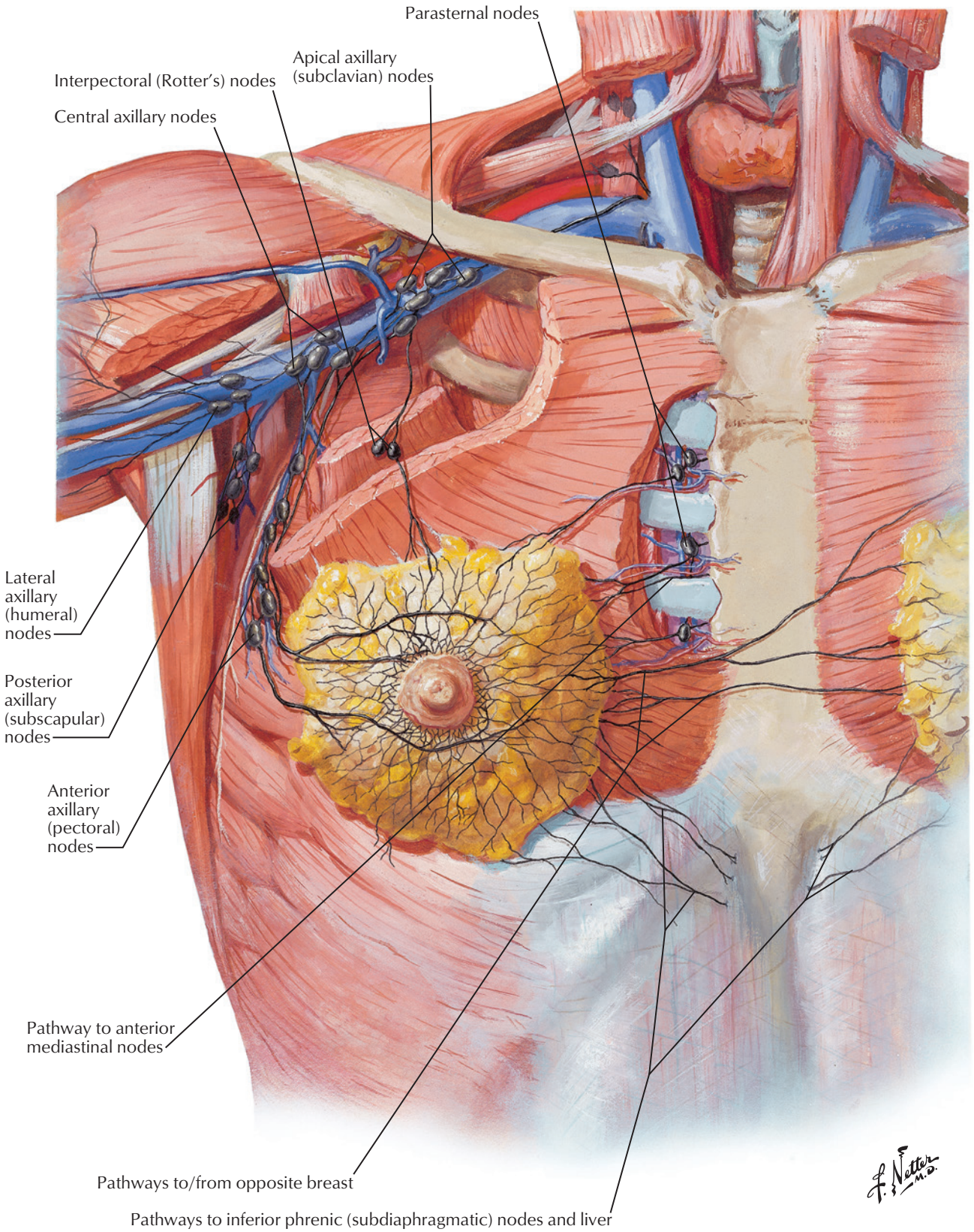
BP57 Thorax: Coronal CTs

See also Plates 171, 194

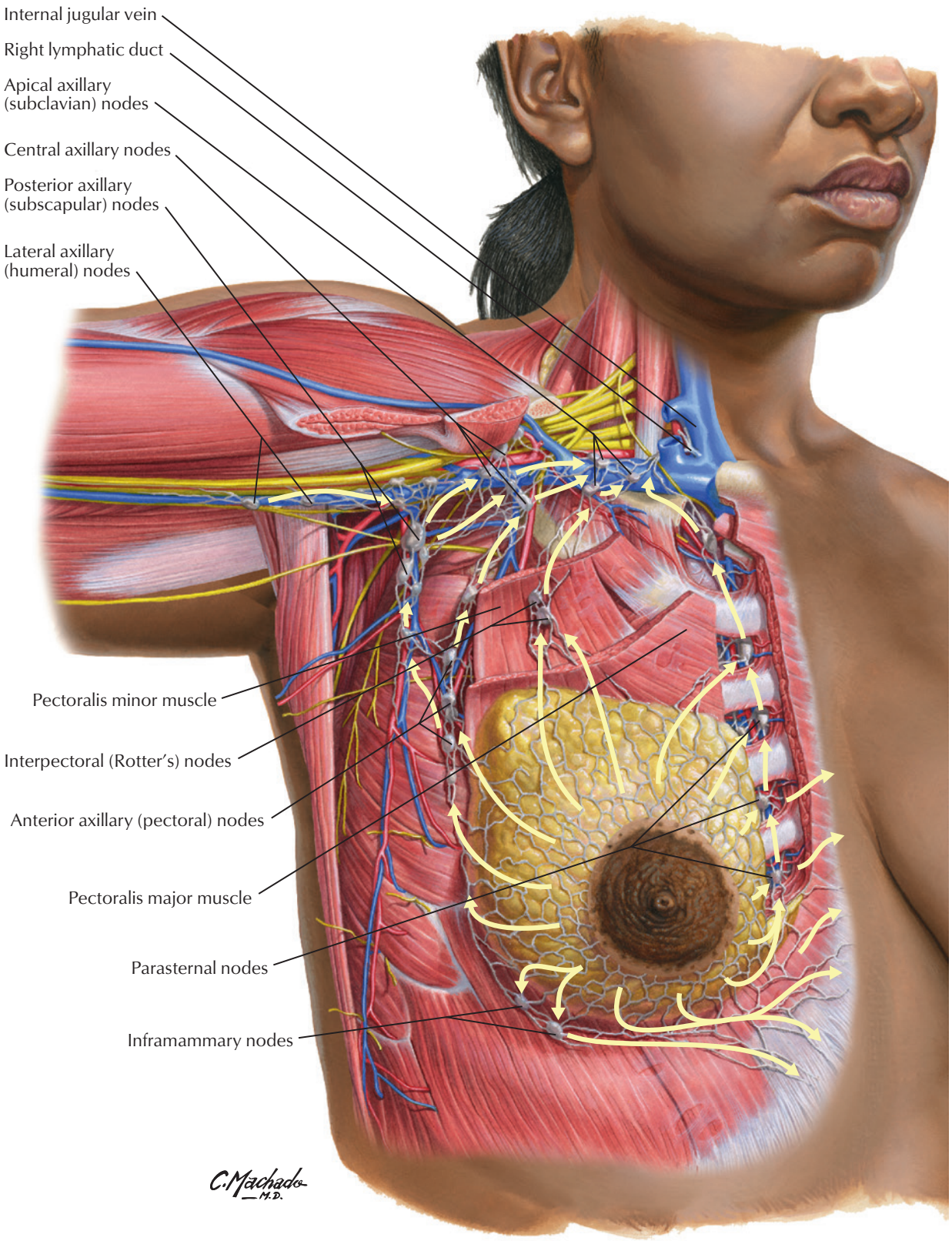


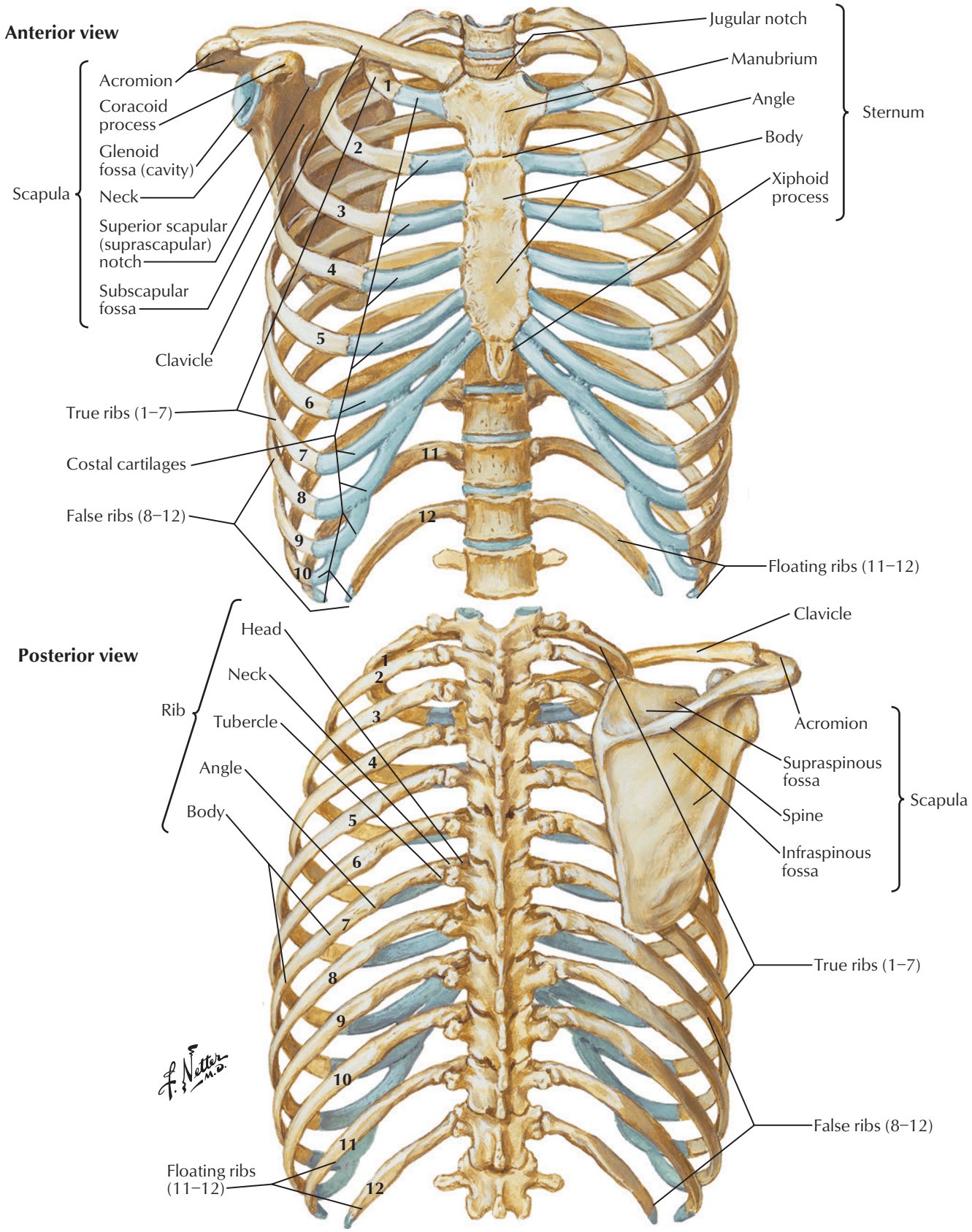

Anterolateral dissection
Pectoralis major muscle (deep to pectoral fascia)
Serratus anterior muscle
External abdominal oblique muscle
Clavicle
Subclavius muscle
2nd rib
Pectoralis major muscle
Pectoral fasciae
Intercostal muscles
Intercostal vessels and nerve
Lung
6th rib
Suspensory retinacula of breast (Cooper's)
Areolar glands (of Montgomery)
Areola
Nipple
Lactiferous ducts
Lactiferous sinus
Fat
Gland lobules
Suspensory retinacula of breast (Cooper's)
Lactiferous ducts
Lactiferous sinus
Gland lobules
Fat (superficial fascia)
Sagittal section

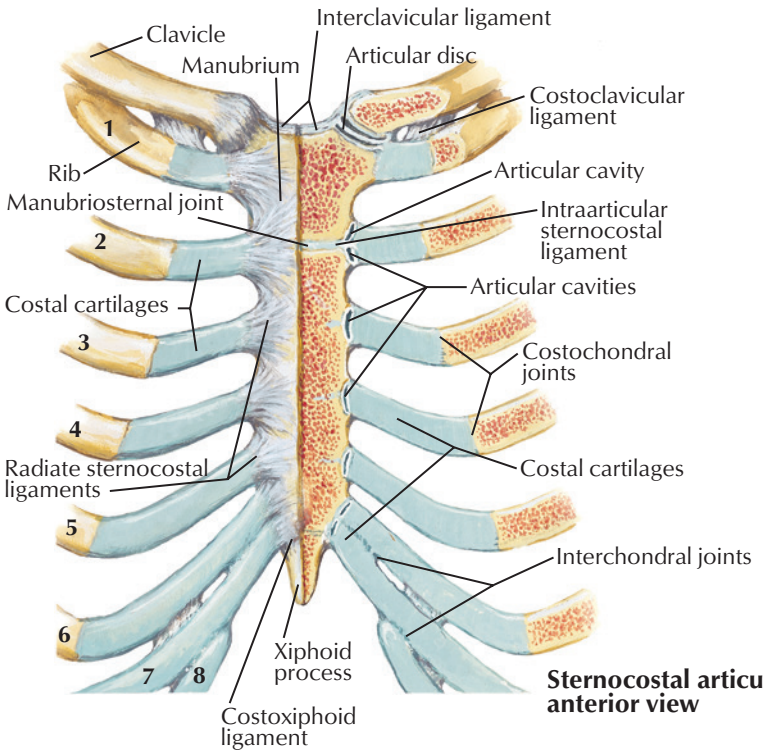

Subclavian artery
Internal thoracic artery and its perforating branches
Medial mammary branches
Axillary artery
Brachial plexus
Brachial artery
Long thoracic nerve
Lateral thoracic artery and Lateral mammary branches
Axillary tail (of Spence)
Lateral mammary branches of lateral cutaneous branches of posterior intercostal arteries
F. Netter M.D.


Parasternal nodes
Apical axillary (subclavian) nodes
Interpectoral (Rotter's) nodes
Central axillary nodes
Lateral axillary (humeral) nodes
Posterior axillary (subscapular) nodes
Anterior axillary (pectoral) nodes
Pathway to anterior mediastinal nodes
Pathways to/from opposite breast
Pathways to inferior phrenic (subdiaphragmatic) nodes and liver

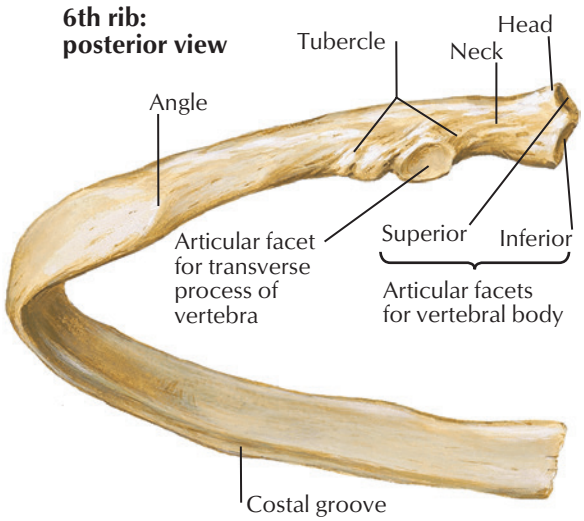
See also Plate 190



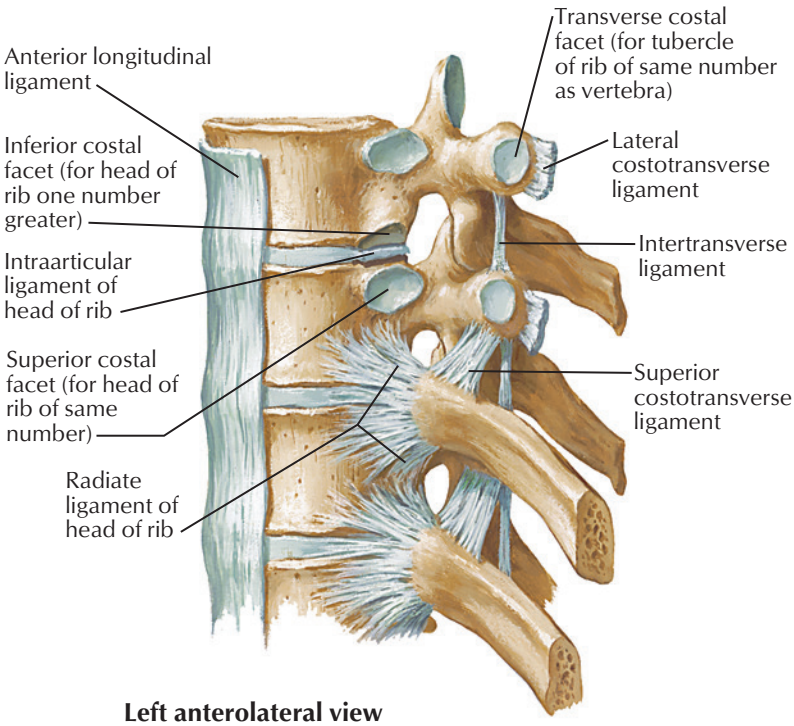

Anterior view
Acromion
Coracoid process
Glenoid fossa (cavity)
Neck
Scapula
Superior scapular (suprascapular) notch
Subscapular fossa
Clavicle
True ribs (1–7)
Costal cartilages
False ribs (8–12)
Floating ribs (11–12)
Jugular notch
Manubrium
Angle
Body
Xiphoid process
Sternum
1
2
3
4
5
6
7
8
9
10
11
12
Posterior view
Rib
Head
Neck
Tubercle
Angle
Body
Floating ribs (11–12)
Clavicle
Acromion
Supraspinous fossa
Spine
Infraspinous fossa
Scapula
True ribs (1–7)
False ribs (8–12)



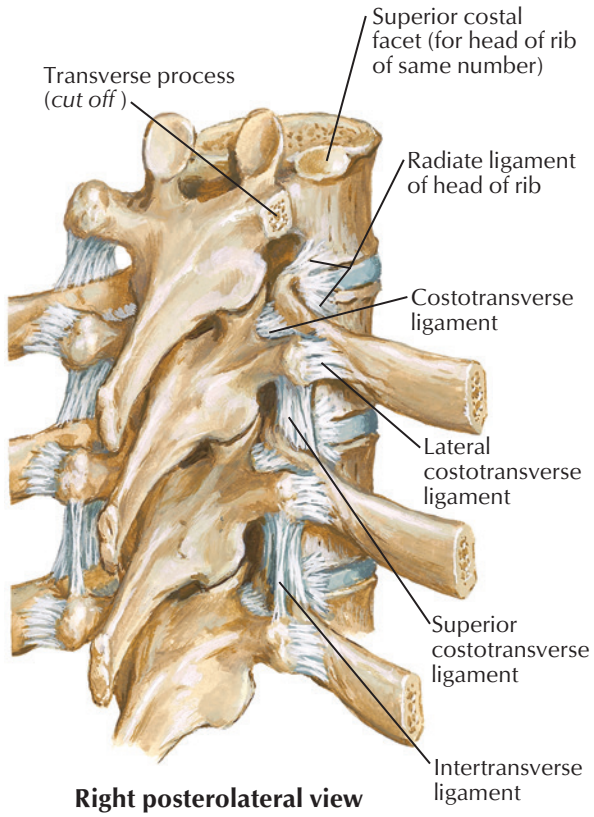
Sternocostal articulations: anterior view



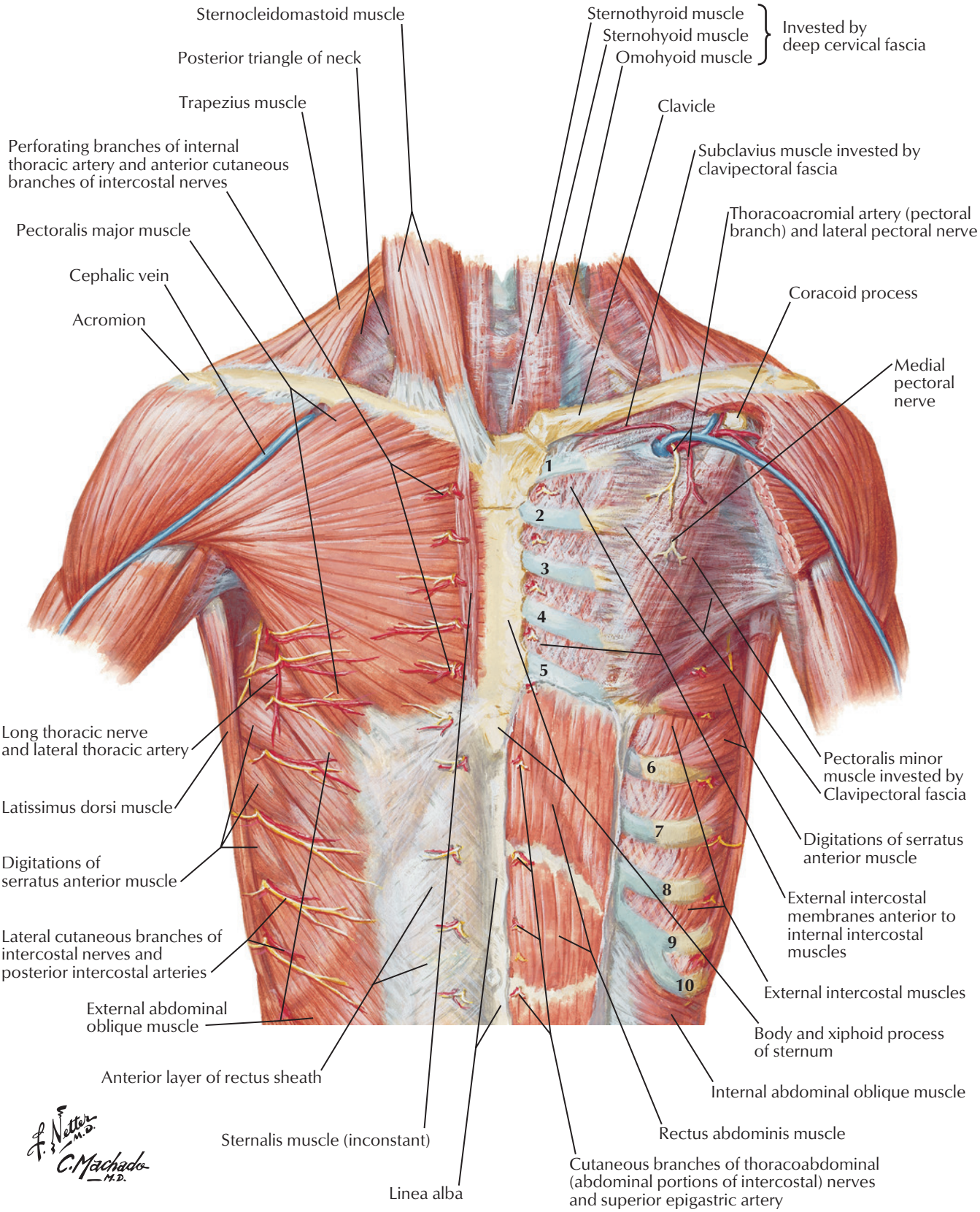
Note: The head of a typical rib articulates with the superior costal facet of the thoracic vertebra of the same number (by its inferior articular facet), the inferior costal facet of the vertebra above (by its superior articular facet), and the intervertebral disc between the two vertebrae. The costal tubercle articulates with the transverse process of the vertebra of the same number.

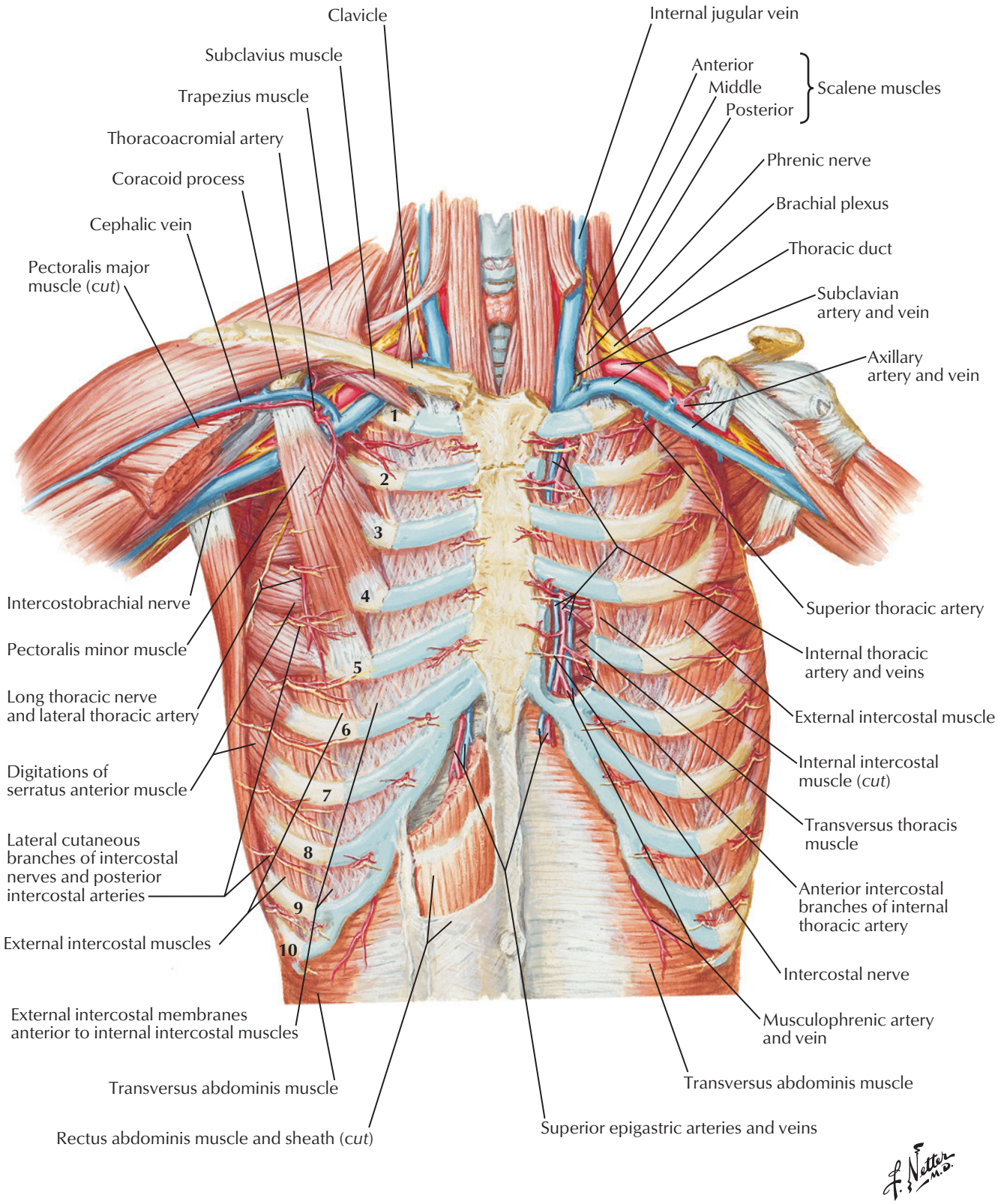


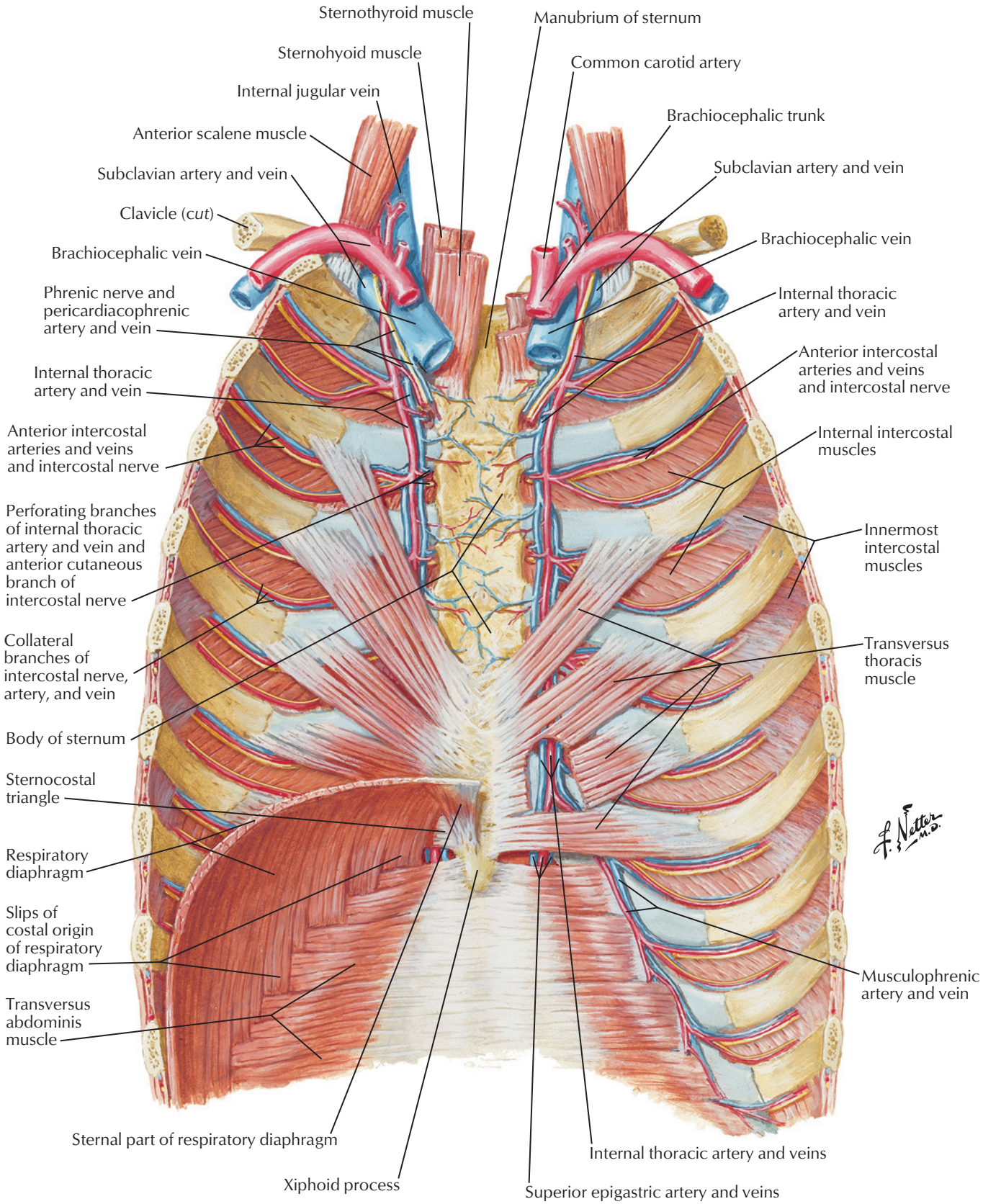
Left anterolateral view



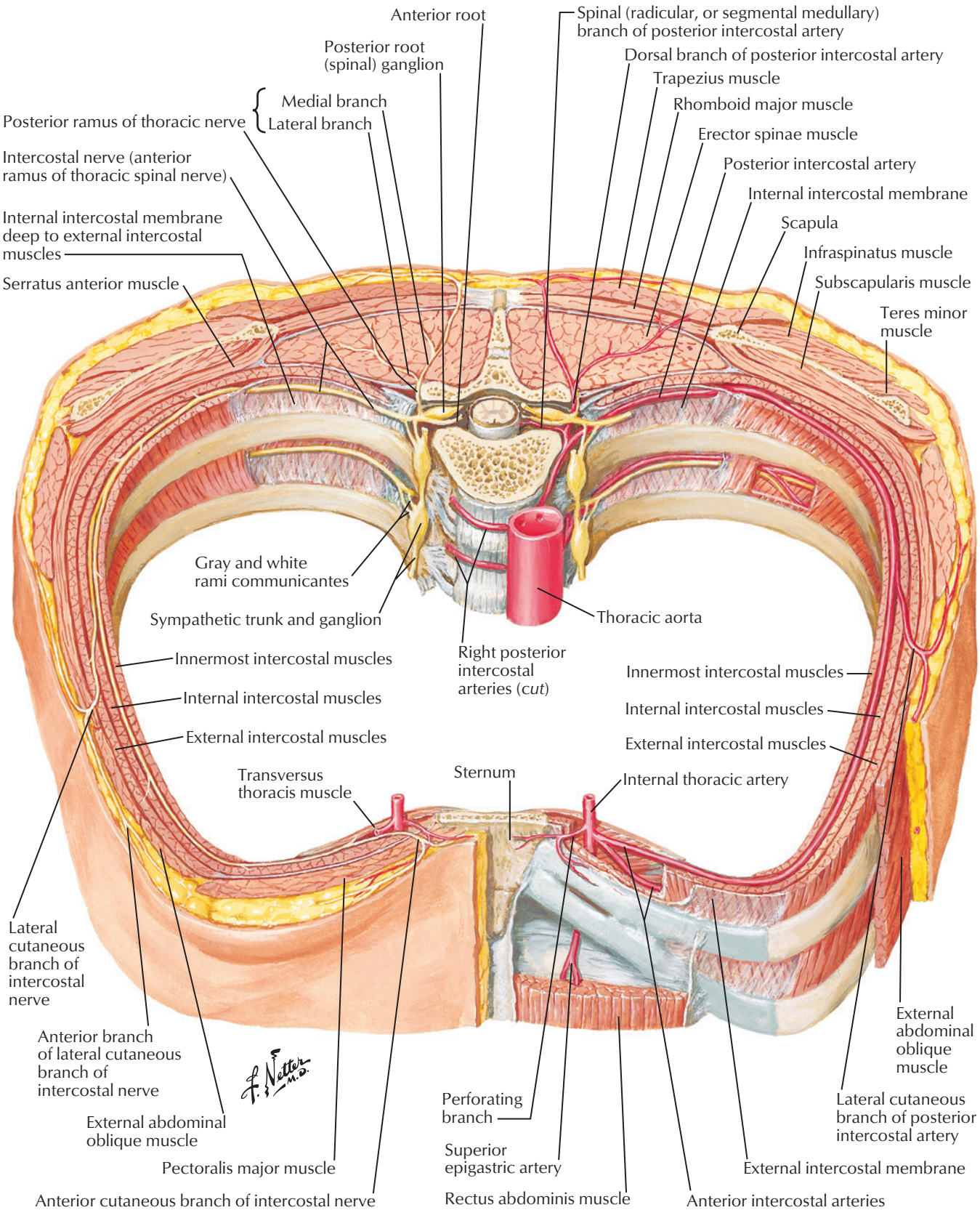
Right posterolateral view


Sternocleidomastoid muscle
Posterior triangle of neck
Trapezius muscle
Perforating branches of internal thoracic artery and anterior cutaneous branches of intercostal nerves
Pectoralis major muscle
Cephalic vein
Acromion
Sternothyroid muscle
Sternohyoid muscle
Omohyoid muscle
Invested by deep cervical fascia
Clavicle
Subclavius muscle invested by clavipectoral fascia
Thoracoacromial artery (pectoral branch) and lateral pectoral nerve
Coracoid process
Medial pectoral nerve
1
2
3
4
5
6
7
8
9
10
Long thoracic nerve and lateral thoracic artery
Latissimus dorsi muscle
Digitations of serratus anterior muscle
Lateral cutaneous branches of intercostal nerves and posterior intercostal arteries
External abdominal oblique muscle
Anterior layer of rectus sheath
Sternalis muscle (inconstant)
Linea alba
Pectoralis minor muscle invested by Clavipectoral fascia
Digitations of serratus anterior muscle
External intercostal membranes anterior to internal intercostal muscles
External intercostal muscles
Body and xiphoid process of sternum
Internal abdominal oblique muscle
Rectus abdominis muscle
Cutaneous branches of thoracoabdominal (abdominal portions of intercostal) nerves and superior epigastric artery


Clavicle
Subclavius muscle
Trapezius muscle
Thoracoacromial artery
Coracoid process
Cephalic vein
Pectoralis major muscle (cut)
Intercostobrachial nerve
Pectoralis minor muscle
Long thoracic nerve and lateral thoracic artery
Digitations of serratus anterior muscle
Lateral cutaneous branches of intercostal nerves and posterior intercostal arteries
External intercostal muscles
External intercostal membranes anterior to internal intercostal muscles
Transversus abdominis muscle
Rectus abdominis muscle and sheath (cut)
Internal jugular vein
Anterior
Middle
Posterior
Scalene muscles
Phrenic nerve
Brachial plexus
Thoracic duct
Subclavian artery and vein
Axillary artery and vein
Superior thoracic artery
Internal thoracic artery and veins
External intercostal muscle
Internal intercostal muscle (cut)
Transversus thoracis muscle
Anterior intercostal branches of internal thoracic artery
Intercostal nerve
Musculophrenic artery and vein
Transversus abdominis muscle
Superior epigastric arteries and veins
1
2
3
4
5
6
7
8
9
10

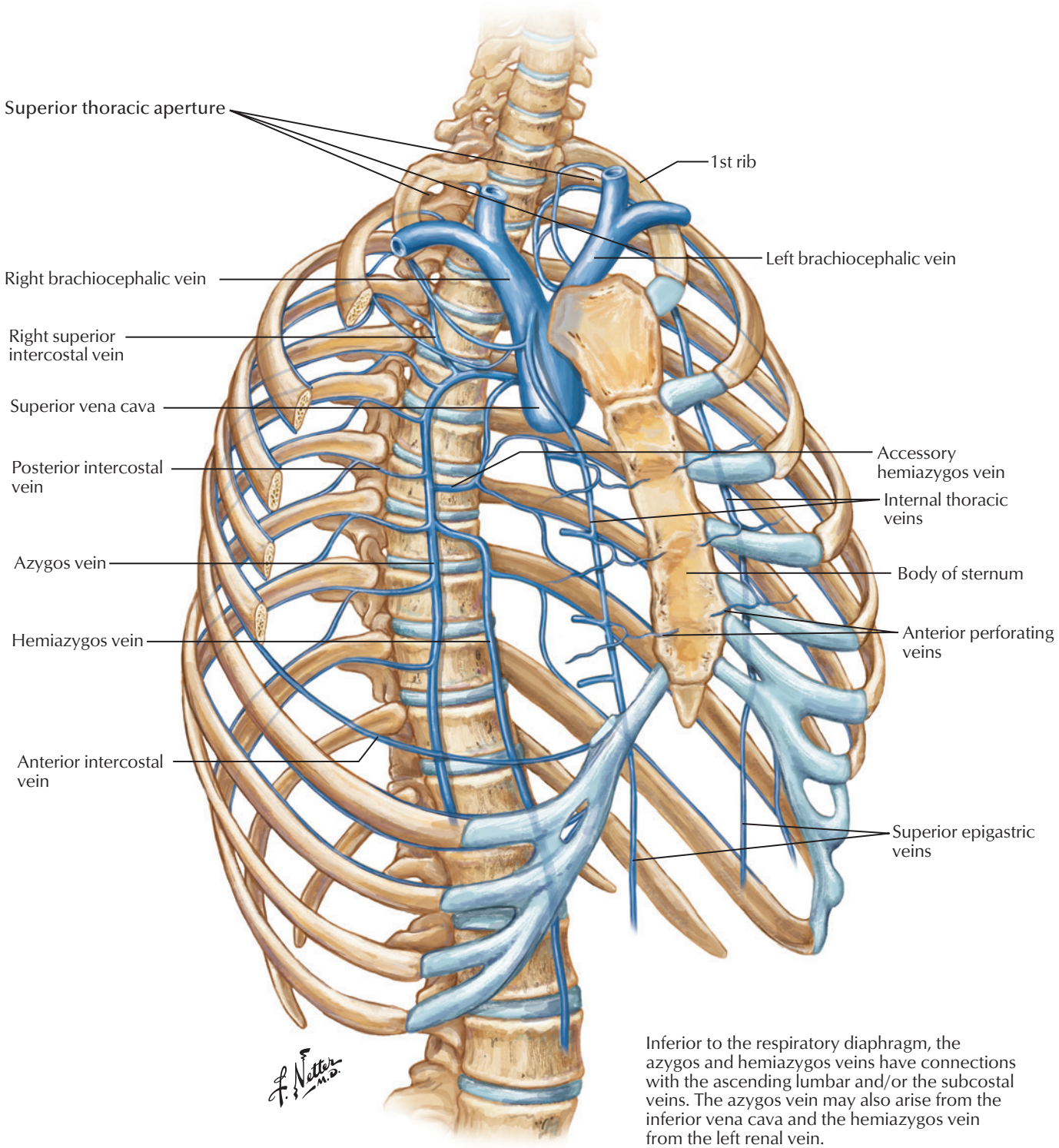

Sternothyroid muscle
Manubrium of sternum
Sternohyoid muscle
Common carotid artery
Internal jugular vein
Brachiocephalic trunk
Anterior scalene muscle
Subclavian artery and vein
Subclavian artery and vein
Clavicle (*cut*)
Brachiocephalic vein
Brachiocephalic vein
Phrenic nerve and pericardiacophrenic artery and vein
Internal thoracic artery and vein
Anterior intercostal arteries and veins and intercostal nerve
Internal thoracic artery and vein
Anterior intercostal arteries and veins and intercostal nerve
Internal intercostal muscles
Perforating branches of internal thoracic artery and vein and anterior cutaneous branch of intercostal nerve
Innermost intercostal muscles
Collateral branches of intercostal nerve, artery, and vein
Transversus thoracis muscle
Body of sternum
Sternocostal triangle
Respiratory diaphragm
Slips of costal origin of respiratory diaphragm
Musculophrenic artery and vein
Transversus abdominis muscle
Sternal part of respiratory diaphragm
Internal thoracic artery and veins
Xiphoid process
Superior epigastric artery and veins

See also Plates 261, 269



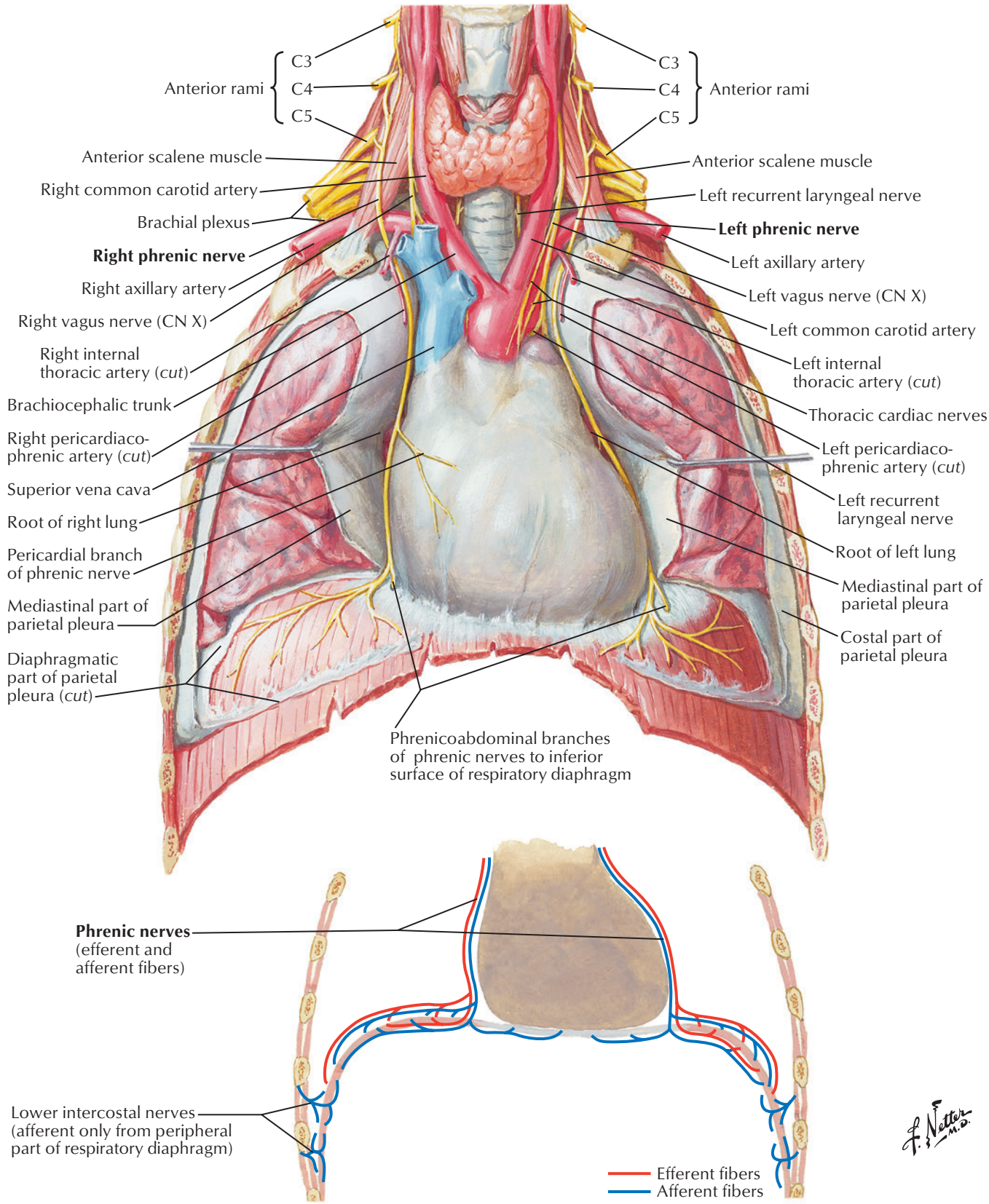
Veins of Internal Thoracic Wall

See also Plates 234, 241, 259

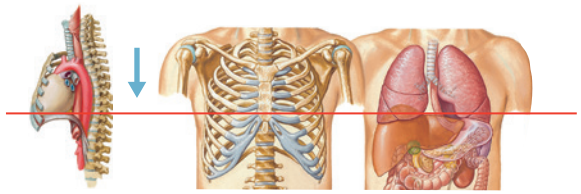


Inferior to the respiratory diaphragm, the azygos and hemiazygos veins have connections with the ascending lumbar and/or the subcostal veins. The azygos vein may also arise from the inferior vena cava and the hemiazygos vein from the left renal vein.

See also Plates 39, 87

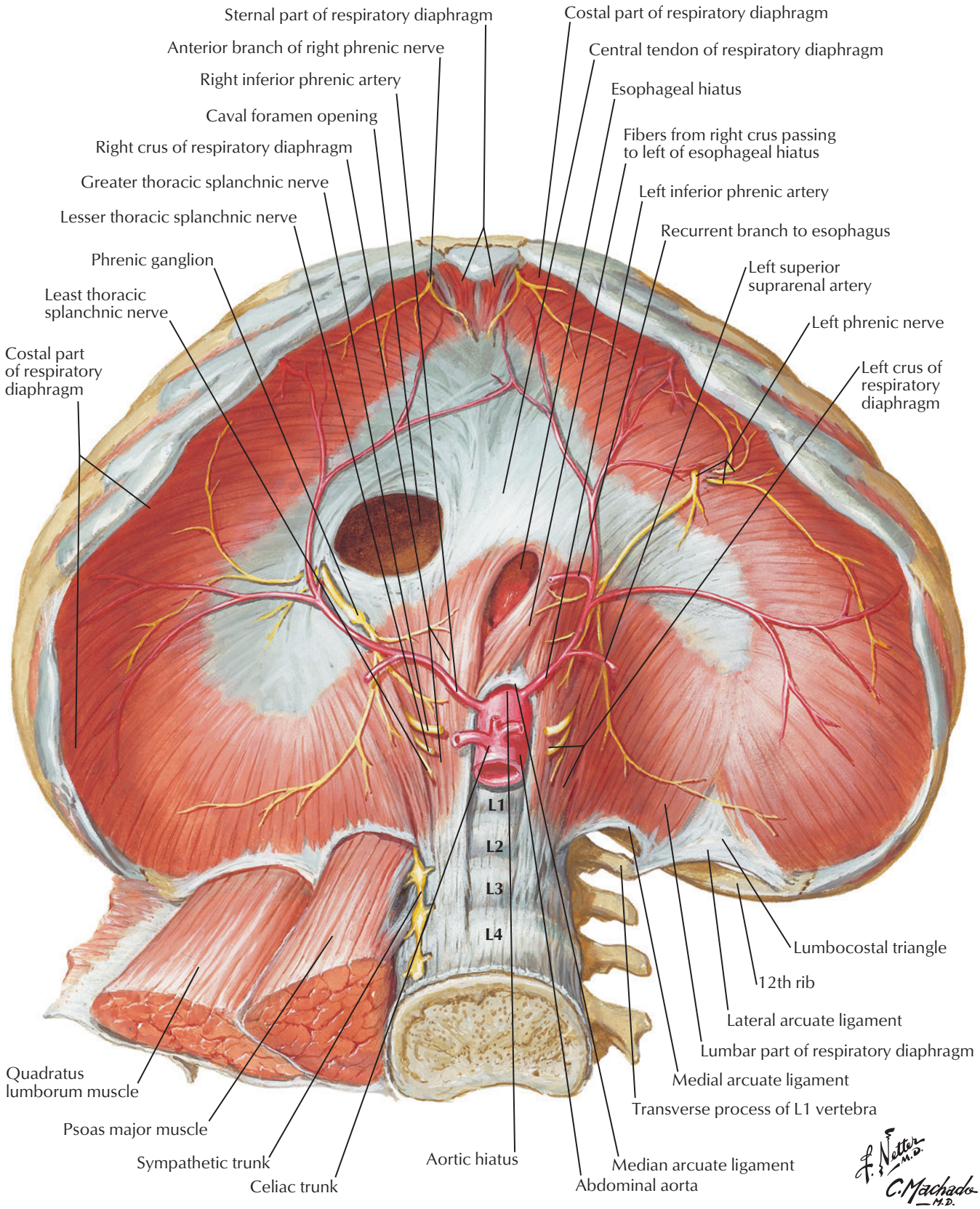


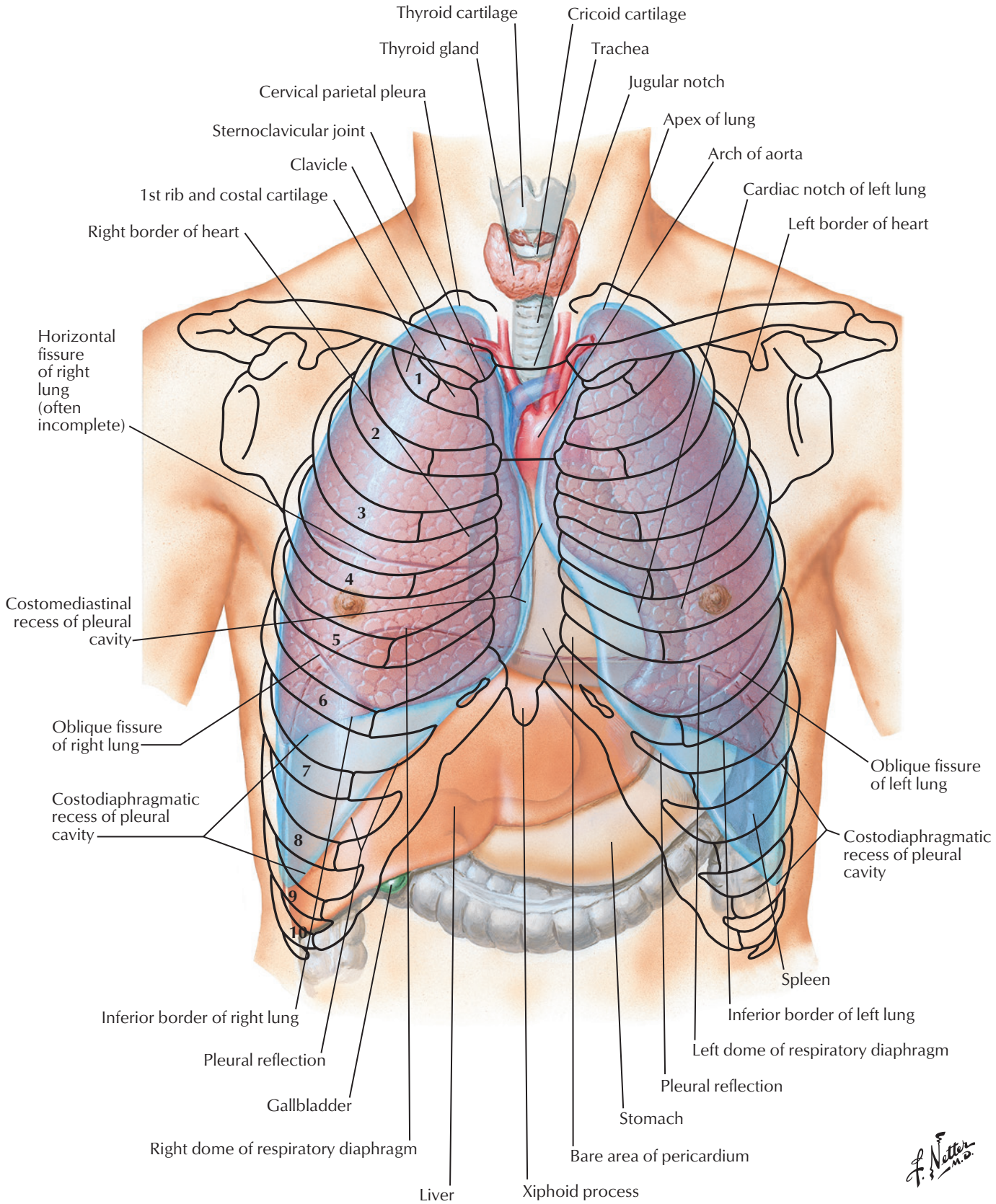
See also Plate 236

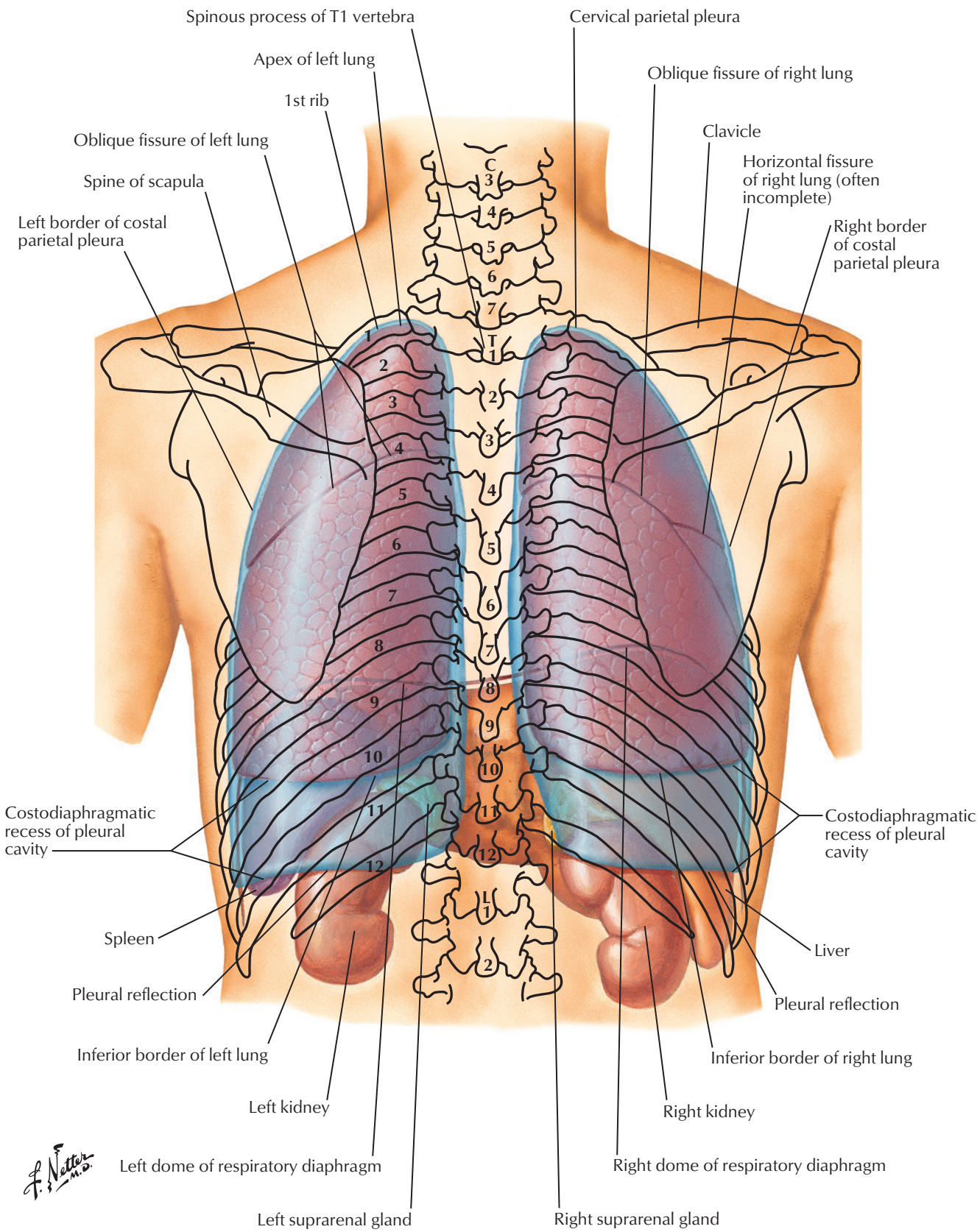


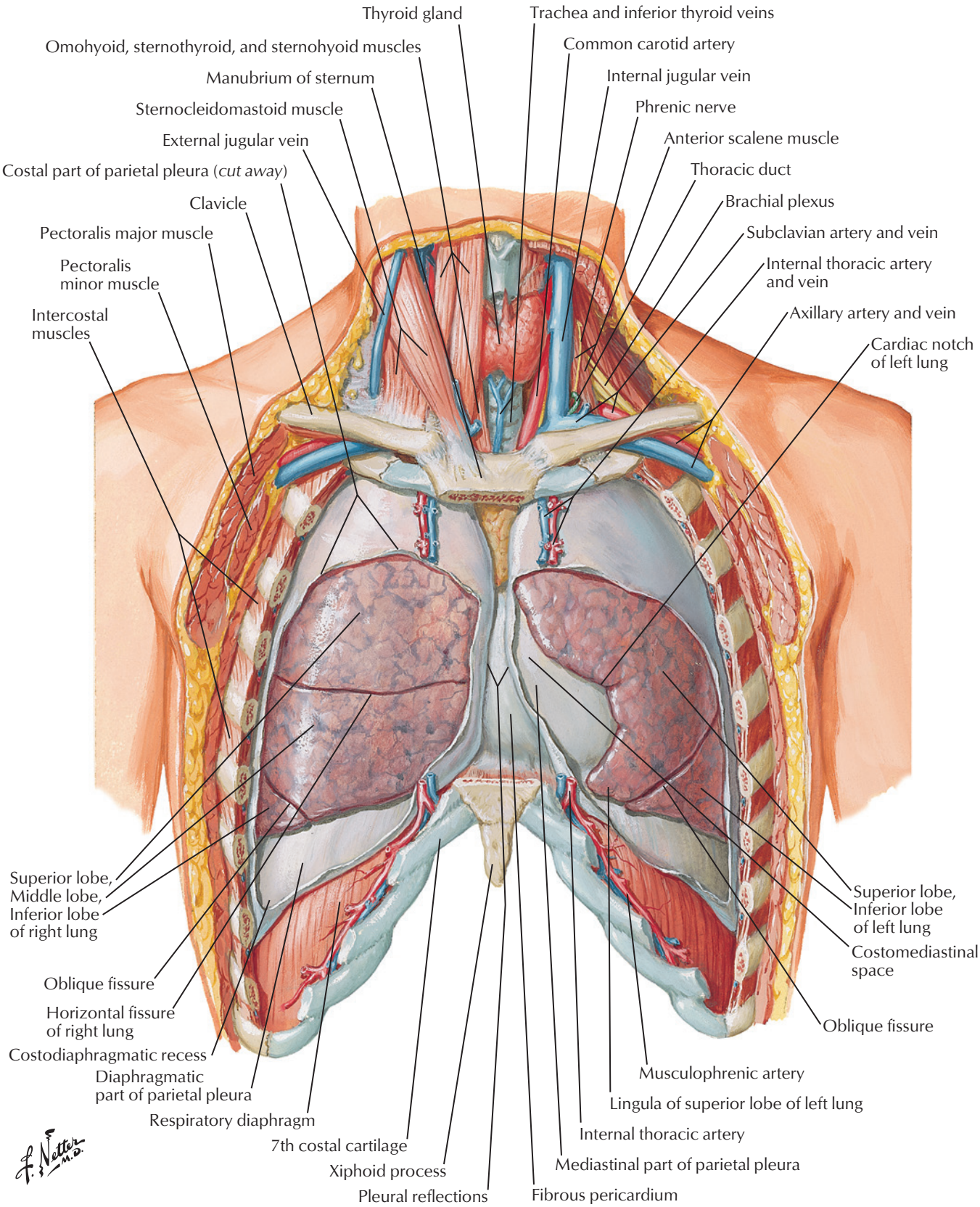
Central tendon covered by pericardium
5th costal cartilage
Left internal thoracic artery and veins
Sternum
Anterior mediastinum
Left costomediastinal recess of pleural cavity
Right costomediastinal recess of pleural cavity
Right internal thoracic artery and veins
Pericardium
Inferior vena cava (receiving hepatic veins)
Left phrenic nerve and pericardiacophrenic artery and vein
Right costodiaphragmatic recess of pleural cavity
Mediastinal part of parietal pleura and pericardium (*cut*)
Mediastinal part of parietal pleura and pericardium (*cut*)
Right phrenic nerve and pericardiacophrenic artery and vein
Central tendon
Diaphragmatic part of parietal pleura (*cut away*)
Diaphragmatic part of parietal pleura (*cut away*)
Central tendon
Thoracic duct
Azygos vein
Esophagus
Costal part of parietal pleura
Mediastinal pleura
Hemiazygos vein
Right greater thoracic splanchnic nerve
Left greater thoracic splanchnic nerve
Right sympathetic trunk
T8–9 intervertebral disc
Left sympathetic trunk
Thoracic (descending) aorta

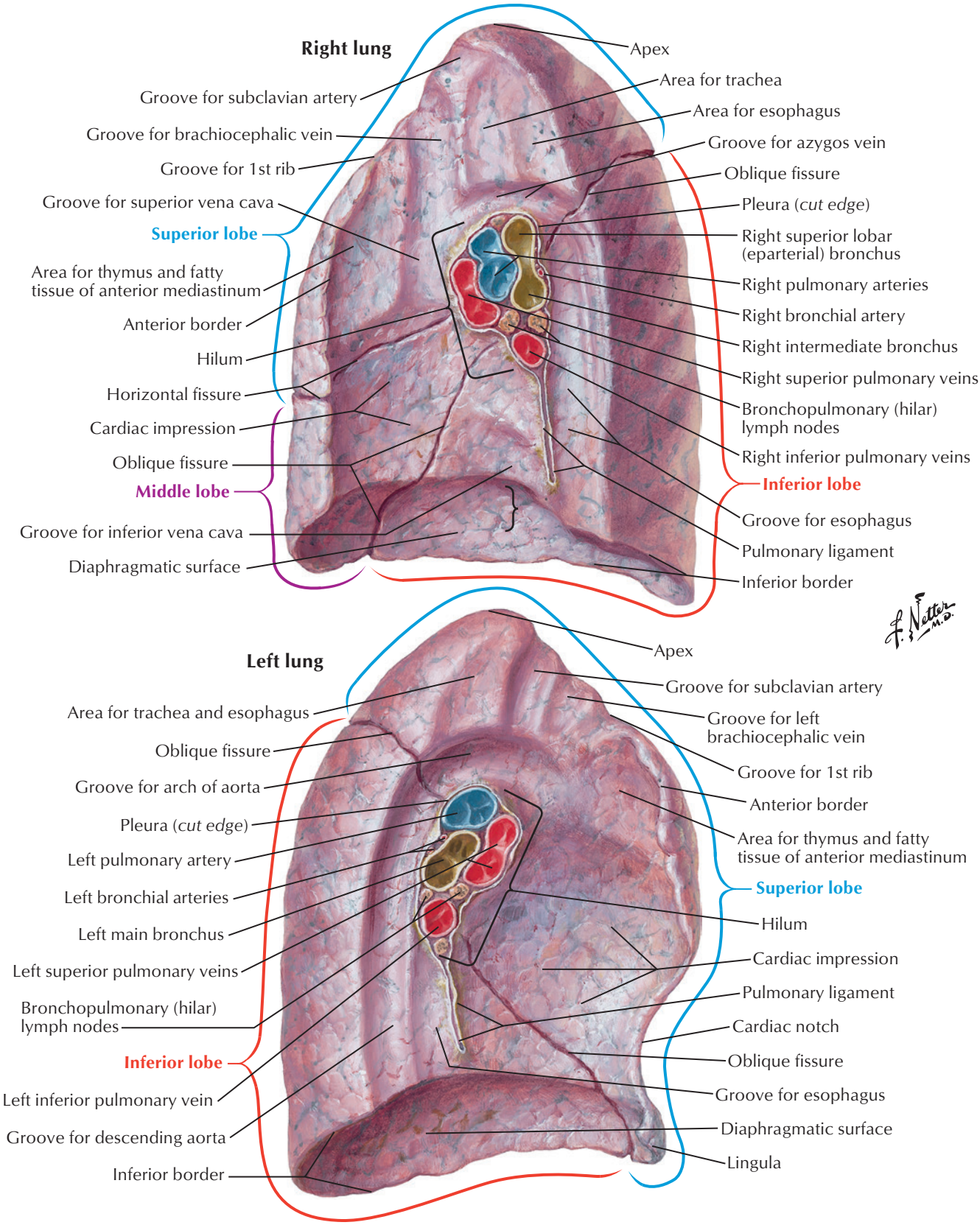
See also Plates 265, 266

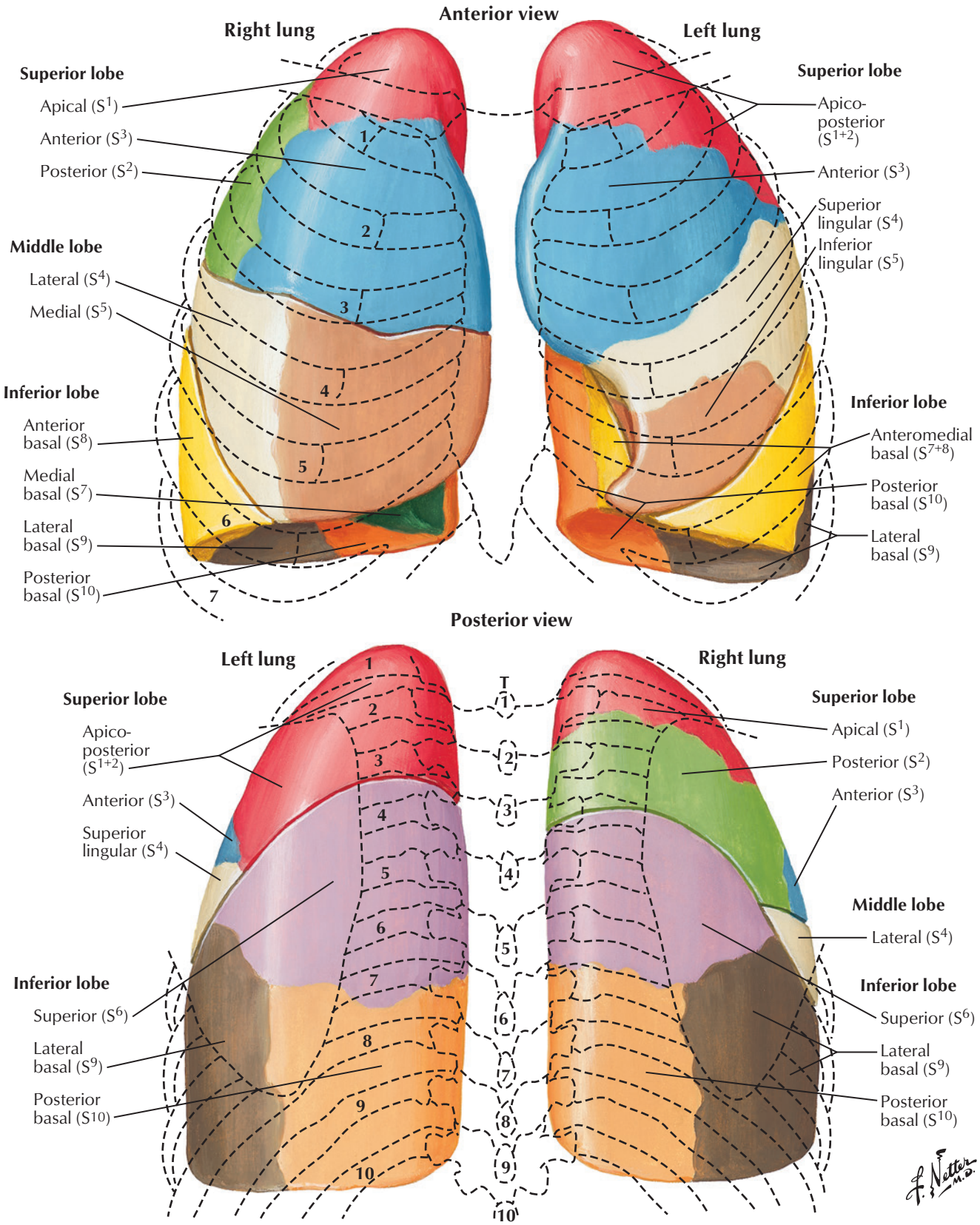



Thyroid cartilage
Cricoid cartilage
Thyroid gland
Trachea
Jugular notch
Cervical parietal pleura
Apex of lung
Sternoclavicular joint
Arch of aorta
Clavicle
Cardiac notch of left lung
1st rib and costal cartilage
Left border of heart
Right border of heart
Horizontal fissure of right lung (often incomplete)
1
2
3
4
5
6
7
8
9
10
Costomediastinal recess of pleural cavity
Oblique fissure of right lung
Oblique fissure of left lung
Costodiaphragmatic recess of pleural cavity
Costodiaphragmatic recess of pleural cavity
Spleen
Inferior border of right lung
Inferior border of left lung
Pleural reflection
Left dome of respiratory diaphragm
Pleural reflection
Gallbladder
Stomach
Right dome of respiratory diaphragm
Bare area of pericardium
Liver
Xiphoid process

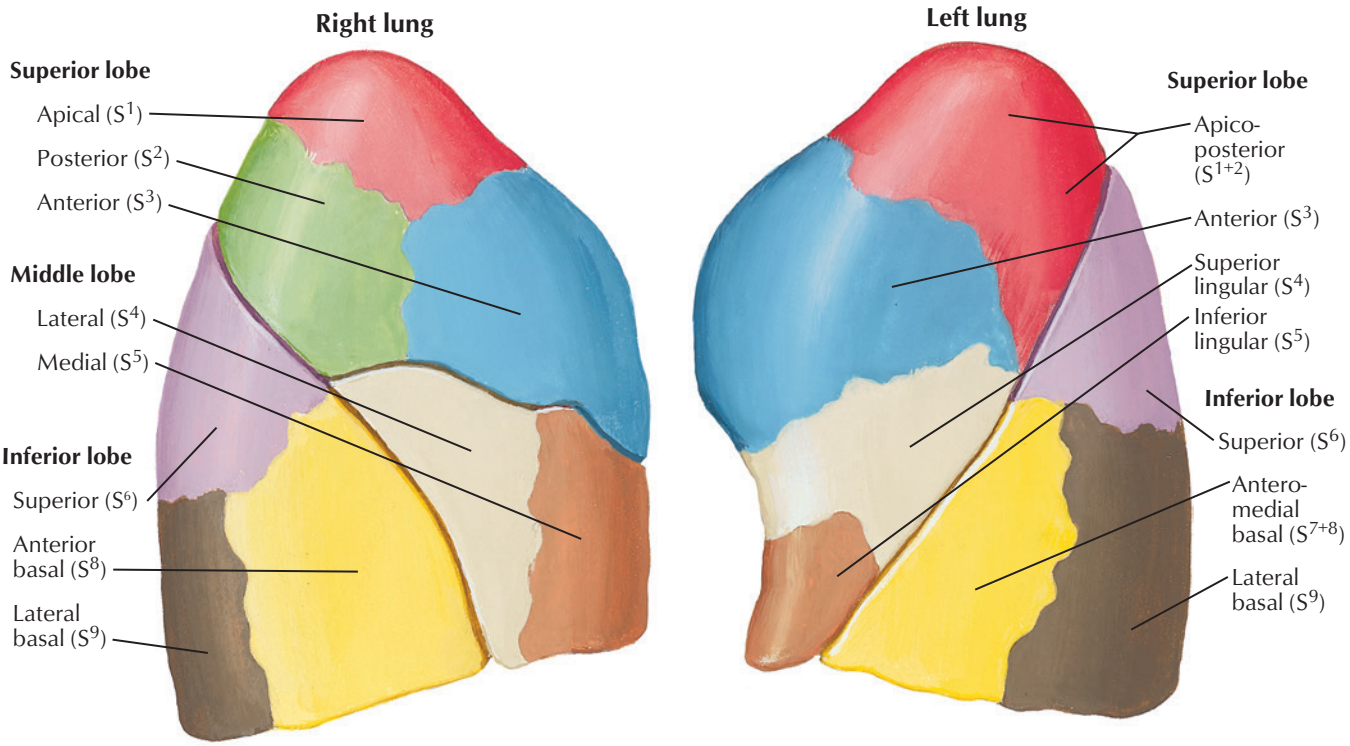

Spinous process of T1 vertebra
Apex of left lung
1st rib
Oblique fissure of left lung
Spine of scapula
Left border of costal parietal pleura
Cervical parietal pleura
Oblique fissure of right lung
Clavicle
Horizontal fissure of right lung (often incomplete)
Right border of costal parietal pleura
C 3
4
5
6
7
T 1
2
3
4
5
6
7
8
9
10
11
12
L 1
2
1
2
3
4
5
6
7
8
9
10
11
12
Costodiaphragmatic recess of pleural cavity
Costodiaphragmatic recess of pleural cavity
Spleen
Liver
Pleural reflection
Pleural reflection
Inferior border of left lung
Inferior border of right lung
Left kidney
Right kidney
Left dome of respiratory diaphragm
Right dome of respiratory diaphragm
Left suprarenal gland
Right suprarenal gland


Thyroid gland
Trachea and inferior thyroid veins
Omohyoid, sternothyroid, and sternohyoid muscles
Common carotid artery
Manubrium of sternum
Internal jugular vein
Sternocleidomastoid muscle
Phrenic nerve
External jugular vein
Anterior scalene muscle
Costal part of parietal pleura (cut away)
Thoracic duct
Clavicle
Brachial plexus
Pectoralis major muscle
Subclavian artery and vein
Pectoralis minor muscle
Internal thoracic artery and vein
Intercostal muscles
Axillary artery and vein
Cardiac notch of left lung
Superior lobe, Middle lobe, Inferior lobe of right lung
Superior lobe, Inferior lobe of left lung
Costomediastinal space
Oblique fissure
Horizontal fissure of right lung
Oblique fissure
Costodiaphragmatic recess
Musculophrenic artery
Diaphragmatic part of parietal pleura
Lingula of superior lobe of left lung
Respiratory diaphragm
Internal thoracic artery
7th costal cartilage
Mediastinal part of parietal pleura
Xiphoid process
Pleural reflections
Fibrous pericardium

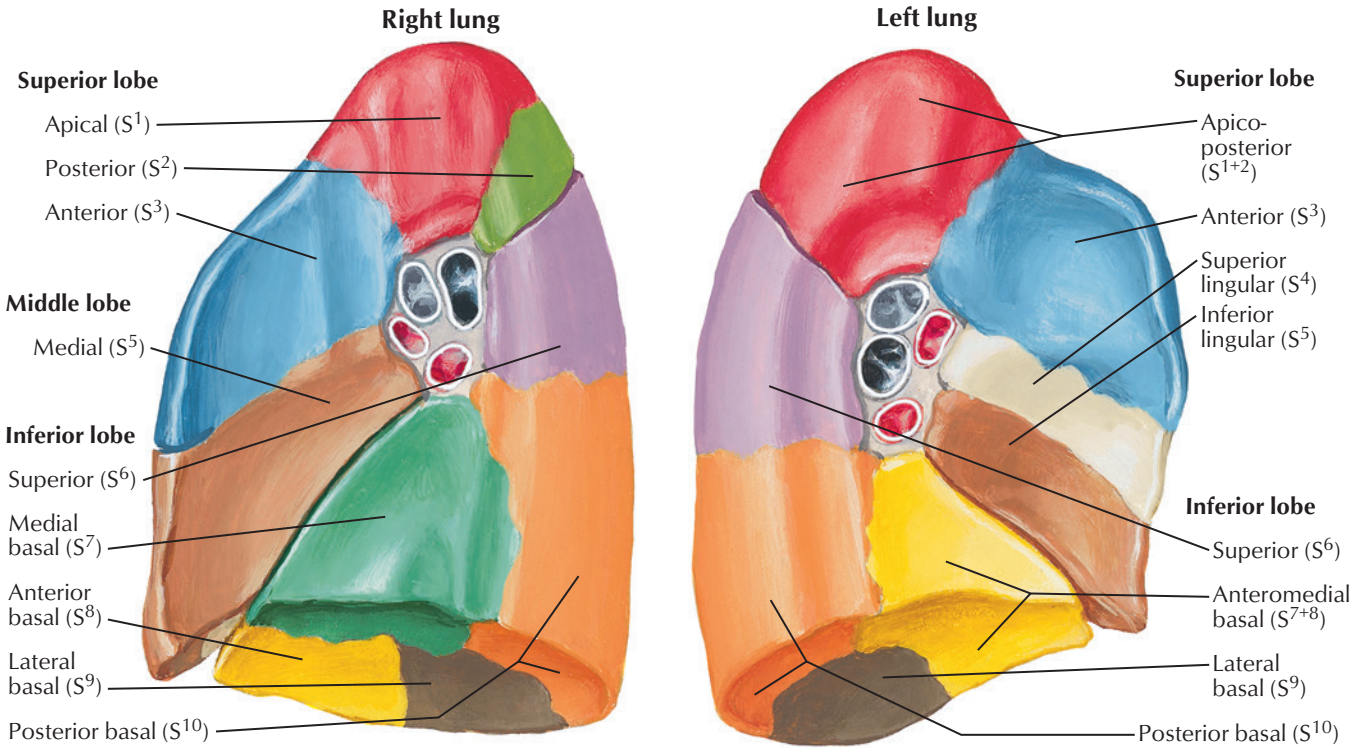

Right lung
Apex
Area for trachea
Area for esophagus
Groove for azygos vein
Oblique fissure
Pleura (cut edge)
Right superior lobar (eparterial) bronchus
Right pulmonary arteries
Right bronchial artery
Right intermediate bronchus
Right superior pulmonary veins
Bronchopulmonary (hilar) lymph nodes
Right inferior pulmonary veins
Inferior lobe
Groove for esophagus
Pulmonary ligament
Inferior border
Groove for subclavian artery
Groove for brachiocephalic vein
Groove for 1st rib
Groove for superior vena cava
Superior lobe
Area for thymus and fatty tissue of anterior mediastinum
Anterior border
Hilum
Horizontal fissure
Cardiac impression
Oblique fissure
Middle lobe
Groove for inferior vena cava
Diaphragmatic surface
Left lung
Apex
Groove for subclavian artery
Groove for left brachiocephalic vein
Groove for 1st rib
Anterior border
Area for thymus and fatty tissue of anterior mediastinum
Superior lobe
Hilum
Cardiac impression
Pulmonary ligament
Cardiac notch
Oblique fissure
Groove for esophagus
Diaphragmatic surface
Lingula
Area for trachea and esophagus
Oblique fissure
Groove for arch of aorta
Pleura (cut edge)
Left pulmonary artery
Left bronchial arteries
Left main bronchus
Left superior pulmonary veins
Bronchopulmonary (hilar) lymph nodes
Inferior lobe
Left inferior pulmonary vein
Groove for descending aorta
Inferior border


Anterior view
Right lung
Left lung
Superior lobe
Apical (S1)
Anterior (S3)
Posterior (S2)
Middle lobe
Lateral (S4)
Medial (S5)
Inferior lobe
Anterior basal (S8)
Medial basal (S7)
Lateral basal (S9)
Posterior basal (S10)
Superior lobe
Apico-posterior (S1+2)
Anterior (S3)
Superior lingular (S4)
Inferior lingular (S5)
Inferior lobe
Anteromedial basal (S7+8)
Posterior basal (S10)
Lateral basal (S9)
1
2
3
4
5
6
7
Posterior view
Left lung
Right lung
Superior lobe
Apico-posterior (S1+2)
Anterior (S3)
Superior lingular (S4)
Inferior lobe
Superior (S6)
Lateral basal (S9)
Posterior basal (S10)
Apical (S1)
Posterior (S2)
Anterior (S3)
Middle lobe
Lateral (S4)
Inferior lobe
Superior (S6)
Lateral basal (S9)
Posterior basal (S10)
T
1
2
3
4
5
6
7
8
9
10

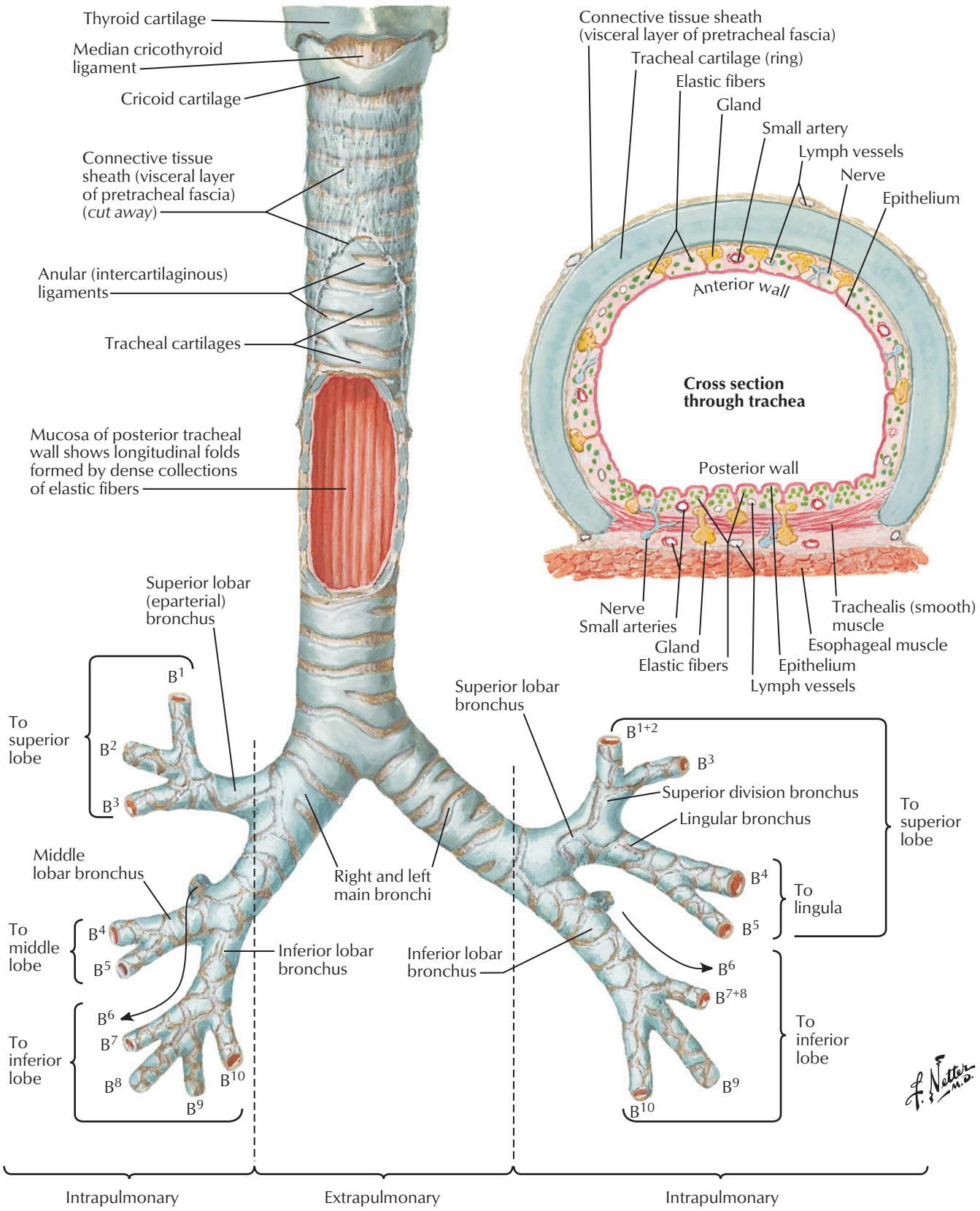
Lateral views

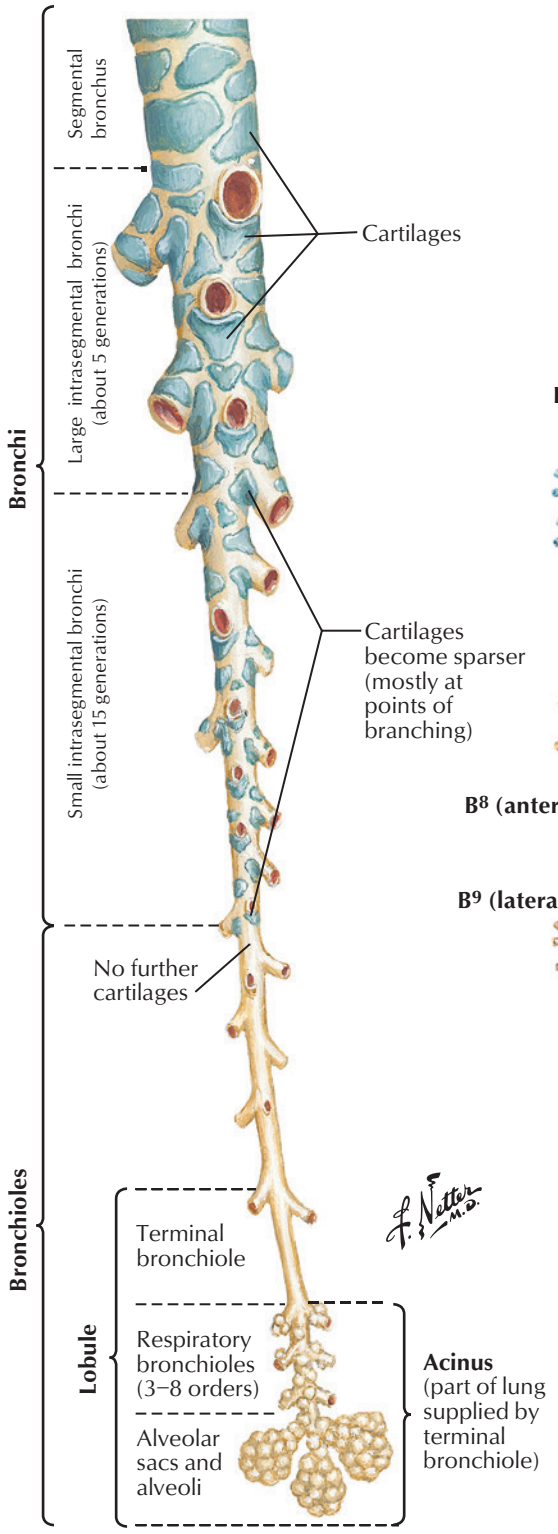


Medial views

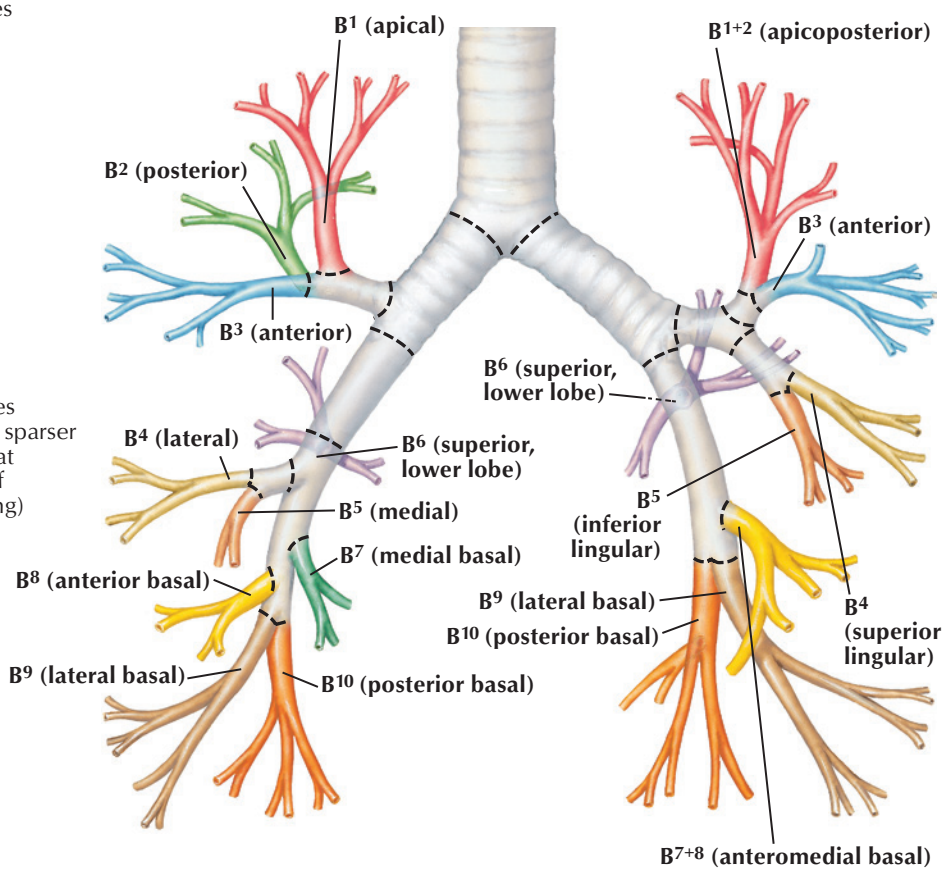


See also Plates 81, 211, 214

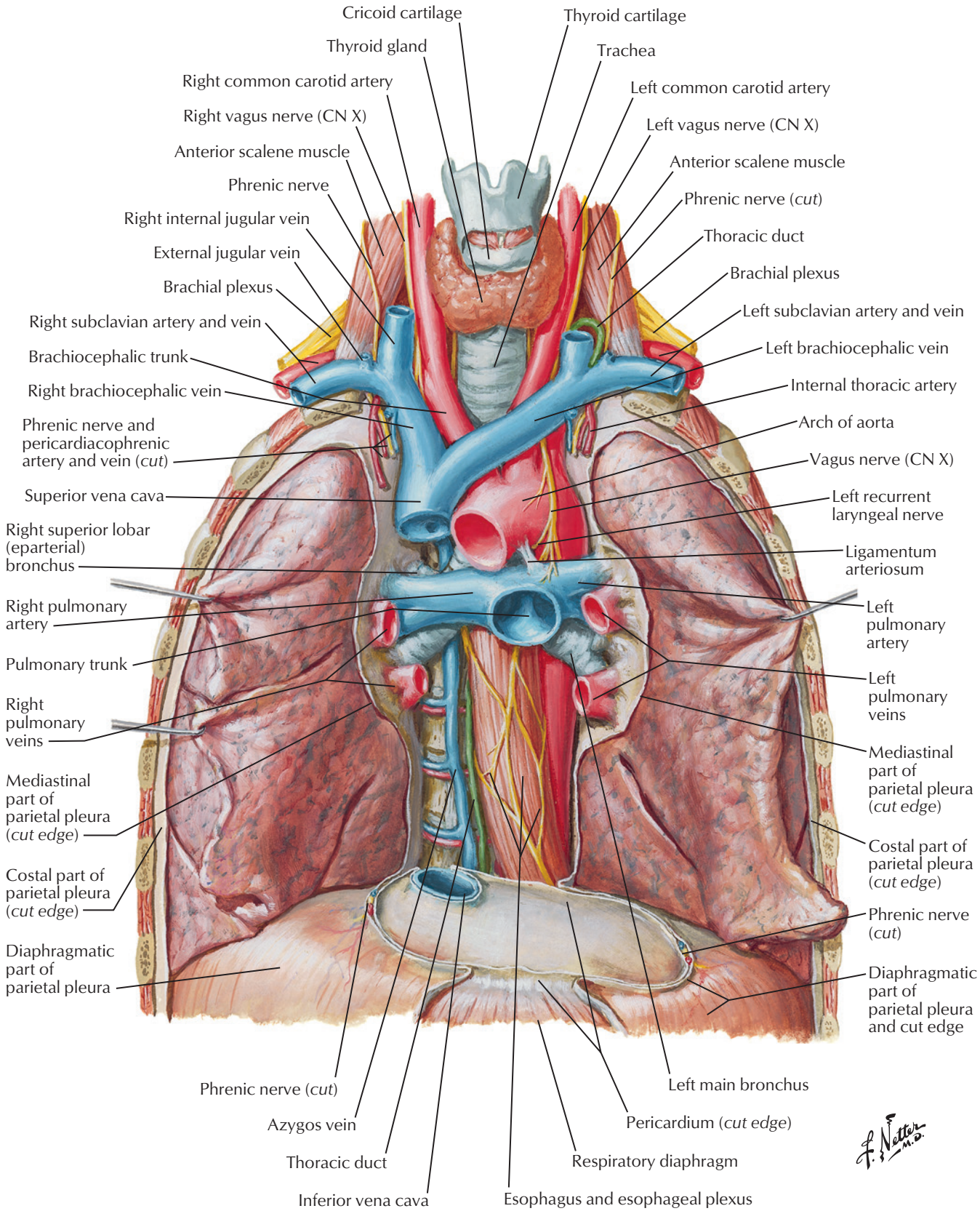


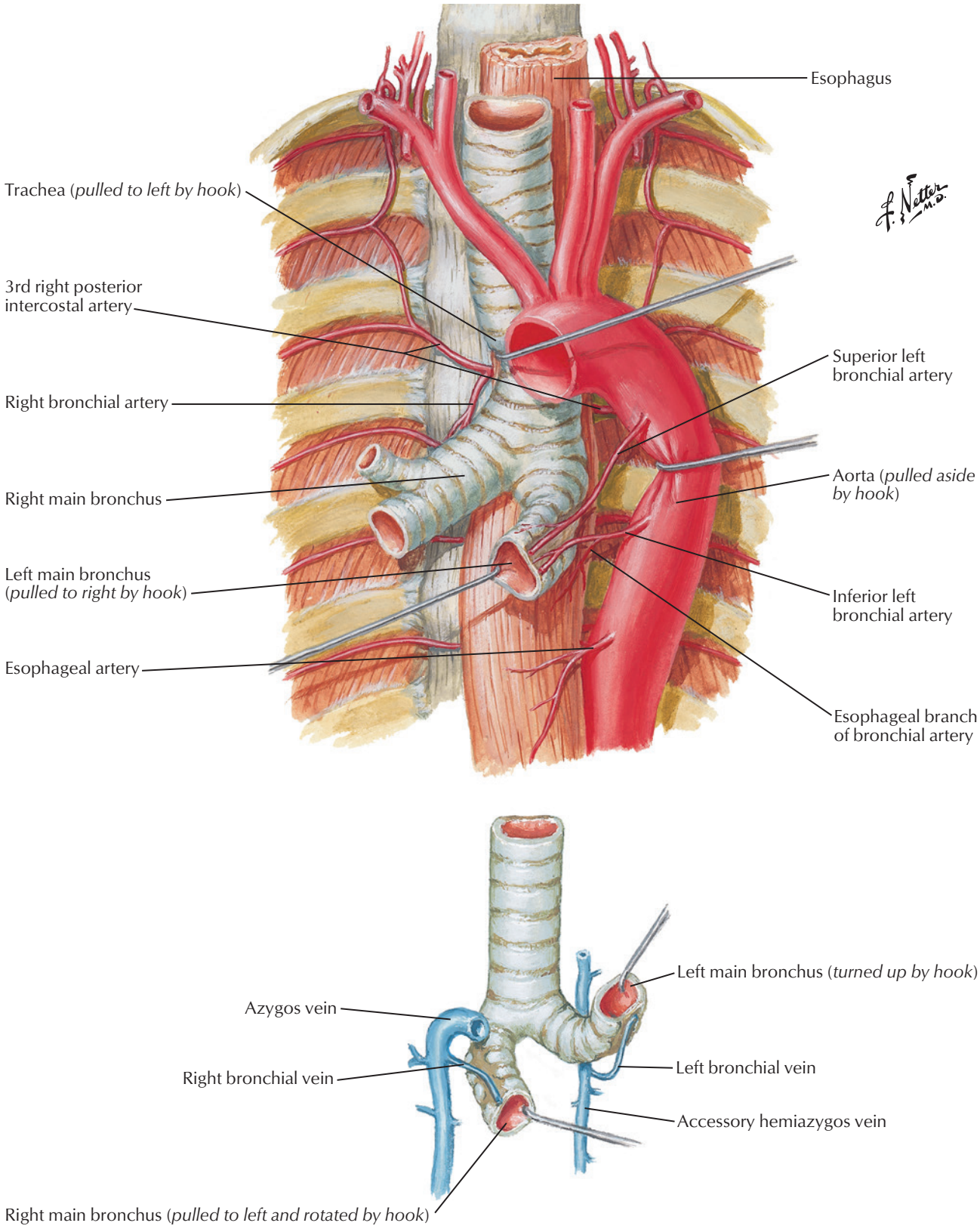


Subdivisions of intrapulmonary airways



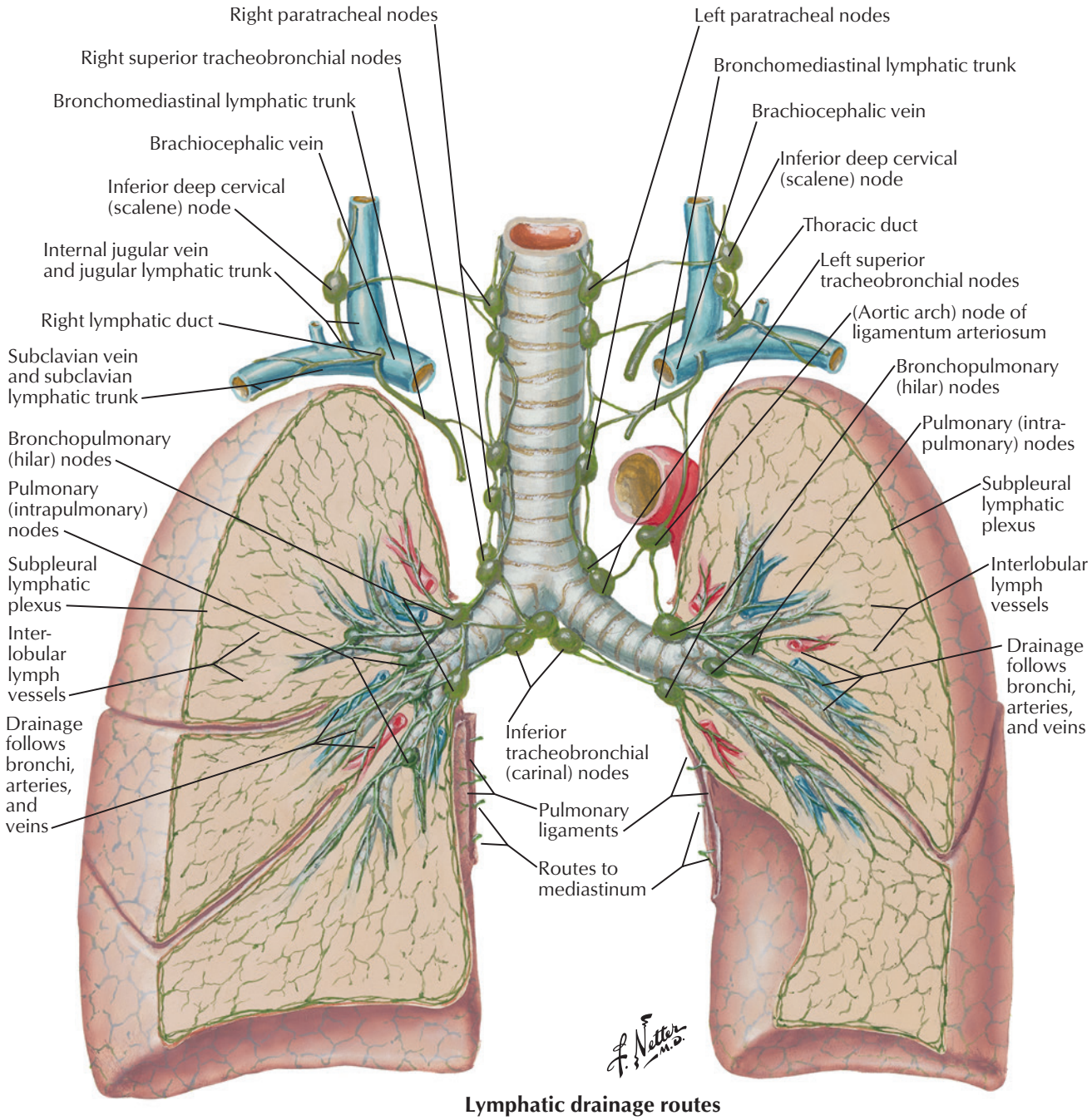
Nomenclature in common usage for bronchopulmonary segments (Plates 206 and 207) is that of Jackson and Huber, and segmental bronchi are named accordingly. Bronchial subdivisions as far as the 5th or 6th generations also are shown but not labelled. Segmental bronchi (B) are numbered from 1 to 10 in each lung, corresponding to the pulmonary segments. In the left lung, B^1 and B^2 are combined, as are B^7 and B^8. Variations of the standard bronchial pattern shown here are common, especially in peripheral airways.


Cricoid cartilage
Thyroid cartilage
Thyroid gland
Trachea
Right common carotid artery
Left common carotid artery
Right vagus nerve (CN X)
Left vagus nerve (CN X)
Anterior scalene muscle
Anterior scalene muscle
Phrenic nerve
Phrenic nerve (cut)
Right internal jugular vein
Thoracic duct
External jugular vein
Brachial plexus
Brachial plexus
Right subclavian artery and vein
Left subclavian artery and vein
Brachiocephalic trunk
Left brachiocephalic vein
Right brachiocephalic vein
Internal thoracic artery
Phrenic nerve and pericardiacophrenic artery and vein (cut)
Arch of aorta
Vagus nerve (CN X)
Superior vena cava
Left recurrent laryngeal nerve
Right superior lobar (eparterial) bronchus
Ligamentum arteriosum
Right pulmonary artery
Left pulmonary artery
Pulmonary trunk
Left pulmonary veins
Right pulmonary veins
Mediastinal part of parietal pleura (cut edge)
Mediastinal part of parietal pleura (cut edge)
Costal part of parietal pleura (cut edge)
Costal part of parietal pleura (cut edge)
Phrenic nerve (cut)
Diaphragmatic part of parietal pleura
Diaphragmatic part of parietal pleura and cut edge
Phrenic nerve (cut)
Left main bronchus
Azygos vein
Pericardium (cut edge)
Thoracic duct
Respiratory diaphragm
Inferior vena cava
Esophagus and esophageal plexus


Esophagus
Trachea (*pulled to left by hook*)
3rd right posterior intercostal artery
Right bronchial artery
Right main bronchus
Left main bronchus (*pulled to right by hook*)
Esophageal artery
Superior left bronchial artery
Aorta (*pulled aside by hook*)
Inferior left bronchial artery
Esophageal branch of bronchial artery
Left main bronchus (*turned up by hook*)
Azygos vein
Right bronchial vein
Left bronchial vein
Accessory hemiazygos vein
Right main bronchus (*pulled to left and rotated by hook*)

Lymph Vessels and Nodes of Lung

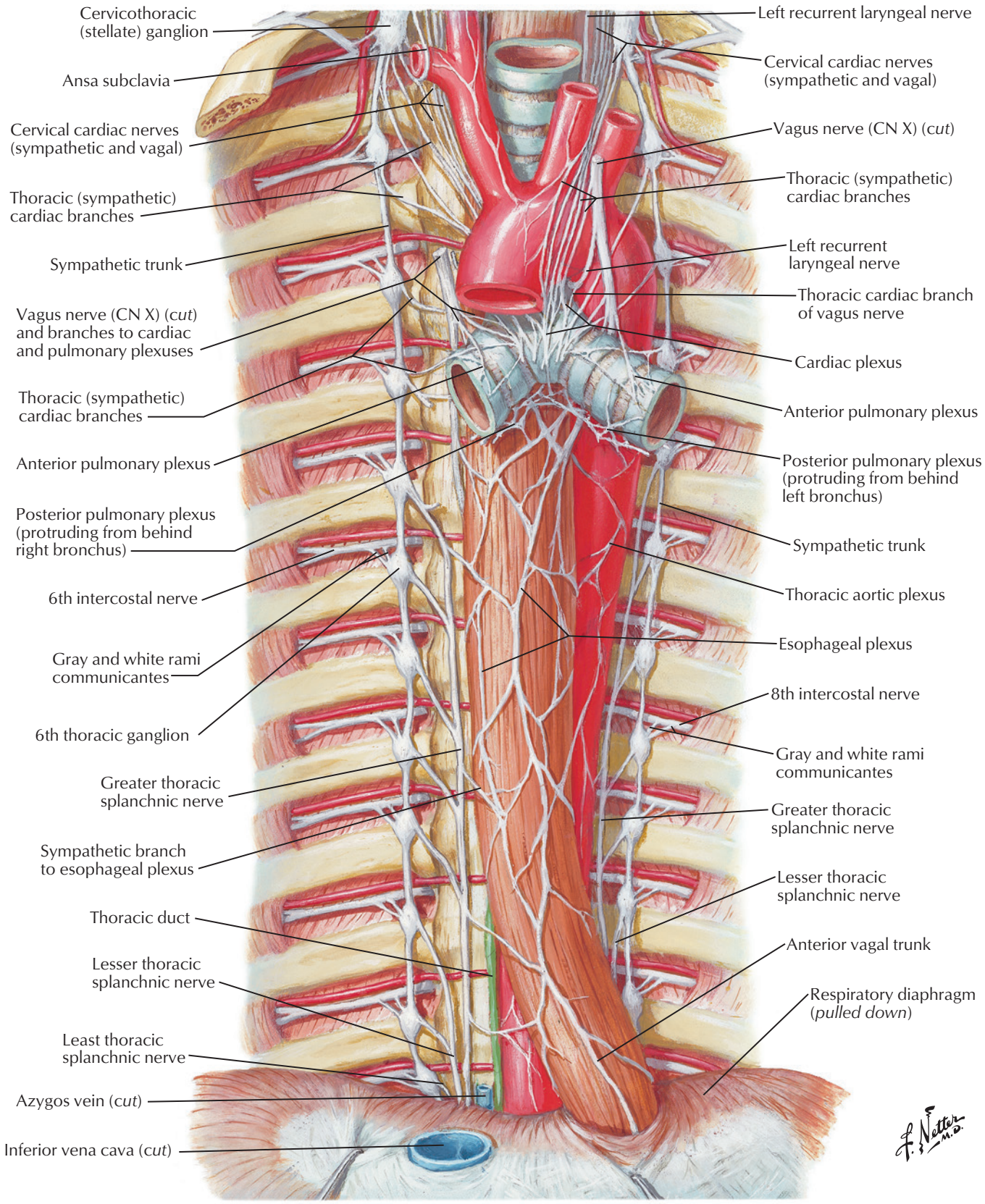
See also Plates 85, 242

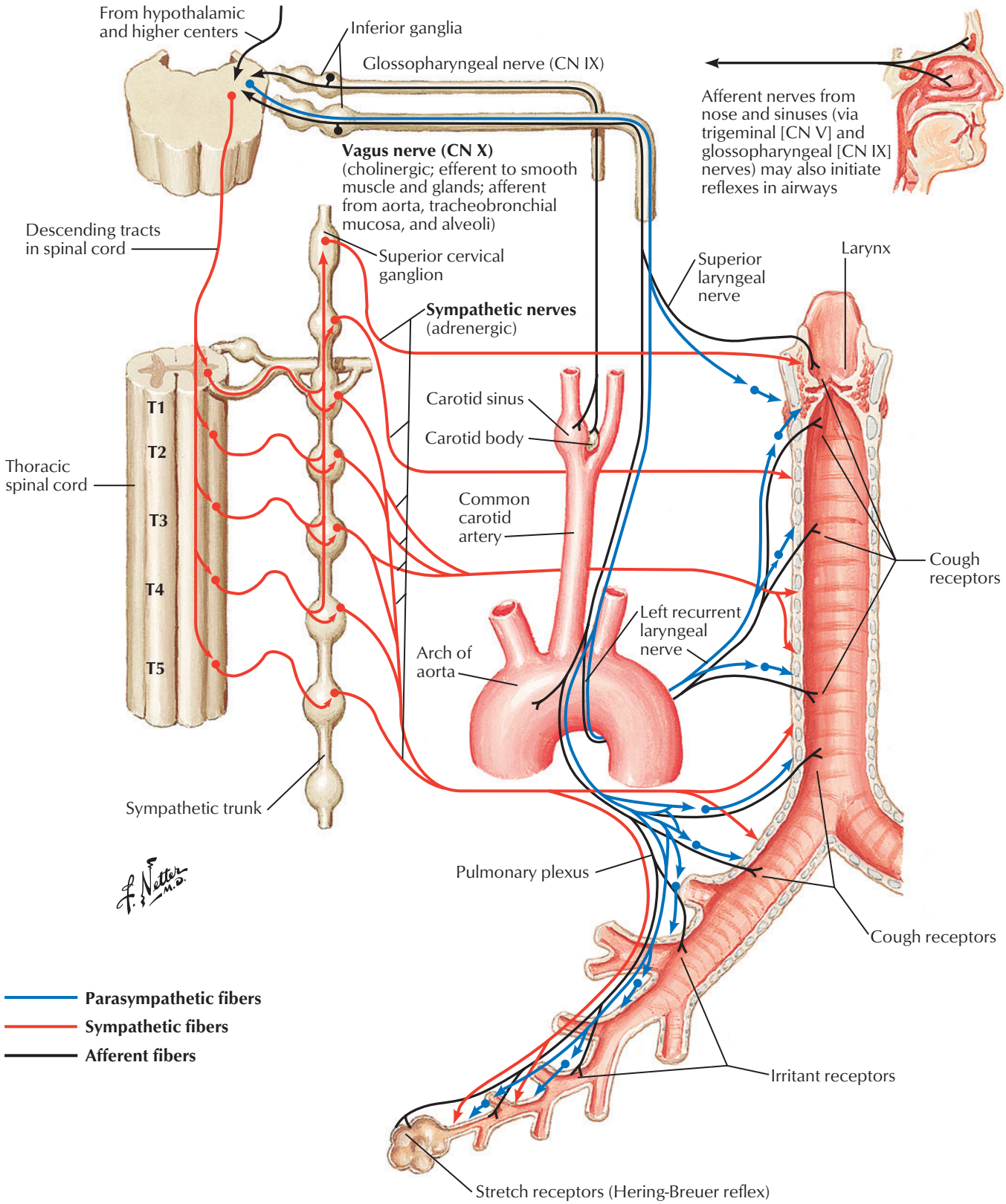


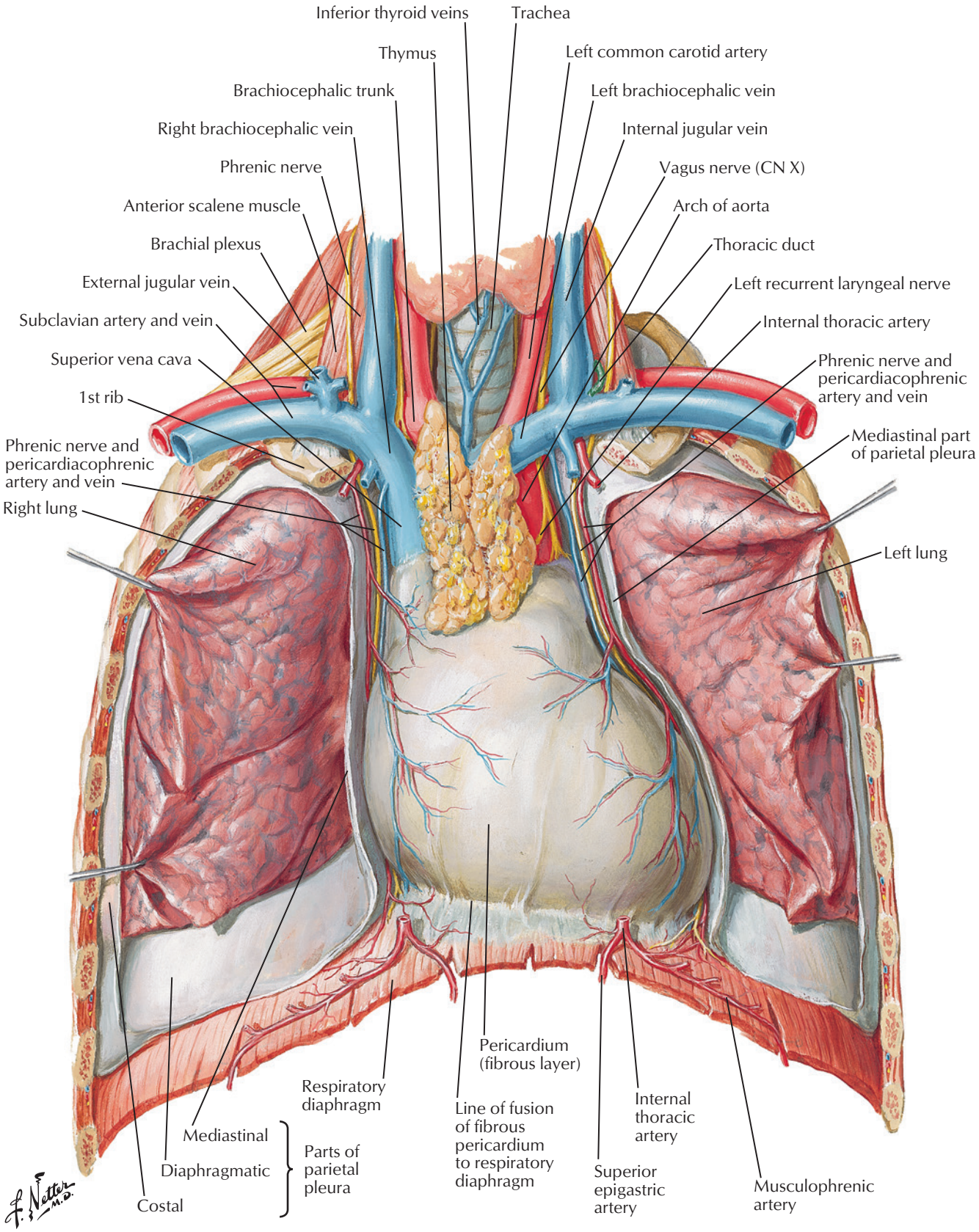
Lymphatic drainage routes

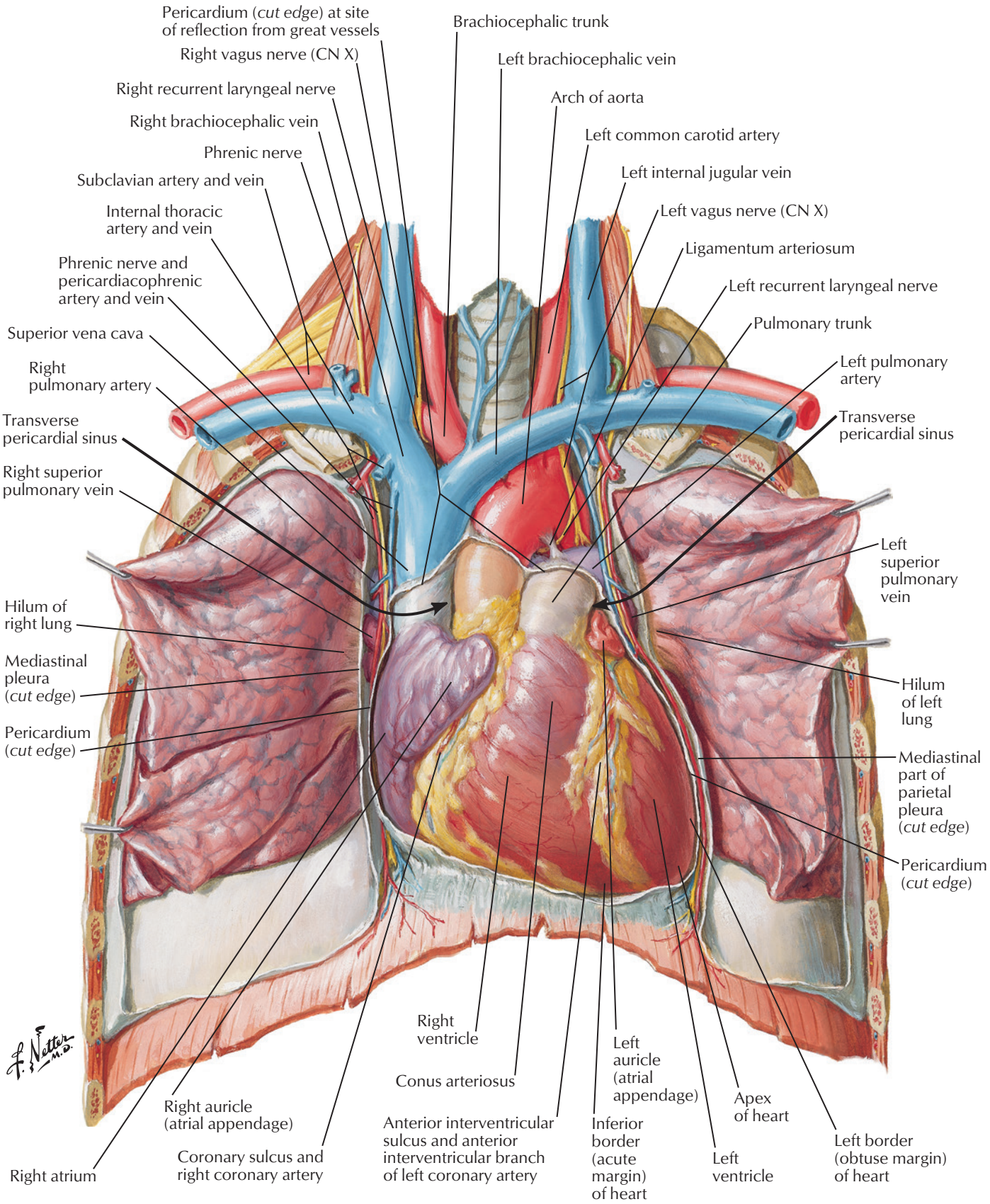
Right lung: All lobes drain to pulmonary and bronchopulmonary (hilar) nodes, then to inferior tracheobronchial (carinal) nodes, right superior tracheobronchial nodes, and right paratracheal nodes on the way to the brachiocephalic vein via the bronchomediastinal lymphatic trunk and/or inferior deep cervical (scalene) node.

Left lung: The superior lobe drains to pulmonary and bronchopulmonary (hilar) nodes, inferior tracheobronchial (carinal) nodes, left superior tracheobronchial nodes, left paratracheal nodes and/or (aortic arch) node of ligamentum arteriosum, then to the brachiocephalic vein via the left bronchomediastinal trunk and thoracic duct. The left inferior lobe also drains to the pulmonary and bronchopulmonary (hilar) nodes and to inferior tracheobronchial (carinal) nodes, but then mostly to right superior tracheobronchial nodes, where it follows the same route as lymph from the right lung.

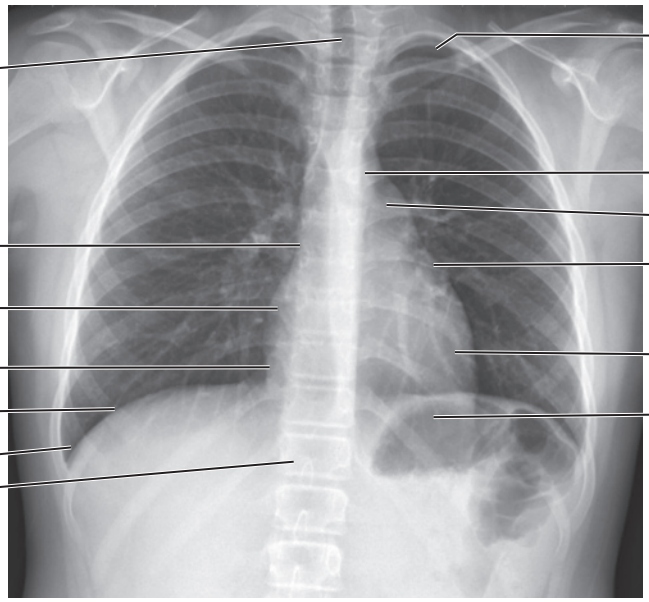

Cervicothoracic (stellate) ganglion
Ansa subclavia
Cervical cardiac nerves (sympathetic and vagal)
Thoracic (sympathetic) cardiac branches
Sympathetic trunk
Vagus nerve (CN X) (cut) and branches to cardiac and pulmonary plexuses
Thoracic (sympathetic) cardiac branches
Anterior pulmonary plexus
Posterior pulmonary plexus (protruding from behind right bronchus)
6th intercostal nerve
Gray and white rami communicantes
6th thoracic ganglion
Greater thoracic splanchnic nerve
Sympathetic branch to esophageal plexus
Thoracic duct
Lesser thoracic splanchnic nerve
Least thoracic splanchnic nerve
Azygos vein (cut)
Inferior vena cava (cut)
Left recurrent laryngeal nerve
Cervical cardiac nerves (sympathetic and vagal)
Vagus nerve (CN X) (cut)
Thoracic (sympathetic) cardiac branches
Left recurrent laryngeal nerve
Thoracic cardiac branch of vagus nerve
Cardiac plexus
Anterior pulmonary plexus
Posterior pulmonary plexus (protruding from behind left bronchus)
Sympathetic trunk
Thoracic aortic plexus
Esophageal plexus
8th intercostal nerve
Gray and white rami communicantes
Greater thoracic splanchnic nerve
Lesser thoracic splanchnic nerve
Anterior vagal trunk
Respiratory diaphragm (pulled down)


From hypothalamic and higher centers
Inferior ganglia
Glossopharyngeal nerve (CN IX)
Afferent nerves from nose and sinuses (via trigeminal [CN V] and glossopharyngeal [CN IX] nerves) may also initiate reflexes in airways
Vagus nerve (CN X)
(cholinergic; efferent to smooth muscle and glands; afferent from aorta, tracheobronchial mucosa, and alveoli)
Descending tracts in spinal cord
Superior cervical ganglion
Larynx
Superior laryngeal nerve
Sympathetic nerves
(adrenergic)
T1
T2
T3
T4
T5
Thoracic spinal cord
Carotid sinus
Carotid body
Common carotid artery
Cough receptors
Left recurrent laryngeal nerve
Arch of aorta
Sympathetic trunk
Pulmonary plexus
Cough receptors
Parasympathetic fibers
Sympathetic fibers
Afferent fibers
Irritant receptors
Stretch receptors (Hering-Breuer reflex)

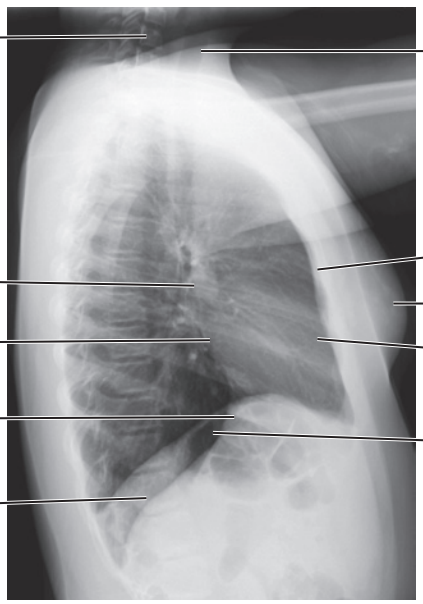

Inferior thyroid veins
Trachea
Thymus
Left common carotid artery
Brachiocephalic trunk
Left brachiocephalic vein
Right brachiocephalic vein
Internal jugular vein
Phrenic nerve
Vagus nerve (CN X)
Anterior scalene muscle
Arch of aorta
Brachial plexus
Thoracic duct
External jugular vein
Left recurrent laryngeal nerve
Subclavian artery and vein
Internal thoracic artery
Superior vena cava
Phrenic nerve and pericardiacophrenic artery and vein
1st rib
Mediastinal part of parietal pleura
Phrenic nerve and pericardiacophrenic artery and vein
Right lung
Left lung
Pericardium (fibrous layer)
Respiratory diaphragm
Line of fusion of fibrous pericardium to respiratory diaphragm
Internal thoracic artery
Mediastinal
Parts of parietal pleura
Diaphragmatic
Superior epigastric artery
Musculophrenic artery
Costal


Pericardium (*cut edge*) at site of reflection from great vessels
Right vagus nerve (CN X)
Right recurrent laryngeal nerve
Right brachiocephalic vein
Phrenic nerve
Subclavian artery and vein
Internal thoracic artery and vein
Phrenic nerve and pericardiacophrenic artery and vein
Superior vena cava
Right pulmonary artery
Transverse pericardial sinus
Right superior pulmonary vein
Hilum of right lung
Mediastinal pleura (*cut edge*)
Pericardium (*cut edge*)
Brachiocephalic trunk
Left brachiocephalic vein
Arch of aorta
Left common carotid artery
Left internal jugular vein
Left vagus nerve (CN X)
Ligamentum arteriosum
Left recurrent laryngeal nerve
Pulmonary trunk
Left pulmonary artery
Transverse pericardial sinus
Left superior pulmonary vein
Hilum of left lung
Mediastinal part of parietal pleura (*cut edge*)
Pericardium (*cut edge*)
Right ventricle
Conus arteriosus
Left auricle (atrial appendage)
Apex of heart
Right auricle (atrial appendage)
Anterior interventricular sulcus and anterior interventricular branch of left coronary artery
Inferior border (acute margin) of heart
Left ventricle
Left border (obtuse margin) of heart
Right atrium
Coronary sulcus and right coronary artery

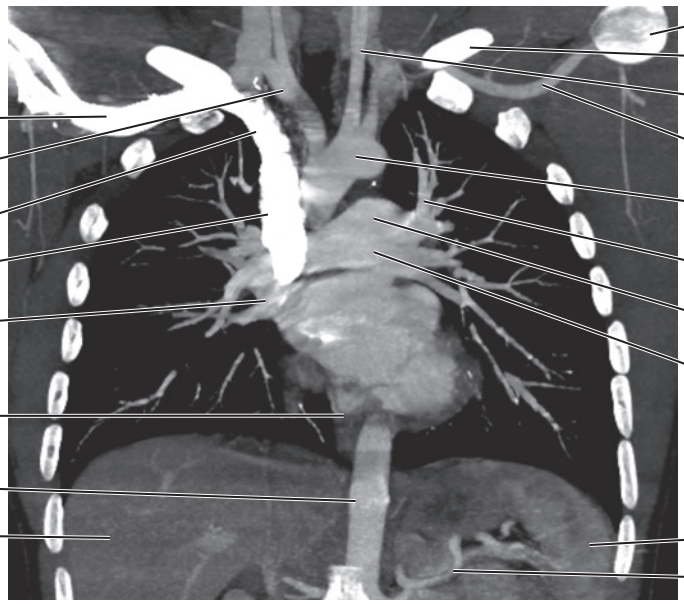
Radiograph: posteroanterior view

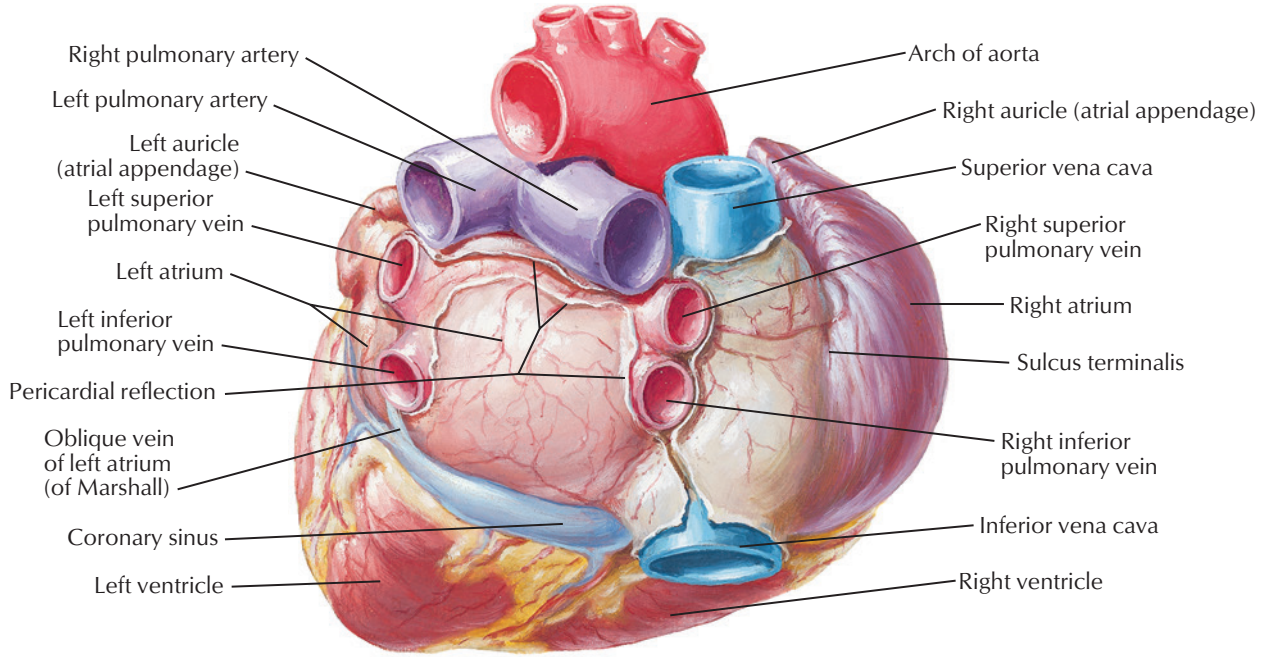


Radiograph: lateral view

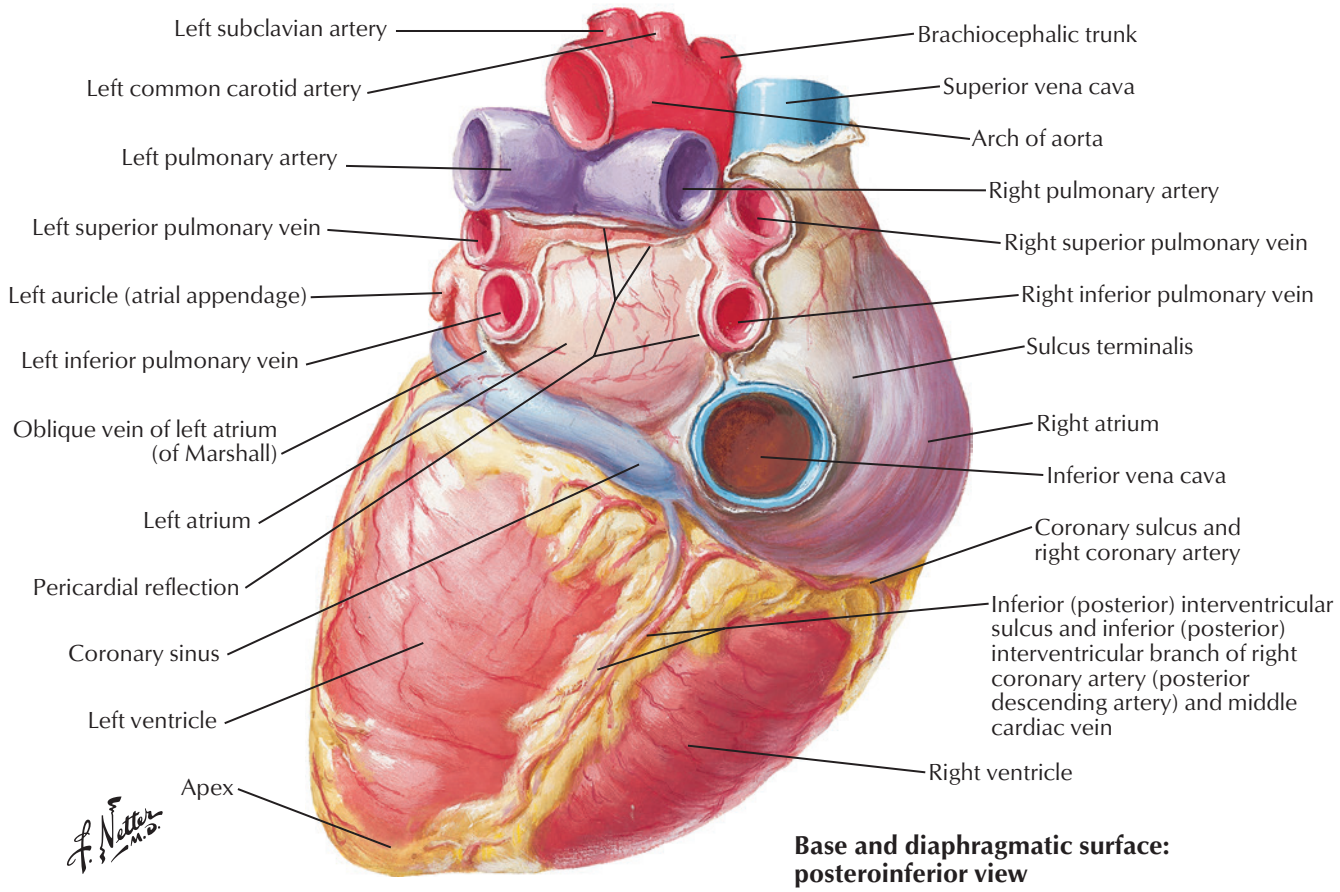


CT angiogram: coronal view

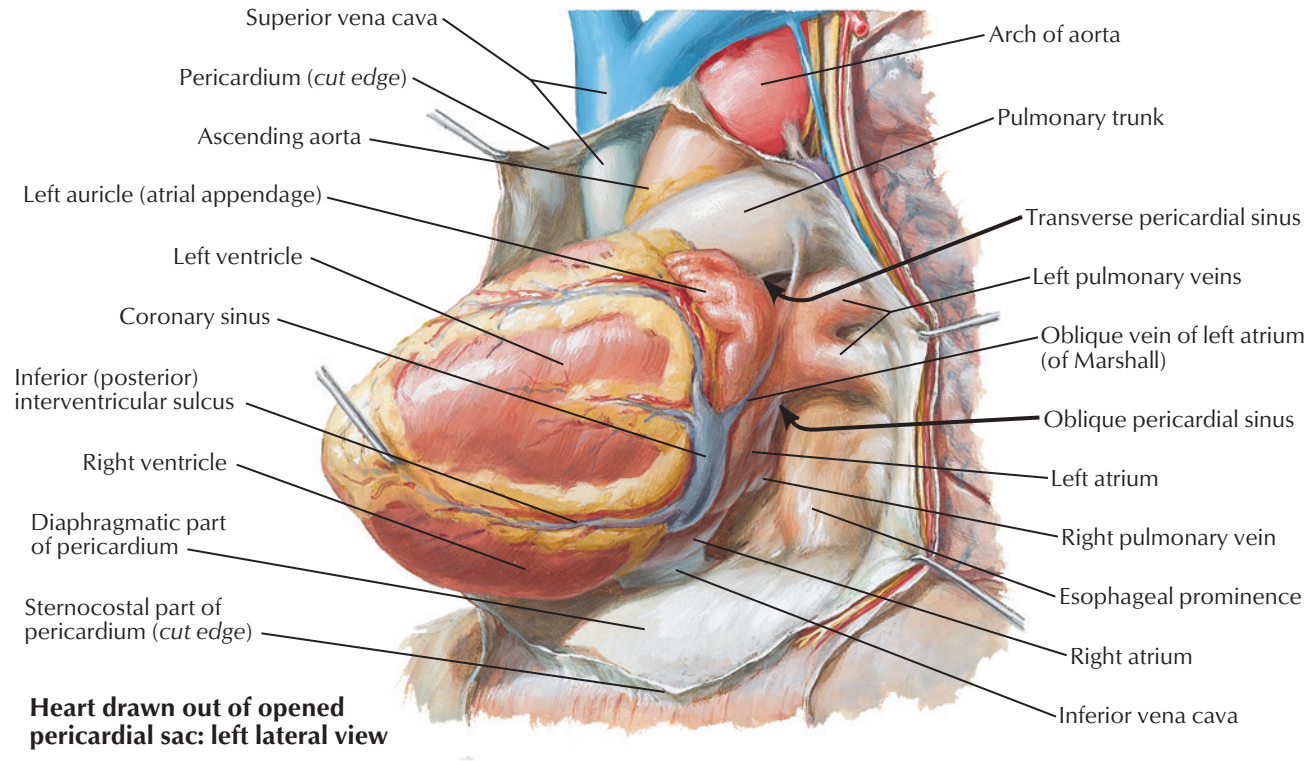




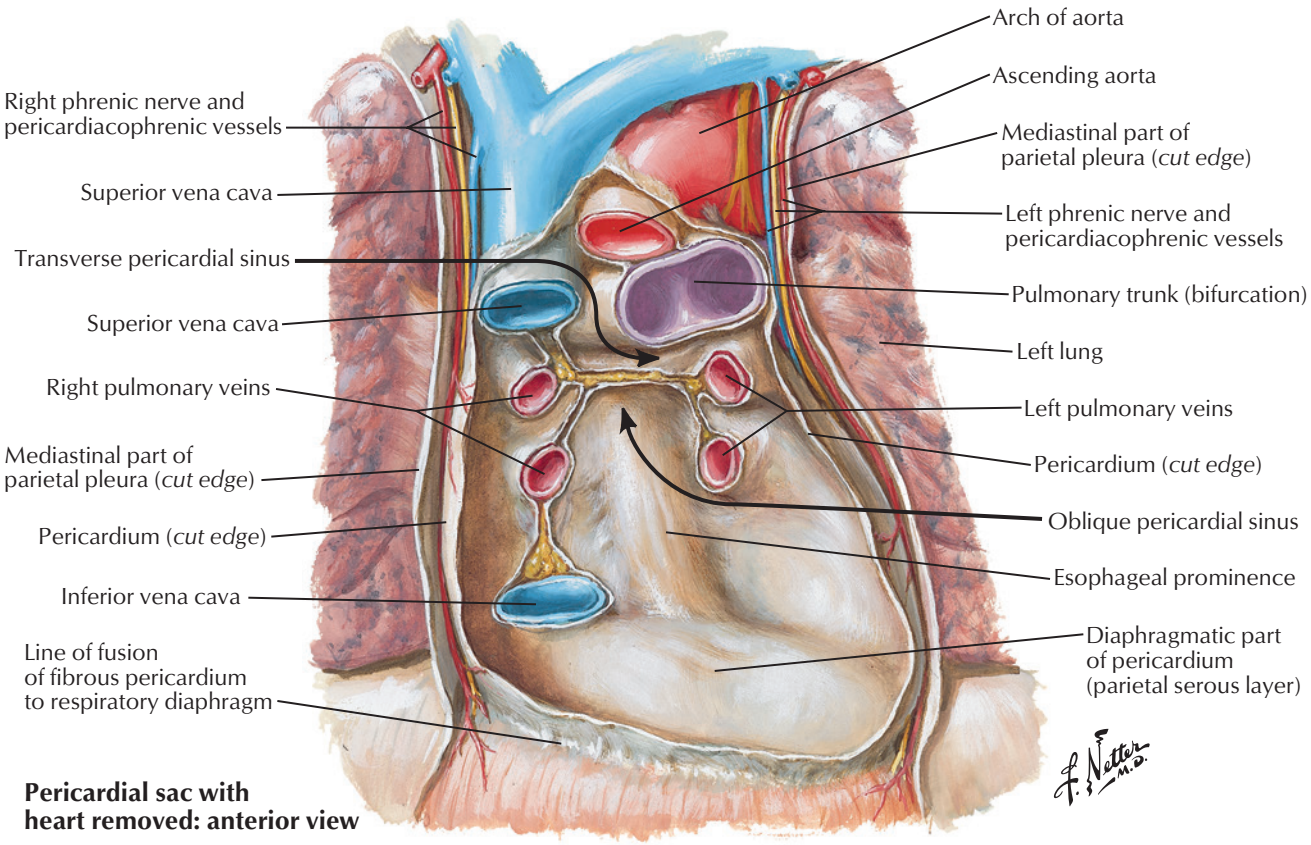
Base of heart: posterior view



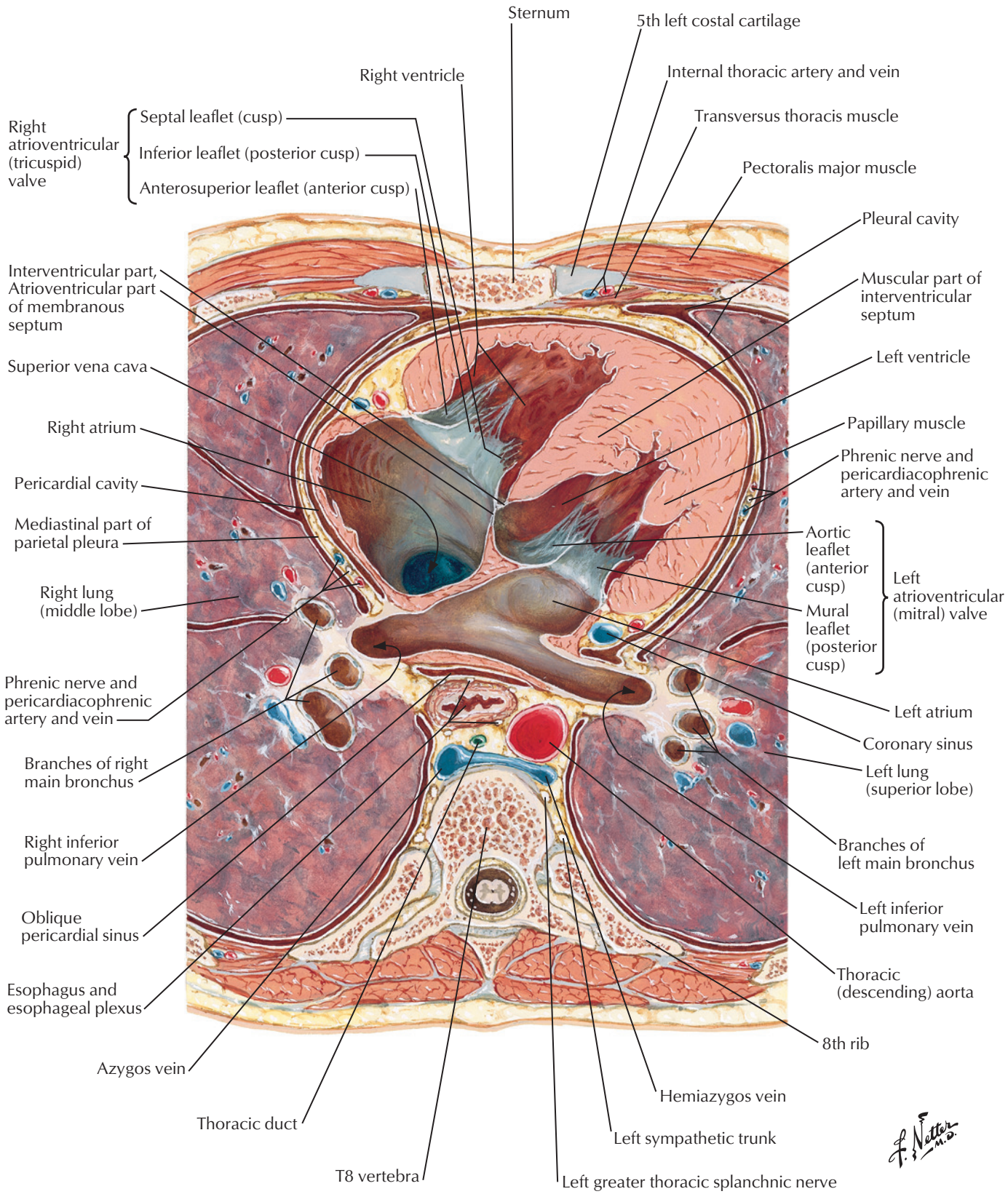
Base and diaphragmatic surface: posteroinferior view

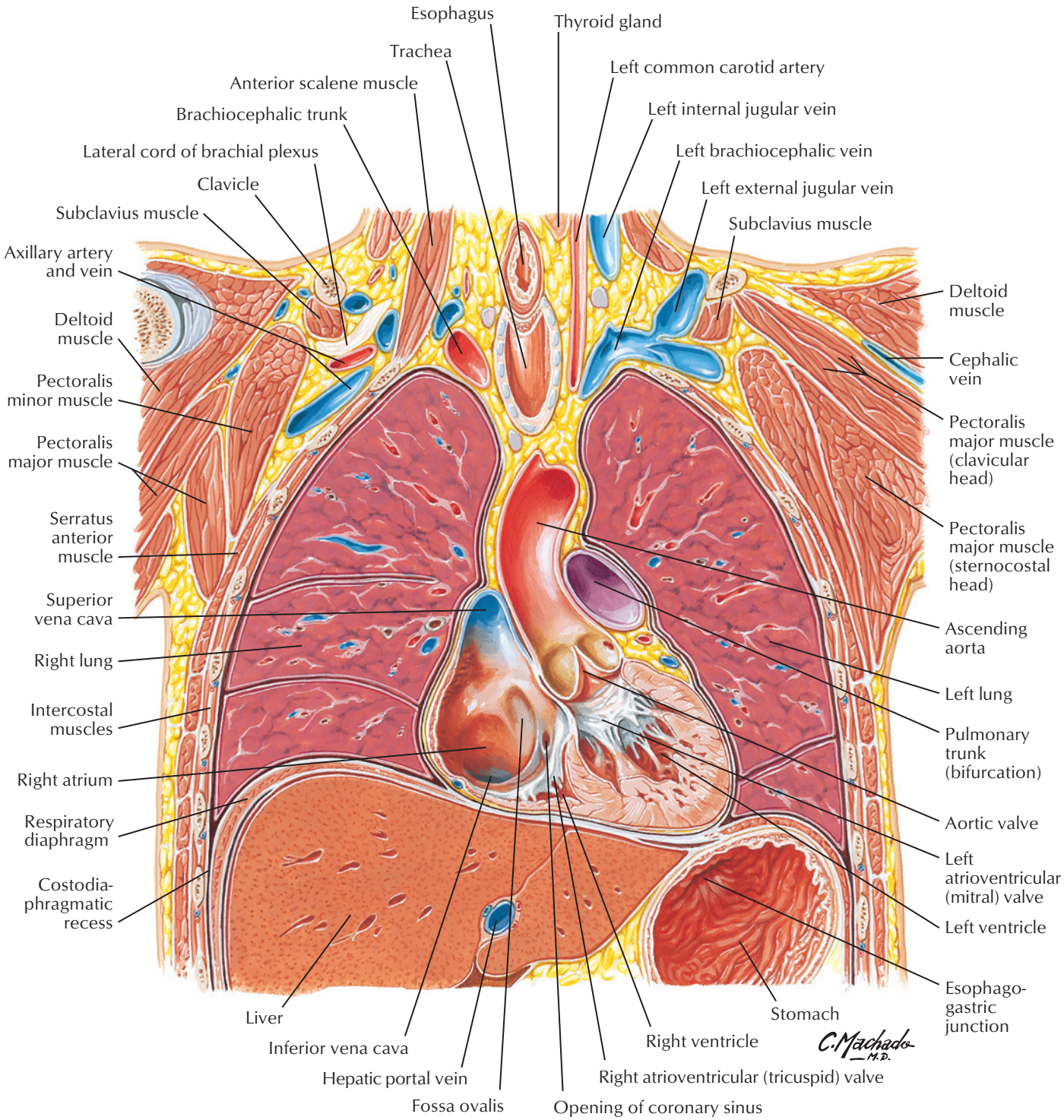


Heart drawn out of opened pericardial sac: left lateral view

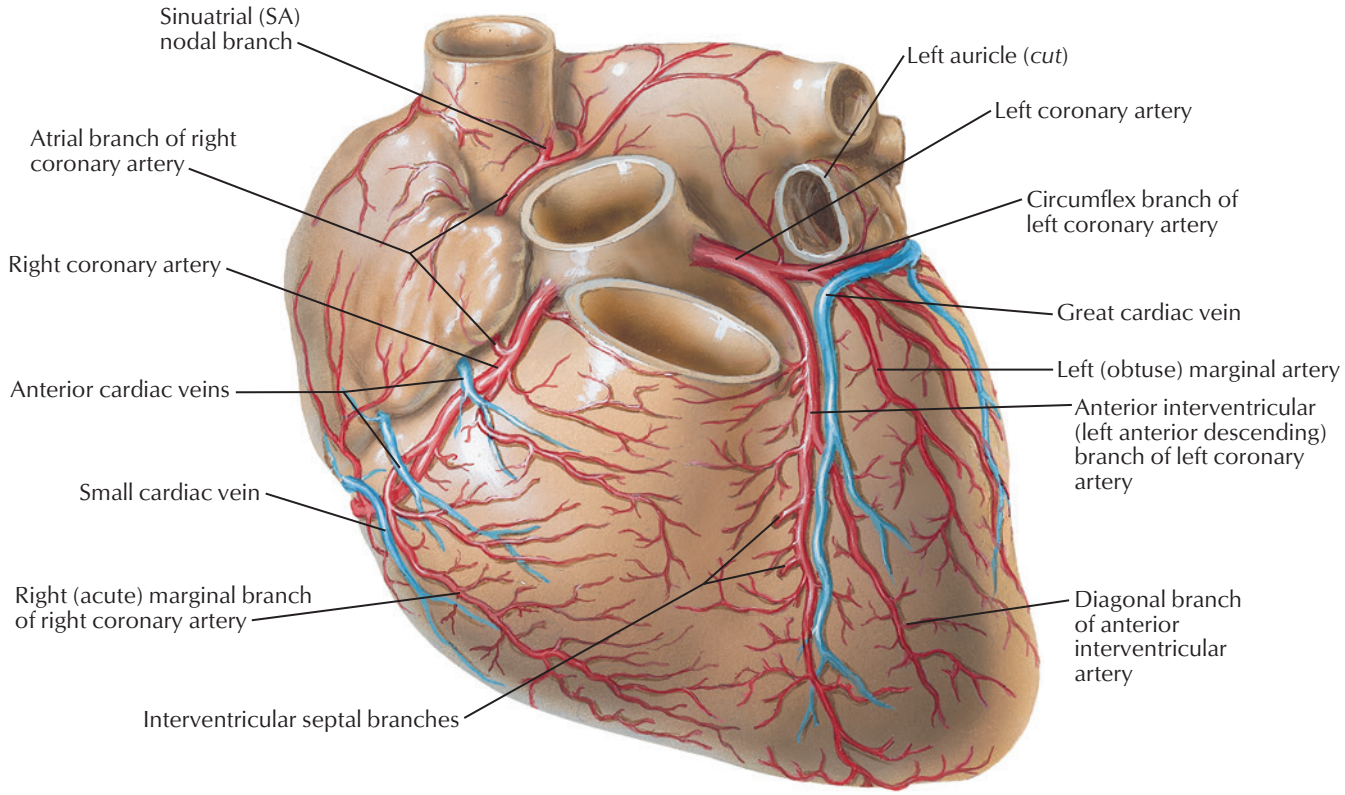


Pericardial sac with heart removed: anterior view

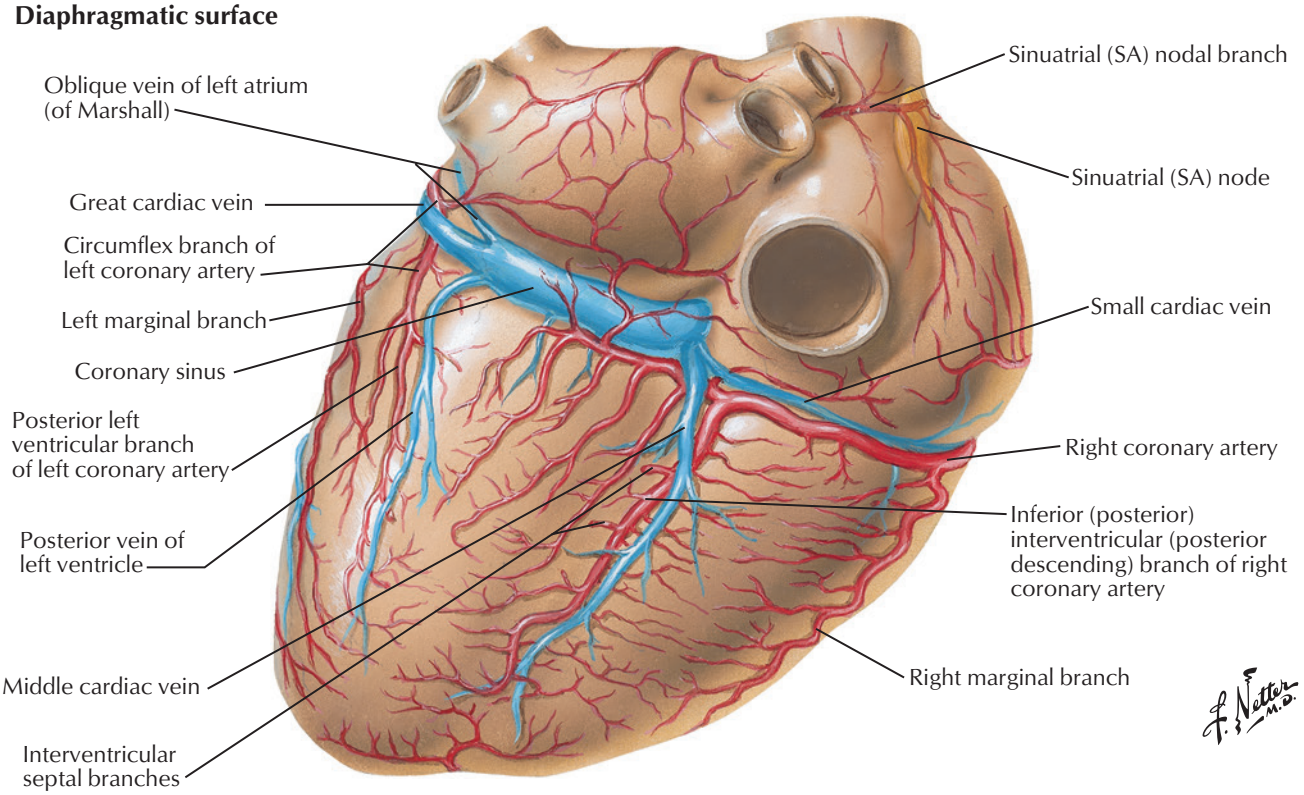

Sternum
5th left costal cartilage
Right ventricle
Internal thoracic artery and vein
Transversus thoracis muscle
Right atrioventricular (tricuspid) valve
Septal leaflet (cusp)
Inferior leaflet (posterior cusp)
Anterosuperior leaflet (anterior cusp)
Pectoralis major muscle
Pleural cavity
Interventricular part, Atrioventricular part of membranous septum
Muscular part of interventricular septum
Superior vena cava
Left ventricle
Right atrium
Papillary muscle
Pericardial cavity
Phrenic nerve and pericardiacophrenic artery and vein
Mediastinal part of parietal pleura
Aortic leaflet (anterior cusp)
Left atrioventricular (mitral) valve
Mural leaflet (posterior cusp)
Right lung (middle lobe)
Phrenic nerve and pericardiacophrenic artery and vein
Left atrium
Coronary sinus
Branches of right main bronchus
Left lung (superior lobe)
Right inferior pulmonary vein
Branches of left main bronchus
Oblique pericardial sinus
Left inferior pulmonary vein
Esophagus and esophageal plexus
Thoracic (descending) aorta
8th rib
Azygos vein
Hemiazygos vein
Thoracic duct
Left sympathetic trunk
T8 vertebra
Left greater thoracic splanchnic nerve

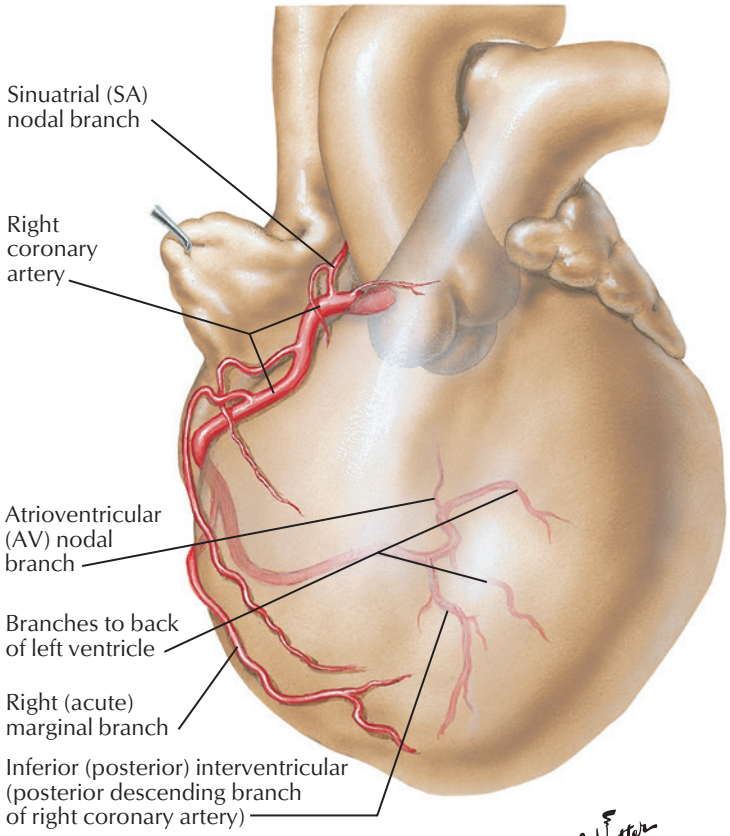

Esophagus
Thyroid gland
Trachea
Left common carotid artery
Anterior scalene muscle
Left internal jugular vein
Brachiocephalic trunk
Left brachiocephalic vein
Lateral cord of brachial plexus
Left external jugular vein
Clavicle
Subclavius muscle
Subclavius muscle
Axillary artery and vein
Deltoid muscle
Deltoid muscle
Cephalic vein
Pectoralis minor muscle
Pectoralis major muscle (clavicular head)
Pectoralis major muscle
Pectoralis major muscle (sternocostal head)
Serratus anterior muscle
Ascending aorta
Superior vena cava
Left lung
Right lung
Pulmonary trunk (bifurcation)
Intercostal muscles
Aortic valve
Right atrium
Left atrioventricular (mitral) valve
Respiratory diaphragm
Left ventricle
Costodiaphragmatic recess
Esophagogastric junction
Liver
Stomach
Inferior vena cava
Right ventricle
Hepatic portal vein
Right atrioventricular (tricuspid) valve
Fossa ovalis
Opening of coronary sinus
C. Machado M.D.

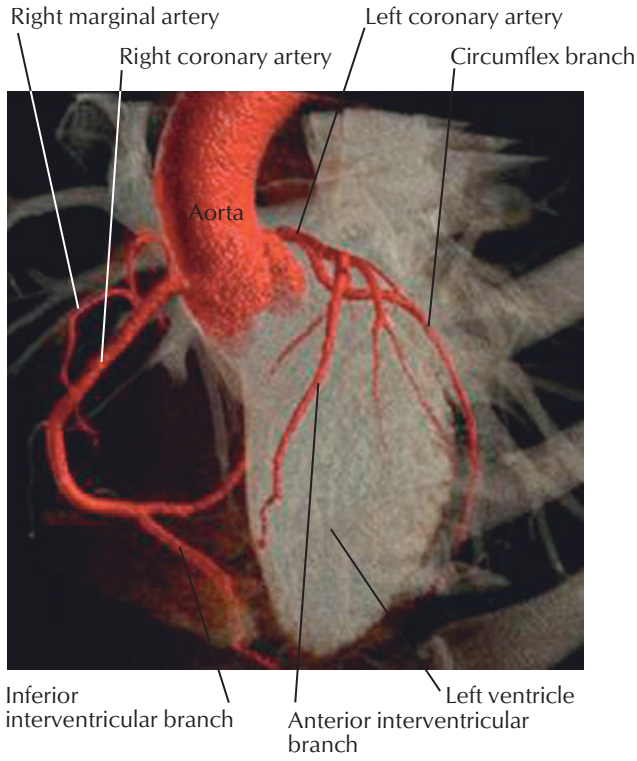
Sternocostal surface

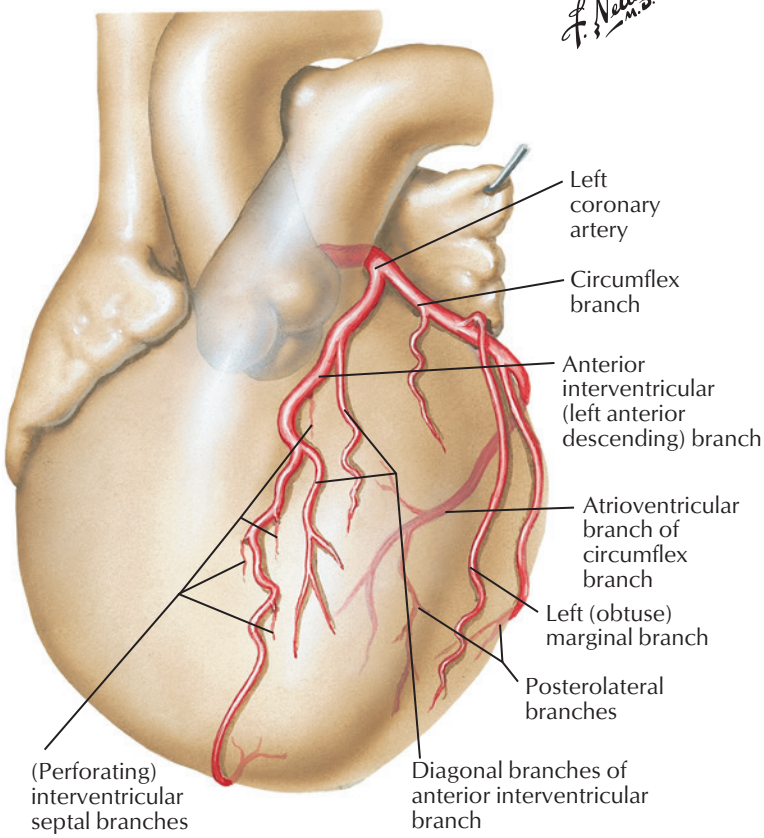


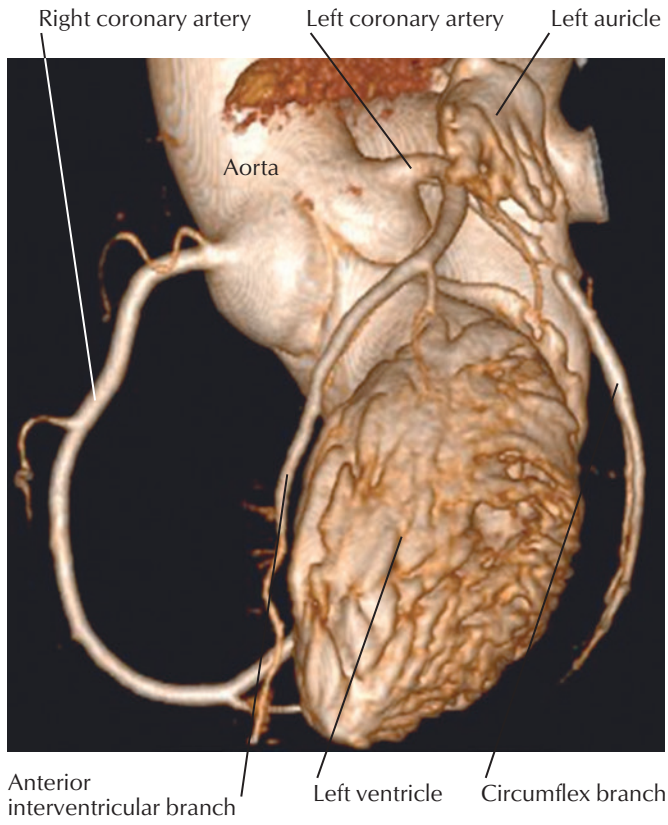
Diaphragmatic surface

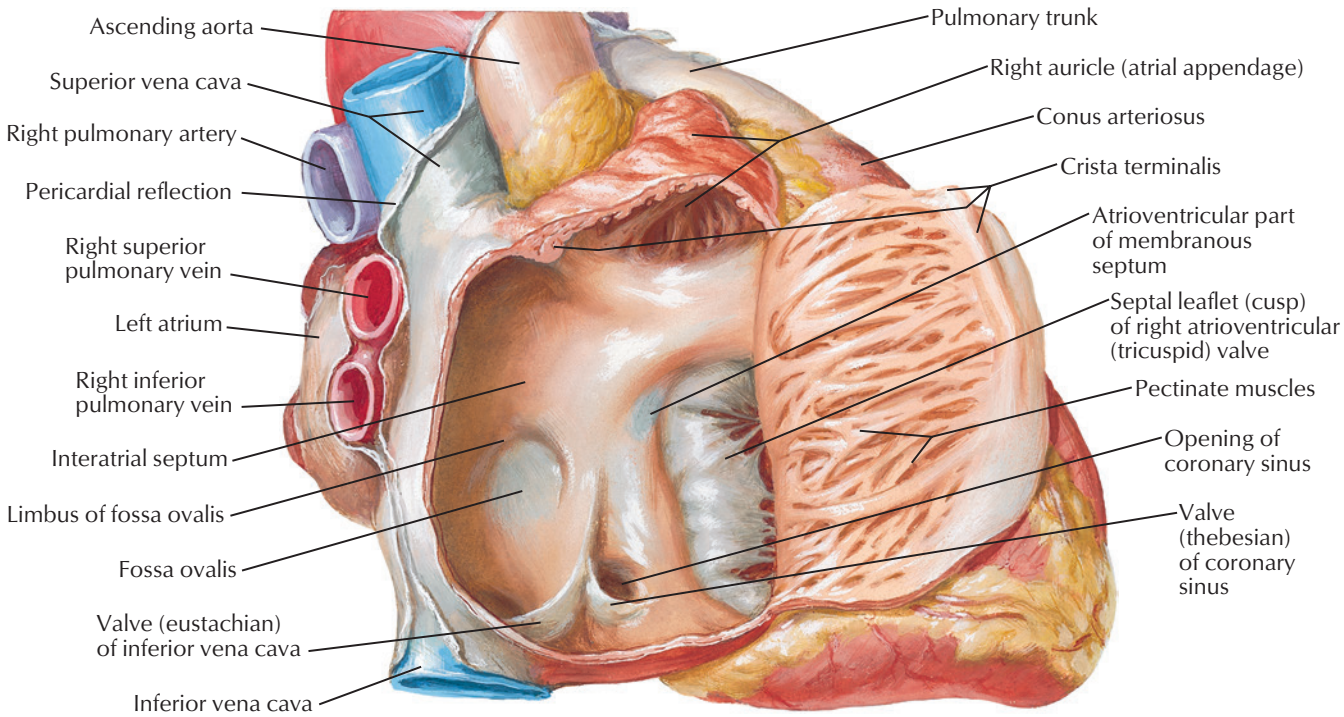



Sinuatrial (SA) nodal branch
Right coronary artery
Atrioventricular (AV) nodal branch
Branches to back of left ventricle
Right (acute) marginal branch
Inferior (posterior) interventricular (posterior descending branch of right coronary artery)

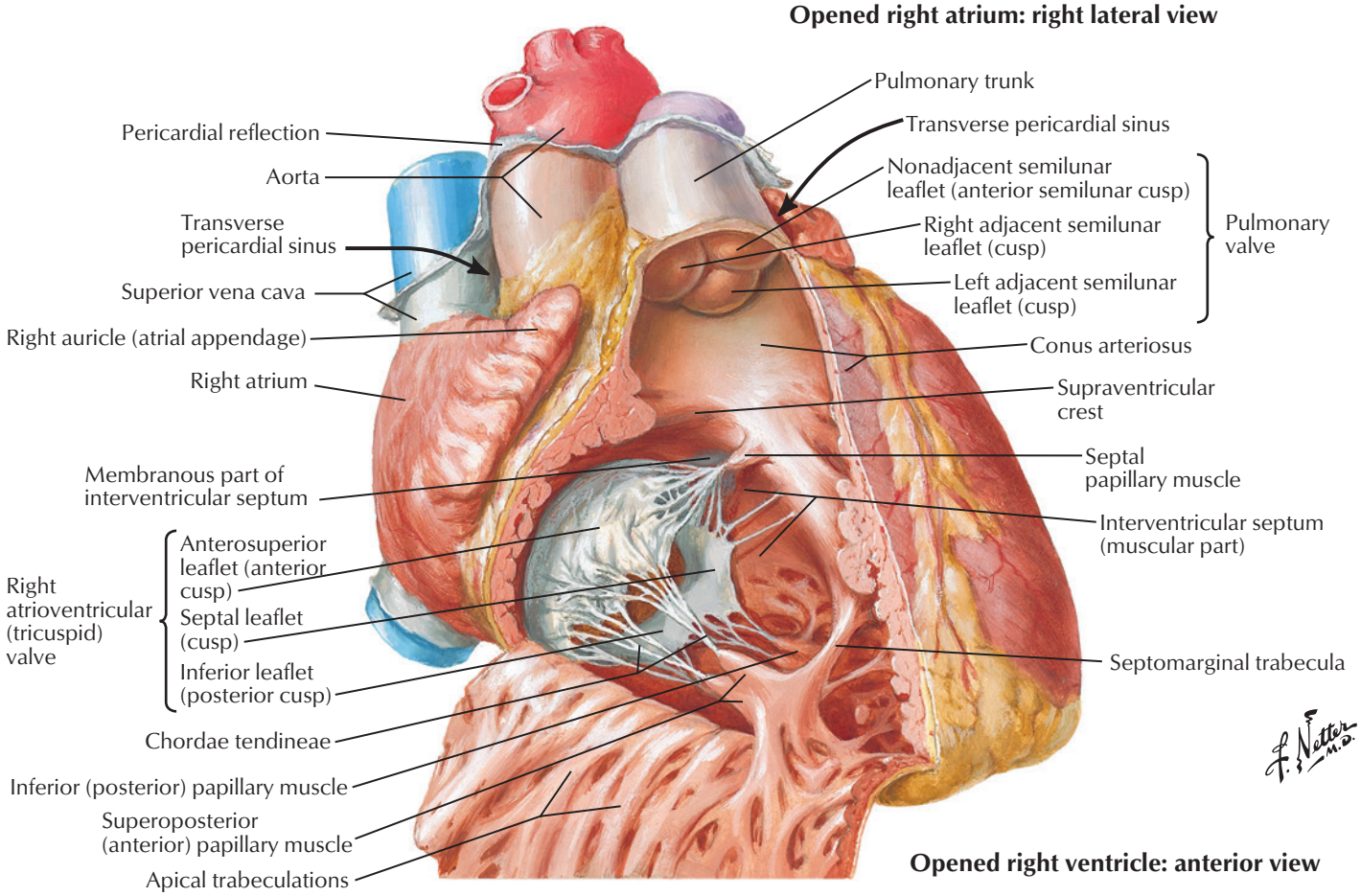

Right marginal artery
Right coronary artery
Left coronary artery
Circumflex branch
Aorta
Inferior interventricular branch
Anterior interventricular branch
Left ventricle


Left coronary artery
Circumflex branch
Anterior interventricular (left anterior descending) branch
Atrioventricular branch of circumflex branch
Left (obtuse) marginal branch
Posterolateral branches
(Perforating) interventricular septal branches
Diagonal branches of anterior interventricular branch

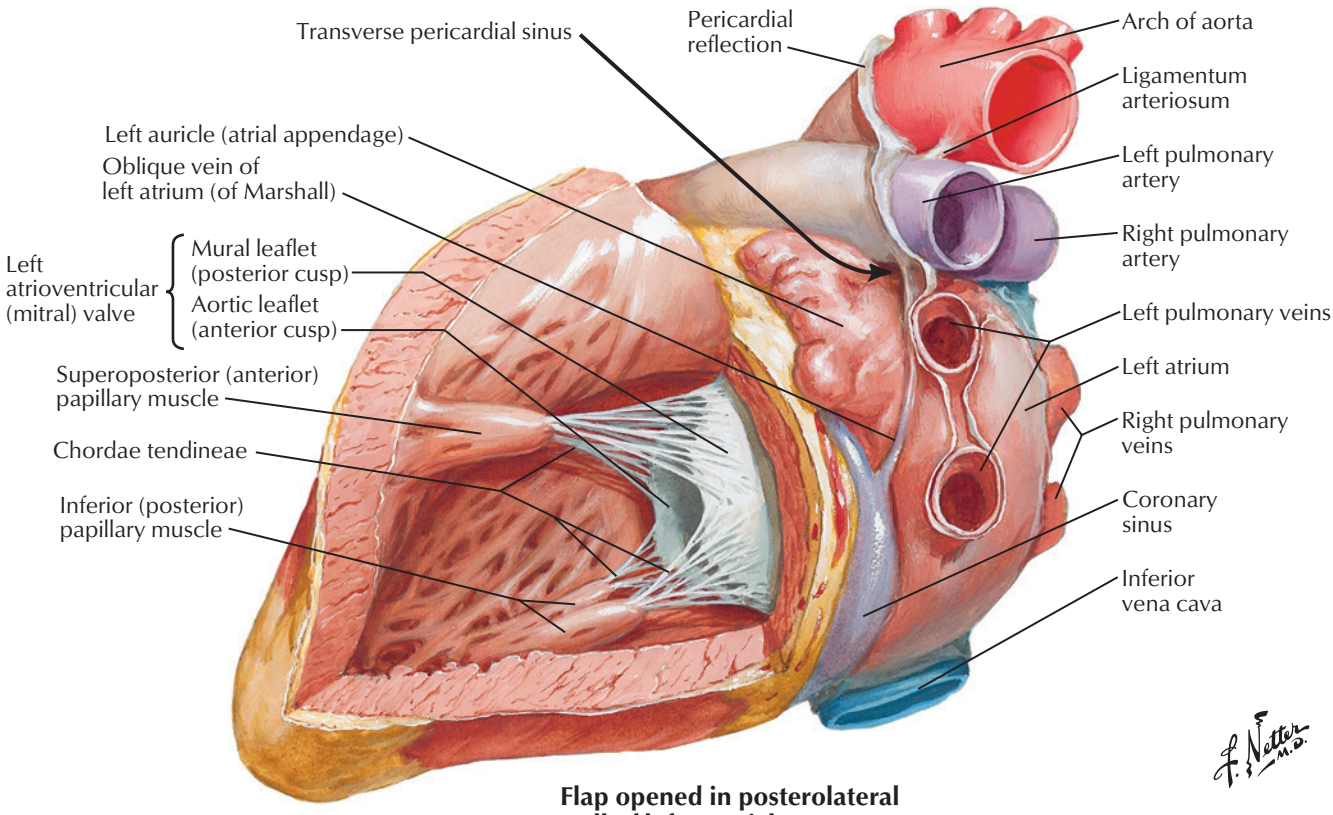

Right coronary artery
Left coronary artery
Left auricle
Aorta
Anterior interventricular branch
Left ventricle
Circumflex branch



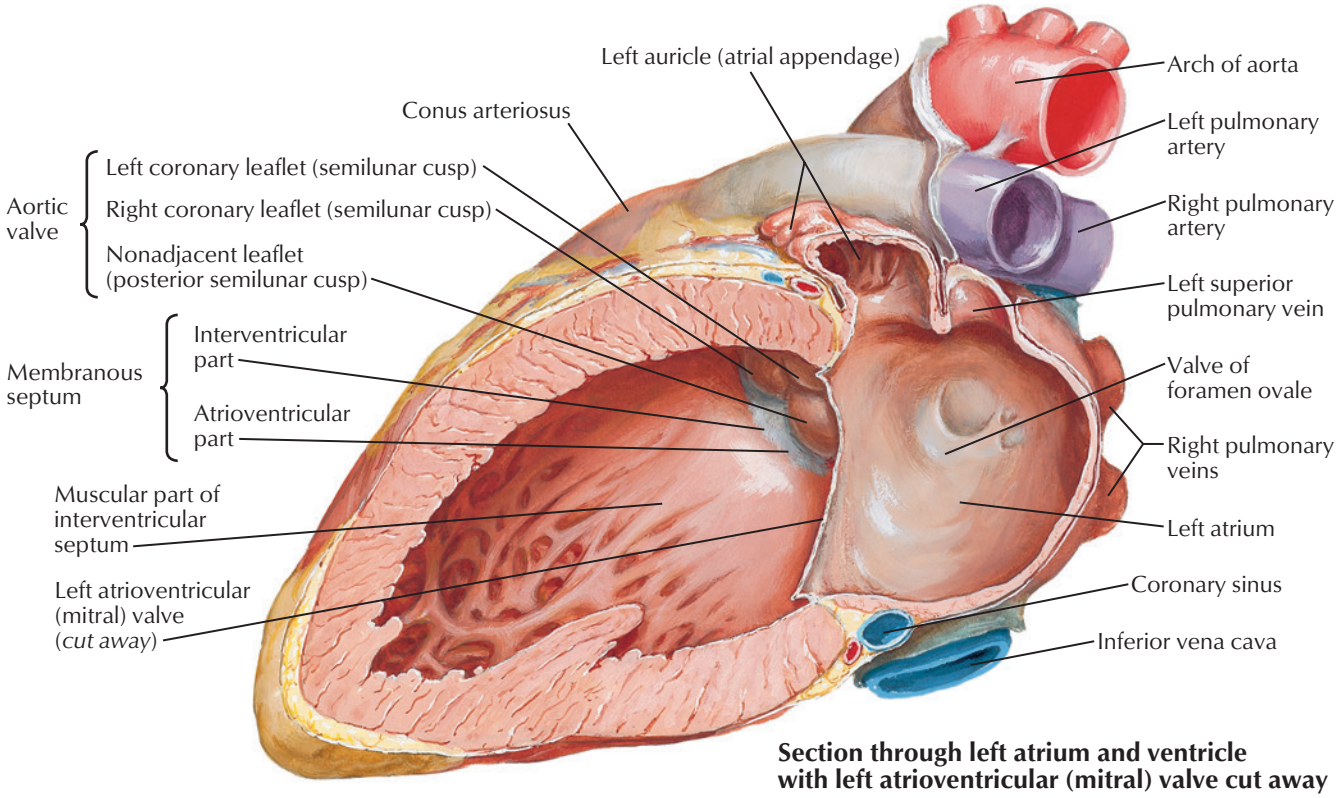
Opened right atrium: right lateral view



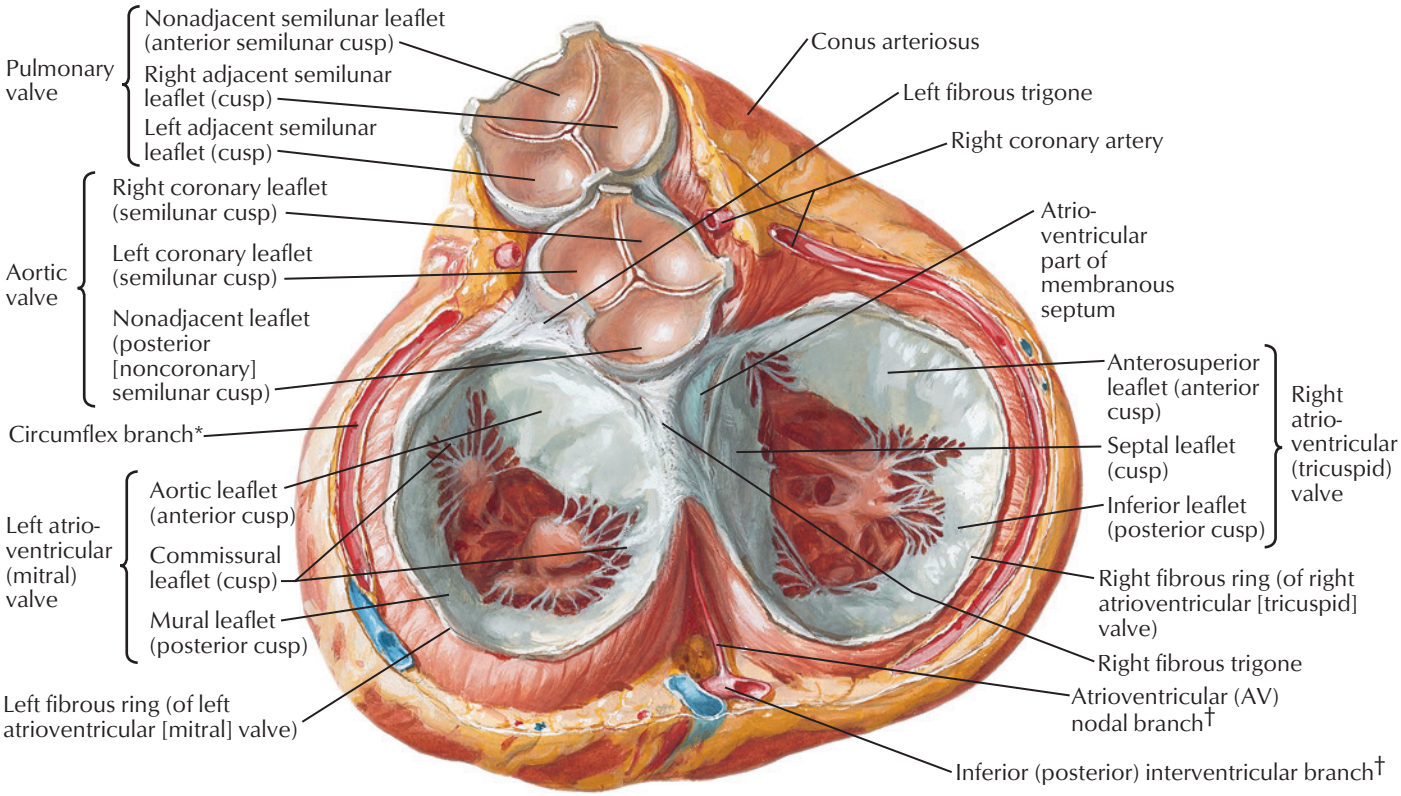
Opened right ventricle: anterior view



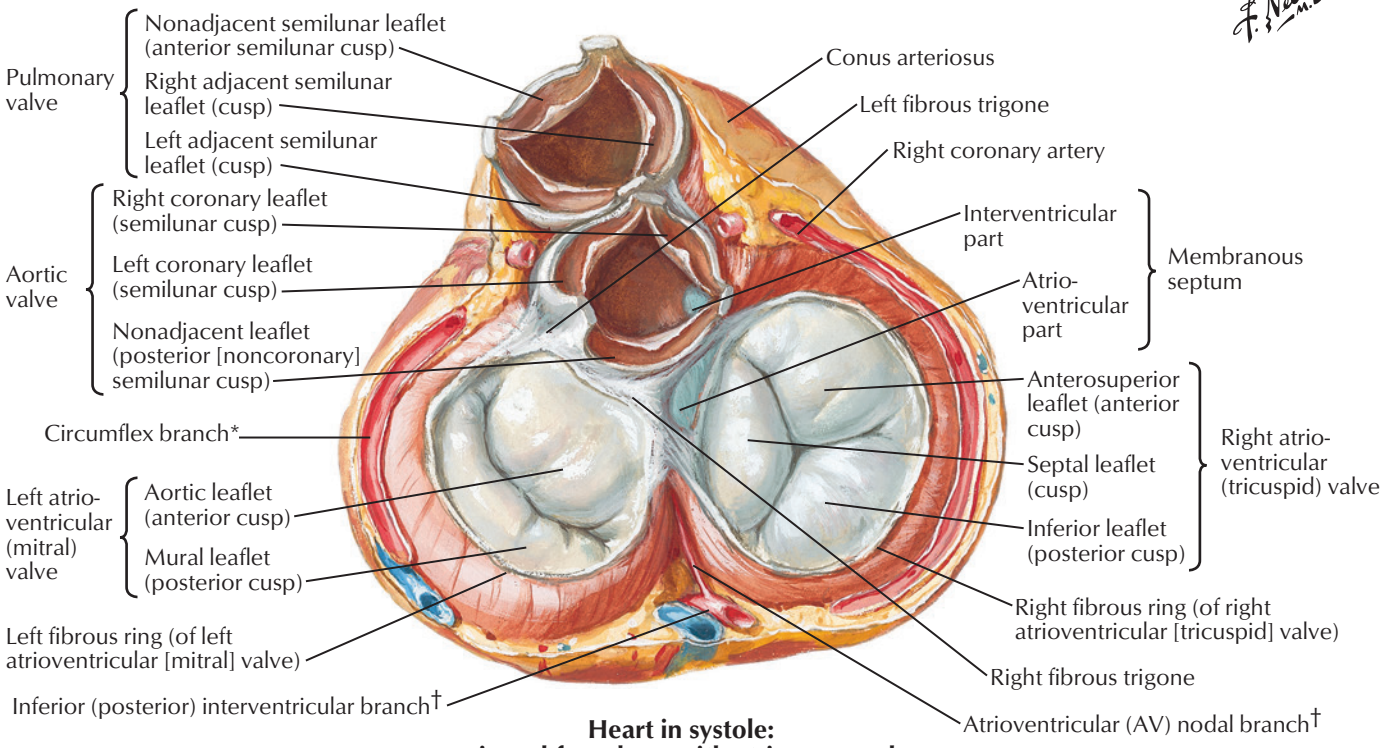
Flap opened in posterolateral wall of left ventricle



Section through left atrium and ventricle with left atrioventricular (mitral) valve cut away

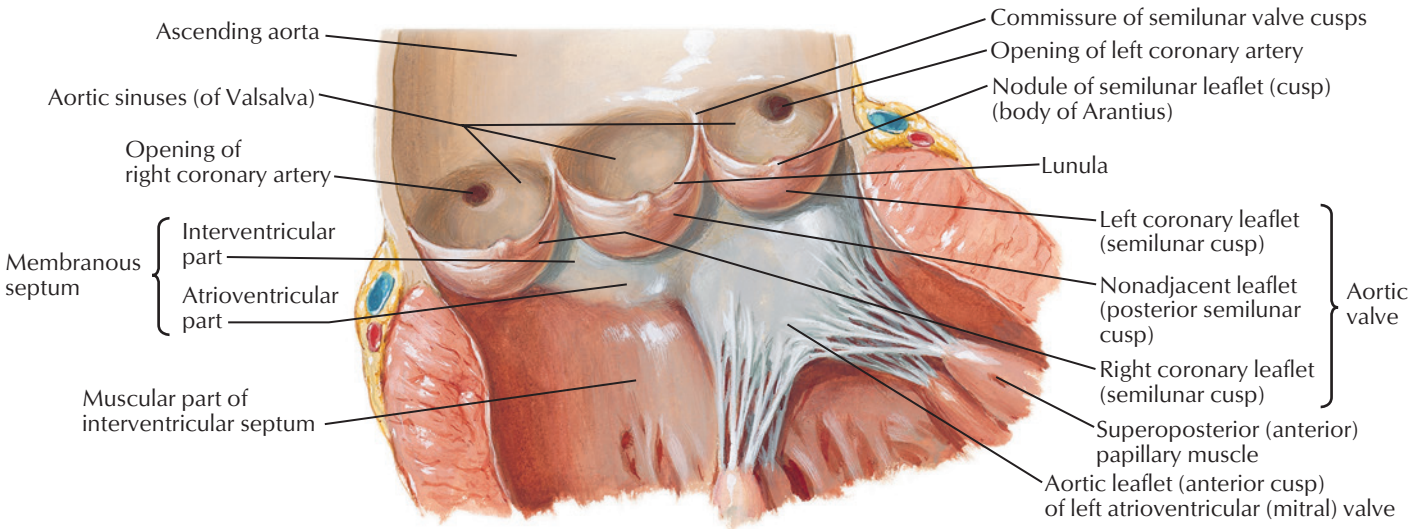


Heart in diastole:
viewed from base with atria removed

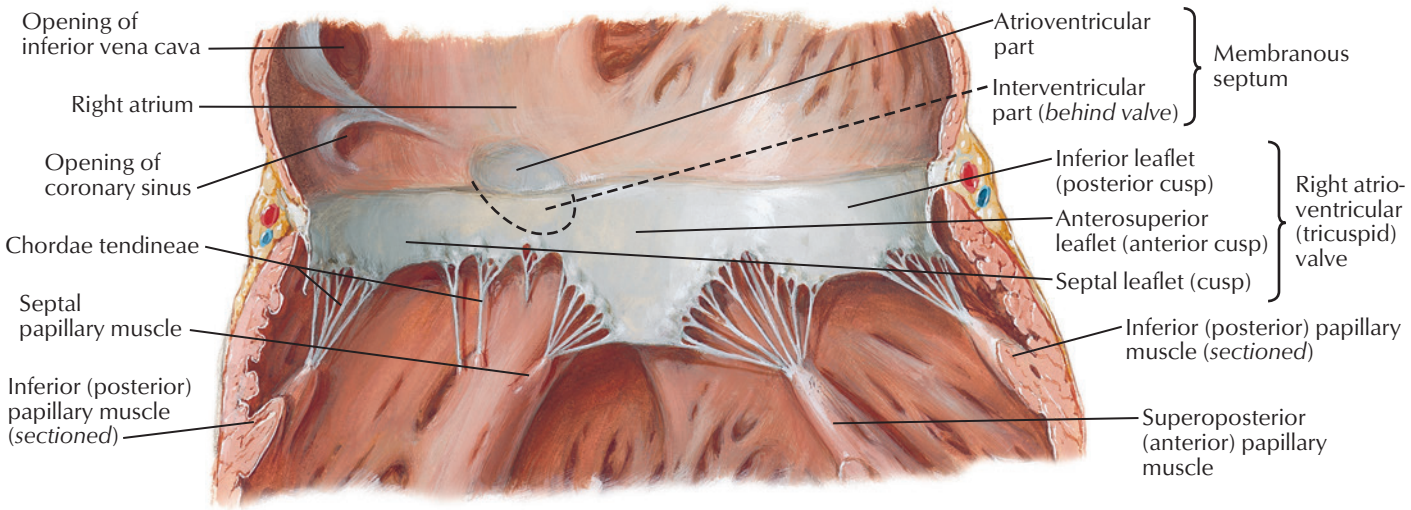


Heart in systole:
viewed from base with atria removed

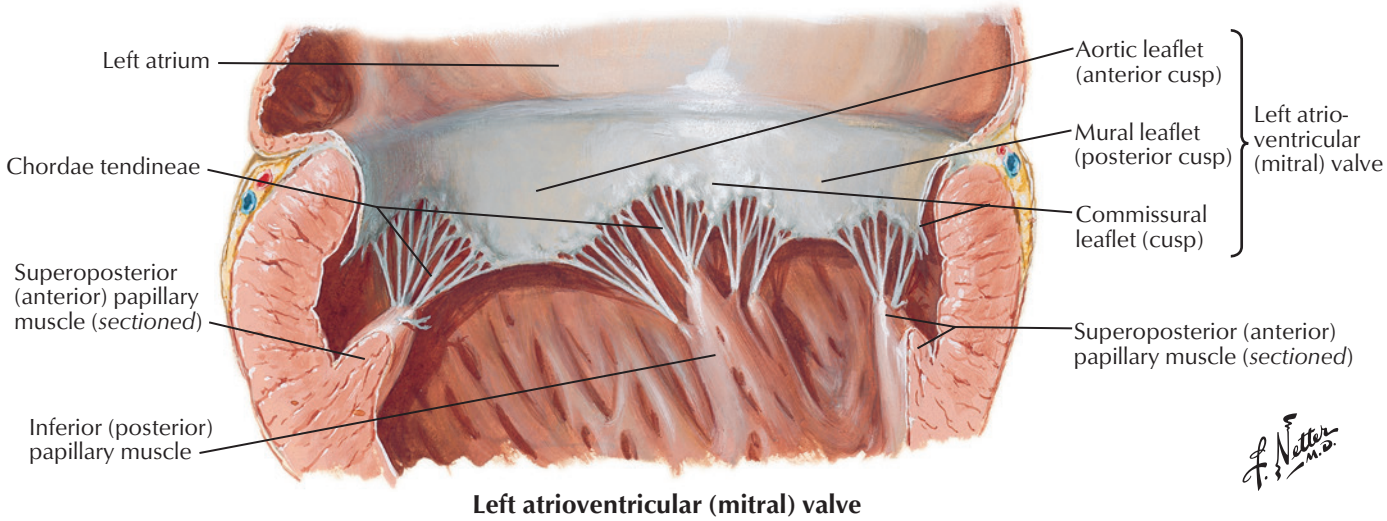
*Of left coronary artery
†Of right coronary artery



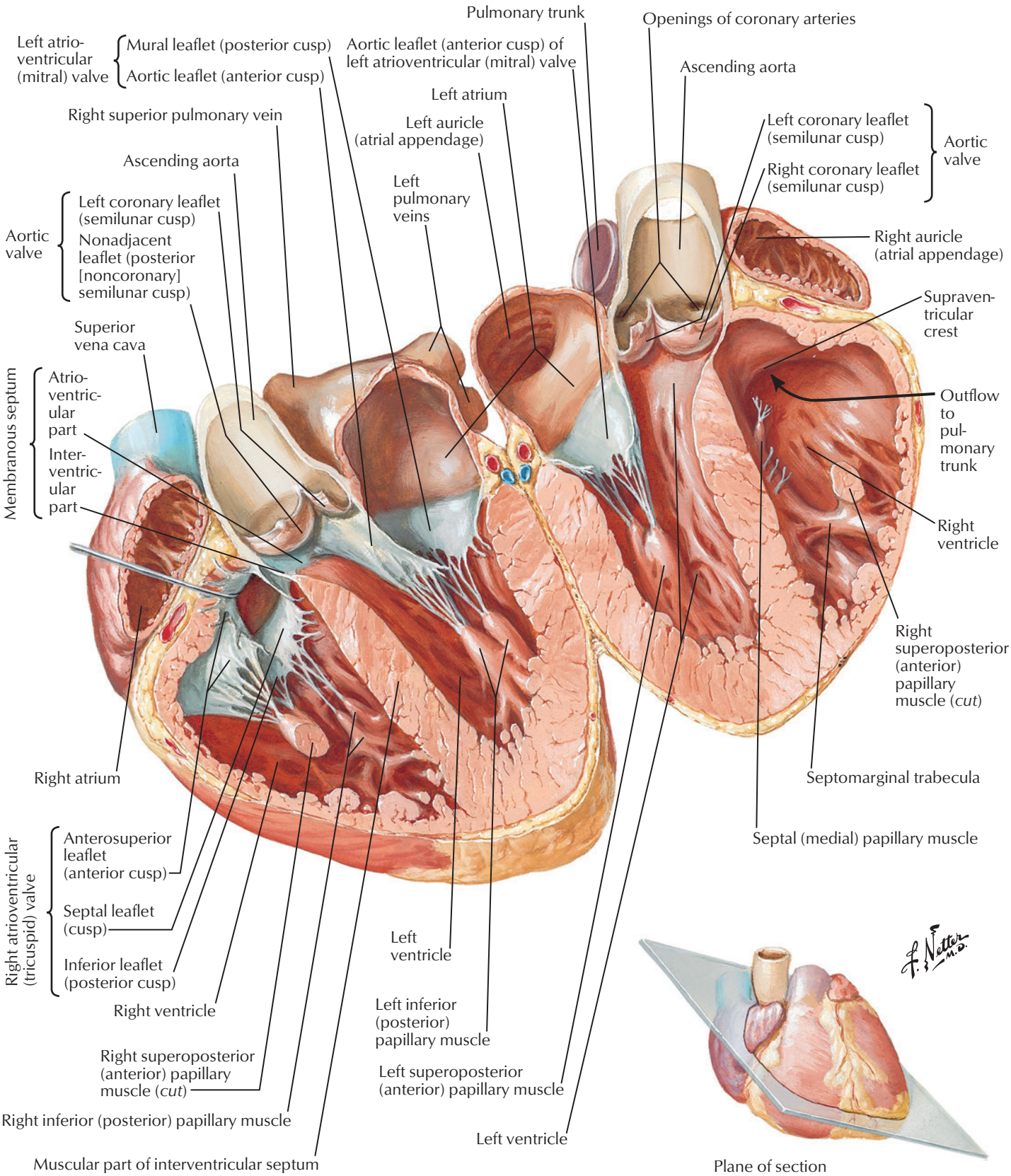
Aortic valve



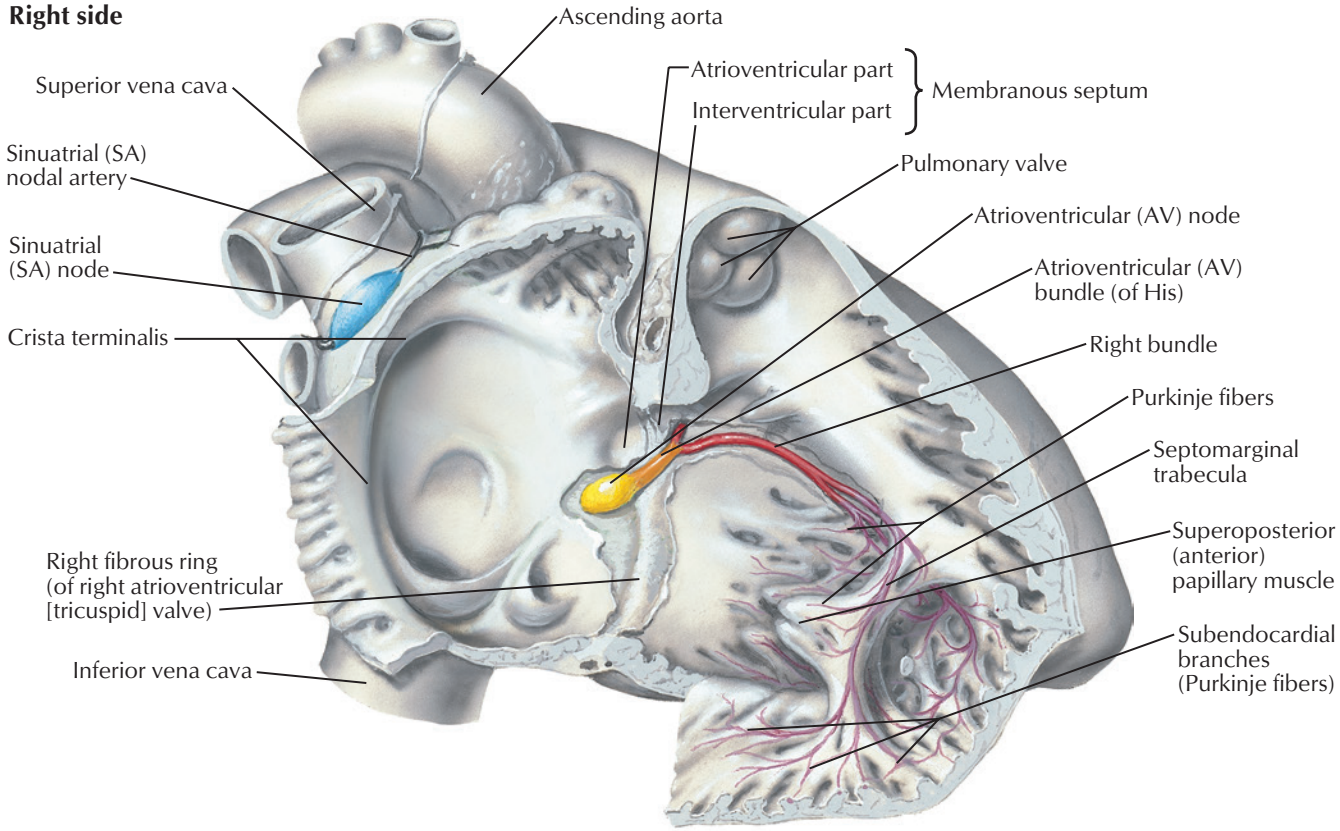
Right atrioventricular (tricuspid) valve



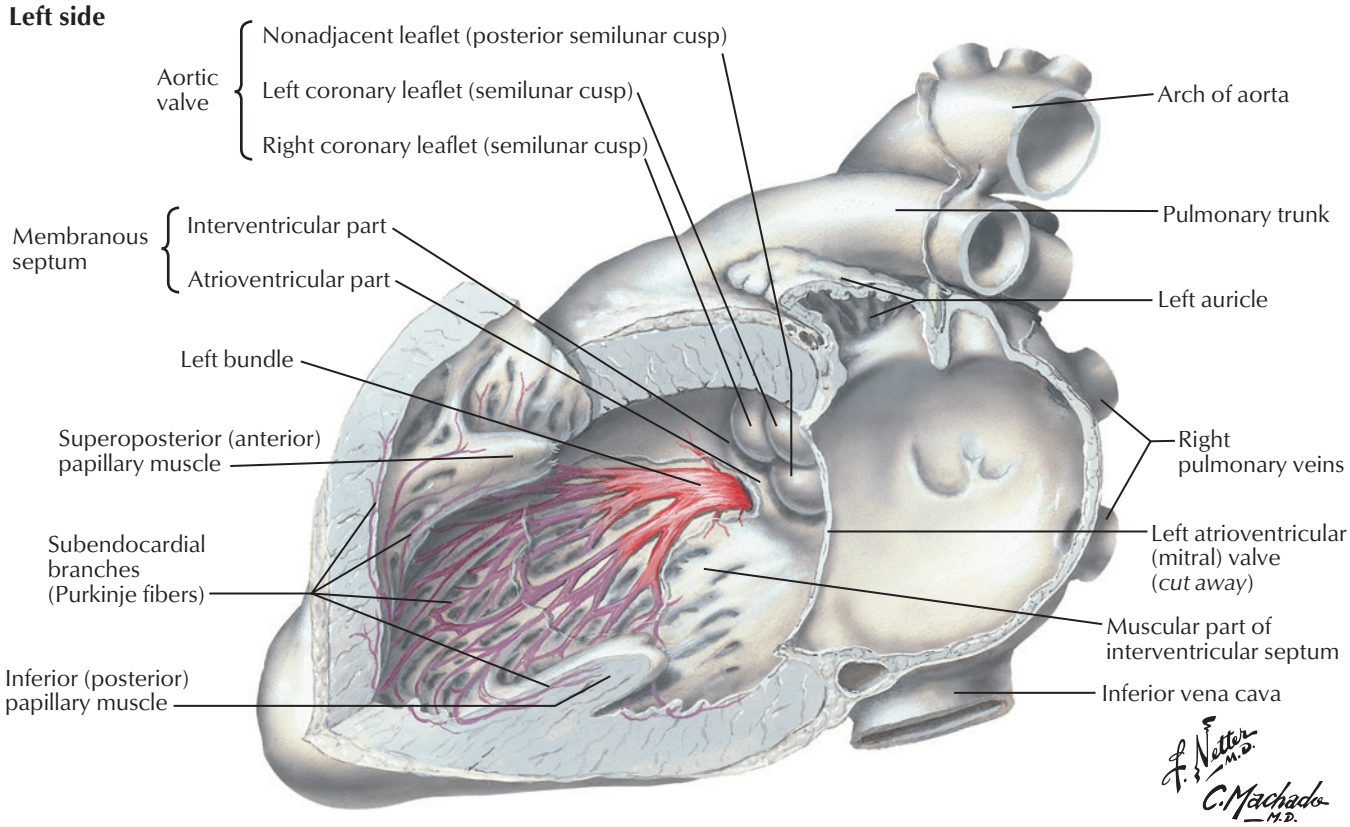
Left atrioventricular (mitral) valve

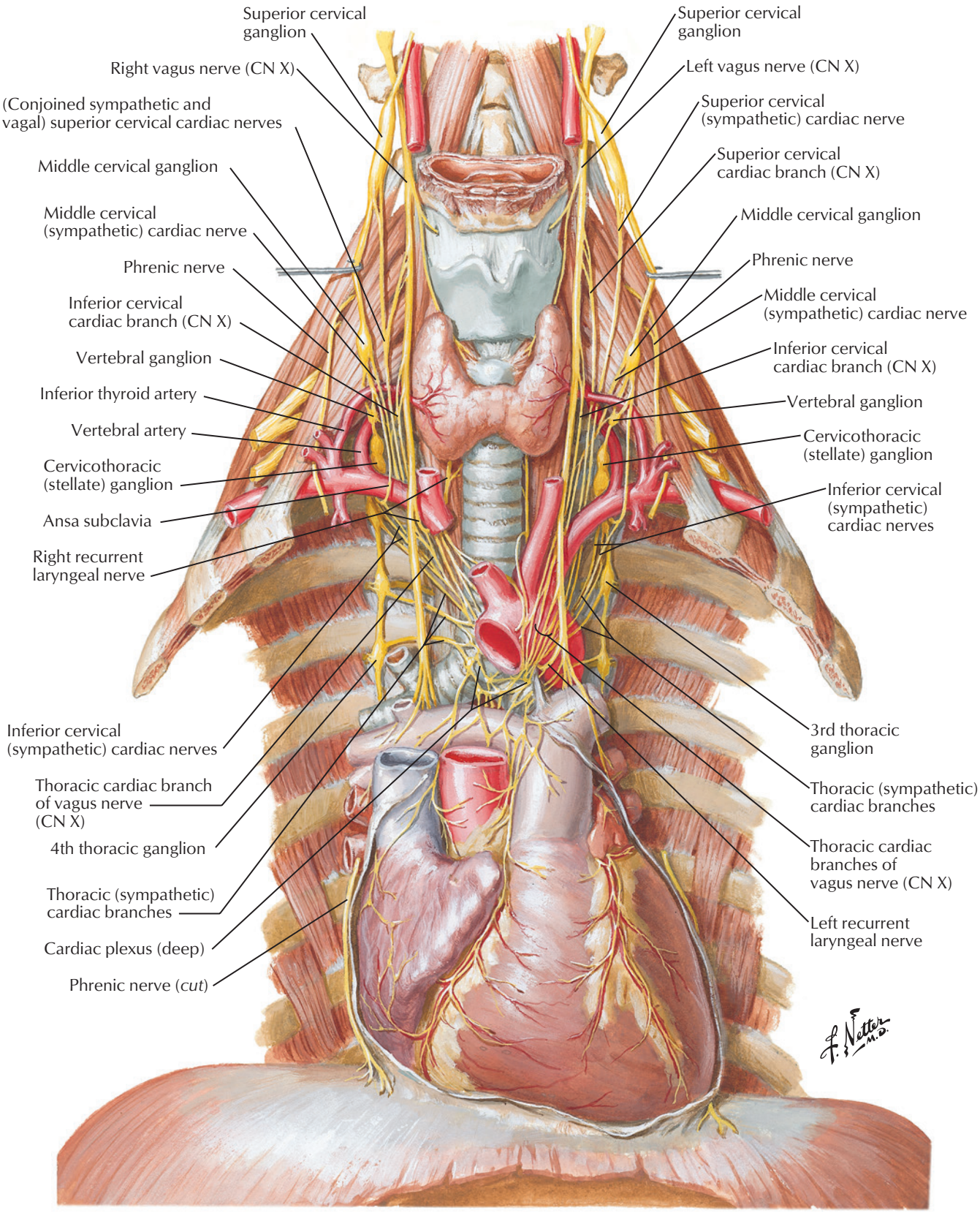

Pulmonary trunk
Openings of coronary arteries
Left atrio-ventricular (mitral) valve
Mural leaflet (posterior cusp)
Aortic leaflet (anterior cusp)
Aortic leaflet (anterior cusp) of left atrioventricular (mitral) valve
Ascending aorta
Left atrium
Right superior pulmonary vein
Left auricle (atrial appendage)
Left coronary leaflet (semilunar cusp)
Right coronary leaflet (semilunar cusp)
Aortic valve
Ascending aorta
Left pulmonary veins
Aortic valve
Left coronary leaflet (semilunar cusp)
Nonadjacent leaflet (posterior [noncoronary] semilunar cusp)
Right auricle (atrial appendage)
Supraventricular crest
Superior vena cava
Membranous septum
Atrioventricular part
Interventricular part
Outflow to pulmonary trunk
Right ventricle
Right superoposterior (anterior) papillary muscle (cut)
Right atrium
Septomarginal trabecula
Septal (medial) papillary muscle
Right atrioventricular (tricuspid) valve
Anterosuperior leaflet (anterior cusp)
Septal leaflet (cusp)
Inferior leaflet (posterior cusp)
Left ventricle
Right ventricle
Left inferior (posterior) papillary muscle
Right superoposterior (anterior) papillary muscle (cut)
Left superoposterior (anterior) papillary muscle
Right inferior (posterior) papillary muscle
Left ventricle
Muscular part of interventricular septum
Plane of section

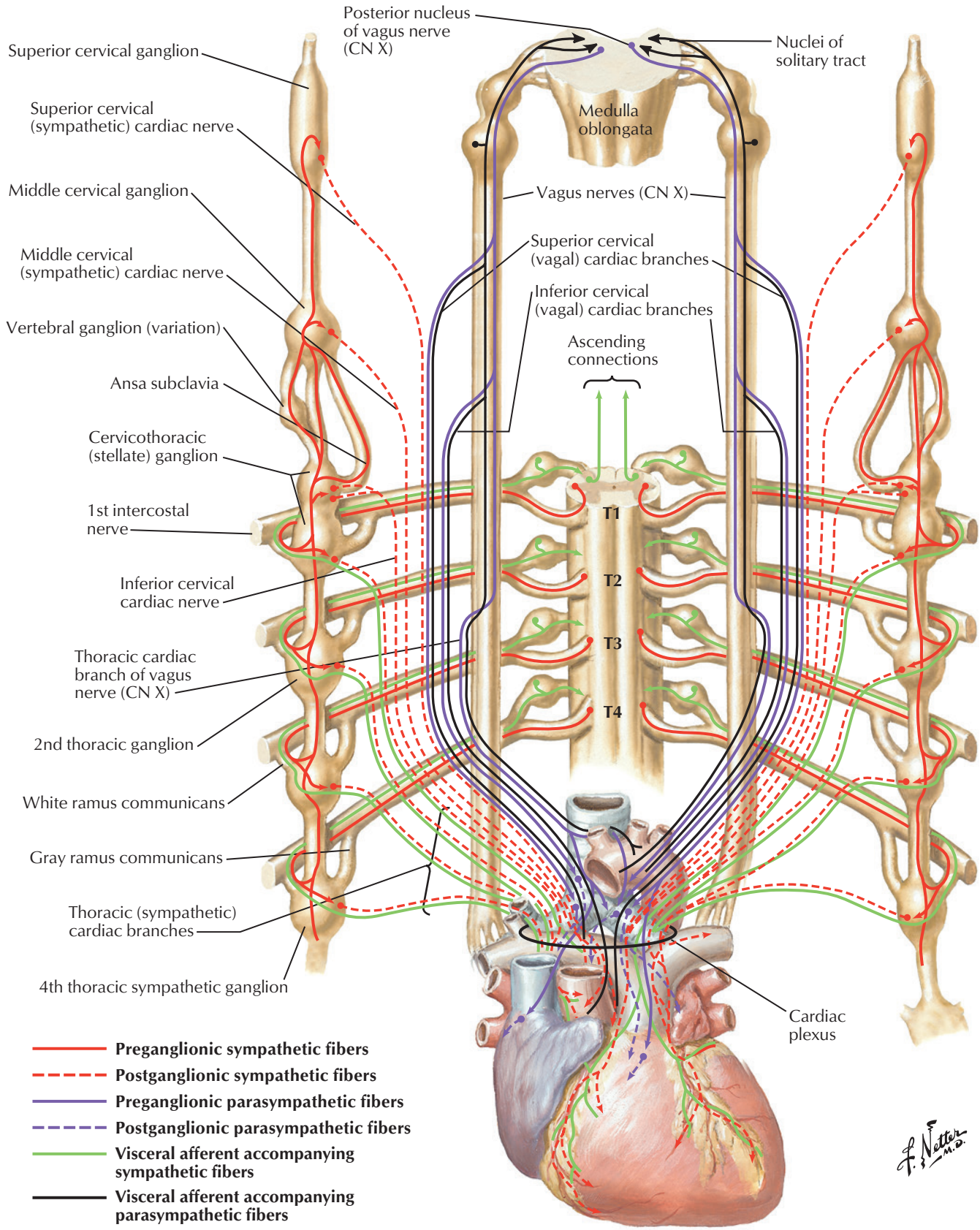
Right side

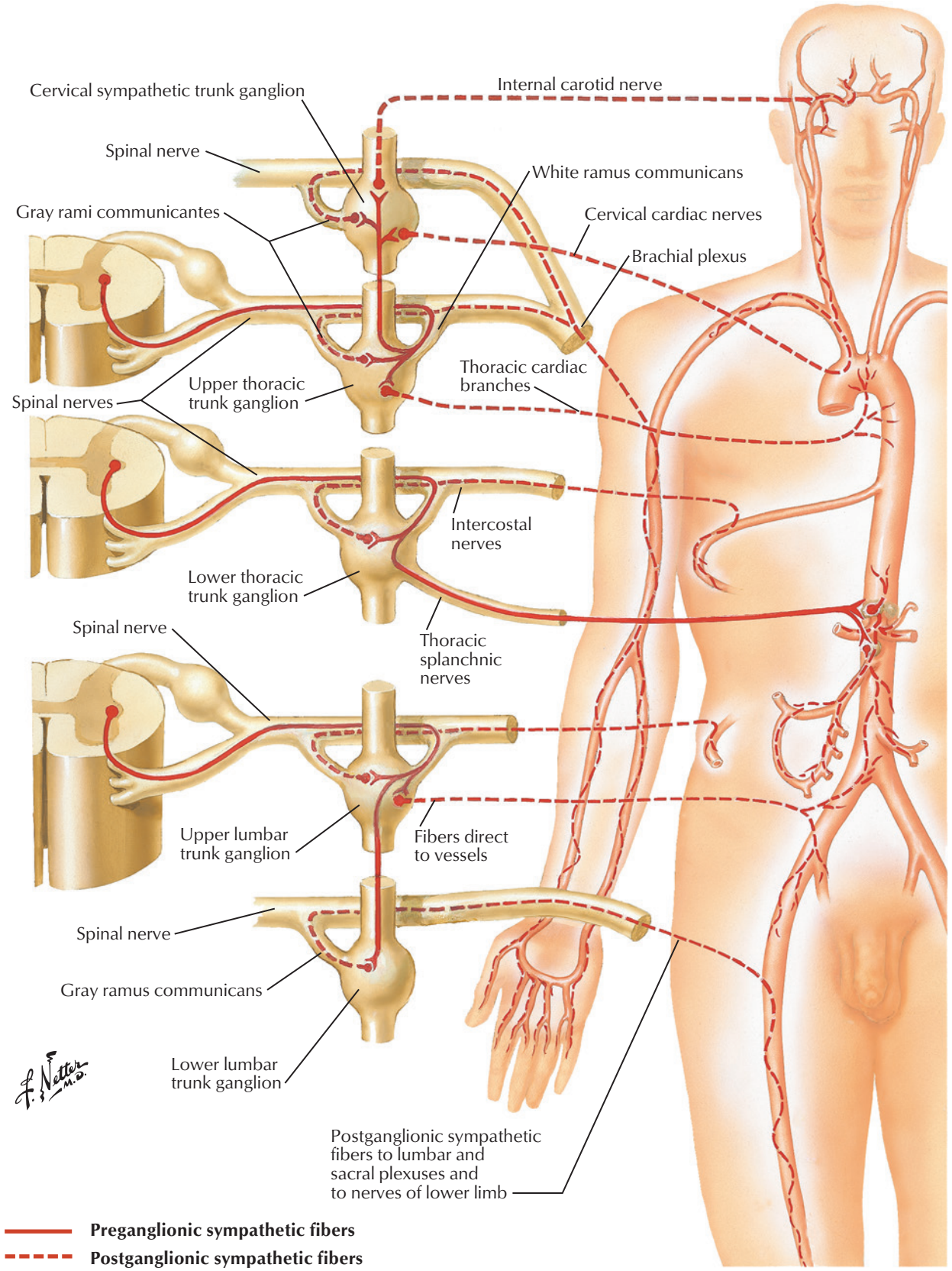


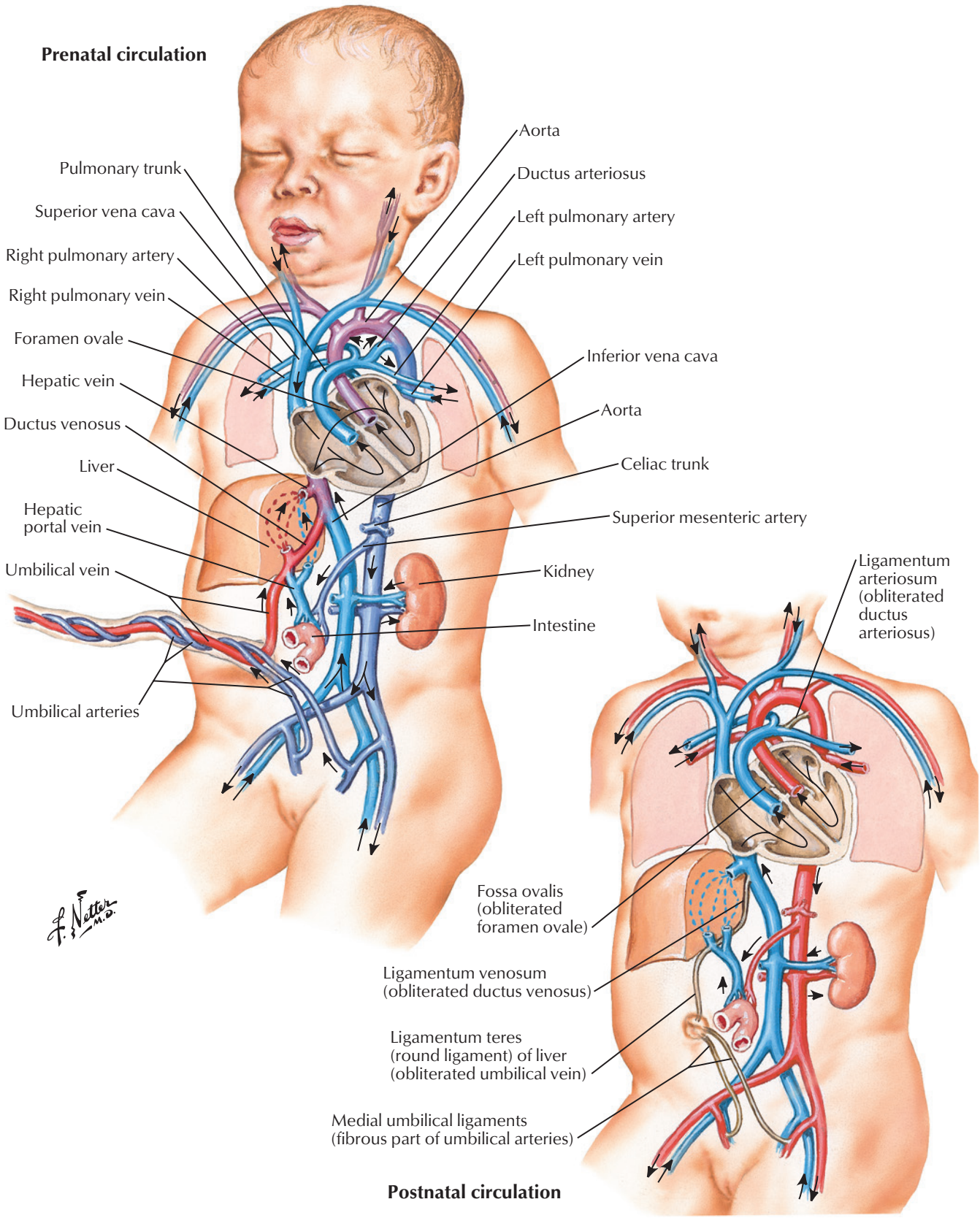
Left side

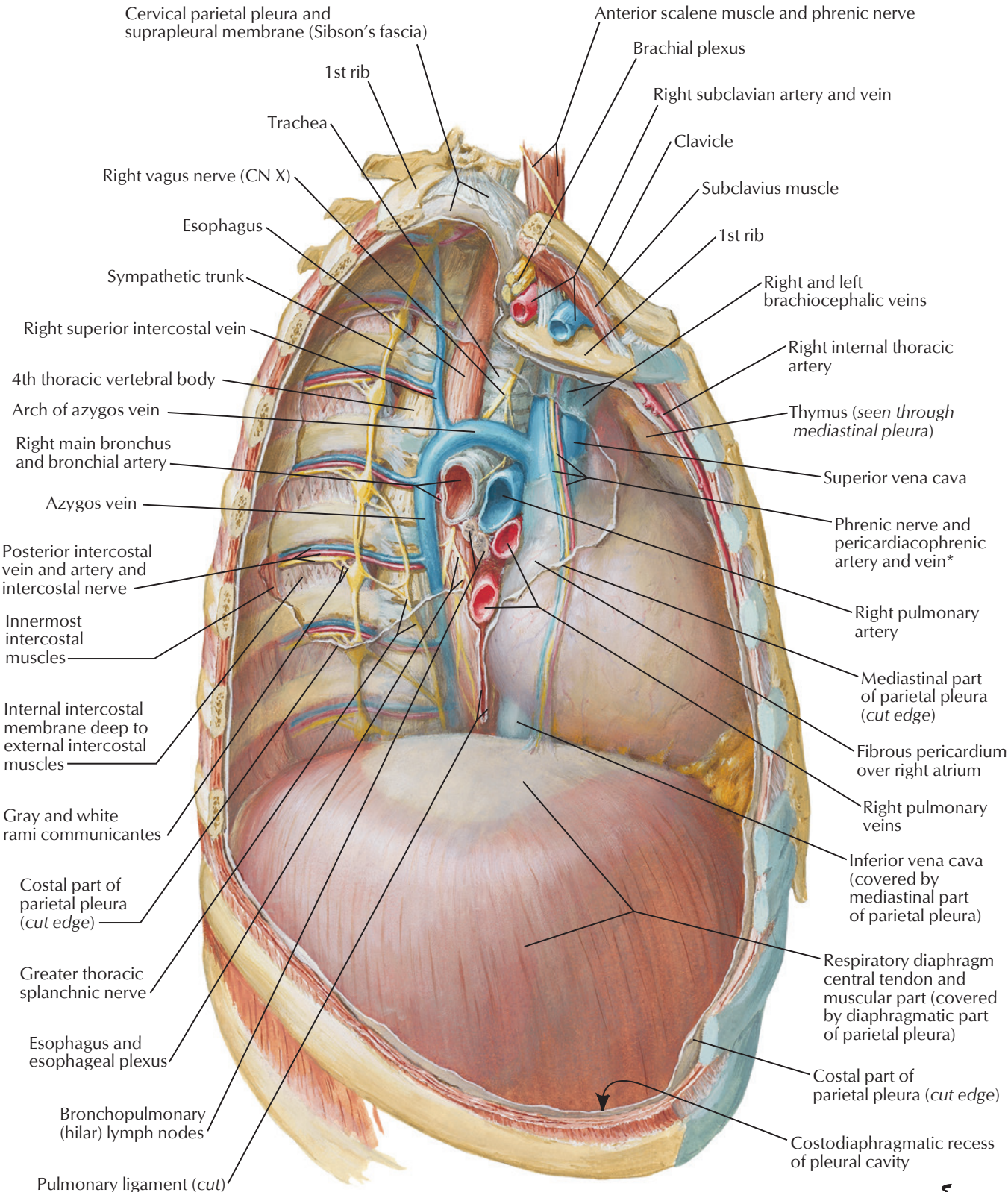



Superior cervical ganglion
Right vagus nerve (CN X)
(Conjoined sympathetic and vagal) superior cervical cardiac nerves
Middle cervical ganglion
Middle cervical (sympathetic) cardiac nerve
Phrenic nerve
Inferior cervical cardiac branch (CN X)
Vertebral ganglion
Inferior thyroid artery
Vertebral artery
Cervicothoracic (stellate) ganglion
Ansa subclavia
Right recurrent laryngeal nerve
Inferior cervical (sympathetic) cardiac nerves
Thoracic cardiac branch of vagus nerve (CN X)
4th thoracic ganglion
Thoracic (sympathetic) cardiac branches
Cardiac plexus (deep)
Phrenic nerve (cut)
Superior cervical ganglion
Left vagus nerve (CN X)
Superior cervical (sympathetic) cardiac nerve
Superior cervical cardiac branch (CN X)
Middle cervical ganglion
Phrenic nerve
Middle cervical (sympathetic) cardiac nerve
Inferior cervical cardiac branch (CN X)
Vertebral ganglion
Cervicothoracic (stellate) ganglion
Inferior cervical (sympathetic) cardiac nerves
3rd thoracic ganglion
Thoracic (sympathetic) cardiac branches
Thoracic cardiac branches of vagus nerve (CN X)
Left recurrent laryngeal nerve

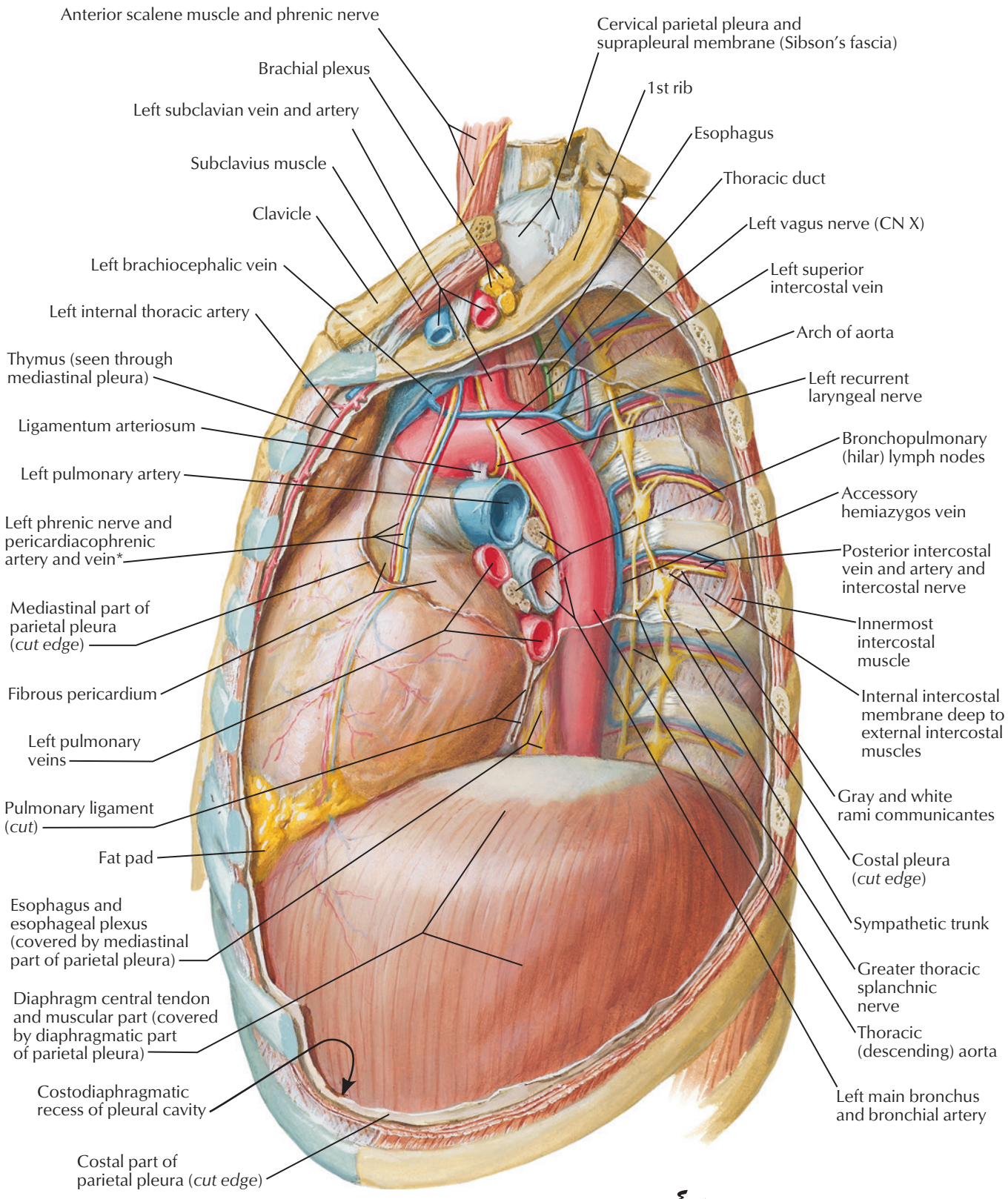

Posterior nucleus of vagus nerve (CN X)
Nuclei of solitary tract
Superior cervical ganglion
Medulla oblongata
Superior cervical (sympathetic) cardiac nerve
Middle cervical ganglion
Vagus nerves (CN X)
Middle cervical (sympathetic) cardiac nerve
Superior cervical (vagal) cardiac branches
Inferior cervical (vagal) cardiac branches
Vertebral ganglion (variation)
Ascending connections
Ansa subclavia
Cervicothoracic (stellate) ganglion
T1
1st intercostal nerve
T2
Inferior cervical cardiac nerve
T3
Thoracic cardiac branch of vagus nerve (CN X)
T4
2nd thoracic ganglion
White ramus communicans
Gray ramus communicans
Thoracic (sympathetic) cardiac branches
4th thoracic sympathetic ganglion
Cardiac plexus
Preganglionic sympathetic fibers
Postganglionic sympathetic fibers
Preganglionic parasympathetic fibers
Postganglionic parasympathetic fibers
Visceral afferent accompanying sympathetic fibers
Visceral afferent accompanying parasympathetic fibers
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Cervical sympathetic trunk ganglion
Internal carotid nerve
Spinal nerve
White ramus communicans
Gray rami communicantes
Cervical cardiac nerves
Brachial plexus
Upper thoracic trunk ganglion
Thoracic cardiac branches
Spinal nerves
Intercostal nerves
Lower thoracic trunk ganglion
Spinal nerve
Thoracic splanchnic nerves
Upper lumbar trunk ganglion
Fibers direct to vessels
Spinal nerve
Gray ramus communicans
Lower lumbar trunk ganglion
Postganglionic sympathetic fibers to lumbar and sacral plexuses and to nerves of lower limb
Preganglionic sympathetic fibers
Postganglionic sympathetic fibers

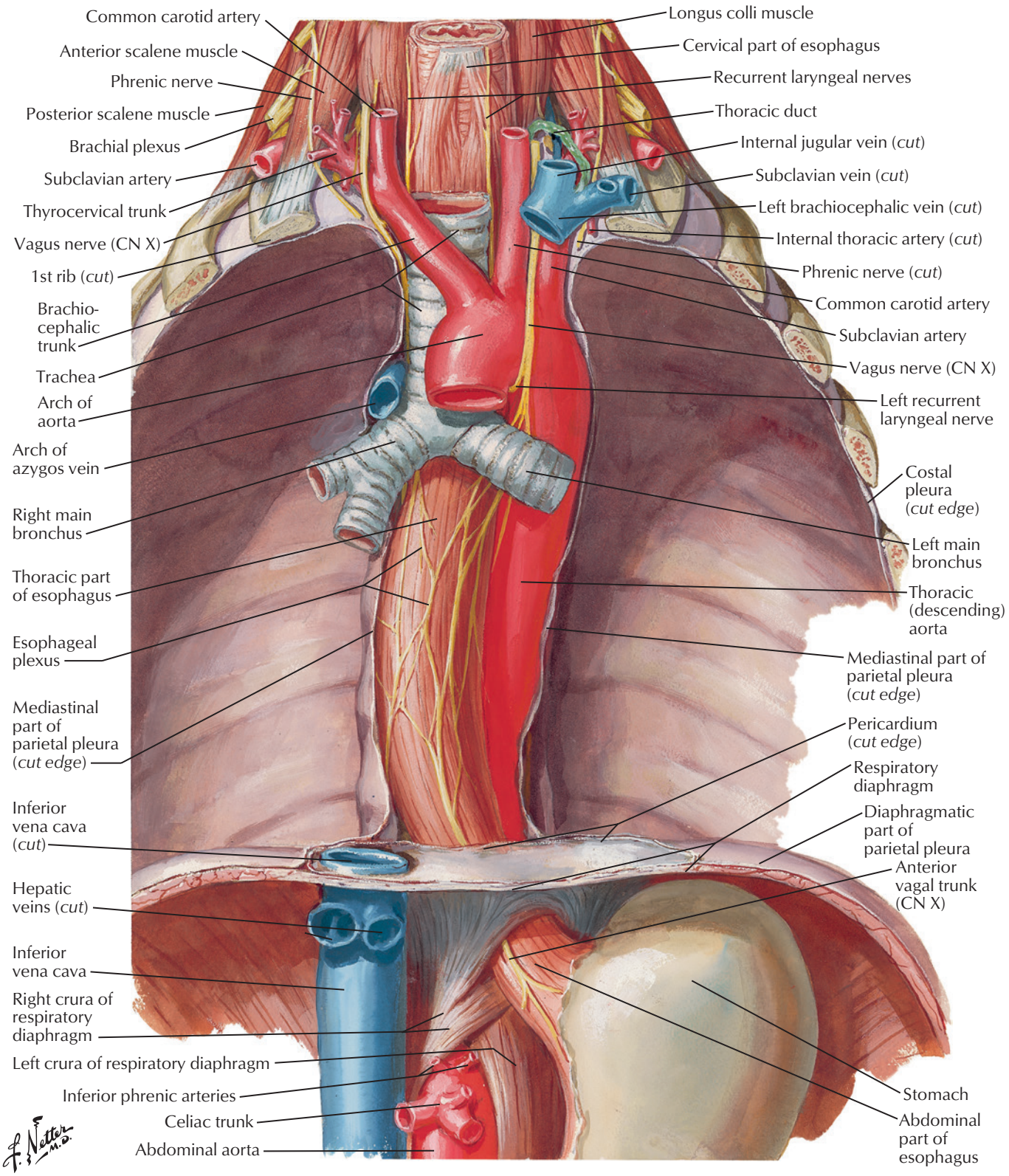

Prenatal circulation
Pulmonary trunk
Superior vena cava
Right pulmonary artery
Right pulmonary vein
Foramen ovale
Hepatic vein
Ductus venosus
Liver
Hepatic portal vein
Umbilical vein
Umbilical arteries
Aorta
Ductus arteriosus
Left pulmonary artery
Left pulmonary vein
Inferior vena cava
Aorta
Celiac trunk
Superior mesenteric artery
Kidney
Intestine
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Ligamentum arteriosum (obliterated ductus arteriosus)
Fossa ovalis (obliterated foramen ovale)
Ligamentum venosum (obliterated ductus venosus)
Ligamentum teres (round ligament) of liver (obliterated umbilical vein)
Medial umbilical ligaments (fibrous part of umbilical arteries)
Postnatal circulation

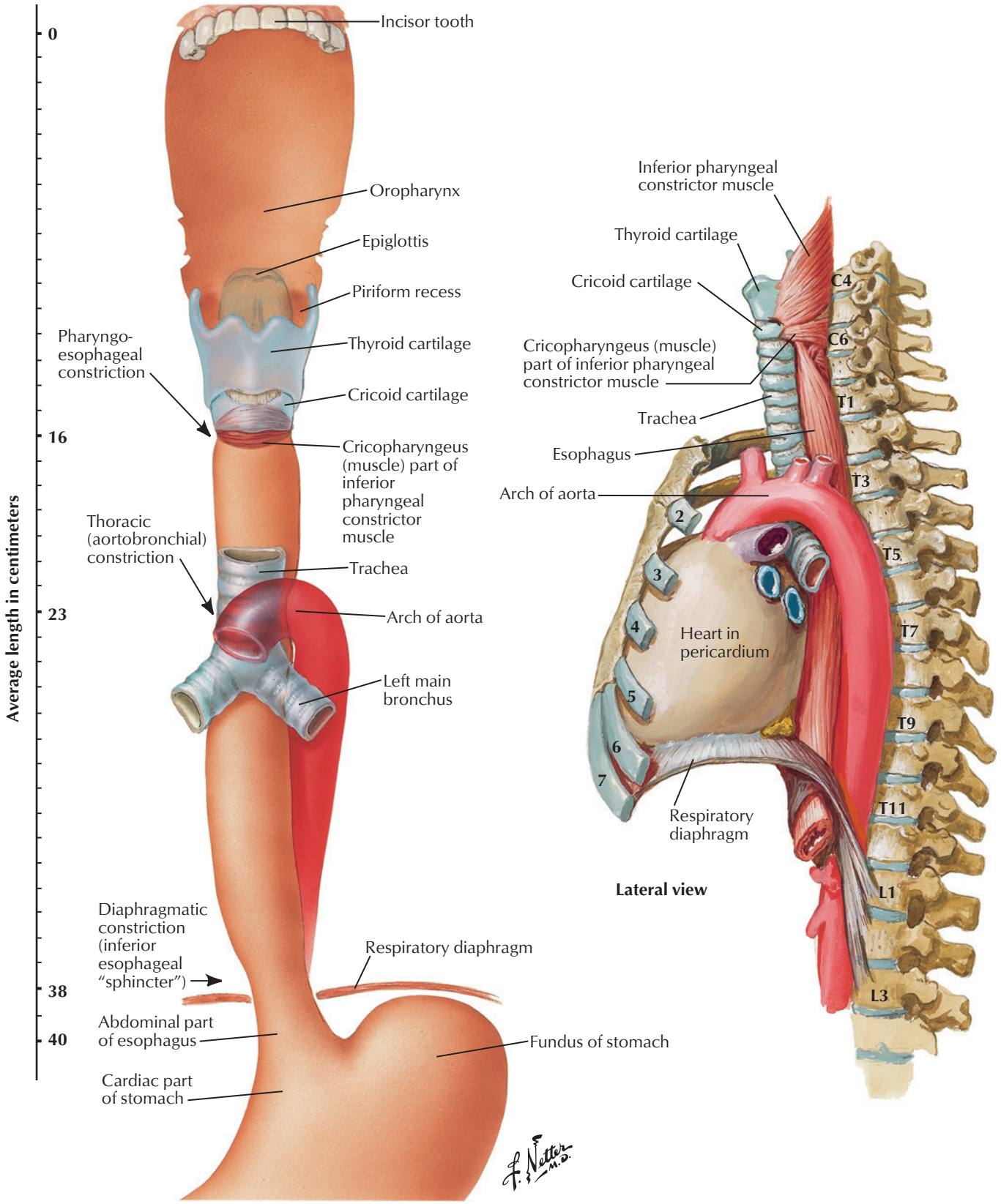


*Nerve and vessels commonly run independently.

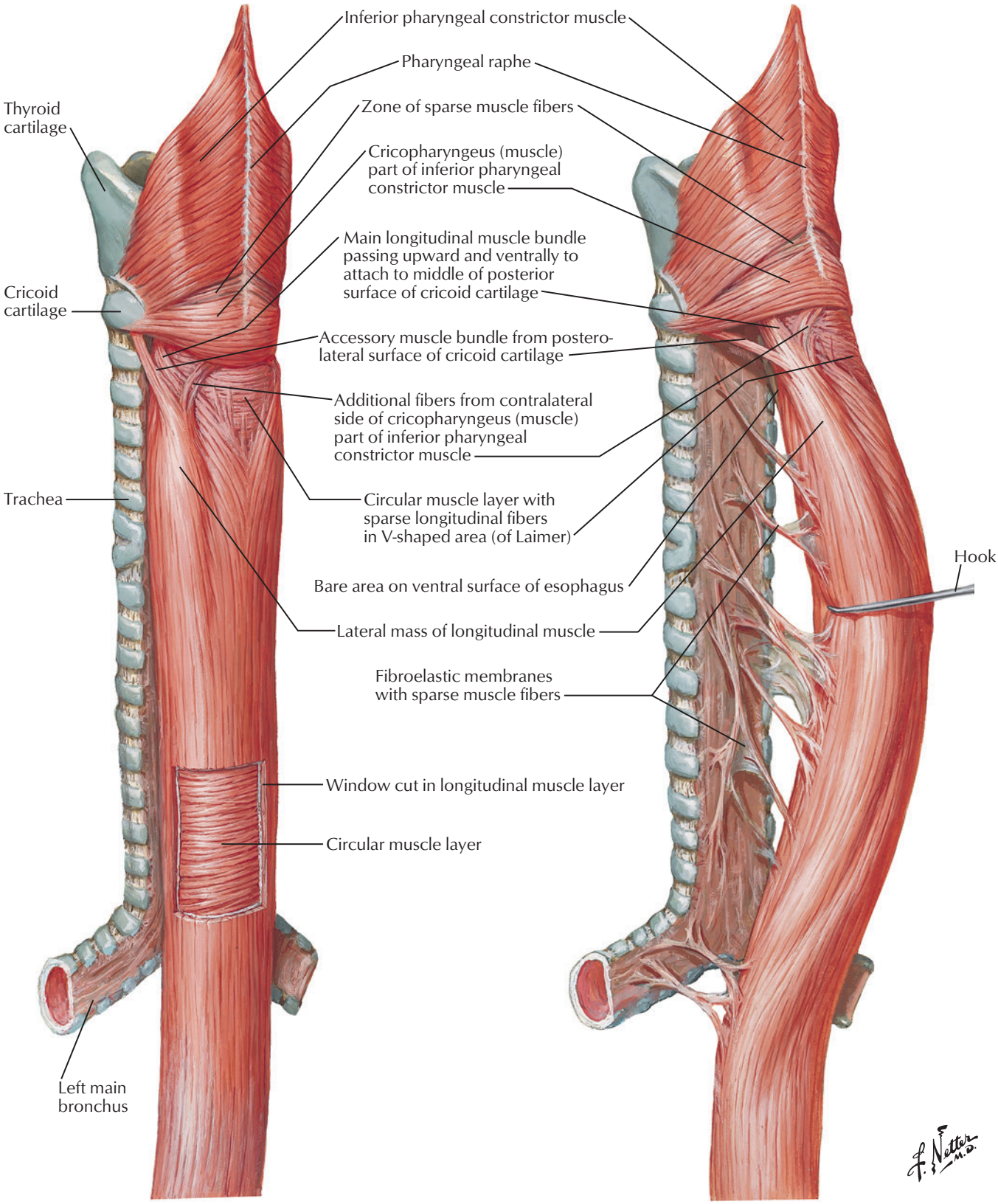


*Nerve and vessels commonly run independently.

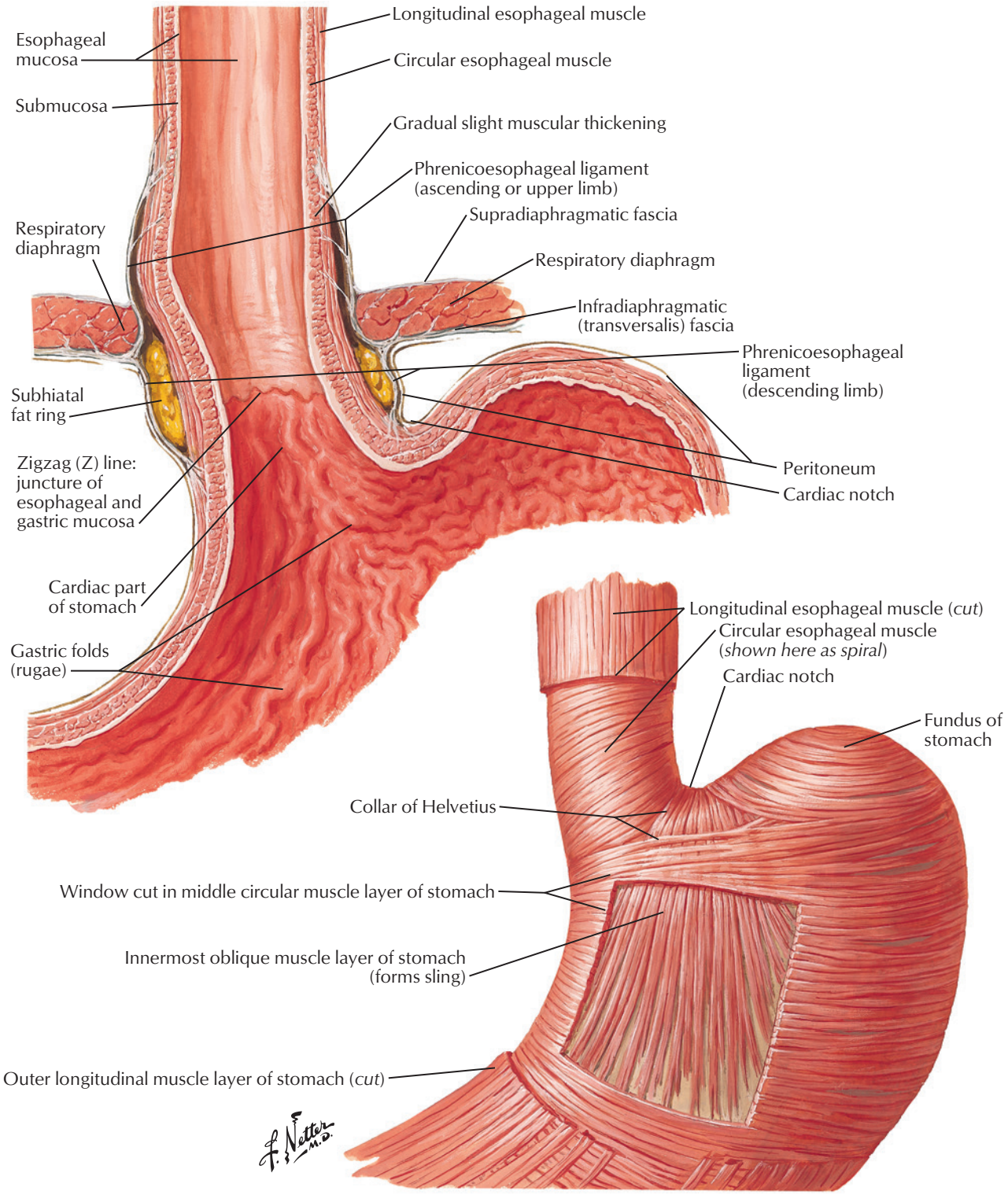

Common carotid artery
Anterior scalene muscle
Phrenic nerve
Posterior scalene muscle
Brachial plexus
Subclavian artery
Thyrocervical trunk
Vagus nerve (CN X)
1st rib (cut)
Brachio-cephalic trunk
Trachea
Arch of aorta
Arch of azygos vein
Right main bronchus
Thoracic part of esophagus
Esophageal plexus
Mediastinal part of parietal pleura (cut edge)
Inferior vena cava (cut)
Hepatic veins (cut)
Inferior vena cava
Right crura of respiratory diaphragm
Left crura of respiratory diaphragm
Inferior phrenic arteries
Celiac trunk
Abdominal aorta
Longus colli muscle
Cervical part of esophagus
Recurrent laryngeal nerves
Thoracic duct
Internal jugular vein (cut)
Subclavian vein (cut)
Left brachiocephalic vein (cut)
Internal thoracic artery (cut)
Phrenic nerve (cut)
Common carotid artery
Subclavian artery
Vagus nerve (CN X)
Left recurrent laryngeal nerve
Costal pleura (cut edge)
Left main bronchus
Thoracic (descending) aorta
Mediastinal part of parietal pleura (cut edge)
Pericardium (cut edge)
Respiratory diaphragm
Diaphragmatic part of parietal pleura
Anterior vagal trunk (CN X)
Stomach
Abdominal part of esophagus


Average length in centimeters
0
16
23
38
40
Incisor tooth
Oropharynx
Epiglottis
Piriform recess
Thyroid cartilage
Cricoid cartilage
Pharyngo-esophageal constriction
Cricopharyngeus (muscle) part of inferior pharyngeal constrictor muscle
Thoracic (aortobronchial) constriction
Trachea
Arch of aorta
Left main bronchus
Diaphragmatic constriction (inferior esophageal "sphincter")
Respiratory diaphragm
Abdominal part of esophagus
Fundus of stomach
Cardiac part of stomach
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Inferior pharyngeal constrictor muscle
Thyroid cartilage
Cricoid cartilage
Cricopharyngeus (muscle) part of inferior pharyngeal constrictor muscle
Trachea
Esophagus
Arch of aorta
2
3
4
5
6
7
Heart in pericardium
Respiratory diaphragm
C4
C6
T1
T3
T5
T7
T9
T11
L1
L3
Lateral view

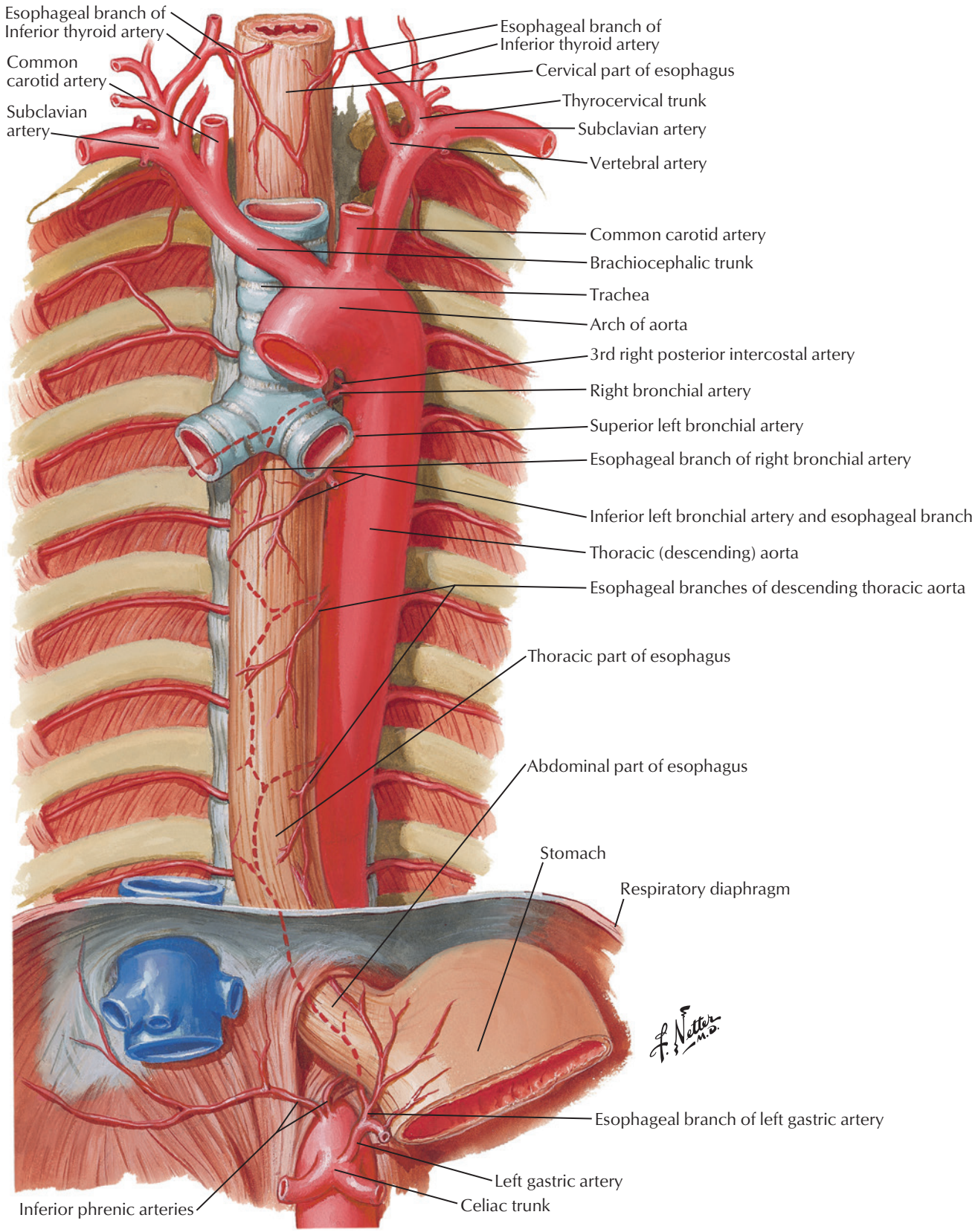
See also Plates 75, 81



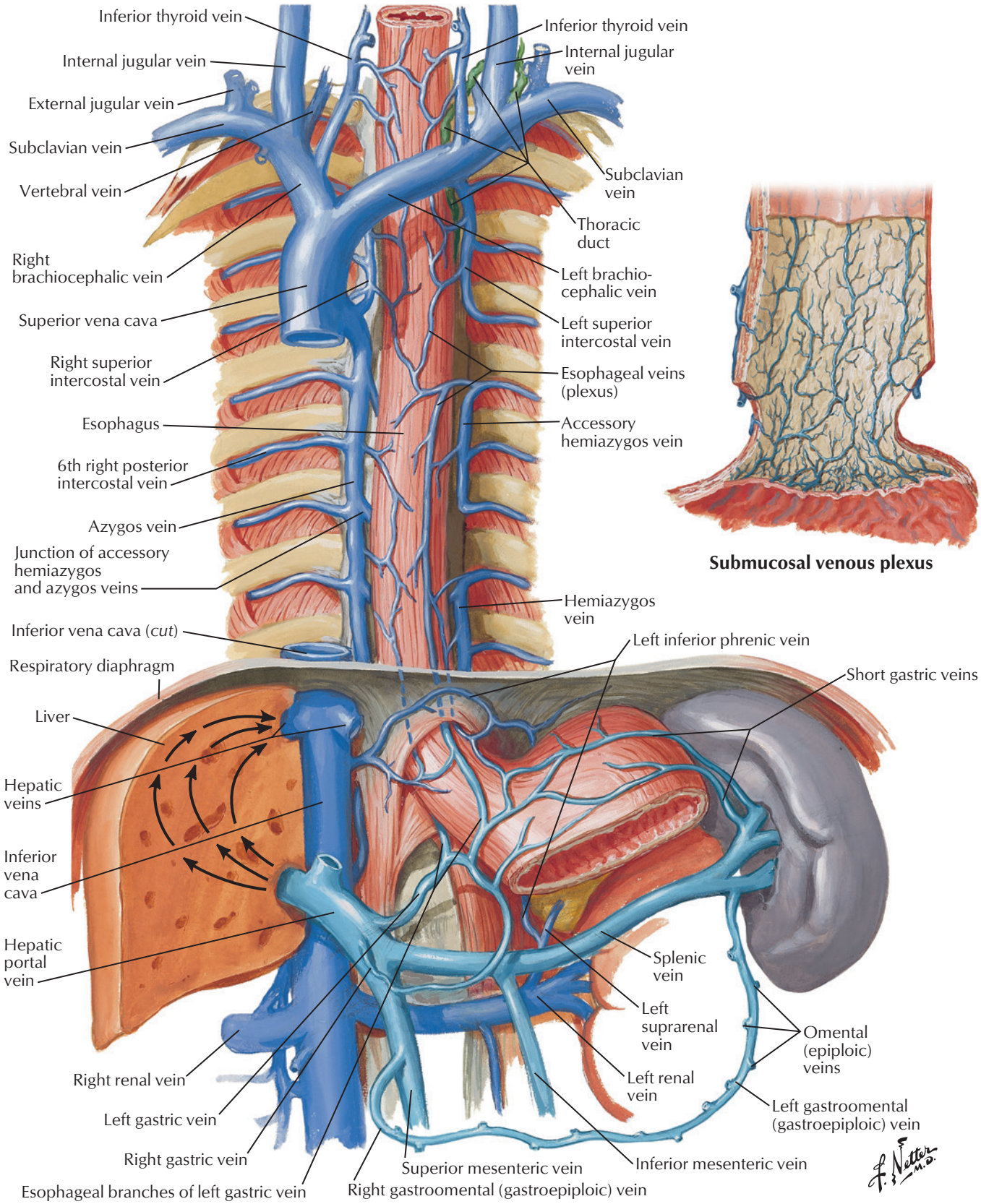
Posterolateral view


Esophageal mucosa
Submucosa
Respiratory diaphragm
Subhiatal fat ring
Zigzag (Z) line: juncture of esophageal and gastric mucosa
Cardiac part of stomach
Gastric folds (rugae)
Longitudinal esophageal muscle
Circular esophageal muscle
Gradual slight muscular thickening
Phrenicoesophageal ligament (ascending or upper limb)
Supradiaphragmatic fascia
Respiratory diaphragm
Infradiaphragmatic (transversalis) fascia
Phrenicoesophageal ligament (descending limb)
Peritoneum
Cardiac notch
Longitudinal esophageal muscle (cut)
Circular esophageal muscle (shown here as spiral)
Cardiac notch
Fundus of stomach
Collar of Helvetius
Window cut in middle circular muscle layer of stomach
Innermost oblique muscle layer of stomach (forms sling)
Outer longitudinal muscle layer of stomach (cut)
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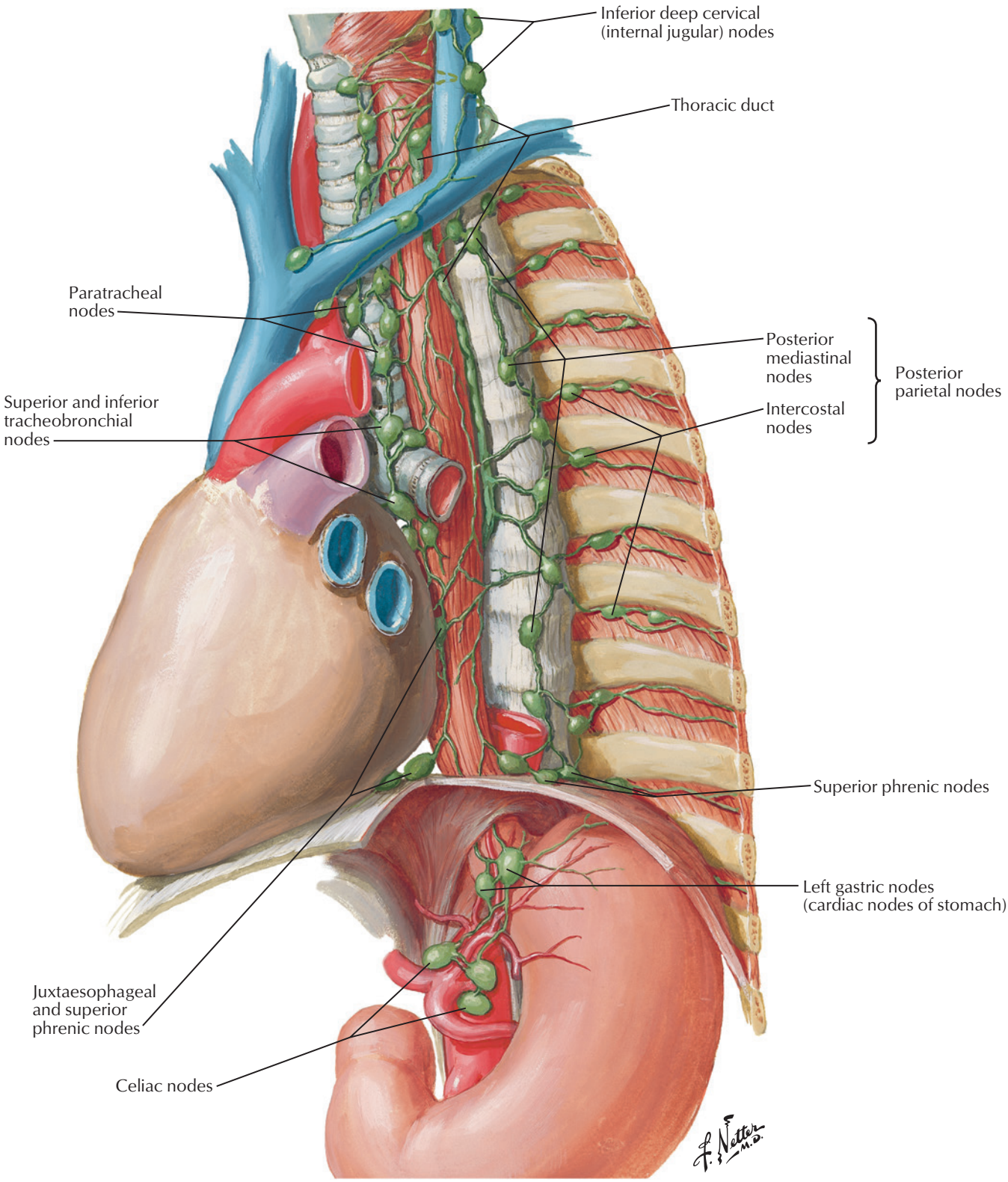
See also Plates 211, 291



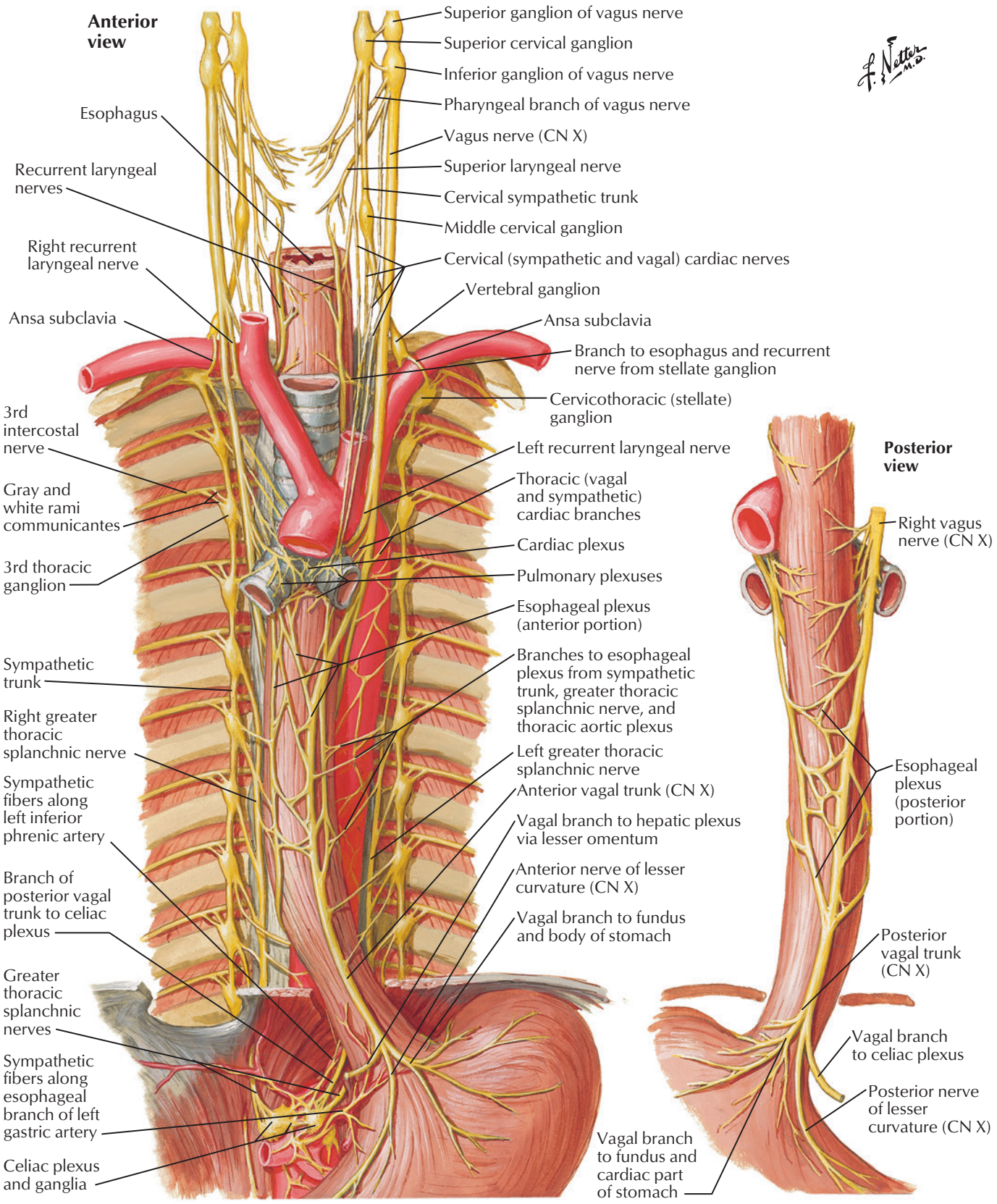
See also Plate 198



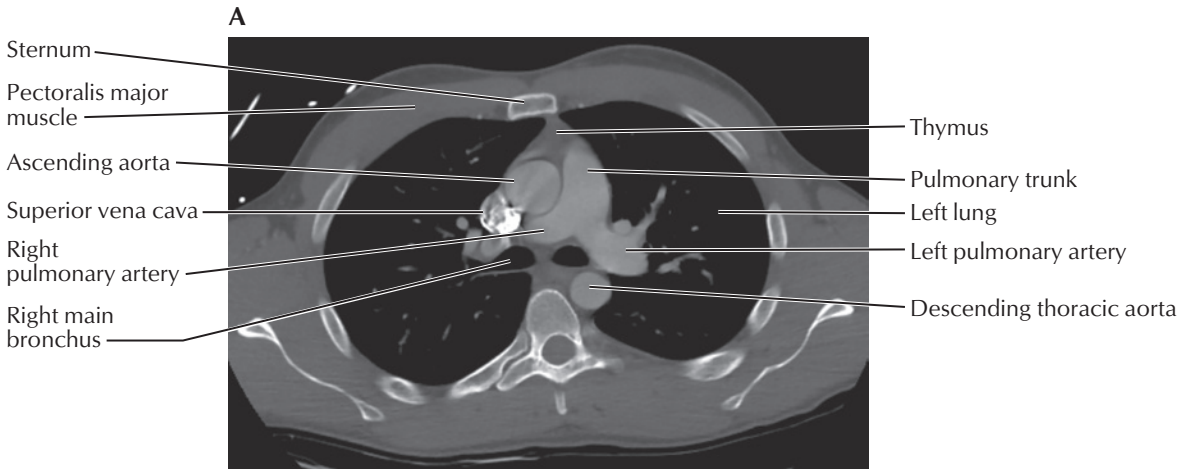
See also Plate 212

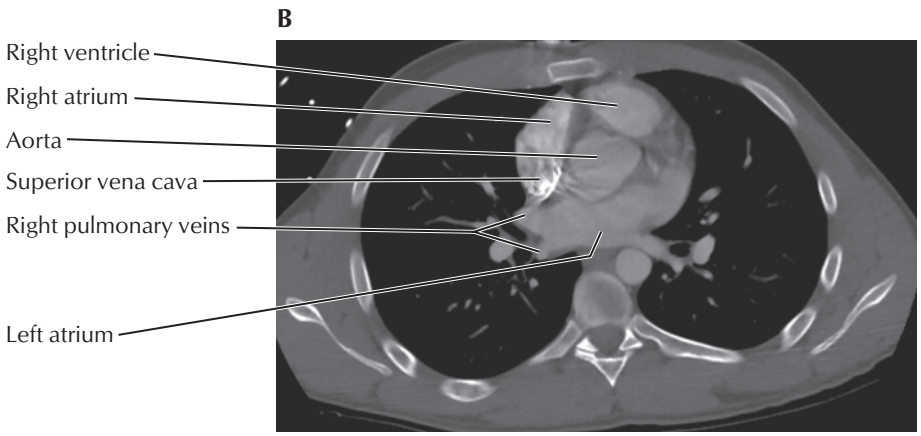


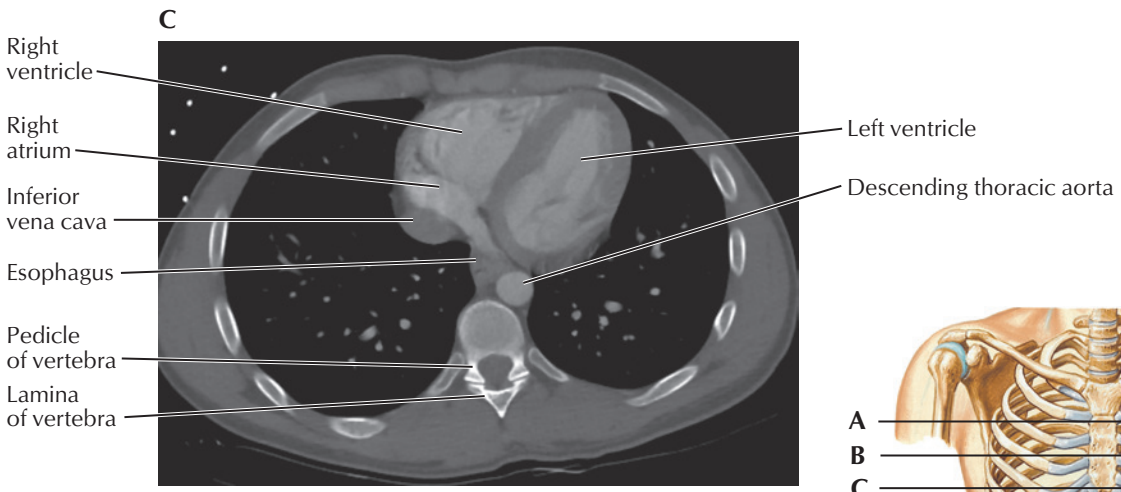
See also Plates 301, 302

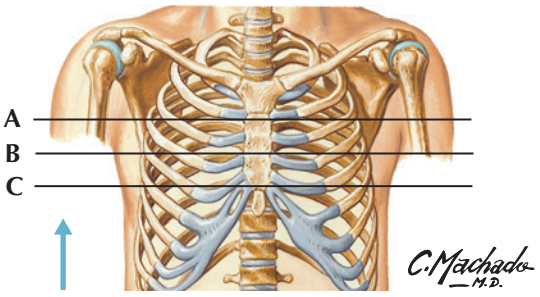


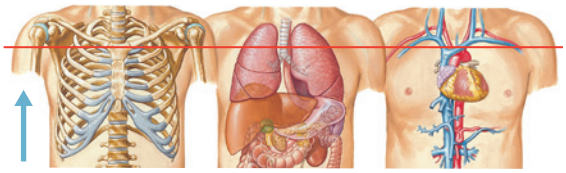
Axial CT images of the thorax from superior (A) to inferior (C)





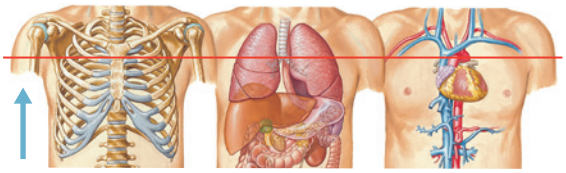


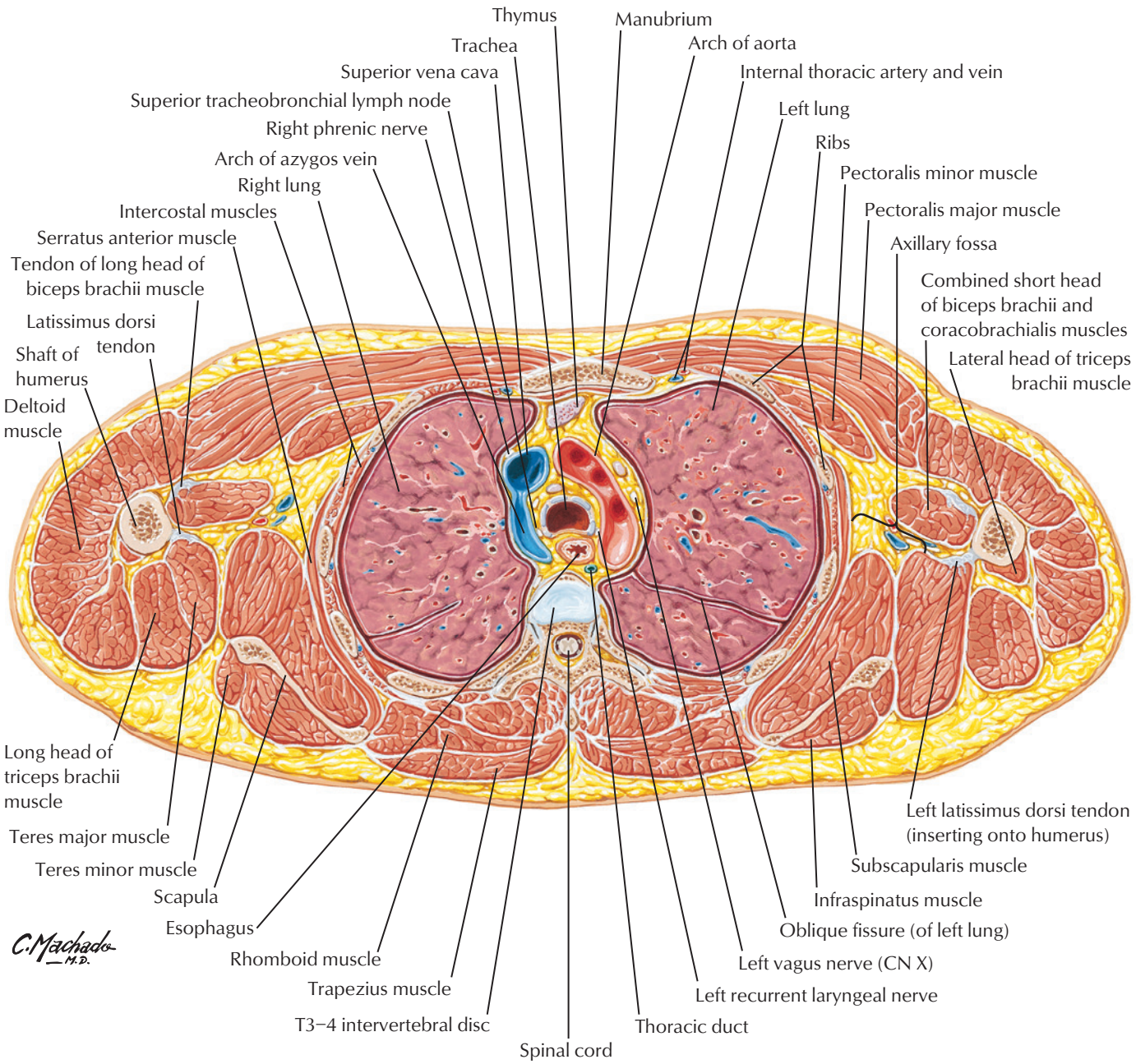


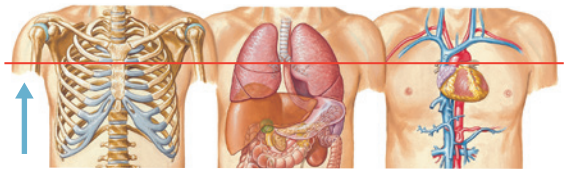


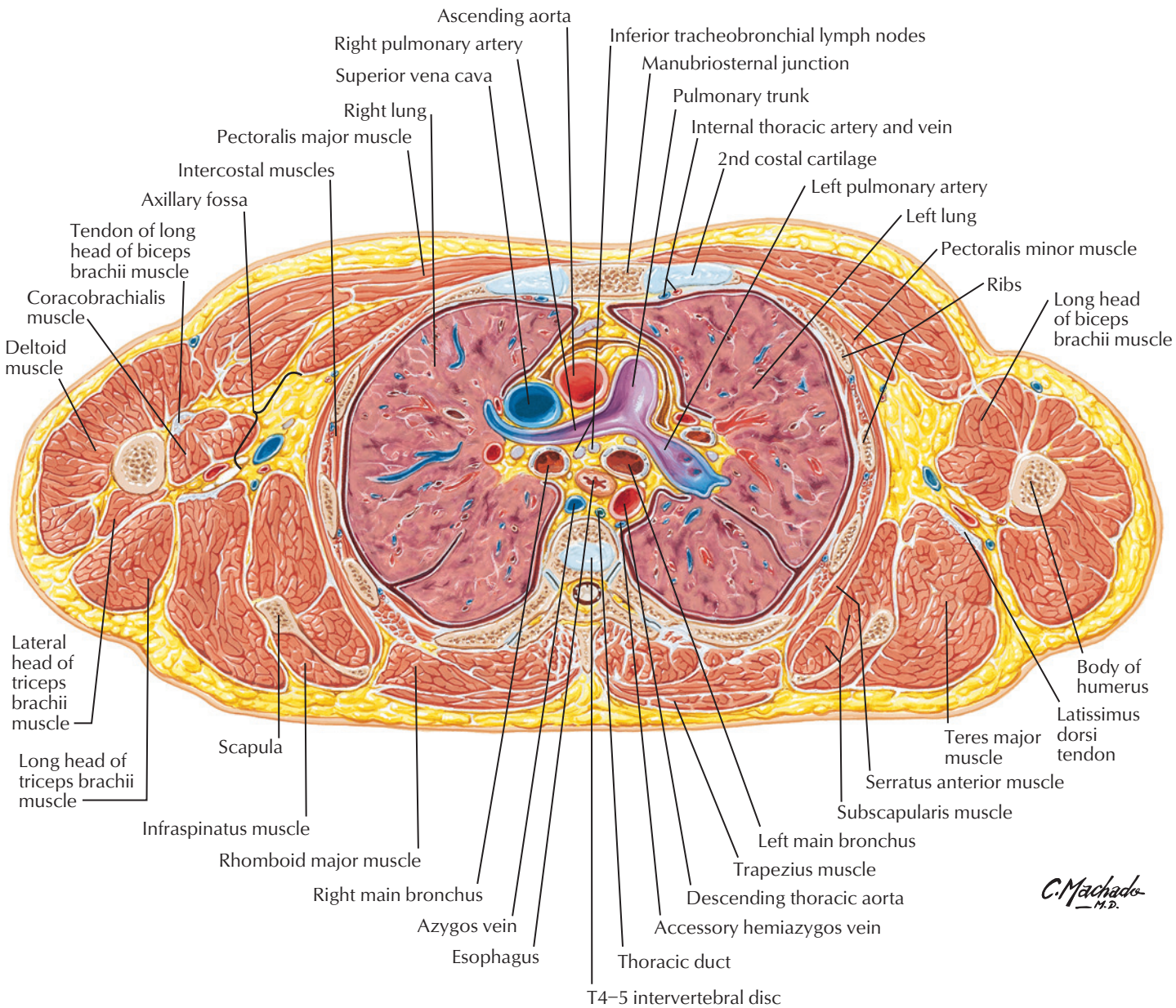
Sternoclavicular joint (articular disc)
Clavicle
Mediastinal lymph node
Right brachiocephalic vein
Manubrium
Brachiocephalic trunk
Costal cartilage of 1st rib
Trachea
Right lung
Left brachiocephalic vein
Pectoralis major muscle
Left common carotid artery
Axillary fossa
Left vagus nerve (CN X)
Tendon of long head of biceps brachii muscle
Pectoralis minor muscle
Surgical neck of right humerus
Shaft of left humerus
Deltoid muscle
Subscapularis muscle
Intercostal muscles
Rhomboid major muscle
Costotransverse joint
Trapezius muscle
Phrenic nerve
Right vagus nerve (CN X)
Body of T3 vertebra
Spinal cord
Esophagus
Transversospinal muscle
Thoracic duct
Left recurrent laryngeal nerve
Erector spinae muscle
Left subclavian artery
Left lung
Serratus anterior muscle
Infraspinatus muscle
Scapula
Teres minor muscle
Long head of triceps brachii muscle

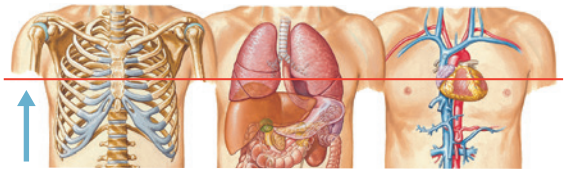
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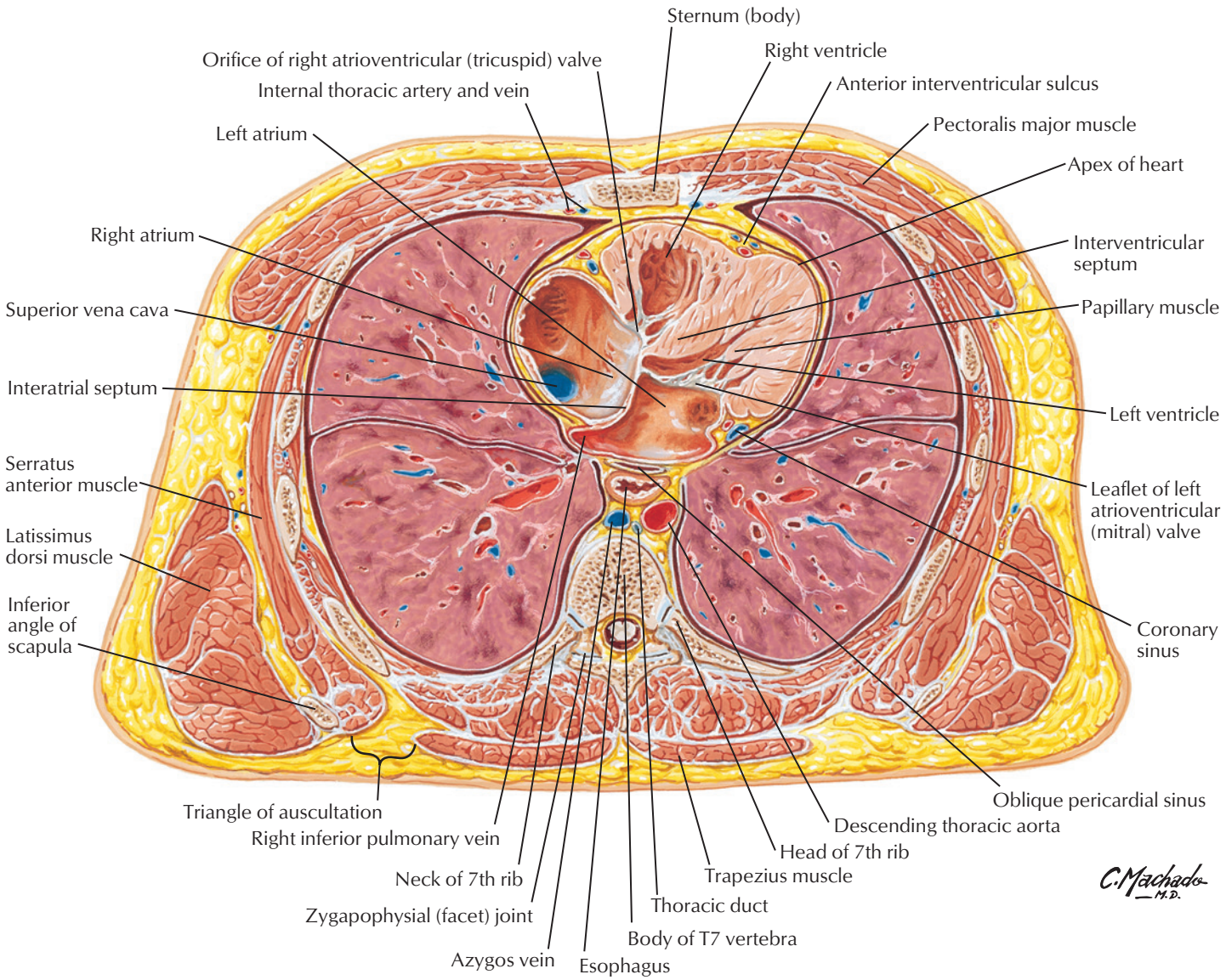



Thymus
Manubrium
Trachea
Arch of aorta
Superior vena cava
Internal thoracic artery and vein
Superior tracheobronchial lymph node
Left lung
Right phrenic nerve
Ribs
Arch of azygos vein
Pectoralis minor muscle
Right lung
Pectoralis major muscle
Intercostal muscles
Axillary fossa
Serratus anterior muscle
Combined short head of biceps brachii and coracobrachialis muscles
Tendon of long head of biceps brachii muscle
Lateral head of triceps brachii muscle
Latissimus dorsi tendon
Shaft of humerus
Deltoid muscle
Long head of triceps brachii muscle
Left latissimus dorsi tendon (inserting onto humerus)
Teres major muscle
Subscapularis muscle
Teres minor muscle
Infraspinatus muscle
Scapula
Oblique fissure (of left lung)
Esophagus
Left vagus nerve (CN X)
Rhomboid muscle
Left recurrent laryngeal nerve
Trapezius muscle
Thoracic duct
T3–4 intervertebral disc
Spinal cord




Ascending aorta
Right pulmonary artery
Superior vena cava
Right lung
Pectoralis major muscle
Intercostal muscles
Axillary fossa
Tendon of long head of biceps brachii muscle
Coracobrachialis muscle
Deltoid muscle
Inferior tracheobronchial lymph nodes
Manubriosternal junction
Pulmonary trunk
Internal thoracic artery and vein
2nd costal cartilage
Left pulmonary artery
Left lung
Pectoralis minor muscle
Ribs
Long head of biceps brachii muscle
Body of humerus
Latissimus dorsi tendon
Teres major muscle
Serratus anterior muscle
Subscapularis muscle
Left main bronchus
Trapezius muscle
Descending thoracic aorta
Accessory hemiazygos vein
Thoracic duct
T4–5 intervertebral disc
Esophagus
Azygos vein
Right main bronchus
Rhomboid major muscle
Infraspinatus muscle
Scapula
Lateral head of triceps brachii muscle
Long head of triceps brachii muscle
C. Machado M.D.




Sternum (body)
Right ventricle
Orifice of right atrioventricular (tricuspid) valve
Internal thoracic artery and vein
Anterior interventricular sulcus
Left atrium
Pectoralis major muscle
Apex of heart
Right atrium
Interventricular septum
Superior vena cava
Papillary muscle
Interatrial septum
Left ventricle
Serratus anterior muscle
Leaflet of left atrioventricular (mitral) valve
Latissimus dorsi muscle
Inferior angle of scapula
Coronary sinus
Oblique pericardial sinus
Triangle of auscultation
Descending thoracic aorta
Right inferior pulmonary vein
Head of 7th rib
Neck of 7th rib
Trapezius muscle
Thoracic duct
Zygapophysial (facet) joint
Body of T7 vertebra
Azygos vein
Esophagus

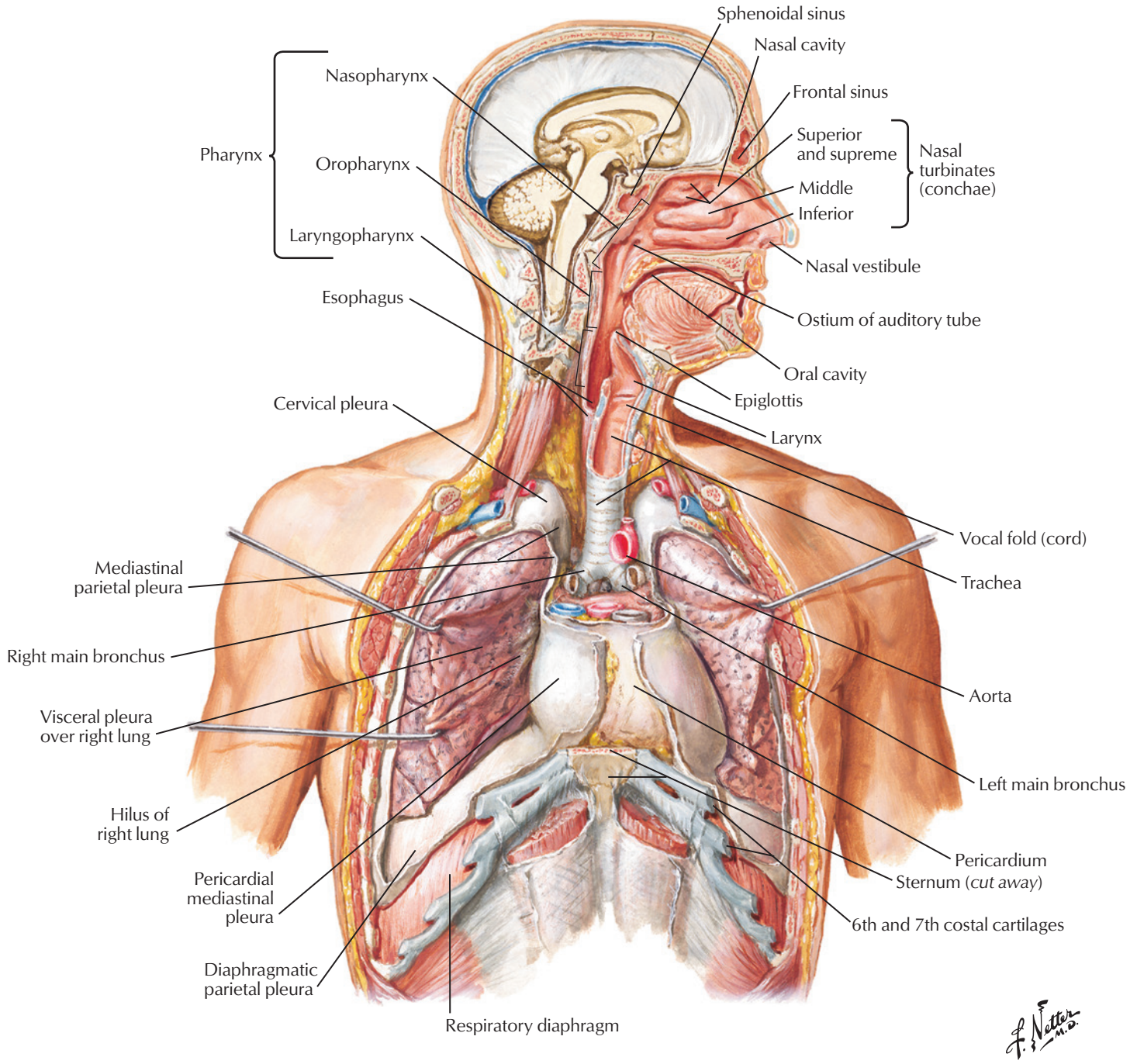
ANATOMICAL STRUCTURES	CLINICAL IMPORTANCE	PLATE NUMBERS
INTEGUMENTARY SYSTEM		
Mammary gland	Breast cancer is most common malignancy in women; movement of breast with pectoral muscles indicates invasion of retromammary space	188
SKELETAL SYSTEM		
Ribs	Rib fractures may breach pleural space and cause pneumothorax; flail chest occurs when multiple rib fractures lead to thoracic cage instability	192
Sternal angle (of Louis)	Surface landmark for counting ribs (2nd pair of ribs articulate here) and intercostal spaces; divides superior from inferior mediastinum	192
Chest wall (ribs and intercostal spaces)	Knowledge of relationships between chest wall and underlying organs is necessary for thoracotomy	194, 202, 204
Left ribs (ribs 9, 10, 11)	If fractured, may cause injury to underlying spleen	202
Superior thoracic aperture	Compression of neurovascular structures traversing superior thoracic aperture may produce thoracic outlet syndrome	198
MUSCULAR SYSTEM		
Intercostal spaces	Important relationship of intercostal neurovascular bundle to ribs when placing chest drainage tube to relieve pneumothorax or hemothorax	195, 221
Respiratory diaphragm	Widening of esophageal hiatus or congenital defect allows for protrusion of stomach into thorax (hiatal hernia)	201, 239
RESPIRATORY SYSTEM		
Lines of pleural reflection	Knowledge of location of lung and pleura with respect to chest wall is necessary for chest tube thoracostomy	202, 203
Pleura of lungs	Air or gas (spontaneous or traumatic) can leak into pleural space between visceral and parietal pleura and compress lung	202, 204
Cervical pleura	Extends into neck superior to 1st rib; it may therefore be punctured during neck procedures, producing pneumothorax	202
Tracheal bifurcation	Right main bronchus is shorter, more vertical, and wider; aspirated objects are therefore often in right lung	208
Apex of lung	Pancoast syndrome (bronchiogenic carcinoma) of apex invades sympathetic trunk, resulting in Horner's syndrome (ipsilateral miosis, ptosis, anhidrosis, facial flushing)	202, 234
NERVOUS SYSTEM		
Long thoracic nerve	May be damaged during chest tube placement or mastectomy, resulting in winged scapula (denervation of serratus anterior muscle)	189, 194
Intercostal nerve	Site of local anesthetic nerve block for procedures such as thoracostomy or to alleviate pain caused by shingles	196, 197
Posterior root (spinal) ganglion	Can house dormant varicella zoster virus, which, when activated, can result in herpes zoster (shingles)	197
Phrenic nerve and respiratory diaphragm	Ipsilateral injury to phrenic nerve may cause ipsilateral paralysis of hemidiaphragm Diaphragmatic irritation may manifest as shoulder pain because of referral to C3-5 spinal levels	199, 201 199, 216
Recurrent laryngeal branch of vagus nerve (CN X)	Pathologic findings in aorticopulmonary window may compress this nerve and produce hoarseness of voice	235, 236

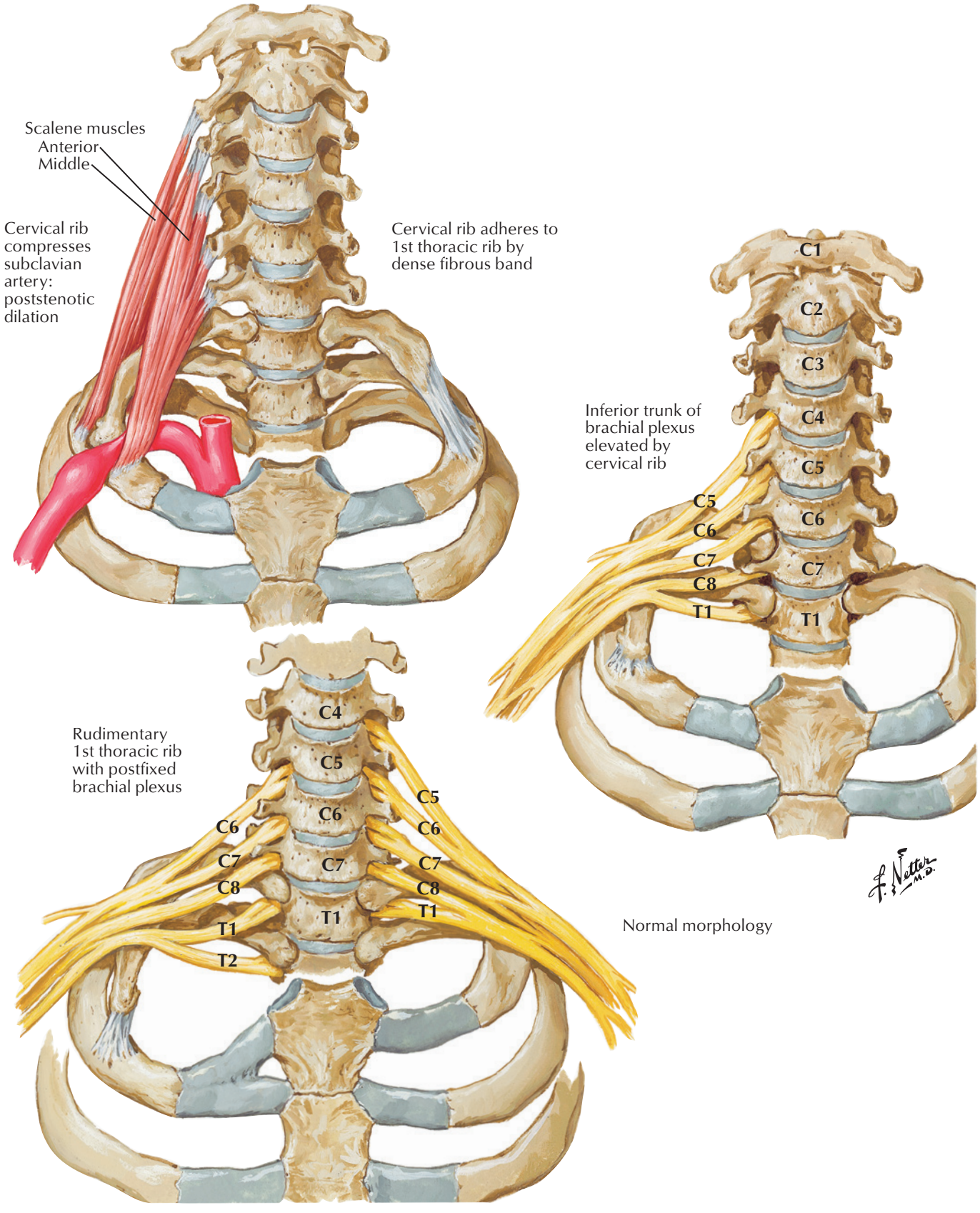
ANATOMICAL STRUCTURES	CLINICAL IMPORTANCE	PLATE NUMBERS
NERVOUS SYSTEM—Continued		
Visceral pain afferents from heart	Pain of myocardial ischemia referred to upper thoracic dermatomes; may be perceived as somatic pain in chest and medial upper limb	231
CARDIOVASCULAR SYSTEM		
Internal thoracic artery	Commonly used for coronary artery bypass grafts	196, 197
Pulmonary arteries	Thromboemboli may obstruct pulmonary vasculature, leading to infarction	205, 210
Pericardium	Pericardial effusion (accumulation of fluid or blood) may compromise heart function (cardiac tamponade)	215, 219
Coronary arteries	Atherosclerotic blockage may cause myocardial ischemia and/or infarct; anterior interventricular (left anterior descending) artery most commonly diseased	222
Interventricular septum of heart	Ventricular septal defect is most common congenital cardiac defect; most often involves membranous part of septum	225, 228
Heart valves	Congenital variations of valve anatomy or valvular disease (e.g., rheumatic heart disease) can cause valvular stenosis	226
Sinuatrial node	Aging, previous heart surgery, and some medications can cause cardiac arrhythmias	229
Ligamentum arteriosum	Abnormal closure of ductus arteriosus can produce aortic coarctation; lack of closure produces patent ductus arteriosus; if not closed, may cause exertional dyspnea, pulmonary vascular disease, or heart failure	233
Thoracic aorta	Congenital coarctation of aorta can compromise systemic blood flow; collateral vascular connections can alleviate this condition	240
Azygos venous system	Drains posterior thorax and provides important collateral channel between inferior vena cava and superior vena cava	241
LYMPHATIC SYSTEM		
Mammary gland lymphatics	Metastatic spread of cancer cells to axilla and chest via lymphatics draining breast	191
Axillary lymph nodes	Primary nodes that receive lymphatic drainage from upper limb, thoracic wall, and breast; commonly enlarged in patients with breast cancer	190, 191

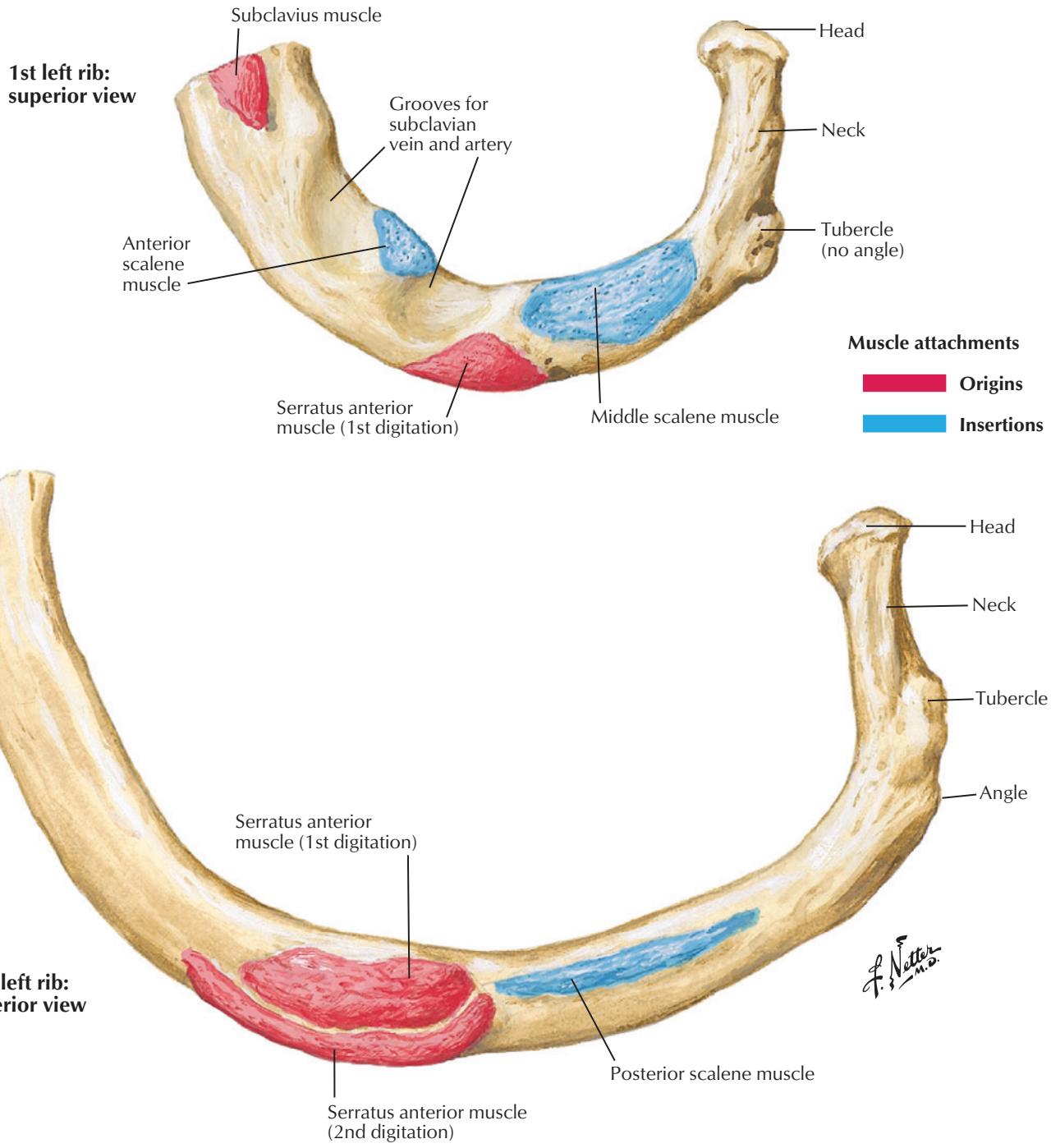
*Selections were based largely on clinical data as well as commonly covered clinical correlations in gross anatomy courses.

MUSCLE	MUSCLE GROUP	PROXIMAL ATTACHMENT (ORIGIN)	DISTAL ATTACHMENT (INSERTION)	INNERVATION	BLOOD SUPPLY	MAIN ACTIONS
Respiratory diaphragm	Posterior abdominal wall	Xiphoid process, lower six costal cartilages, L1–L3 vertebrae	Converge into central tendon	Phrenic nerve	Pericardiacophrenic, musculophrenic, superior and inferior phrenic arteries	Draws central tendon down and forward during inspiration
External intercostal	Thoracic wall	Lower border of ribs	Upper border of rib below rib of origin	Intercostal nerves	Posterior intercostal arteries, collateral branches of posterior intercostal arteries, costocervical trunk, anterior intercostal branches of internal thoracic artery, musculophrenic artery	Supports intercostal spaces in inspiration and expiration, elevates ribs in inspiration
Innermost intercostal	Thoracic wall	Lower border of ribs	Upper border of rib below rib of origin	Intercostal nerves	Muscular branches of anterior intercostal arteries, muscular branches of posterior intercostal arteries, intercostal branches of internal thoracic and musculophrenic arteries, costocervical trunk branches	Elevates ribs
Internal intercostal	Thoracic wall	Lower border of ribs	Costal cartilage and edge of costal groove of rib above rib of origin	Intercostal nerves	Muscular branches of anterior intercostal arteries, muscular branches of posterior intercostal arteries, intercostal branches of internal thoracic and musculophrenic arteries, costocervical trunk branches	Prevents pushing out or drawing in of intercostal spaces in inspiration and expiration, lowers ribs in forced expiration
Levator costarum	Thoracic wall	Transverse processes of C7 and T1–T11	Subjacent ribs between tubercle and angle	Posterior ramus of lower thoracic nerves	Posterior intercostal arteries	Elevates ribs
Pectoralis major	Pectoral/ axillary regions	Sternal half of clavicle, sternum to 7th rib, cartilages of true ribs, aponeurosis of external abdominal oblique muscle	Lateral lip of intertubercular sulcus of humerus	Medial and lateral pectoral nerves	Pectoral branch of thoracoacromial artery, perforating branches of internal thoracic artery	Flexes, adducts, and medially rotates arm
Pectoralis minor	Pectoral/ axillary regions	Outer surface of upper margin of ribs 3–5	Coracoid process of scapula	Medial pectoral nerve	Pectoral branch of thoracoacromial artery, and superior and lateral thoracic arteries	Lowers lateral angle of scapula and protracts scapula
Serratus anterior	Shoulder	Lateral surfaces of upper 8–9 ribs	Costal surface of medial border of scapula	Long thoracic nerve	Lateral thoracic artery	Protracts and rotates scapula and holds it against thoracic wall
Serratus posterior inferior	Intermediate back	Spinous processes of T11–L2	Inferior aspect of ribs 9–12	Anterior rami of lower thoracic nerves	Posterior intercostal arteries	Depresses ribs
Serratus posterior superior	Intermediate back	Nuchal ligament, spinous processes of C7–T3	Superior aspect of ribs 2–5	Anterior rami of upper thoracic nerves	Posterior intercostal arteries	Elevates ribs
Subcostal	Thoracic wall	Internal surface of lower ribs near their angles	Superior borders of 2nd or 3rd rib below	Intercostal nerves 2nd–5th	Posterior intercostal artery, musculophrenic artery	Depresses ribs
Transversus thoracis	Thoracic wall	Internal surfaces of costal cartilages 2–6	Posterior surface of lower sternum	Intercostal nerves	Anterior intercostal arteries, internal thoracic artery	Depresses ribs and costal cartilages

Variations in spinal nerve contributions to the innervation of muscles, their arterial supply, their attachments, and their actions are common themes in human anatomy. Therefore, expect differences between texts and realize that anatomical variation is normal.


Sphenoidal sinus
Nasal cavity
Nasopharynx
Frontal sinus
Pharynx
Oropharynx
Superior and supreme
Middle
Inferior
Nasal turbinates (conchae)
Laryngopharynx
Nasal vestibule
Esophagus
Ostium of auditory tube
Oral cavity
Epiglottis
Cervical pleura
Larynx
Vocal fold (cord)
Mediastinal parietal pleura
Trachea
Right main bronchus
Aorta
Visceral pleura over right lung
Left main bronchus
Hilus of right lung
Pericardium
Sternum (cut away)
Pericardial mediastinal pleura
6th and 7th costal cartilages
Diaphragmatic parietal pleura
Respiratory diaphragm


Scalene muscles
Anterior
Middle
Cervical rib compresses subclavian artery: poststenotic dilation
Cervical rib adheres to 1st thoracic rib by dense fibrous band
Inferior trunk of brachial plexus elevated by cervical rib
C1
C2
C3
C4
C5
C5
C6
C6
C7
C7
C8
T1
T1
Rudimentary 1st thoracic rib with postfixed brachial plexus
C4
C5
C5
C6
C6
C7
C7
C7
C8
C8
T1
T1
T1
T2
Normal morphology


1st left rib:
superior view
Subclavius muscle
Head
Grooves for
subclavian
vein and artery
Neck
Anterior
scalene
muscle
Tubercle
(no angle)
Muscle attachments
Origins
Insertions
Serratus anterior
muscle (1st digitation)
Middle scalene muscle
Head
Neck
Tubercle
Angle
Serratus anterior
muscle (1st digitation)
2nd left rib:
superior view
Posterior scalene muscle
Serratus anterior muscle
(2nd digitation)

Muscles of inspiration

Accessory

Sternocleidomastoid (elevates sternum)

Scalene muscles
- Anterior
- Middle
- Posterior

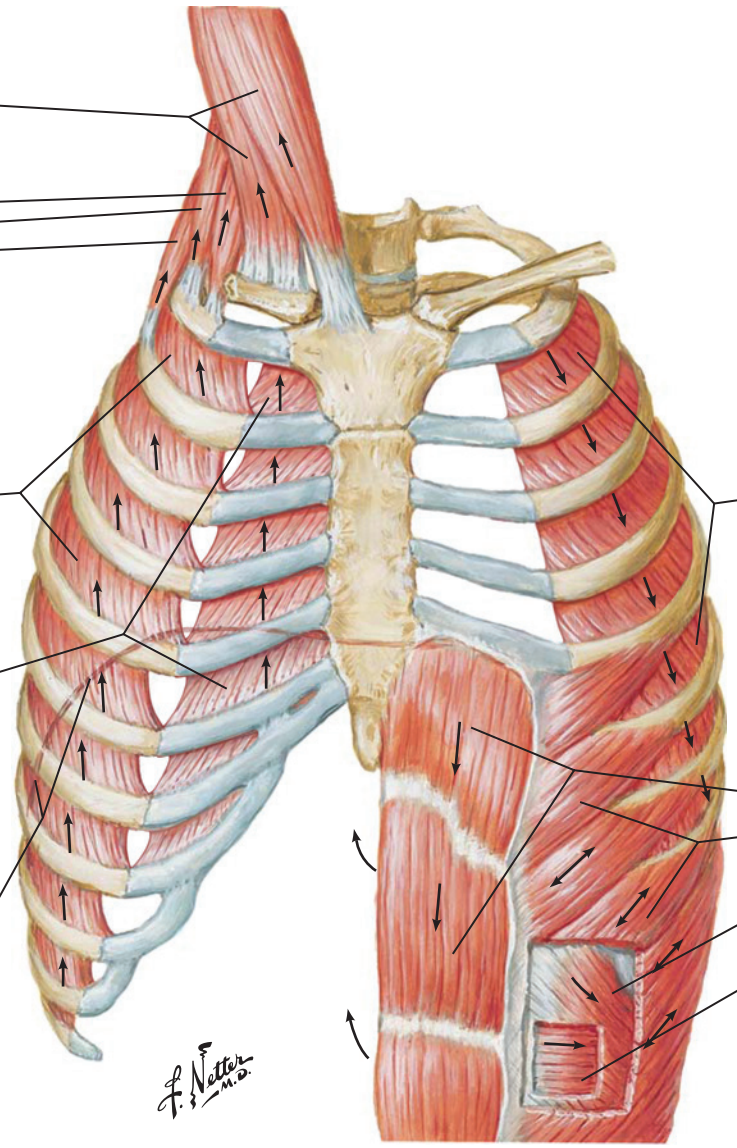
(elevate and fix upper ribs)

Principal

External intercostals, most superficial (elevate ribs, thus increasing width of thoracic cavity and aiding deep inspiration)

Interchondral parts of internal intercostals are deep to external intercostals (also elevate ribs and aid external intercostals with deep inspiration)

Respiratory diaphragm (domes descend, thus increasing vertical dimension of thoracic cavity; also elevates lower ribs)



Muscles of expiration

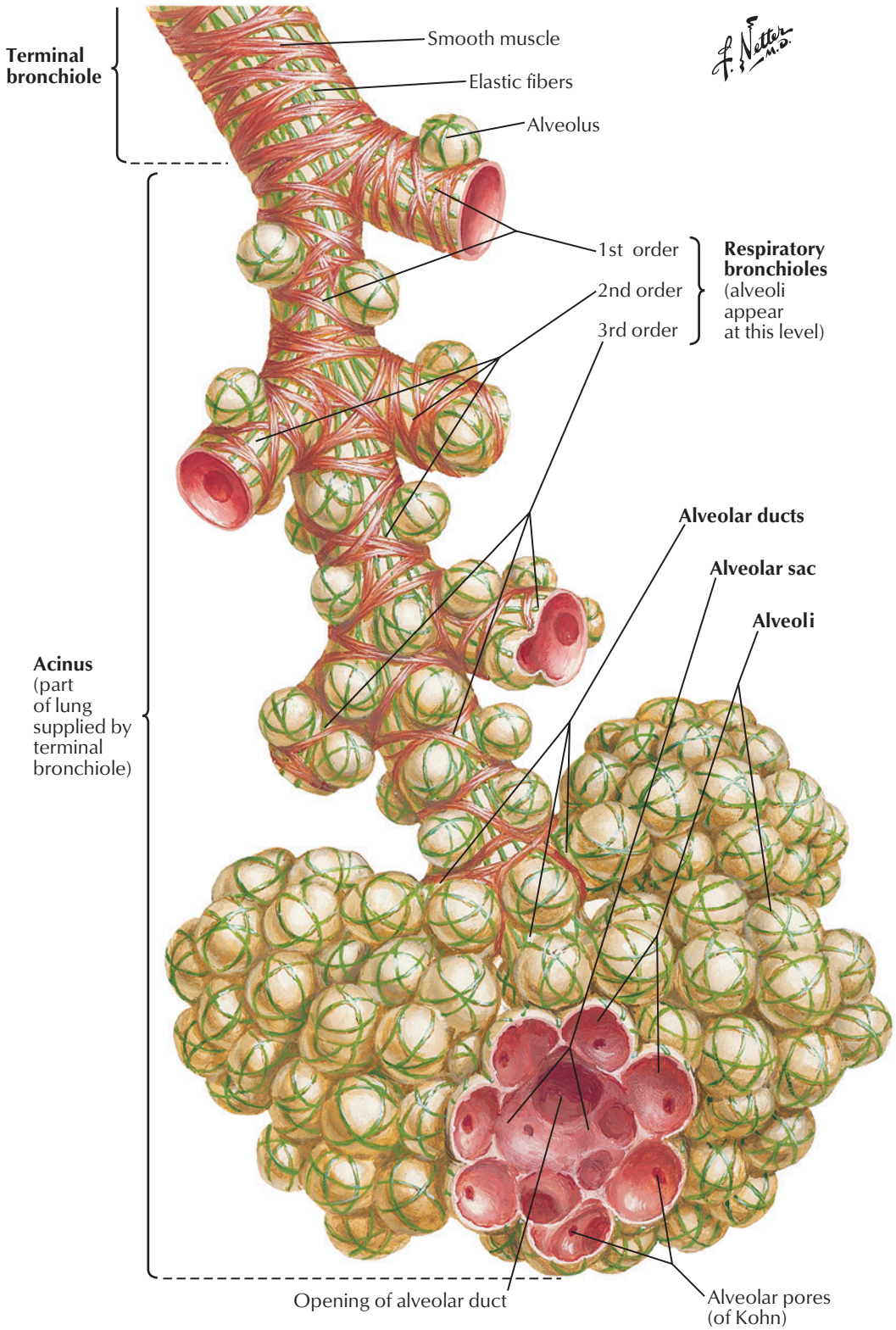
Quiet breathing

Expiration results from passive recoil of lungs and rib cage

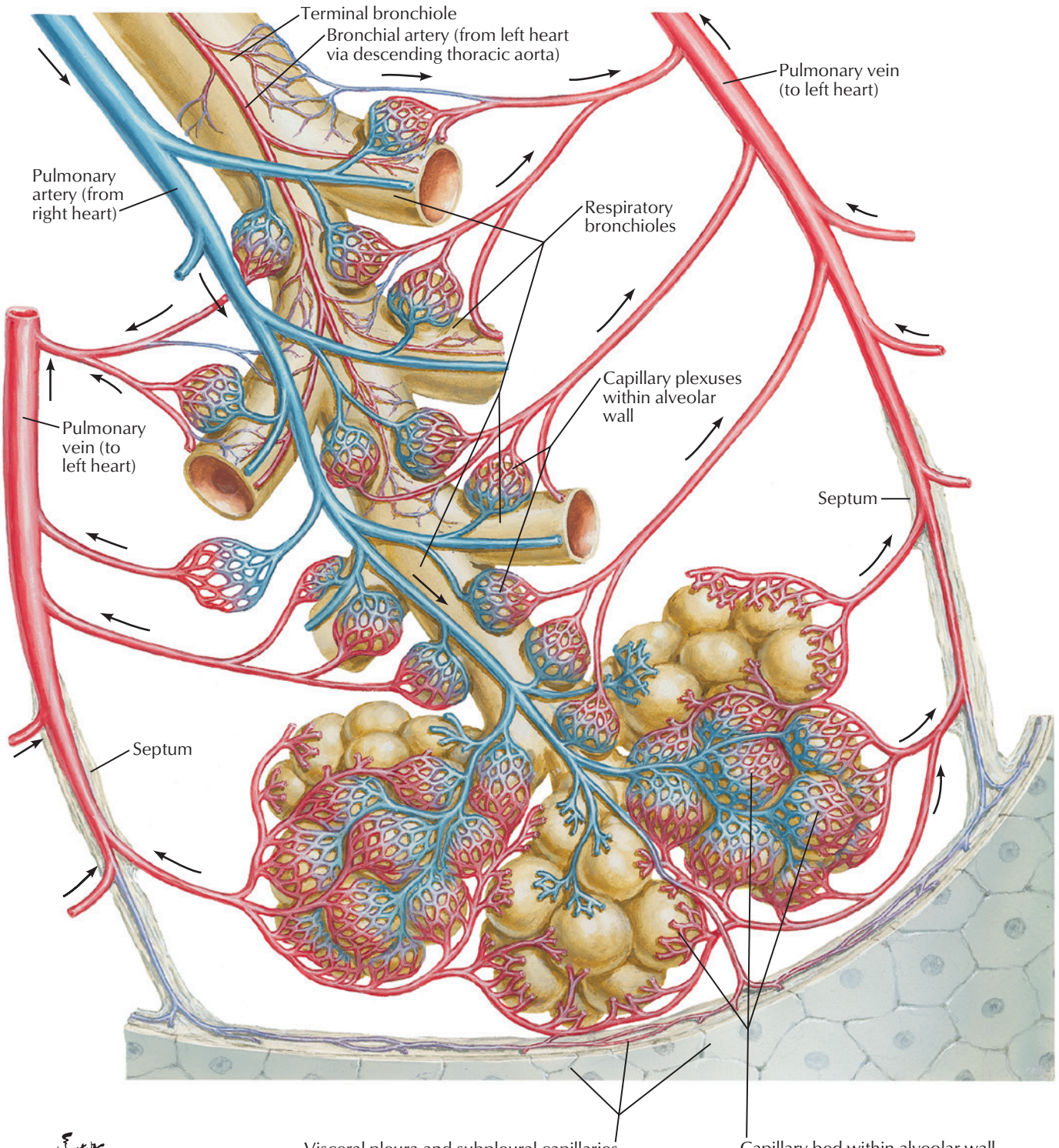
Active breathing

Internal intercostal muscles, except interchondral part (aid forced expiration)

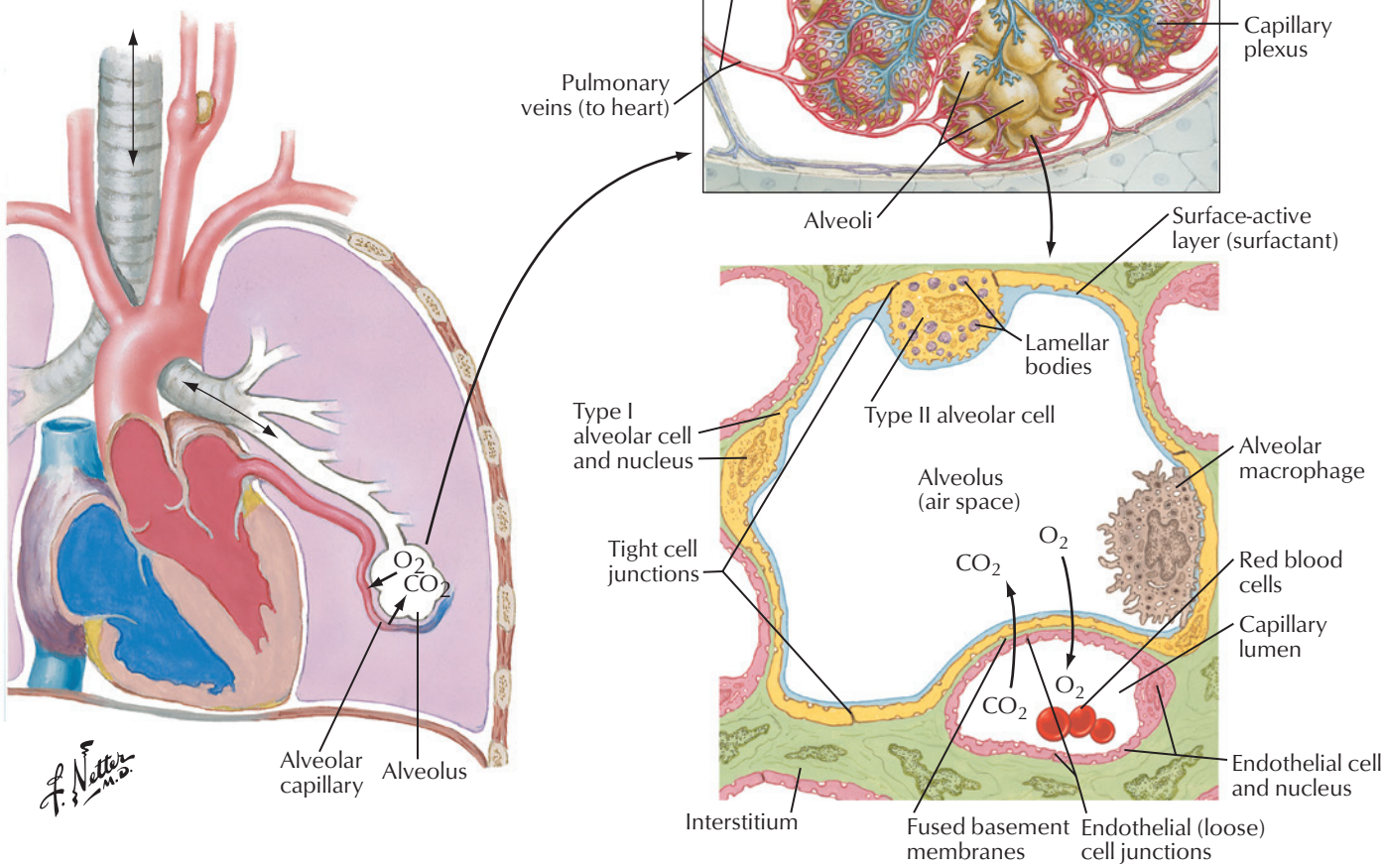
Abdominals (depress lower ribs, compress abdominal contents, thus pushing up respiratory diaphragm, aiding forced expiration)
- Rectus abdominis
- External abdominal oblique muscle
- Internal abdominal oblique muscle
- Transversus abdominis muscle

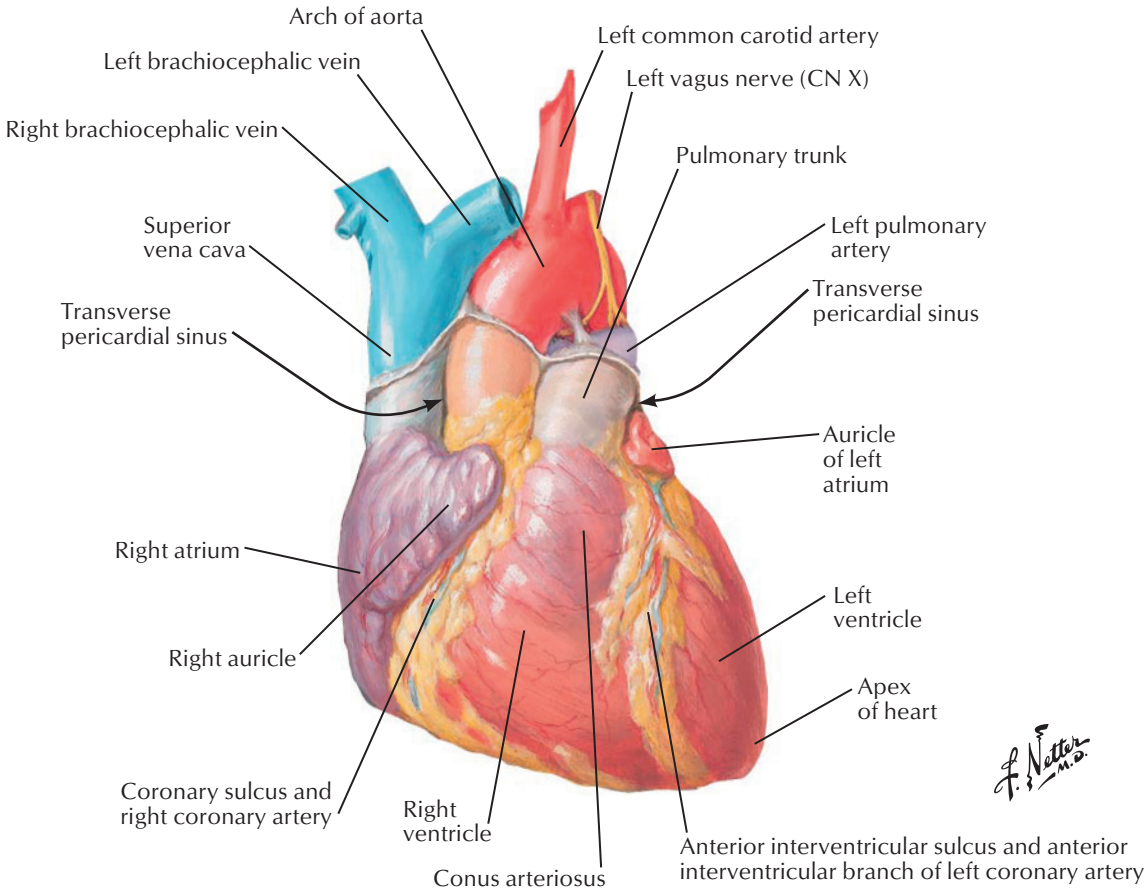


Structure of intrapulmonary airways

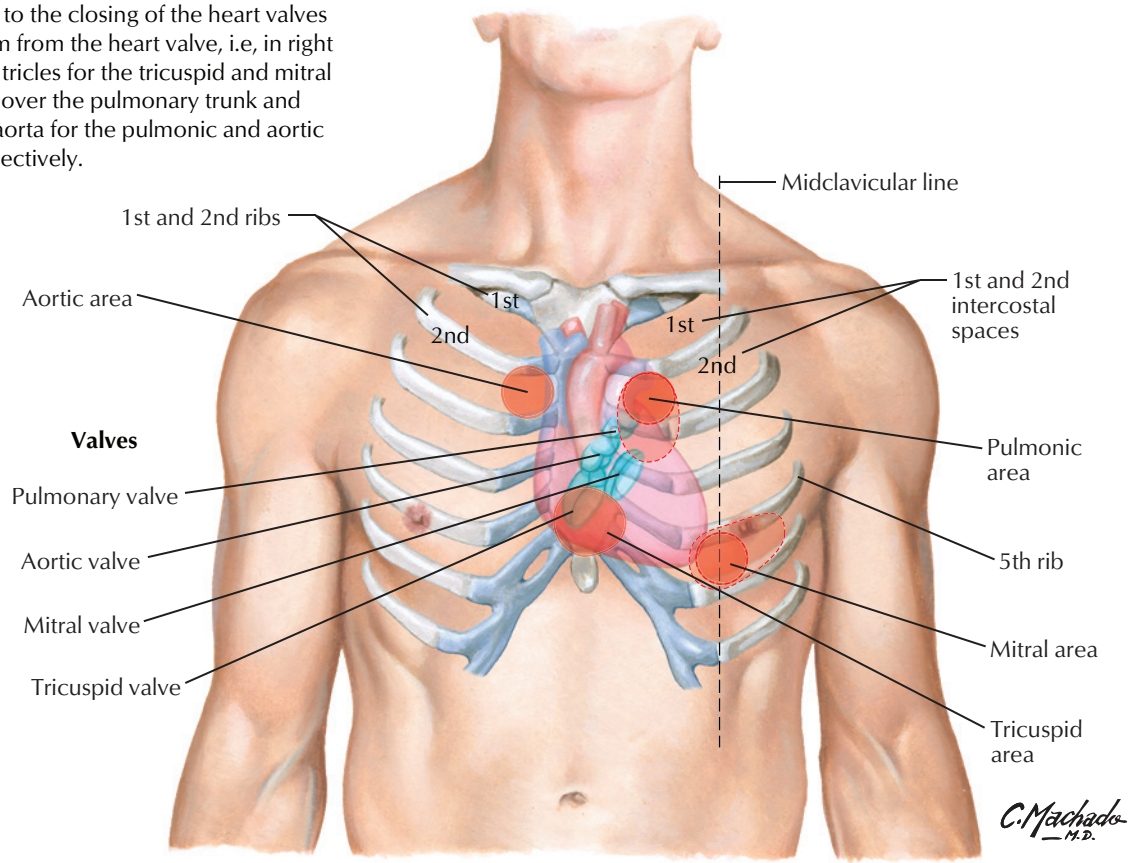


Pulmonary arteries and their branches distribute segmentally with the bronchi. Pulmonary veins and their tributaries drain intersegmentally.

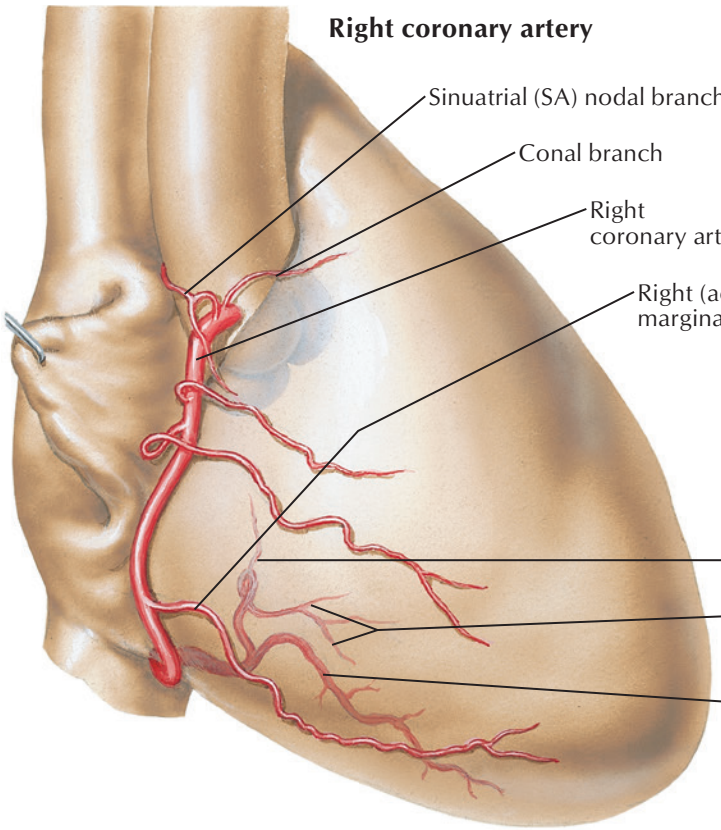

Air flows into lungs
During inhalation
Chest expands
Intercostal muscles contract
Alveolar pressure becomes less than airway opening
Air flows out of lungs
During exhalation
Chest contracts
Elastic recoil of chest wall and lungs
Intercostal muscles relax
Alveolar pressure greater than at airway opening
Pulmonary artery (from heart)
Capillary plexus
Pulmonary veins (to heart)
Alveoli
Surface-active layer (surfactant)
Lamellar bodies
Type II alveolar cell
Type I alveolar cell and nucleus
Alveolar macrophage
Alveolus (air space)
Tight cell junctions
Red blood cells
Capillary lumen
Endothelial cell and nucleus
Interstitium
Fused basement membranes
Endothelial (loose) cell junctions
O2
CO2
Alveolar capillary
Alveolus

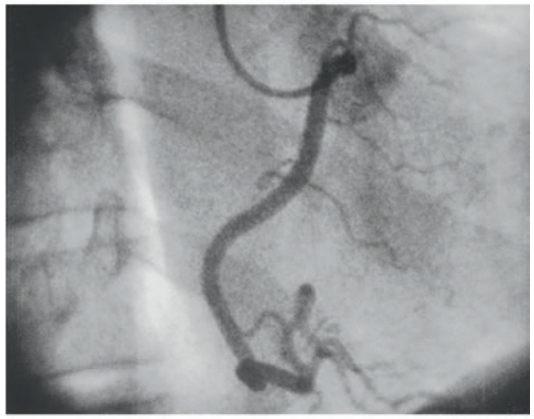


Precordial areas of auscultation:
One listens to the closing of the heart valves downstream from the heart valve, i.e, in right and left ventricles for the tricuspid and mitral valves, and over the pulmonary trunk and ascending aorta for the pulmonic and aortic valves, respectively.



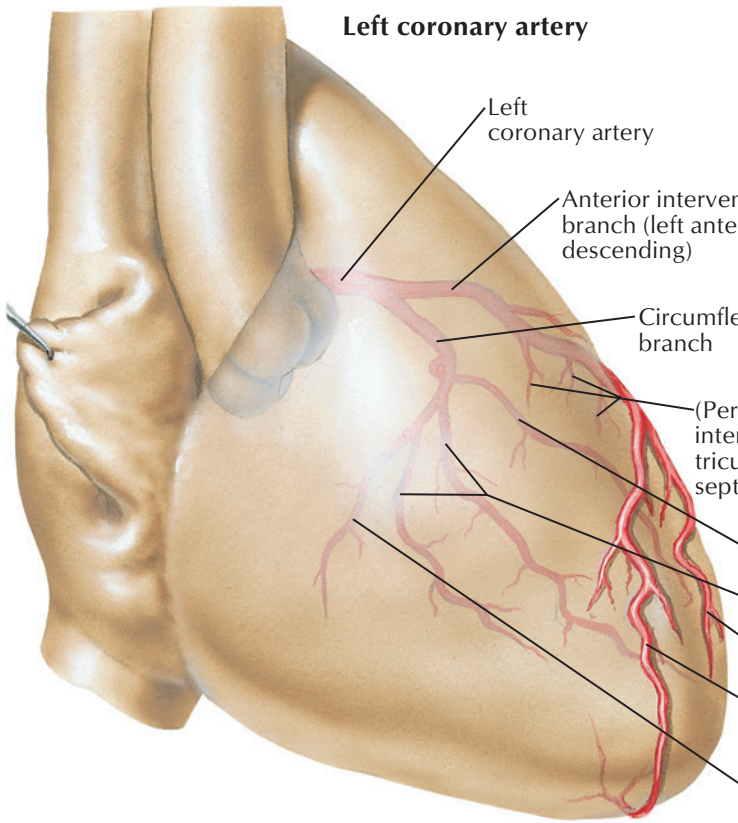
Right coronary artery

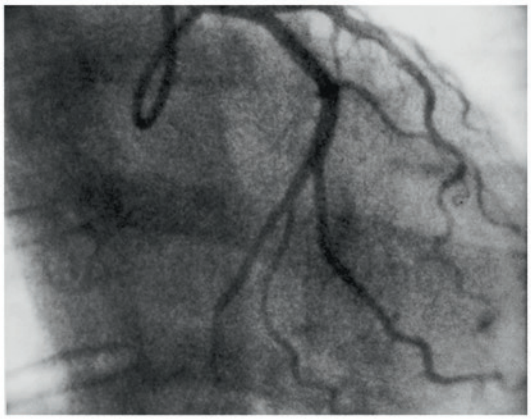




Arteriogram

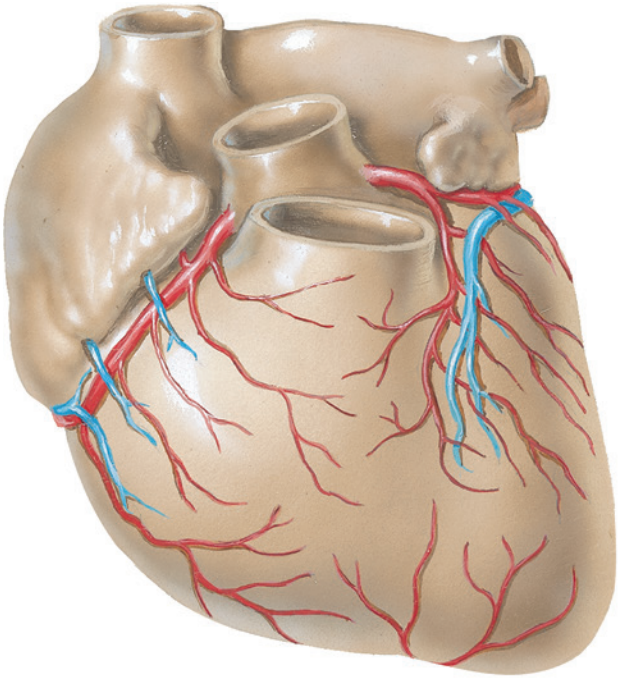
Left coronary artery



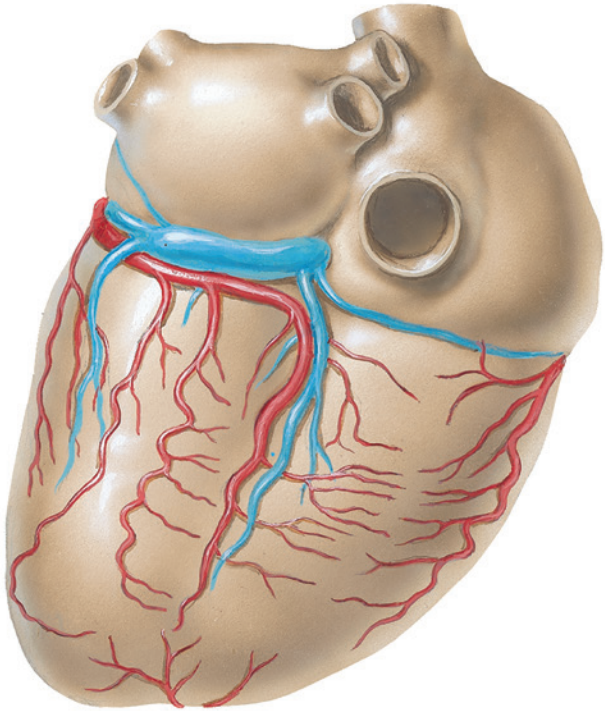


Arteriogram

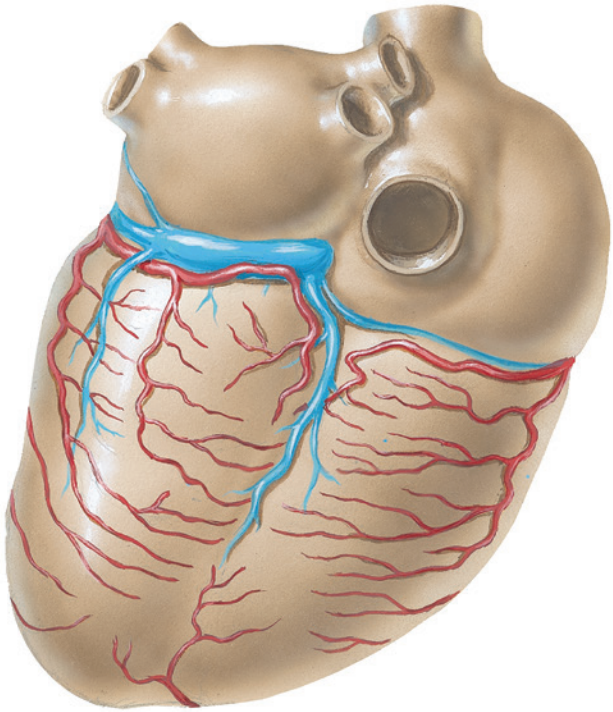
F. Netter M.D.



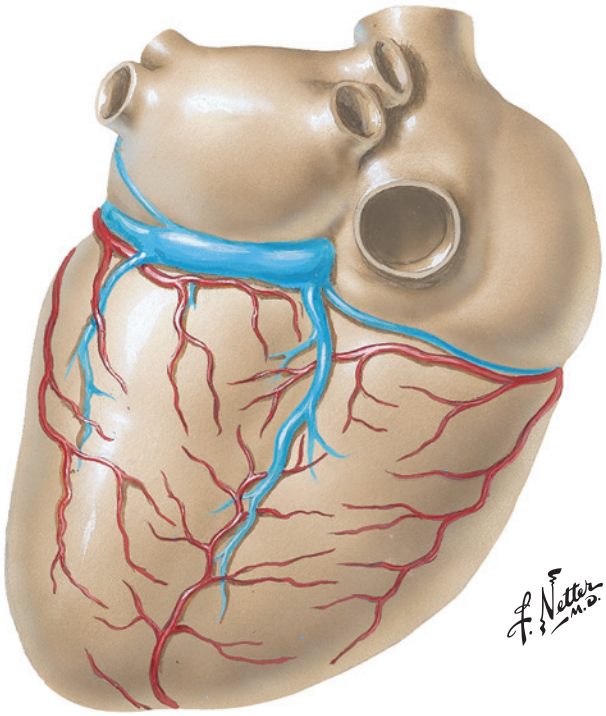
Anterior interventricular (left anterior descending) branch of left coronary artery is very short. Apical part of anterior (sternocostal) surface is supplied by branches from inferior interventricular (posterior descending) branch of right coronary artery curving around apex.



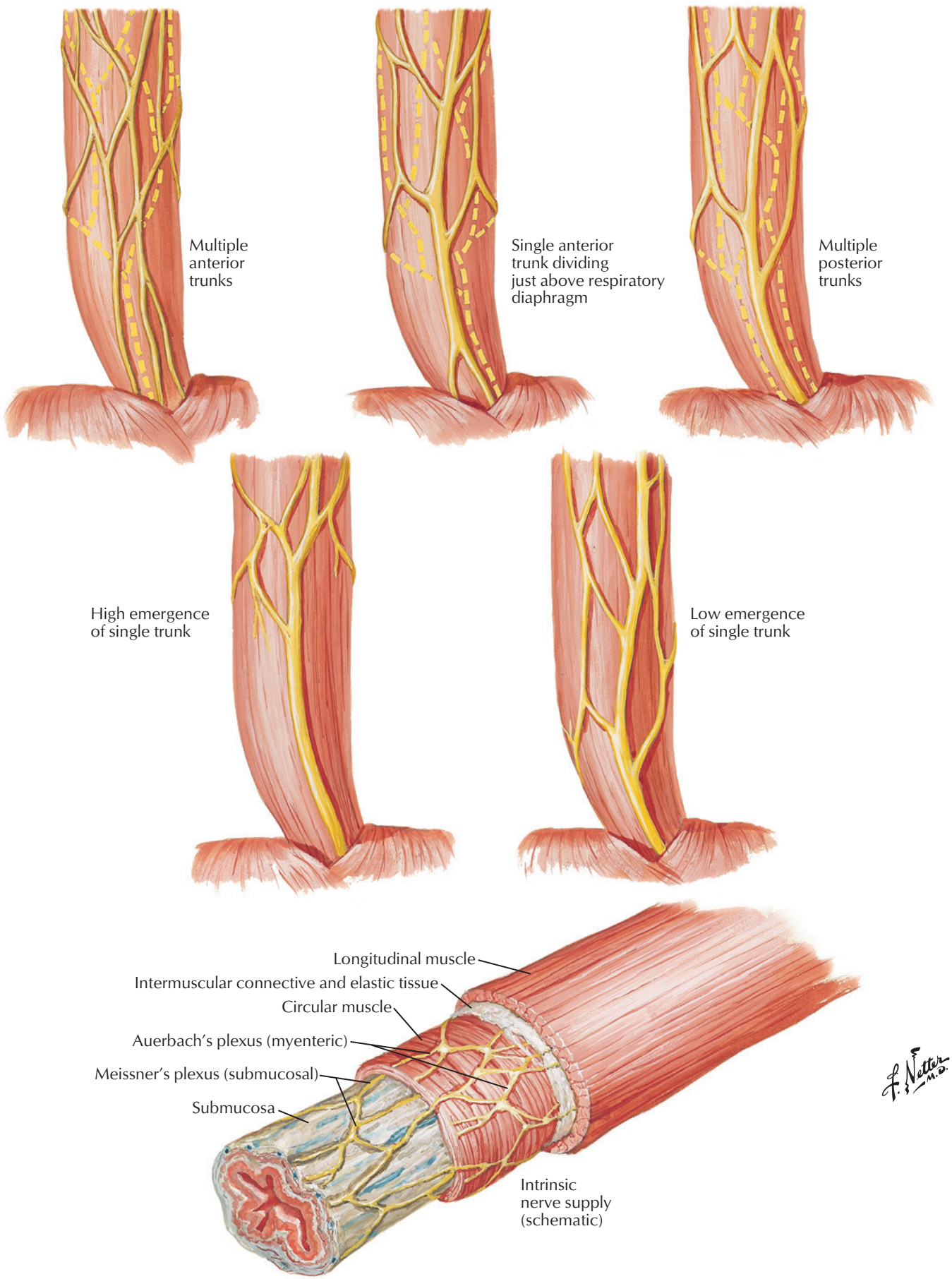
Inferior interventricular (posterior descending) branch is derived from circumflex branch of left coronary artery instead of from right coronary artery.

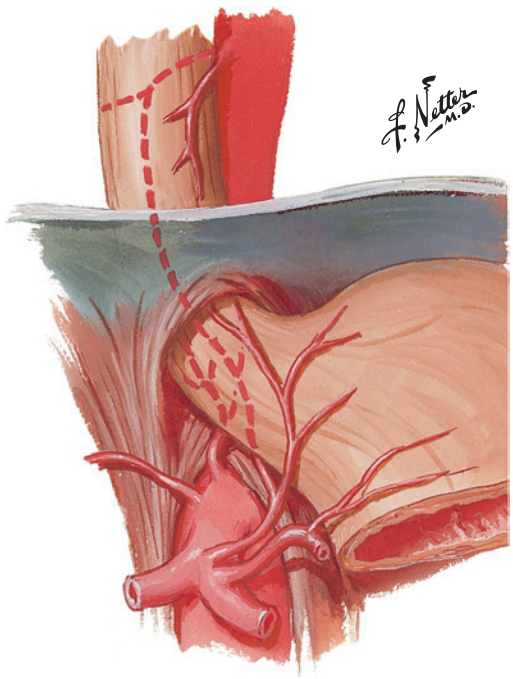


Inferior interventricular (posterior descending) branch is absent. Area is supplied chiefly by small branches from circumflex branch of left coronary artery and from right coronary artery.

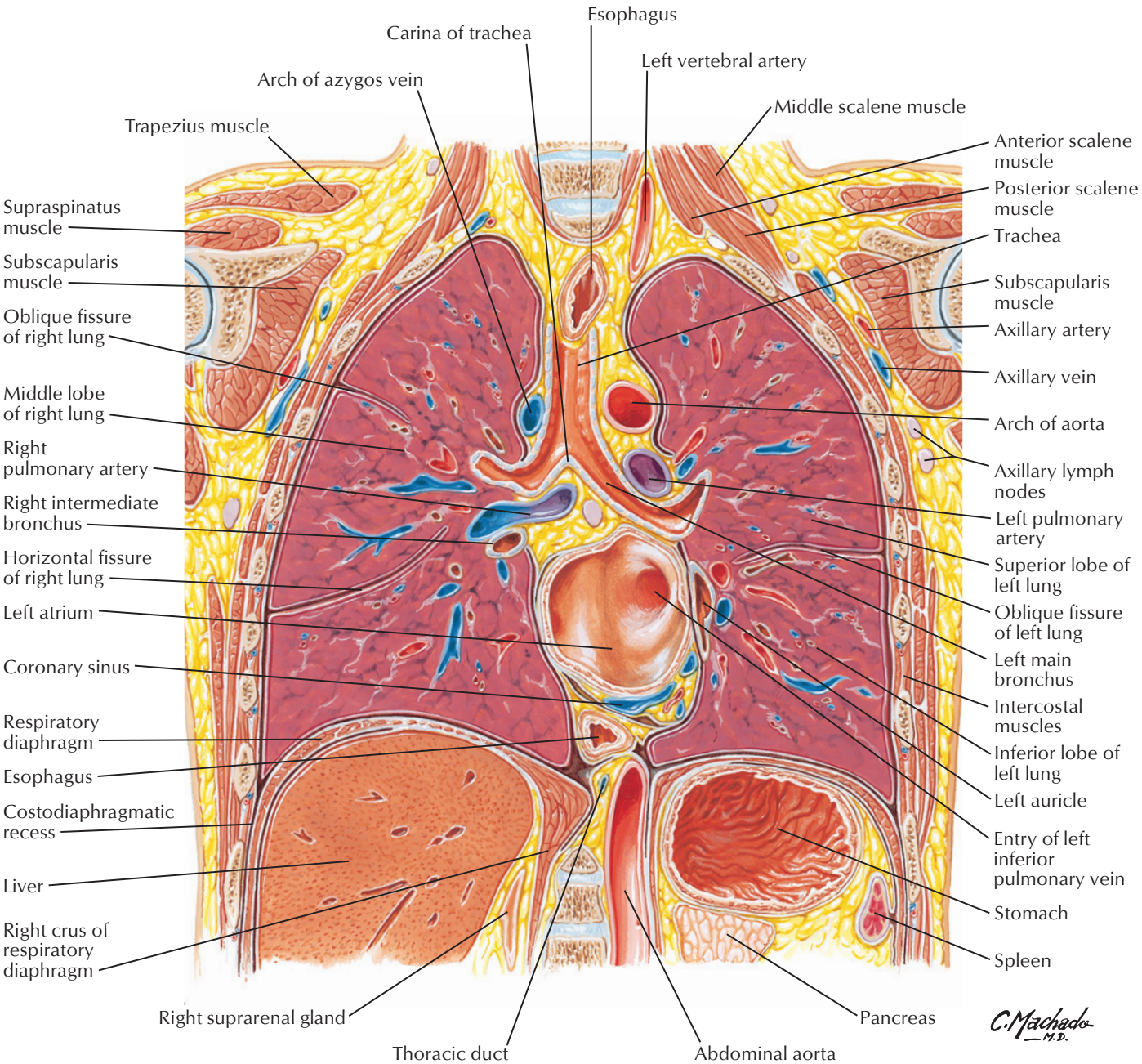


Inferior interventricular (posterior descending) branch is absent. Area is supplied chiefly by elongated anterior interventricular (left anterior descending) branch curving around apex.

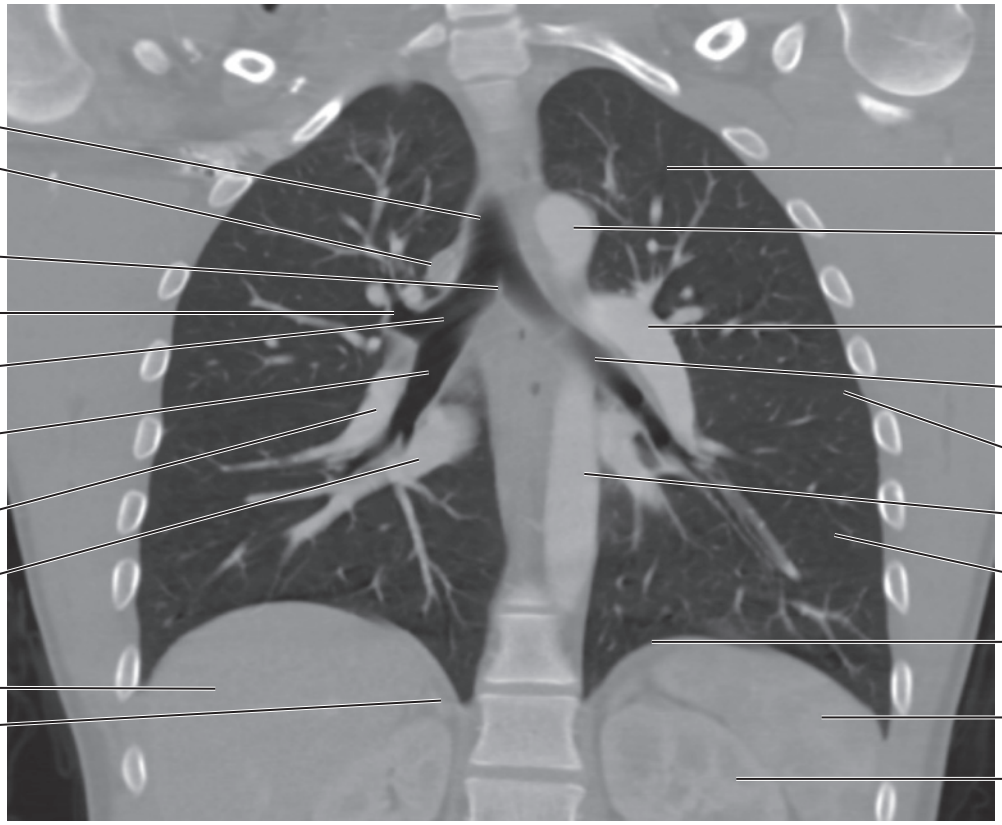

Multiple anterior trunks
Single anterior trunk dividing just above respiratory diaphragm
Multiple posterior trunks
High emergence of single trunk
Low emergence of single trunk
Longitudinal muscle
Intermuscular connective and elastic tissue
Circular muscle
Auerbach's plexus (myenteric)
Meissner's plexus (submucosal)
Submucosa
Intrinsic nerve supply (schematic)



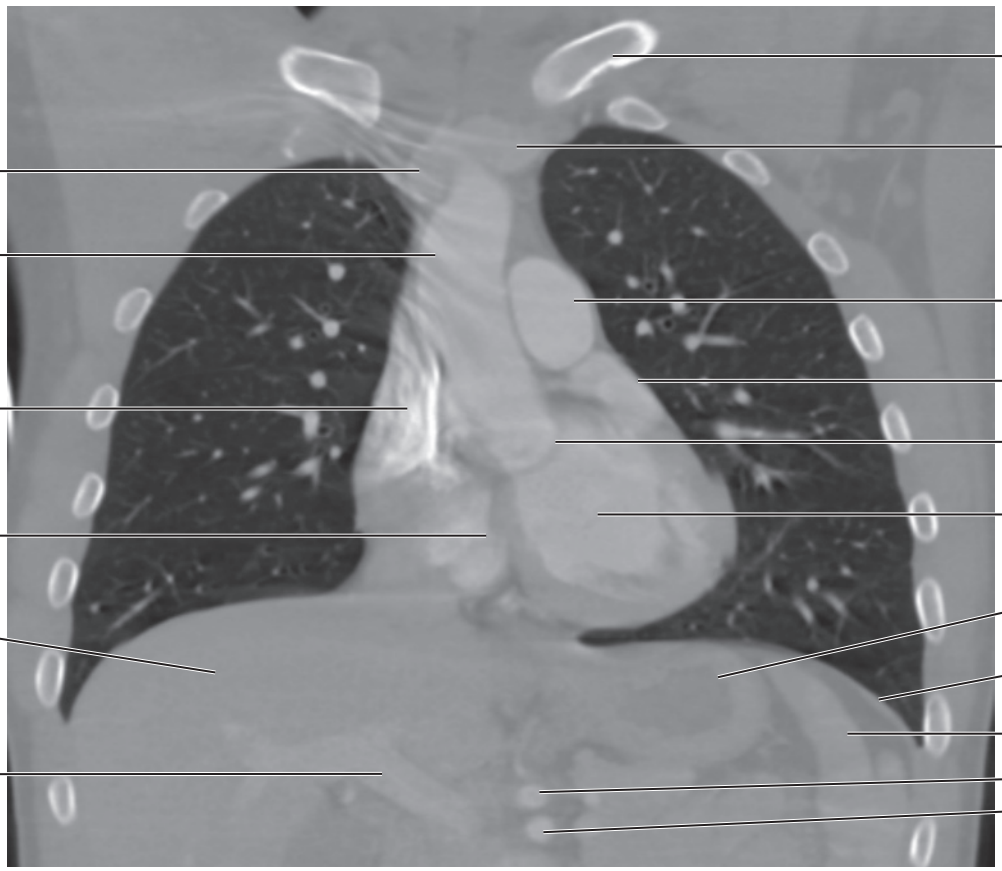
Common variations: Esophageal branches may originate from left inferior phrenic artery and/or directly from celiac trunk. Branches to abdominal esophagus may also come from splenic or short gastric arteries.


Esophagus
Carina of trachea
Left vertebral artery
Arch of azygos vein
Middle scalene muscle
Trapezius muscle
Anterior scalene muscle
Posterior scalene muscle
Supraspinatus muscle
Trachea
Subscapularis muscle
Subscapularis muscle
Oblique fissure of right lung
Axillary artery
Axillary vein
Middle lobe of right lung
Arch of aorta
Right pulmonary artery
Axillary lymph nodes
Right intermediate bronchus
Left pulmonary artery
Horizontal fissure of right lung
Superior lobe of left lung
Left atrium
Oblique fissure of left lung
Coronary sinus
Left main bronchus
Intercostal muscles
Respiratory diaphragm
Inferior lobe of left lung
Esophagus
Left auricle
Costodiaphragmatic recess
Entry of left inferior pulmonary vein
Liver
Stomach
Right crus of respiratory diaphragm
Spleen
Right suprarenal gland
Pancreas
Thoracic duct
Abdominal aorta
C. Machado M.D.

Contrast windowed to accentuate lungs and bones



Contrast windowed to accentuate lungs and bones

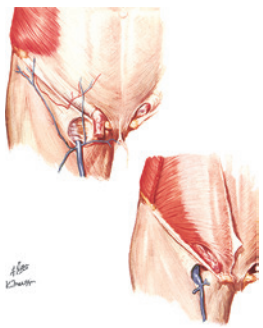


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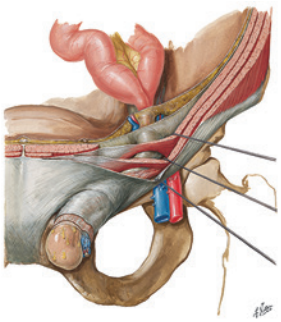
ABDOMEN 5

Surface Anatomy	249	**Lymphatics**	325
Body Wall	250-269	**Regional Scans**	326-327
Peritoneal Cavity	270-275	**Cross-Sectional Anatomy**	328-332
Viscera (Gut)	276-283	**Structures with High Clinical Significance**	Tables 5.1-5.2
Viscera (Accessory Organs)	284-289	**Muscle Table**	Table 5.3
Visceral Vasculature	290-299	**Electronic Bonus Plates**	BP58-BP87
Innervation	300-310		
Kidneys and Suprarenal Glands	311-324		

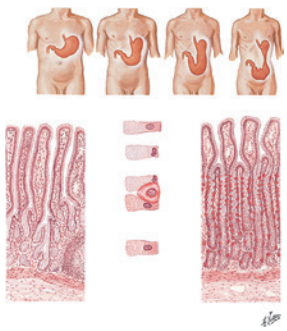
ELECTRONIC BONUS PLATES



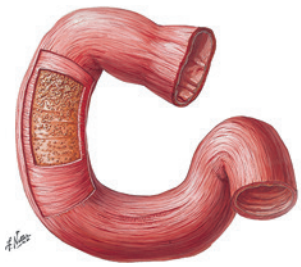
BP58 Inguinal and Femoral Regions



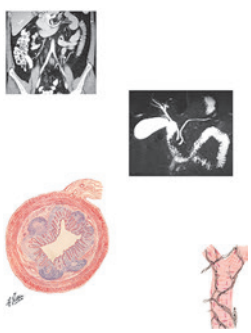
BP59 Indirect Inguinal Hernia



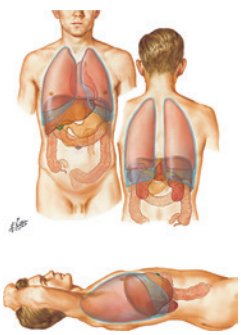
BP60 Variations in Position and Contour of Stomach in Relation to Body Habitus



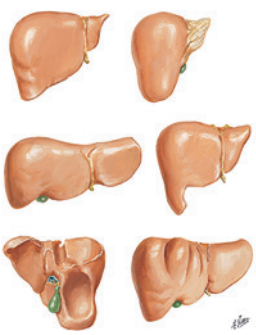
BP61 Layers of Duodenal Wall



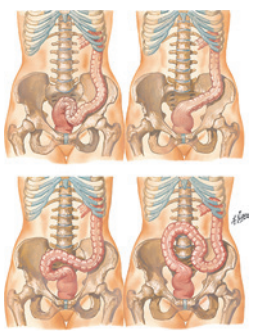
BP62 CT and MRCP Showing Appendix, Gallbladder, and Ducts; Nerve Branches of Hepatic Artery



BP63 Topography of Liver

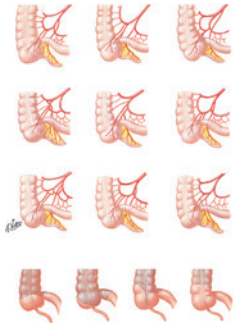


BP64 Variations in Form of Liver

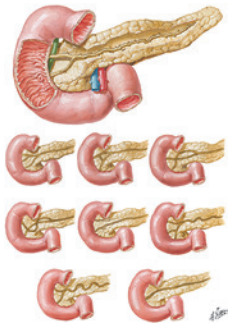


BP65 Sigmoid Colon: Variations in Position

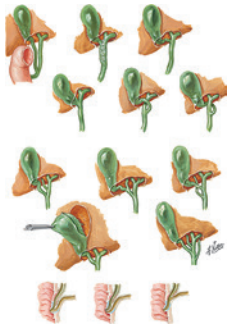
ELECTRONIC BONUS PLATES—*cont'd*



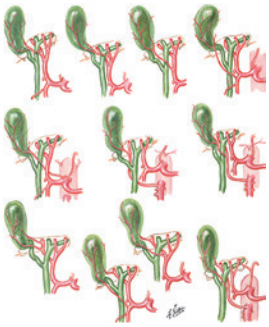
BP66 Variations in Arterial Supply to Cecum and Posterior Peritoneal Attachment of Cecum



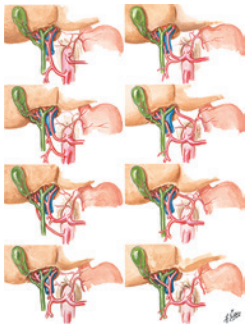
BP67 Variations in Pancreatic Duct



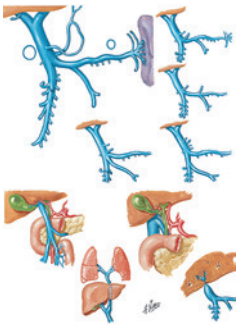
BP68 Variations in Cystic, Hepatic, and Pancreatic Ducts



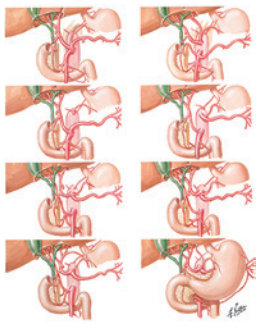
BP69 Variations in Cystic Arteries



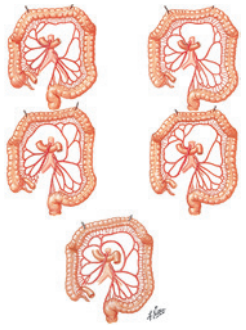
BP70 Variations in Hepatic Arteries



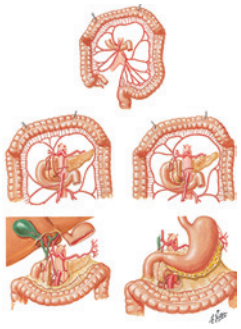
BP71 Variations and Anomalies of Hepatic Portal Vein



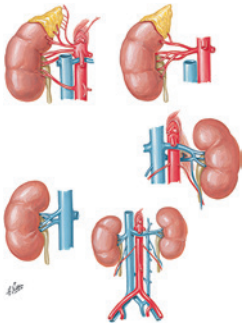
BP72 Variations in Celiac Trunk



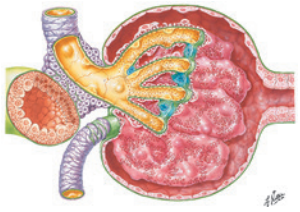
BP73 Variations in Colic Arteries



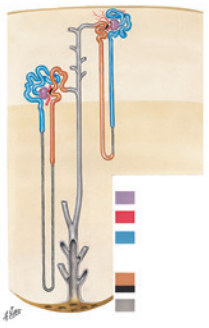
BP74 Variations in Colic Arteries (continued)



BP75 Variations in Renal Artery and Vein

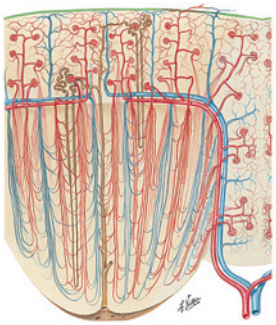


BP76 Histology of Renal Corpuscle

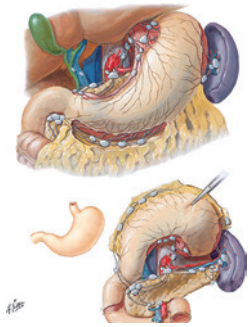


BP77 Nephron and Collecting Tubule: Schema

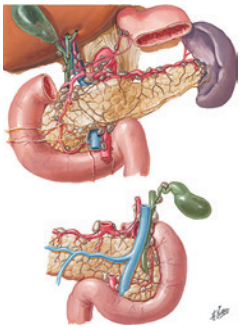
ELECTRONIC BONUS PLATES—*cont'd*



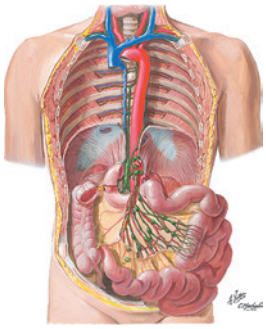
BP78 Blood Vessels in Parenchyma of Kidney: Schema



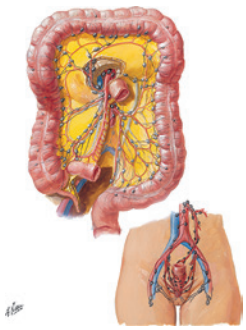
BP79 Lymph Vessels and Nodes of Stomach



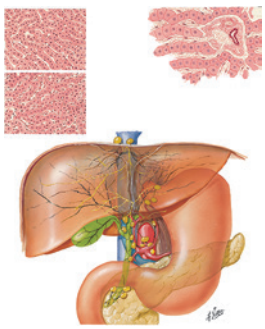
BP80 Lymph Vessels and Nodes of Pancreas



BP81 Lymph Vessels and Nodes of Small Intestine



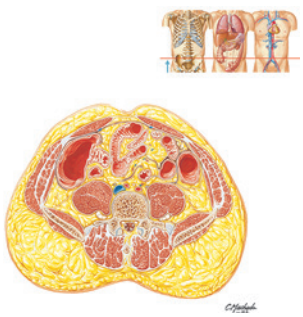
BP82 Lymph Vessels and Nodes of Large Intestine



BP83 Lymph Vessels and Nodes of Liver



BP84 Schematic Cross Section of Abdomen at Middle T12



BP85 Transverse Section of Abdomen: Level of L5, Near Transtubercular Plane



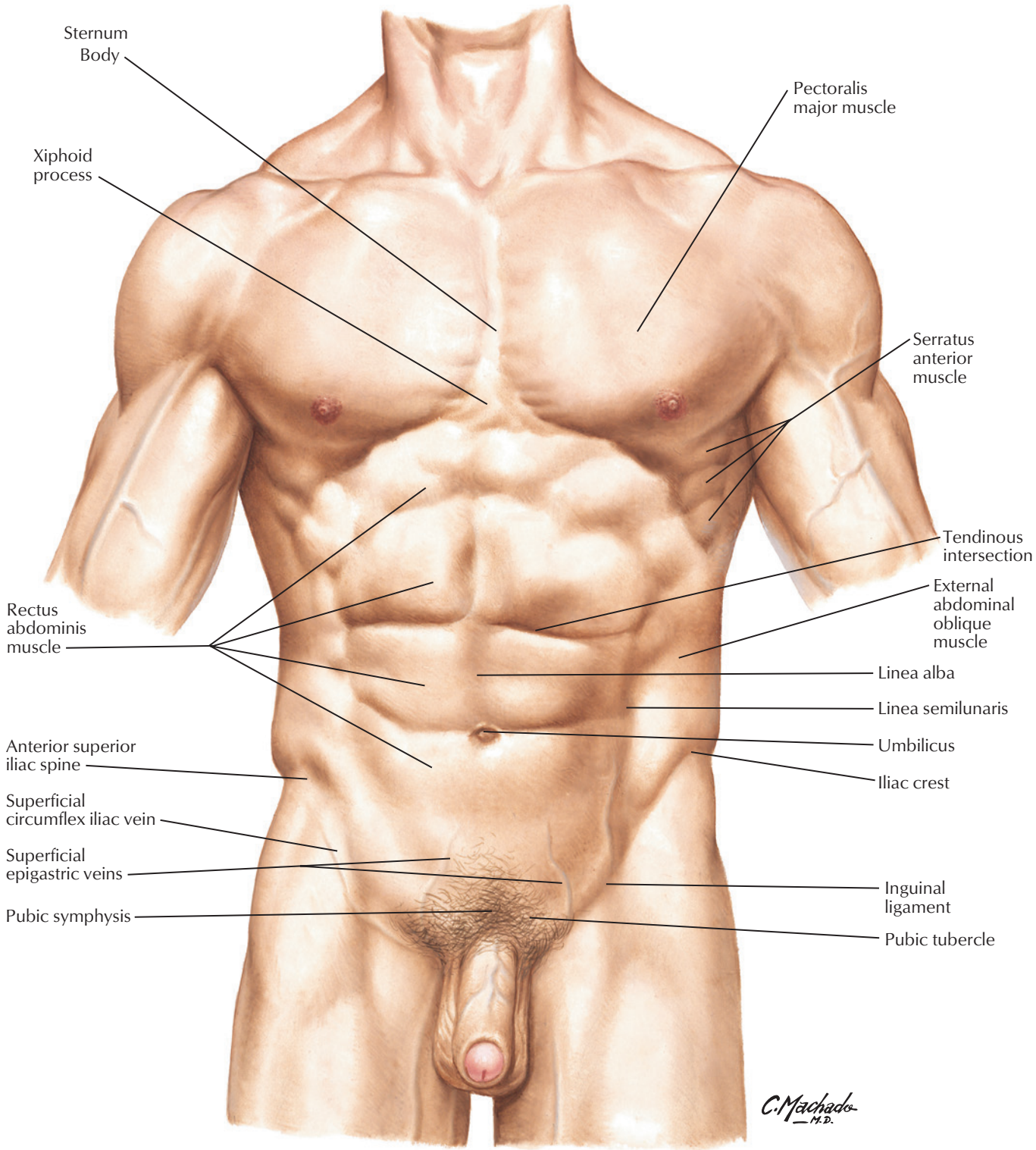
BP86 Transverse Section of Abdomen: Level of S1, Anterior Superior Iliac Spine



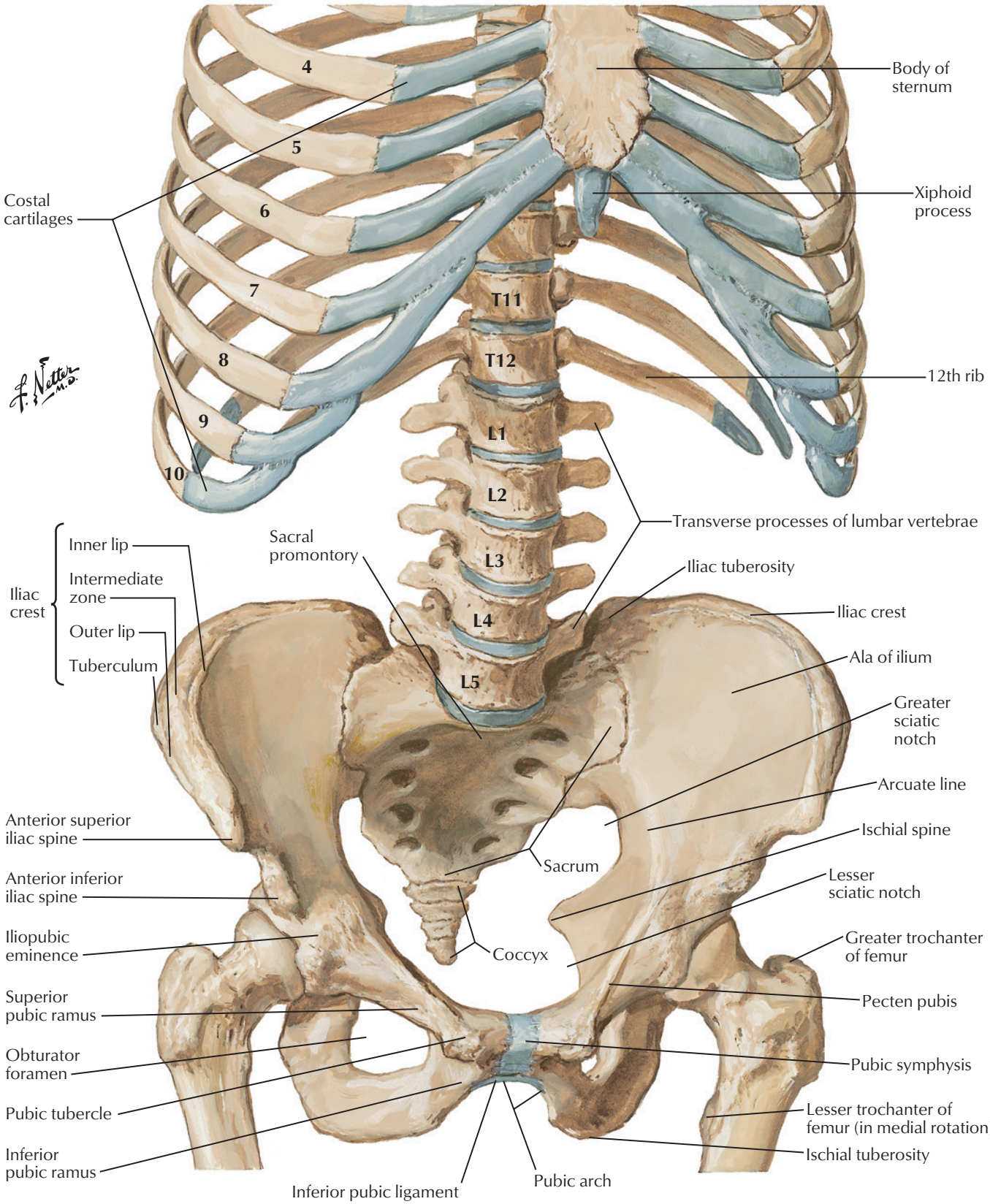
BP87 Axial CT Image of Upper Abdomen

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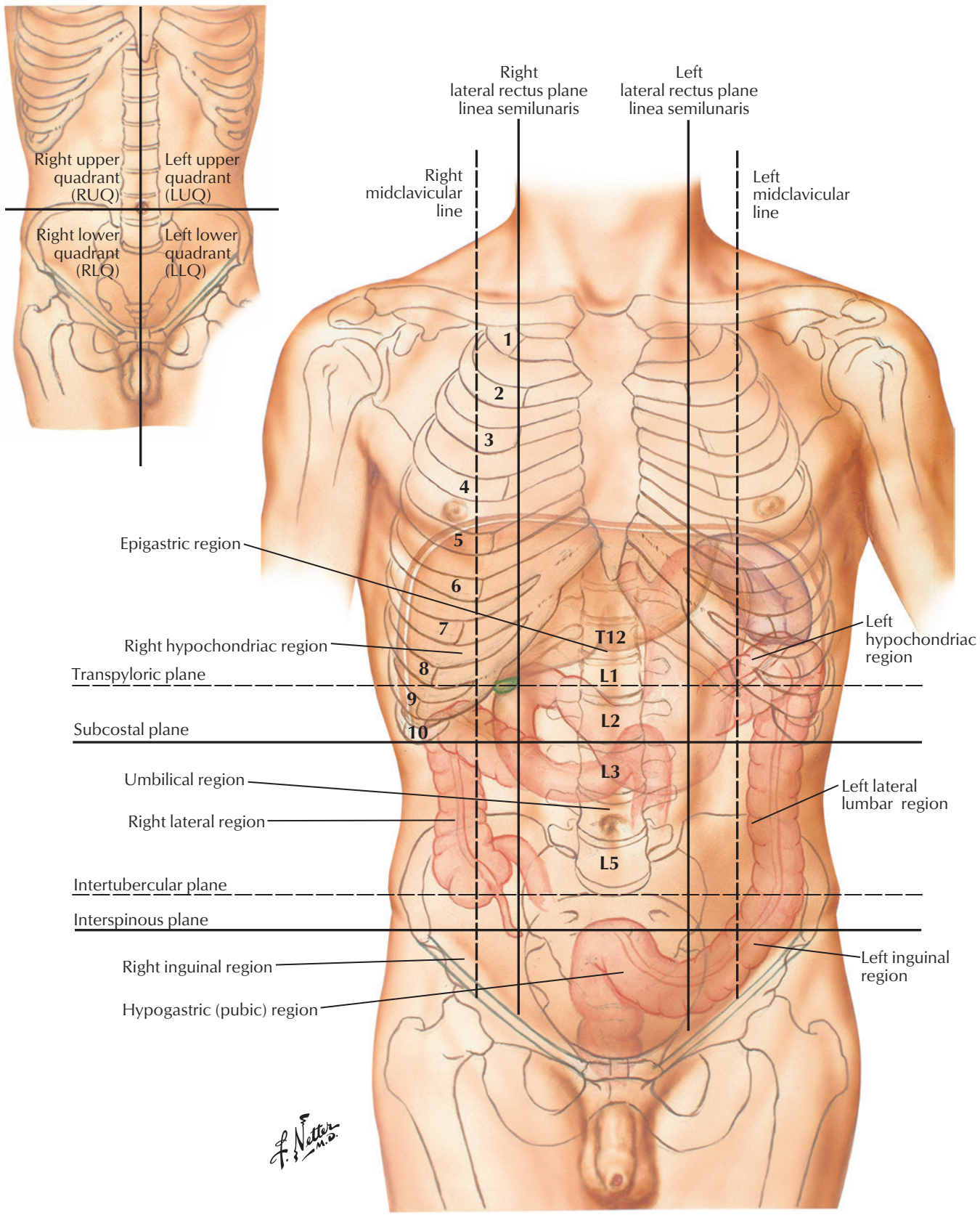
See also Plates 171, 252



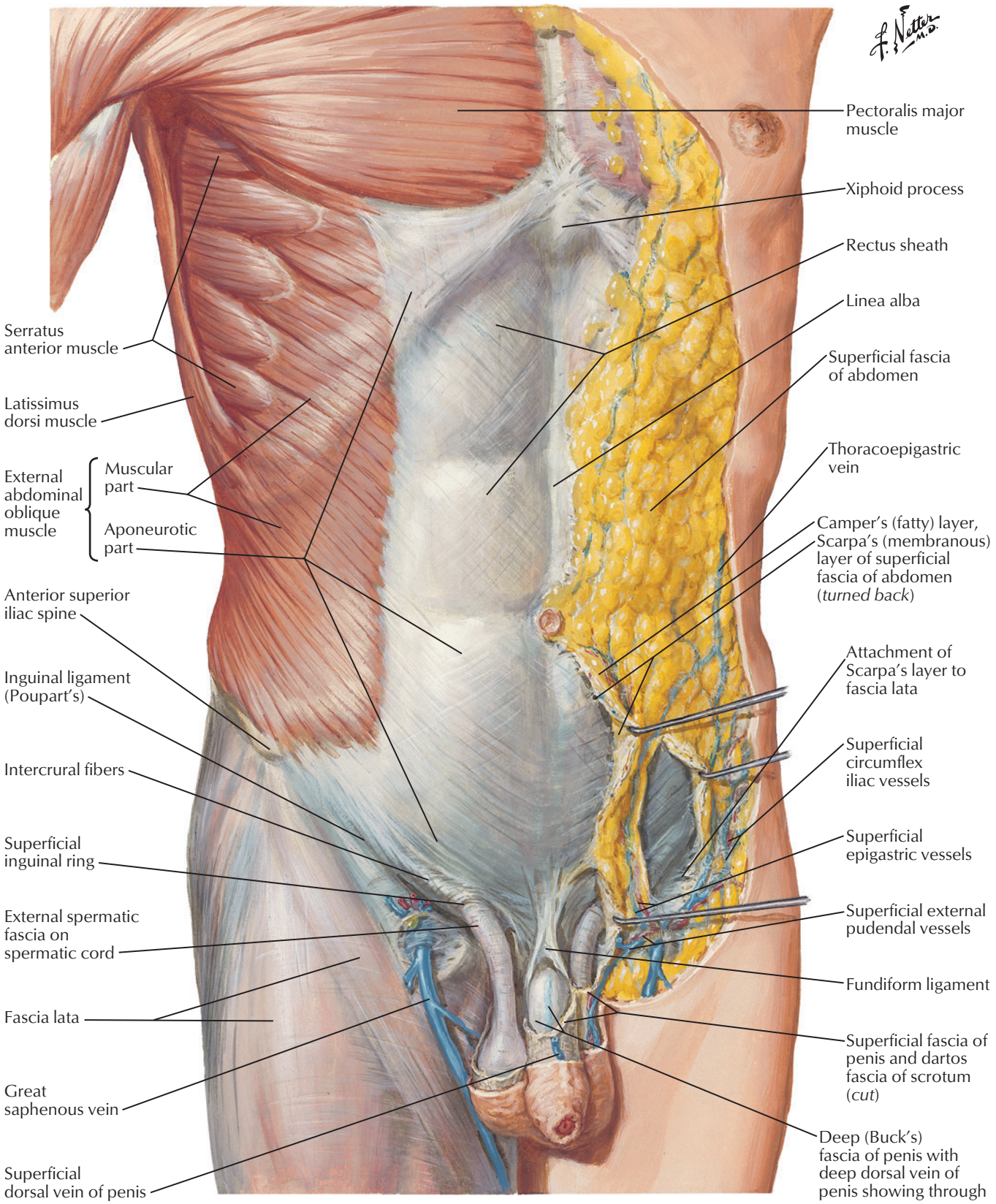
See also Plates 192, 334



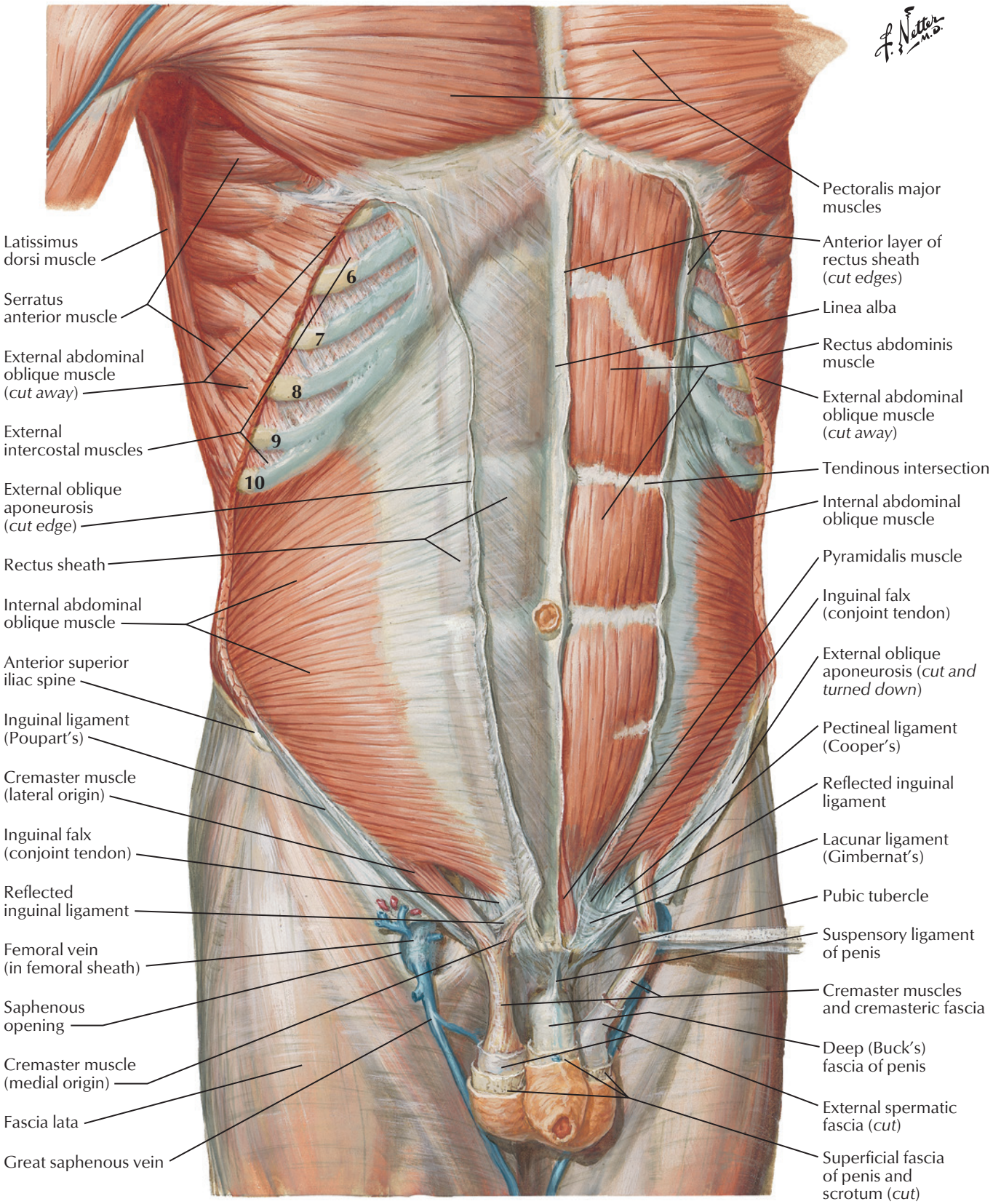
See also Plate 202



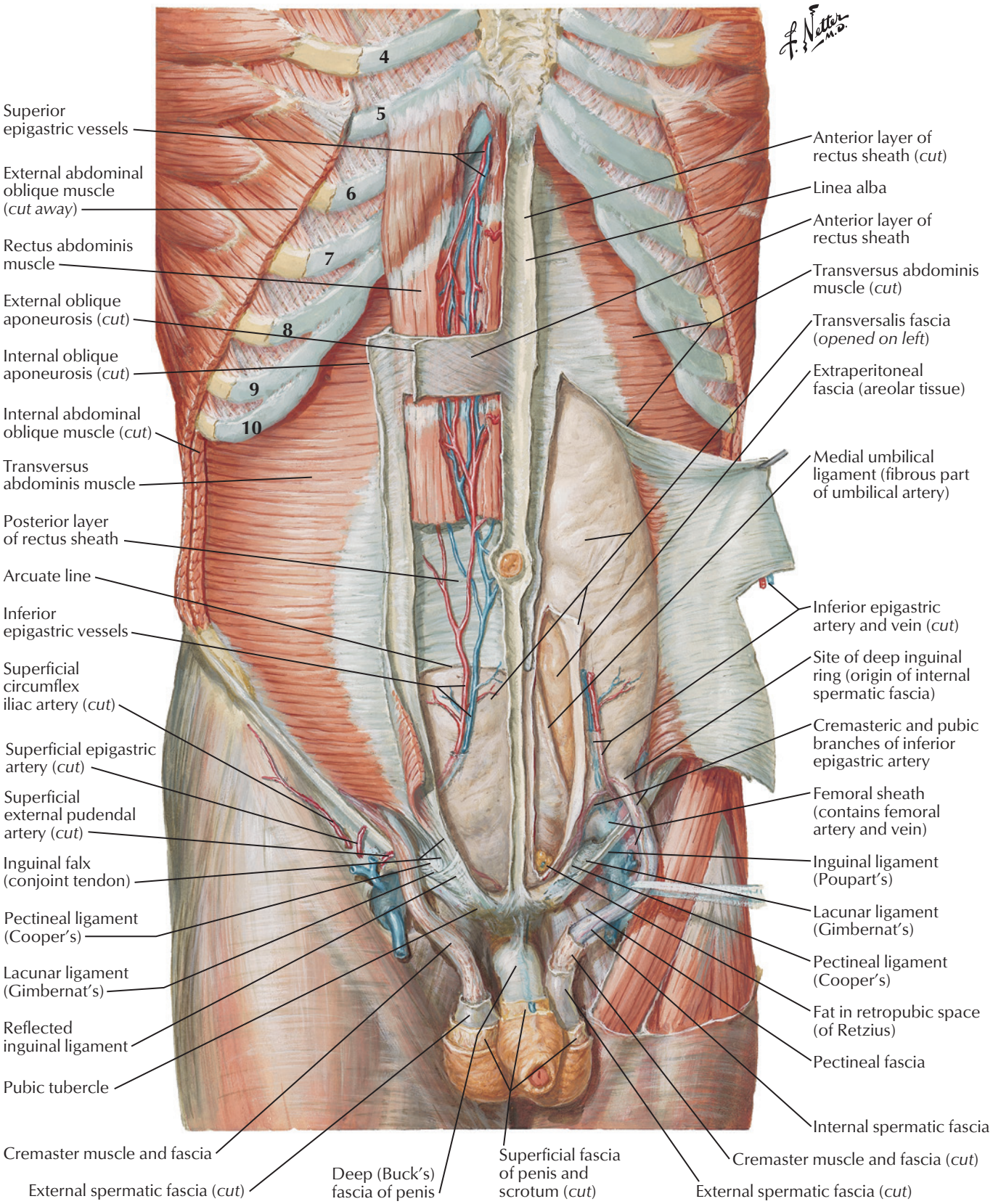
See also Plates 259, 333



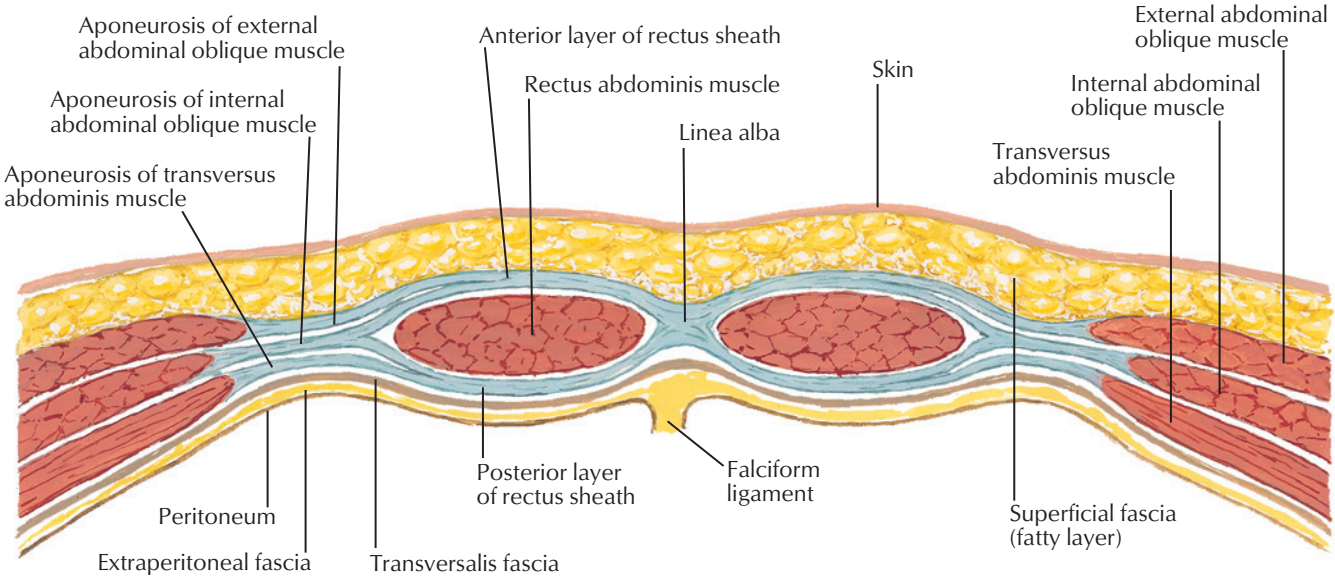
See also Plates 194, 195



See also Plates 195, 258

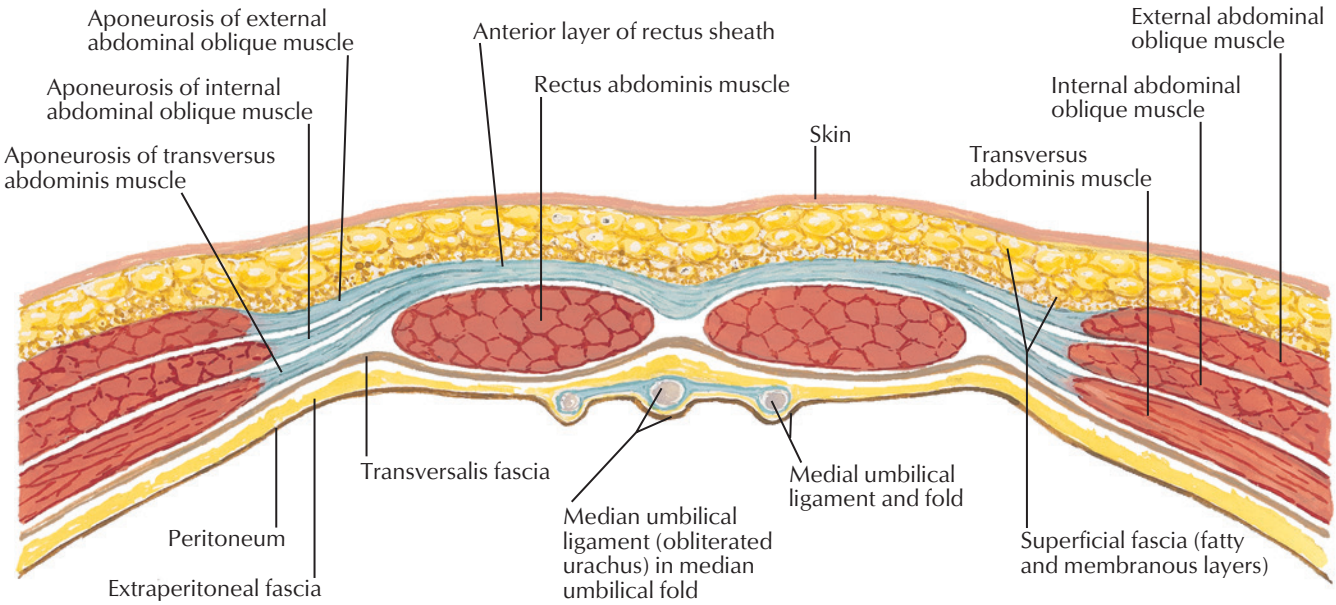


Section above arcuate line



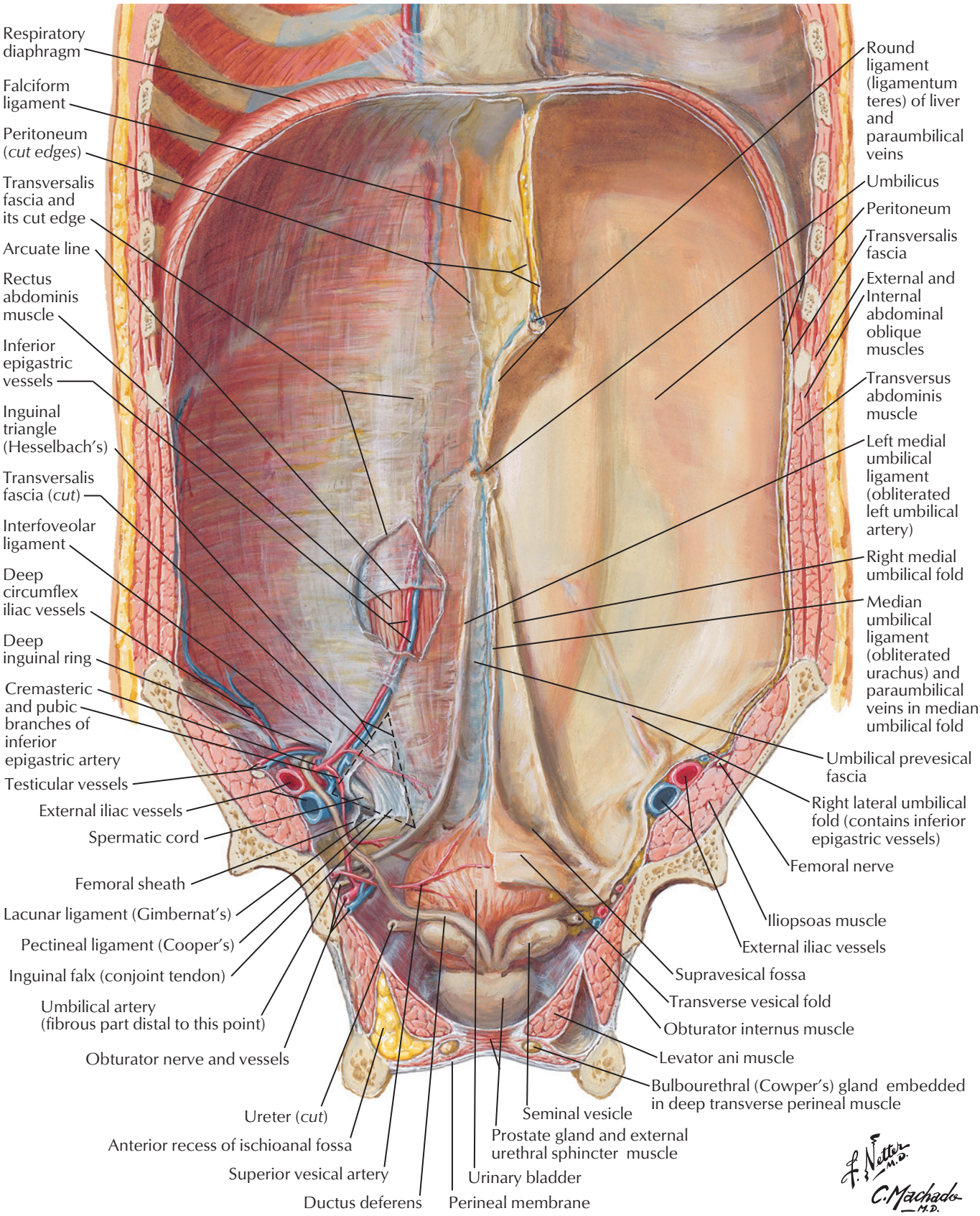
Aponeurosis of internal abdominal oblique muscle splits to form anterior and posterior layers of rectus sheath. Aponeurosis of external abdominal oblique muscle joins anterior layer of sheath; aponeurosis of transversus abdominis muscle joins posterior layer. Anterior and posterior layers of rectus sheath unite medially to form linea alba.

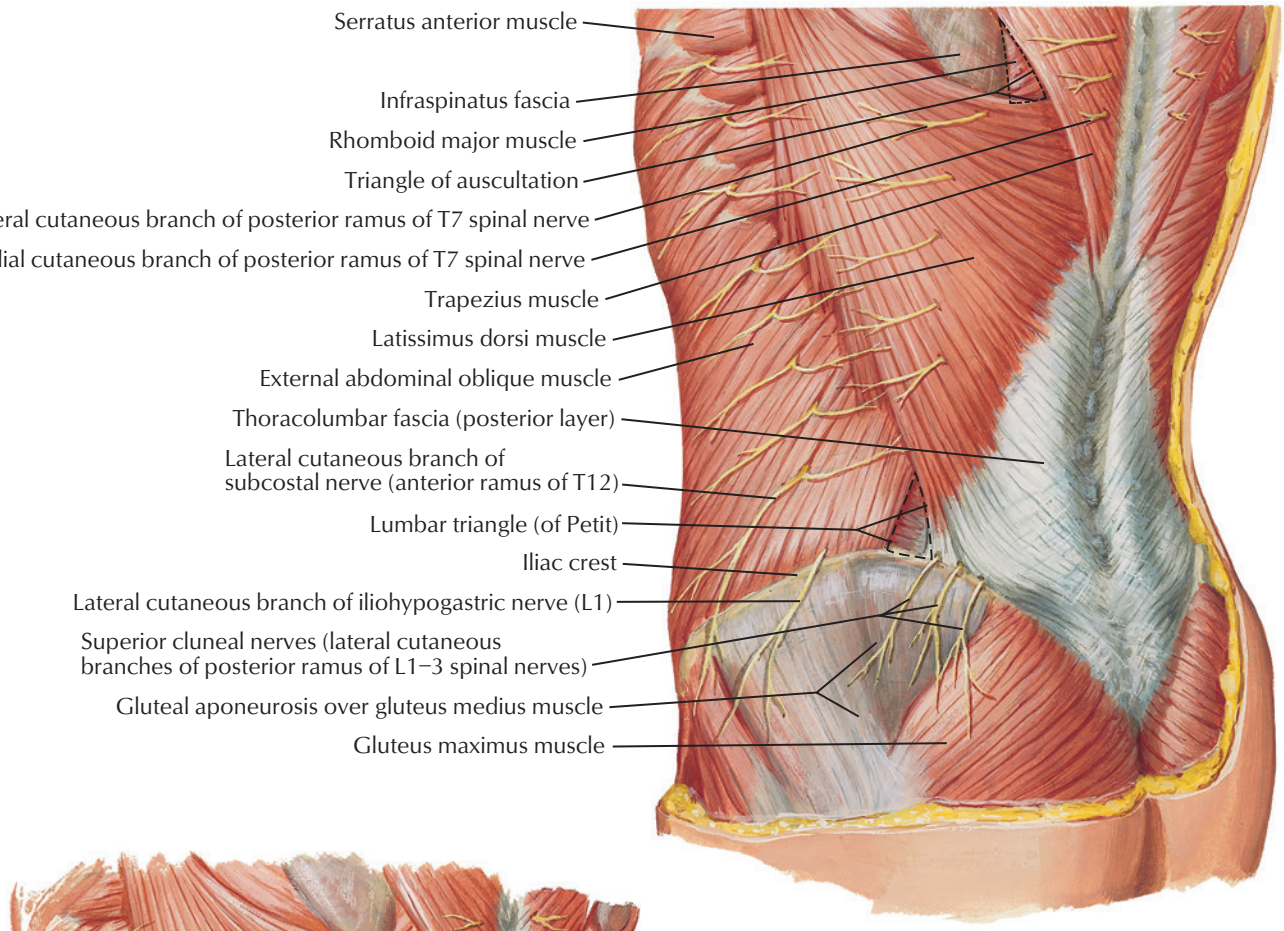
Section below arcuate line

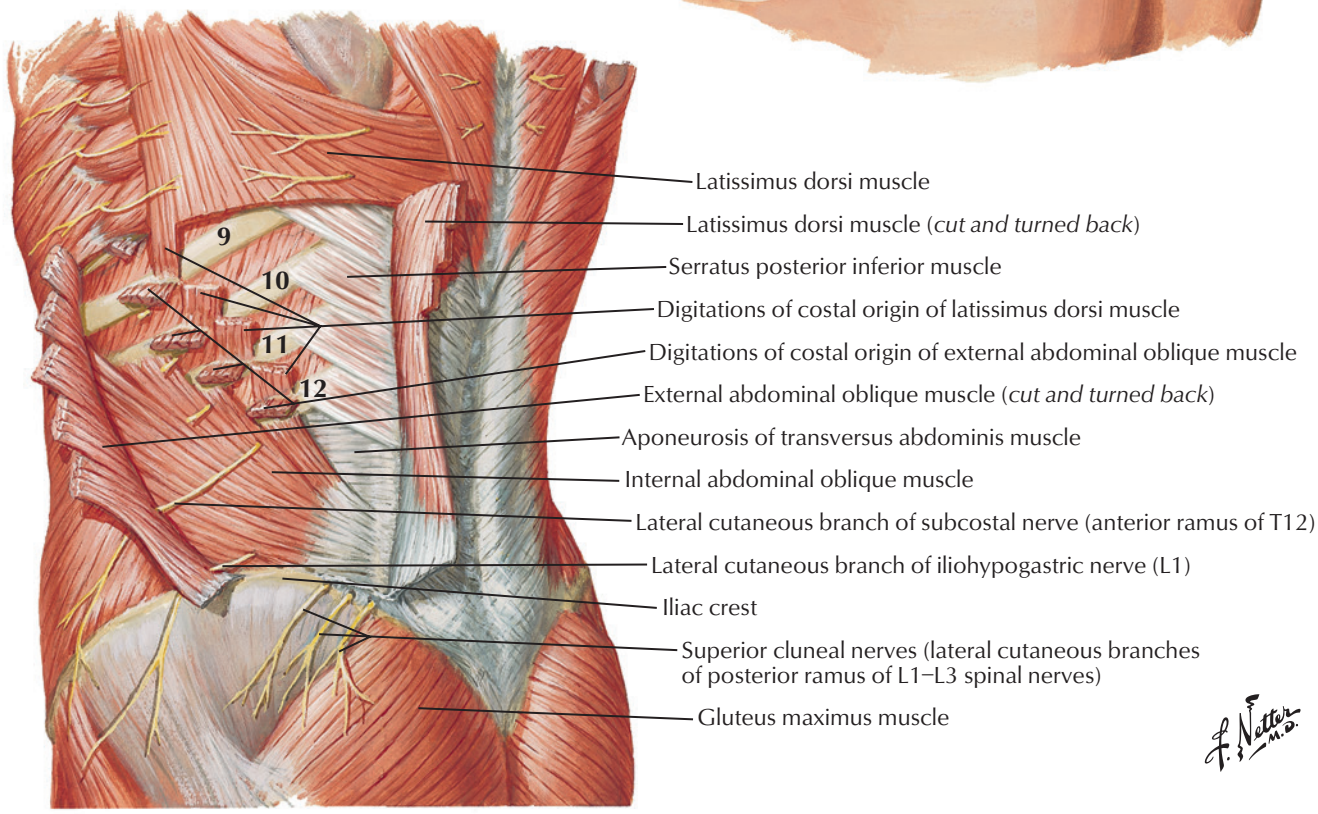


Aponeurosis of internal abdominal oblique muscle does not split at this level but passes completely anterior to rectus abdominis muscle and is fused there with both aponeurosis of external abdominal oblique muscle and that of transversus abdominis muscle. Thus, posterior wall of rectus sheath is absent below arcuate line, leaving only transversalis fascia.

See also Plate 366

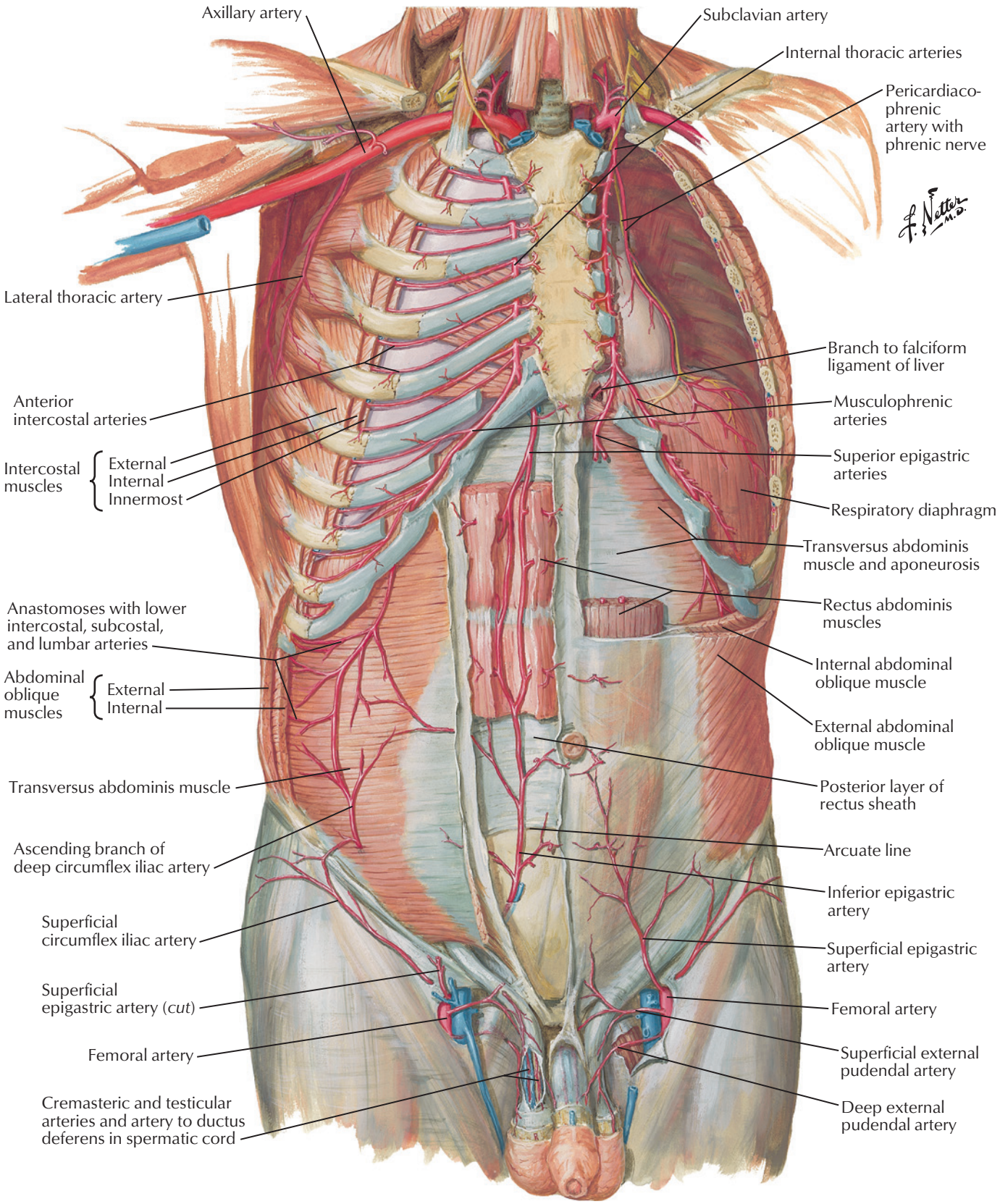



Serratus anterior muscle
Infraspinatus fascia
Rhomboid major muscle
Triangle of auscultation
Lateral cutaneous branch of posterior ramus of T7 spinal nerve
Medial cutaneous branch of posterior ramus of T7 spinal nerve
Trapezius muscle
Latissimus dorsi muscle
External abdominal oblique muscle
Thoracolumbar fascia (posterior layer)
Lateral cutaneous branch of subcostal nerve (anterior ramus of T12)
Lumbar triangle (of Petit)
Iliac crest
Lateral cutaneous branch of iliohypogastric nerve (L1)
Superior cluneal nerves (lateral cutaneous branches of posterior ramus of L1–3 spinal nerves)
Gluteal aponeurosis over gluteus medius muscle
Gluteus maximus muscle

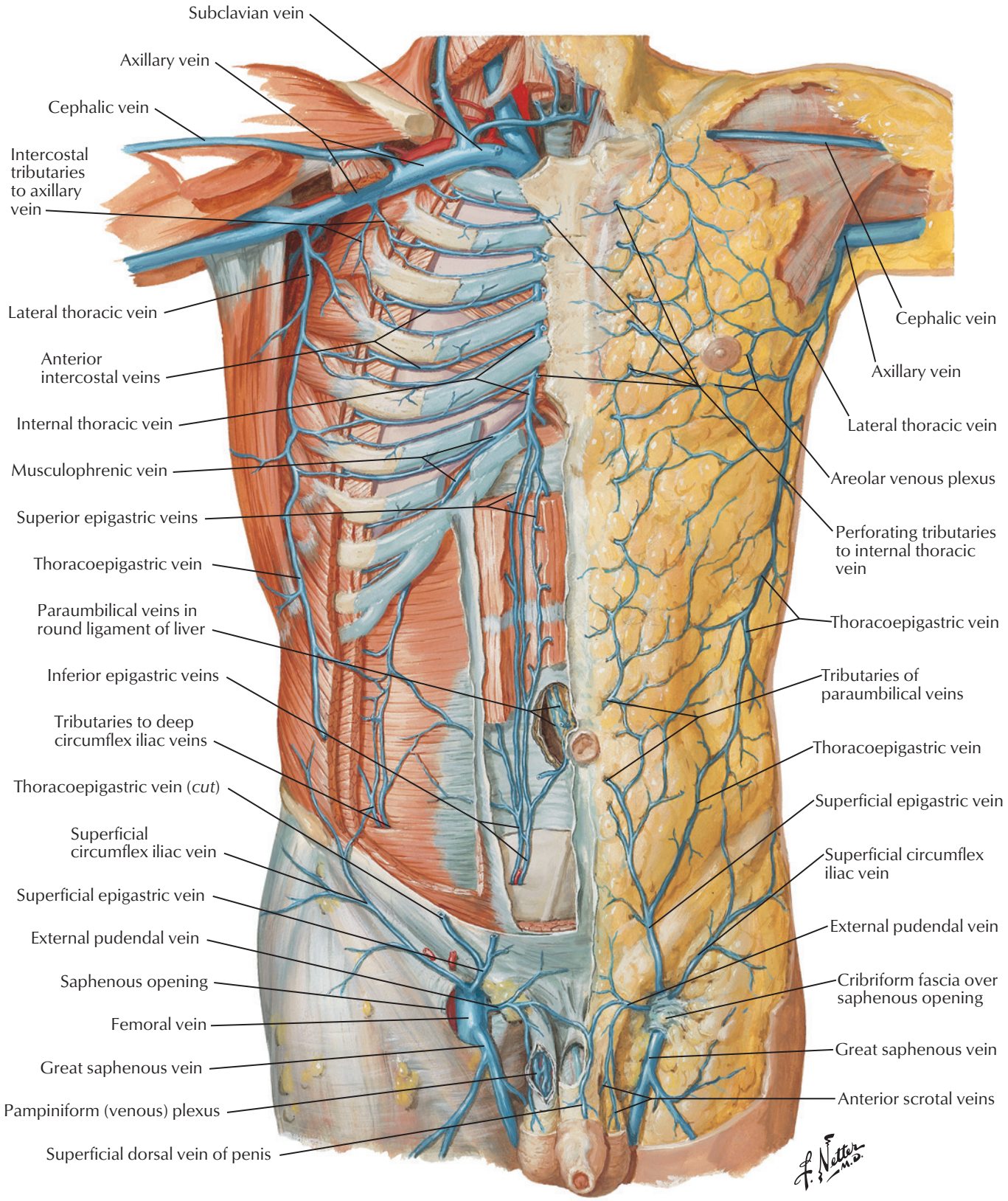

9
10
11
12
Latissimus dorsi muscle
Latissimus dorsi muscle (cut and turned back)
Serratus posterior inferior muscle
Digitations of costal origin of latissimus dorsi muscle
Digitations of costal origin of external abdominal oblique muscle
External abdominal oblique muscle (cut and turned back)
Aponeurosis of transversus abdominis muscle
Internal abdominal oblique muscle
Lateral cutaneous branch of subcostal nerve (anterior ramus of T12)
Lateral cutaneous branch of iliohypogastric nerve (L1)
Iliac crest
Superior cluneal nerves (lateral cutaneous branches of posterior ramus of L1–L3 spinal nerves)
Gluteus maximus muscle

Arteries of Anterior Abdominal Wall

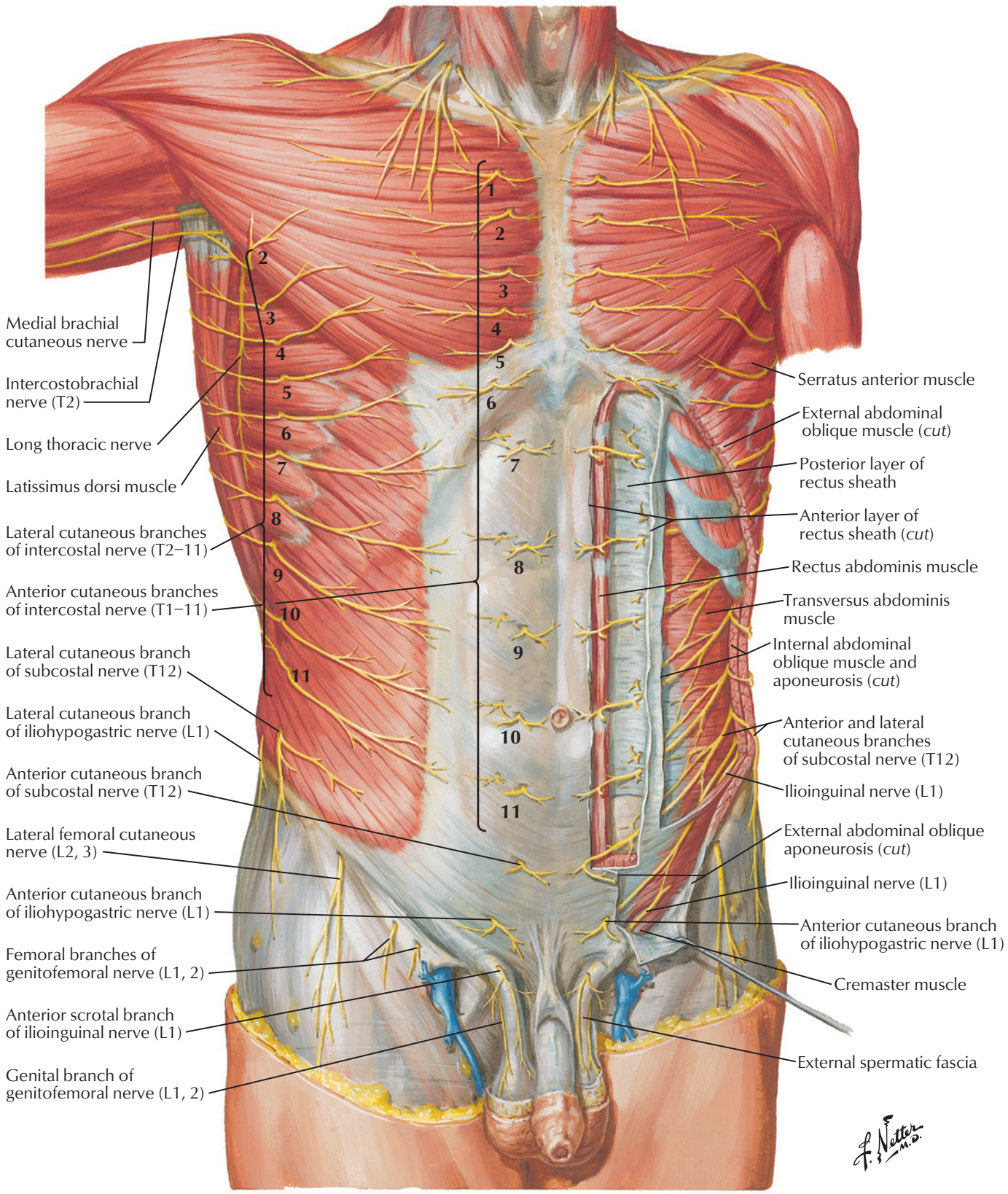
See also Plate 254

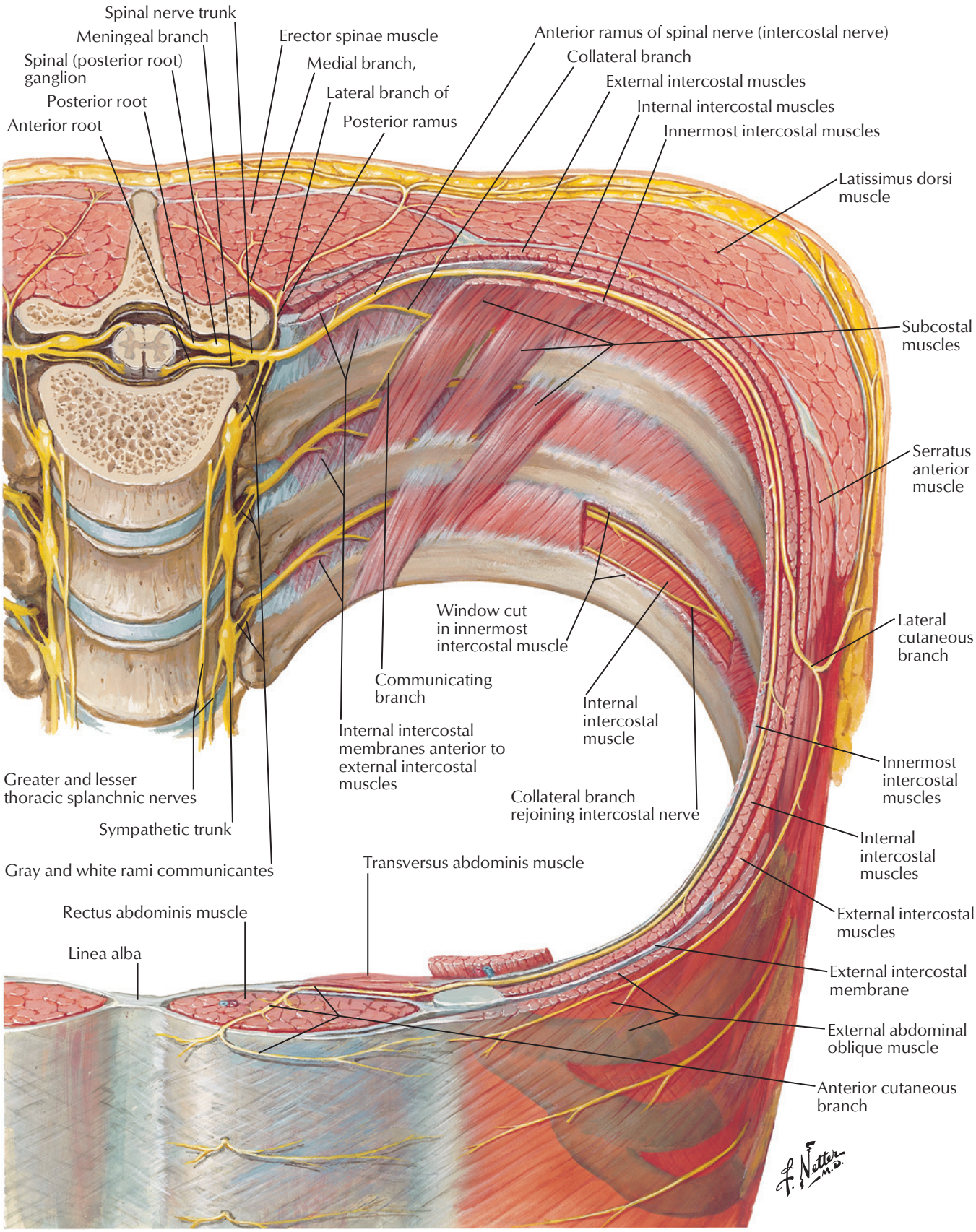


See also Plates 252, 254



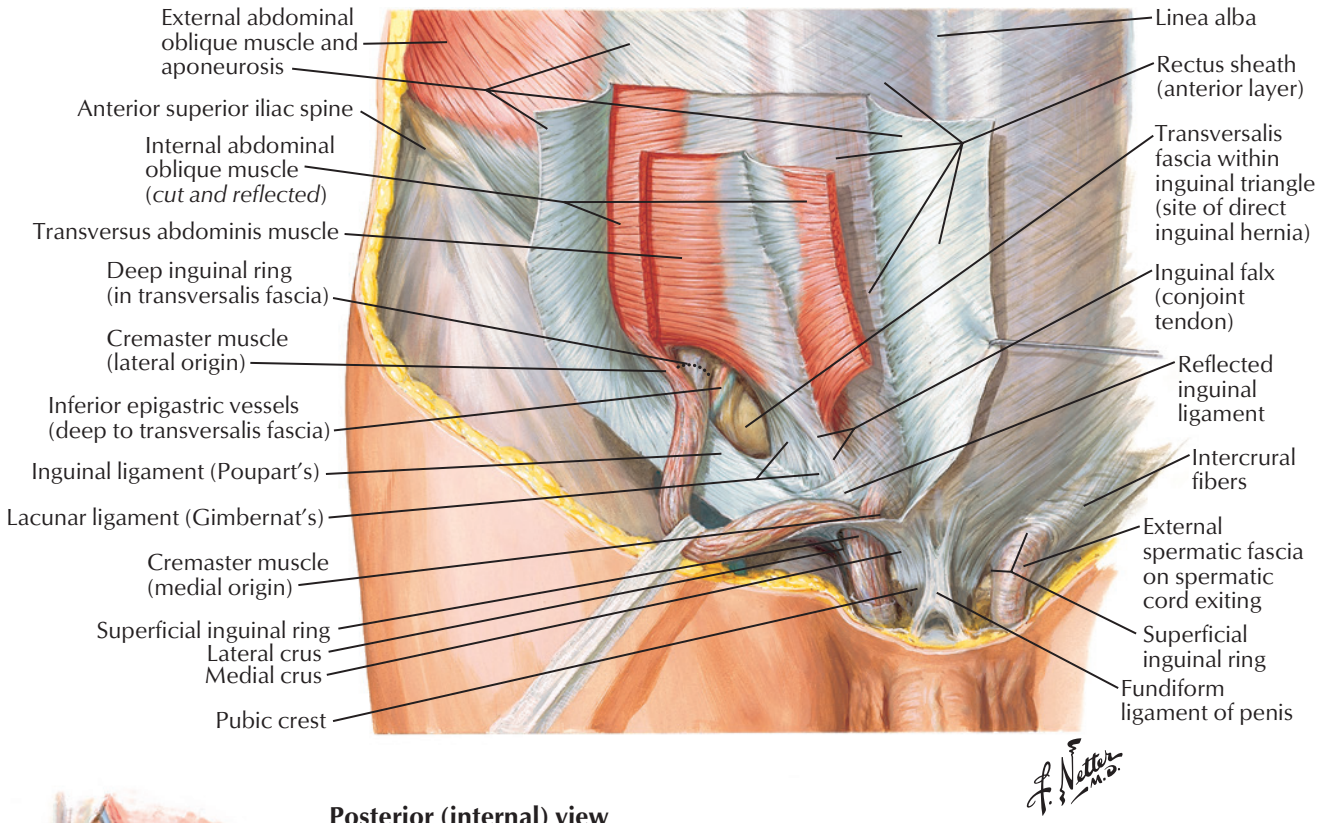
See also Plates 186, 194, 261



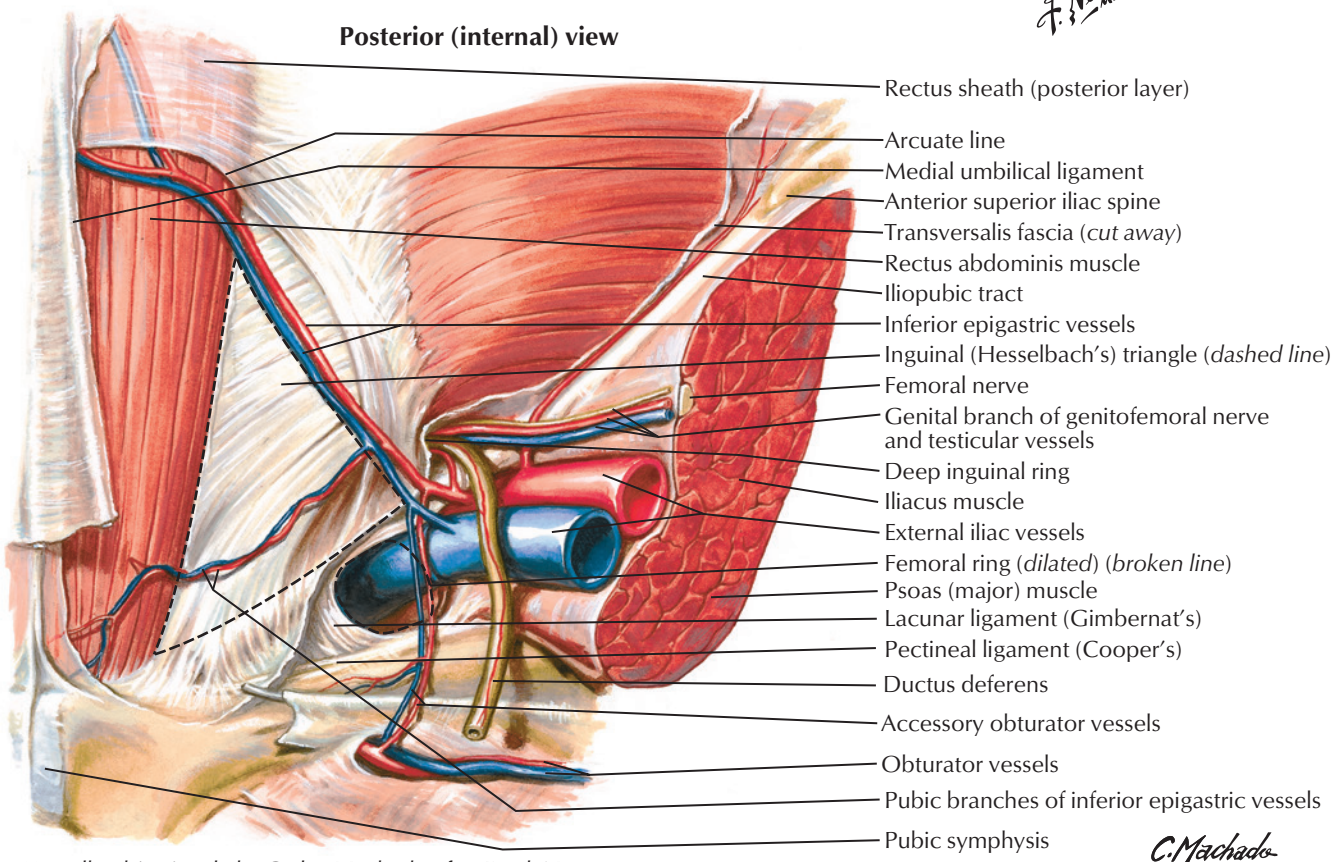

Spinal nerve trunk
Meningeal branch
Spinal (posterior root) ganglion
Posterior root
Anterior root
Erector spinae muscle
Medial branch,
Lateral branch of
Posterior ramus
Anterior ramus of spinal nerve (intercostal nerve)
Collateral branch
External intercostal muscles
Internal intercostal muscles
Innermost intercostal muscles
Latissimus dorsi muscle
Subcostal muscles
Serratus anterior muscle
Lateral cutaneous branch
Window cut in innermost intercostal muscle
Communicating branch
Internal intercostal muscle
Internal intercostal membranes anterior to external intercostal muscles
Greater and lesser thoracic splanchnic nerves
Sympathetic trunk
Gray and white rami communicantes
Collateral branch rejoining intercostal nerve
Innermost intercostal muscles
Internal intercostal muscles
External intercostal muscles
Transversus abdominis muscle
Rectus abdominis muscle
Linea alba
External intercostal membrane
External abdominal oblique muscle
Anterior cutaneous branch
F. Netter M.D.

See also Plates 254, 256

Anterior view

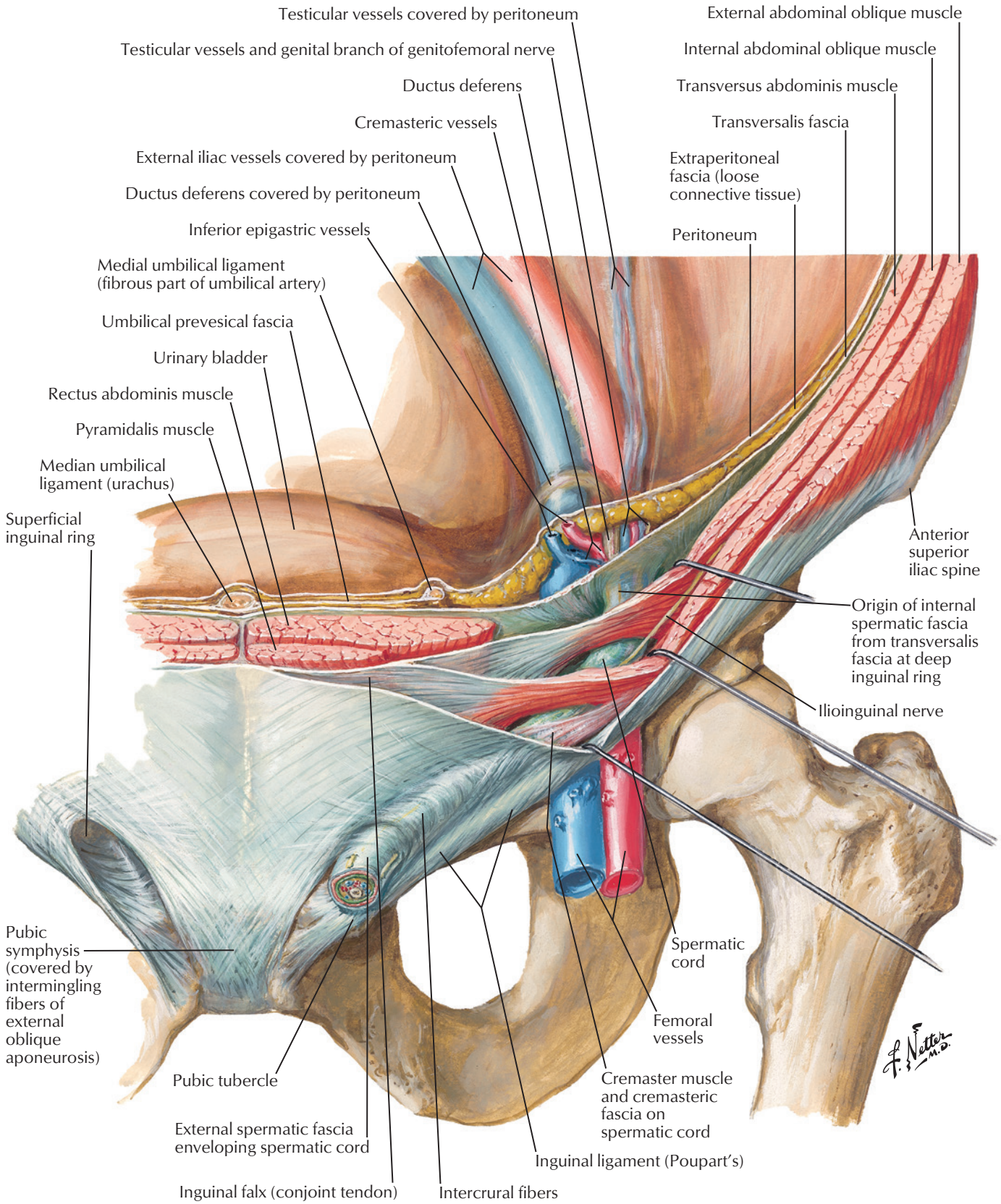


Posterior (internal) view

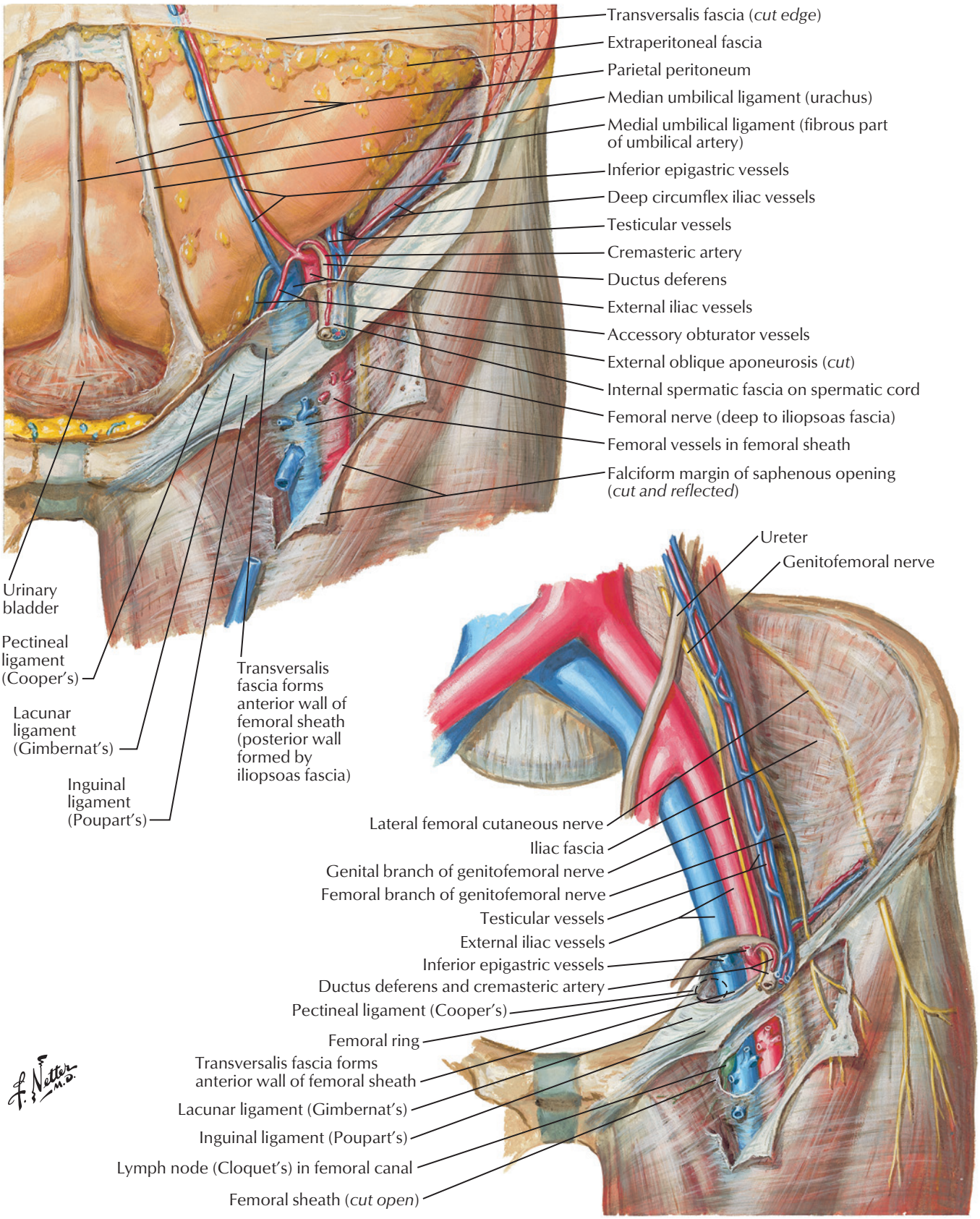


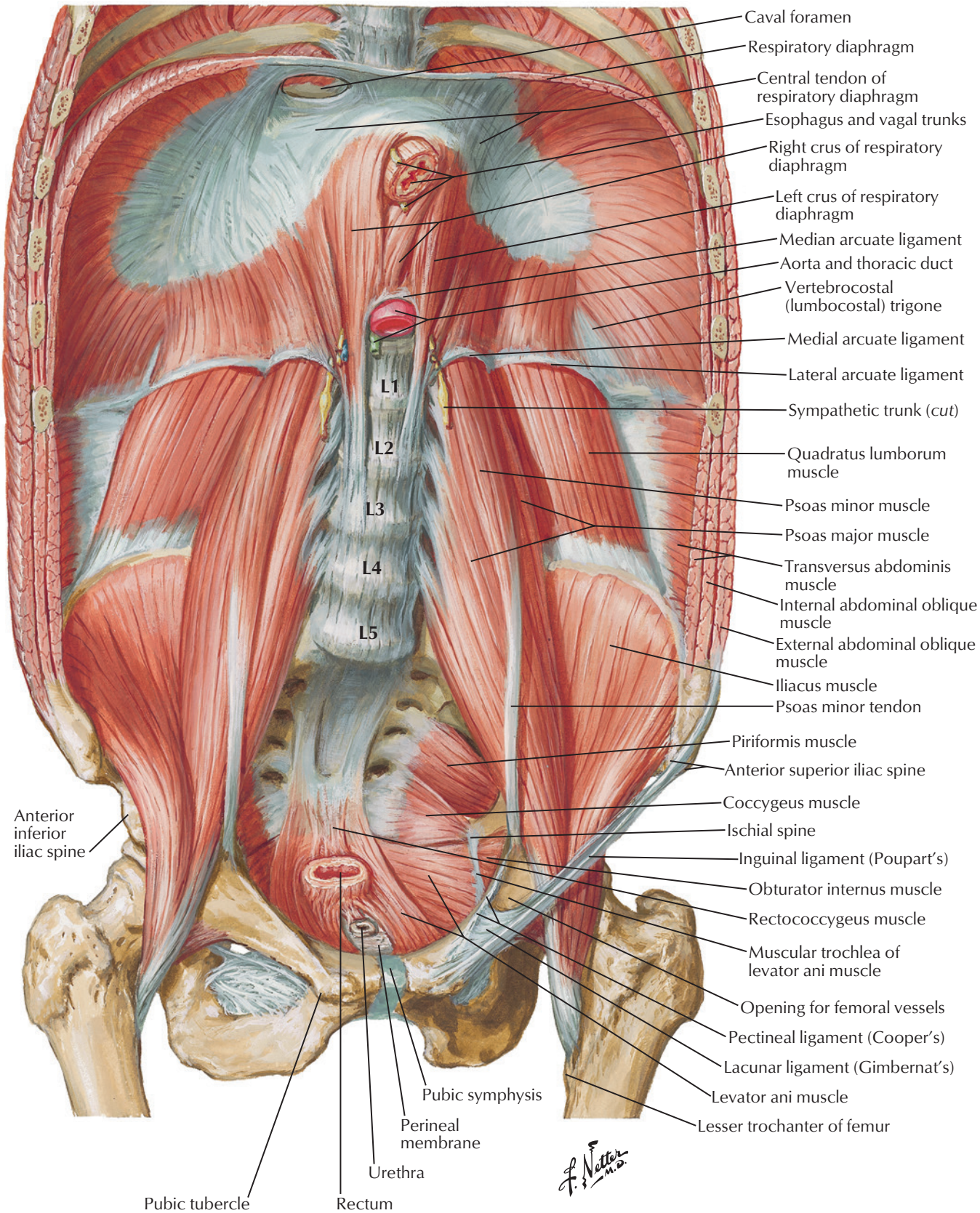
Hesselbach's triangle by Carlos Machado after Frank Netter

See also Plates 252, 260



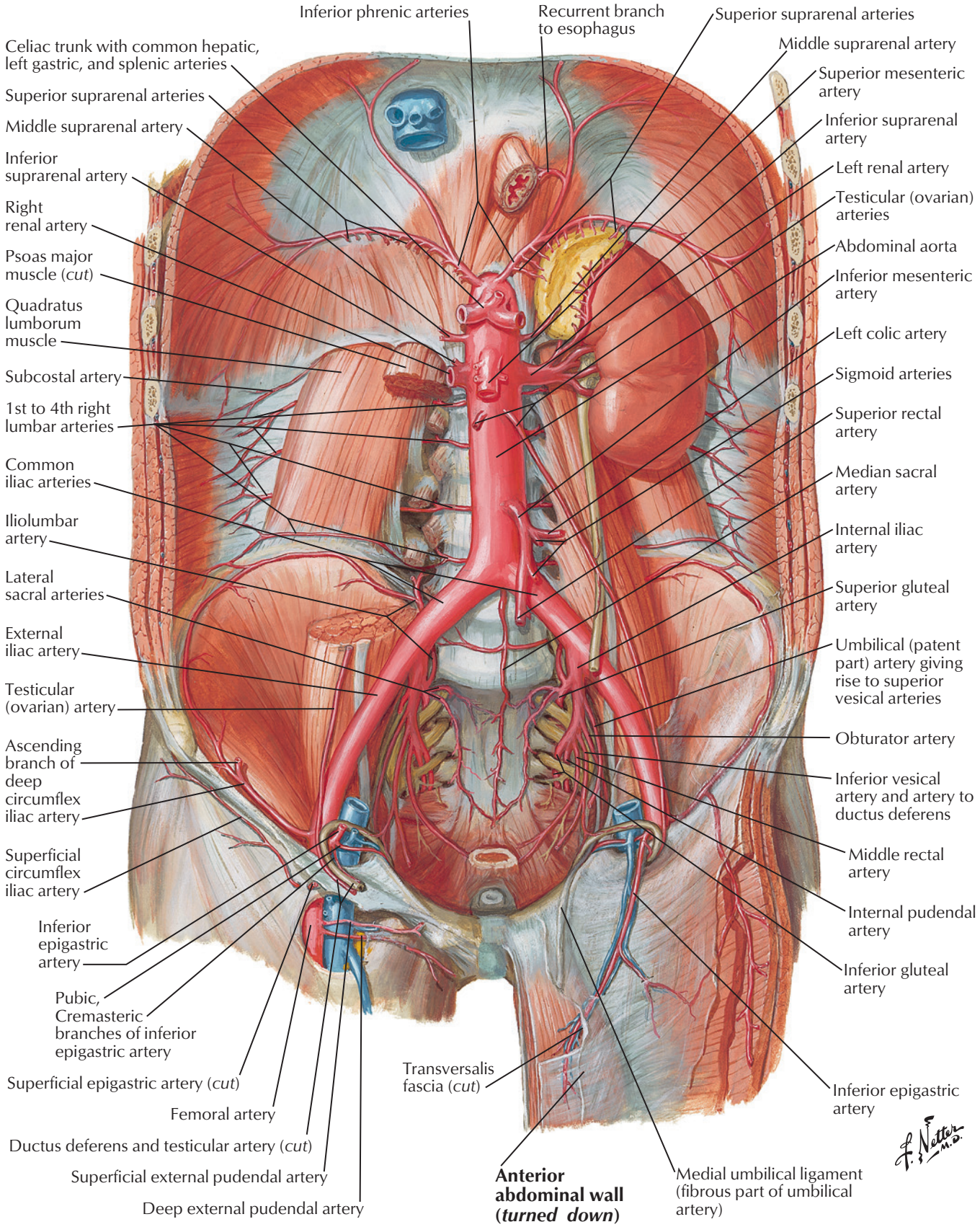
See also Plates 253, 254, 256



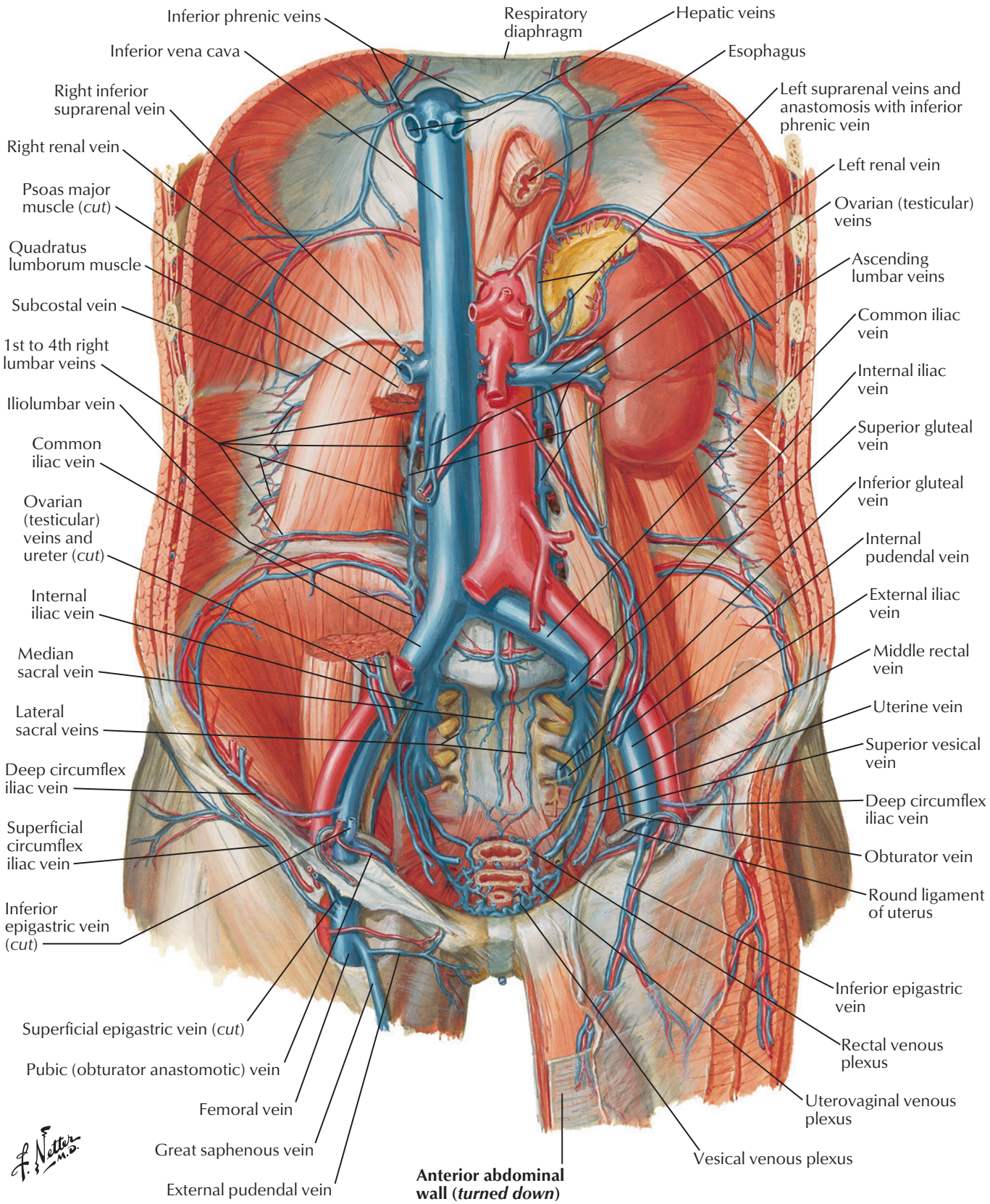

Caval foramen
Respiratory diaphragm
Central tendon of respiratory diaphragm
Esophagus and vagal trunks
Right crus of respiratory diaphragm
Left crus of respiratory diaphragm
Median arcuate ligament
Aorta and thoracic duct
Vertebrocostal (lumbocostal) trigone
Medial arcuate ligament
Lateral arcuate ligament
Sympathetic trunk (*cut*)
Quadratus lumborum muscle
Psoas minor muscle
Psoas major muscle
Transversus abdominis muscle
Internal abdominal oblique muscle
External abdominal oblique muscle
Iliacus muscle
Psoas minor tendon
Piriformis muscle
Anterior superior iliac spine
Coccygeus muscle
Ischial spine
Inguinal ligament (Poupart's)
Obturator internus muscle
Rectococcygeus muscle
Muscular trochlea of levator ani muscle
Opening for femoral vessels
Pectineal ligament (Cooper's)
Lacunar ligament (Gimbernat's)
Levator ani muscle
Lesser trochanter of femur
L1
L2
L3
L4
L5
Anterior inferior iliac spine
Pubic symphysis
Perineal membrane
Urethra
Pubic tubercle
Rectum
F. Netter M.D.

Arteries of Posterior Abdominal Wall

See also Plates 201, 383, 384

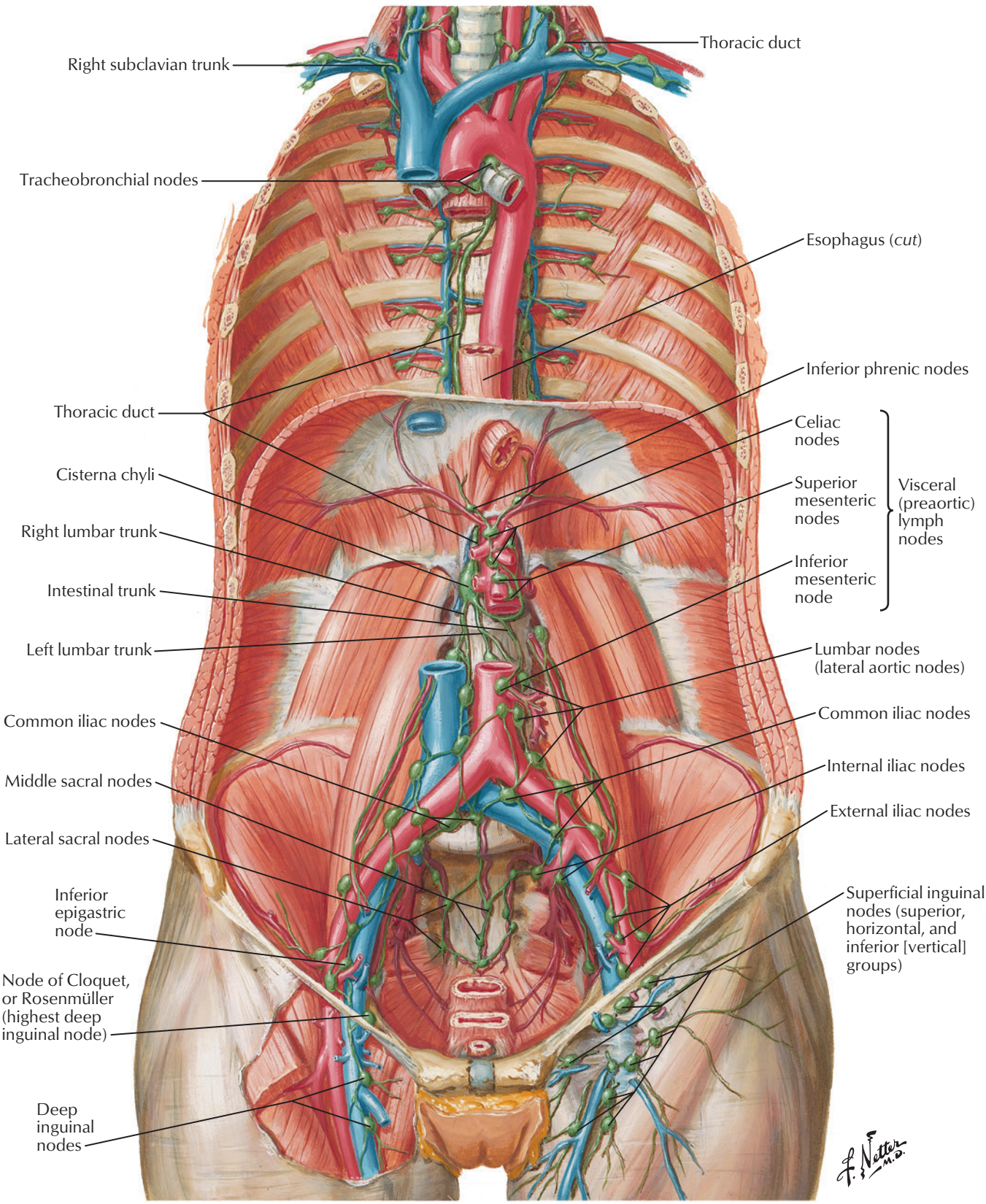


See also Plates 382, 383

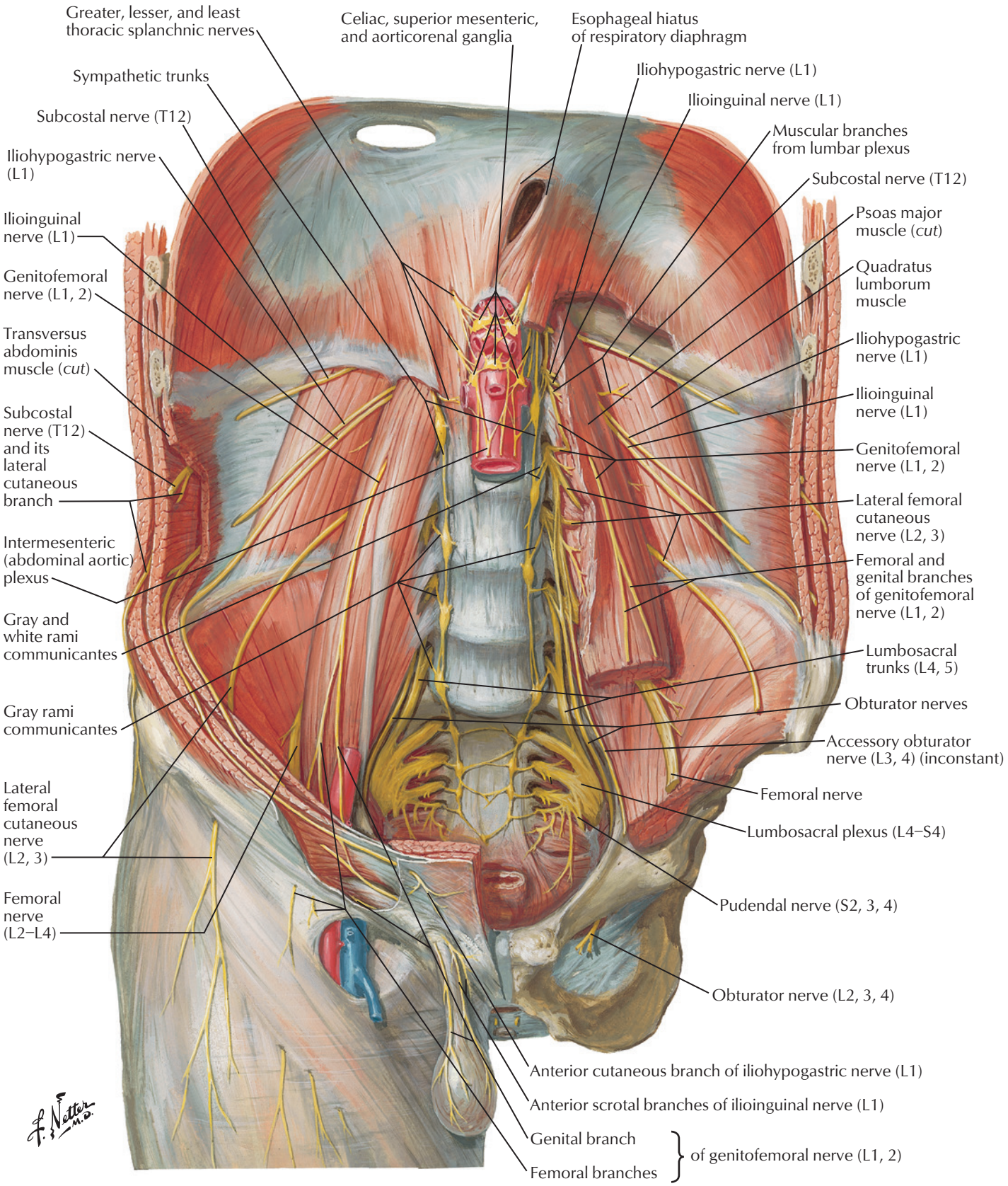


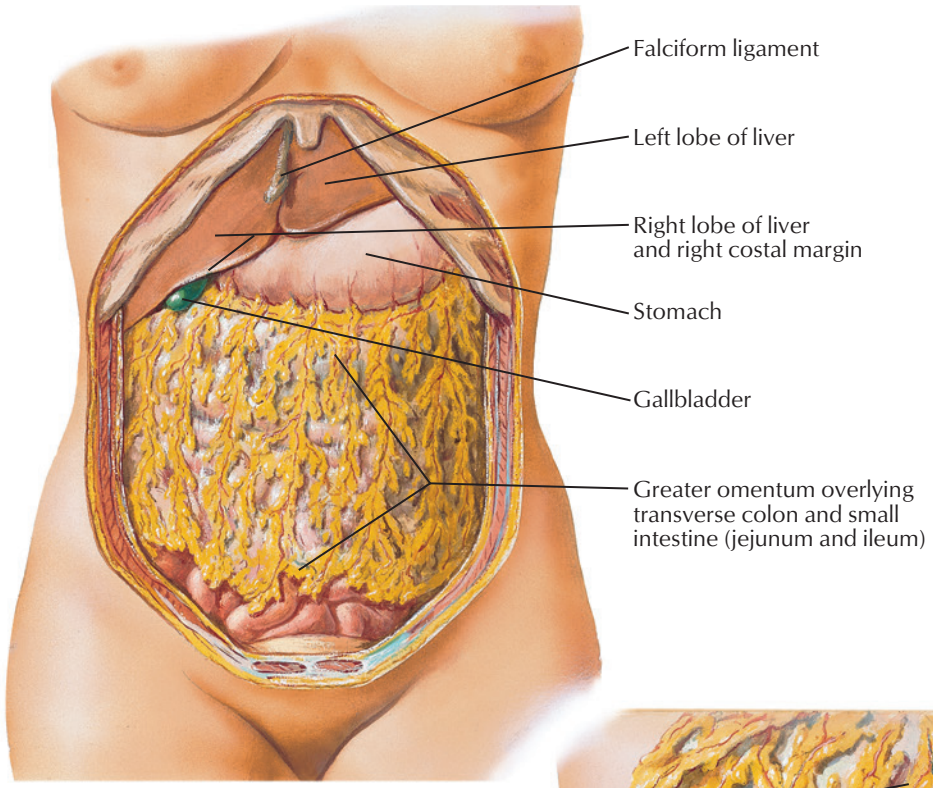
Lymph Vessels and Nodes of Posterior Abdominal Wall

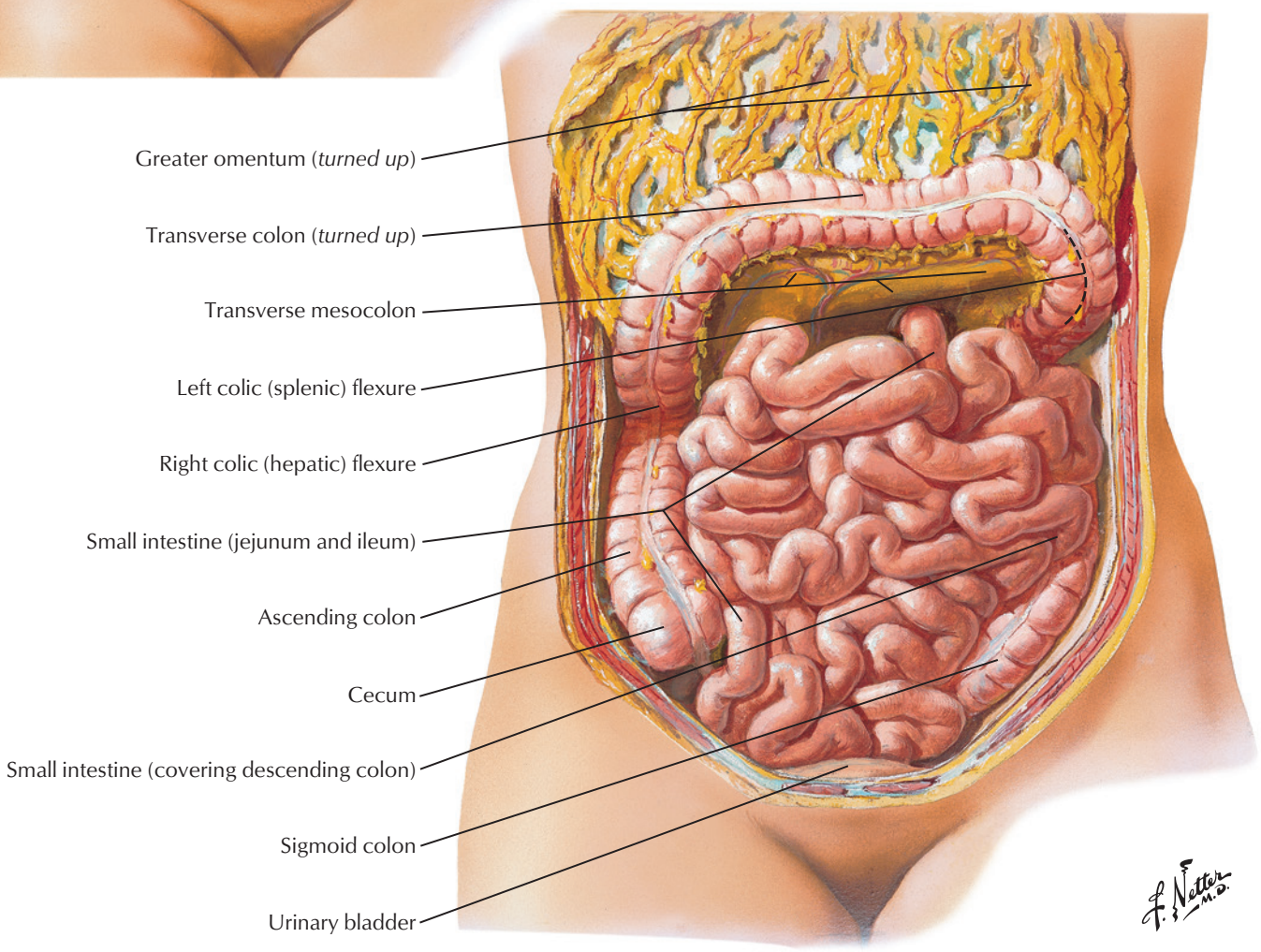
See also Plates 319, 388



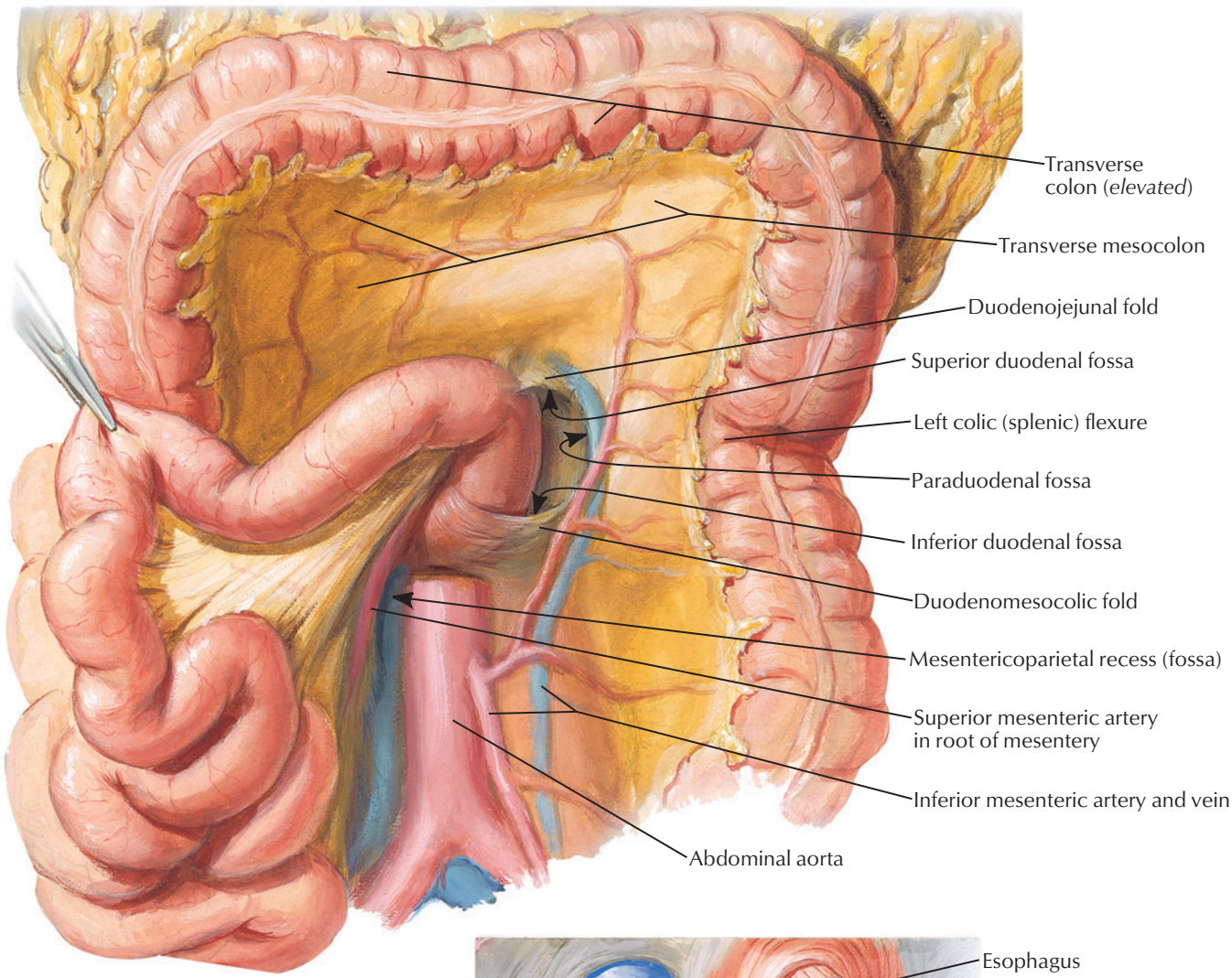
See also Plates 201, 392



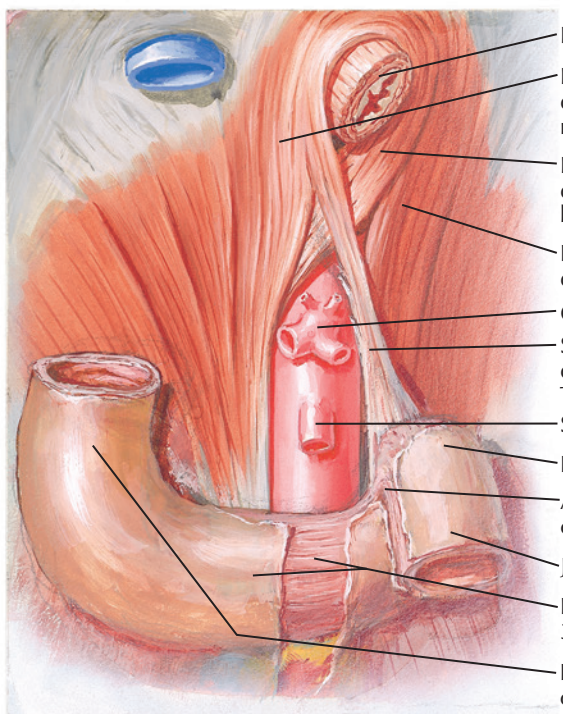

Falciform ligament
Left lobe of liver
Right lobe of liver and right costal margin
Stomach
Gallbladder
Greater omentum overlying transverse colon and small intestine (jejunum and ileum)


Greater omentum (*turned up*)
Transverse colon (*turned up*)
Transverse mesocolon
Left colic (splenic) flexure
Right colic (hepatic) flexure
Small intestine (jejunum and ileum)
Ascending colon
Cecum
Small intestine (covering descending colon)
Sigmoid colon
Urinary bladder

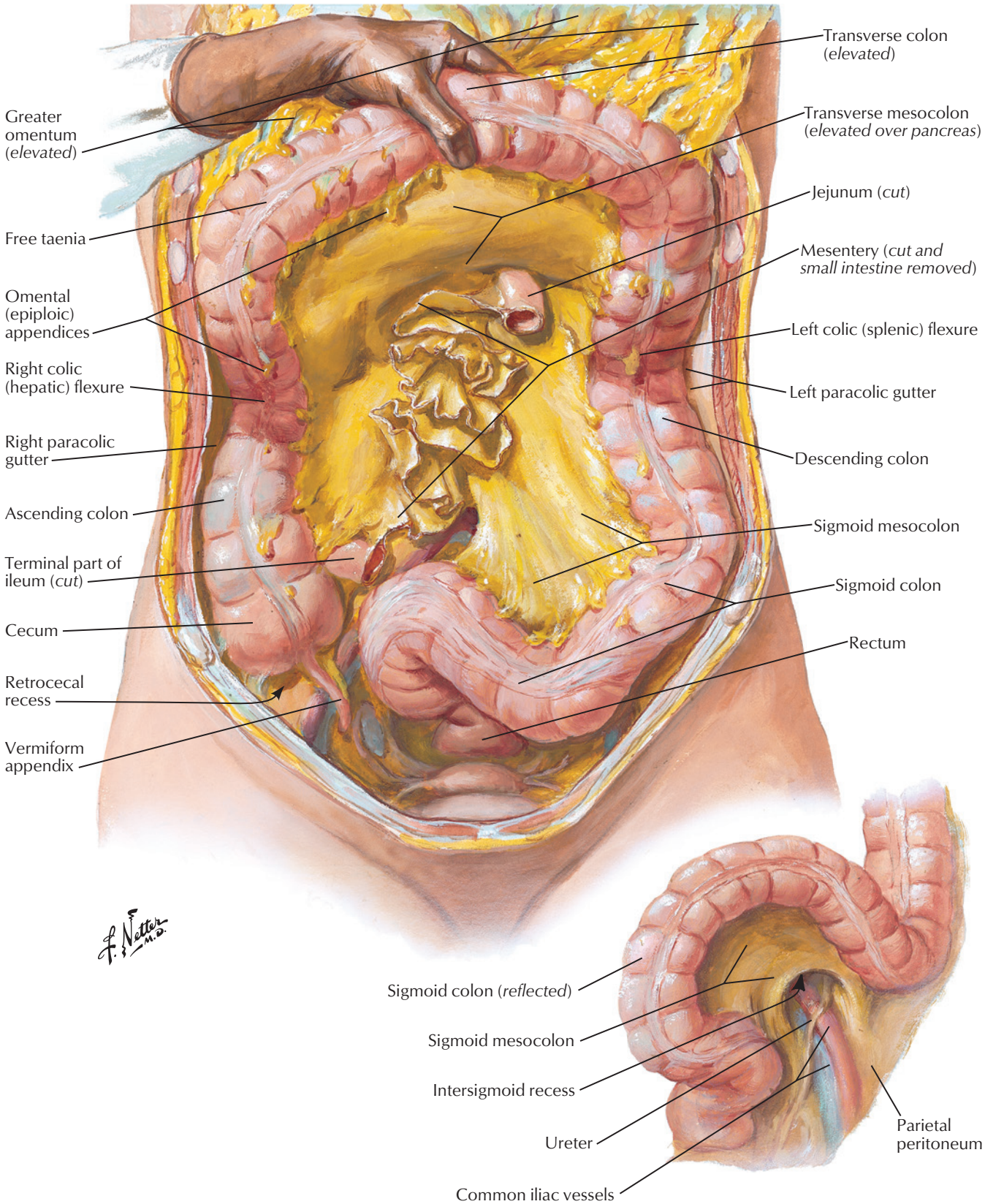
See also Plate 288



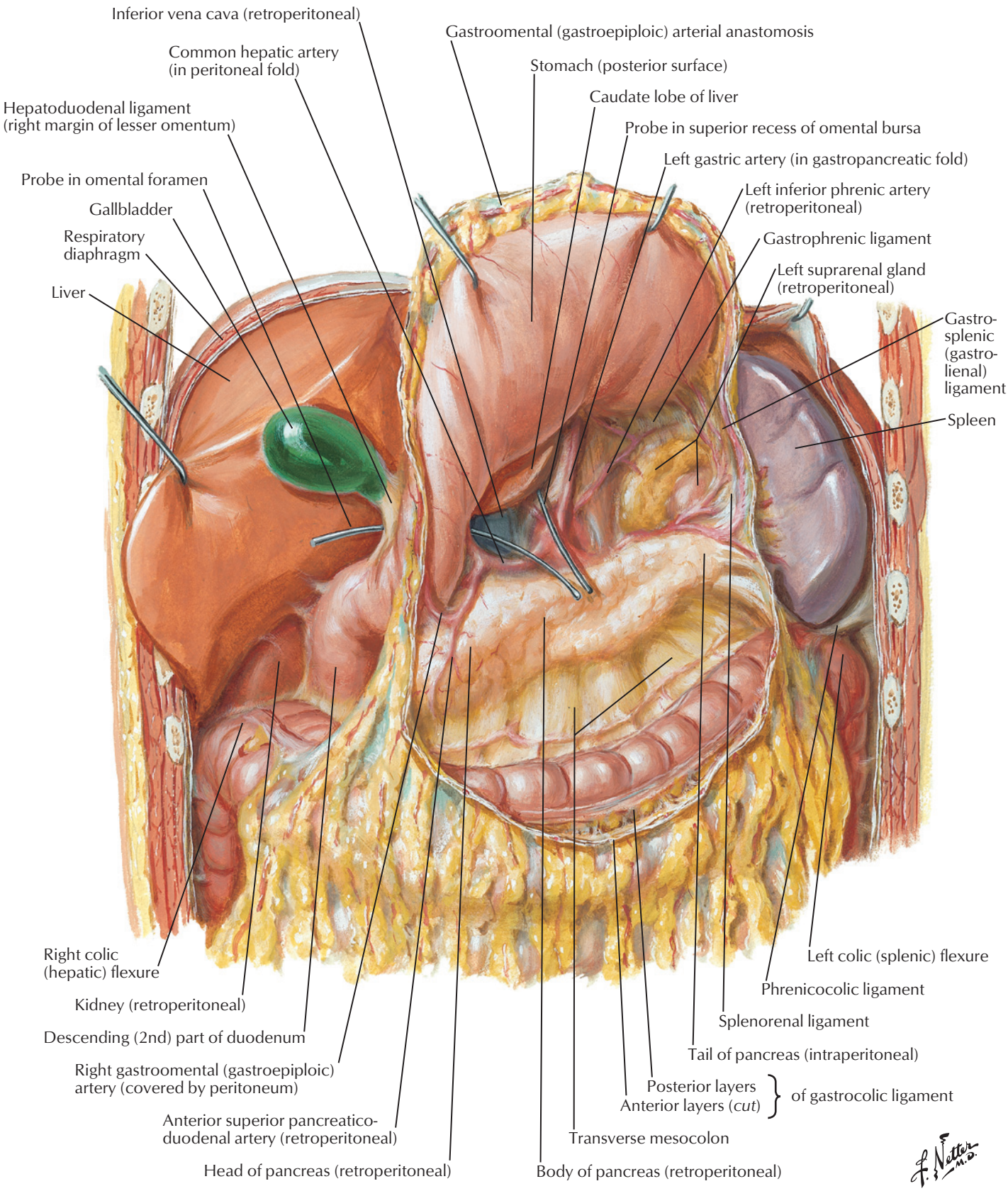
Exposure of suspensory muscle of duodenum (ligament of Treitz)



See also Plate 295

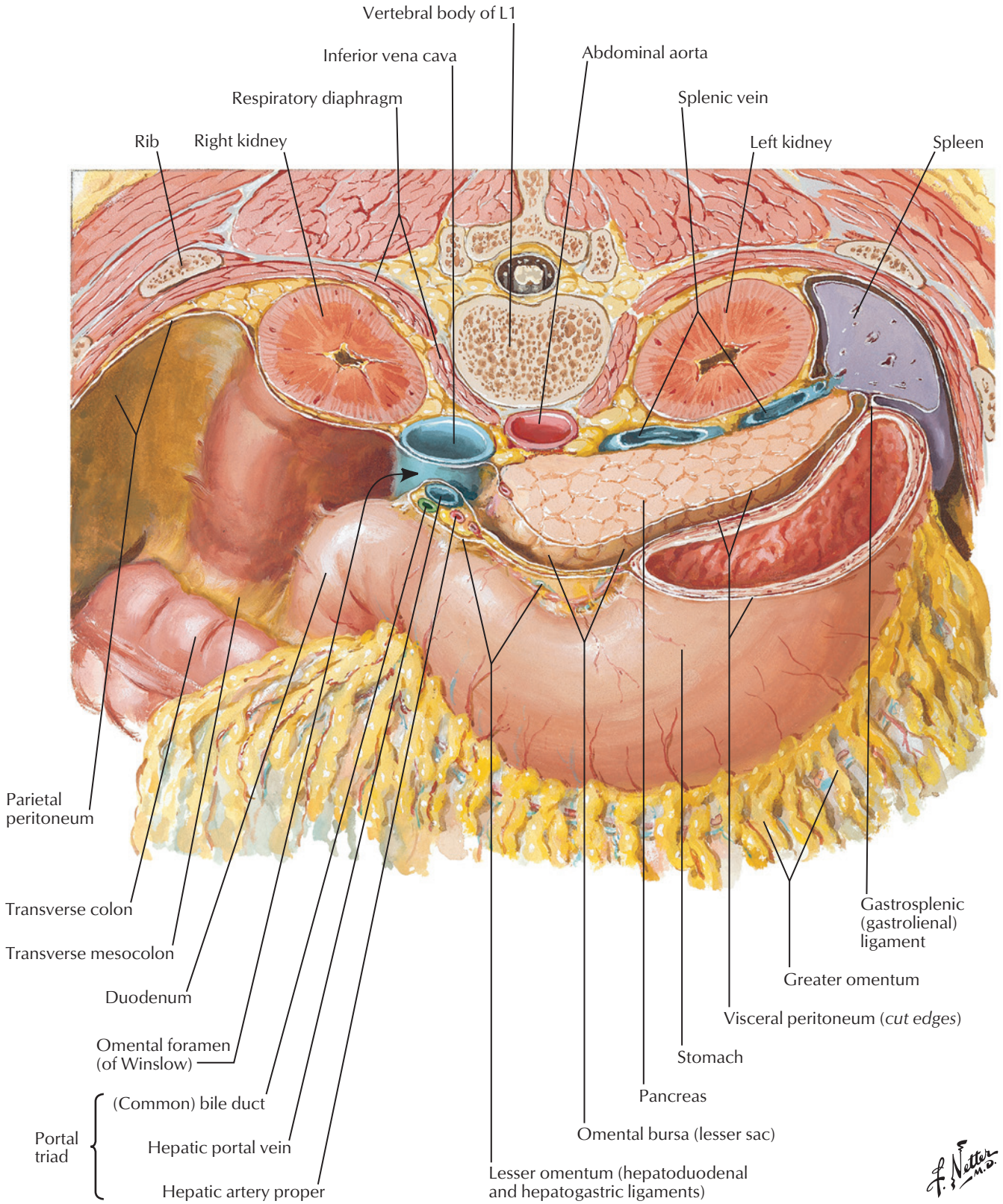


See also Plates 288, 291

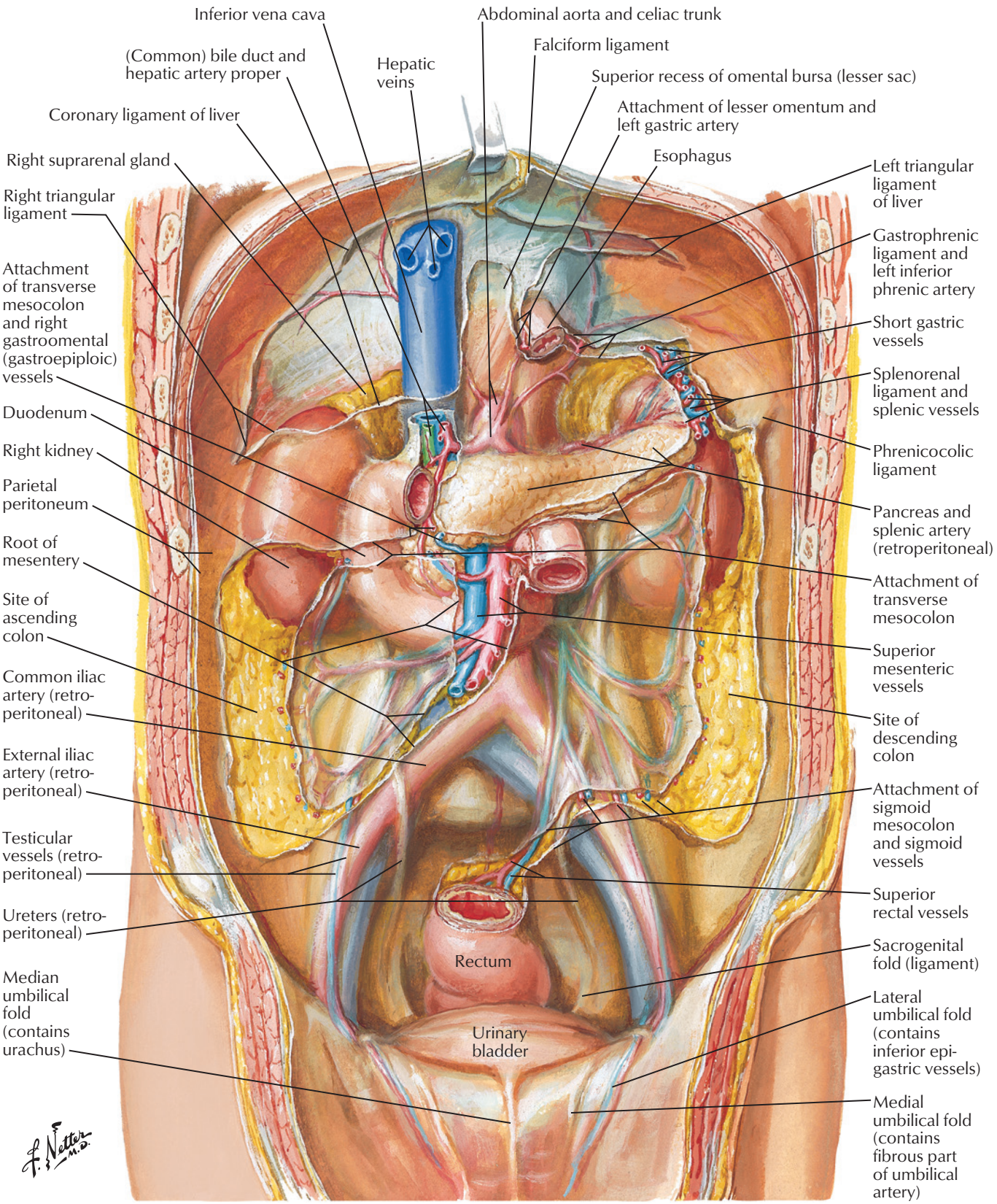


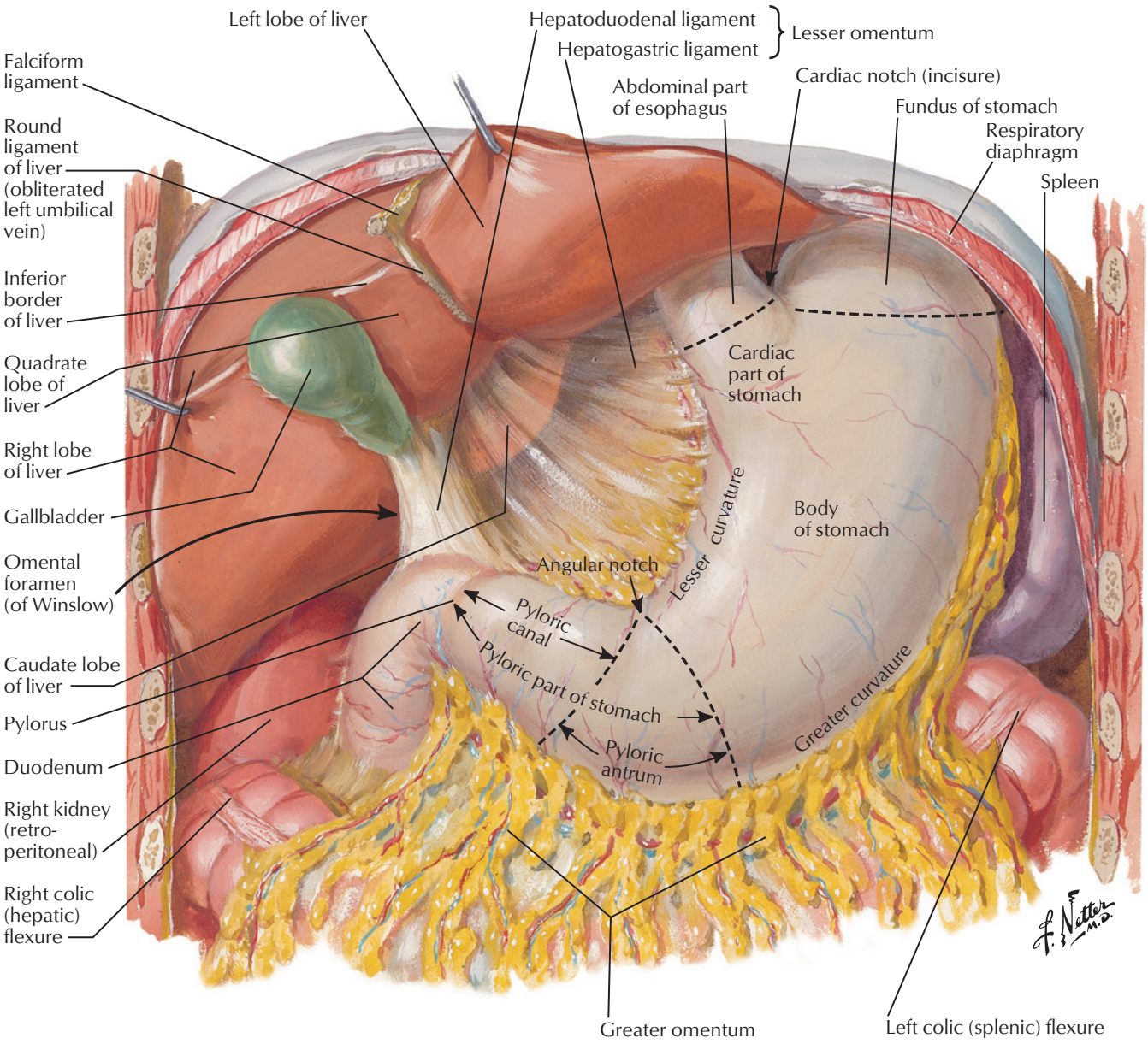
Omental Bursa: Cross Section

See also Plate 276

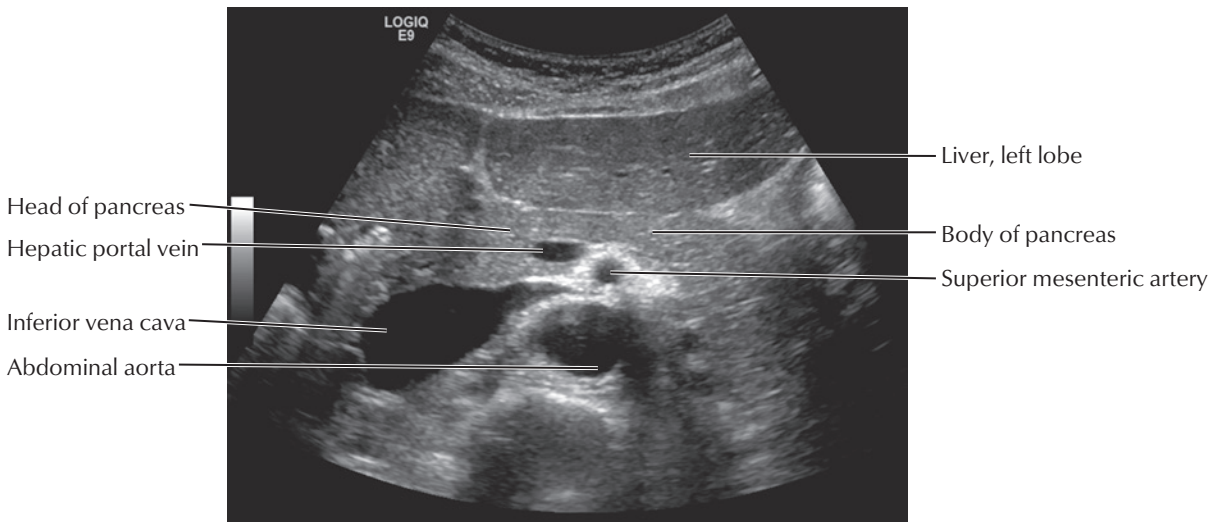


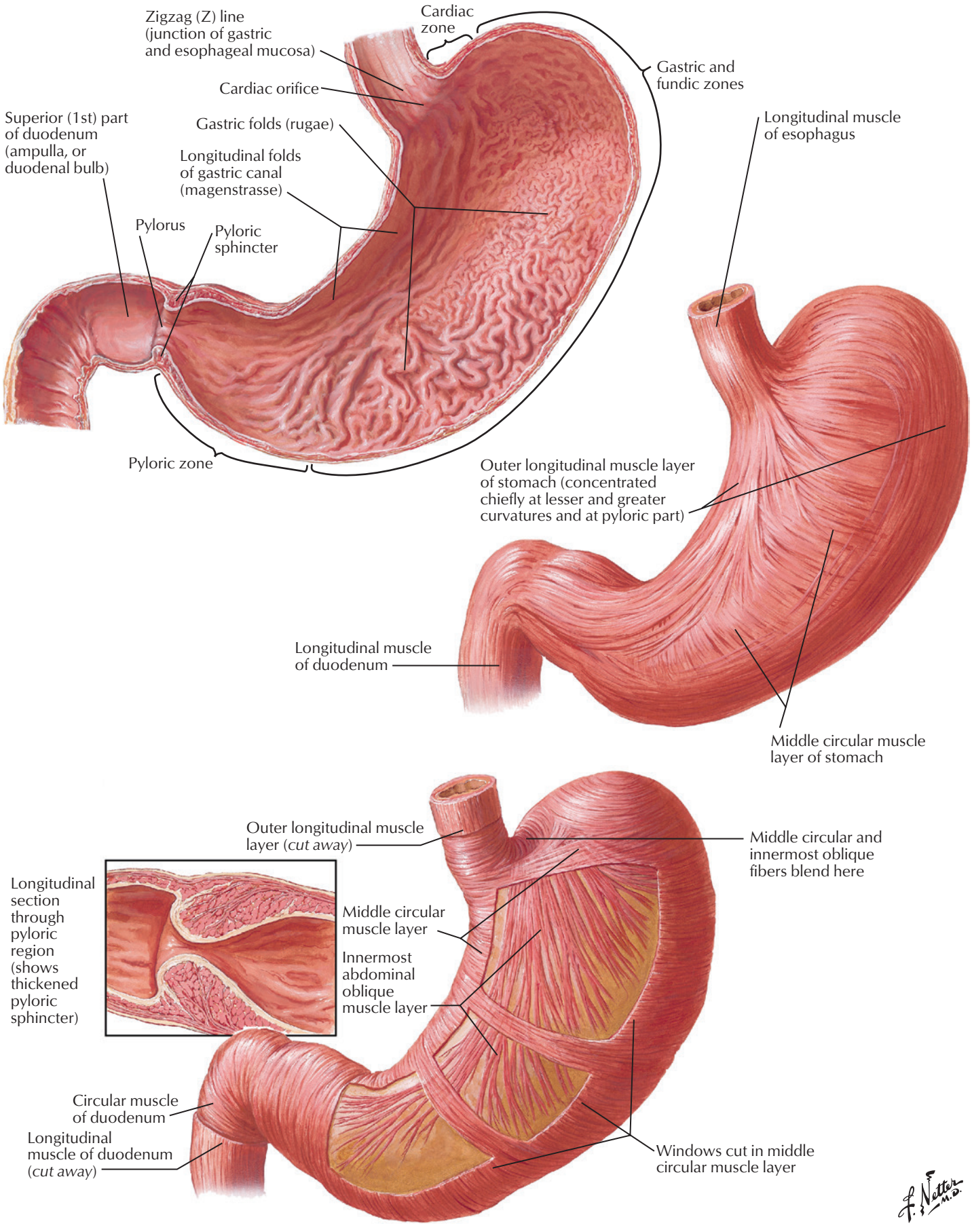
See also Plate 278





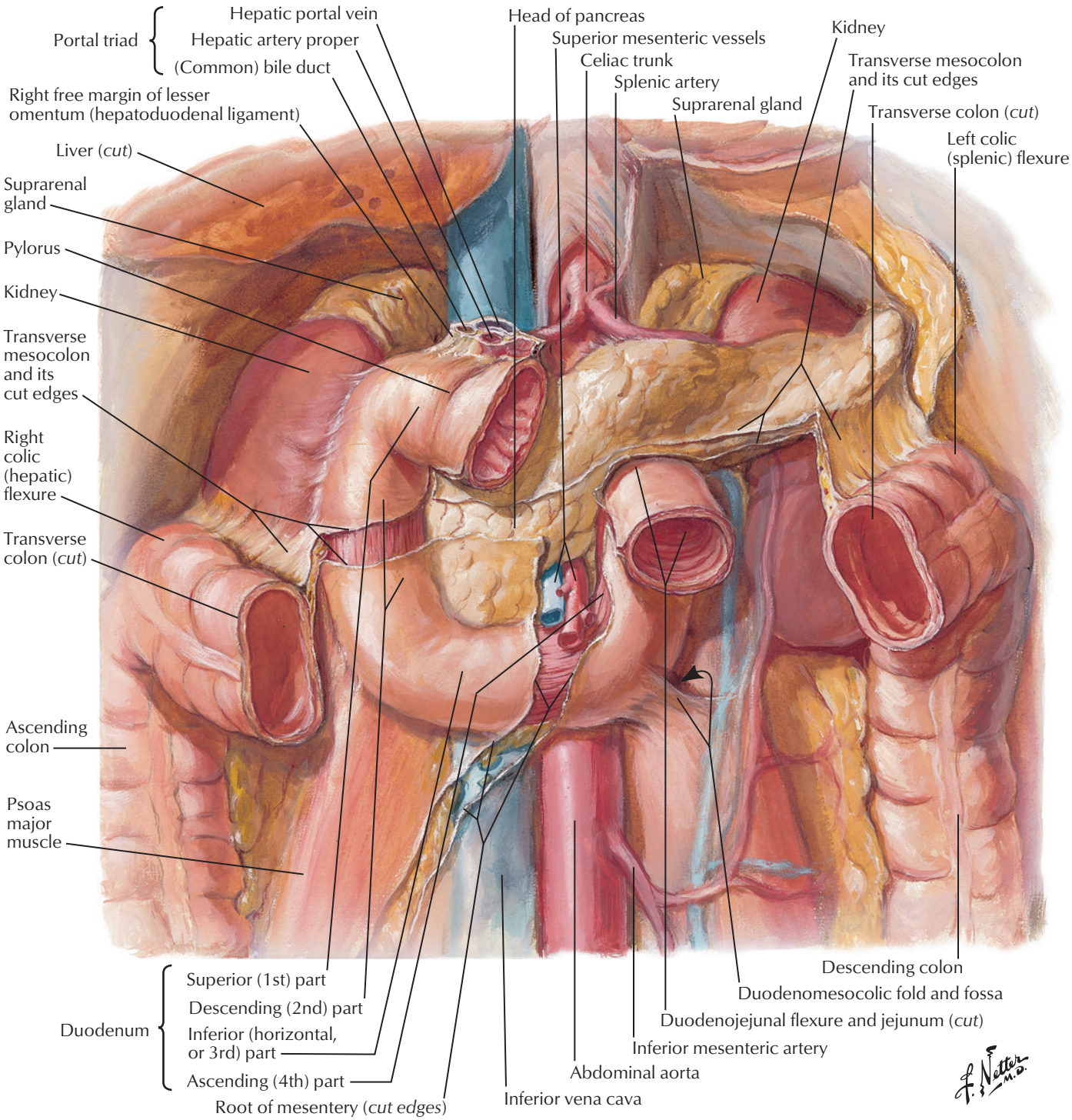
Transverse gray-scale ultrasound image of midabdomen



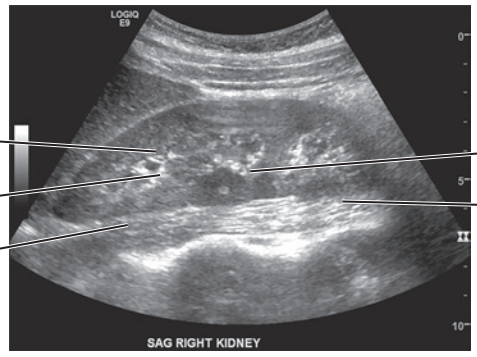

Zigzag (Z) line (junction of gastric and esophageal mucosa)
Cardiac zone
Cardiac orifice
Gastric and fundic zones
Superior (1st) part of duodenum (ampulla, or duodenal bulb)
Gastric folds (rugae)
Longitudinal folds of gastric canal (magenstrasse)
Longitudinal muscle of esophagus
Pylorus
Pyloric sphincter
Pyloric zone
Outer longitudinal muscle layer of stomach (concentrated chiefly at lesser and greater curvatures and at pyloric part)
Longitudinal muscle of duodenum
Middle circular muscle layer of stomach
Outer longitudinal muscle layer (cut away)
Middle circular and innermost oblique fibers blend here
Longitudinal section through pyloric region (shows thickened pyloric sphincter)
Middle circular muscle layer
Innermost abdominal oblique muscle layer
Circular muscle of duodenum
Longitudinal muscle of duodenum (cut away)
Windows cut in middle circular muscle layer

Duodenum in Situ

See also Plate 275

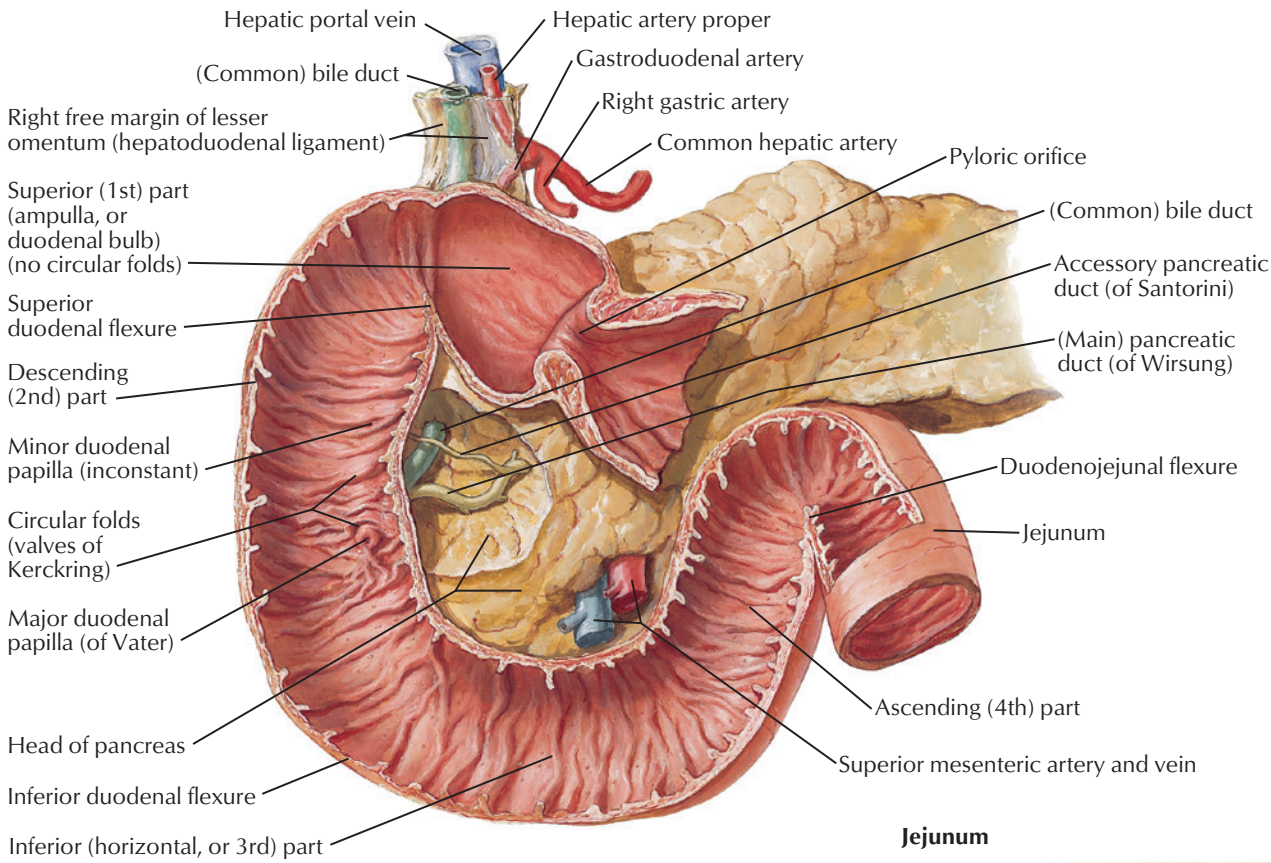


Gray-scale ultrasound image of right kidney, sagittal view

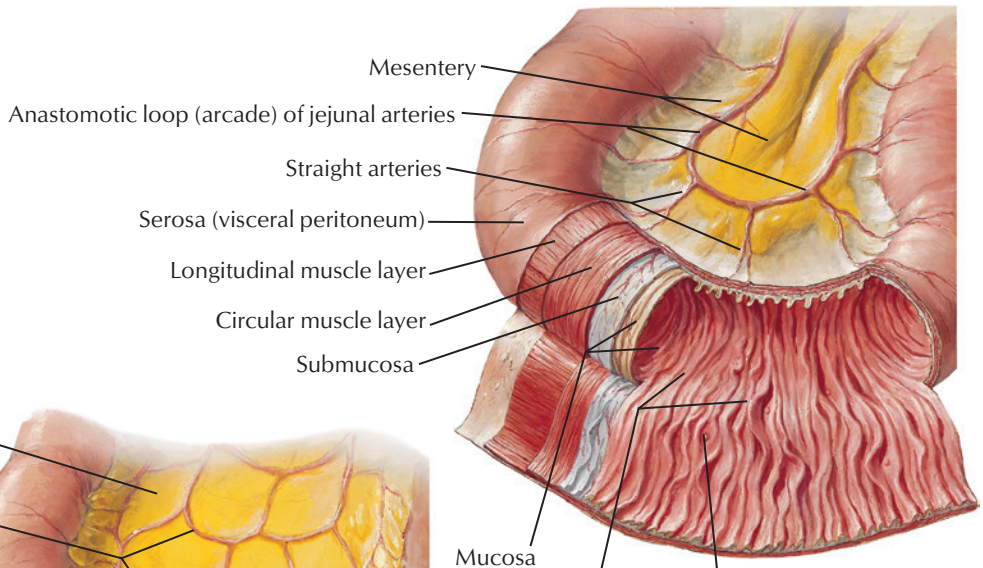


Liver
Hepatorenal space (of Morrison)
Superior pole of kidney
Renal cortex
Lower pole of kidney

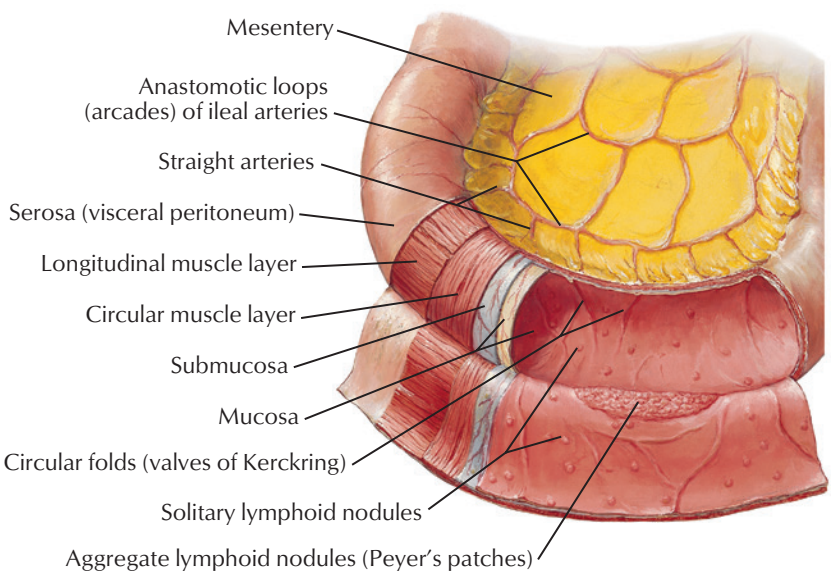
See also Plate 277



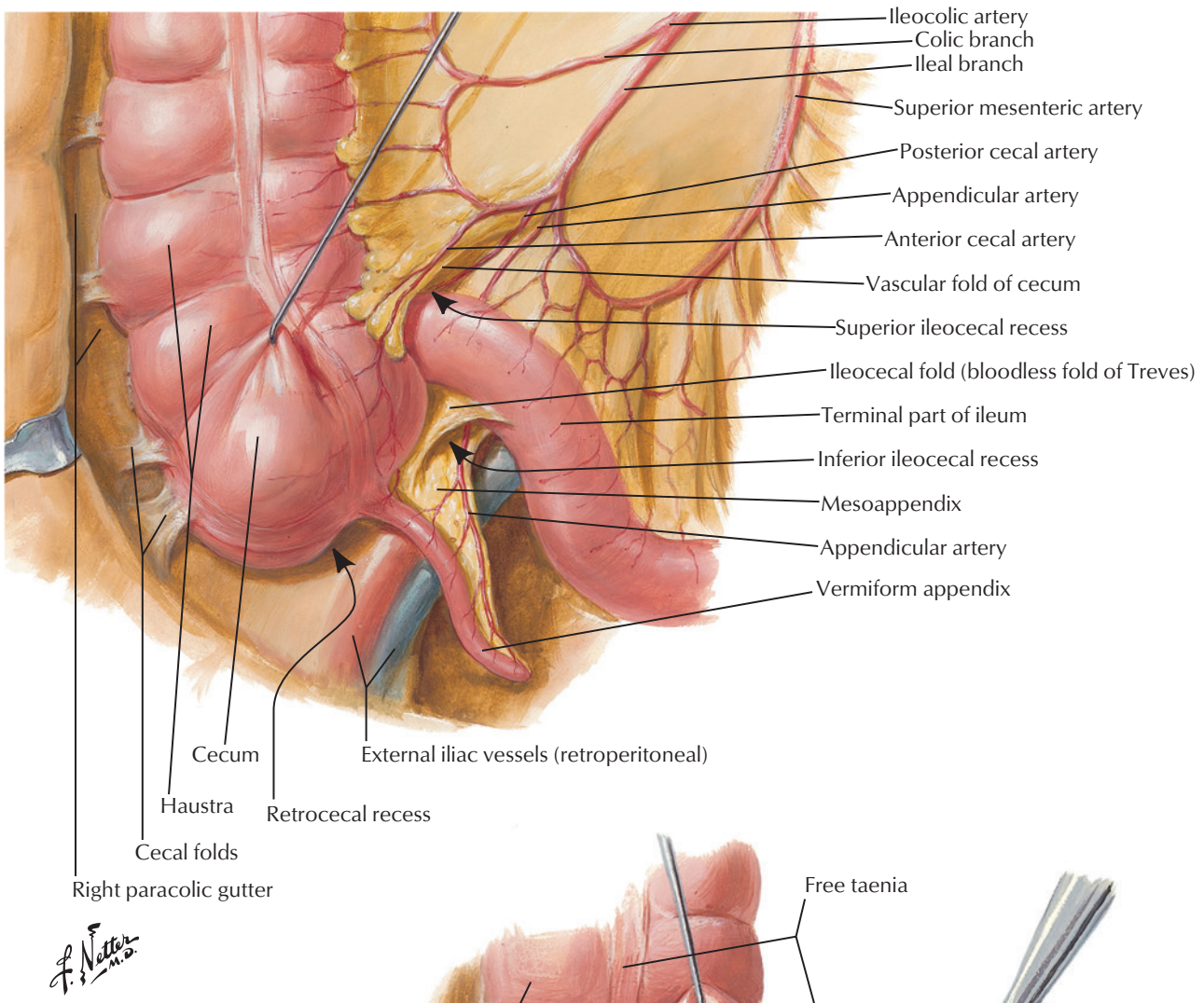
Jejunum

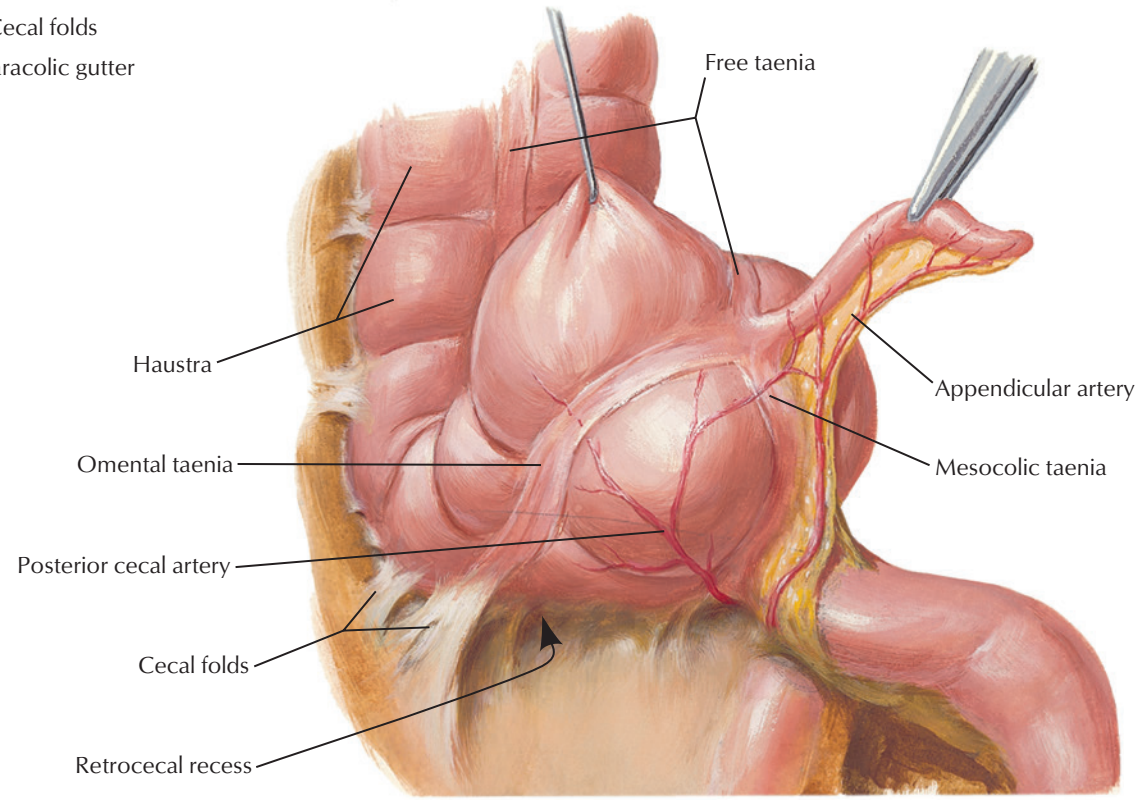


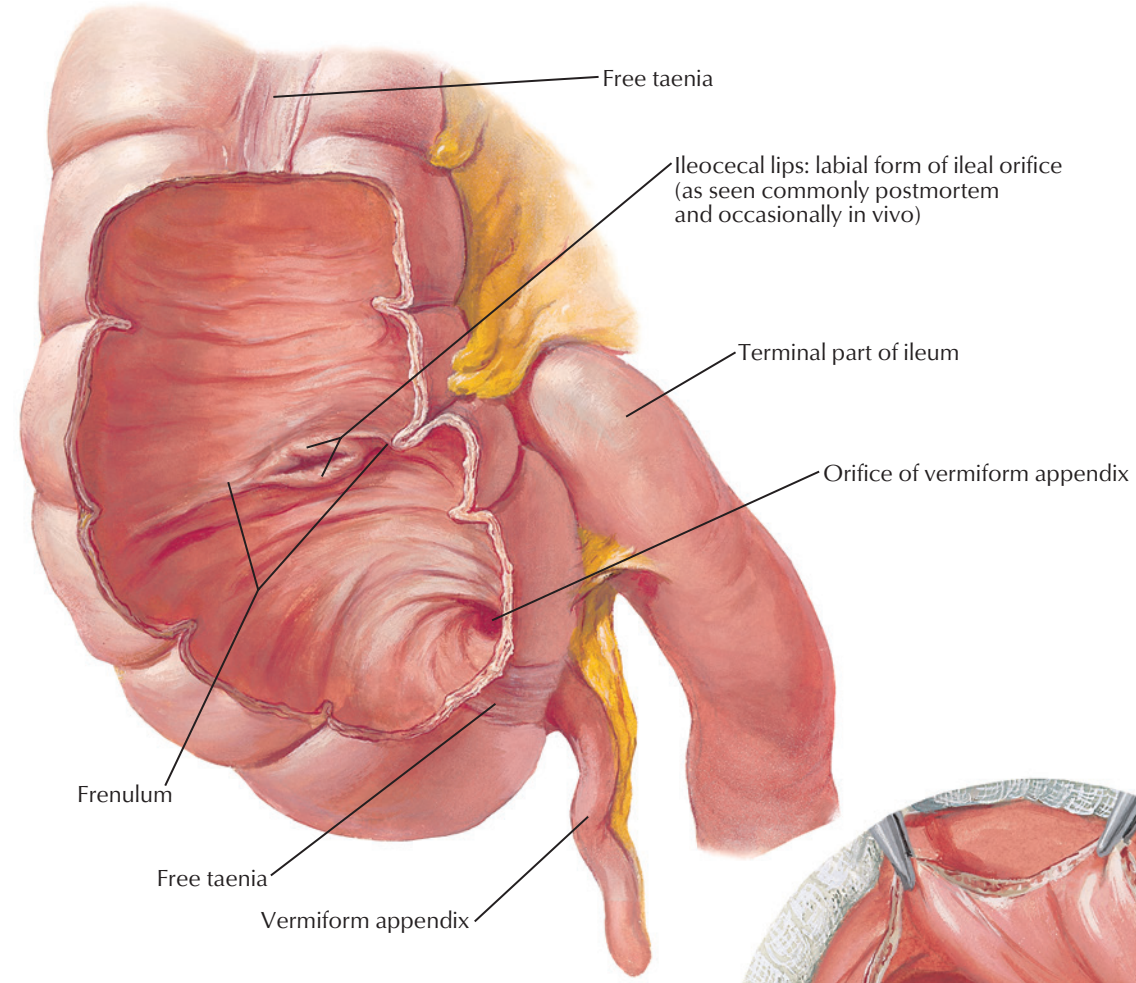
Ileum

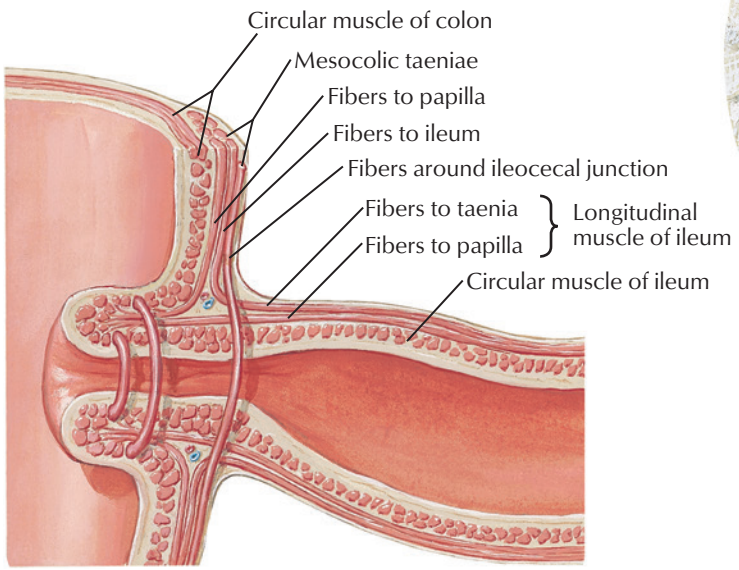


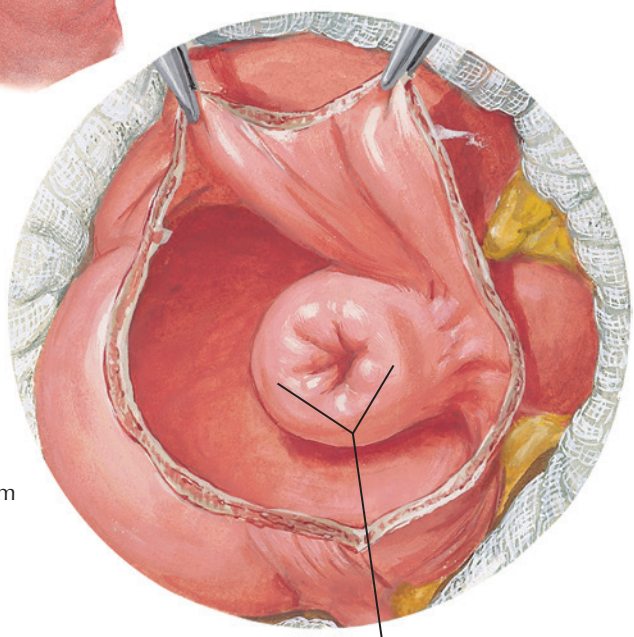
See also Plates 294, 295



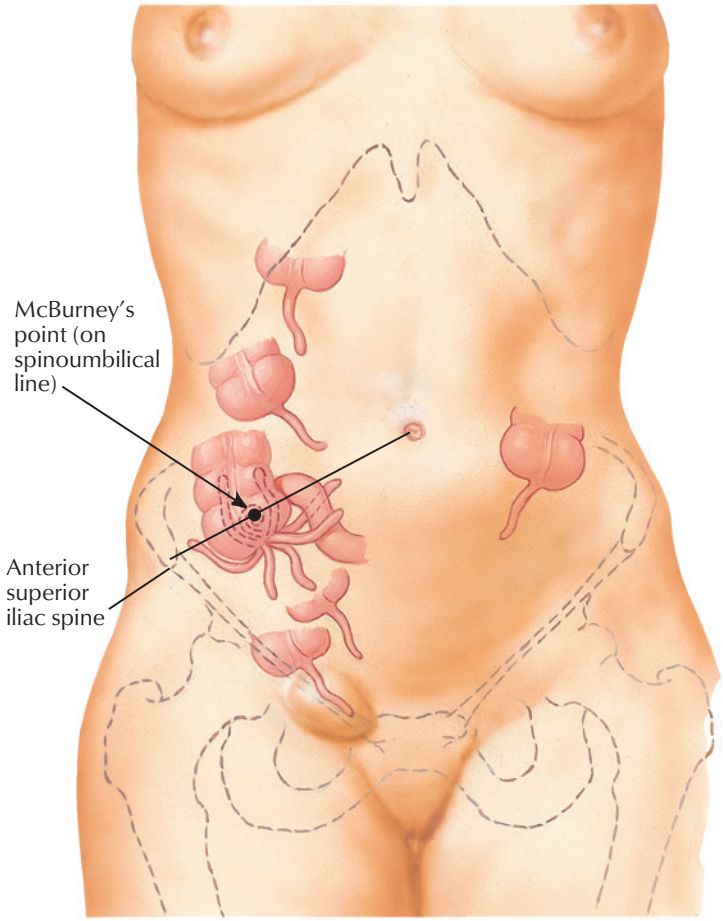




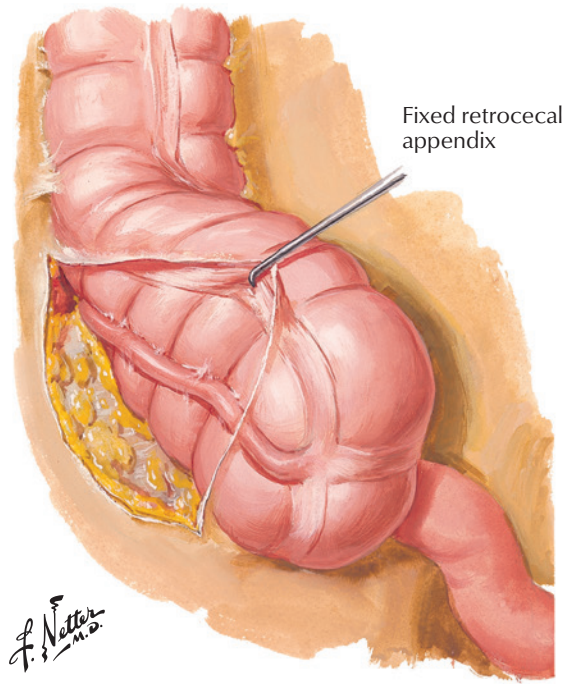




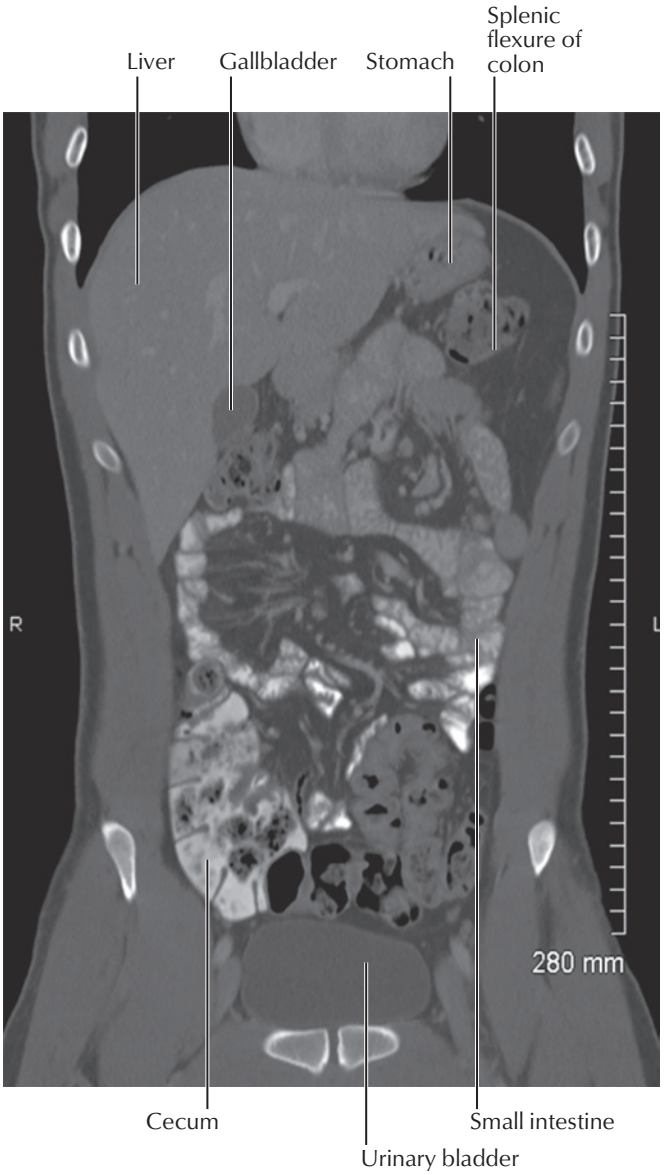
Schema of muscle fibers at ileal orifice



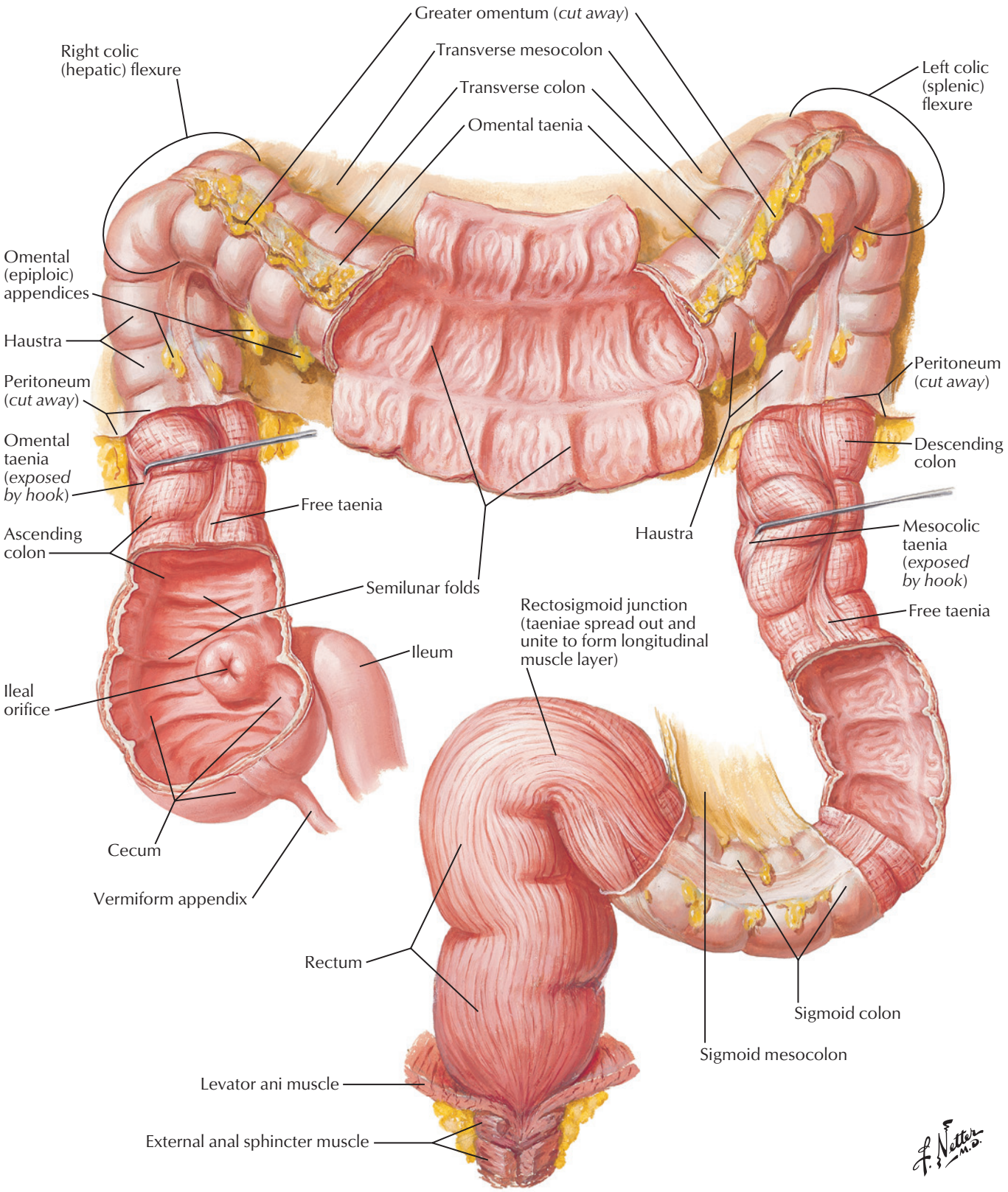
Variations in position of appendix



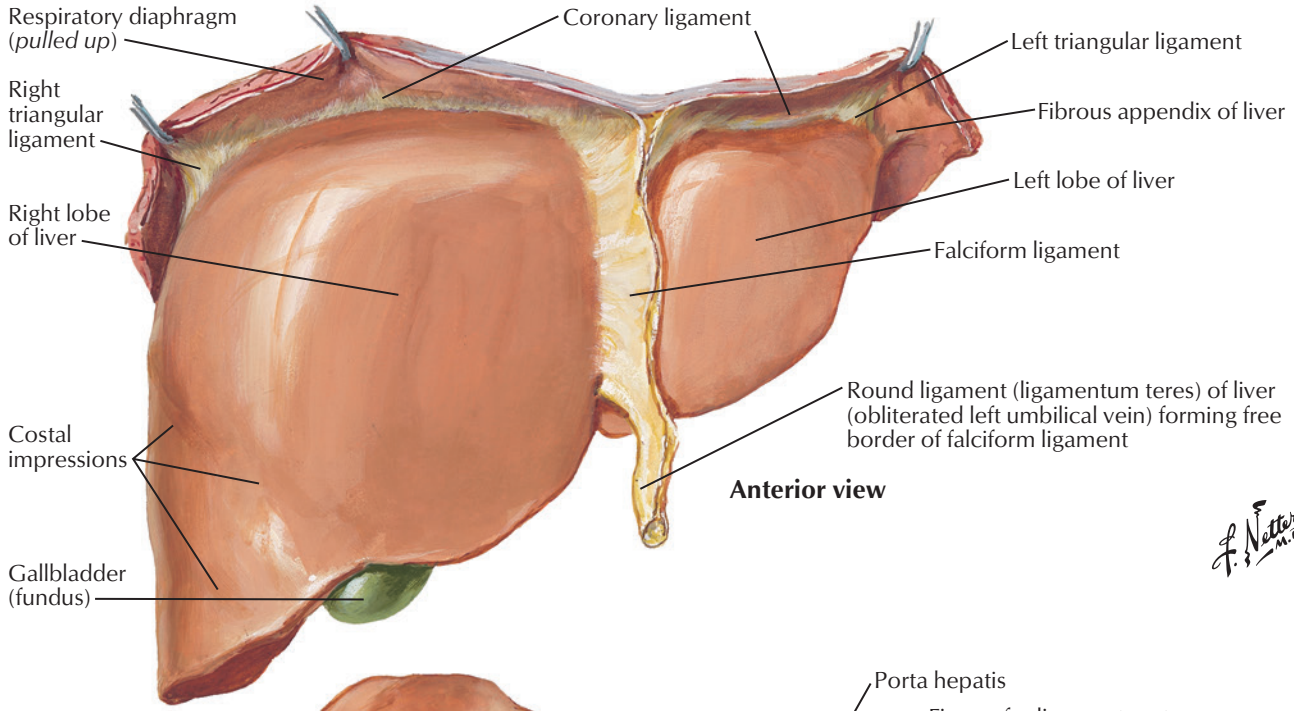
Coronal CT image with oral and intravenous contrast



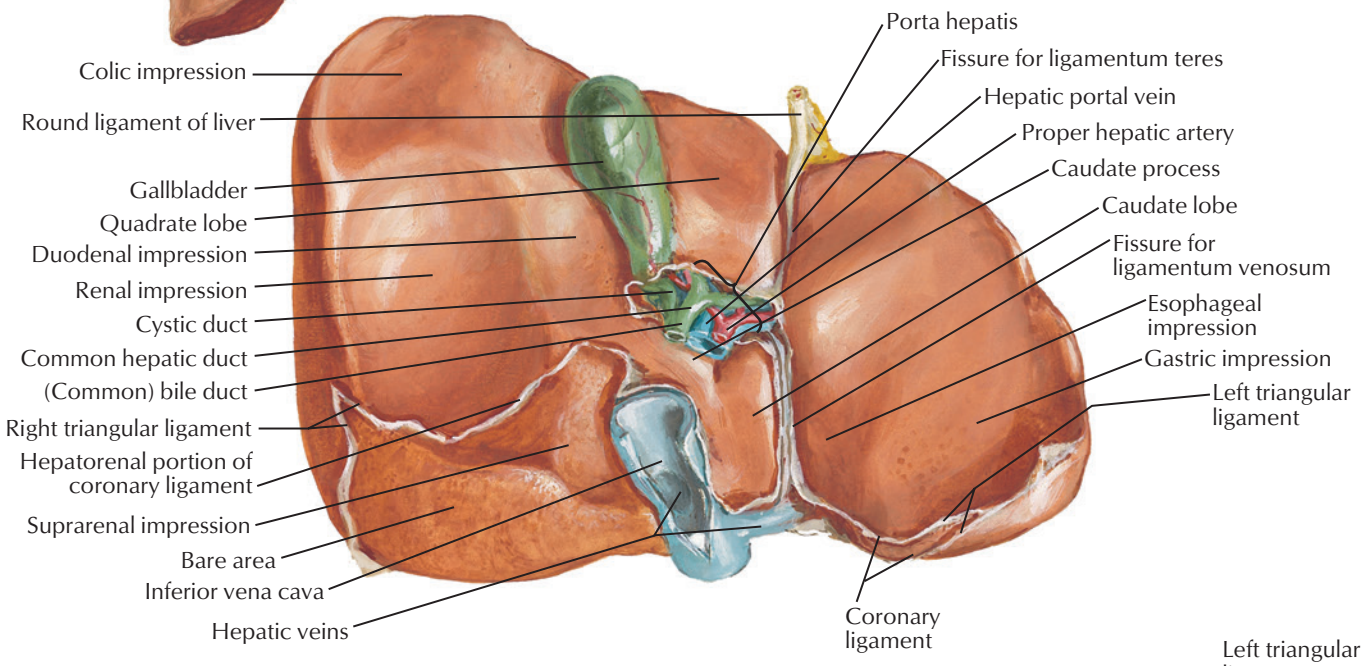
See also Plate 295



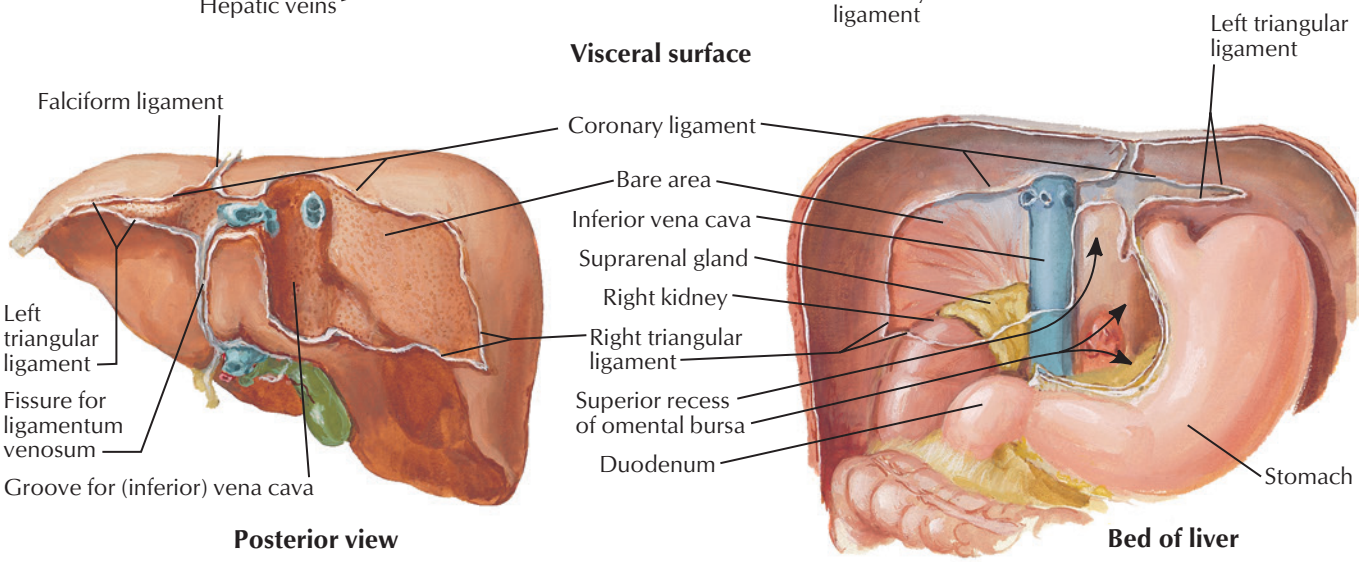
See also Plate 275



Anterior view



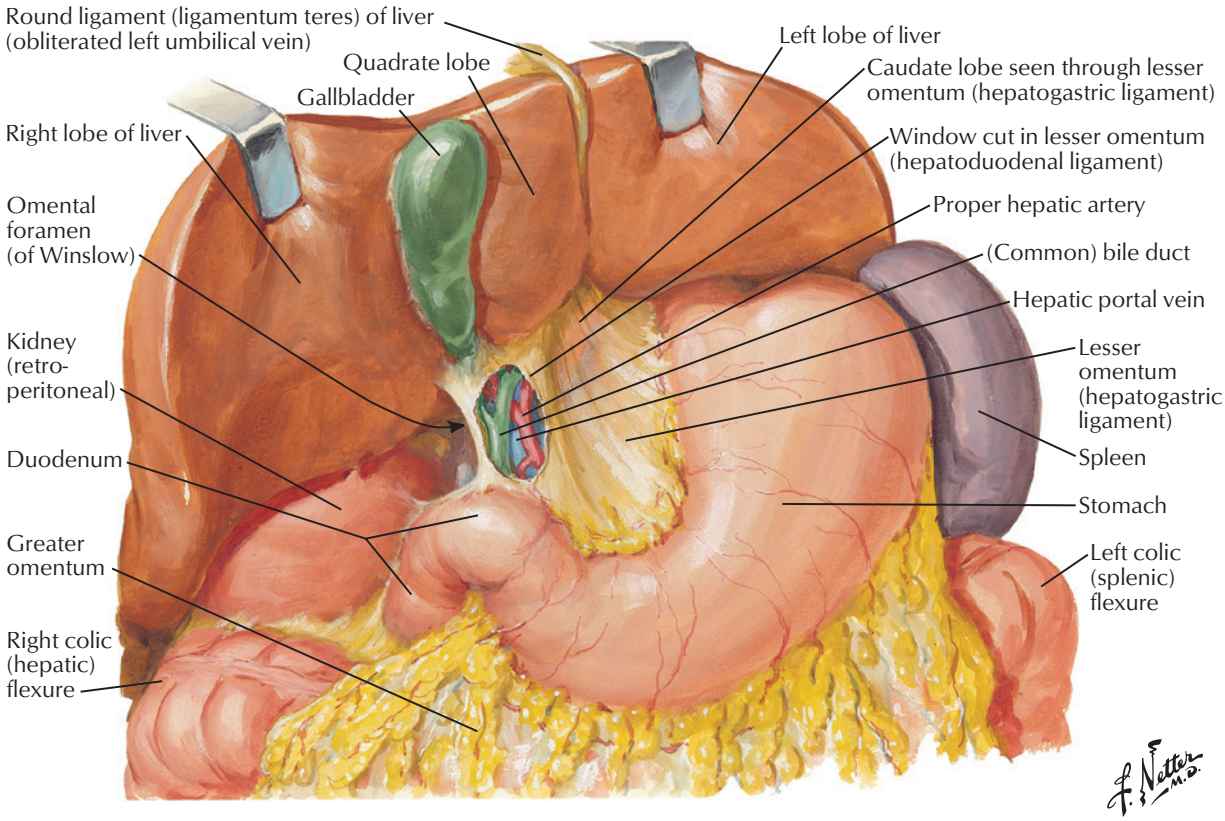
Visceral surface

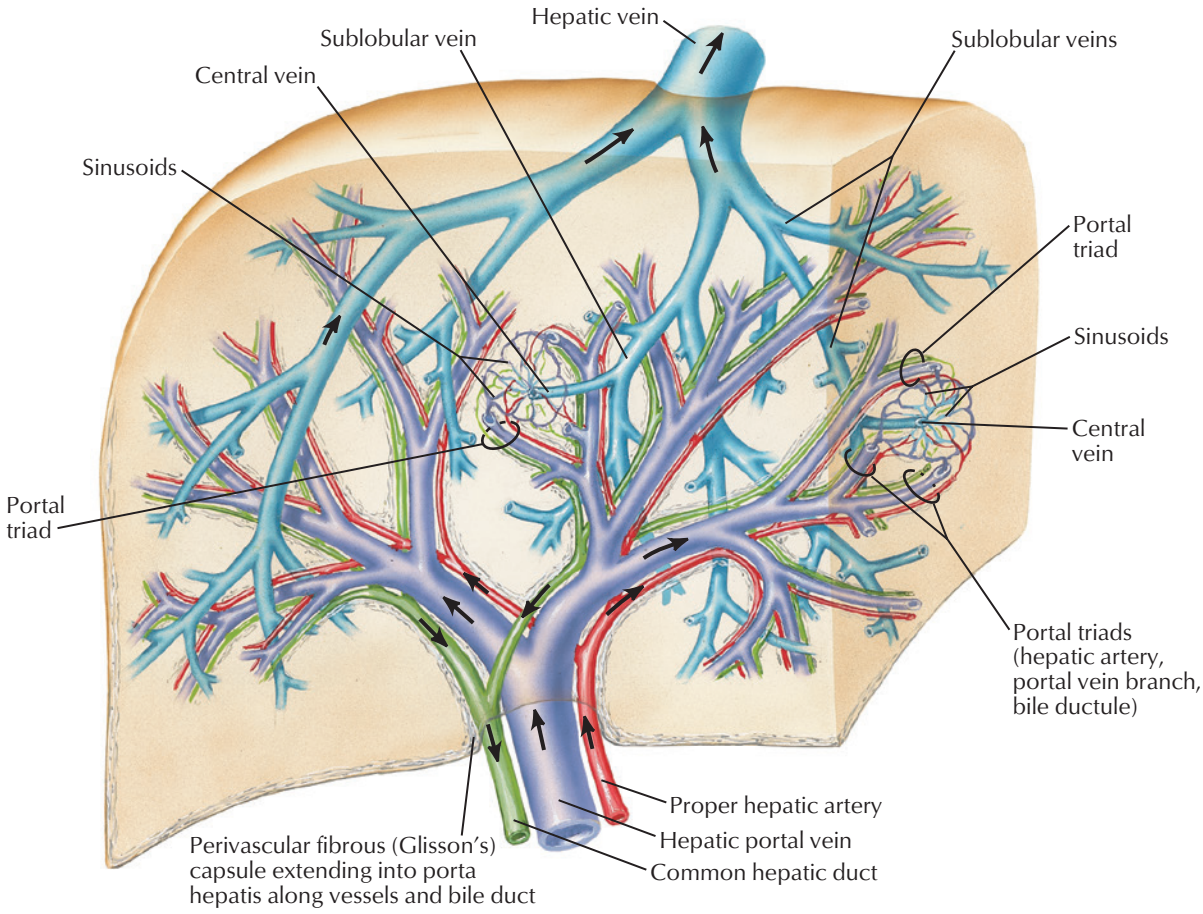


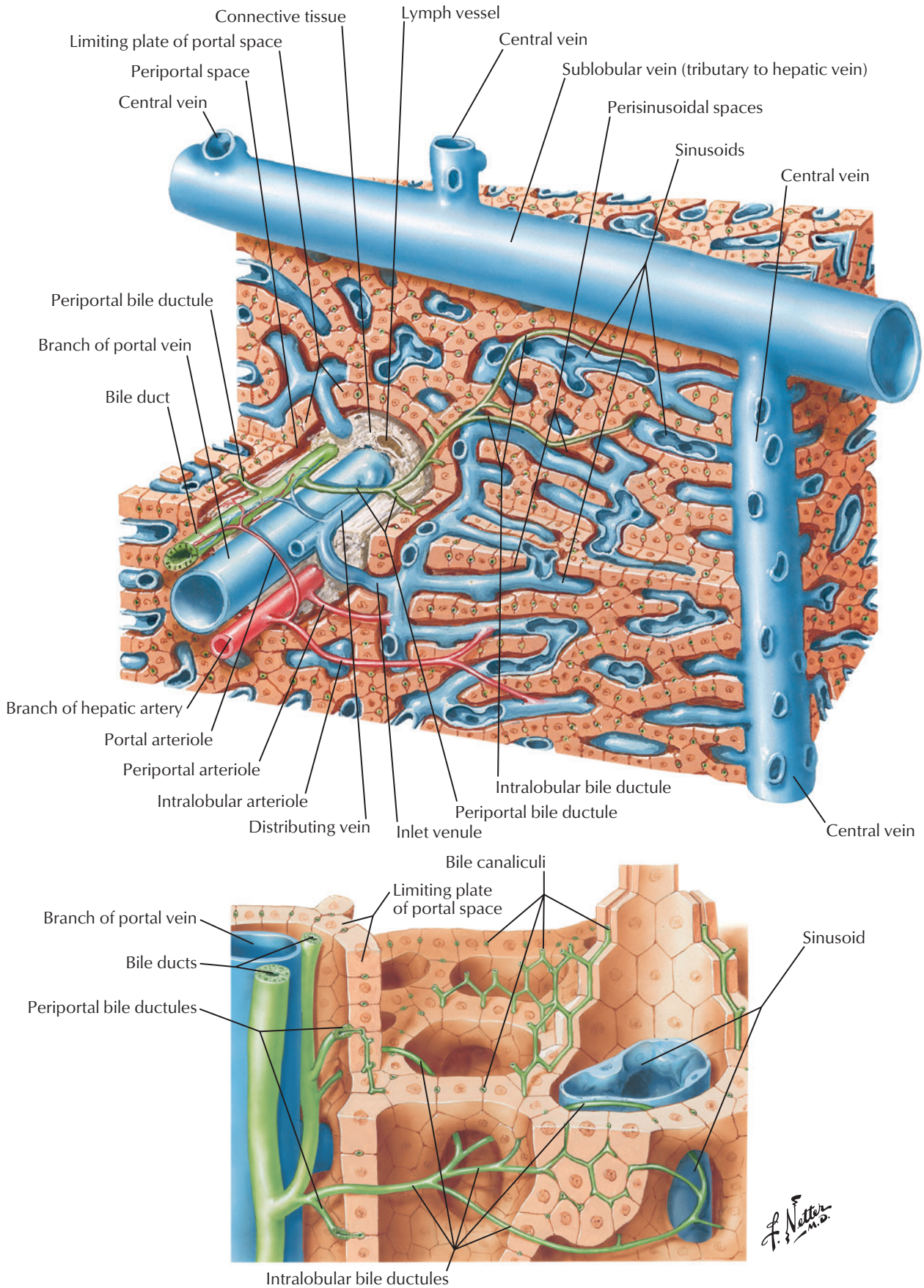
Posterior view

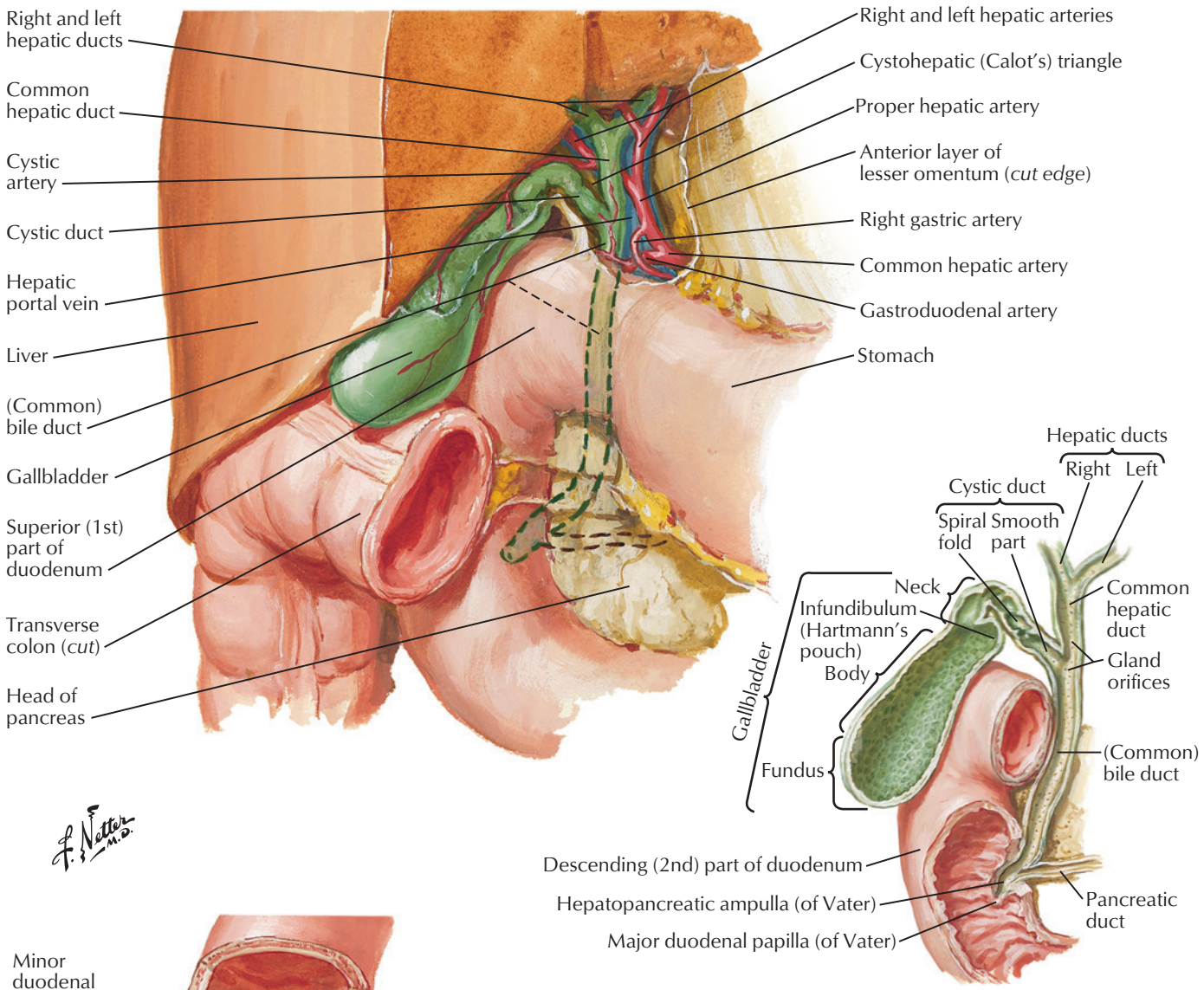
Bed of liver

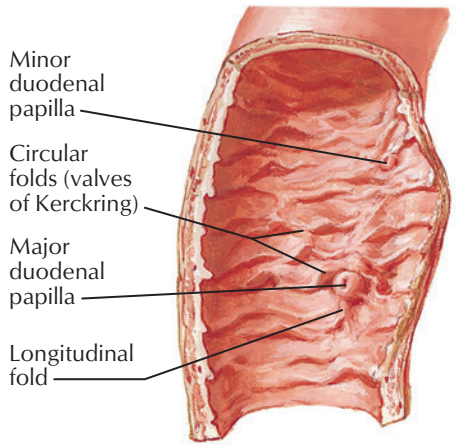
See also Plate 274



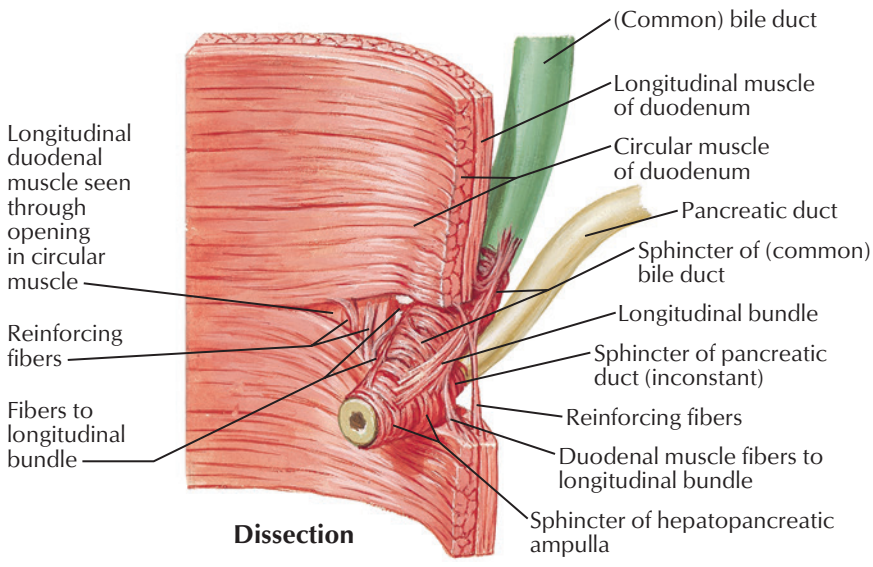



Connective tissue
Lymph vessel
Limiting plate of portal space
Central vein
Periportal space
Sublobular vein (tributary to hepatic vein)
Central vein
Perisinusoidal spaces
Sinusoids
Central vein
Periportal bile ductule
Branch of portal vein
Bile duct
Branch of hepatic artery
Portal arteriole
Periportal arteriole
Intralobular arteriole
Distributing vein
Inlet venule
Intralobular bile ductule
Periportal bile ductule
Central vein
Bile canaliculi
Limiting plate of portal space
Branch of portal vein
Bile ducts
Periportal bile ductules
Sinusoid
Intralobular bile ductules

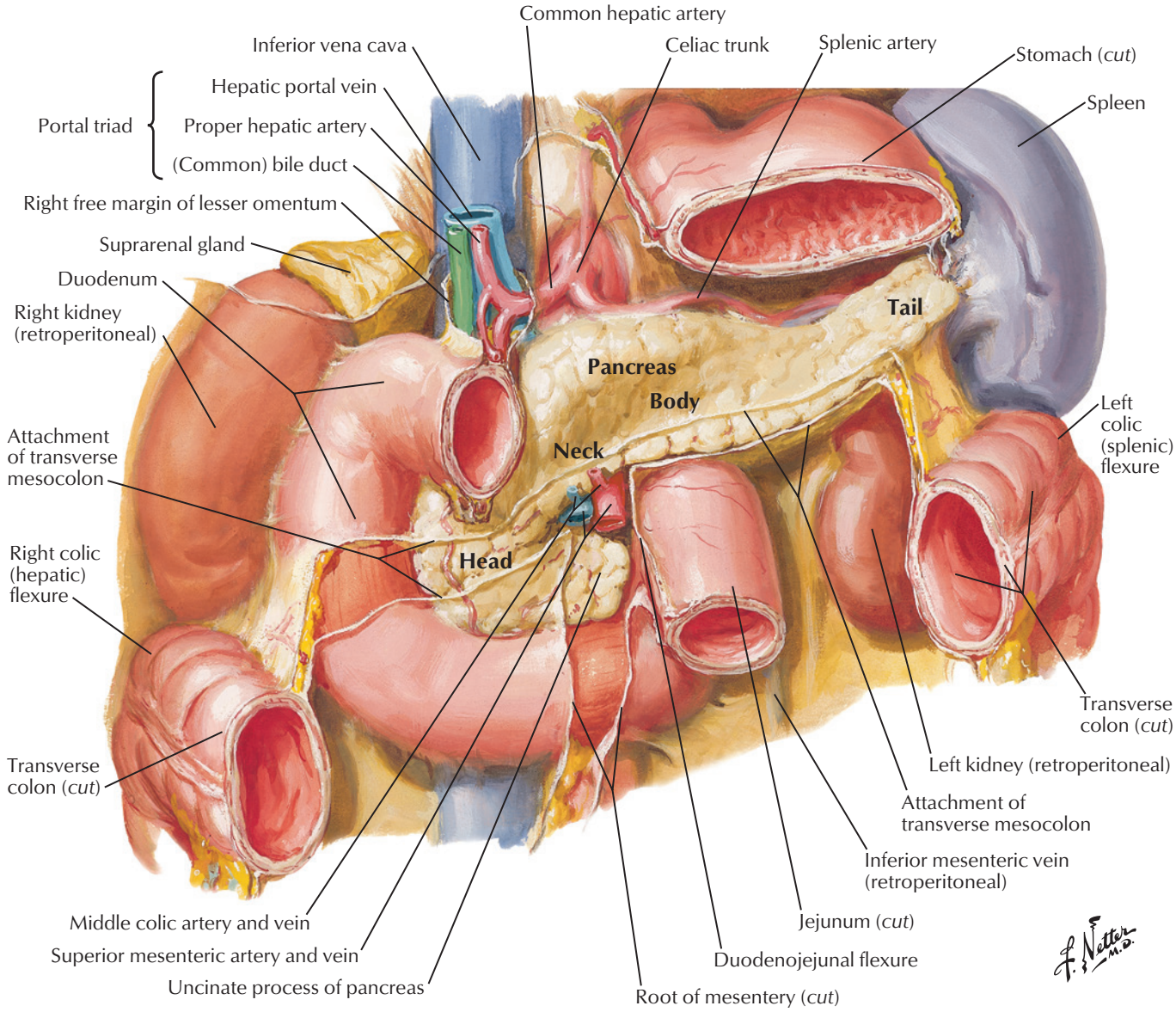




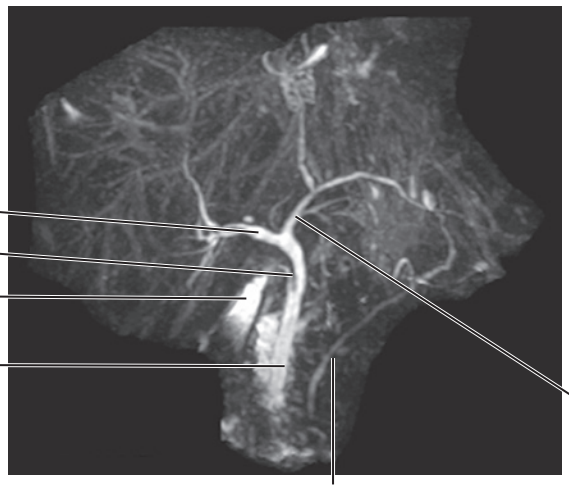
Interior of descending (2nd) part of duodenum

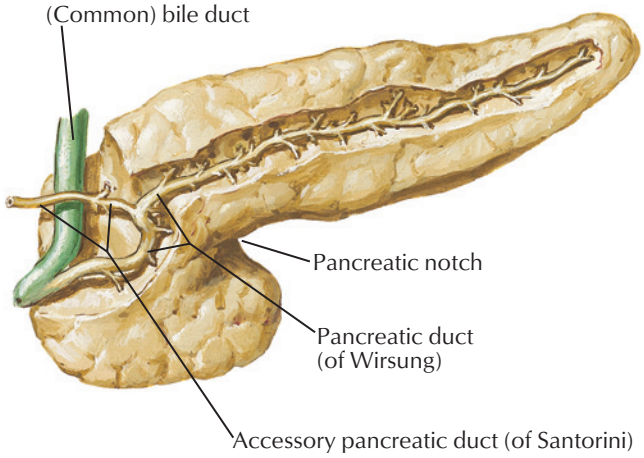


Dissection

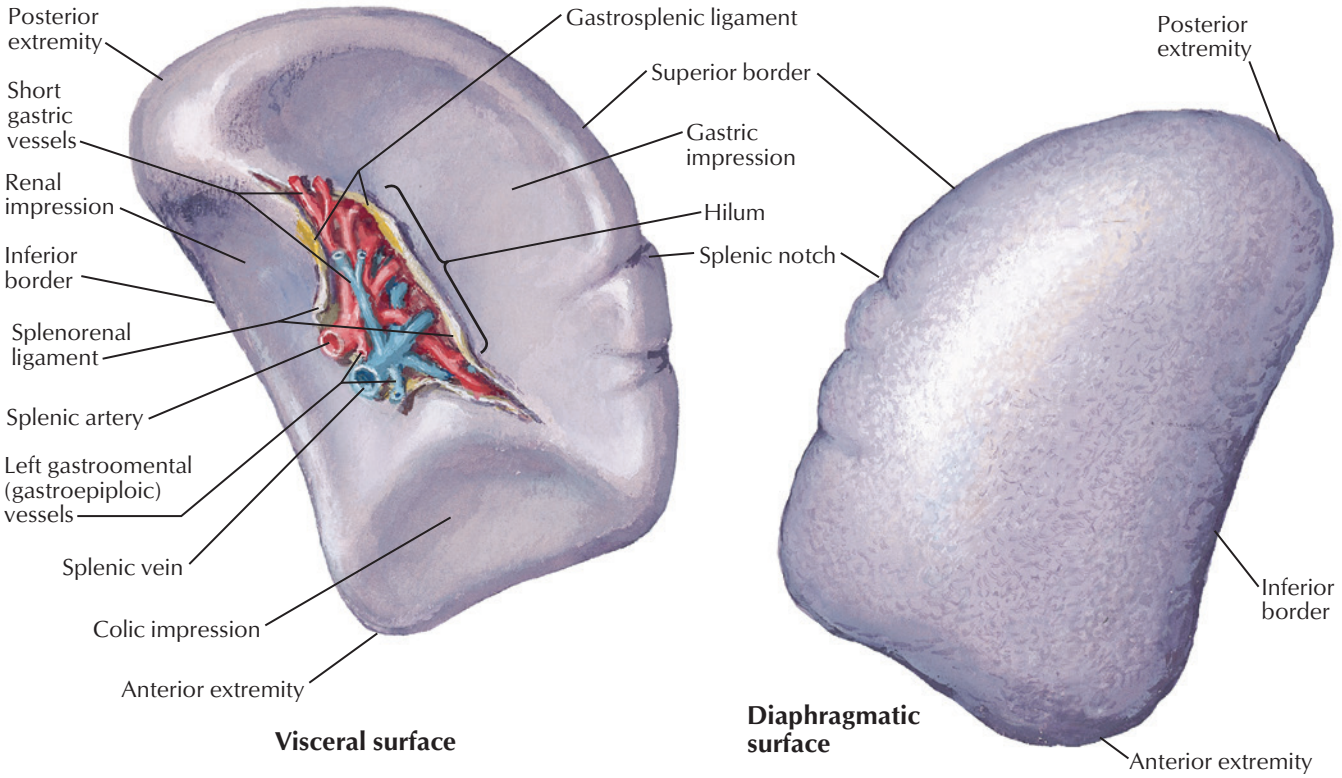


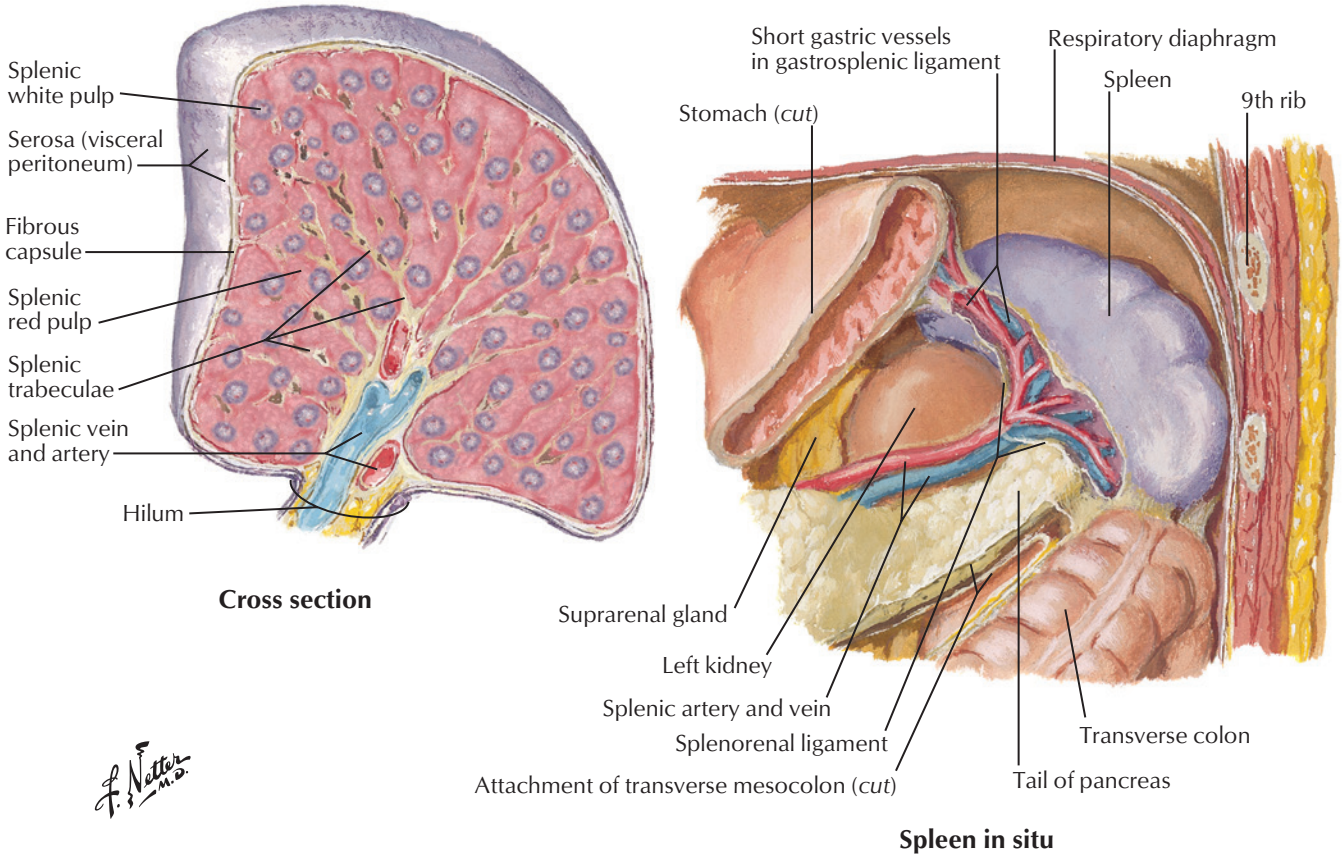
Magnetic resonance cholangiopancreatography (MRCP)

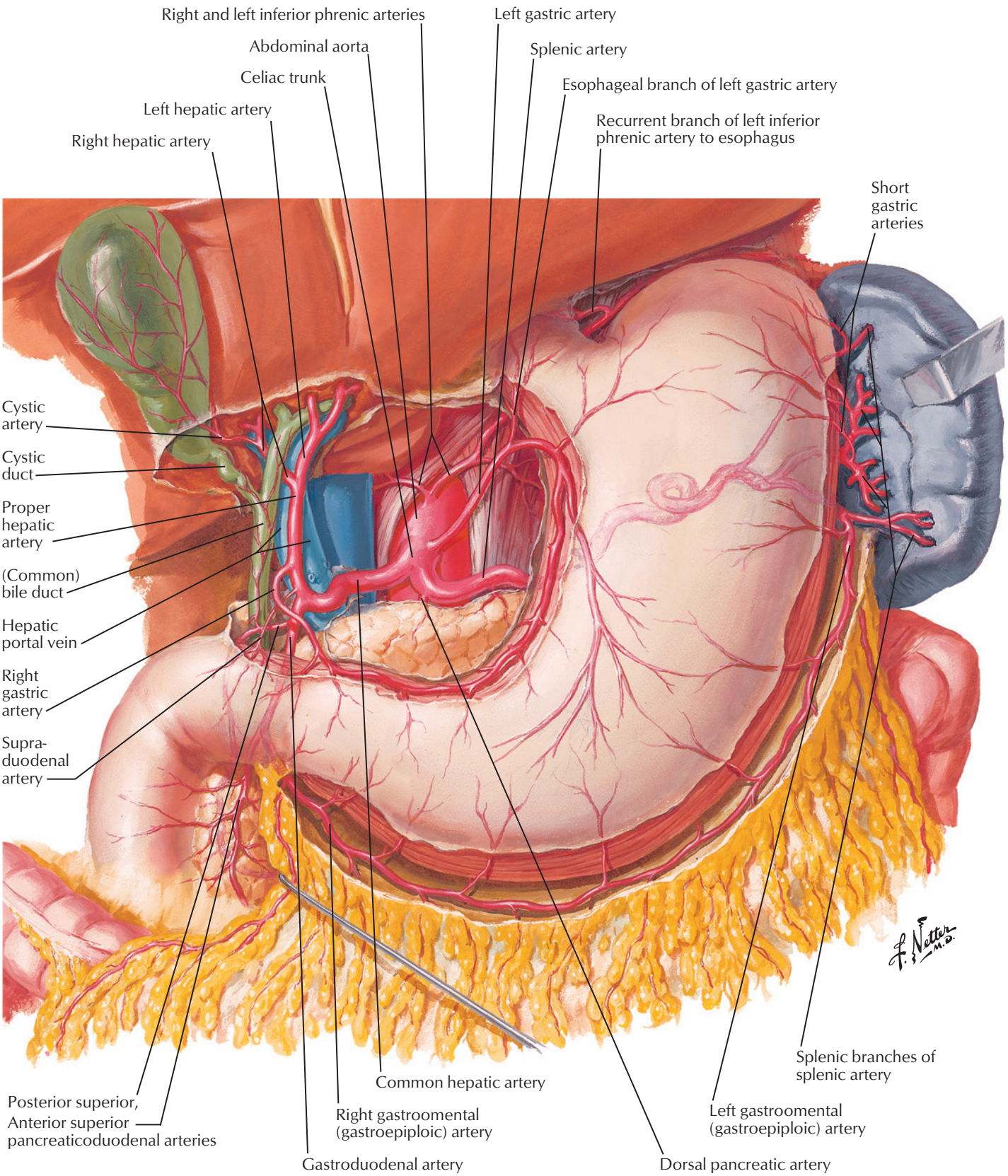


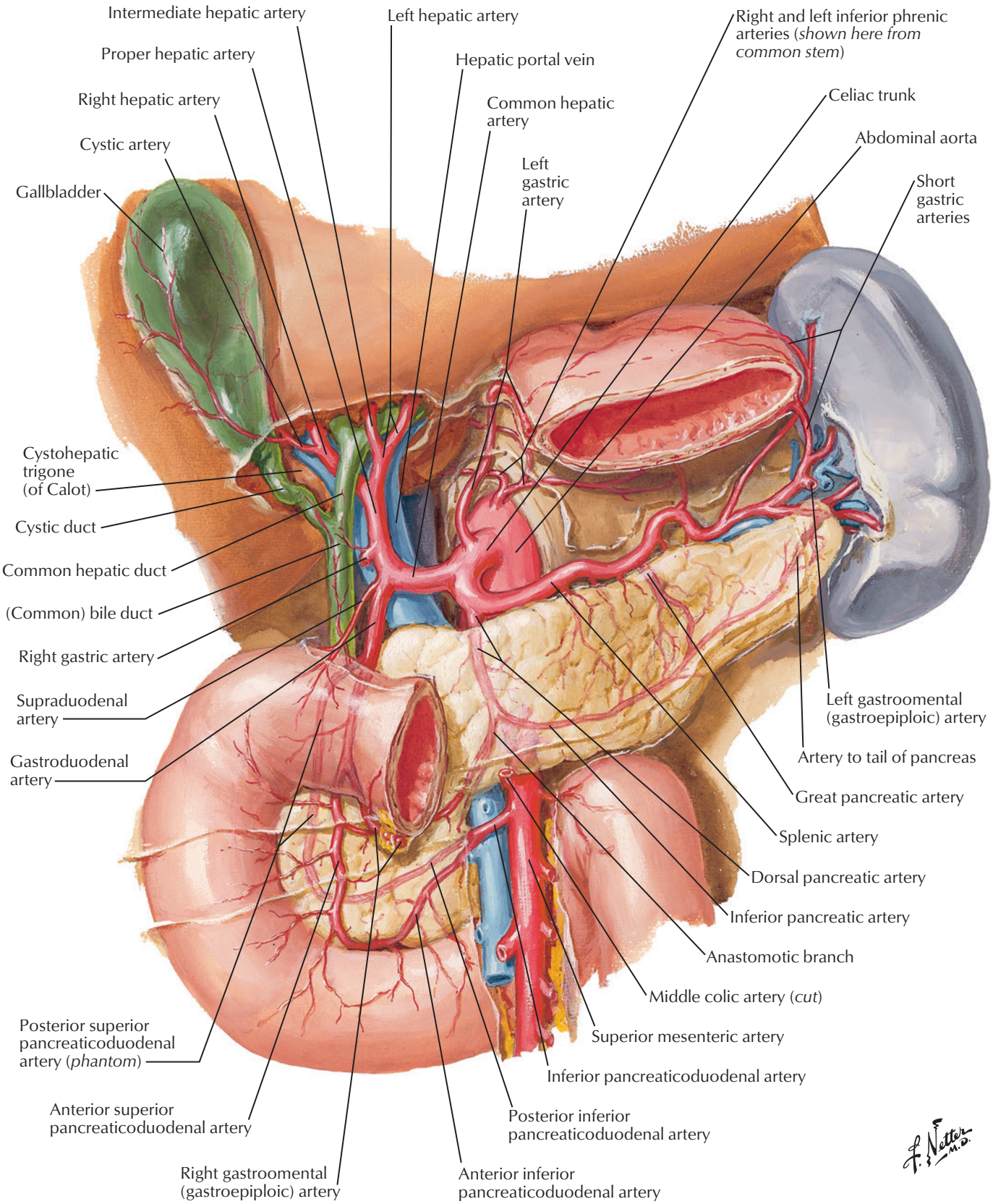


See also Plate 273






Right and left inferior phrenic arteries
Abdominal aorta
Celiac trunk
Left hepatic artery
Right hepatic artery
Left gastric artery
Splenic artery
Esophageal branch of left gastric artery
Recurrent branch of left inferior phrenic artery to esophagus
Short gastric arteries
Cystic artery
Cystic duct
Proper hepatic artery
(Common) bile duct
Hepatic portal vein
Right gastric artery
Supra-duodenal artery
Posterior superior, Anterior superior pancreaticoduodenal arteries
Gastroduodenal artery
Common hepatic artery
Right gastroomental (gastroepiploic) artery
Dorsal pancreatic artery
Left gastroomental (gastroepiploic) artery
Splenic branches of splenic artery

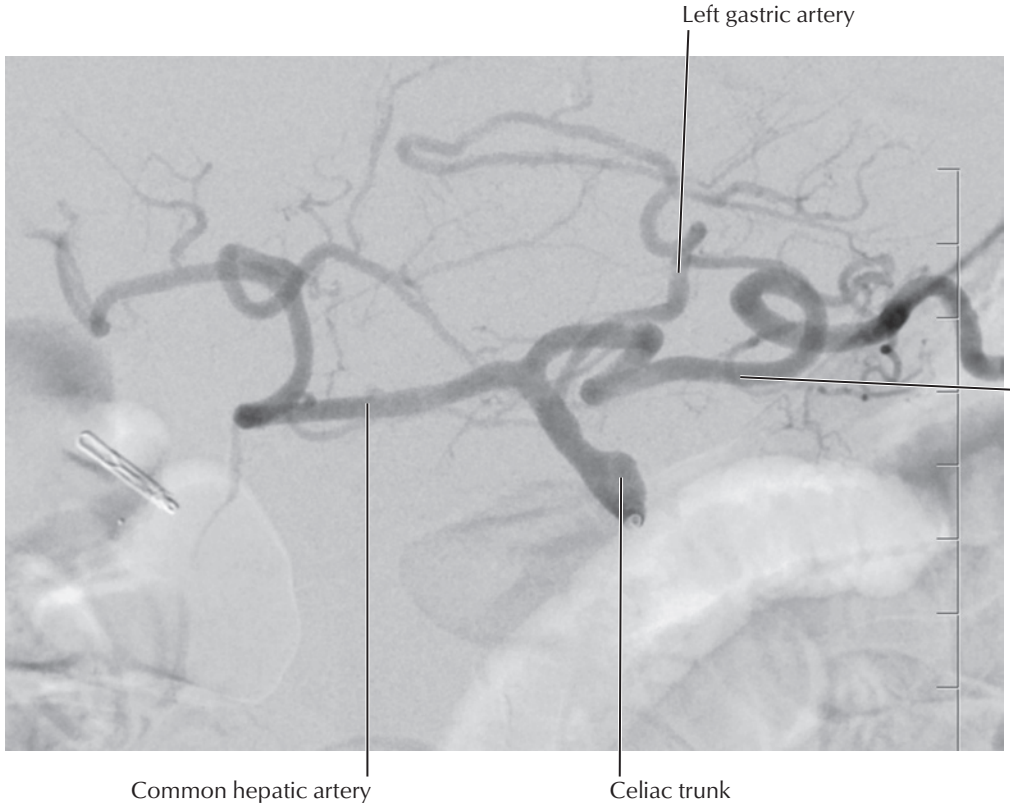

Intermediate hepatic artery
Left hepatic artery
Right and left inferior phrenic arteries (*shown here from common stem*)
Proper hepatic artery
Hepatic portal vein
Right hepatic artery
Common hepatic artery
Celiac trunk
Cystic artery
Abdominal aorta
Left gastric artery
Gallbladder
Short gastric arteries
Cystohepatic trigone (of Calot)
Cystic duct
Common hepatic duct
(Common) bile duct
Right gastric artery
Supraduodenal artery
Gastroduodenal artery
Left gastroomental (gastroepiploic) artery
Artery to tail of pancreas
Great pancreatic artery
Splenic artery
Dorsal pancreatic artery
Inferior pancreatic artery
Anastomotic branch
Middle colic artery (*cut*)
Posterior superior pancreaticoduodenal artery (*phantom*)
Superior mesenteric artery
Inferior pancreaticoduodenal artery
Anterior superior pancreaticoduodenal artery
Posterior inferior pancreaticoduodenal artery
Right gastroomental (gastroepiploic) artery
Anterior inferior pancreaticoduodenal artery

See also Plates 290, 291

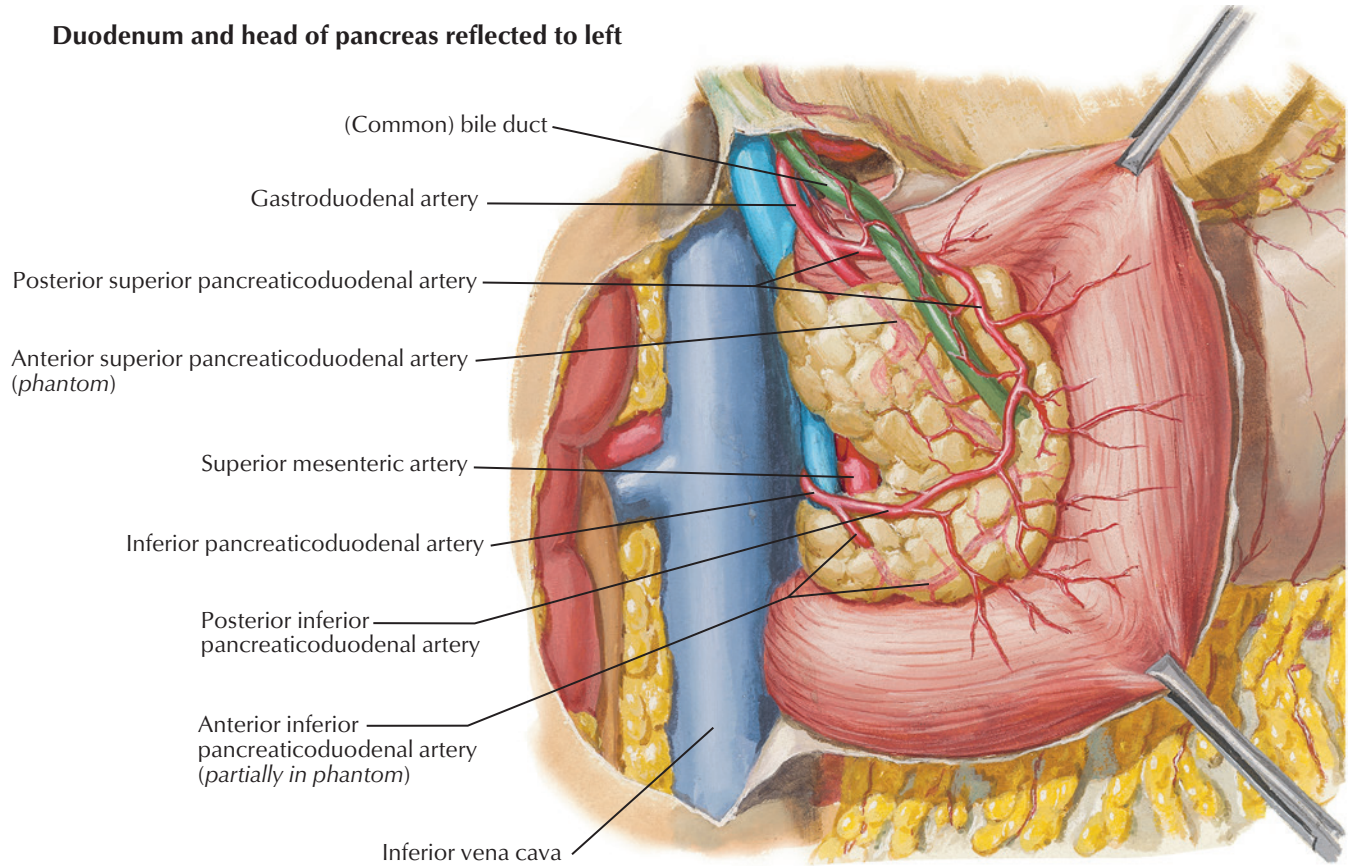
3D volume-rendered CT image with intravenous contrast enhancement

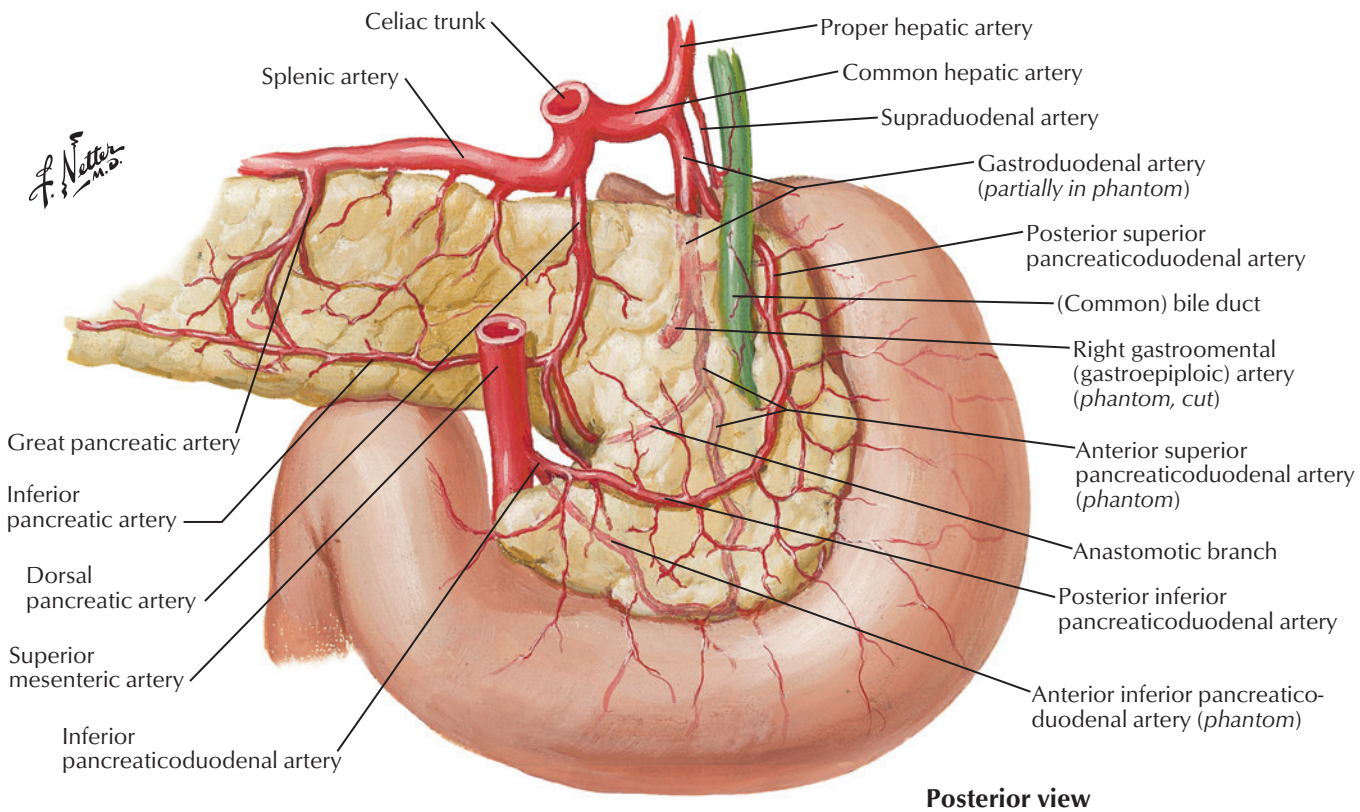


Selective digital subtraction angiogram, celiac trunk

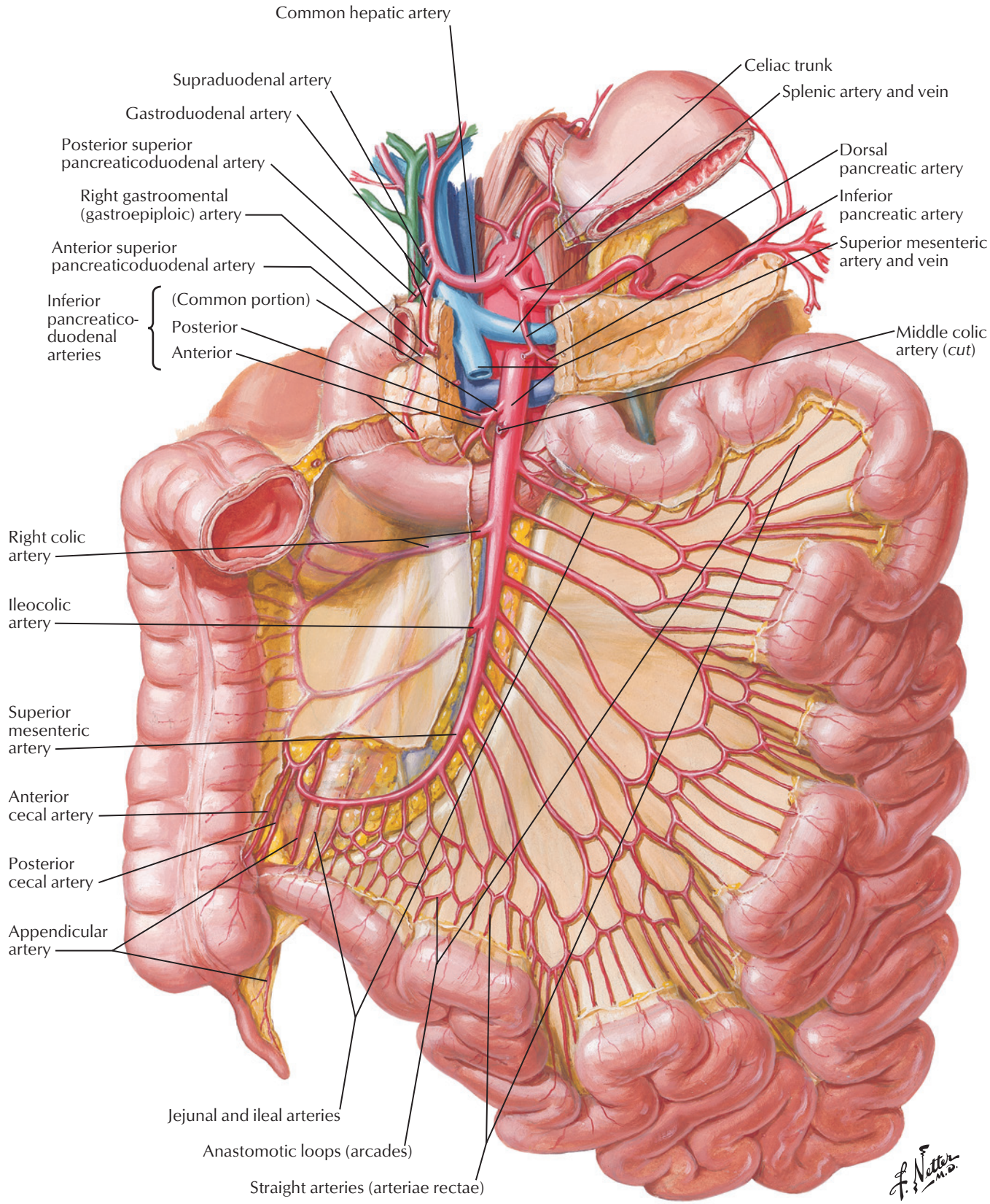


Duodenum and head of pancreas reflected to left

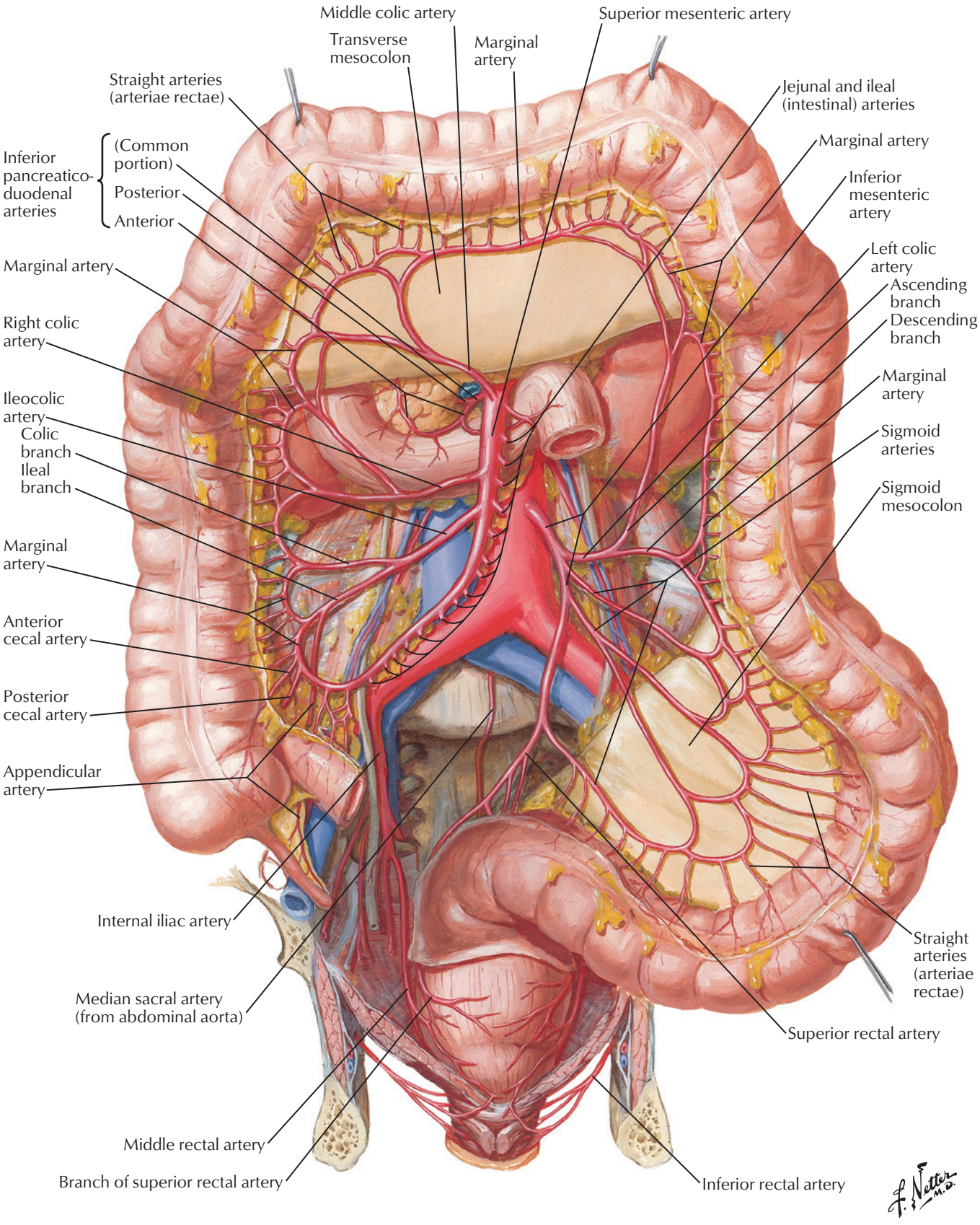


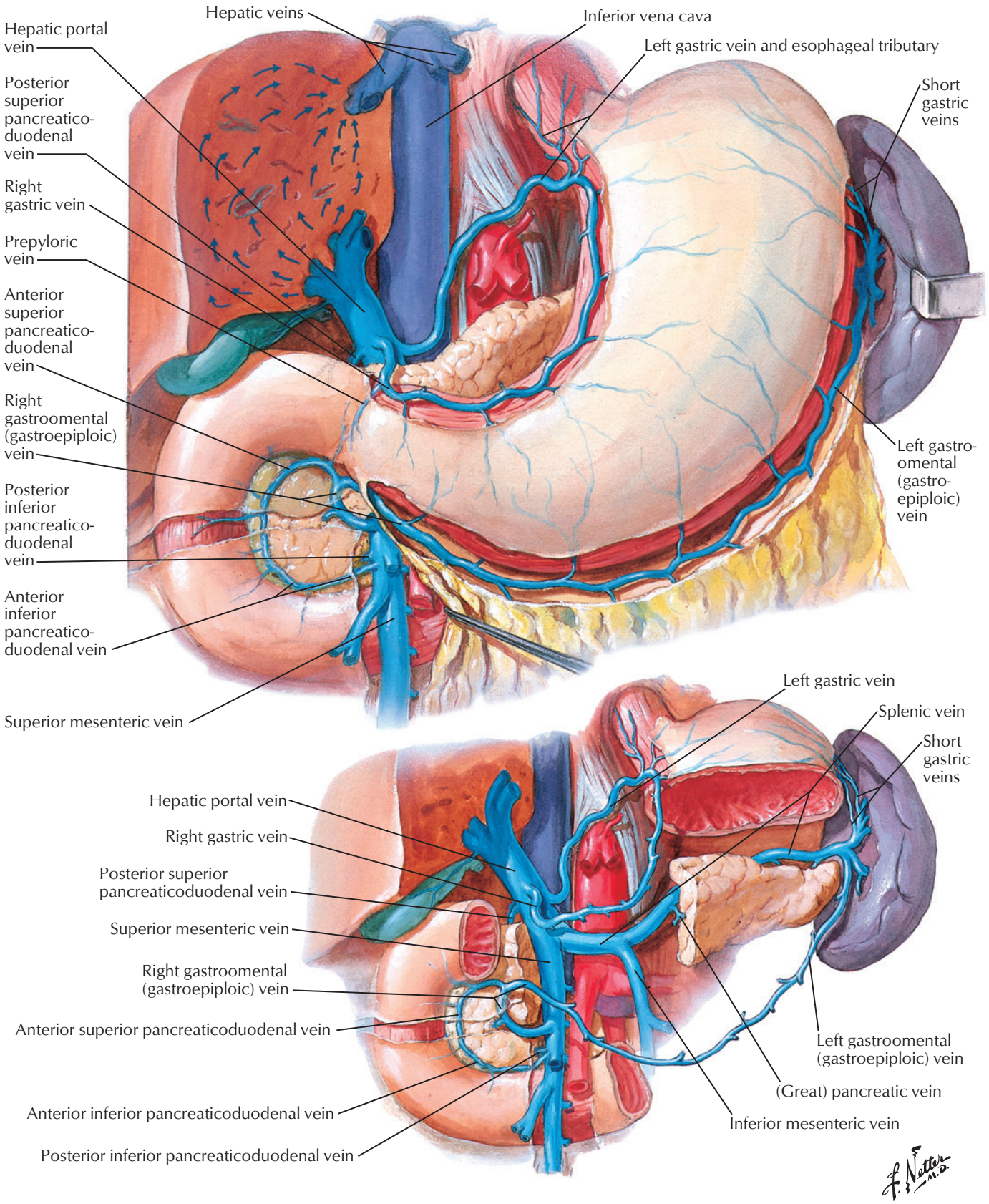


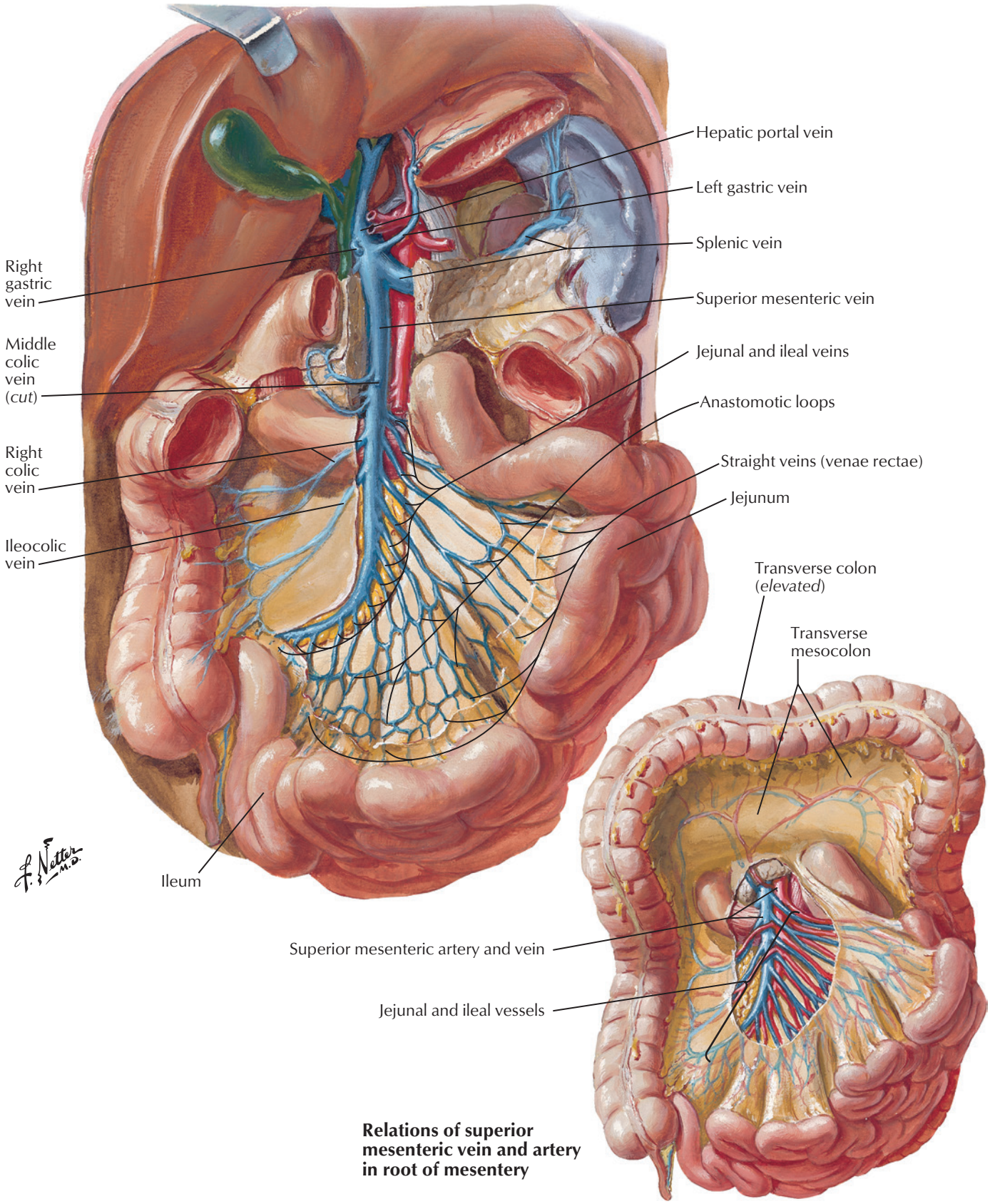
Posterior view


Common hepatic artery
Supraduodenal artery
Gastroduodenal artery
Posterior superior pancreaticoduodenal artery
Right gastroomental (gastroepiploic) artery
Anterior superior pancreaticoduodenal artery
Inferior pancreatico-duodenal arteries
(Common portion)
Posterior
Anterior
Celiac trunk
Splenic artery and vein
Dorsal pancreatic artery
Inferior pancreatic artery
Superior mesenteric artery and vein
Middle colic artery (cut)
Right colic artery
Ileocolic artery
Superior mesenteric artery
Anterior cecal artery
Posterior cecal artery
Appendicular artery
Jejunal and ileal arteries
Anastomotic loops (arcades)
Straight arteries (arteriae rectae)

See also Plate 380

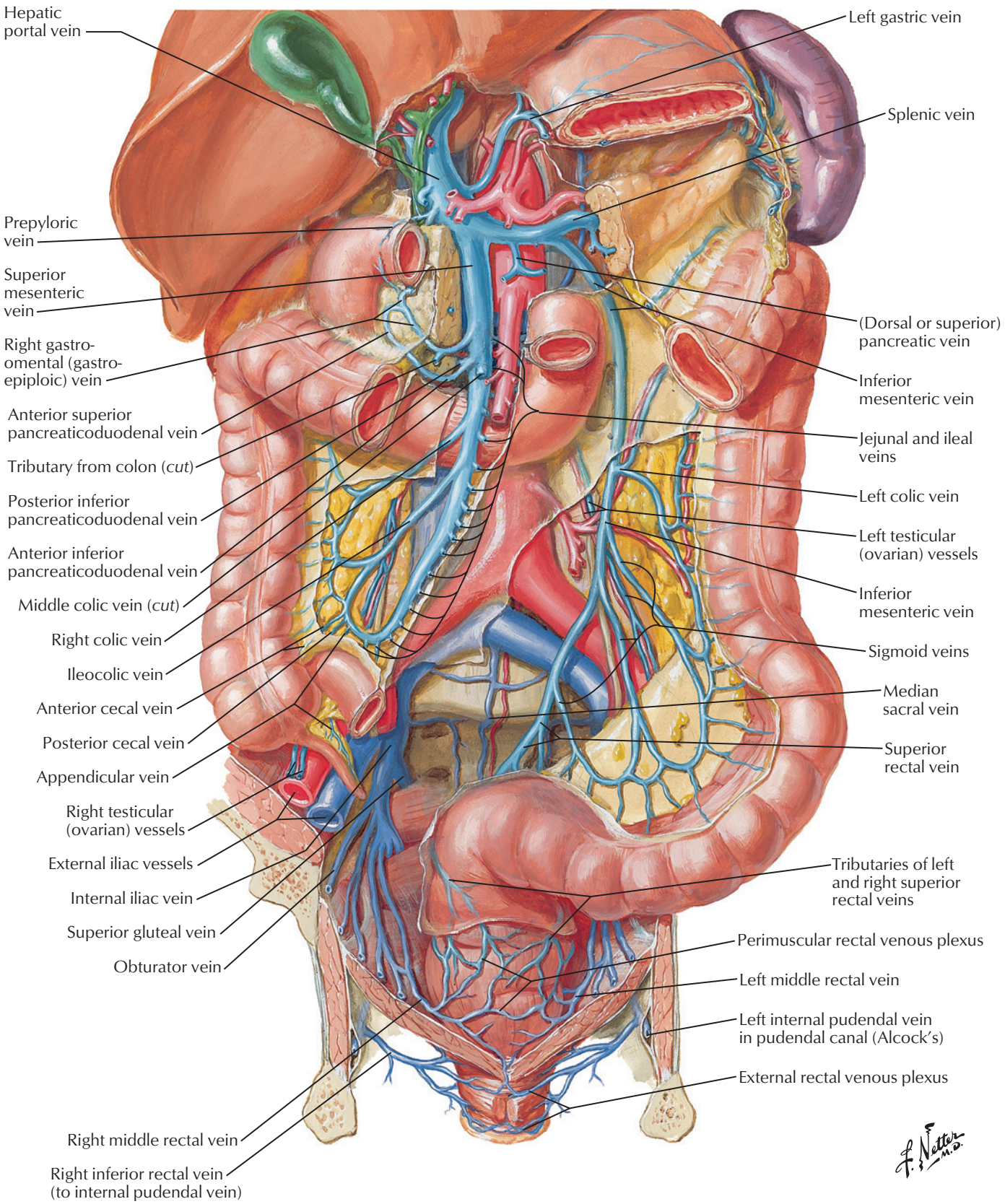


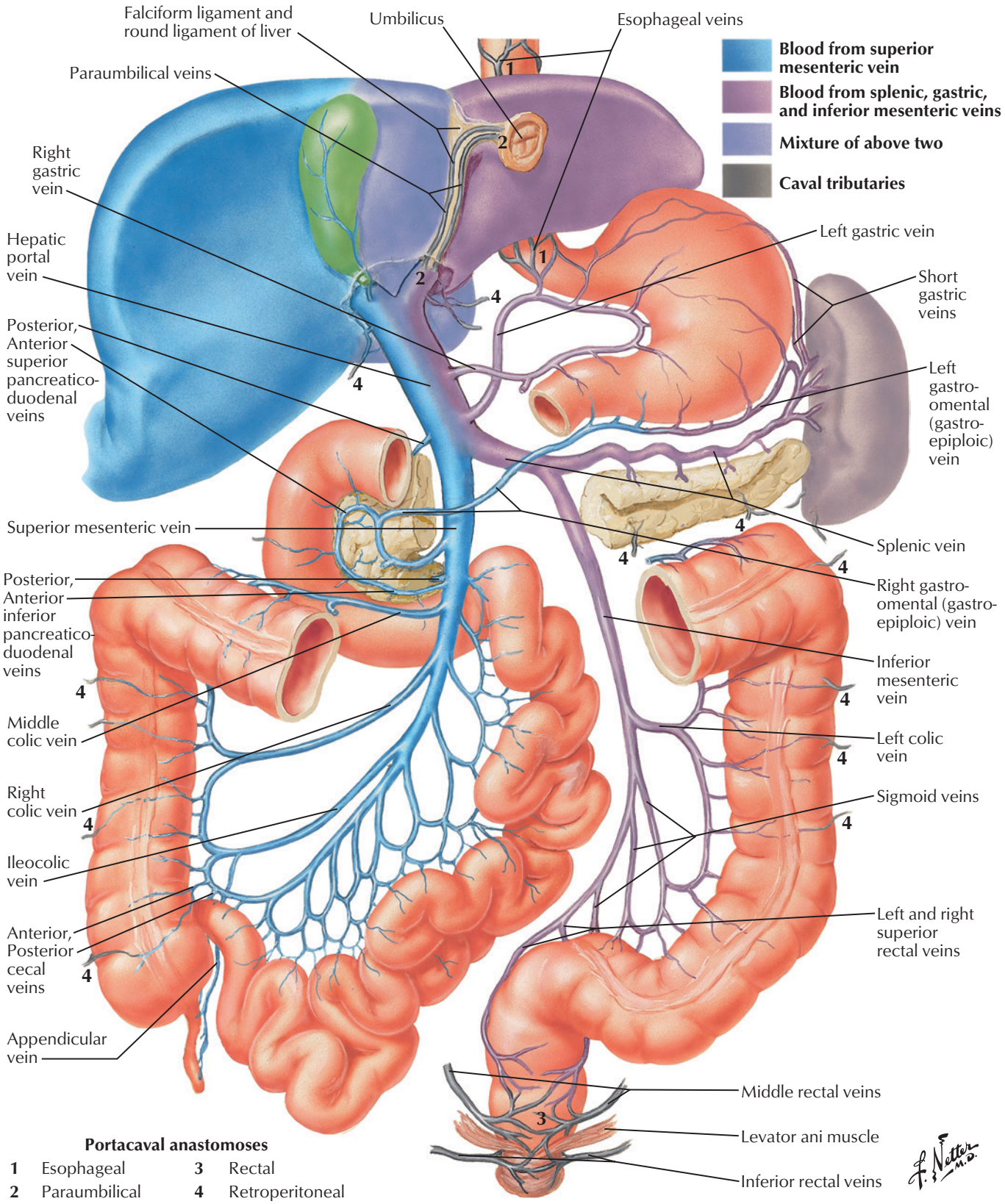

Hepatic veins
Inferior vena cava
Hepatic portal vein
Left gastric vein and esophageal tributary
Posterior superior pancreatico-duodenal vein
Short gastric veins
Right gastric vein
Prepyloric vein
Anterior superior pancreatico-duodenal vein
Right gastroomental (gastroepiploic) vein
Left gastro-omental (gastro-epiploic) vein
Posterior inferior pancreatico-duodenal vein
Anterior inferior pancreatico-duodenal vein
Superior mesenteric vein
Left gastric vein
Splenic vein
Short gastric veins
Hepatic portal vein
Right gastric vein
Posterior superior pancreaticoduodenal vein
Superior mesenteric vein
Right gastroomental (gastroepiploic) vein
Anterior superior pancreaticoduodenal vein
Left gastroomental (gastroepiploic) vein
(Great) pancreatic vein
Anterior inferior pancreaticoduodenal vein
Inferior mesenteric vein
Posterior inferior pancreaticoduodenal vein



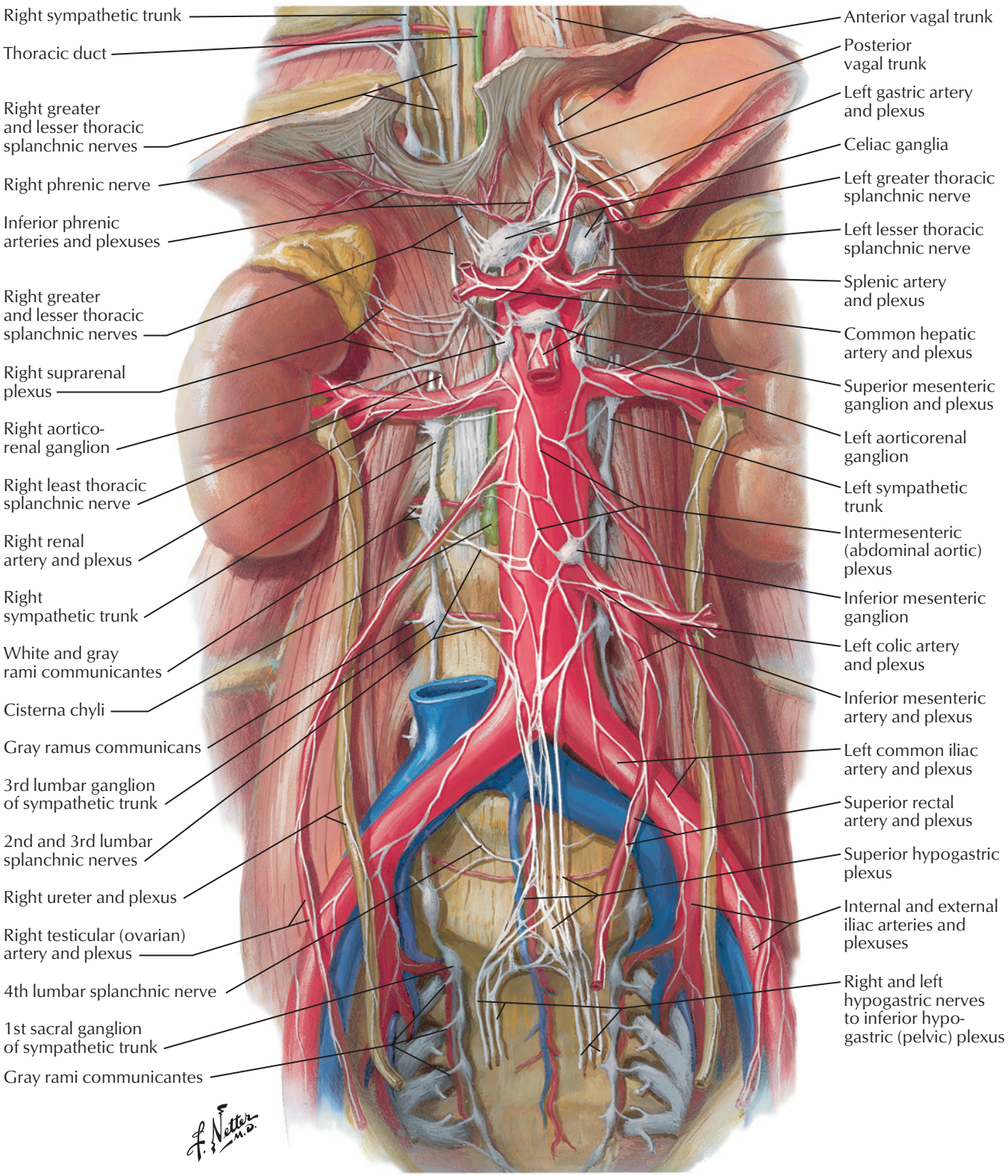
Relations of superior mesenteric vein and artery in root of mesentery

See also Plate 381

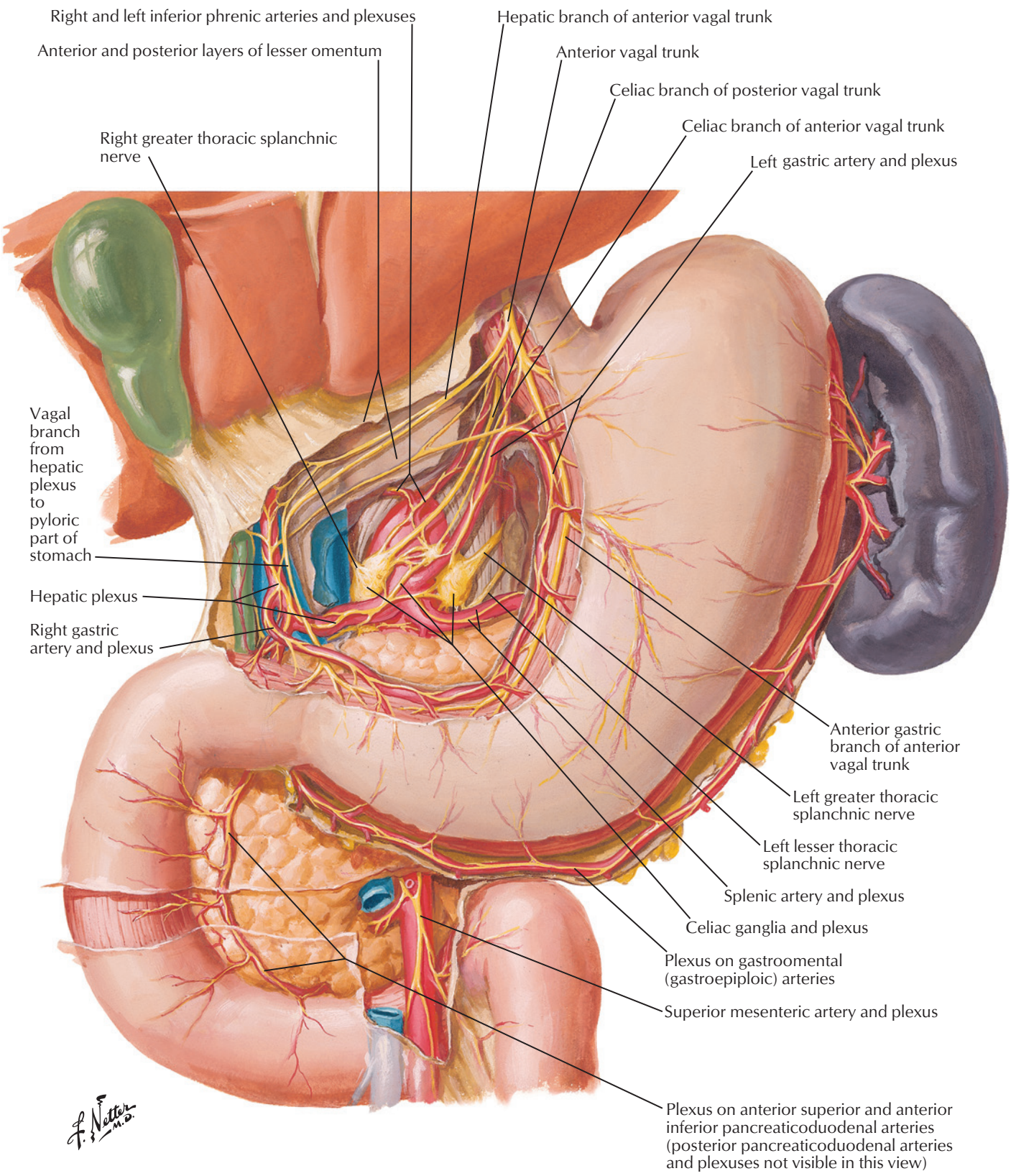


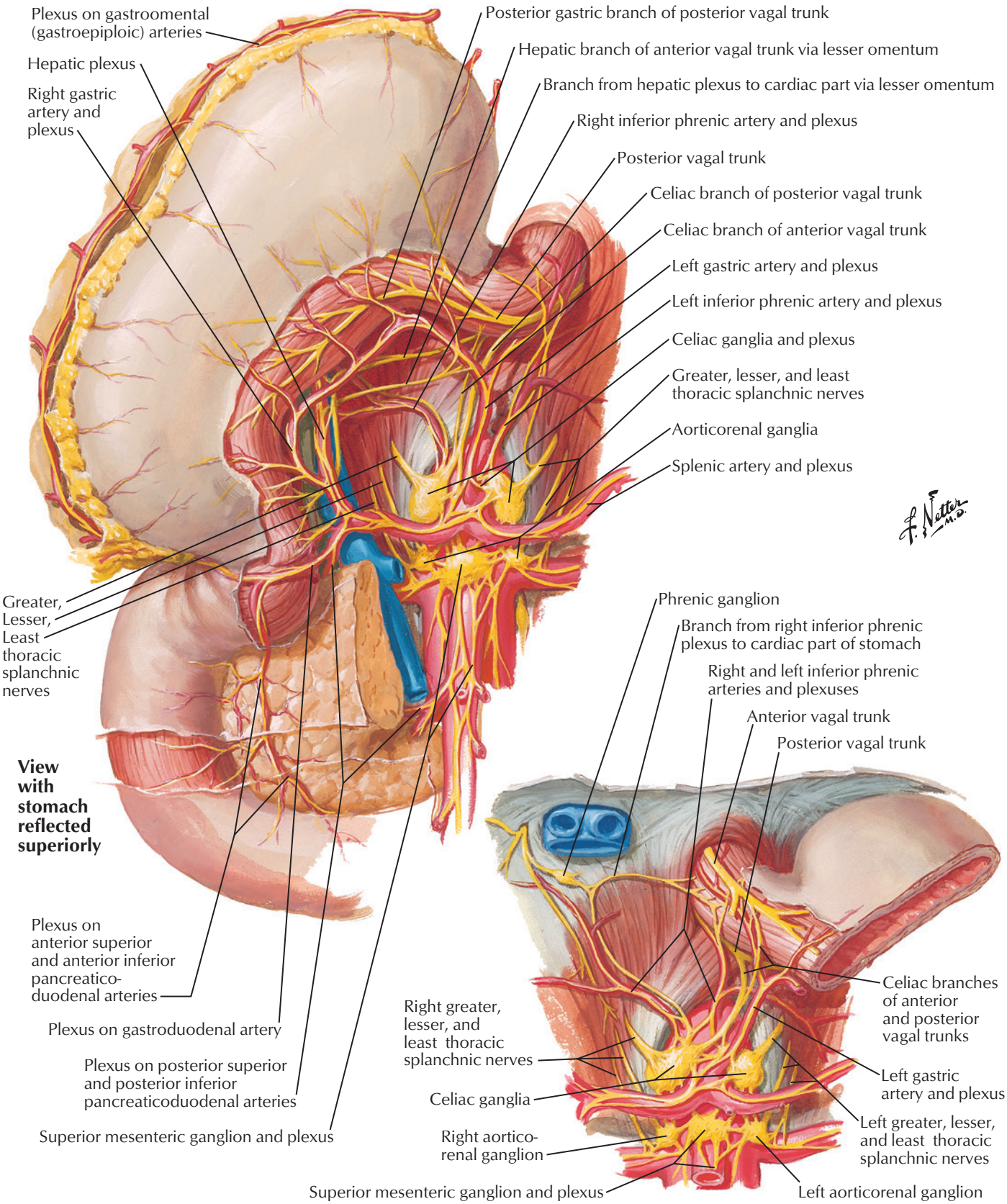

Falciform ligament and round ligament of liver
Umbilicus
Esophageal veins
Paraumbilical veins
Blood from superior mesenteric vein
Blood from splenic, gastric, and inferior mesenteric veins
Mixture of above two
Caval tributaries
Right gastric vein
Hepatic portal vein
Posterior, Anterior superior pancreatico-duodenal veins
Left gastric vein
Short gastric veins
Left gastro-omental (gastro-epiploic) vein
Superior mesenteric vein
Splenic vein
Posterior, Anterior inferior pancreatico-duodenal veins
Right gastro-omental (gastro-epiploic) vein
Inferior mesenteric vein
Middle colic vein
Left colic vein
Right colic vein
Sigmoid veins
Ileocolic vein
Left and right superior rectal veins
Anterior, Posterior cecal veins
Appendicular vein
Middle rectal veins
Levator ani muscle
Inferior rectal veins
Portacaval anastomoses
1 Esophageal
2 Paraumbilical
3 Rectal
4 Retroperitoneal

See also Plate 305

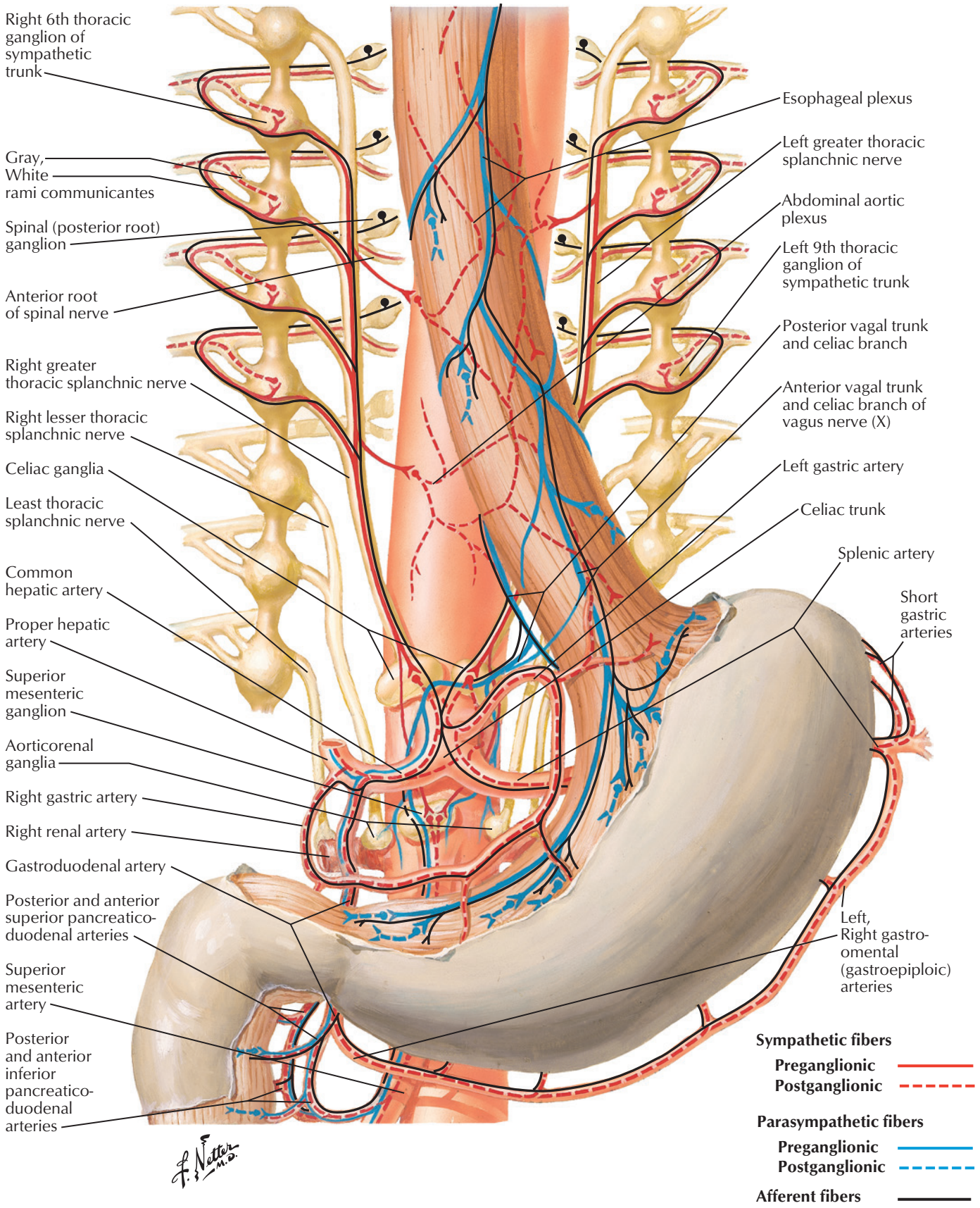


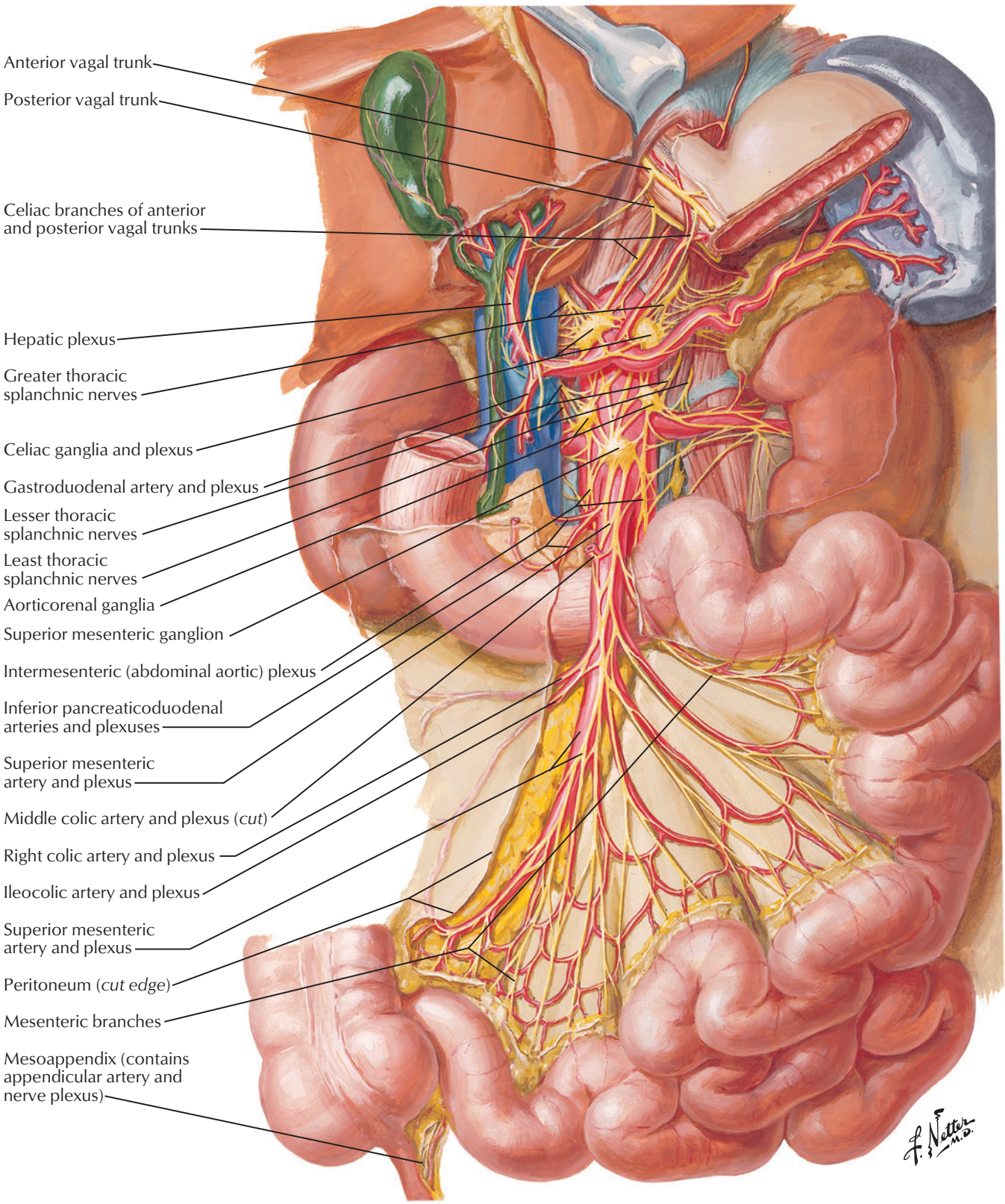
See also Plate 243



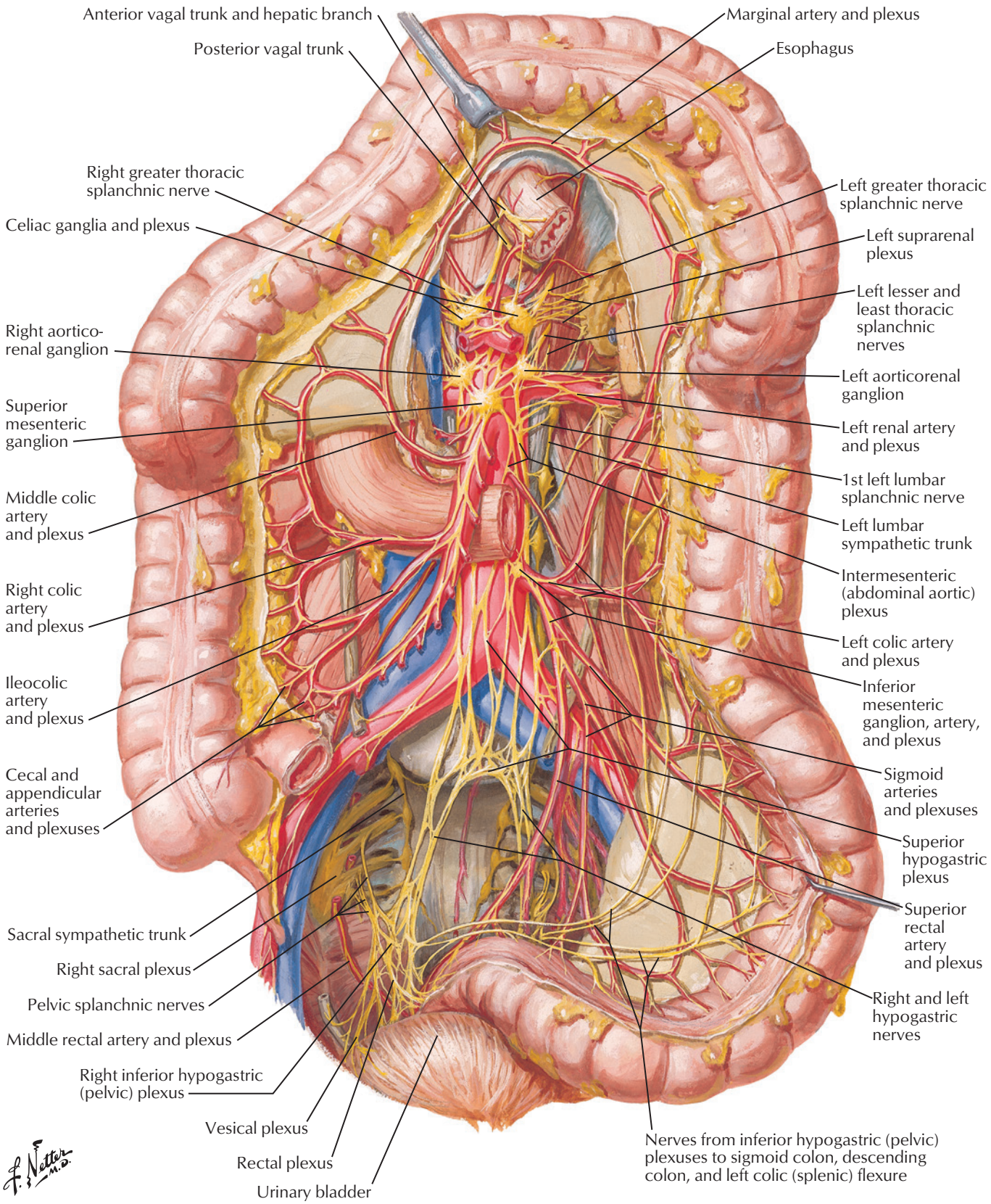

Plexus on gastroomental (gastroepiploic) arteries
Hepatic plexus
Right gastric artery and plexus
Posterior gastric branch of posterior vagal trunk
Hepatic branch of anterior vagal trunk via lesser omentum
Branch from hepatic plexus to cardiac part via lesser omentum
Right inferior phrenic artery and plexus
Posterior vagal trunk
Celiac branch of posterior vagal trunk
Celiac branch of anterior vagal trunk
Left gastric artery and plexus
Left inferior phrenic artery and plexus
Celiac ganglia and plexus
Greater, lesser, and least thoracic splanchnic nerves
Aorticorenal ganglia
Splenic artery and plexus
Greater, Lesser, Least thoracic splanchnic nerves
View with stomach reflected superiorly
Plexus on anterior superior and anterior inferior pancreatico-duodenal arteries
Plexus on gastroduodenal artery
Plexus on posterior superior and posterior inferior pancreaticoduodenal arteries
Superior mesenteric ganglion and plexus
Phrenic ganglion
Branch from right inferior phrenic plexus to cardiac part of stomach
Right and left inferior phrenic arteries and plexuses
Anterior vagal trunk
Posterior vagal trunk
Celiac branches of anterior and posterior vagal trunks
Right greater, lesser, and least thoracic splanchnic nerves
Left gastric artery and plexus
Celiac ganglia
Left greater, lesser, and least thoracic splanchnic nerves
Right aortico-renal ganglion
Superior mesenteric ganglion and plexus
Left aorticorenal ganglion

See also Plates 172, 173

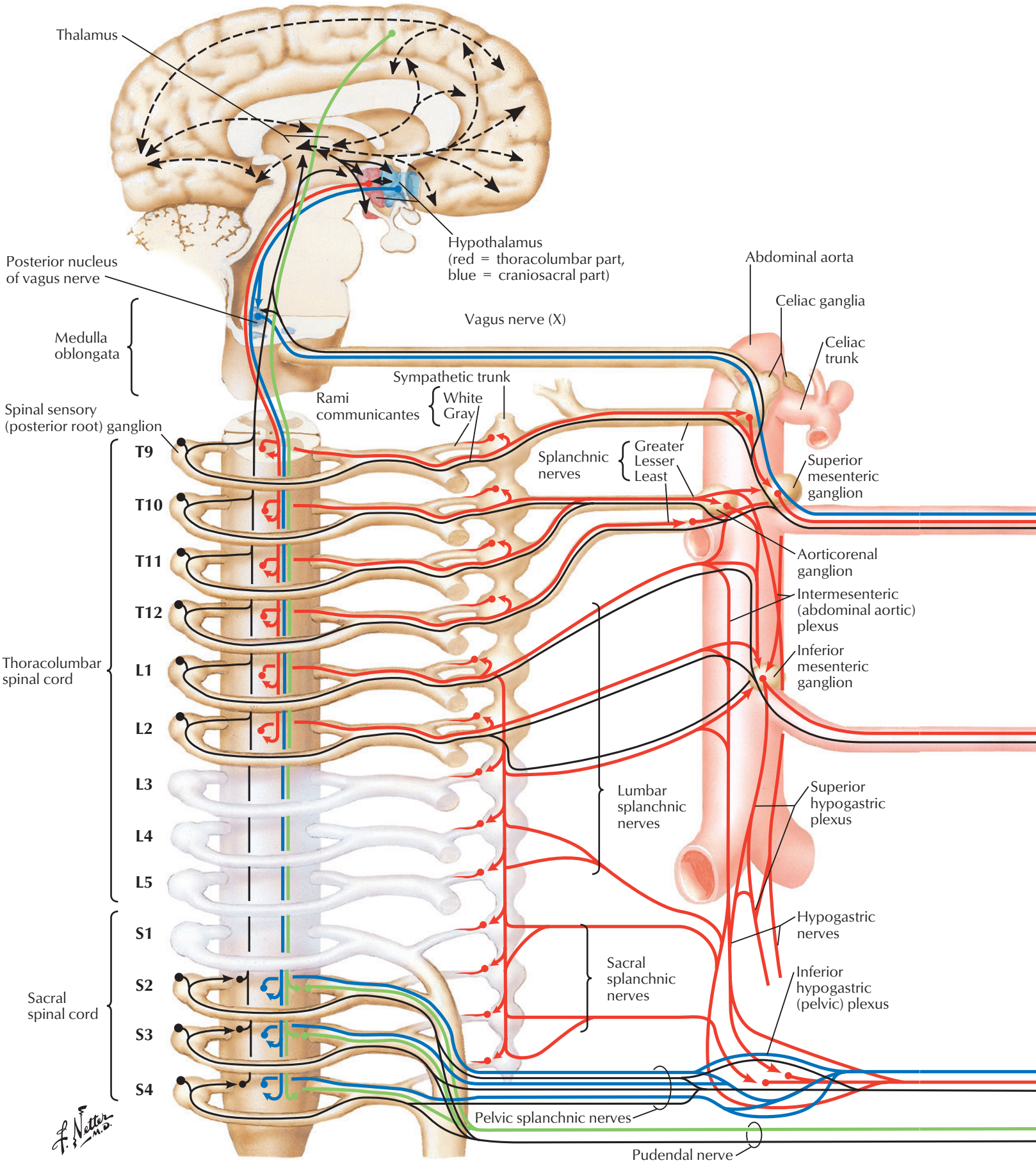



Anterior vagal trunk
Posterior vagal trunk
Celiac branches of anterior and posterior vagal trunks
Hepatic plexus
Greater thoracic splanchnic nerves
Celiac ganglia and plexus
Gastroduodenal artery and plexus
Lesser thoracic splanchnic nerves
Least thoracic splanchnic nerves
Aorticorenal ganglia
Superior mesenteric ganglion
Intermesenteric (abdominal aortic) plexus
Inferior pancreaticoduodenal arteries and plexuses
Superior mesenteric artery and plexus
Middle colic artery and plexus (cut)
Right colic artery and plexus
Ileocolic artery and plexus
Superior mesenteric artery and plexus
Peritoneum (cut edge)
Mesenteric branches
Mesoappendix (contains appendicular artery and nerve plexus)

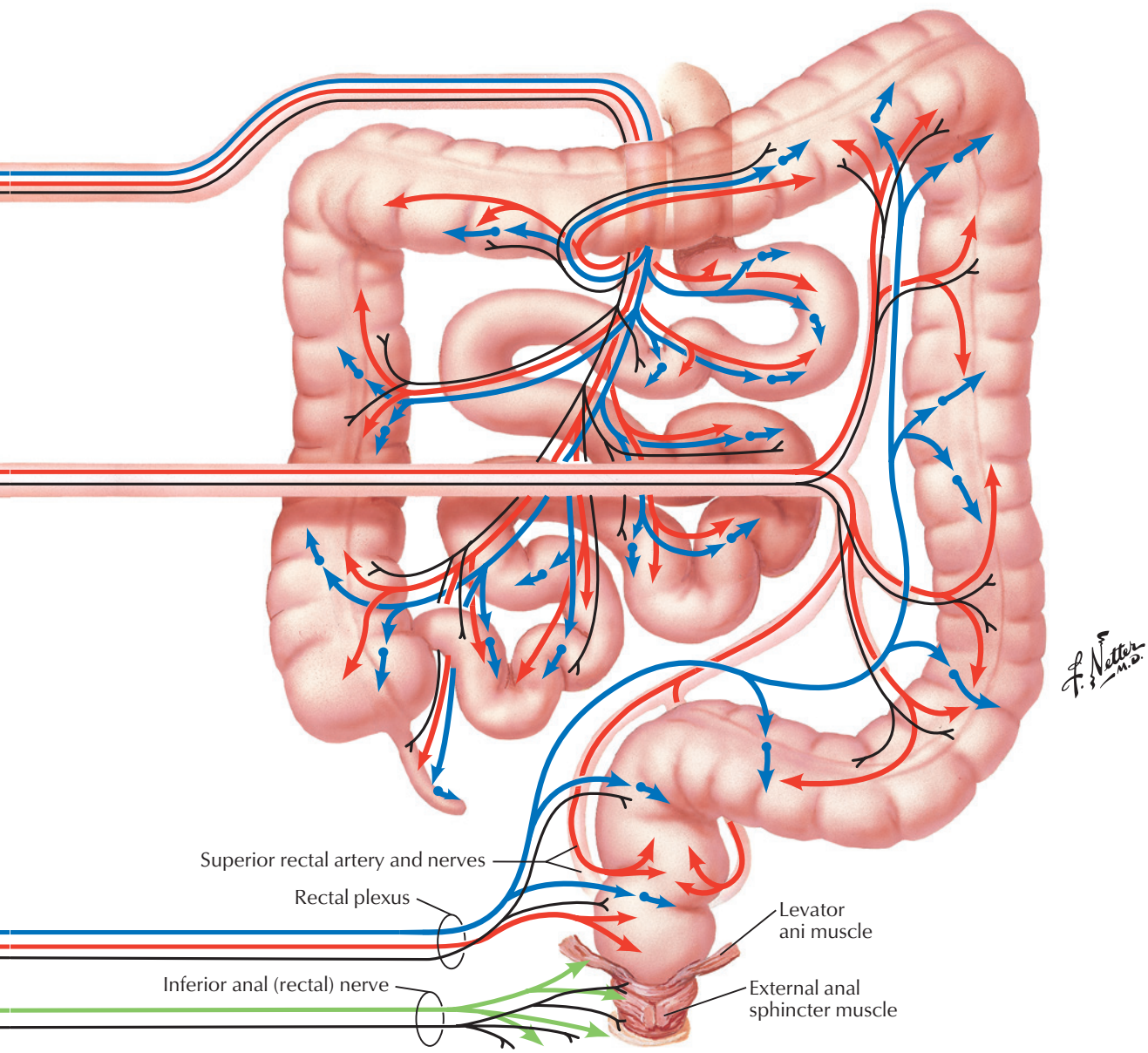
See also Plates 392, 393, 394

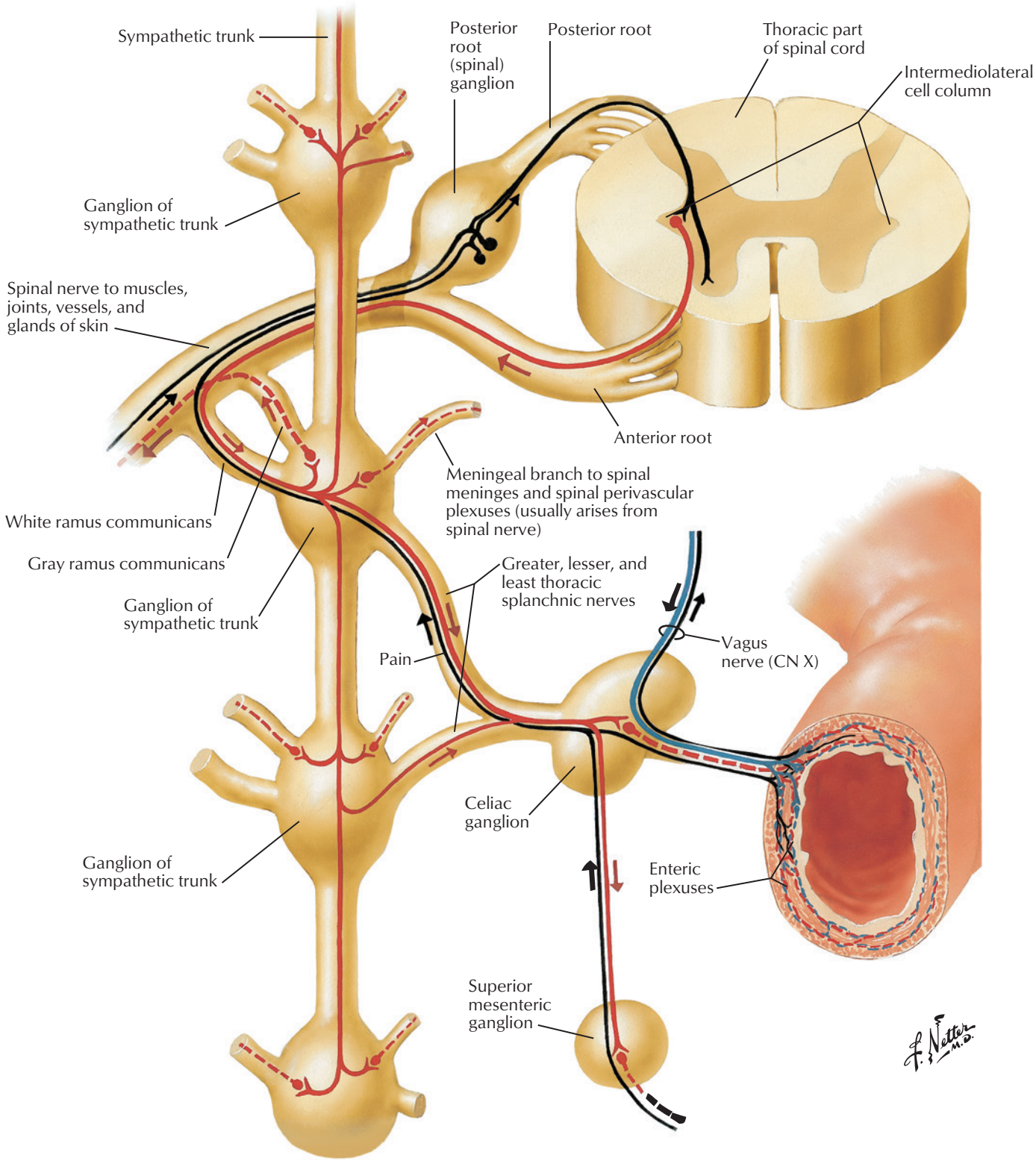


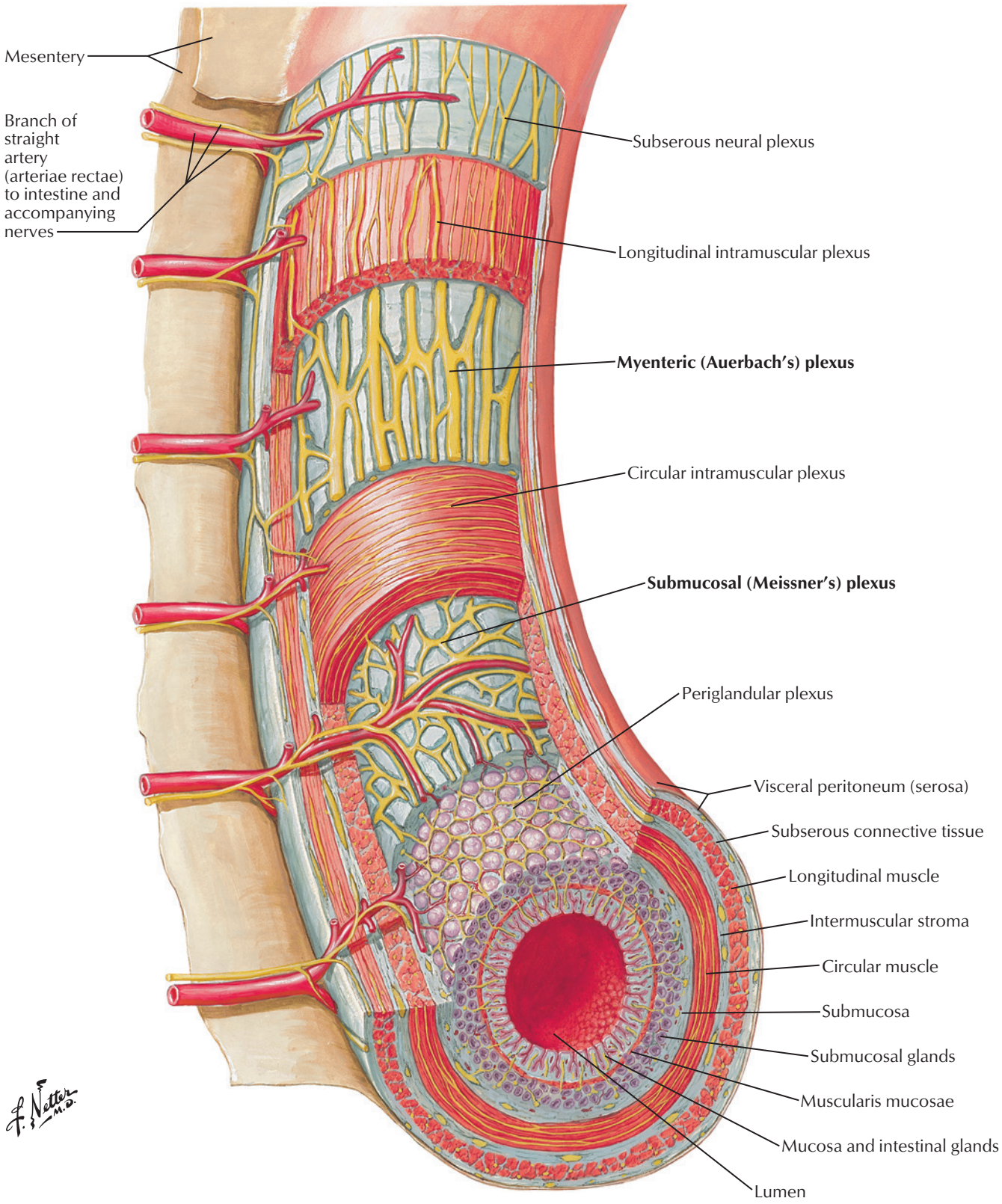
See also Plates 172, 173



See also **Plates 172, 173**

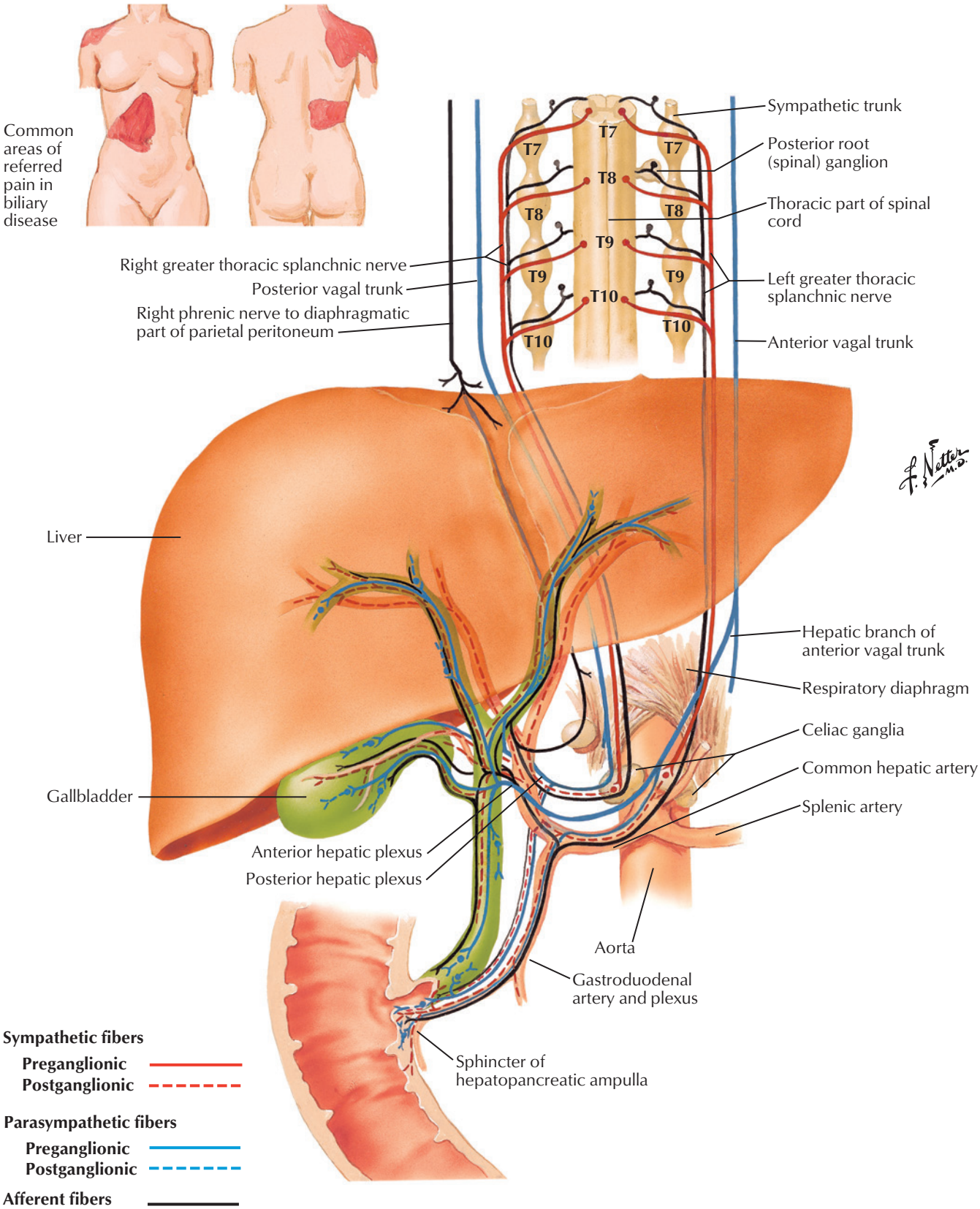



Sympathetic trunk
Posterior root (spinal) ganglion
Posterior root
Thoracic part of spinal cord
Intermediolateral cell column
Ganglion of sympathetic trunk
Spinal nerve to muscles, joints, vessels, and glands of skin
Anterior root
Meningeal branch to spinal meninges and spinal perivascular plexuses (usually arises from spinal nerve)
White ramus communicans
Gray ramus communicans
Ganglion of sympathetic trunk
Greater, lesser, and least thoracic splanchnic nerves
Pain
Vagus nerve (CN X)
Celiac ganglion
Ganglion of sympathetic trunk
Enteric plexuses
Superior mesenteric ganglion
Sympathetic fibers
Preganglionic
Postganglionic
Parasympathetic fibers
Preganglionic
Postganglionic
Afferent fibers

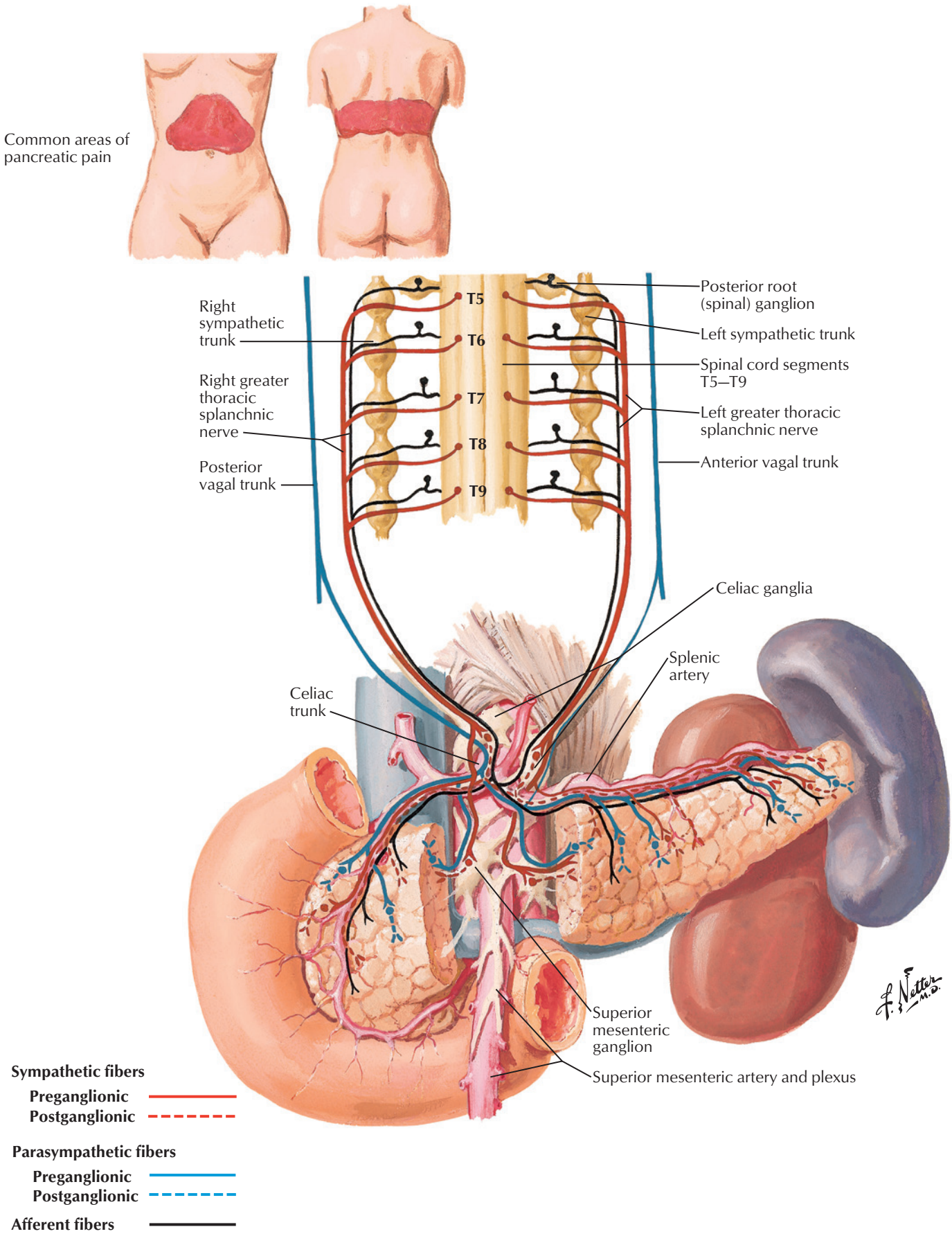


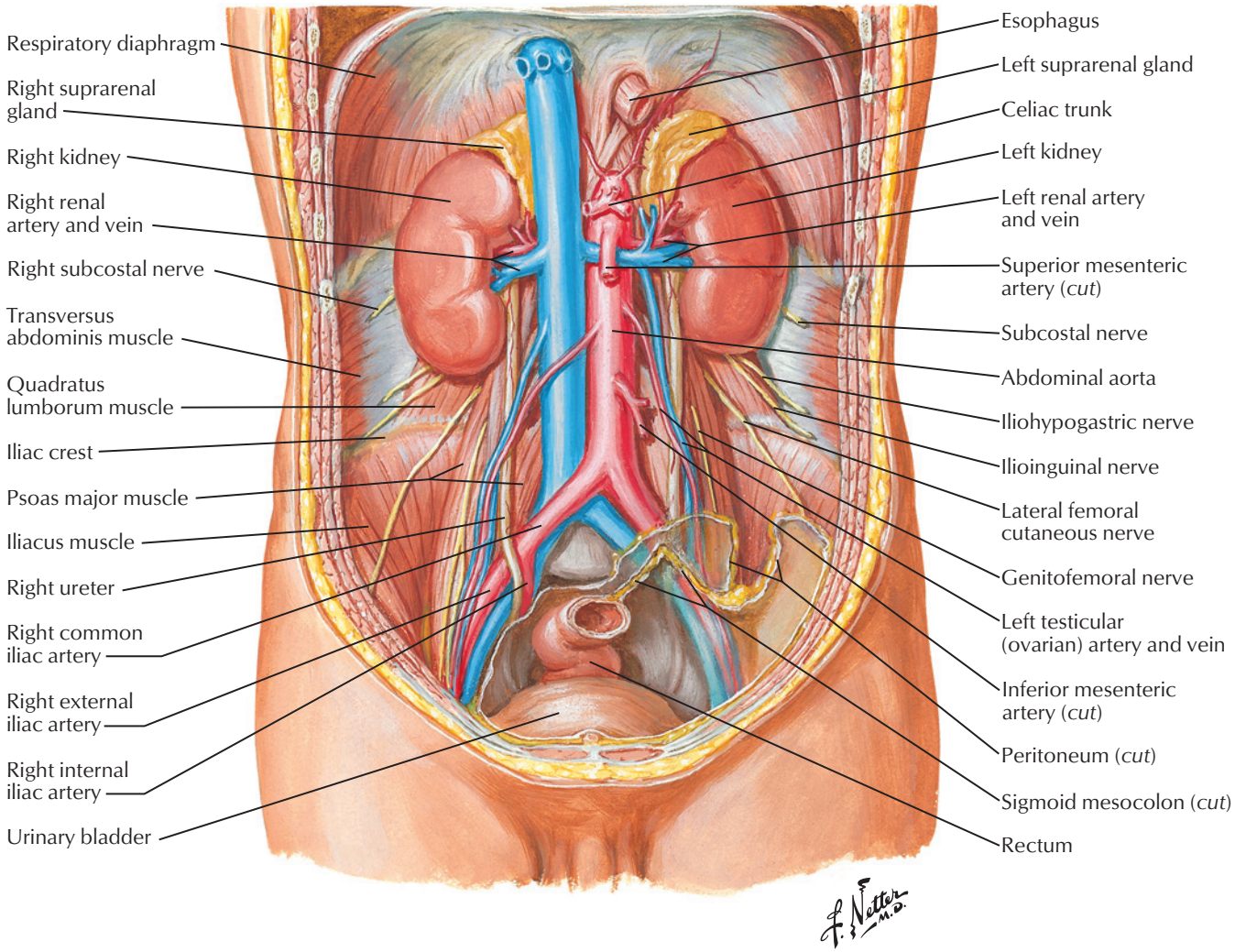
Note: Intestinal wall is shown much thicker than in actuality.

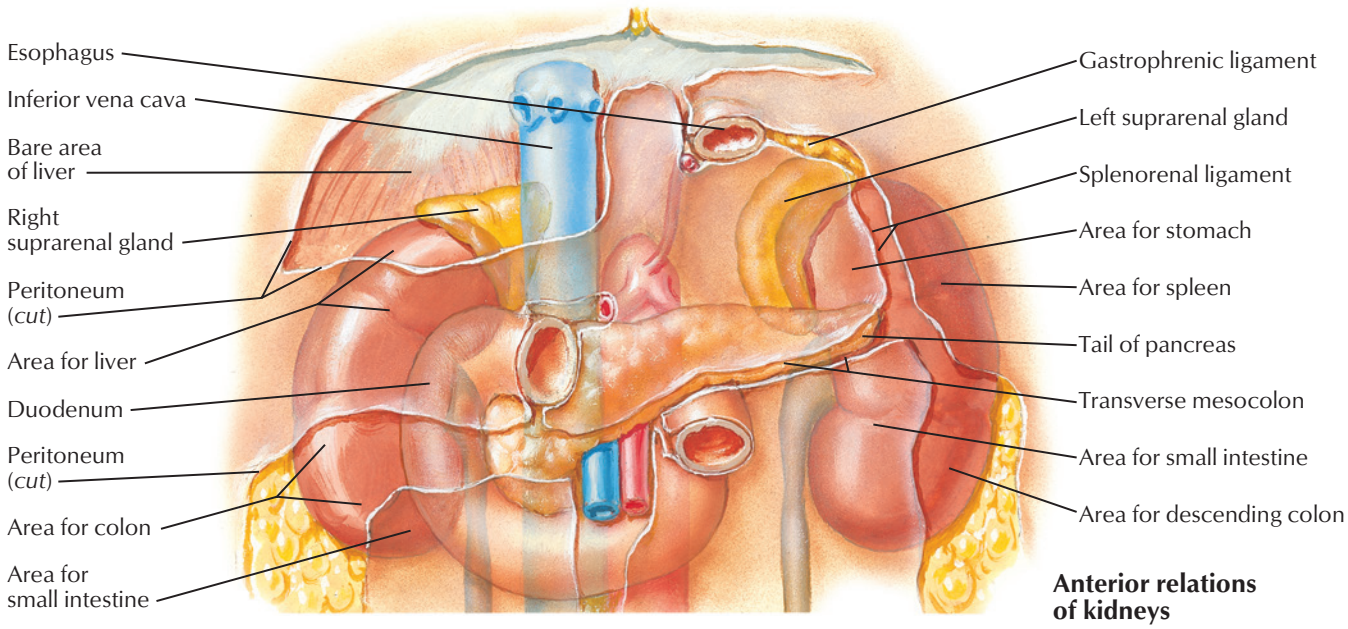
See also Plates 172, 173



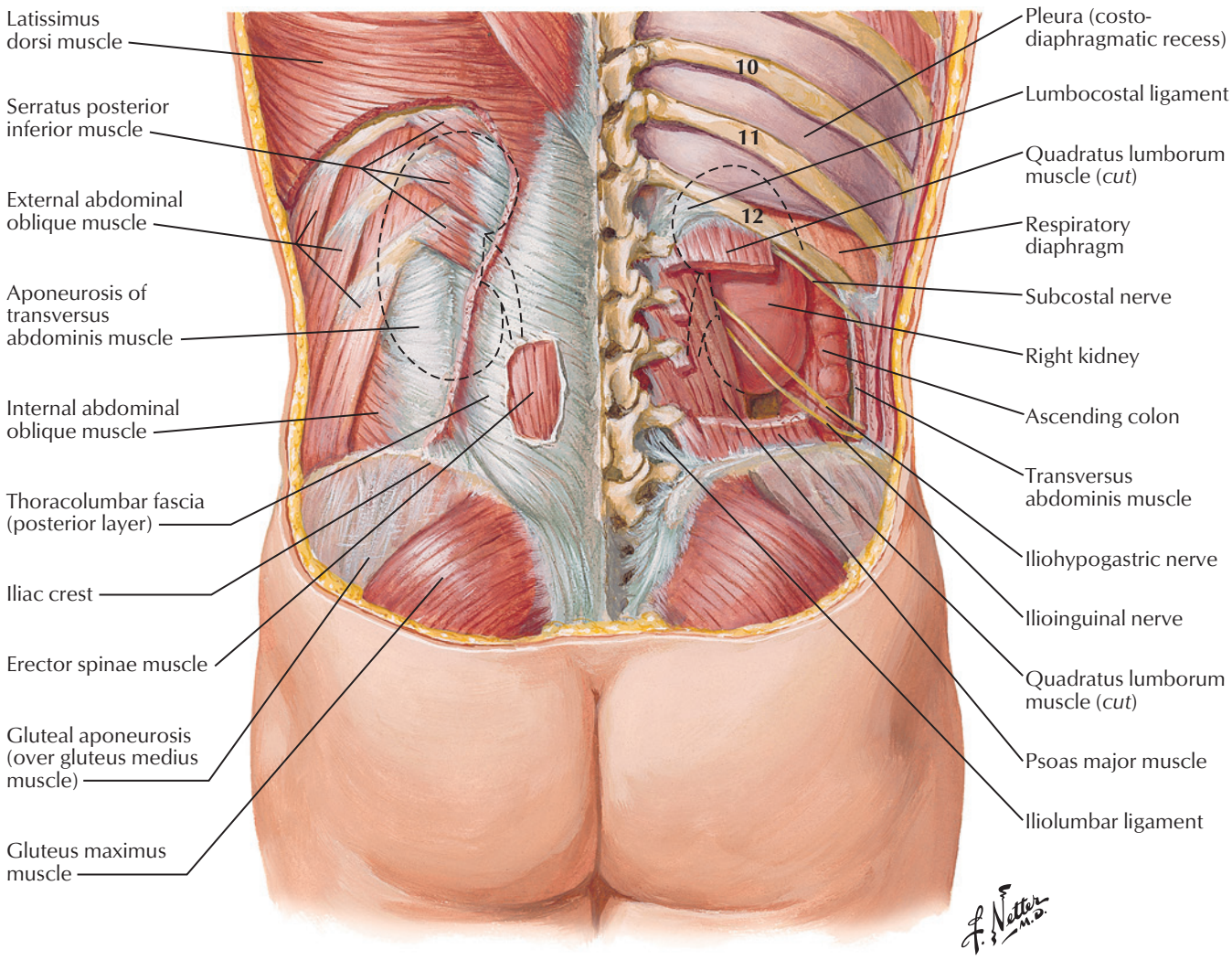
See also Plates 172, 173

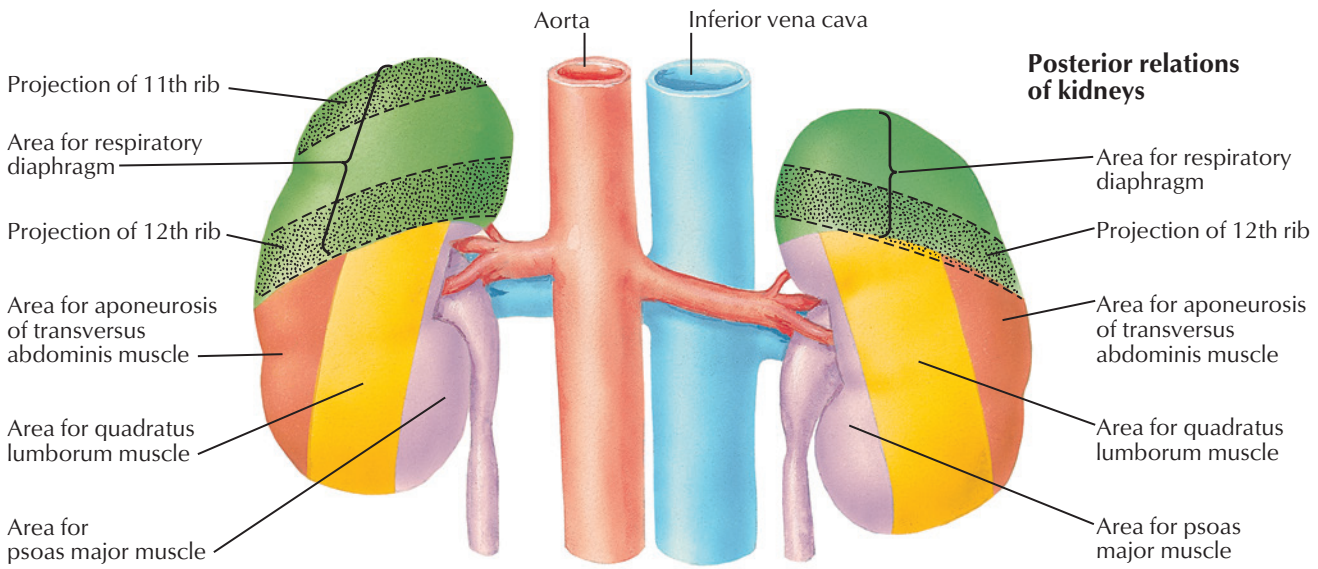


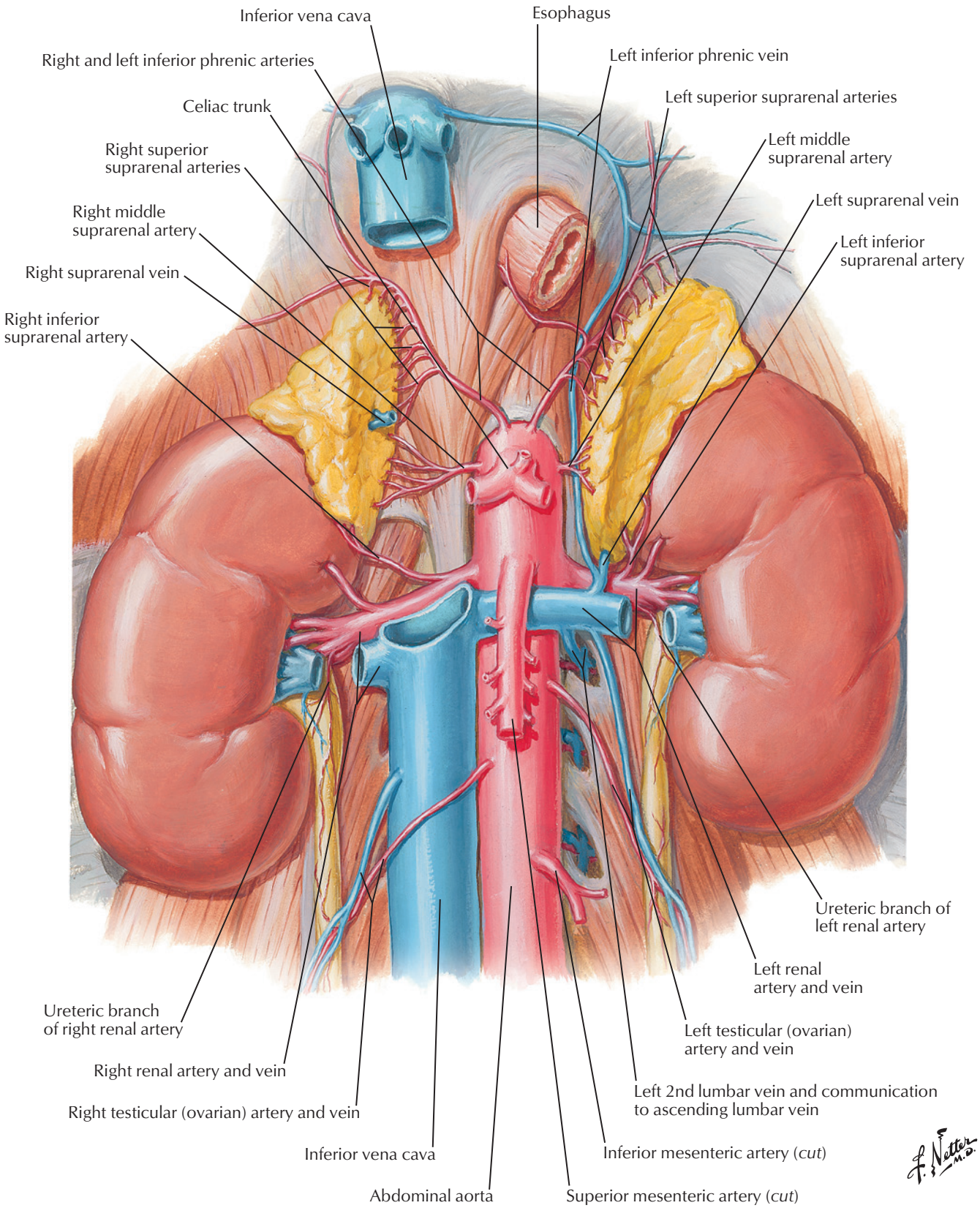


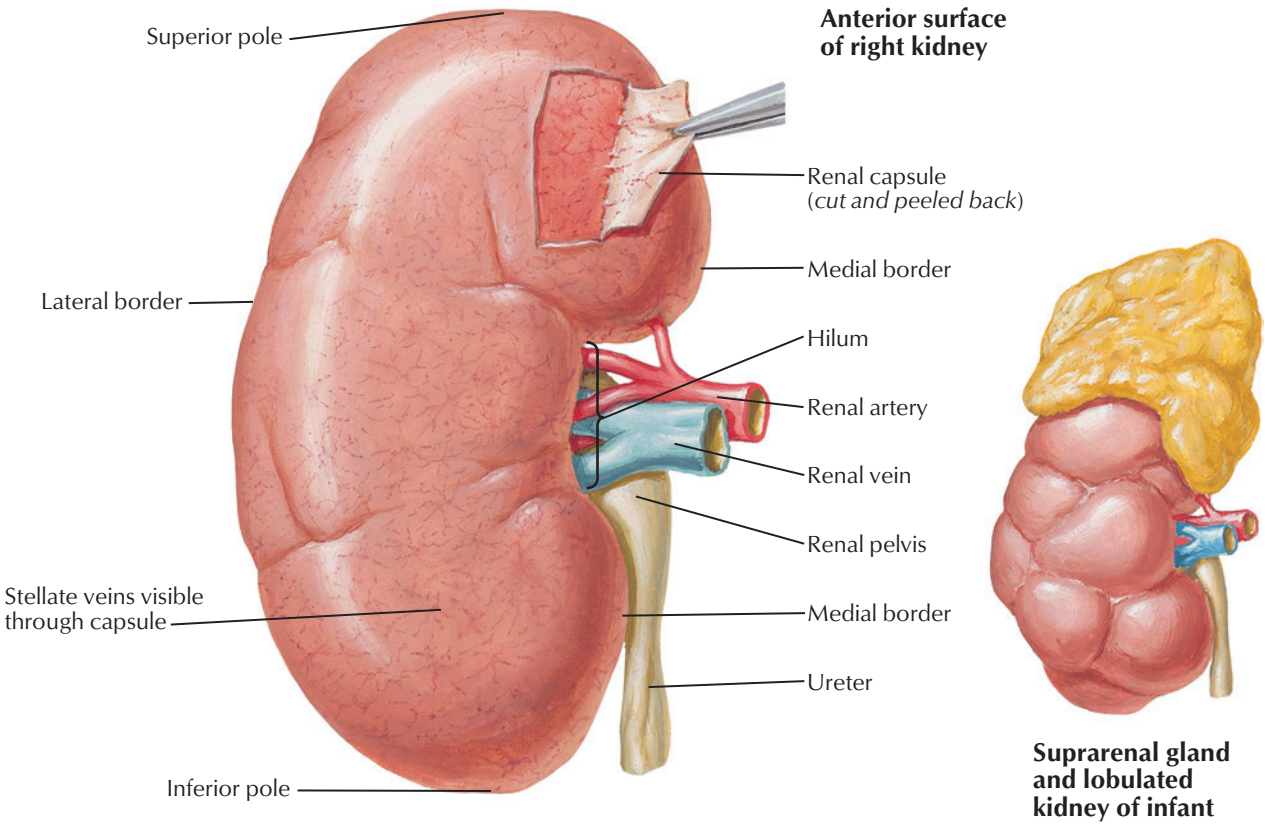


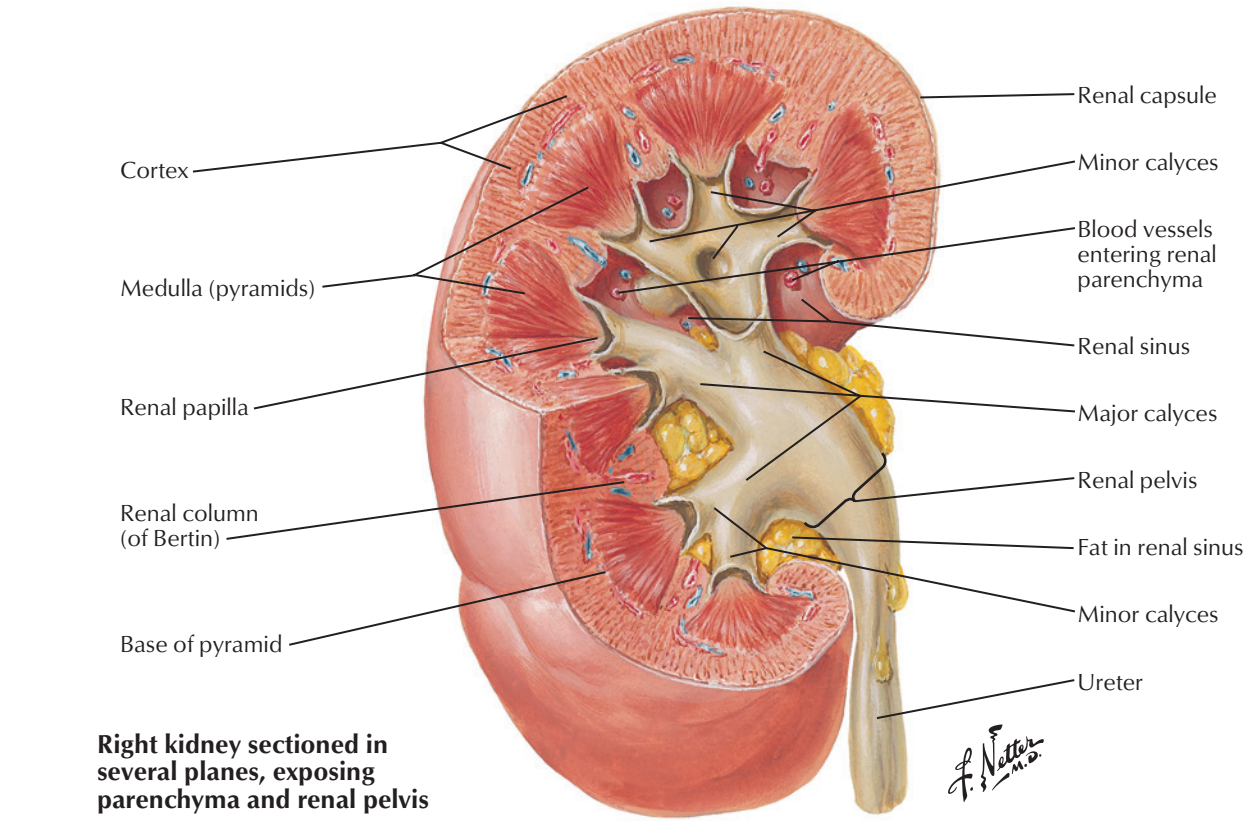
Anterior relations of kidneys


Latissimus dorsi muscle
Serratus posterior inferior muscle
External abdominal oblique muscle
Aponeurosis of transversus abdominis muscle
Internal abdominal oblique muscle
Thoracolumbar fascia (posterior layer)
Iliac crest
Erector spinae muscle
Gluteal aponeurosis (over gluteus medius muscle)
Gluteus maximus muscle
10
11
12
Pleura (costo-diaphragmatic recess)
Lumbocostal ligament
Quadratus lumborum muscle (cut)
Respiratory diaphragm
Subcostal nerve
Right kidney
Ascending colon
Transversus abdominis muscle
Iliohypogastric nerve
Ilioinguinal nerve
Quadratus lumborum muscle (cut)
Psoas major muscle
Iliolumbar ligament
F. Netter M.D.

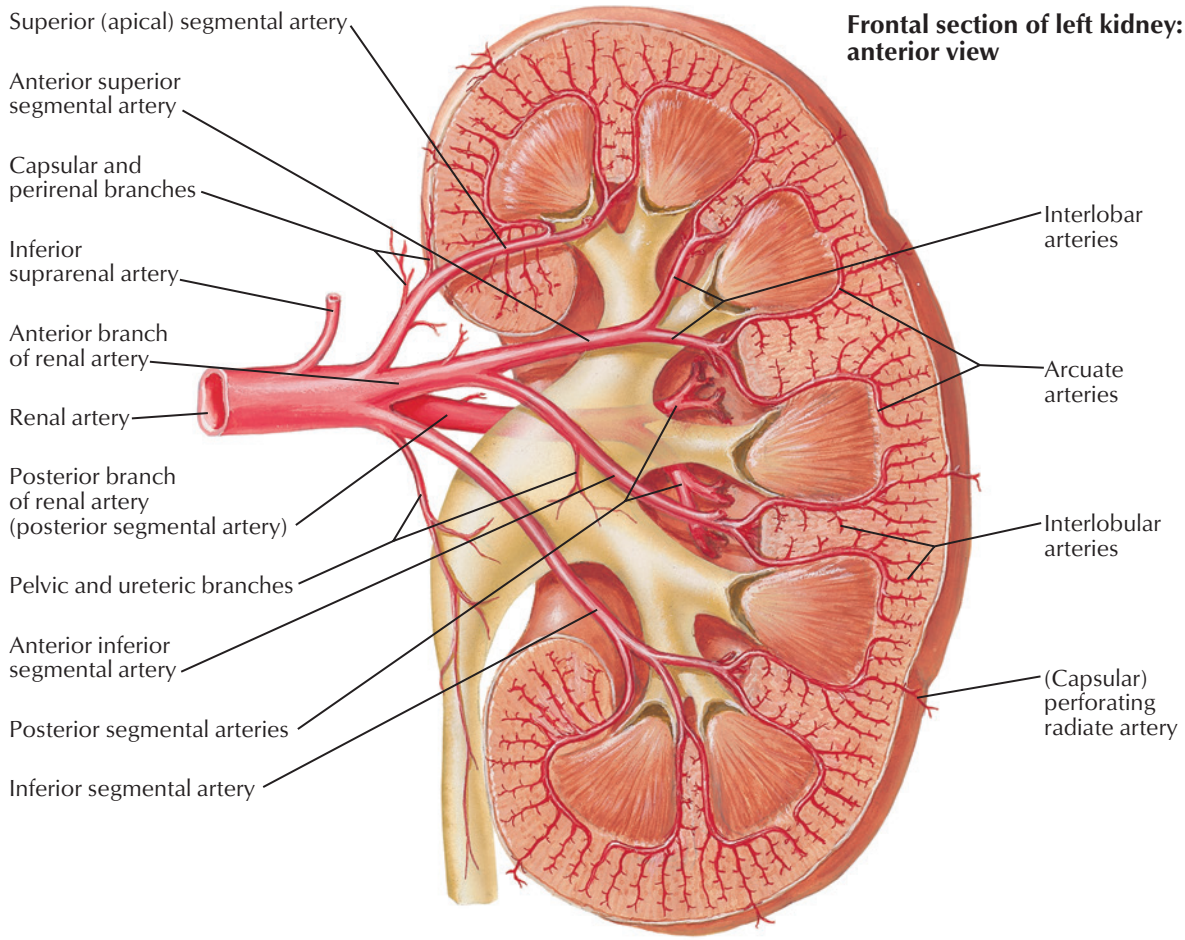

Aorta
Inferior vena cava
Projection of 11th rib
Area for respiratory diaphragm
Projection of 12th rib
Area for aponeurosis of transversus abdominis muscle
Area for quadratus lumborum muscle
Area for psoas major muscle
Posterior relations of kidneys
Area for respiratory diaphragm
Projection of 12th rib
Area for aponeurosis of transversus abdominis muscle
Area for quadratus lumborum muscle
Area for psoas major muscle

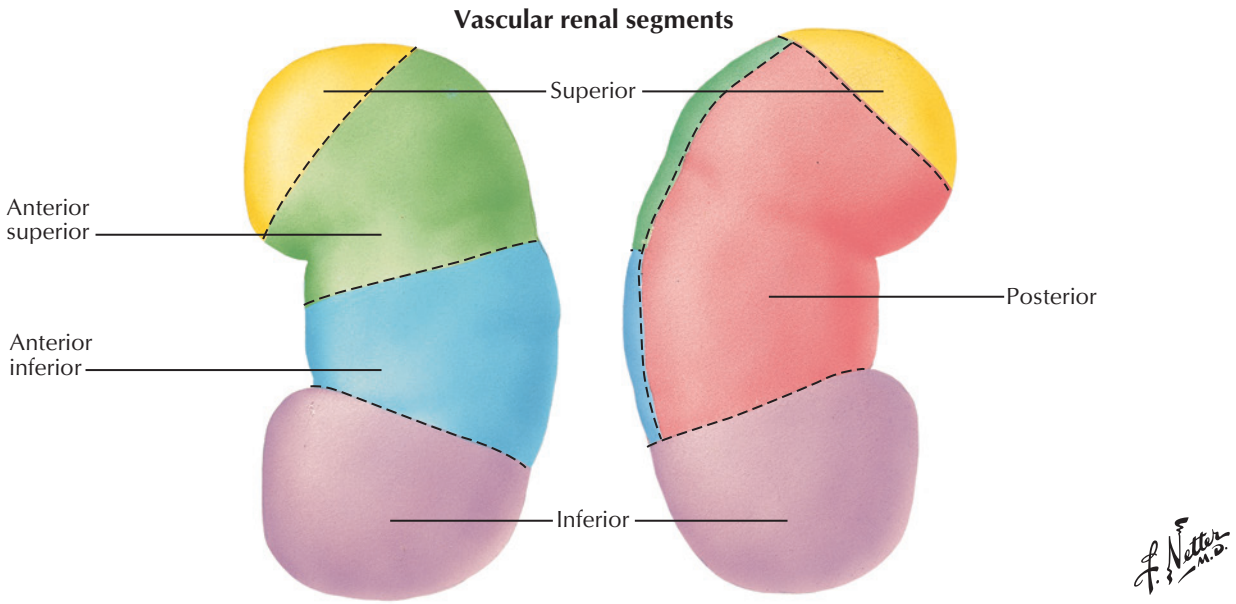

Inferior vena cava
Esophagus
Right and left inferior phrenic arteries
Left inferior phrenic vein
Celiac trunk
Left superior suprarenal arteries
Right superior suprarenal arteries
Left middle suprarenal artery
Right middle suprarenal artery
Left suprarenal vein
Right suprarenal vein
Left inferior suprarenal artery
Right inferior suprarenal artery
Ureteric branch of left renal artery
Left renal artery and vein
Ureteric branch of right renal artery
Left testicular (ovarian) artery and vein
Right renal artery and vein
Left 2nd lumbar vein and communication to ascending lumbar vein
Right testicular (ovarian) artery and vein
Inferior vena cava
Inferior mesenteric artery (cut)
Abdominal aorta
Superior mesenteric artery (cut)





Right kidney sectioned in several planes, exposing parenchyma and renal pelvis

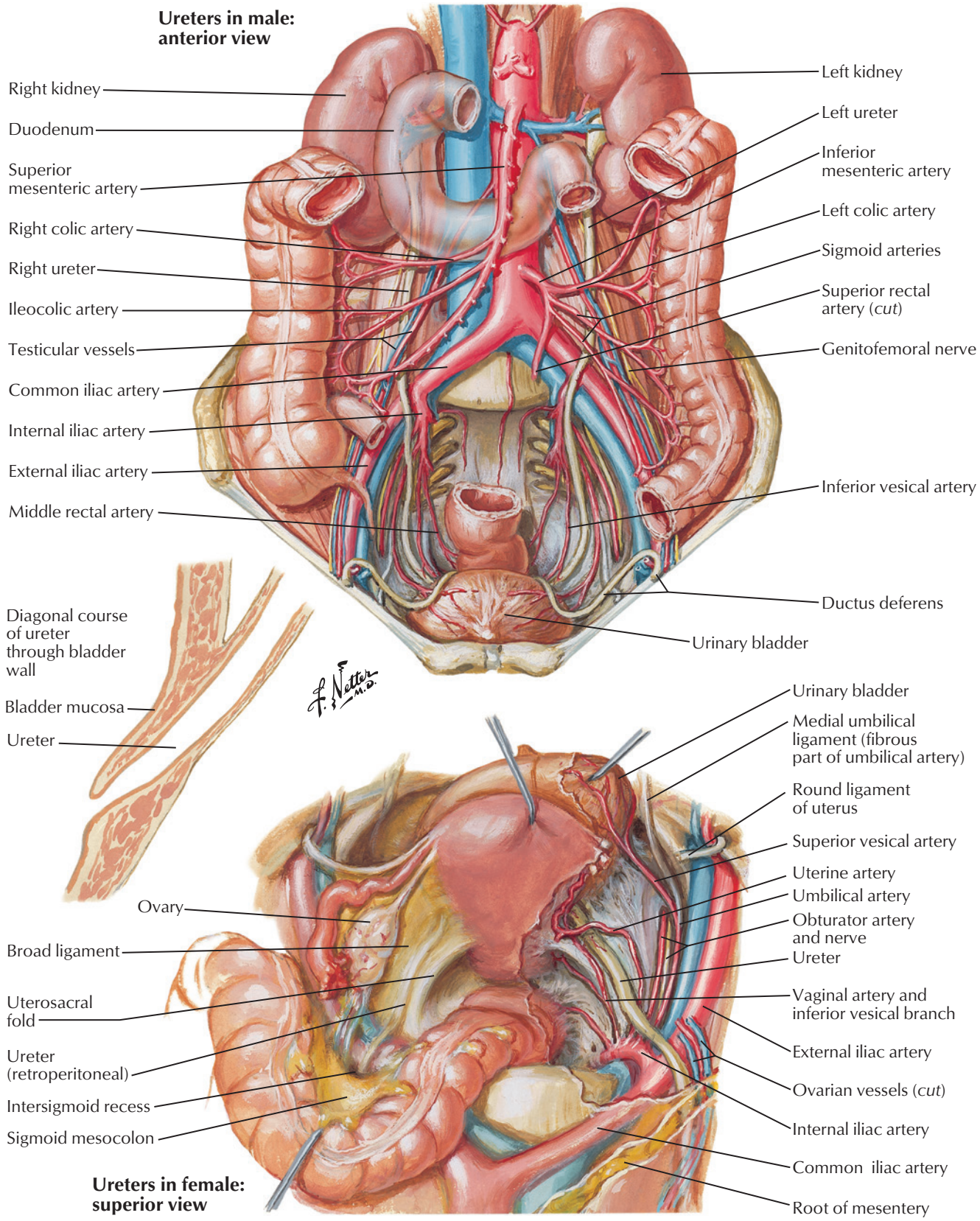


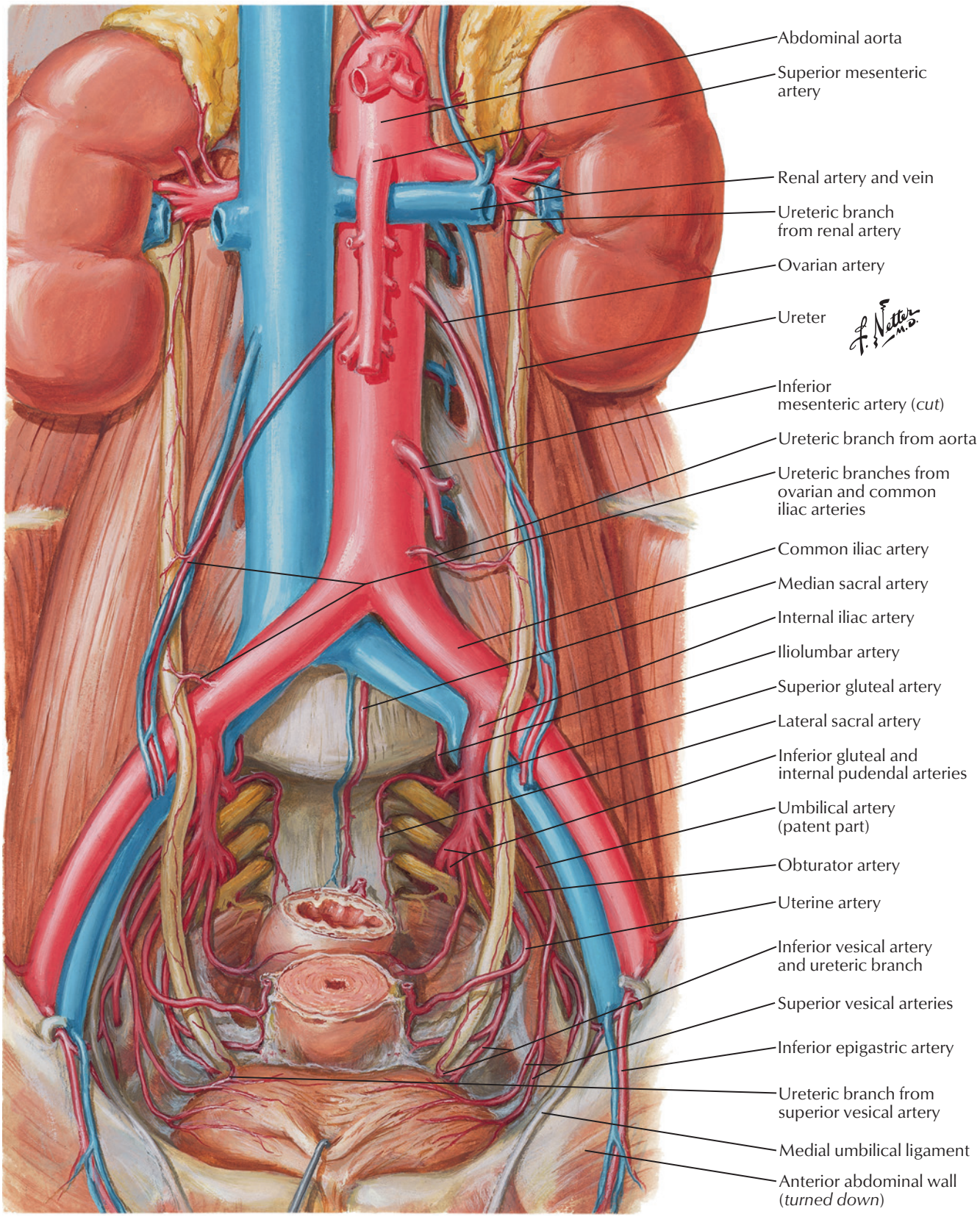


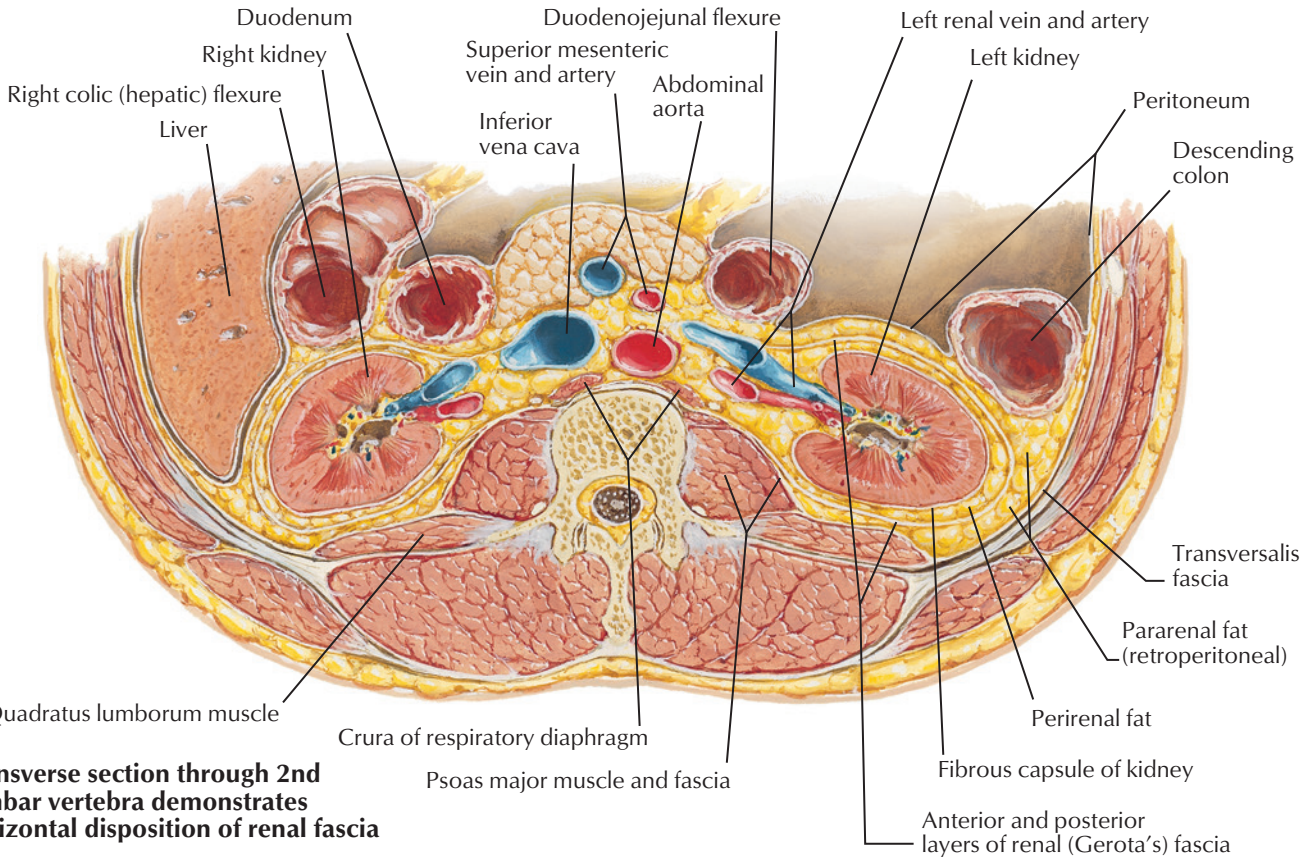
Anterior surface of left kidney

Posterior surface of left kidney

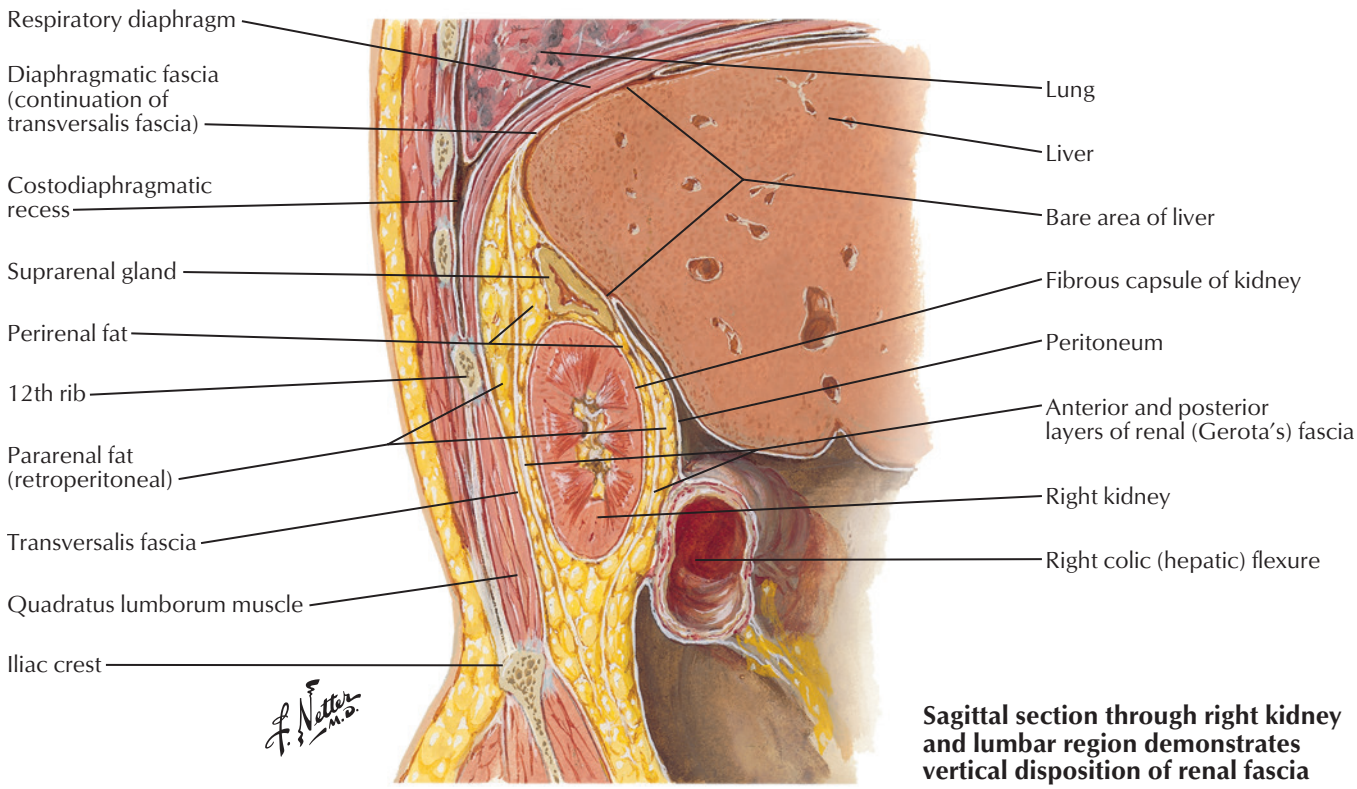
See also Plates 344, 346, 348




Abdominal aorta
Superior mesenteric artery
Renal artery and vein
Ureteric branch from renal artery
Ovarian artery
Ureter
Inferior mesenteric artery (*cut*)
Ureteric branch from aorta
Ureteric branches from ovarian and common iliac arteries
Common iliac artery
Median sacral artery
Internal iliac artery
Iliolumbar artery
Superior gluteal artery
Lateral sacral artery
Inferior gluteal and internal pudendal arteries
Umbilical artery (patent part)
Obturator artery
Uterine artery
Inferior vesical artery and ureteric branch
Superior vesical arteries
Inferior epigastric artery
Ureteric branch from superior vesical artery
Medial umbilical ligament
Anterior abdominal wall (*turned down*)

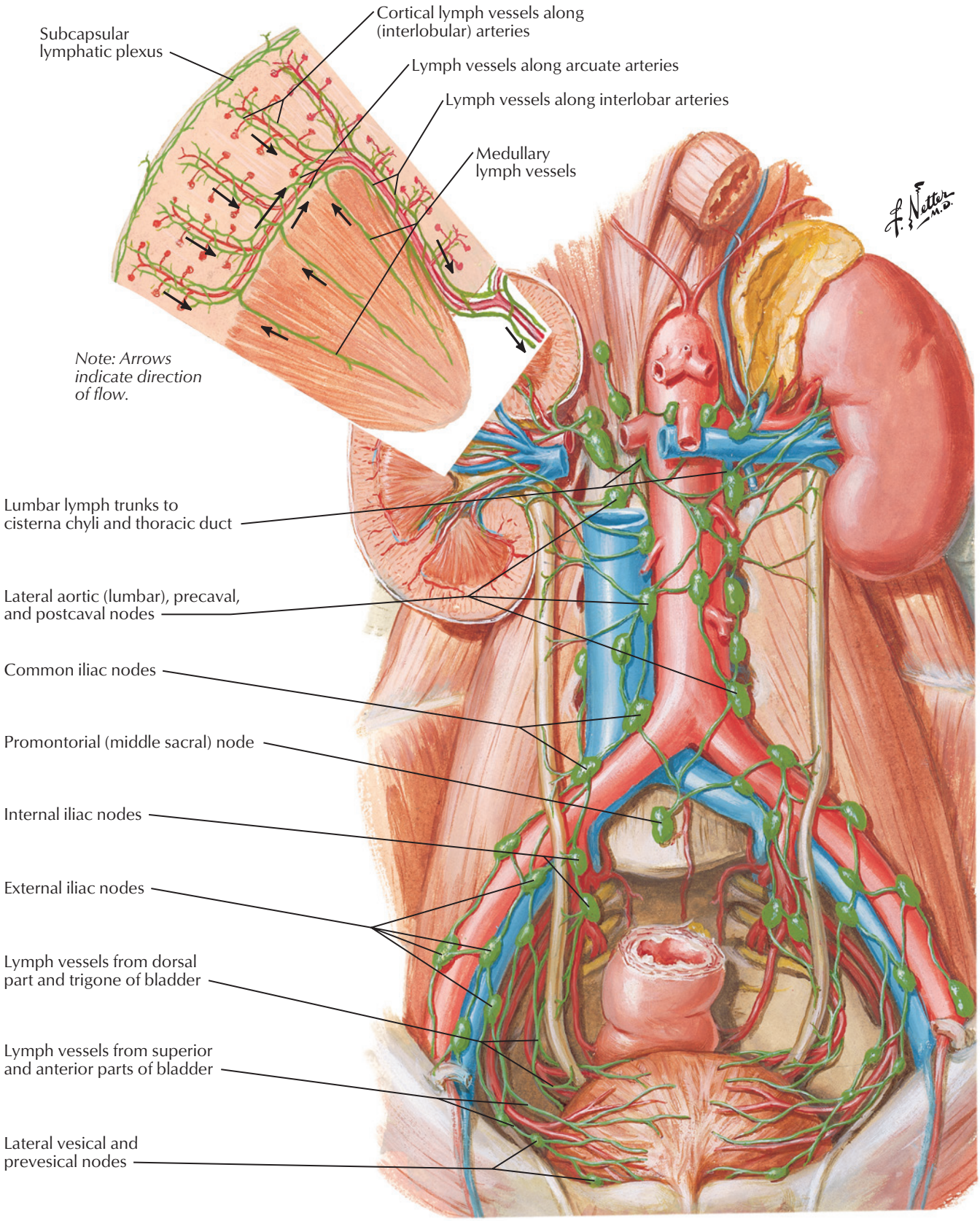


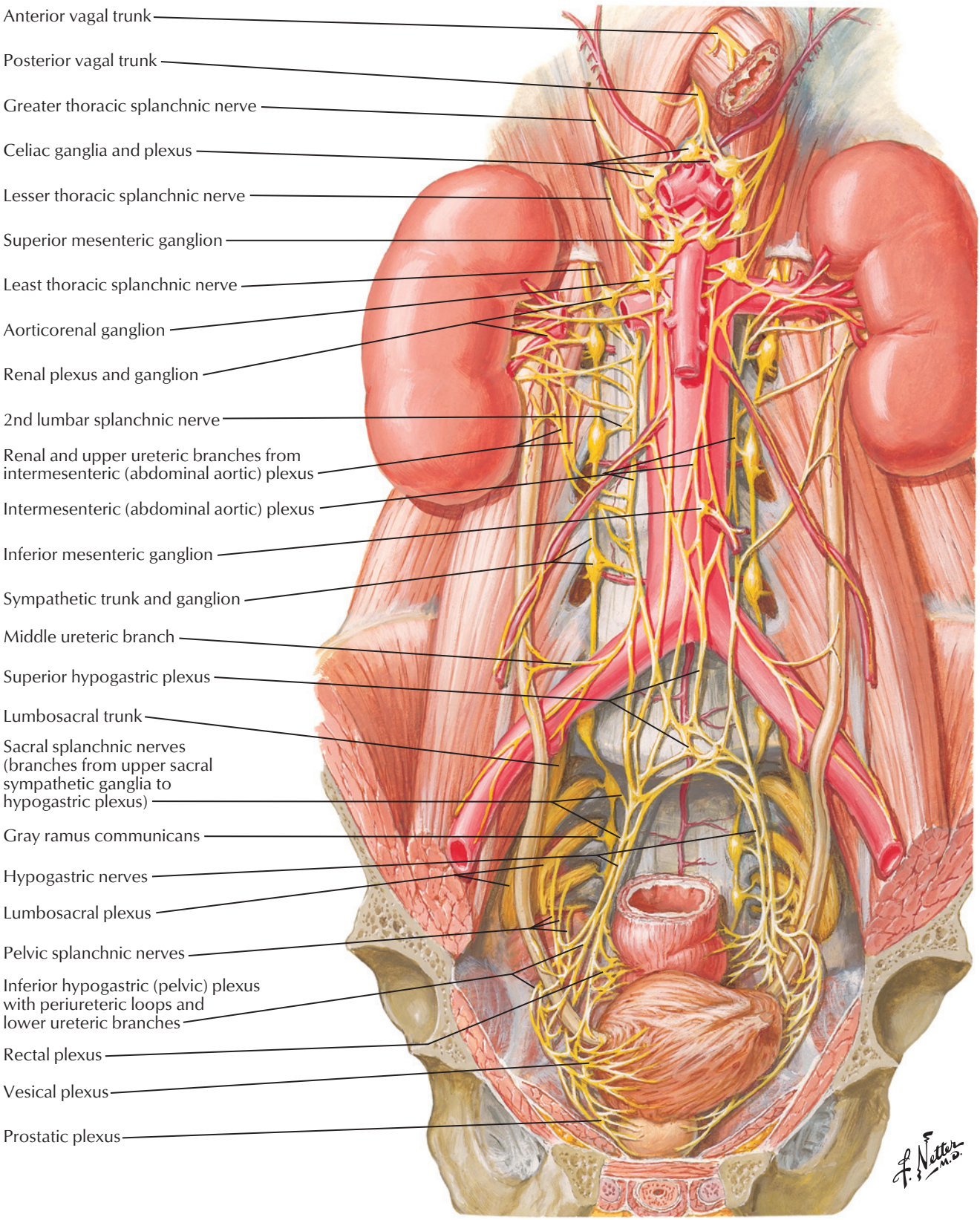
Transverse section through 2nd lumbar vertebra demonstrates horizontal disposition of renal fascia



Sagittal section through right kidney and lumbar region demonstrates vertical disposition of renal fascia

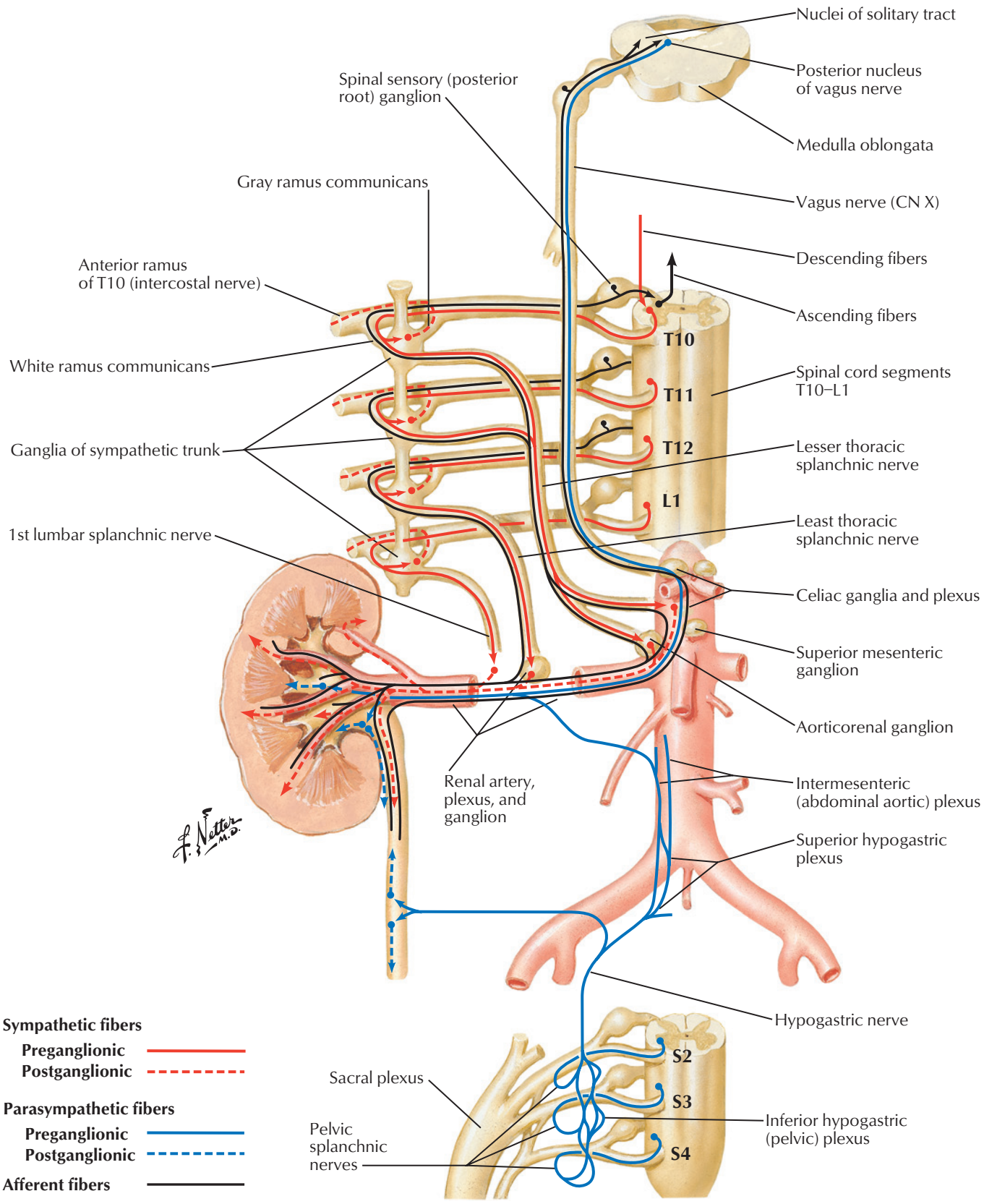
See also Plates 388, 390



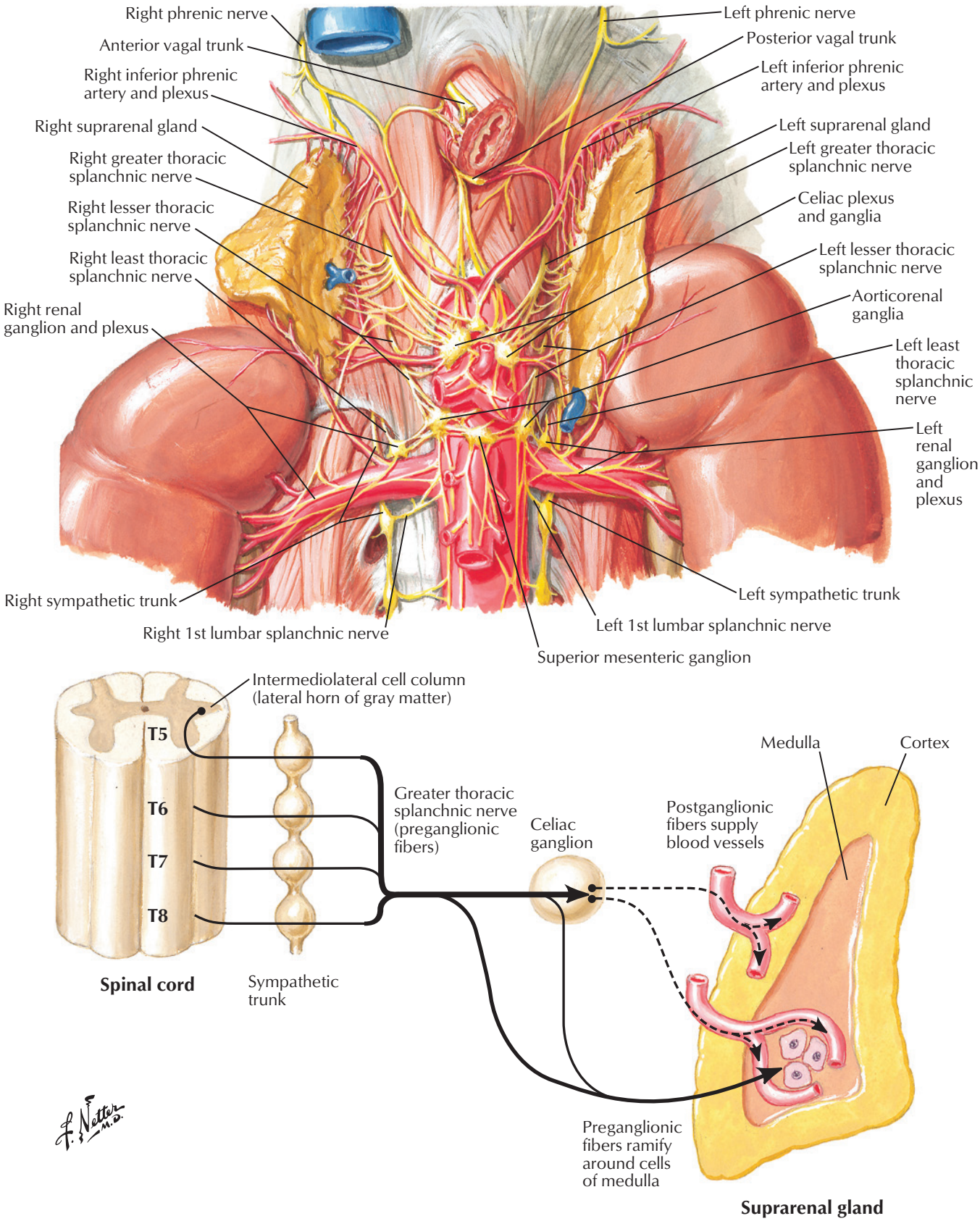

Anterior vagal trunk
Posterior vagal trunk
Greater thoracic splanchnic nerve
Celiac ganglia and plexus
Lesser thoracic splanchnic nerve
Superior mesenteric ganglion
Least thoracic splanchnic nerve
Aorticorenal ganglion
Renal plexus and ganglion
2nd lumbar splanchnic nerve
Renal and upper ureteric branches from intermesenteric (abdominal aortic) plexus
Intermesenteric (abdominal aortic) plexus
Inferior mesenteric ganglion
Sympathetic trunk and ganglion
Middle ureteric branch
Superior hypogastric plexus
Lumbosacral trunk
Sacral splanchnic nerves (branches from upper sacral sympathetic ganglia to hypogastric plexus)
Gray ramus communicans
Hypogastric nerves
Lumbosacral plexus
Pelvic splanchnic nerves
Inferior hypogastric (pelvic) plexus with periureteric loops and lower ureteric branches
Rectal plexus
Vesical plexus
Prostatic plexus
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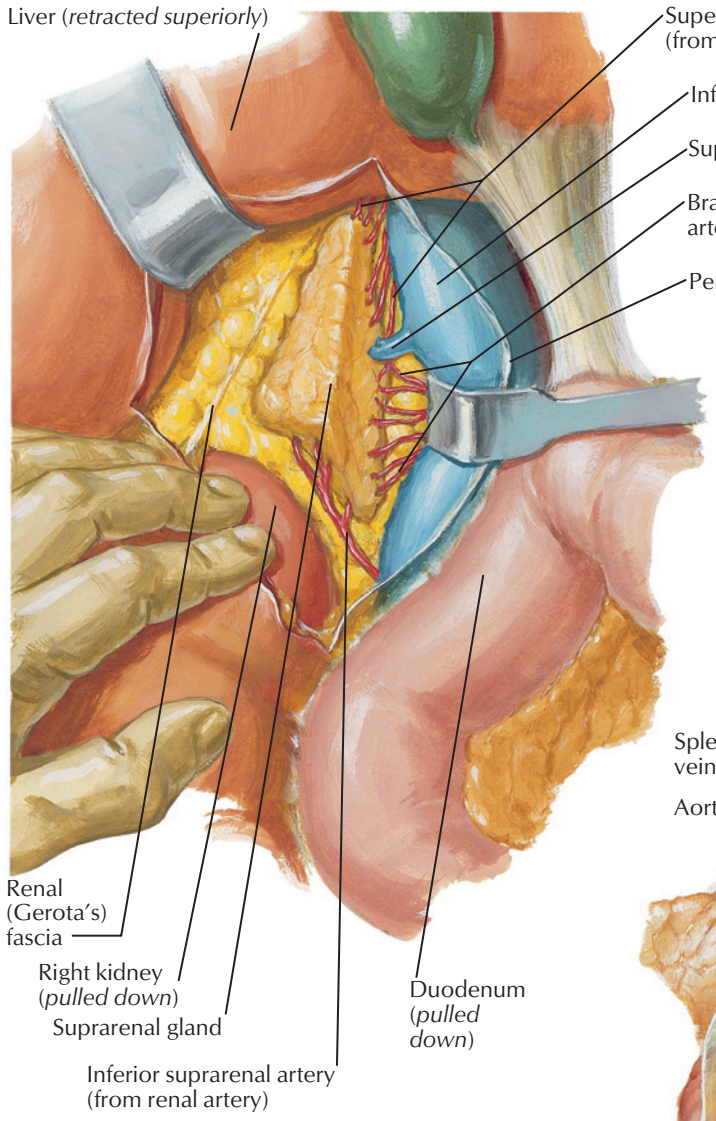
Autonomic Innervation of Kidneys and Upper Ureters: Schema

See also Plates 172, 173, 399

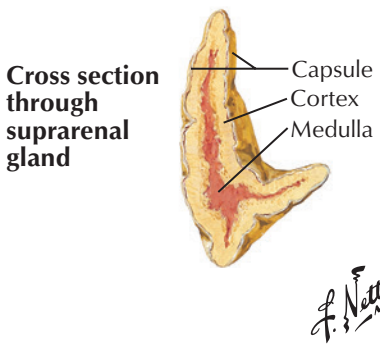


See also Plates 172, 173

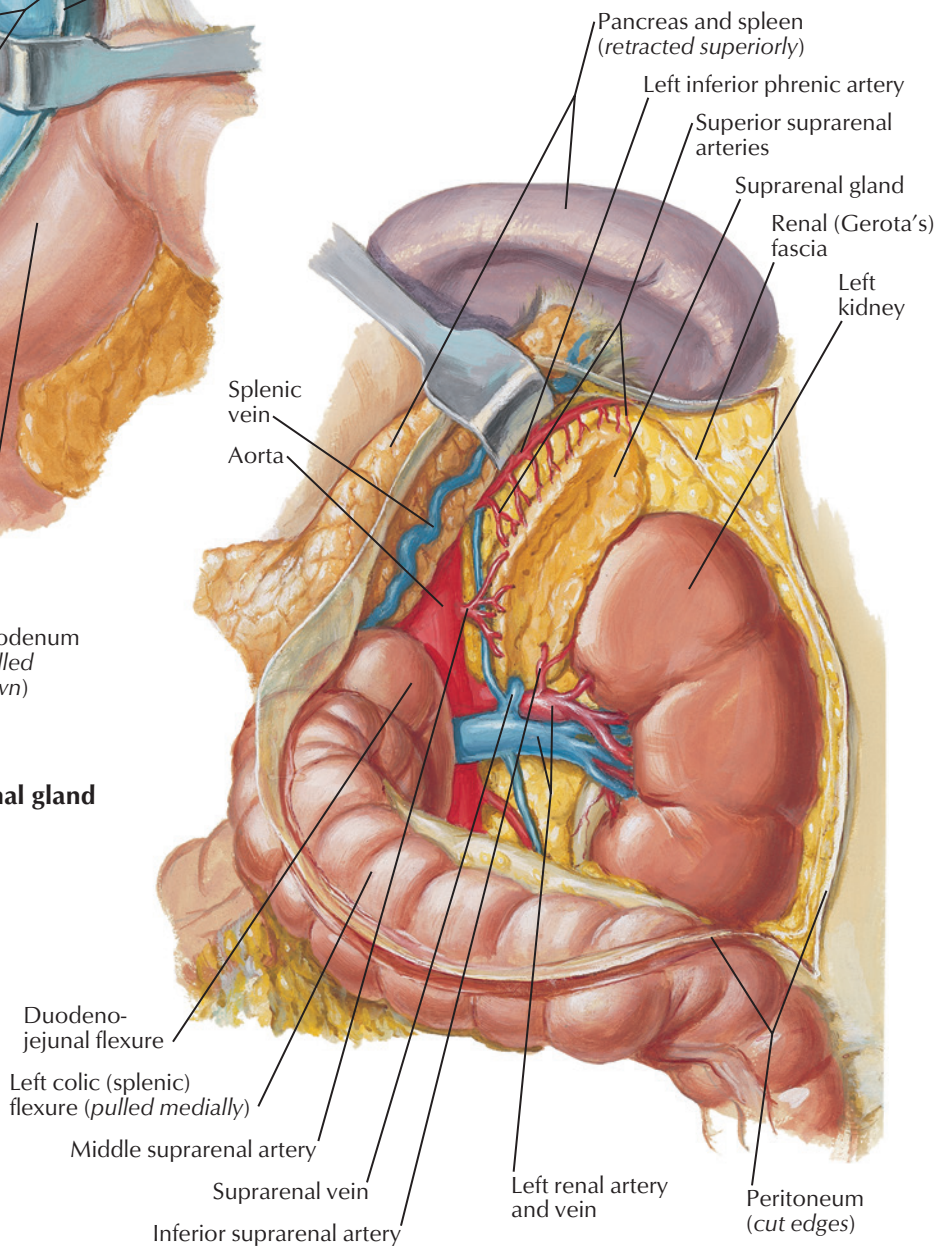




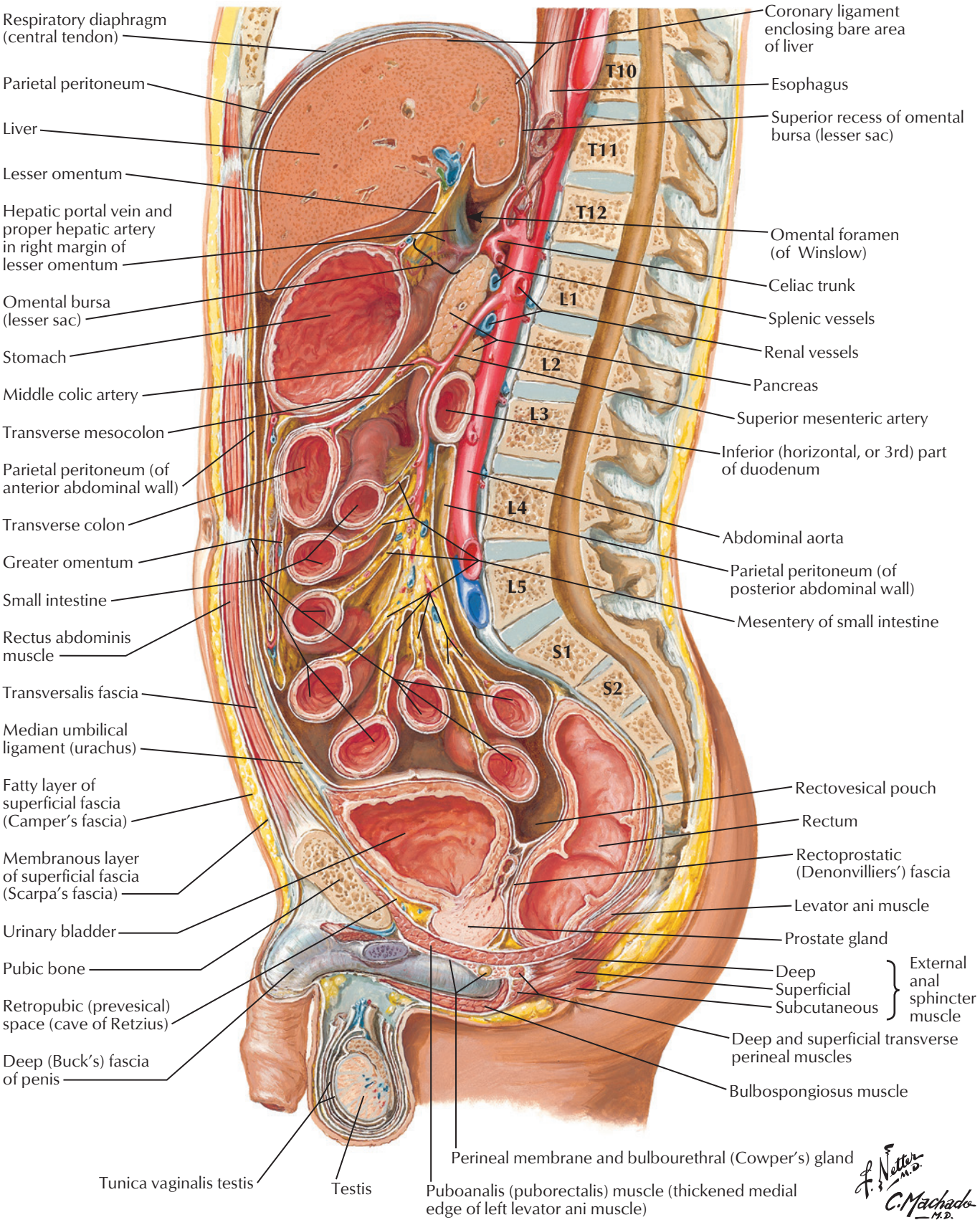
Abdominal exposure of right suprarenal gland



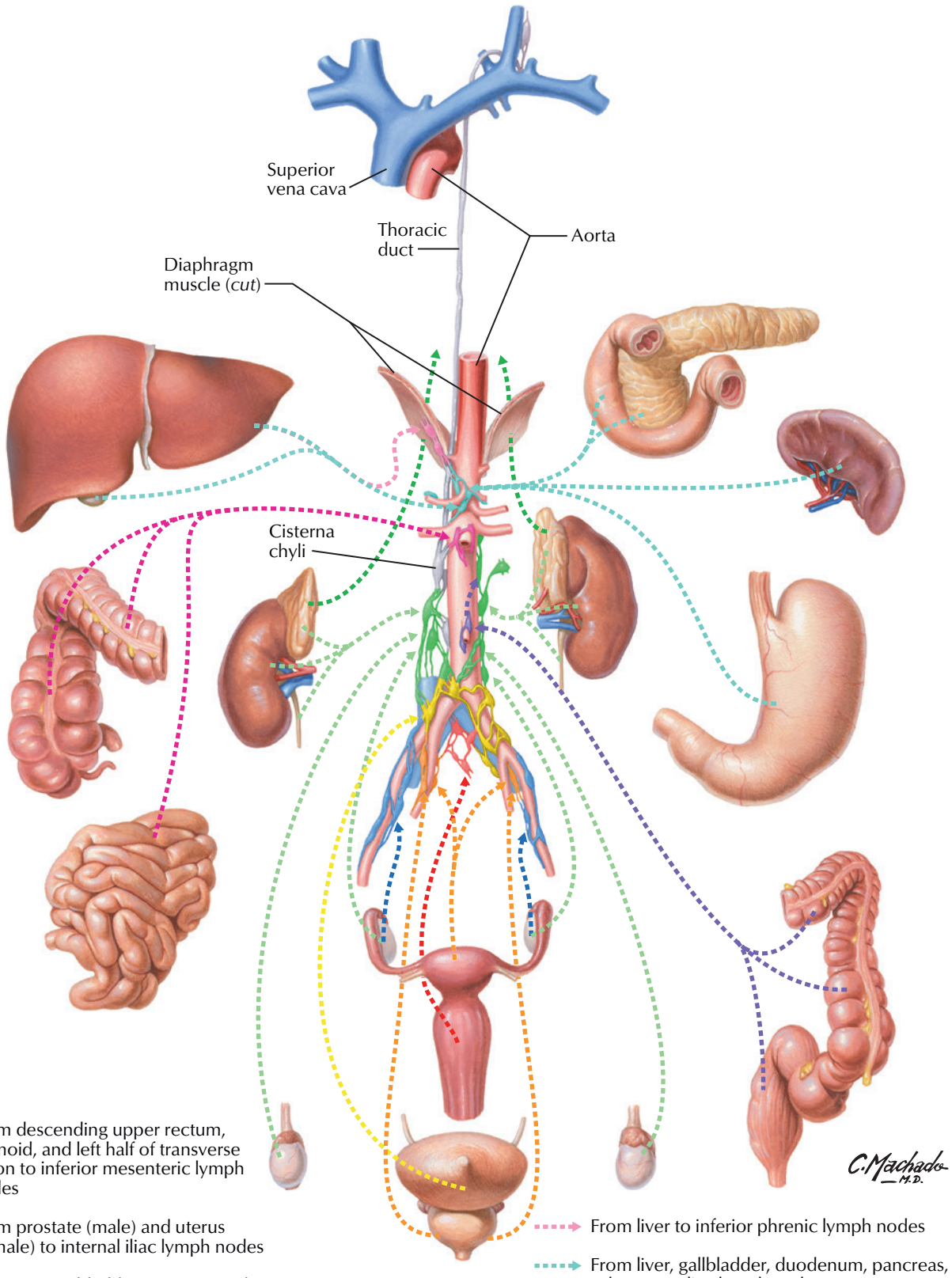
Cross section through suprarenal gland



Abdominal exposure of left suprarenal gland

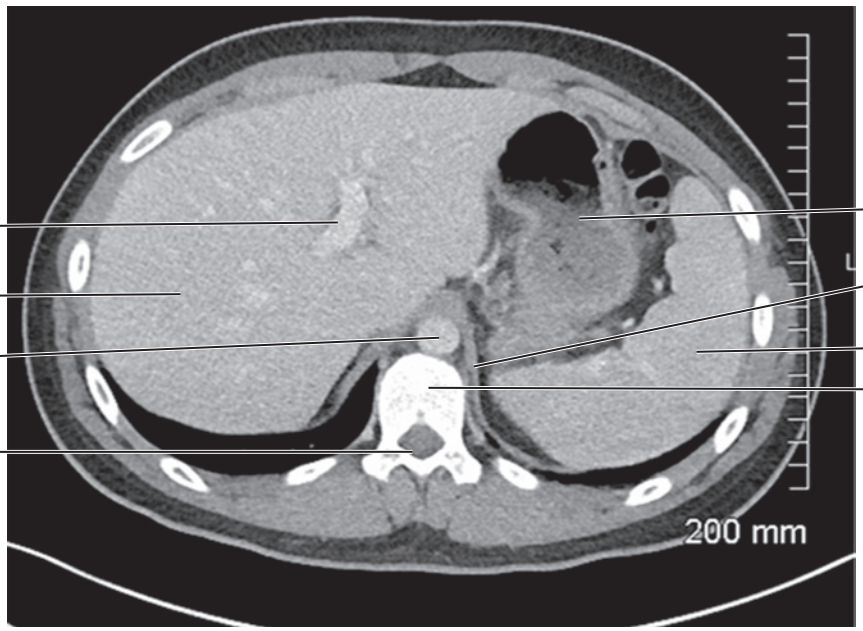

Respiratory diaphragm (central tendon)
Parietal peritoneum
Liver
Lesser omentum
Hepatic portal vein and proper hepatic artery in right margin of lesser omentum
Omental bursa (lesser sac)
Stomach
Middle colic artery
Transverse mesocolon
Parietal peritoneum (of anterior abdominal wall)
Transverse colon
Greater omentum
Small intestine
Rectus abdominis muscle
Transversalis fascia
Median umbilical ligament (urachus)
Fatty layer of superficial fascia (Camper's fascia)
Membranous layer of superficial fascia (Scarpa's fascia)
Urinary bladder
Pubic bone
Retropubic (prevesical) space (cave of Retzius)
Deep (Buck's) fascia of penis
Tunica vaginalis testis
Testis
Perineal membrane and bulbourethral (Cowper's) gland
Puboanalis (puborectalis) muscle (thickened medial edge of left levator ani muscle)
Bulbospongiosus muscle
Deep and superficial transverse perineal muscles
Deep
Superficial
Subcutaneous
External anal sphincter muscle
Prostate gland
Levator ani muscle
Rectoprostatic (Denonvilliers') fascia
Rectum
Rectovesical pouch
Mesentery of small intestine
Parietal peritoneum (of posterior abdominal wall)
Abdominal aorta
Inferior (horizontal, or 3rd) part of duodenum
Superior mesenteric artery
Pancreas
Renal vessels
Splenic vessels
Celiac trunk
Omental foramen (of Winslow)
Superior recess of omental bursa (lesser sac)
Esophagus
Coronary ligament enclosing bare area of liver
T10
T11
T12
L1
L2
L3
L4
L5
S1
S2
F. Netter M.D.
C. Machado M.D.

Abdominal and Pelvic Lymphatics: Schema

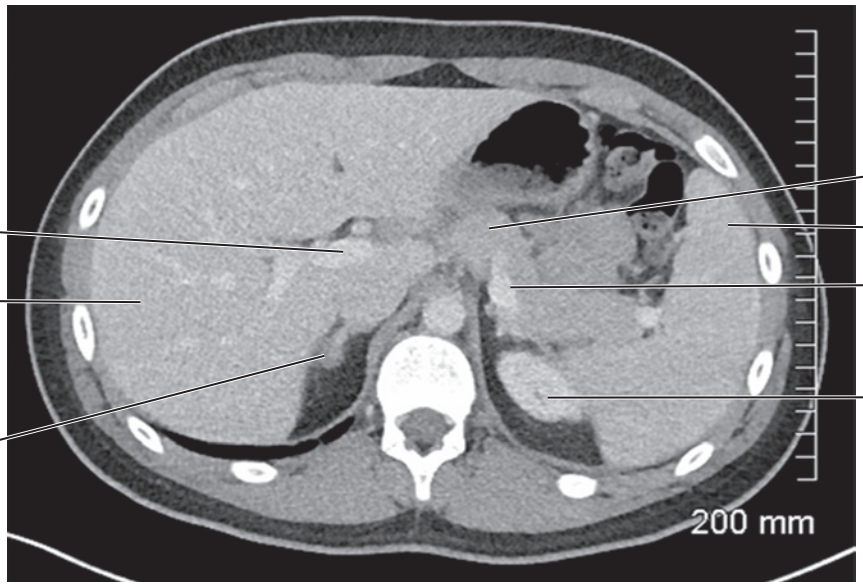


- From descending upper rectum, sigmoid, and left half of transverse colon to inferior mesenteric lymph nodes
- From prostate (male) and uterus (female) to internal iliac lymph nodes
- From urinary bladder to common iliac lymph nodes (internal iliac nodes)
- From vagina to sacral lymph nodes
- From ovaries to external iliac lymph nodes
- From suprarenal glands to posterior mediastinal nodes
- From liver to inferior phrenic lymph nodes
- From liver, gallbladder, duodenum, pancreas, and spleen to celiac lymph nodes
- From cecum, ascending and right half of transverse colon, jejunum, and ileum to superior mesenteric lymph nodes
- From kidneys, suprarenal glands, ureters, testis (male), and ovaries (female) to lateral aortic lymph nodes

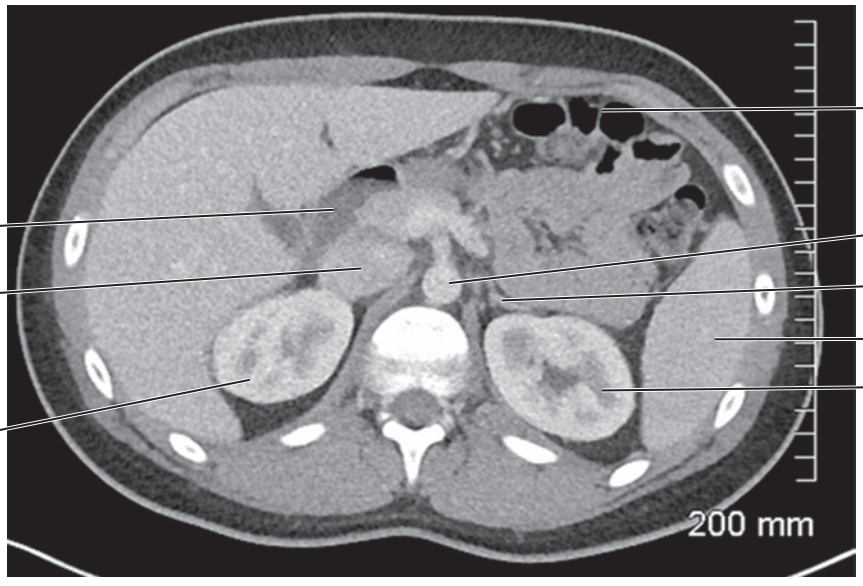
Axial CT image of abdomen with intravenous contrast enhancement



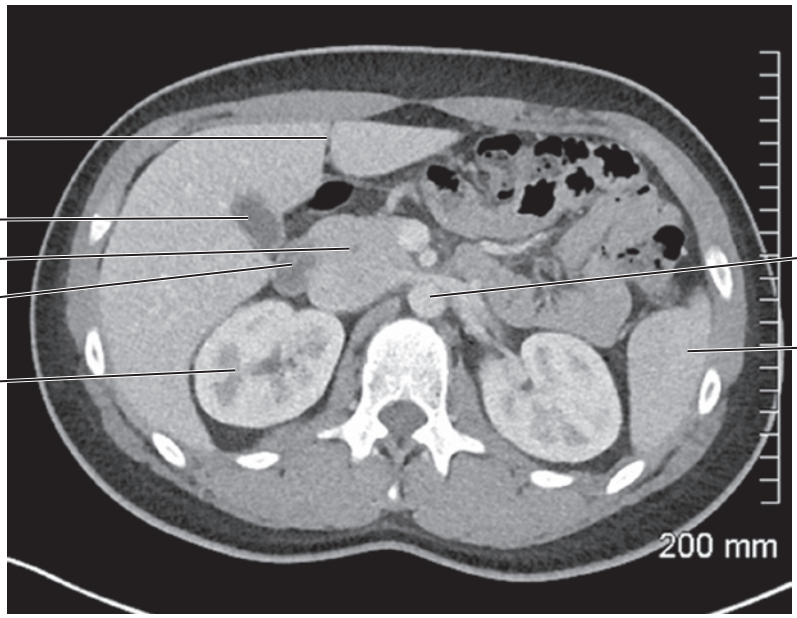
Axial CT image of upper abdomen with intravenous contrast enhancement



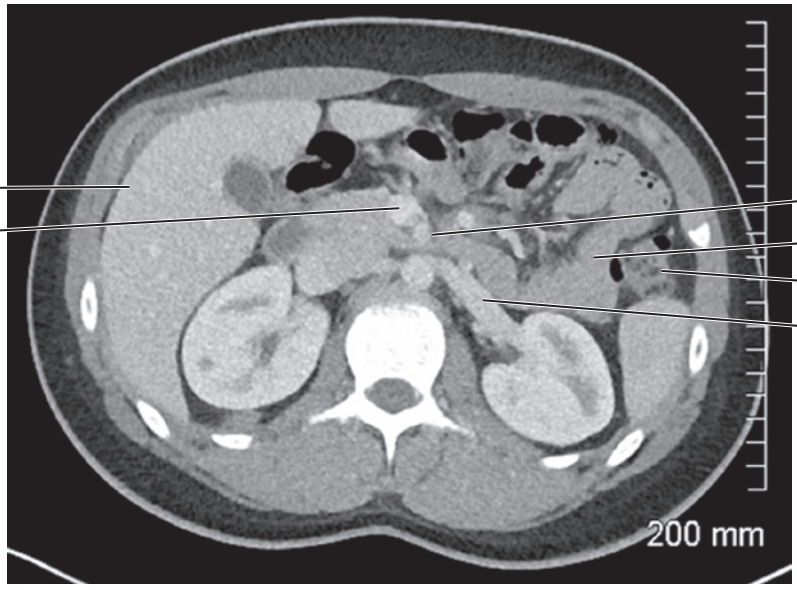
Axial CT image of midabdomen with intravenous contrast enhancement



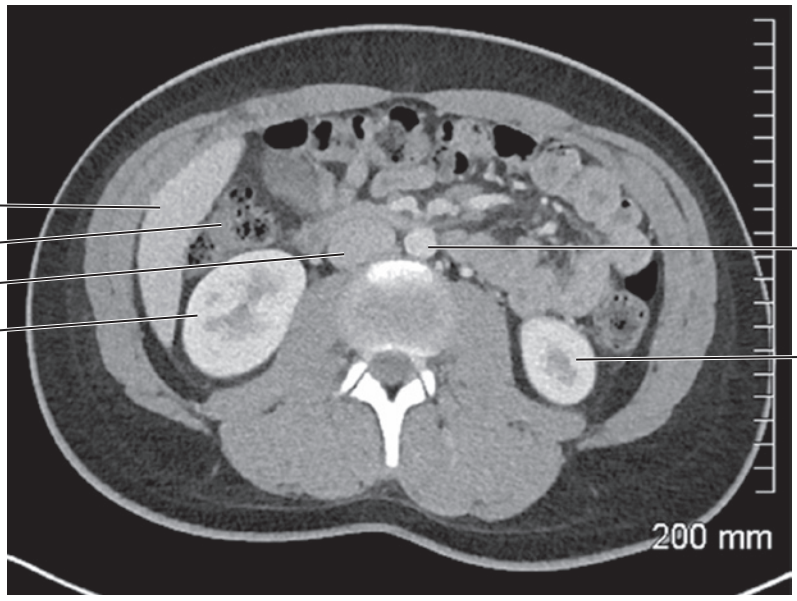
Axial CT image of midabdomen with intravenous contrast enhancement

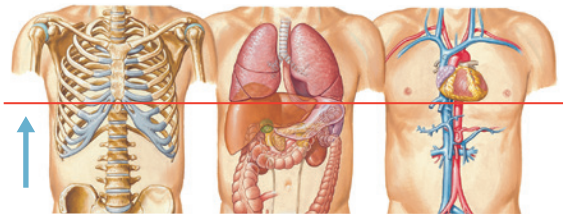


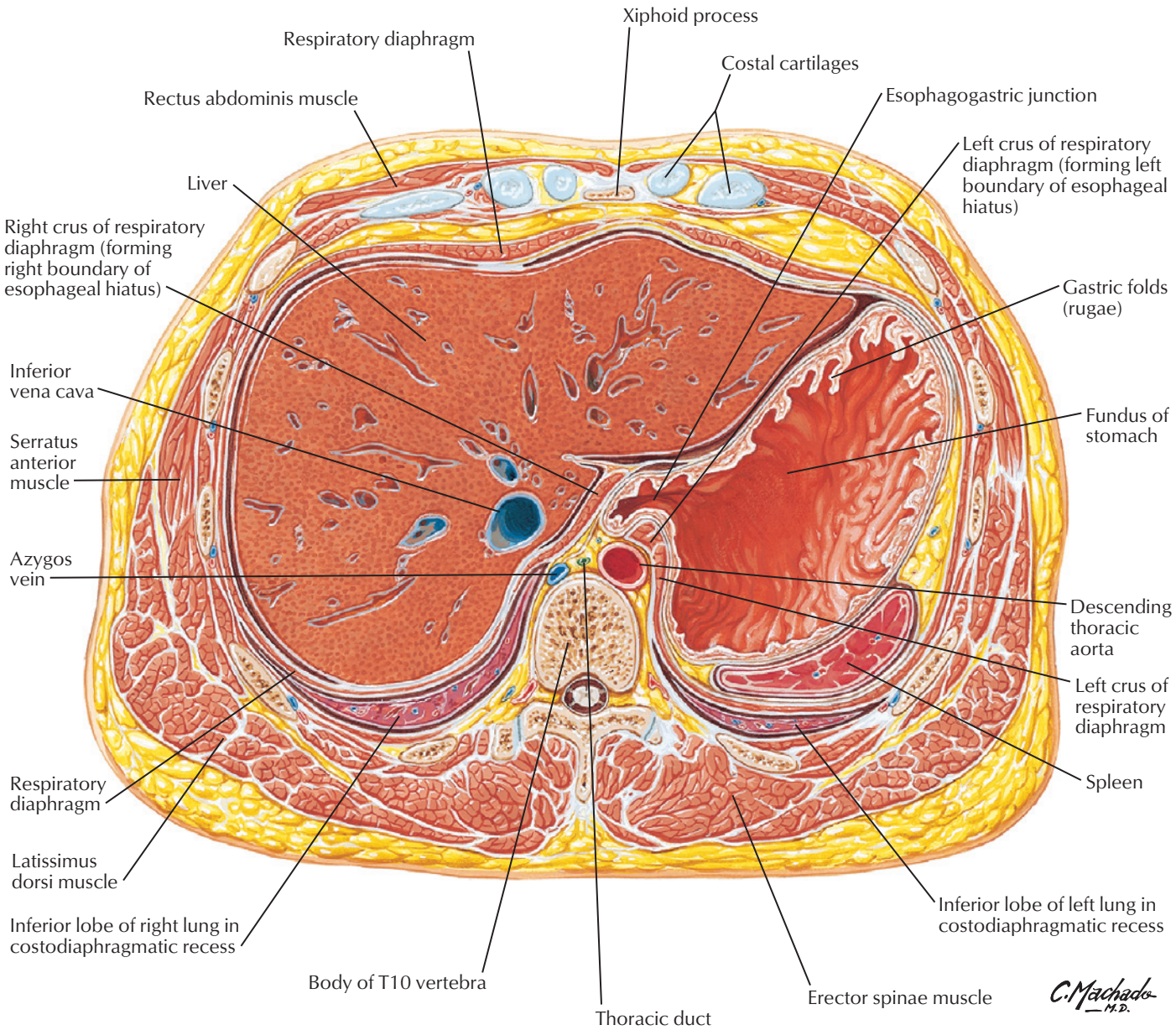
Axial CT image of abdomen with intravenous contrast enhancement

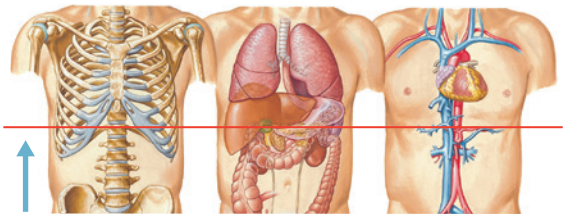


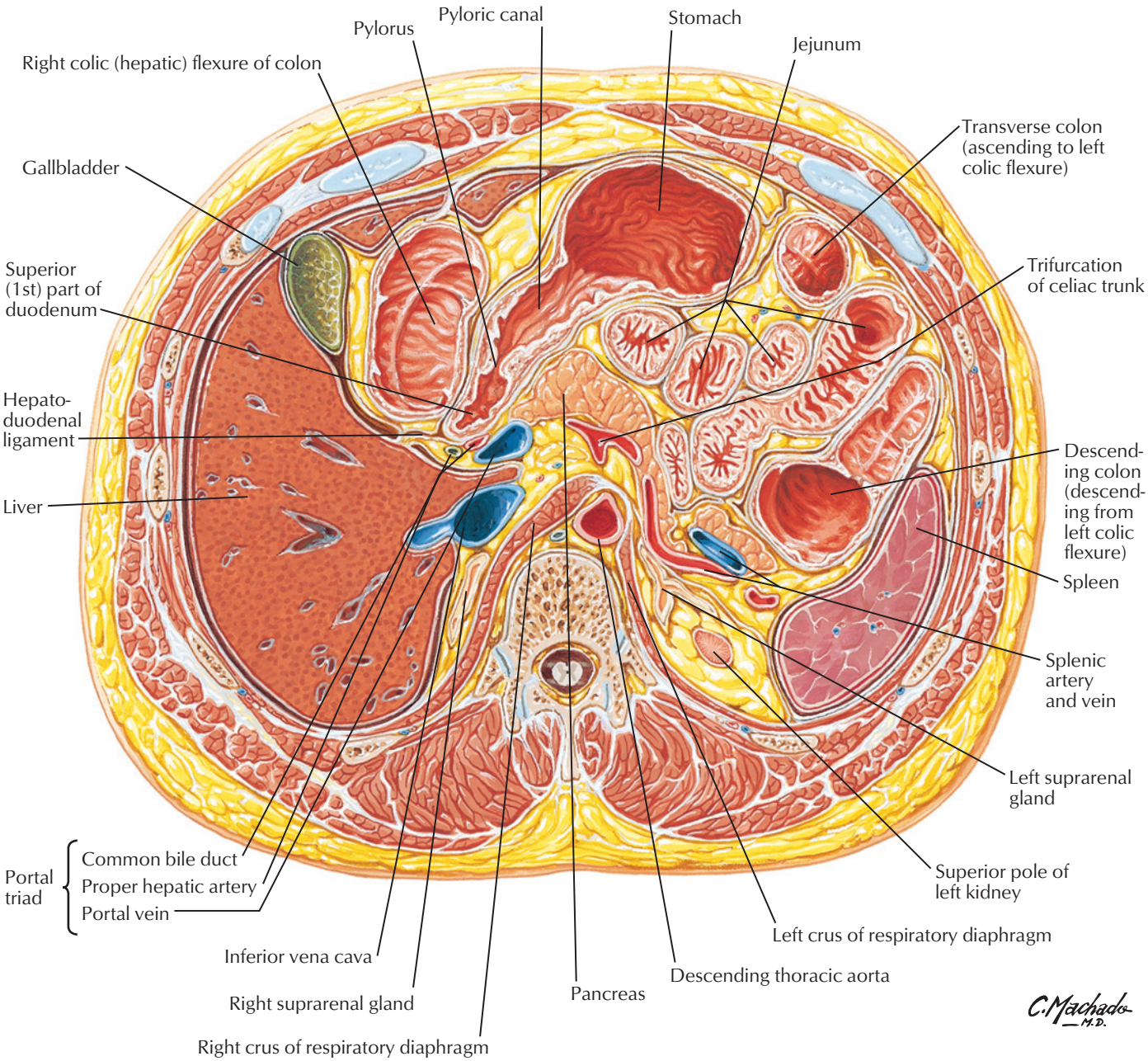
Axial CT image of abdomen with intravenous contrast enhancement

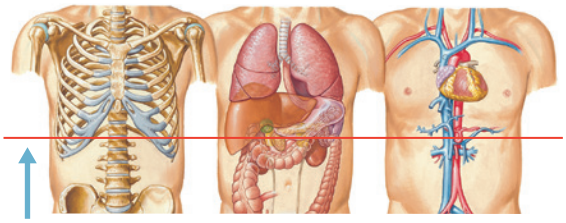


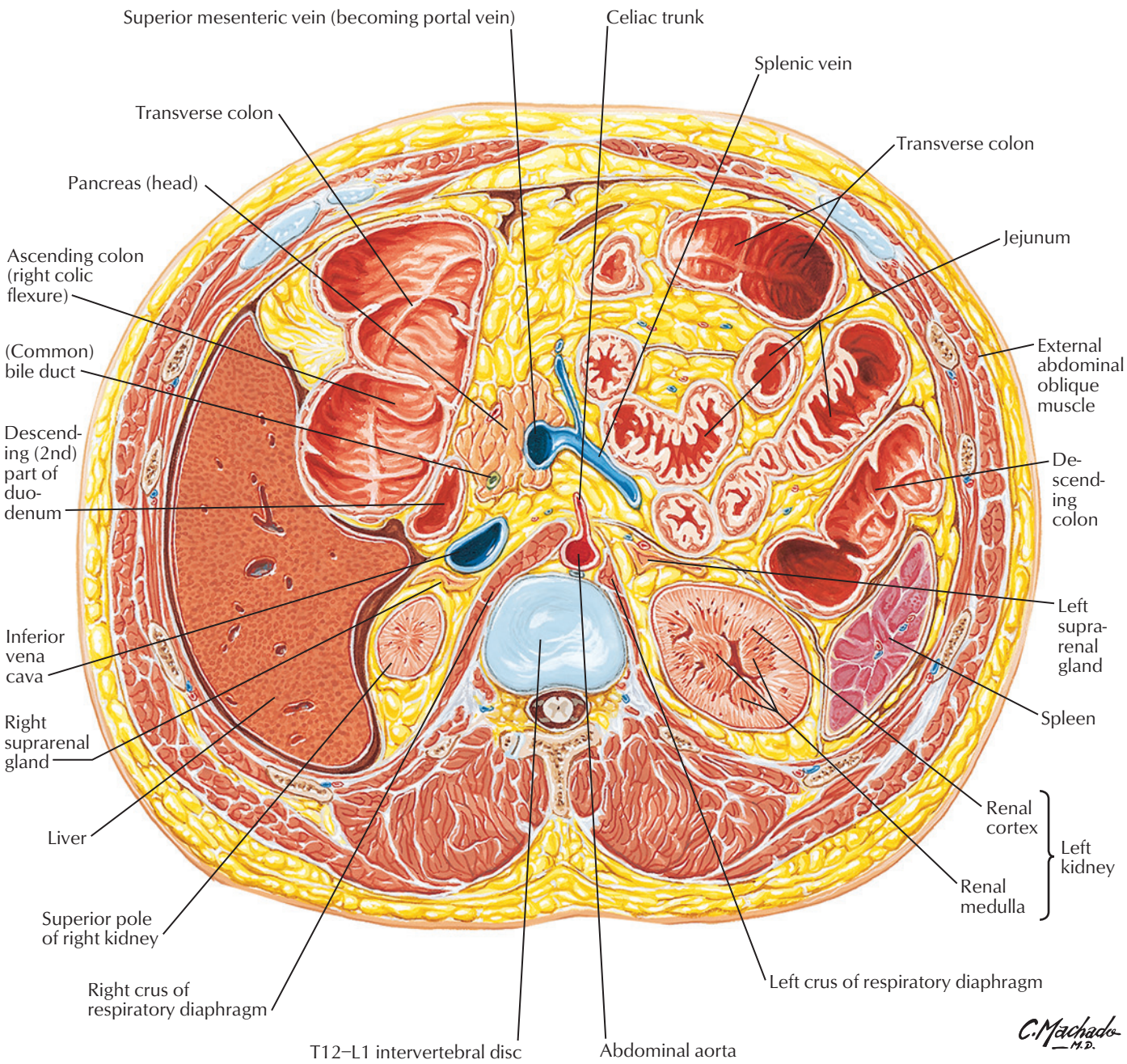



Xiphoid process
Respiratory diaphragm
Costal cartilages
Rectus abdominis muscle
Esophagogastric junction
Left crus of respiratory diaphragm (forming left boundary of esophageal hiatus)
Liver
Right crus of respiratory diaphragm (forming right boundary of esophageal hiatus)
Gastric folds (rugae)
Inferior vena cava
Fundus of stomach
Serratus anterior muscle
Azygos vein
Descending thoracic aorta
Left crus of respiratory diaphragm
Spleen
Respiratory diaphragm
Latissimus dorsi muscle
Inferior lobe of left lung in costodiaphragmatic recess
Inferior lobe of right lung in costodiaphragmatic recess
Body of T10 vertebra
Thoracic duct
Erector spinae muscle
C. Machado M.D.

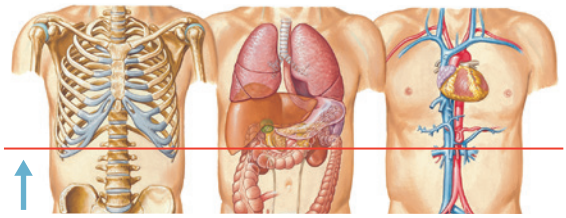


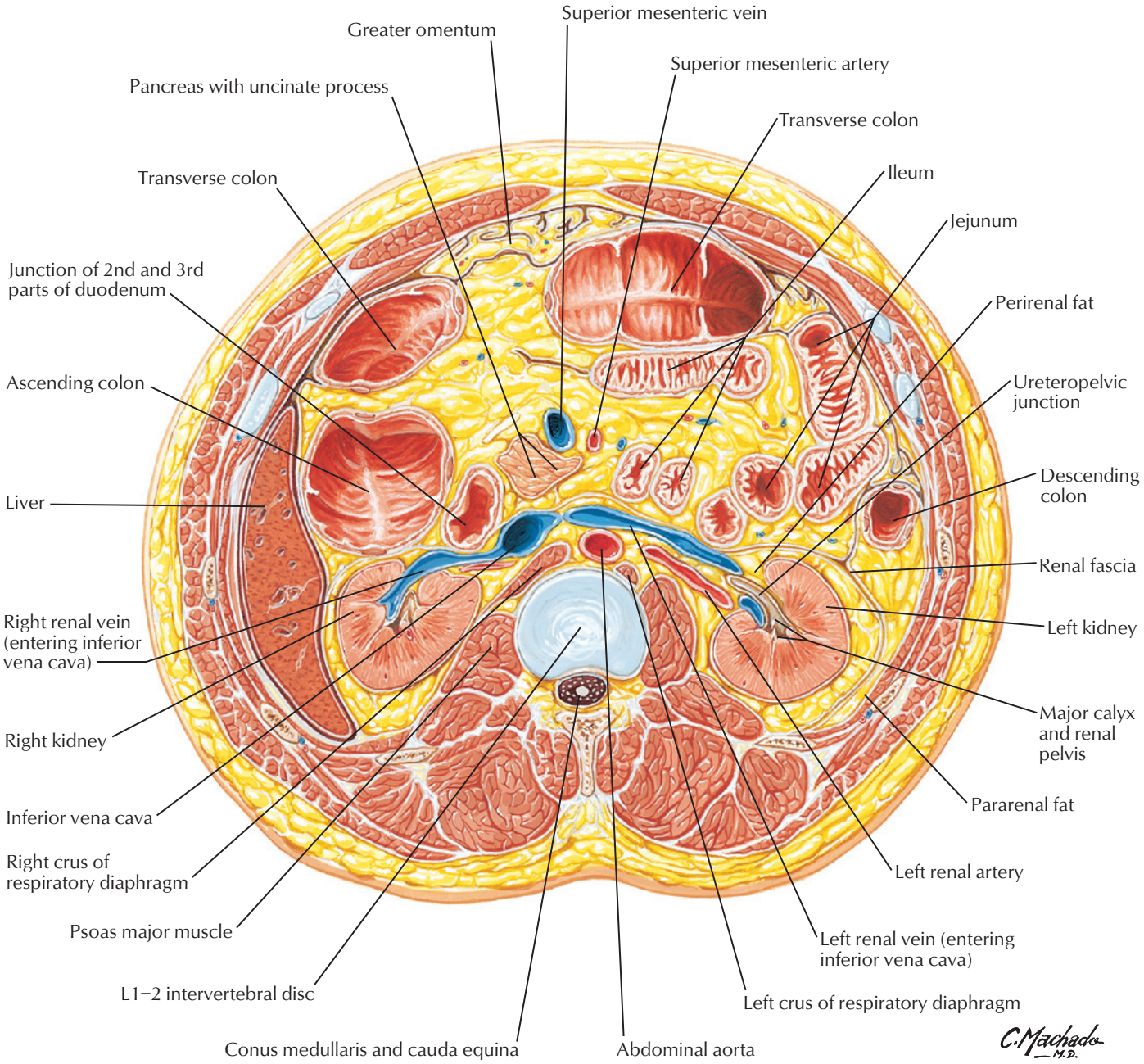

Pylorus
Pyloric canal
Stomach
Jejunum
Right colic (hepatic) flexure of colon
Transverse colon (ascending to left colic flexure)
Gallbladder
Superior (1st) part of duodenum
Trifurcation of celiac trunk
Hepato-duodenal ligament
Descend-ing colon (descend-ing from left colic flexure)
Liver
Spleen
Splenic artery and vein
Left suprarenal gland
Portal triad
Common bile duct
Proper hepatic artery
Portal vein
Superior pole of left kidney
Left crus of respiratory diaphragm
Inferior vena cava
Descending thoracic aorta
Right suprarenal gland
Pancreas
Right crus of respiratory diaphragm
C. Machado M.D.

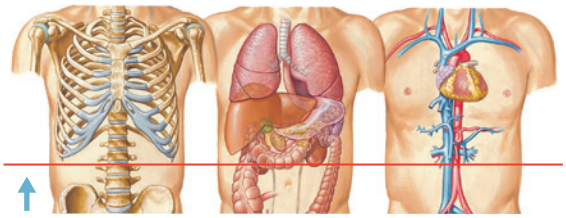


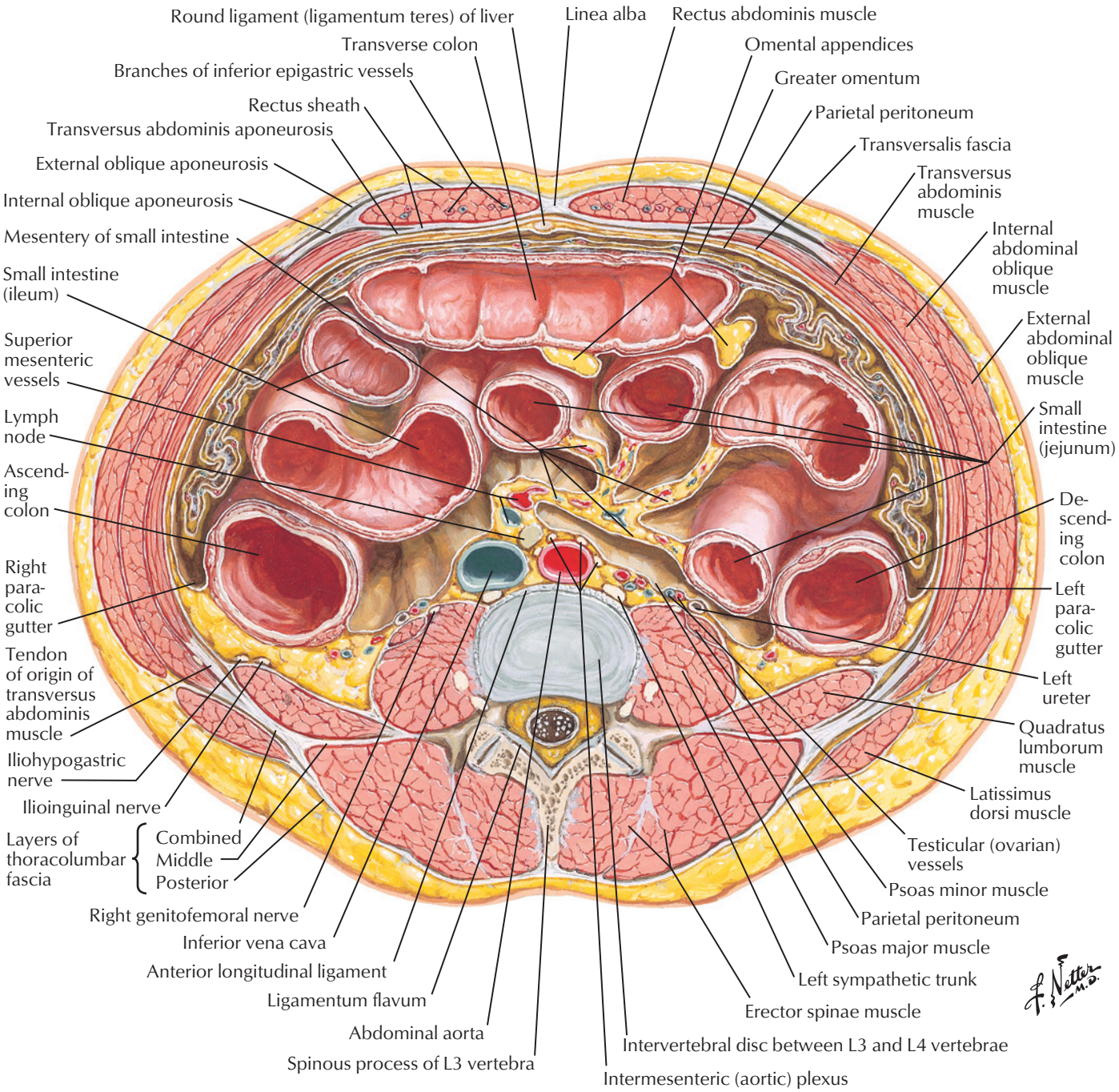

Superior mesenteric vein (becoming portal vein)
Celiac trunk
Splenic vein
Transverse colon
Transverse colon
Pancreas (head)
Jejunum
Ascending colon (right colic flexure)
(Common) bile duct
External abdominal oblique muscle
Descend-ing (2nd) part of duo-denum
De-scend-ing colon
Left supra-renal gland
Inferior vena cava
Spleen
Right suprarenal gland
Renal cortex
Left kidney
Renal medulla
Liver
Superior pole of right kidney
Left crus of respiratory diaphragm
Right crus of respiratory diaphragm
T12–L1 intervertebral disc
Abdominal aorta
C. Machado M.D.

Cross Section at L1–2, Intervertebral Disc








Round ligament (ligamentum teres) of liver
Linea alba
Rectus abdominis muscle
Transverse colon
Omental appendices
Branches of inferior epigastric vessels
Greater omentum
Rectus sheath
Parietal peritoneum
Transversus abdominis aponeurosis
Transversalis fascia
External oblique aponeurosis
Transversus abdominis muscle
Internal oblique aponeurosis
Mesentery of small intestine
Internal abdominal oblique muscle
Small intestine (ileum)
External abdominal oblique muscle
Superior mesenteric vessels
Small intestine (jejunum)
Lymph node
Ascending colon
Descending colon
Right paracolic gutter
Left paracolic gutter
Tendon of origin of transversus abdominis muscle
Left ureter
Quadratus lumborum muscle
Iliohypogastric nerve
Latissimus dorsi muscle
Ilioinguinal nerve
Layers of thoracolumbar fascia
Combined
Middle
Posterior
Testicular (ovarian) vessels
Psoas minor muscle
Right genitofemoral nerve
Parietal peritoneum
Inferior vena cava
Psoas major muscle
Anterior longitudinal ligament
Left sympathetic trunk
Ligamentum flavum
Erector spinae muscle
Abdominal aorta
Intervertebral disc between L3 and L4 vertebrae
Spinous process of L3 vertebra
Intermesenteric (aortic) plexus

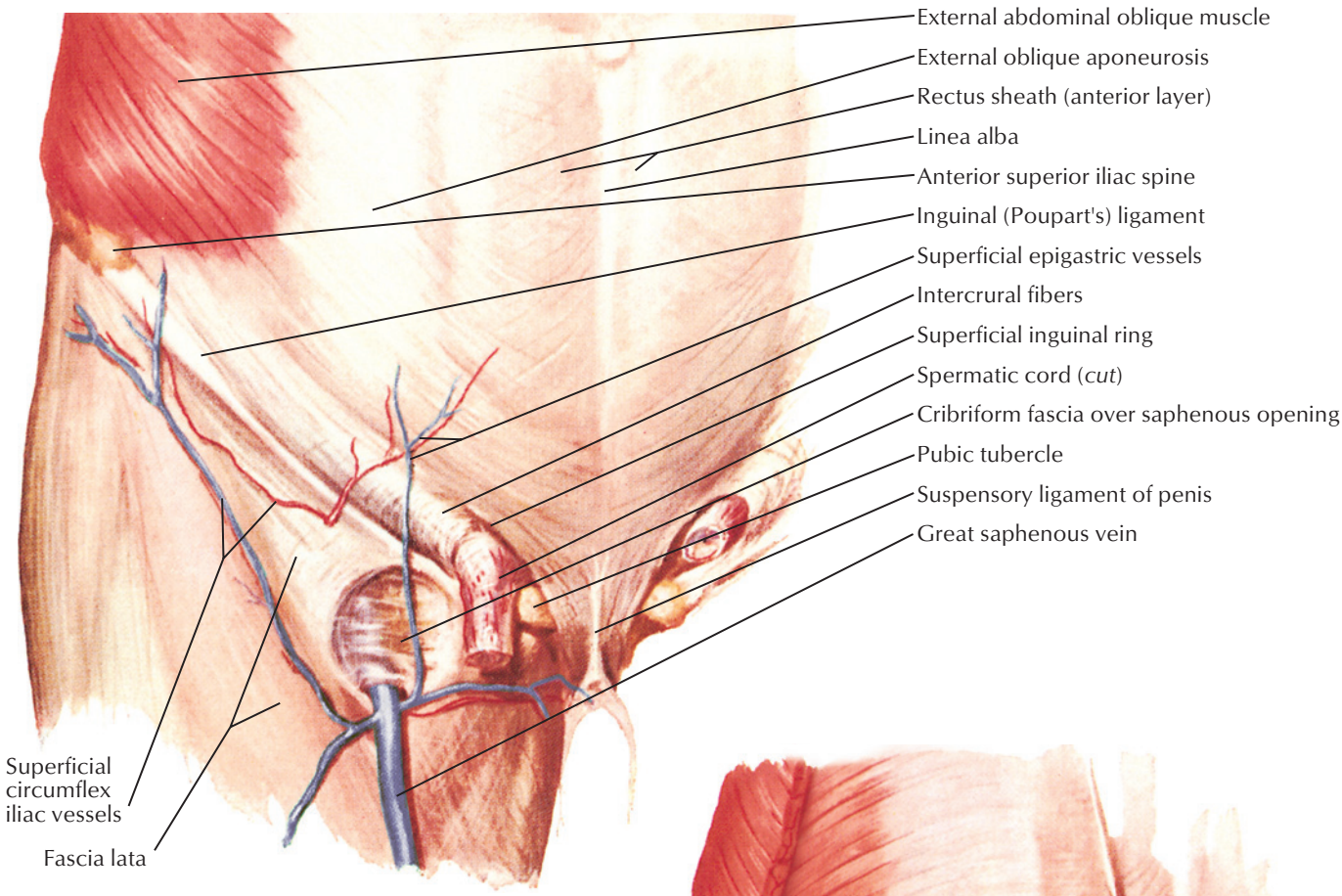
ANATOMICAL STRUCTURES	CLINICAL IMPORTANCE	PLATE NUMBERS
INTEGUMENTARY SYSTEM		
Umbilicus	Landmark for locating transumbilical plane, which is used to divide abdomen into quadrants; marks position of T10 dermatome; used to locate McBurney's point; common site for hernias in abdominal wall	249, 251
SKELETAL SYSTEM		
Xiphoid process, pubic symphysis	Palpable landmarks used to locate median plane, which is used to divide abdomen into quadrants	249
Anterior superior iliac spine (ASIS)	Palpable landmark used to located McBurney's point; tenderness over McBurney's point is indication of appendicitis	250, 282
MUSCULAR SYSTEM		
Linea alba	Site used for abdominal wall incisions because there is lack of significant neurovascular branches in this region	249, 254
Inguinal ligament	Surface landmark that marks division between abdominal wall and thigh	249, 253
Inguinal (Hesselbach's) triangle	Weak area on anterior abdominal wall where abdominal contents may herniate, producing direct inguinal hernia	256, 262
Deep (internal) inguinal ring	Opening on anterior abdominal wall where abdominal contents may herniate, producing indirect inguinal hernia	262, 263
Femoral ring	Opening medial to external iliac vessels where abdominal contents may herniate, producing femoral hernia	264
Esophageal hiatus of diaphragm	Widening of this opening allows stomach to protrude into mediastinum, causing gastroesophageal reflux	269, 271
DIGESTIVE SYSTEM		
Liver	Palpable inferior to right costal margin	270, 276
Gastroesophageal junction	Transient relaxations or decreased tone of lower esophageal sphincter can cause gastric esophageal reflux disease (GERD)	277, 328
Stomach, duodenum	Site of peptic ulcer formation	276, 277
Appendix	Prone to inflammation and rupture	280, 282
Colon	Common site of diverticula; colonoscopy is performed to screen for colon cancer	283
Gallbladder	Palpable at junction of right costal margin and midclavicular line; may become inflamed (cholecystitis) and cause pain; gallstones can block biliary ducts	284, 309
URINARY SYSTEM		
Kidney	Maintain fluid and electrolyte balance; may develop renal calculi (kidney stones)	314
ENDOCRINE SYSTEM		
Pancreas	Due to its retroperitoneal position, pain from pancreas is typically referred to the back; cancer of head of pancreas can compress common bile duct	288, 310

ANATOMICAL STRUCTURES	CLINICAL IMPORTANCE	PLATE NUMBERS
NERVOUS SYSTEM		
Ilioinguinal and genitofemoral nerves	Mediate cremasteric reflex, which tests integrity of L1 spinal nerve	269
Intercostal, subcostal, and iliohypogastric nerves	Convey well-localized pain sensations from abdominal wall and parietal peritoneum; pain in dermatomal distribution indicates problem with spinal nerves (e.g., herpes zoster infection)	260
Renal artery sympathetic fibers	Medically resistant hypertension can be treated in some patients by denervating sympathetic fibers traveling along renal arteries	300, 321
Celiac ganglion	Some patients with medically intractable pain from chronic pancreatitis undergo celiac ganglion block	301, 310
Sympathetic splanchnic nerves	Convey pain sensations from abdominal viscera that are often referred to other sites; quadrant in which pain is located and site of radiation provide clues to source of pain	303, 306
Iliohypogastric nerve	Nephrectomy through quadratus lumborum can damage iliohypogastric nerve, with resultant anesthesia above pubis	312
CARDIOVASCULAR SYSTEM		
Arterial anastomoses of anterior abdominal wall	Anastomosis between epigastric arteries and internal thoracic arteries and between circumflex arteries and intercostal and lateral thoracic arteries	258
Venous anastomoses of anterior abdominal wall	Anastomosis between epigastric veins and internal thoracic veins and between circumflex and thoracoepigastric veins and lateral thoracic veins	259
Paraumbilical veins	May become dilated in patients with portal hypertension, producing caput medusa	259, 299
Cystic artery	Ligated during cholecystectomy	291
Superior mesenteric artery	May compress 3rd part of duodenum in thin patient or patient who has recently lost a lot of weight	291, 294
Intestinal arteries	Areas without significant collateral circulation between major vessels (watershed areas) are at risk for ischemia	294, 295
Marginal artery anastomosis	Marginal artery connects right, middle, and left colic arteries, providing important anastomosis for collateral circulation	295
Esophageal veins	May become dilated with portal hypertension, resulting in esophageal varices	296, 299
Hepatic portal vein	Reduced blood flow through liver (e.g., due to cirrhosis) may produce portal hypertension and dilation of tributaries of portal vein; blood may return to heart at sites of portosystemic anastomosis	298, 299
Superior rectal vein	Has anastomoses with systemic rectal veins that may become dilated with portal hypertension	298, 299
Abdominal aorta	Common site for aneurysm in abdomen, especially inferior to renal arteries	317
LYMPHATIC SYSTEM		
Spleen	May be ruptured by fracture of ribs 9 to 11; splenic enlargement is assessed by palpation	273, 289

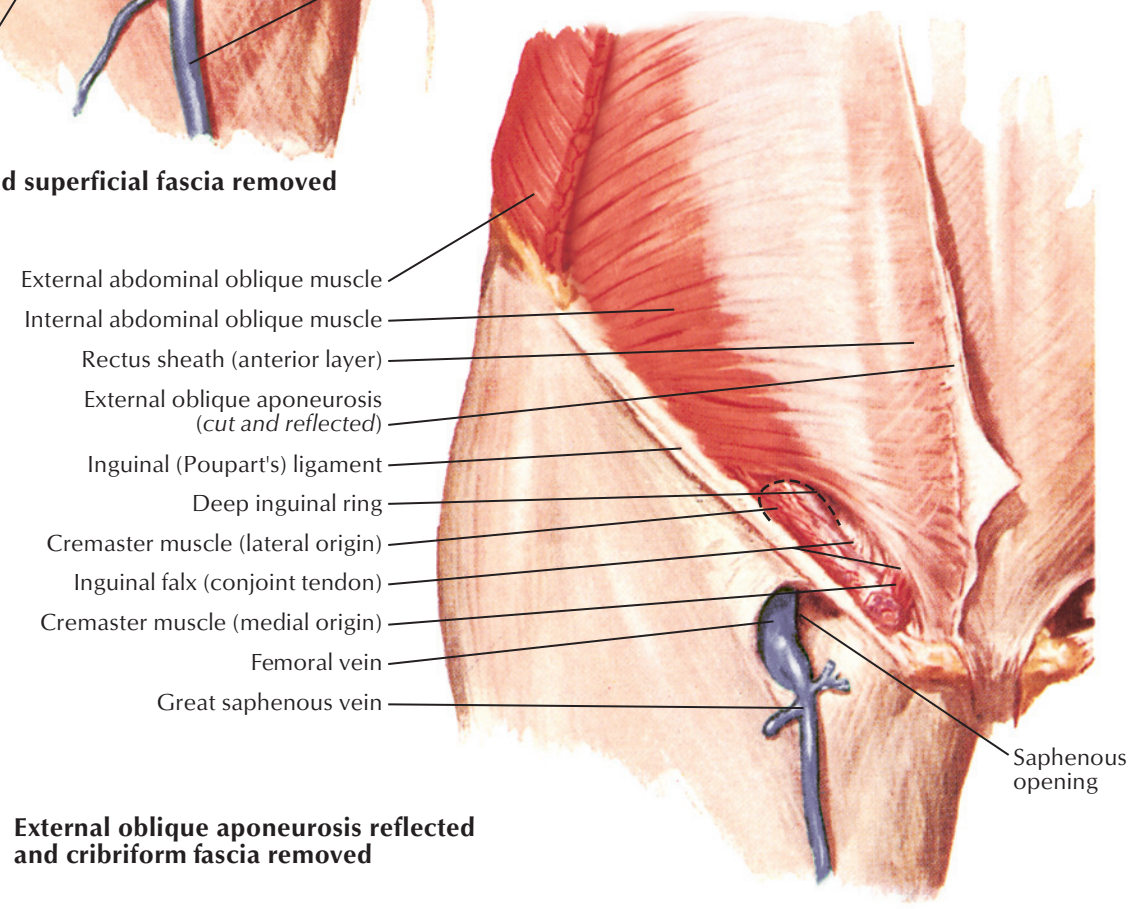
*Selections were based largely on clinical data as well as commonly covered clinical correlations in gross anatomy courses.

MUSCLE	MUSCLE GROUP	PROXIMAL ATTACHMENT (ORIGIN)	DISTAL ATTACHMENT (INSERTION)	INNERVATION	BLOOD SUPPLY	MAIN ACTIONS
Respiratory diaphragm	Posterior abdominal wall	Xiphoid process, lower six costal cartilages, L1–L3 vertebrae	Converges into central tendon	Phrenic nerve	Pericardiacophrenic, musculophrenic, superior and inferior phrenic arteries	Draws central tendon down and forward during inspiration
External abdominal oblique	Anterior abdominal wall	External surfaces of ribs 5–12	Linea alba, pubic tubercle, anterior half of iliac crest	Anterior rami of six inferior thoracic nerves	Superior and inferior epigastric arteries	Compresses and supports abdominal viscera, flexes and rotates trunk
Internal abdominal oblique	Anterior abdominal wall	Thoracolumbar fascia, anterior 2/3 of iliac crest, lateral half of inguinal ligament	Inferior borders of ribs 10–12, linea alba, pubis via conjoint tendon	Anterior rami of six inferior thoracic and first lumbar nerves	Superior and inferior epigastric and deep circumflex iliac arteries	Compresses and supports abdominal viscera, flexes and rotates trunk
Psoas major	Posterior abdominal wall	Transverse processes of lumbar vertebrae, sides of bodies of T12–L5 vertebrae, intervening intervertebral discs	Lesser trochanter of femur	Anterior rami of first three lumbar nerves	Lumbar branches of iliolumbar artery	Acting superiorly with iliacus, flexes hip; acting inferiorly, flexes vertebral column laterally; used to balance trunk in sitting position; acting inferiorly with iliacus, flexes trunk
Psoas minor	Posterior abdominal wall	Vertebral margins of T12–L1 vertebrae, corresponding intervertebral disc	Pectineal line, iliopectineal eminence	Anterior rami of first lumbar nerve	Lumbar branch of iliolumbar artery	Flexes pelvis on vertebral column
Pyramidalis	Anterior abdominal wall	Body of pubis, anterior to rectus abdominis	Linea alba	Iliohypogastric nerve	Inferior epigastric artery	Tenses linea alba
Quadratus lumborum	Posterior abdominal wall	Medial half of inferior border of 12th rib, tips of lumbar transverse processes	Iliolumbar ligament, internal lip of iliac crest	Anterior rami of T12 and first four lumbar nerves	Iliolumbar artery	Extends and laterally flexes vertebral column, fixes 12th rib during inspiration
Rectus abdominis	Anterior abdominal wall	Pubic symphysis, pubic crest	Xiphoid process, costal cartilages 5–7	Anterior rami of six inferior thoracic nerves	Superior and interior epigastric arteries	Flexes trunk, compresses abdominal viscera
Transversus abdominis	Anterior abdominal wall	Internal surfaces of costal cartilages 7–12, thoracolumbar fascia, iliac crest, lateral third of inguinal ligament	Linea alba with aponeurosis of internal abdominal oblique, pubic crest, and pecten pubis via conjoint tendon	Anterior rami of six inferior thoracic and first lumbar nerves	Deep circumflex iliac and inferior epigastric arteries	Compresses and supports abdominal viscera

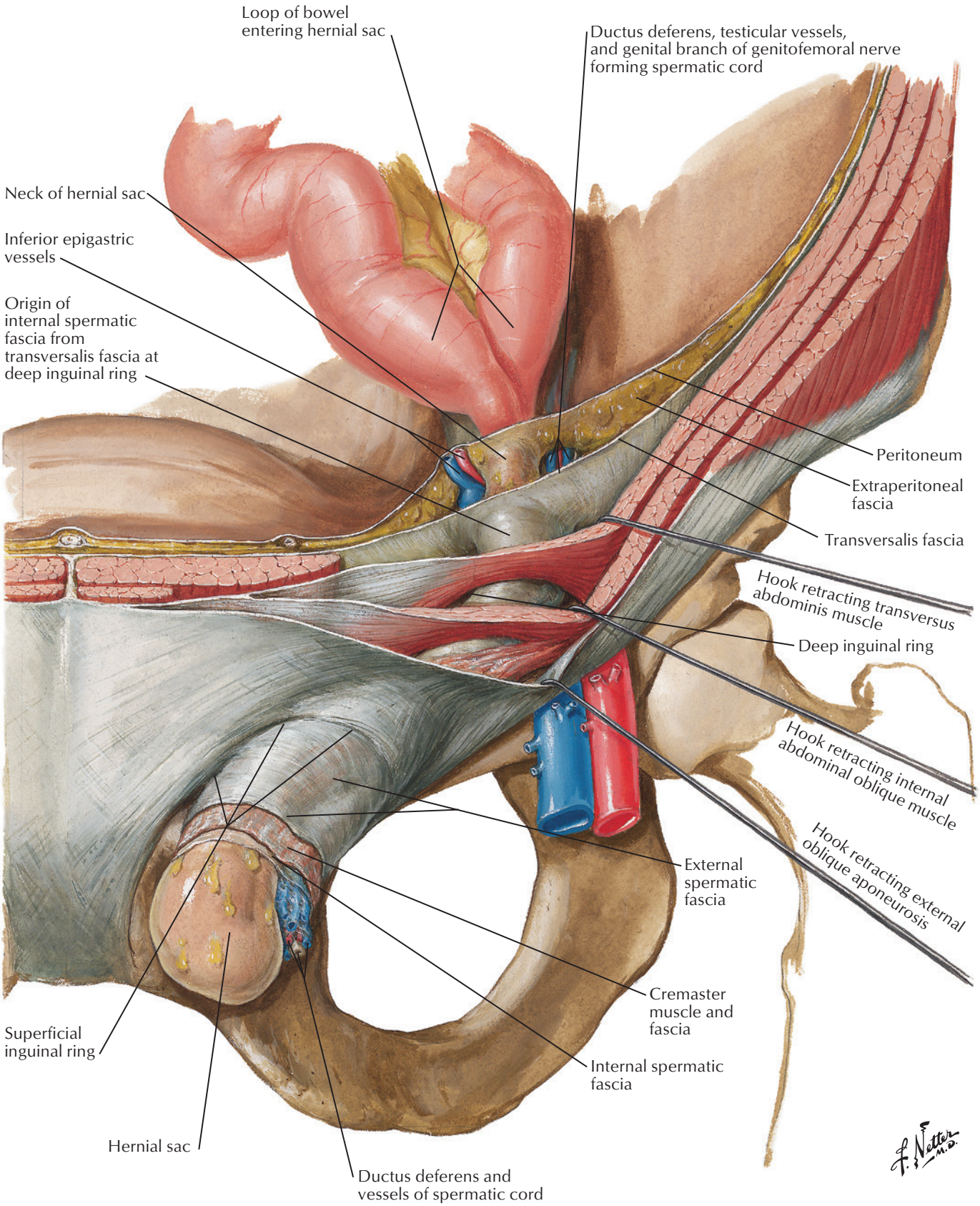
Variations in spinal nerve contributions to the innervation of muscles, their arterial supply, their attachments, and their actions are common themes in human anatomy. Therefore, expect differences between texts and realize that anatomical variation is normal.



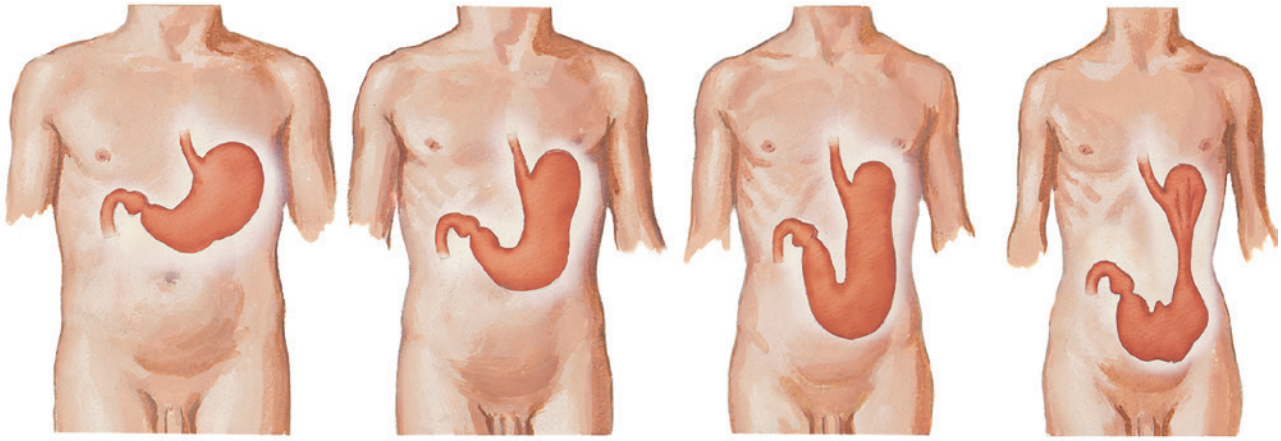
Skin and superficial fascia removed



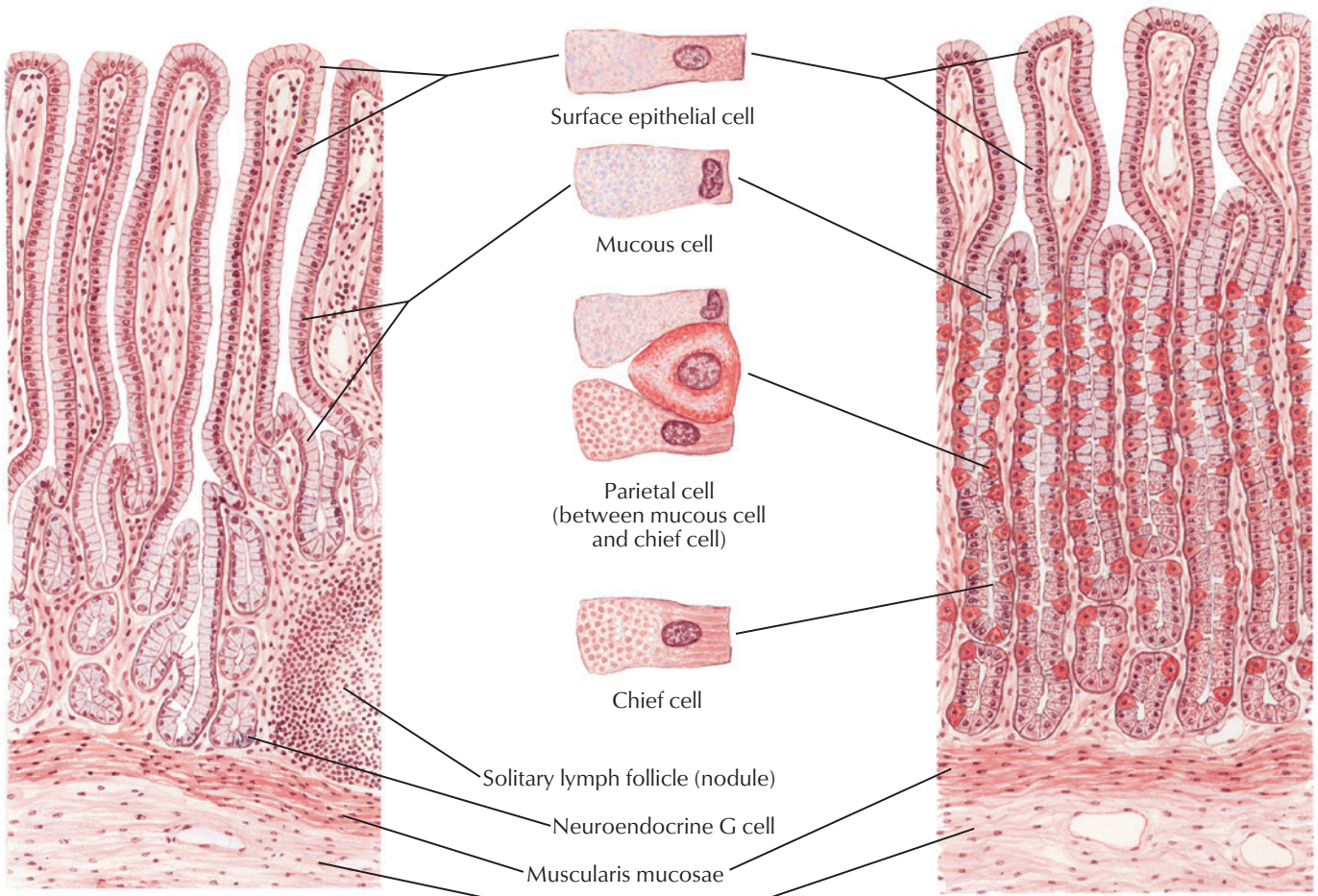
External oblique aponeurosis reflected and cribriform fascia removed

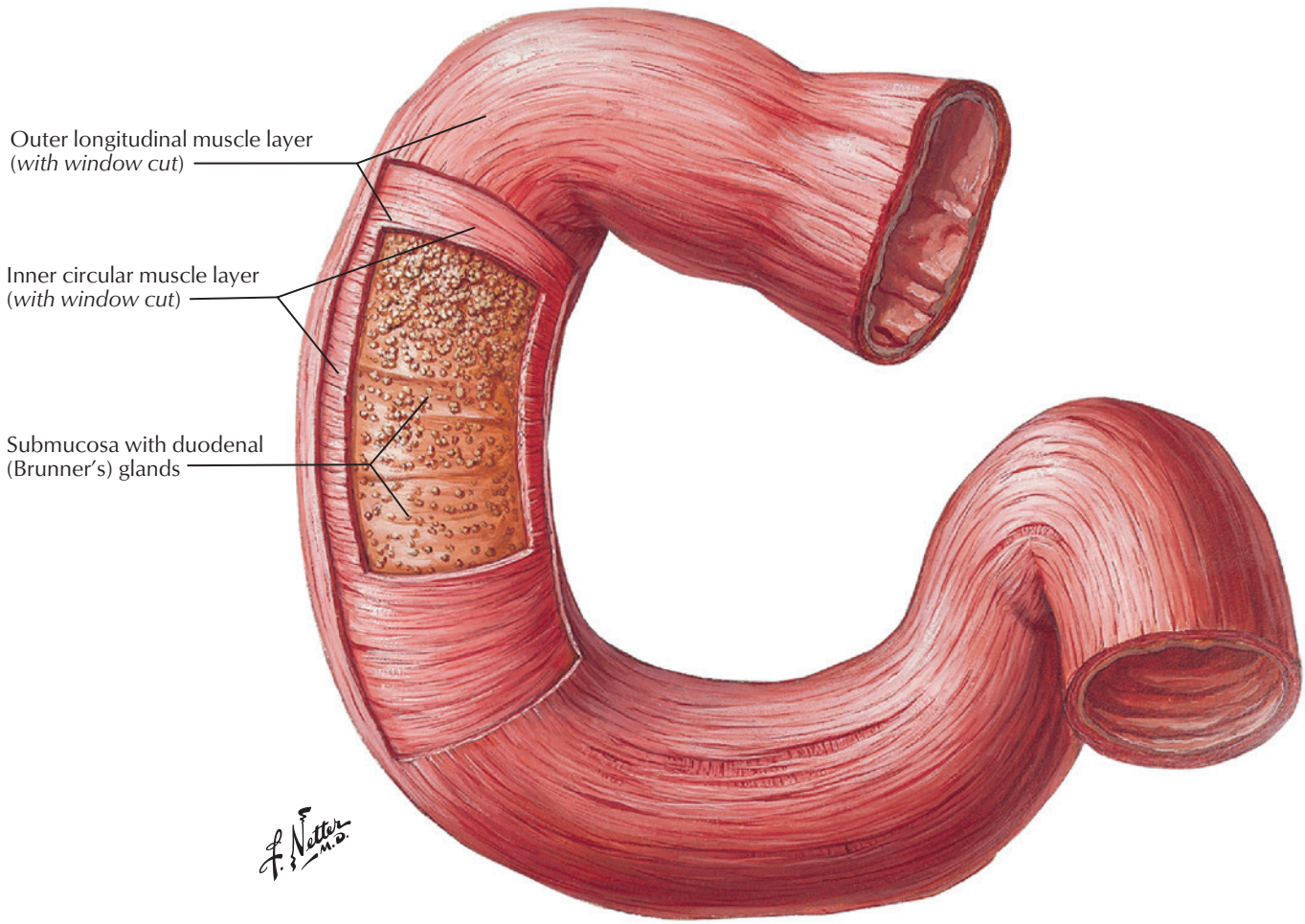

Loop of bowel entering hernial sac
Ductus deferens, testicular vessels, and genital branch of genitofemoral nerve forming spermatic cord
Neck of hernial sac
Inferior epigastric vessels
Origin of internal spermatic fascia from transversalis fascia at deep inguinal ring
Peritoneum
Extraperitoneal fascia
Transversalis fascia
Hook retracting transversus abdominis muscle
Deep inguinal ring
Hook retracting internal abdominal oblique muscle
Hook retracting external oblique aponeurosis
External spermatic fascia
Cremaster muscle and fascia
Internal spermatic fascia
Superficial inguinal ring
Hernial sac
Ductus deferens and vessels of spermatic cord

Variations in position and contour of stomach in relation to body habitus

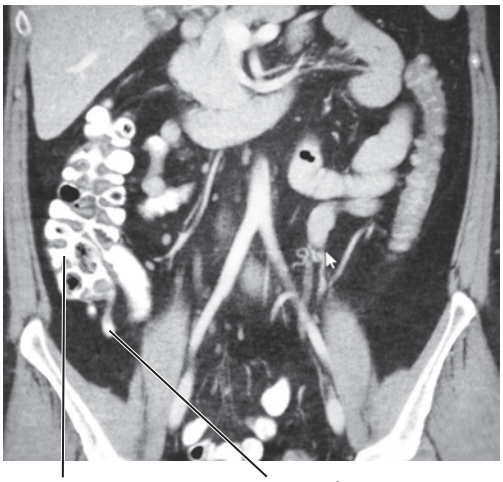


Hypertonic stomach | Orthotonic stomach | Hypotonic stomach | Atonic stomach

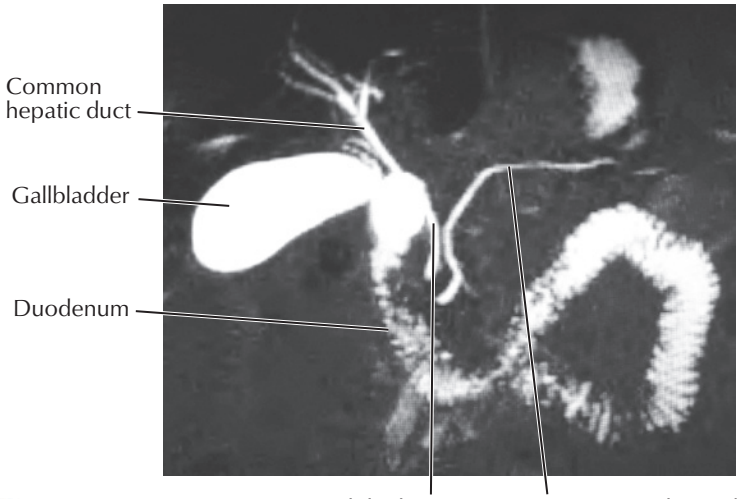


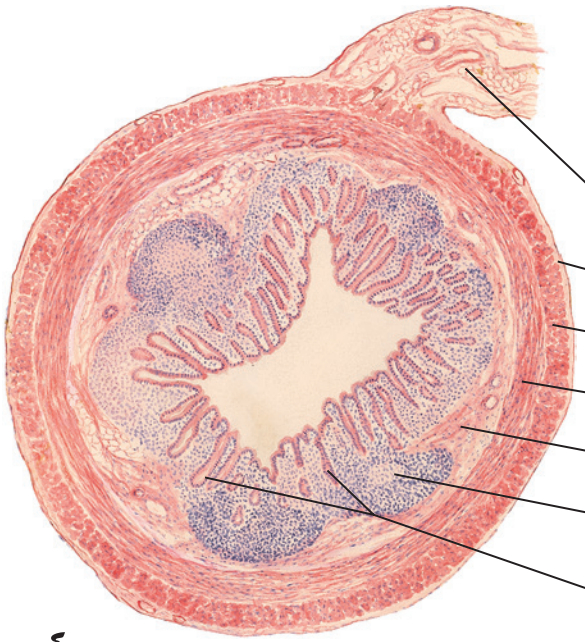

Outer longitudinal muscle layer
(*with window cut*)
Inner circular muscle layer
(*with window cut*)
Submucosa with duodenal
(Brunner's) glands

Coronal CT image with contrast



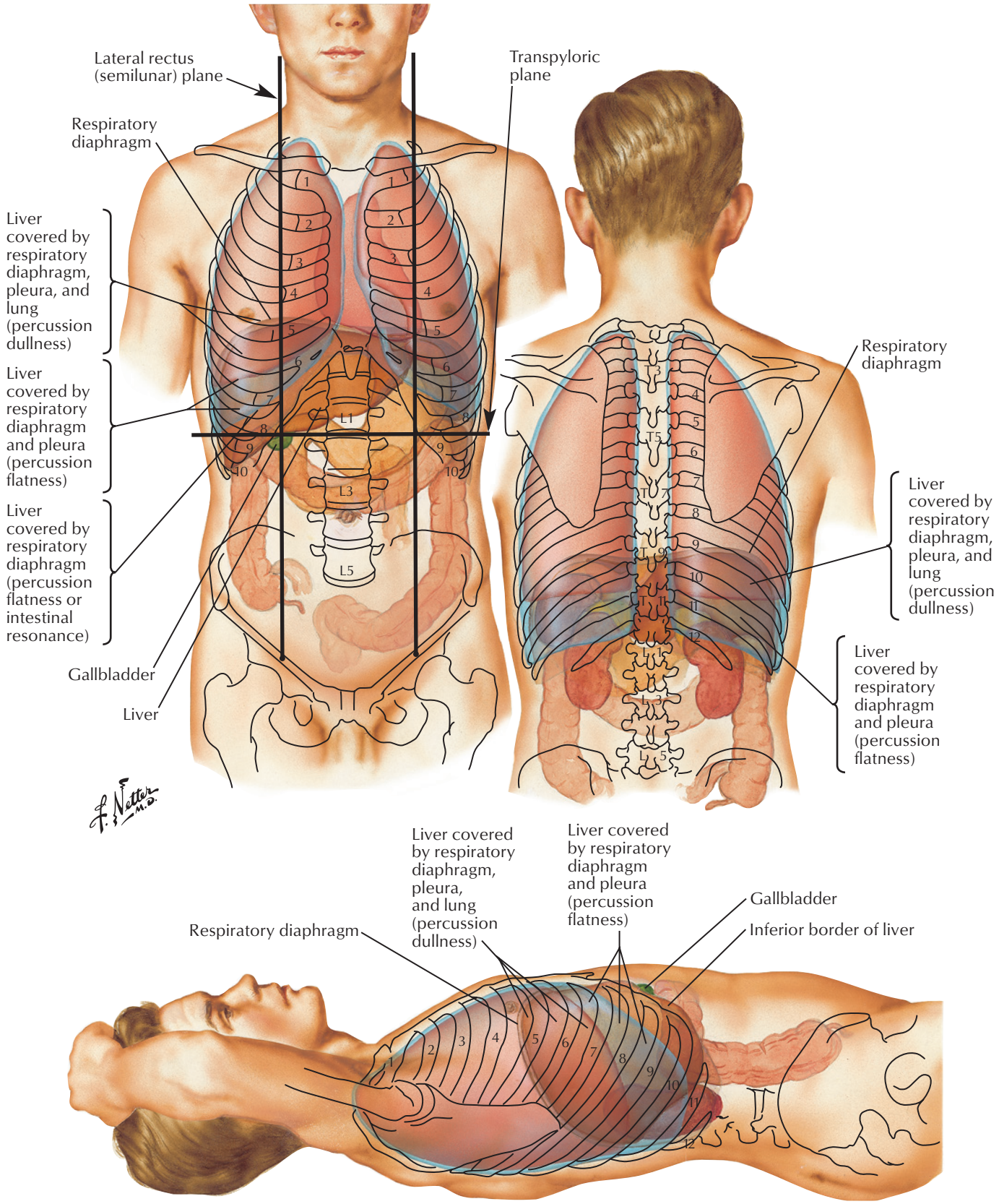
Magnetic resonance cholangiopancreatography (MRCP)

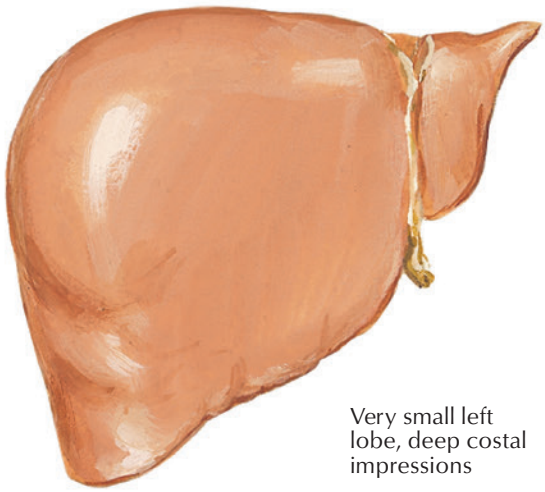




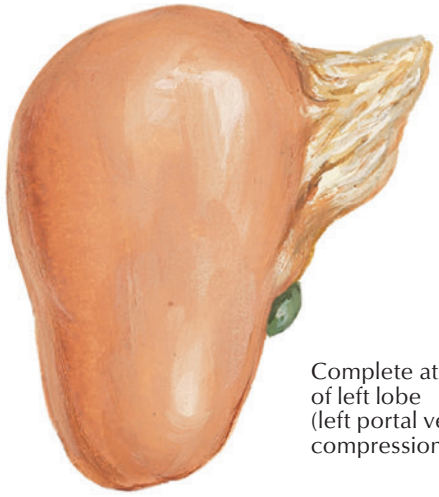


Ramification of nerve fibers around fine branch of hepatic artery

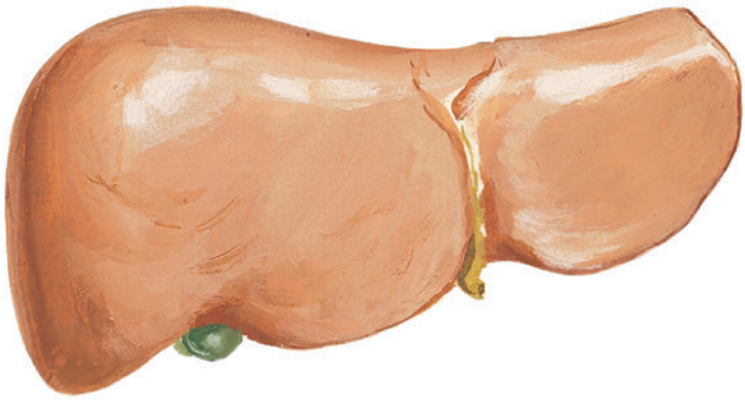

Lateral rectus (semilunar) plane
Transpyloric plane
Respiratory diaphragm
Liver covered by respiratory diaphragm, pleura, and lung (percussion dullness)
Liver covered by respiratory diaphragm and pleura (percussion flatness)
Liver covered by respiratory diaphragm (percussion flatness or intestinal resonance)
Gallbladder
Liver
Respiratory diaphragm
Liver covered by respiratory diaphragm, pleura, and lung (percussion dullness)
Liver covered by respiratory diaphragm and pleura (percussion flatness)
Liver covered by respiratory diaphragm, pleura, and lung (percussion dullness)
Liver covered by respiratory diaphragm and pleura (percussion flatness)
Respiratory diaphragm
Gallbladder
Inferior border of liver



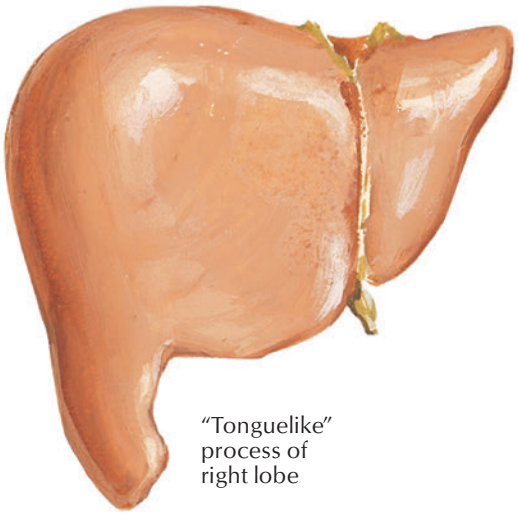
Very small left lobe, deep costal impressions



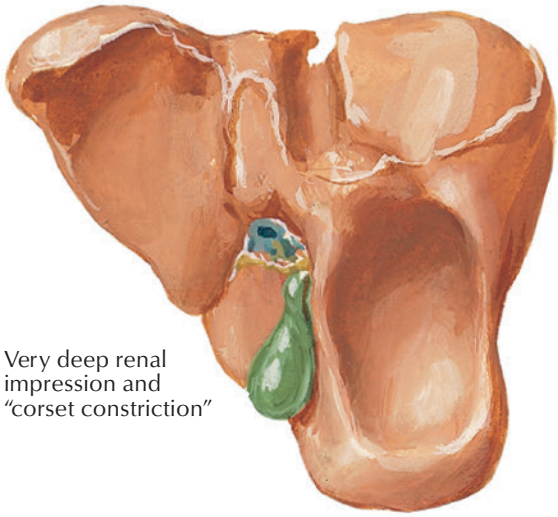
Complete atrophy of left lobe (left portal vein compression)



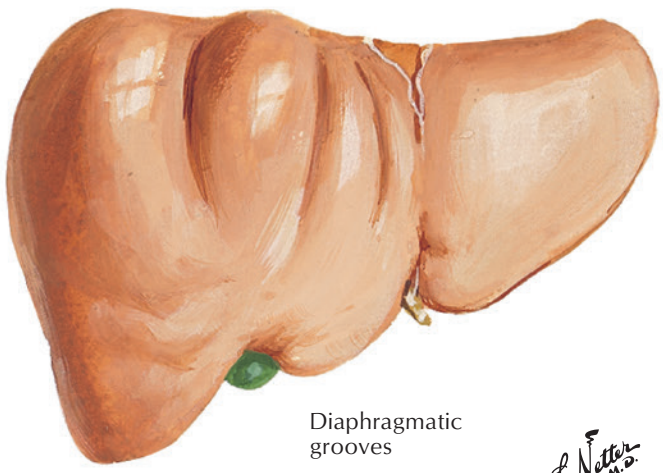
Transverse, "saddlelike" liver, relatively large left lobe



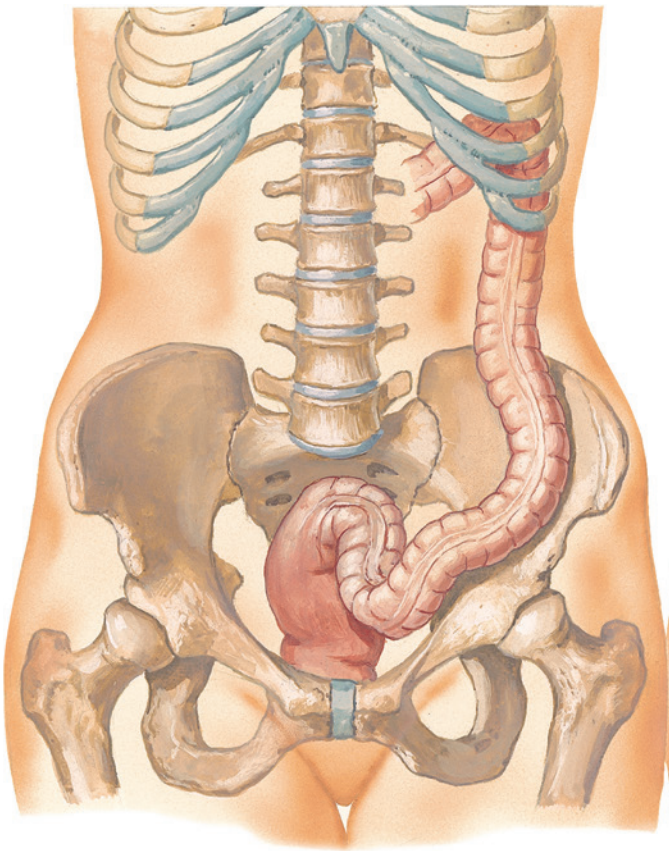
"Tonguelike" process of right lobe



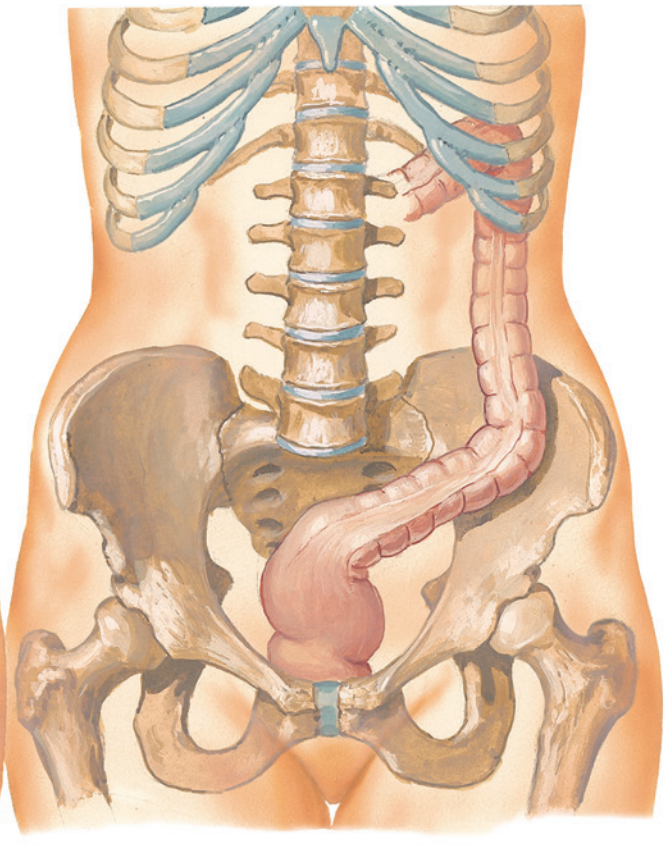
Very deep renal impression and "corset constriction"



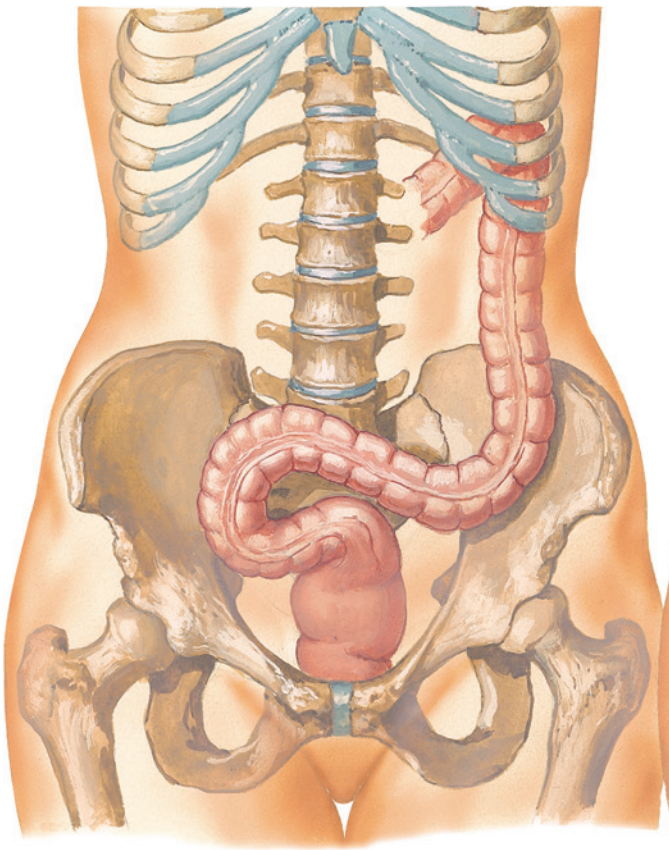
Diaphragmatic grooves



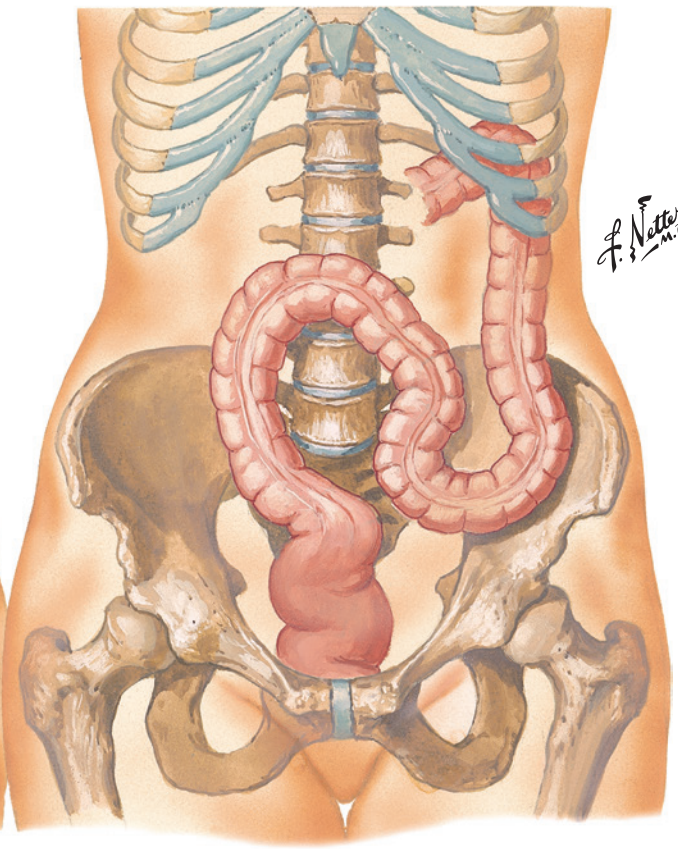
Typical



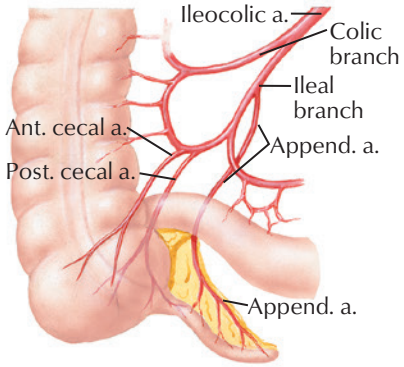
Short, straight, obliquely into pelvis



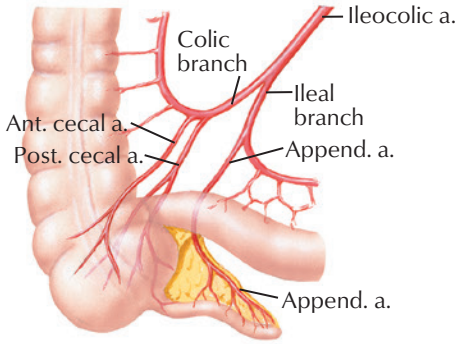
Looping to right side



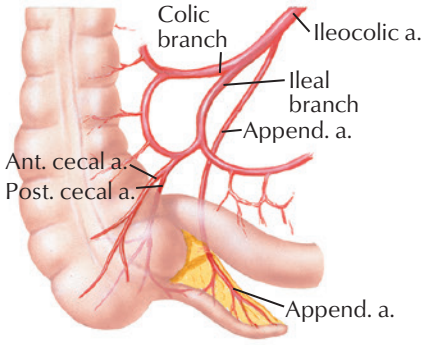
Ascending high into abdomen



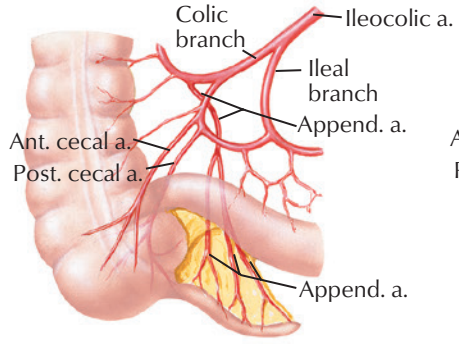
Anterior cecal and posterior cecal arteries originate from arcade between colic and ileal branches of ileocolic appendicular artery from ileal branch



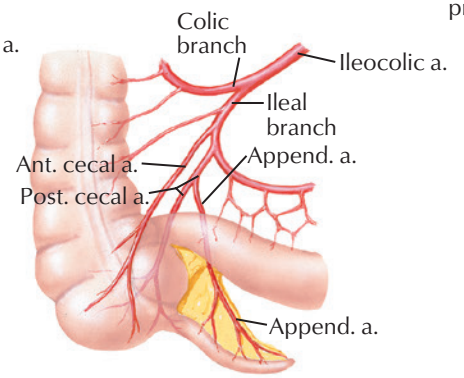
Anterior cecal and posterior cecal arteries originate from colic branch; appendicular artery from ileal branch of ileocolic artery



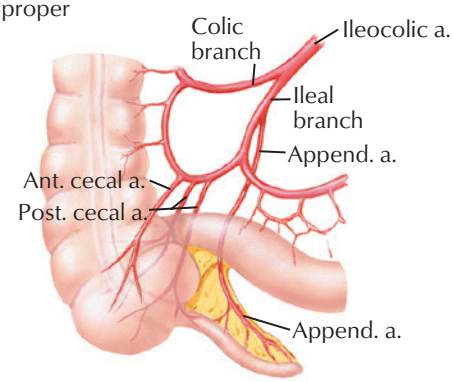
Anterior cecal and posterior cecal arteries have common origin from arcade; appendicular artery from ileocolic artery proper



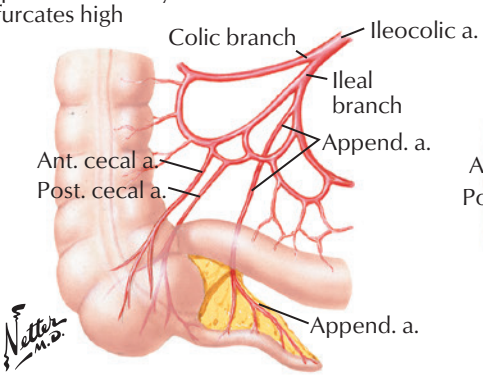
Anterior cecal and posterior cecal arteries originate from arcade between colic and ileal branches of ileocolic artery; appendicular artery from colic branch bifurcates high



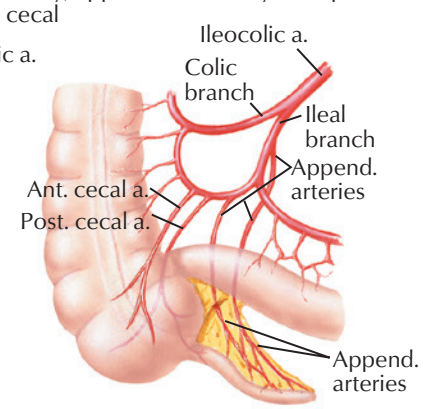
Anterior cecal and posterior cecal arteries originate from ileal branch of ileocolic artery; appendicular artery from posterior cecal



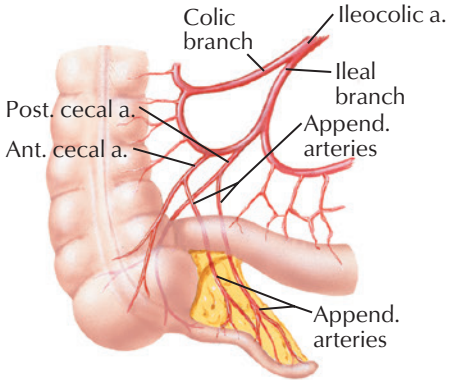
Anterior cecal and two posterior cecal arteries originate from arcade; appendicular artery from ileal branch of ileocolic artery



Multiple arcades between ileal branch and colic branch of ileocolic artery. Anterior cecal and posterior cecal arteries originate from these arcades; appendicular artery from ileal branch

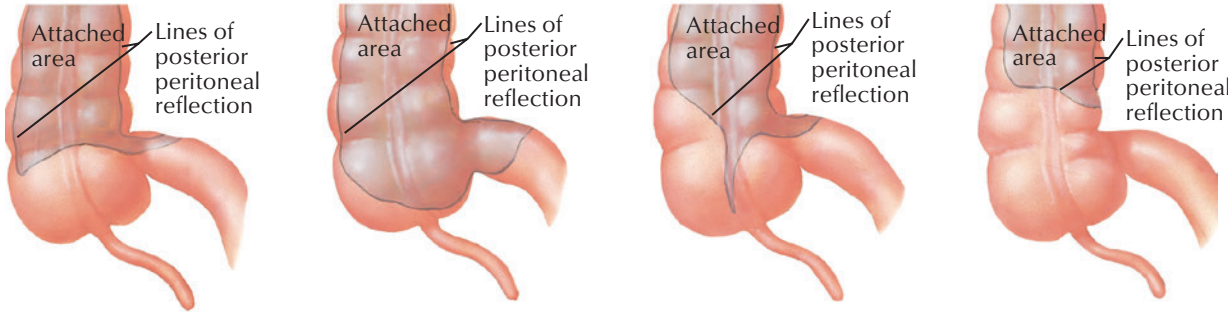


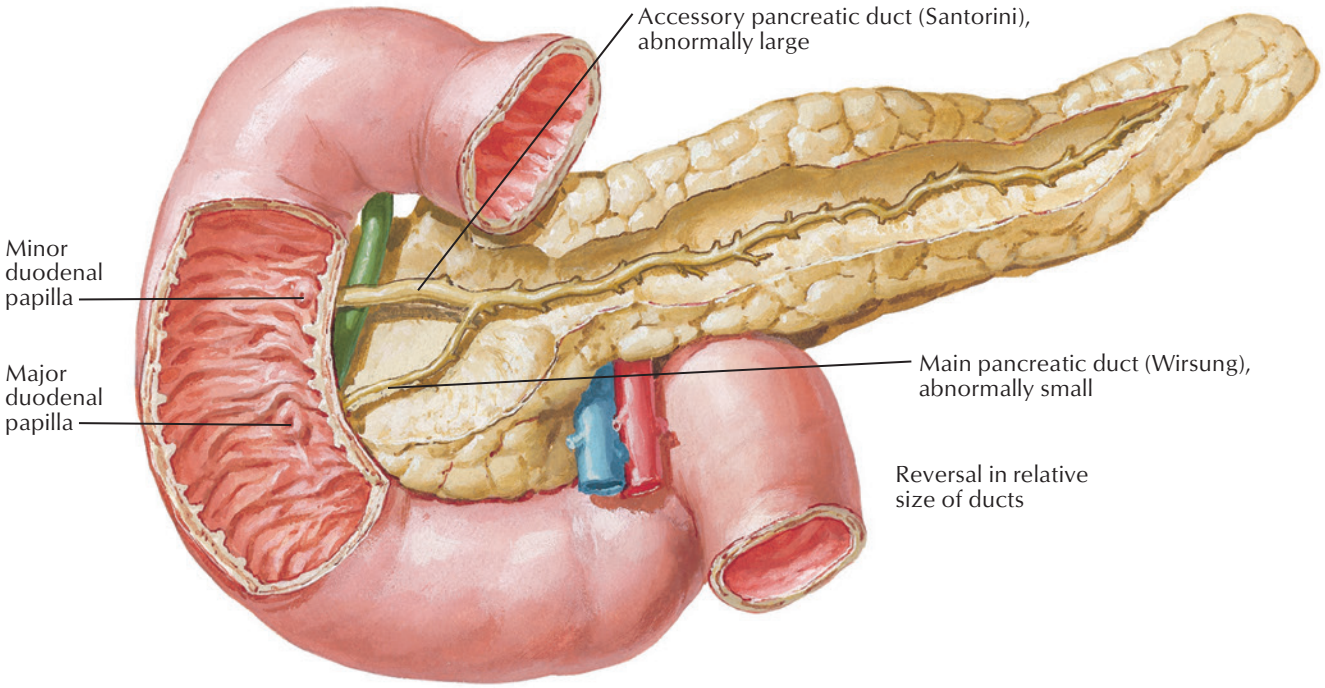
Anterior cecal and posterior cecal arteries originate from arcade between colic and ileal branches of ileocolic artery; two appendicular arteries, one deriving from arcade, the other from ileal branch, are present

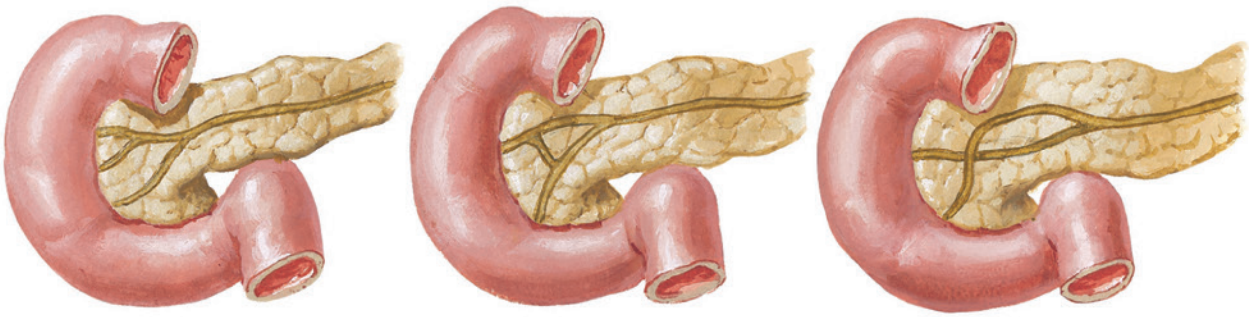


Anterior cecal and posterior cecal arteries originate from arcade; two appendicular arteries, one deriving from anterior cecal, the other from posterior cecal, are present

Some variations in posterior peritoneal attachment of cecum







Double accessory pancreatic duct (Santorini)

Anastomosis between ducts

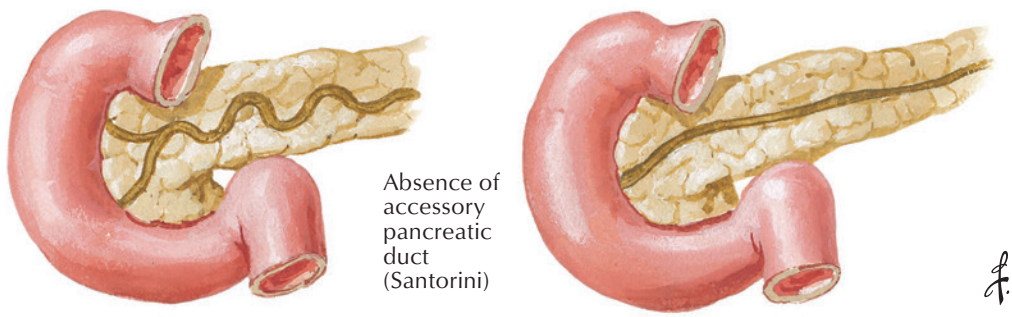
Crossing of ducts



Double crossing of ducts

No communication between ducts

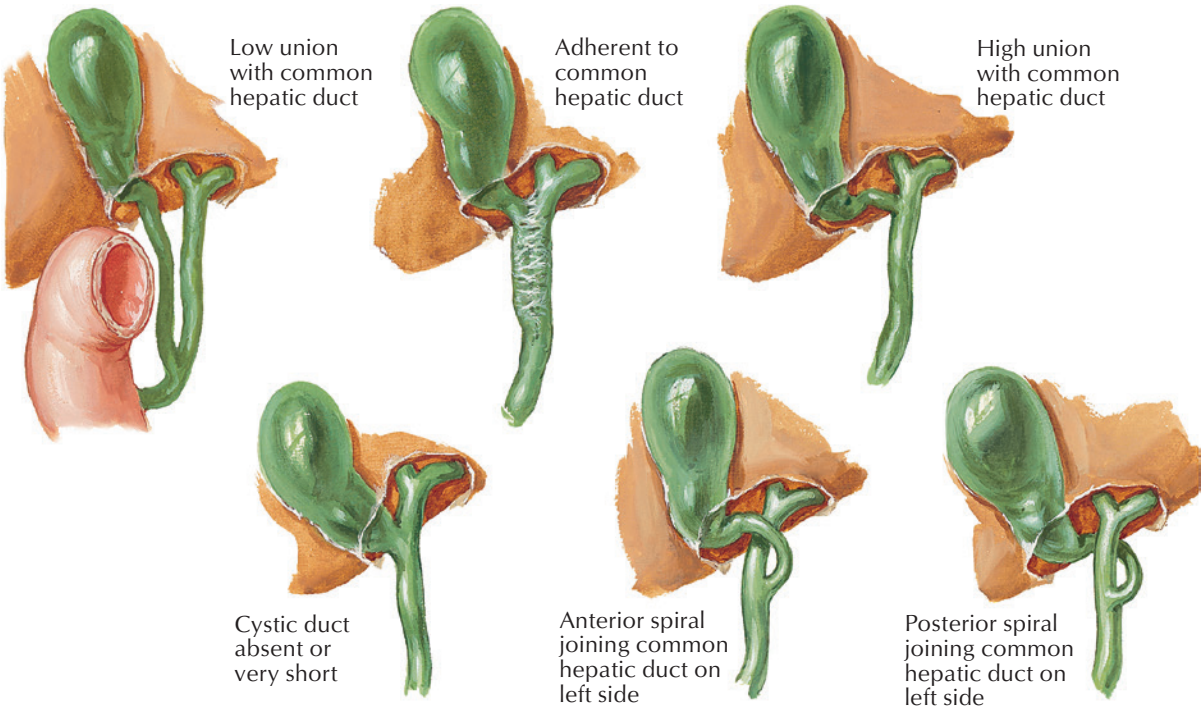
Double main pancreatic duct (Wirsung)



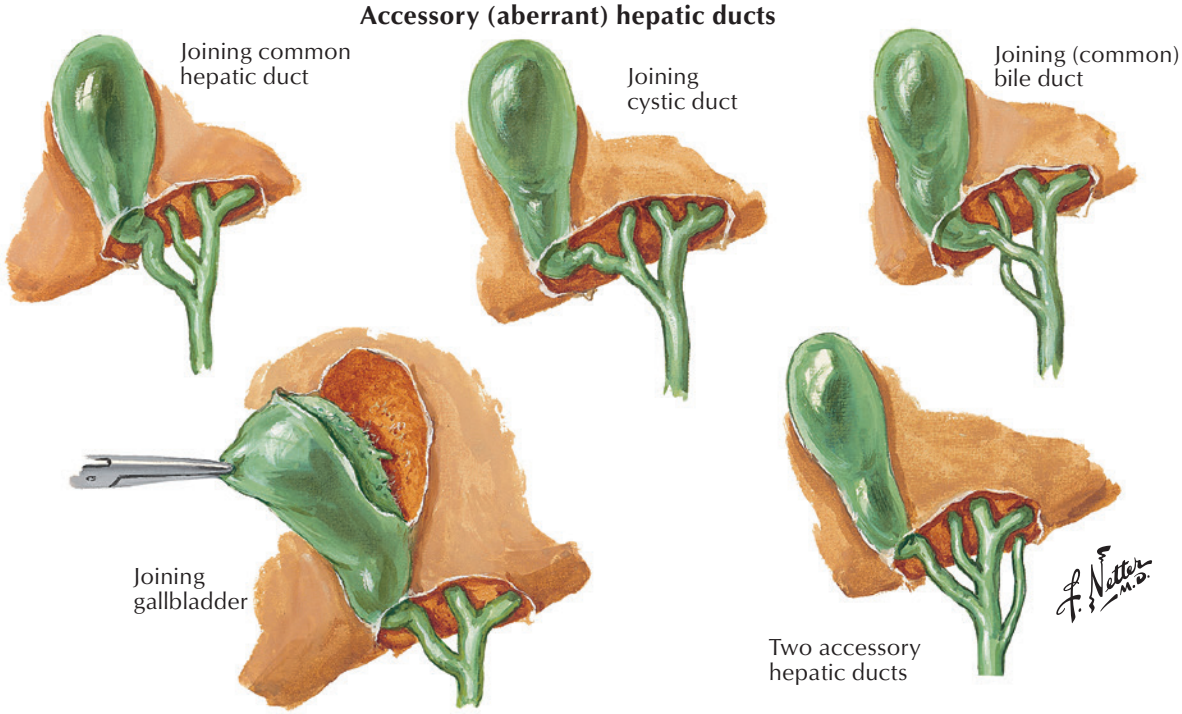
Tortuosity of ducts

Absence of accessory pancreatic duct (Santorini)

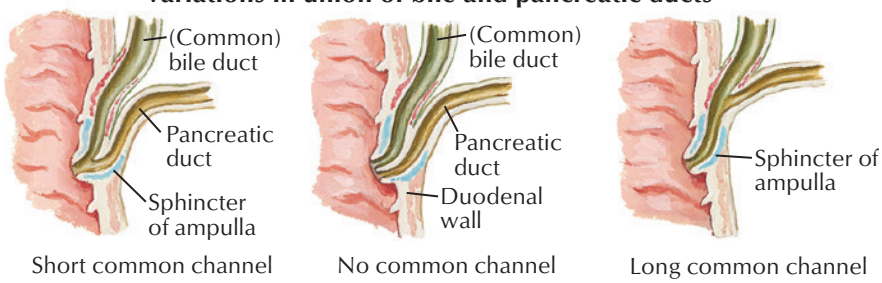
Variations in cystic duct

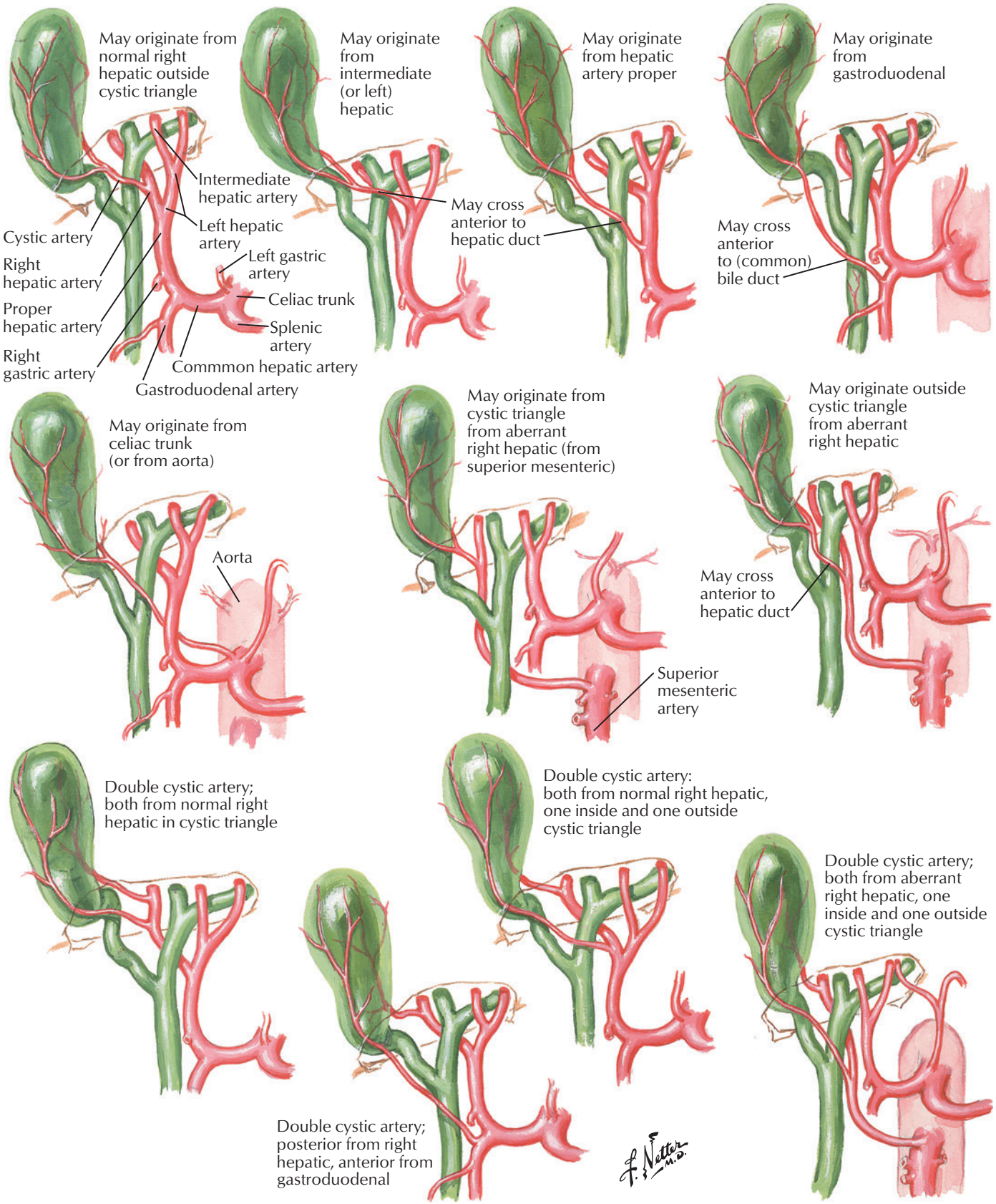


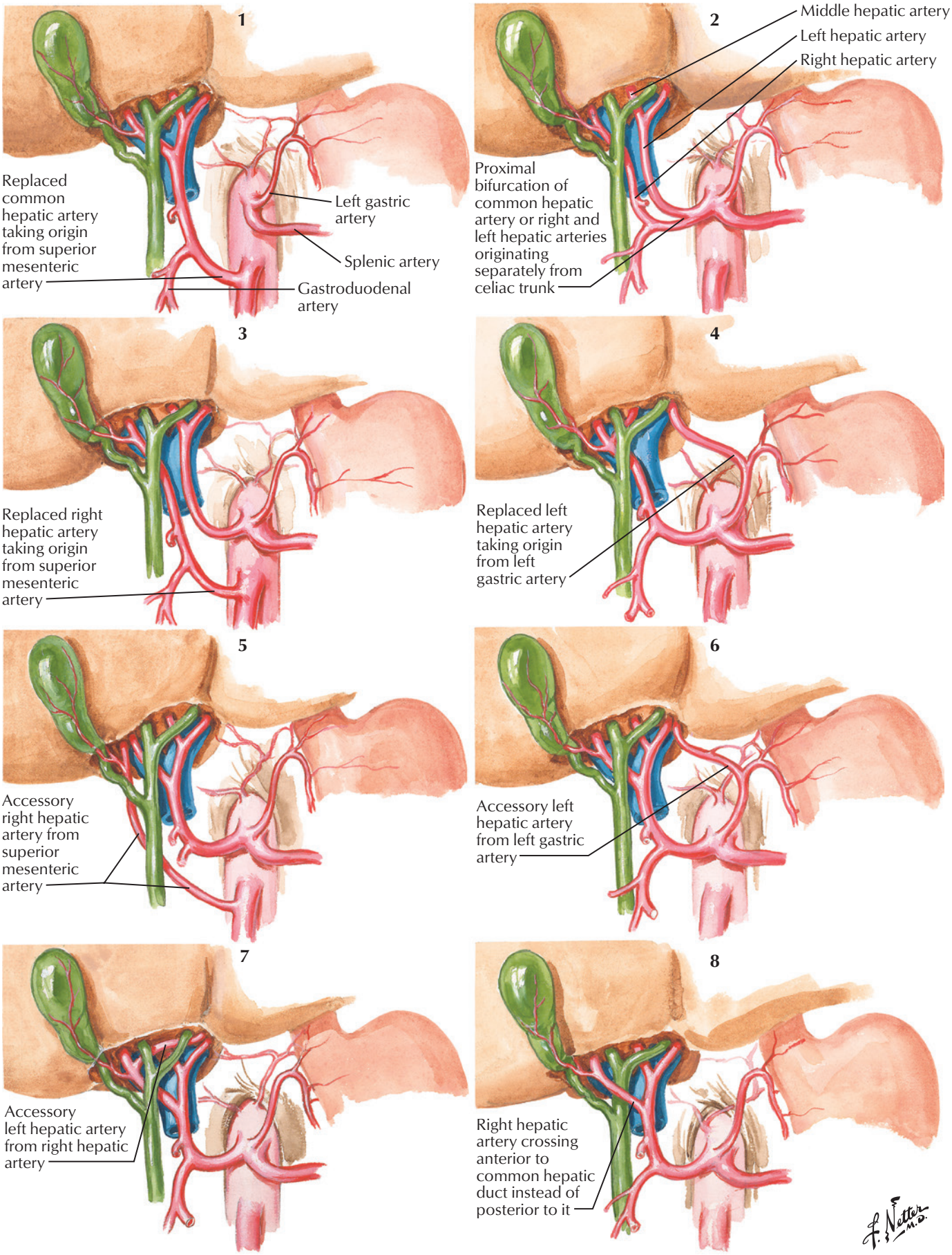
Accessory (aberrant) hepatic ducts



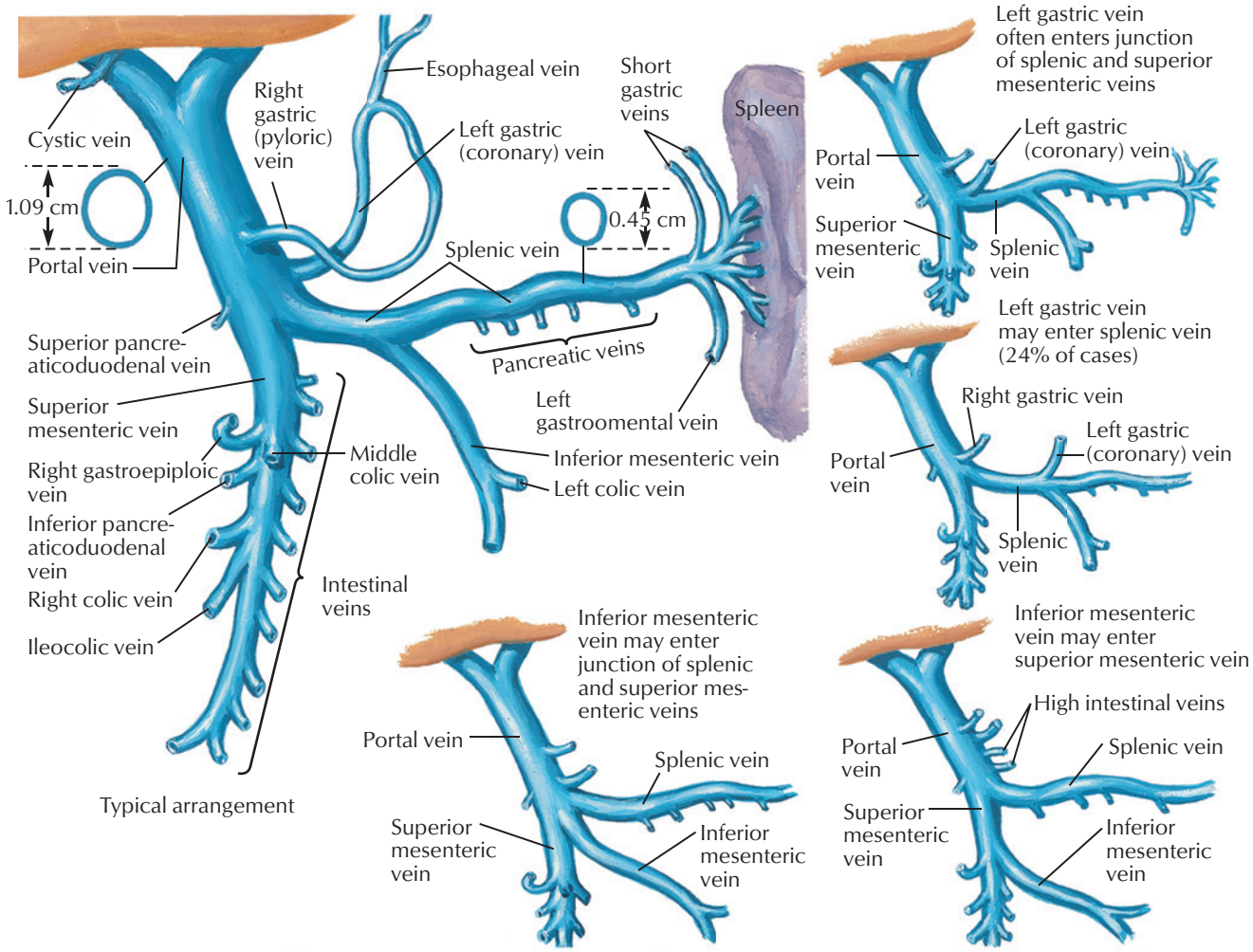
Variations in union of bile and pancreatic ducts



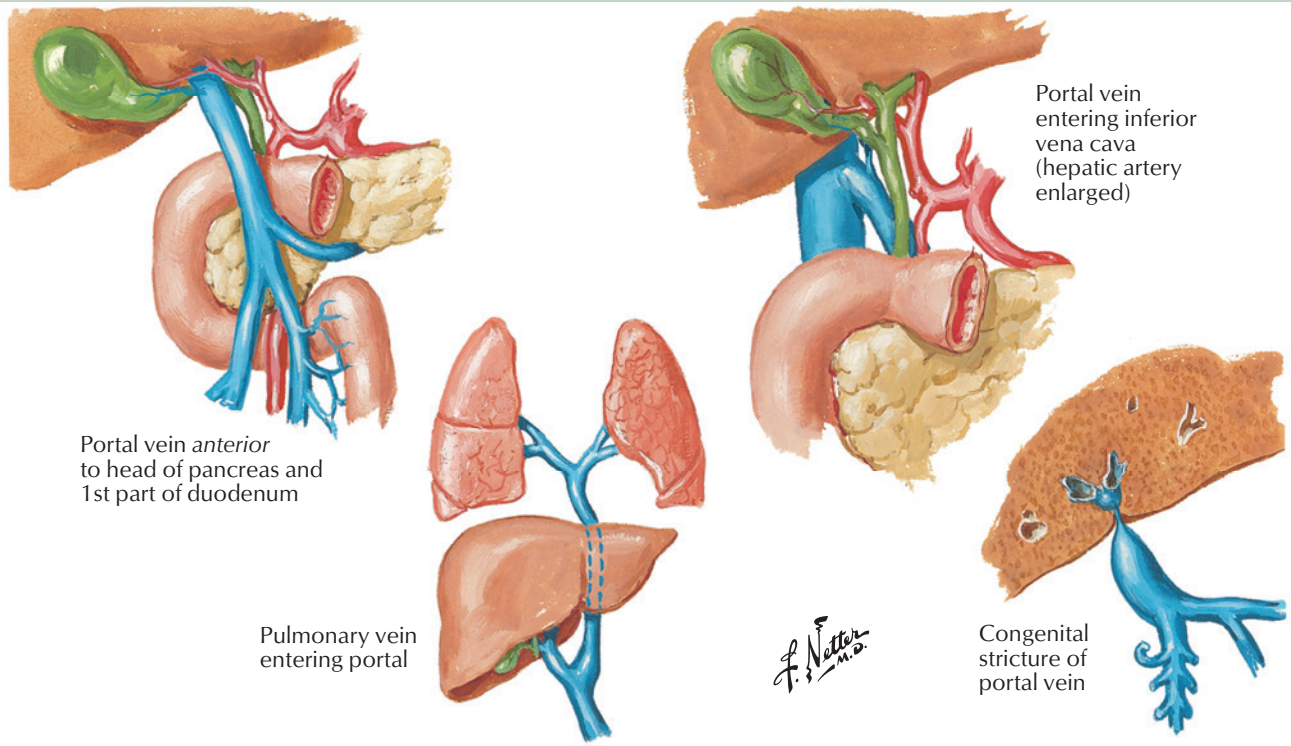

May originate from normal right hepatic outside cystic triangle
Intermediate hepatic artery
Left hepatic artery
Cystic artery
Right hepatic artery
Proper hepatic artery
Right gastric artery
Left gastric artery
Celiac trunk
Splenic artery
Commmon hepatic artery
Gastroduodenal artery
May originate from intermediate (or left) hepatic
May cross anterior to hepatic duct
May originate from hepatic artery proper
May originate from gastroduodenal
May cross anterior to (common) bile duct
May originate from celiac trunk (or from aorta)
Aorta
May originate from cystic triangle from aberrant right hepatic (from superior mesenteric)
Superior mesenteric artery
May originate outside cystic triangle from aberrant right hepatic
May cross anterior to hepatic duct
Double cystic artery; both from normal right hepatic in cystic triangle
Double cystic artery: both from normal right hepatic, one inside and one outside cystic triangle
Double cystic artery; both from aberrant right hepatic, one inside and one outside cystic triangle
Double cystic artery; posterior from right hepatic, anterior from gastroduodenal

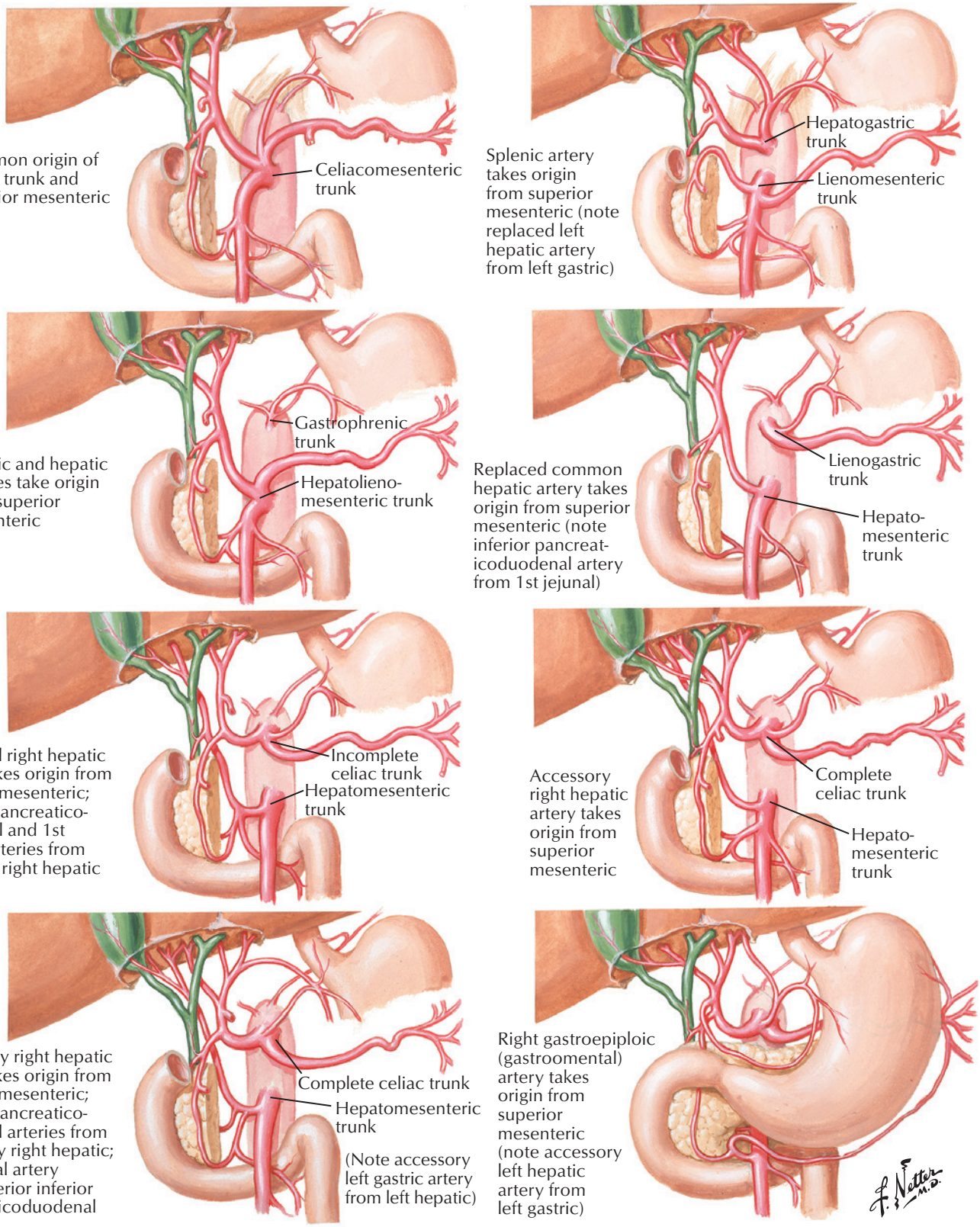

1
Replaced common hepatic artery taking origin from superior mesenteric artery
Left gastric artery
Splenic artery
Gastroduodenal artery
2
Middle hepatic artery
Left hepatic artery
Right hepatic artery
Proximal bifurcation of common hepatic artery or right and left hepatic arteries originating separately from celiac trunk
3
Replaced right hepatic artery taking origin from superior mesenteric artery
4
Replaced left hepatic artery taking origin from left gastric artery
5
Accessory right hepatic artery from superior mesenteric artery
6
Accessory left hepatic artery from left gastric artery
7
Accessory left hepatic artery from right hepatic artery
8
Right hepatic artery crossing anterior to common hepatic duct instead of posterior to it

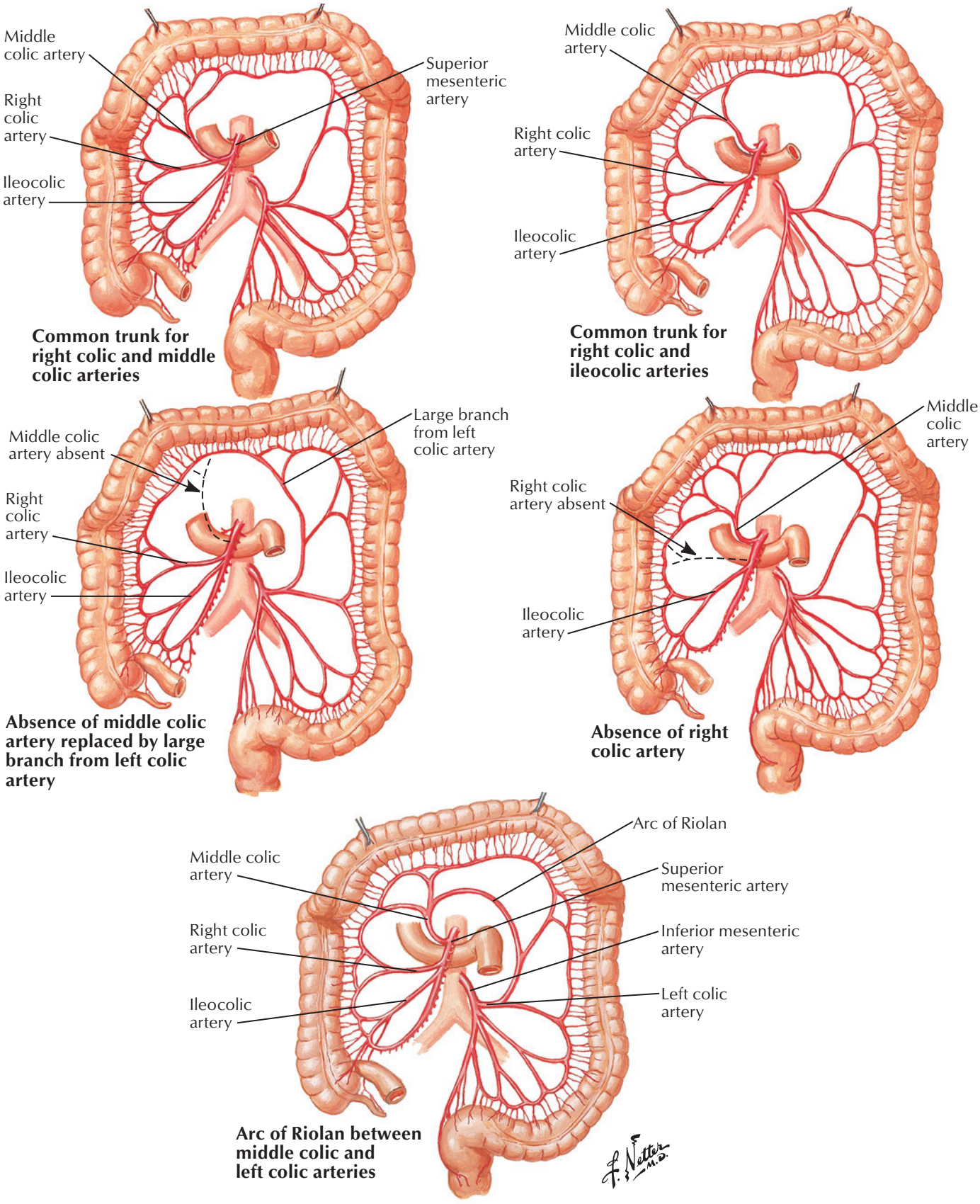
Variations

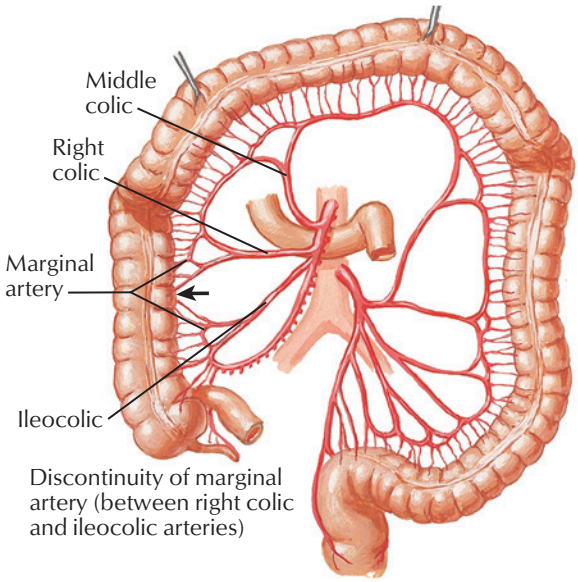


Anomalies

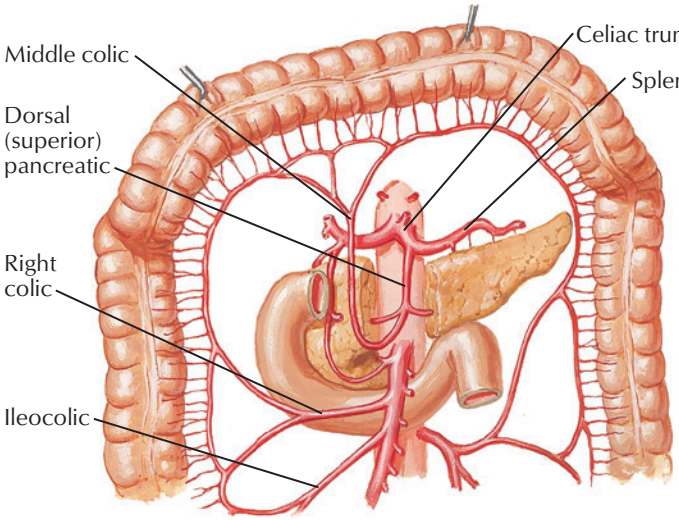



Common origin of celiac trunk and superior mesenteric artery
Celiacomesenteric trunk
Splenic artery takes origin from superior mesenteric (note replaced left hepatic artery from left gastric)
Hepatogastric trunk
Lienomesenteric trunk
Splenic and hepatic arteries take origin from superior mesenteric
Gastrophrenic trunk
Hepatolieno-mesenteric trunk
Replaced common hepatic artery takes origin from superior mesenteric (note inferior pancreat-icoduodenal artery from 1st jejunal)
Lienogastric trunk
Hepato-mesenteric trunk
Replaced right hepatic artery takes origin from superior mesenteric; inferior pancreatico-duodenal and 1st jejunal arteries from replaced right hepatic
Incomplete celiac trunk
Hepatomesenteric trunk
Accessory right hepatic artery takes origin from superior mesenteric
Complete celiac trunk
Hepato-mesenteric trunk
Accessory right hepatic artery takes origin from superior mesenteric; inferior pancreatico-duodenal arteries from accessory right hepatic; 1st jejunal artery from anterior inferior pancreaticoduodenal
Complete celiac trunk
Hepatomesenteric trunk
(Note accessory left gastric artery from left hepatic)
Right gastroepiploic (gastroomental) artery takes origin from superior mesenteric (note accessory left hepatic artery from left gastric)
F. Netter M.D.

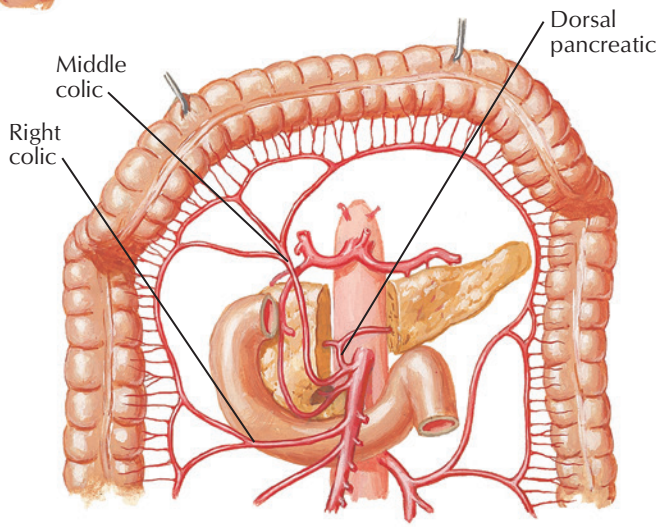

Middle colic artery
Right colic artery
Ileocolic artery
Superior mesenteric artery
Common trunk for right colic and middle colic arteries
Middle colic artery
Right colic artery
Ileocolic artery
Common trunk for right colic and ileocolic arteries
Middle colic artery absent
Right colic artery
Ileocolic artery
Large branch from left colic artery
Absence of middle colic artery replaced by large branch from left colic artery
Right colic artery absent
Ileocolic artery
Middle colic artery
Absence of right colic artery
Middle colic artery
Right colic artery
Ileocolic artery
Arc of Riolan
Superior mesenteric artery
Inferior mesenteric artery
Left colic artery
Arc of Riolan between middle colic and left colic arteries



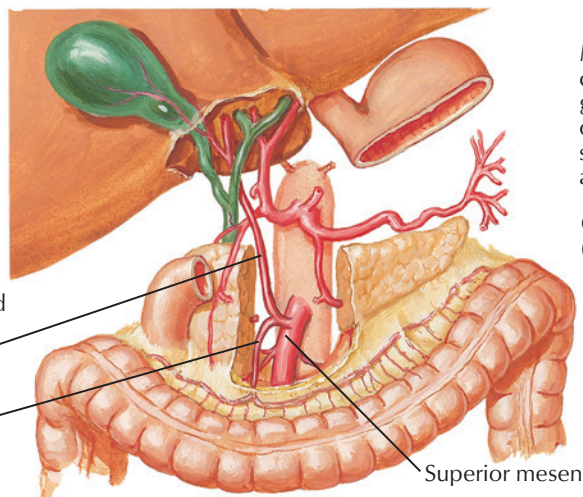
Discontinuity of marginal artery (between right colic and ileocolic arteries)



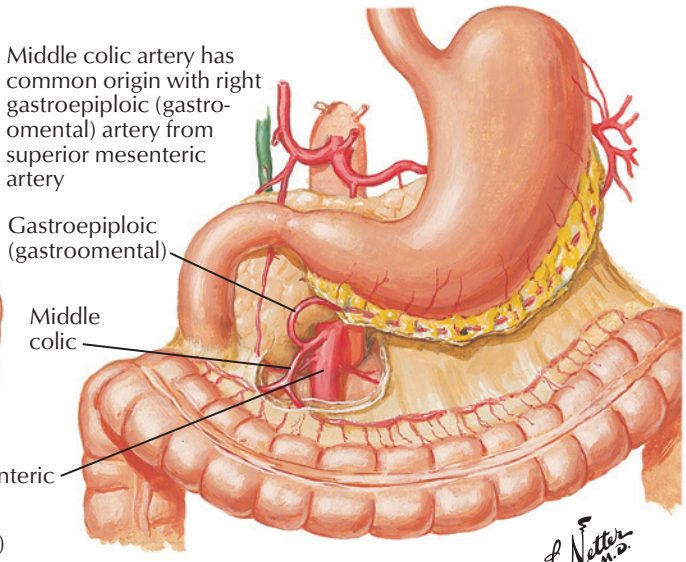
Middle colic artery originates from celiac trunk via dorsal pancreatic artery

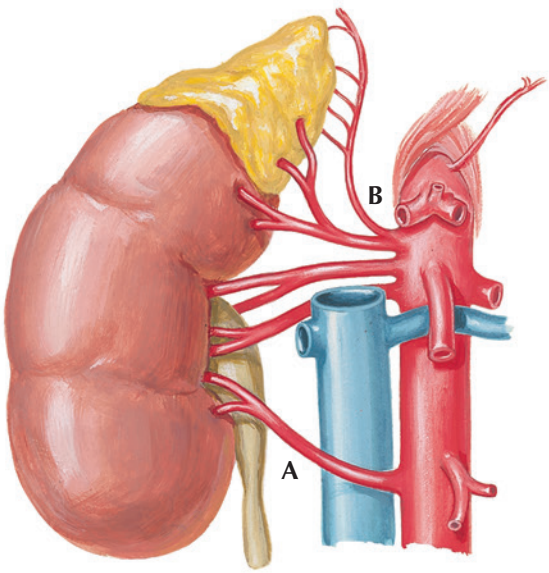


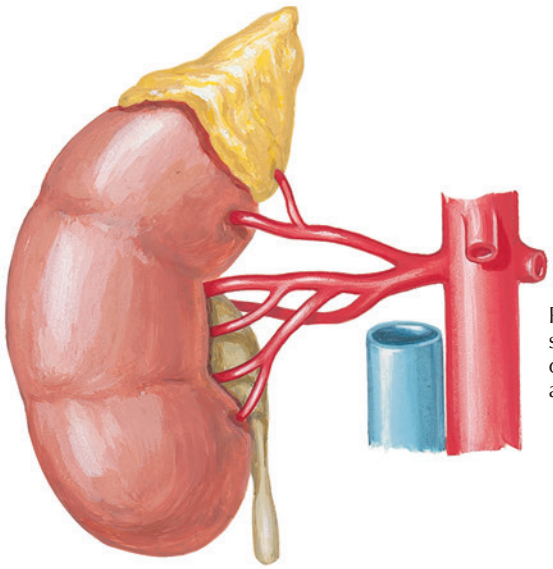
Middle colic artery gives origin to dorsal pancreatic artery



Middle colic artery originates from replaced right hepatic artery (from superior mesenteric artery)



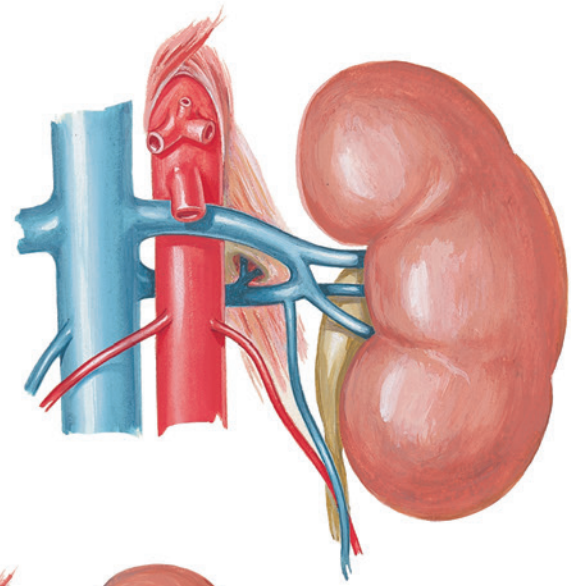




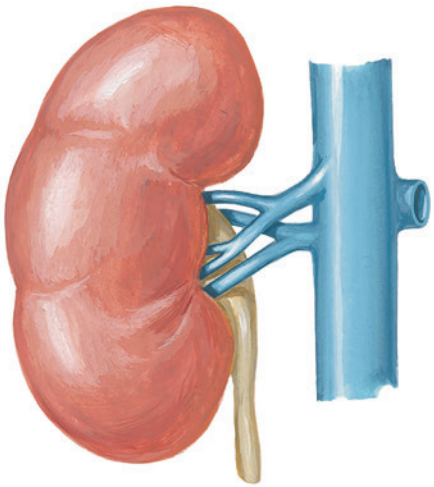
Proximal subdivision of renal artery

A Low accessory right renal artery may pass anterior to inferior vena cava instead of posterior to it

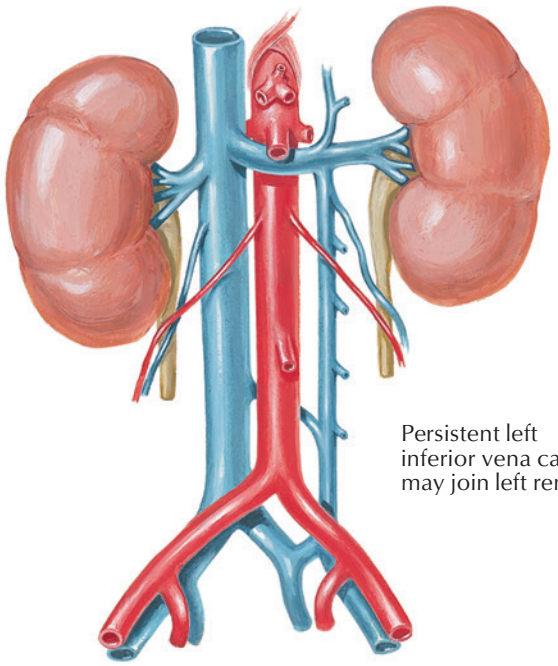
B Inferior phrenic artery with superior suprarenal arteries may arise from renal artery (middle suprarenal artery absent)



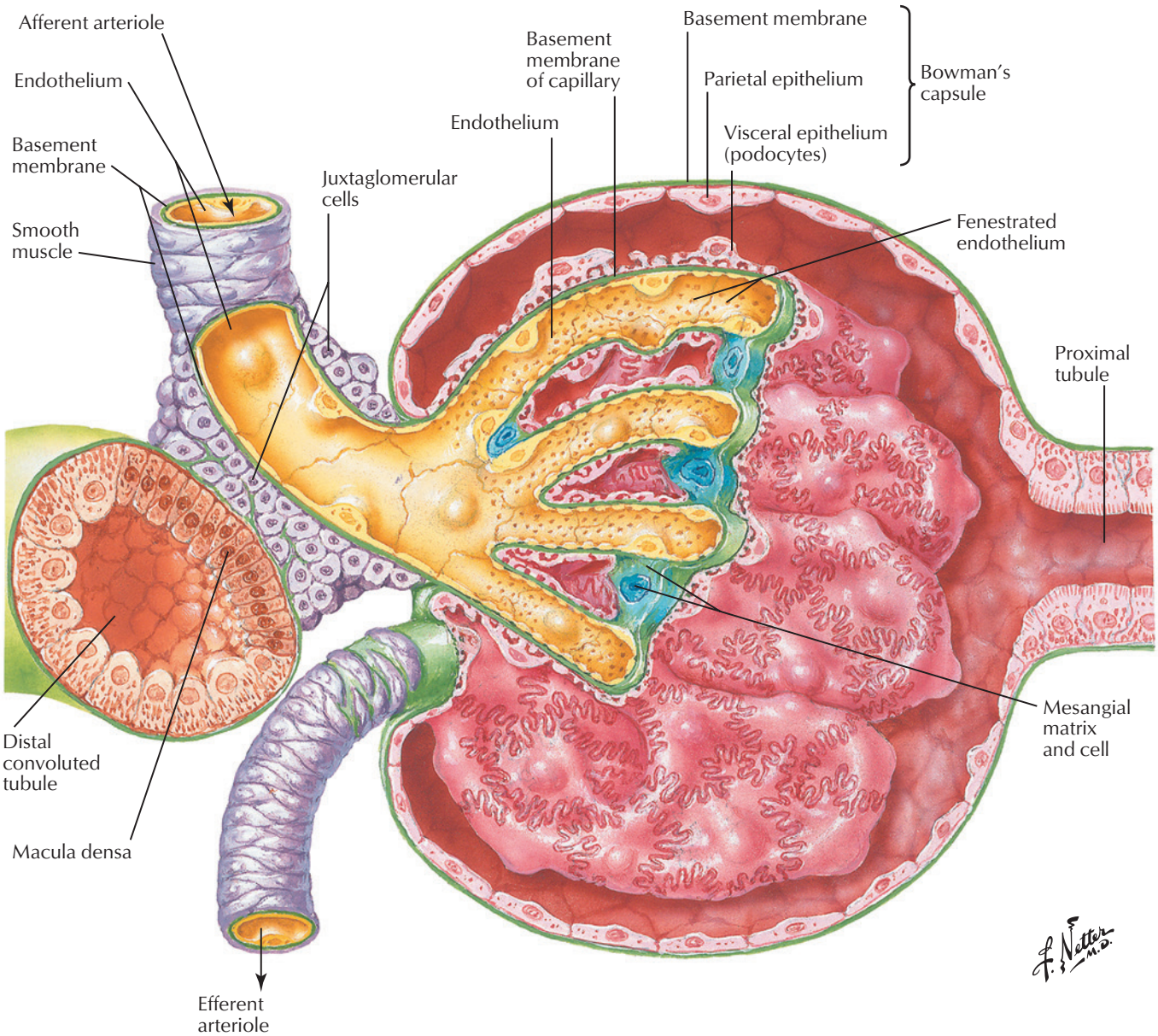
Double left renal vein may form ring around abdominal aorta

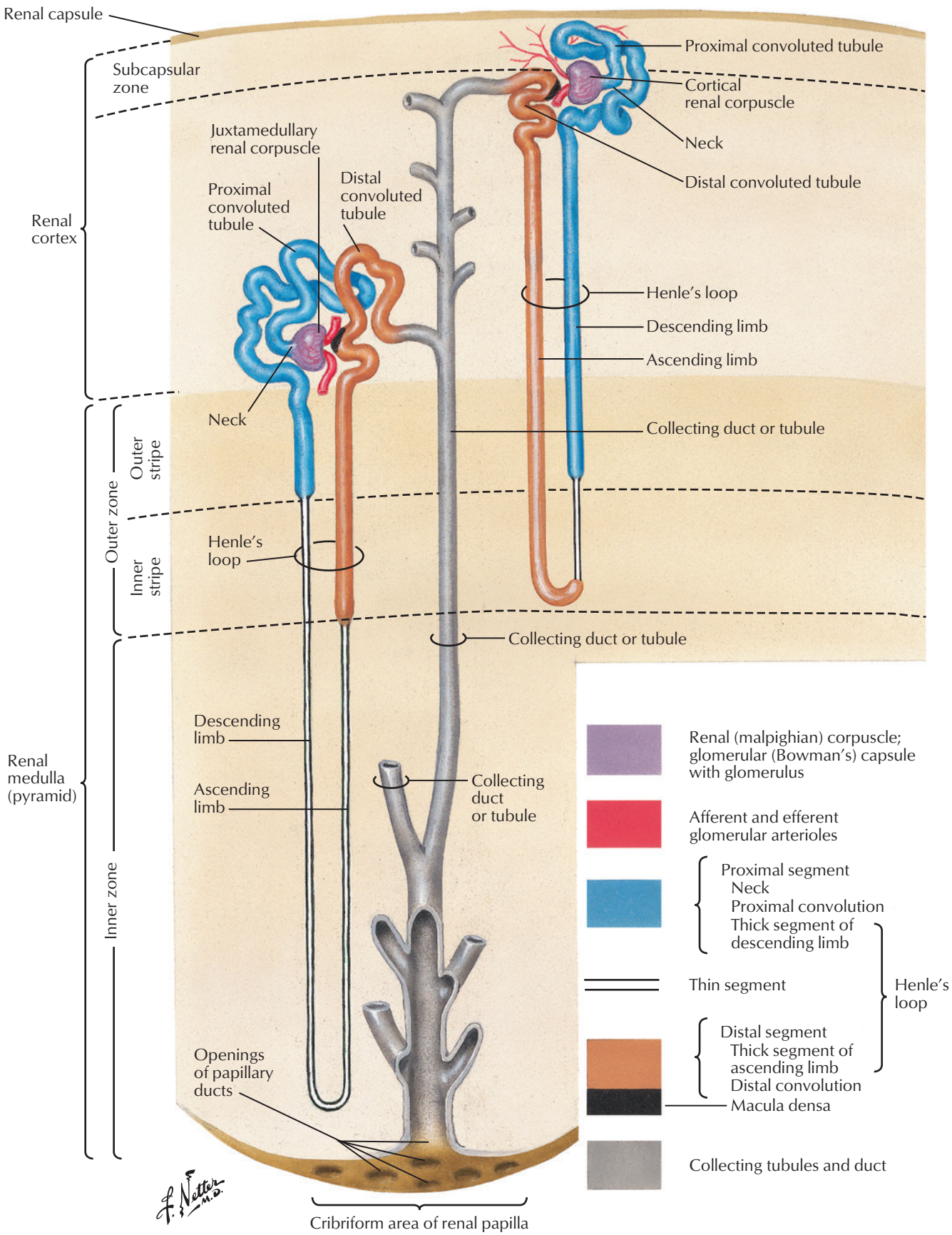


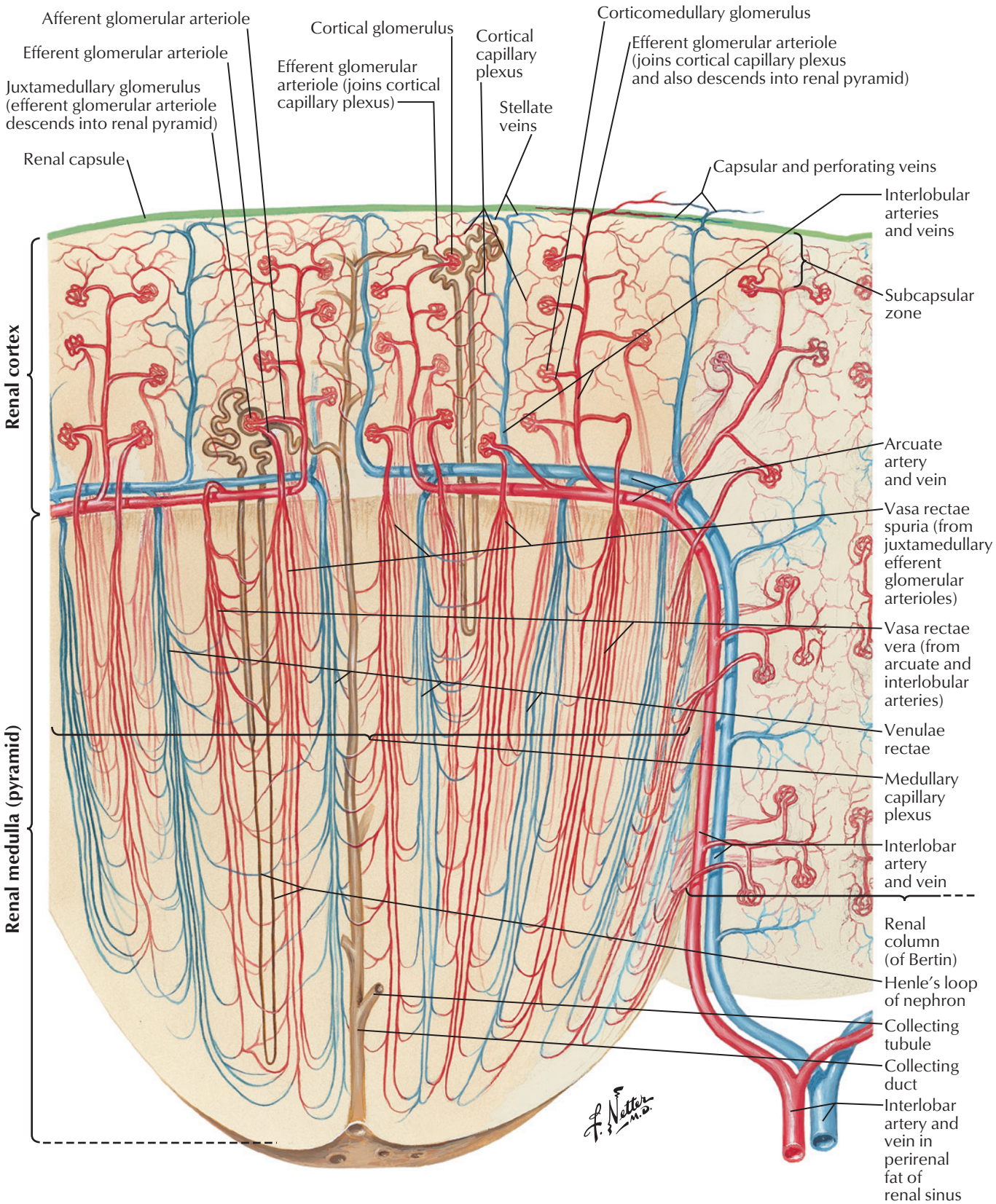
Multiple renal veins

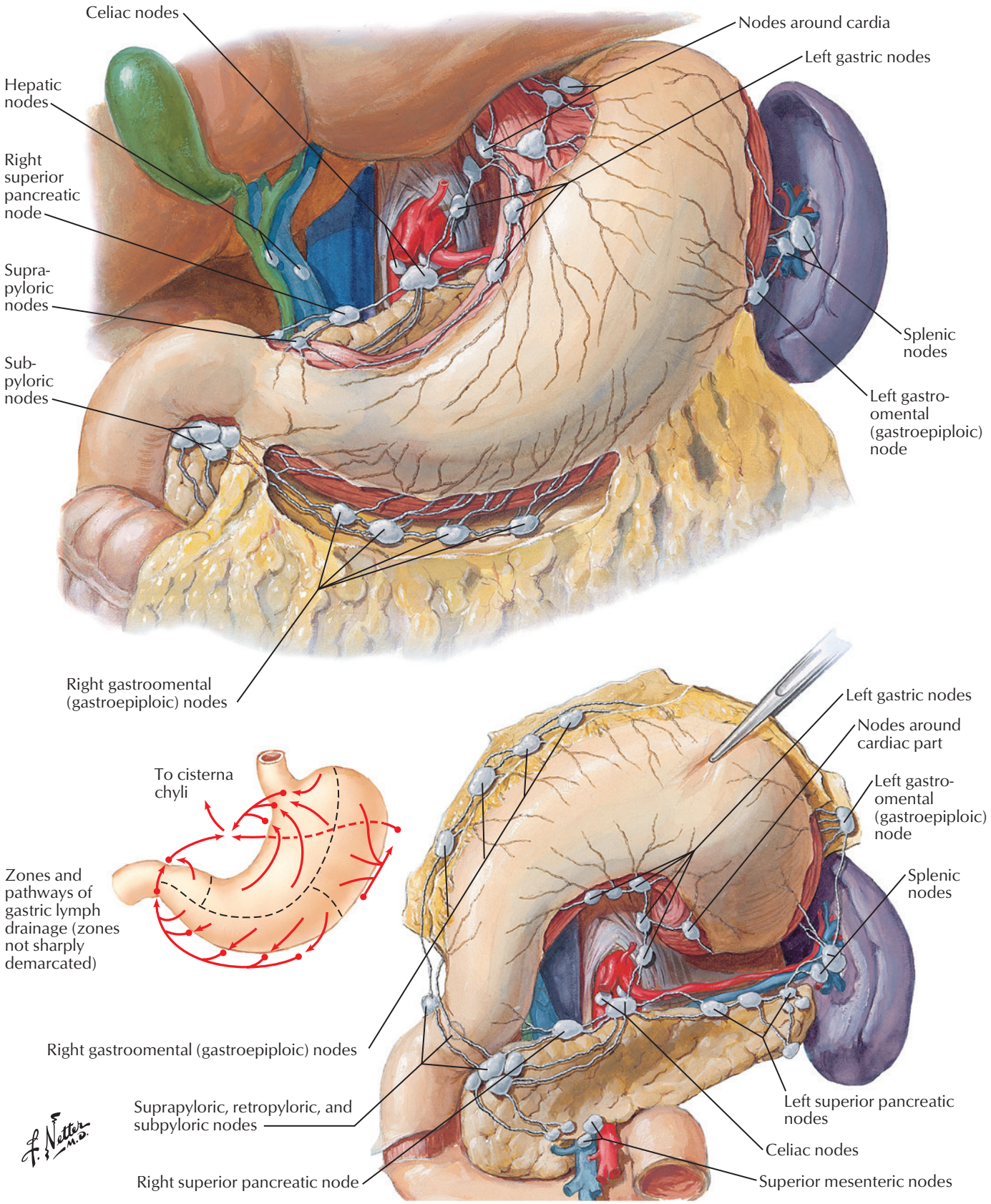


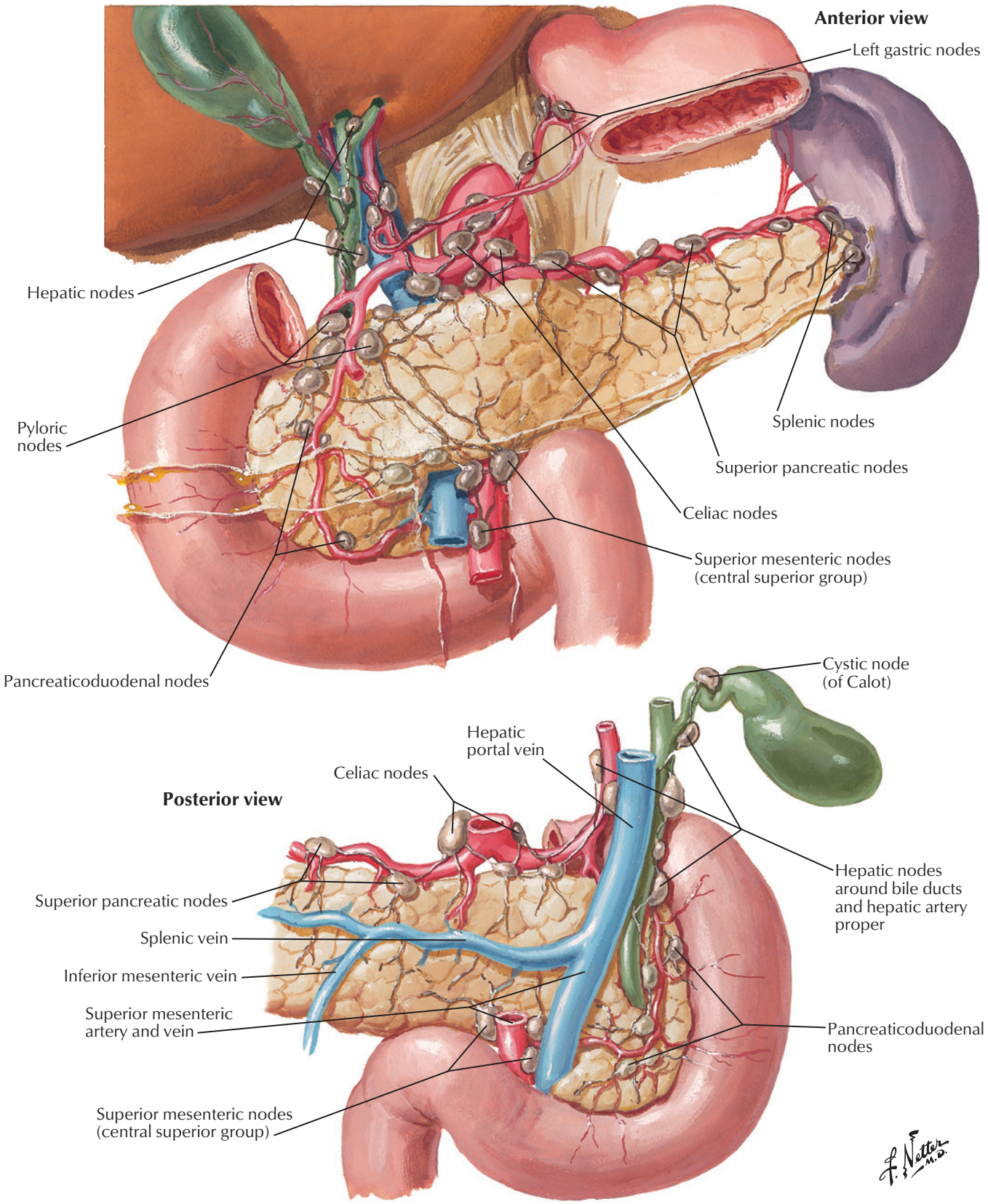
Persistent left inferior vena cava may join left renal vein

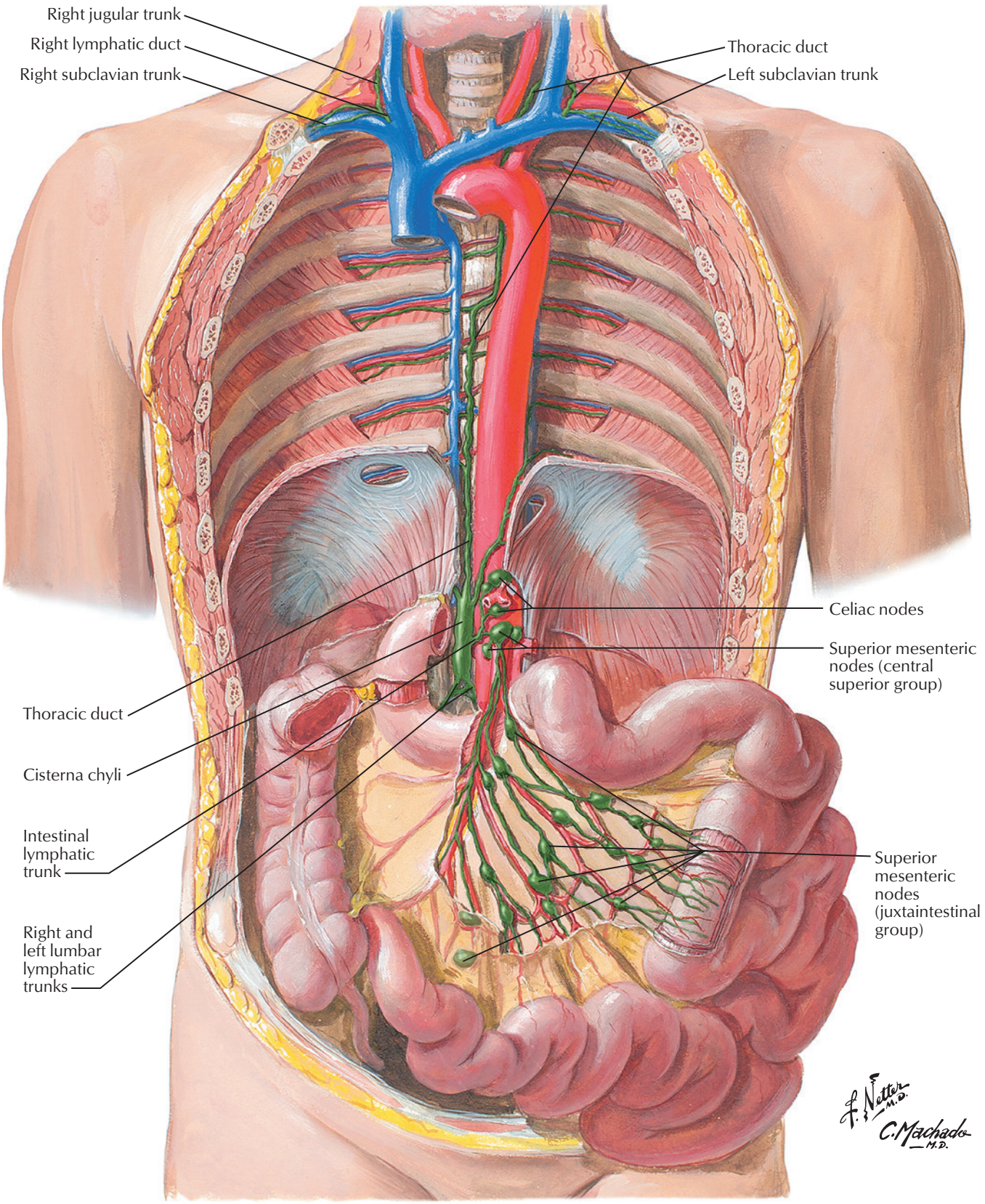

Afferent arteriole
Endothelium
Basement membrane
Smooth muscle
Juxtaglomerular cells
Basement membrane of capillary
Endothelium
Basement membrane
Parietal epithelium
Visceral epithelium (podocytes)
Bowman's capsule
Fenestrated endothelium
Proximal tubule
Mesangial matrix and cell
Distal convoluted tubule
Macula densa
Efferent arteriole

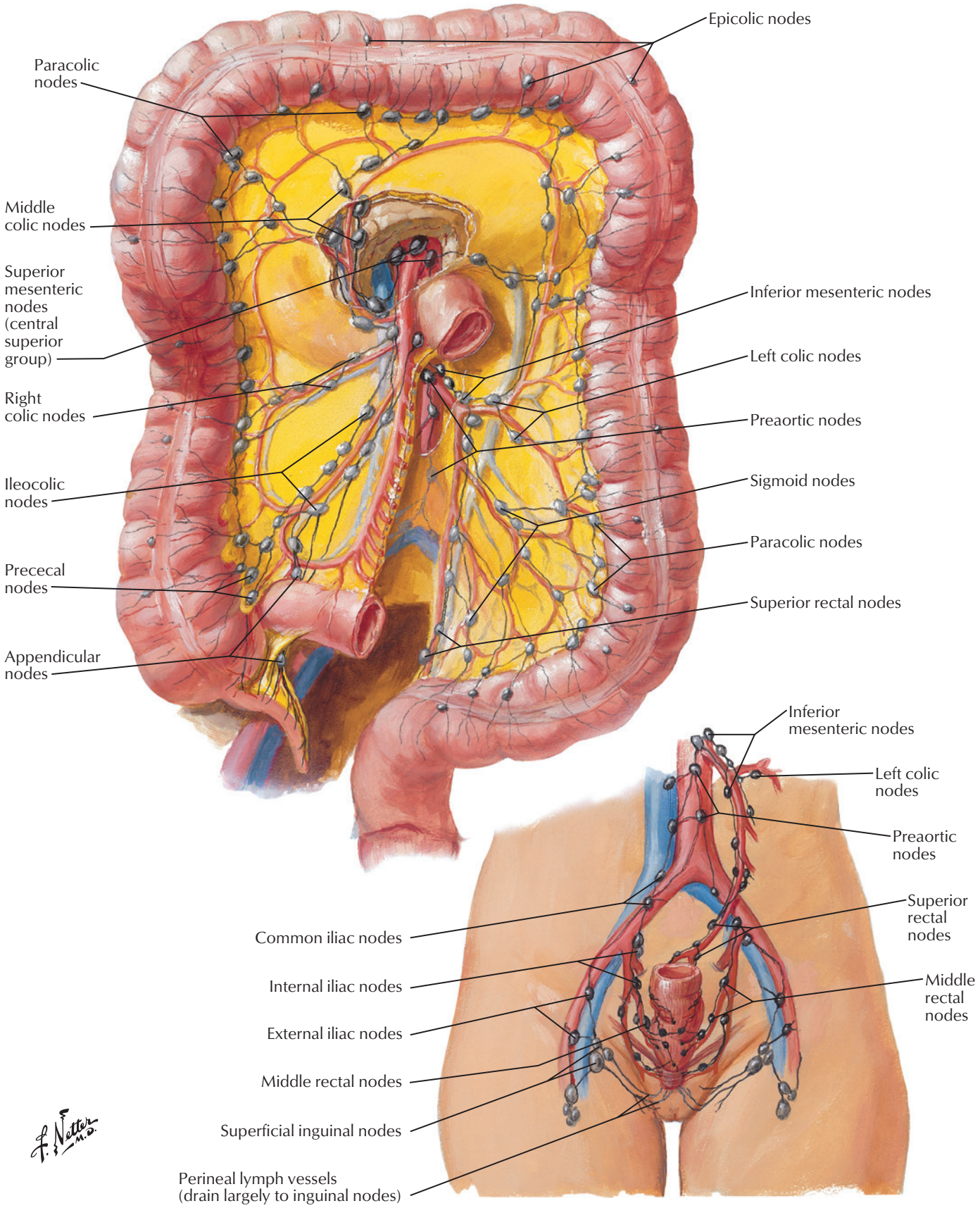

Renal capsule
Subcapsular zone
Renal cortex
Outer zone
Outer stripe
Inner stripe
Inner zone
Renal medulla (pyramid)
Proximal convoluted tubule
Cortical renal corpuscle
Neck
Distal convoluted tubule
Juxtamedullary renal corpuscle
Proximal convoluted tubule
Distal convoluted tubule
Henle's loop
Descending limb
Ascending limb
Collecting duct or tubule
Neck
Henle's loop
Collecting duct or tubule
Descending limb
Ascending limb
Collecting duct or tubule
Openings of papillary ducts
Cribriform area of renal papilla
Renal (malpighian) corpuscle; glomerular (Bowman's) capsule with glomerulus
Afferent and efferent glomerular arterioles
Proximal segment
Neck
Proximal convolution
Thick segment of descending limb
Thin segment
Distal segment
Thick segment of ascending limb
Distal convolution
Macula densa
Henle's loop
Collecting tubules and duct

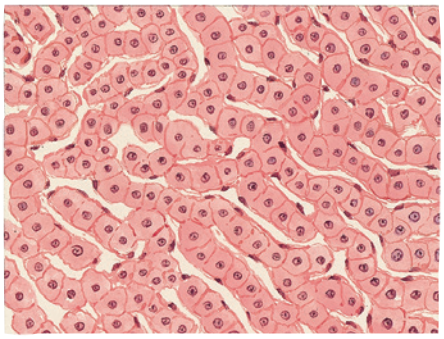

Afferent glomerular arteriole
Efferent glomerular arteriole
Juxtamedullary glomerulus (efferent glomerular arteriole descends into renal pyramid)
Renal capsule
Cortical glomerulus
Efferent glomerular arteriole (joins cortical capillary plexus)
Cortical capillary plexus
Stellate veins
Corticomedullary glomerulus
Efferent glomerular arteriole (joins cortical capillary plexus and also descends into renal pyramid)
Capsular and perforating veins
Interlobular arteries and veins
Subcapsular zone
Renal cortex
Renal medulla (pyramid)
Arcuate artery and vein
Vasa rectae spuria (from juxtamedullary efferent glomerular arterioles)
Vasa rectae vera (from arcuate and interlobular arteries)
Venulae rectae
Medullary capillary plexus
Interlobar artery and vein
Renal column (of Bertin)
Henle's loop of nephron
Collecting tubule
Collecting duct
Interlobar artery and vein in perirenal fat of renal sinus
F. Netter M.D.


Celiac nodes
Nodes around cardia
Left gastric nodes
Hepatic nodes
Right superior pancreatic node
Supra-pyloric nodes
Sub-pyloric nodes
Splenic nodes
Left gastro-omental (gastroepiploic) node
Right gastroomental (gastroepiploic) nodes
To cisterna chyli
Zones and pathways of gastric lymph drainage (zones not sharply demarcated)
Left gastric nodes
Nodes around cardiac part
Left gastro-omental (gastroepiploic) node
Splenic nodes
Right gastroomental (gastroepiploic) nodes
Suprapyloric, retropyloric, and subpyloric nodes
Left superior pancreatic nodes
Celiac nodes
Right superior pancreatic node
Superior mesenteric nodes


Anterior view
Left gastric nodes
Hepatic nodes
Pyloric nodes
Splenic nodes
Superior pancreatic nodes
Celiac nodes
Superior mesenteric nodes (central superior group)
Pancreaticoduodenal nodes
Cystic node (of Calot)
Hepatic portal vein
Celiac nodes
Posterior view
Hepatic nodes around bile ducts and hepatic artery proper
Superior pancreatic nodes
Splenic vein
Inferior mesenteric vein
Superior mesenteric artery and vein
Pancreaticoduodenal nodes
Superior mesenteric nodes (central superior group)

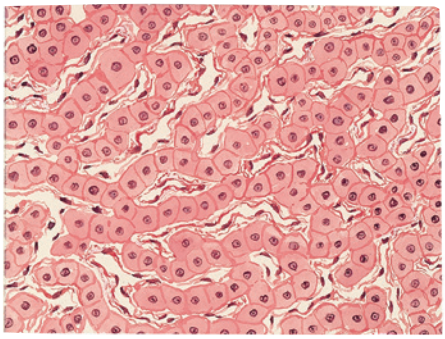

Right jugular trunk
Right lymphatic duct
Right subclavian trunk
Thoracic duct
Left subclavian trunk
Celiac nodes
Superior mesenteric nodes (central superior group)
Thoracic duct
Cisterna chyli
Intestinal lymphatic trunk
Right and left lumbar lymphatic trunks
Superior mesenteric nodes (juxtaintestinal group)
F. Netter M.D.
C. Machado M.D.


Epicolic nodes
Paracolic nodes
Middle colic nodes
Superior mesenteric nodes (central superior group)
Right colic nodes
Ileocolic nodes
Prececal nodes
Appendicular nodes
Inferior mesenteric nodes
Left colic nodes
Preaortic nodes
Sigmoid nodes
Paracolic nodes
Superior rectal nodes
Inferior mesenteric nodes
Left colic nodes
Preaortic nodes
Superior rectal nodes
Middle rectal nodes
Common iliac nodes
Internal iliac nodes
External iliac nodes
Middle rectal nodes
Superficial inguinal nodes
Perineal lymph vessels (drain largely to inguinal nodes)

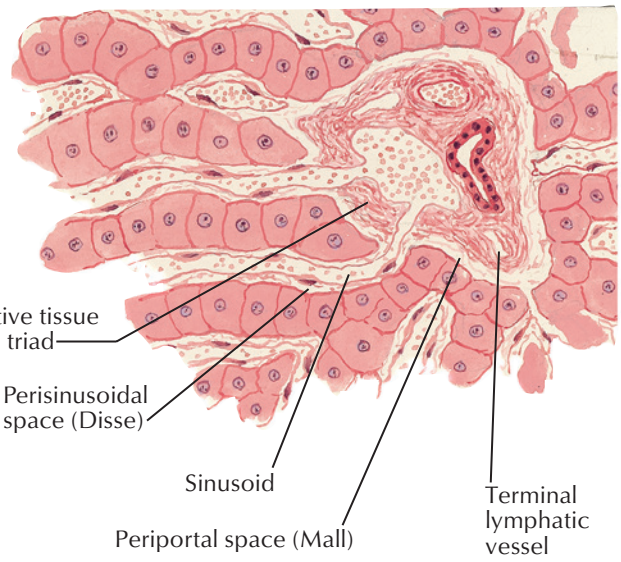


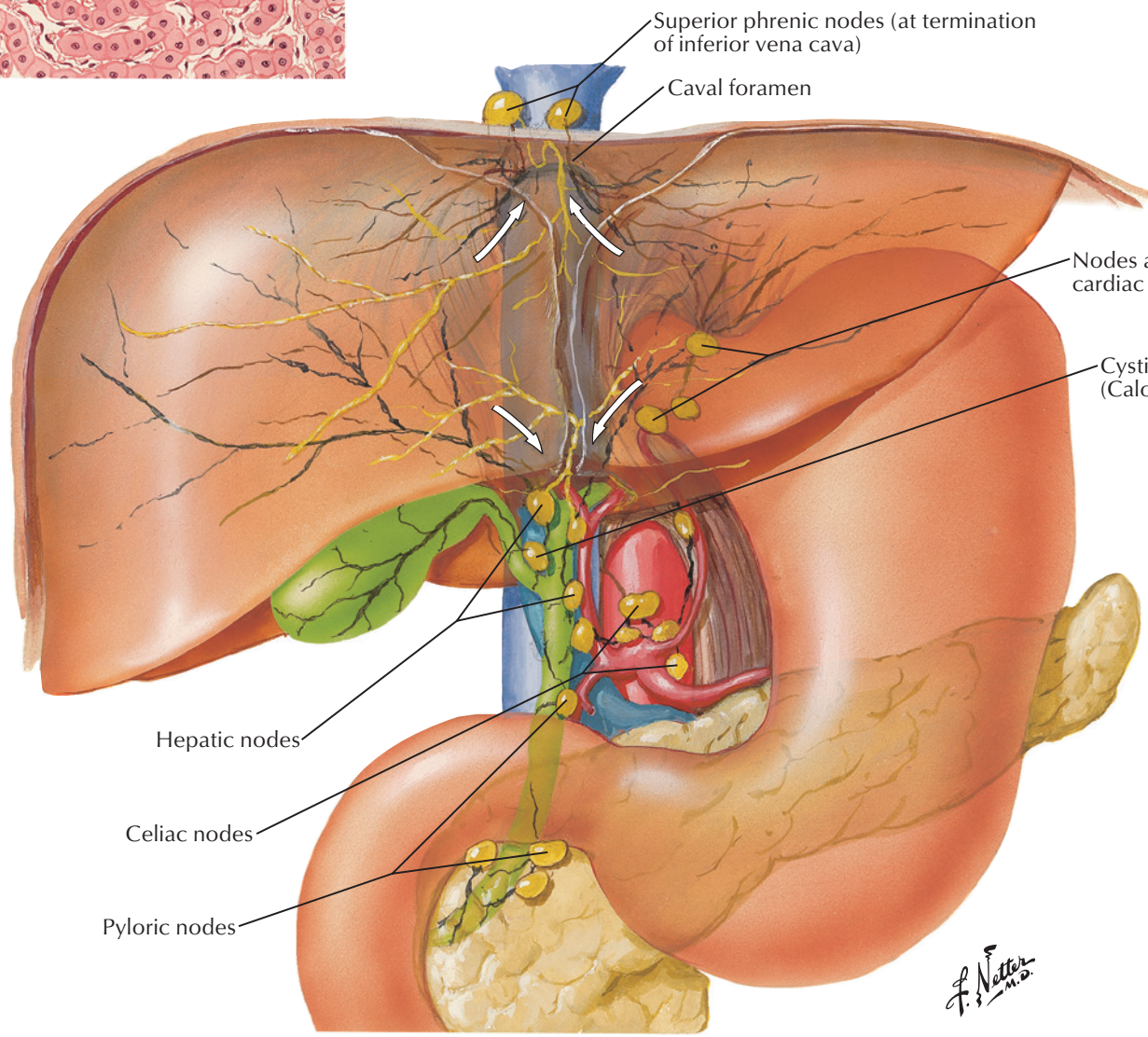
Low-power sections of liver

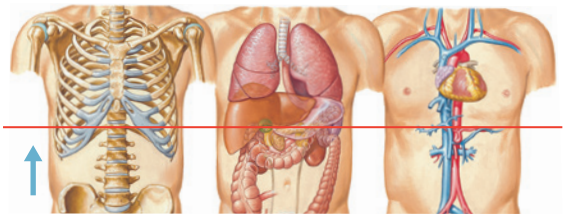
Perisinusoidal spaces (Disse) very narrow or obliterated

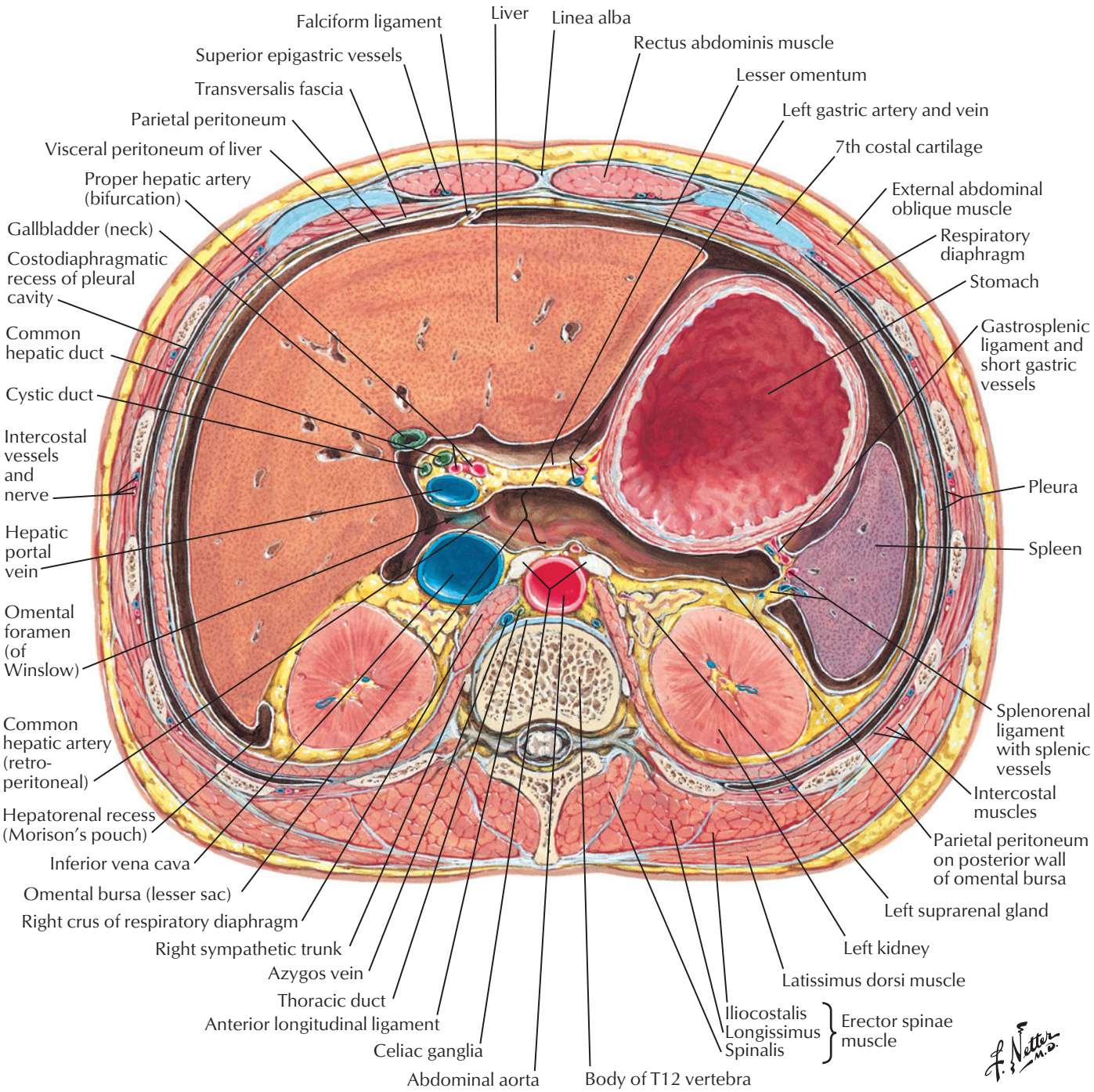


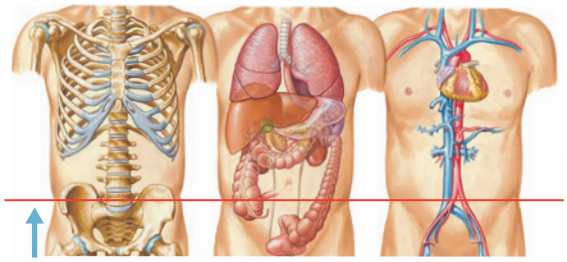
Perisinusoidal spaces (Disse) markedly widened

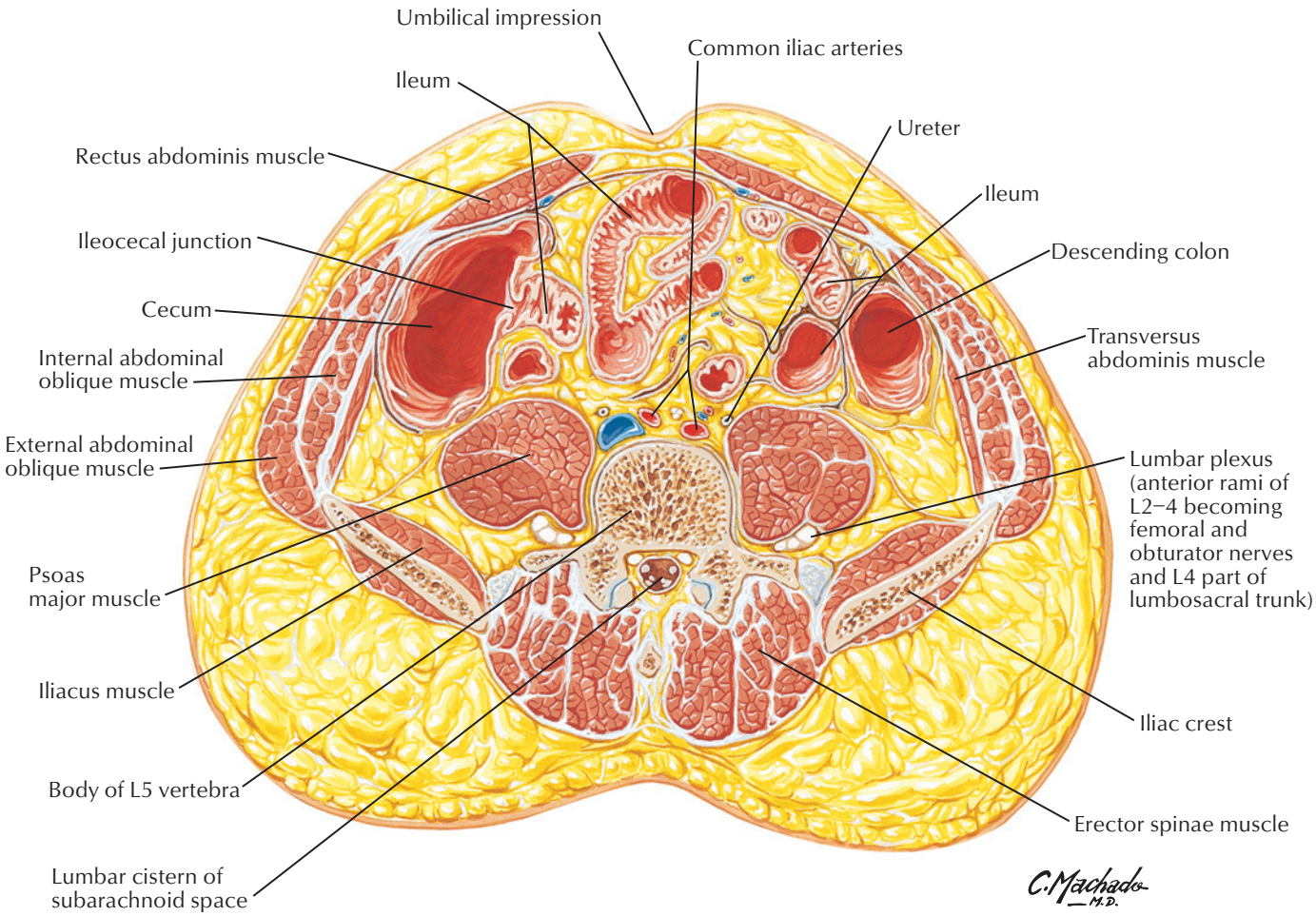


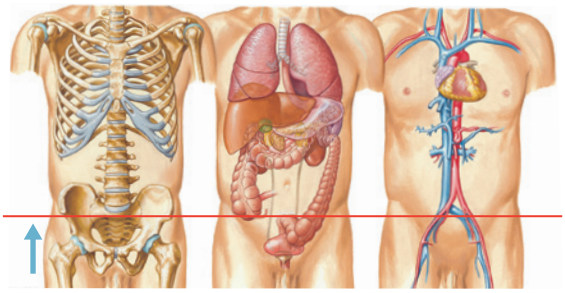


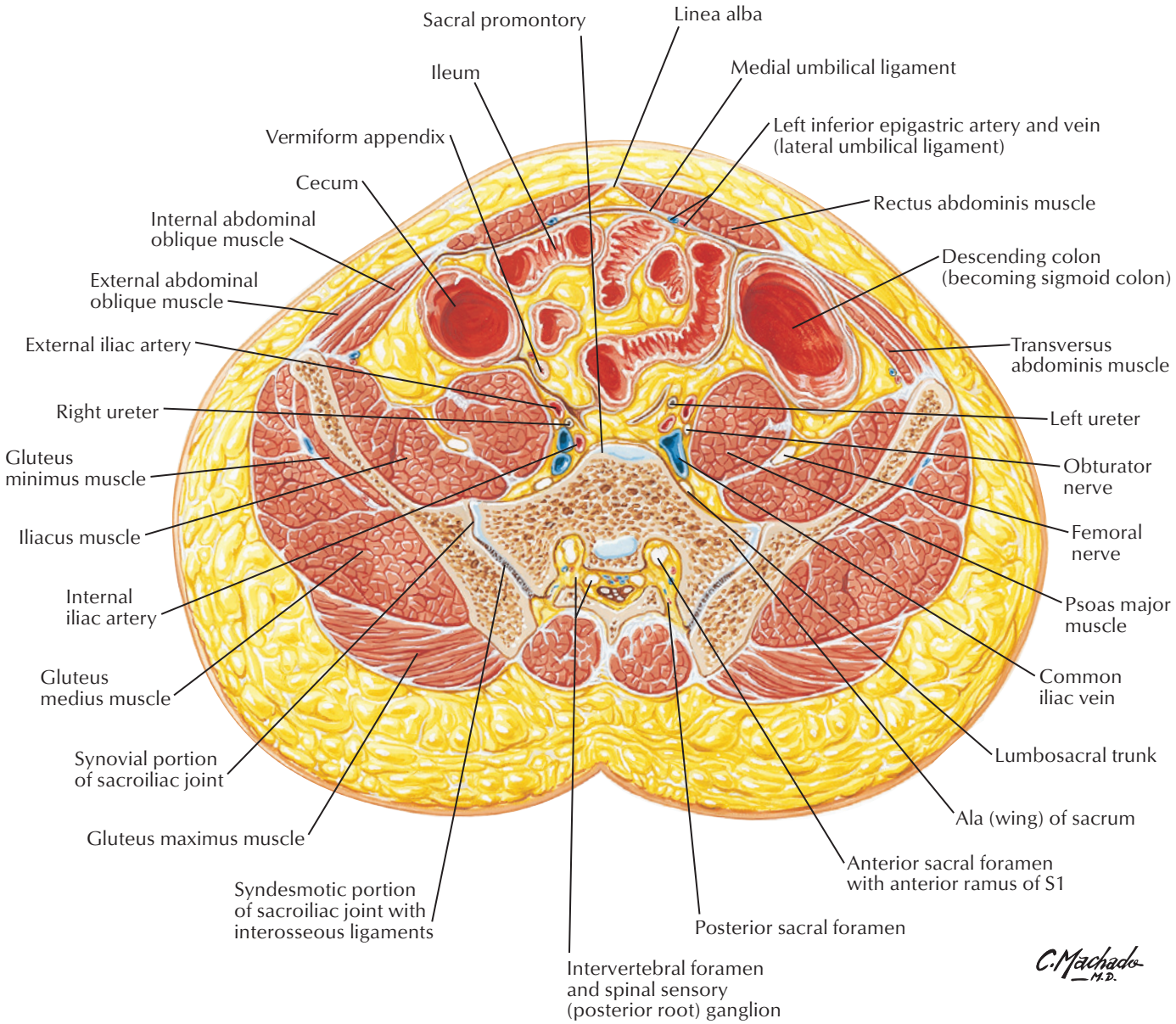



Falciform ligament
Liver
Linea alba
Rectus abdominis muscle
Superior epigastric vessels
Lesser omentum
Transversalis fascia
Left gastric artery and vein
Parietal peritoneum
7th costal cartilage
Visceral peritoneum of liver
Proper hepatic artery (bifurcation)
External abdominal oblique muscle
Gallbladder (neck)
Respiratory diaphragm
Costodiaphragmatic recess of pleural cavity
Stomach
Common hepatic duct
Gastrosplenic ligament and short gastric vessels
Cystic duct
Intercostal vessels and nerve
Pleura
Hepatic portal vein
Spleen
Omental foramen (of Winslow)
Splenorenal ligament with splenic vessels
Common hepatic artery (retro-peritoneal)
Intercostal muscles
Hepatorenal recess (Morison's pouch)
Parietal peritoneum on posterior wall of omental bursa
Inferior vena cava
Left suprarenal gland
Omental bursa (lesser sac)
Right crus of respiratory diaphragm
Left kidney
Right sympathetic trunk
Azygos vein
Latissimus dorsi muscle
Thoracic duct
Iliocostalis
Longissimus
Spinalis
Erector spinae muscle
Anterior longitudinal ligament
Celiac ganglia
Abdominal aorta
Body of T12 vertebra

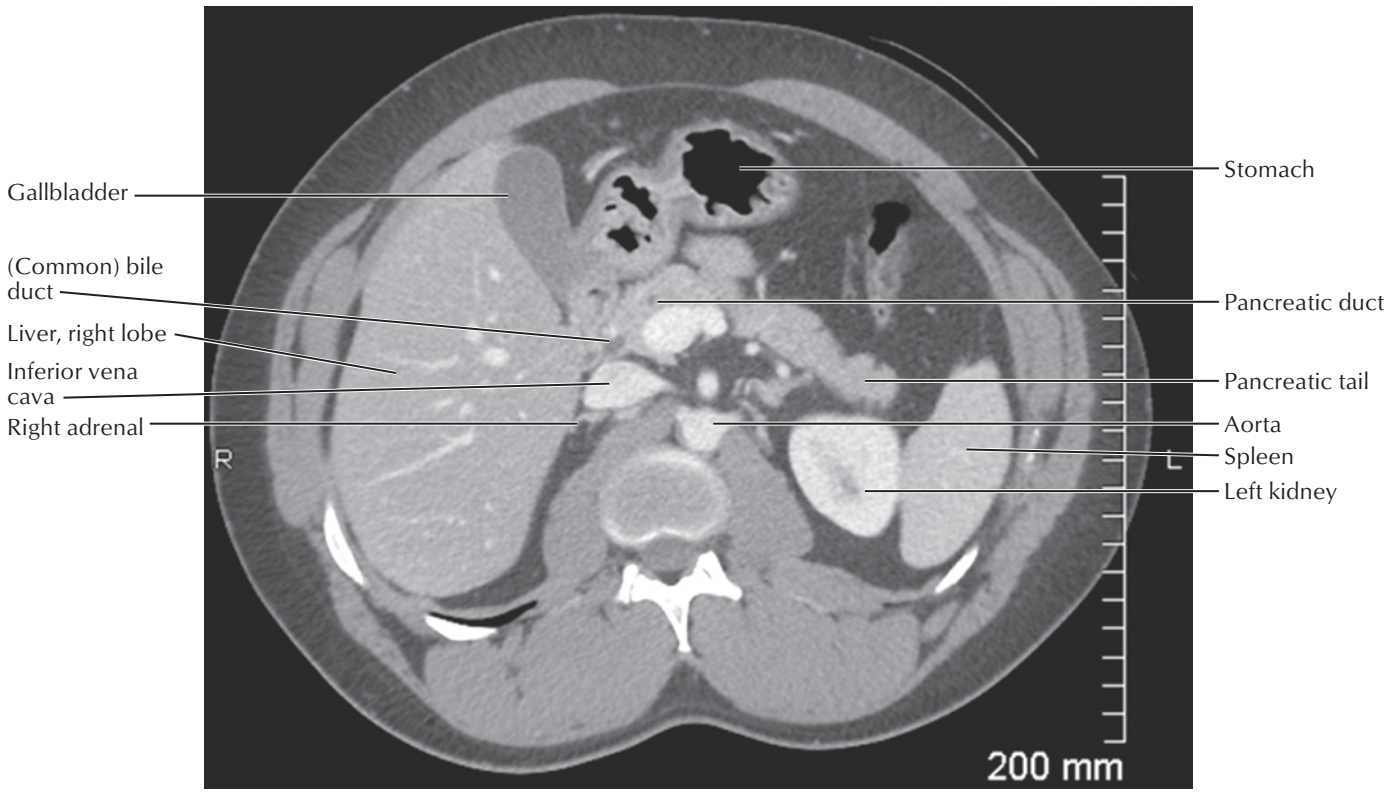



Umbilical impression
Common iliac arteries
Ileum
Ureter
Rectus abdominis muscle
Ileum
Ileocecal junction
Descending colon
Cecum
Transversus abdominis muscle
Internal abdominal oblique muscle
External abdominal oblique muscle
Lumbar plexus (anterior rami of L2–4 becoming femoral and obturator nerves and L4 part of lumbosacral trunk)
Psoas major muscle
Iliacus muscle
Iliac crest
Body of L5 vertebra
Erector spinae muscle
Lumbar cistern of subarachnoid space
C. Machado M.D.




Sacral promontory
Linea alba
Ileum
Medial umbilical ligament
Vermiform appendix
Left inferior epigastric artery and vein (lateral umbilical ligament)
Cecum
Rectus abdominis muscle
Internal abdominal oblique muscle
Descending colon (becoming sigmoid colon)
External abdominal oblique muscle
External iliac artery
Transversus abdominis muscle
Right ureter
Left ureter
Gluteus minimus muscle
Obturator nerve
Iliacus muscle
Femoral nerve
Internal iliac artery
Psoas major muscle
Gluteus medius muscle
Common iliac vein
Synovial portion of sacroiliac joint
Lumbosacral trunk
Ala (wing) of sacrum
Gluteus maximus muscle
Anterior sacral foramen with anterior ramus of S1
Syndesmotic portion of sacroiliac joint with interosseous ligaments
Posterior sacral foramen
Intervertebral foramen and spinal sensory (posterior root) ganglion
C. Machado M.D.

Axial CT image enhanced with intravenous contrast



PELVIS AND PERINEUM 6

Surface Anatomy	333	**Testis, Epididymis, and Ductus Deferens**	372
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Homologues of Genitalia	370-371	**Muscle Tables**	Tables 6.3-6.4
		Electronic Bonus Plates	BP88-BP98

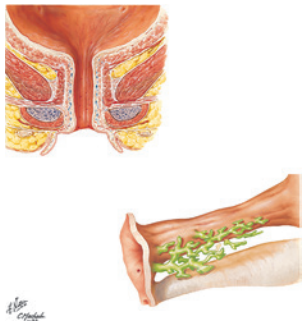
ELECTRONIC BONUS PLATES



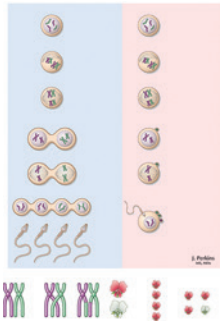
BP88 Fasciae of Male and Female Pelvis and Perineum



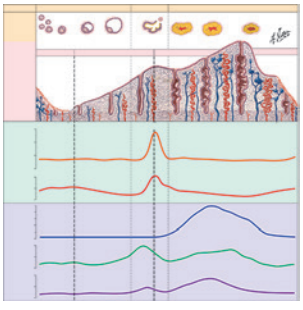
BP89 Male and Female Cystourethrograms



BP90 Female Urethra



BP91 Genetics of Reproduction



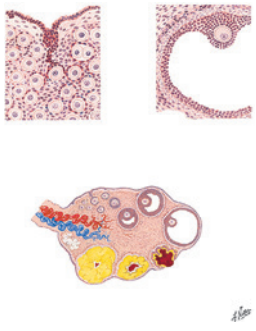
BP92 Menstrual Cycle



BP93 Testes

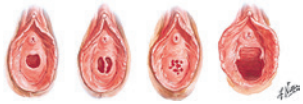


BP94 Uterine Development



BP95 Ovary, Ova, and Follicles

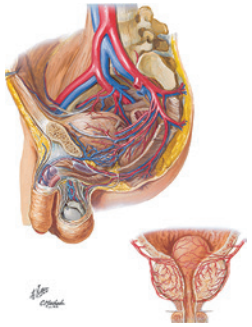
ELECTRONIC BONUS PLATES—*cont'd*



BP96 Variations in Hymen

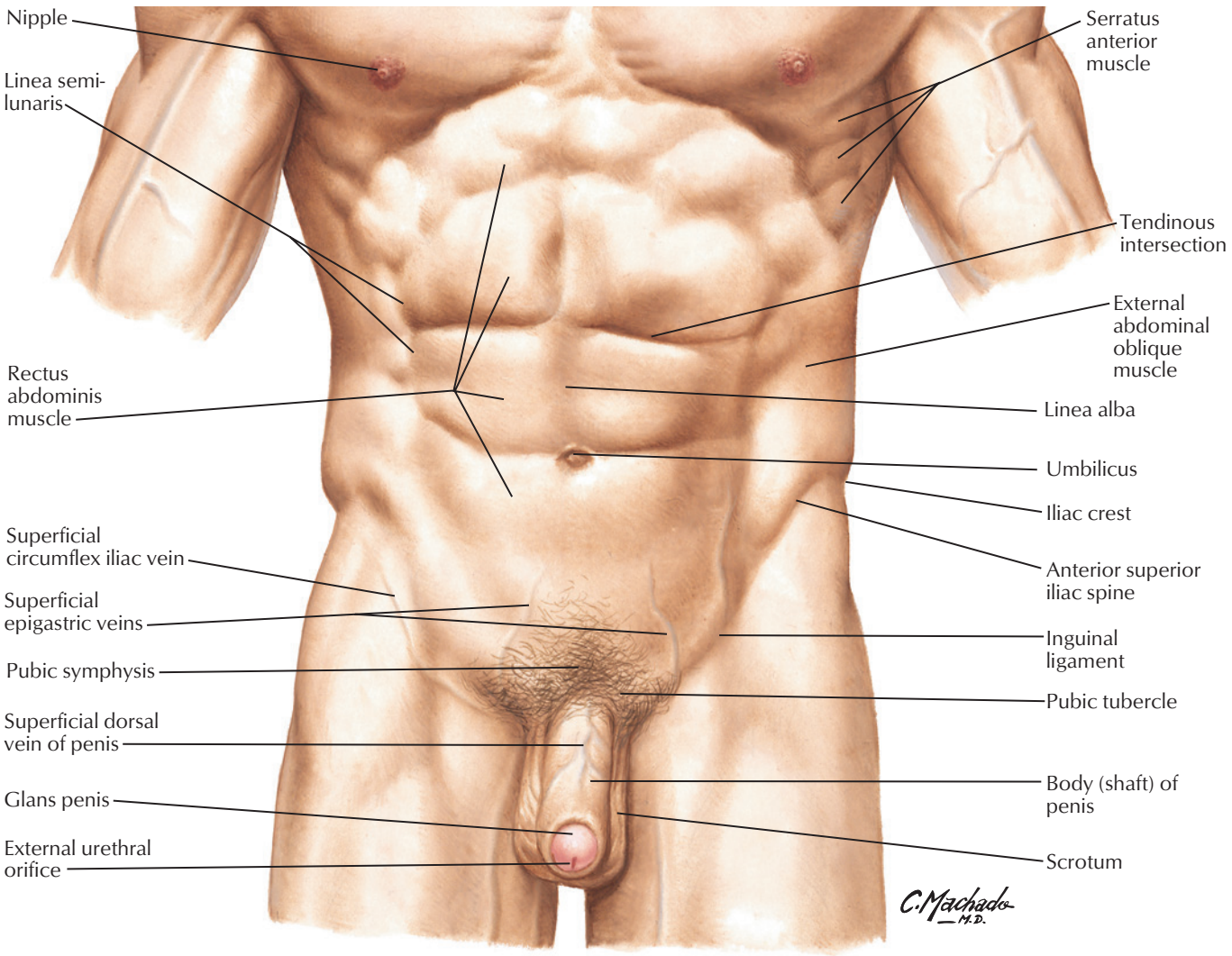


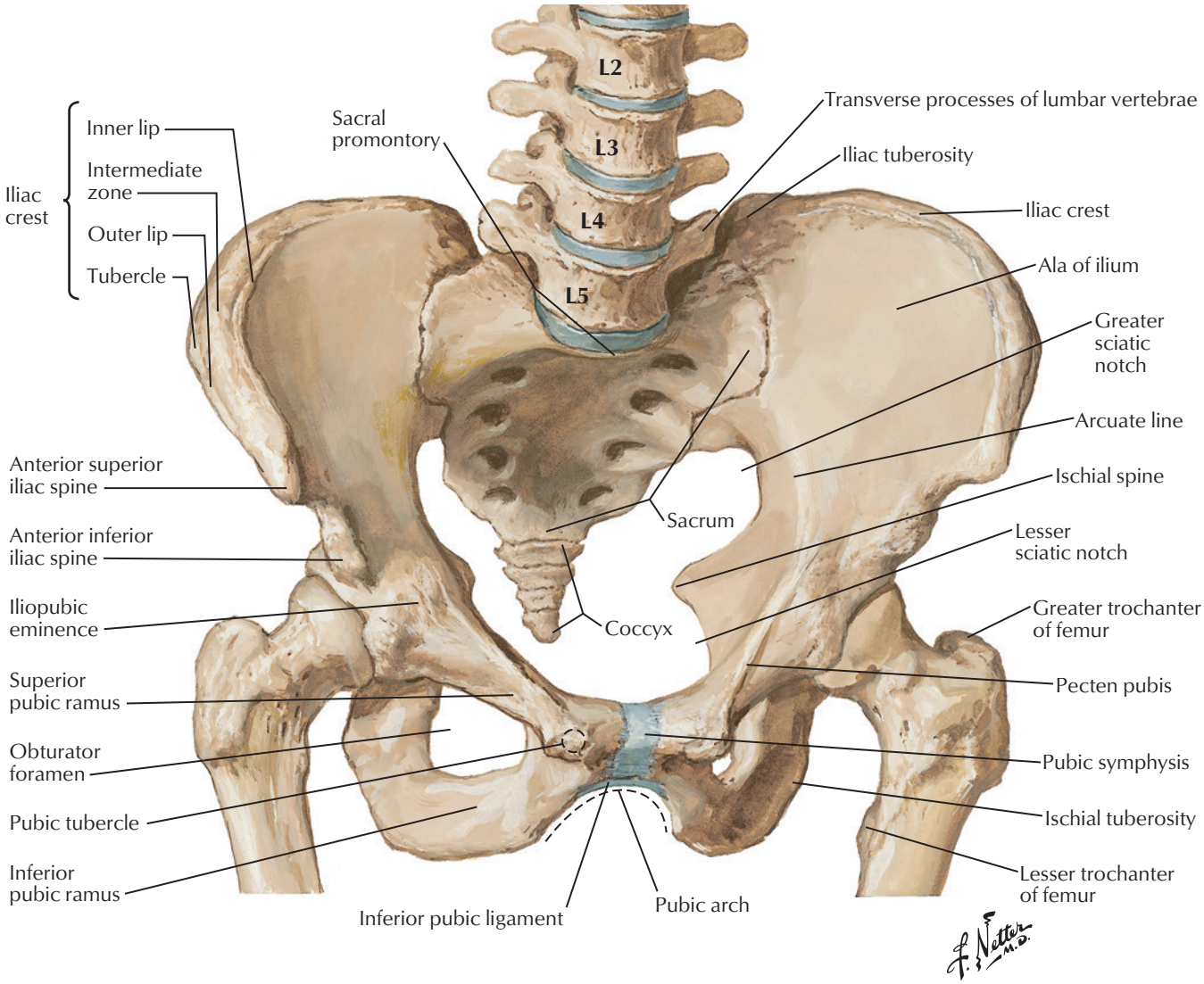
BP97 Cross Section Through Prostate



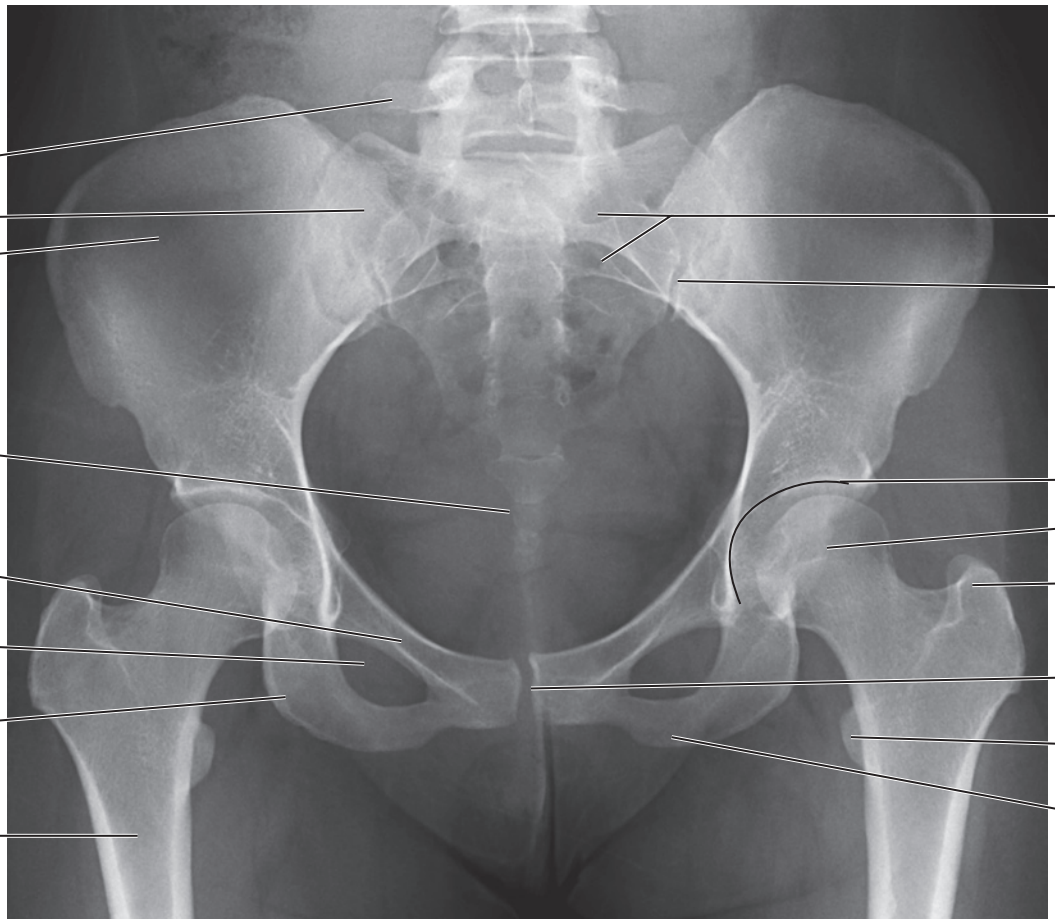
BP98 Arteries and Veins of Pelvis: Male

See also Plates 171, 252

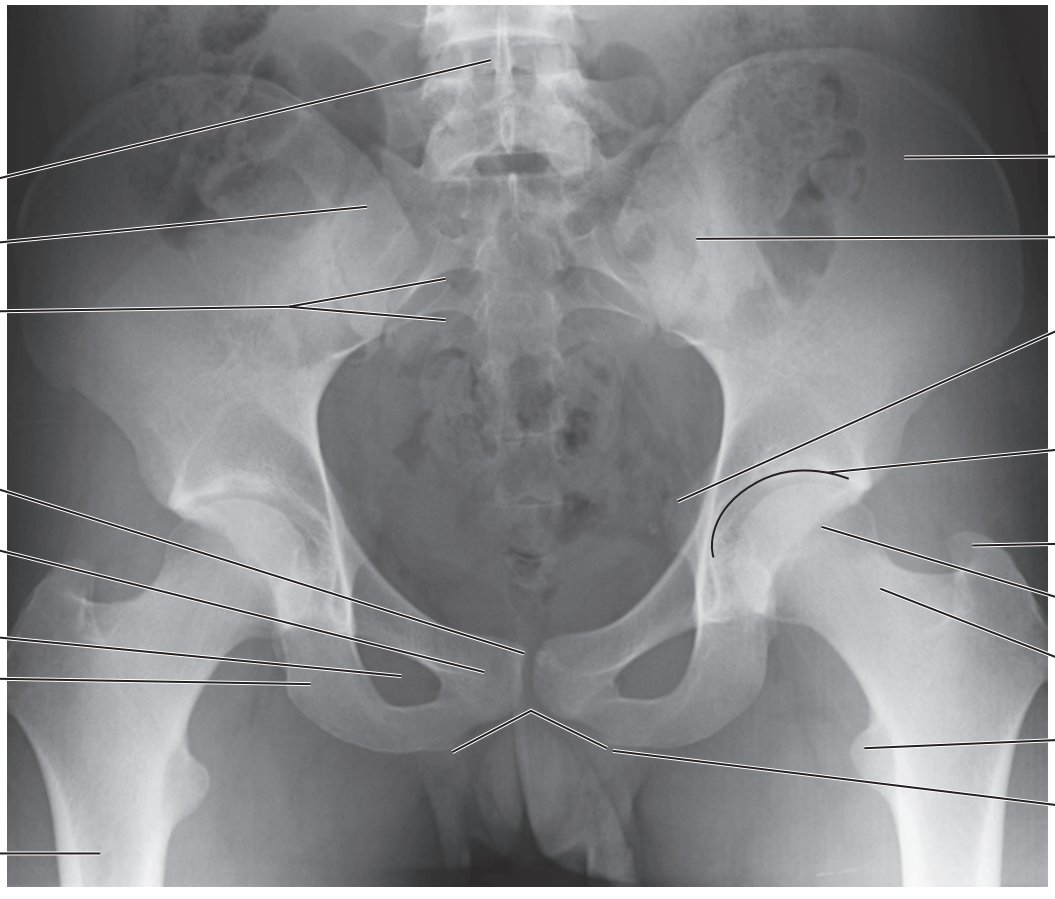



L2
L3
L4
L5
Sacral promontory
Transverse processes of lumbar vertebrae
Iliac tuberosity
Iliac crest
Ala of ilium
Greater sciatic notch
Arcuate line
Ischial spine
Lesser sciatic notch
Greater trochanter of femur
Pecten pubis
Pubic symphysis
Ischial tuberosity
Lesser trochanter of femur
Iliac crest
Inner lip
Intermediate zone
Outer lip
Tubercle
Anterior superior iliac spine
Anterior inferior iliac spine
Iliopubic eminence
Superior pubic ramus
Obturator foramen
Pubic tubercle
Inferior pubic ramus
Sacrum
Coccyx
Inferior pubic ligament
Pubic arch

Female

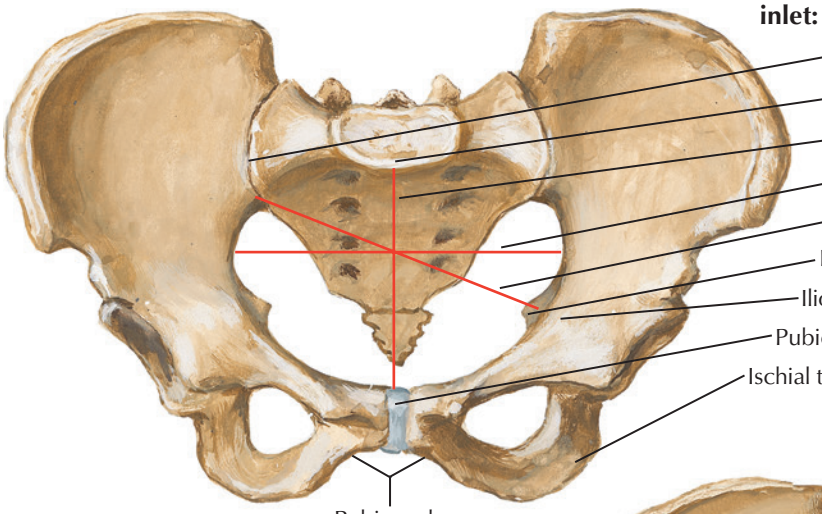

Transverse process L5
Ala of sacrum
Ilium
Coccyx
Superior pubic ramus
Obturator foramen
Ischial tuberosity
Femur
Anterior sacral foramina
Sacroiliac joint
Acetabulum
Head of femur
Greater trochanter
Pubic symphysis
Lesser trochanter
Inferior pubic ramus

Male

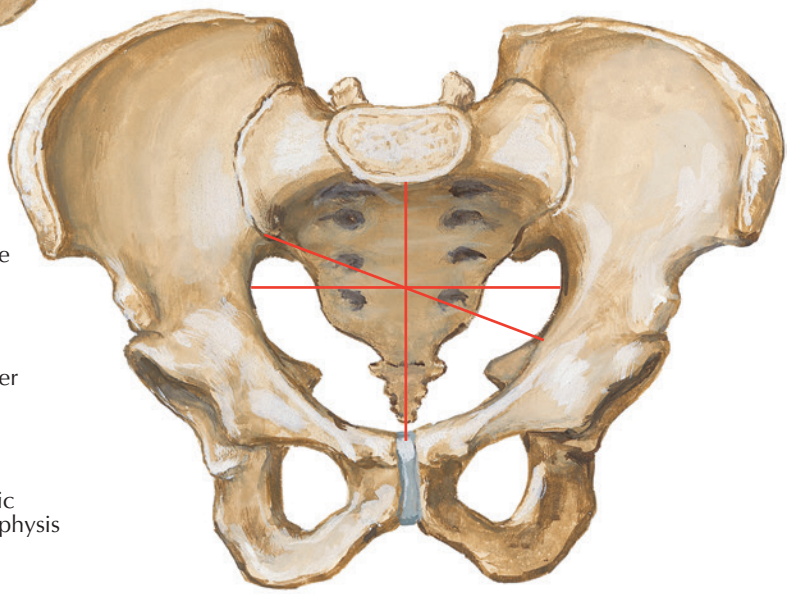

Spinous process L4
Ala of sacrum
Anterior sacral foramina
Pubic symphysis
Pubis
Obturator foramen
Ischium
Femur
Ilium
Sacroiliac joint
Ischial spine
Acetabulum
Greater trochanter
Head of femur
Neck of femur
Lesser trochanter
Subpubic angle

See also Plate 250

Female pelvis/female pelvic inlet: anterior view



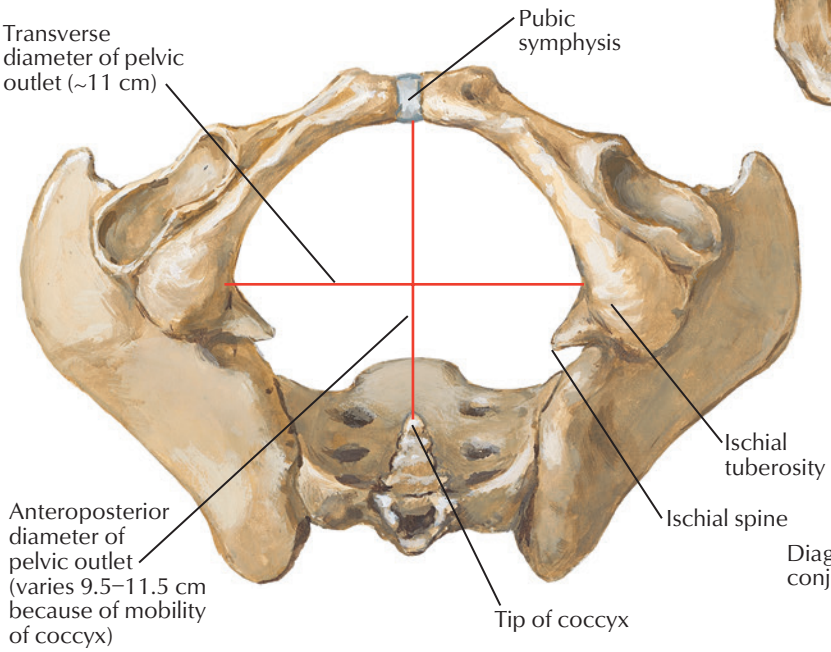
Male pelvis/male pelvic inlet: anterior view



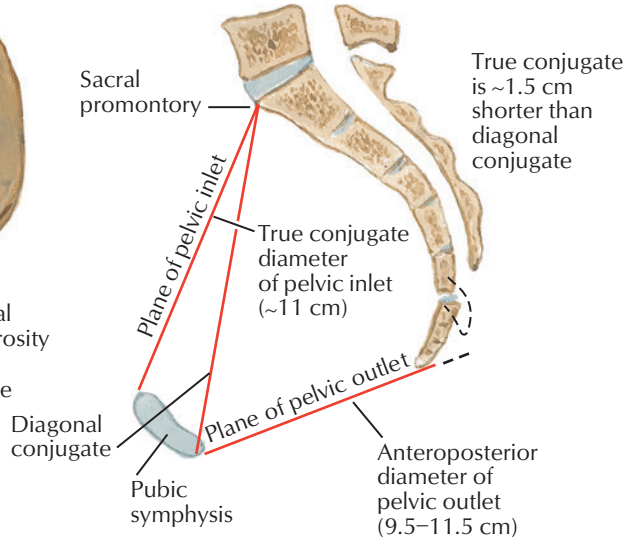
Diagonal conjugate is only diameter of pelvic inlet that can be measured clinically

- All measurements slightly shorter in relation to body size than in female
- Pelvic inlet oriented more antero-posteriorly than in female, where it tends to be transversely oval
- Pubic symphysis deeper (taller)
- Pubic arch (subpubic angle) narrower
- Ischial tuberosities less far apart
- Iliac wings less flared

Female pelvis/female pelvic outlet: inferior view

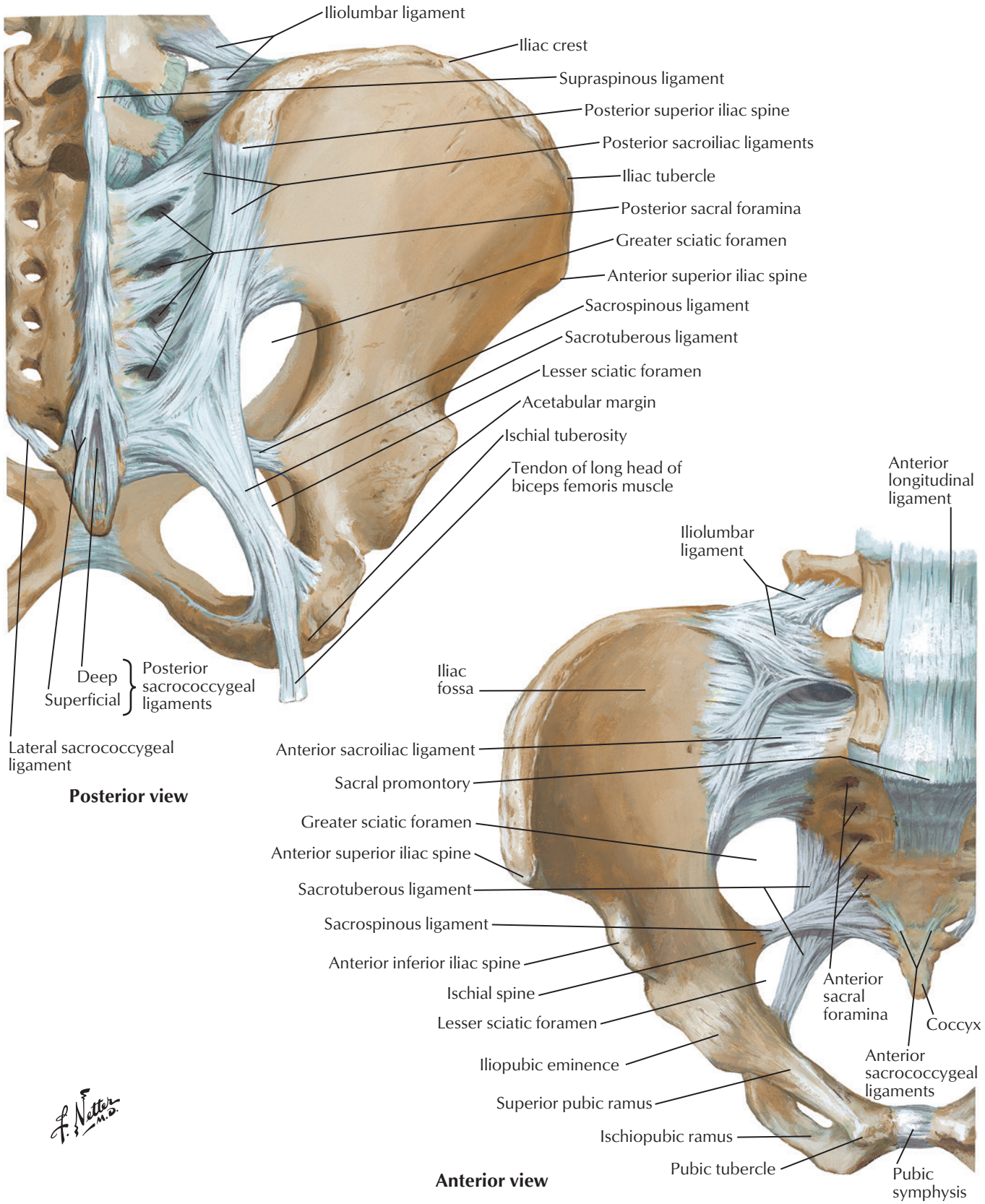


Female: sagittal section

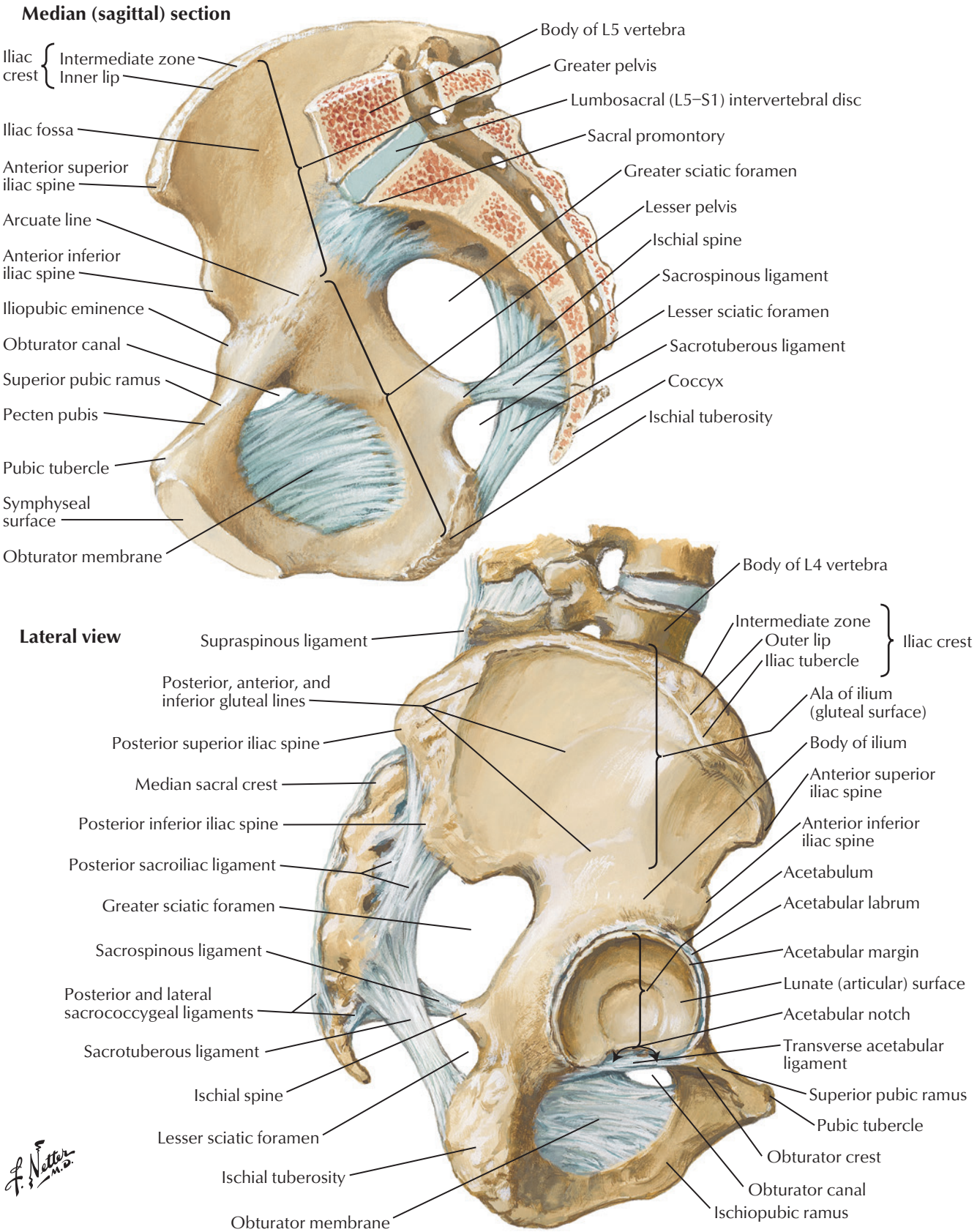


Transverse diameter is the widest distance of pelvic inlet

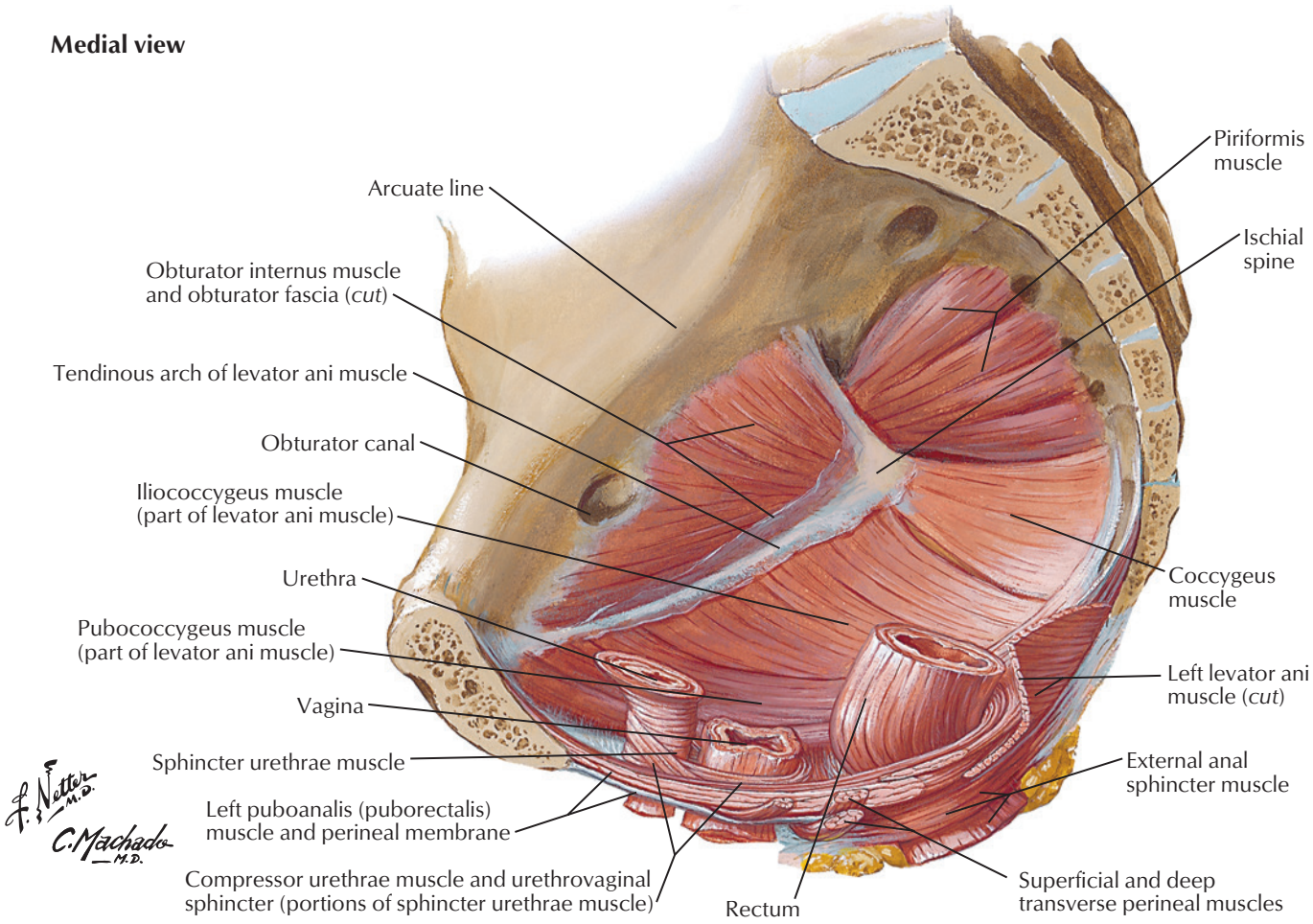
See also Plate 167



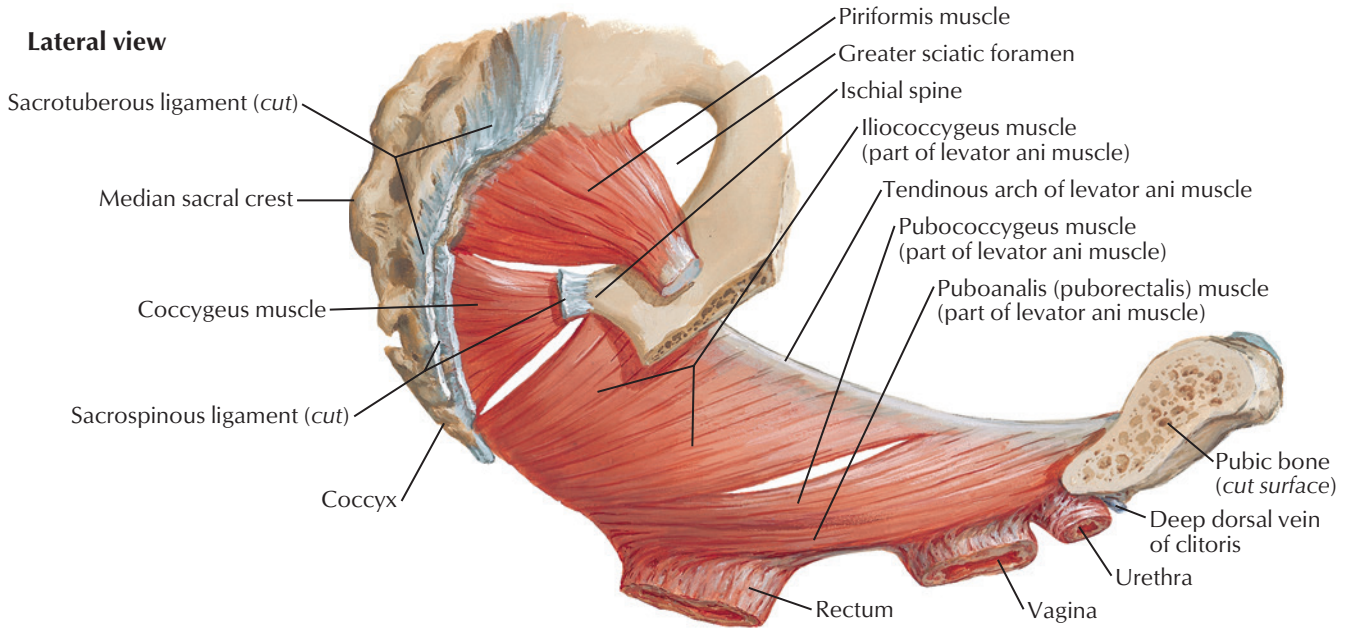
See also Plate 167



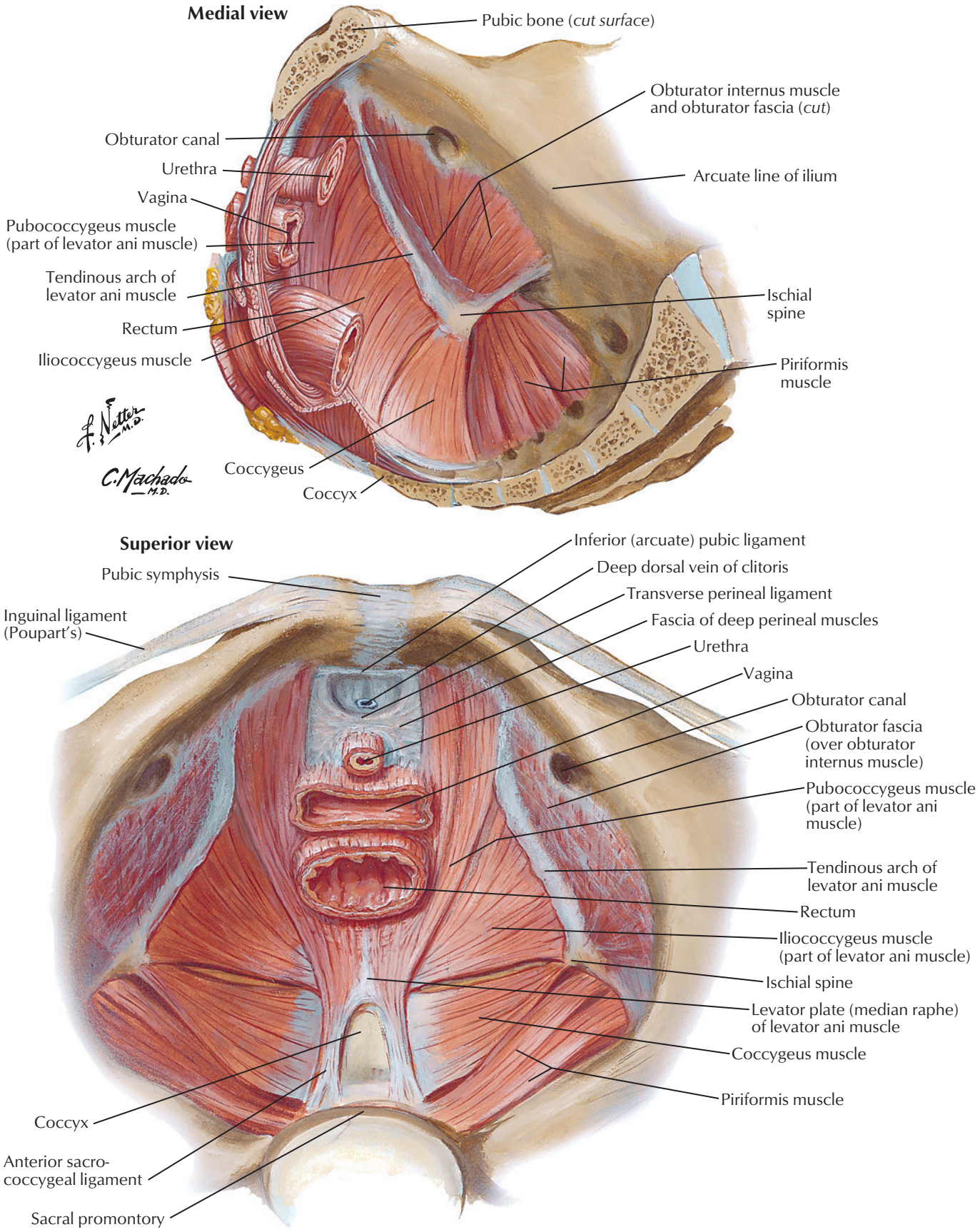
Medial view



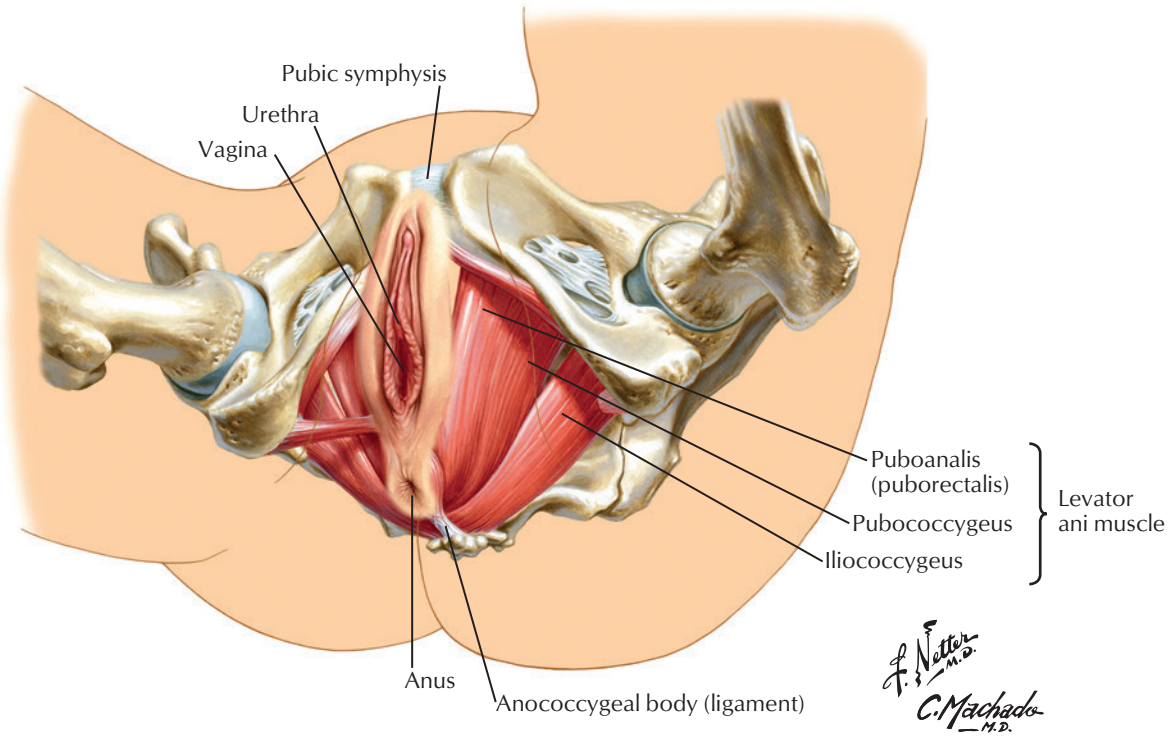
Lateral view



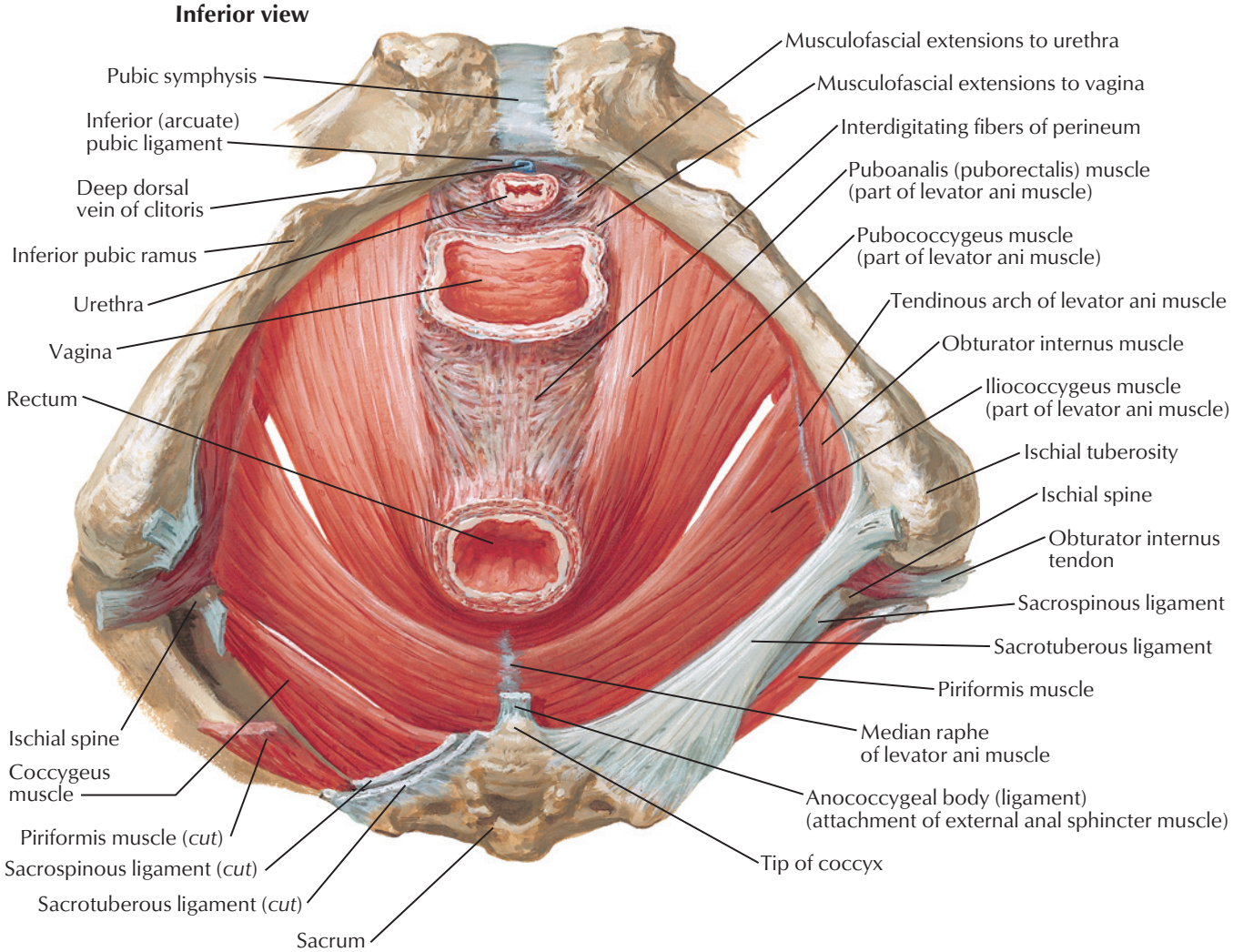
For urogenital diaphragm see Plate 360



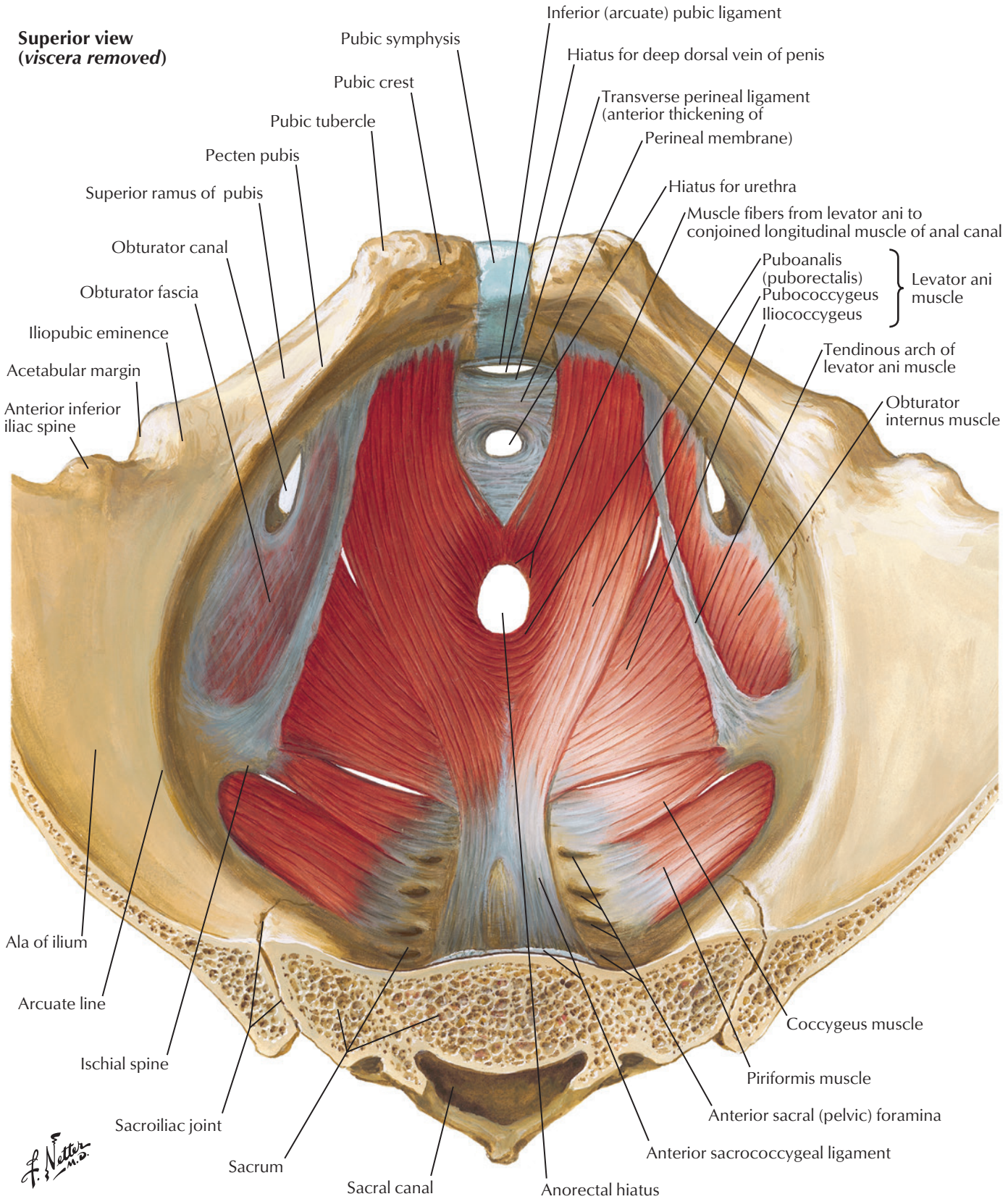
See also Plate 361



Inferior view

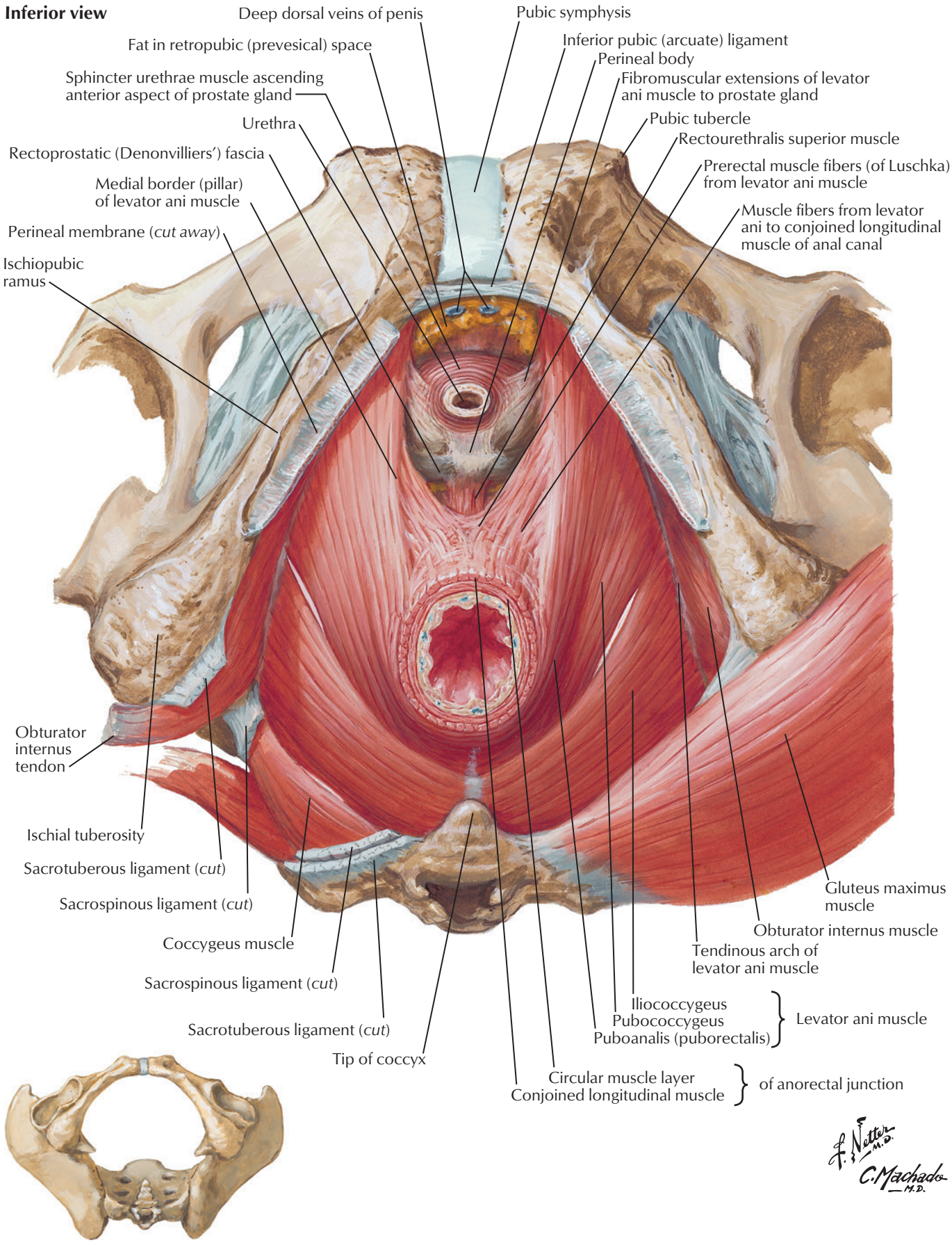


See also Plate 343

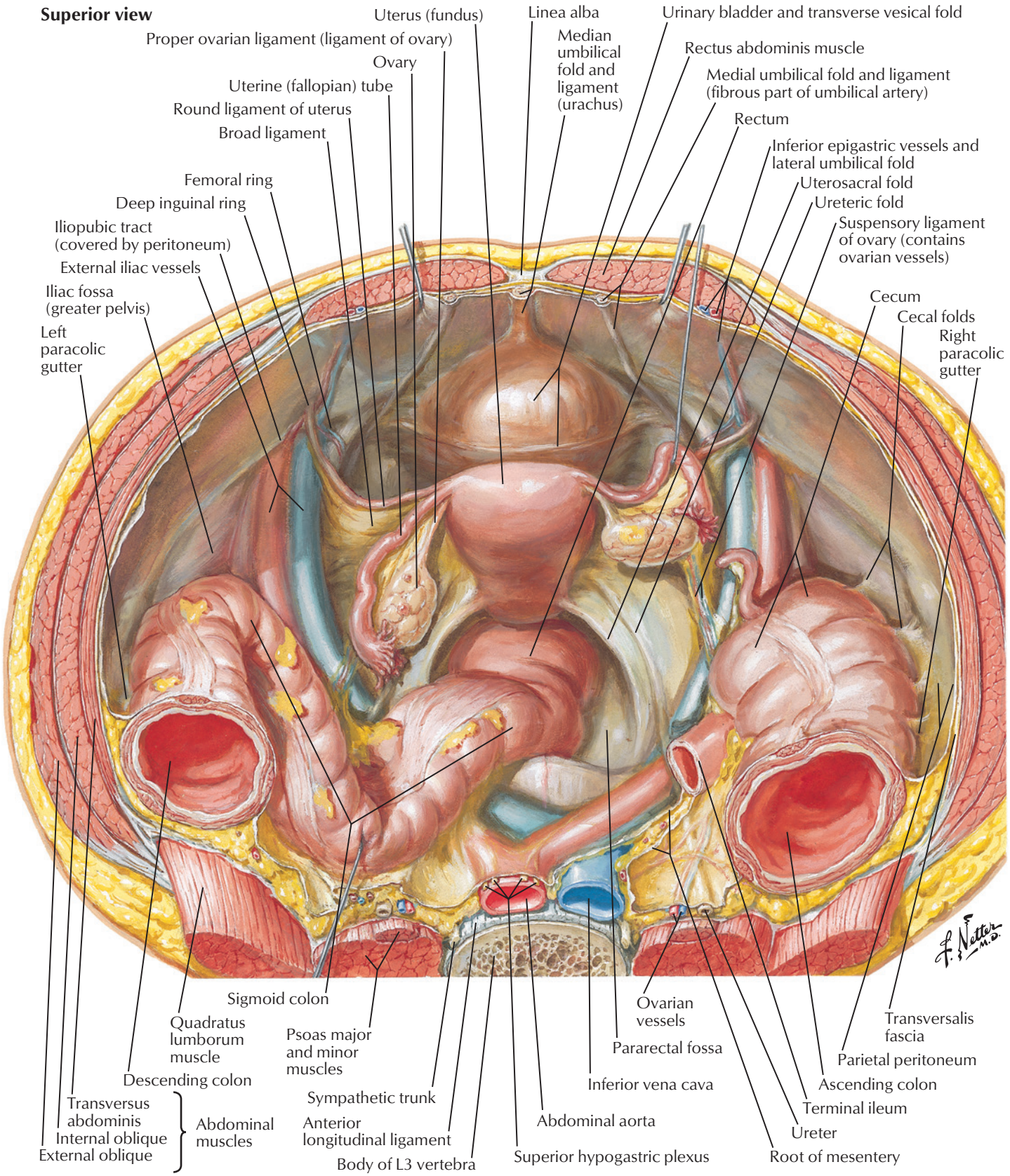


For urogenital diaphragm see Plate 365

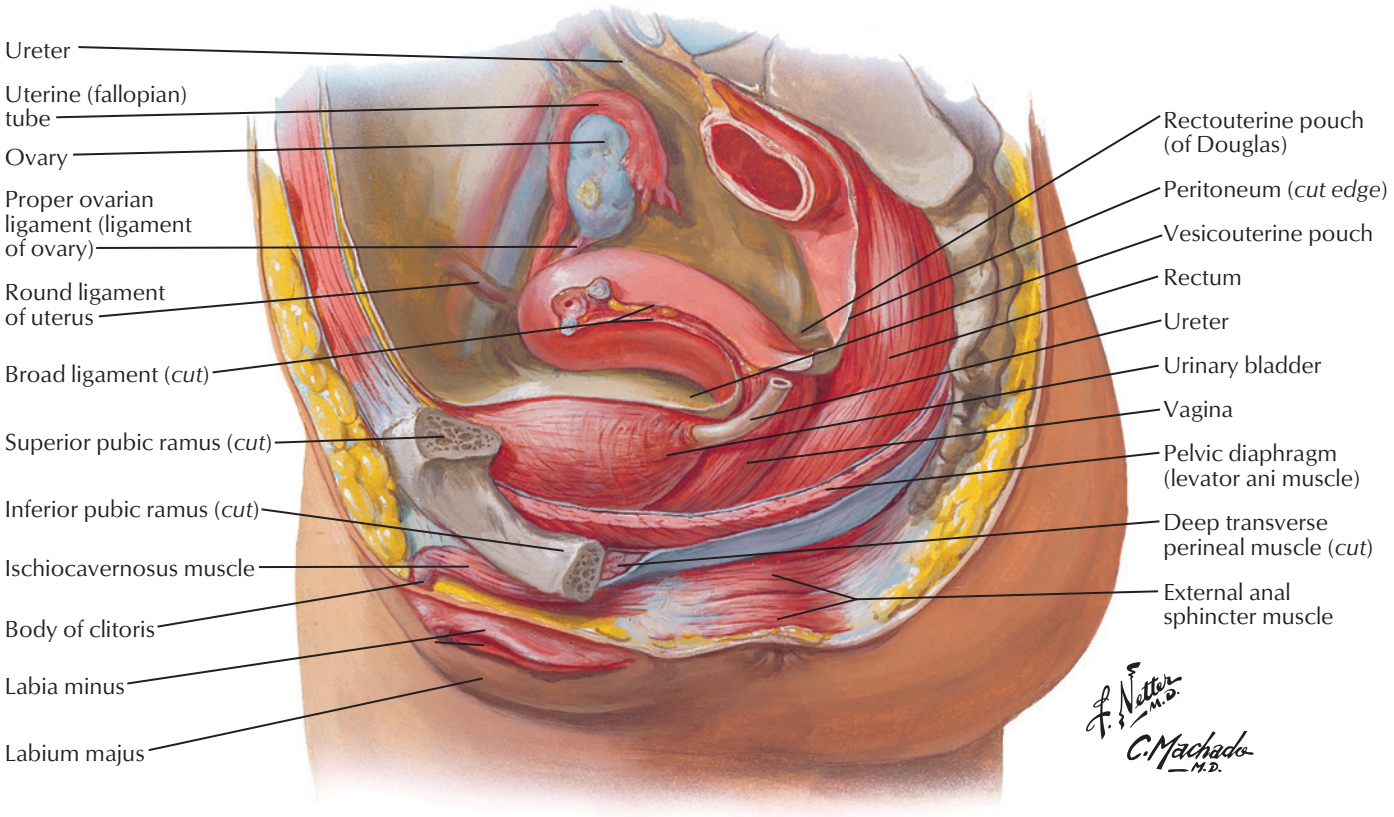
Inferior view



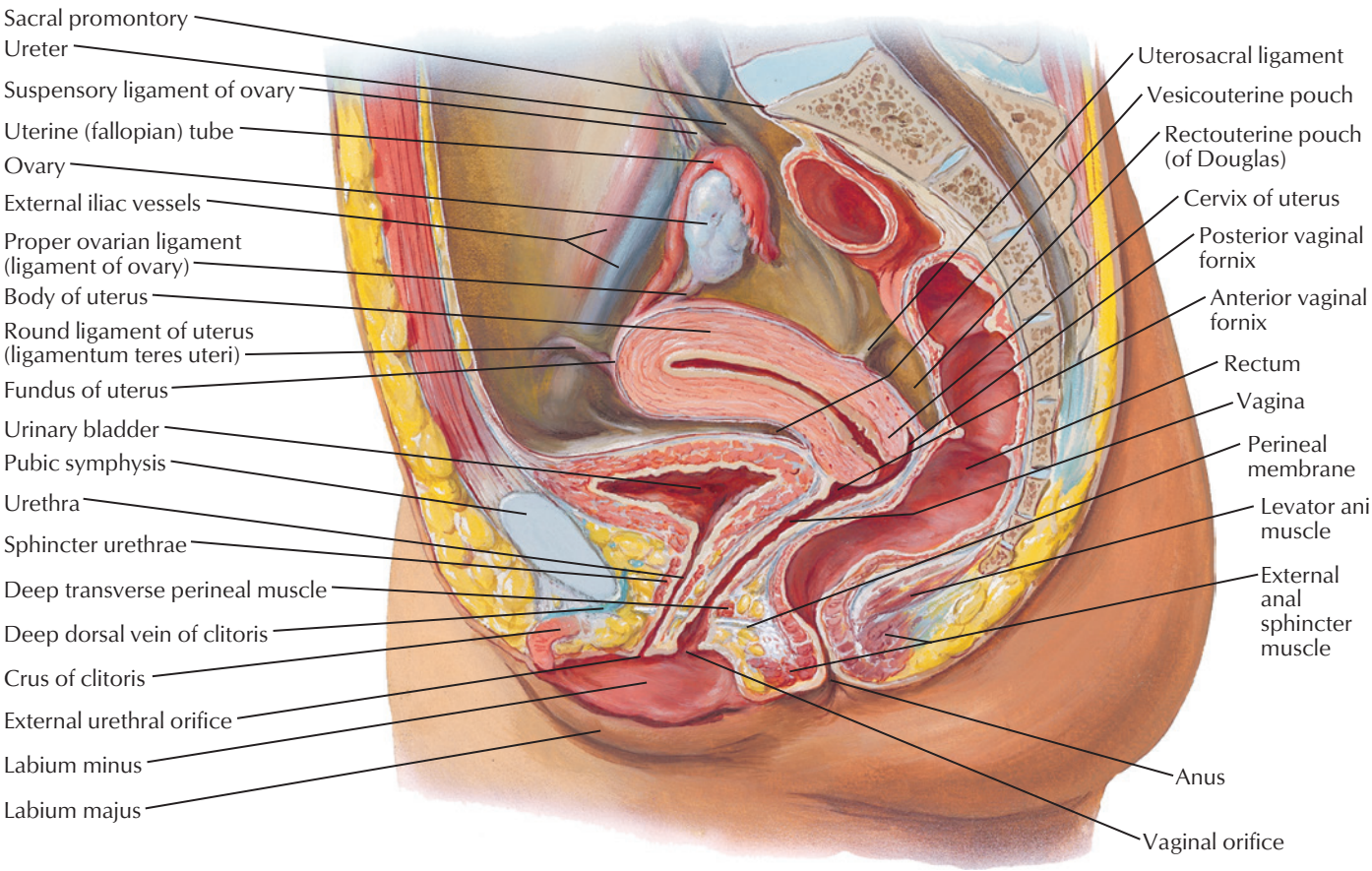
F. Netter M.D.
C. Machado M.D.


Superior view
Uterus (fundus)
Linea alba
Urinary bladder and transverse vesical fold
Proper ovarian ligament (ligament of ovary)
Median umbilical fold and ligament (urachus)
Rectus abdominis muscle
Ovary
Medial umbilical fold and ligament (fibrous part of umbilical artery)
Uterine (fallopian) tube
Rectum
Round ligament of uterus
Broad ligament
Inferior epigastric vessels and lateral umbilical fold
Femoral ring
Uterosacral fold
Deep inguinal ring
Ureteric fold
Iliopubic tract (covered by peritoneum)
Suspensory ligament of ovary (contains ovarian vessels)
External iliac vessels
Cecum
Iliac fossa (greater pelvis)
Cecal folds
Left paracolic gutter
Right paracolic gutter
Sigmoid colon
Ovarian vessels
Quadratus lumborum muscle
Transversalis fascia
Psoas major and minor muscles
Pararectal fossa
Parietal peritoneum
Descending colon
Inferior vena cava
Ascending colon
Transversus abdominis
Sympathetic trunk
Terminal ileum
Internal oblique
Abdominal muscles
Anterior longitudinal ligament
Abdominal aorta
Ureter
External oblique
Body of L3 vertebra
Superior hypogastric plexus
Root of mesentery

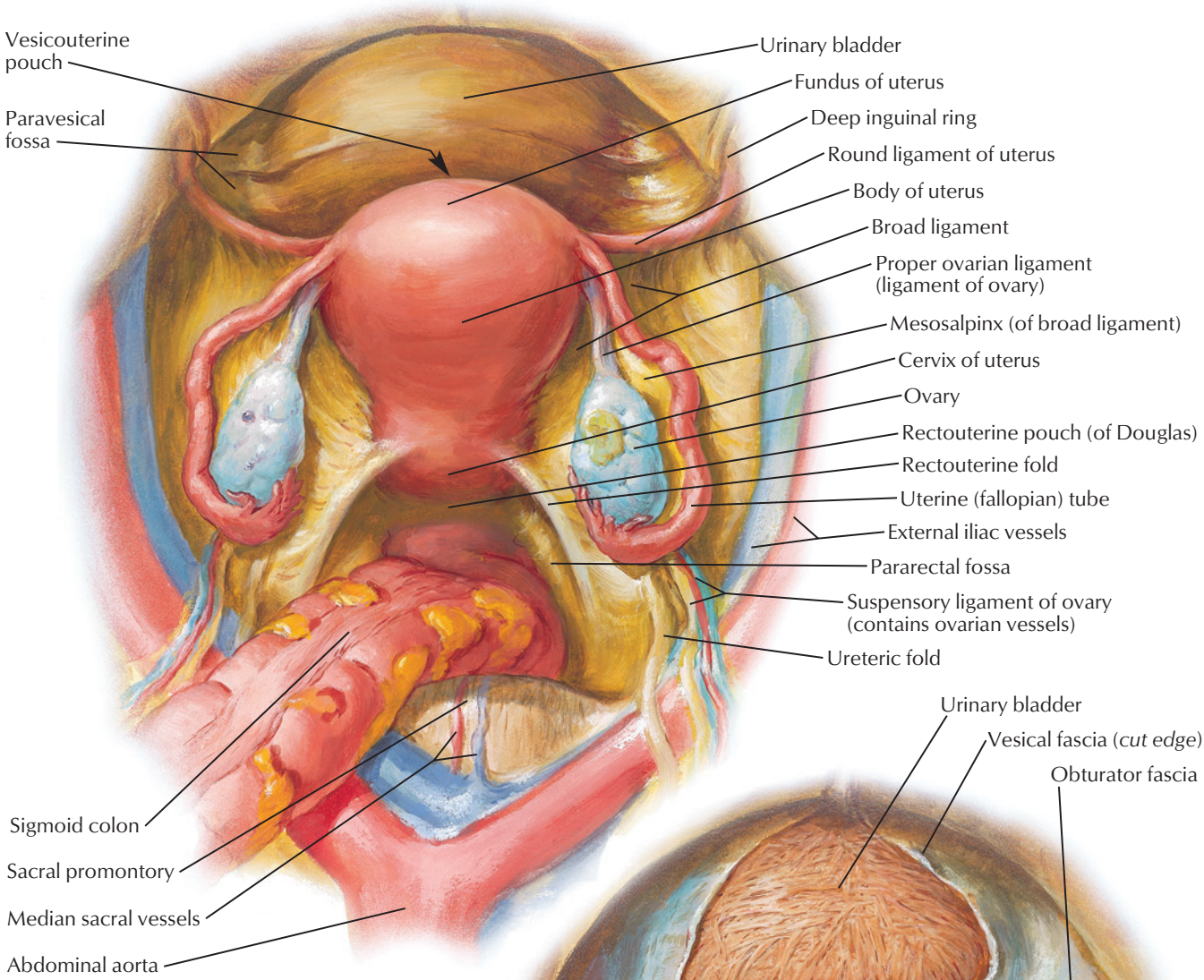
Paramedian (sagittal) dissection

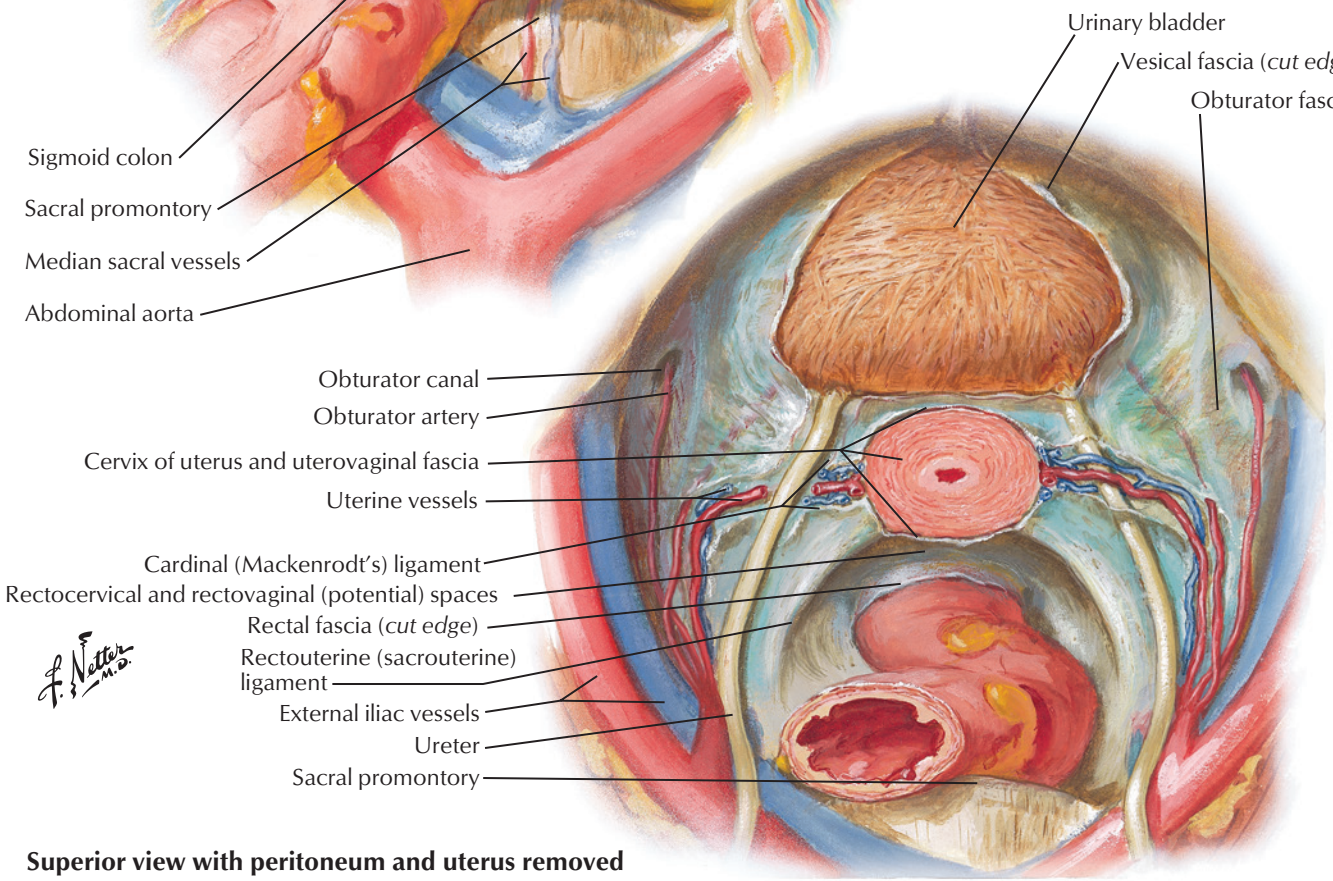


Median (sagittal) section



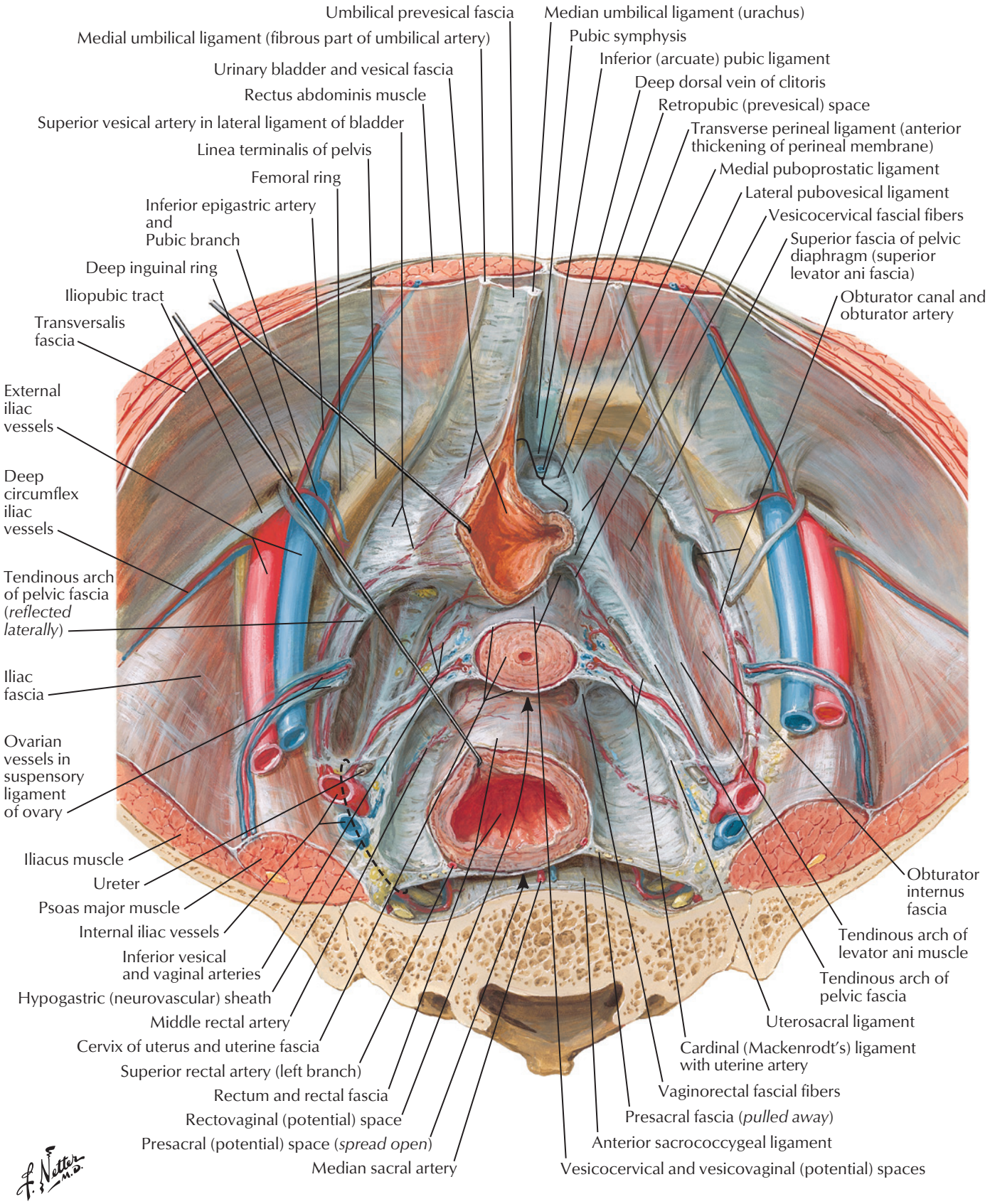
Superior view with peritoneum intact



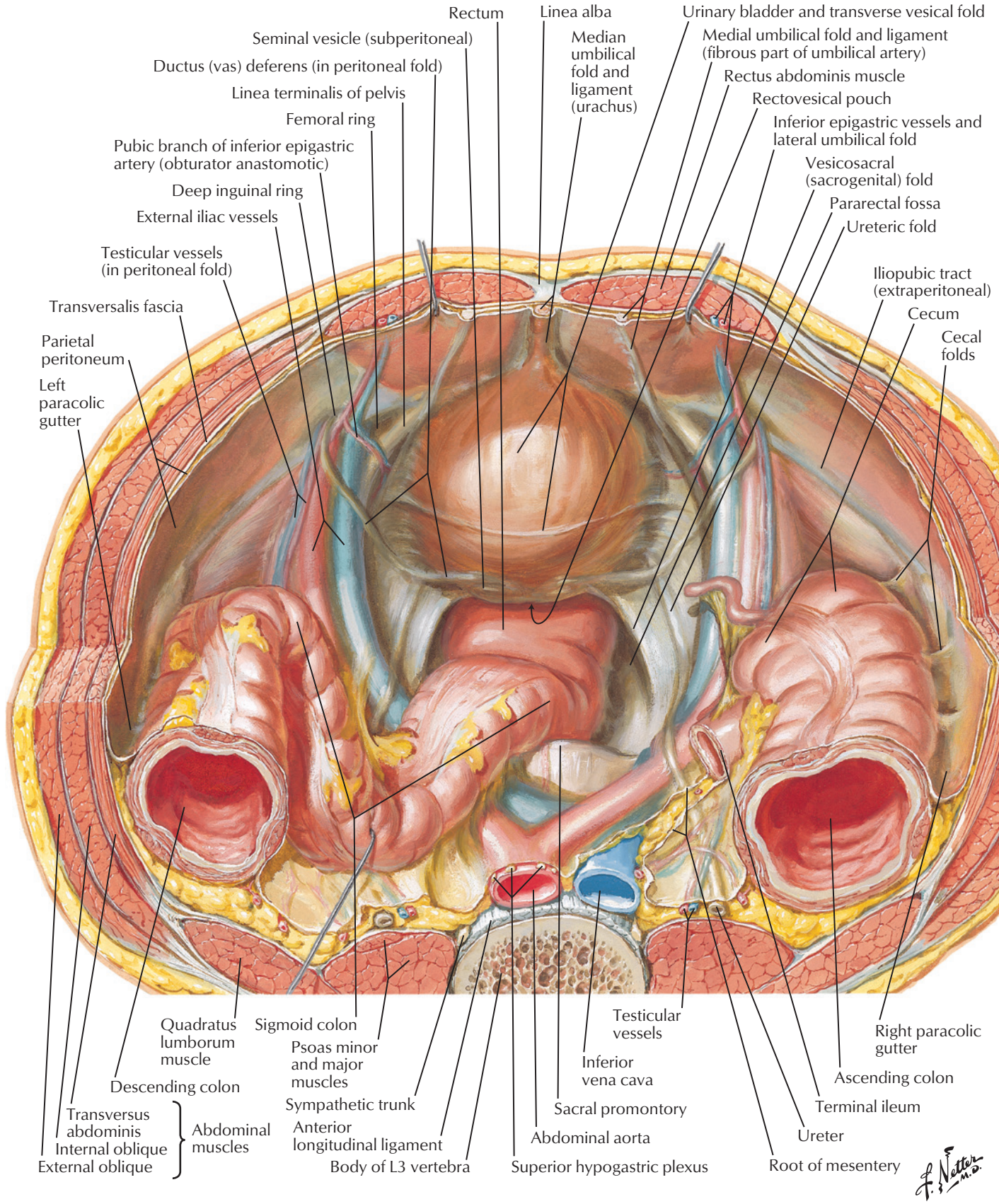


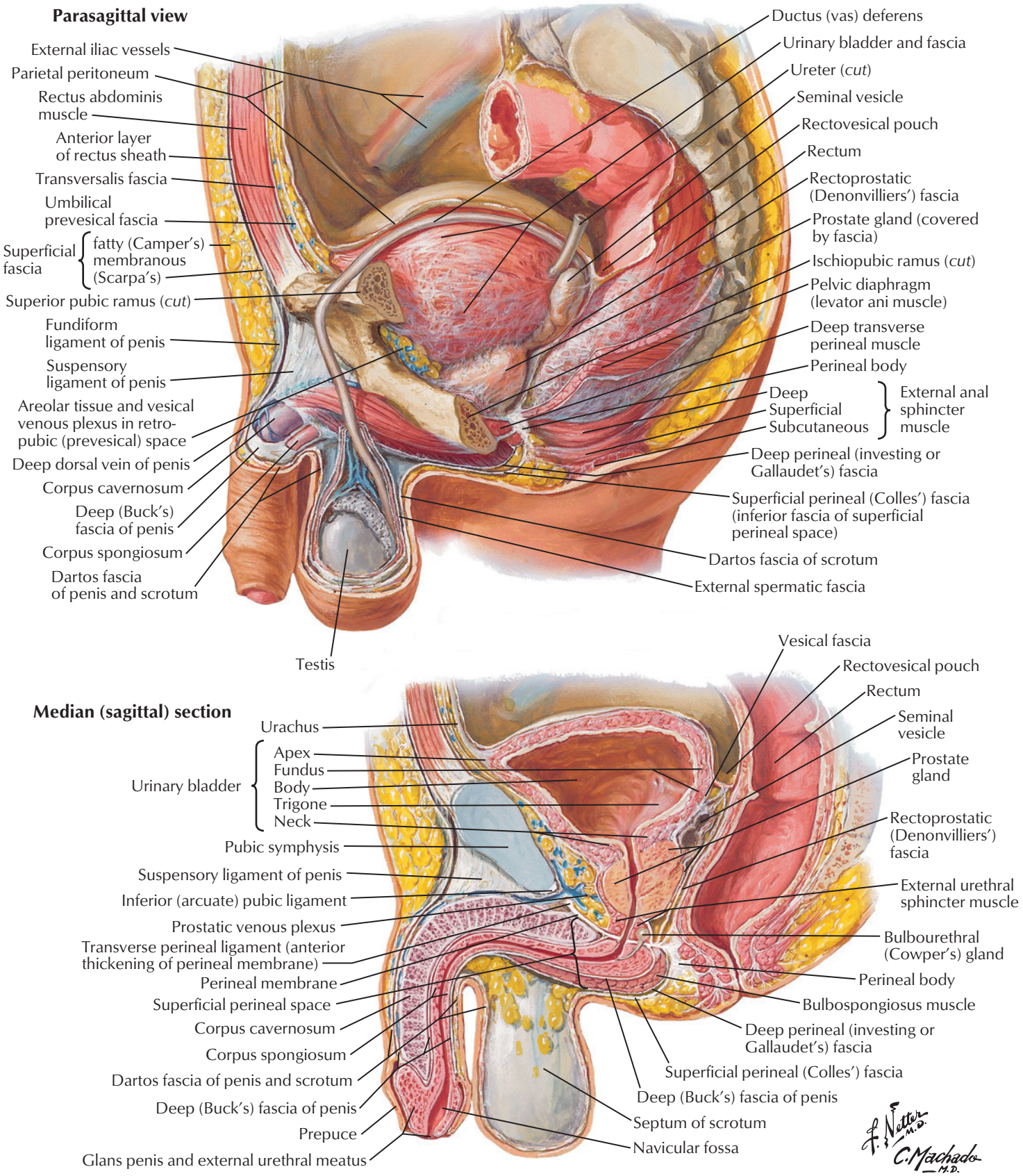
Superior view with peritoneum and uterus removed

Female: superior view (peritoneum and loose areolar tissue removed)

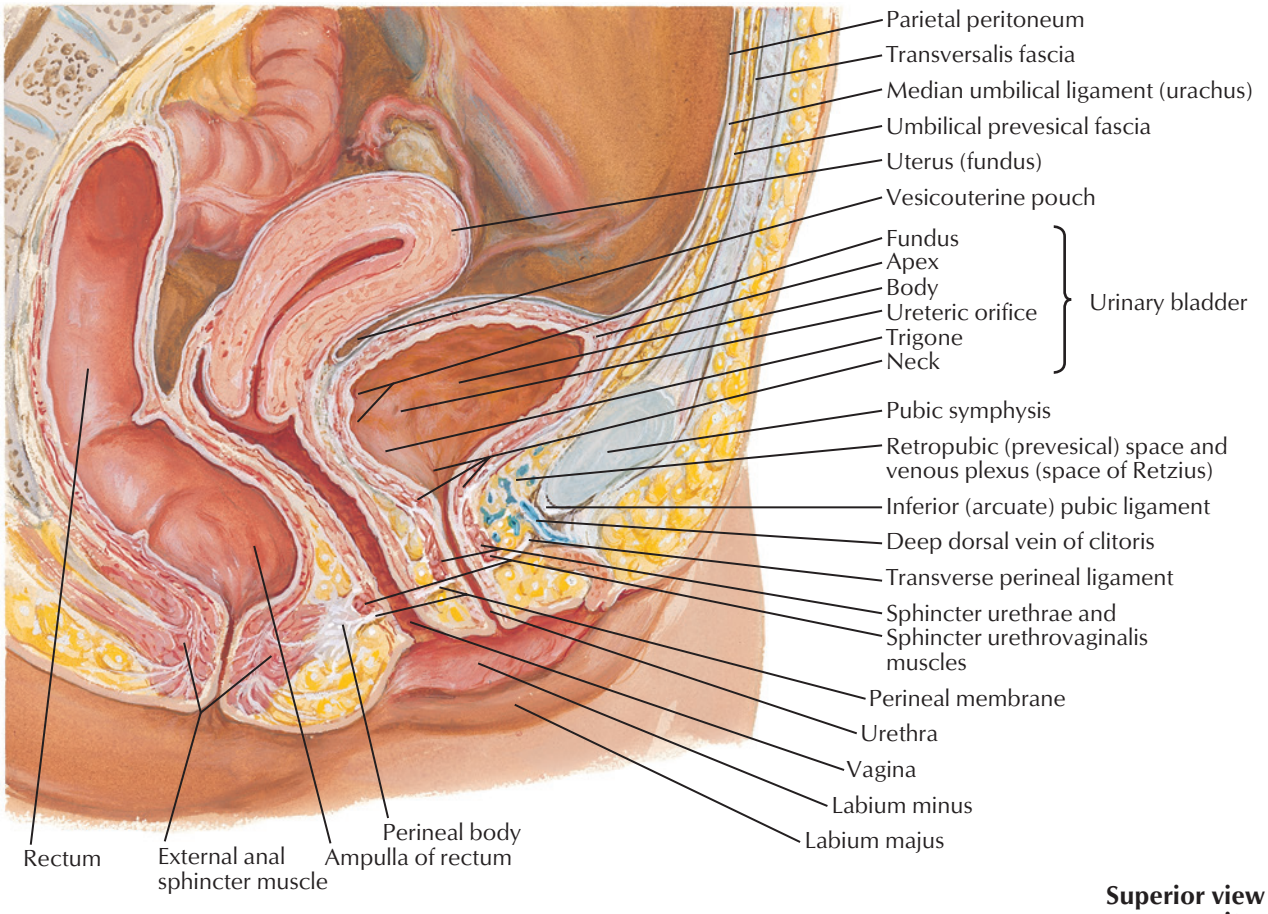


Superior view

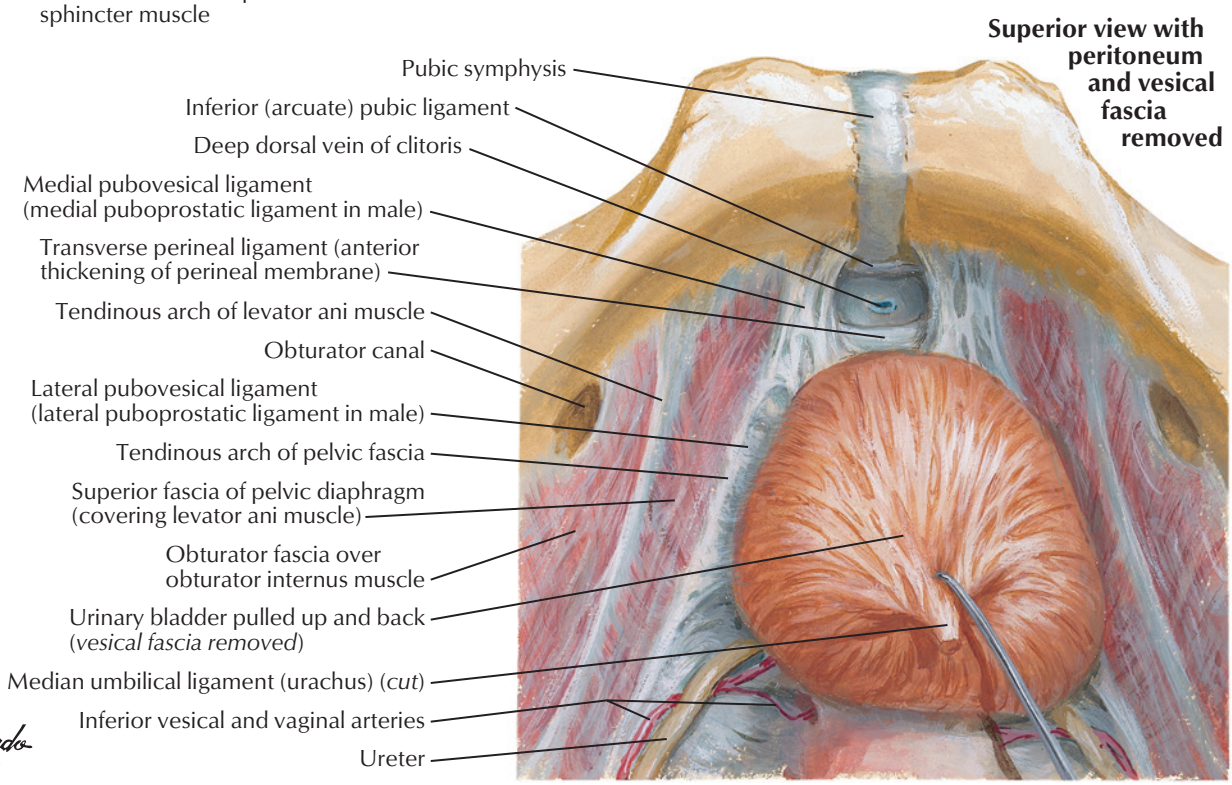



Parasagittal view
External iliac vessels
Parietal peritoneum
Rectus abdominis muscle
Anterior layer of rectus sheath
Transversalis fascia
Umbilical prevesical fascia
Superficial fascia
fatty (Camper's)
membranous (Scarpa's)
Superior pubic ramus (cut)
Fundiform ligament of penis
Suspensory ligament of penis
Areolar tissue and vesical venous plexus in retro-pubic (prevesical) space
Deep dorsal vein of penis
Corpus cavernosum
Deep (Buck's) fascia of penis
Corpus spongiosum
Dartos fascia of penis and scrotum
Testis
Ductus (vas) deferens
Urinary bladder and fascia
Ureter (cut)
Seminal vesicle
Rectovesical pouch
Rectum
Rectoprostatic (Denonvilliers') fascia
Prostate gland (covered by fascia)
Ischiopubic ramus (cut)
Pelvic diaphragm (levator ani muscle)
Deep transverse perineal muscle
Perineal body
Deep
Superficial
Subcutaneous
External anal sphincter muscle
Deep perineal (investing or Gallaudet's) fascia
Superficial perineal (Colles') fascia (inferior fascia of superficial perineal space)
Dartos fascia of scrotum
External spermatic fascia
Median (sagittal) section
Urachus
Urinary bladder
Apex
Fundus
Body
Trigone
Neck
Pubic symphysis
Suspensory ligament of penis
Inferior (arcuate) pubic ligament
Prostatic venous plexus
Transverse perineal ligament (anterior thickening of perineal membrane)
Perineal membrane
Superficial perineal space
Corpus cavernosum
Corpus spongiosum
Dartos fascia of penis and scrotum
Deep (Buck's) fascia of penis
Prepuce
Glans penis and external urethral meatus
Vesical fascia
Rectovesical pouch
Rectum
Seminal vesicle
Prostate gland
Rectoprostatic (Denonvilliers') fascia
External urethral sphincter muscle
Bulbourethral (Cowper's) gland
Perineal body
Bulbospongiosus muscle
Deep perineal (investing or Gallaudet's) fascia
Superficial perineal (Colles') fascia
Deep (Buck's) fascia of penis
Septum of scrotum
Navicular fossa
F. Netter M.D.
C. Machado M.D.

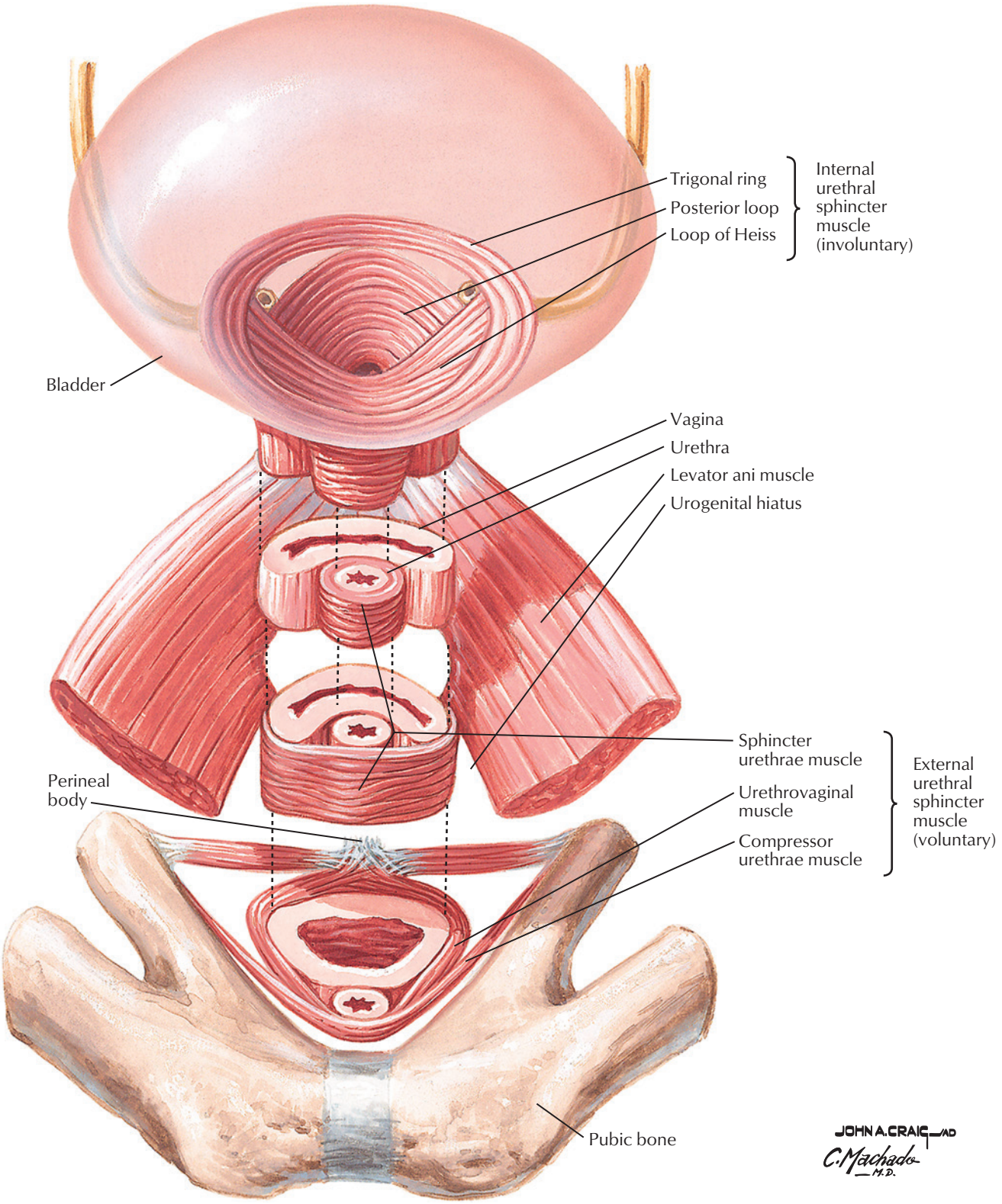
Female: midsagittal section



Superior view with peritoneum and vesical fascia removed

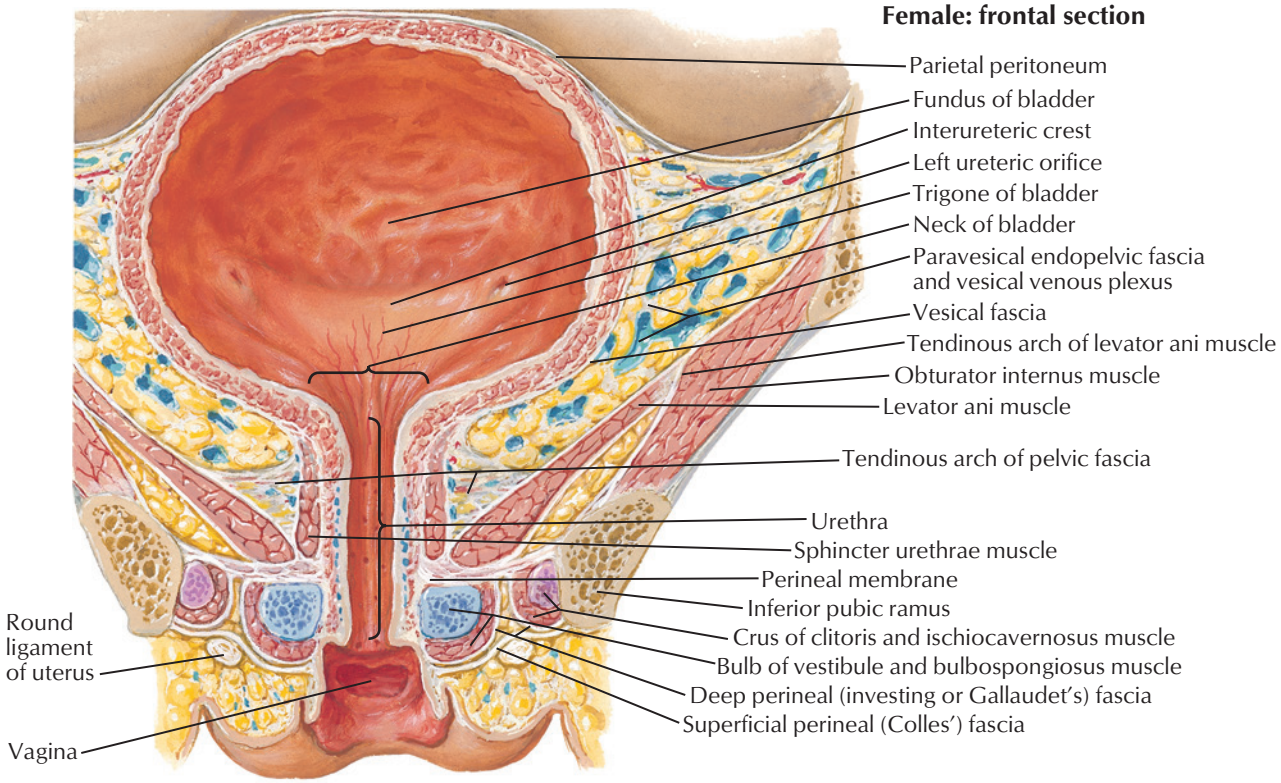


See also Plates 352, 360

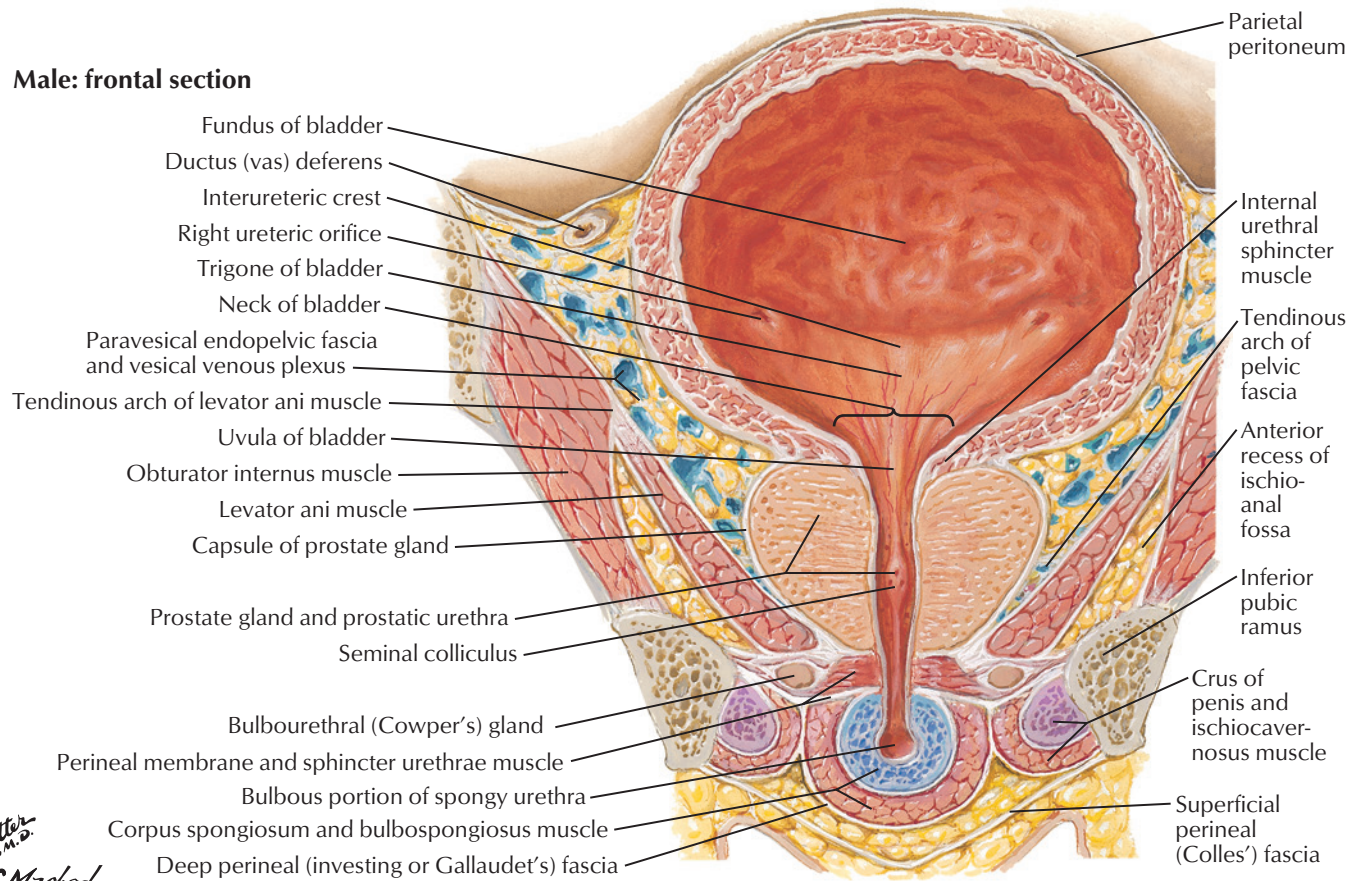


See also Plates 345, 349, 385

Female: frontal section

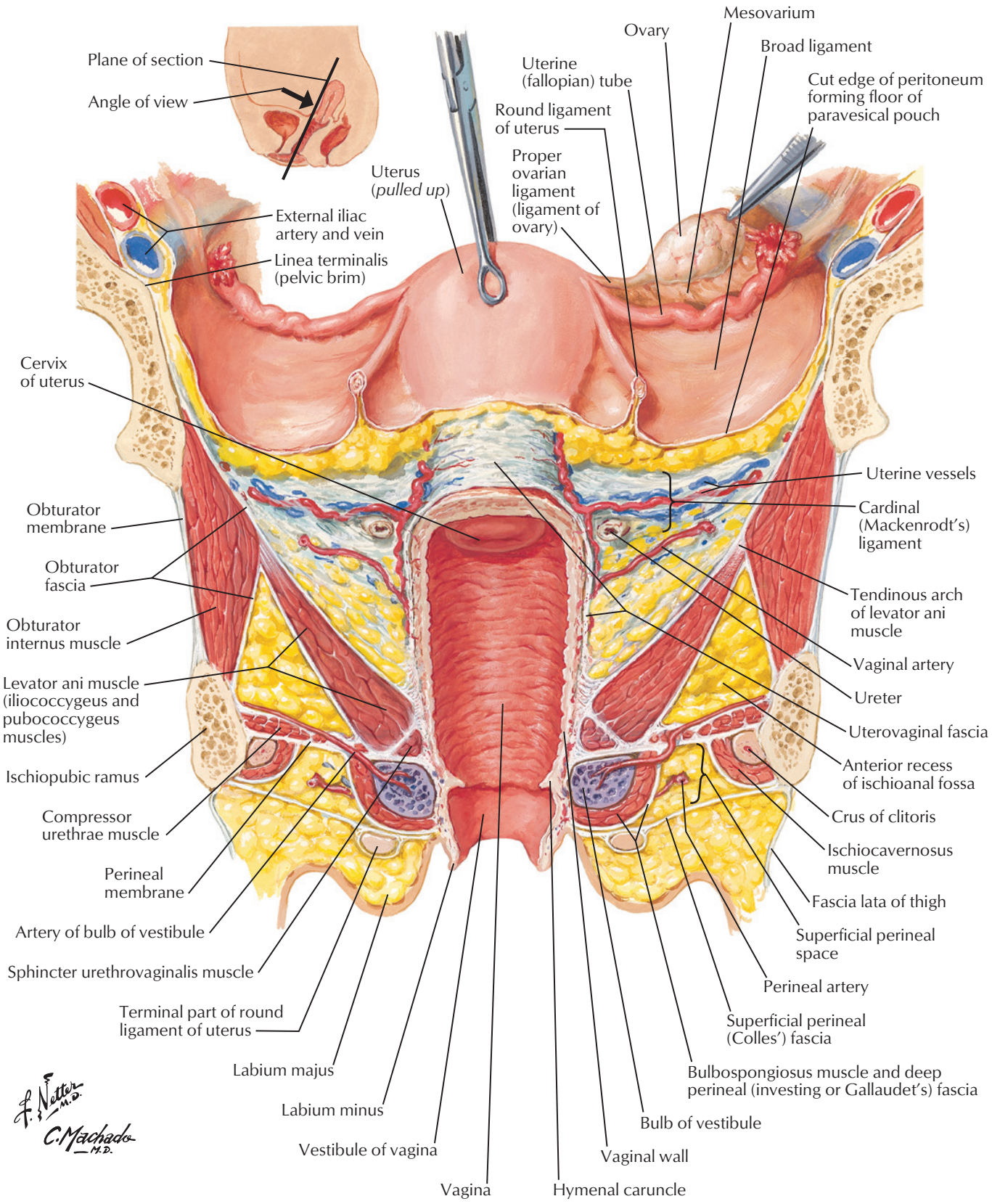


Male: frontal section



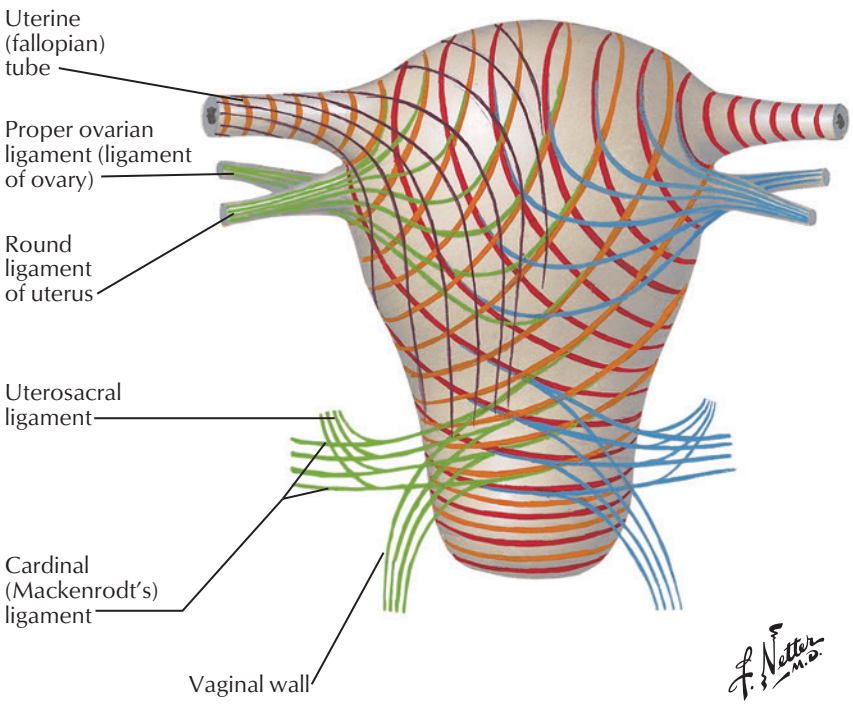
F. Netter M.D. C. Machado M.D.

See also Plates 386, 388, 394

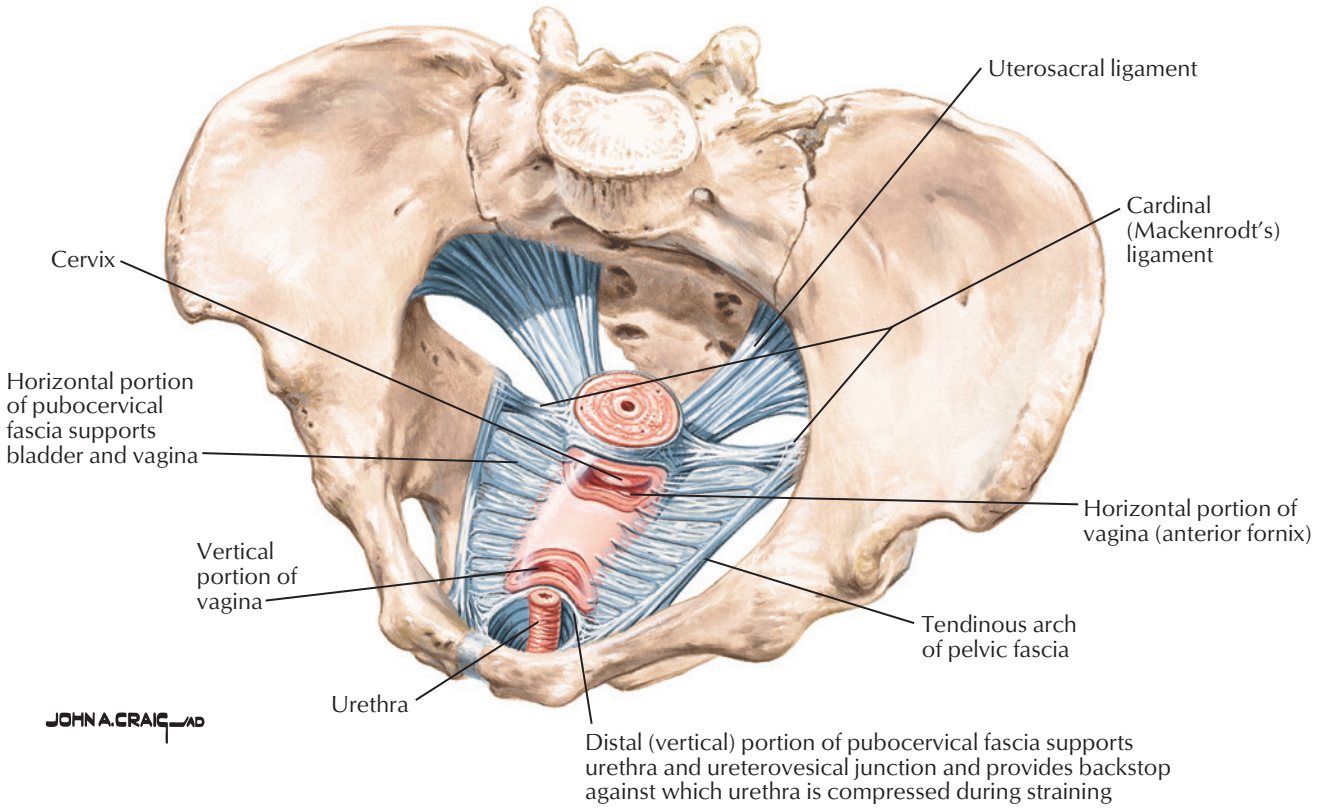


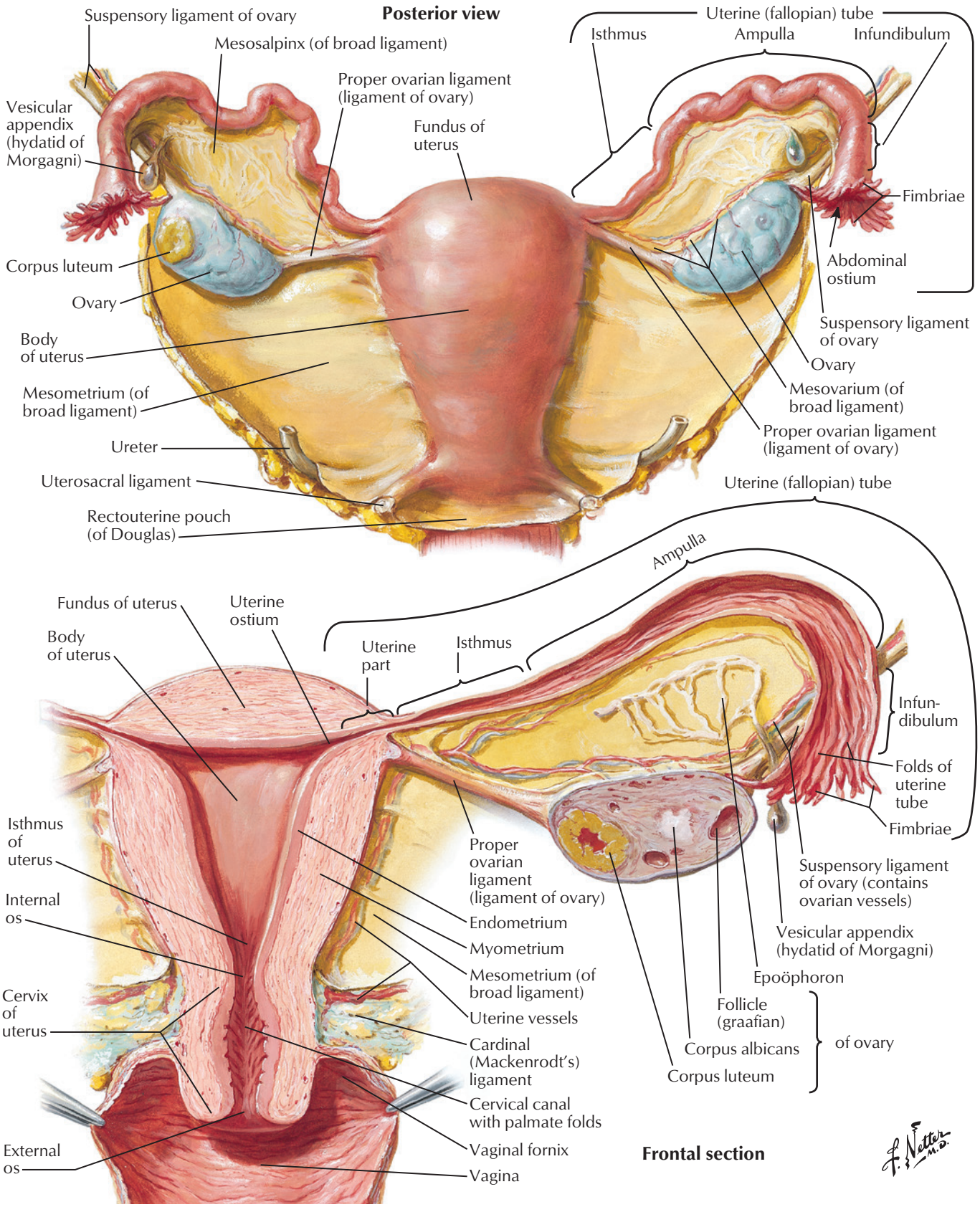
See also Plate 347

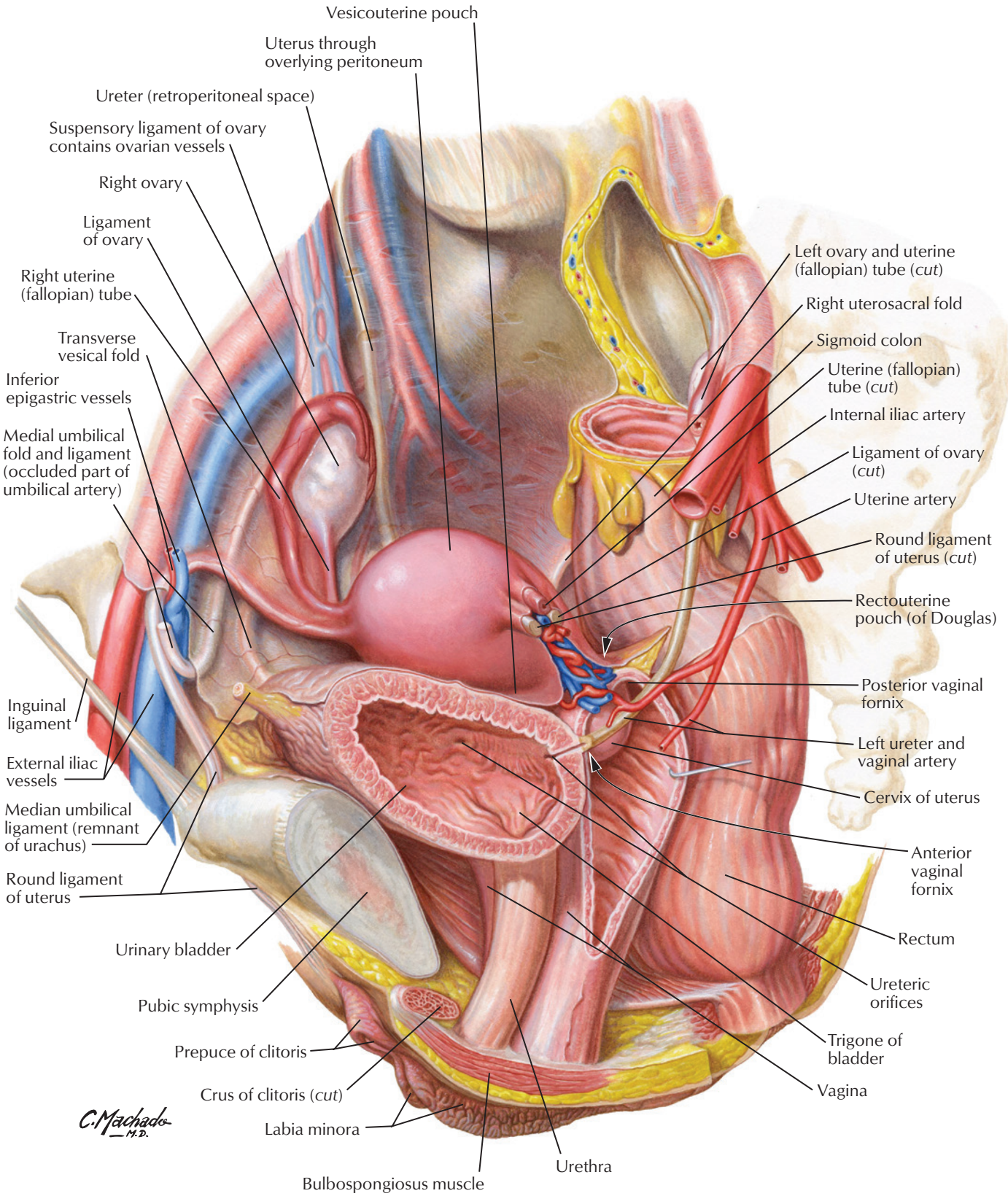
Fascial ligaments of uterus

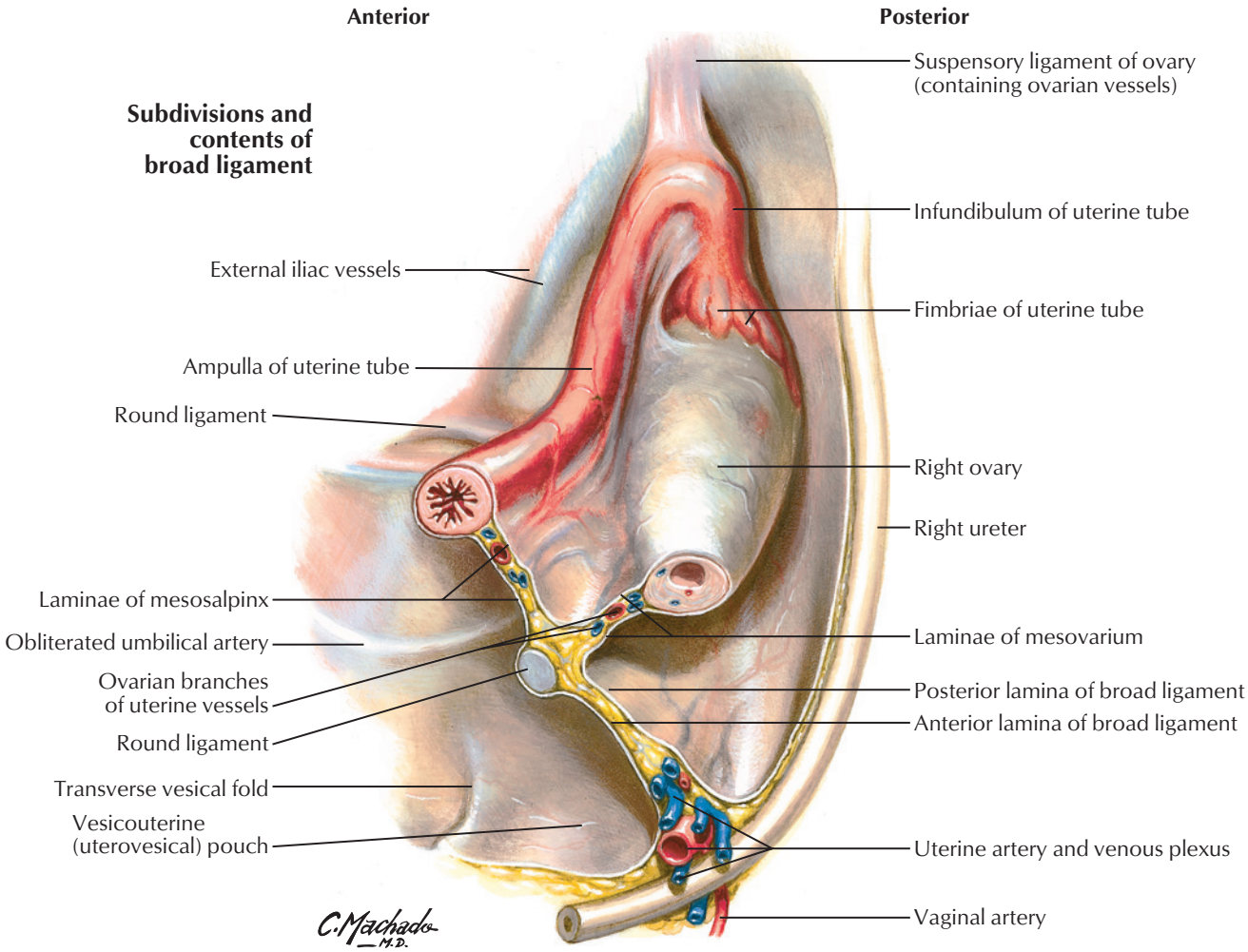


Pelvic fascia and ligaments

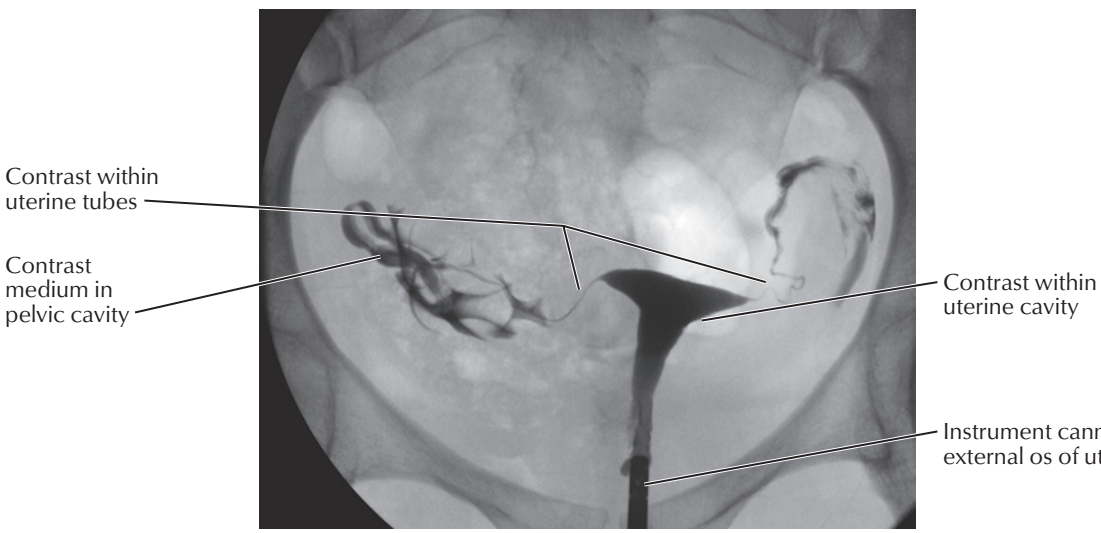



Posterior view
Suspensory ligament of ovary
Mesosalpinx (of broad ligament)
Proper ovarian ligament (ligament of ovary)
Fundus of uterus
Vesicular appendix (hydatid of Morgagni)
Corpus luteum
Ovary
Body of uterus
Mesometrium (of broad ligament)
Ureter
Uterosacral ligament
Rectouterine pouch (of Douglas)
Uterine (fallopian) tube
Isthmus
Ampulla
Infundibulum
Fimbriae
Abdominal ostium
Suspensory ligament of ovary
Ovary
Mesovarium (of broad ligament)
Proper ovarian ligament (ligament of ovary)
Uterine (fallopian) tube
Ampulla
Fundus of uterus
Uterine ostium
Body of uterus
Uterine part
Isthmus
Infun-dibulum
Folds of uterine tube
Fimbriae
Isthmus of uterus
Internal os
Cervix of uterus
External os
Proper ovarian ligament (ligament of ovary)
Endometrium
Myometrium
Mesometrium (of broad ligament)
Uterine vessels
Cardinal (Mackenrodt's) ligament
Cervical canal with palmate folds
Vaginal fornix
Vagina
Suspensory ligament of ovary (contains ovarian vessels)
Vesicular appendix (hydatid of Morgagni)
Epoöphoron
Follicle (graafian)
Corpus albicans
Corpus luteum
of ovary
Frontal section


Vesicouterine pouch
Uterus through overlying peritoneum
Ureter (retroperitoneal space)
Suspensory ligament of ovary contains ovarian vessels
Right ovary
Ligament of ovary
Right uterine (fallopian) tube
Transverse vesical fold
Inferior epigastric vessels
Medial umbilical fold and ligament (occluded part of umbilical artery)
Inguinal ligament
External iliac vessels
Median umbilical ligament (remnant of urachus)
Round ligament of uterus
Urinary bladder
Pubic symphysis
Prepuce of clitoris
Crus of clitoris (cut)
Labia minora
Bulbospongiosus muscle
Urethra
Vagina
Trigone of bladder
Ureteric orifices
Rectum
Anterior vaginal fornix
Cervix of uterus
Left ureter and vaginal artery
Posterior vaginal fornix
Rectouterine pouch (of Douglas)
Round ligament of uterus (cut)
Uterine artery
Ligament of ovary (cut)
Internal iliac artery
Uterine (fallopian) tube (cut)
Sigmoid colon
Right uterosacral fold
Left ovary and uterine (fallopian) tube (cut)
C. Machado M.D.

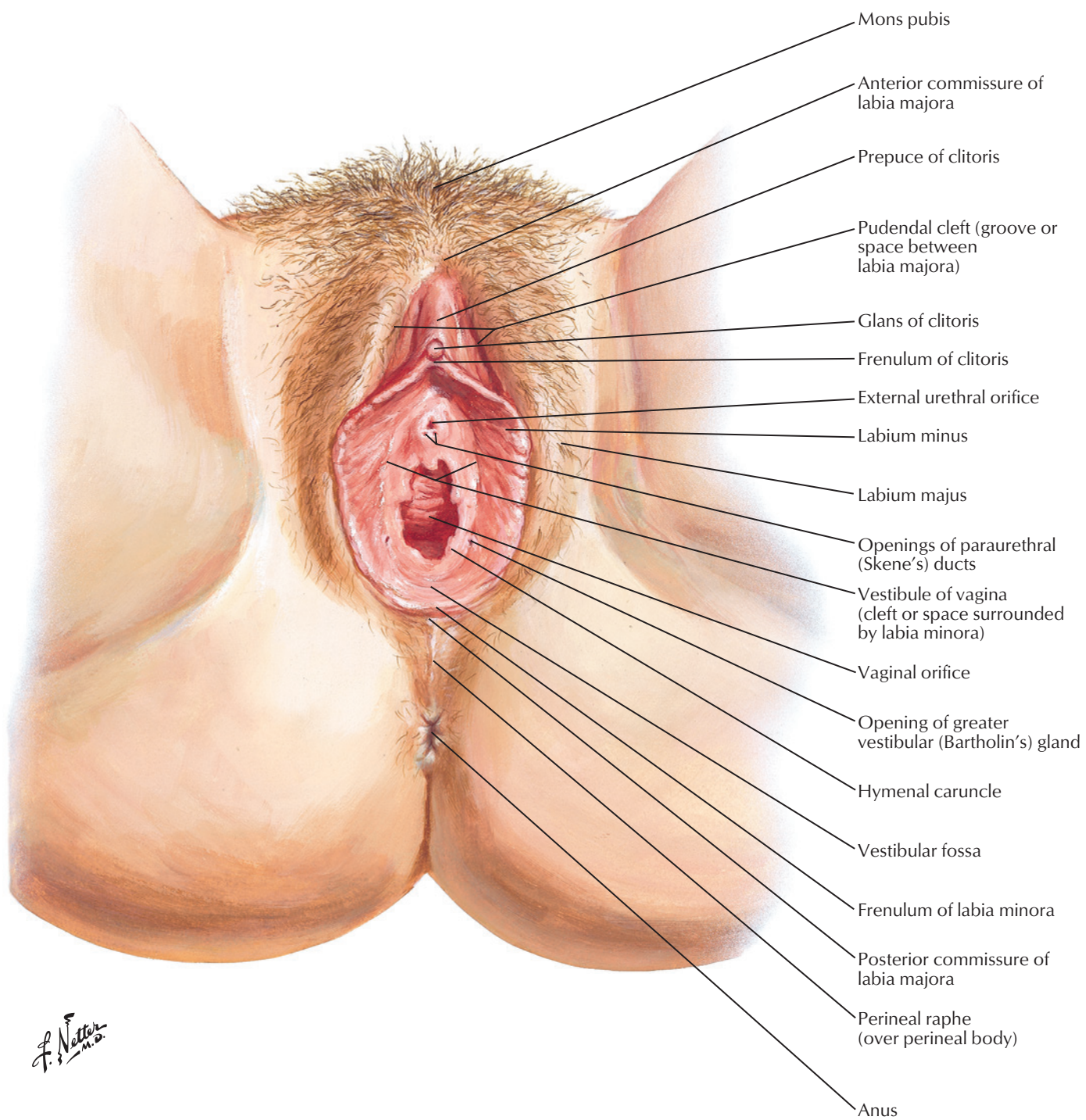


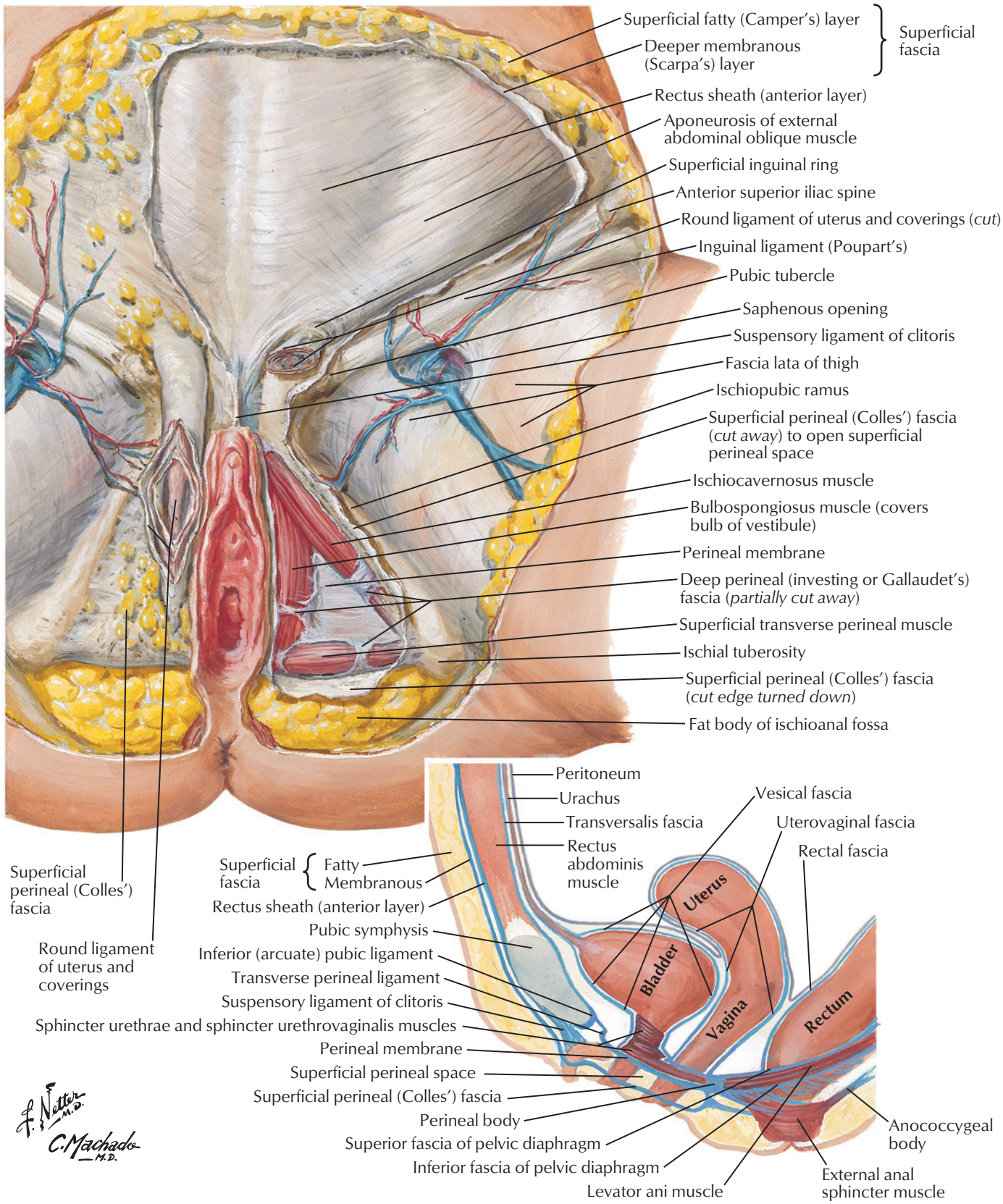
Anteroposterior fluoroscopic image obtained during hysterosalpingography

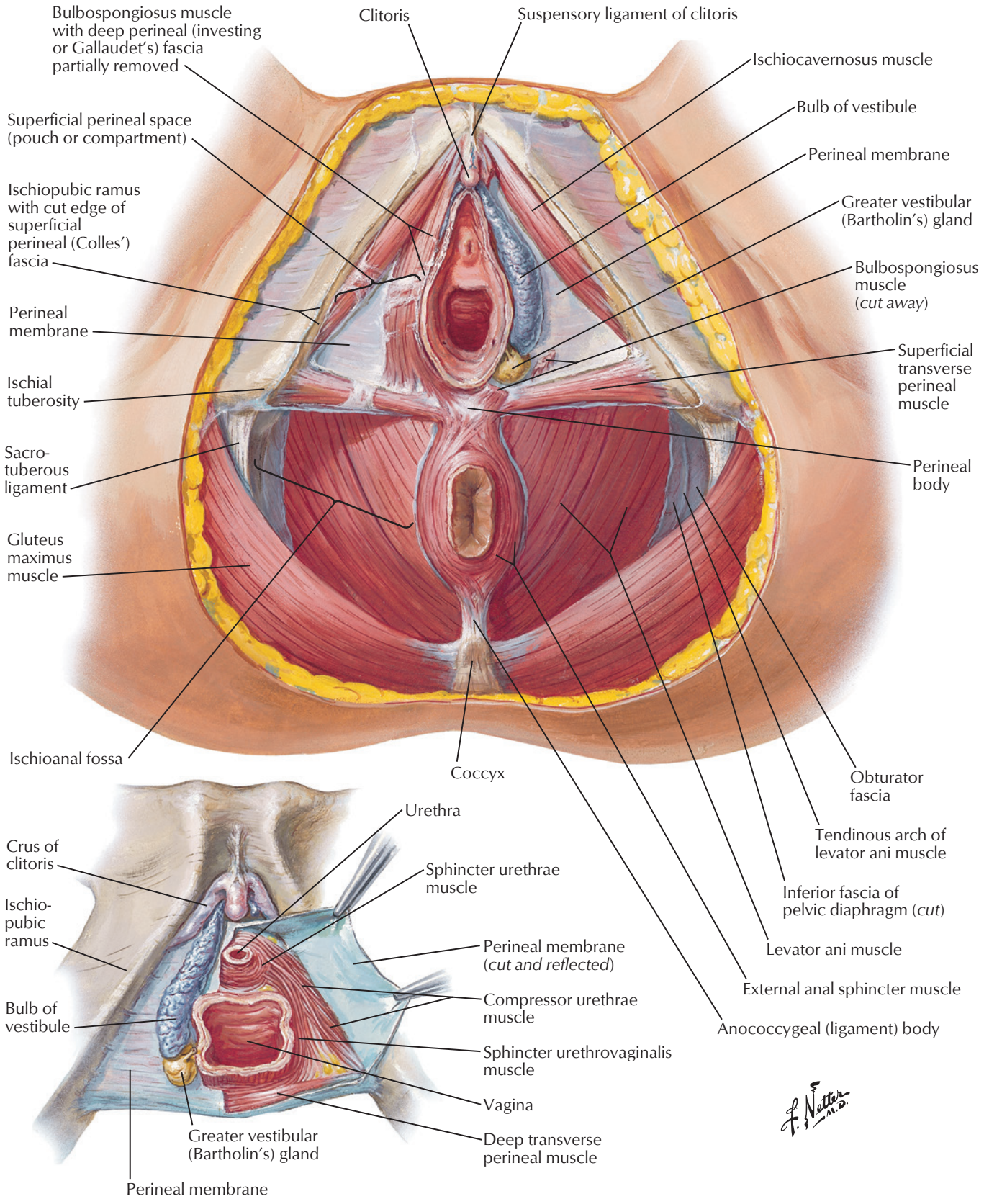


Female Perineum and External Genitalia (Pudendum or Vulva)

See also Plates 386, 389, 395

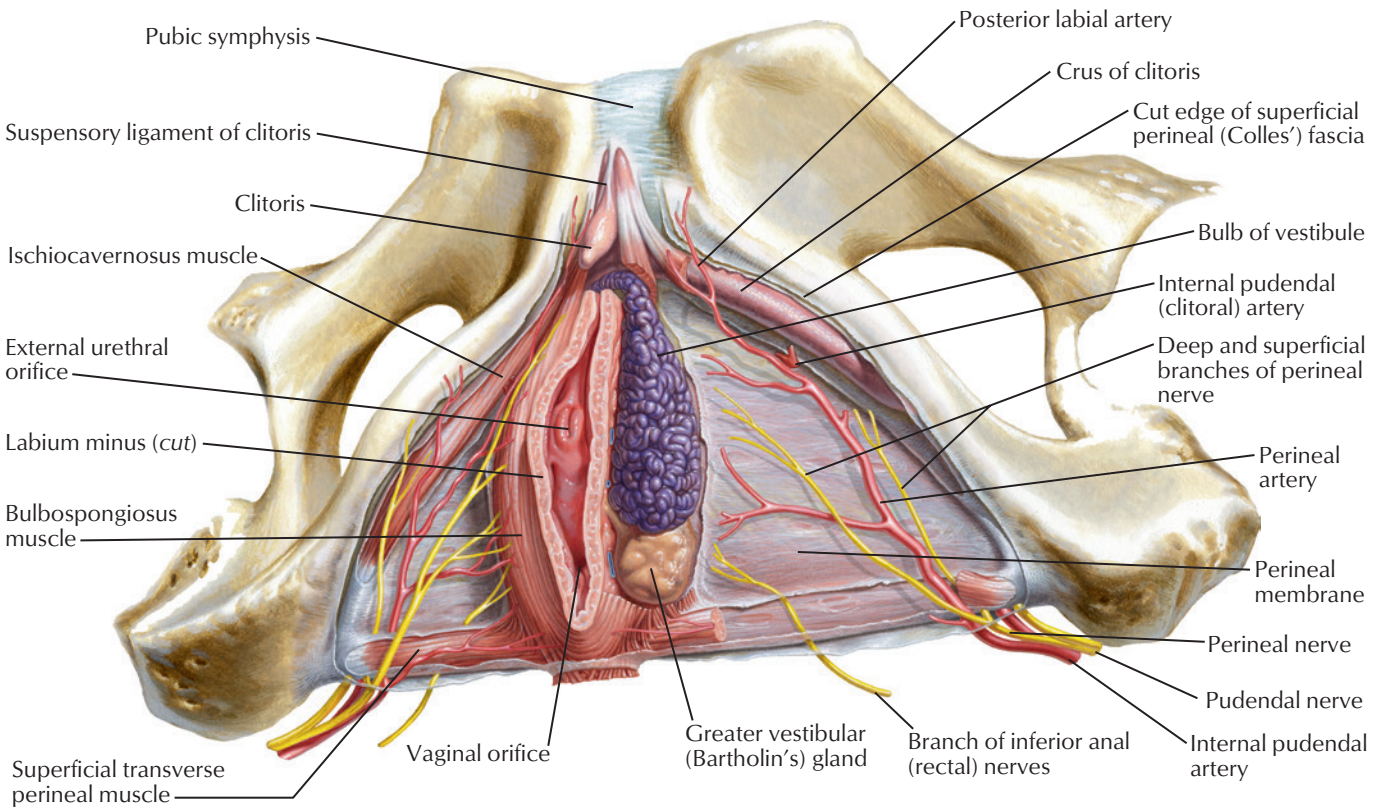



Superficial fatty (Camper's) layer
Deeper membranous (Scarpa's) layer
Superficial fascia
Rectus sheath (anterior layer)
Aponeurosis of external abdominal oblique muscle
Superficial inguinal ring
Anterior superior iliac spine
Round ligament of uterus and coverings (cut)
Inguinal ligament (Poupart's)
Pubic tubercle
Saphenous opening
Suspensory ligament of clitoris
Fascia lata of thigh
Ischiopubic ramus
Superficial perineal (Colles') fascia (cut away) to open superficial perineal space
Ischiocavernosus muscle
Bulbospongiosus muscle (covers bulb of vestibule)
Perineal membrane
Deep perineal (investing or Gallaudet's) fascia (partially cut away)
Superficial transverse perineal muscle
Ischial tuberosity
Superficial perineal (Colles') fascia (cut edge turned down)
Fat body of ischioanal fossa
Superficial perineal (Colles') fascia
Round ligament of uterus and coverings
Superficial fascia
Fatty
Membranous
Rectus sheath (anterior layer)
Pubic symphysis
Inferior (arcuate) pubic ligament
Transverse perineal ligament
Suspensory ligament of clitoris
Sphincter urethrae and sphincter urethrovaginalis muscles
Perineal membrane
Superficial perineal space
Superficial perineal (Colles') fascia
Perineal body
Superior fascia of pelvic diaphragm
Inferior fascia of pelvic diaphragm
Levator ani muscle
Peritoneum
Urachus
Transversalis fascia
Rectus abdominis muscle
Vesical fascia
Uterovaginal fascia
Rectal fascia
Uterus
Bladder
Vagina
Rectum
Anococcygeal body
External anal sphincter muscle
F. Netter M.D.
C. Machado M.D.

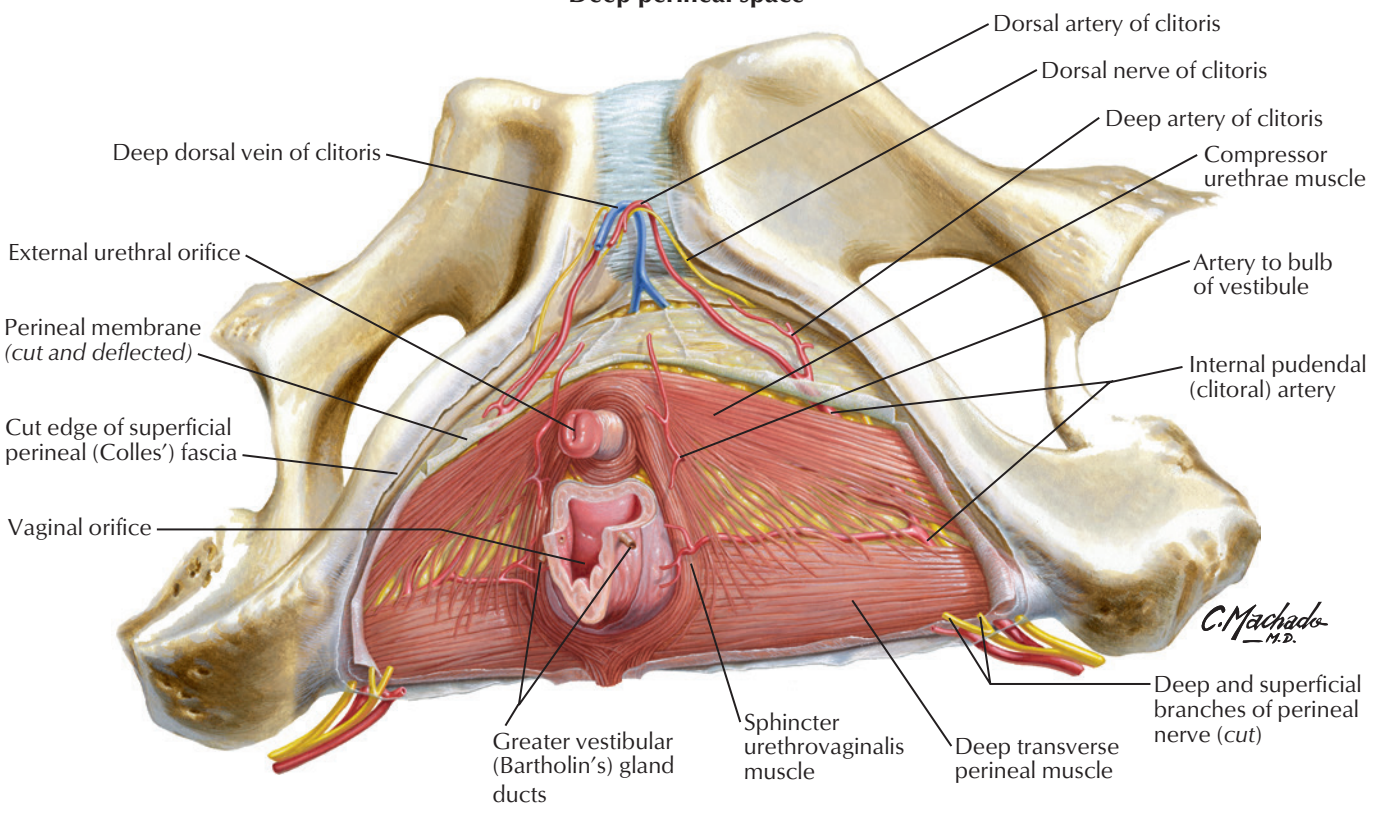

Bulbospongiosus muscle with deep perineal (investing or Gallaudet's) fascia partially removed
Clitoris
Suspensory ligament of clitoris
Ischiocavernosus muscle
Bulb of vestibule
Superficial perineal space (pouch or compartment)
Perineal membrane
Ischiopubic ramus with cut edge of superficial perineal (Colles') fascia
Greater vestibular (Bartholin's) gland
Bulbospongiosus muscle (cut away)
Perineal membrane
Superficial transverse perineal muscle
Ischial tuberosity
Perineal body
Sacro-tuberous ligament
Gluteus maximus muscle
Ischioanal fossa
Coccyx
Obturator fascia
Tendinous arch of levator ani muscle
Inferior fascia of pelvic diaphragm (cut)
Levator ani muscle
External anal sphincter muscle
Anococcygeal (ligament) body
Urethra
Crus of clitoris
Sphincter urethrae muscle
Ischio-pubic ramus
Perineal membrane (cut and reflected)
Compressor urethrae muscle
Bulb of vestibule
Sphincter urethrovaginalis muscle
Vagina
Greater vestibular (Bartholin's) gland
Deep transverse perineal muscle
Perineal membrane

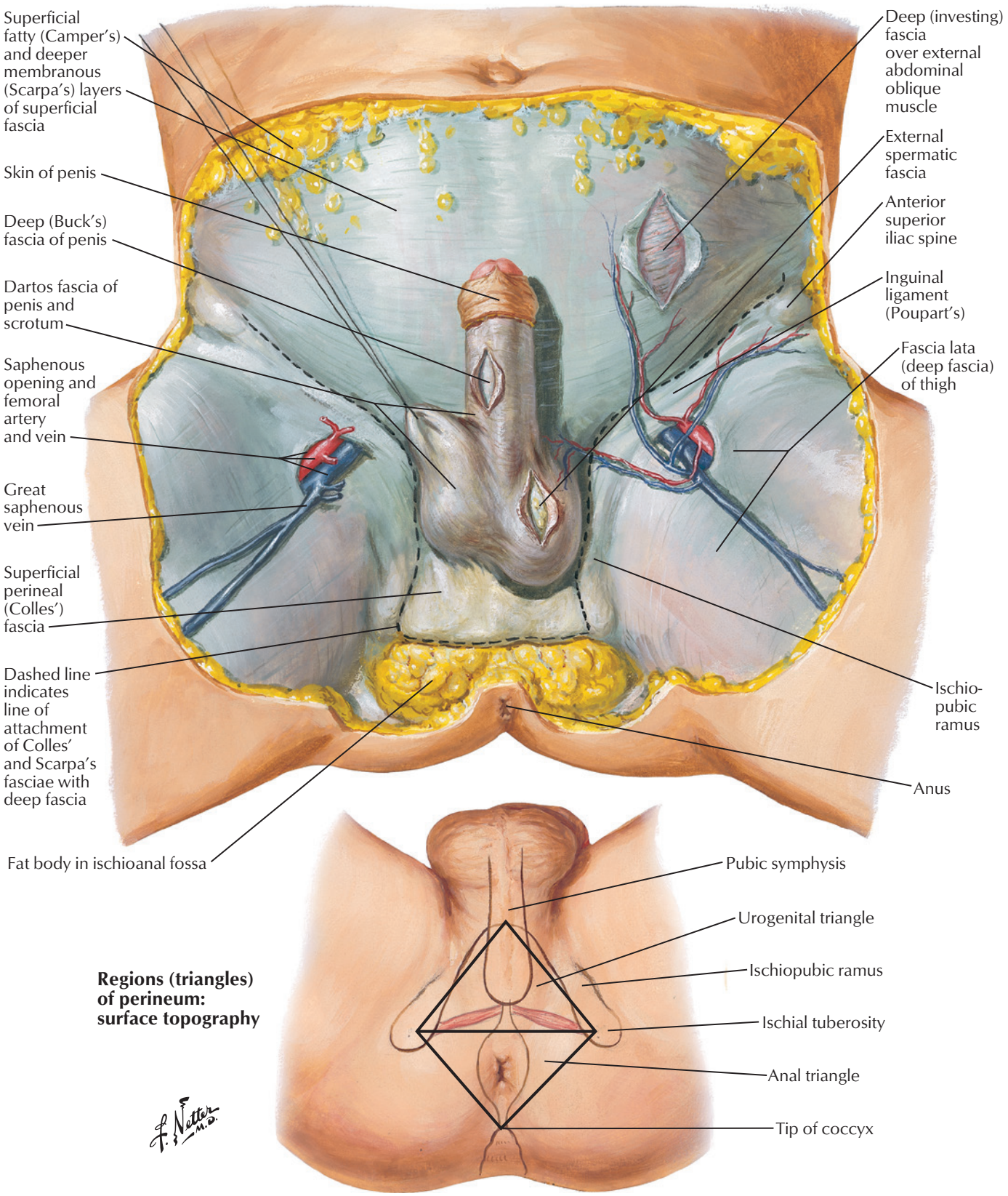
See also Plates 386, 395

Superficial perineal space

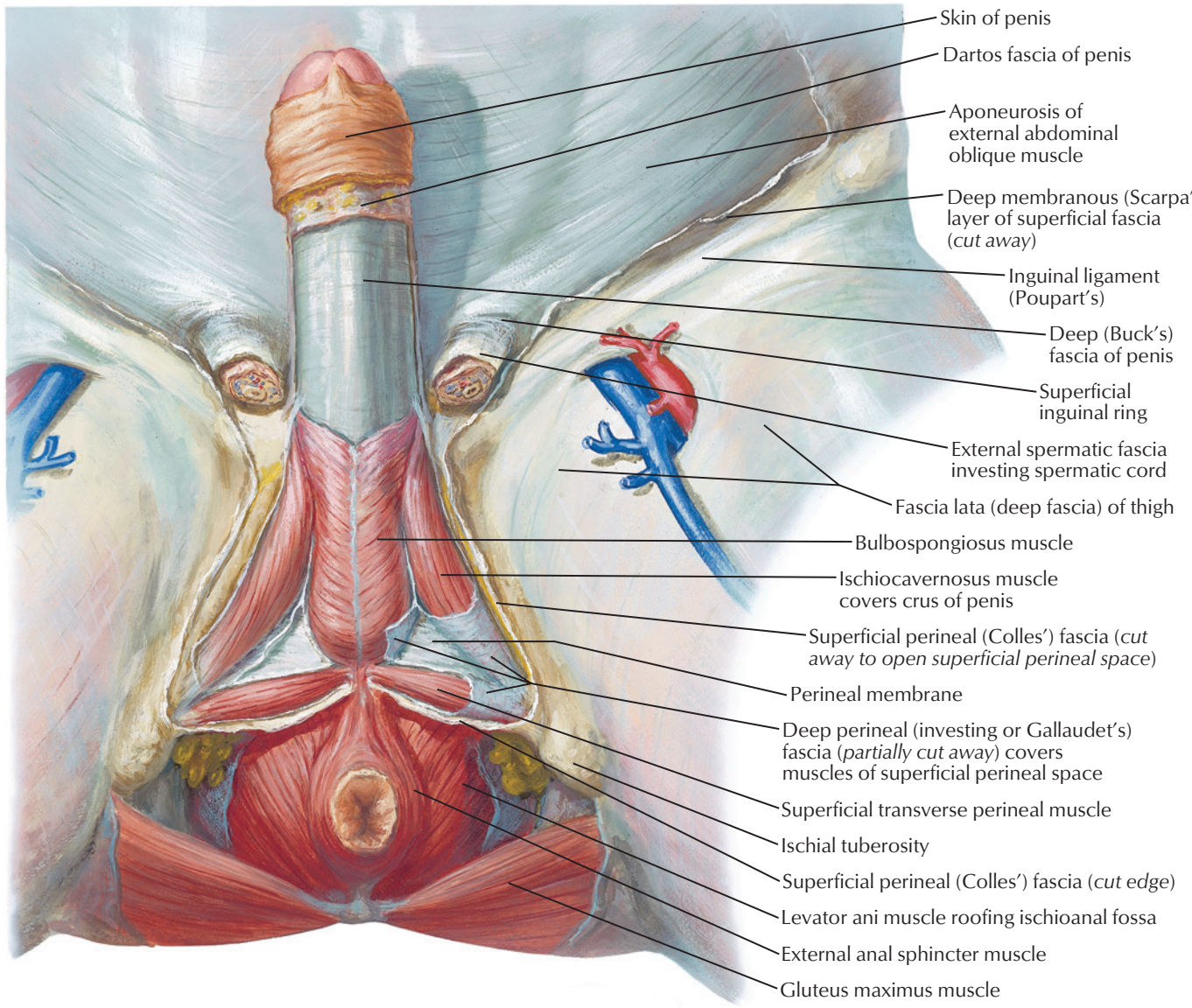


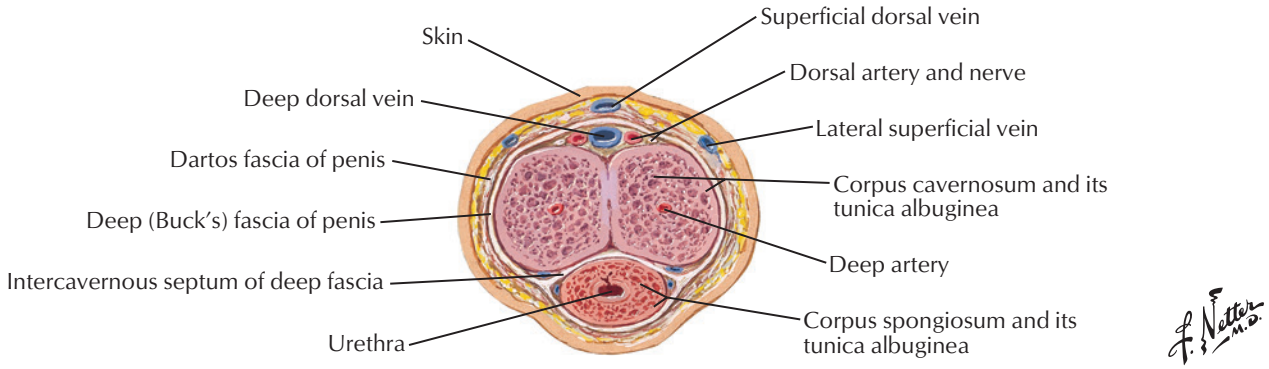
Deep perineal space



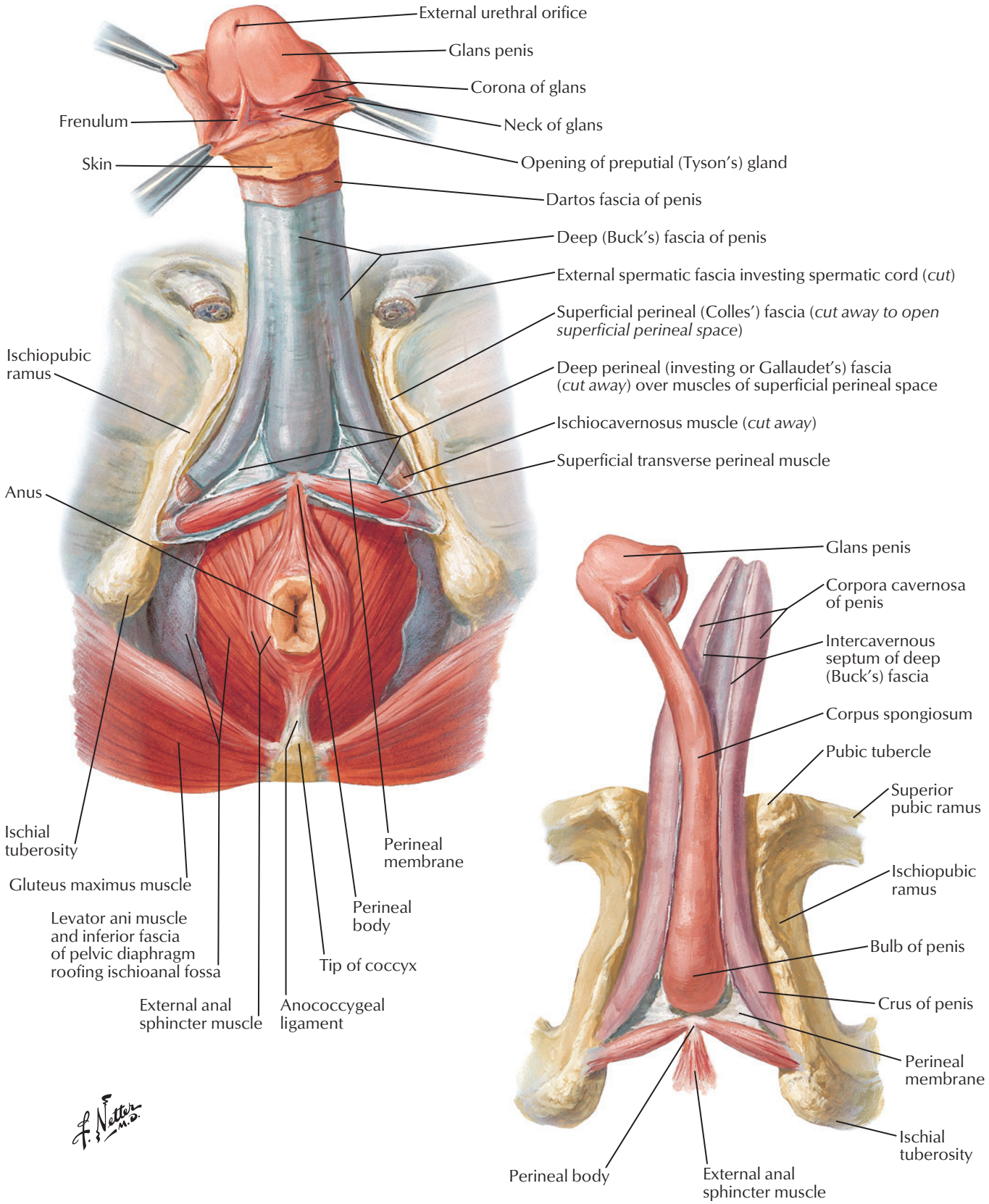

Superficial fatty (Camper's) and deeper membranous (Scarpa's) layers of superficial fascia
Skin of penis
Deep (Buck's) fascia of penis
Dartos fascia of penis and scrotum
Saphenous opening and femoral artery and vein
Great saphenous vein
Superficial perineal (Colles') fascia
Dashed line indicates line of attachment of Colles' and Scarpa's fasciae with deep fascia
Fat body in ischioanal fossa
Deep (investing) fascia over external abdominal oblique muscle
External spermatic fascia
Anterior superior iliac spine
Inguinal ligament (Poupart's)
Fascia lata (deep fascia) of thigh
Ischio-pubic ramus
Anus
Regions (triangles) of perineum: surface topography
Pubic symphysis
Urogenital triangle
Ischiopubic ramus
Ischial tuberosity
Anal triangle
Tip of coccyx

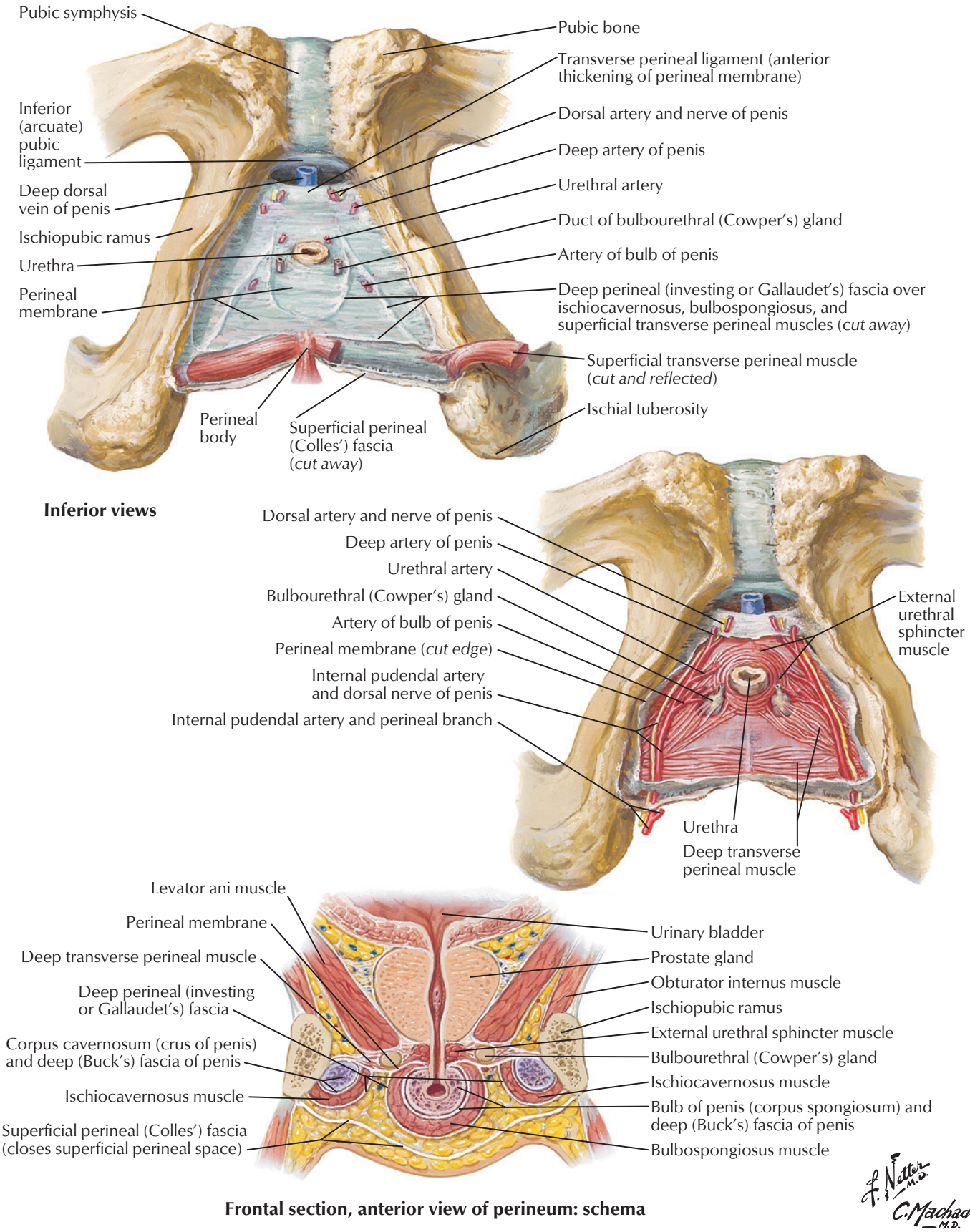
See also Plates 382, 384, 387





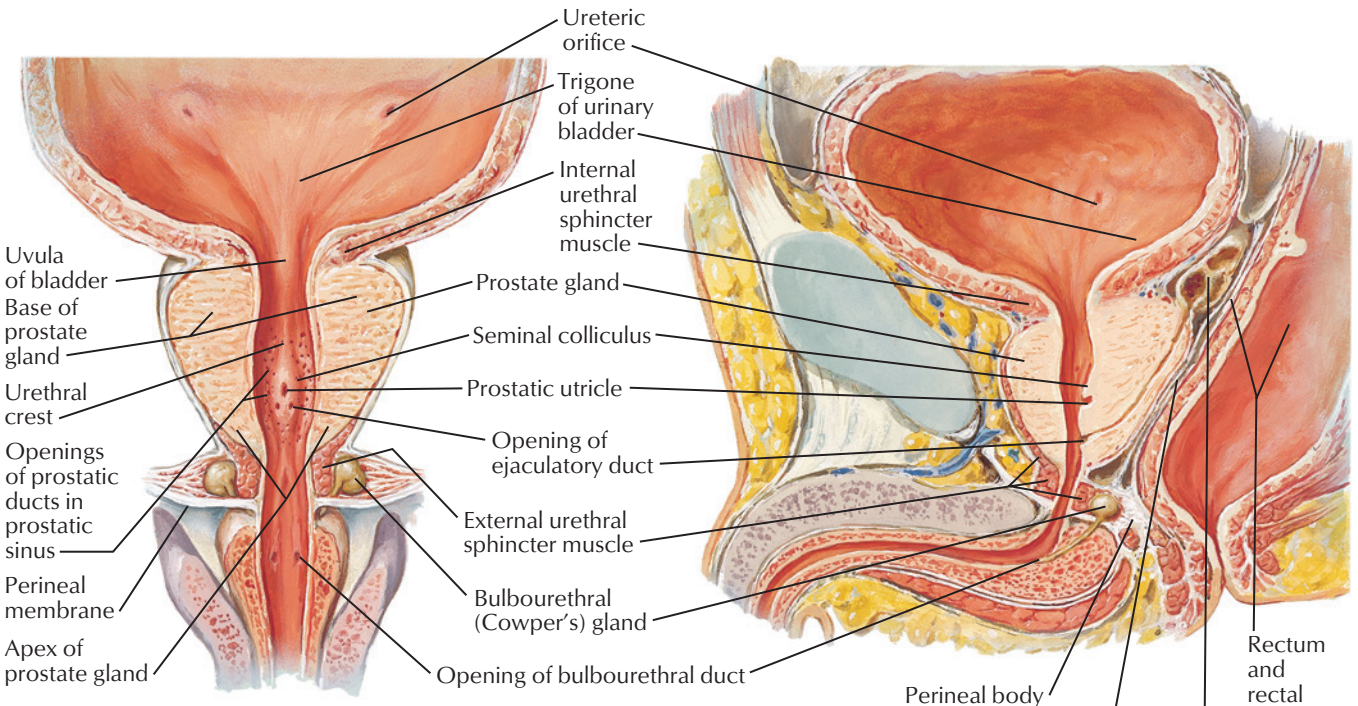
Transverse section through body of penis


External urethral orifice
Glans penis
Corona of glans
Frenulum
Neck of glans
Skin
Opening of preputial (Tyson's) gland
Dartos fascia of penis
Deep (Buck's) fascia of penis
External spermatic fascia investing spermatic cord (cut)
Superficial perineal (Colles') fascia (cut away to open superficial perineal space)
Ischiopubic ramus
Deep perineal (investing or Gallaudet's) fascia (cut away) over muscles of superficial perineal space
Ischiocavernosus muscle (cut away)
Superficial transverse perineal muscle
Anus
Ischial tuberosity
Perineal membrane
Gluteus maximus muscle
Perineal body
Levator ani muscle and inferior fascia of pelvic diaphragm roofing ischioanal fossa
Tip of coccyx
External anal sphincter muscle
Anococcygeal ligament
Glans penis
Corpora cavernosa of penis
Intercavernous septum of deep (Buck's) fascia
Corpus spongiosum
Pubic tubercle
Superior pubic ramus
Ischiopubic ramus
Bulb of penis
Crus of penis
Perineal membrane
Ischial tuberosity
Perineal body
External anal sphincter muscle



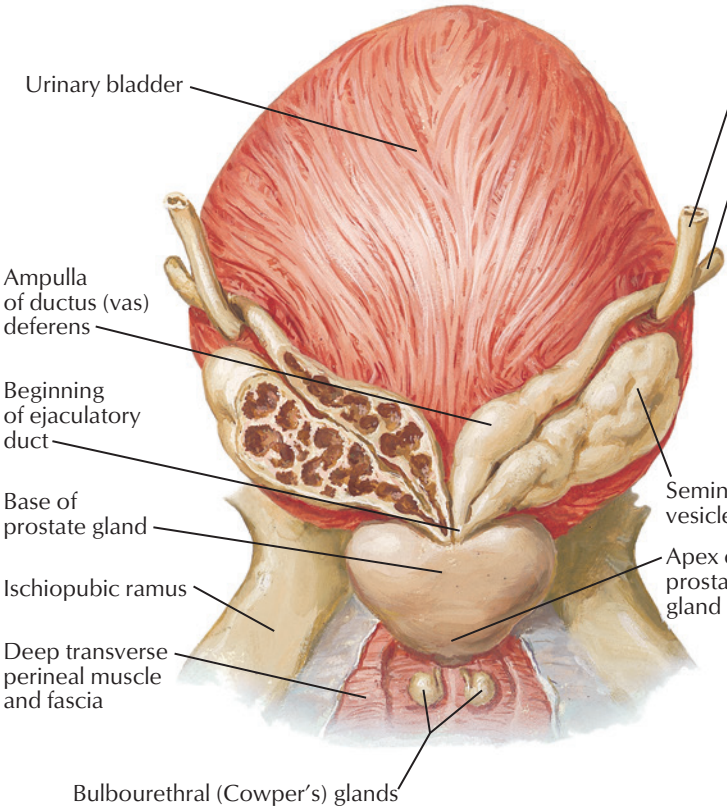
Frontal section, anterior view of perineum: schema

See also Plates 349, 352, 385

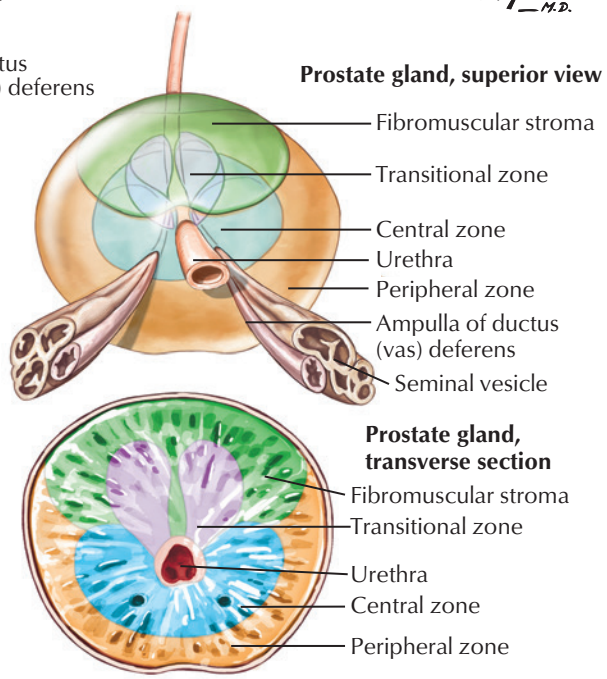


Frontal section, anterior view of bulbous portion of spongy urethra schematically extended

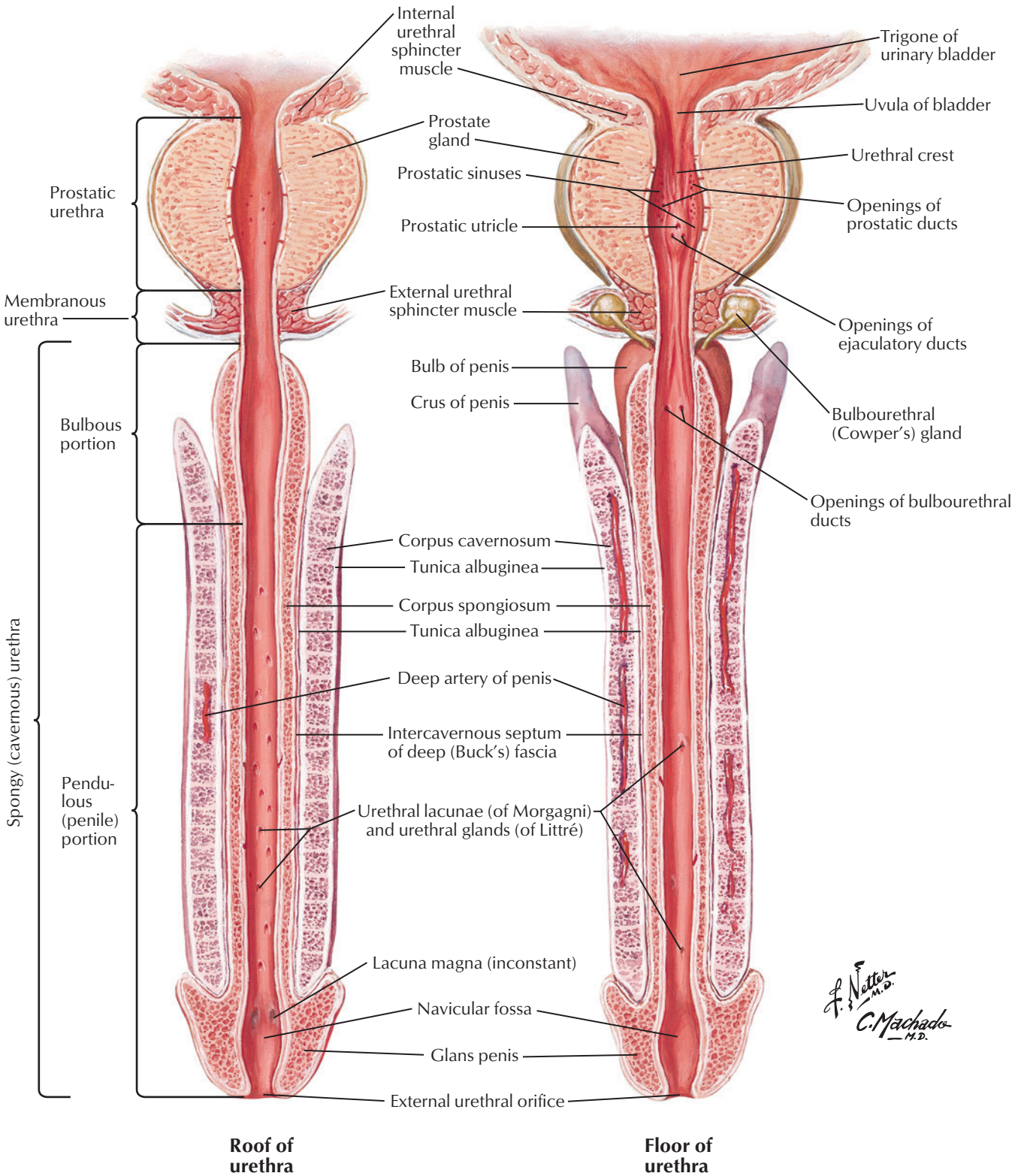
Sagittal section

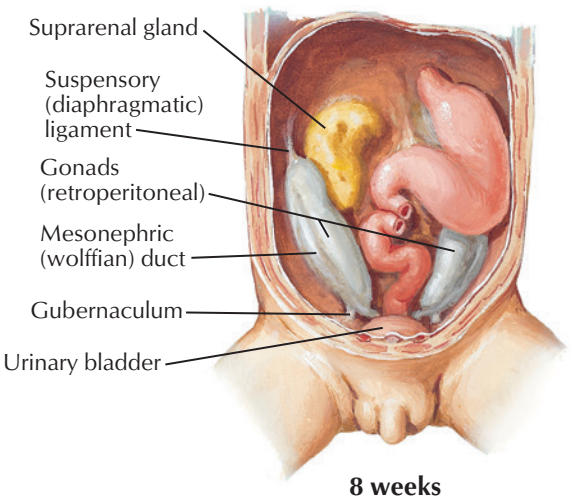


Posterior view

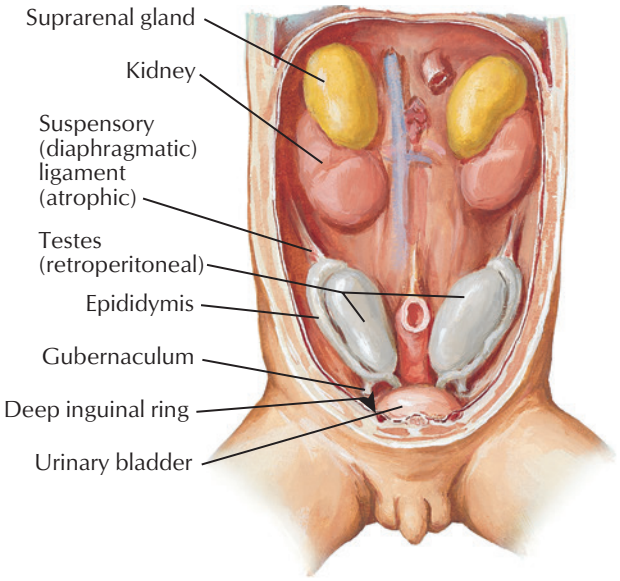


Posterior view

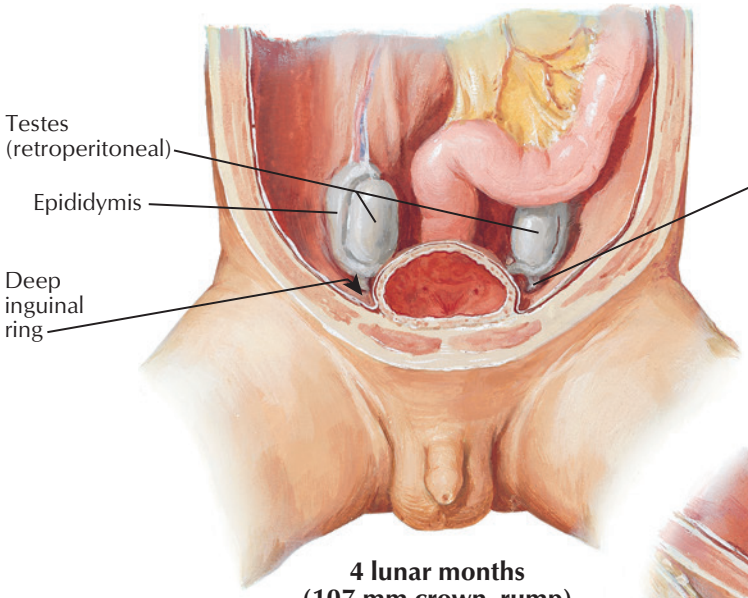

Internal urethral sphincter muscle
Prostate gland
Prostatic sinuses
Prostatic utricle
External urethral sphincter muscle
Bulb of penis
Crus of penis
Corpus cavernosum
Tunica albuginea
Corpus spongiosum
Tunica albuginea
Deep artery of penis
Intercavernous septum of deep (Buck's) fascia
Urethral lacunae (of Morgagni) and urethral glands (of Littré)
Lacuna magna (inconstant)
Navicular fossa
Glans penis
External urethral orifice
Trigone of urinary bladder
Uvula of bladder
Urethral crest
Openings of prostatic ducts
Openings of ejaculatory ducts
Bulbourethral (Cowper's) gland
Openings of bulbourethral ducts
Prostatic urethra
Membranous urethra
Bulbous portion
Pendulous (penile) portion
Spongy (cavernous) urethra
Roof of urethra
Floor of urethra
F. Netter M.D.
C. Machado M.D.



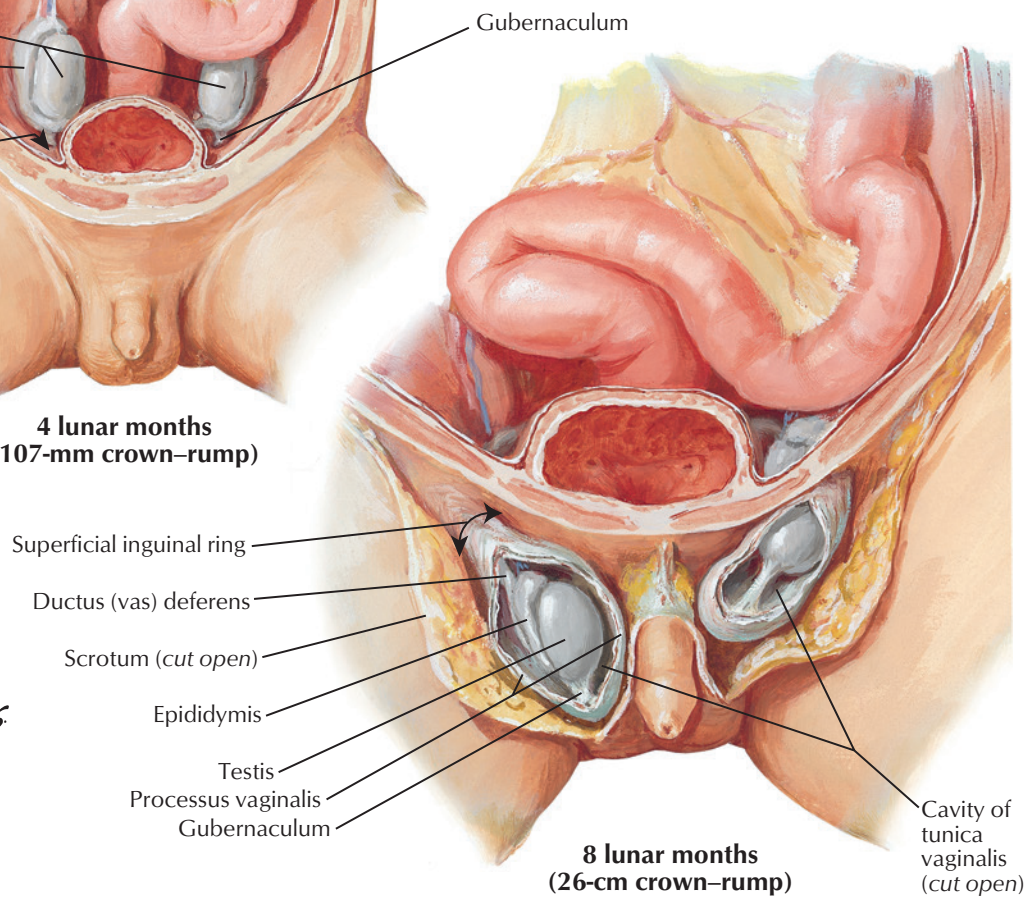
8 weeks
(22.5-mm crown–rump)



11 weeks
(43-mm crown–rump)

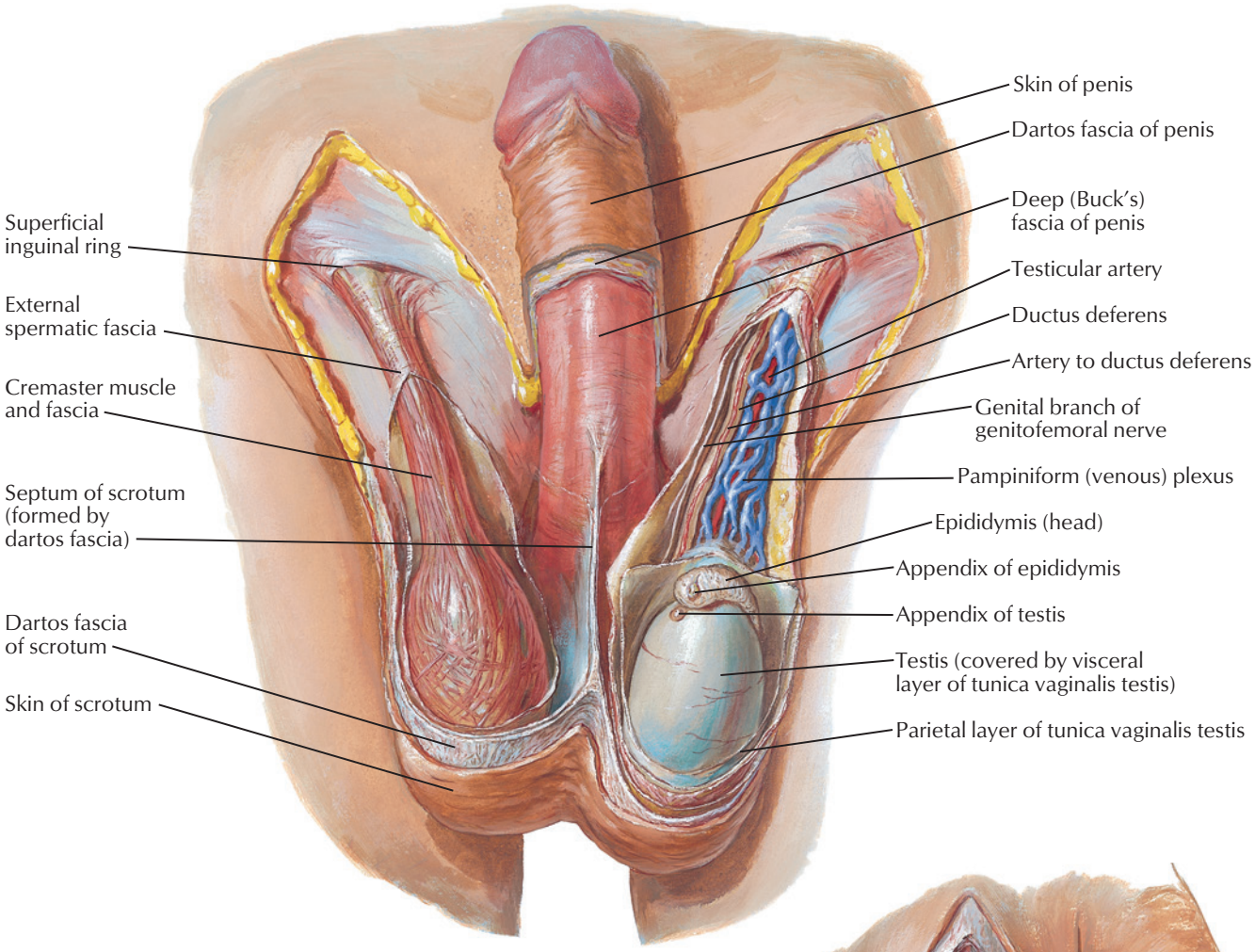


4 lunar months
(107-mm crown–rump)

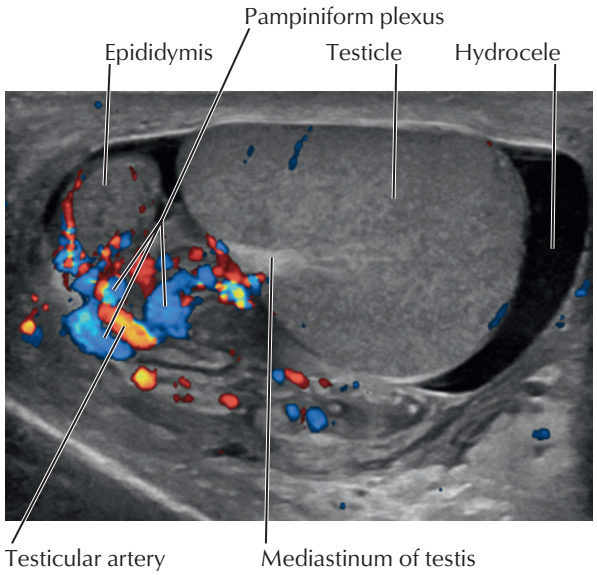


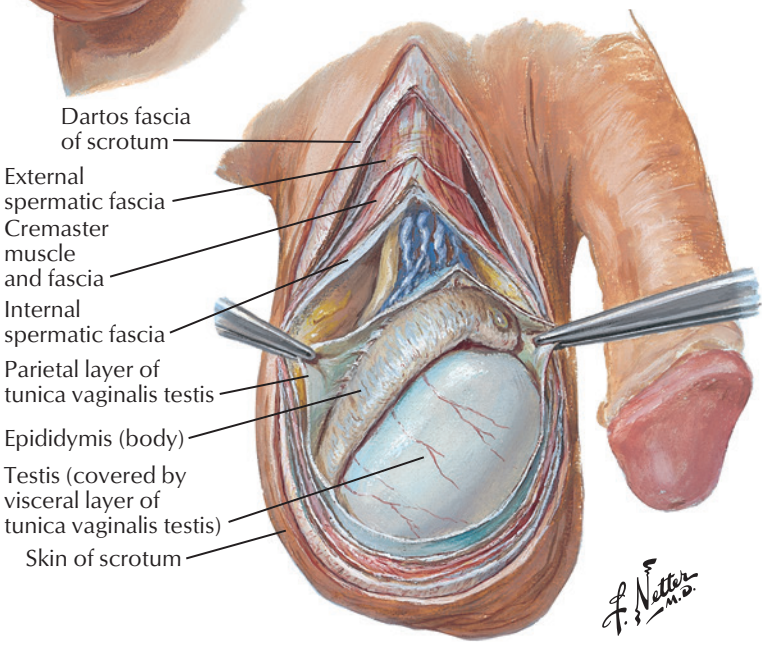
8 lunar months
(26-cm crown–rump)

See also Plates 324, 349

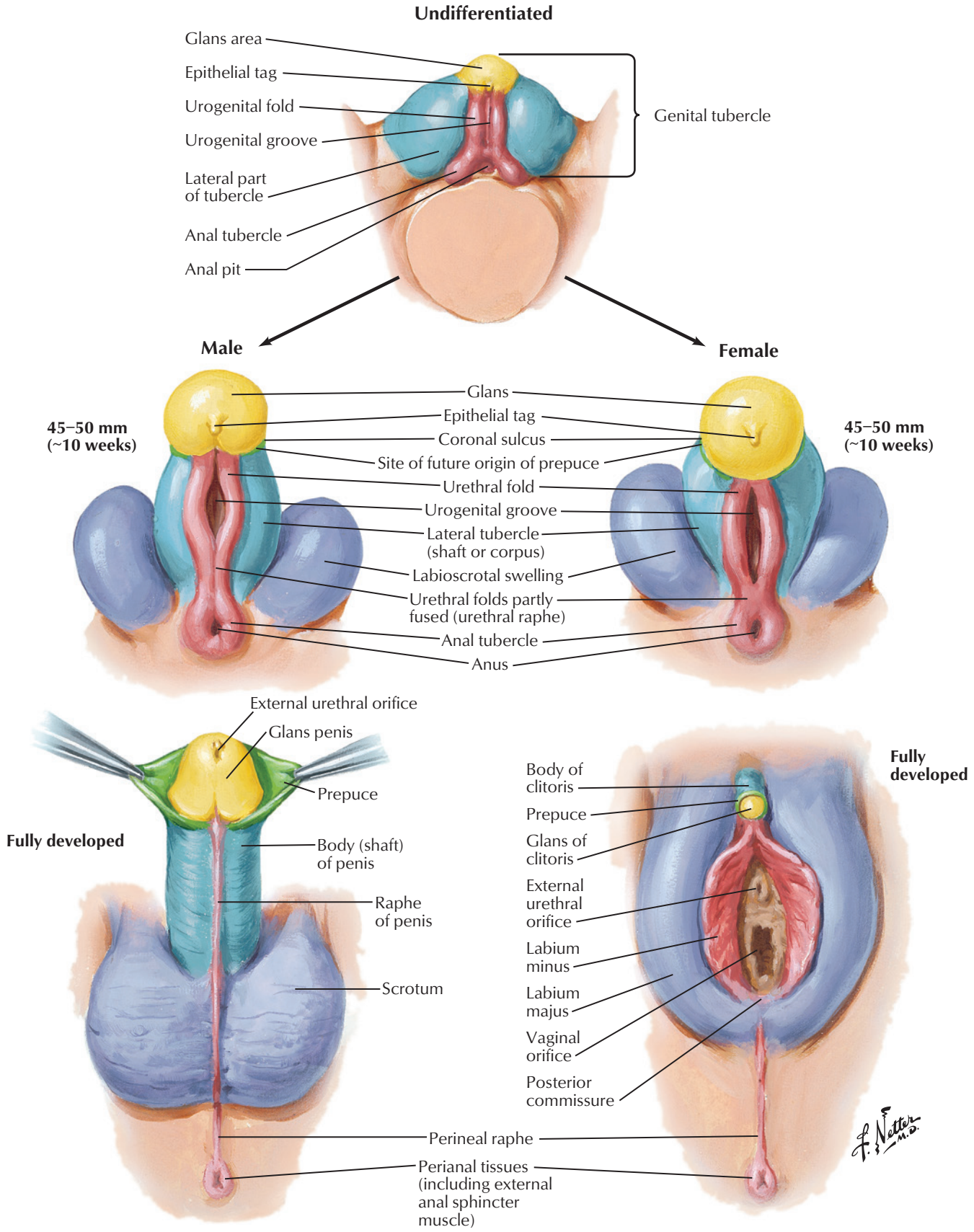


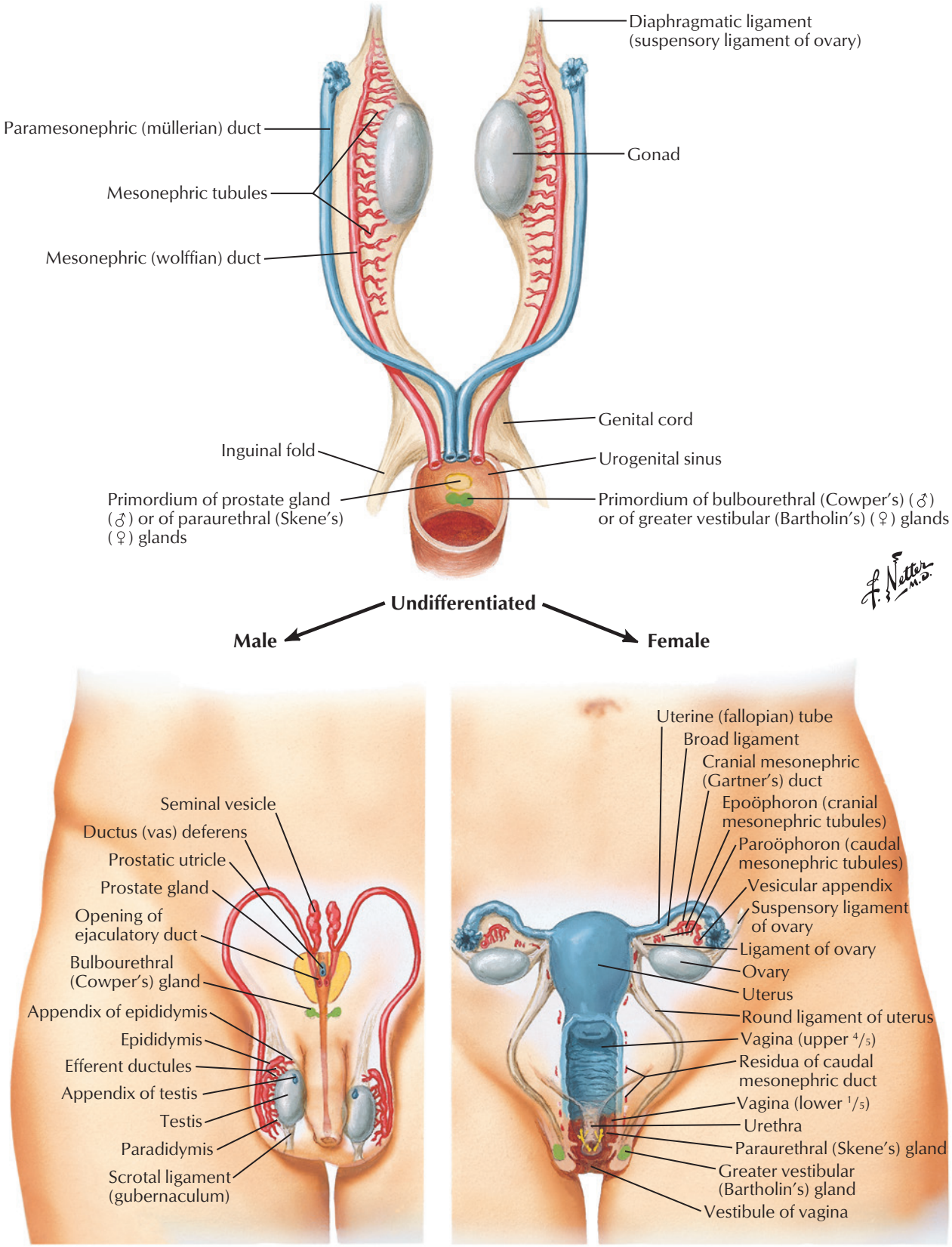
Color Doppler ultrasound: transverse view of testicle

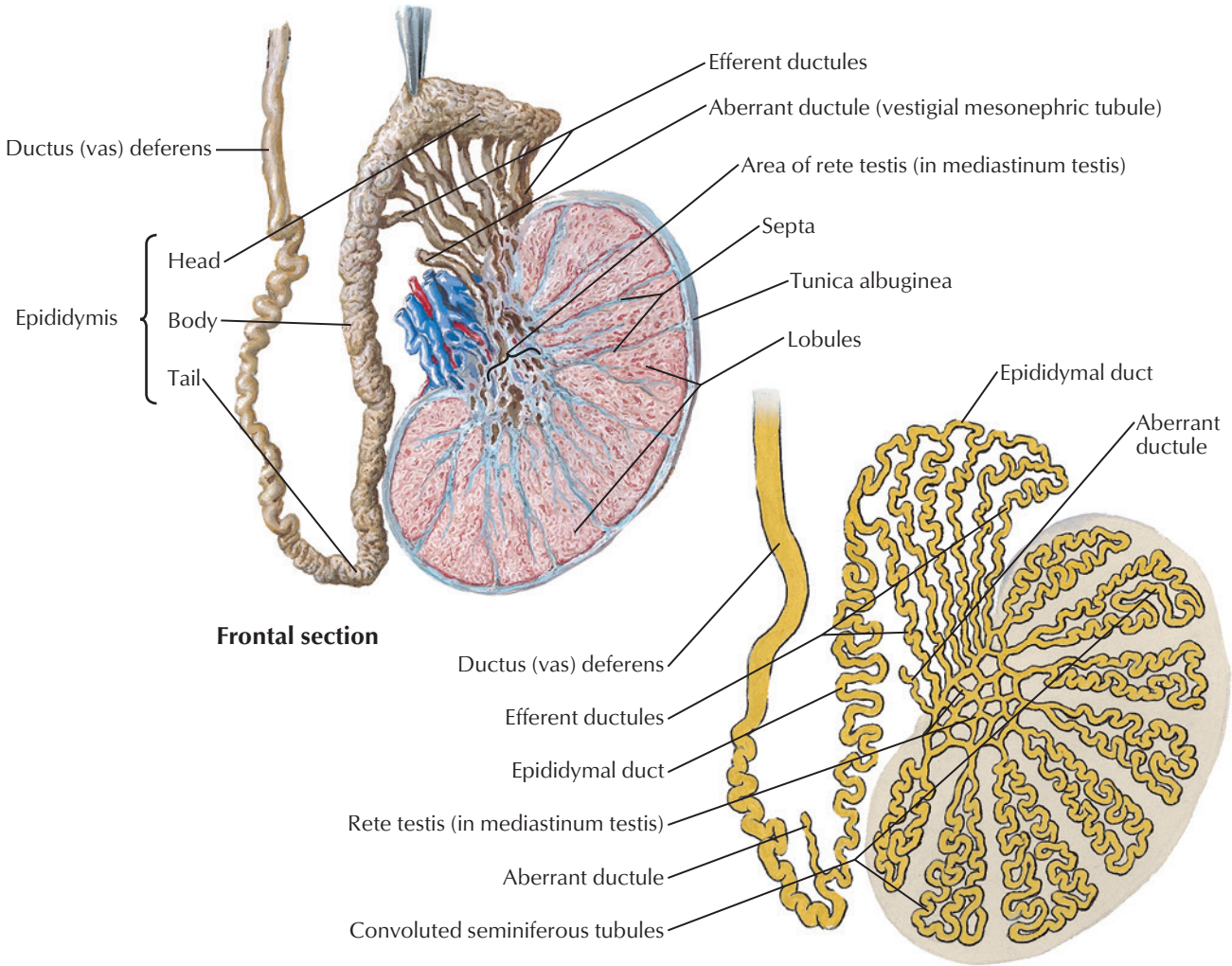




See also Plate 358

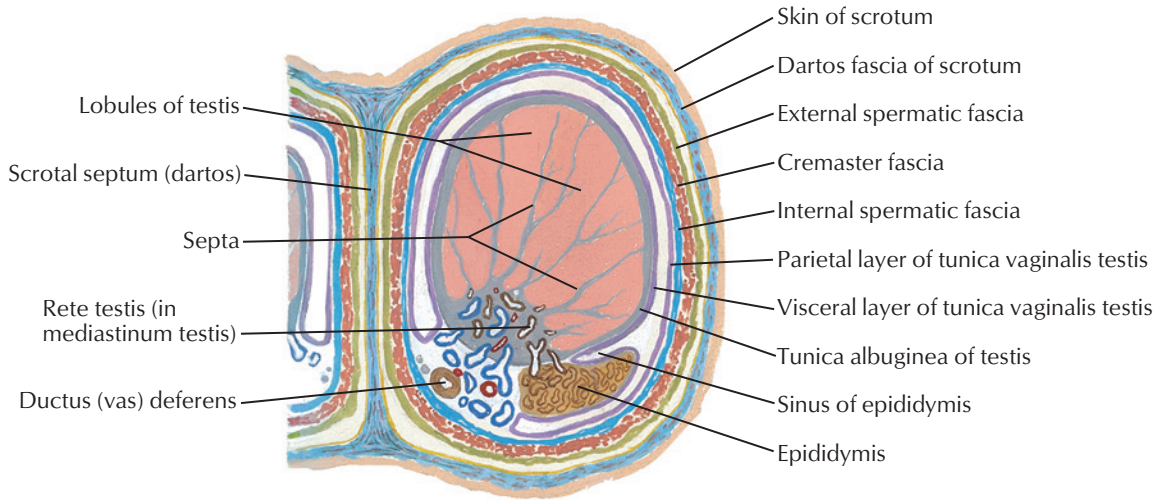



Diaphragmatic ligament
(suspensory ligament of ovary)
Paramesonephric (müllerian) duct
Gonad
Mesonephric tubules
Mesonephric (wolffian) duct
Genital cord
Inguinal fold
Urogenital sinus
Primordium of prostate gland (♂) or of paraurethral (Skene's) (♀) glands
Primordium of bulbourethral (Cowper's) (♂) or of greater vestibular (Bartholin's) (♀) glands
Undifferentiated
Male
Female
Seminal vesicle
Ductus (vas) deferens
Prostatic utricle
Prostate gland
Opening of ejaculatory duct
Bulbourethral (Cowper's) gland
Appendix of epididymis
Epididymis
Efferent ductules
Appendix of testis
Testis
Paradidymis
Scrotal ligament (gubernaculum)
Uterine (fallopian) tube
Broad ligament
Cranial mesonephric (Gartner's) duct
Epoöphoron (cranial mesonephric tubules)
Paroöphoron (caudal mesonephric tubules)
Vesicular appendix
Suspensory ligament of ovary
Ligament of ovary
Ovary
Uterus
Round ligament of uterus
Vagina (upper 4/5)
Residua of caudal mesonephric duct
Vagina (lower 1/5)
Urethra
Paraurethral (Skene's) gland
Greater vestibular (Bartholin's) gland
Vestibule of vagina

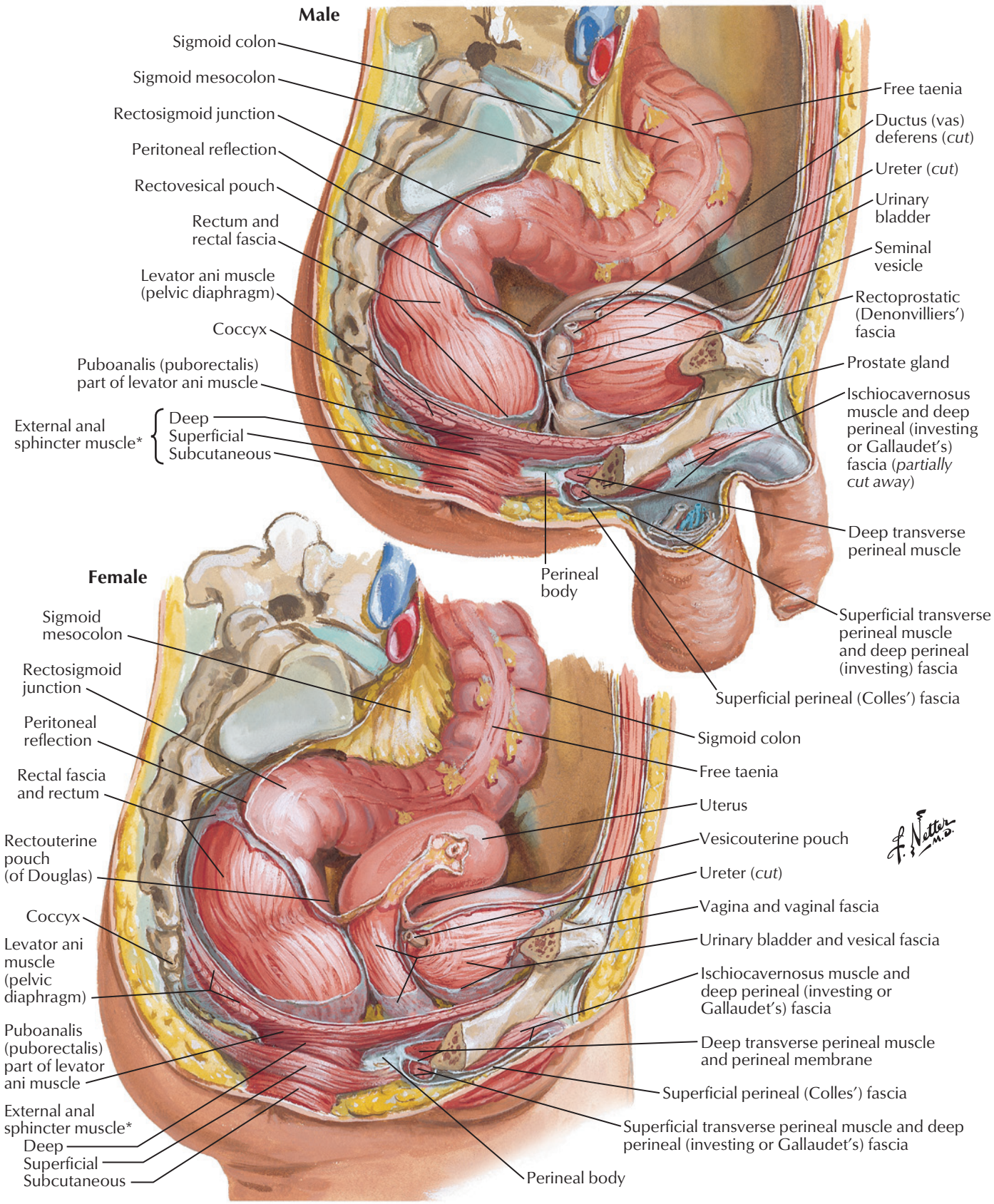


Frontal section

Schema

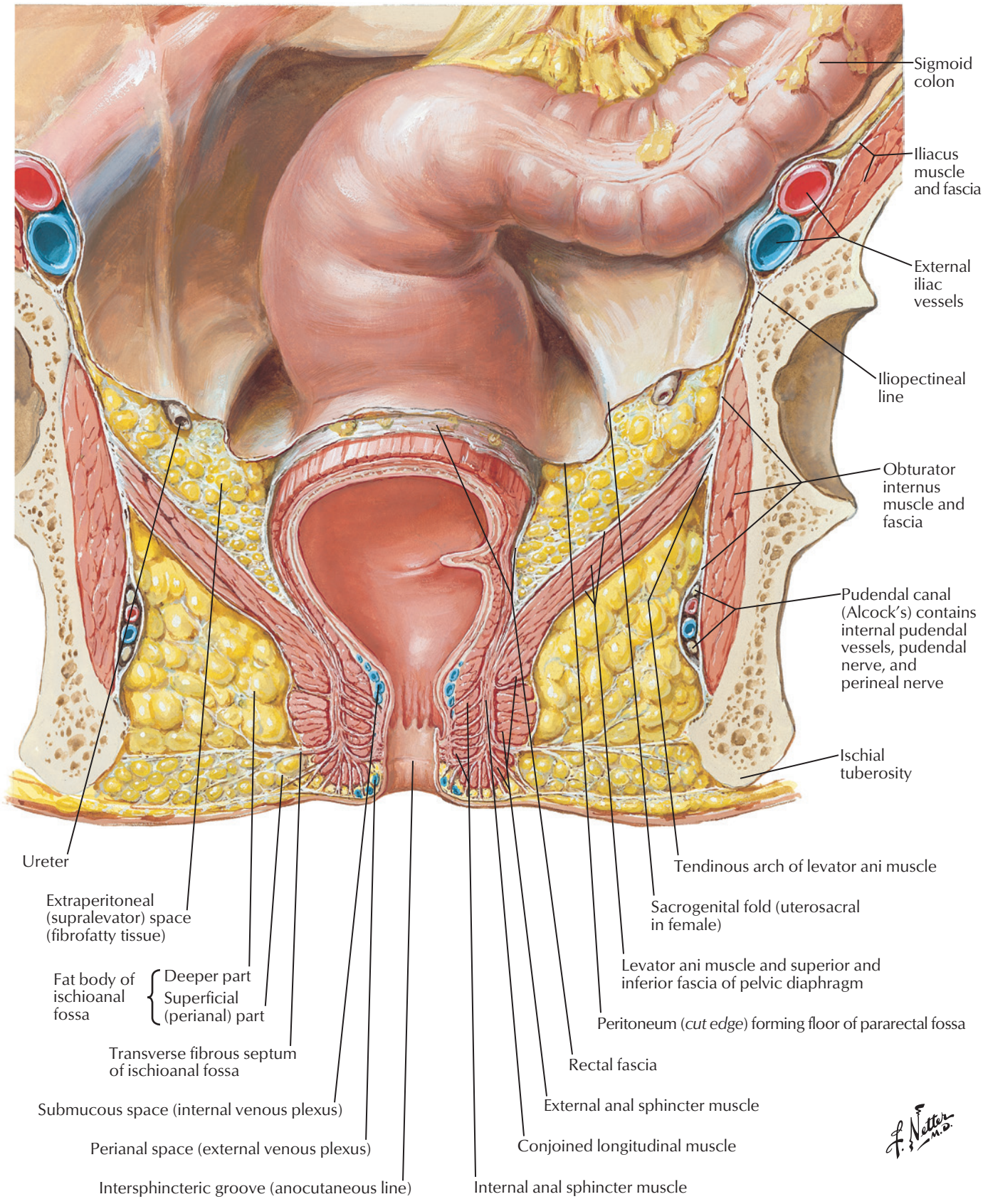


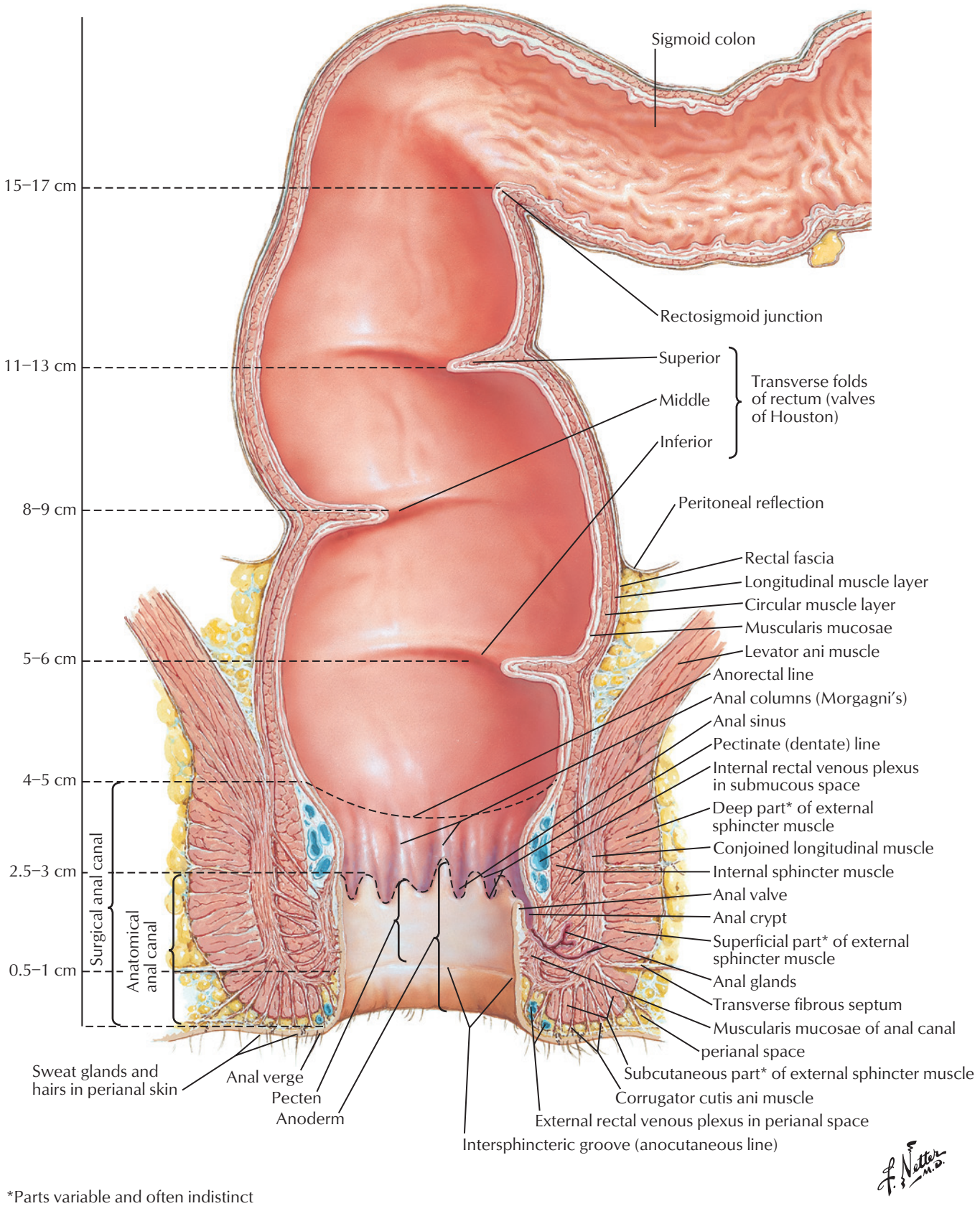
Cross section through scrotum and testis



*Parts variable and often indistinct

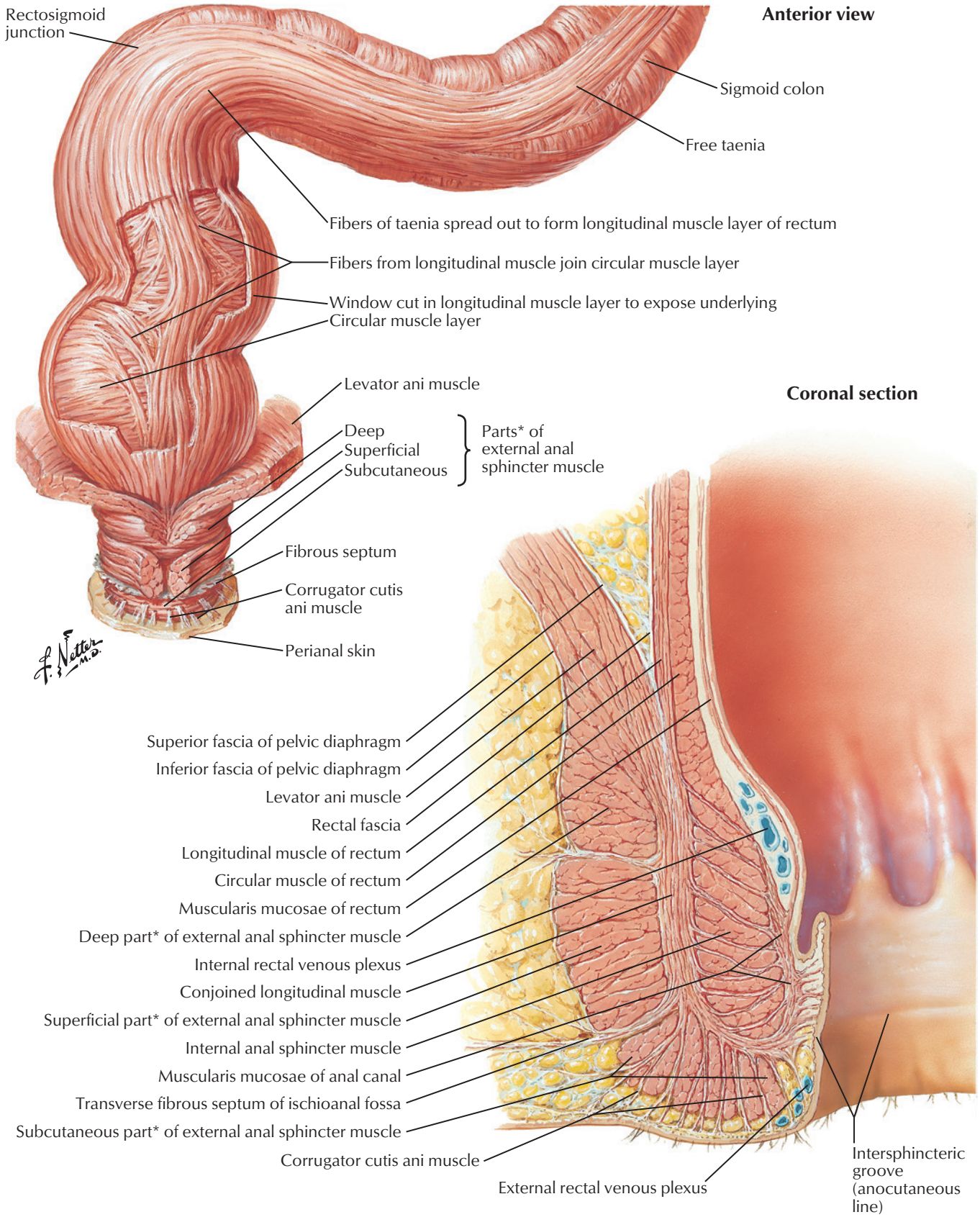
See also Plate 392





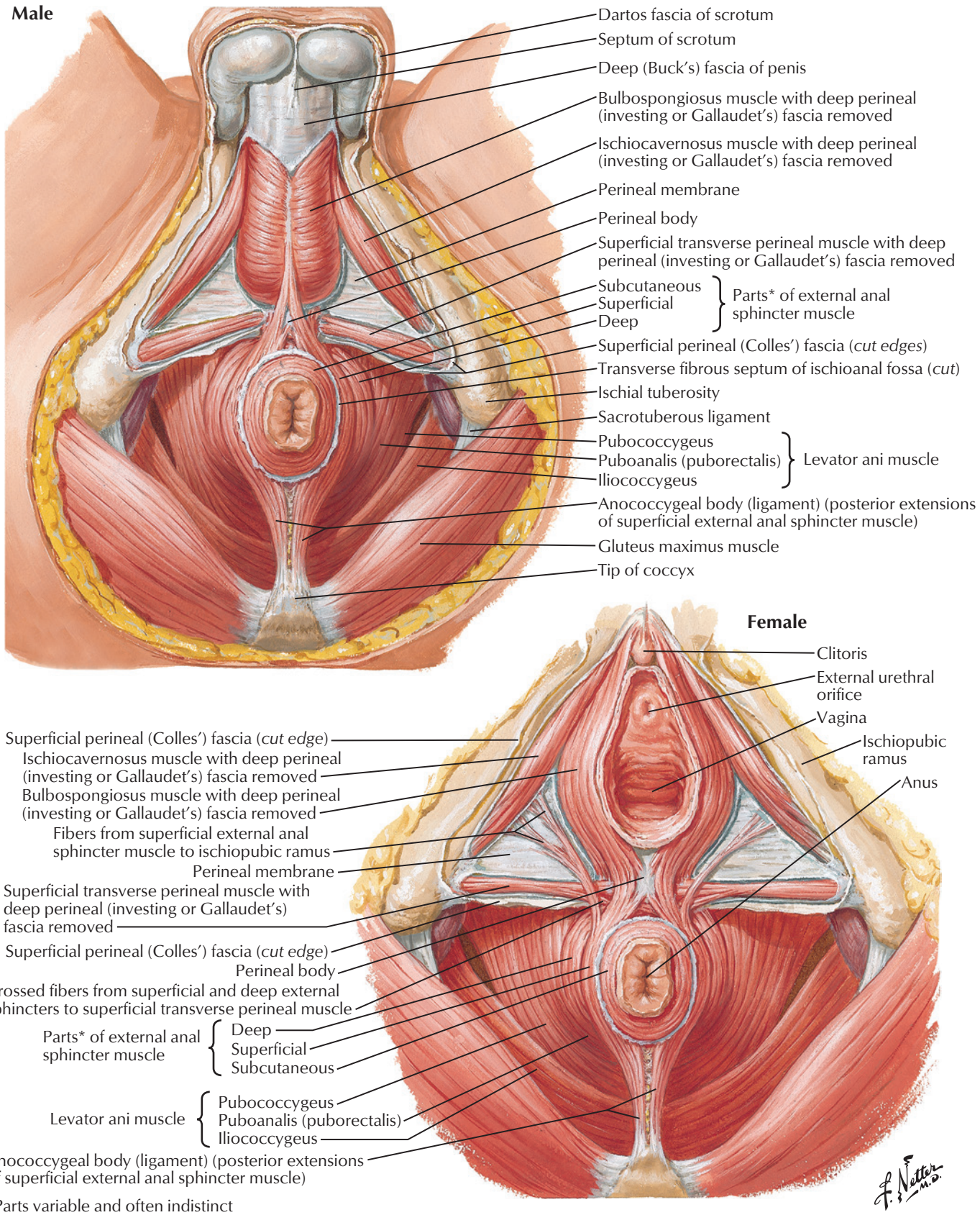
*Parts variable and often indistinct

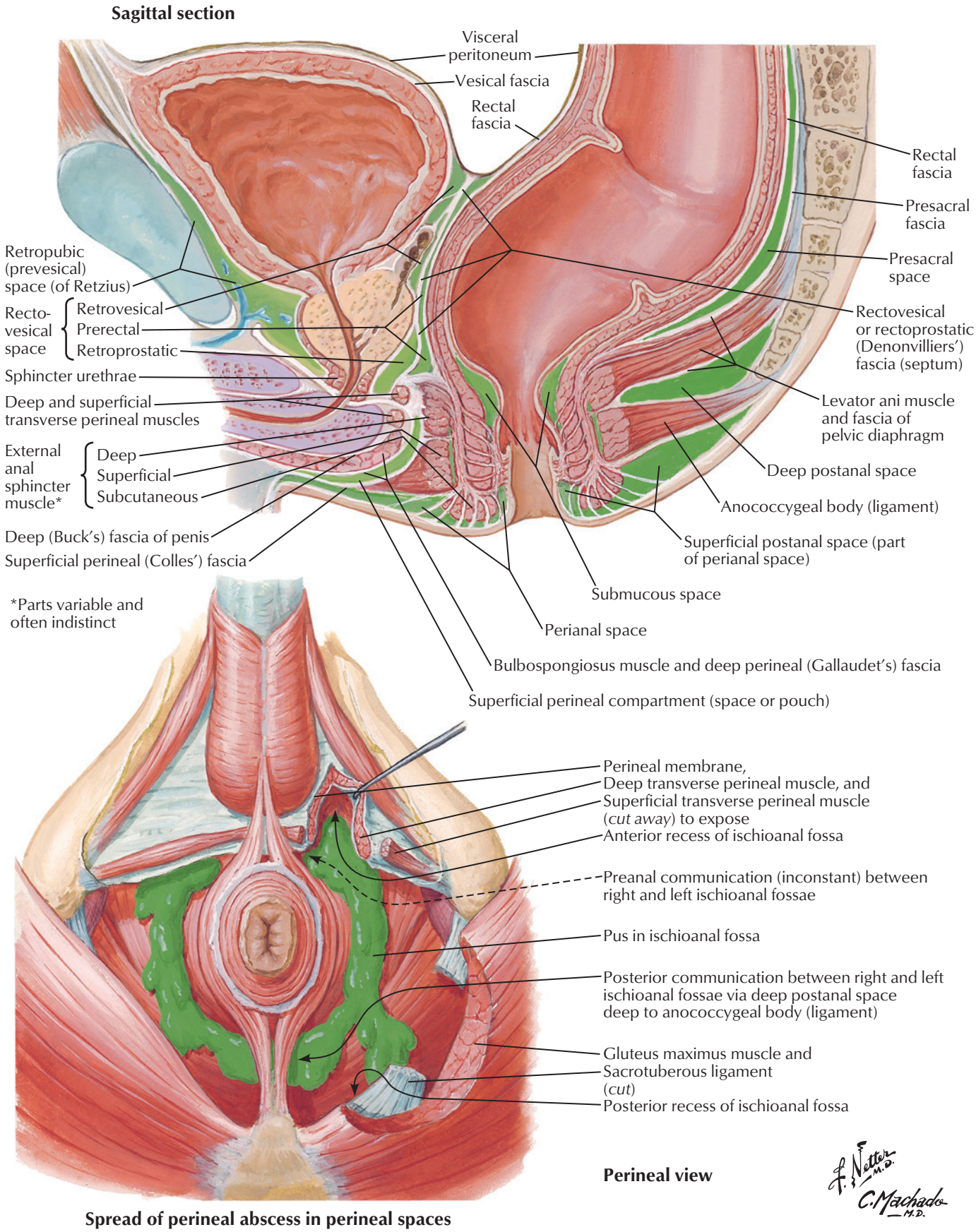
See also Plate 381



*Parts variable and often indistinct

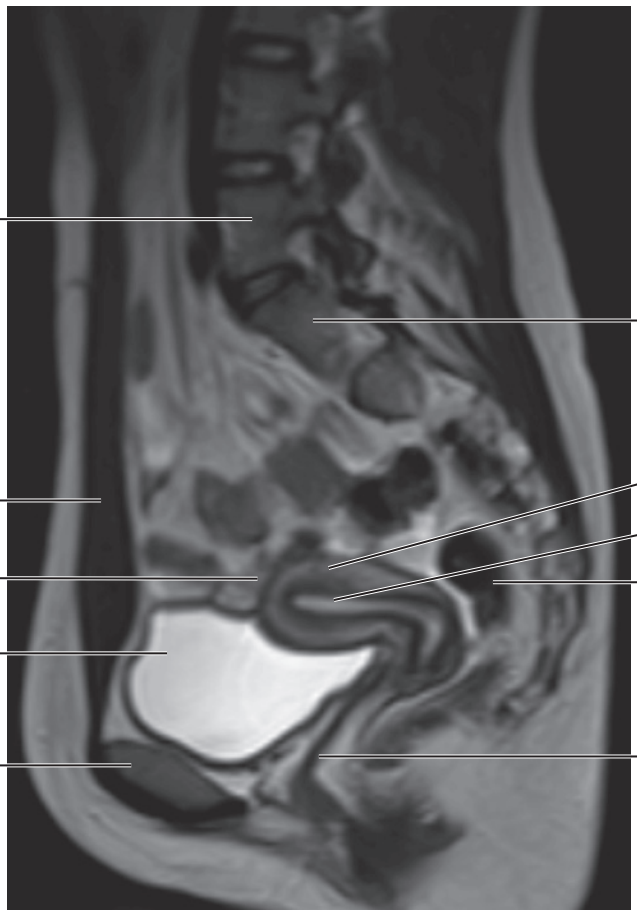
See also Plates 360, 365



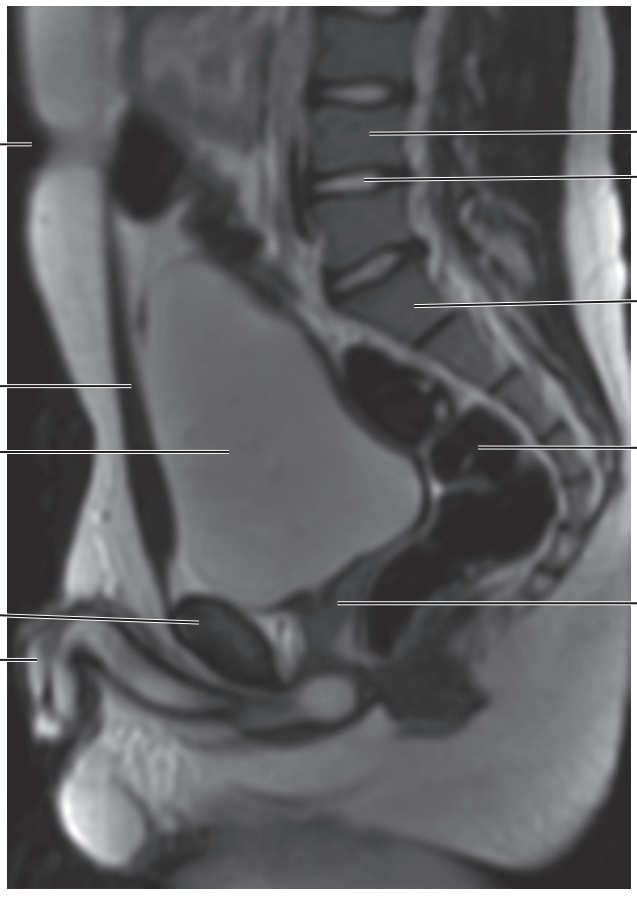


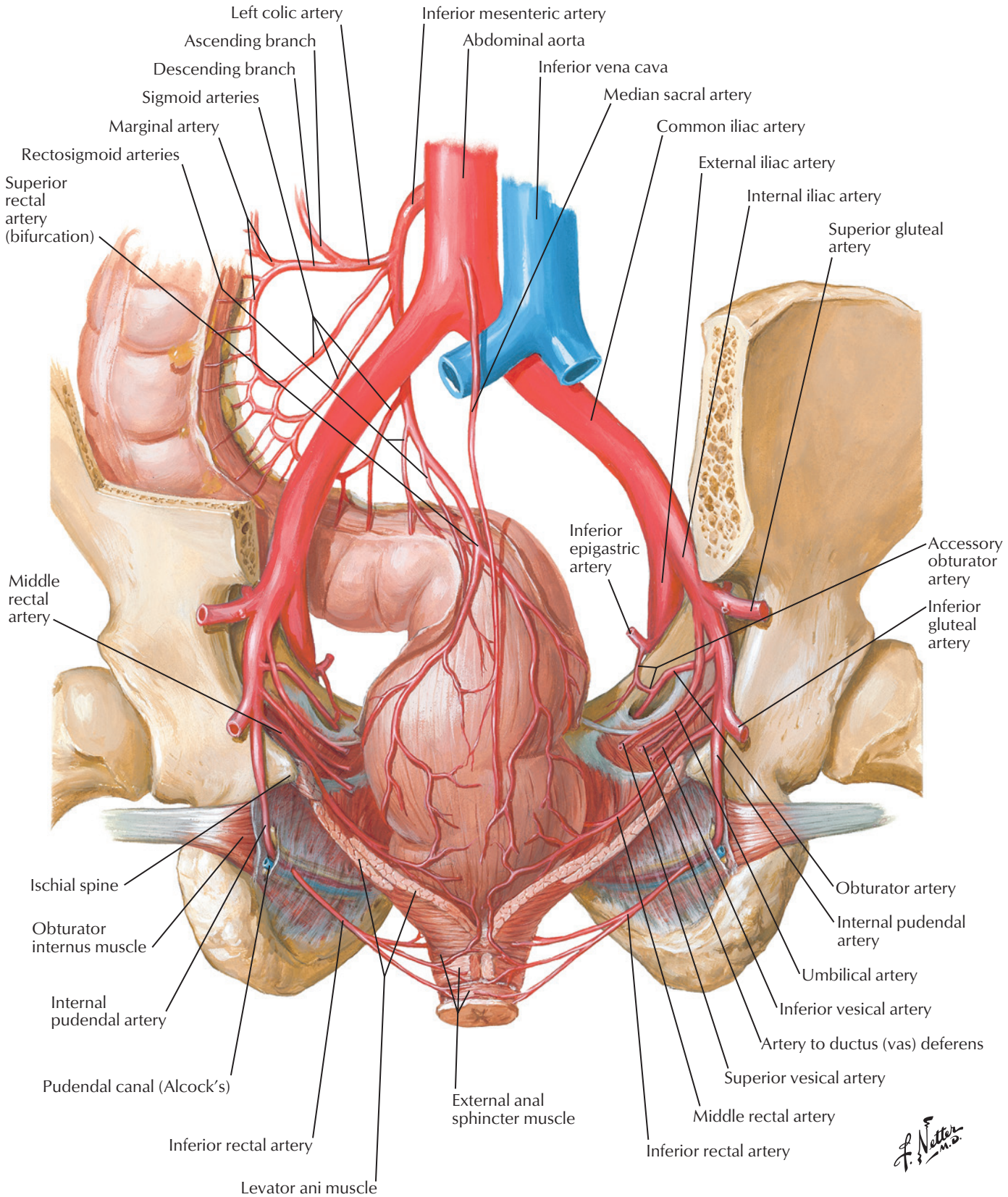
Spread of perineal abscess in perineal spaces

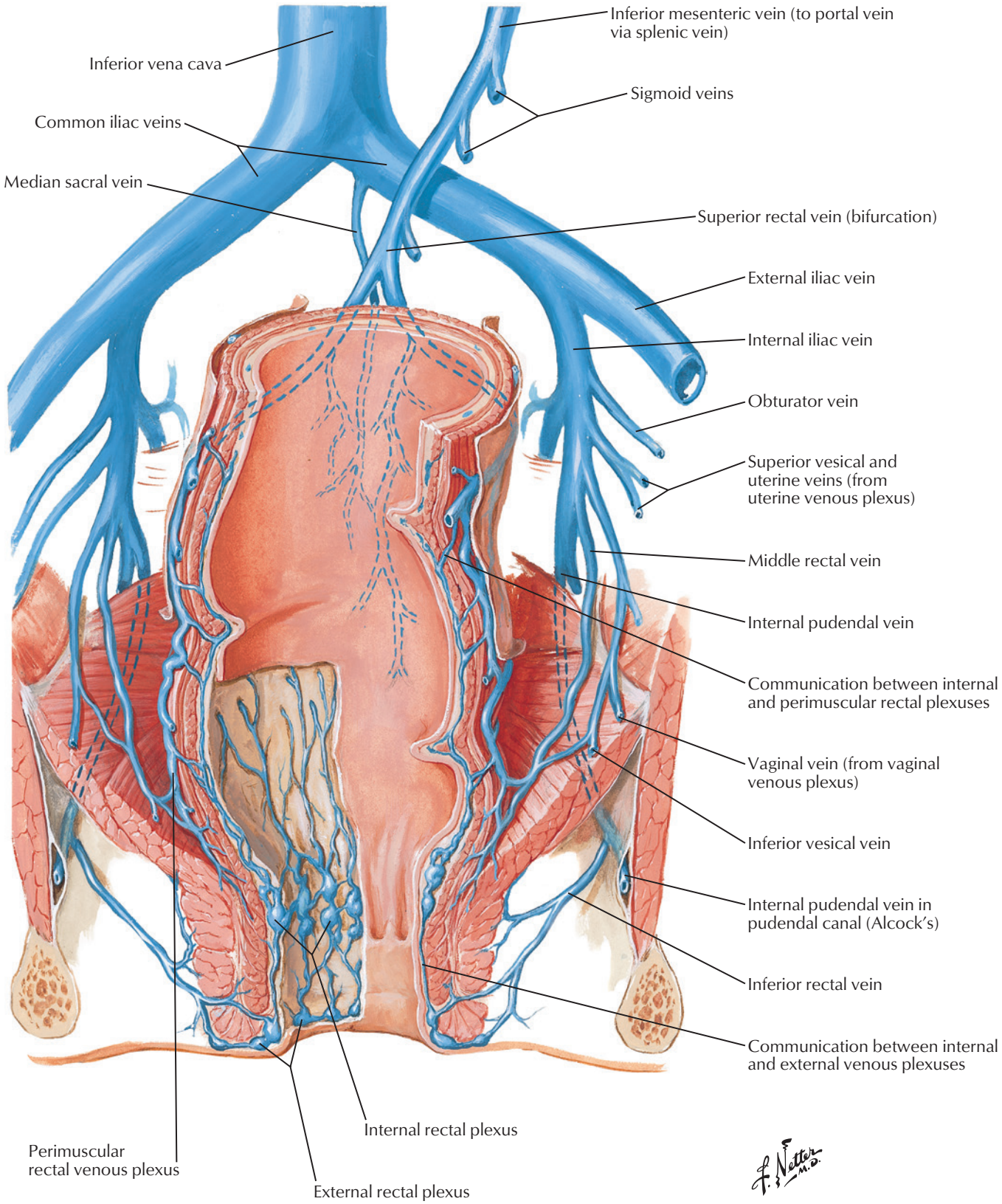
MRI of female pelvis (without intravenous contrast medium)

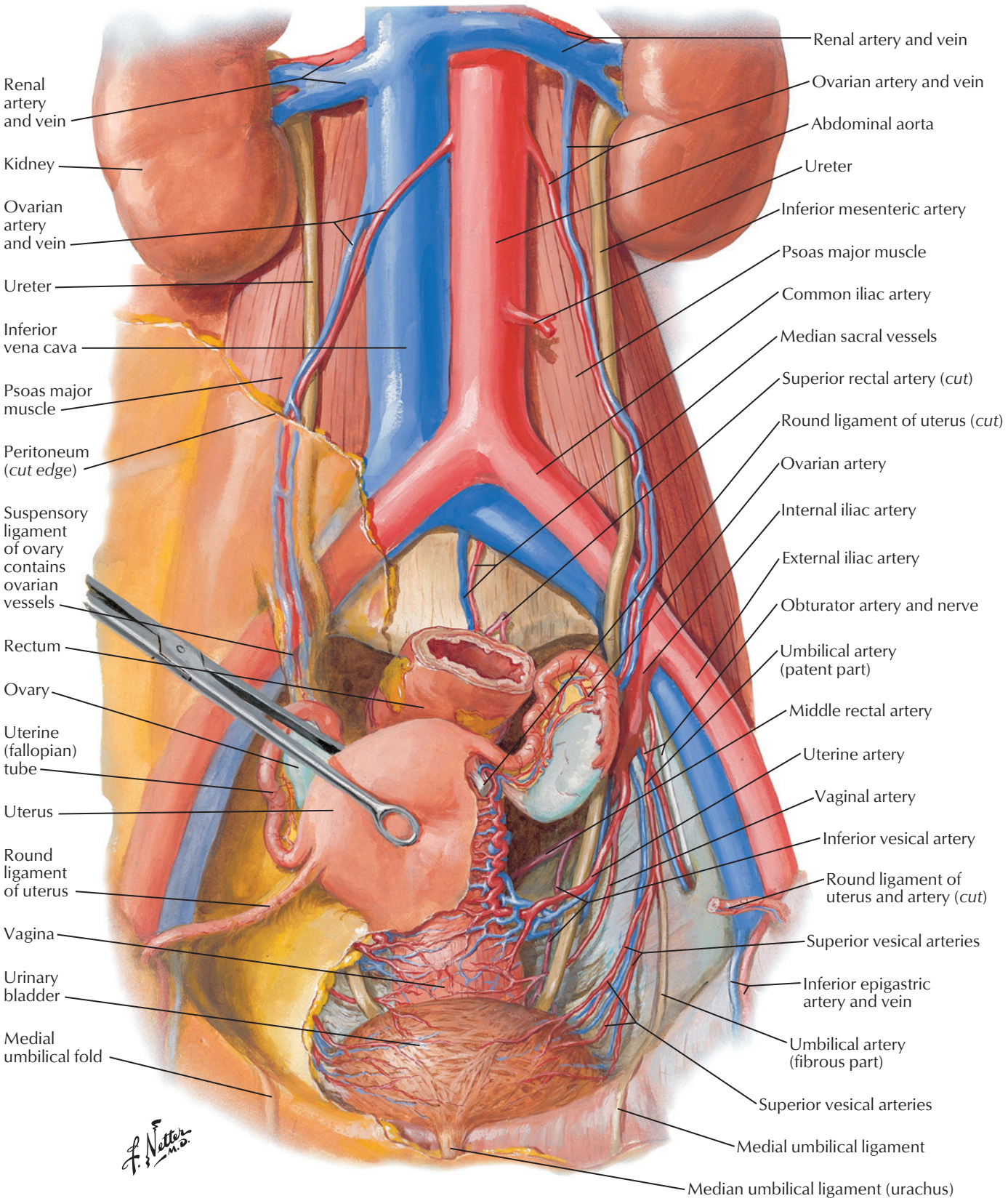


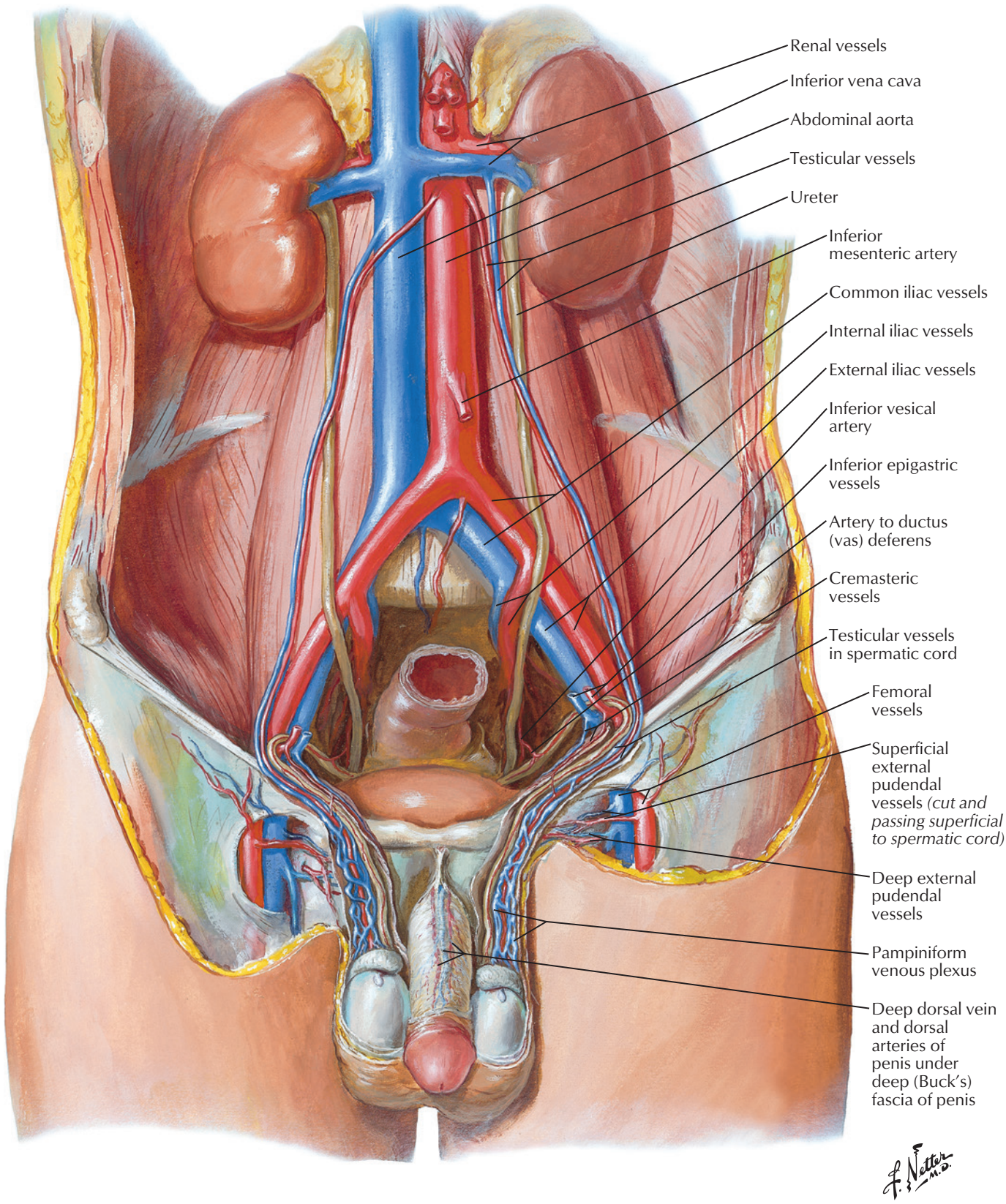
MRI of male pelvis (without intravenous contrast medium)

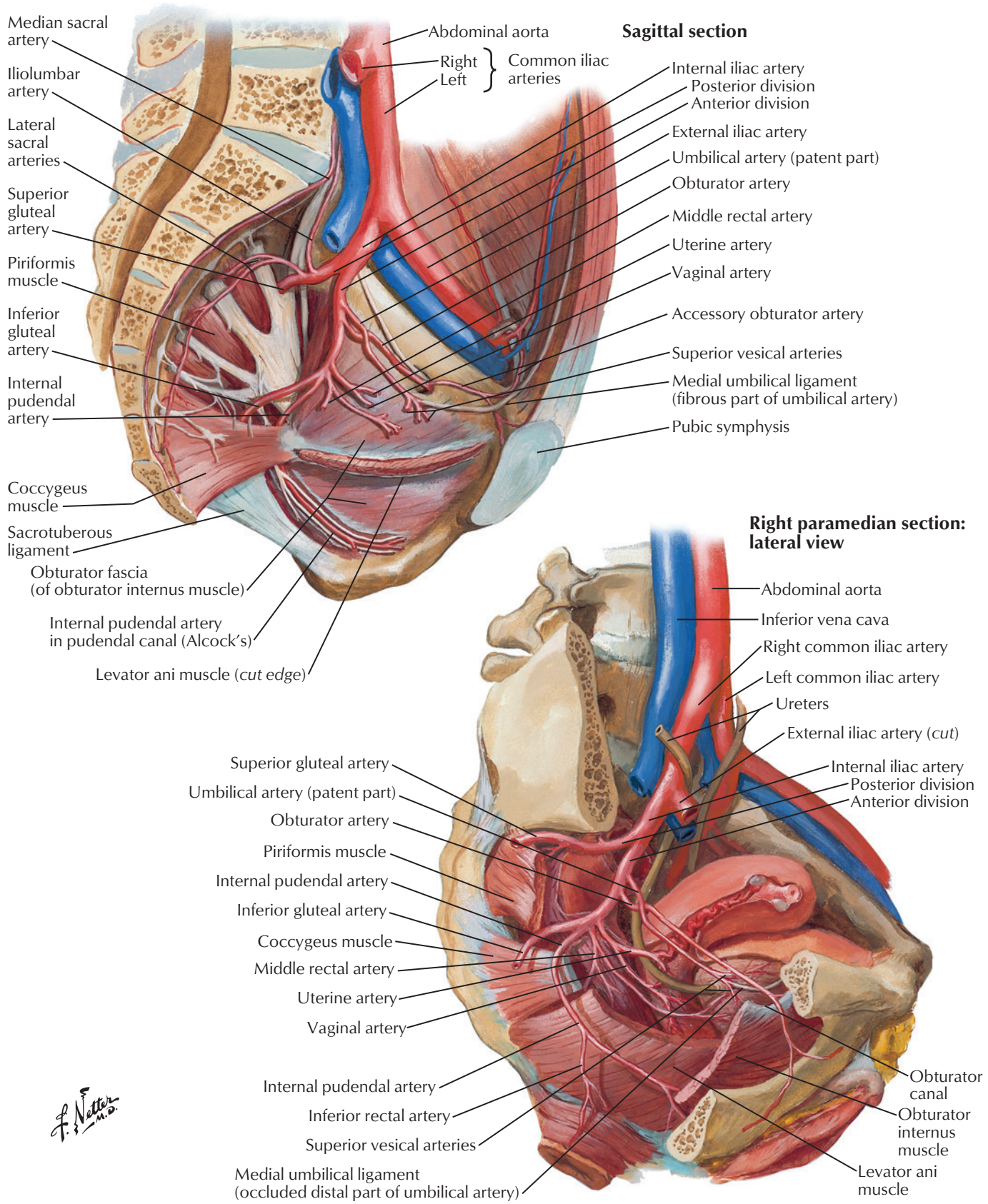


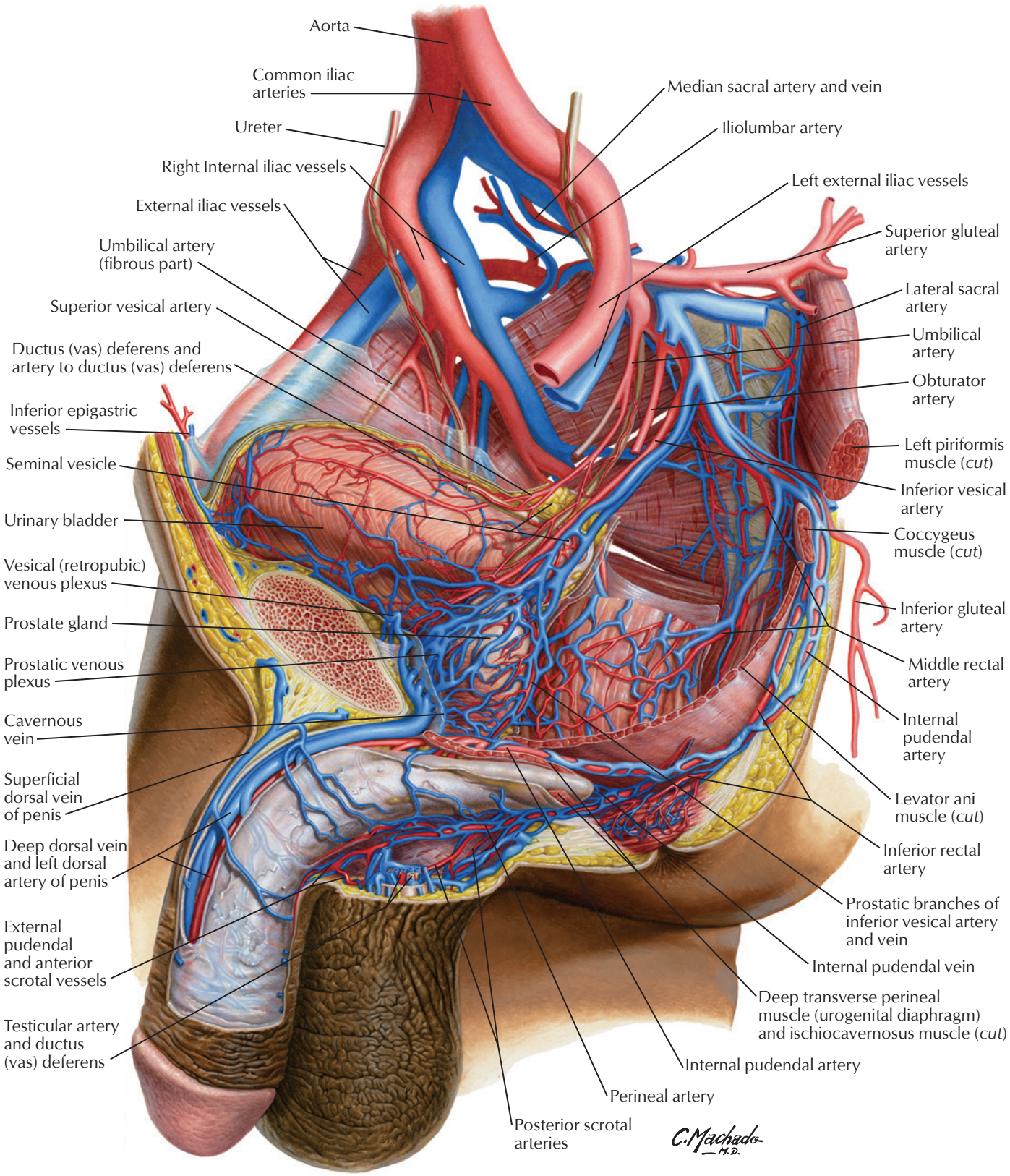

Left colic artery
Ascending branch
Descending branch
Sigmoid arteries
Marginal artery
Rectosigmoid arteries
Superior rectal artery (bifurcation)
Inferior mesenteric artery
Abdominal aorta
Inferior vena cava
Median sacral artery
Common iliac artery
External iliac artery
Internal iliac artery
Superior gluteal artery
Inferior epigastric artery
Accessory obturator artery
Inferior gluteal artery
Middle rectal artery
Ischial spine
Obturator internus muscle
Internal pudendal artery
Pudendal canal (Alcock's)
Inferior rectal artery
Levator ani muscle
External anal sphincter muscle
Obturator artery
Internal pudendal artery
Umbilical artery
Inferior vesical artery
Artery to ductus (vas) deferens
Superior vesical artery
Middle rectal artery
Inferior rectal artery

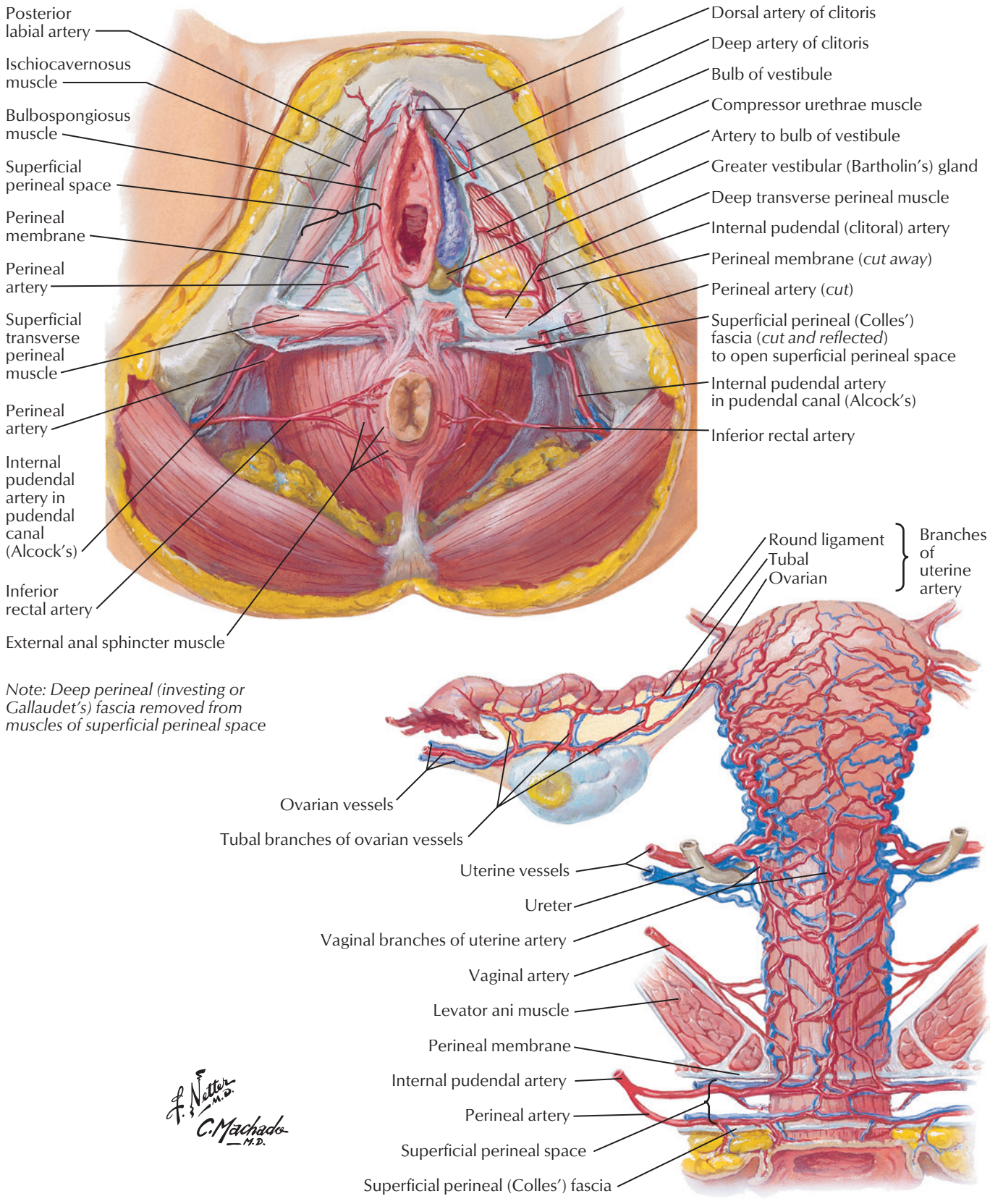

Inferior mesenteric vein (to portal vein via splenic vein)
Inferior vena cava
Sigmoid veins
Common iliac veins
Median sacral vein
Superior rectal vein (bifurcation)
External iliac vein
Internal iliac vein
Obturator vein
Superior vesical and uterine veins (from uterine venous plexus)
Middle rectal vein
Internal pudendal vein
Communication between internal and perimuscular rectal plexuses
Vaginal vein (from vaginal venous plexus)
Inferior vesical vein
Internal pudendal vein in pudendal canal (Alcock's)
Inferior rectal vein
Communication between internal and external venous plexuses
Internal rectal plexus
Perimuscular rectal venous plexus
External rectal plexus


Renal artery and vein
Ovarian artery and vein
Abdominal aorta
Ureter
Inferior mesenteric artery
Psoas major muscle
Common iliac artery
Median sacral vessels
Superior rectal artery (cut)
Round ligament of uterus (cut)
Ovarian artery
Internal iliac artery
External iliac artery
Obturator artery and nerve
Umbilical artery (patent part)
Middle rectal artery
Uterine artery
Vaginal artery
Inferior vesical artery
Round ligament of uterus and artery (cut)
Superior vesical arteries
Inferior epigastric artery and vein
Umbilical artery (fibrous part)
Superior vesical arteries
Medial umbilical ligament
Median umbilical ligament (urachus)
Renal artery and vein
Kidney
Ovarian artery and vein
Ureter
Inferior vena cava
Psoas major muscle
Peritoneum (cut edge)
Suspensory ligament of ovary contains ovarian vessels
Rectum
Ovary
Uterine (fallopian) tube
Uterus
Round ligament of uterus
Vagina
Urinary bladder
Medial umbilical fold


Renal vessels
Inferior vena cava
Abdominal aorta
Testicular vessels
Ureter
Inferior mesenteric artery
Common iliac vessels
Internal iliac vessels
External iliac vessels
Inferior vesical artery
Inferior epigastric vessels
Artery to ductus (vas) deferens
Cremasteric vessels
Testicular vessels in spermatic cord
Femoral vessels
Superficial external pudendal vessels *(cut and passing superficial to spermatic cord)*
Deep external pudendal vessels
Pampiniform venous plexus
Deep dorsal vein and dorsal arteries of penis under deep (Buck's) fascia of penis
F. Netter M.D.

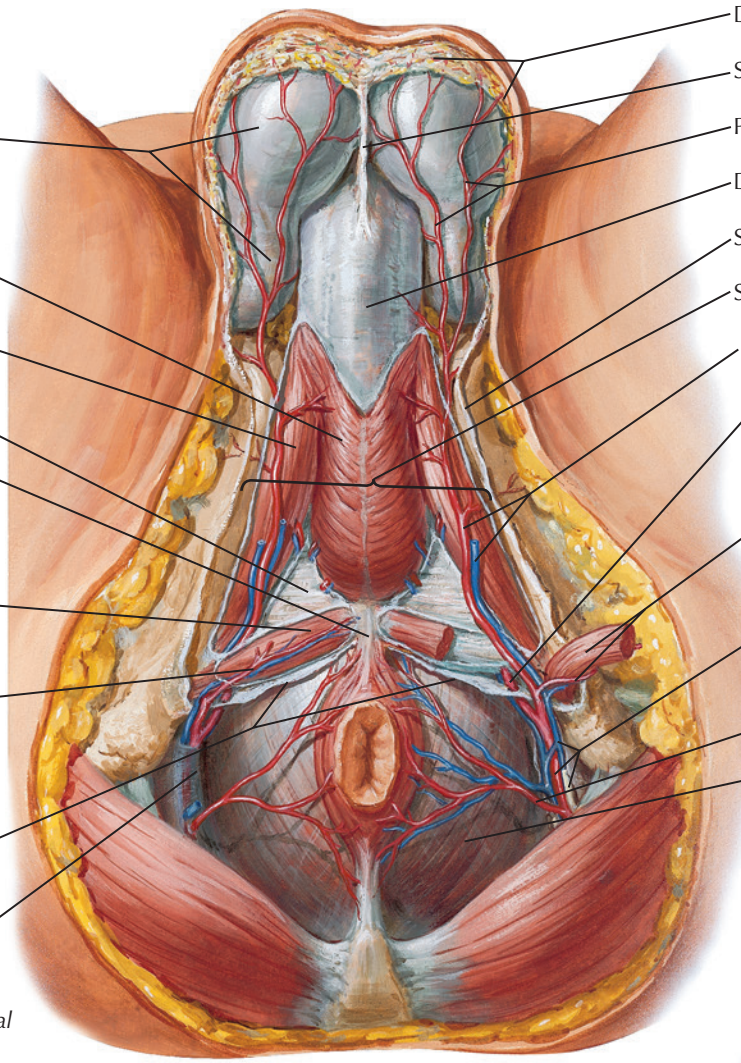

Median sacral artery
Iliolumbar artery
Lateral sacral arteries
Superior gluteal artery
Piriformis muscle
Inferior gluteal artery
Internal pudendal artery
Coccygeus muscle
Sacrotuberous ligament
Obturator fascia (of obturator internus muscle)
Internal pudendal artery in pudendal canal (Alcock's)
Levator ani muscle (cut edge)
Abdominal aorta
Right
Left
Common iliac arteries
Sagittal section
Internal iliac artery
Posterior division
Anterior division
External iliac artery
Umbilical artery (patent part)
Obturator artery
Middle rectal artery
Uterine artery
Vaginal artery
Accessory obturator artery
Superior vesical arteries
Medial umbilical ligament (fibrous part of umbilical artery)
Pubic symphysis
Right paramedian section: lateral view
Abdominal aorta
Inferior vena cava
Right common iliac artery
Left common iliac artery
Ureters
External iliac artery (cut)
Internal iliac artery
Posterior division
Anterior division
Superior gluteal artery
Umbilical artery (patent part)
Obturator artery
Piriformis muscle
Internal pudendal artery
Inferior gluteal artery
Coccygeus muscle
Middle rectal artery
Uterine artery
Vaginal artery
Internal pudendal artery
Inferior rectal artery
Superior vesical arteries
Medial umbilical ligament (occluded distal part of umbilical artery)
Obturator canal
Obturator internus muscle
Levator ani muscle


Aorta
Common iliac arteries
Ureter
Right Internal iliac vessels
External iliac vessels
Umbilical artery (fibrous part)
Superior vesical artery
Ductus (vas) deferens and artery to ductus (vas) deferens
Inferior epigastric vessels
Seminal vesicle
Urinary bladder
Vesical (retropubic) venous plexus
Prostate gland
Prostatic venous plexus
Cavernous vein
Superficial dorsal vein of penis
Deep dorsal vein and left dorsal artery of penis
External pudendal and anterior scrotal vessels
Testicular artery and ductus (vas) deferens
Median sacral artery and vein
Iliolumbar artery
Left external iliac vessels
Superior gluteal artery
Lateral sacral artery
Umbilical artery
Obturator artery
Left piriformis muscle (cut)
Inferior vesical artery
Coccygeus muscle (cut)
Inferior gluteal artery
Middle rectal artery
Internal pudendal artery
Levator ani muscle (cut)
Inferior rectal artery
Prostatic branches of inferior vesical artery and vein
Internal pudendal vein
Deep transverse perineal muscle (urogenital diaphragm) and ischiocavernosus muscle (cut)
Internal pudendal artery
Perineal artery
Posterior scrotal arteries
C. Machado M.D.

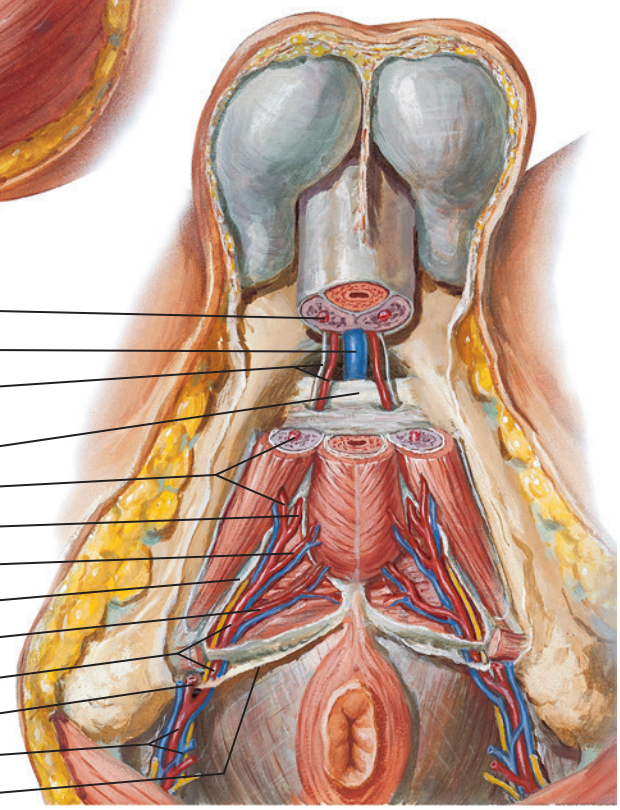


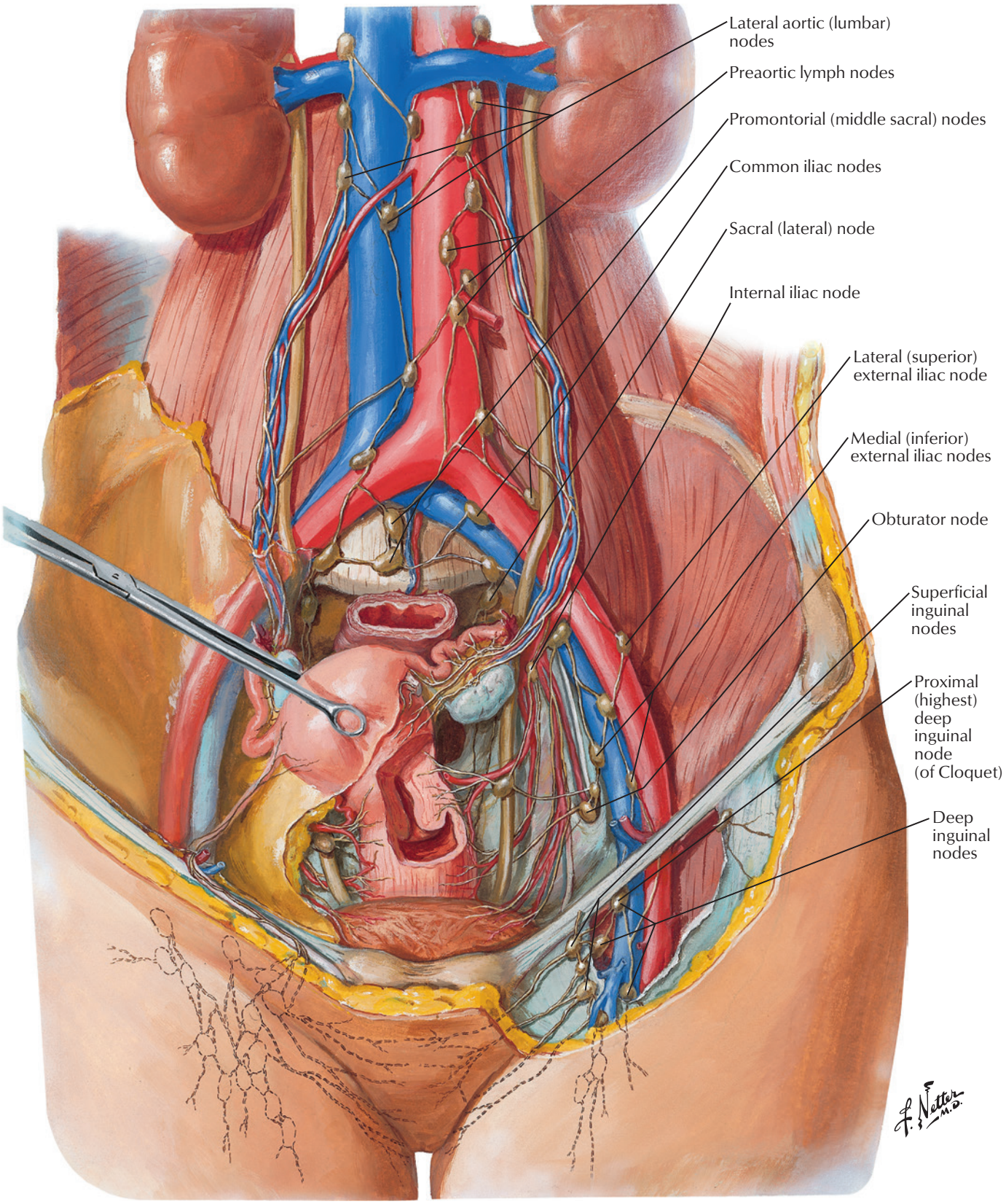
Note: Deep perineal (investing or Gallaudet's) fascia removed from muscles of superficial perineal space

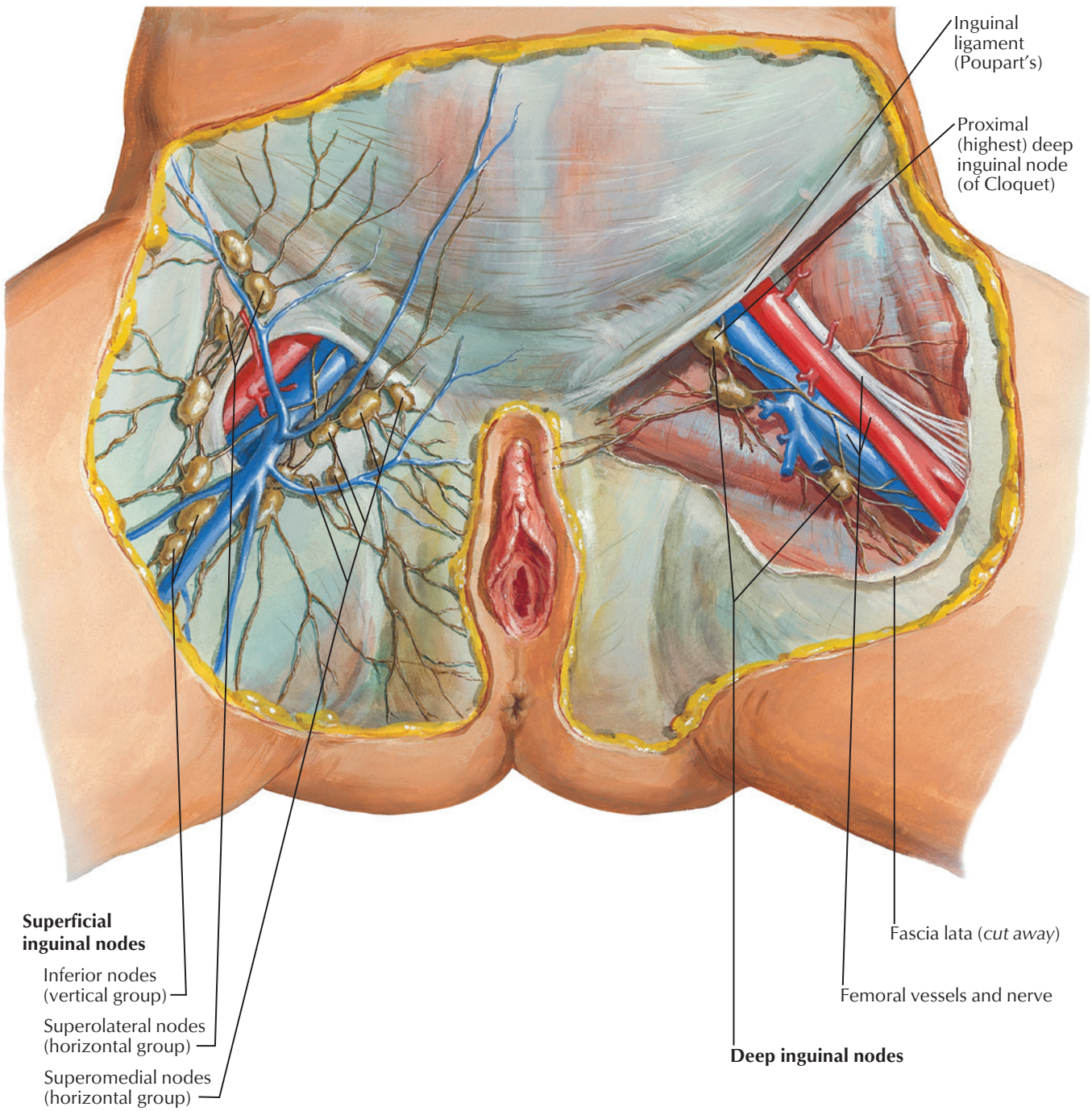
F. Netter M.D. C. Machado M.D.

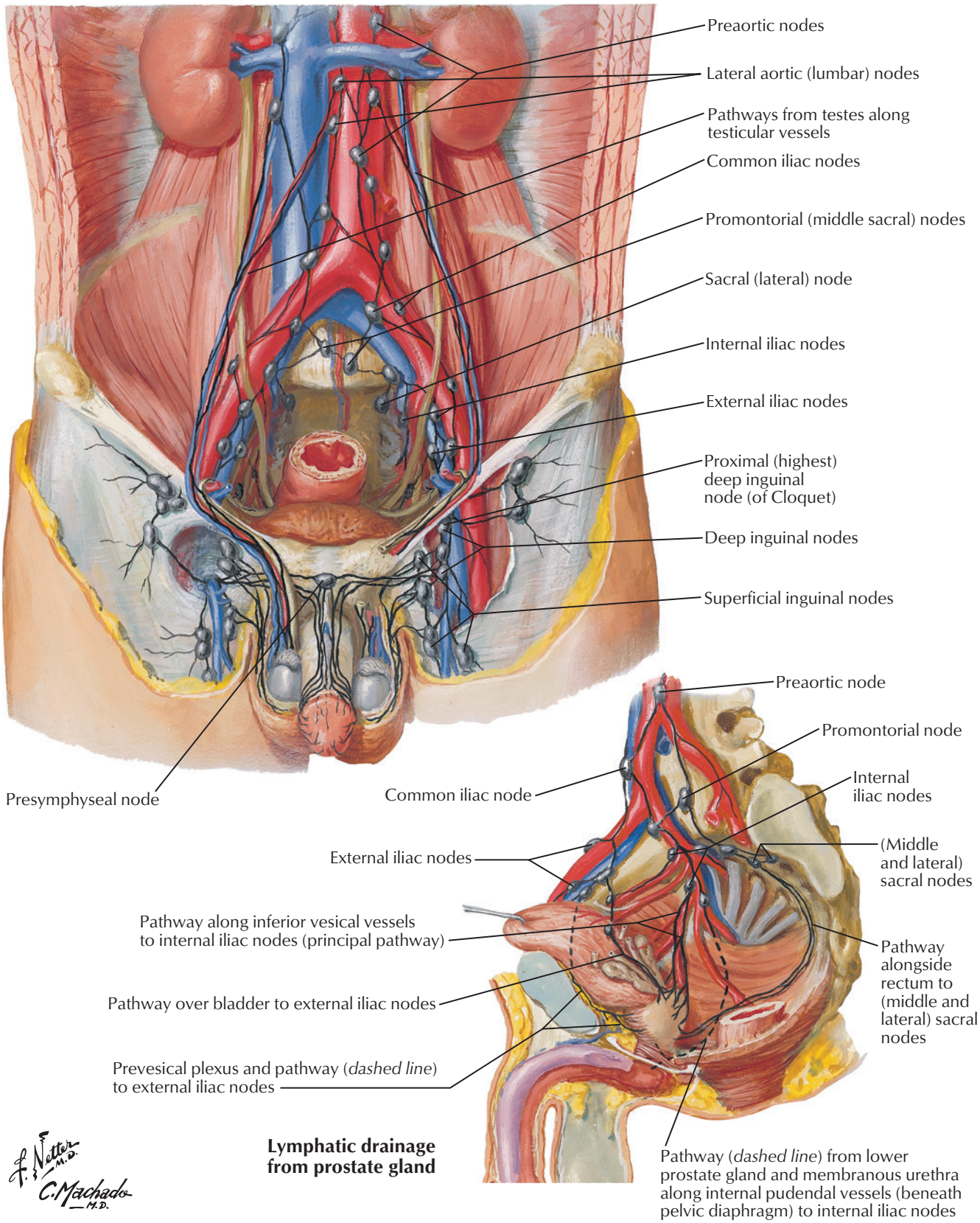


Note: Deep perineal (investing or Gallaudet's) fascia removed from muscles of superficial perineal space



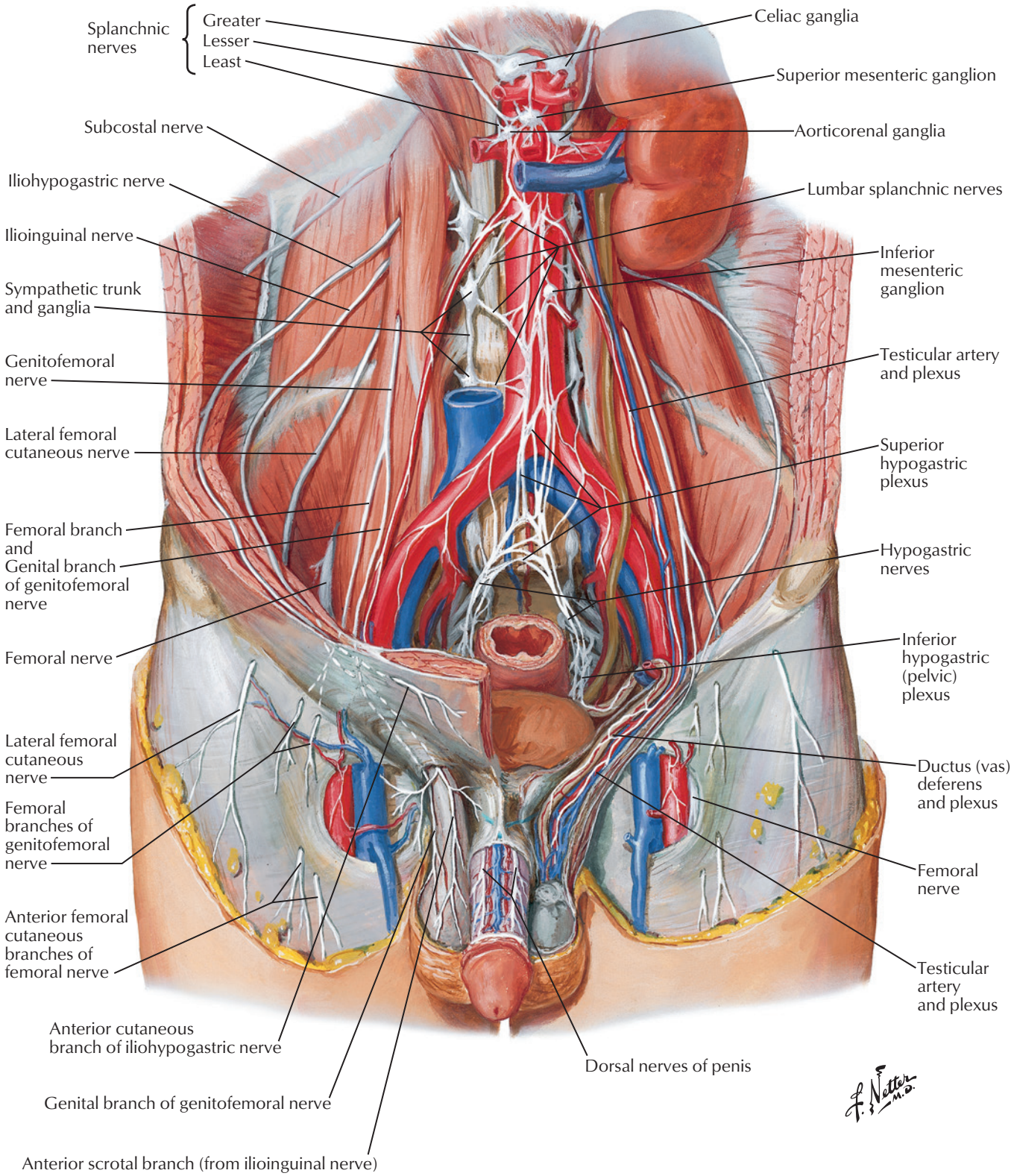

Lateral aortic (lumbar) nodes
Preaortic lymph nodes
Promontorial (middle sacral) nodes
Common iliac nodes
Sacral (lateral) node
Internal iliac node
Lateral (superior) external iliac node
Medial (inferior) external iliac nodes
Obturator node
Superficial inguinal nodes
Proximal (highest) deep inguinal node (of Cloquet)
Deep inguinal nodes


Inguinal ligament (Poupart's)
Proximal (highest) deep inguinal node (of Cloquet)
Superficial inguinal nodes
Inferior nodes (vertical group)
Superolateral nodes (horizontal group)
Superomedial nodes (horizontal group)
Fascia lata (*cut away*)
Femoral vessels and nerve
Deep inguinal nodes

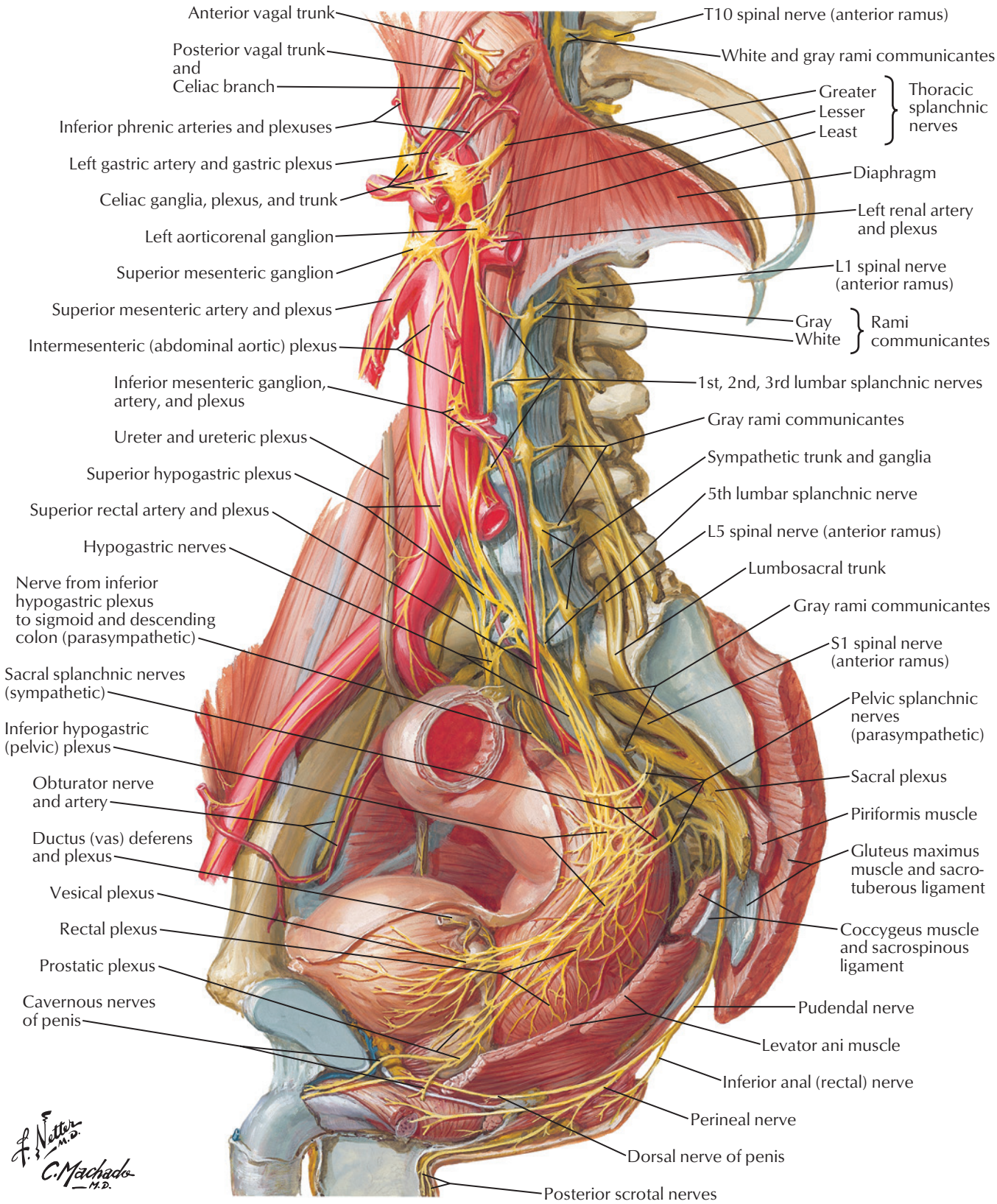


Lymphatic drainage from prostate gland

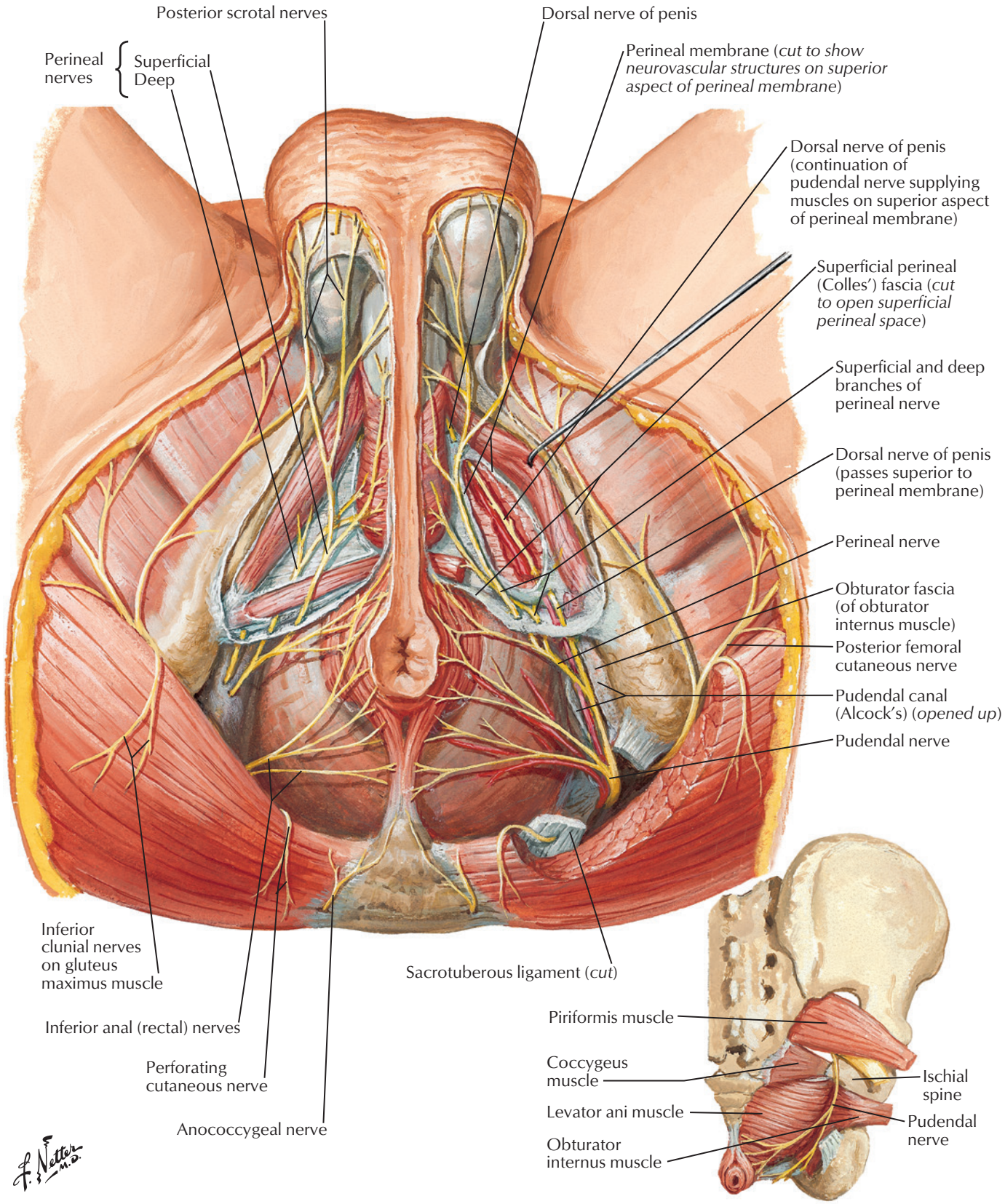
See also Plate 300



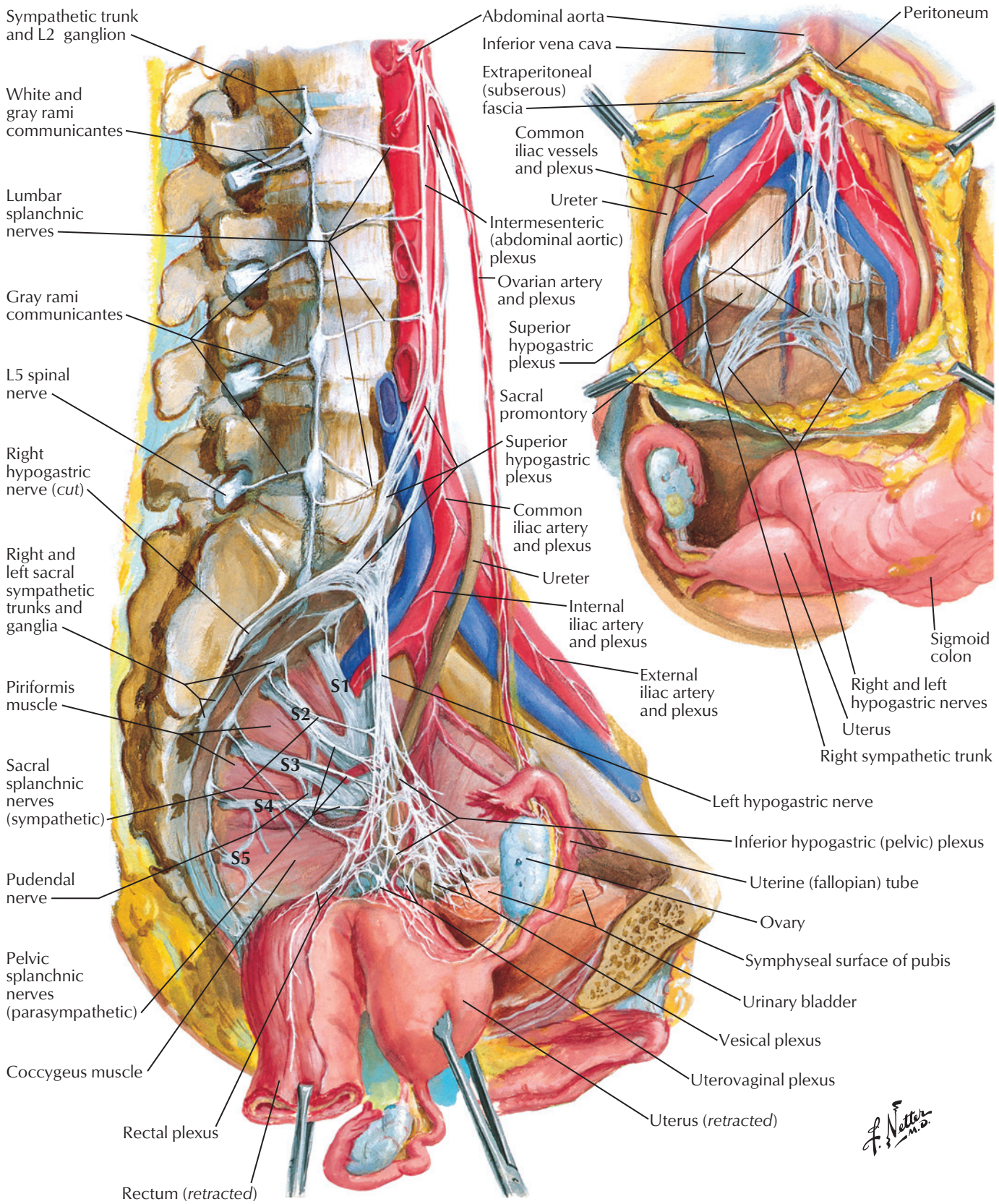
See also Plates 300, 385

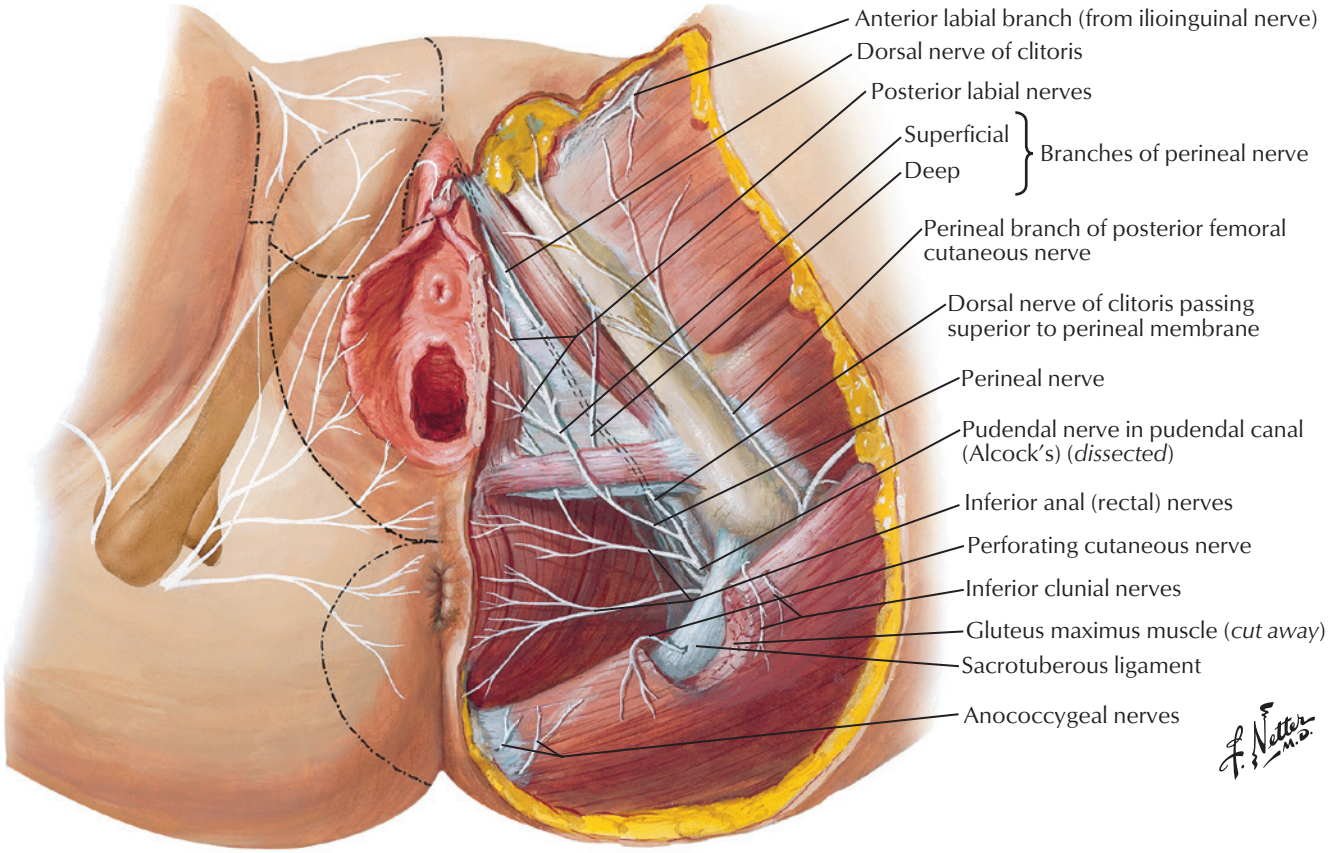


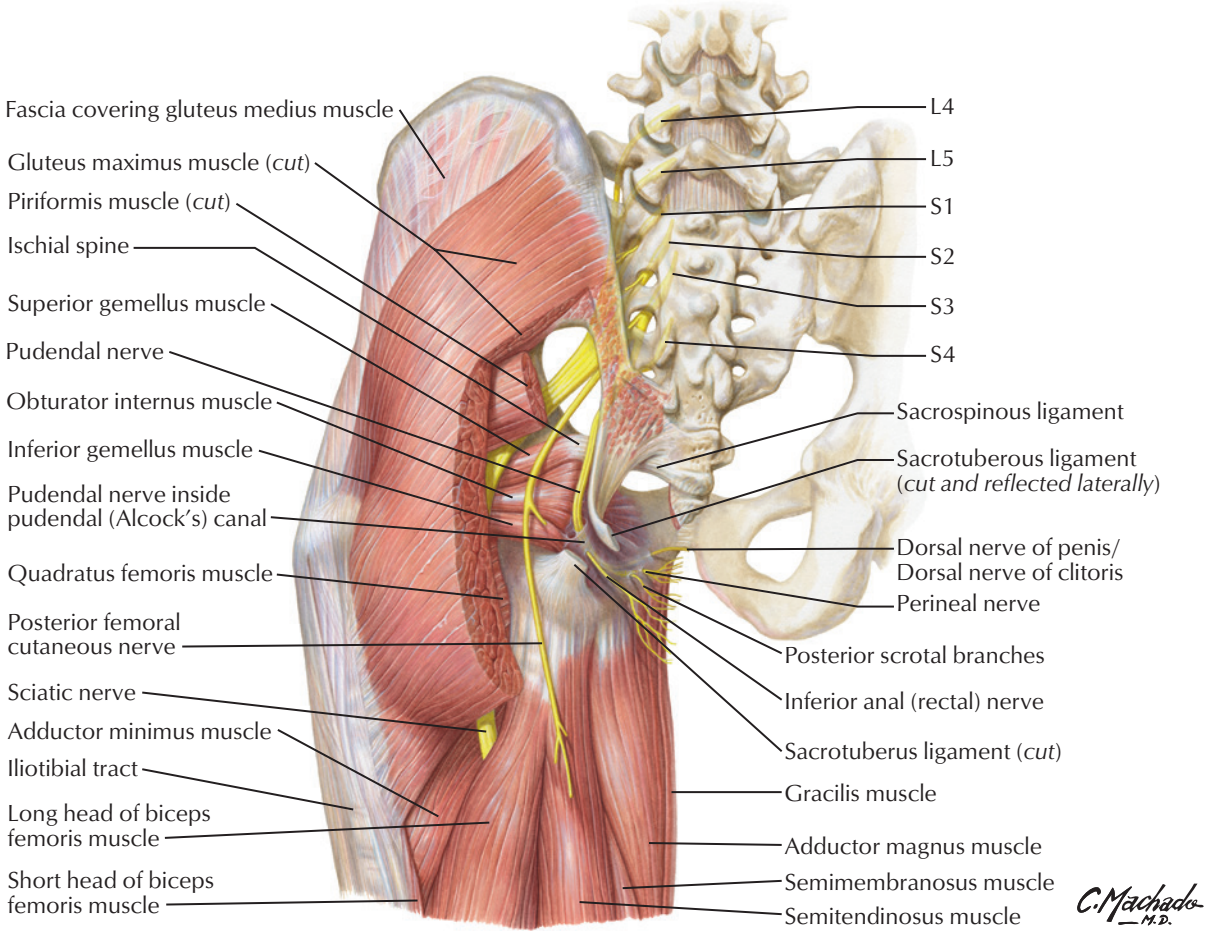
See also Plate 398

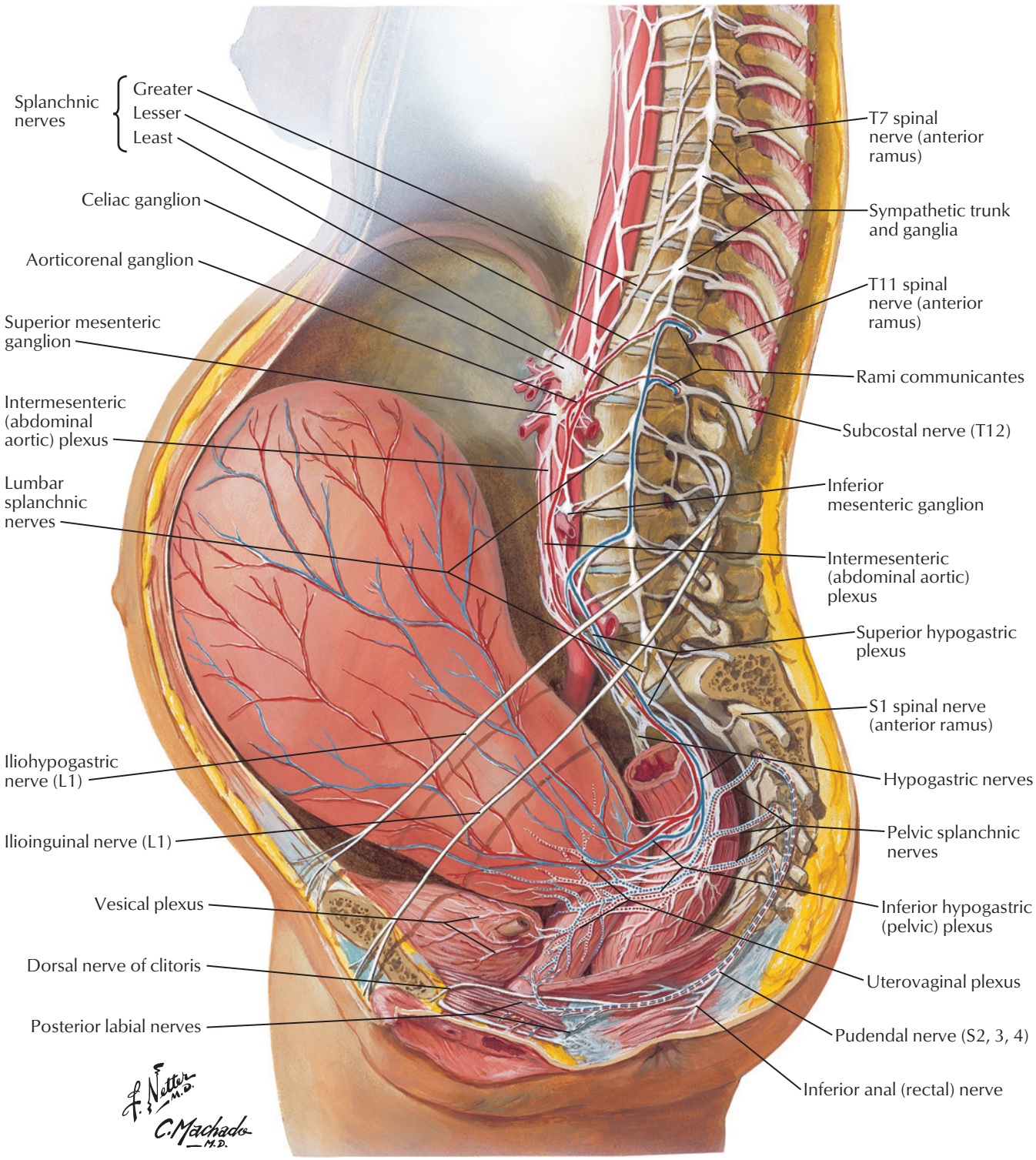


See also Plate 300




Anterior labial branch (from ilioinguinal nerve)
Dorsal nerve of clitoris
Posterior labial nerves
Superficial
Deep
Branches of perineal nerve
Perineal branch of posterior femoral cutaneous nerve
Dorsal nerve of clitoris passing superior to perineal membrane
Perineal nerve
Pudendal nerve in pudendal canal (Alcock's) (*dissected*)
Inferior anal (rectal) nerves
Perforating cutaneous nerve
Inferior clunial nerves
Gluteus maximus muscle (*cut away*)
Sacrotuberous ligament
Anococcygeal nerves
F. Netter M.D.


Fascia covering gluteus medius muscle
Gluteus maximus muscle (*cut*)
Piriformis muscle (*cut*)
Ischial spine
Superior gemellus muscle
Pudendal nerve
Obturator internus muscle
Inferior gemellus muscle
Pudendal nerve inside pudendal (Alcock's) canal
Quadratus femoris muscle
Posterior femoral cutaneous nerve
Sciatic nerve
Adductor minimus muscle
Iliotibial tract
Long head of biceps femoris muscle
Short head of biceps femoris muscle
L4
L5
S1
S2
S3
S4
Sacrospinous ligament
Sacrotuberous ligament (*cut and reflected laterally*)
Dorsal nerve of penis/ Dorsal nerve of clitoris
Perineal nerve
Posterior scrotal branches
Inferior anal (rectal) nerve
Sacrotuberus ligament (*cut*)
Gracilis muscle
Adductor magnus muscle
Semimembranosus muscle
Semitendinosus muscle
C. Machado M.D.



Sensory fibers from uterine body and fundus accompany sympathetic fibers via hypogastric plexuses to T11, 12 (L1?)

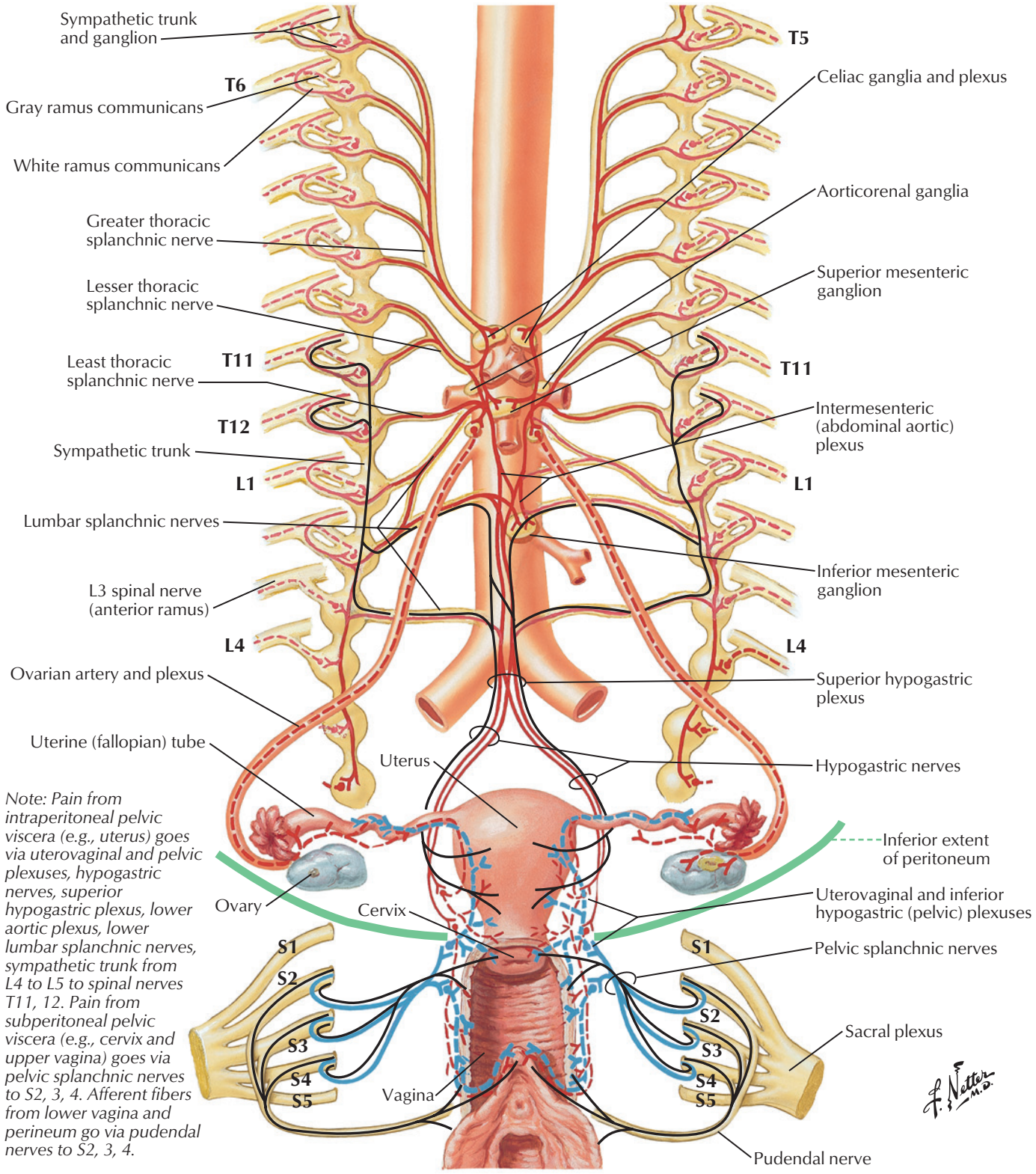
Motor fibers to uterine body and fundus (sympathetic)

Sensory fibers from cervix and upper vagina accompany pelvic splanchnic nerves (parasympathetic) to S2, 3, 4

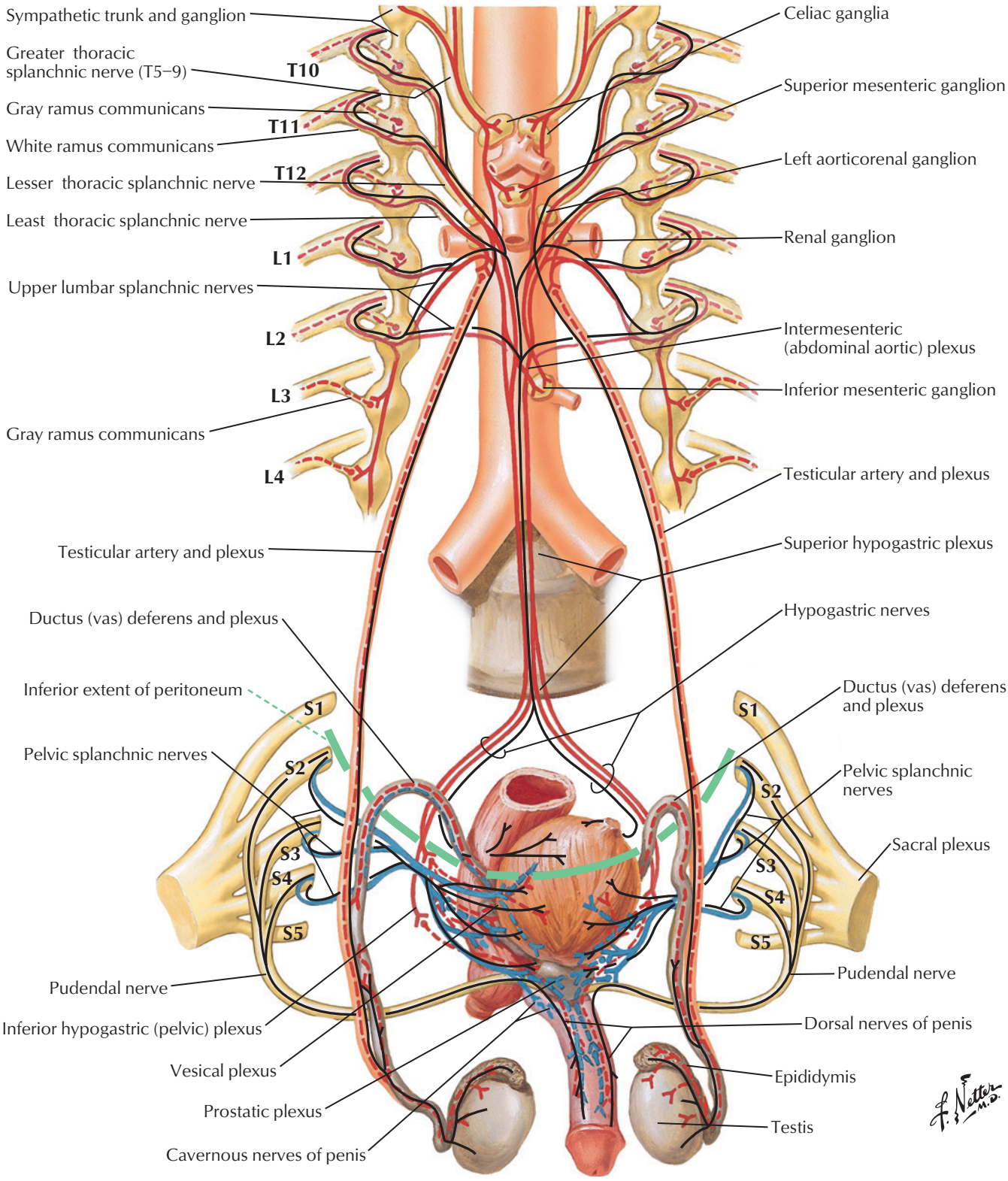
Motor fibers to lower uterine segment, cervix, and upper vagina (parasympathetic)

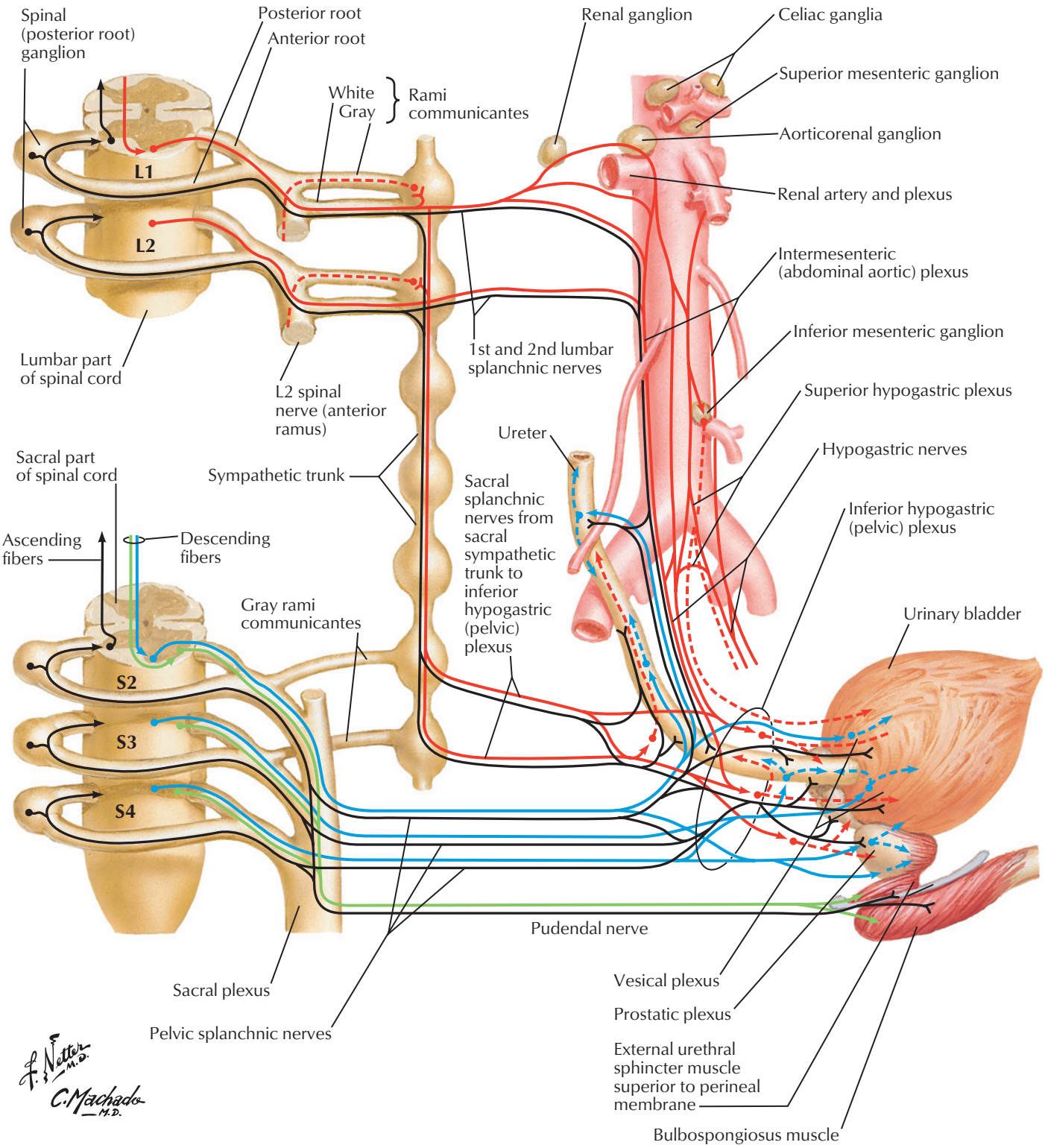
Sensory fibers from lower vagina and perineum accompany somatic fibers via pudendal nerve to S2, 3, 4

Motor fibers to lower vagina and perineum via pudendal nerve (somatic)

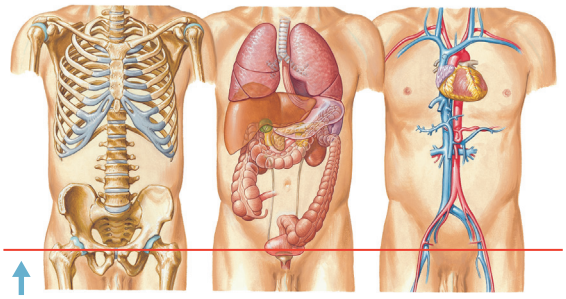


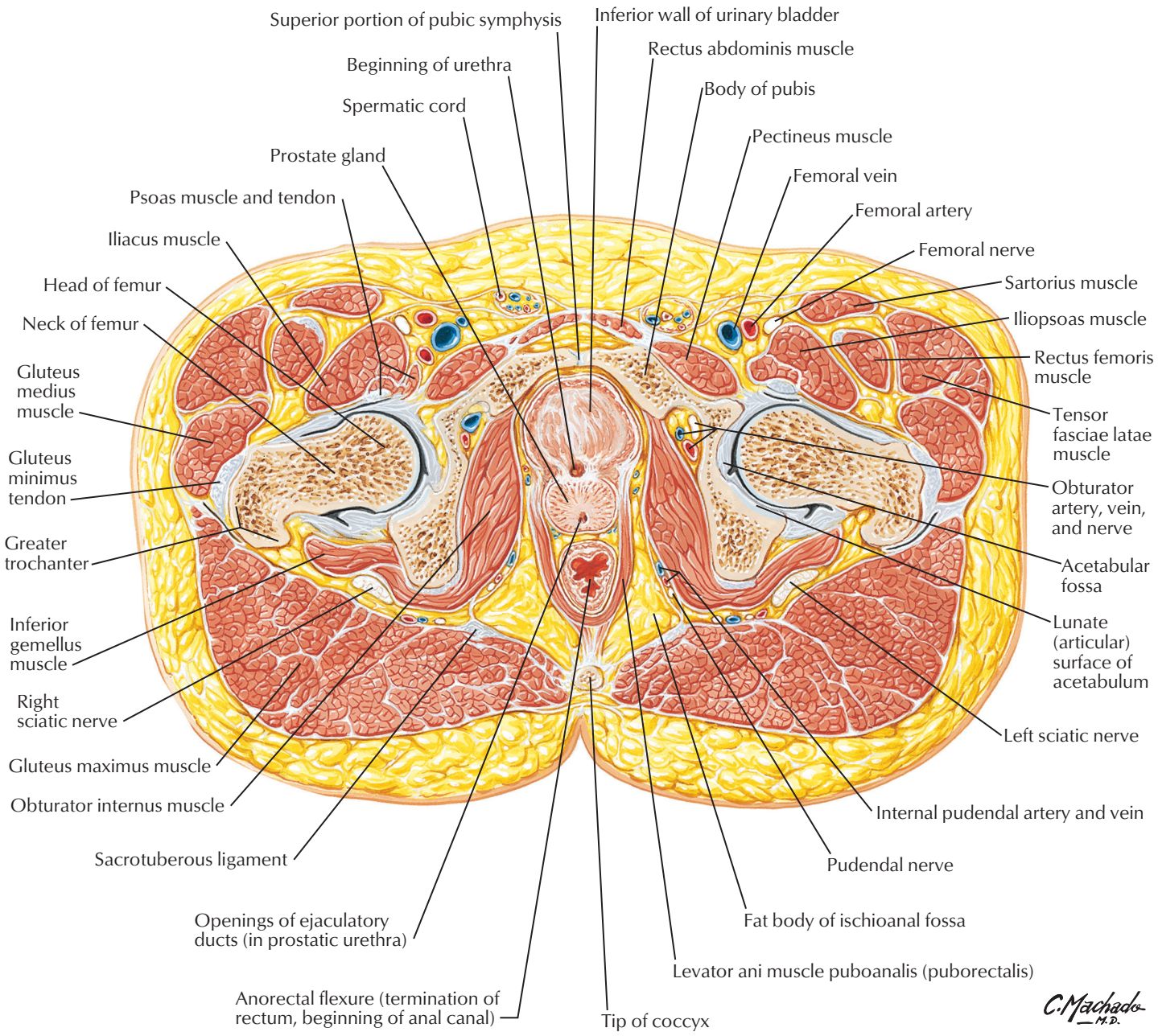
Note: Pain from intraperitoneal pelvic viscera (e.g., uterus) goes via uterovaginal and pelvic plexuses, hypogastric nerves, superior hypogastric plexus, lower aortic plexus, lower lumbar splanchnic nerves, sympathetic trunk from L4 to L5 to spinal nerves T11, 12. Pain from subperitoneal pelvic viscera (e.g., cervix and upper vagina) goes via pelvic splanchnic nerves to S2, 3, 4. Afferent fibers from lower vagina and perineum go via pudendal nerves to S2, 3, 4.

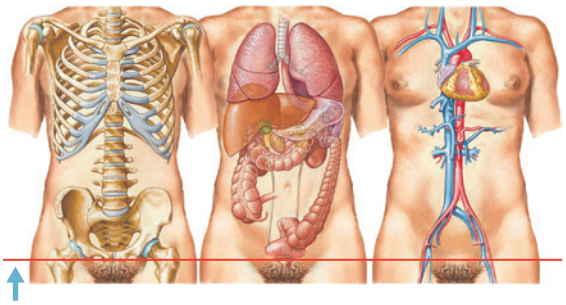

Sympathetic trunk and ganglion
Greater thoracic splanchnic nerve (T5–9)
Gray ramus communicans
White ramus communicans
Lesser thoracic splanchnic nerve
Least thoracic splanchnic nerve
Upper lumbar splanchnic nerves
Gray ramus communicans
Testicular artery and plexus
Ductus (vas) deferens and plexus
Inferior extent of peritoneum
Pelvic splanchnic nerves
Pudendal nerve
Inferior hypogastric (pelvic) plexus
Vesical plexus
Prostatic plexus
Cavernous nerves of penis
T10
T11
T12
L1
L2
L3
L4
S1
S2
S3
S4
S5
Celiac ganglia
Superior mesenteric ganglion
Left aorticorenal ganglion
Renal ganglion
Intermesenteric (abdominal aortic) plexus
Inferior mesenteric ganglion
Testicular artery and plexus
Superior hypogastric plexus
Hypogastric nerves
Ductus (vas) deferens and plexus
Pelvic splanchnic nerves
Sacral plexus
Pudendal nerve
Dorsal nerves of penis
Epididymis
Testis
Sympathetic fibers
Preganglionic
Postganglionic
Parasympathetic fibers
Preganglionic
Postganglionic
Afferent fibers


Spinal (posterior root) ganglion
Posterior root
Anterior root
White
Gray
Rami communicantes
L1
L2
Lumbar part of spinal cord
L2 spinal nerve (anterior ramus)
1st and 2nd lumbar splanchnic nerves
Renal ganglion
Celiac ganglia
Superior mesenteric ganglion
Aorticorenal ganglion
Renal artery and plexus
Intermesenteric (abdominal aortic) plexus
Inferior mesenteric ganglion
Superior hypogastric plexus
Hypogastric nerves
Inferior hypogastric (pelvic) plexus
Ureter
Sacral part of spinal cord
Sympathetic trunk
Sacral splanchnic nerves from sacral sympathetic trunk to inferior hypogastric (pelvic) plexus
Ascending fibers
Descending fibers
Gray rami communicantes
Urinary bladder
S2
S3
S4
Pudendal nerve
Sacral plexus
Pelvic splanchnic nerves
Vesical plexus
Prostatic plexus
External urethral sphincter muscle superior to perineal membrane
Bulbospongiosus muscle
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Sympathetic fibers
Preganglionic
Postganglionic
Parasympathetic fibers
Preganglionic
Postganglionic
Somatic efferent fibers
Afferent fibers

Male Pelvis: Cross Section of Bladder–Prostate Gland Junction







Pubic symphysis
Pubic bone
Urethra
Pectineus muscle
Vagina
Obturator externus muscle
Vaginal venous plexus
Iliopsoas muscle
Lymph node
Sartorius muscle
Greater saphenous and femoral veins
Rectus femoris muscle
Femoral artery
Tensor fasciae latae muscle
Femoral nerve
Vastus lateralis muscle
Deep femoral artery
Femur, neck
Gluteus medius muscle
Femur, greater trochanter
Fat tissue
Sciatic nerve
Inferior gemellus muscle
Gluteus maximus muscle
Ischium
Obturator internus muscle
Internal pudendal vessels and pudendal nerve
Levator ani muscle puboanalis (puborectalis)
Rectum

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ANATOMICAL STRUCTURES	CLINICAL IMPORTANCE	PLATE NUMBERS
SKELETAL SYSTEM		
Pubic symphysis	Palpable landmark used to obtain pelvic measurements (e.g., diagonal conjugate) that are used to assess adequacy of pelvis for childbirth; during prenatal examinations, used for estimating fetal growth (symphysis–fundal height measurement)	336
Ischial spine	Palpable landmark used to estimate interspinous diameter for childbirth and to locate pudendal nerve for pudendal nerve block	336
Ischial tuberosity	Palpable landmark used to estimate width of pelvic outlet for childbirth	336
Superior pubic ramus	Often fractured by compression of pelvis in anteroposterior plane by crush injury	338
Ischial spine	Pudendal nerve blocks target pudendal nerve at its entry into lesser sciatic foramen, approximately 1 cm inferior and medial to attachment of sacrospinous ligament on ischial spine	384, 393
MUSCULAR SYSTEM		
Pelvic diaphragm (levator ani and coccygeus muscles)	Provides support to urethrovesical angle, helping to maintain urinary continence; weakness or injury during childbirth can lead to stress incontinence in women	340, 351
Endopelvic fascia	Weakness or tearing of endopelvic fascial ligaments (e.g., pubovesical or cardinal ligaments) facilitates prolapse of pelvic organs	350, 353
Perineal body	Tearing of perineal body can lead to prolapse of pelvic organs or loss of continence	360
DIGESTIVE SYSTEM		
Rectum	Examined by digital rectal examination to detect internal hemorrhoids, fecal impaction, and rectal cancer; provides access to colon for colonoscopy	373, 375
Peritoneum	Common site for metastatic spread of ovarian cancer via peritoneal fluid in peritoneal cavity	344, 345
URINARY SYSTEM		
Urinary bladder	Landmark used to identify structures of pelvis during ultrasound examination	349, 350
Ureter	May be injured during hysterectomy because of its close relationship to uterine artery	346, 347
REPRODUCTIVE SYSTEM		
Rectouterine pouch (of Douglas)	Region examined with ultrasound to detect presence of abdominal or pelvic fluid; common site of ectopic pregnancy; may be accessed via posterior vaginal fornix	345, 346
Uterus	Palpated during prenatal examinations to assess fetal growth and during pelvic examinations; examined with ultrasound to detect abnormalities (e.g., fibroids)	345, 355
Cervix of uterus	Epithelium of transformation zone of cervix is prone to dysplasia and malignancy; cells are sampled from this region during pap examination	353, 355
Vagina	Posterior vaginal fornix allows access to rectouterine pouch of Douglas	345
Prostate gland	Prone to benign hypertrophy with aging; prostate cancer is second most common cancer in men	349, 366

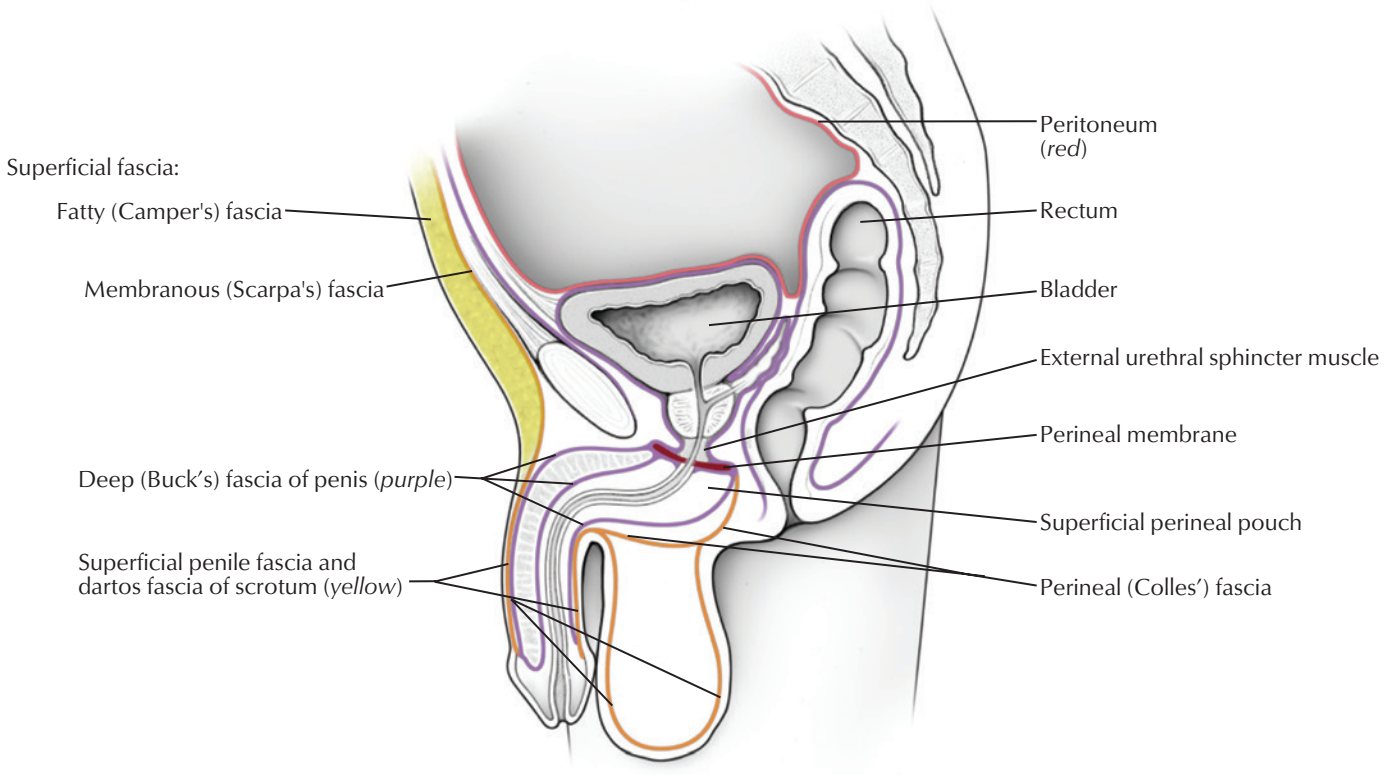
ANATOMICAL STRUCTURES	CLINICAL IMPORTANCE	PLATE NUMBERS
REPRODUCTIVE SYSTEM—Continued		
Ovary	Examined with ultrasound to identify cysts or for oocyte collection	344, 355
Ductus (vas) deferens	Ligated during vasectomy for sterilization in males	349, 369
NERVOUS SYSTEM		
Pudendal nerve	Pudendal block is performed to anesthetize perineum for childbirth or minor surgical procedures in perineum	395
Inferior rectal nerve	Anesthetized in ischioanal fossa for surgical excision of external hemorrhoids	393
Prostatic plexus/cavernous nerves	Disruption of these nerves during procedures (e.g., prostate surgery) can produce inability to achieve erection	392
CARDIOVASCULAR SYSTEM		
Pampiniform venous plexus	Dilation can cause testicular varicocele, most commonly on left side due to differences in drainage pattern of right and left gonadal veins	369
Uterine artery	Ligated or cauterized during hysterectomy; embolization is performed to treat uterine fibroids	382, 386
Arteries of penis (deep, dorsal), cavernous tissue	Blockage or loss of vascular smooth muscle function can lead to erectile dysfunction	387
Internal iliac veins	Provide communication between prostatic venous plexus and veins draining vertebral column, which is route of spread for prostate cancer	385
Rectal veins (superior, middle, inferior)	Portal hypertension may cause dilated rectal veins (hemorrhoids) because portosystemic anastomoses develop between rectal veins	381, 299
LYMPHATIC SYSTEM		
Pelvic and paraaortic (lateral aortic, lumbar) lymph nodes	Spread of ovarian cancer cells via venous drainage to inferior vena cava and lungs and via lymphatics	388
Paraaortic and tracheobronchial lymph nodes	Prostate cancer cells may spread via lymphatics	390
Preaortic and paraaortic (lateral aortic, lumbar) lymph nodes	Receive lymphatic drainage from ovary, uterine tube, and uterine fundus in women and from testis in men; cancers in these organs may therefore spread to retroperitoneum	388, 390
Pelvic lymph nodes	Lymph node sampling or dissection is performed to assess spread of gynecologic malignancies	388

*Selections were based largely on clinical data as well as commonly covered clinical correlations in gross anatomy courses.

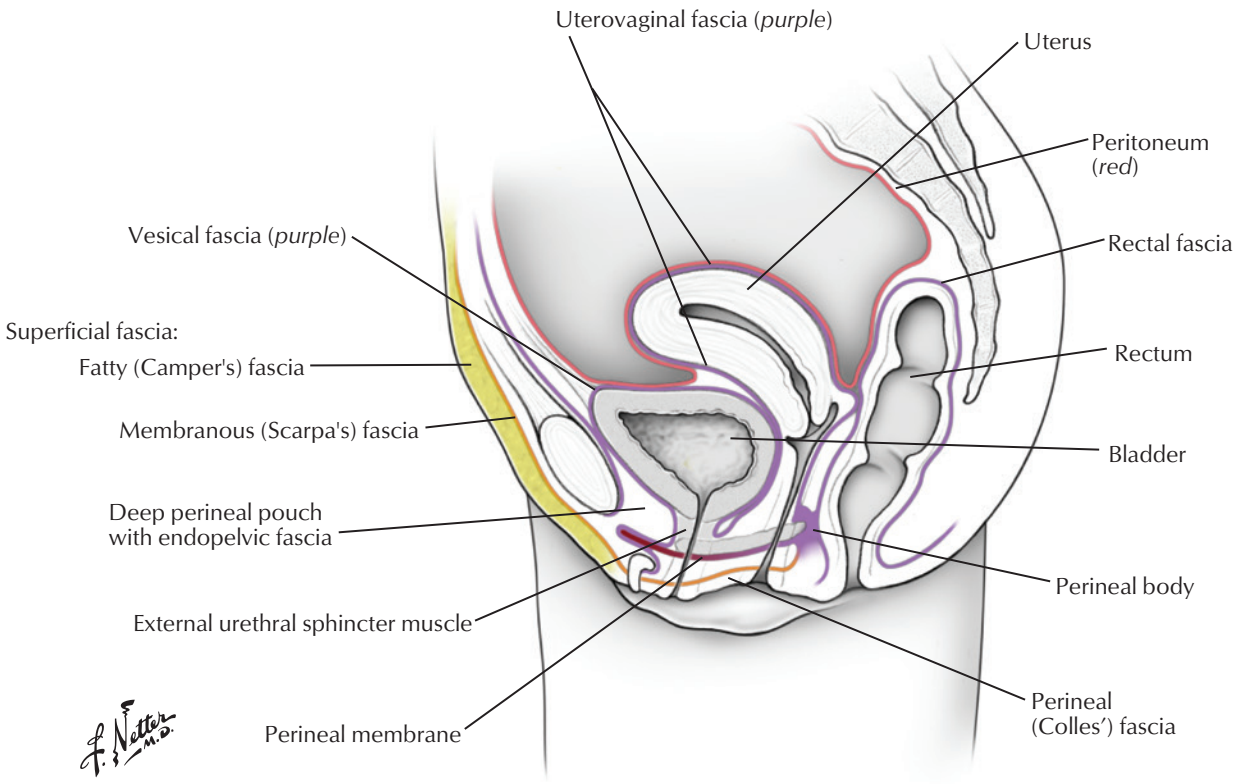
MUSCLE	MUSCLE GROUP	PROXIMAL ATTACHMENT (ORIGIN)	DISTAL ATTACHMENT (INSERTION)	INNERVATION	BLOOD SUPPLY	MAIN ACTIONS
Bulbospongiosus	Perineal	*Male:* median raphe, bulb of penis, perineal body *Female:* perineal body	*Male:* perineal membrane, corpus cavernosum, bulb of penis *Female:* dorsum of clitoris, inferior fascia of urogenital diaphragm, bulb of vestibule, pubic arch	Deep branch of perineal nerve from pudendal nerve	Internal pudendal artery and its branch (perineal artery)	*Male:* compresses bulb of penis, forces blood into body of penis during erection, removes urine from urethra and semen during ejaculation *Female:* constricts vaginal orifice, assists in expressing secretions of greater vestibular gland, forces blood into body of clitoris
Coccygeus	Pelvic floor	Ischial spine, sacrospinous ligament	Inferior sacrum, coccyx	Anterior rami of lower sacral nerves	Inferior gluteal artery	Supports pelvic viscera, draws coccyx forward
Compressor urethrae (female only)	Perineal	Ischiopubic ramus	Anterior aspect of urethra	Perineal branches of pudendal nerve	Perineal branch of internal pudendal artery	Sphincter of urethra
Cremaster	Spermatic cord	Lower edge of internal abdominal oblique and middle of inguinal ligament	Pubic tubercle, crest of pubis	Genital branch of genitofemoral nerve	Cremasteric branch of inferior epigastric artery	Retracts testicle
Deep transverse perineal	Perineal	Inner surface of inferior ischial rami	*Male:* medial tendinous raphe and perineal body *Female:* sides of vagina	Perineal branches of pudendal nerve	Perineal branch of internal pudendal artery	Stabilizes perineal body, supports prostate gland/ vagina
External anal sphincter	Perineal	Tip of coccyx, anococcygeal ligament	Deeper fibers surround anal canal, attach posteriorly to coccyx and anteriorly to central point of perineum	Perineal and inferior rectal branches of pudendal nerve	Inferior rectal and transverse perineal artery	Closes anal orifice
Iliacus	Anterior thigh	Superior 2/3 of iliac fossa, ala of sacrum, anterior sacroiliac ligaments	Lesser trochanter of femur and body inferior to it, to psoas major tendon	Femoral nerve	Iliac branches of iliolumbar artery	Flexes thigh at hips and stabilizes hip joint, acts with psoas major
Ischiocavernosus	Perineal	Inferior internal surface of ischiopubic ramus, ischial tuberosity	Crus of penis or clitoris	Deep branch of perineal nerve from pudendal nerve	Internal pudendal artery and its branch (perineal artery)	Forces blood into body of penis and clitoris during erection
Levator ani (iliococcygeus, pubococcygeus, and puboanalis)	Pelvic floor	Body of pubis, tendinous arch of obturator fascia, ischial spine	Perineal body, coccyx, anococcygeal raphe, walls of prostate gland or vagina, rectum, anal canal	Anterior rami of lower sacral nerves, perineal nerve	Inferior gluteal artery, internal pudendal artery and its branches (inferior rectal and perineal arteries)	Supports pelvic viscera, raises pelvic floor
Obturator internus	Gluteal region	Pelvic surface of obturator membrane and surrounding bone	Medial surface of greater trochanter of femur	Nerve to obturator internus muscle	Internal pudendal and obturator arteries	Laterally rotates extended thigh, abducts flexed thigh at hip
Piriformis	Gluteal region	Anterior surface of sacral segments 2–4, sacrotuberous ligament	Superior border of greater trochanter of femur	Anterior rami of L5, S1, S2	Superior and inferior gluteal arteries, internal pudendal artery	Laterally rotates extended thigh, abducts flexed thigh at hip

Variations in spinal nerve contributions to the innervation of muscles, their arterial supply, their attachments, and their actions are common themes in human anatomy. Therefore, expect differences between texts and realize that anatomical variation is normal.

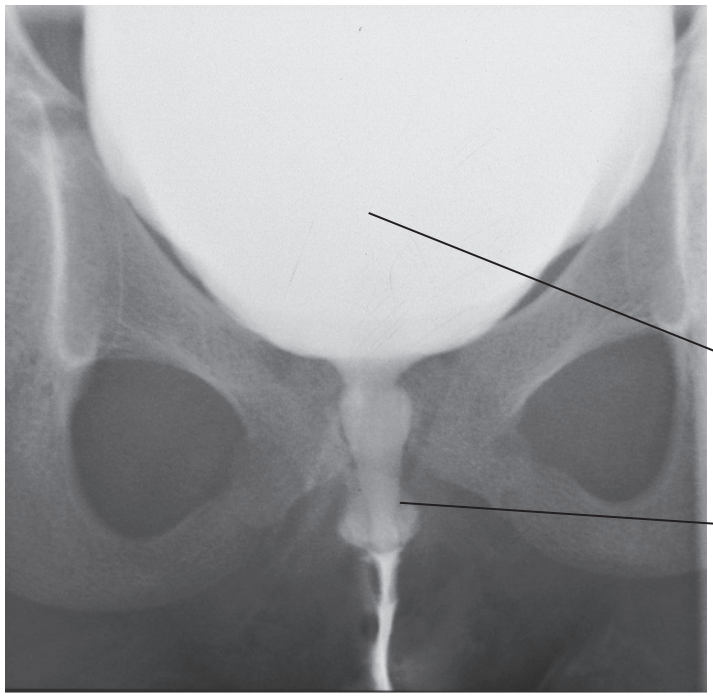
MUSCLE	MUSCLE GROUP	PROXIMAL ATTACHMENT (ORIGIN)	DISTAL ATTACHMENT (INSERTION)	INNERVATION	BLOOD SUPPLY	MAIN ACTIONS
Sphincter urethrae	Perineal	External fibers from junction of inferior pubic and ischial rami and adjacent fascia; internal fibers pass medially to surround membranous urethra	*Male:* median raphe in front and behind urethra *Female:* encloses urethra, attaches to sides of vagina	Perineal branches of pudendal nerve	Perineal branch of internal pudendal artery	Compresses urethra at end of micturition; in female also compresses distal vagina
Sphincter urethrovaginalis (female only)	Perineal	Perineal body	Passes forward and anteriorly around urethra	Perineal branches of pudendal nerve	Perineal branch of pudendal artery	Sphincter of urethra and vagina
Superficial transverse perineal	Perineal	Ischial rami and tuberosities	Central tendon (perineal body)	Perineal branches of pudendal nerve	Perineal branch of internal pudendal artery	Stabilizes central tendon



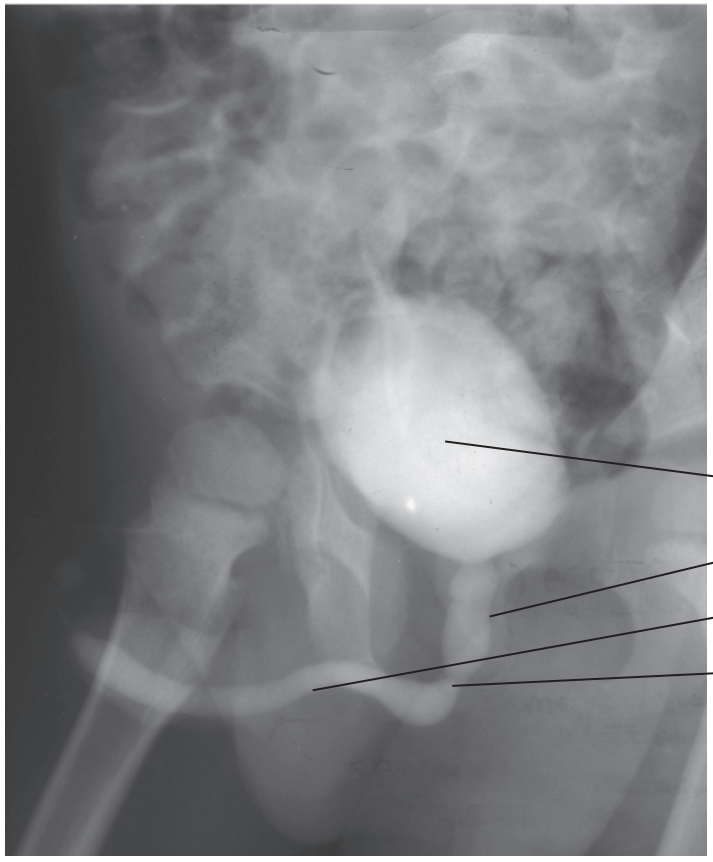
Median section of male



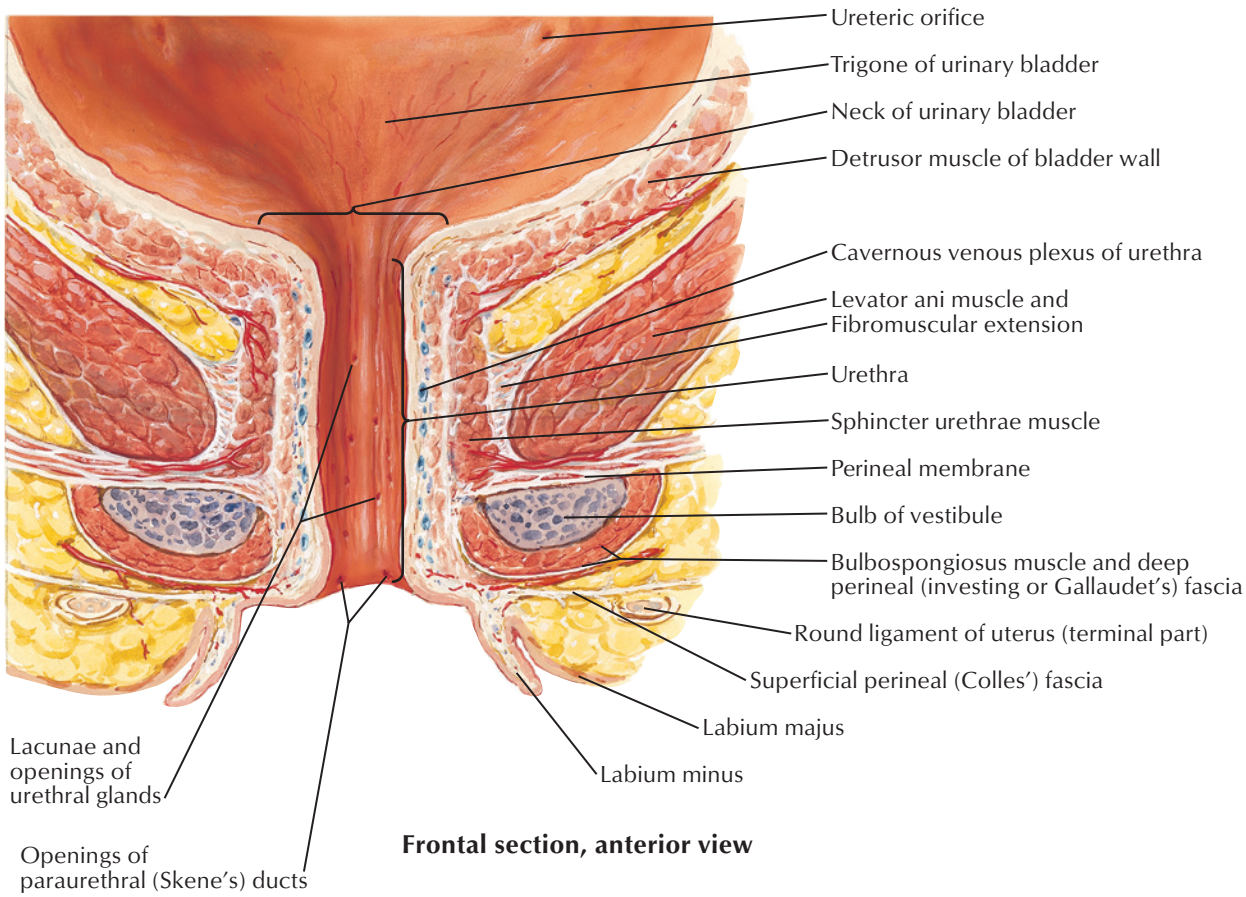
Median section of female



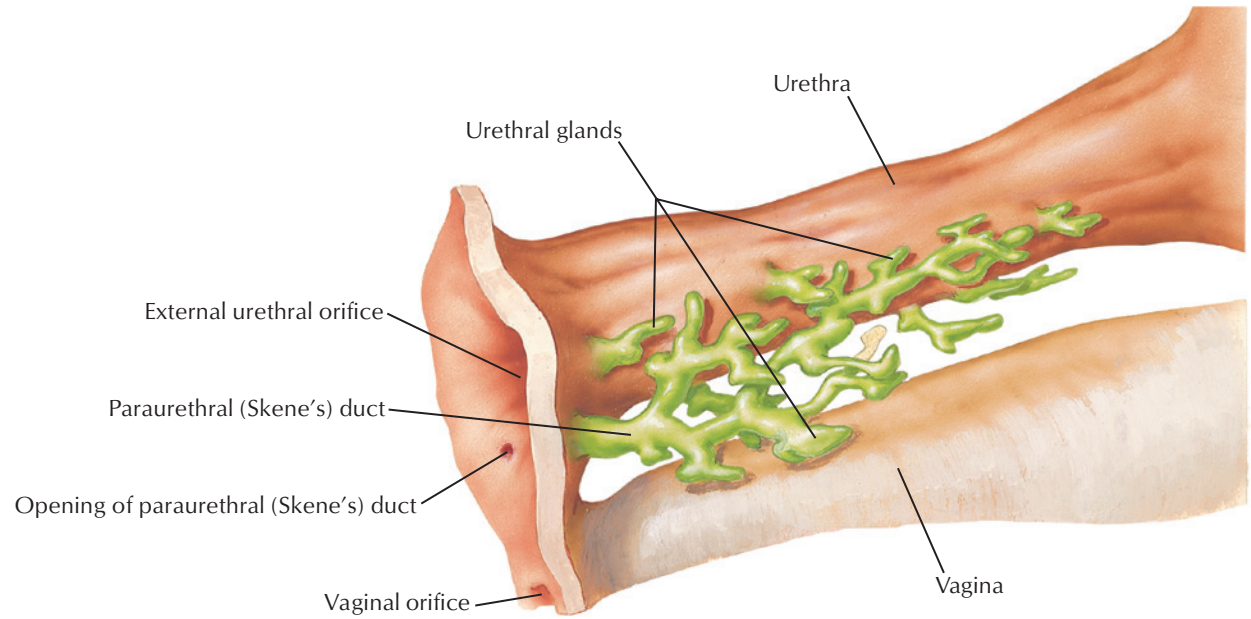
Cystourethrogram of urethra in 8-year-old girl



Voiding cystourethrogram in 2-year-old boy

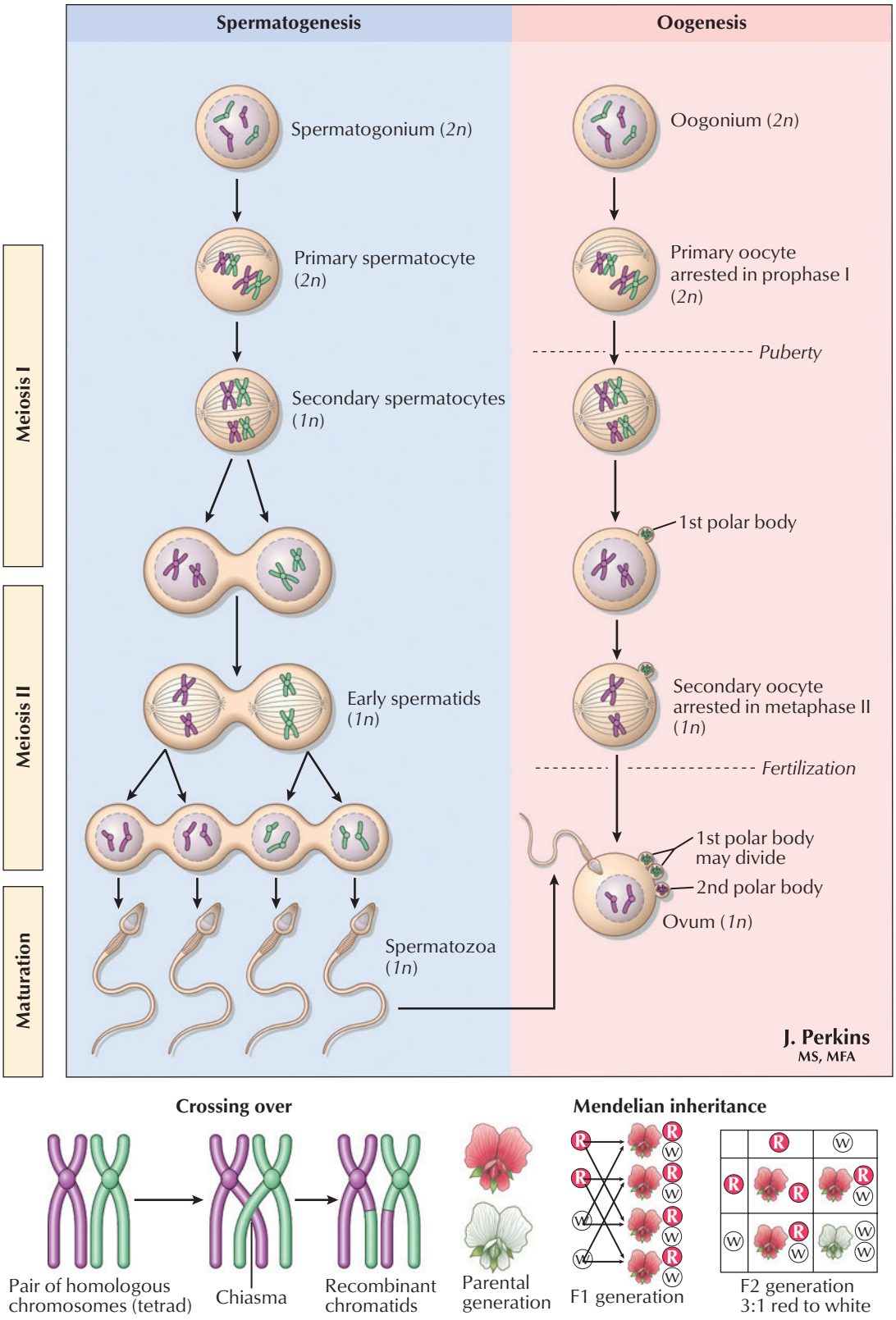


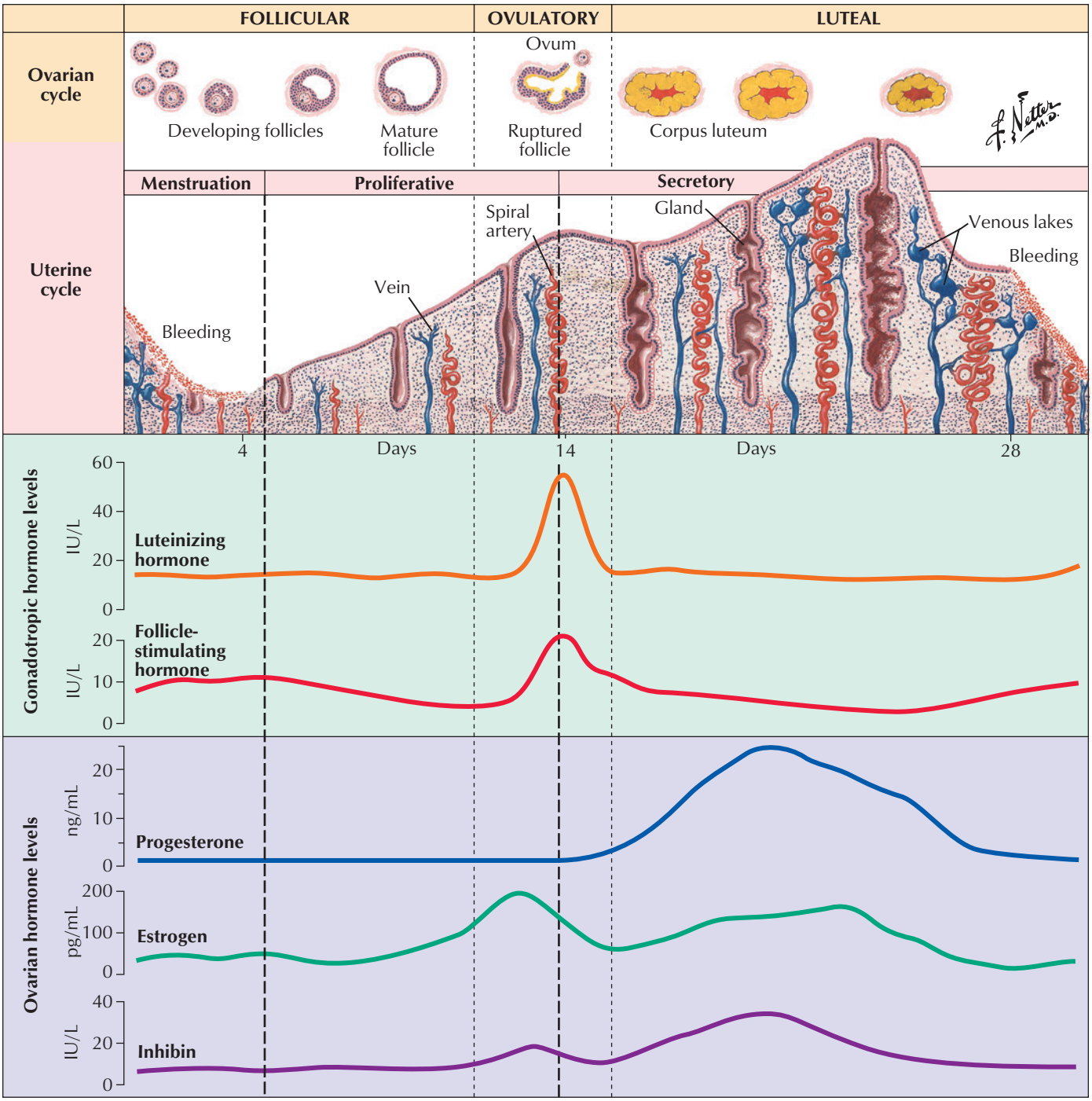
Frontal section, anterior view



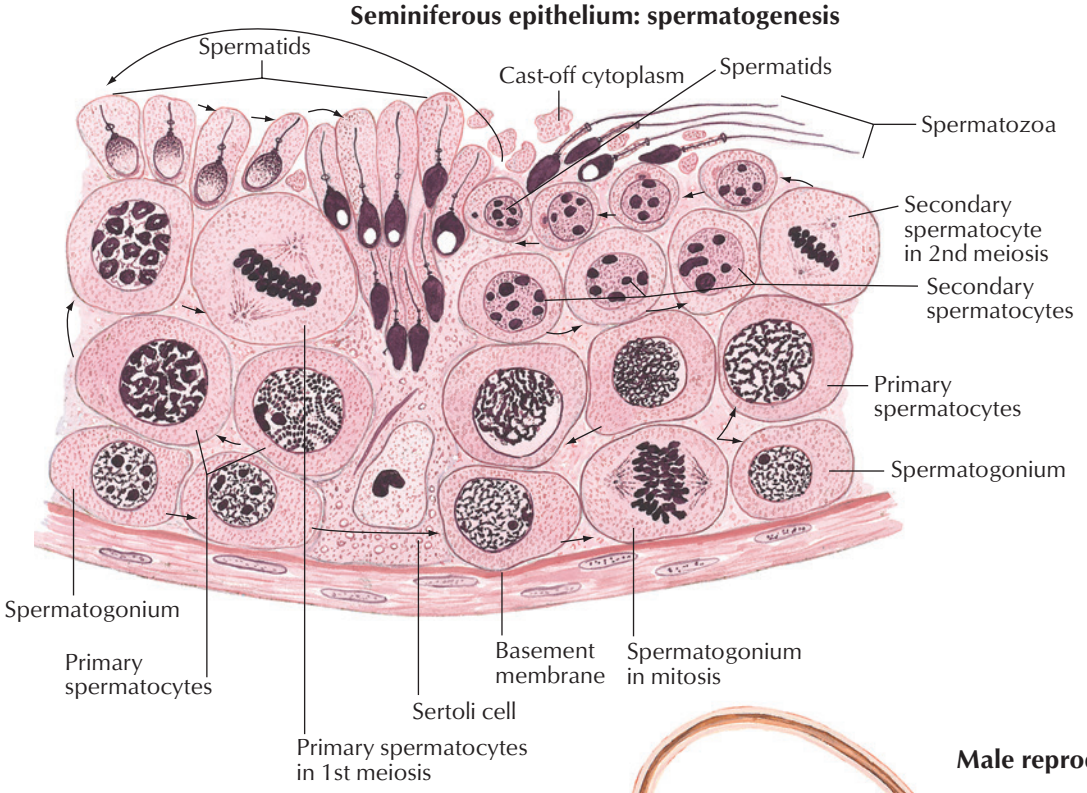
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Schematic reconstruction

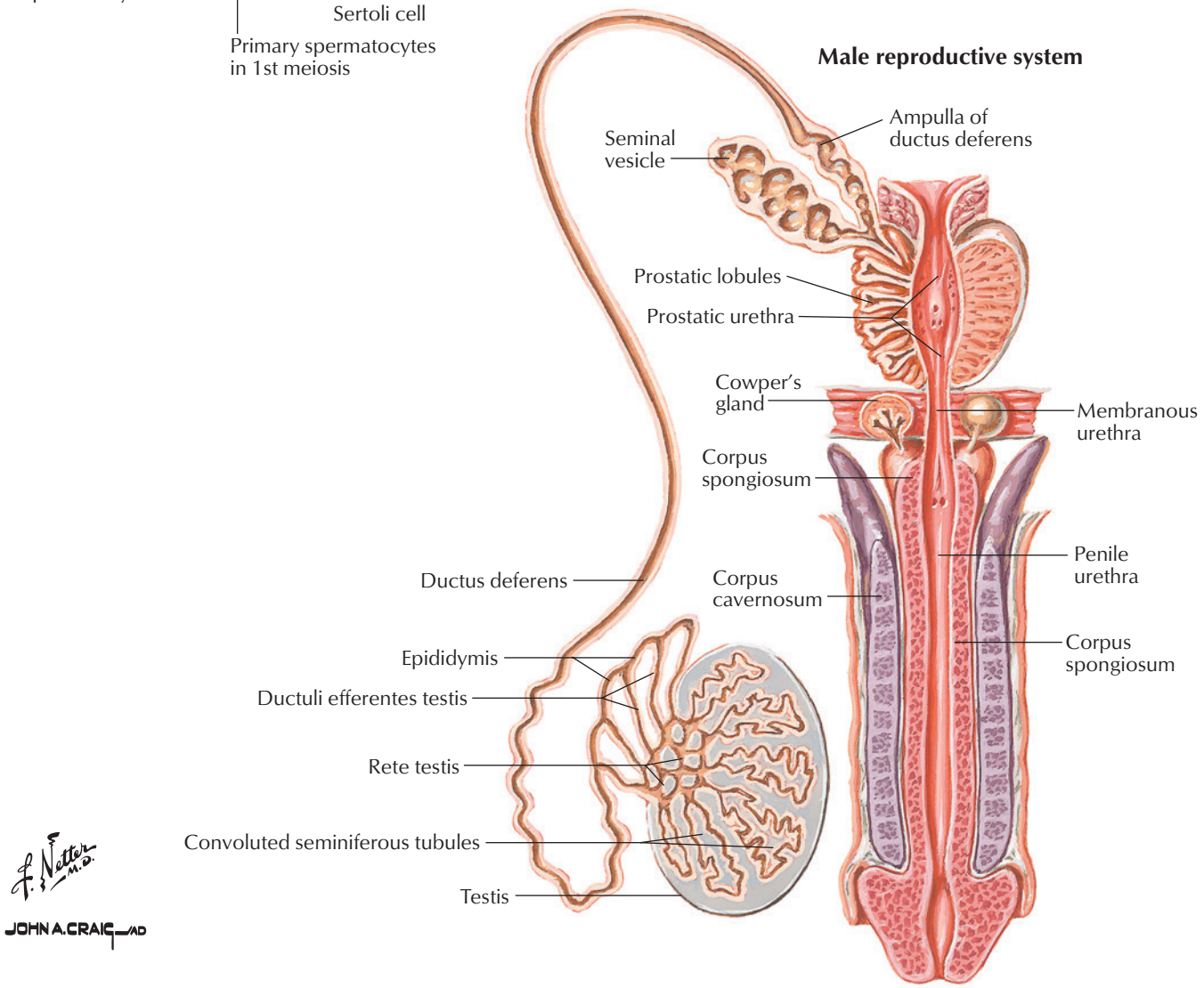

Spermatogenesis
Oogenesis
Meiosis I
Meiosis II
Maturation
Spermatogonium (2n)
Oogonium (2n)
Primary spermatocyte (2n)
Primary oocyte arrested in prophase I (2n)
Puberty
Secondary spermatocytes (1n)
1st polar body
Early spermatids (1n)
Secondary oocyte arrested in metaphase II (1n)
Fertilization
1st polar body may divide
2nd polar body
Ovum (1n)
Spermatozoa (1n)
J. Perkins
MS, MFA
Crossing over
Pair of homologous chromosomes (tetrad)
Chiasma
Recombinant chromatids
Parental generation
Mendelian inheritance
F1 generation
F2 generation
3:1 red to white


FOLLICULAR
OVULATORY
LUTEAL
Ovarian cycle
Ovum
Developing follicles
Mature follicle
Ruptured follicle
Corpus luteum
Uterine cycle
Menstruation
Proliferative
Secretory
Spiral artery
Gland
Venous lakes
Bleeding
Vein
Bleeding
4
Days
14
Days
28
Gonadotropic hormone levels
IU/L
60
40
20
0
Luteinizing hormone
Follicle-stimulating hormone
20
10
0
Ovarian hormone levels
ng/mL
Progesterone
pg/mL
200
100
Estrogen
IU/L
40
20
Inhibin

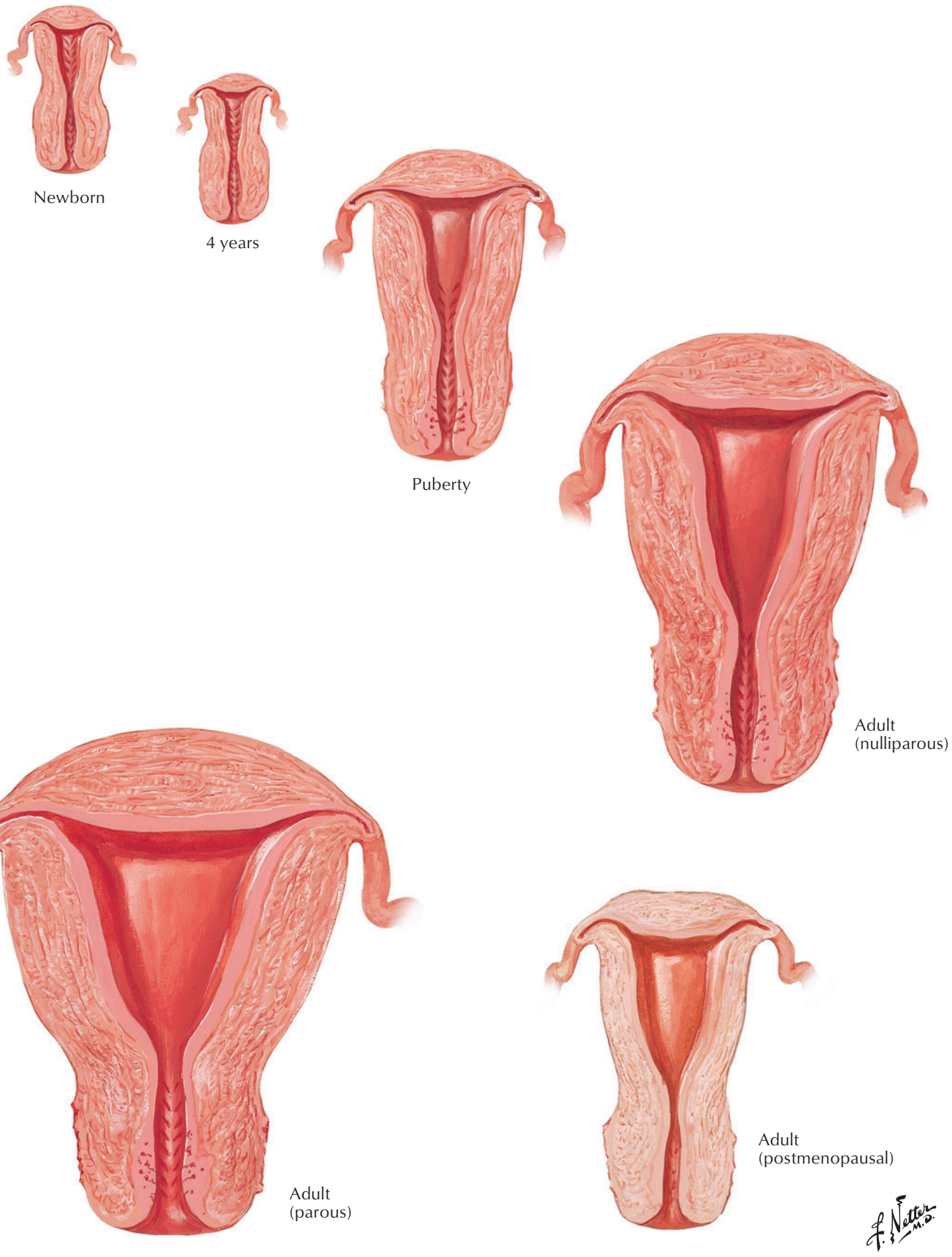
Seminiferous epithelium: spermatogenesis

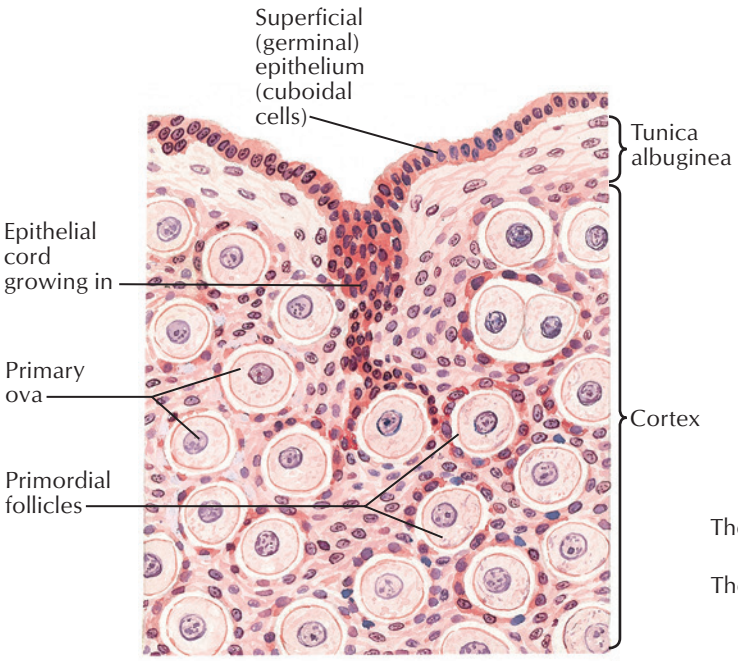


Male reproductive system

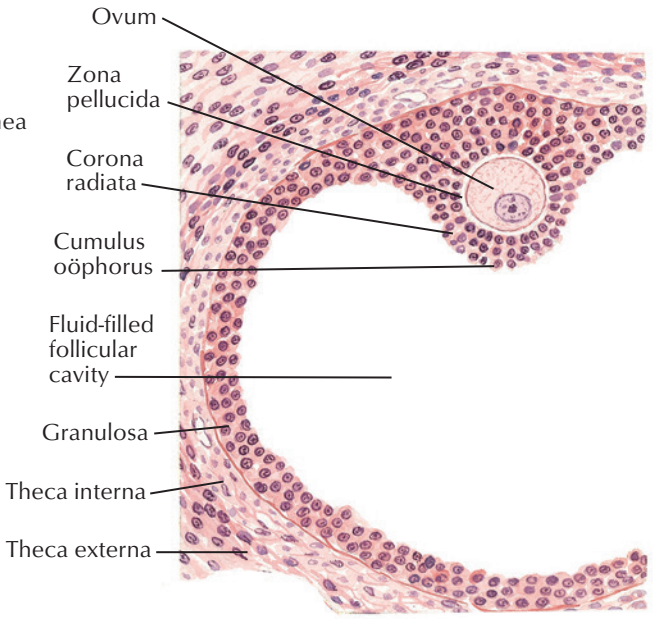


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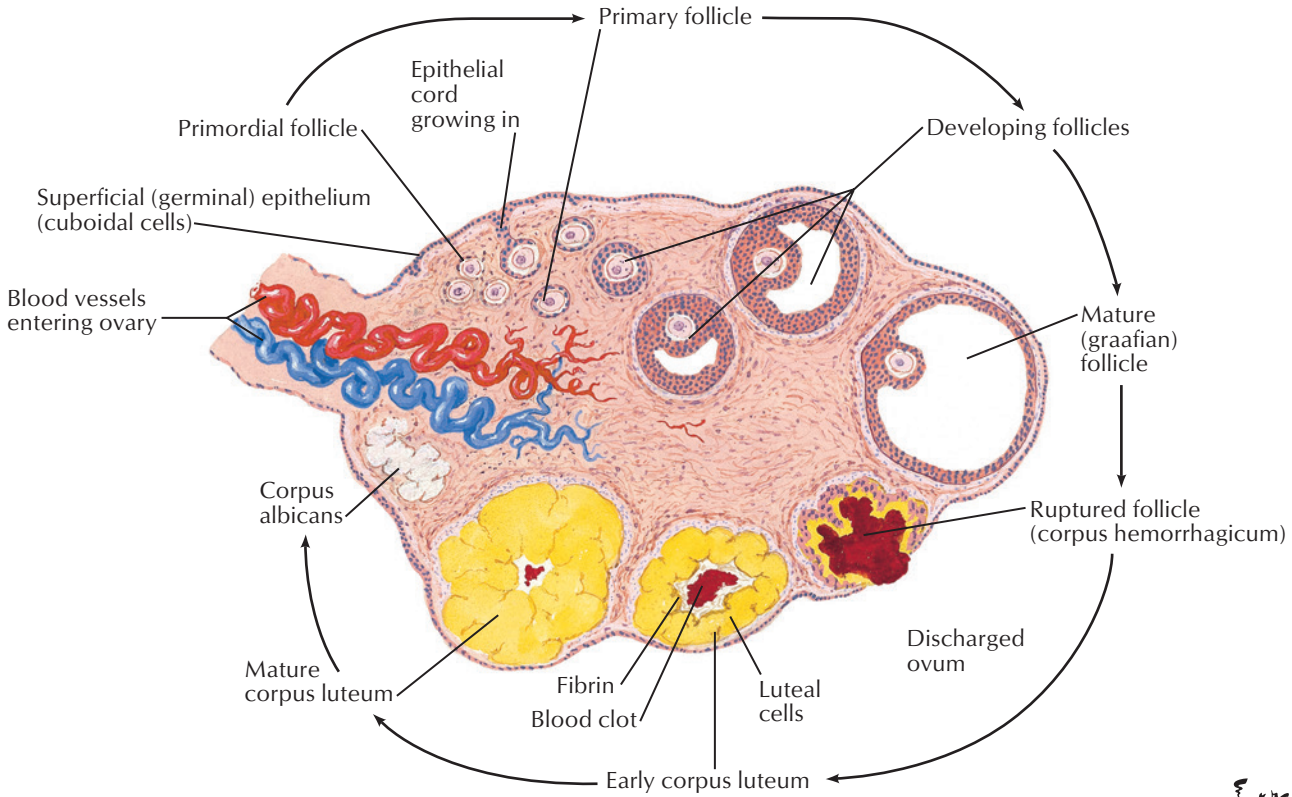

Newborn
4 years
Puberty
Adult
(nulliparous)
Adult
(parous)
Adult
(postmenopausal)



Infant ovary



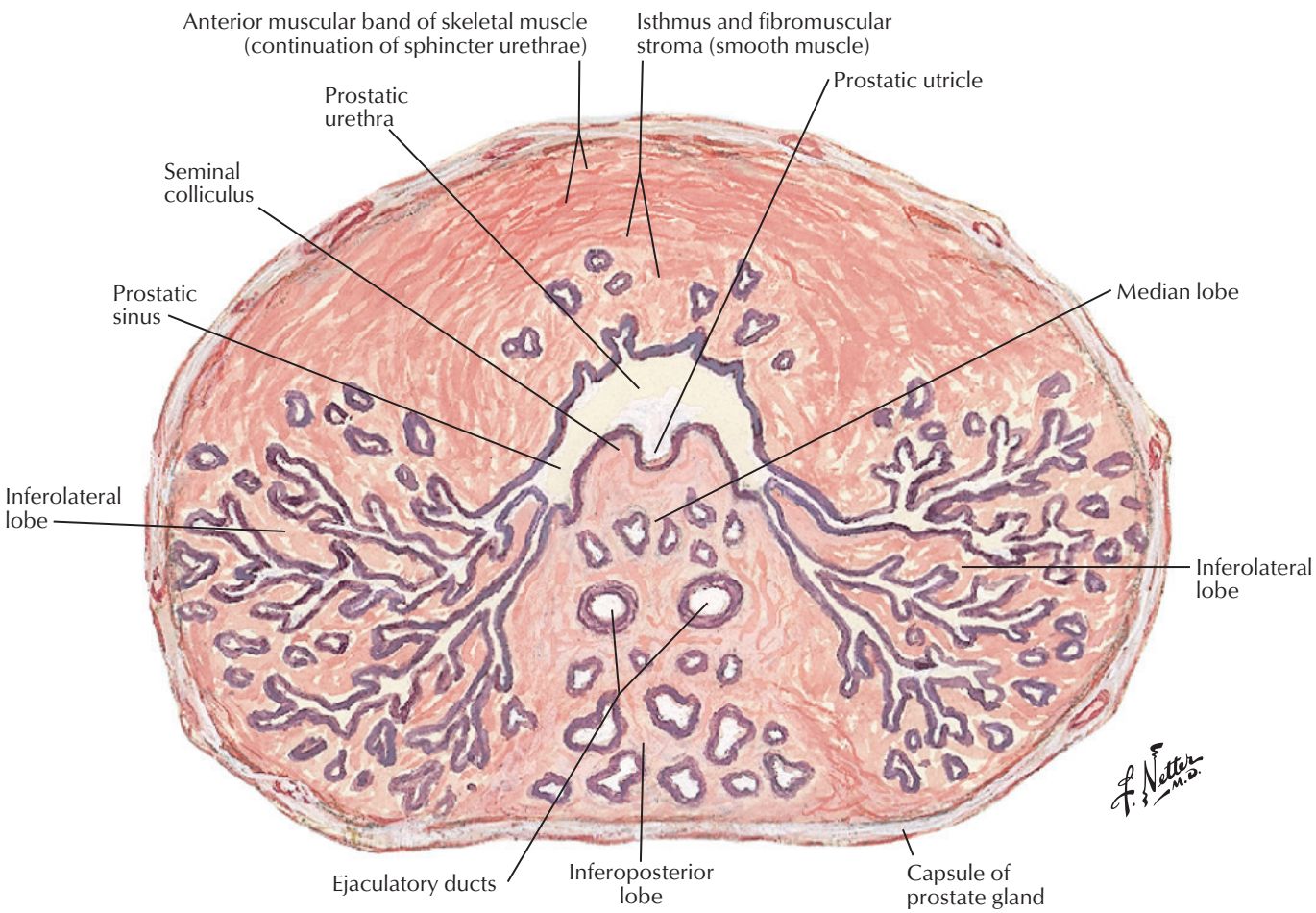
Ripening follicle



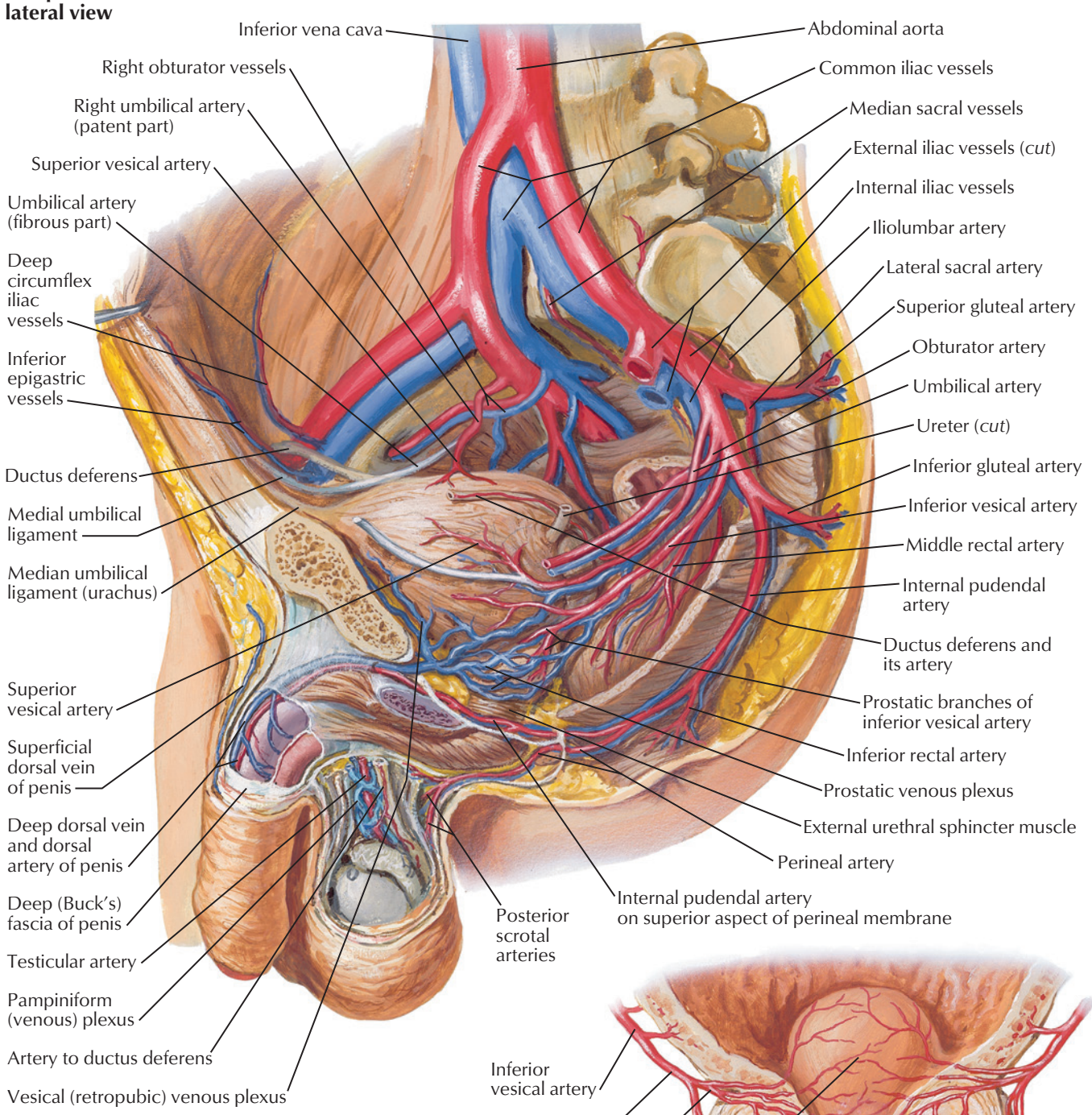
Stages of ovum and follicle

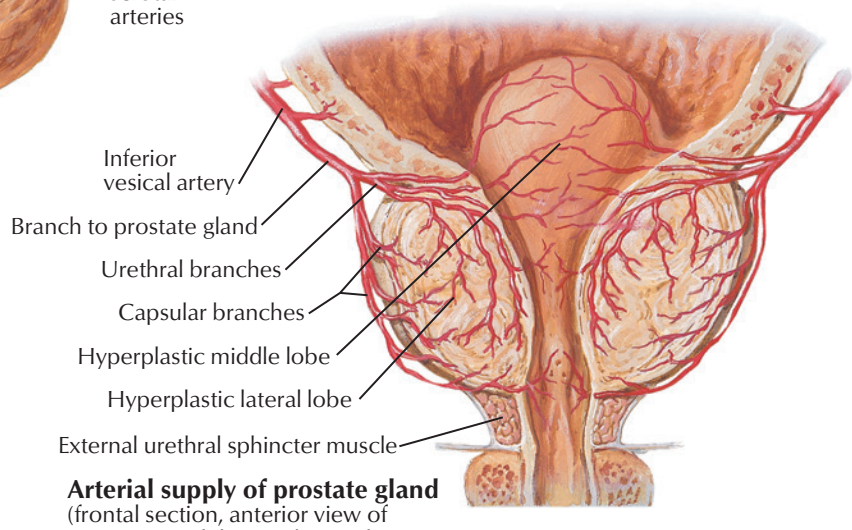


Annular hymen | Septate hymen | Cribriform hymen | Parous introitus


Anterior muscular band of skeletal muscle (continuation of sphincter urethrae)
Isthmus and fibromuscular stroma (smooth muscle)
Prostatic utricle
Prostatic urethra
Seminal colliculus
Prostatic sinus
Median lobe
Inferolateral lobe
Inferolateral lobe
Ejaculatory ducts
Inferoposterior lobe
Capsule of prostate gland

Left paramedian section: lateral view





Arterial supply of prostate gland
(frontal section, anterior view of specimen with benign hyperplasia)

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UPPER LIMB 7

Surface Anatomy	402	**Neurovasculature**	462-469
Cutaneous Anatomy	403-407	**Regional Imaging**	470
Shoulder and Axilla	408-420	**Structures With High Clinical Significance**	Tables 7.1-7.2
Arm	421-425	**Muscle Tables**	Tables 7.3-7.6
Elbow and Forearm	426-441	**Electronic Bonus Plates**	BP99-BP106
Wrist and Hand	442-461		

ELECTRONIC BONUS PLATES



BP99 Veins of Upper Limb



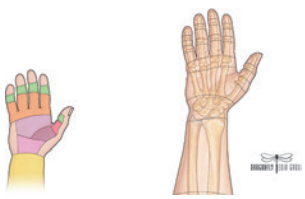
BP100 Arteries of Arm and Proximal Forearm



BP101 Arteries of Forearm and Hand



BP102 Ligaments of Wrist



BP103 Flexor and Extensor Zones of Hand



BP104 Section Through Metacarpal and Distal Carpal Bones

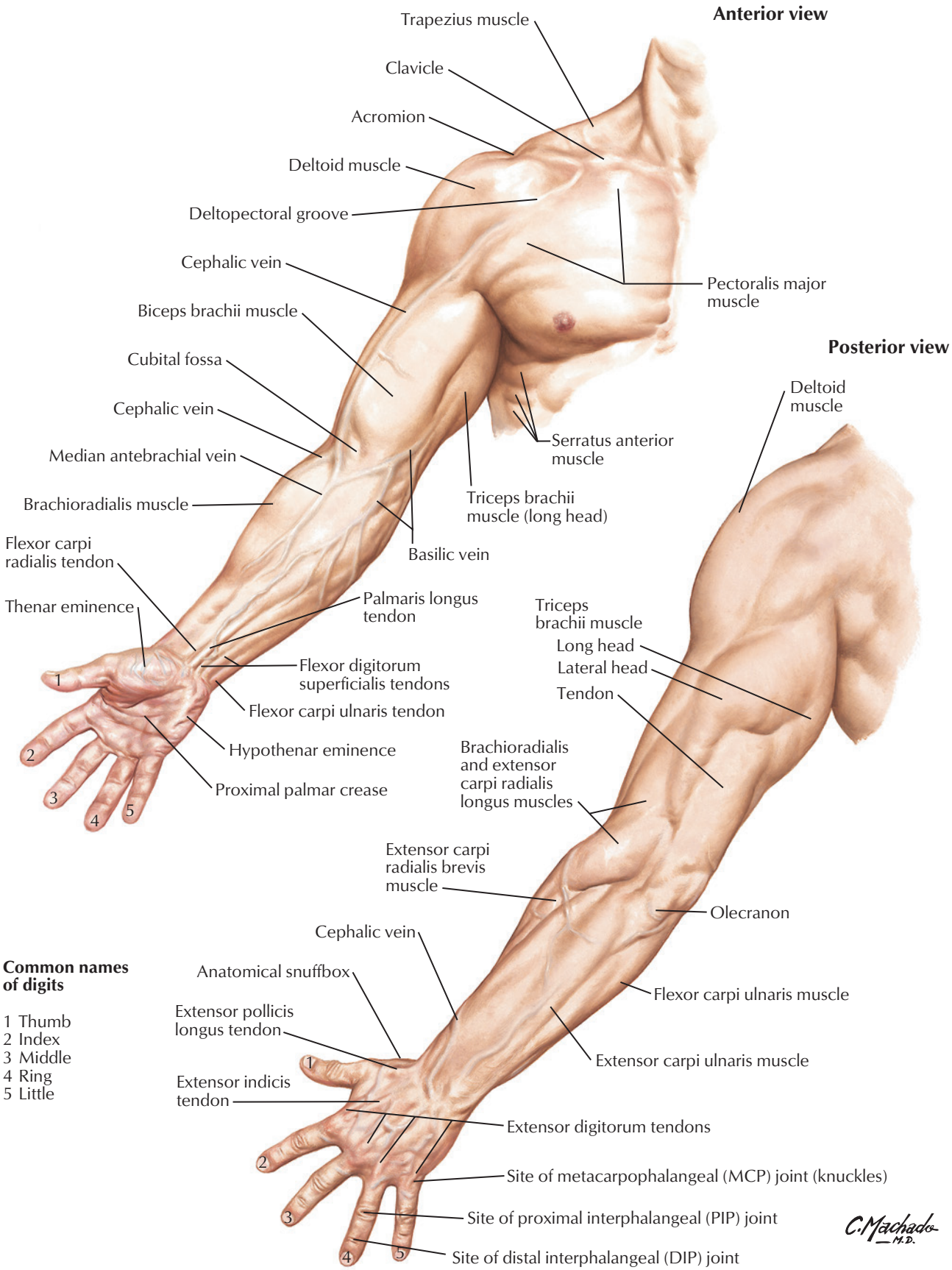


BP105 Cross Section of Hand: Axial View



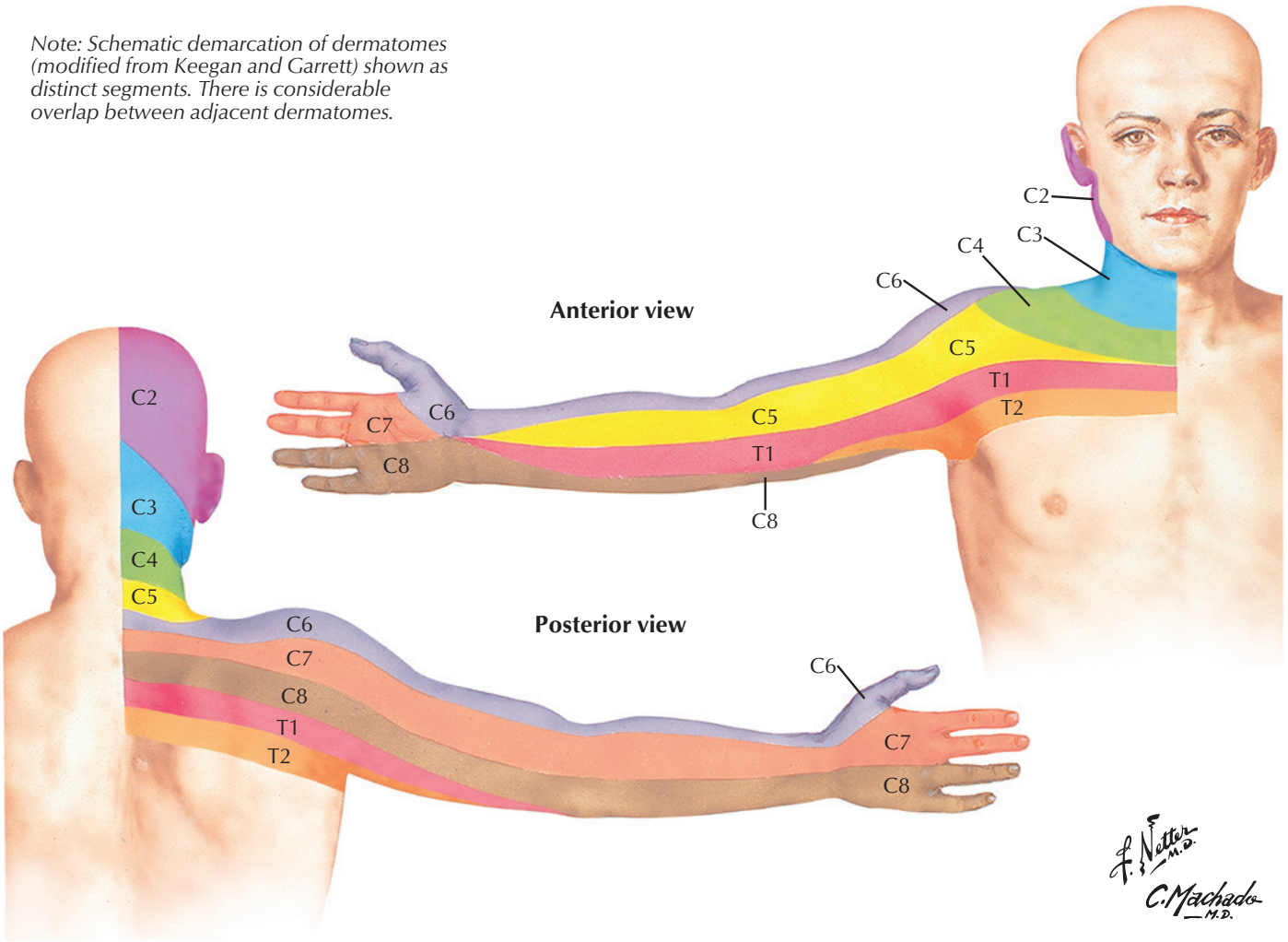
BP106 Cross Section of Hand: Axial View (continued)

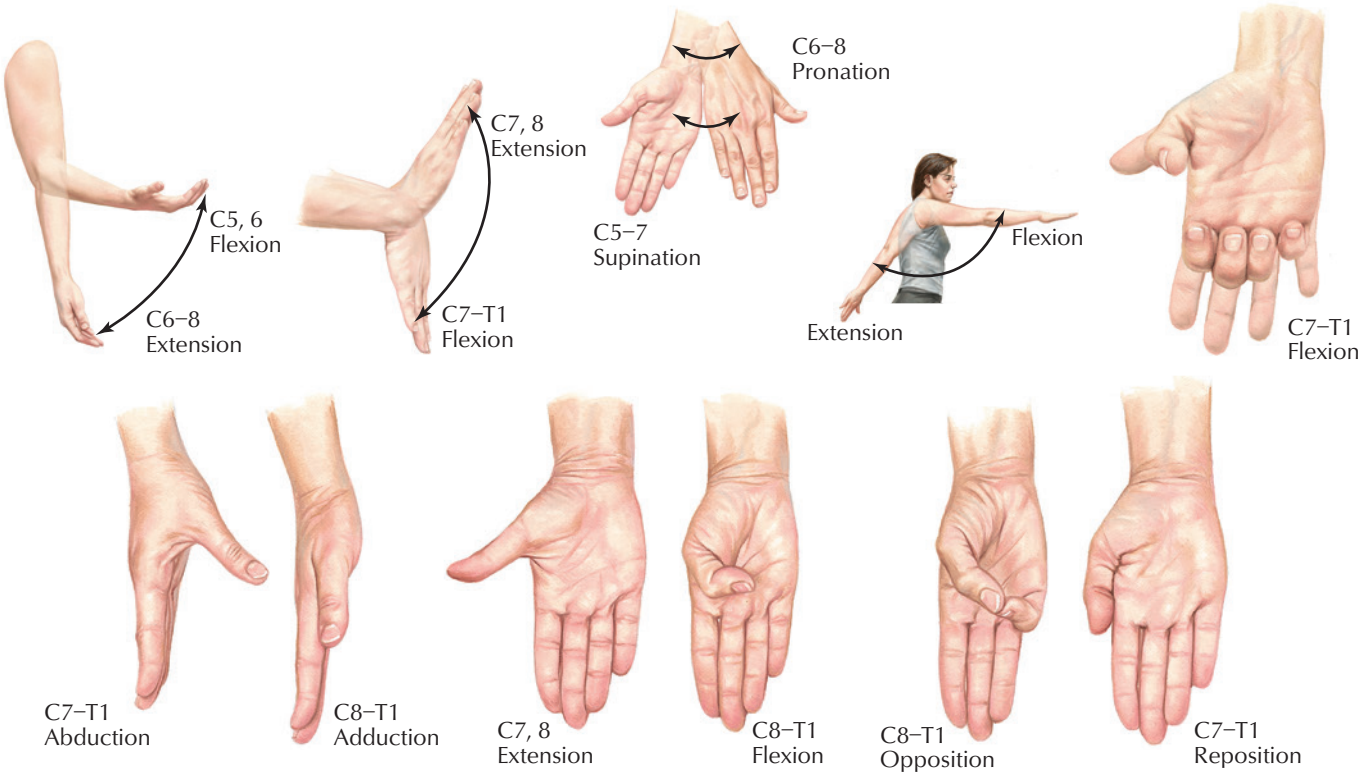
See also Plates 161, 249, 403



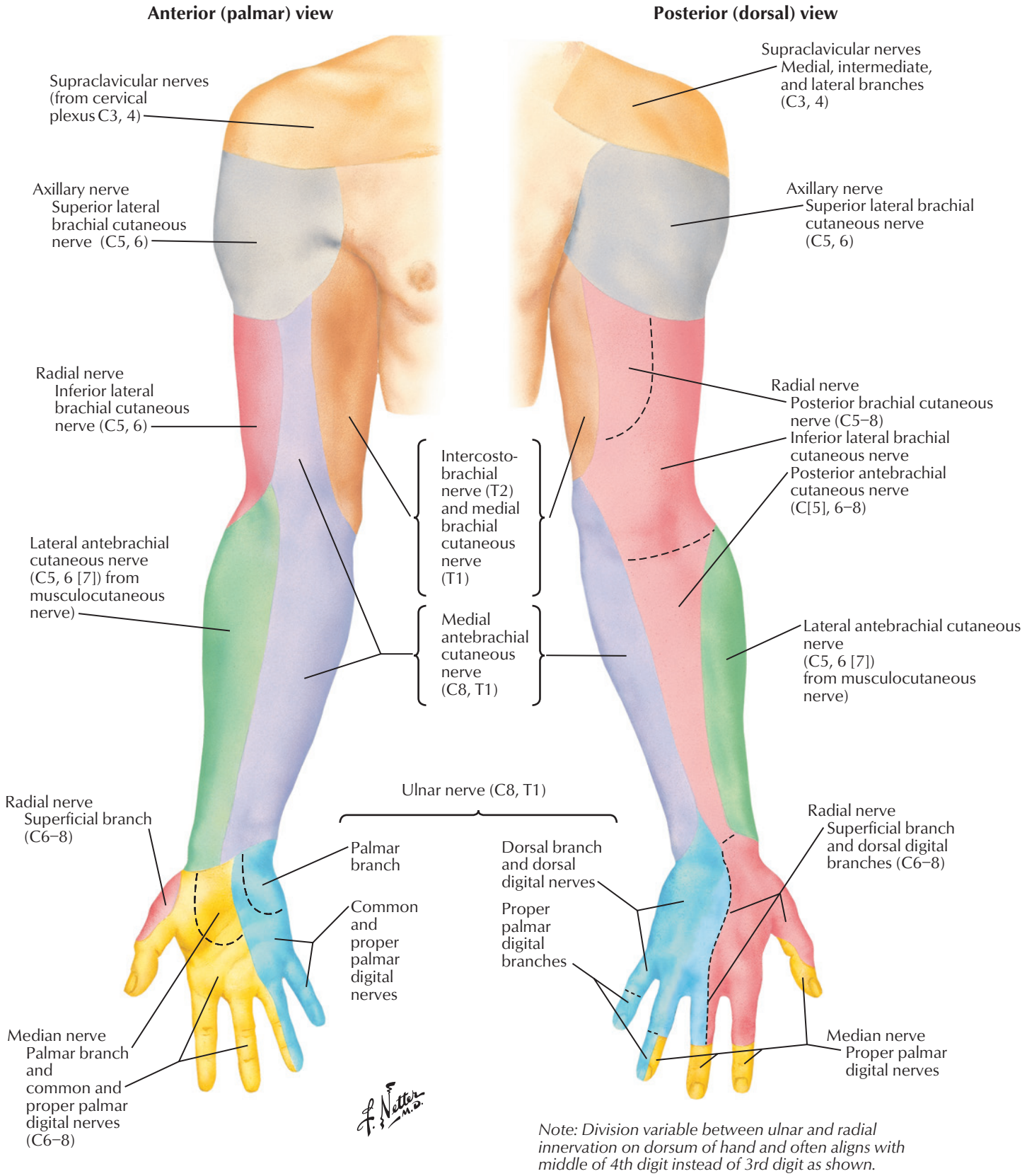
See also Plate 171

Note: Schematic demarcation of dermatomes (modified from Keegan and Garrett) shown as distinct segments. There is considerable overlap between adjacent dermatomes.



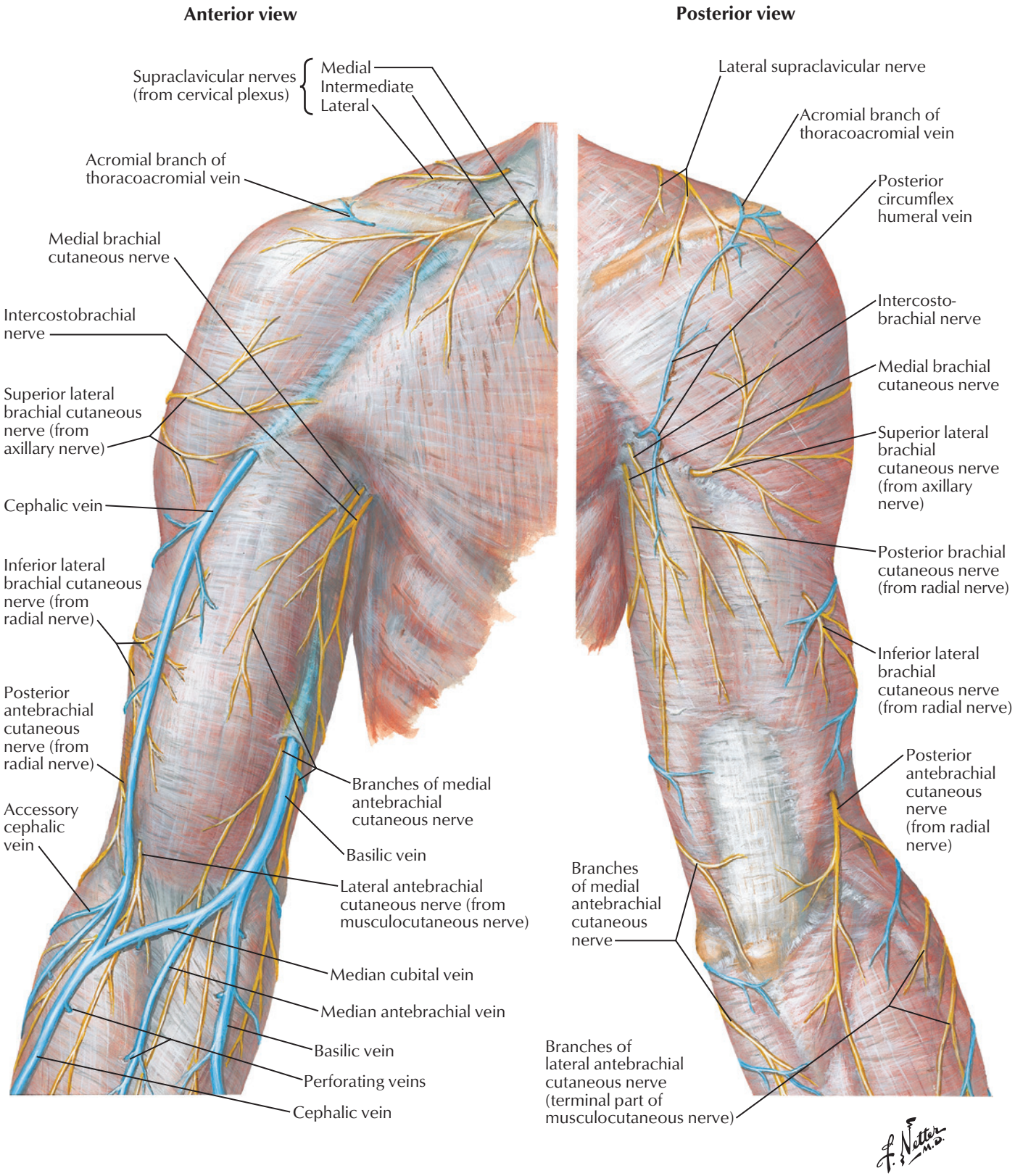


See also Plates 172, 462, 464



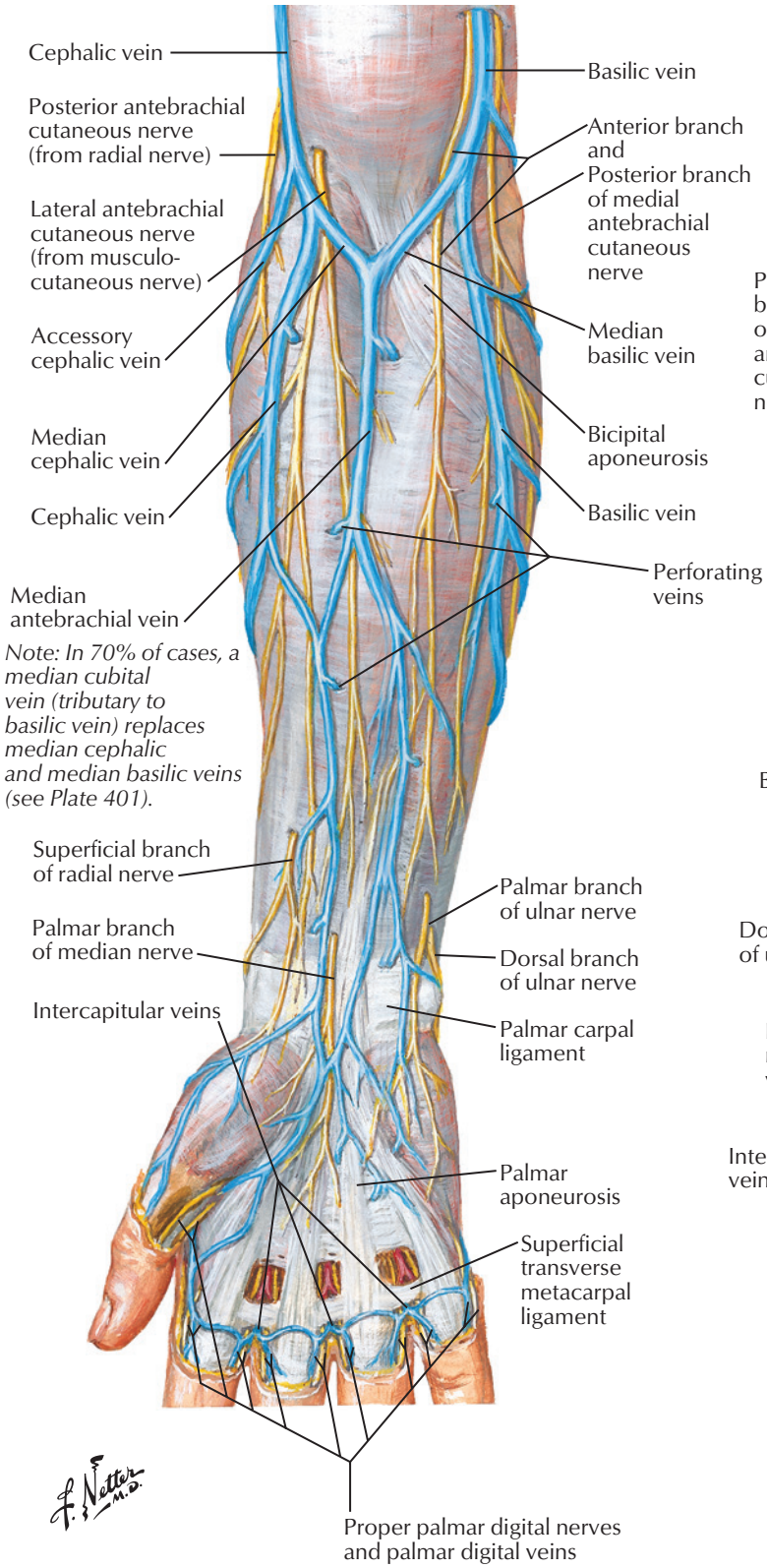
Note: Division variable between ulnar and radial innervation on dorsum of hand and often aligns with middle of 4th digit instead of 3rd digit as shown.

See also Plates 259, 407

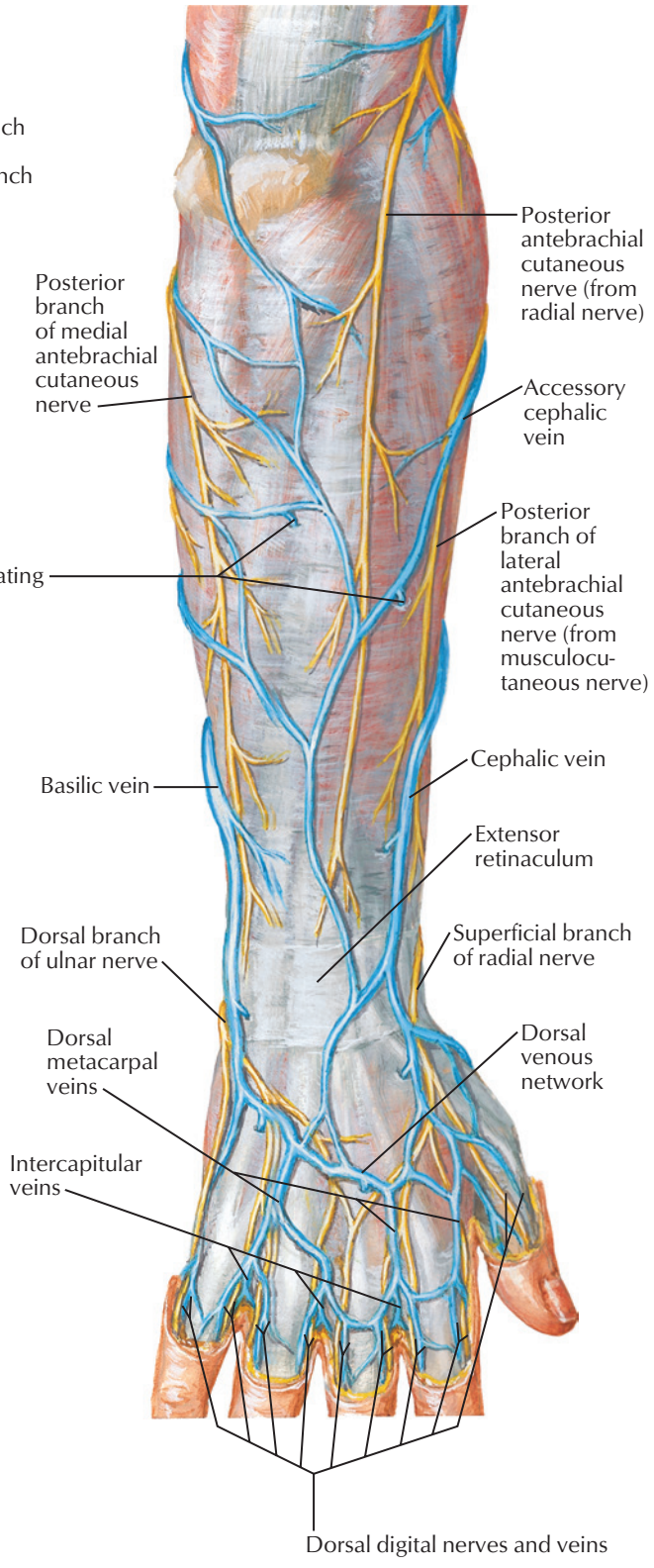


See also Plates 404, 458

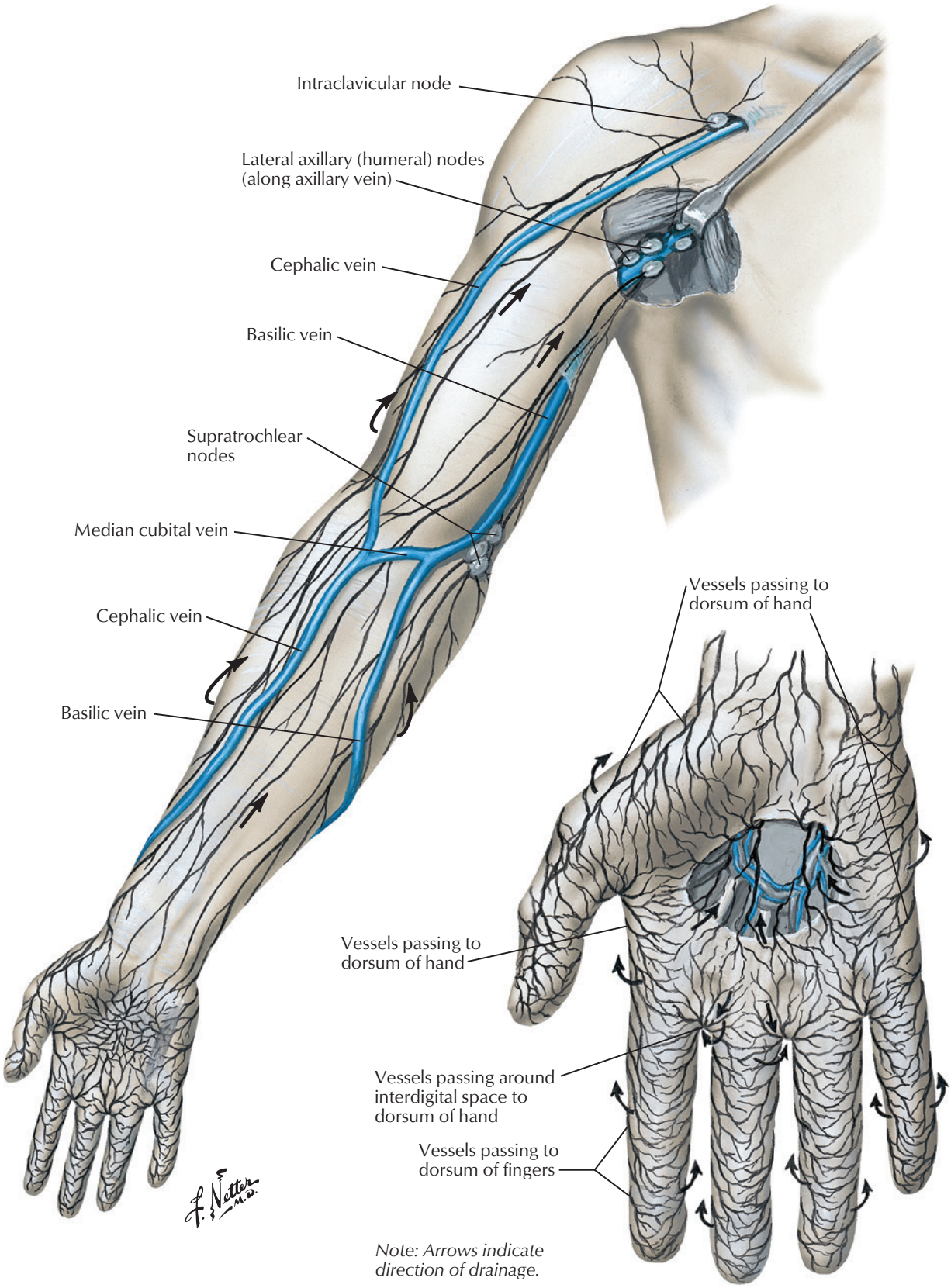
Anterior (palmar) view



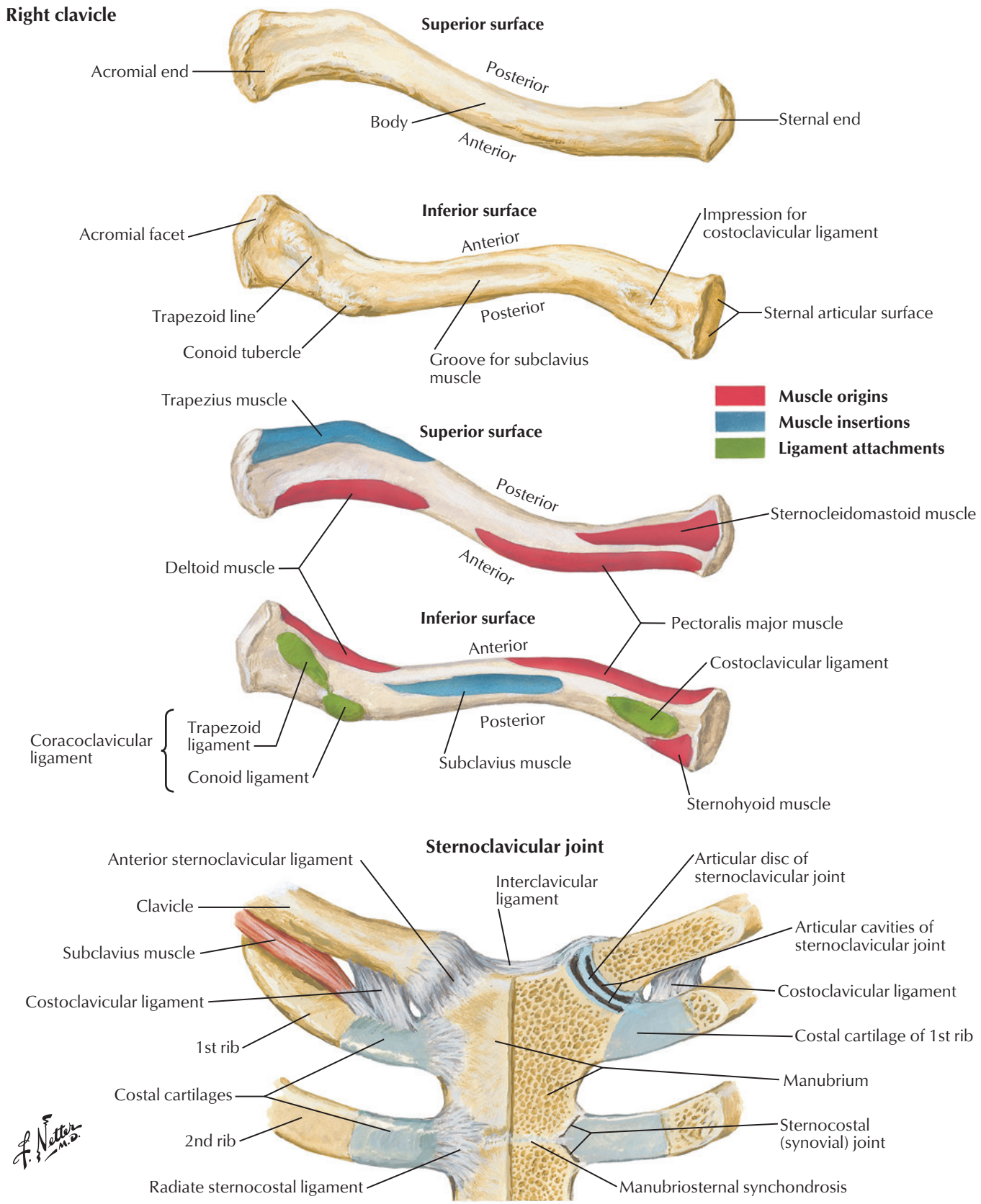
Posterior (dorsal) view



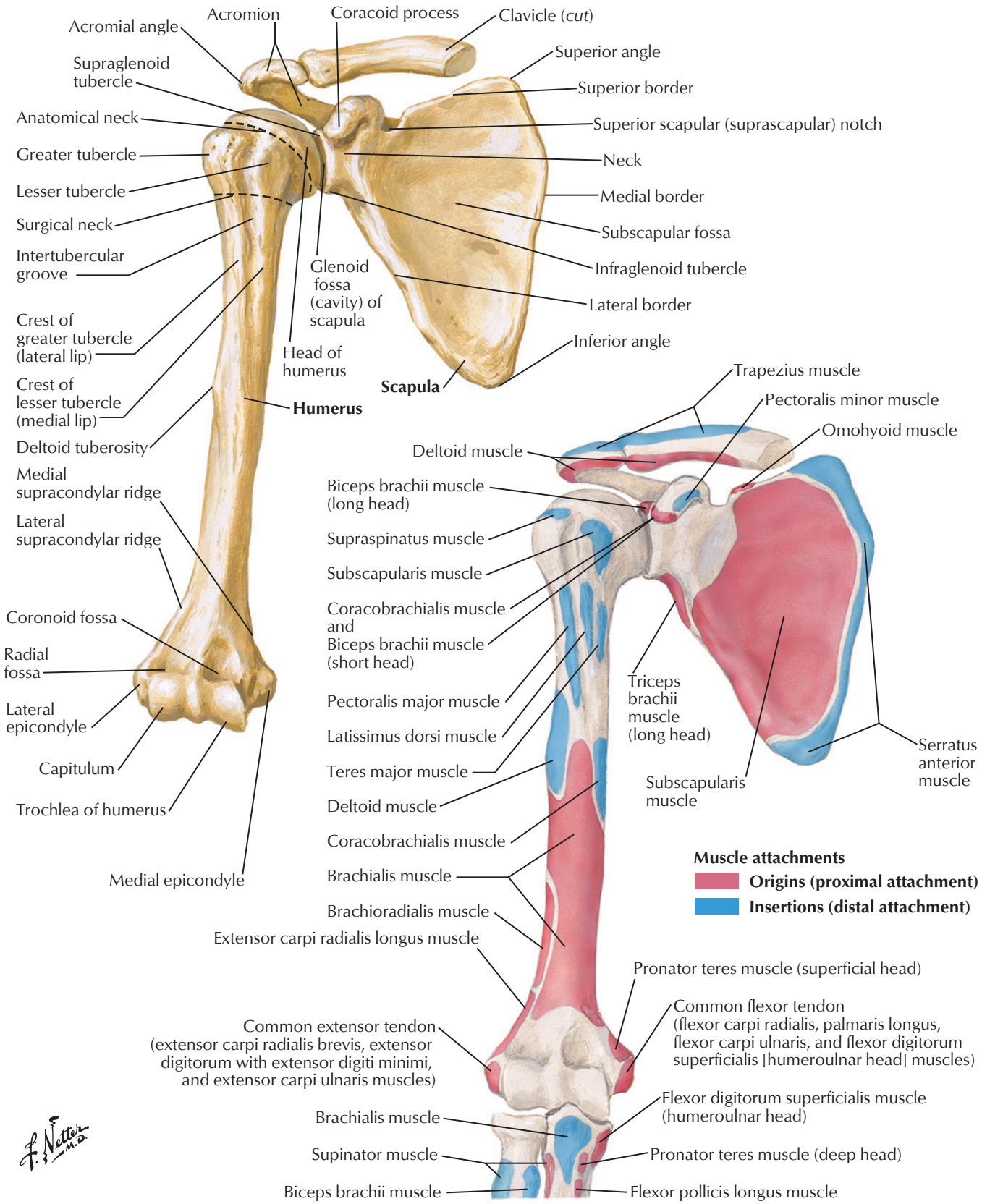
See also Plates 191, 458



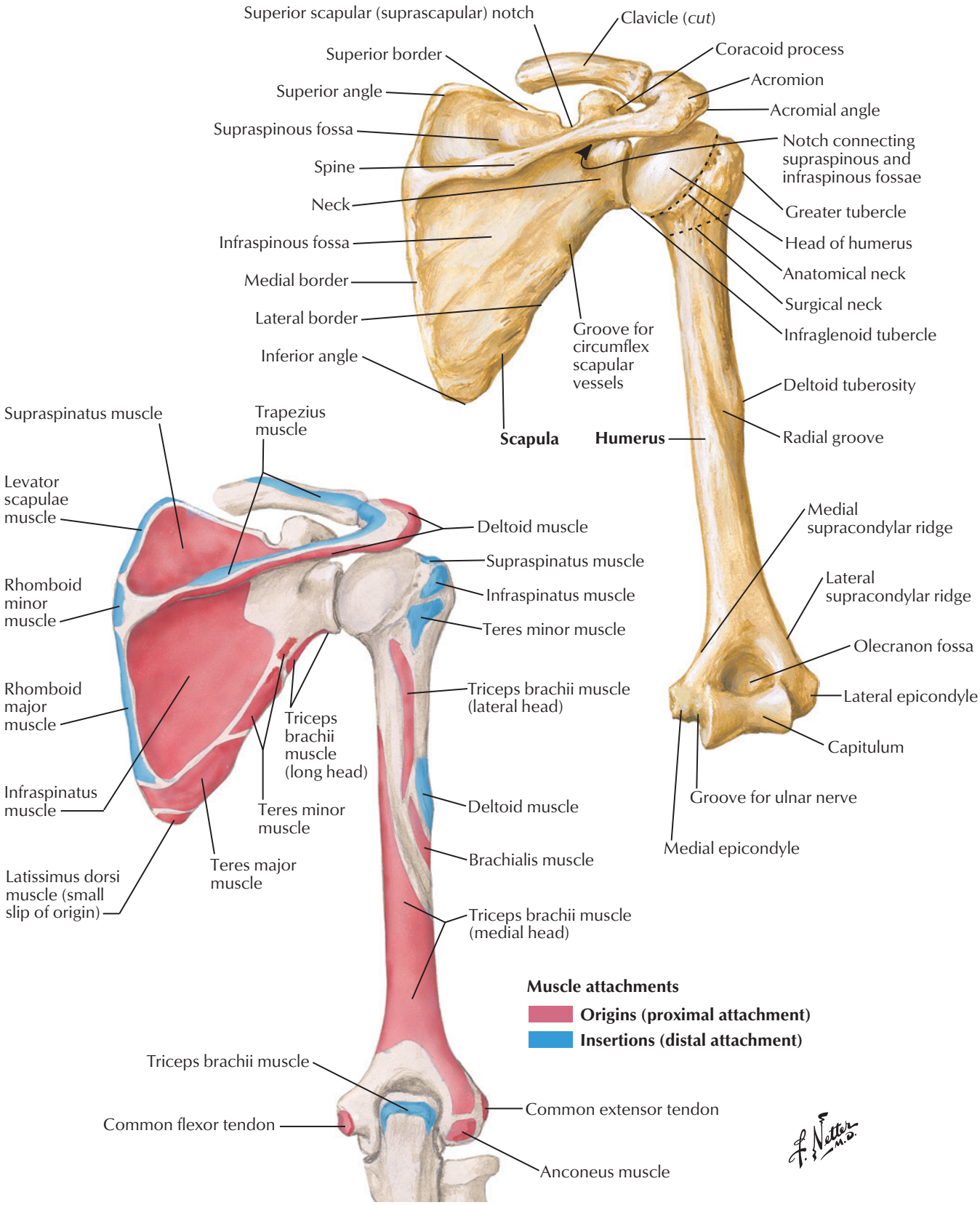
See also Plates 192, 195



See also Plates 192, 411

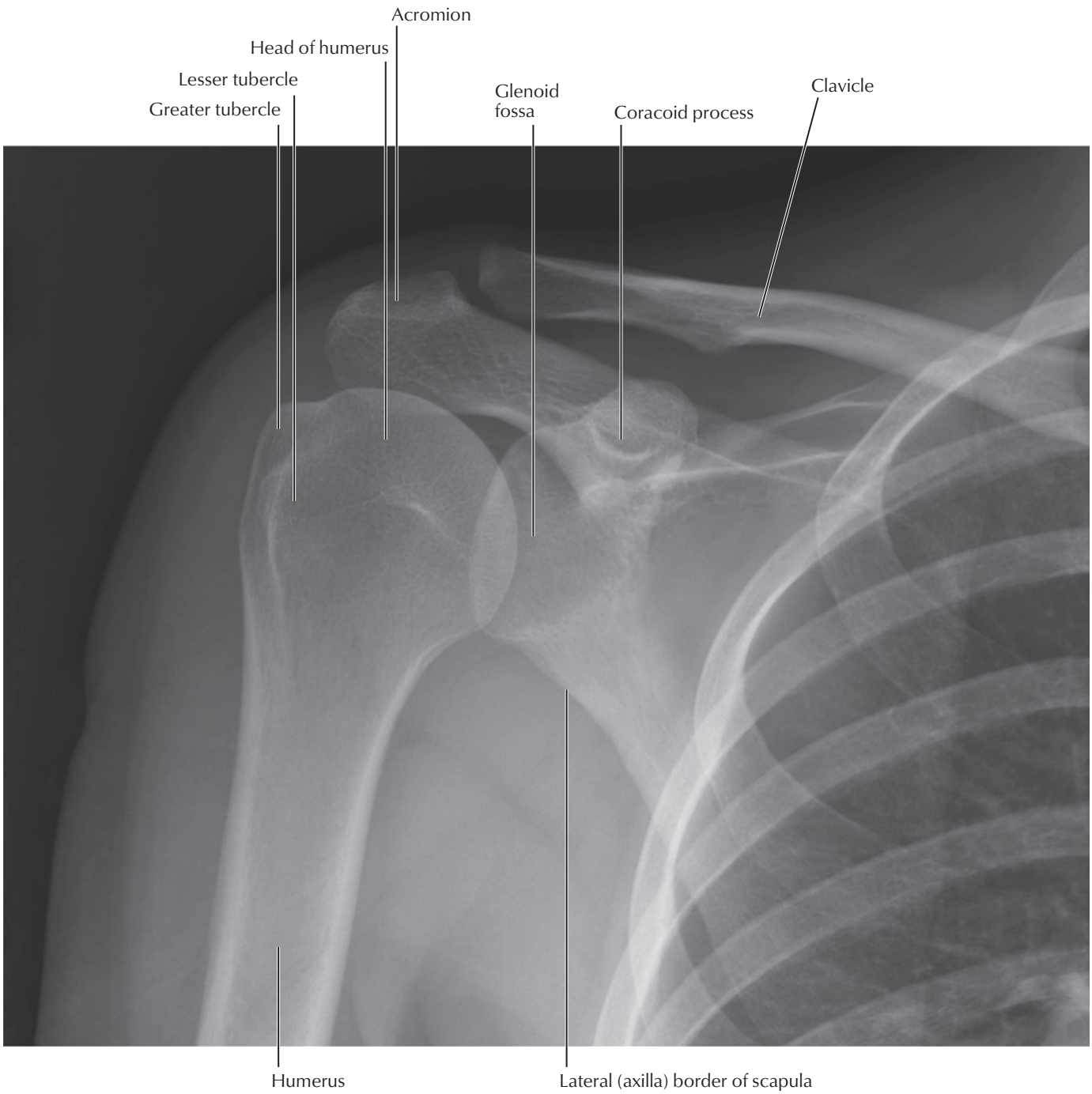


See also Plate 192

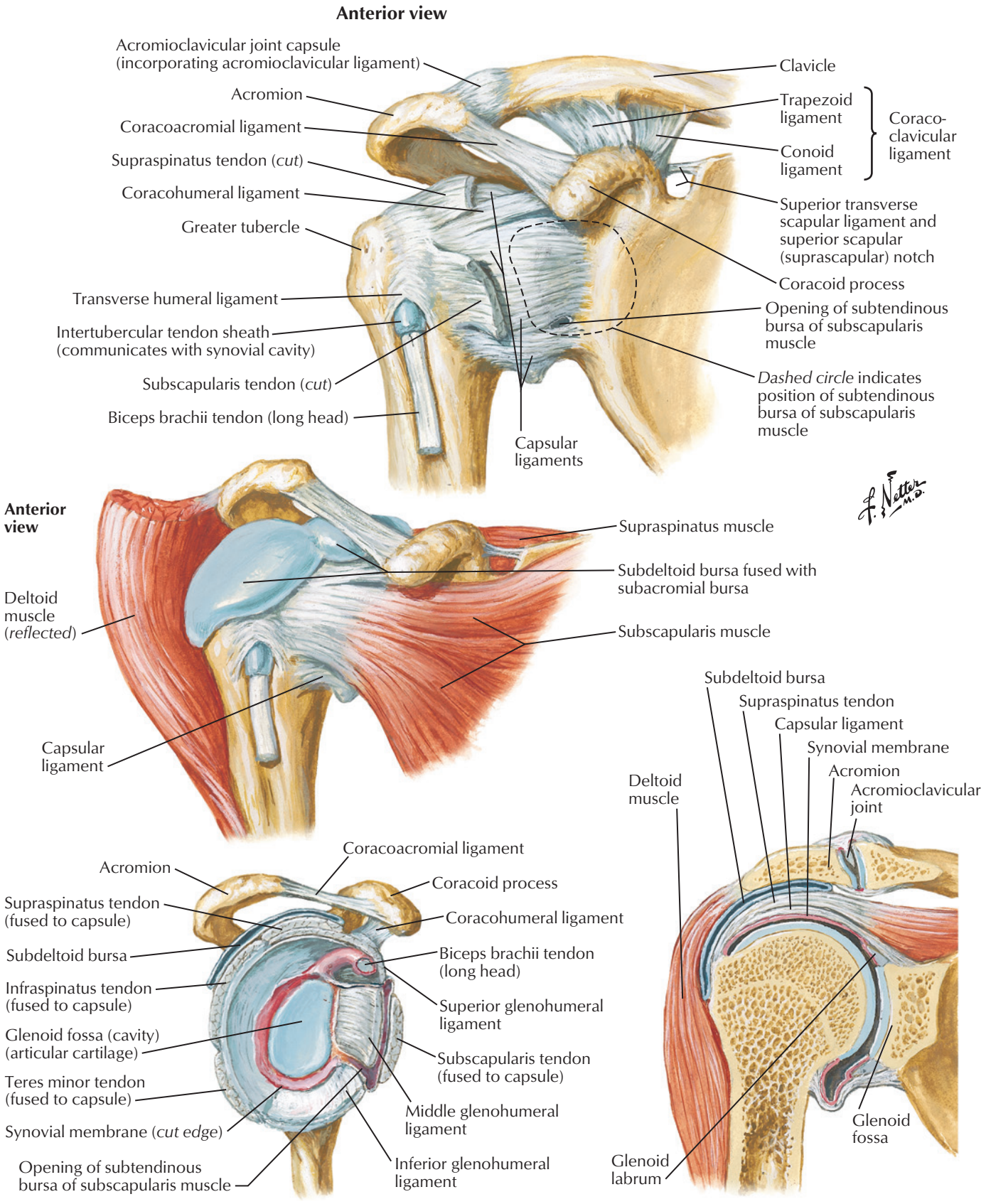


See also Plate 409

Anteroposterior Radiograph of Shoulder



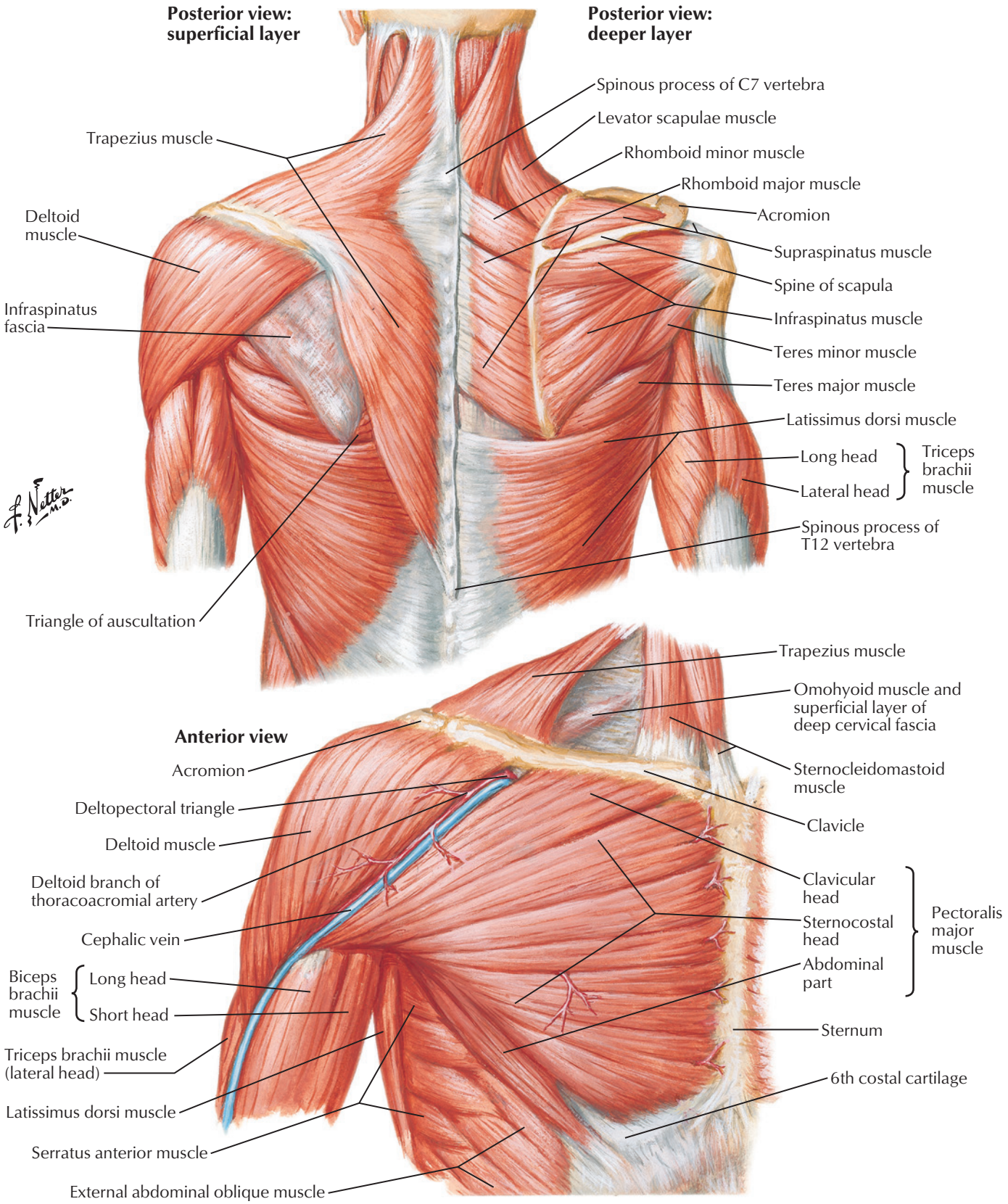
See also Plate 415

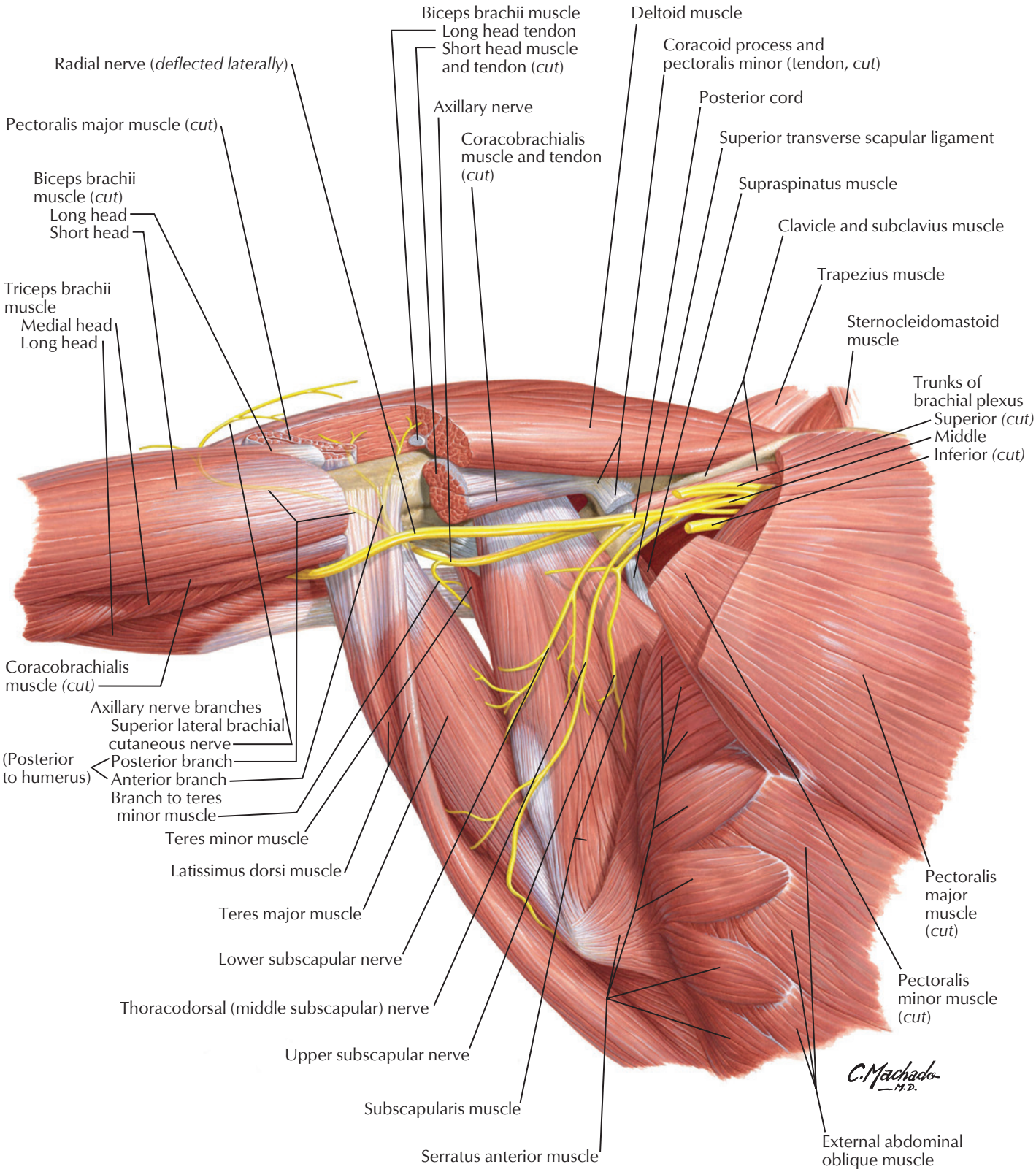


Joint opened: lateral view

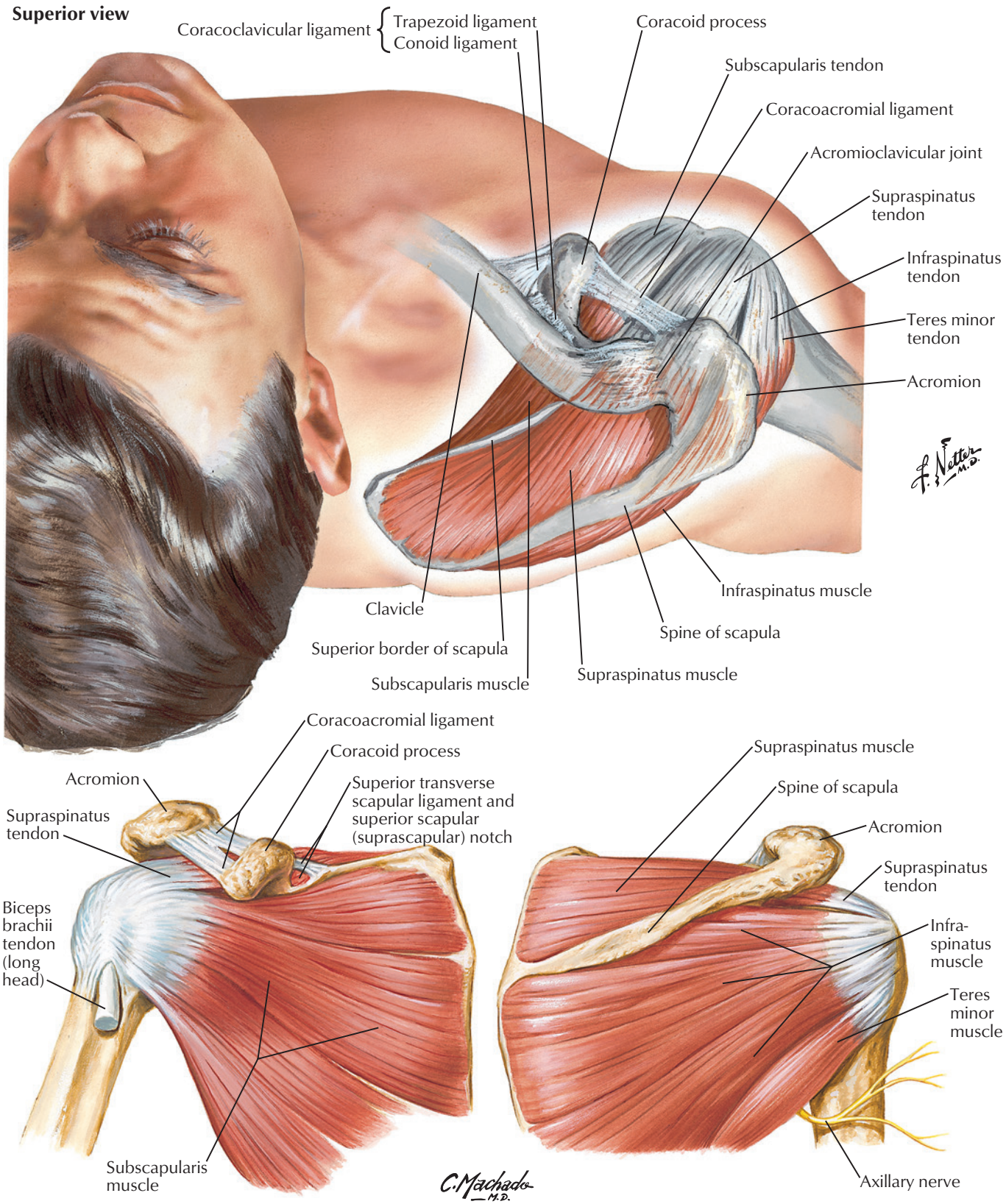
Coronal section through shoulder girdle

See also Plates 180, 194

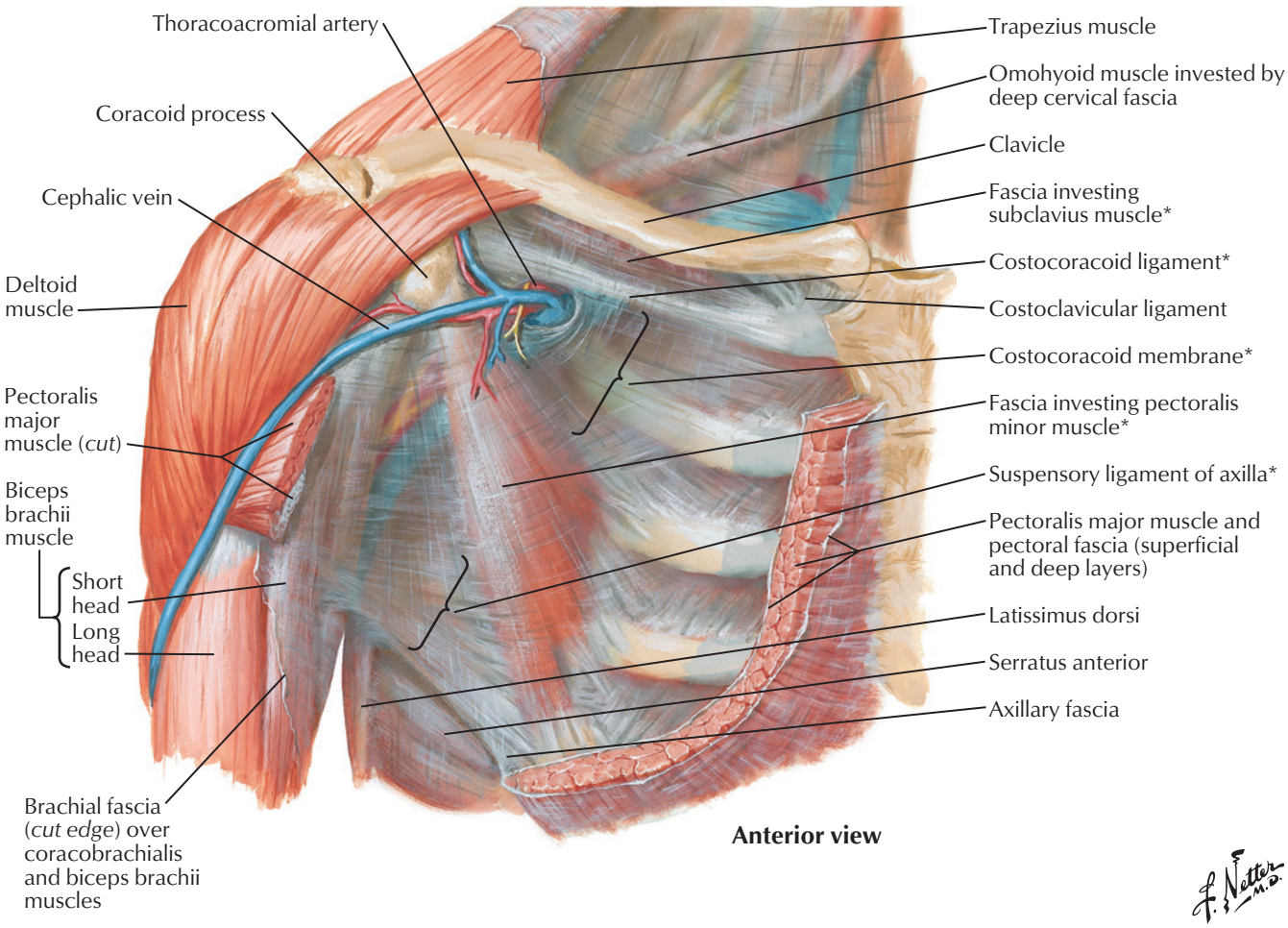



Biceps brachii muscle
Long head tendon
Short head muscle and tendon (cut)
Deltoid muscle
Radial nerve (deflected laterally)
Coracoid process and pectoralis minor (tendon, cut)
Axillary nerve
Posterior cord
Pectoralis major muscle (cut)
Coracobrachialis muscle and tendon (cut)
Superior transverse scapular ligament
Biceps brachii muscle (cut)
Long head
Short head
Supraspinatus muscle
Clavicle and subclavius muscle
Trapezius muscle
Triceps brachii muscle
Medial head
Long head
Sternocleidomastoid muscle
Trunks of brachial plexus
Superior (cut)
Middle
Inferior (cut)
Coracobrachialis muscle (cut)
Axillary nerve branches
Superior lateral brachial cutaneous nerve
(Posterior to humerus)
Posterior branch
Anterior branch
Branch to teres minor muscle
Teres minor muscle
Latissimus dorsi muscle
Teres major muscle
Lower subscapular nerve
Thoracodorsal (middle subscapular) nerve
Upper subscapular nerve
Subscapularis muscle
Serratus anterior muscle
Pectoralis major muscle (cut)
Pectoralis minor muscle (cut)
External abdominal oblique muscle
C. Machado M.D.

See also Plates 412, 421, 422

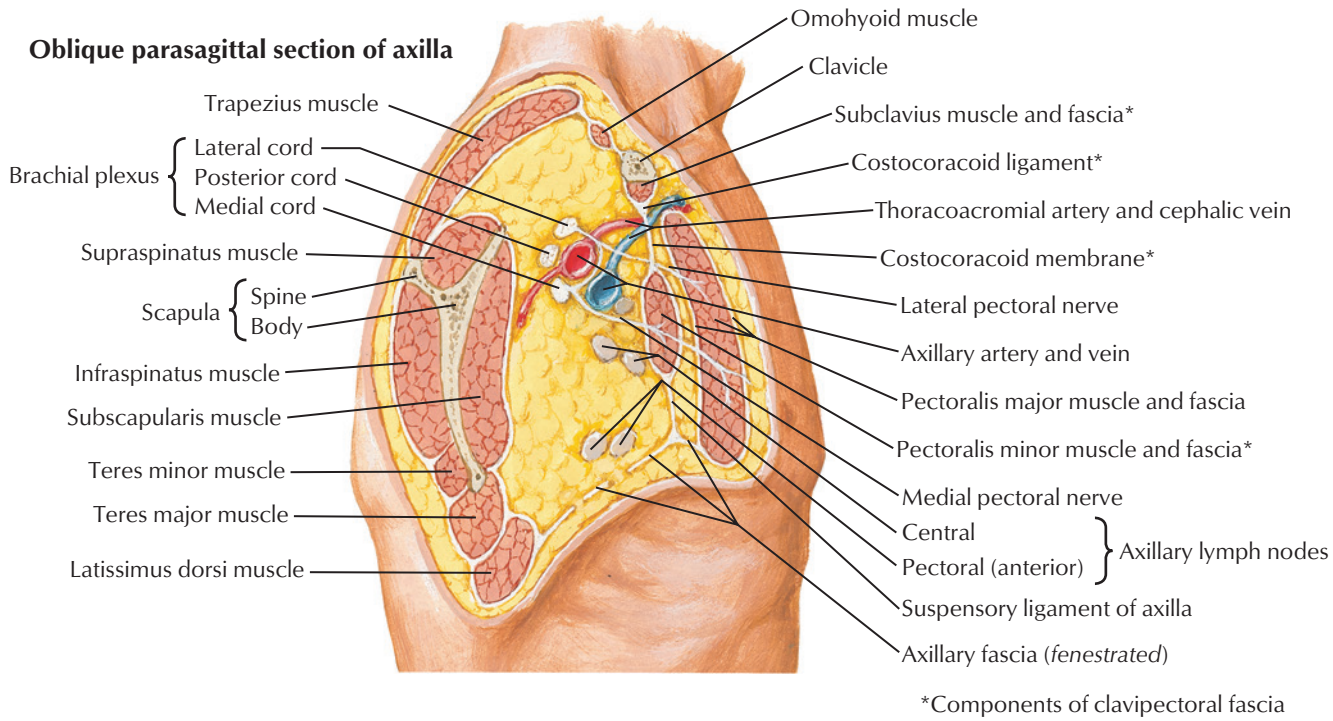


See also Plates 190, 194



Anterior view

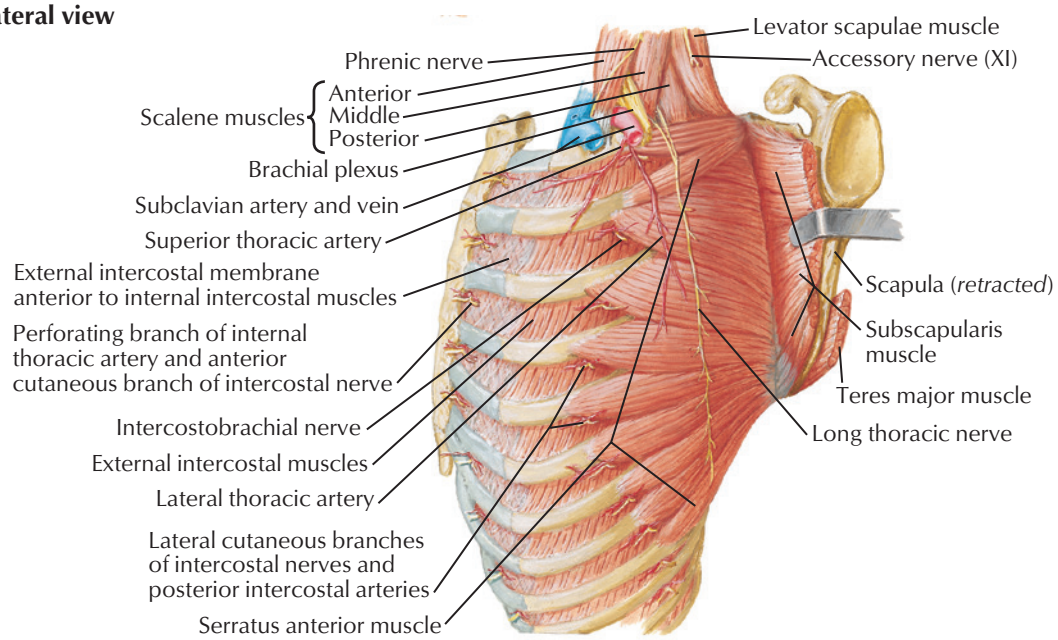
Oblique parasagittal section of axilla



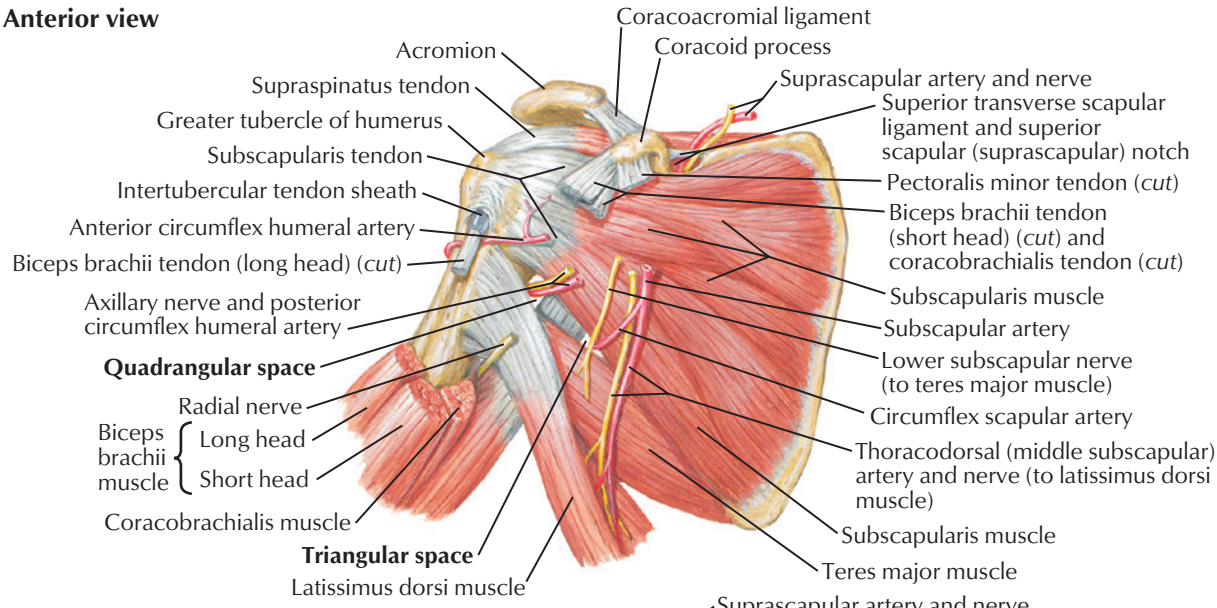
*Components of clavipectoral fascia

See also Plates 419, 468

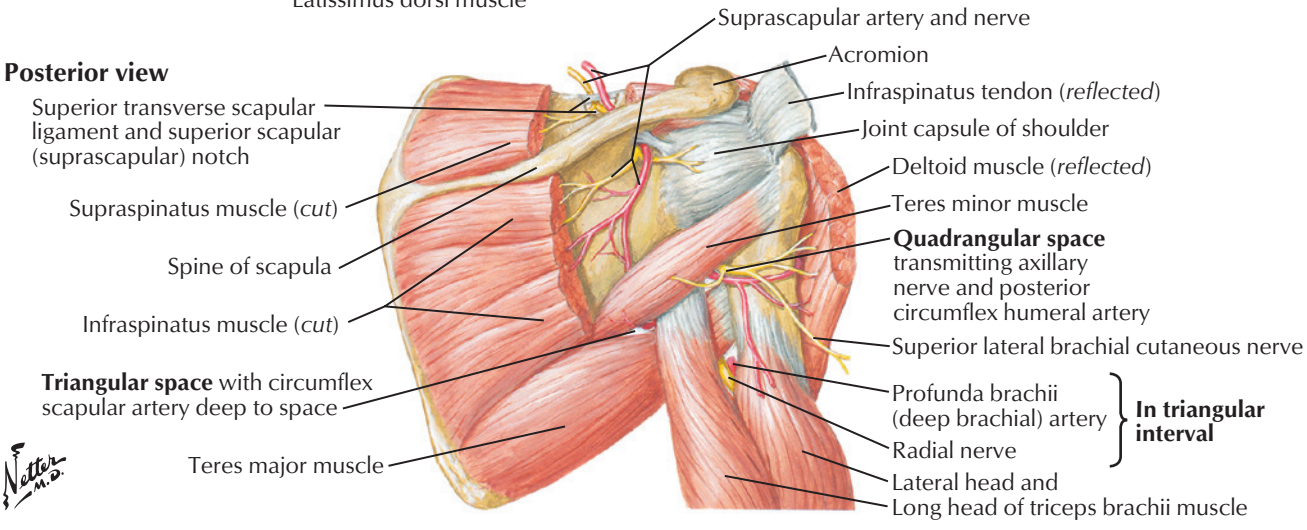
Lateral view



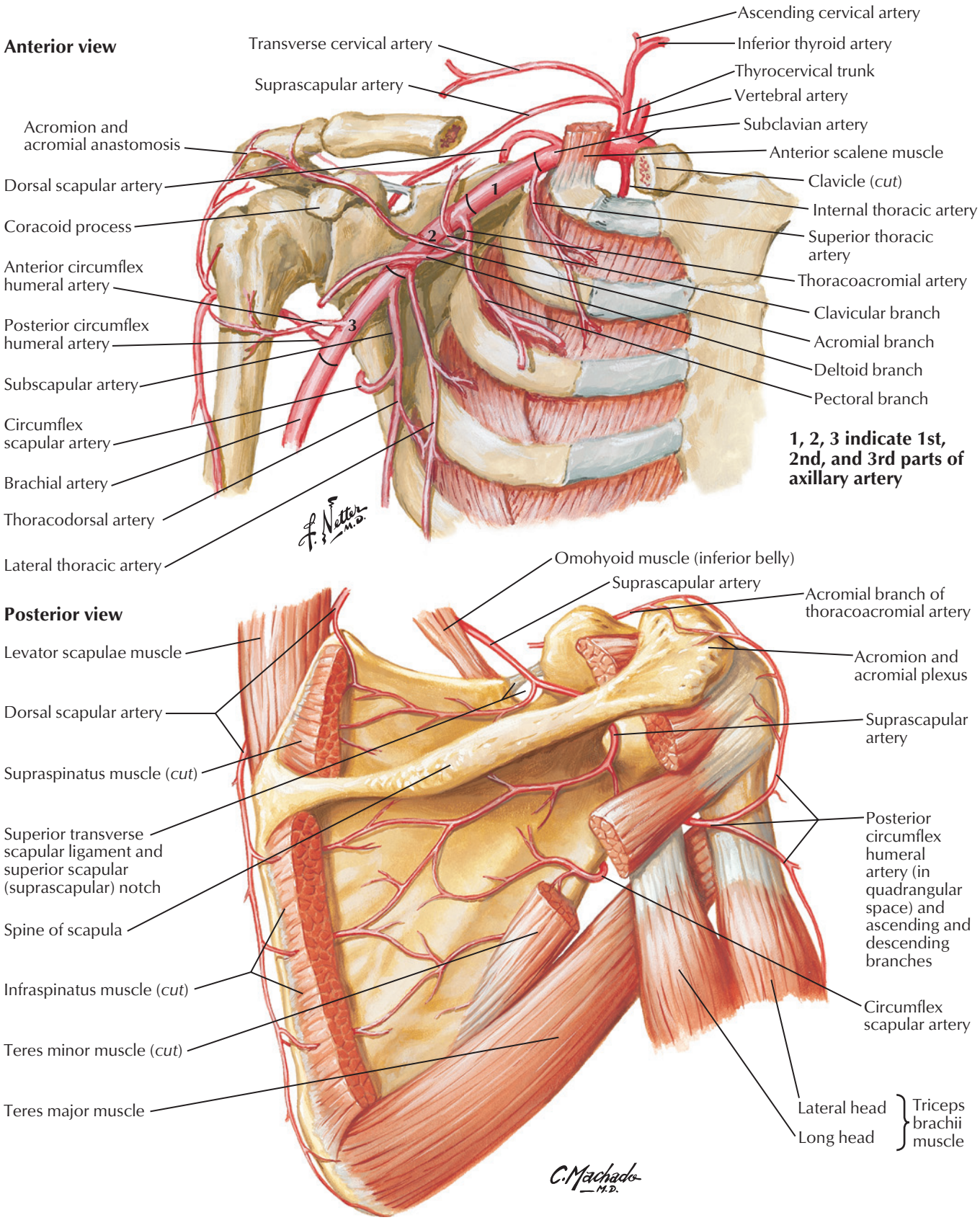
Anterior view



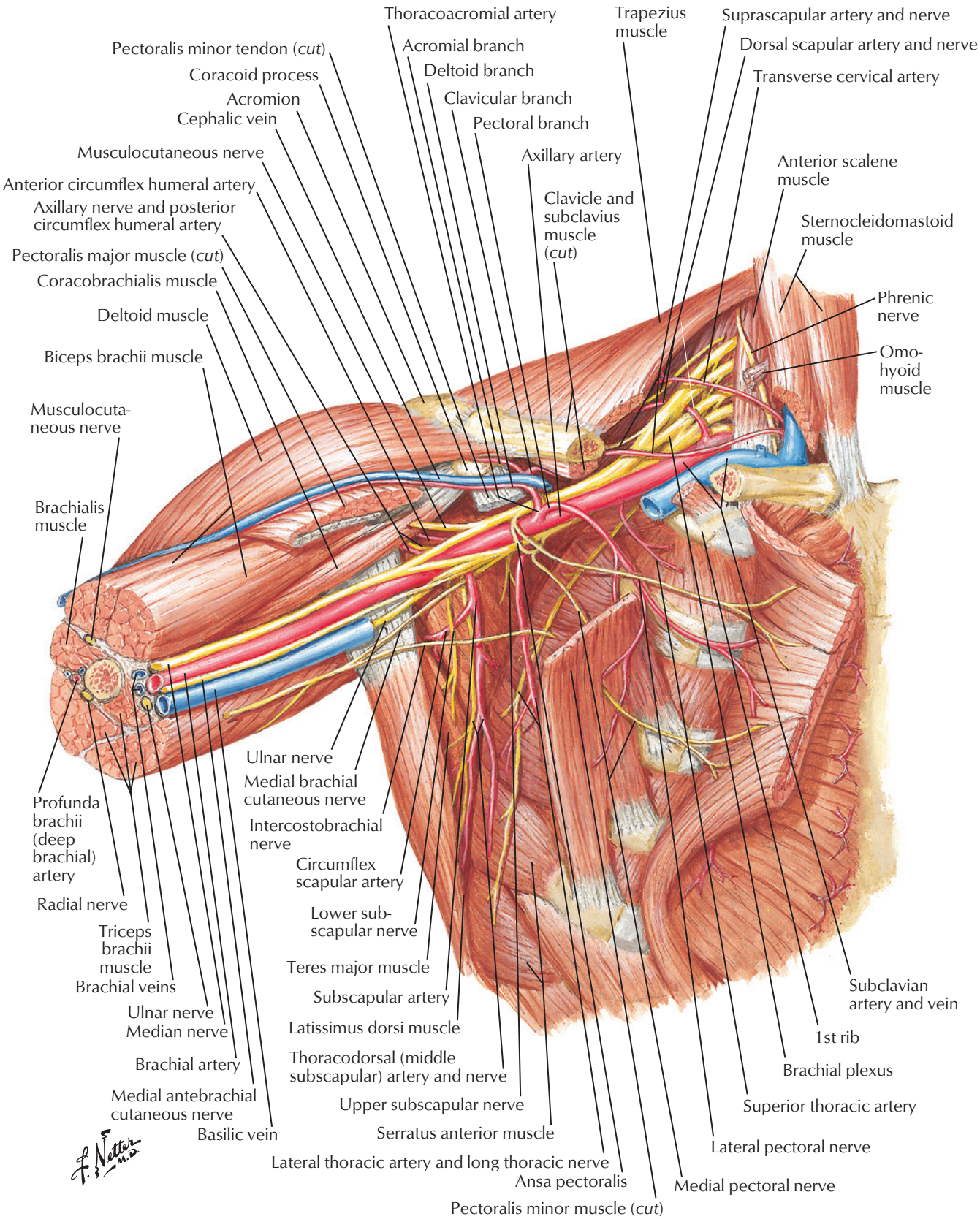
Posterior view



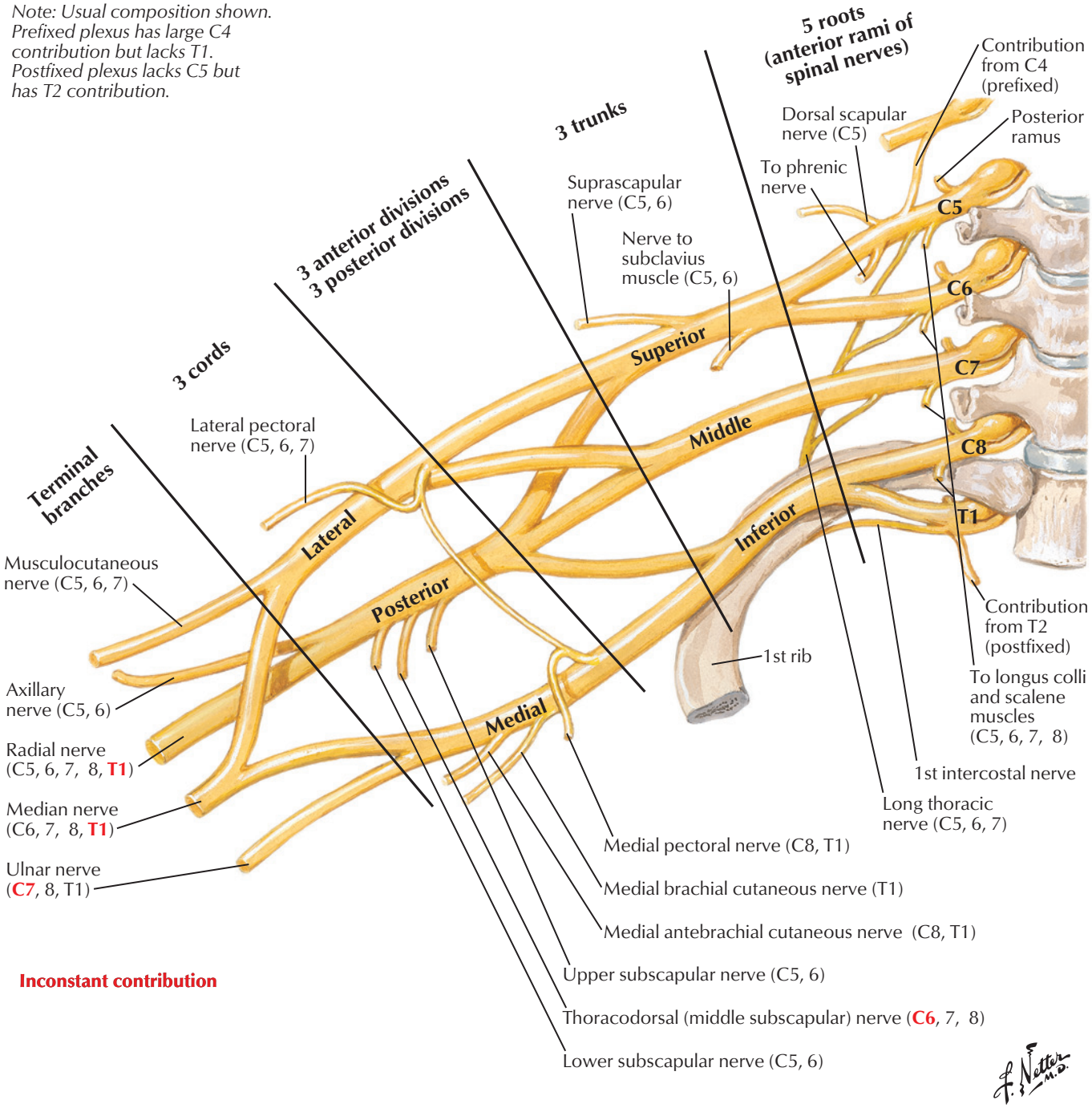
See also Plates 40, 424



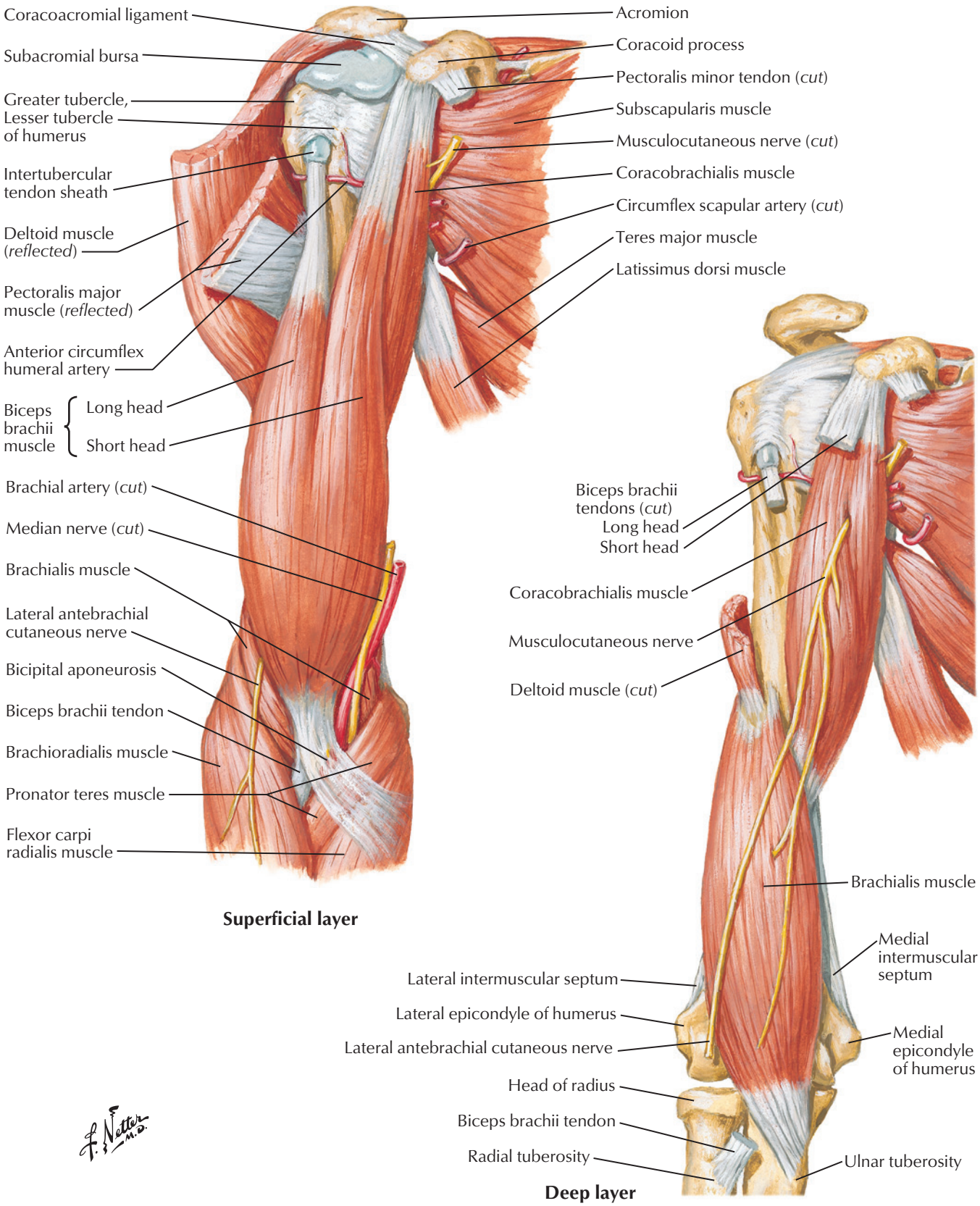
See also Plates 414, 417



Note: Usual composition shown. Prefixed plexus has large C4 contribution but lacks T1. Postfixed plexus lacks C5 but has T2 contribution.



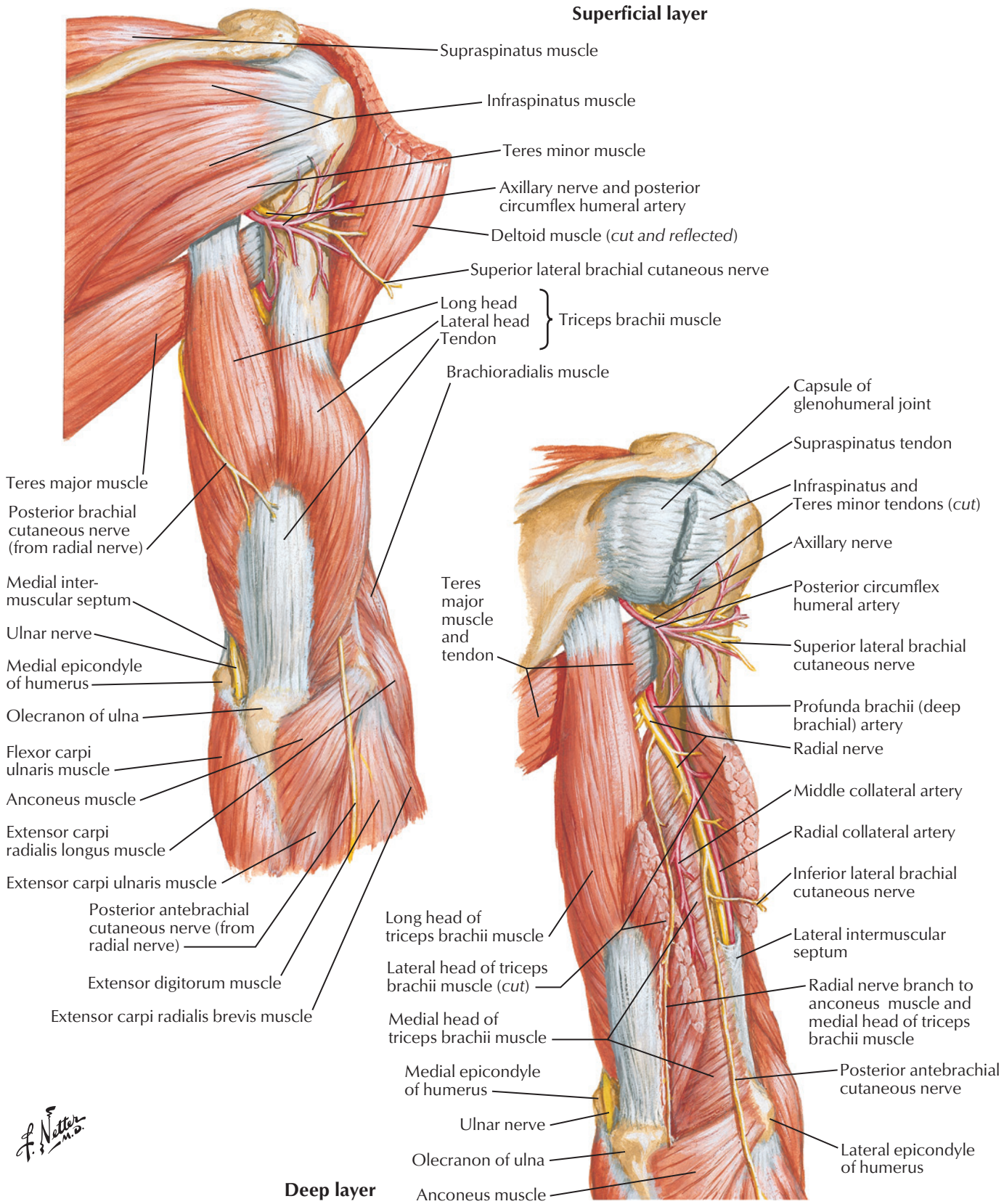
See also Plates 415, 465

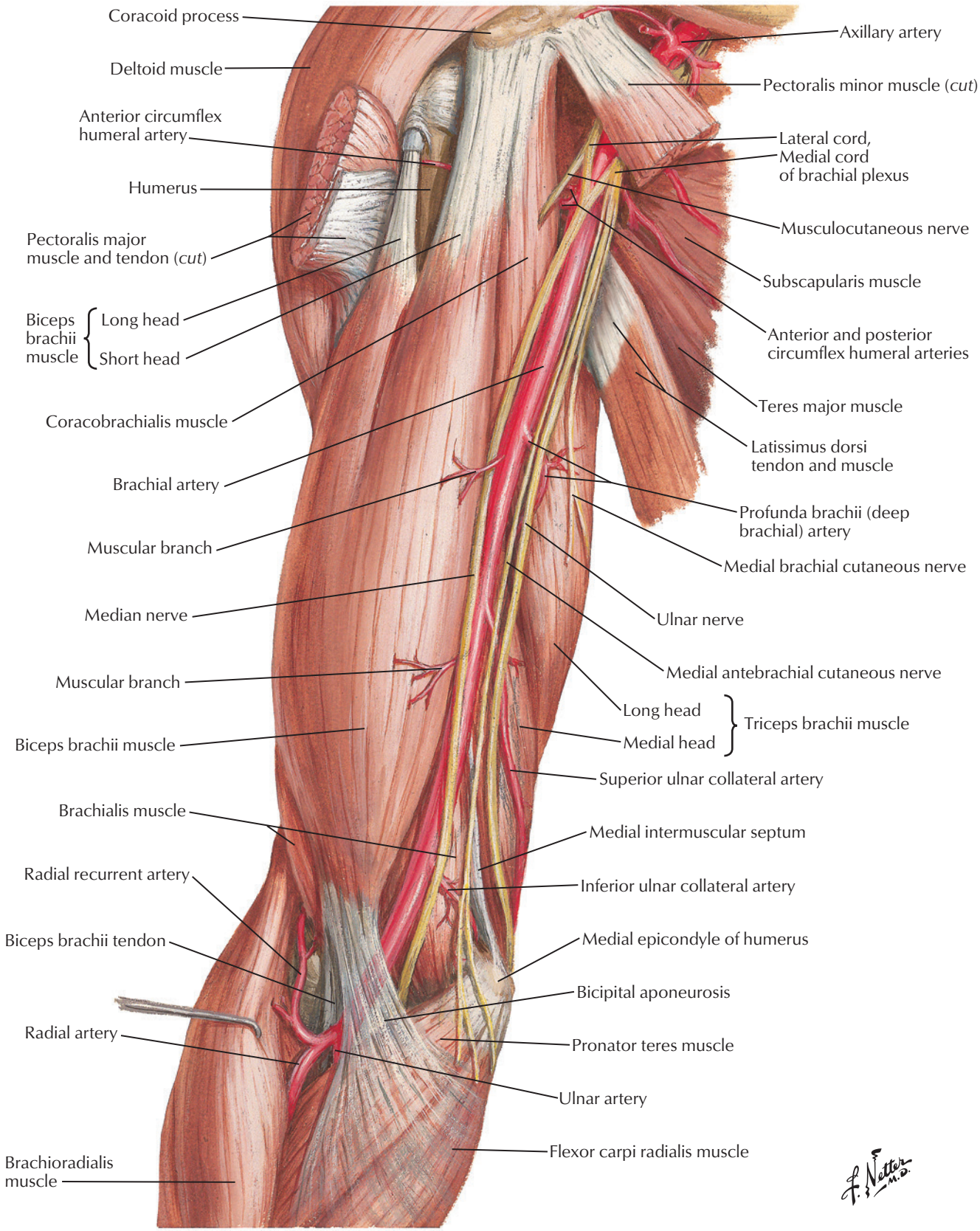


Superficial layer

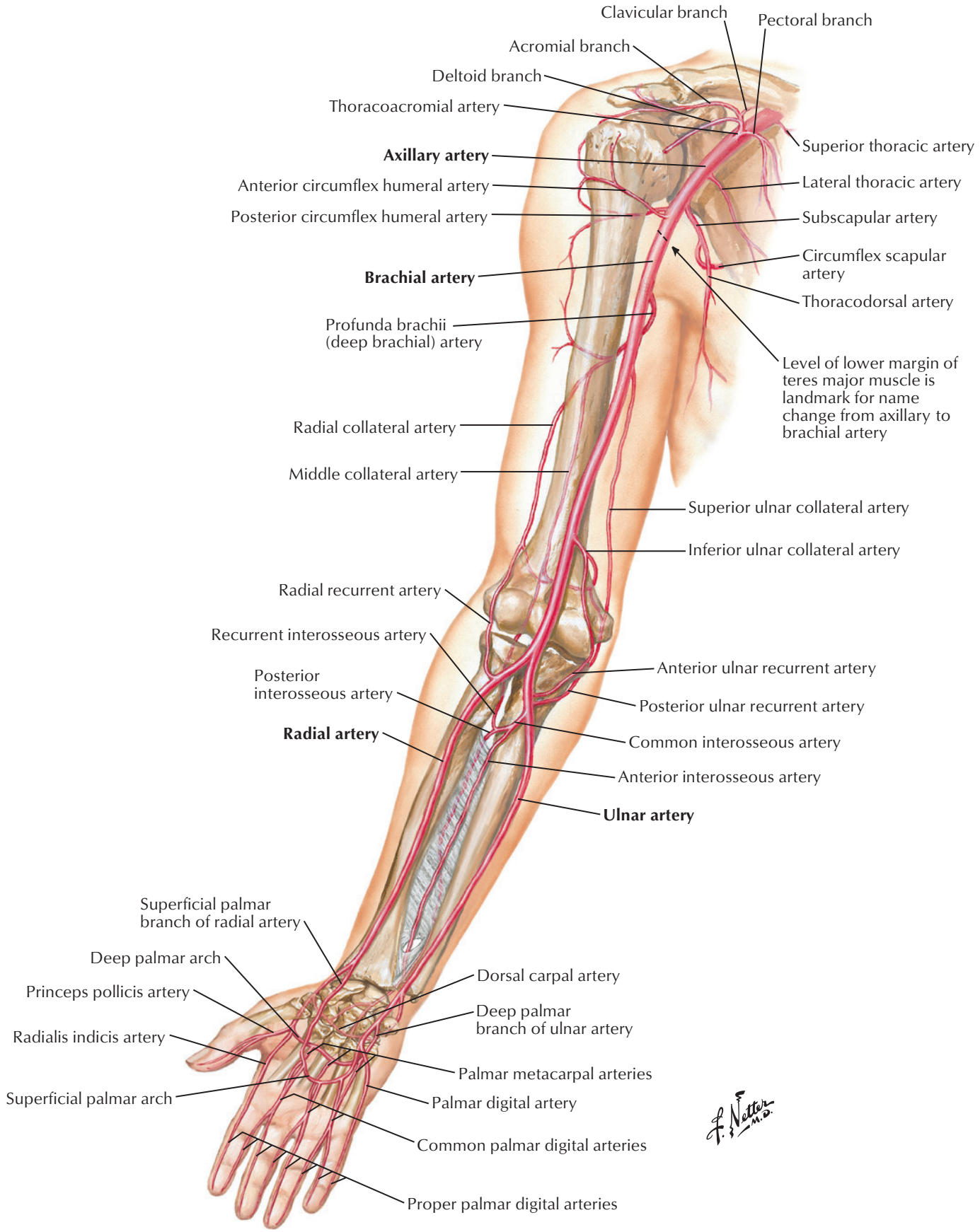
Deep layer

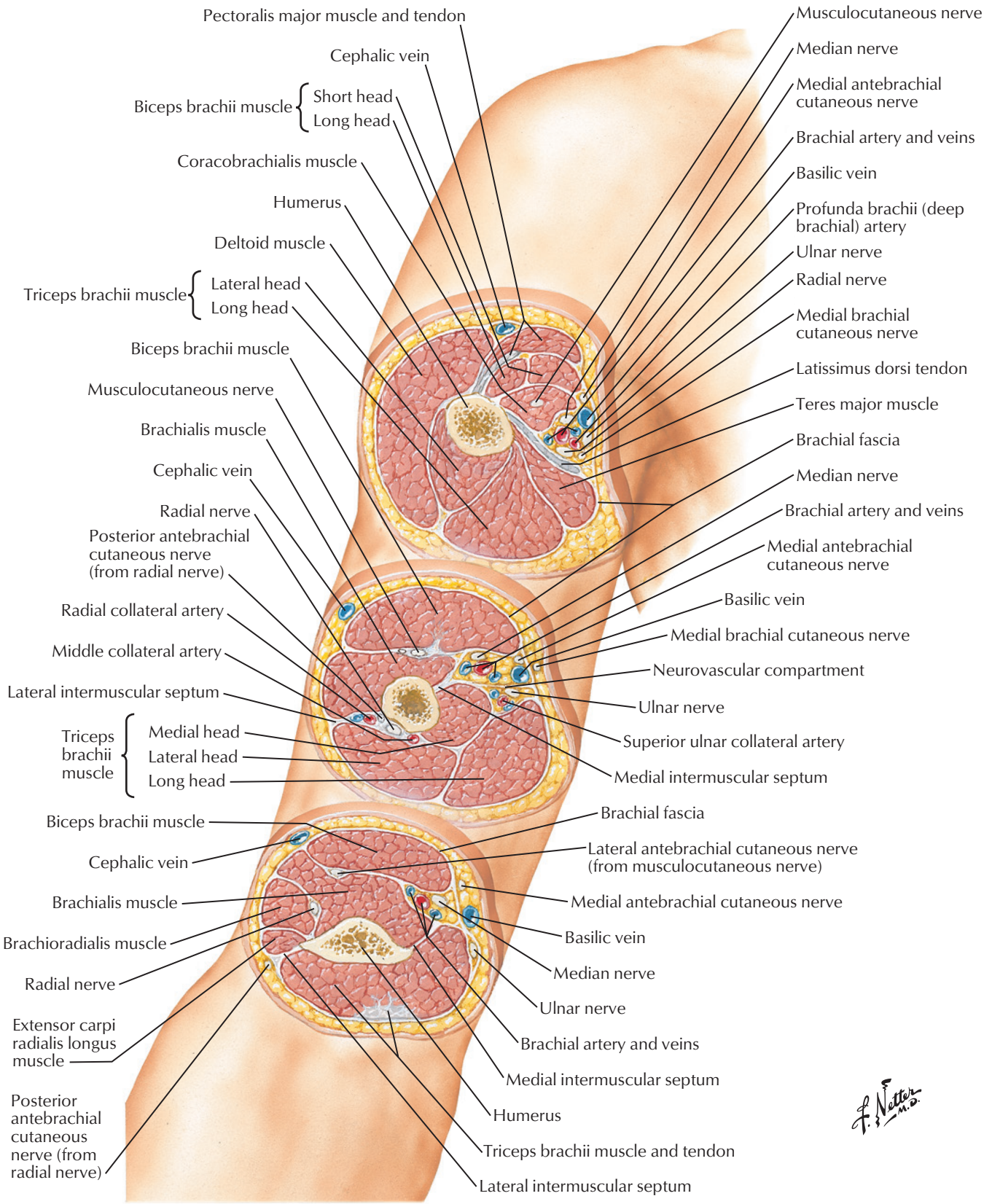
See also Plates 415, 468



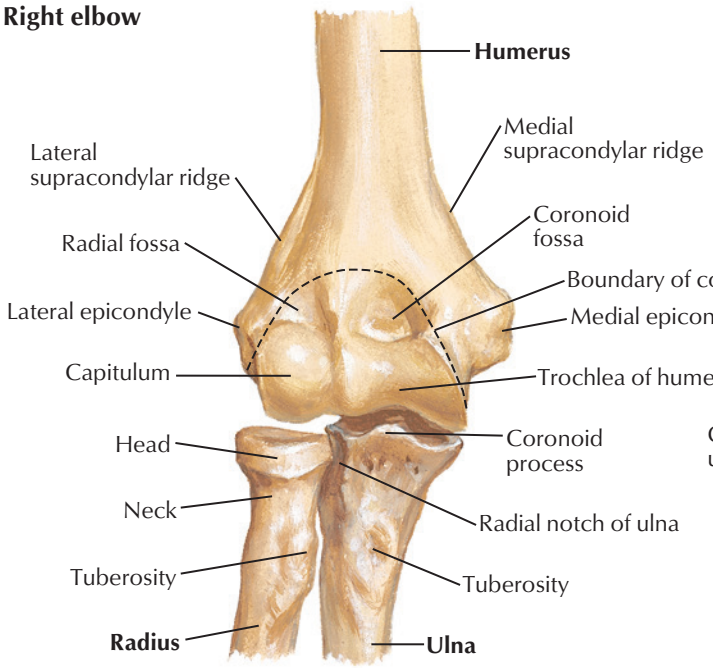

Coracoid process
Deltoid muscle
Anterior circumflex humeral artery
Humerus
Pectoralis major muscle and tendon (cut)
Biceps brachii muscle
Long head
Short head
Coracobrachialis muscle
Brachial artery
Muscular branch
Median nerve
Muscular branch
Biceps brachii muscle
Brachialis muscle
Radial recurrent artery
Biceps brachii tendon
Radial artery
Brachioradialis muscle
Axillary artery
Pectoralis minor muscle (cut)
Lateral cord,
Medial cord
of brachial plexus
Musculocutaneous nerve
Subscapularis muscle
Anterior and posterior circumflex humeral arteries
Teres major muscle
Latissimus dorsi tendon and muscle
Profunda brachii (deep brachial) artery
Medial brachial cutaneous nerve
Ulnar nerve
Medial antebrachial cutaneous nerve
Long head
Medial head
Triceps brachii muscle
Superior ulnar collateral artery
Medial intermuscular septum
Inferior ulnar collateral artery
Medial epicondyle of humerus
Bicipital aponeurosis
Pronator teres muscle
Ulnar artery
Flexor carpi radialis muscle

See also **Plates 437, 456**

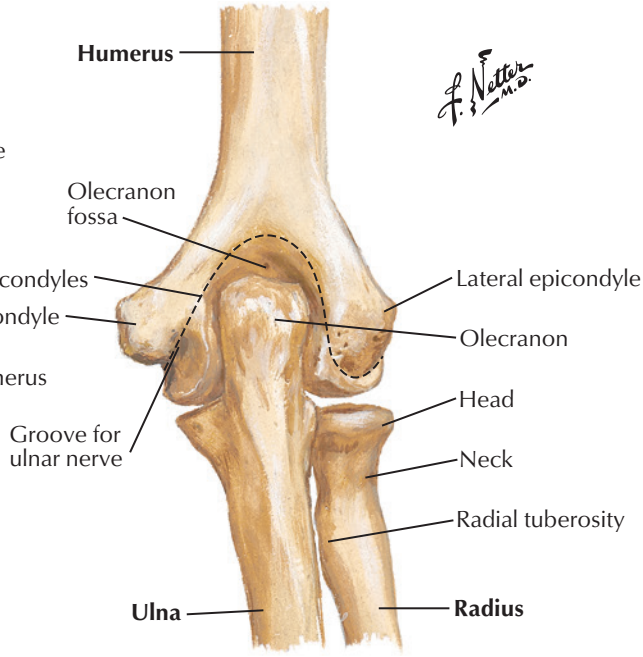



Pectoralis major muscle and tendon
Cephalic vein
Biceps brachii muscle
Short head
Long head
Coracobrachialis muscle
Humerus
Deltoid muscle
Triceps brachii muscle
Lateral head
Long head
Biceps brachii muscle
Musculocutaneous nerve
Brachialis muscle
Cephalic vein
Radial nerve
Posterior antebrachial cutaneous nerve (from radial nerve)
Radial collateral artery
Middle collateral artery
Lateral intermuscular septum
Triceps brachii muscle
Medial head
Lateral head
Long head
Biceps brachii muscle
Cephalic vein
Brachialis muscle
Brachioradialis muscle
Radial nerve
Extensor carpi radialis longus muscle
Posterior antebrachial cutaneous nerve (from radial nerve)
Musculocutaneous nerve
Median nerve
Medial antebrachial cutaneous nerve
Brachial artery and veins
Basilic vein
Profunda brachii (deep brachial) artery
Ulnar nerve
Radial nerve
Medial brachial cutaneous nerve
Latissimus dorsi tendon
Teres major muscle
Brachial fascia
Median nerve
Brachial artery and veins
Medial antebrachial cutaneous nerve
Basilic vein
Medial brachial cutaneous nerve
Neurovascular compartment
Ulnar nerve
Superior ulnar collateral artery
Medial intermuscular septum
Brachial fascia
Lateral antebrachial cutaneous nerve (from musculocutaneous nerve)
Medial antebrachial cutaneous nerve
Basilic vein
Median nerve
Ulnar nerve
Brachial artery and veins
Medial intermuscular septum
Humerus
Triceps brachii muscle and tendon
Lateral intermuscular septum

Right elbow



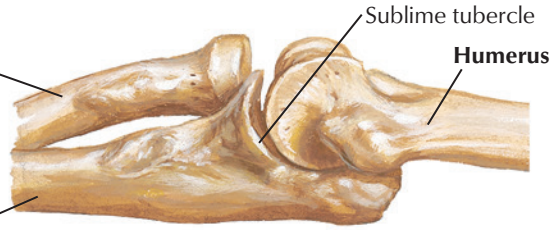
In extension: anterior view



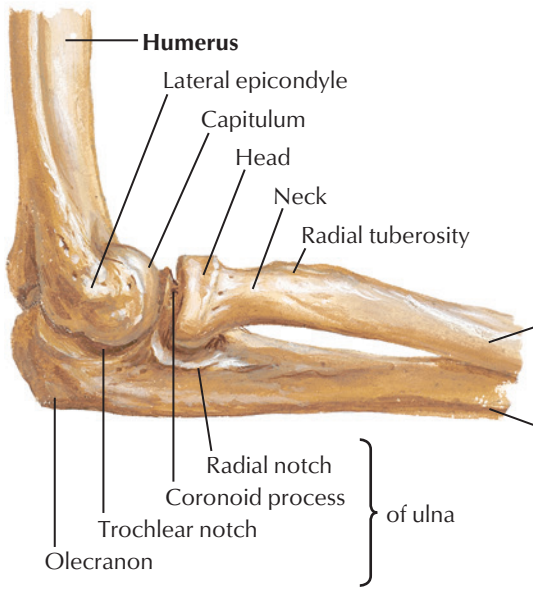
In extension: posterior view



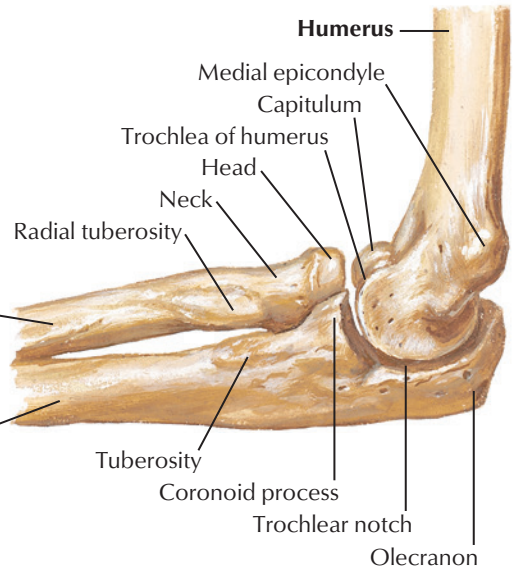
In extension: lateral view



In extension: medial view

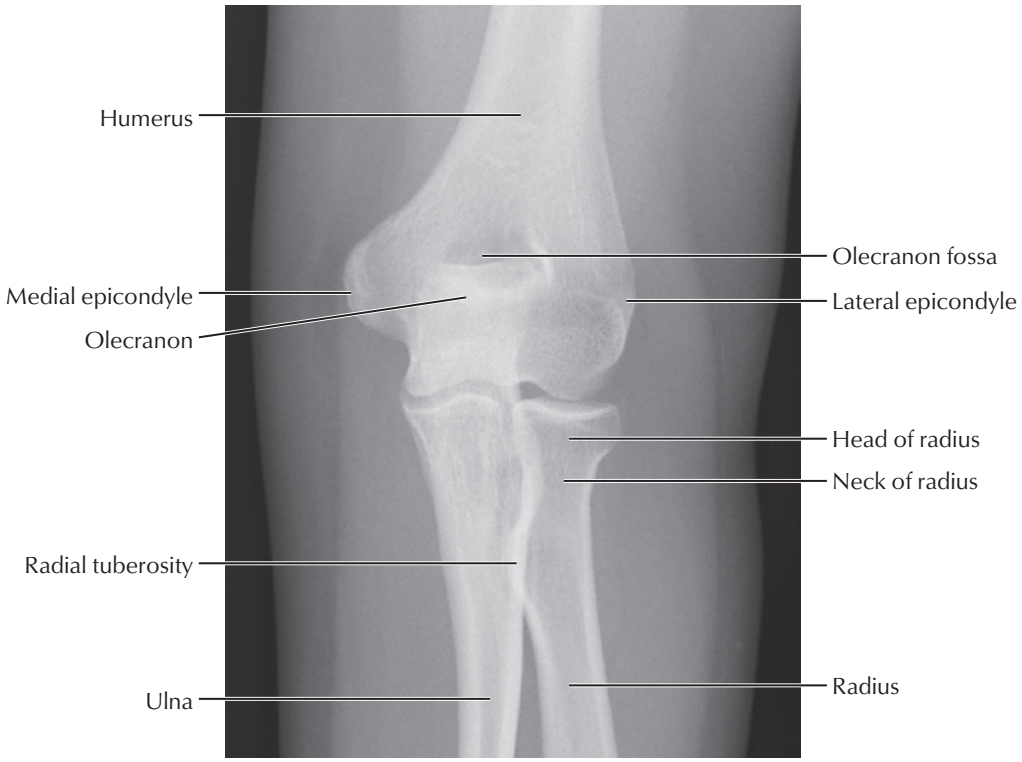


In 90 degrees of flexion: lateral view

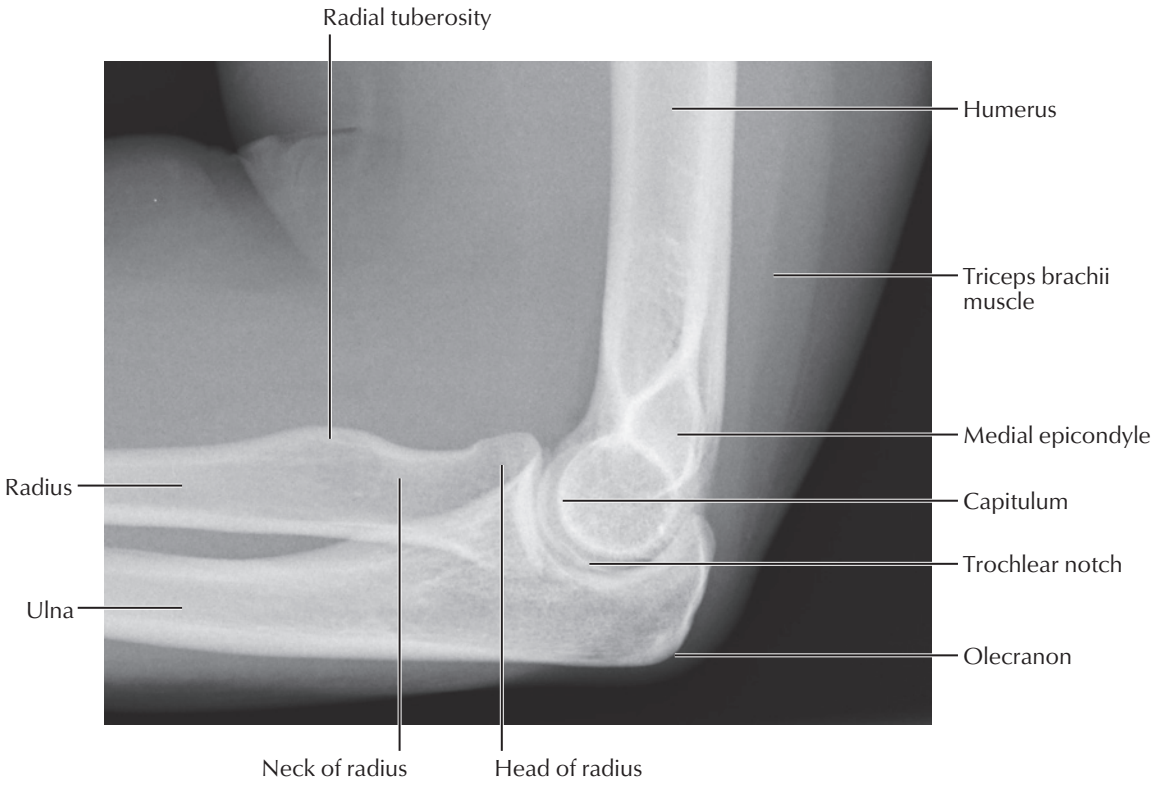


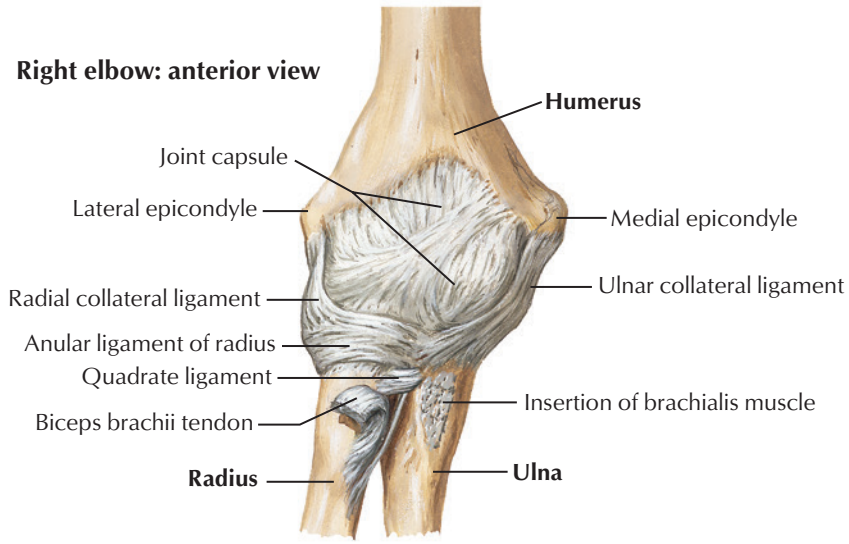
In 90 degrees of flexion: medial view

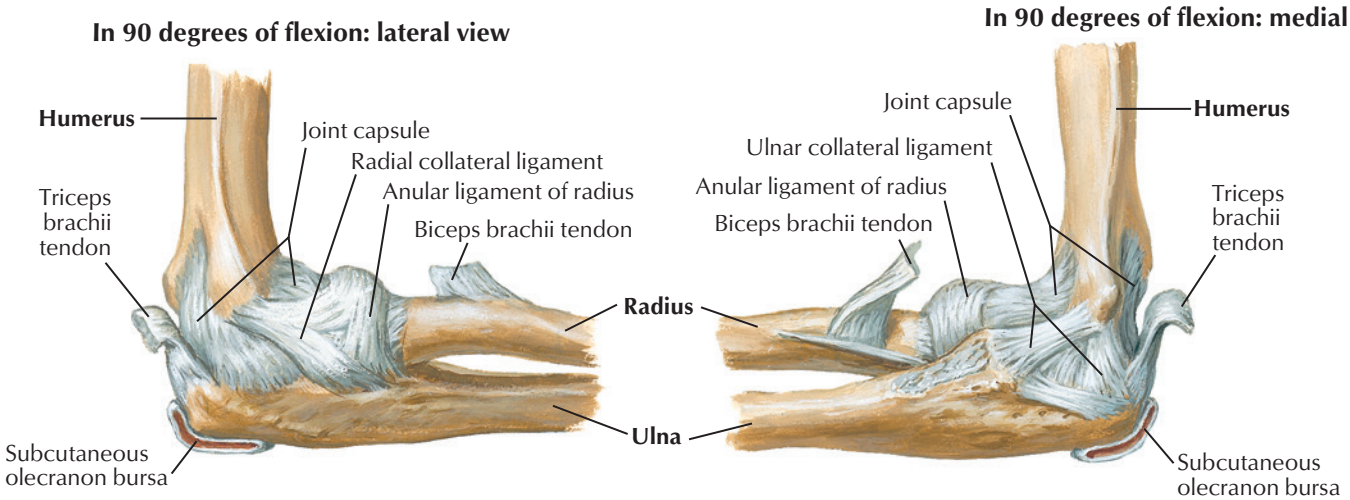
Anteroposterior view

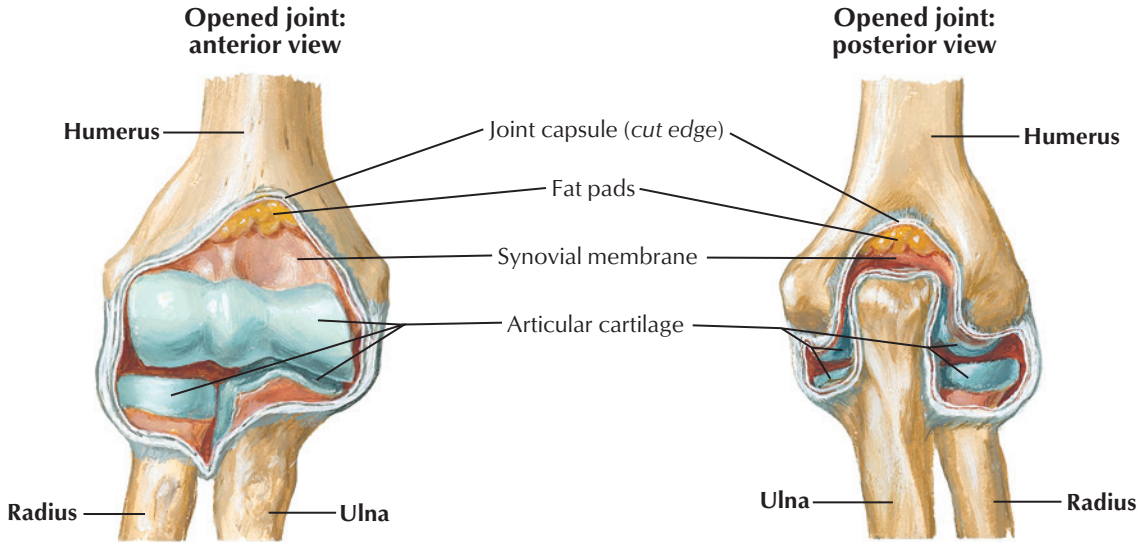


Lateral view



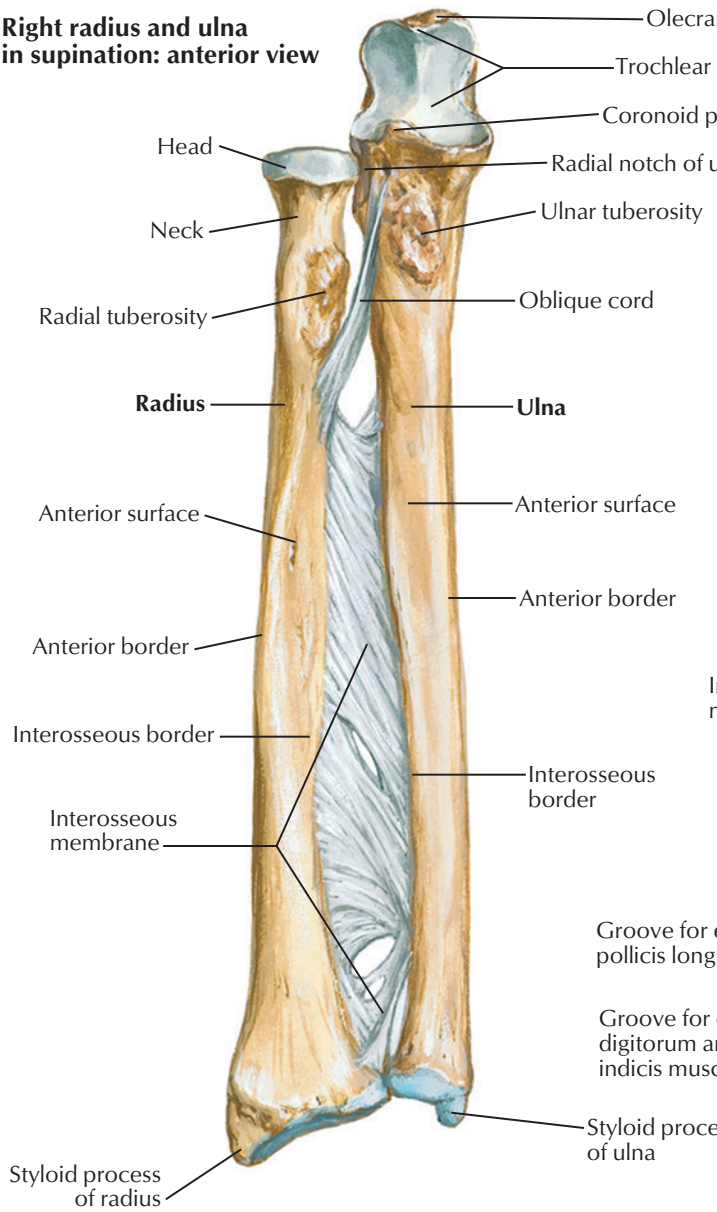

Right elbow: anterior view
Humerus
Joint capsule
Lateral epicondyle
Medial epicondyle
Radial collateral ligament
Ulnar collateral ligament
Anular ligament of radius
Quadrate ligament
Insertion of brachialis muscle
Biceps brachii tendon
Radius
Ulna


In 90 degrees of flexion: lateral view
Humerus
Joint capsule
Radial collateral ligament
Anular ligament of radius
Biceps brachii tendon
Triceps brachii tendon
Radius
Ulna
Subcutaneous olecranon bursa
In 90 degrees of flexion: medial view
Joint capsule
Humerus
Ulnar collateral ligament
Anular ligament of radius
Biceps brachii tendon
Triceps brachii tendon
Subcutaneous olecranon bursa

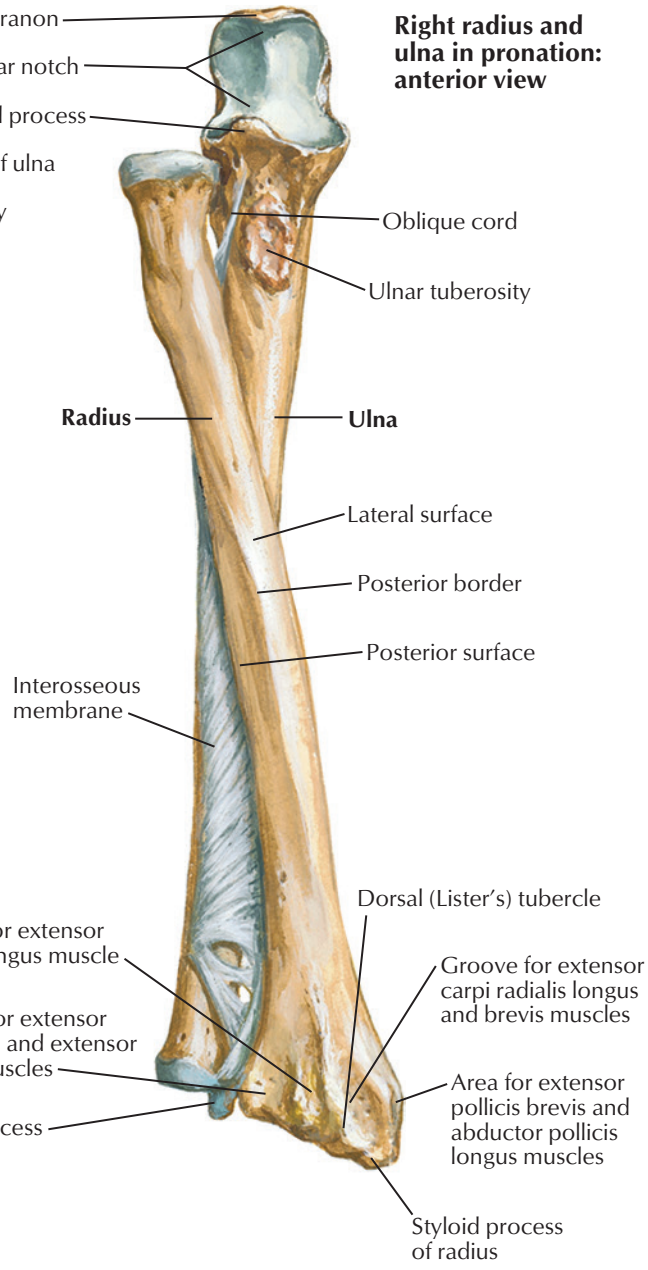

Opened joint: anterior view
Humerus
Joint capsule (cut edge)
Fat pads
Synovial membrane
Articular cartilage
Radius
Ulna
Opened joint: posterior view
Humerus
Ulna
Radius

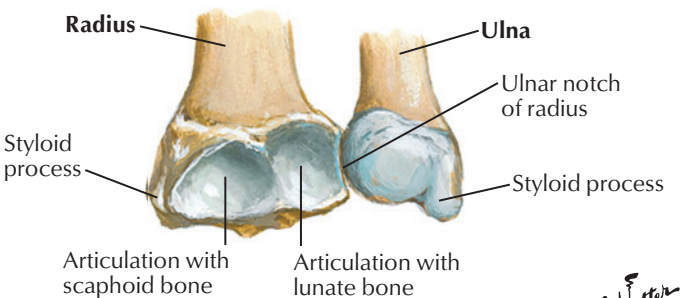
See also Plate 440

Right radius and ulna in supination: anterior view



Right radius and ulna in pronation: anterior view





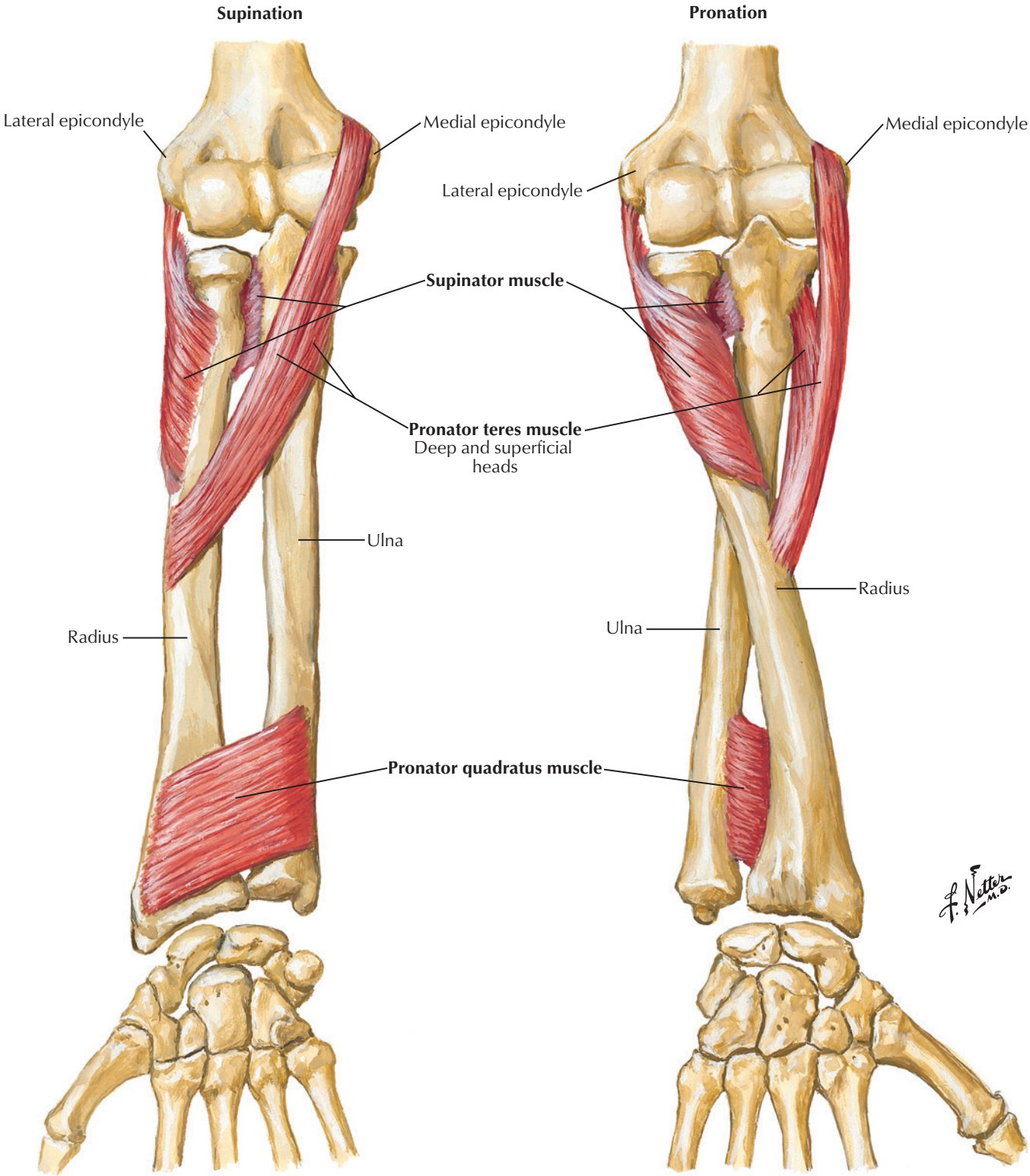
Carpal articular surface



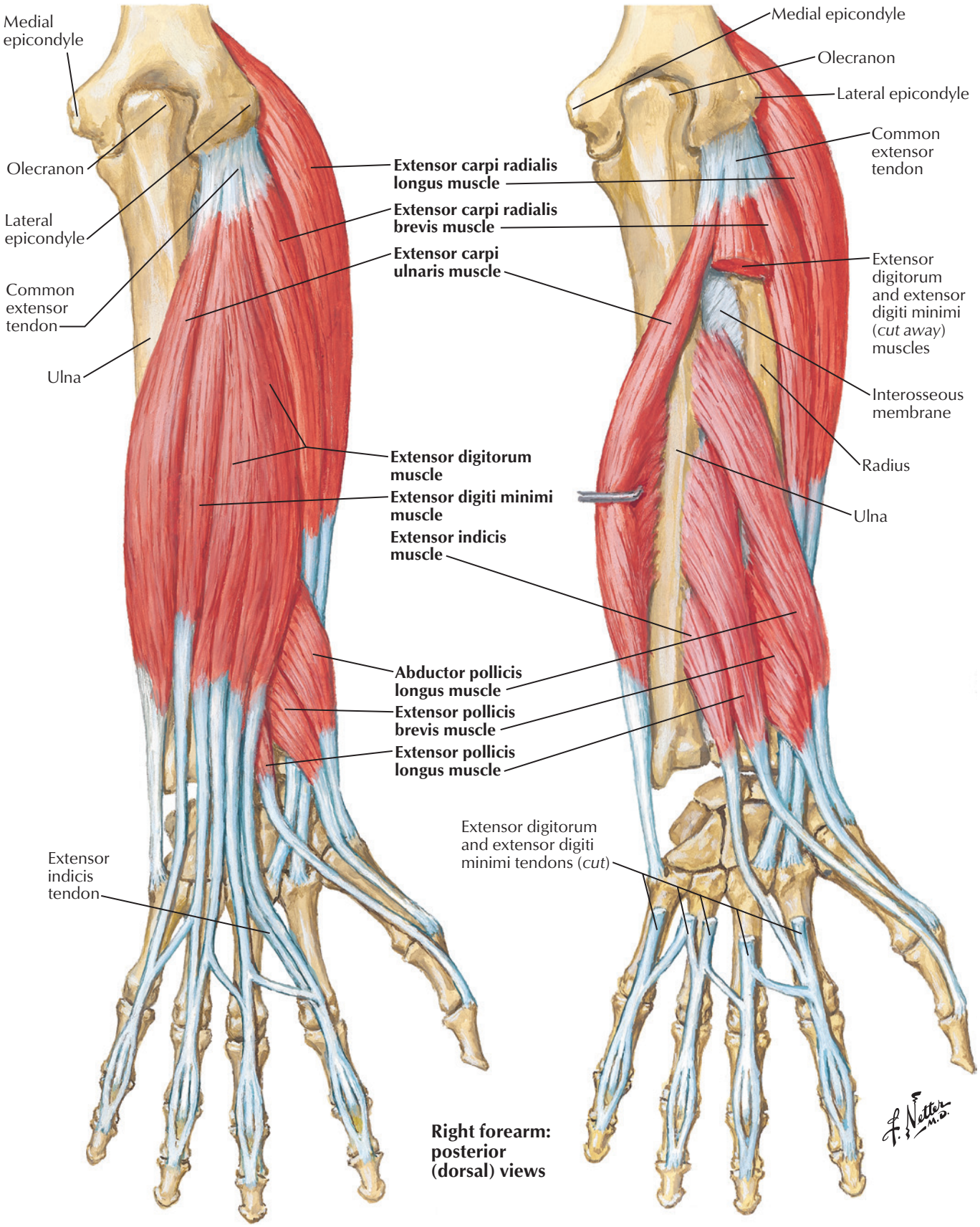
Coronal section of radius demonstrates how thickness of cortical bone of body of radius diminishes to thin layer over cancellous bone at distal end

See also Plate 438

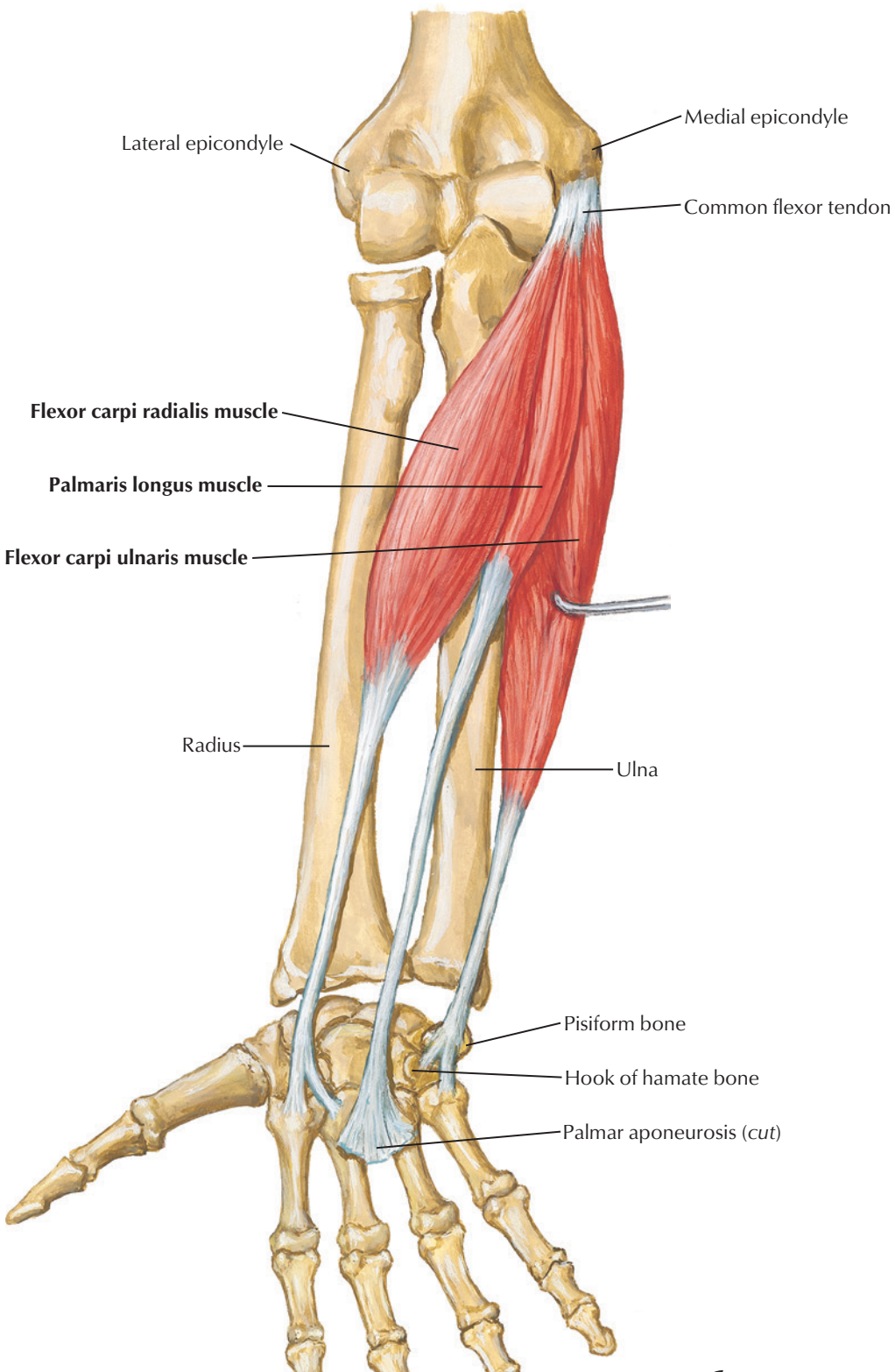
Right forearm: anterior view



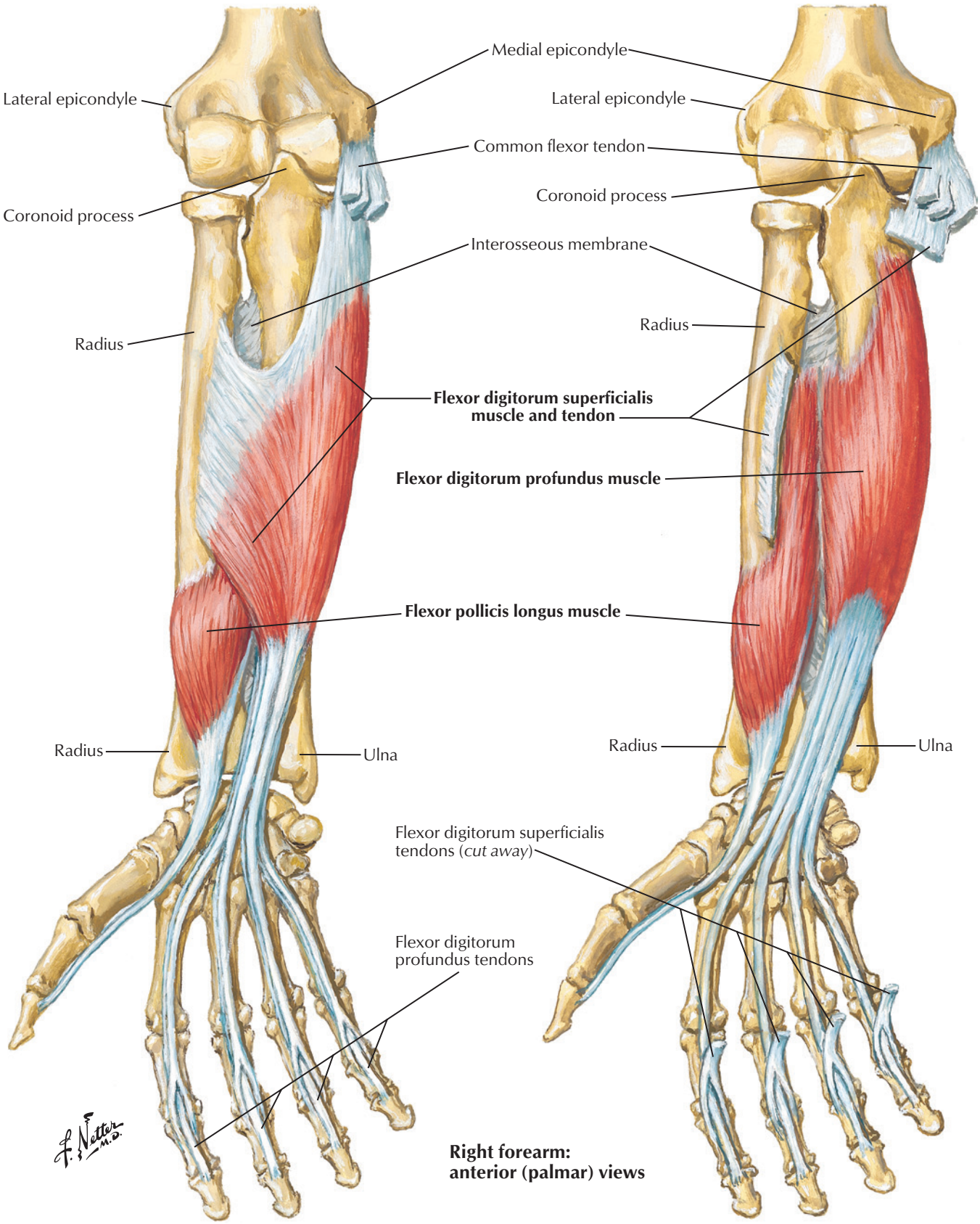
See also Plate 441



Right forearm: posterior (dorsal) views

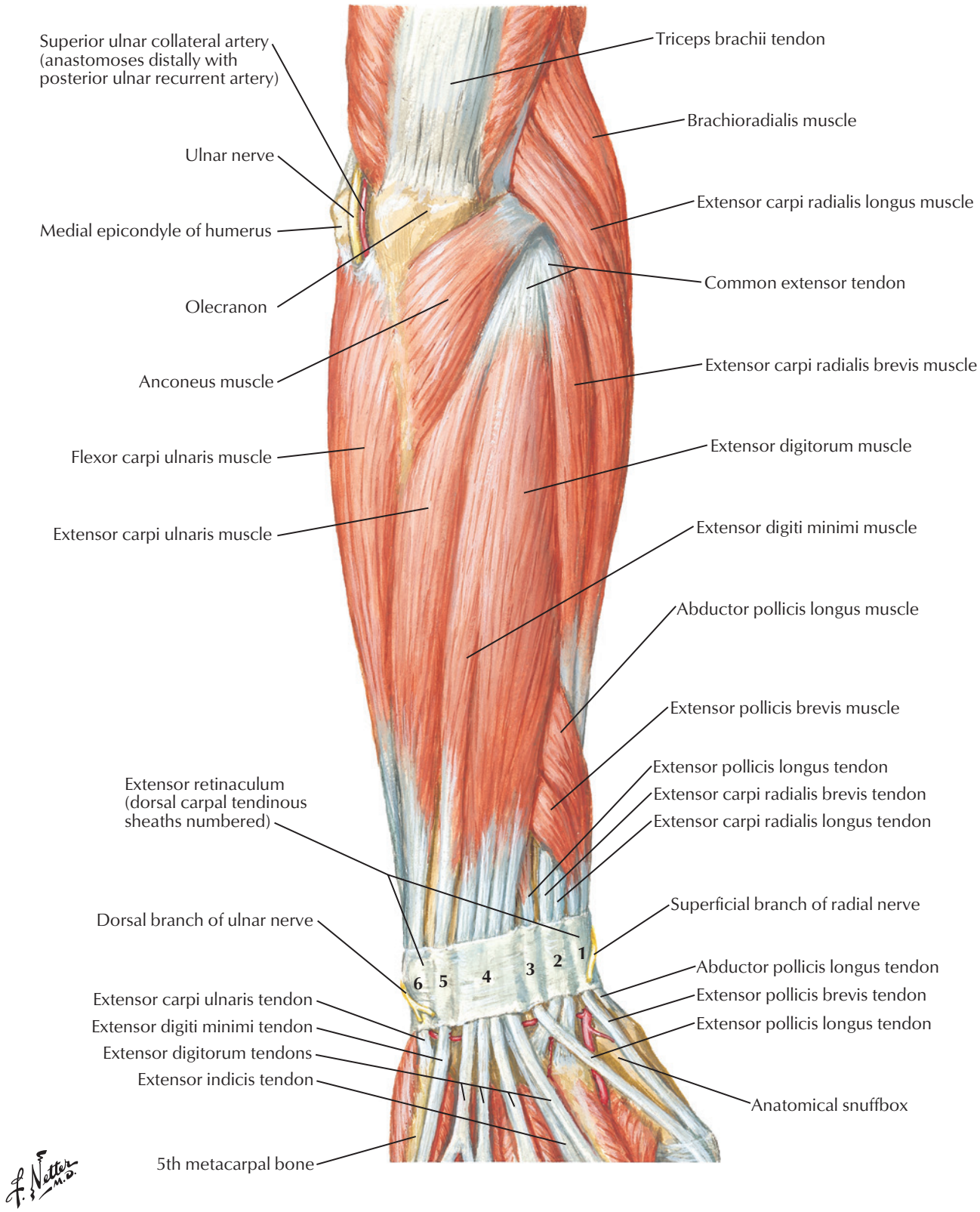


Right forearm:
anterior (palmar) view

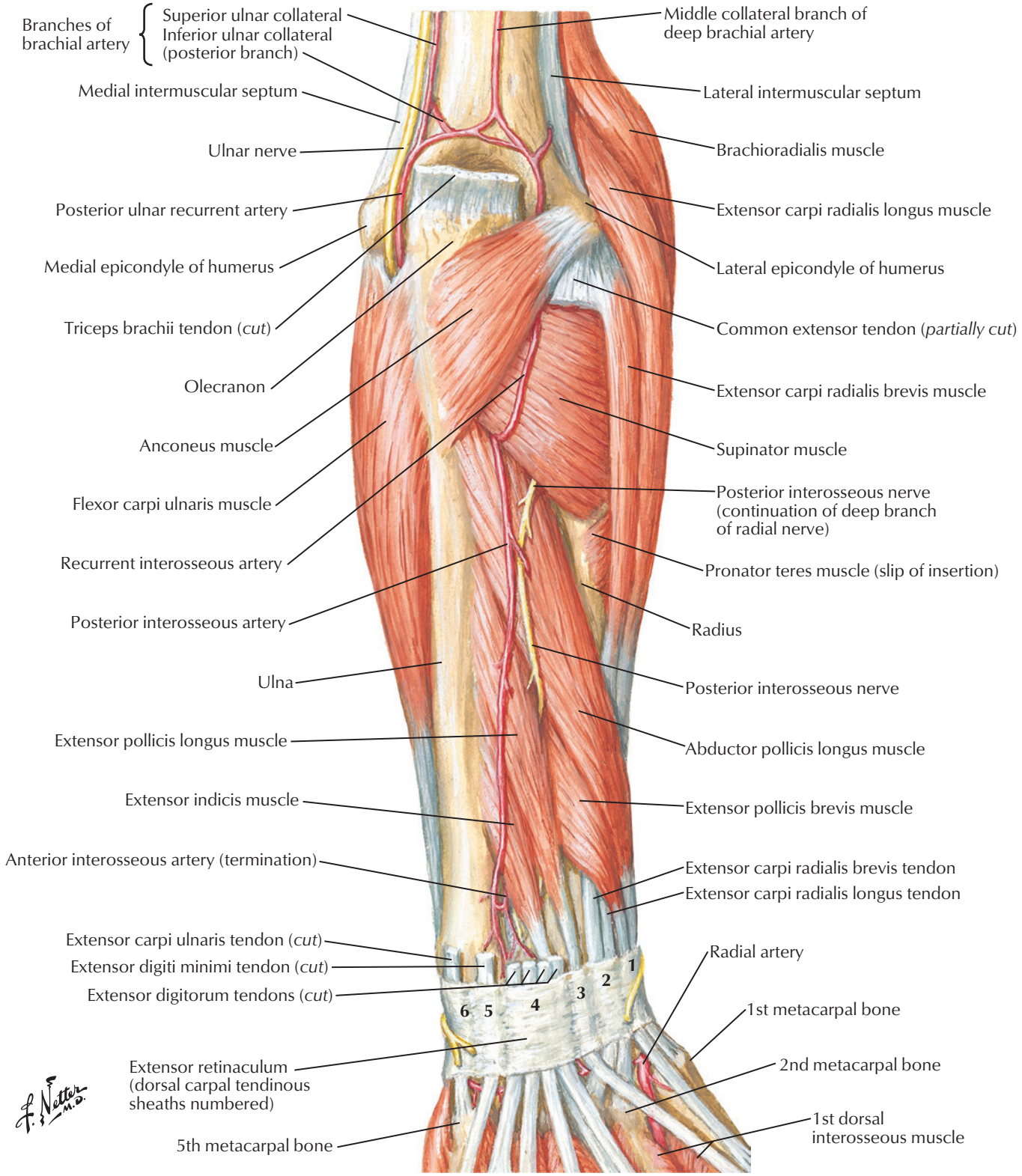


Right forearm: anterior (palmar) views

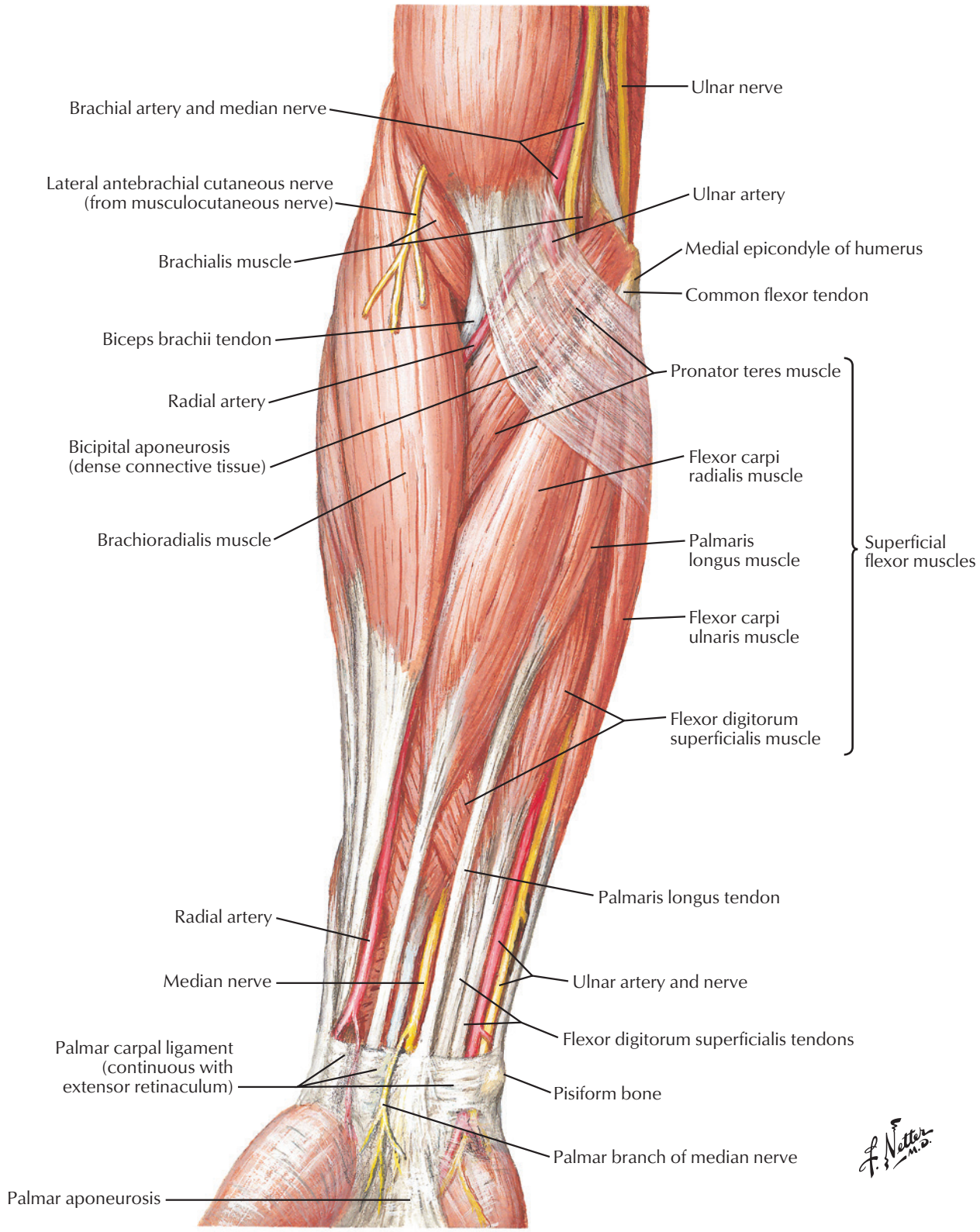
See also Plates 460, 469



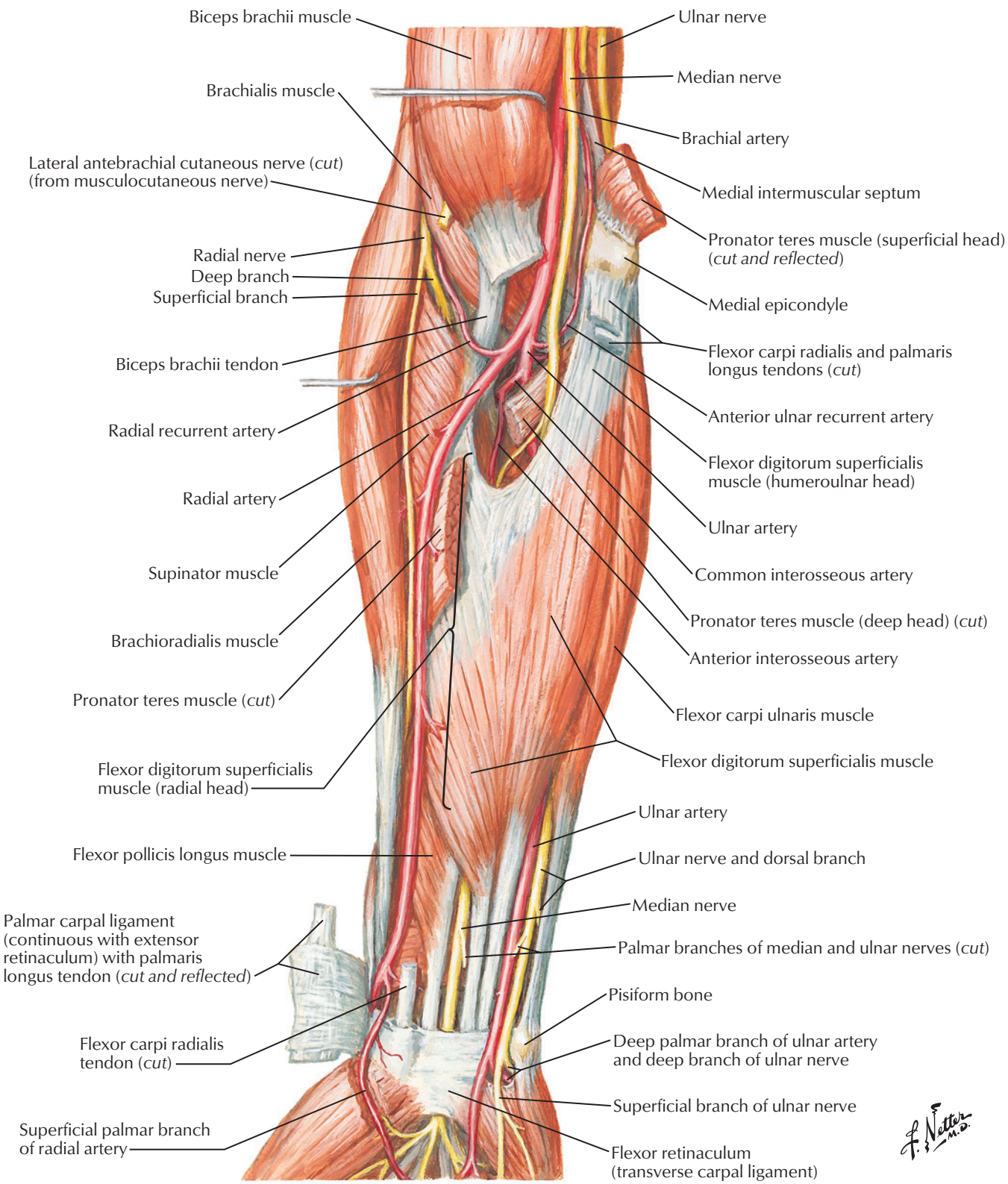
See also Plate 460



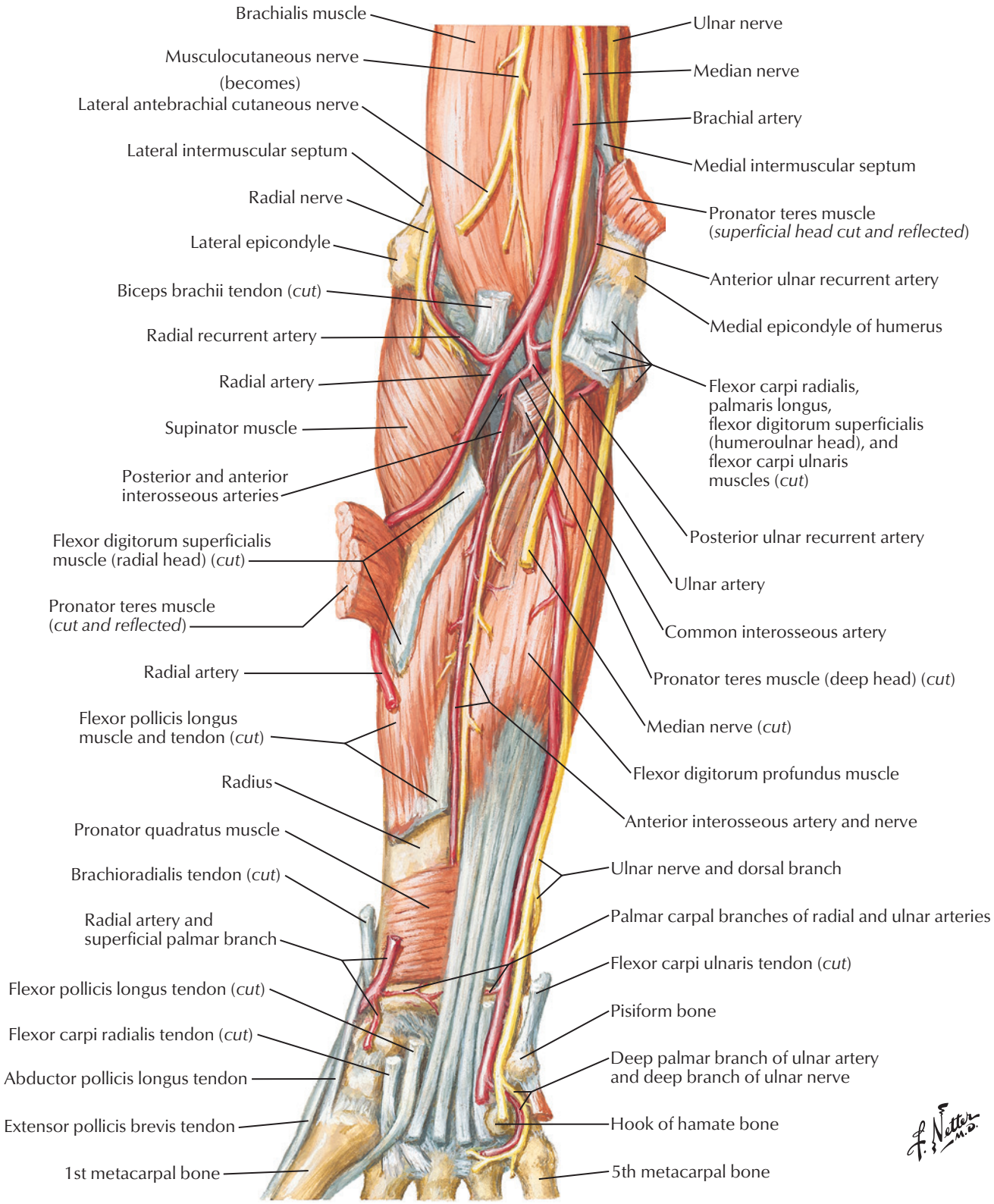
See also Plates 466, 467

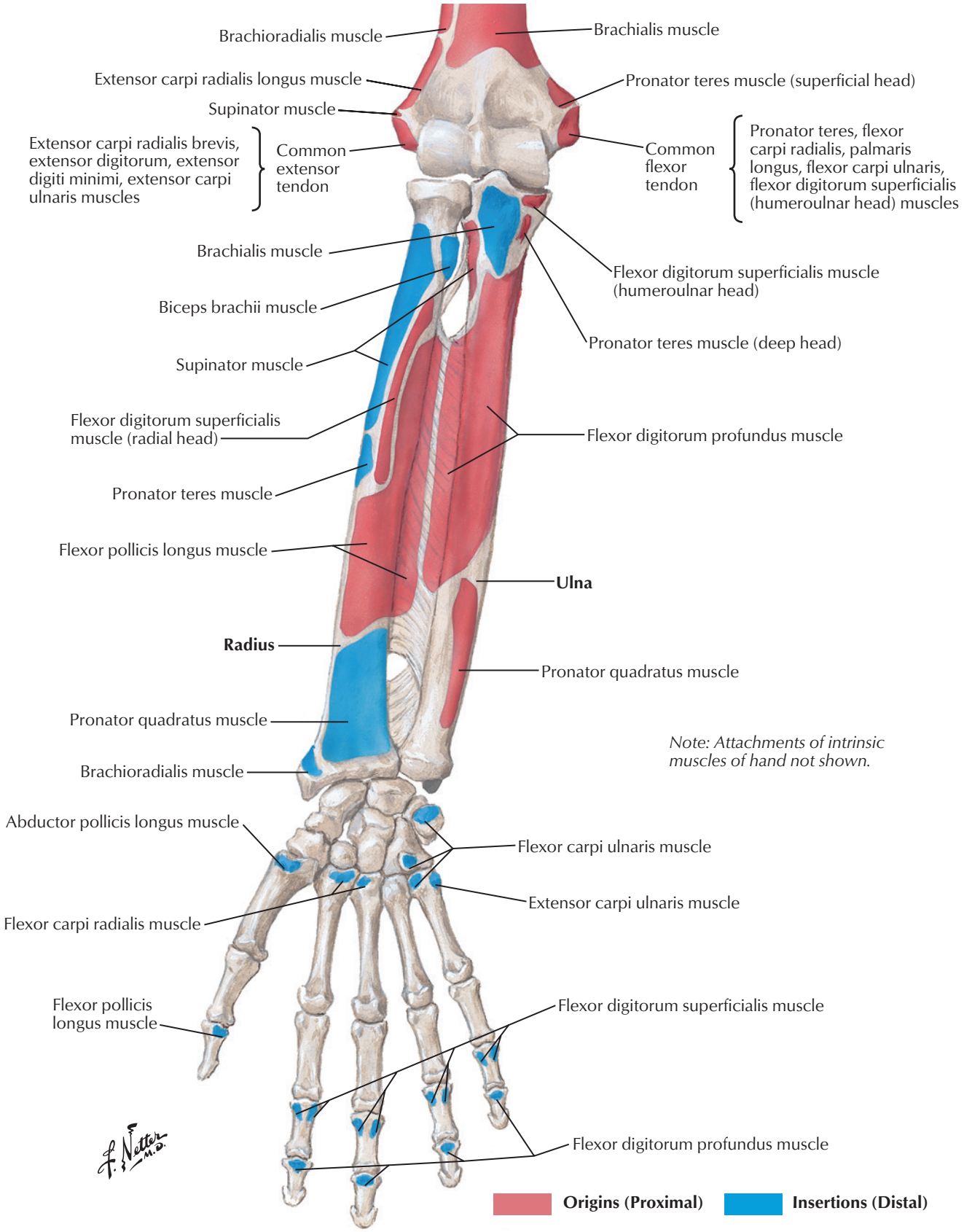


See also Plates 424, 466

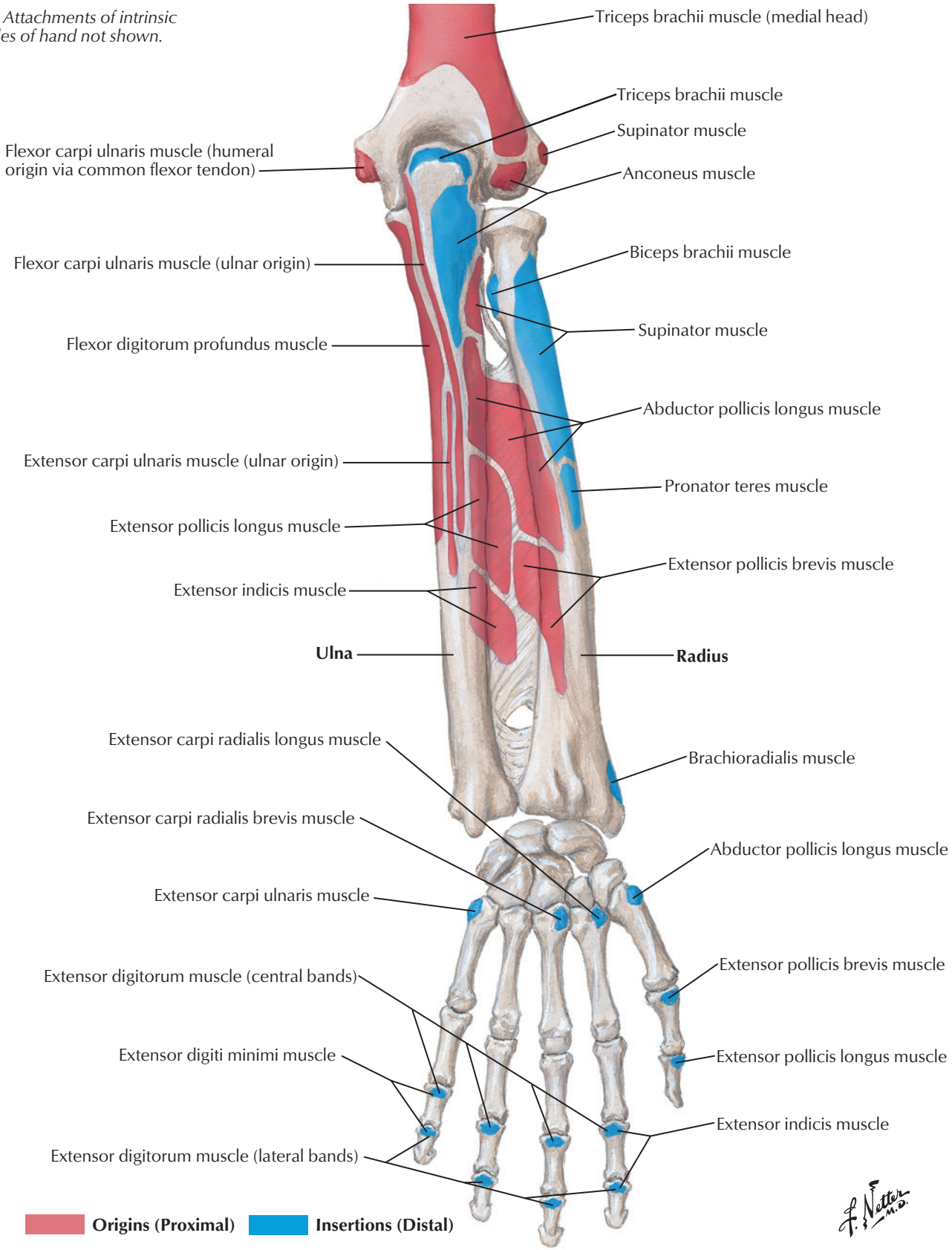


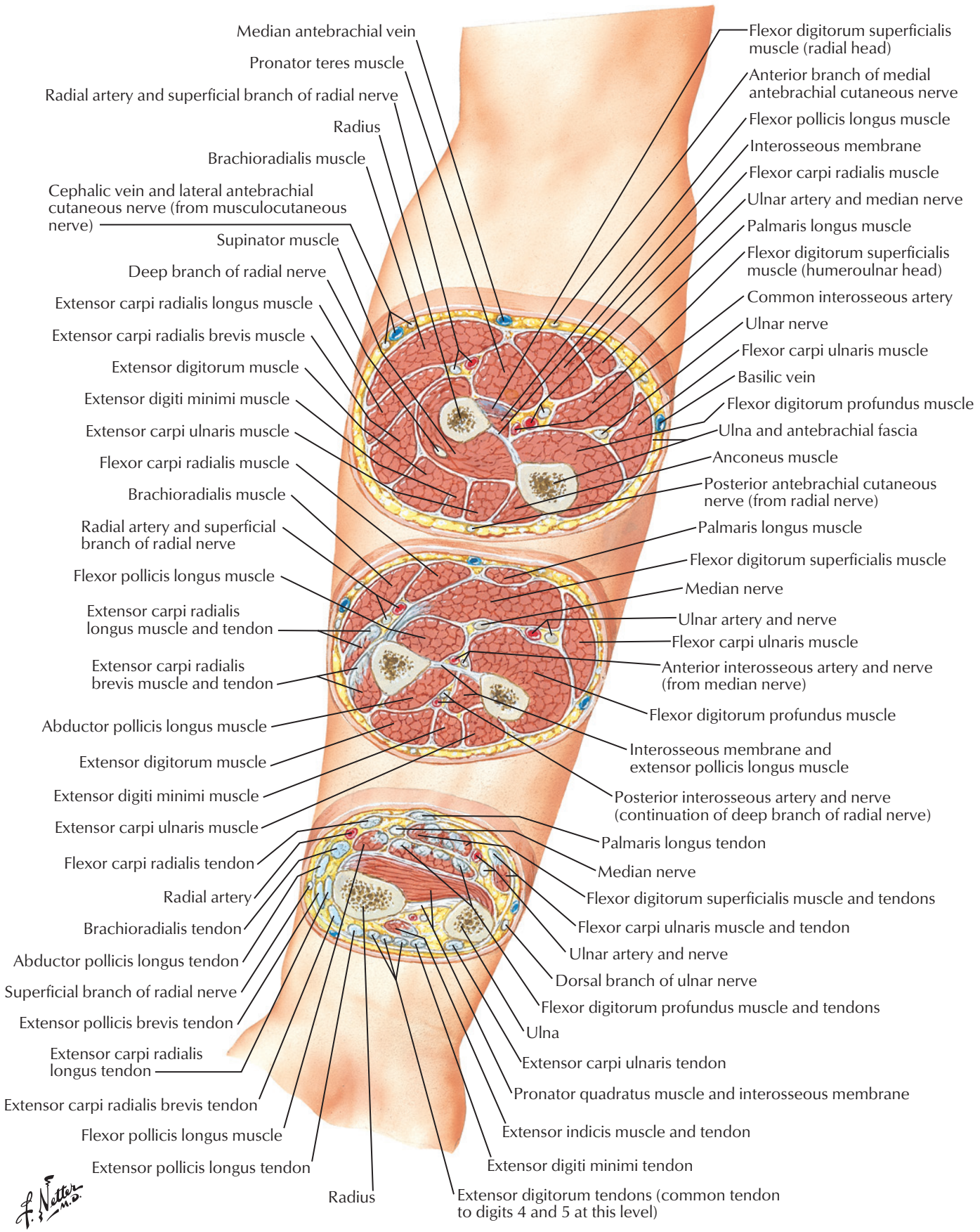
See also Plates 421, 467



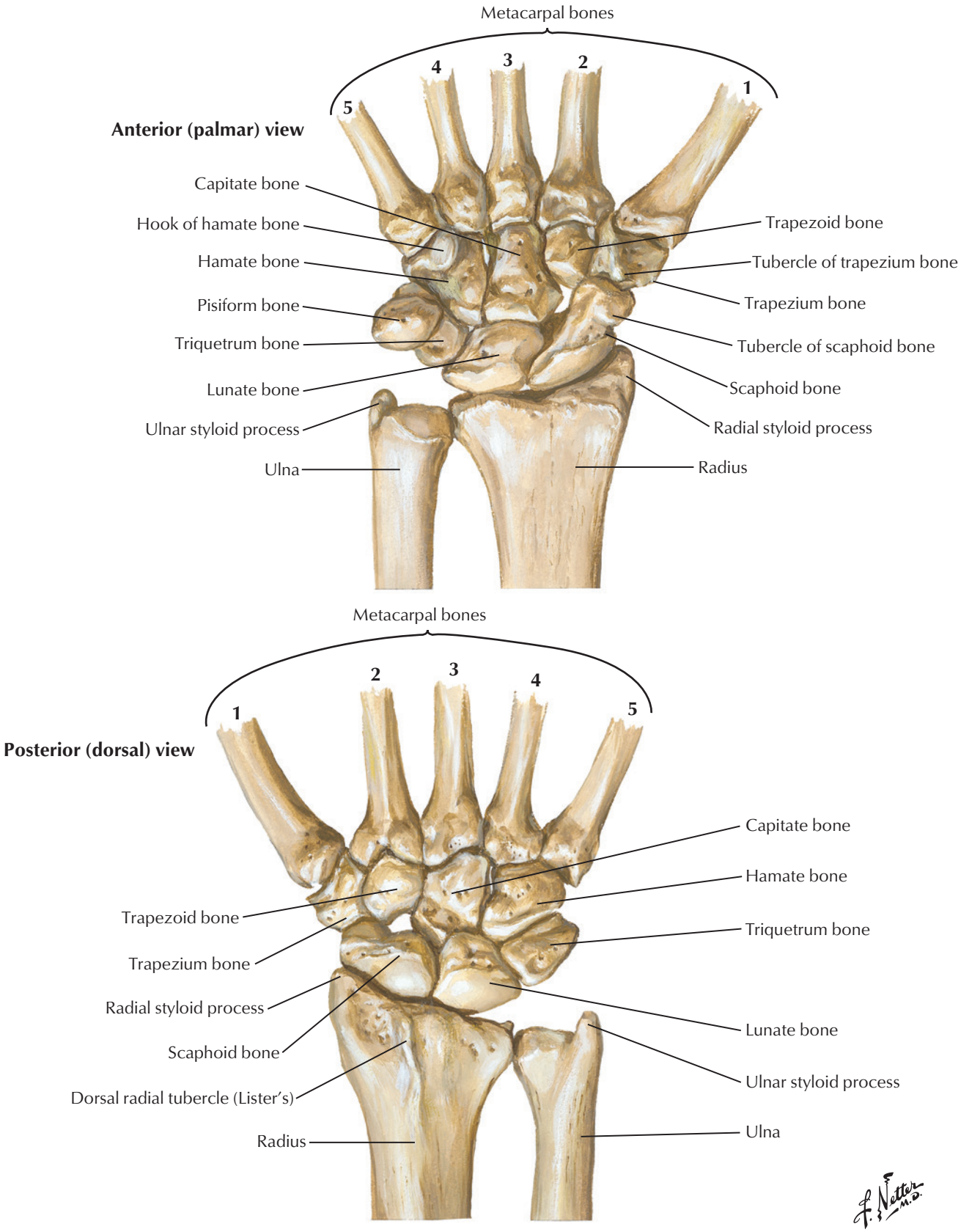

Brachioradialis muscle
Brachialis muscle
Extensor carpi radialis longus muscle
Pronator teres muscle (superficial head)
Supinator muscle
Extensor carpi radialis brevis, extensor digitorum, extensor digiti minimi, extensor carpi ulnaris muscles
Common extensor tendon
Common flexor tendon
Pronator teres, flexor carpi radialis, palmaris longus, flexor carpi ulnaris, flexor digitorum superficialis (humeroulnar head) muscles
Brachialis muscle
Flexor digitorum superficialis muscle (humeroulnar head)
Biceps brachii muscle
Pronator teres muscle (deep head)
Supinator muscle
Flexor digitorum superficialis muscle (radial head)
Flexor digitorum profundus muscle
Pronator teres muscle
Flexor pollicis longus muscle
Ulna
Radius
Pronator quadratus muscle
Pronator quadratus muscle
Brachioradialis muscle
Note: Attachments of intrinsic muscles of hand not shown.
Abductor pollicis longus muscle
Flexor carpi ulnaris muscle
Extensor carpi ulnaris muscle
Flexor carpi radialis muscle
Flexor pollicis longus muscle
Flexor digitorum superficialis muscle
Flexor digitorum profundus muscle
Origins (Proximal)
Insertions (Distal)

Note: Attachments of intrinsic muscles of hand not shown.

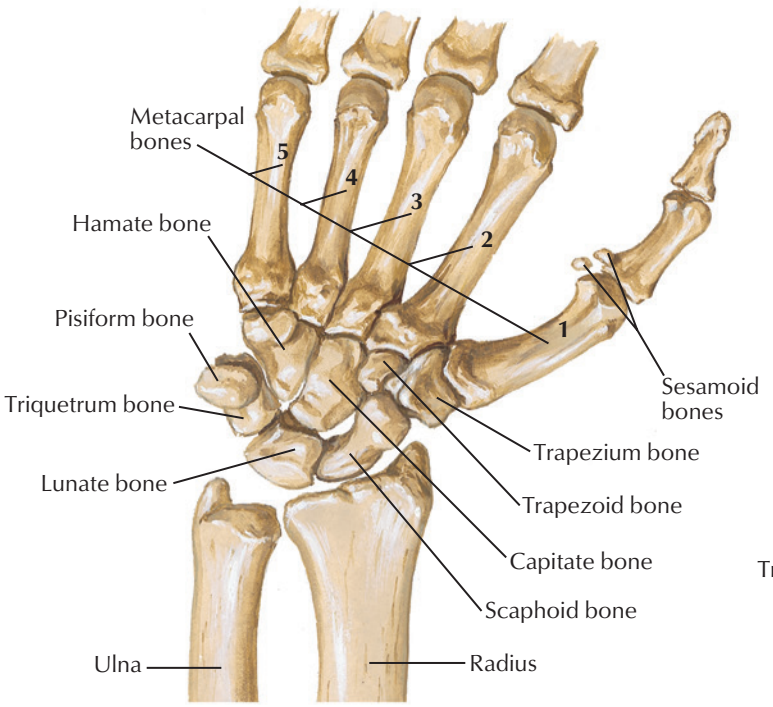



Median antebrachial vein
Pronator teres muscle
Radial artery and superficial branch of radial nerve
Radius
Brachioradialis muscle
Cephalic vein and lateral antebrachial cutaneous nerve (from musculocutaneous nerve)
Supinator muscle
Deep branch of radial nerve
Extensor carpi radialis longus muscle
Extensor carpi radialis brevis muscle
Extensor digitorum muscle
Extensor digiti minimi muscle
Extensor carpi ulnaris muscle
Flexor carpi radialis muscle
Brachioradialis muscle
Radial artery and superficial branch of radial nerve
Flexor pollicis longus muscle
Extensor carpi radialis longus muscle and tendon
Extensor carpi radialis brevis muscle and tendon
Abductor pollicis longus muscle
Extensor digitorum muscle
Extensor digiti minimi muscle
Extensor carpi ulnaris muscle
Flexor carpi radialis tendon
Radial artery
Brachioradialis tendon
Abductor pollicis longus tendon
Superficial branch of radial nerve
Extensor pollicis brevis tendon
Extensor carpi radialis longus tendon
Extensor carpi radialis brevis tendon
Flexor pollicis longus muscle
Extensor pollicis longus tendon
Radius
Flexor digitorum superficialis muscle (radial head)
Anterior branch of medial antebrachial cutaneous nerve
Flexor pollicis longus muscle
Interosseous membrane
Flexor carpi radialis muscle
Ulnar artery and median nerve
Palmaris longus muscle
Flexor digitorum superficialis muscle (humeroulnar head)
Common interosseous artery
Ulnar nerve
Flexor carpi ulnaris muscle
Basilic vein
Flexor digitorum profundus muscle
Ulna and antebrachial fascia
Anconeus muscle
Posterior antebrachial cutaneous nerve (from radial nerve)
Palmaris longus muscle
Flexor digitorum superficialis muscle
Median nerve
Ulnar artery and nerve
Flexor carpi ulnaris muscle
Anterior interosseous artery and nerve (from median nerve)
Flexor digitorum profundus muscle
Interosseous membrane and extensor pollicis longus muscle
Posterior interosseous artery and nerve (continuation of deep branch of radial nerve)
Palmaris longus tendon
Median nerve
Flexor digitorum superficialis muscle and tendons
Flexor carpi ulnaris muscle and tendon
Ulnar artery and nerve
Dorsal branch of ulnar nerve
Flexor digitorum profundus muscle and tendons
Ulna
Extensor carpi ulnaris tendon
Pronator quadratus muscle and interosseous membrane
Extensor indicis muscle and tendon
Extensor digiti minimi tendon
Extensor digitorum tendons (common tendon to digits 4 and 5 at this level)

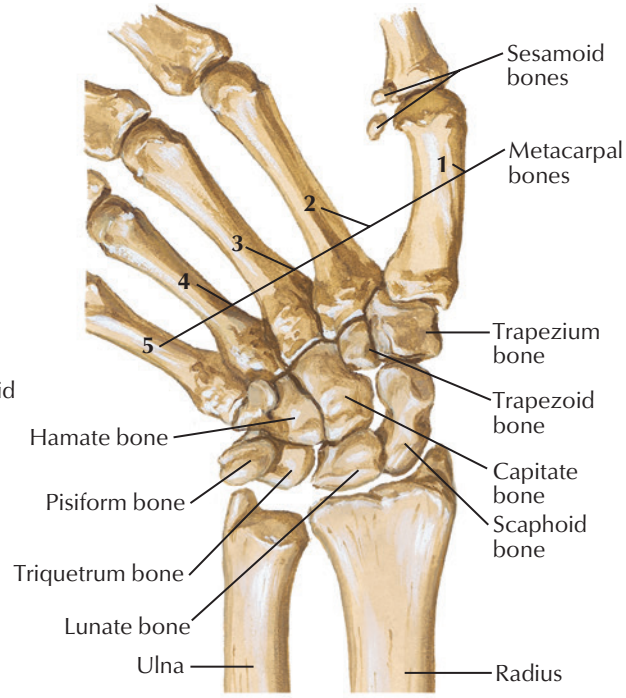
See also Plate 447



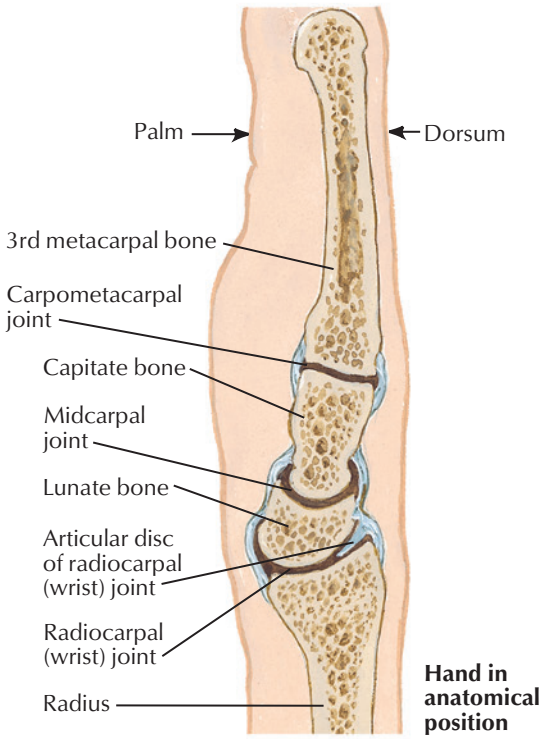
See also Plates 446, 447



Position of carpal bones with hand in abduction: anterior (palmar) view

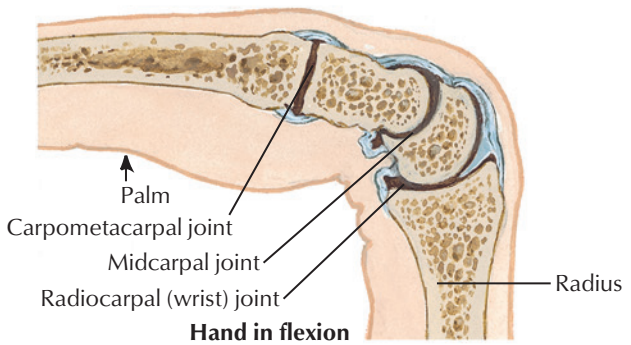


Position of carpal bones with hand in adduction: anterior (palmar) view

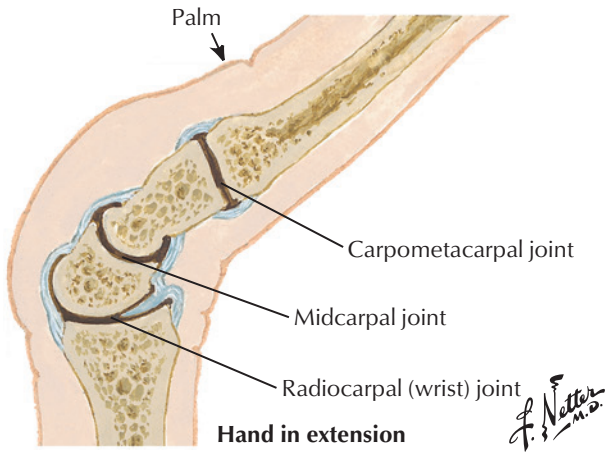


Hand in anatomical position

Sagittal sections through wrist and middle finger

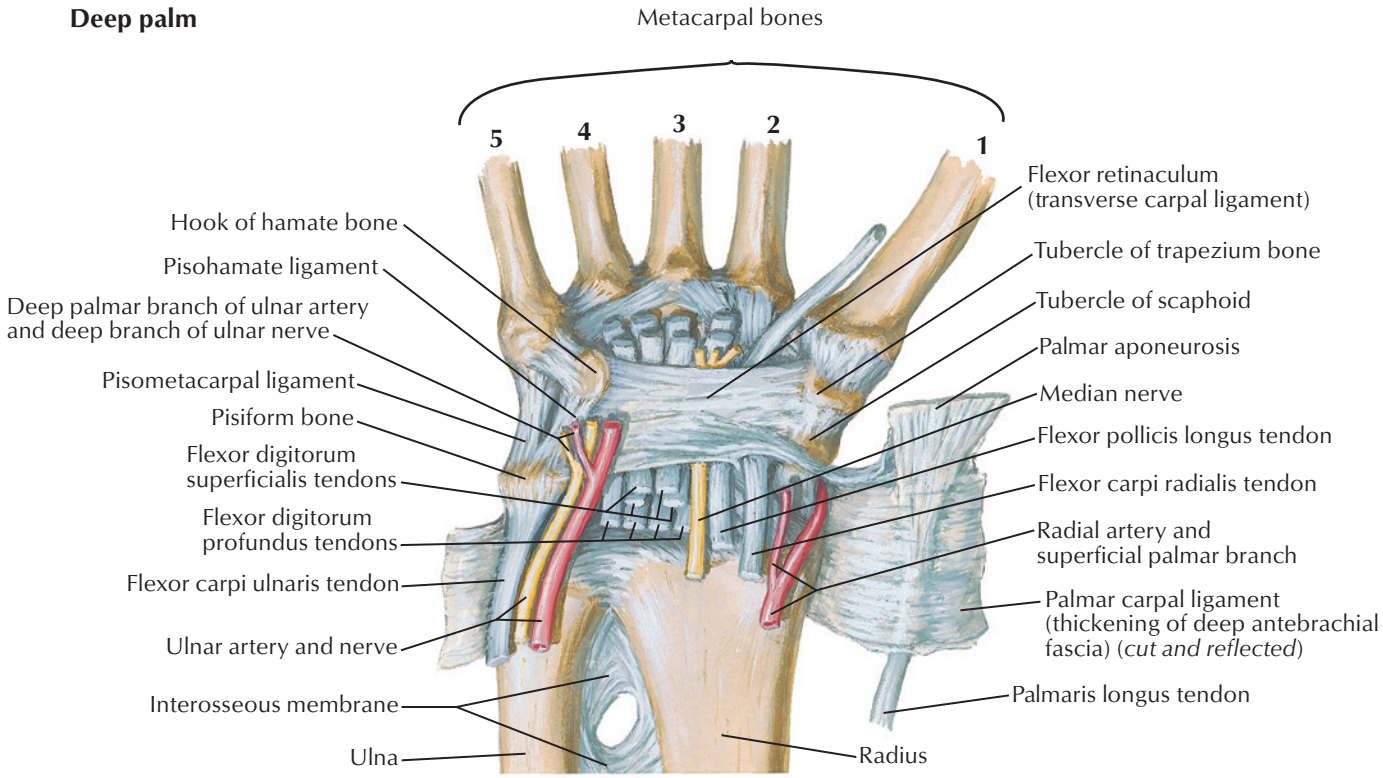


Hand in flexion

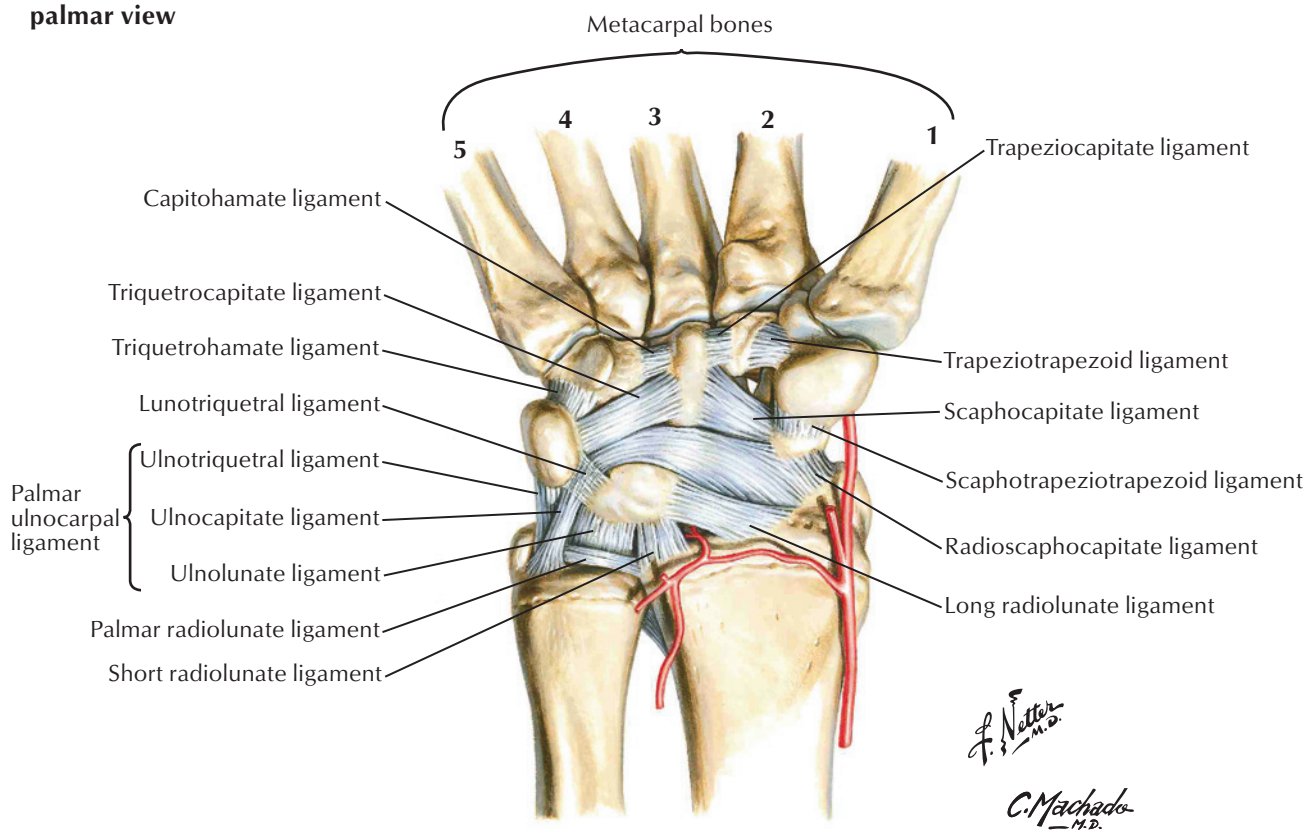


Hand in extension

Deep palm

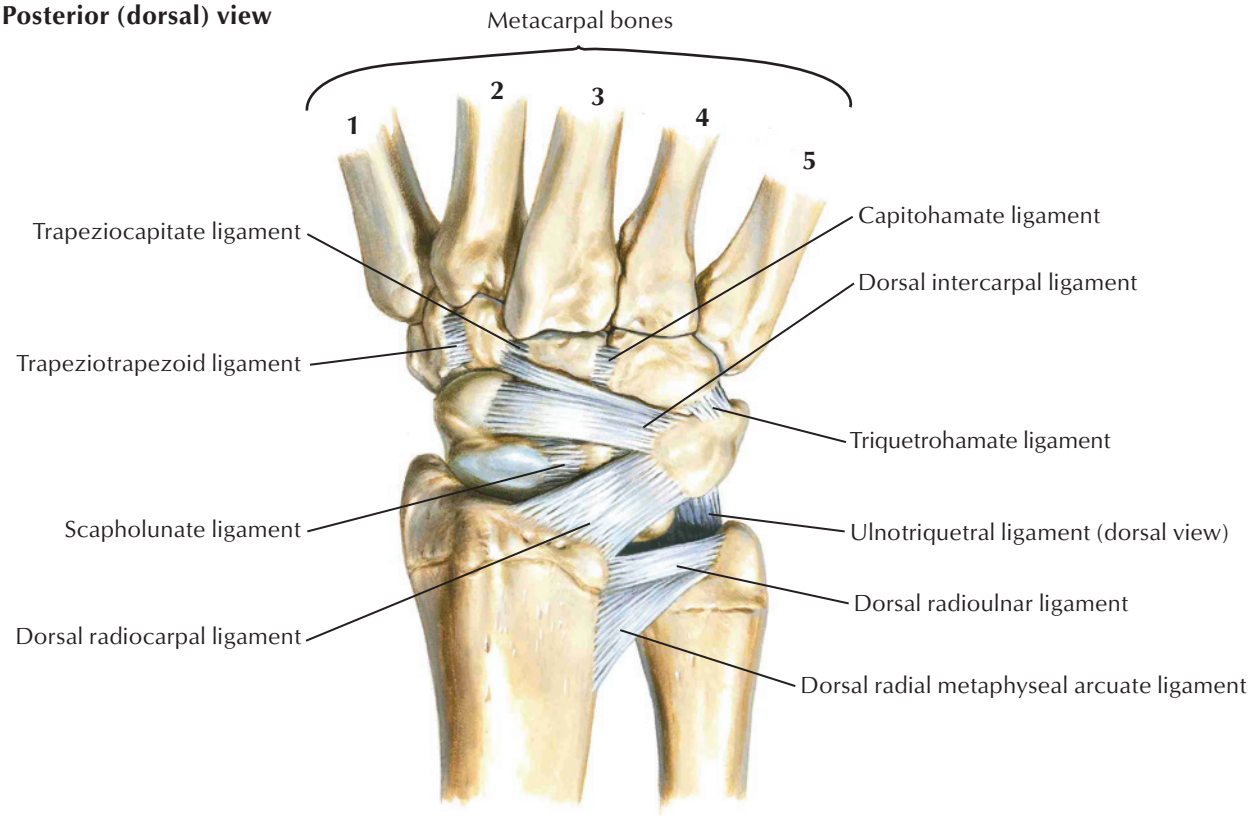


Flexor retinaculum removed: palmar view

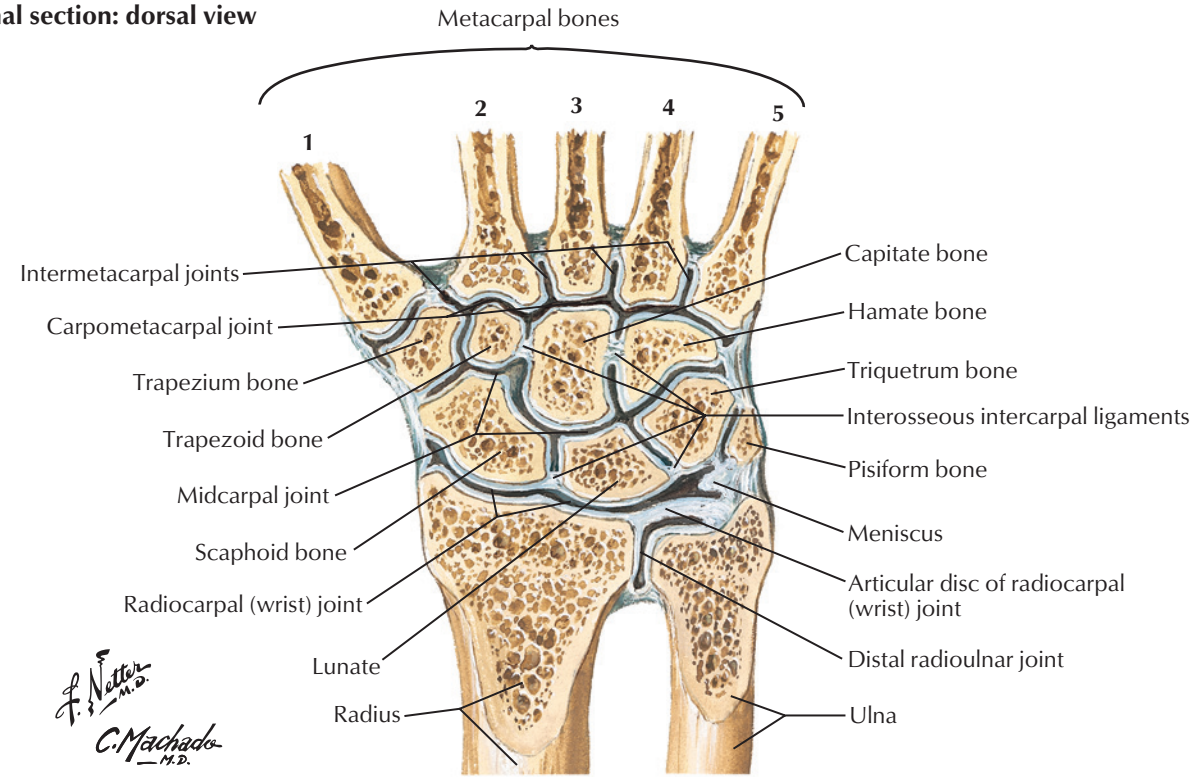


See also Plate 447

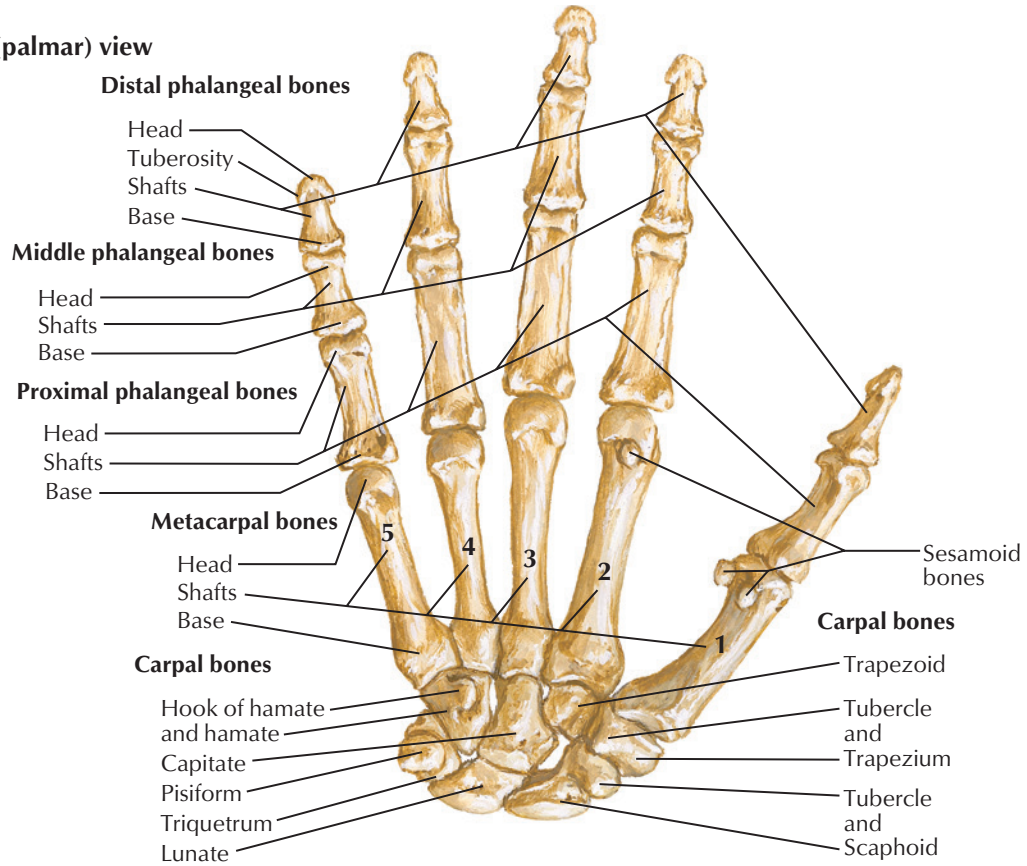
Posterior (dorsal) view



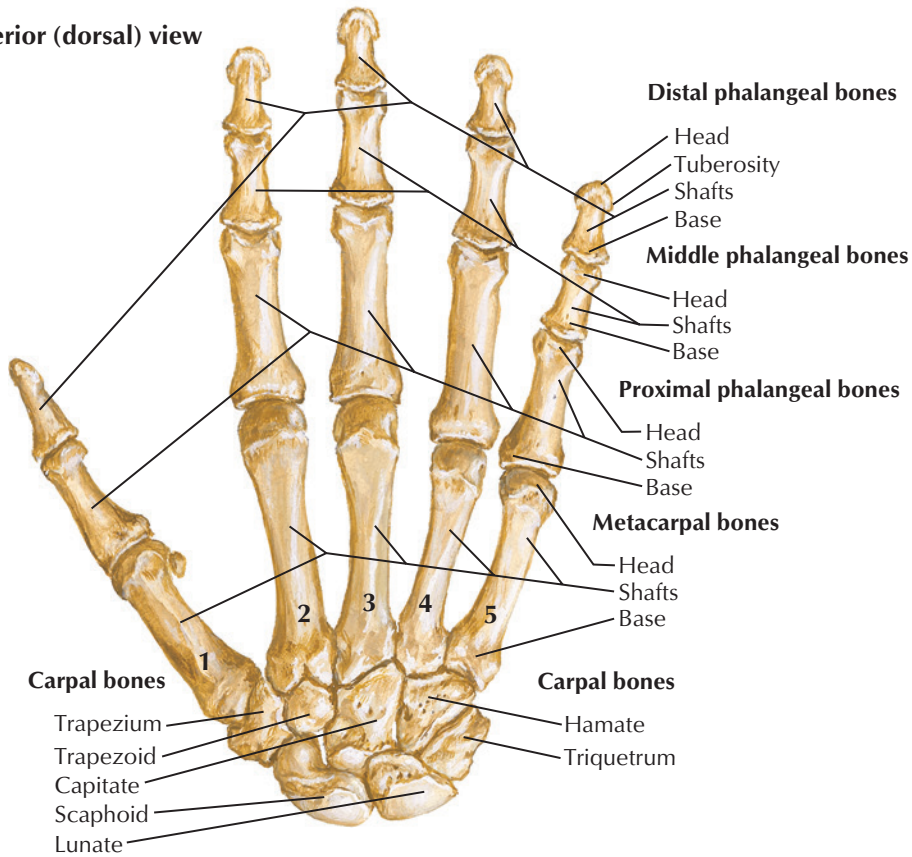
Coronal section: dorsal view



Right hand: anterior (palmar) view

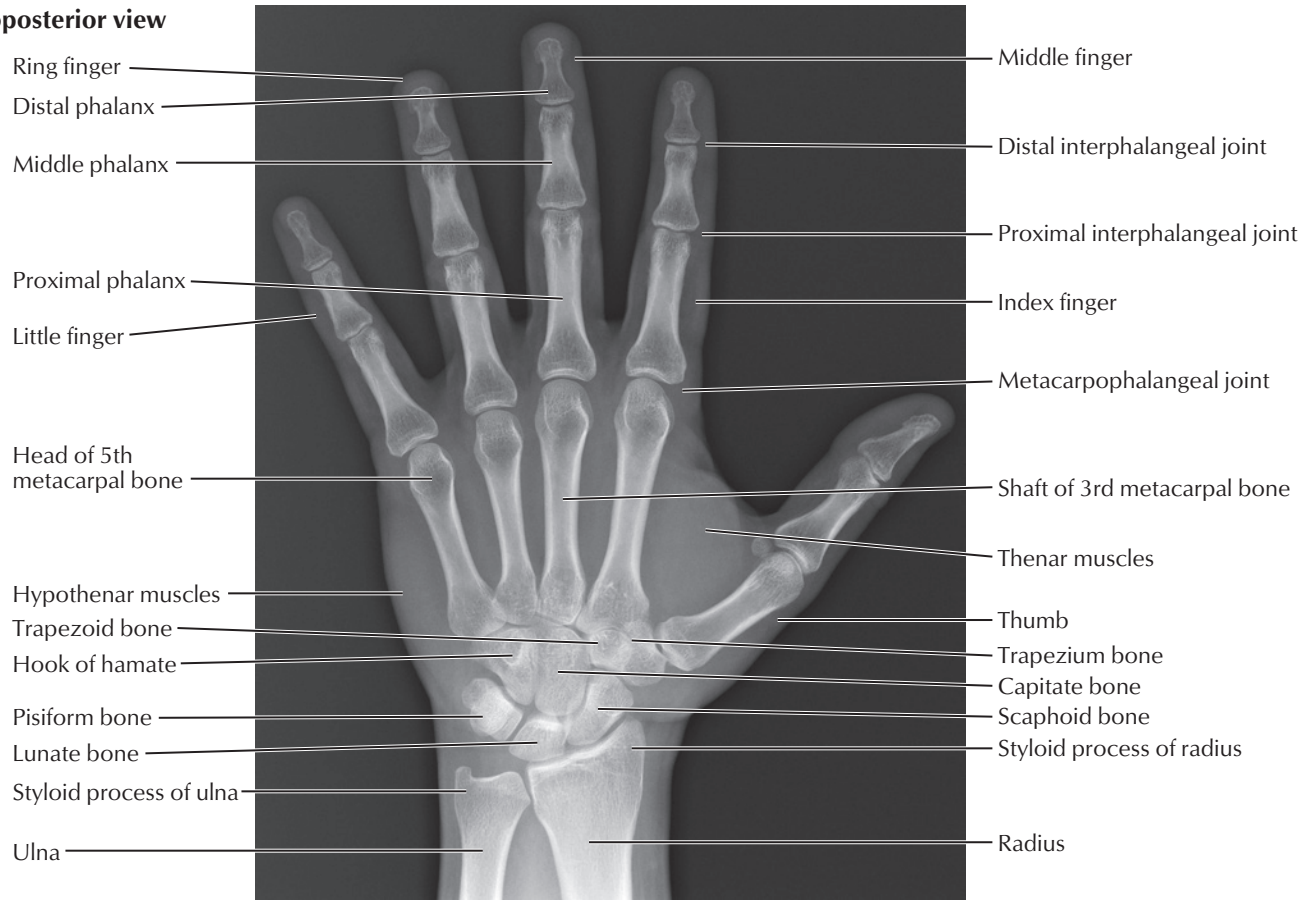


Right hand: posterior (dorsal) view

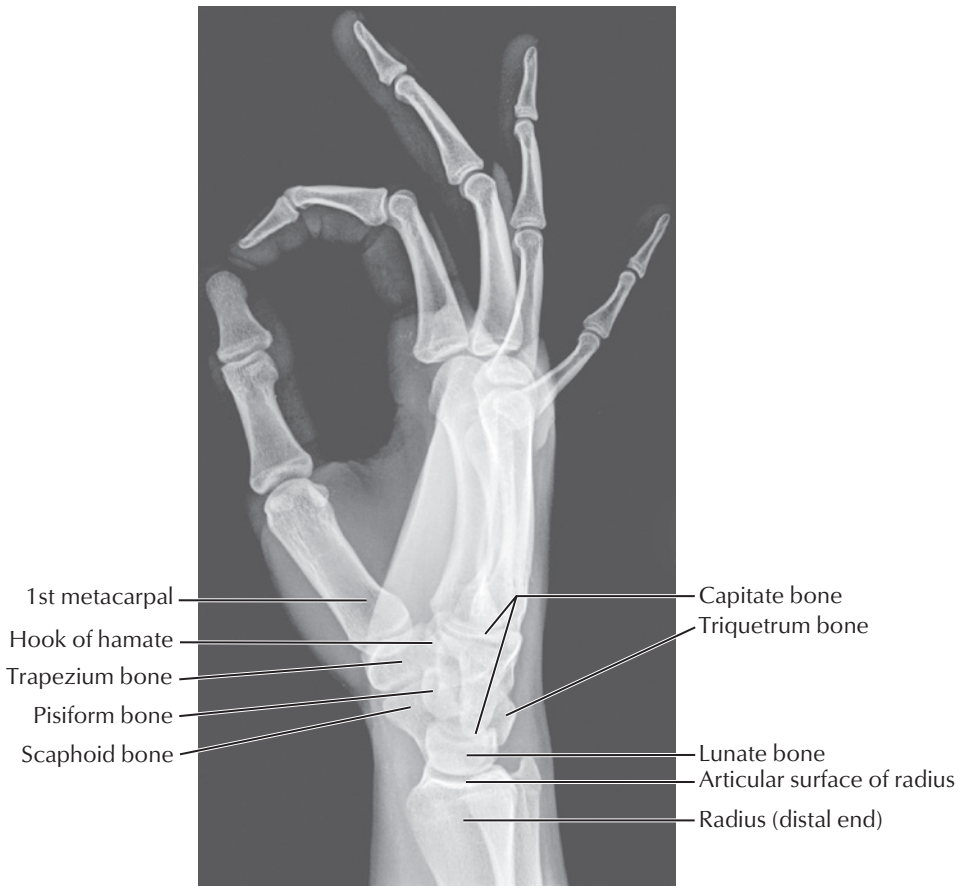


See also Plate 446

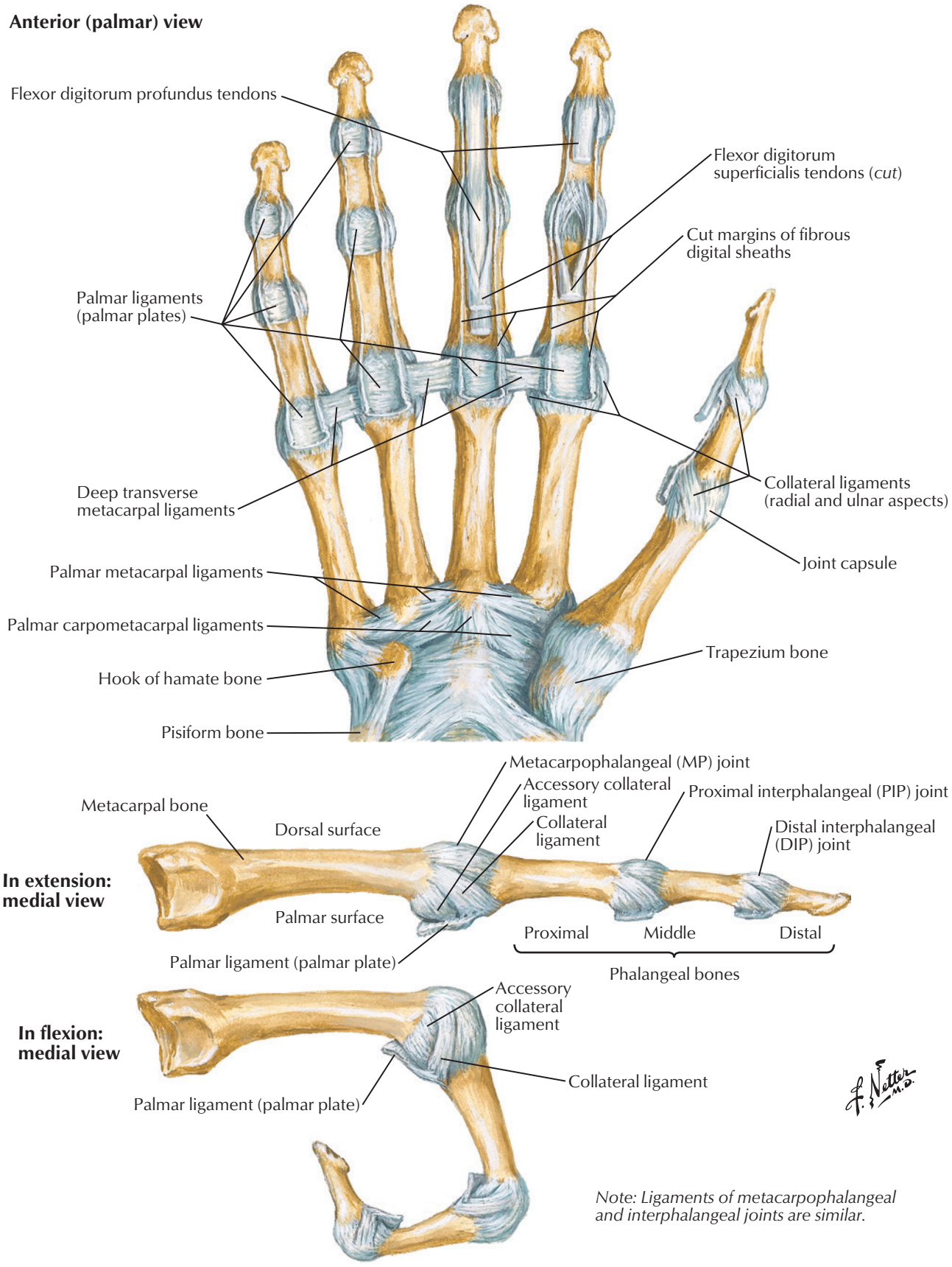
Anteroposterior view



Lateral view



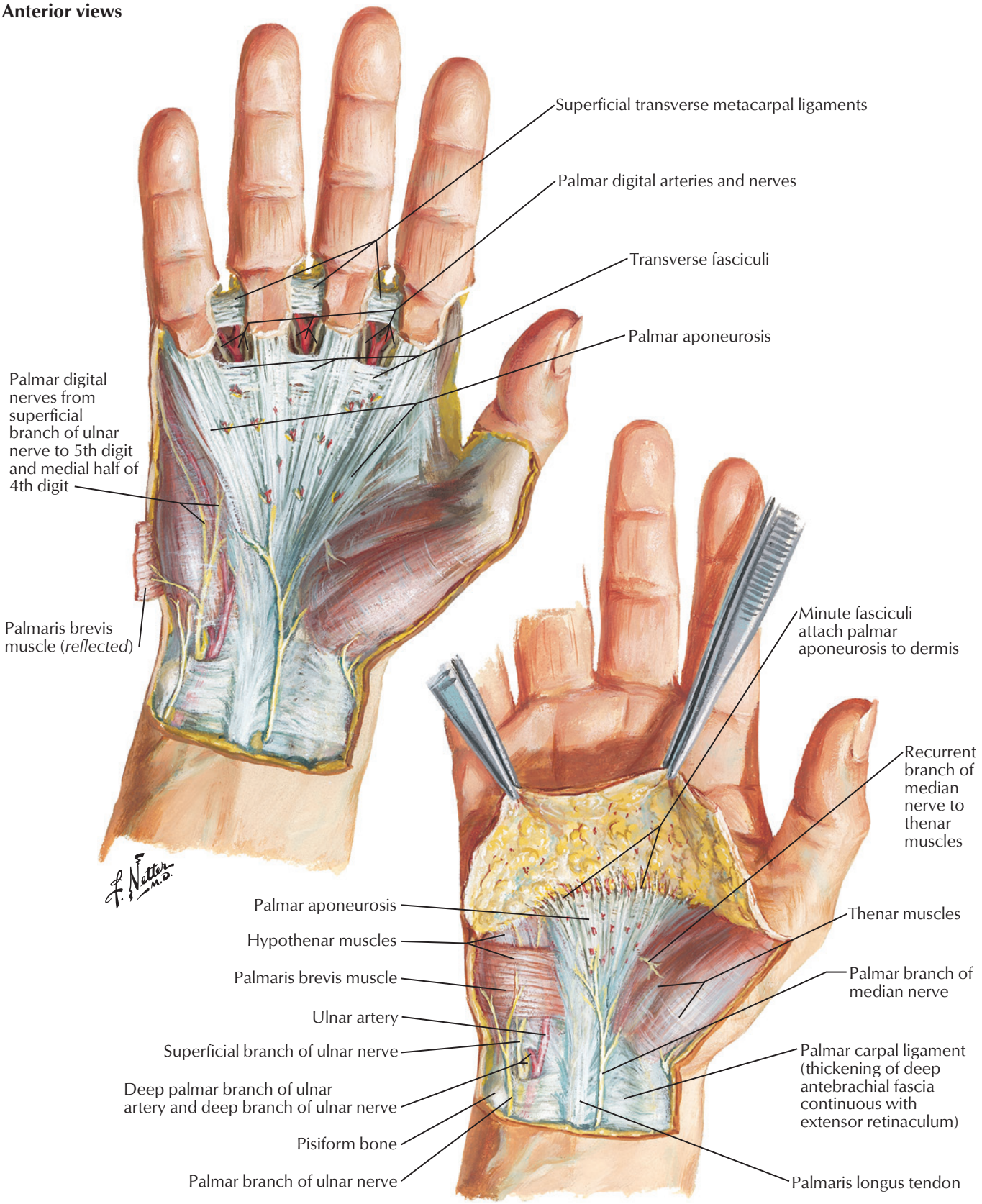
See also Plate 451

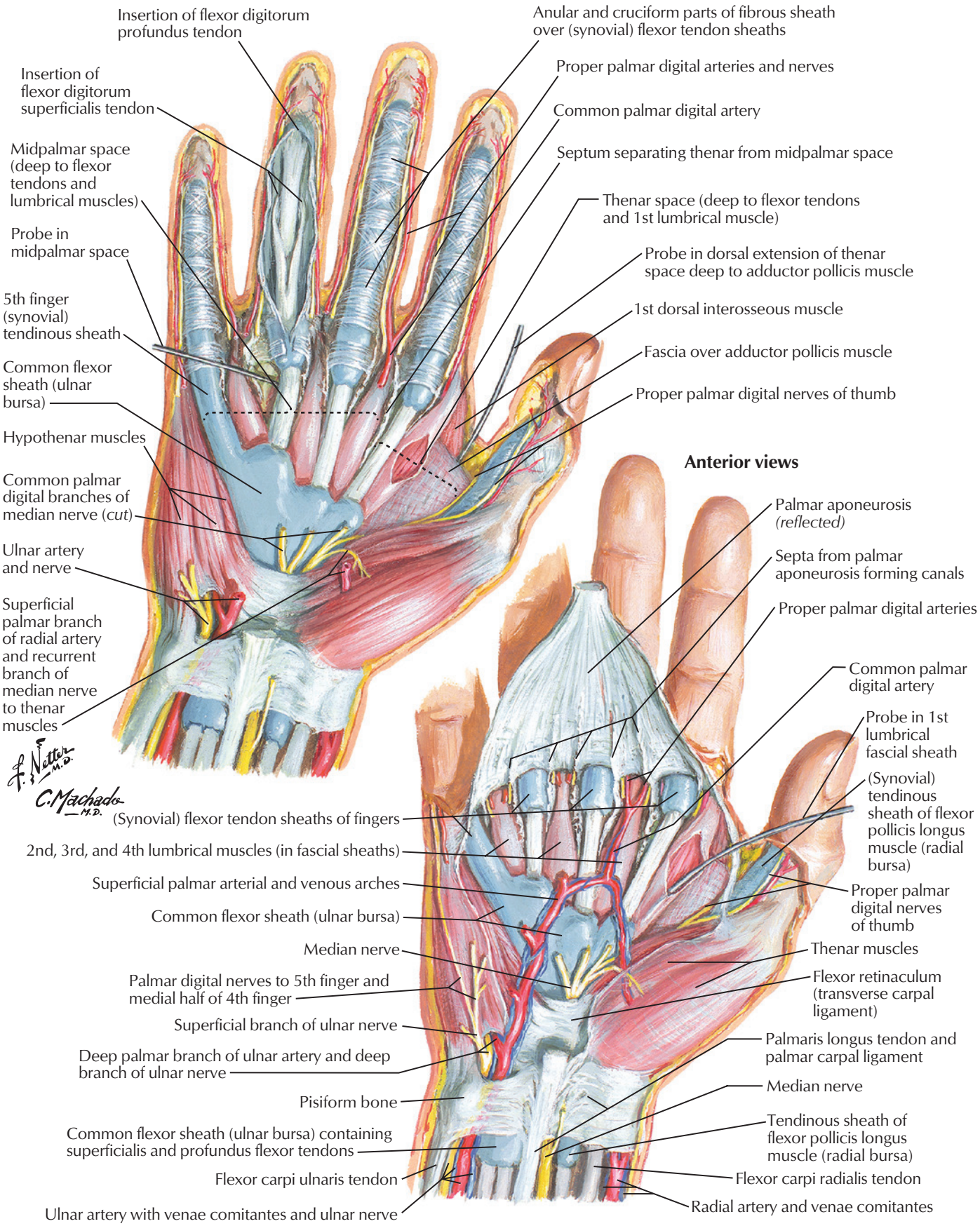


Note: Ligaments of metacarpophalangeal and interphalangeal joints are similar.

See also Plate 462

Anterior views

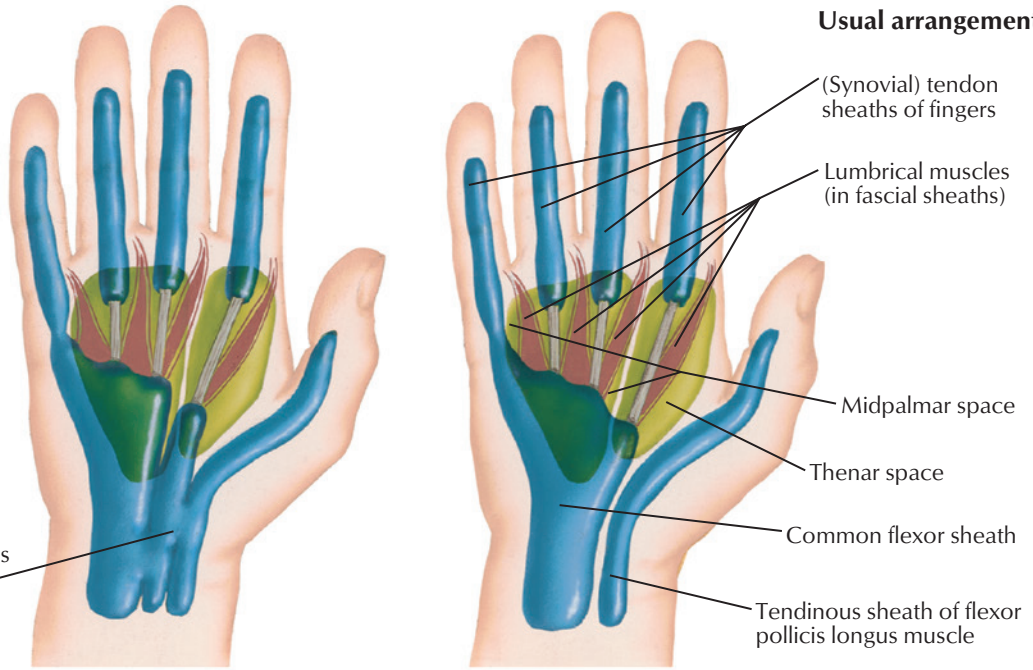



Insertion of flexor digitorum profundus tendon
Insertion of flexor digitorum superficialis tendon
Midpalmar space (deep to flexor tendons and lumbrical muscles)
Probe in midpalmar space
5th finger (synovial) tendinous sheath
Common flexor sheath (ulnar bursa)
Hypothenar muscles
Common palmar digital branches of median nerve (cut)
Ulnar artery and nerve
Superficial palmar branch of radial artery and recurrent branch of median nerve to thenar muscles
Anular and cruciform parts of fibrous sheath over (synovial) flexor tendon sheaths
Proper palmar digital arteries and nerves
Common palmar digital artery
Septum separating thenar from midpalmar space
Thenar space (deep to flexor tendons and 1st lumbrical muscle)
Probe in dorsal extension of thenar space deep to adductor pollicis muscle
1st dorsal interosseous muscle
Fascia over adductor pollicis muscle
Proper palmar digital nerves of thumb
Anterior views
Palmar aponeurosis (reflected)
Septa from palmar aponeurosis forming canals
Proper palmar digital arteries
Common palmar digital artery
Probe in 1st lumbrical fascial sheath
(Synovial) tendinous sheath of flexor pollicis longus muscle (radial bursa)
Proper palmar digital nerves of thumb
Thenar muscles
Flexor retinaculum (transverse carpal ligament)
Palmaris longus tendon and palmar carpal ligament
Median nerve
Tendinous sheath of flexor pollicis longus muscle (radial bursa)
Flexor carpi radialis tendon
Radial artery and venae comitantes
(Synovial) flexor tendon sheaths of fingers
2nd, 3rd, and 4th lumbrical muscles (in fascial sheaths)
Superficial palmar arterial and venous arches
Common flexor sheath (ulnar bursa)
Median nerve
Palmar digital nerves to 5th finger and medial half of 4th finger
Superficial branch of ulnar nerve
Deep palmar branch of ulnar artery and deep branch of ulnar nerve
Pisiform bone
Common flexor sheath (ulnar bursa) containing superficialis and profundus flexor tendons
Flexor carpi ulnaris tendon
Ulnar artery with venae comitantes and ulnar nerve
F. Netter M.D.
C. Machado M.D.

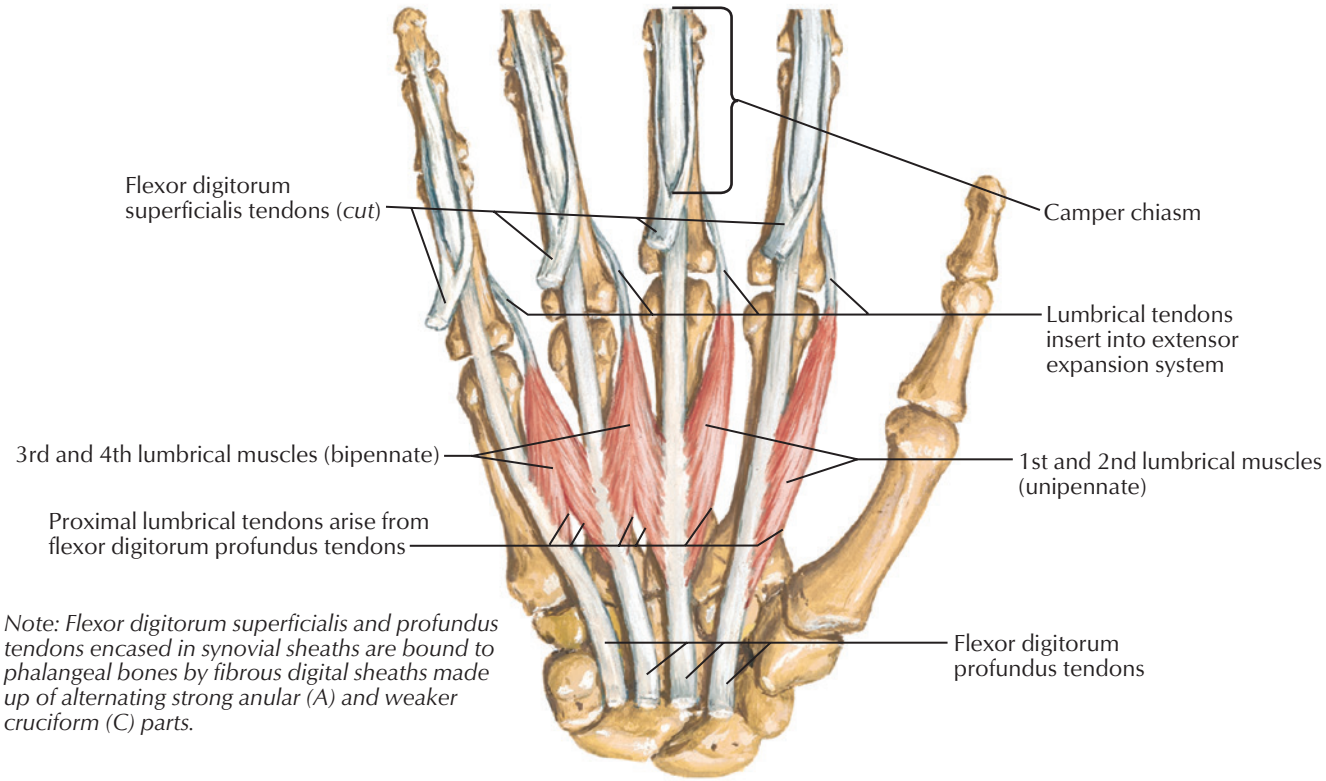
See also Plate 448

Common variation

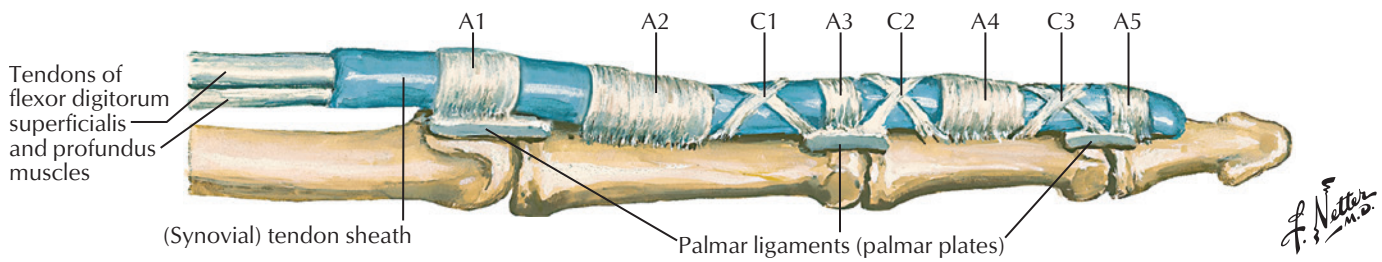
Usual arrangement



Lumbrical muscles: schema

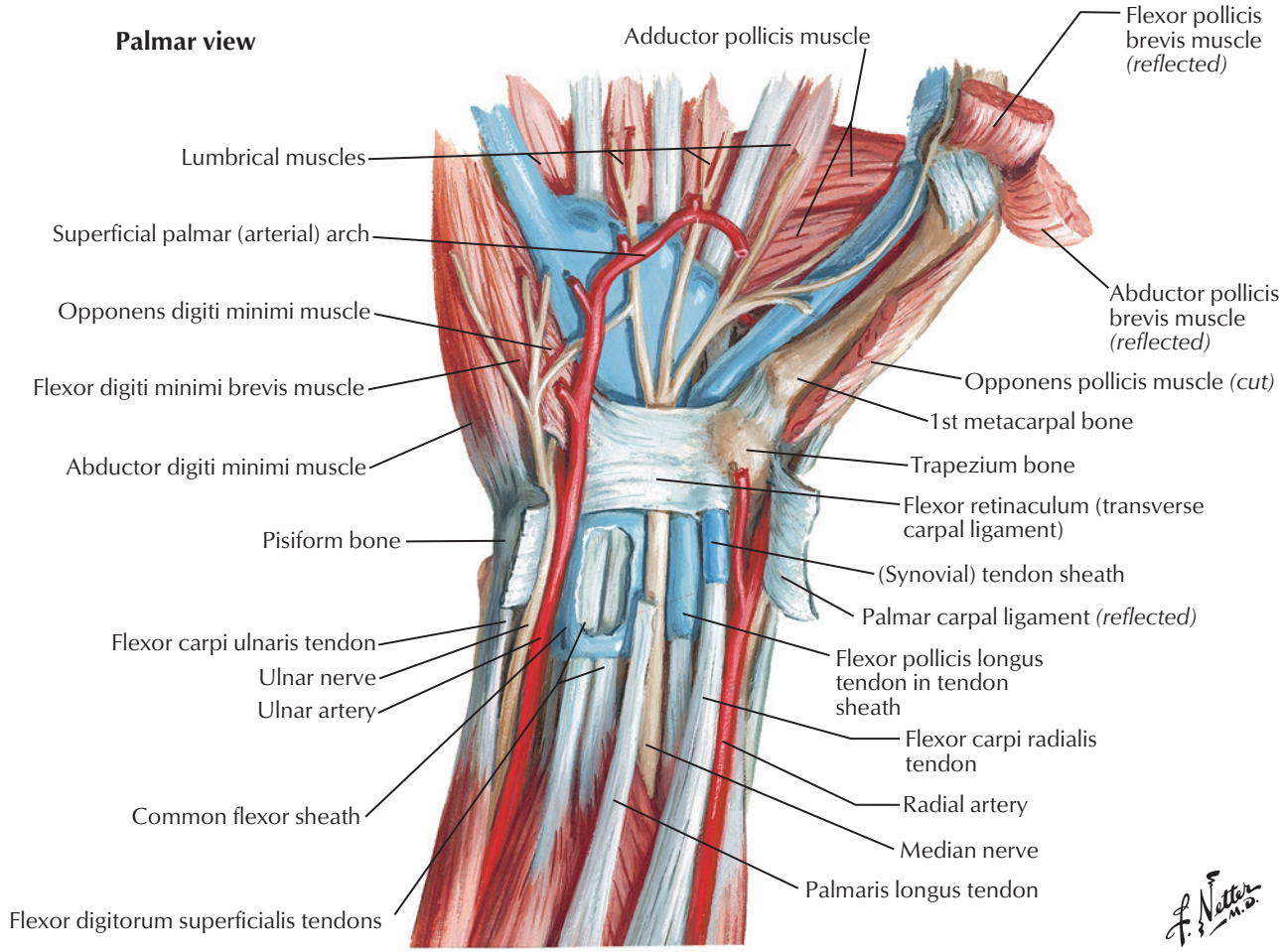


Note: Flexor digitorum superficialis and profundus tendons encased in synovial sheaths are bound to phalangeal bones by fibrous digital sheaths made up of alternating strong anular (A) and weaker cruciform (C) parts.

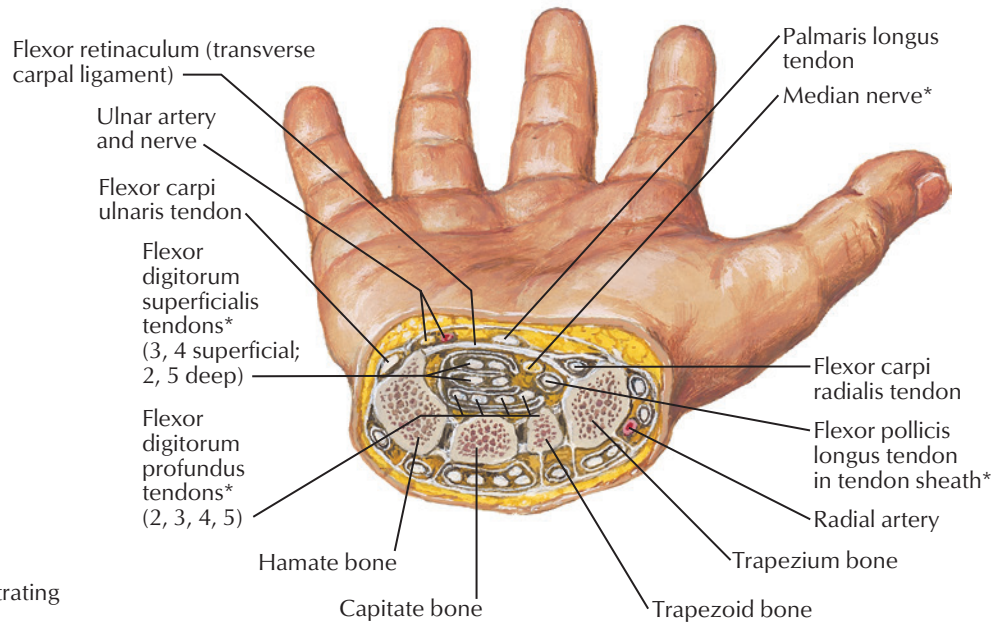


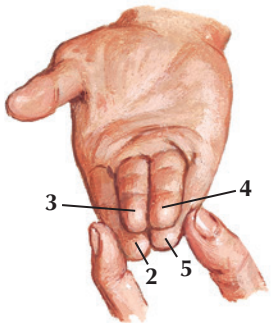
See also Plates 462, 463

Palmar view



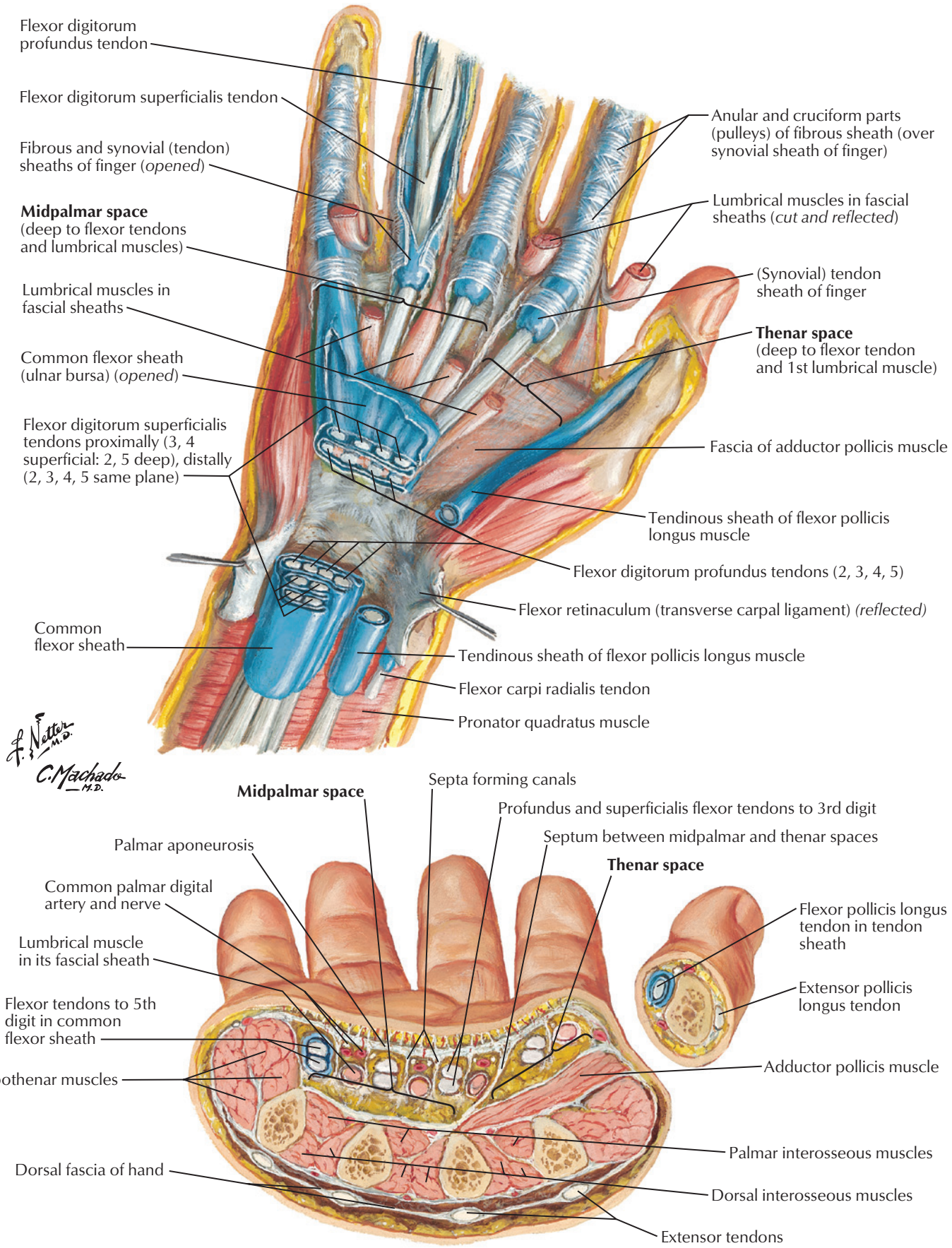
Cross section of wrist demonstrating carpal tunnel



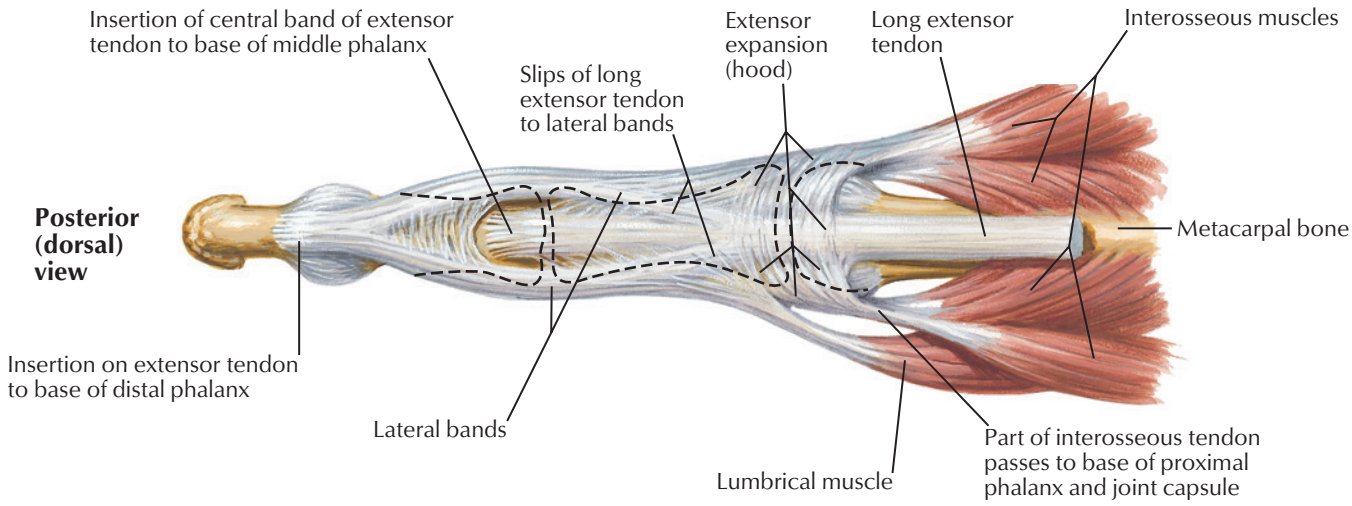


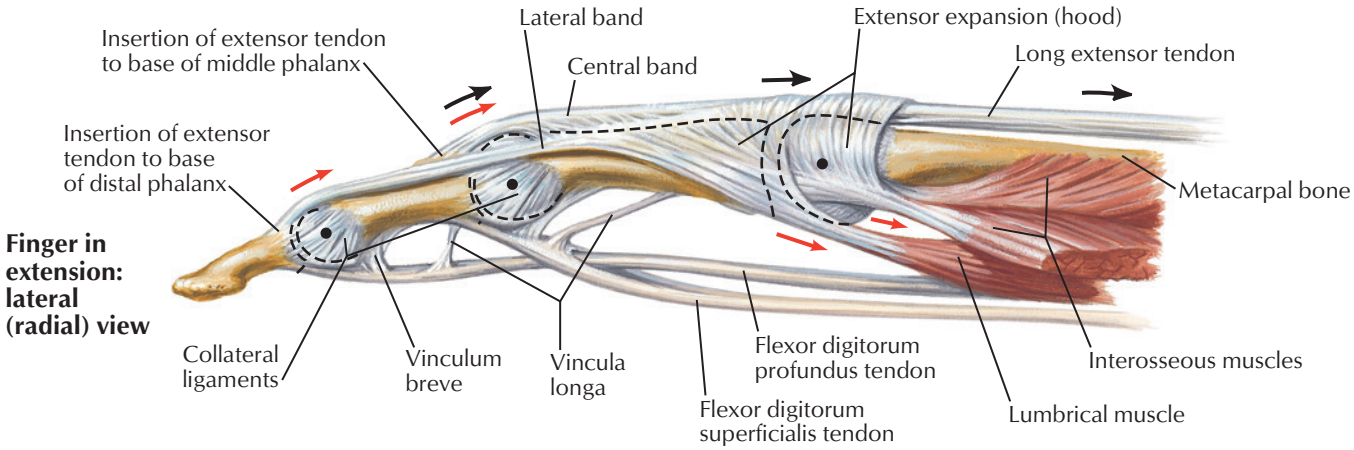
Simple method of demonstrating arrangement of flexor digitorum superficialis tendons within carpal tunnel

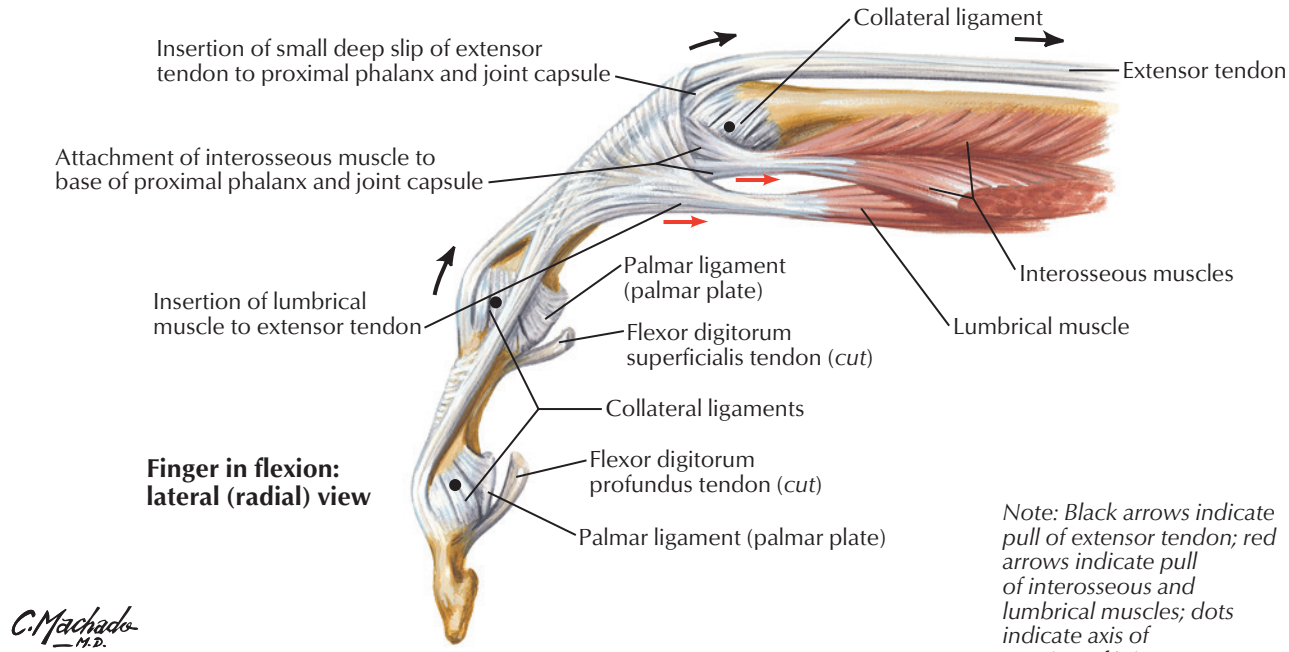
*Contents of carpal tunnel


Flexor digitorum profundus tendon
Flexor digitorum superficialis tendon
Fibrous and synovial (tendon) sheaths of finger (*opened*)
Midpalmar space (deep to flexor tendons and lumbrical muscles)
Lumbrical muscles in fascial sheaths
Common flexor sheath (ulnar bursa) (*opened*)
Flexor digitorum superficialis tendons proximally (3, 4 superficial: 2, 5 deep), distally (2, 3, 4, 5 same plane)
Common flexor sheath
Anular and cruciform parts (pulleys) of fibrous sheath (over synovial sheath of finger)
Lumbrical muscles in fascial sheaths (*cut and reflected*)
(Synovial) tendon sheath of finger
Thenar space (deep to flexor tendon and 1st lumbrical muscle)
Fascia of adductor pollicis muscle
Tendinous sheath of flexor pollicis longus muscle
Flexor digitorum profundus tendons (2, 3, 4, 5)
Flexor retinaculum (transverse carpal ligament) *(reflected)*
Tendinous sheath of flexor pollicis longus muscle
Flexor carpi radialis tendon
Pronator quadratus muscle
F. Netter M.D.
C. Machado M.D.
Midpalmar space
Septa forming canals
Profundus and superficialis flexor tendons to 3rd digit
Septum between midpalmar and thenar spaces
Thenar space
Palmar aponeurosis
Common palmar digital artery and nerve
Lumbrical muscle in its fascial sheath
Flexor tendons to 5th digit in common flexor sheath
Hypothenar muscles
Dorsal fascia of hand
Flexor pollicis longus tendon in tendon sheath
Extensor pollicis longus tendon
Adductor pollicis muscle
Palmar interosseous muscles
Dorsal interosseous muscles
Extensor tendons

See also Plate 455

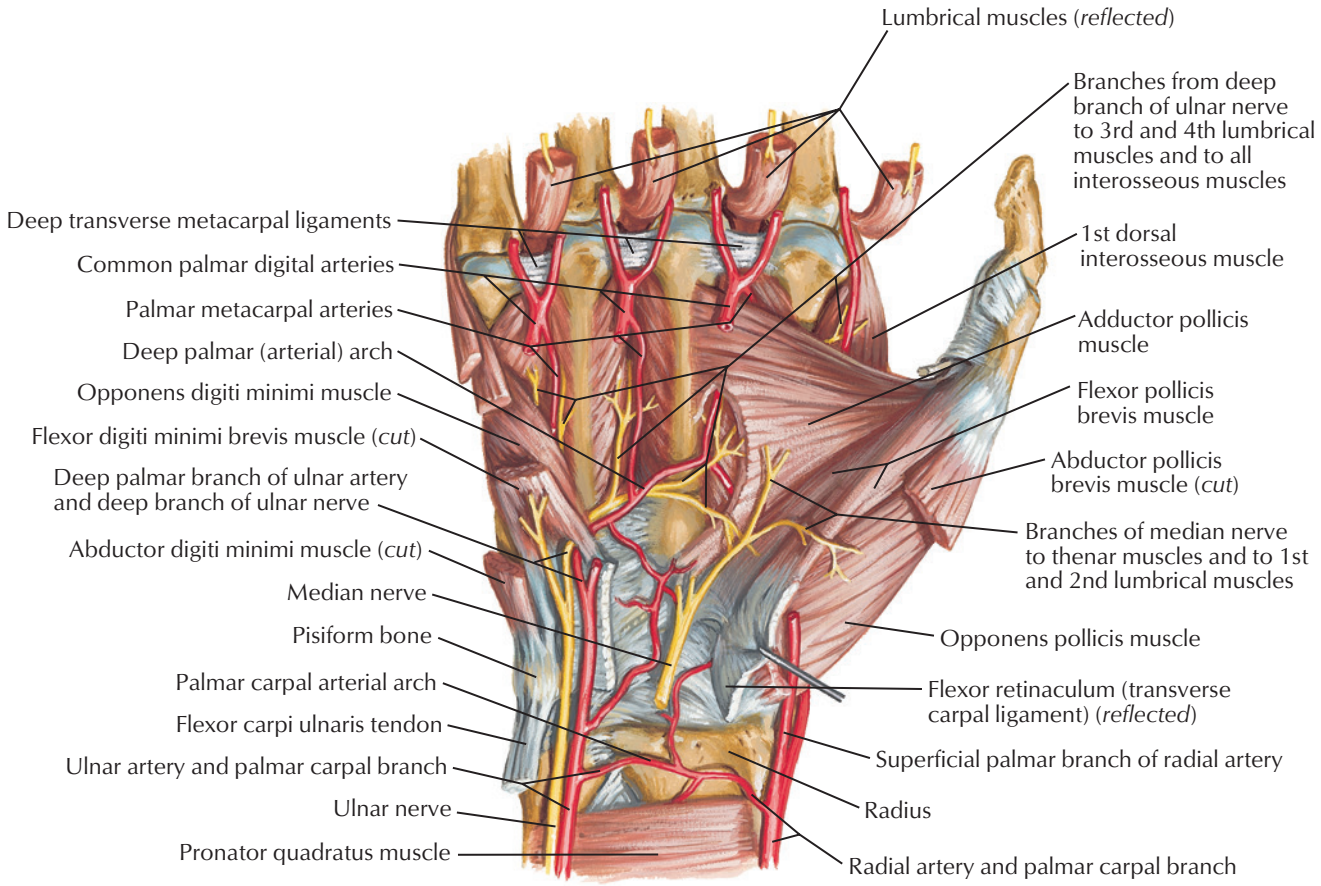




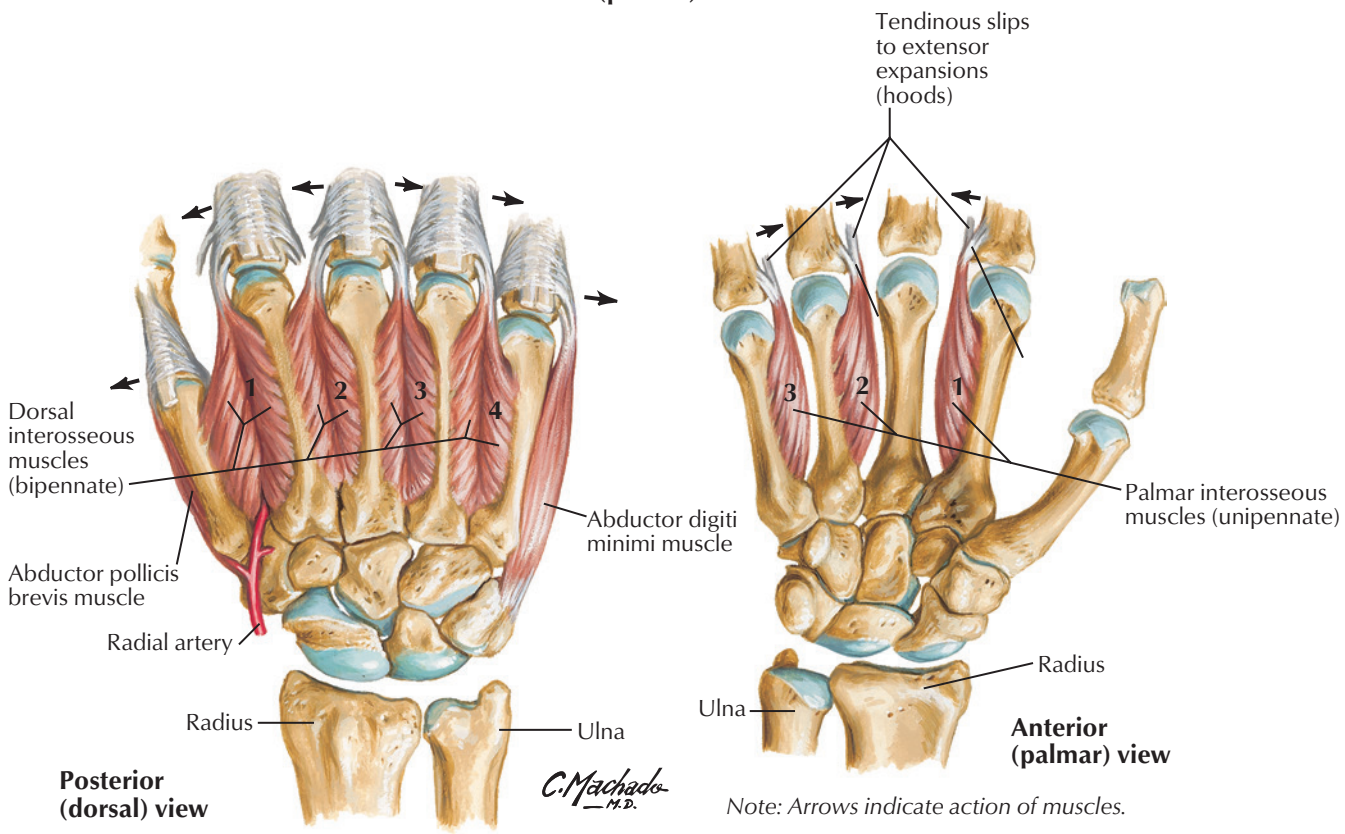


C. Machado M.D.

Note: Black arrows indicate pull of extensor tendon; red arrows indicate pull of interosseous and lumbrical muscles; dots indicate axis of rotation of joints.



Anterior (palmar) view

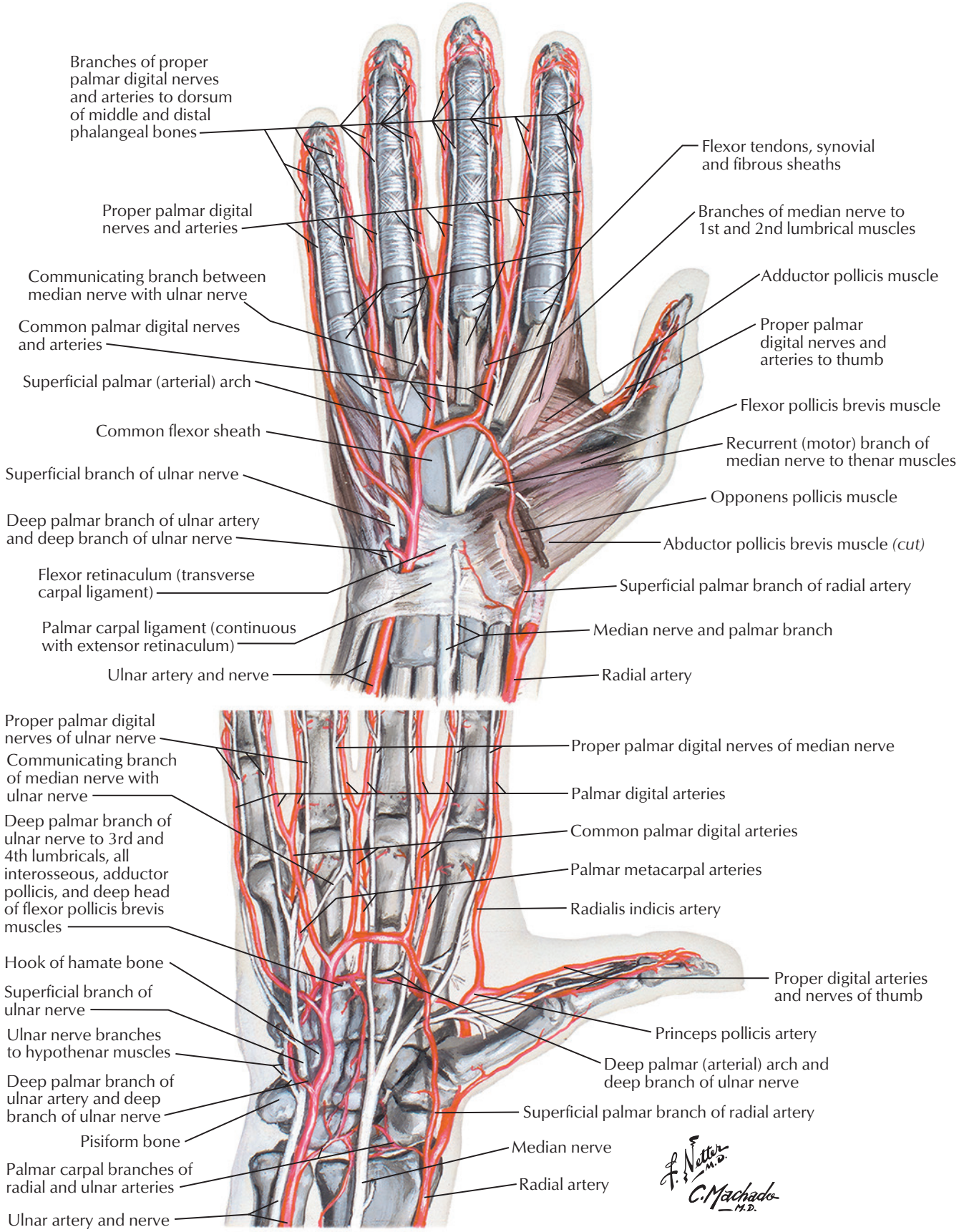


Posterior (dorsal) view

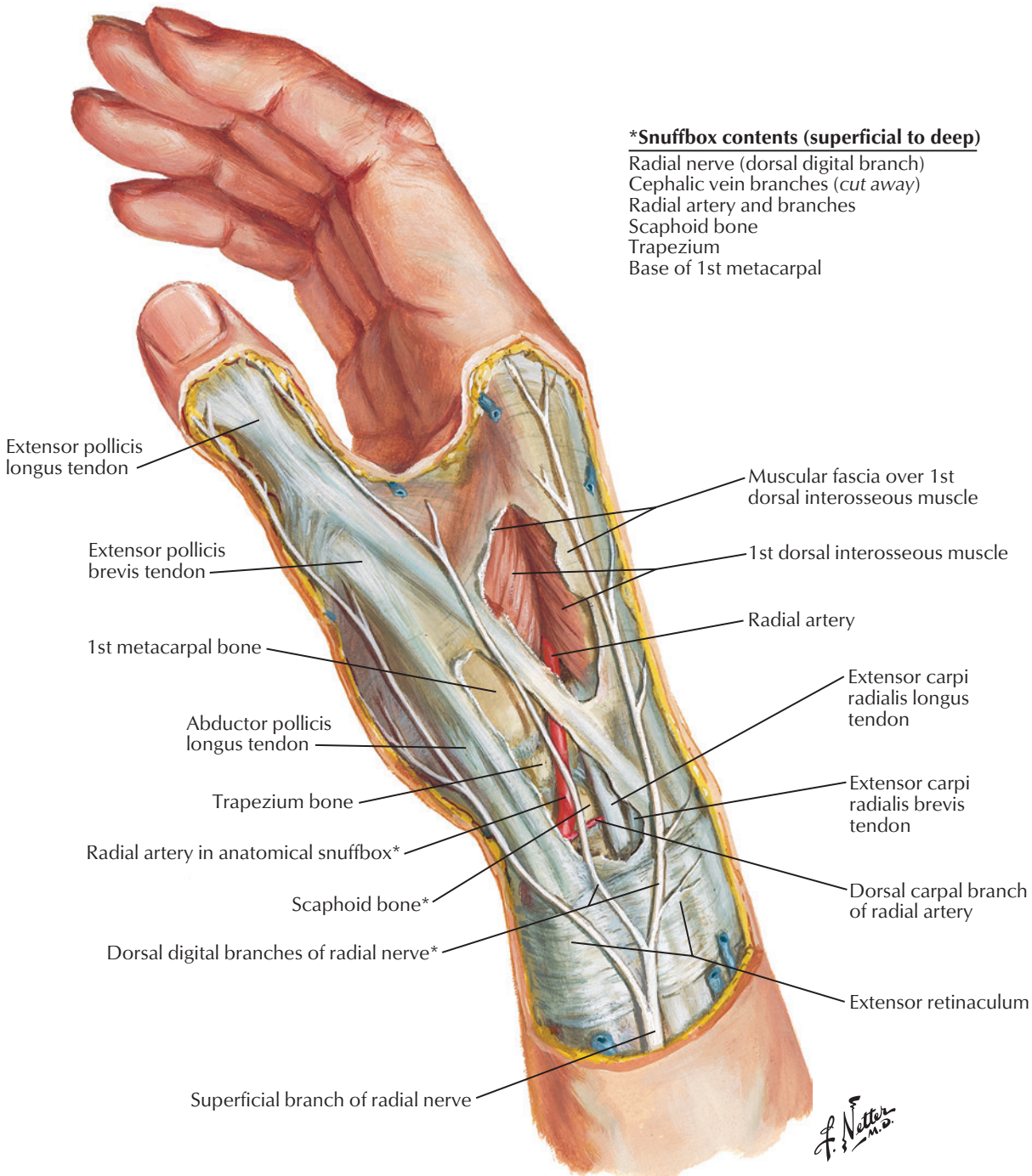
Anterior (palmar) view

Note: Arrows indicate action of muscles.

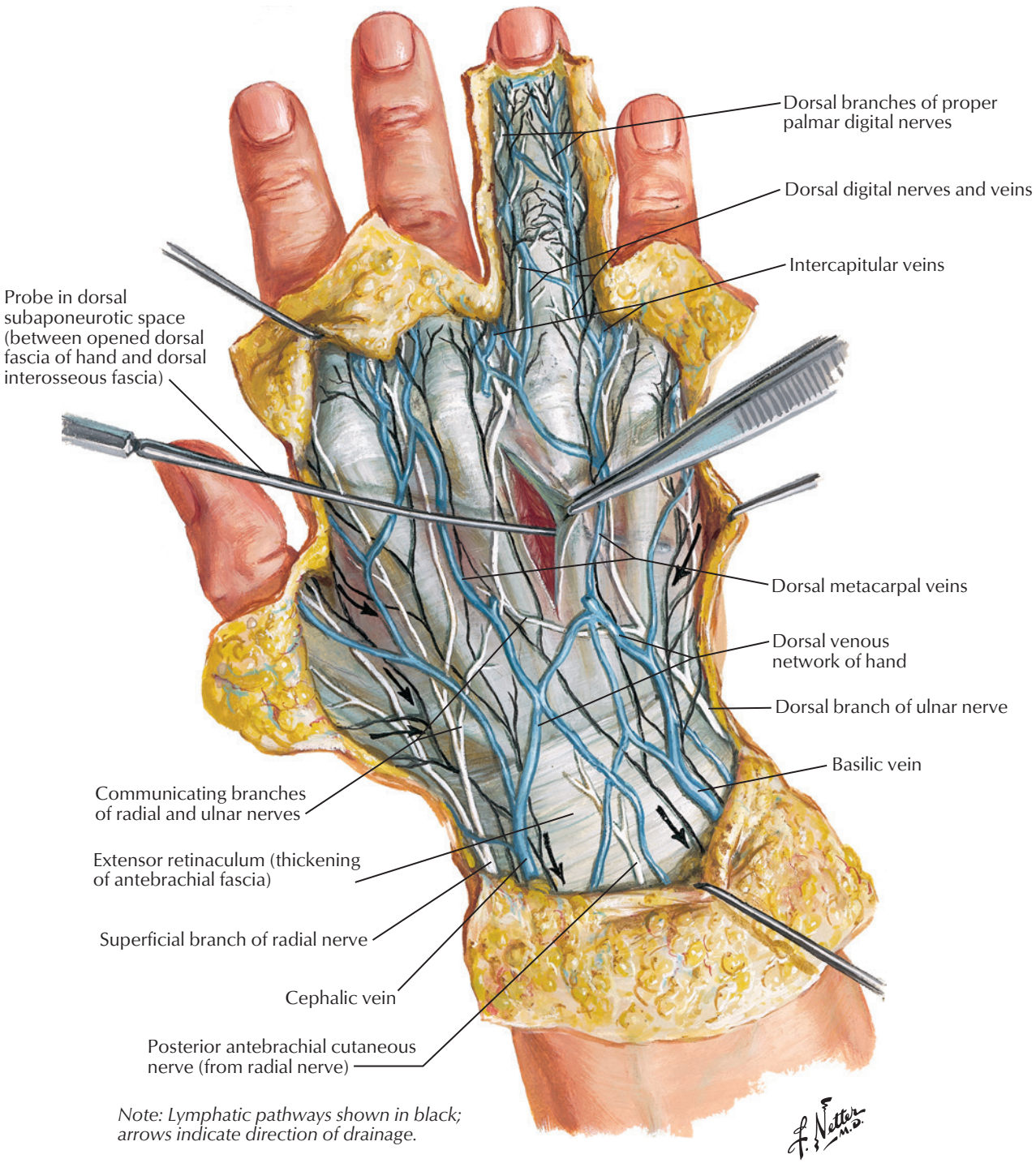
See also Plate 424



See also Plate 469



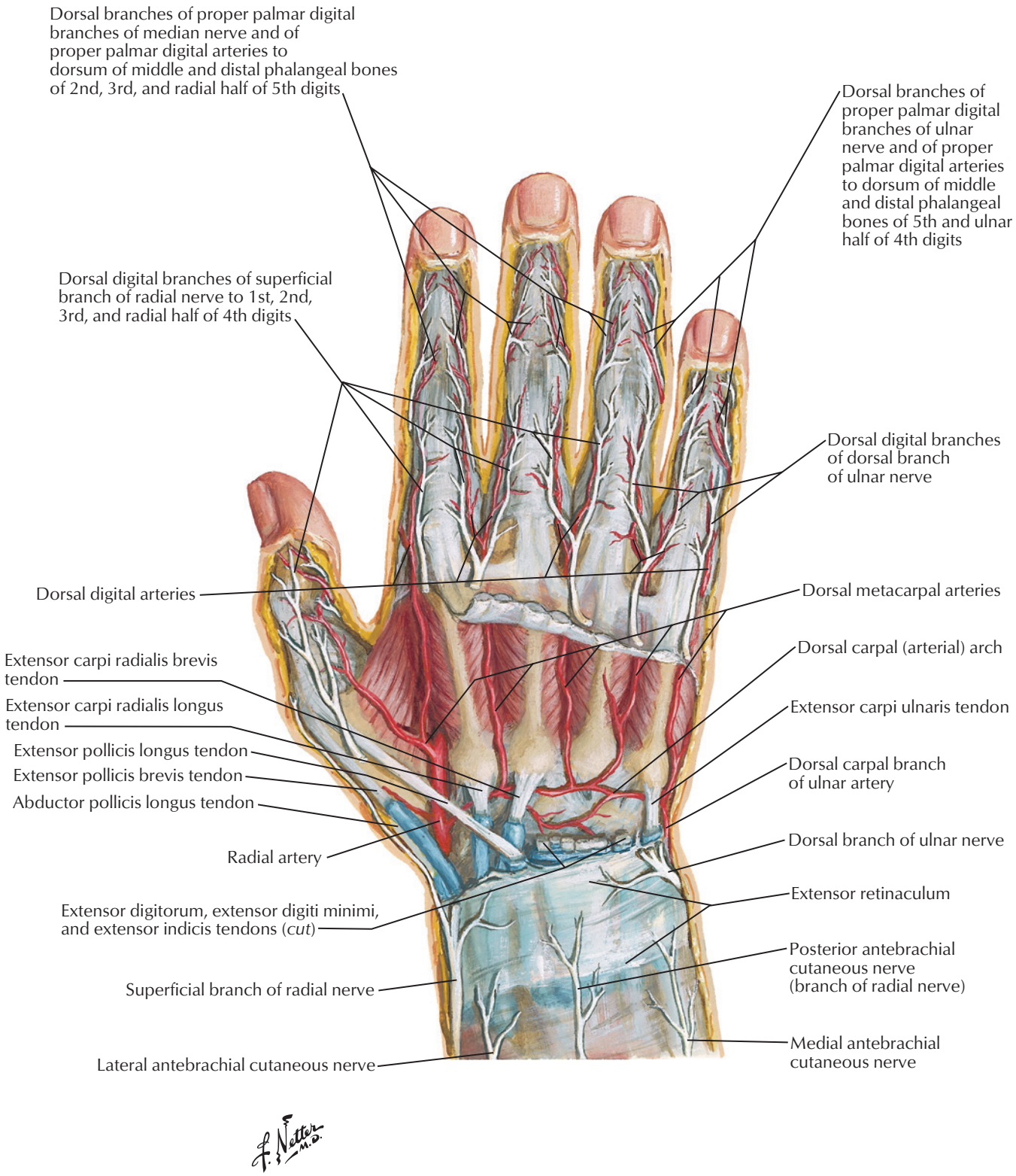
See also Plate 406



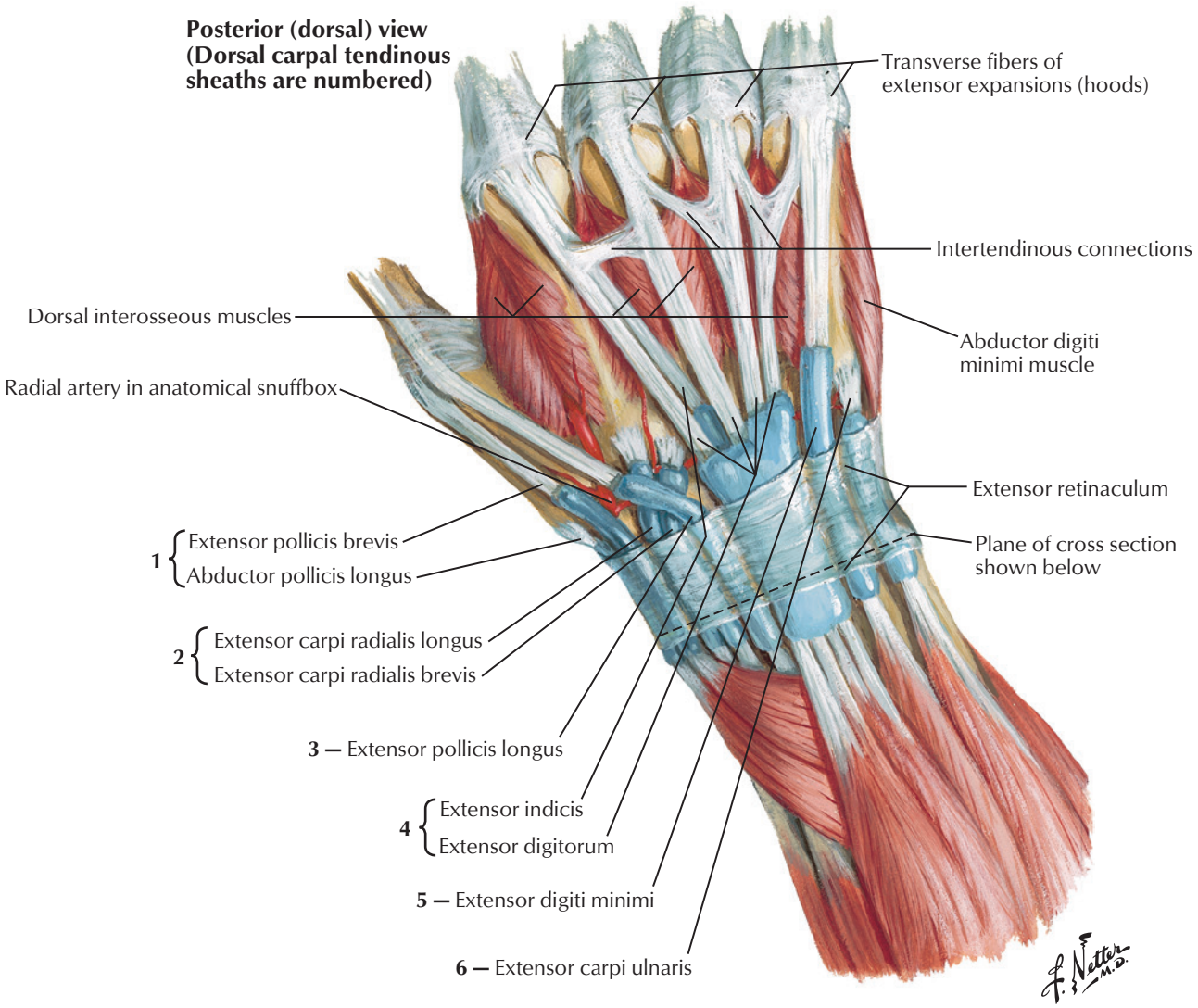
Note: Lymphatic pathways shown in black; arrows indicate direction of drainage.

Nerves and Arteries of Dorsal Hand and Wrist

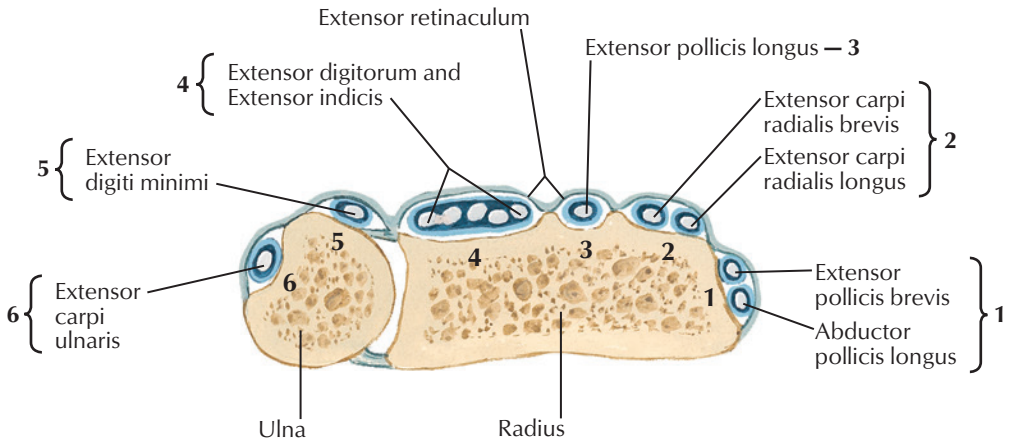
See also Plate 460

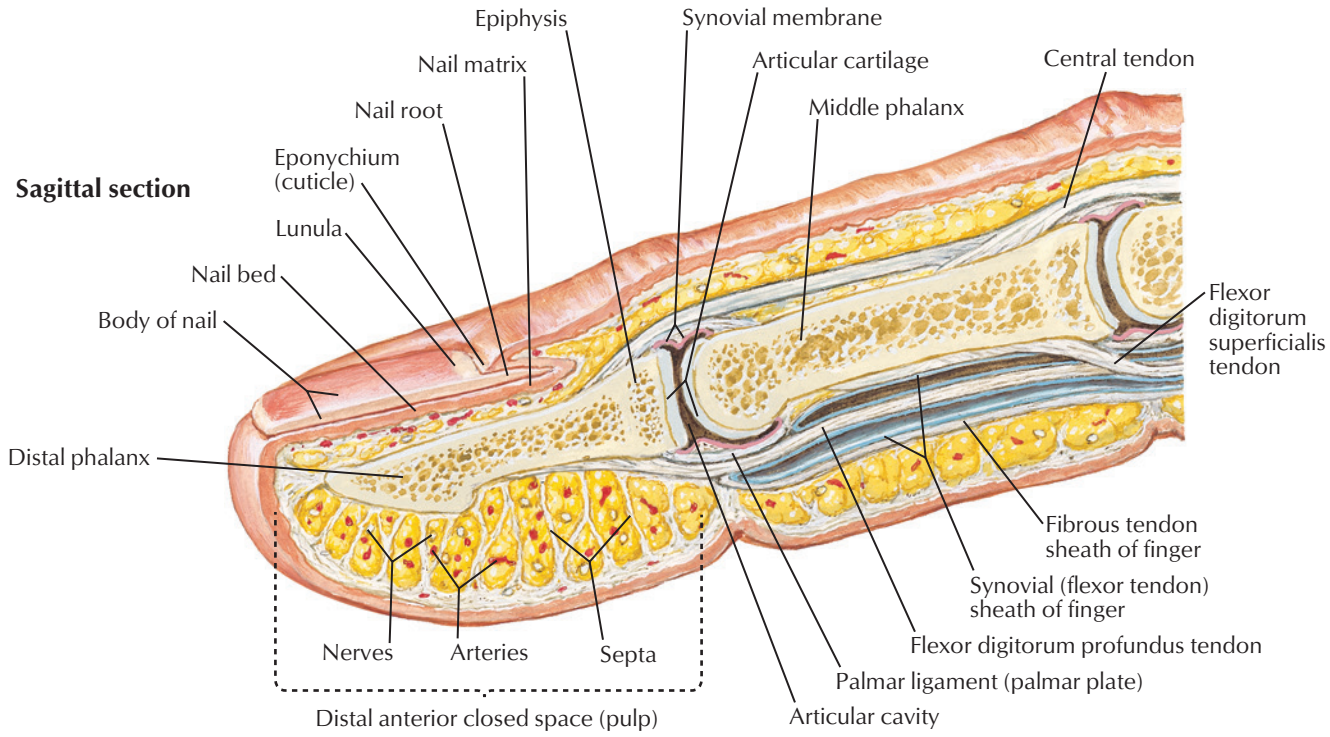


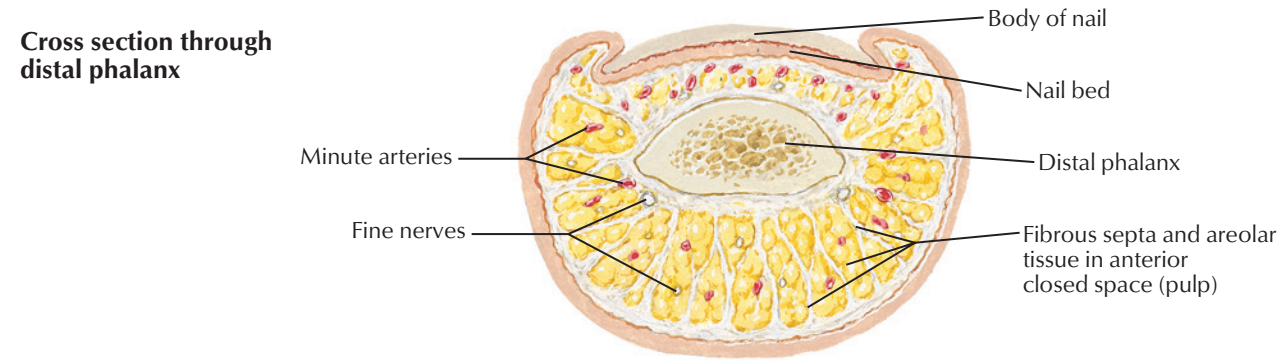
See also Plates 434, 435

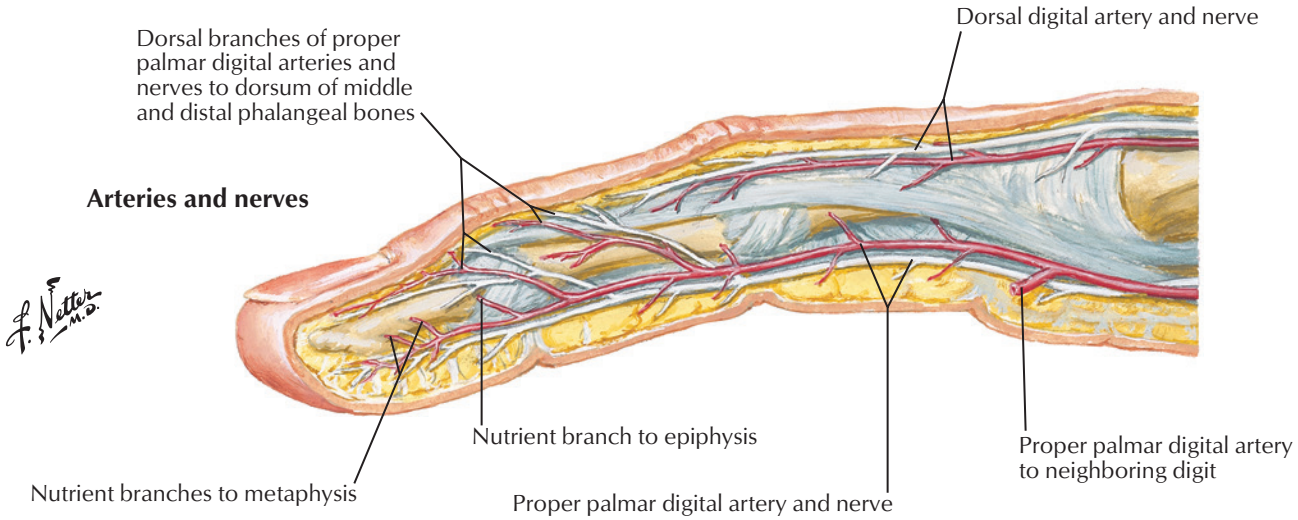


Cross section of most distal portion of forearm

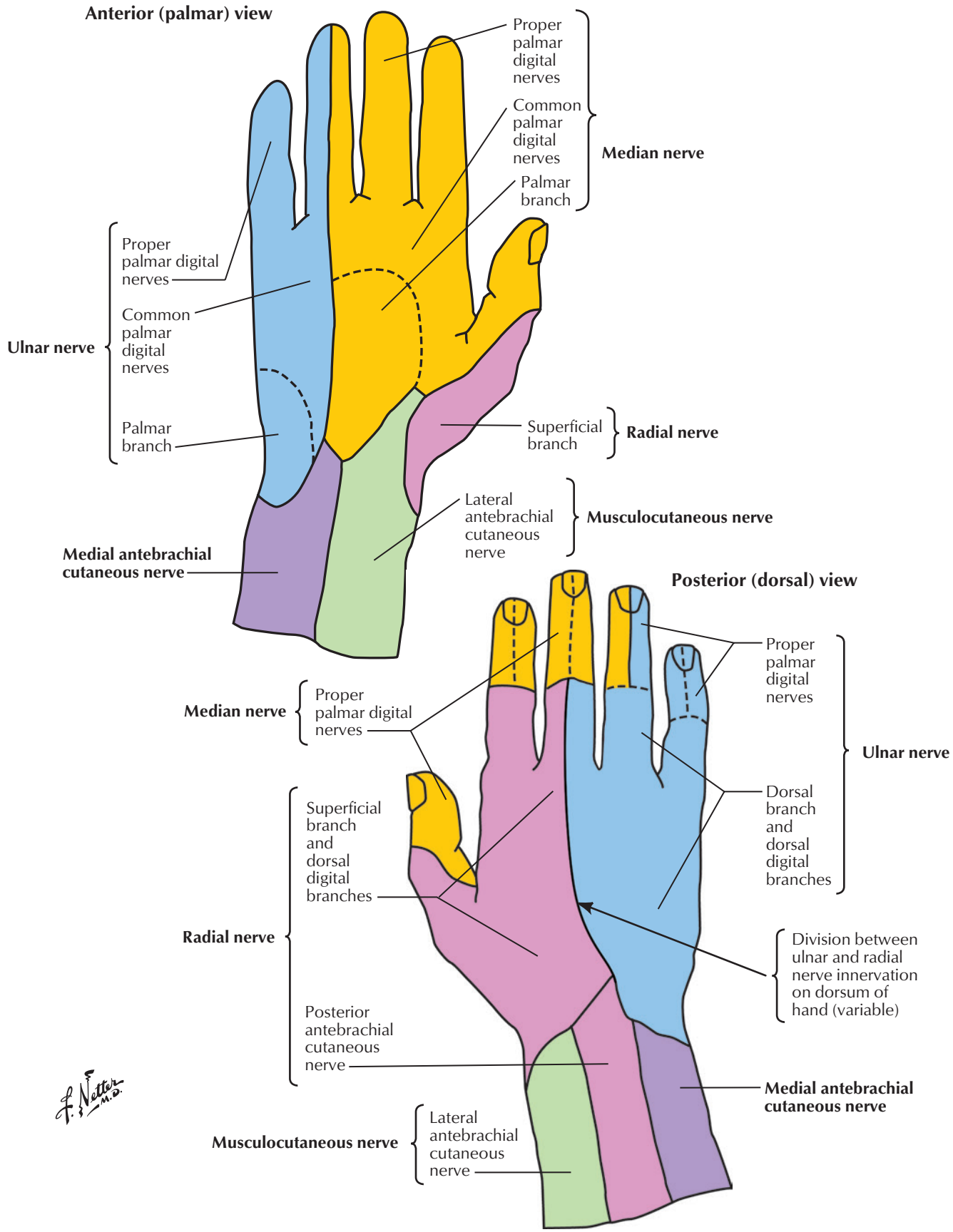



Sagittal section
Epiphysis
Synovial membrane
Nail matrix
Articular cartilage
Central tendon
Nail root
Middle phalanx
Eponychium (cuticle)
Lunula
Nail bed
Body of nail
Flexor digitorum superficialis tendon
Distal phalanx
Fibrous tendon sheath of finger
Synovial (flexor tendon) sheath of finger
Flexor digitorum profundus tendon
Nerves
Arteries
Septa
Palmar ligament (palmar plate)
Distal anterior closed space (pulp)
Articular cavity


Cross section through distal phalanx
Body of nail
Nail bed
Minute arteries
Distal phalanx
Fine nerves
Fibrous septa and areolar tissue in anterior closed space (pulp)

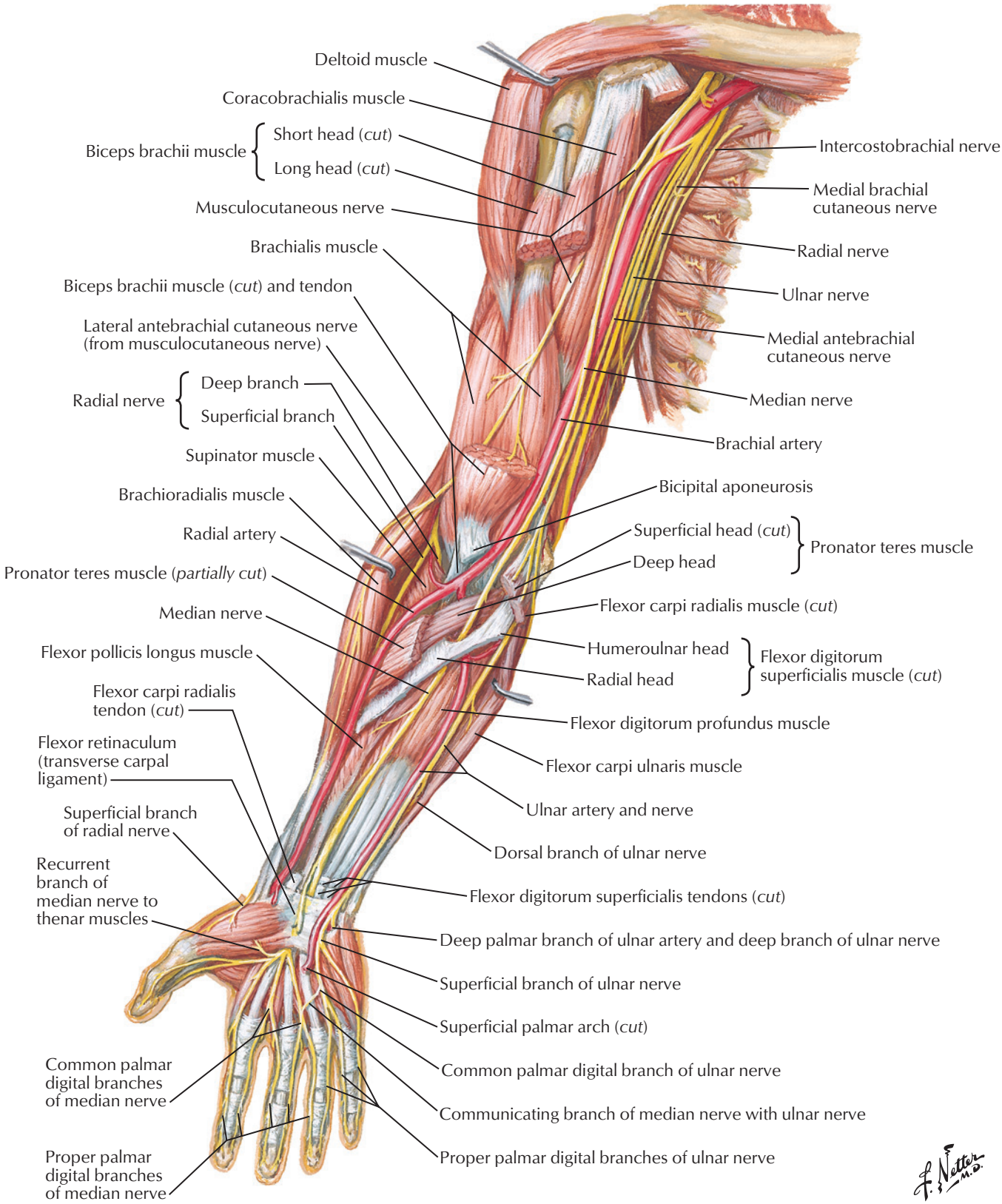

Dorsal digital artery and nerve
Dorsal branches of proper palmar digital arteries and nerves to dorsum of middle and distal phalangeal bones
Arteries and nerves
Nutrient branch to epiphysis
Proper palmar digital artery to neighboring digit
Nutrient branches to metaphysis
Proper palmar digital artery and nerve

See also Plates 404, 452

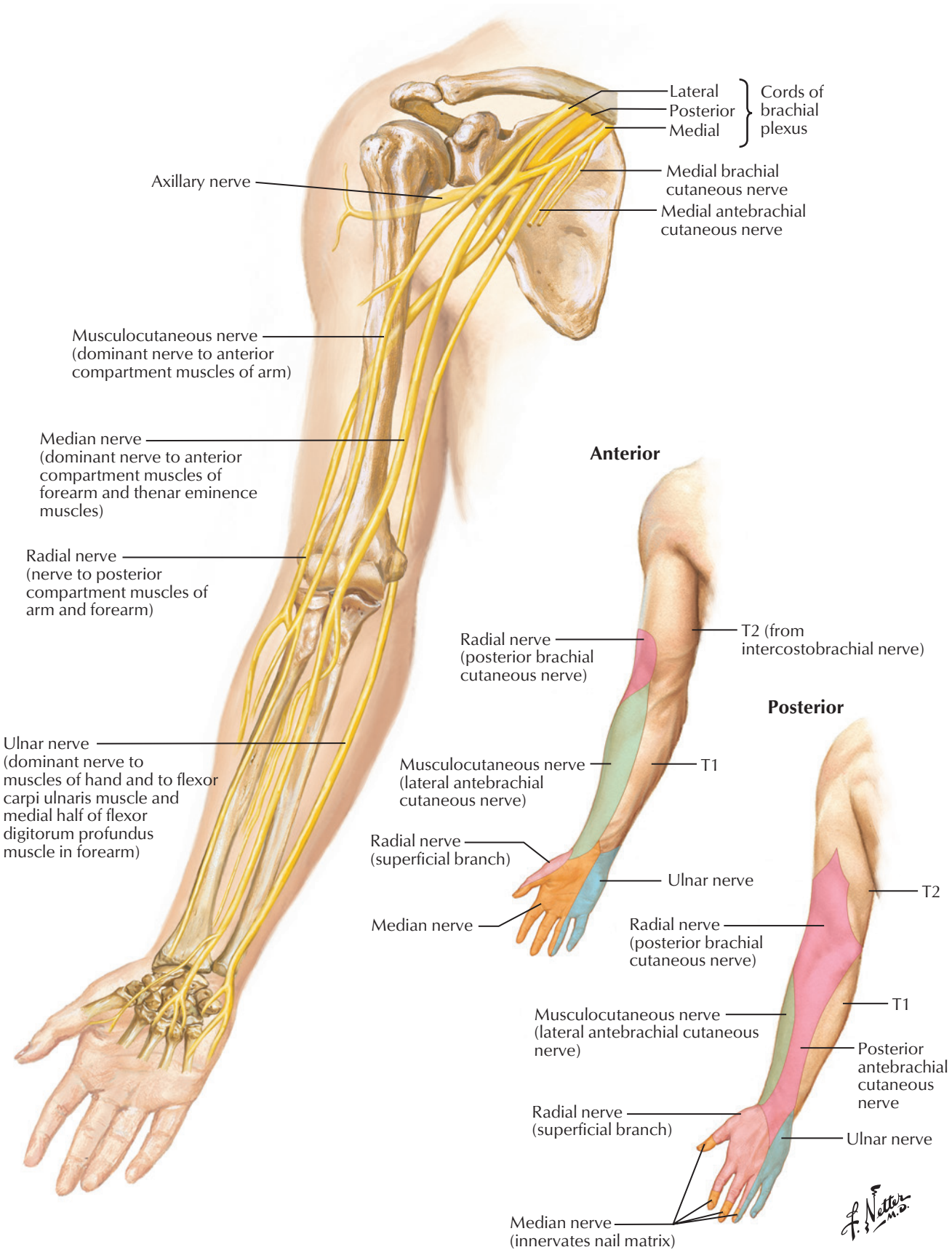


Arteries and Nerves of Upper Limb: Anterior View

See also Plates 423, 438

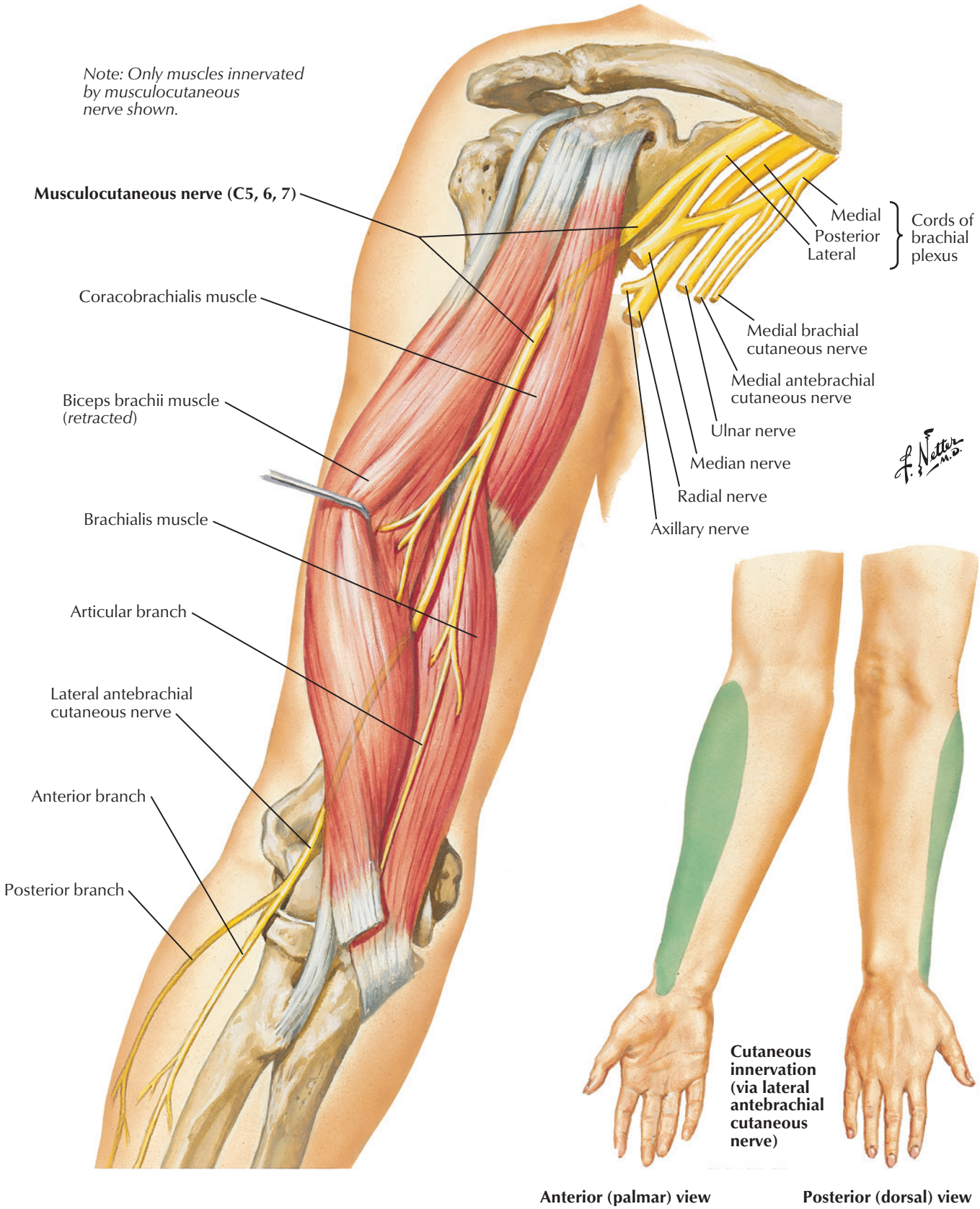


See also Plates 404, 414, 420



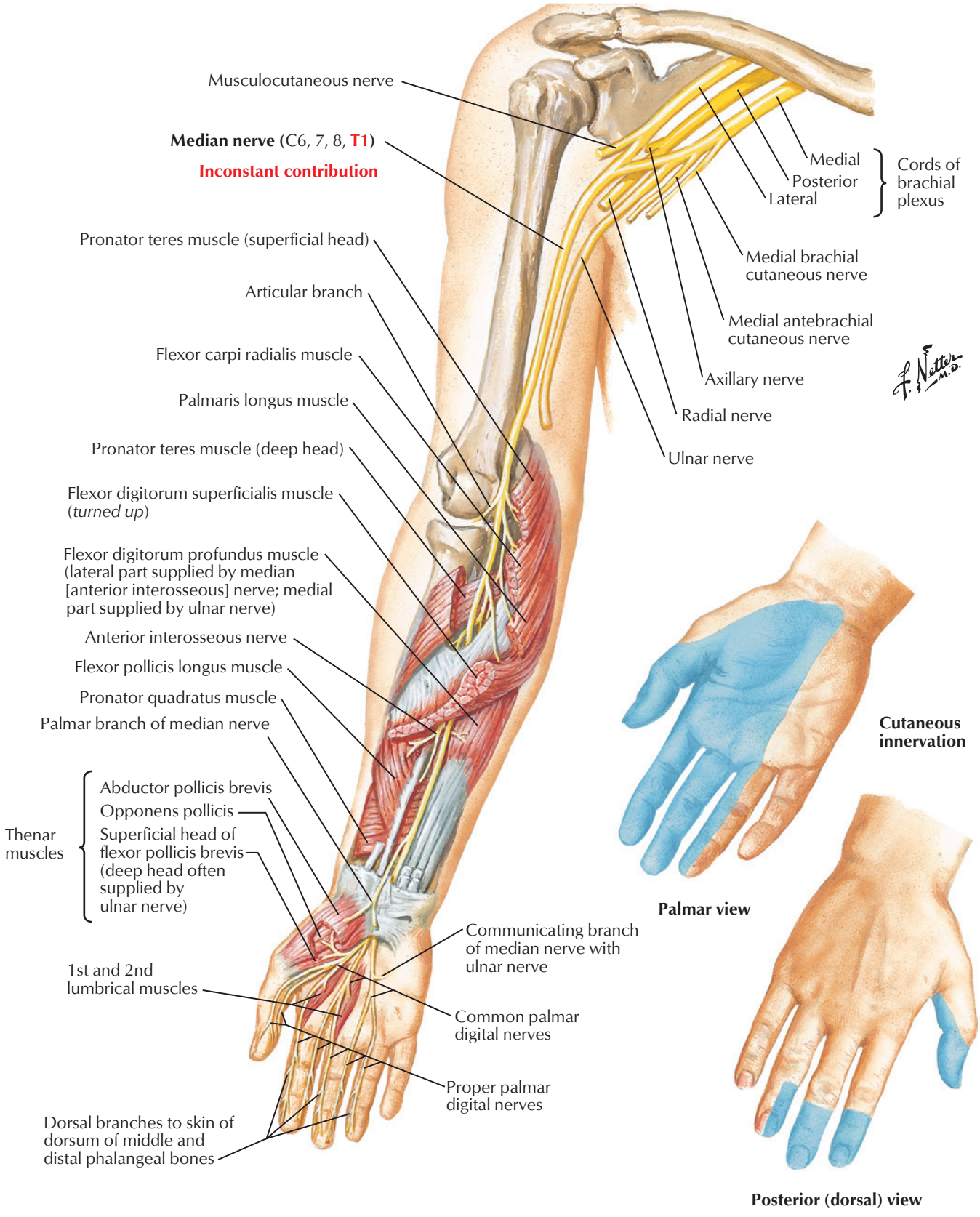
Musculocutaneous Nerve: Anterior View

See also Plate 421



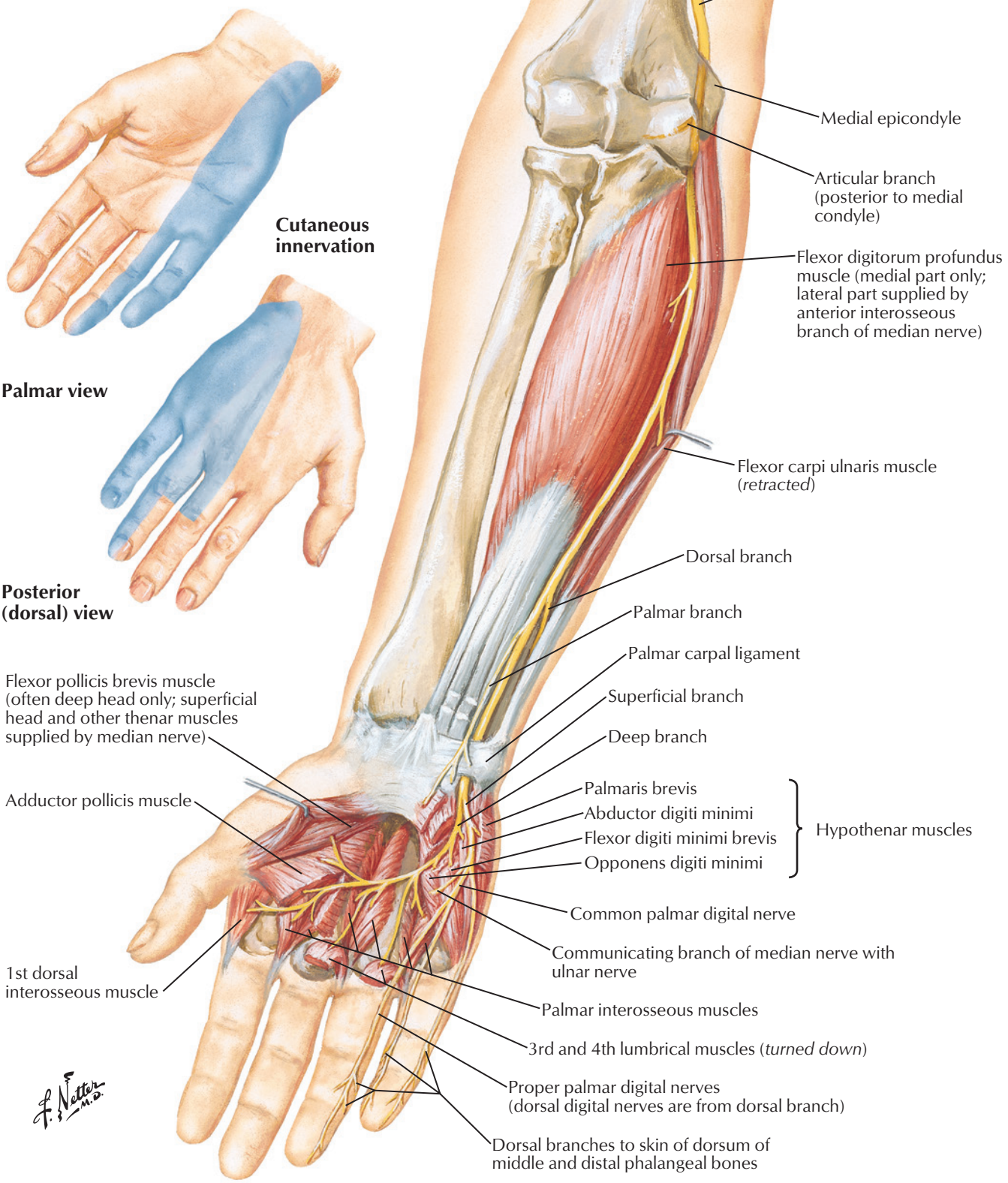
See also Plates 404, 436, 437

Note: Only muscles innervated by median nerve shown.

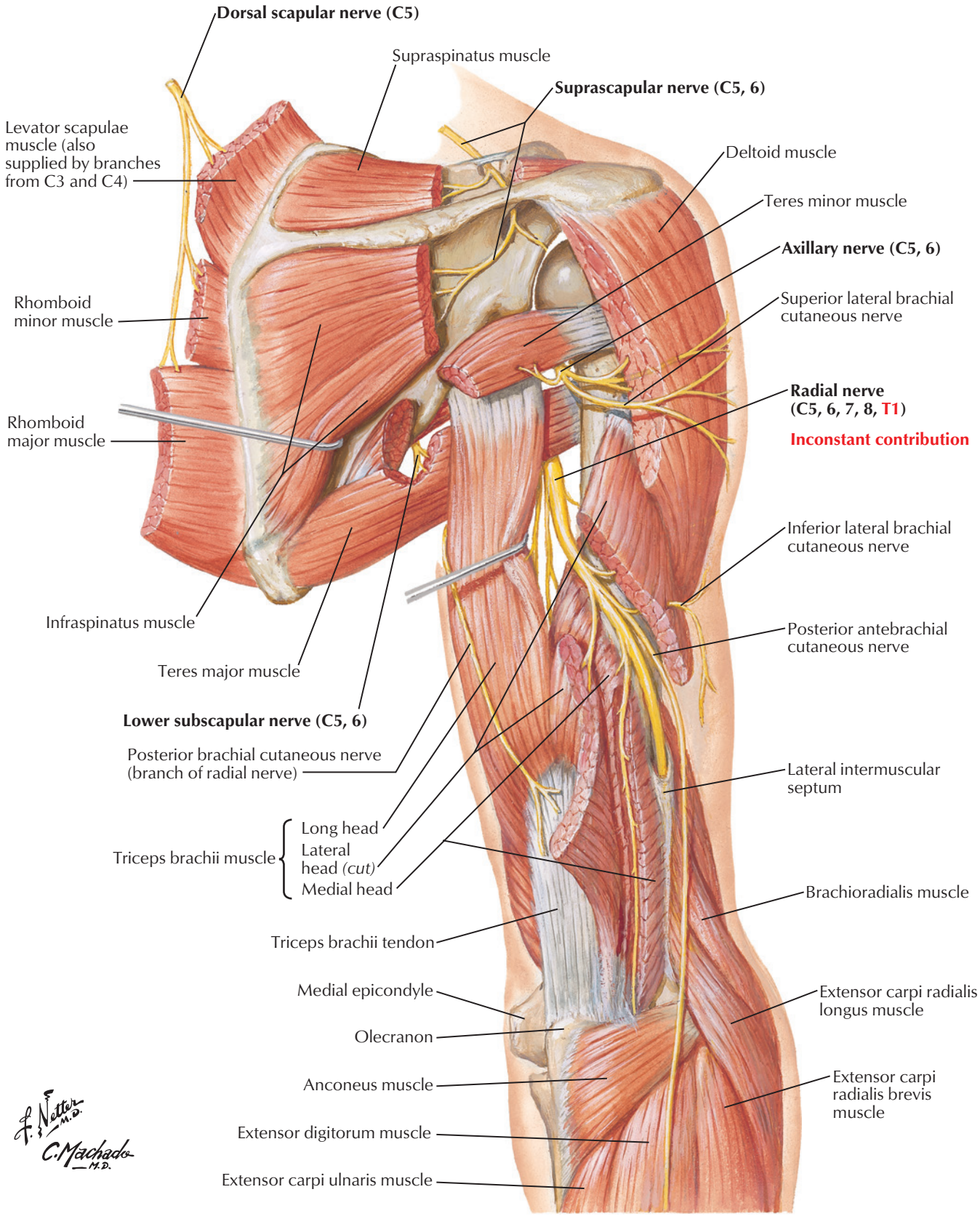


See also Plates 436, 438

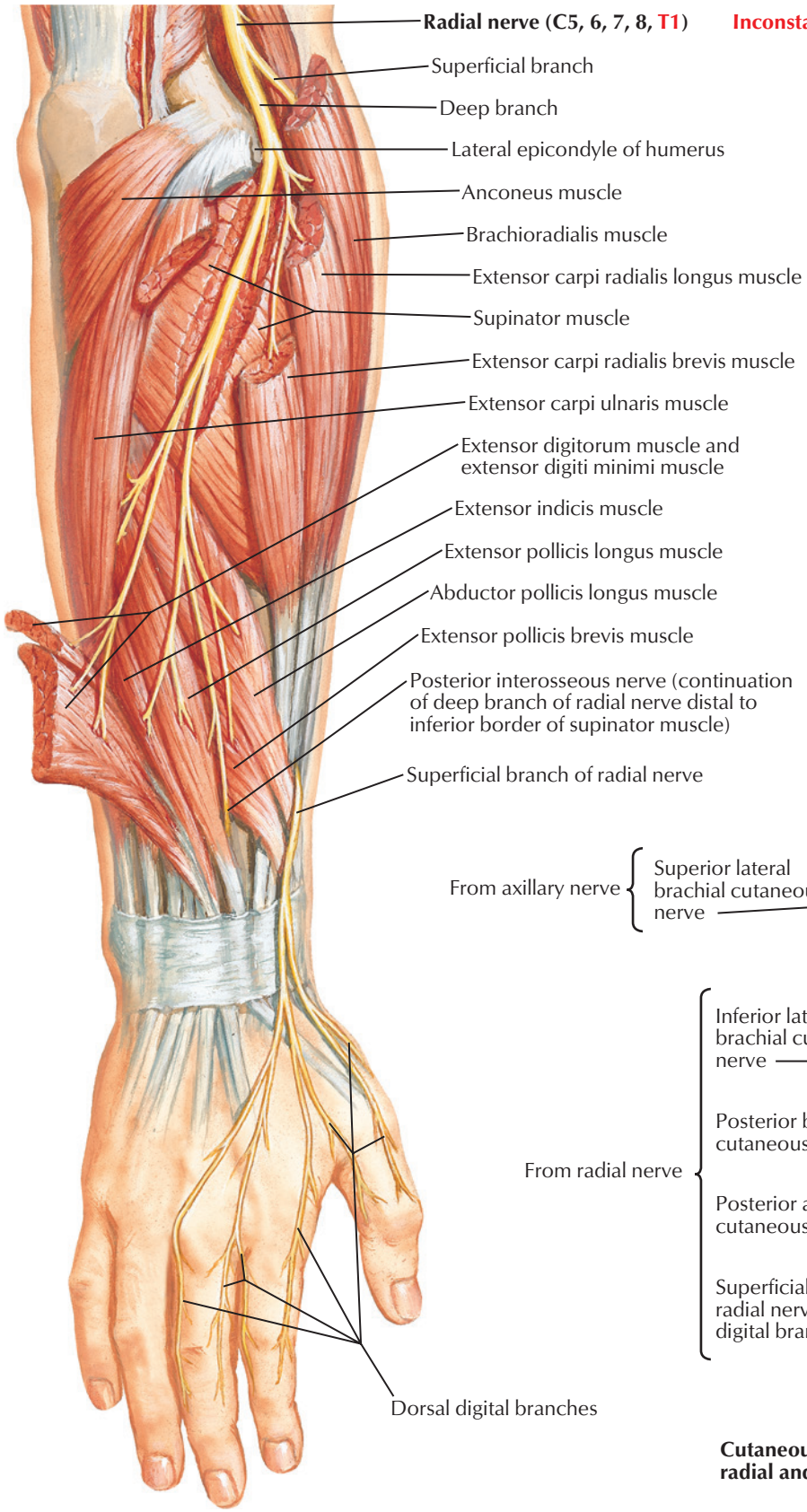
Note: Only muscles innervated by ulnar nerve shown.



See also Plates 417, 422



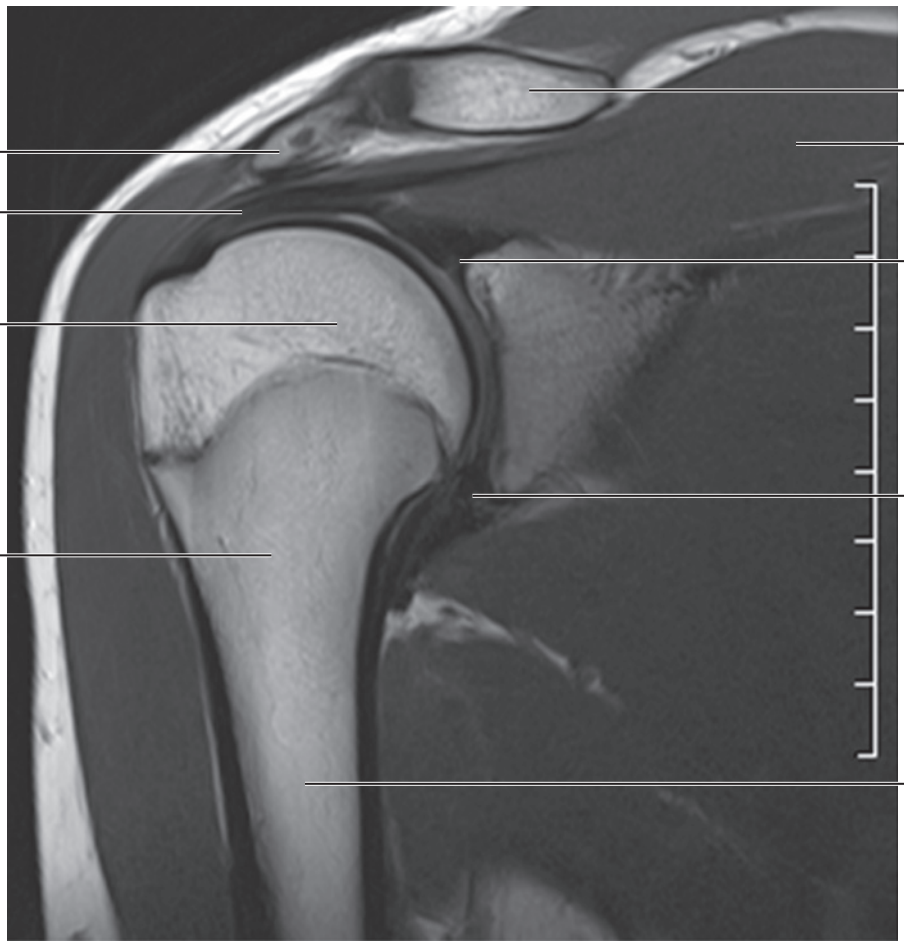
See also Plates 434, 457



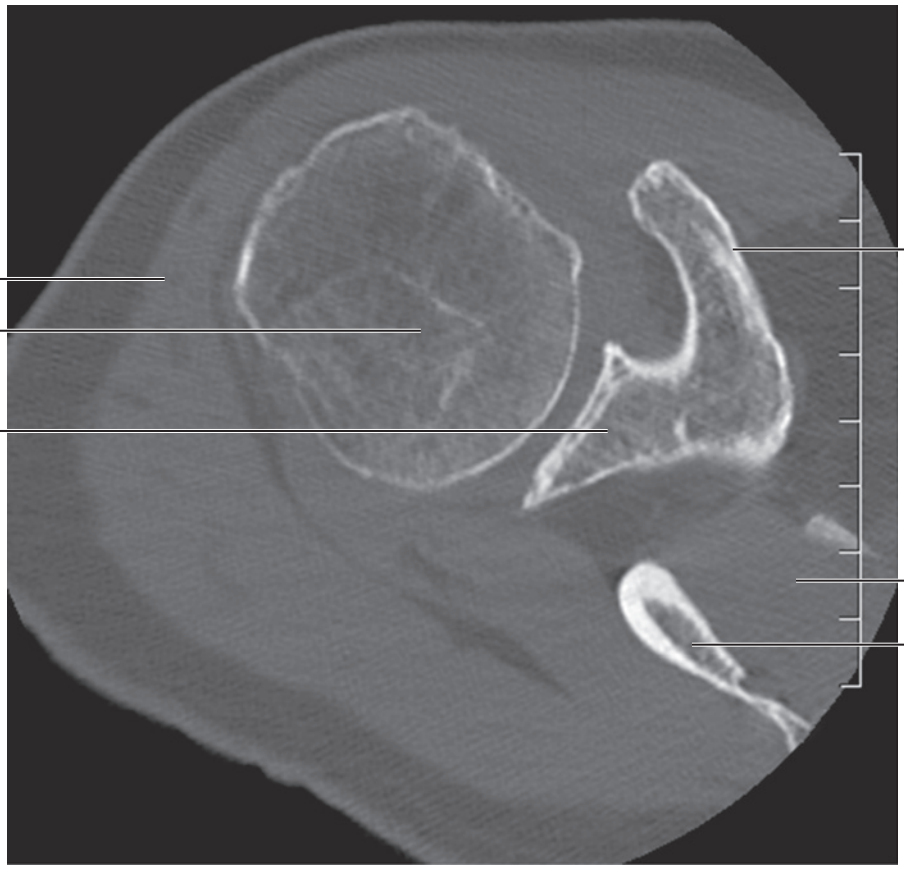
Cutaneous innervation from radial and axillary nerves

See also Plates 245, 412

Coronal Proton-Density MRI of Glenohumeral Joint



Axial CT Image of Glenohumeral Joint



ANATOMICAL STRUCTURES	CLINICAL IMPORTANCE	PLATE NUMBERS
SKELETAL SYSTEM		
Clavicle	Most clavicular fractures are caused from a fall on an outstretched arm or direct trauma delivered to the lateral side of the shoulder. Middle third of the clavicle is most commonly fractured due to the changing bony morphology of the clavicle, its strutlike function, and ligament attachments.	408, 409
Humerus	The proximal humerus, especially the surgical neck, is fractured due to low-energy falls in the elderly and high-energy trauma in youth. The axillary nerve is in harm's way and the circumflex humeral arteries can be injured. Midshaft fractures are also relatively common and place the radial nerve in harm's way.	409–411
Ulna	Subcutaneous location of olecranon makes it vulnerable to fracture by direct trauma, especially when elbow is flexed; ulnar styloid process may also be fractured in distal radial fractures	426, 429
Radius	Fractures of distal radius are most common fracture of upper extremity, typically caused by fall on outstretched hand	429
Scaphoid	Most commonly fractured carpal bone; fracture is often due to fall on outstretched hand	439, 440, 442
MUSCULAR SYSTEM		
Rotator (compressor) cuff muscles	Injuries to this group of muscles can be from an acute injury or chronic overuse injury leading to common causes of shoulder pain and disability	412, 415, 422
Supraspinatus tendon	Most commonly injured rotator (compressor) cuff muscle tendon complex. Often torn beneath the acromion	415–417, 422
Biceps brachii tendon	Proximally the long head of the biceps tendon tears in the elderly from falls on an outstretched arm, and distally the biceps tendon is used to perform flexor compartment reflex assessing the C5 and C6 spinal nerves	421, 423
Long head of biceps brachii	When long head has been ruptured, it pulls off supraglenoid tubercle and retracts down into arm; muscle bulges (Popeye deformity) at midshaft of humerus	421
Posterior forearm muscles	Repetitive use of muscles arising from common extensor origin can damage tendons and produce pain over lateral epicondyle, associated with tennis elbow	431
Anterior forearm muscles	Repetitive use of muscles arising from common flexor origin can damage tendons and produce pain over medial epicondyle, associated with golfer's elbow	432, 433
NERVOUS SYSTEM		
Long thoracic nerve	Injury may produce "winged scapula" caused by denervation of serratus anterior	417, 419
Axillary nerve	Position of nerve close to medial aspect of humeral head makes it vulnerable to injury with fractures of surgical neck of humerus or humeral dislocations	422
Median nerve	Commonly compressed in carpal tunnel, producing pain and paresthesia in lateral three and one-half digits	450, 466
Recurrent branch of median nerve	May be injured in superficial lacerations of palm over thenar eminence	449
Ulnar nerve	Vulnerable to compression or injury where it passes posterior to medial epicondyle of humerus, and at wrist in ulnar tunnel (Guyon's canal)	463, 467
Radial nerve	Vulnerable to compression or injury where it lies against humerus in radial groove (e.g., with humeral fracture); common symptom is "wrist drop" due to weakness of wrist extensors	468, 469

ANATOMICAL STRUCTURES	CLINICAL IMPORTANCE	PLATE NUMBERS
CARDIOVASCULAR SYSTEM		
Median cubital vein	Accessed in cubital fossa for venipuncture	405
Suprascapular, dorsal scapular, and circumflex scapular arteries	Provide collateral circulation around scapula, allowing blood to reach distal part of upper extremity if axillary artery is blocked or compressed	418
Brachial artery	Palpated in cubital fossa to assess brachial pulse prior to taking blood pressure measurement	423, 424
Radial artery	Palpated at lateral aspect of wrist to assess radial pulse	424

*Selections were based largely on clinical data as well as commonly covered clinical correlations in gross anatomy courses.

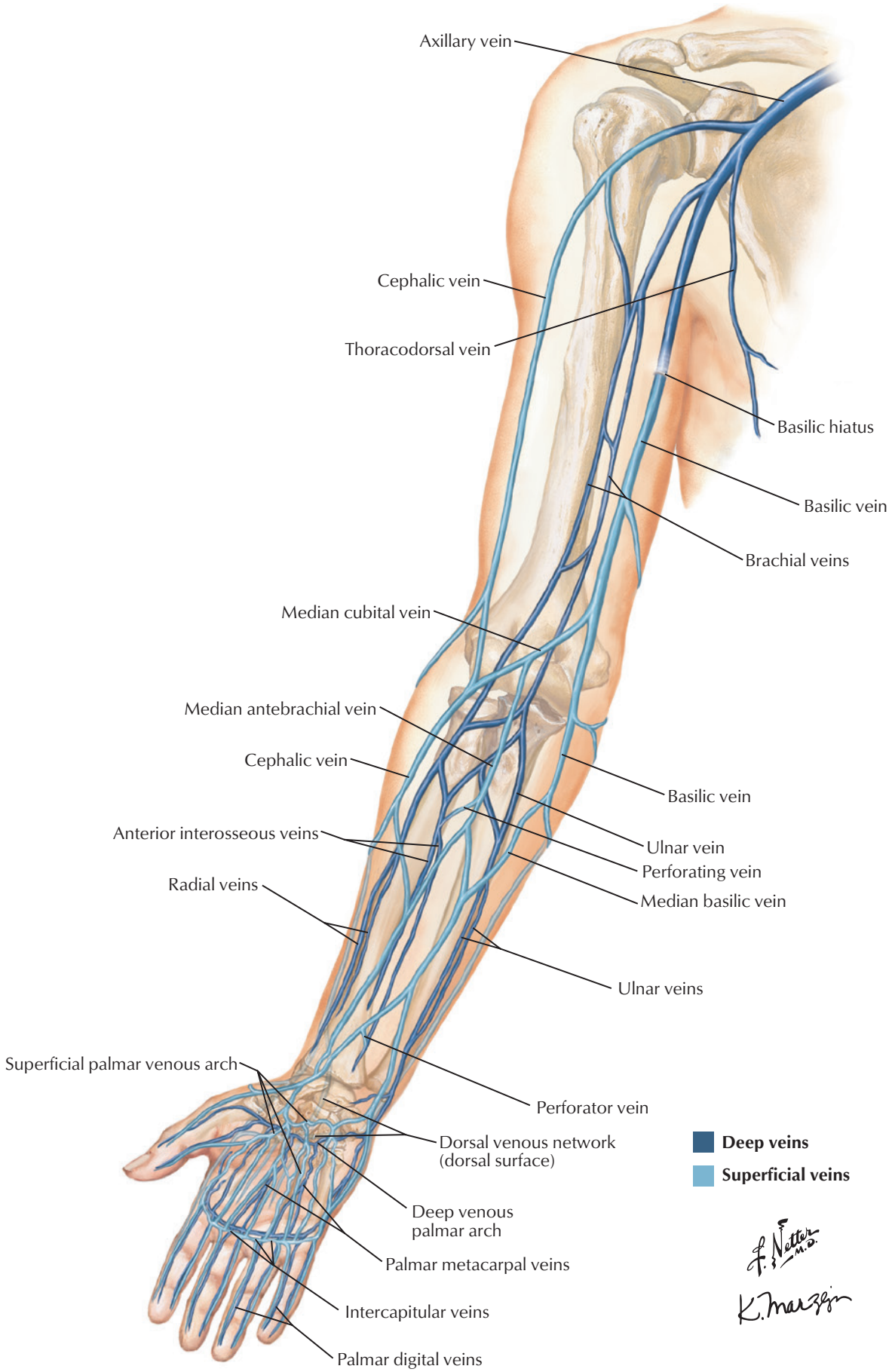
MUSCLE	MUSCLE GROUP	PROXIMAL ATTACHMENT (ORIGIN)	DISTAL ATTACHMENT (INSERTION)	INNERVATION	BLOOD SUPPLY	MAIN ACTIONS
Abductor digiti minimi	Hand	Pisiform bone and tendon of flexor carpi ulnaris	Medial side of base of proximal phalanx of little finger (5th digit)	Ulnar nerve (deep branch)	Deep palmar branch of ulnar artery	Abducts little finger
Abductor pollicis brevis	Hand	Flexor retinaculum, tubercles of scaphoid and trapezium bones	Base of proximal phalanx of thumb	Median nerve (recurrent branch)	Superficial palmar branch of radial artery	Abducts thumb
Abductor pollicis longus	Posterior forearm	Posterior surface of ulna, radius, and interosseous membrane	Base of 1st metacarpal	Radial nerve (posterior interosseous)	Posterior interosseous artery	Abducts and extends thumb at carpometacarpal joint
Adductor pollicis	Hand	*Oblique head*: bases of 2nd and 3rd metacarpals and capitate bone and adjacent bones *Transverse head:* anterior surface of 3rd metacarpal	Base of proximal phalanx of thumb	Ulnar nerve (deep branch)	Deep palmar arch	Adducts thumb
Anconeus	Arm	Posterior surface of lateral epicondyle of humerus	Lateral surface of olecranon and posterior proximal ulna	Radial nerve	Deep brachial artery	Assists triceps brachii in extending elbow, abducts ulna in pronation
Biceps brachii	Arm	*Long head:* supraglenoid tubercle of scapula *Short head:* coracoid process of scapula	Radial tuberosity, fascia of forearm via bicipital aponeurosis	Musculocutaneous nerve	Muscular branches of brachial artery	Flexes and supinates forearm at elbow
Brachialis	Arm	Distal half of anterior surface of humerus	Coronoid process and tuberosity of ulna	Musculocutaneous nerve and radial nerve	Radial recurrent artery, muscular branches of brachial artery	Flexes forearm at elbow
Brachioradialis	Posterior forearm	Proximal 2/3 of lateral supracondylar ridge of humerus	Lateral side of distal end of radius	Radial nerve	Radial recurrent artery	Weak flexion of forearm when forearm is midpronated
Coracobrachialis	Arm	Coracoid process of scapula	Middle third of medial surface of humerus	Musculocutaneous nerve	Muscular branches of brachial artery	Flexes and adducts arm at shoulder
Deltoid	Shoulder	Lateral third of clavicle, acromion, spine of scapula	Deltoid tuberosity of humerus	Axillary nerve	Posterior circumflex humeral artery, deltoid branch of thoracoacromial artery	*Clavicular part*: flexes and medially rotates arm *Acromial part:* abducts arm beyond initial 15 degrees done by supraspinatus *Spinous part:* extends and laterally rotates arm
Dorsal interosseous muscles	Hand	Sides of two adjacent metacarpal bones	Base of proximal phalangeal bones, extensor expansion of digits 2–4	Ulnar nerve (deep branch)	Deep palmar arch	Abduct digits; flex digits at metacarpophalangeal joint and extend interphalangeal joints
Extensor carpi radialis brevis	Posterior forearm	Lateral epicondyle of humerus	Base of 3rd metacarpal and slip to 2nd metacarpal	Radial nerve (deep branch)	Radial artery, radial recurrent artery	Extends and abducts hand at wrist
Extensor carpi radialis longus	Posterior forearm	Distal third of lateral supracondylar ridge of humerus	Base of 2nd metacarpal and slip to 3rd metacarpal	Radial nerve	Radial artery, radial recurrent artery	Extends and abducts hand at wrist
Extensor carpi ulnaris	Posterior forearm	Lateral epicondyle of humerus and posterior border of ulna	Base of 5th metacarpal	Radial nerve (posterior interosseous nerve)	Posterior interosseous artery	Extends and adducts hand at wrist

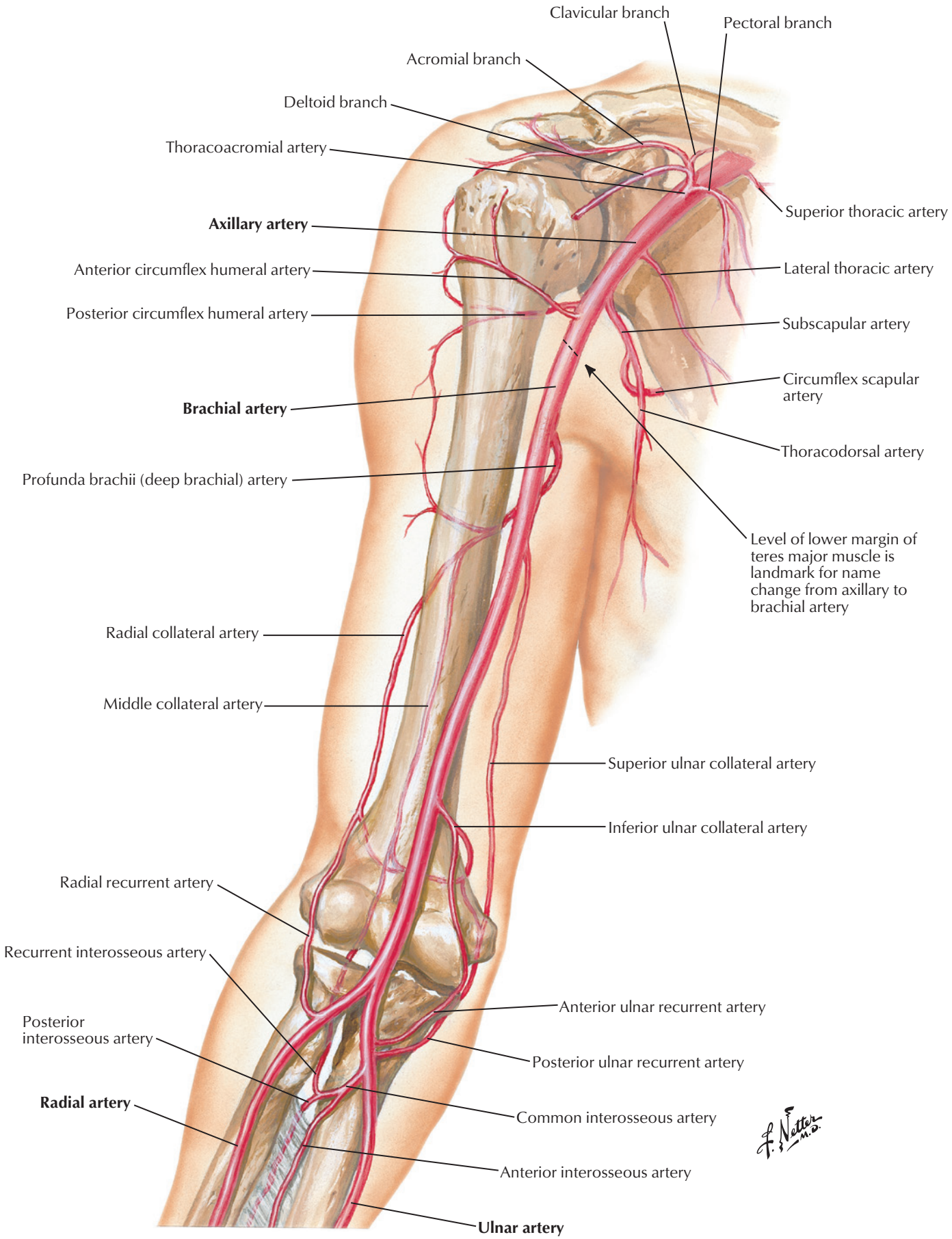
Variations in spinal nerve contributions to the innervation of muscles, their arterial supply, their attachments, and their actions are common themes in human anatomy. Therefore, expect differences between texts and realize that anatomical variation is normal.

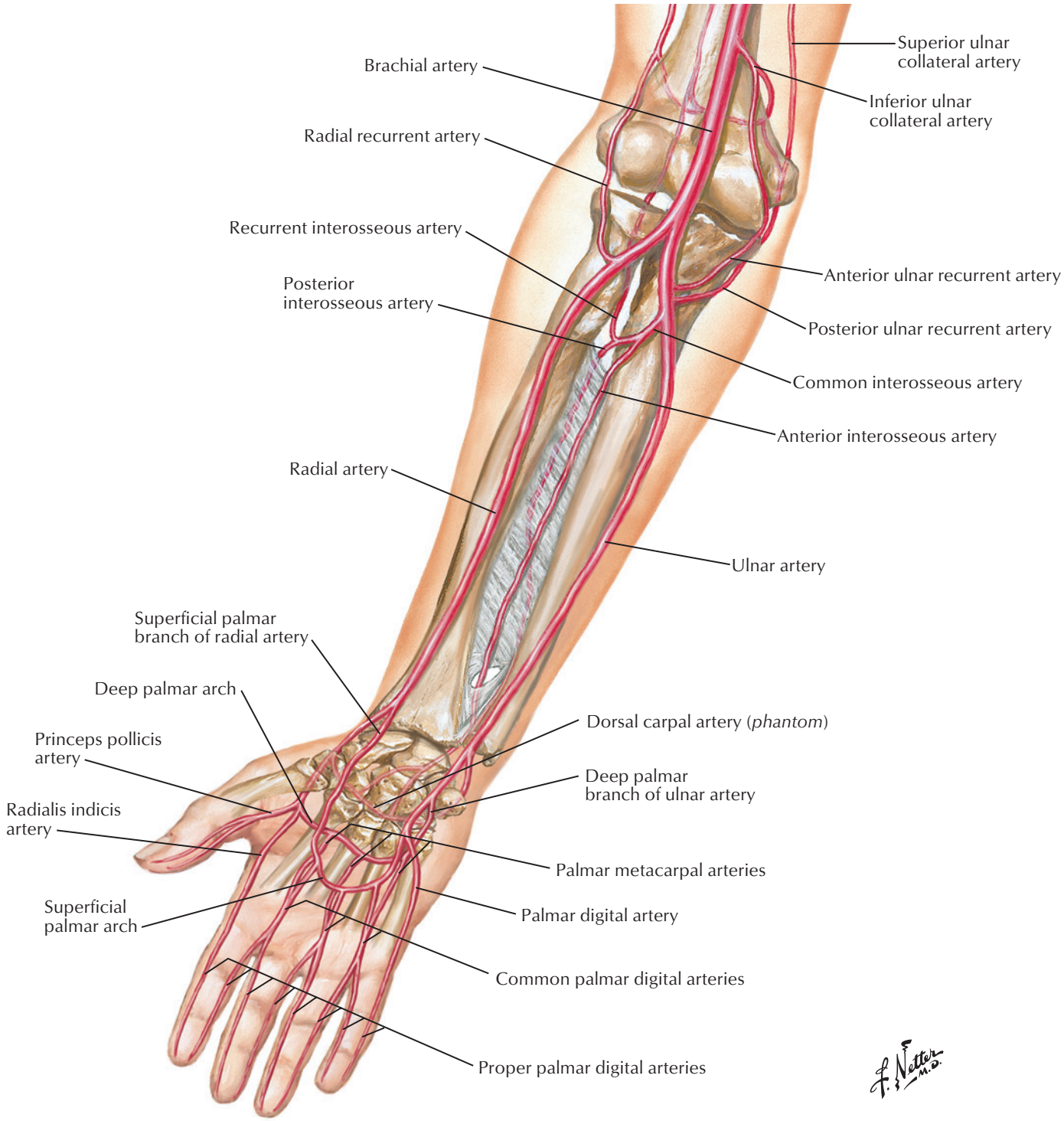
MUSCLE	MUSCLE GROUP	PROXIMAL ATTACHMENT (ORIGIN)	DISTAL ATTACHMENT (INSERTION)	INNERVATION	BLOOD SUPPLY	MAIN ACTIONS
Extensor digiti minimi	Posterior forearm	Lateral epicondyle of humerus	Extensor expansion of 5th digit	Radial nerve (posterior interosseous nerve)	Posterior interosseous artery	Extends 5th digit
Extensor digitorum	Posterior forearm	Lateral epicondyle of humerus	Extensor expansions of medial four digits	Radial nerve (posterior interosseous nerve)	Posterior interosseous artery	Extends medial four digits, assists in wrist extension
Extensor indicis	Posterior forearm	Posterior surface of ulna and interosseous membrane	Extensor expansion of 2nd digit	Radial nerve (posterior interosseous nerve)	Posterior interosseous artery	Extends 2nd digit and helps extend hand at wrist
Extensor pollicis brevis	Posterior forearm	Posterior surface of radius and interosseous membrane	Dorsal base of proximal phalanx of thumb	Radial nerve (posterior interosseous nerve)	Posterior interosseous artery	Extends proximal phalanx of thumb at carpometacarpal joint
Extensor pollicis longus	Posterior forearm	Posterior surface of middle third of ulna, interosseous membrane	Dorsal base of distal phalanx of thumb	Radial nerve (posterior interosseous nerve)	Posterior interosseous artery	Extends distal phalanx of thumb at interphalangeal and metacarpophalangeal joints
Flexor carpi radialis	Anterior forearm	Medial epicondyle of humerus	Base of 2nd metacarpal	Median nerve	Radial artery	Flexes and abducts hand at wrist
Flexor carpi ulnaris	Anterior forearm	*Superficial head:* medial epicondyle of humerus *Deep head:* olecranon and posterior border of ulna	Pisiform bone, hook of hamate bone, base of 5th metacarpal	Ulnar nerve	Posterior ulnar recurrent artery	Flexes and adducts hand at wrist
Flexor digiti minimi brevis	Hand	Flexor retinaculum and hook of hamate bone	Medial side of base of proximal phalanx of little finger	Ulnar nerve (deep branch)	Deep palmar branch of ulnar artery	Flexes proximal phalanx of little finger
Flexor digitorum profundus	Anterior forearm	Medial and anterior surface of proximal 3/4 of ulna and interosseous membrane	Palmar base of distal phalangeal bones of medial four digits	*Medial part:* ulnar nerve *Lateral part:* median nerve	Anterior interosseous artery, muscular branches of ulnar artery	Flexes distal phalangeal bones of medial four digits, assists with flexion of hand at wrist
Flexor digitorum superficialis	Anterior forearm	*Humeroulnar head:* medial epicondyle of humerus, coronoid, process of ulna, ulnar collateral ligament *Radial head:* superior half of anterior radius	Bodies of middle phalangeal bones of medial four digits	Median nerve	Ulnar and radial arteries	Flexes middle and proximal phalangeal bones of medial four digits, flexes hand at wrist
Flexor pollicis brevis	Hand	Flexor retinaculum and tubercle of trapezium bone	Lateral side of base of proximal phalanx of thumb	Median nerve (recurrent branch)	Superficial palmar branch of radial artery	Flexes proximal phalanx of thumb
Flexor pollicis longus	Anterior forearm	Anterior surface of radius and interosseous membrane	Palmar base of distal phalanx of thumb	Median nerve (anterior interosseous nerve)	Anterior interosseous artery	Flexes phalangeal bones of thumb
Infraspinatus	Shoulder	Infraspinous fossa of scapula and deep fascia	Greater tubercle of humerus	Suprascapular nerve	Suprascapular artery	Lateral rotation of arm
Latissimus dorsi	Shoulder	Spinous processes of T7–L5, thoracolumbar fascia, iliac crest, and last three ribs	Intertubercular sulcus of humerus	Thoracodorsal nerve	Thoracodorsal artery, dorsal perforating branches of 9th, 10th, and 11th posterior intercostal, subcostal, and first three lumbar arteries	Extends, adducts, and medially rotates humerus
Levator scapulae	Superficial back	Posterior tubercles of transverse processes of C1–C4	Medial border of scapula from superior angle to spine	Anterior rami of C3–C4 and dorsal scapular nerve	Dorsal scapular artery, transverse cervical artery, ascending cervical artery	Elevates scapula medially, inferiorly rotates glenoid fossa
Lumbrical, first and second	Hand	Lateral two tendons of flexor digitorum profundus	Lateral sides of extensor expansion of digits 2 and 3	Median nerve (digital branches)	Superficial and deep palmar arches	Extend digits at interphalangeal joints, flex metacarpophalangeal joints

MUSCLE	MUSCLE GROUP	PROXIMAL ATTACHMENT (ORIGIN)	DISTAL ATTACHMENT (INSERTION)	INNERVATION	BLOOD SUPPLY	MAIN ACTIONS
Lumbrical, third and fourth	Hand	Medial three tendons of flexor digitorum profundus	Lateral sides of extensor expansion of digits 4 and 5	Ulnar nerve (deep branch)	Superficial and deep palmar arches	Extend digits at interphalangeal joints, flex metacarpophalangeal joints
Opponens digiti minimi	Hand	Flexor retinaculum and hook of hamate bone	Palmar surface of 5th metacarpal	Ulnar nerve (deep branch)	Deep palmar branch of ulnar artery	Draws 5th metacarpal anteriorly and rotates it to face thumb
Opponens pollicis	Hand	Flexor retinaculum and tubercle of trapezium bone	Lateral side of 1st metacarpal	Median nerve (recurrent branch)	Superficial palmar branch of radial artery	Draws 1st metacarpal forward and rotates it medially
Palmar interosseous muscles	Hand	Sides of metacarpal bones 2, 4, and 5	Bases of proximal phalanx and extensor expansion of digits 2, 4, and 5	Ulnar nerve (deep branch)	Deep palmar arch	Adducts digits; flexes digits and extends interphalangeal joints
Palmaris brevis	Hand	Palmar aponeurosis and flexor retinaculum	Skin of medial border of palm	Superficial branch of ulnar nerve	Superficial palmar arch	Deepens hollow of hand, assists grip
Palmaris longus	Anterior forearm	Medial epicondyle of humerus	Distal half of flexor retinaculum and palmar aponeurosis	Median nerve	Posterior ulnar recurrent artery	Flexes hand at wrist and tenses palmar aponeurosis
Pectoralis major	Pectoral/ axillary regions	Sternal half of clavicle, sternum to 7th rib, cartilages of true ribs, aponeurosis of external abdominal oblique muscle	Lateral lip of intertubercular sulcus of humerus	Medial and lateral pectoral nerves	Pectoral branch of thoracoacromial artery, perforating branches of internal thoracic artery	Flexes, adducts, and medially rotates arm
Pectoralis minor	Pectoral/ axillary regions	Outer surface of upper margin of ribs 3–5	Coracoid process of scapula	Medial pectoral nerve	Pectoral branch of thoracoacromial artery, and superior and lateral thoracic arteries	Lowers lateral angle of scapula and protracts scapula
Pronator quadratus	Anterior forearm	Distal fourth of anterior ulna	Distal fourth of anterior radius	Median nerve (anterior interosseous nerve)	Anterior interosseous artery	Pronates forearm
Pronator teres	Anterior forearm	Two heads: medial epicondyle of humerus and coronoid process of ulna	Midway along lateral surface of radius	Median nerve	Anterior ulnar recurrent artery	Pronates forearm and weakly flexes elbow
Rhomboid major	Superficial back	Spinous processes of T2–T5 vertebrae	Medial border of scapula below base of spine of scapula	Dorsal scapular nerve	Dorsal scapular OR deep branch of transverse cervical artery, dorsal perforating branches of upper five or six posterior intercostal arteries	Fixes scapula to thoracic wall and retracts and rotates it to depress glenoid cavity
Rhomboid minor	Superficial back	Nuchal ligament, spines of C7 and T1 vertebrae	Medial border of scapula at spine of scapula	Dorsal scapular nerve	Dorsal scapular artery OR deep branch of transverse cervical artery, dorsal perforating branches of upper five or six posterior intercostal arteries	Fixes scapula to thoracic wall and retracts and rotates it to depress glenoid cavity
Serratus anterior	Shoulder	Lateral surfaces of upper 8–9 ribs	Costal surface of medial border of scapula	Long thoracic nerve	Lateral thoracic artery	Protracts and rotates scapula and holds it against thoracic wall
Subclavius	Shoulder	Upper border of 1st rib and its cartilage	Inferior surface of middle third of clavicle	Nerve to subclavius	Clavicular branch of thoracoacromial artery	Anchors and depresses clavicle

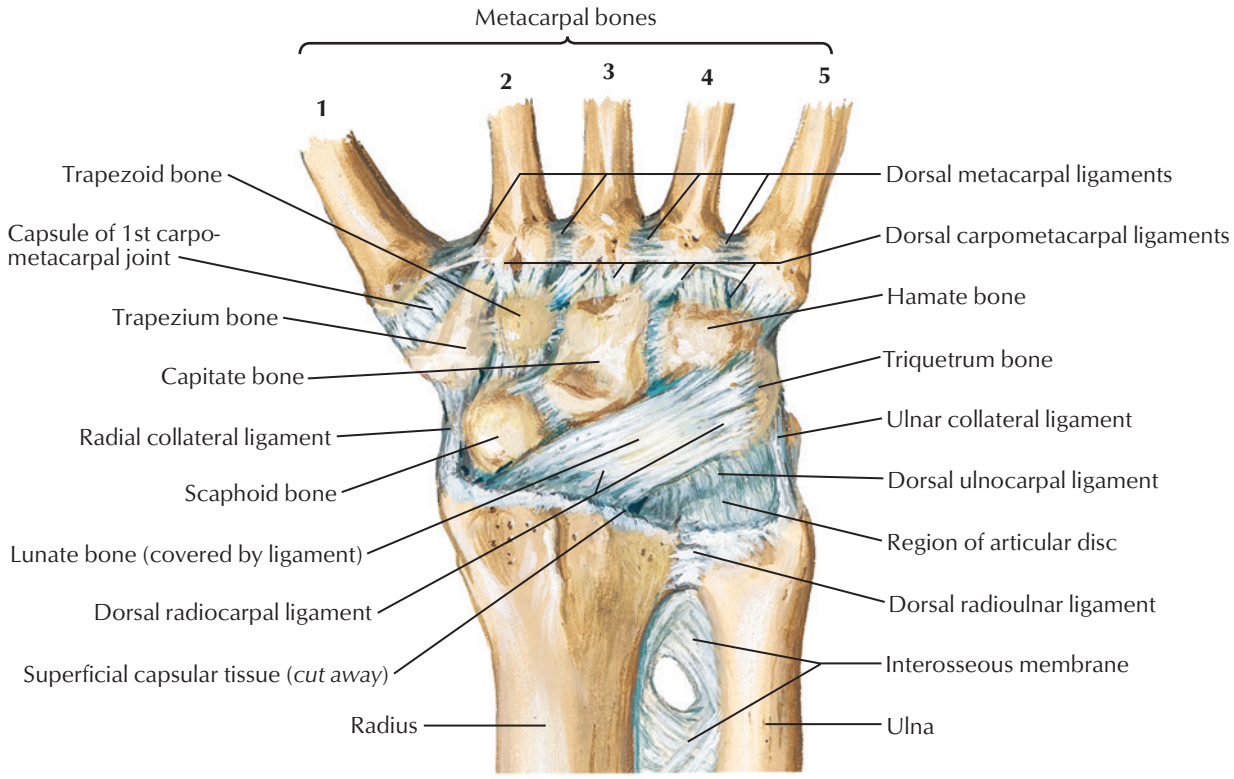
MUSCLE	MUSCLE GROUP	PROXIMAL ATTACHMENT (ORIGIN)	DISTAL ATTACHMENT (INSERTION)	INNERVATION	BLOOD SUPPLY	MAIN ACTIONS
Subscapularis	Shoulder	Subscapular fossa	Lesser tubercle of humerus	Upper and lower subscapular nerves	Subscapular artery, lateral thoracic artery	Medially rotates and adducts arm; helps hold humeral head in glenoid fossa
Supinator	Posterior forearm	Lateral epicondyle of humerus, radial collateral and anular ligaments, supinator fossa, and crest of ulna	Lateral, posterior, and anterior surfaces of proximal third of radius	Radial nerve (deep branch)	Radial recurrent artery, posterior interosseous arteries	Supinates forearm
Supraspinatus	Shoulder	Supraspinous fossa of scapula and deep fascia	Greater tubercle of humerus	Suprascapular nerve	Suprascapular artery	Initiates arm abduction
Teres major	Shoulder	Posterior surface of inferior angle of scapula	Medial lip of intertubercular sulcus of humerus	Lower subscapular nerve	Circumflex scapular artery	Adducts and medially rotates arm
Teres minor	Shoulder	Upper 2/3 of posterior surface of lateral border of scapula	Inferior facet of greater tubercle of humerus	Axillary nerve	Circumflex scapular artery	Laterally rotates arm
Trapezius	Superficial back	Superior nuchal line, external occipital protuberance, nuchal ligament, spinous processes of C7–T12	Lateral third of clavicle, acromion, and spine of scapula	Accessory nerve (cranial nerve XI)	Transverse cervical artery, dorsal perforating branches of posterior intercostal arteries	Elevates, retracts, and rotates scapula; lower fibers depress scapula
Triceps brachii	Arm	*Long head:* infraglenoid tubercle of scapula *Lateral head:* upper half of posterior humerus *Medial head:* distal 2/3 of medial and posterior humerus	Posterior surface of olecranon process of ulna	Radial nerve	Branch of profunda brachii artery	Extends forearm at elbow; long head stabilizes head of abducted humerus and extends and adducts arm


Axillary vein
Cephalic vein
Thoracodorsal vein
Basilic hiatus
Basilic vein
Brachial veins
Median cubital vein
Median antebrachial vein
Cephalic vein
Basilic vein
Anterior interosseous veins
Ulnar vein
Perforating vein
Radial veins
Median basilic vein
Ulnar veins
Superficial palmar venous arch
Perforator vein
Dorsal venous network (dorsal surface)
Deep venous palmar arch
Palmar metacarpal veins
Intercapitular veins
Palmar digital veins
Deep veins
Superficial veins

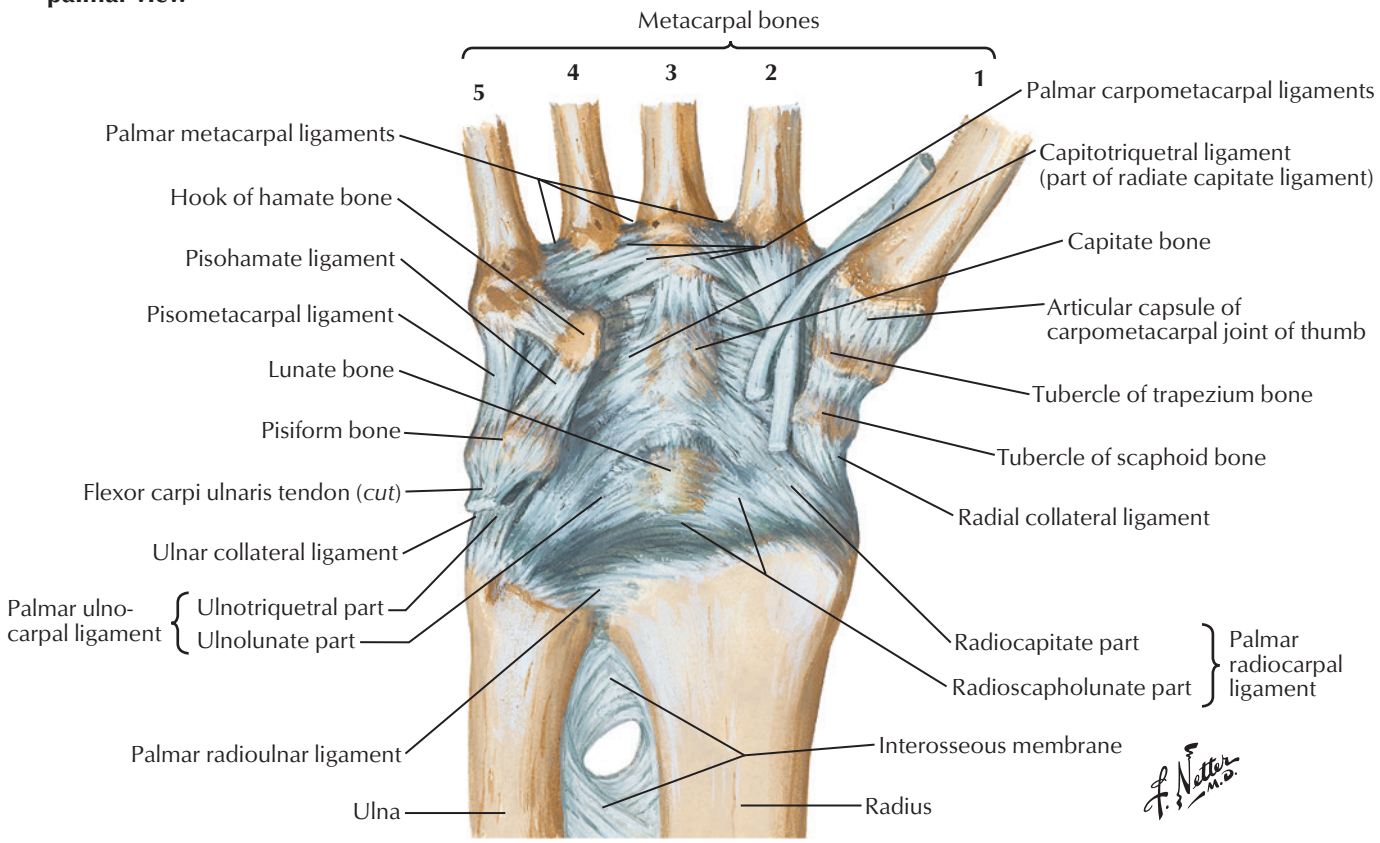

Clavicular branch
Pectoral branch
Acromial branch
Deltoid branch
Thoracoacromial artery
Superior thoracic artery
Axillary artery
Anterior circumflex humeral artery
Lateral thoracic artery
Posterior circumflex humeral artery
Subscapular artery
Circumflex scapular artery
Brachial artery
Thoracodorsal artery
Profunda brachii (deep brachial) artery
Level of lower margin of teres major muscle is landmark for name change from axillary to brachial artery
Radial collateral artery
Middle collateral artery
Superior ulnar collateral artery
Inferior ulnar collateral artery
Radial recurrent artery
Recurrent interosseous artery
Anterior ulnar recurrent artery
Posterior interosseous artery
Posterior ulnar recurrent artery
Radial artery
Common interosseous artery
Anterior interosseous artery
Ulnar artery

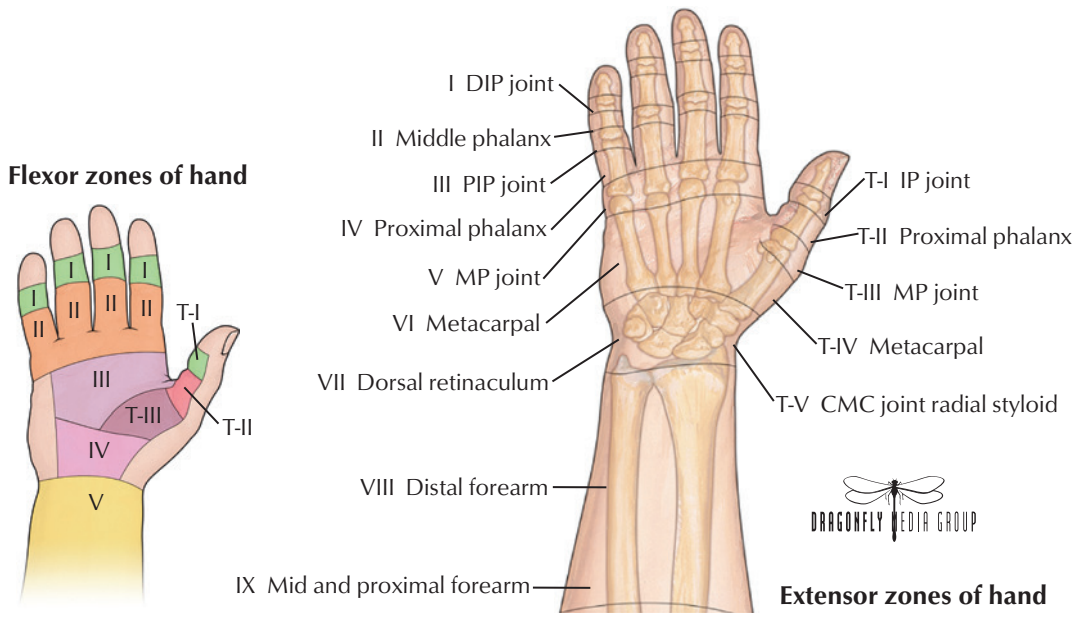

Brachial artery
Radial recurrent artery
Recurrent interosseous artery
Posterior interosseous artery
Radial artery
Superficial palmar branch of radial artery
Deep palmar arch
Princeps pollicis artery
Radialis indicis artery
Superficial palmar arch
Superior ulnar collateral artery
Inferior ulnar collateral artery
Anterior ulnar recurrent artery
Posterior ulnar recurrent artery
Common interosseous artery
Anterior interosseous artery
Ulnar artery
Dorsal carpal artery (phantom)
Deep palmar branch of ulnar artery
Palmar metacarpal arteries
Palmar digital artery
Common palmar digital arteries
Proper palmar digital arteries

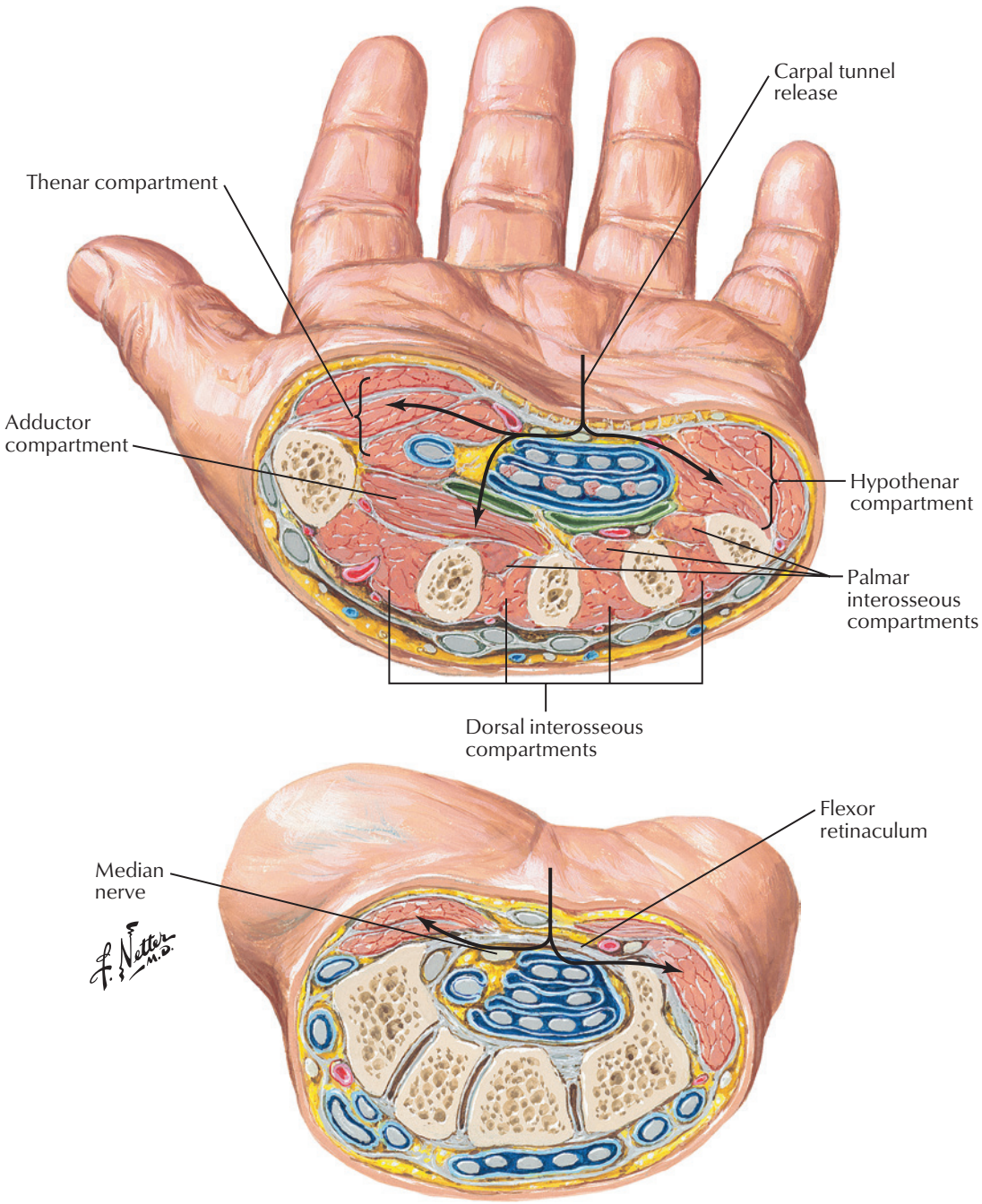
Posterior (dorsal) view

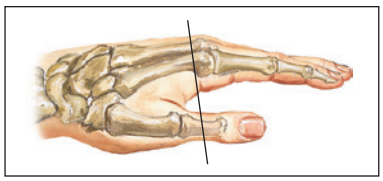


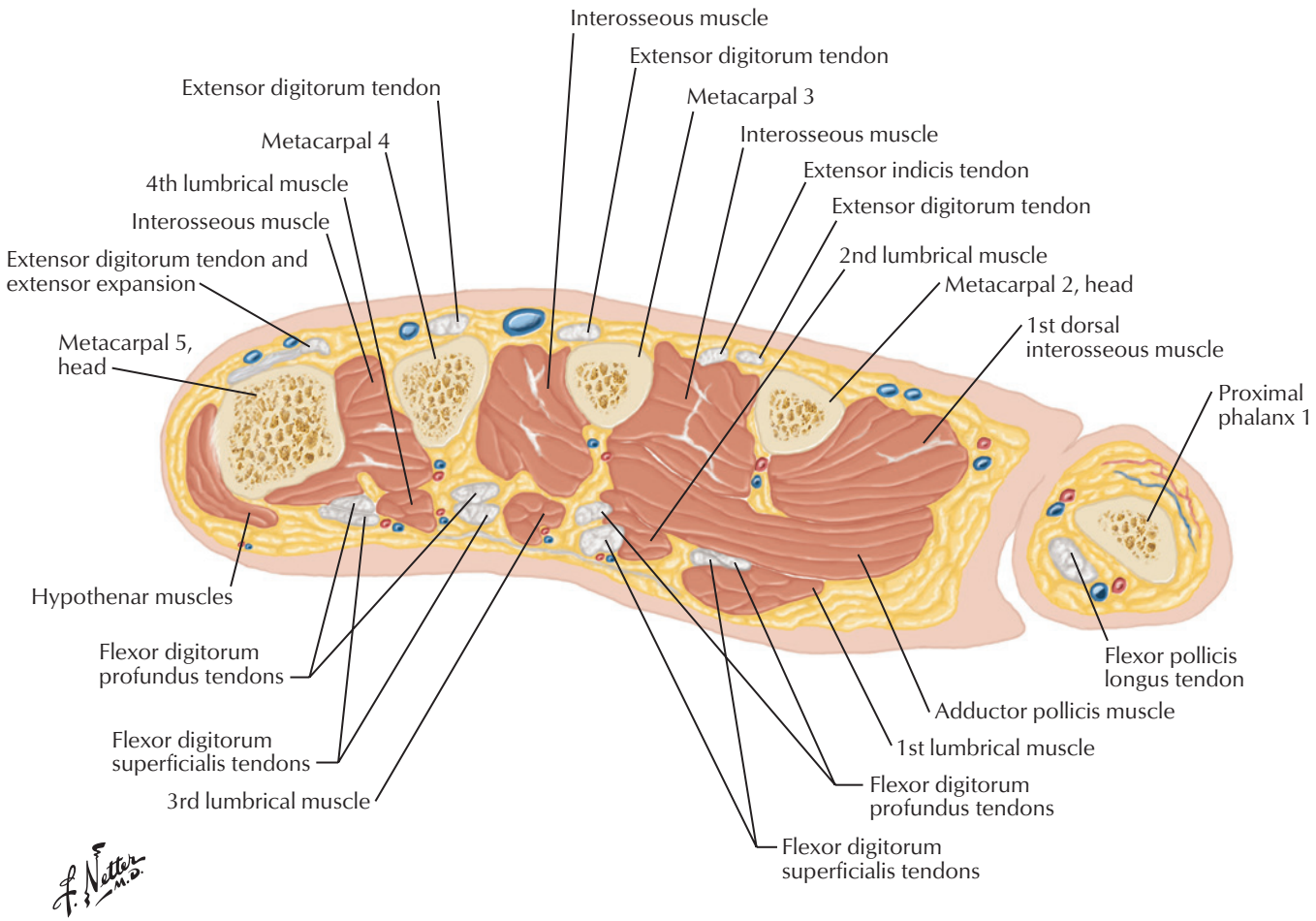
Flexor retinaculum removed: palmar view

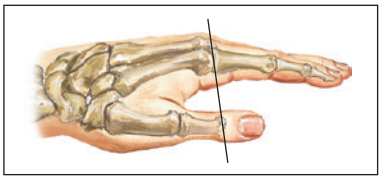


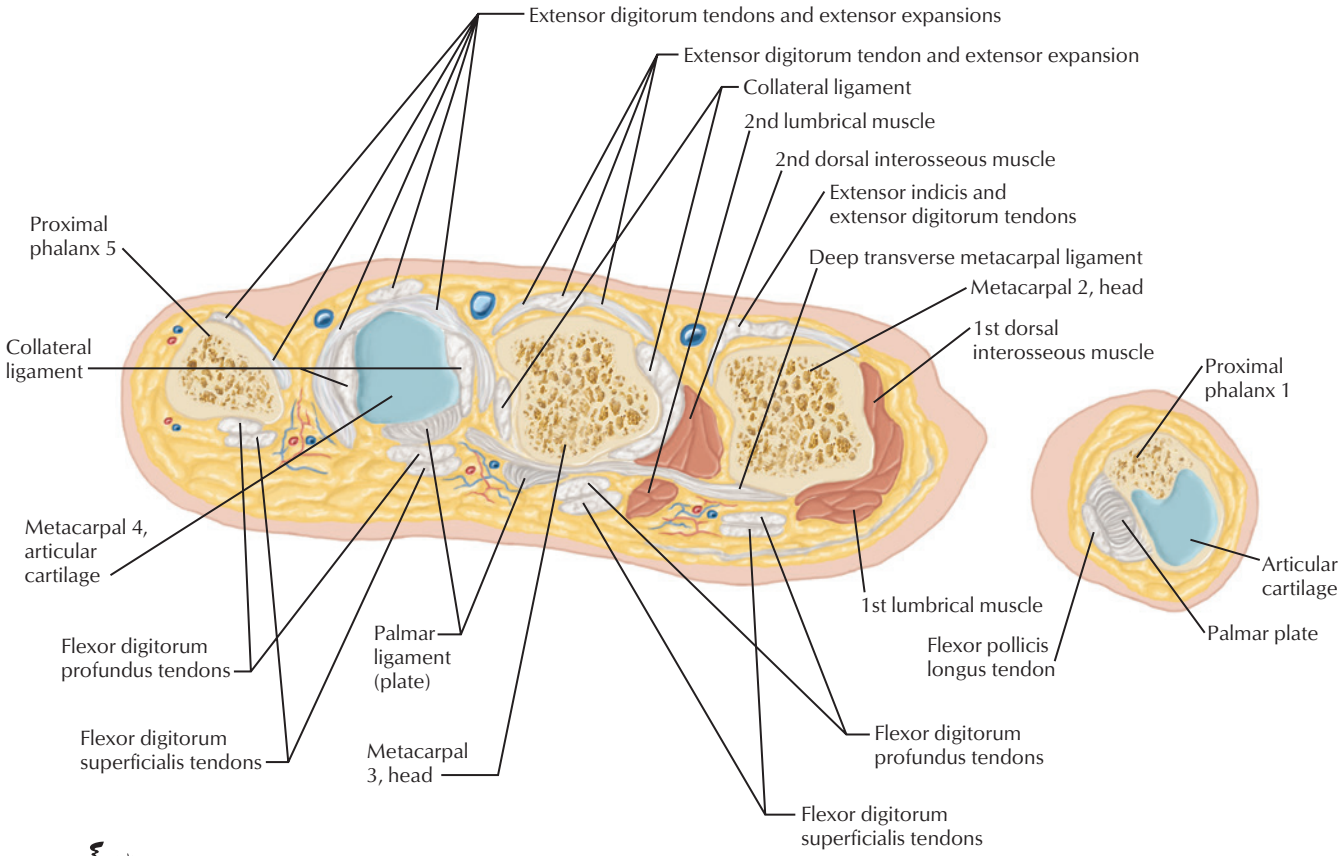

Flexor zones of hand
I
II
III
IV
V
T-I
T-II
T-III
I DIP joint
II Middle phalanx
III PIP joint
IV Proximal phalanx
V MP joint
VI Metacarpal
VII Dorsal retinaculum
VIII Distal forearm
IX Mid and proximal forearm
T-I IP joint
T-II Proximal phalanx
T-III MP joint
T-IV Metacarpal
T-V CMC joint radial styloid
DRAGONFLY MEDIA GROUP
Extensor zones of hand


Carpal tunnel release
Thenar compartment
Adductor compartment
Hypothenar compartment
Palmar interosseous compartments
Dorsal interosseous compartments
Flexor retinaculum
Median nerve




Interosseous muscle
Extensor digitorum tendon
Extensor digitorum tendon
Metacarpal 3
Metacarpal 4
Interosseous muscle
4th lumbrical muscle
Extensor indicis tendon
Interosseous muscle
Extensor digitorum tendon
Extensor digitorum tendon and extensor expansion
2nd lumbrical muscle
Metacarpal 2, head
Metacarpal 5, head
1st dorsal interosseous muscle
Proximal phalanx 1
Hypothenar muscles
Flexor digitorum profundus tendons
Flexor pollicis longus tendon
Adductor pollicis muscle
Flexor digitorum superficialis tendons
1st lumbrical muscle
3rd lumbrical muscle
Flexor digitorum profundus tendons
Flexor digitorum superficialis tendons
F. Netter M.D.




Extensor digitorum tendons and extensor expansions
Extensor digitorum tendon and extensor expansion
Collateral ligament
2nd lumbrical muscle
2nd dorsal interosseous muscle
Extensor indicis and extensor digitorum tendons
Deep transverse metacarpal ligament
Metacarpal 2, head
1st dorsal interosseous muscle
Proximal phalanx 5
Collateral ligament
Metacarpal 4, articular cartilage
Flexor digitorum profundus tendons
Flexor digitorum superficialis tendons
Palmar ligament (plate)
Metacarpal 3, head
1st lumbrical muscle
Flexor digitorum profundus tendons
Flexor digitorum superficialis tendons
Proximal phalanx 1
Articular cartilage
Palmar plate
Flexor pollicis longus tendon

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LOWER LIMB 8

Surface Anatomy	471	**Neurovasculature**	529-533
Cutaneous Anatomy	472-475	**Regional Imaging**	534-535
Hip and Thigh	476-496	**Structures with High Clinical Significance**	Tables 8.1-8.2
Knee	497-503	**Muscle Tables**	Tables 8.3-8.6
Leg	504-514	**Electronic Bonus Plates**	BP107-BP117
Ankle and Foot	515-528		

ELECTRONIC BONUS PLATES



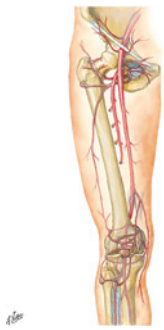
BP107 Veins of Lower Limb



BP108 Arteries of Thigh and Knee



BP109 Cross-Sectional Anatomy of Hip: Axial View



BP110 Arteries of Knee and Foot



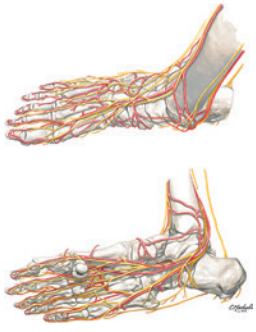
BP111 Leg: Serial Cross Sections



BP112 Osteology of Knee



BP113 Knee Radiograph: Lateral View



BP114 Anatomy of Foot: Nerves and Arteries

ELECTRONIC BONUS PLATES—*cont'd*



BP115 Cross-Sectional Anatomy of Ankle and Foot

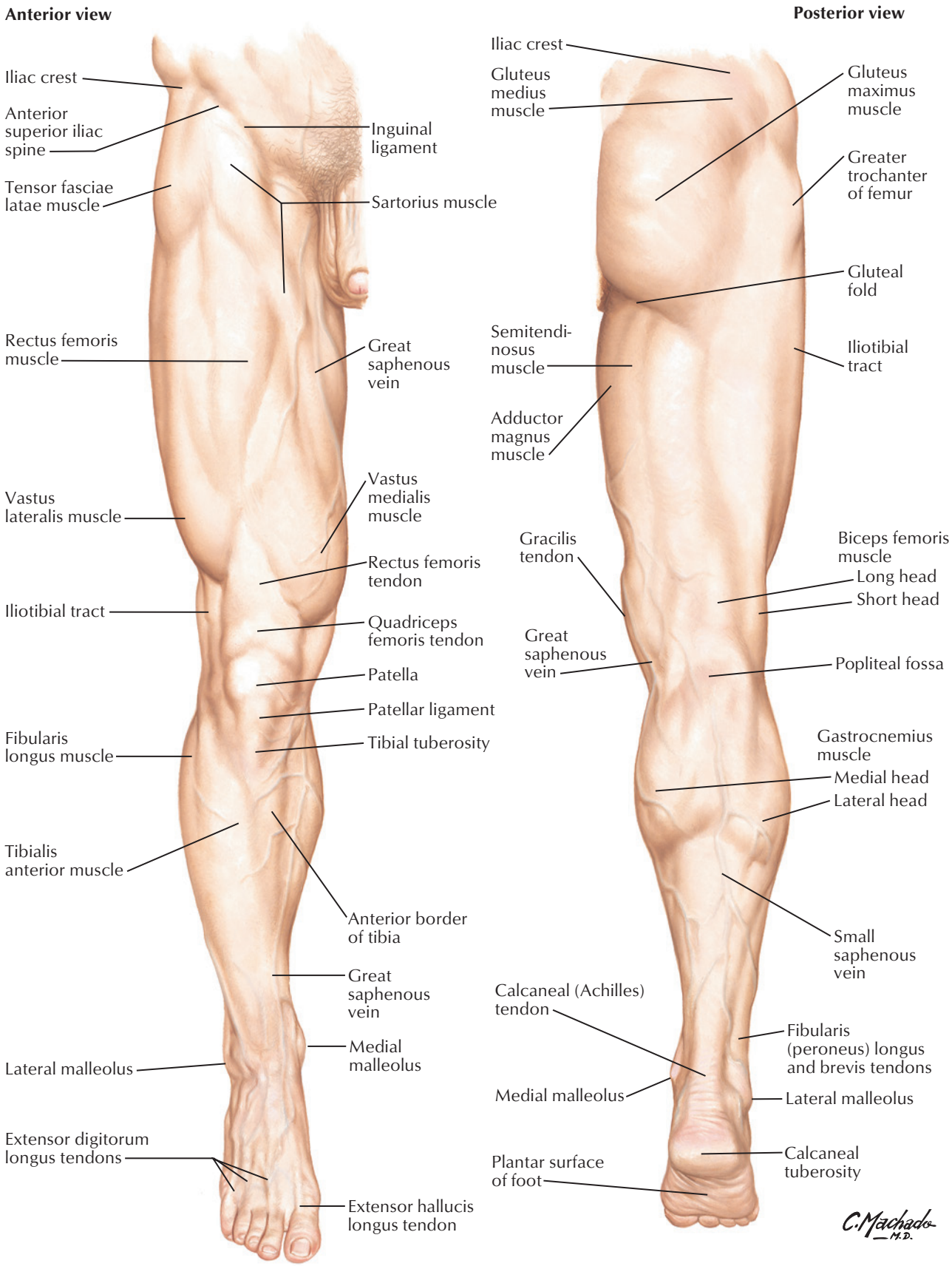


BP116 Cross-Sectional Anatomy of Ankle and Foot (continued)



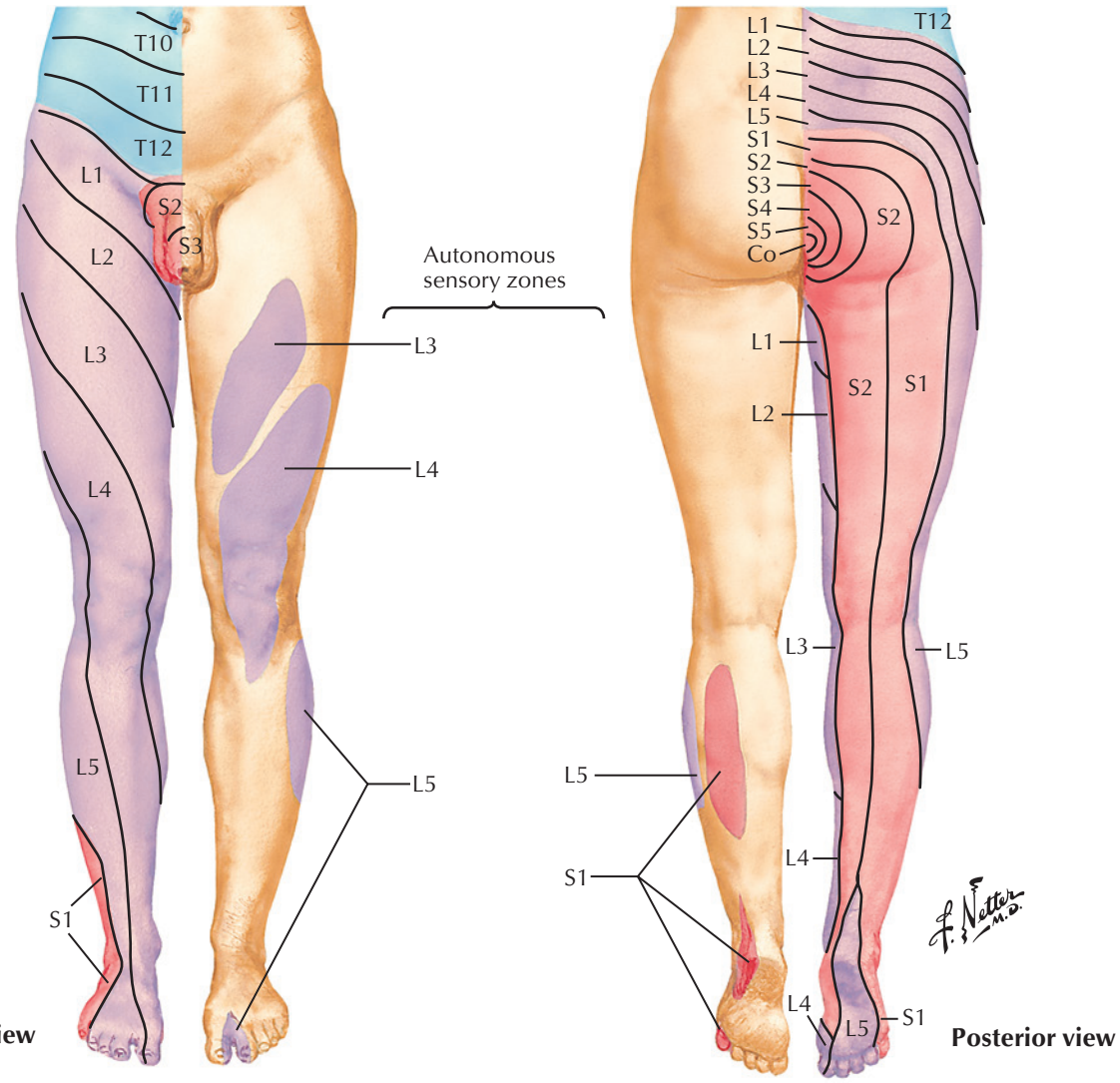
BP117 Anatomy of Toenail

See also Plates 472-474

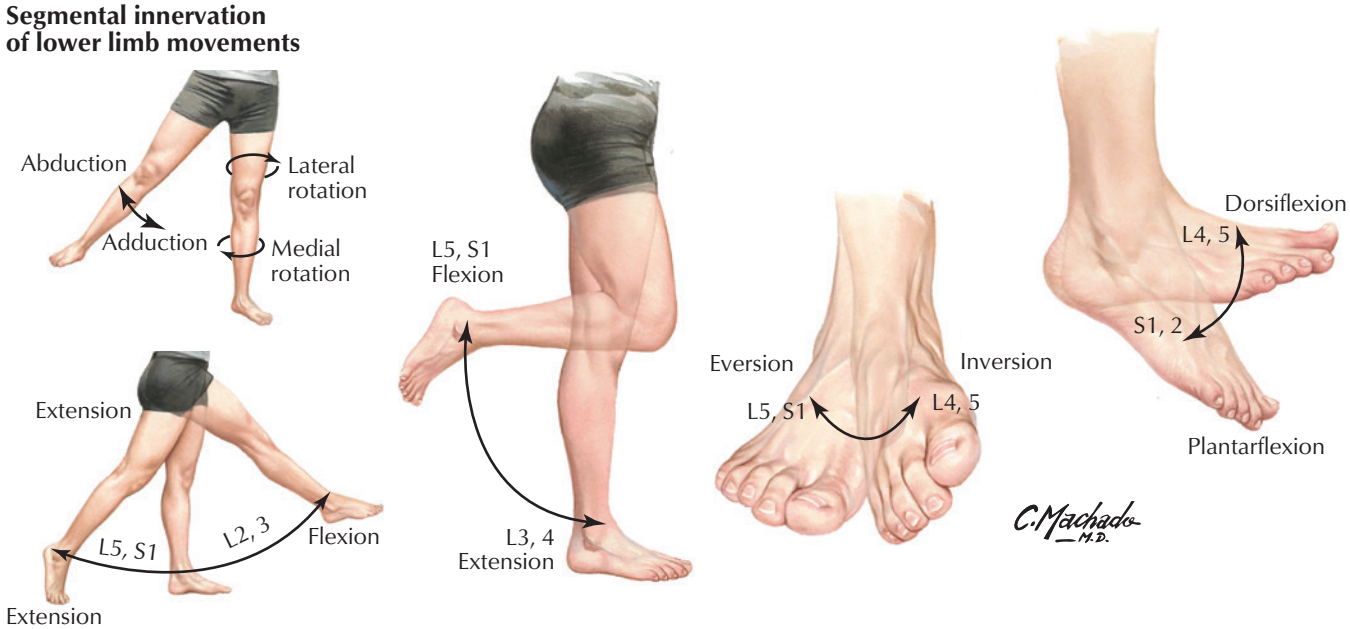


See also Plate 171

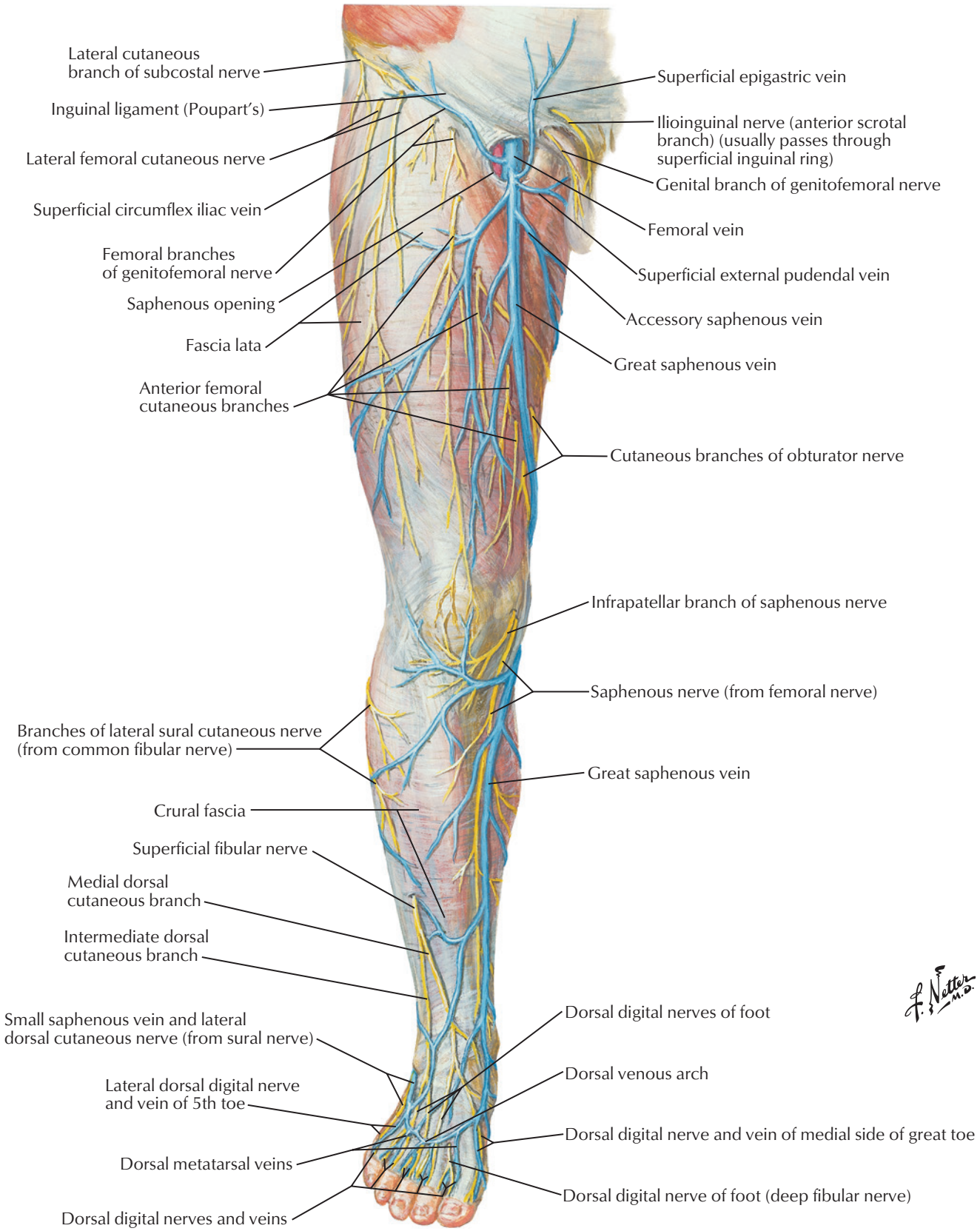
Schematic demarcation of dermatomes (according to Keegan and Garrett) shown as distinct segments. There is considerable overlap between any two adjacent dermatomes.



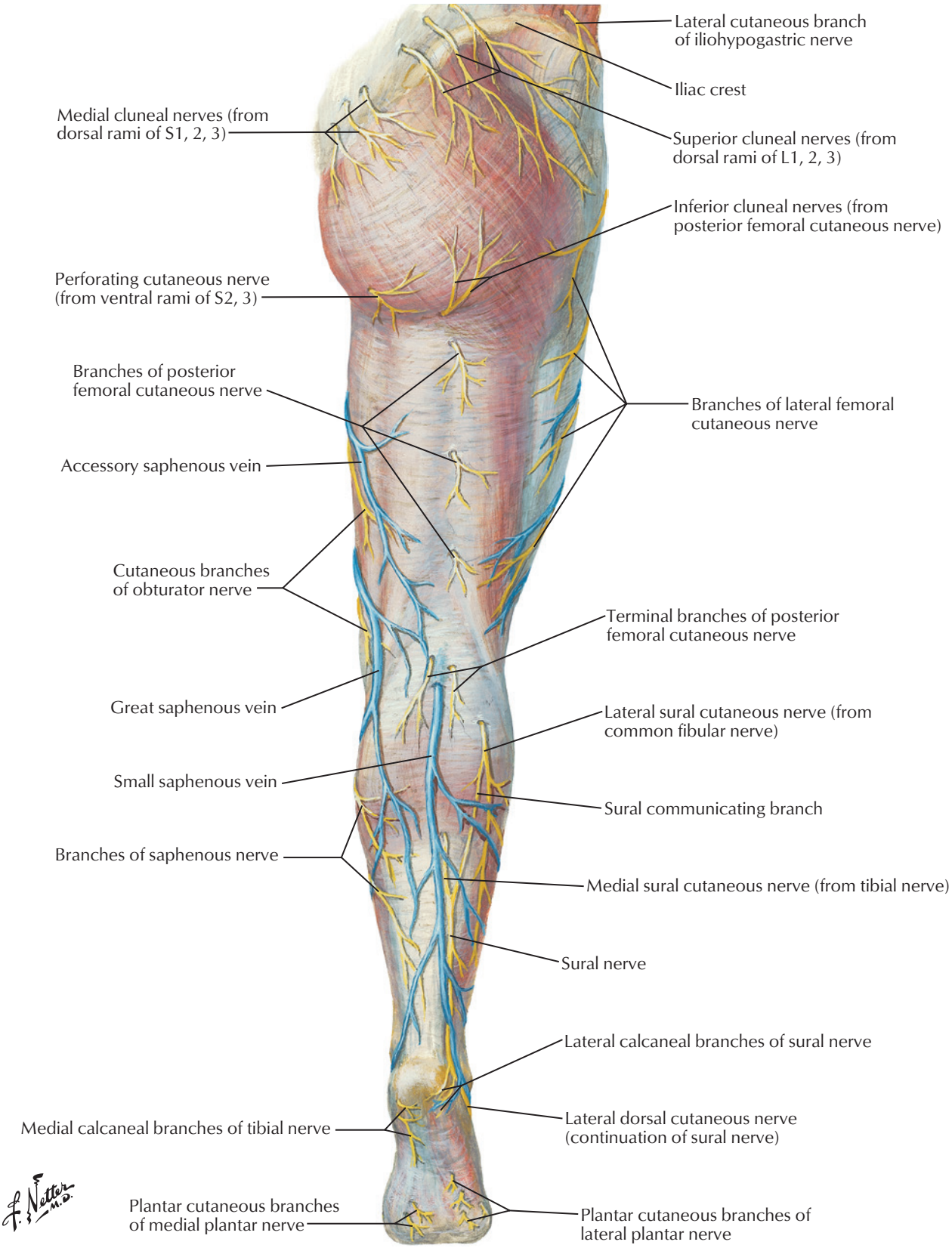
Segmental innervation of lower limb movements



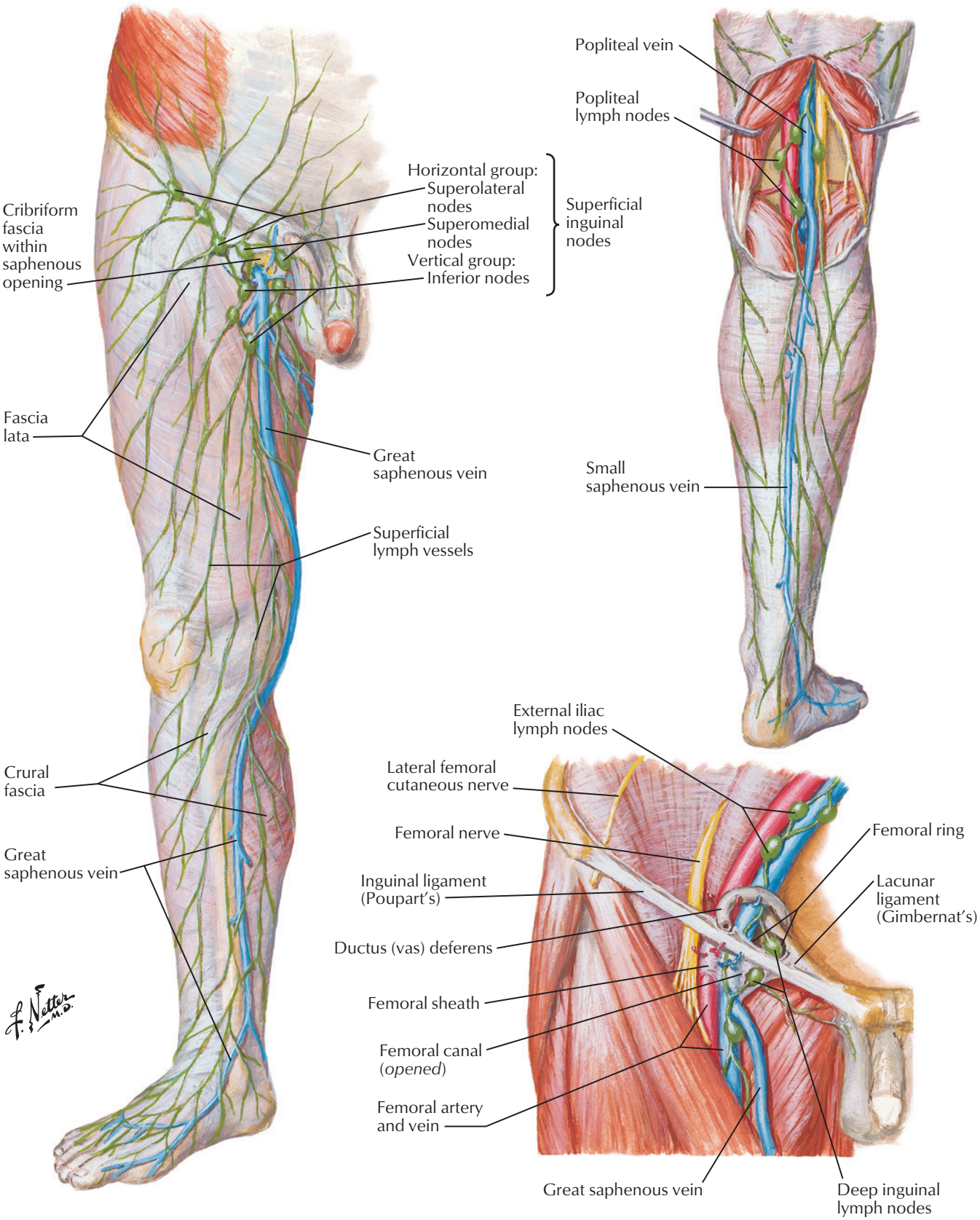
See also Plates 529, 530, 533



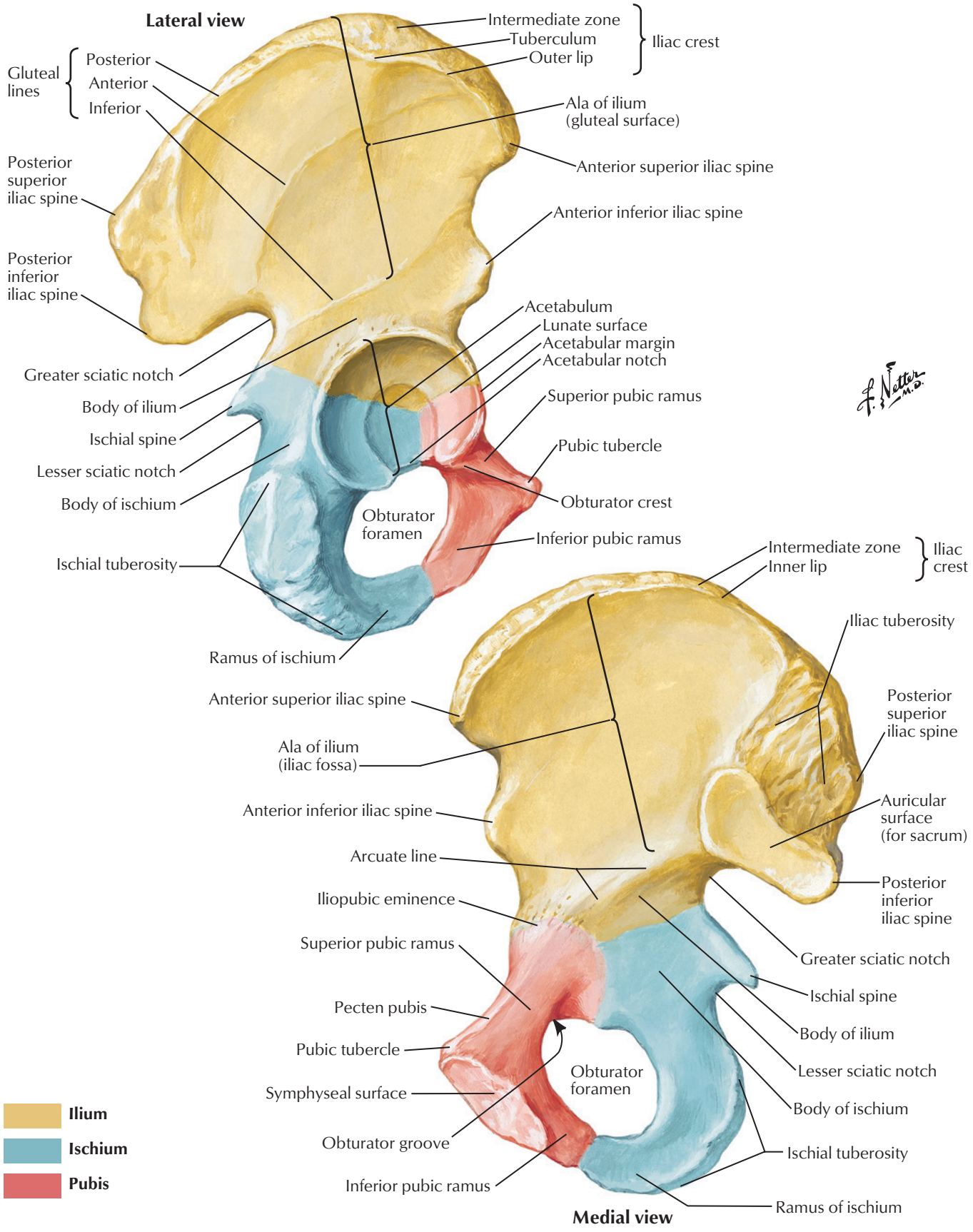
See also Plates 531, 532



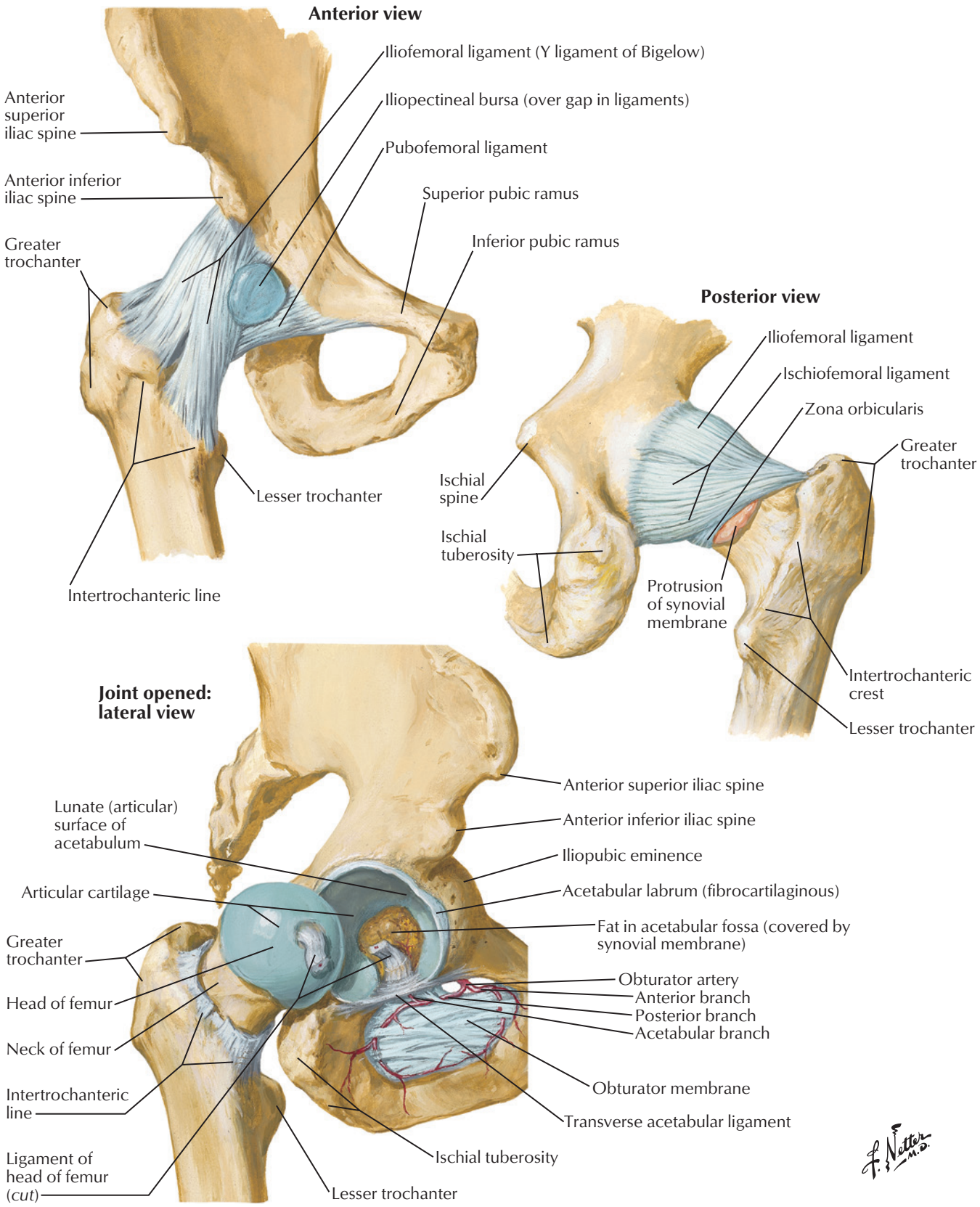
See also Plates 389, 390



See also Plates 250, 337, 338

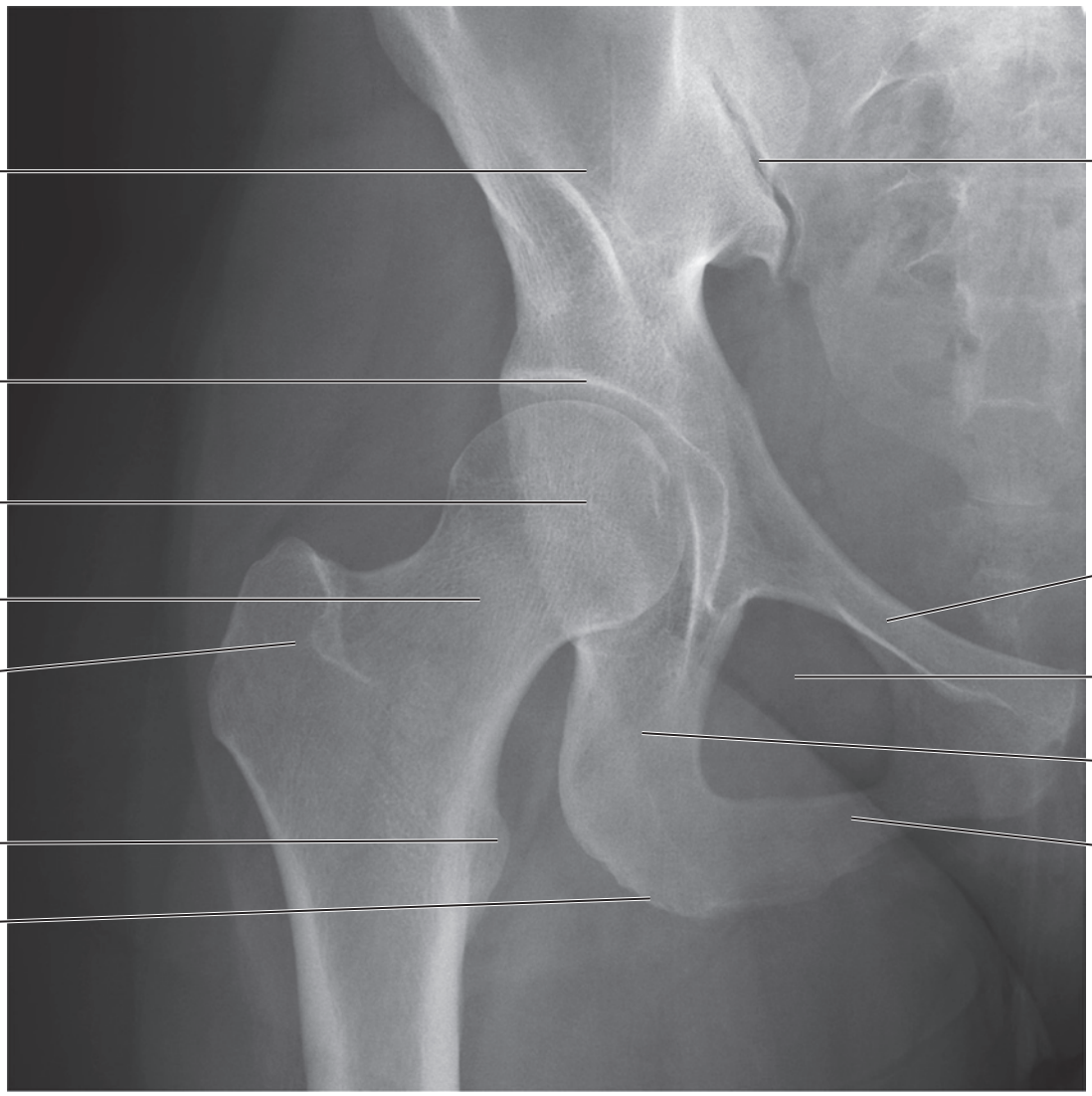


See also Plates 334, 338

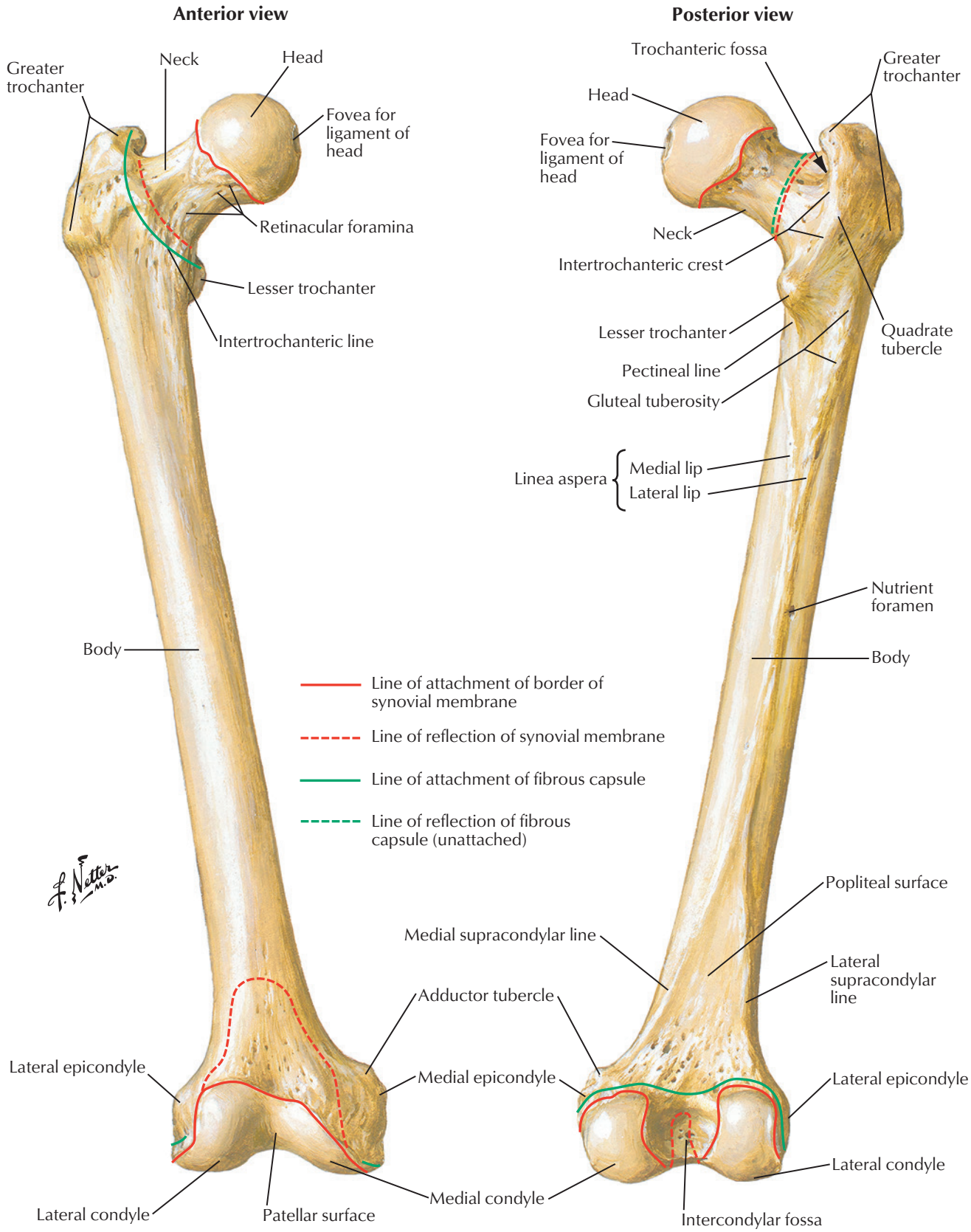


Hip Joint: Anteroposterior Radiograph

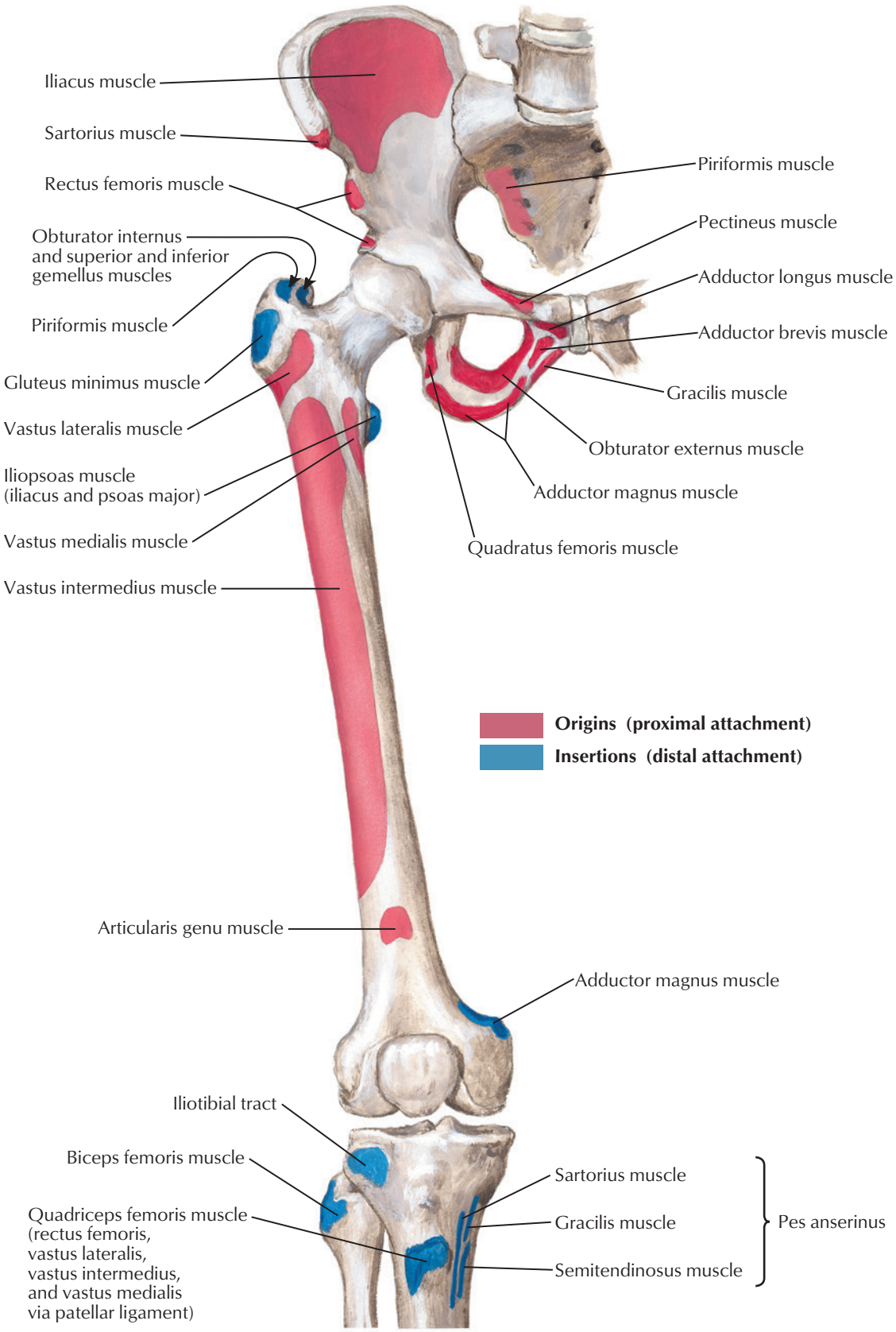
See also Plates 335, 477, 480



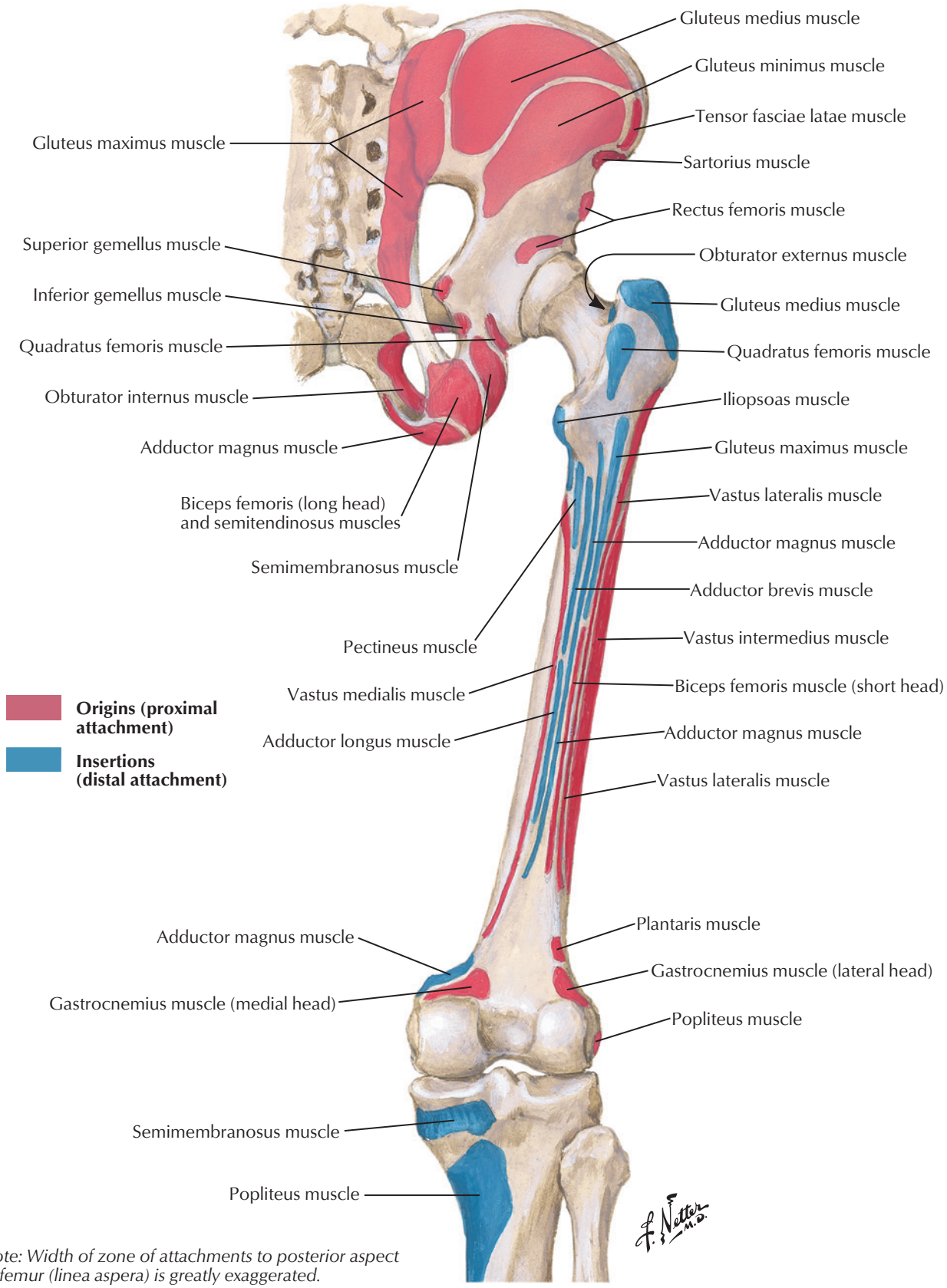
See also Plate 495



See also Plates 478, 534

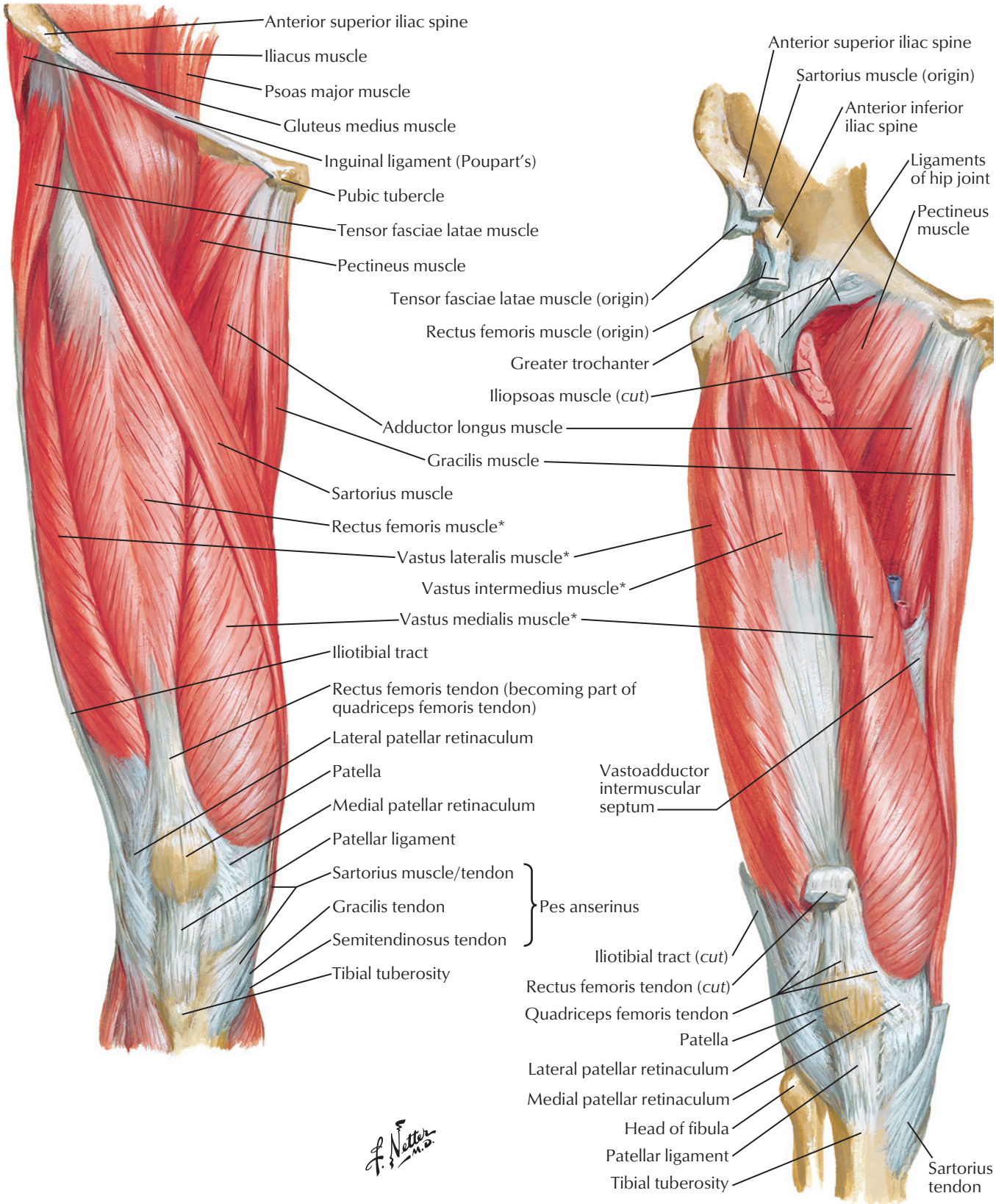


See also Plate 478



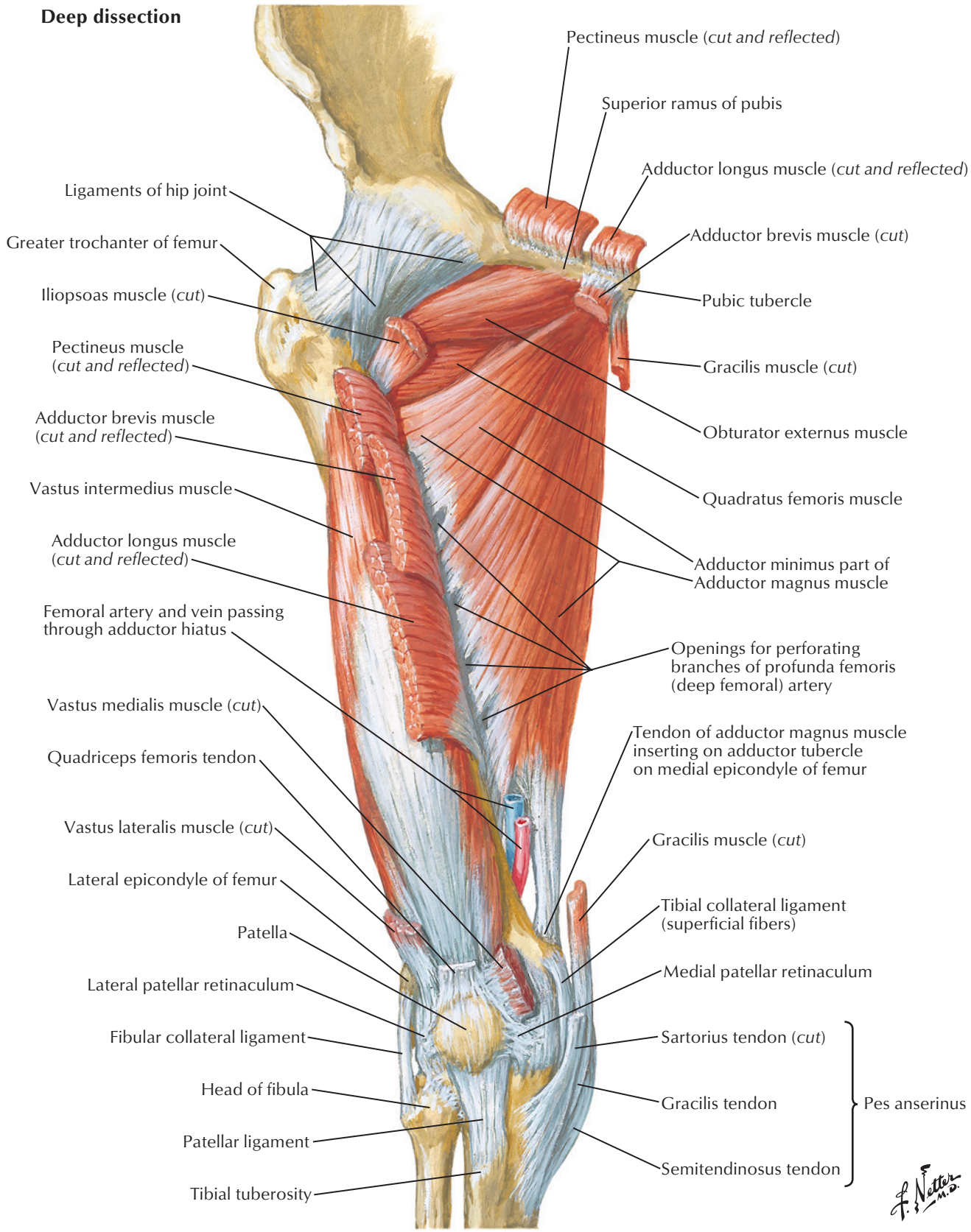
Note: Width of zone of attachments to posterior aspect of femur (linea aspera) is greatly exaggerated.

See also Plate 265

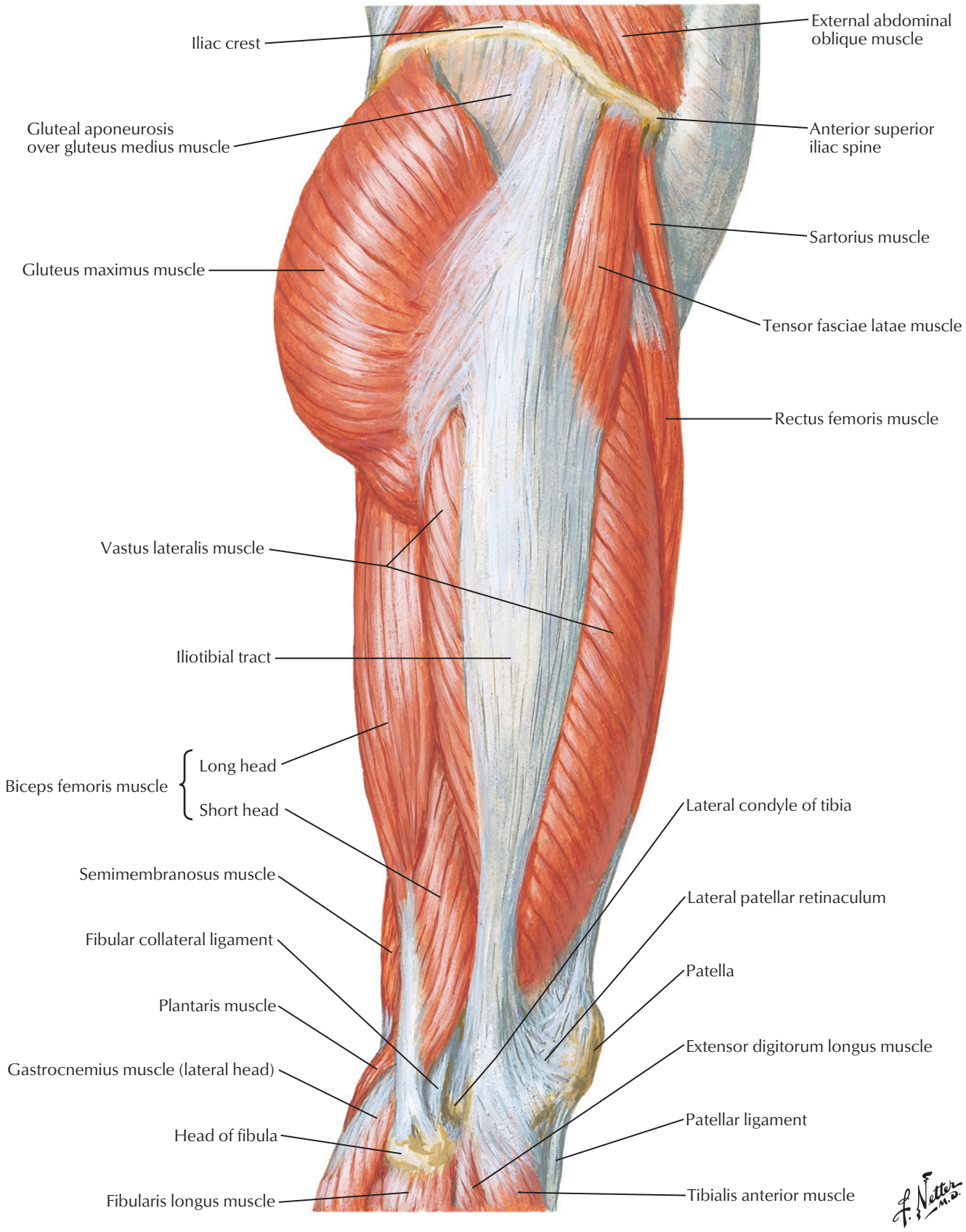


*Muscles of quadriceps femoris

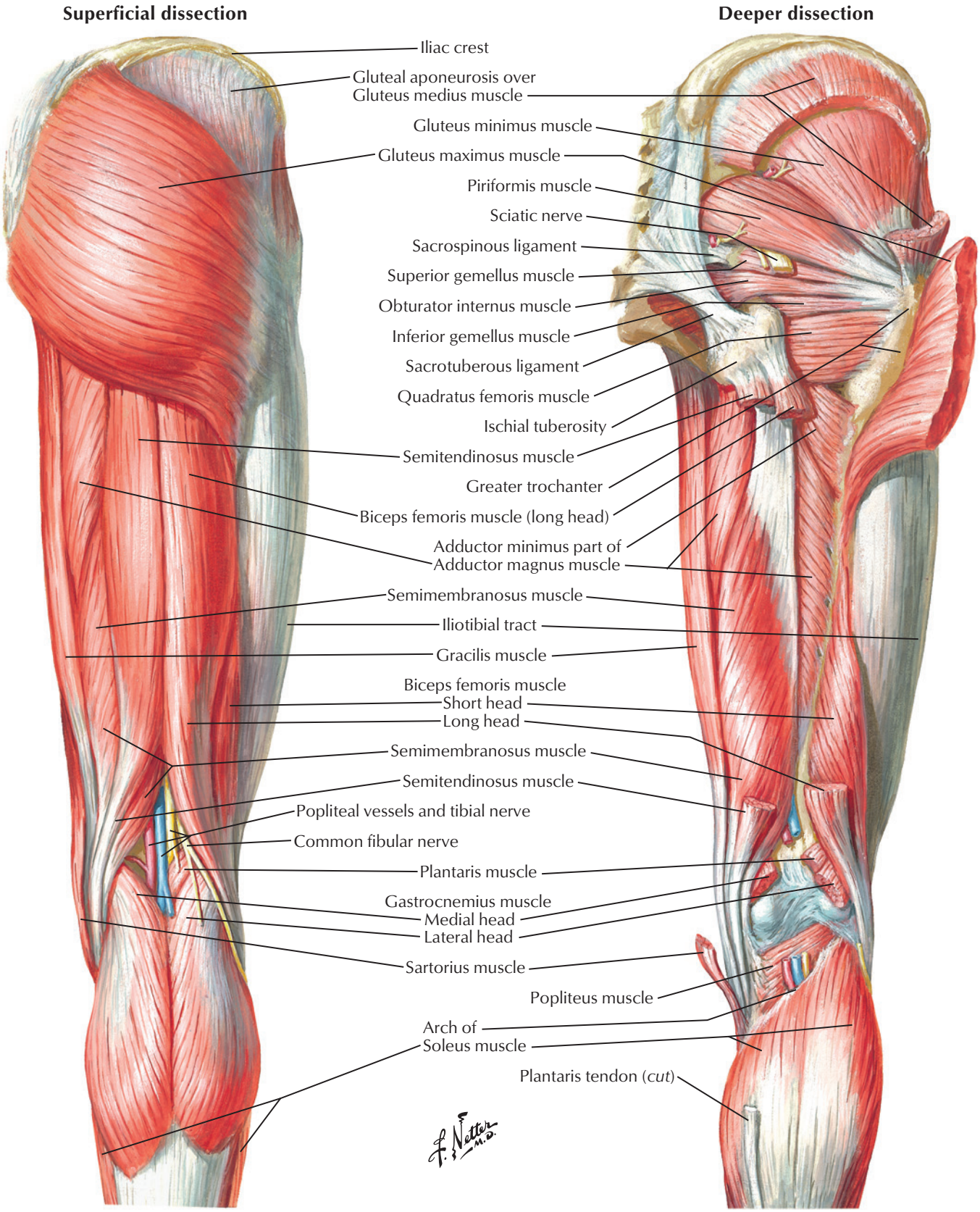
Deep dissection



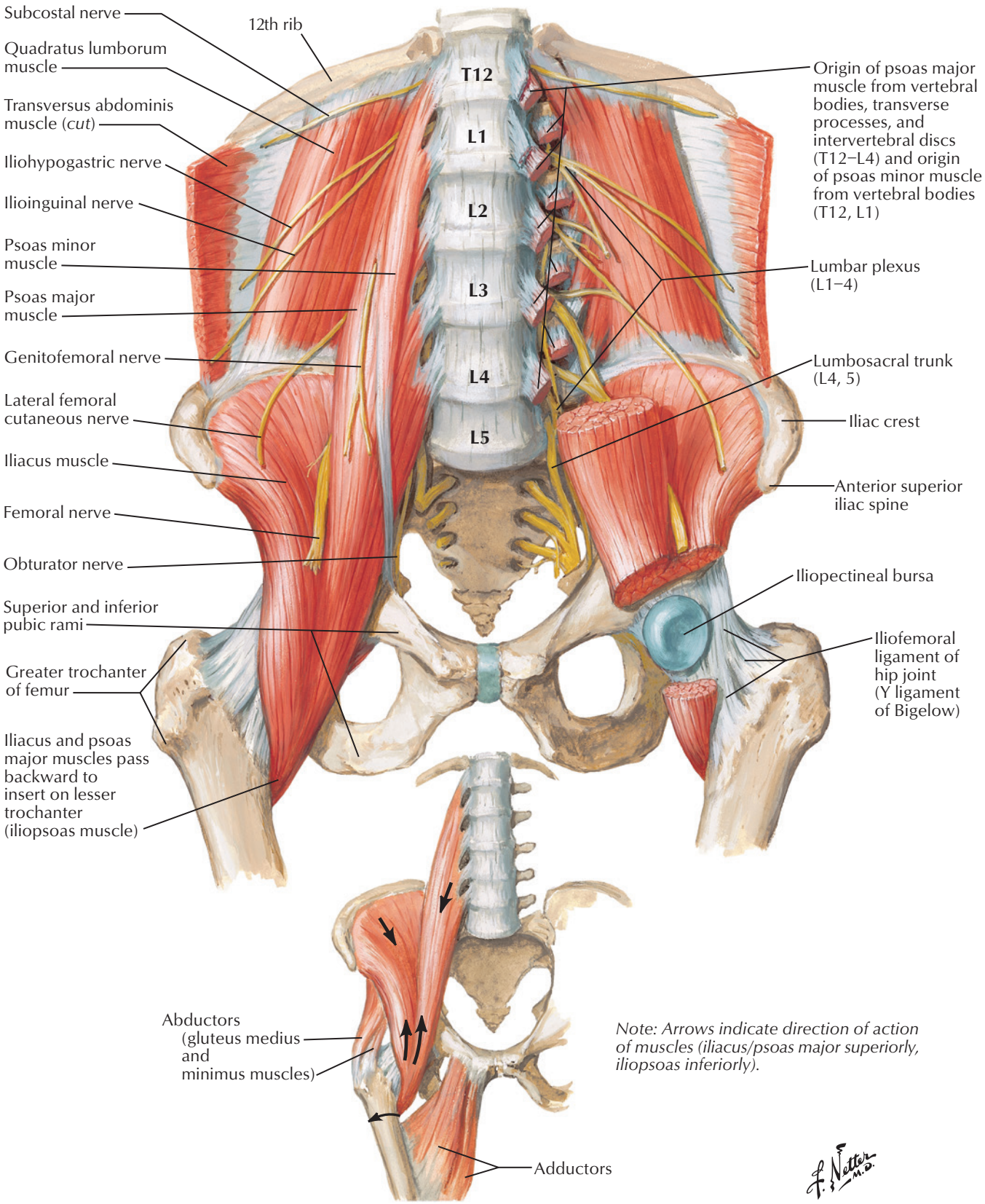
See also Plate 496



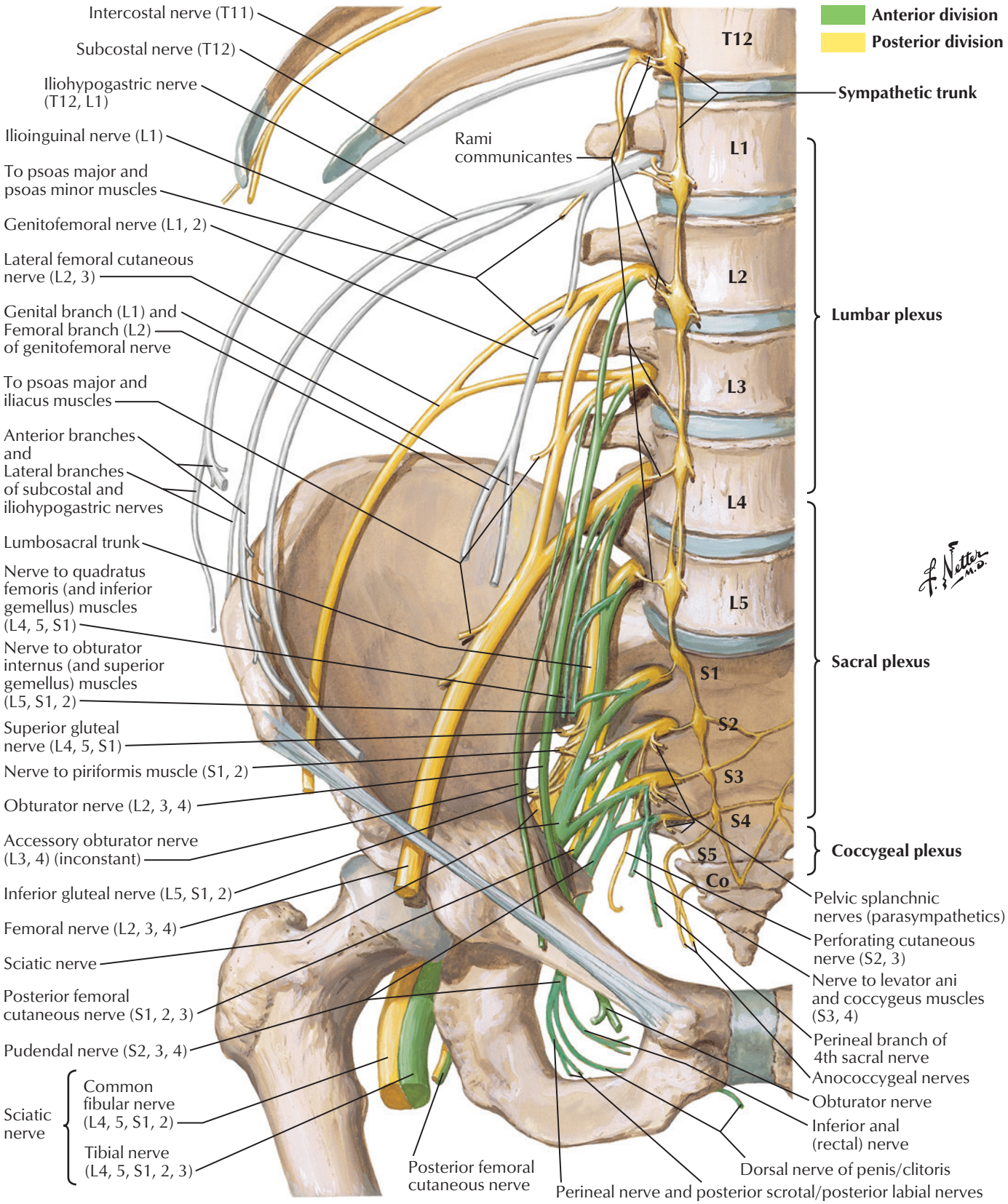
See also Plates 342, 343, 491



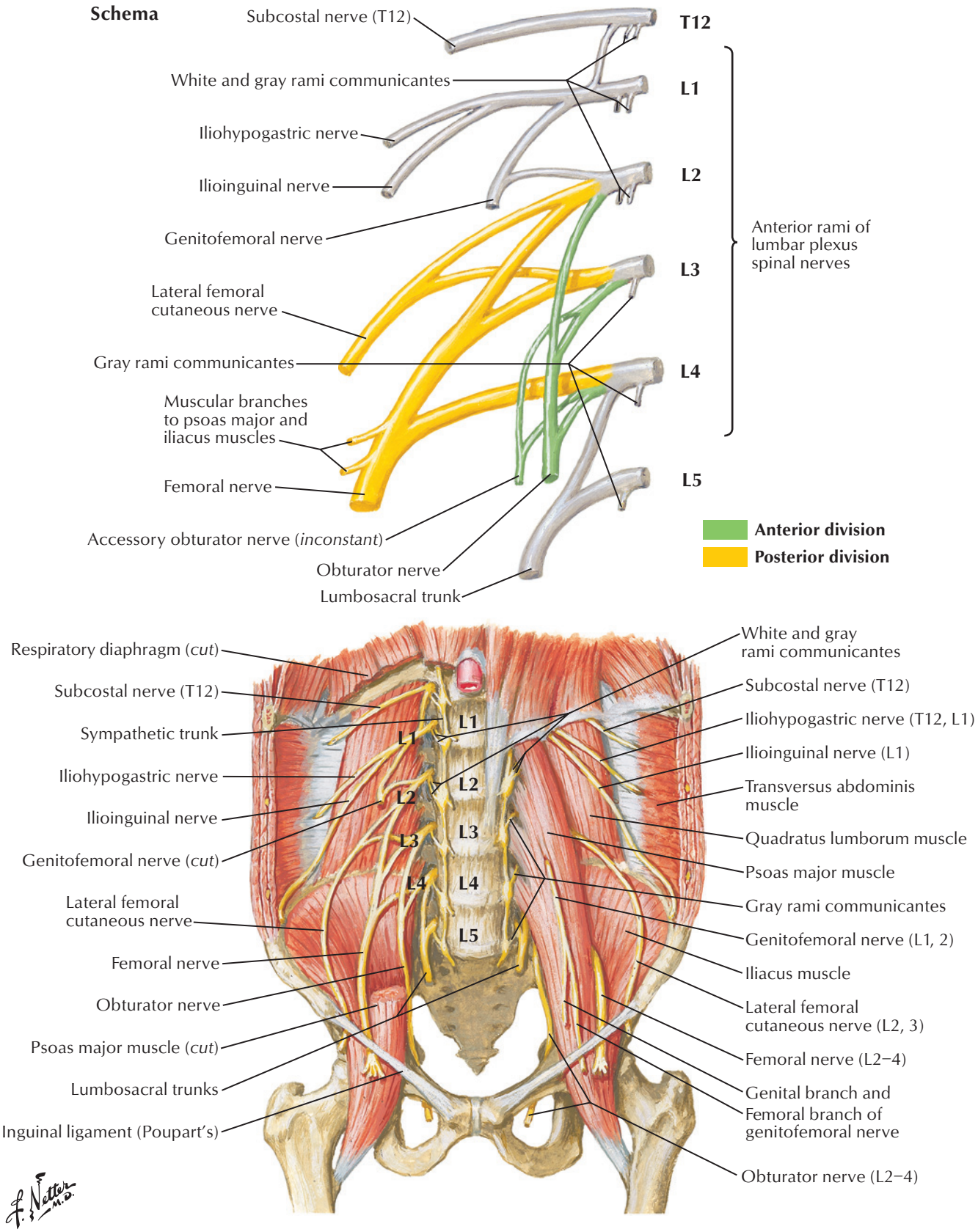
See also Plates 265, 269



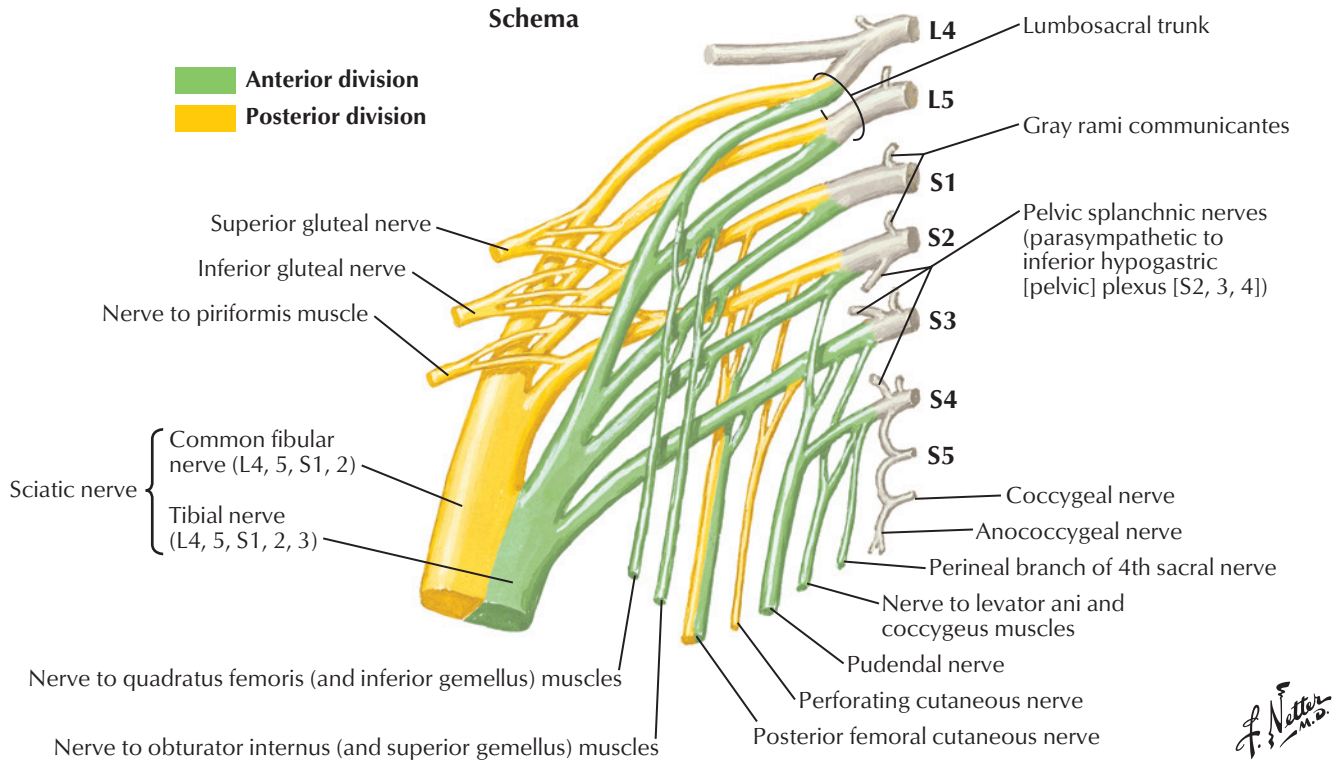
See also Plate 269

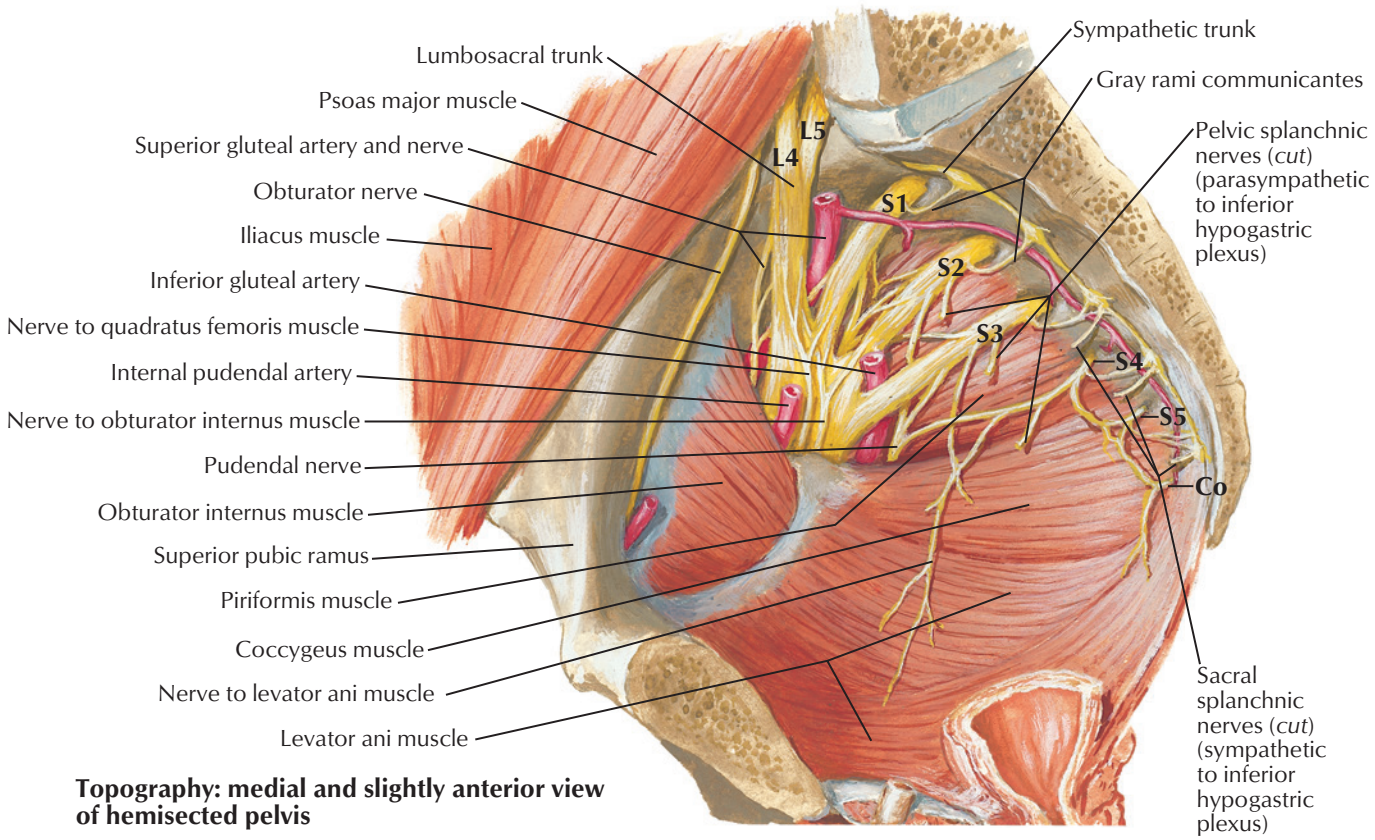


See also Plate 269



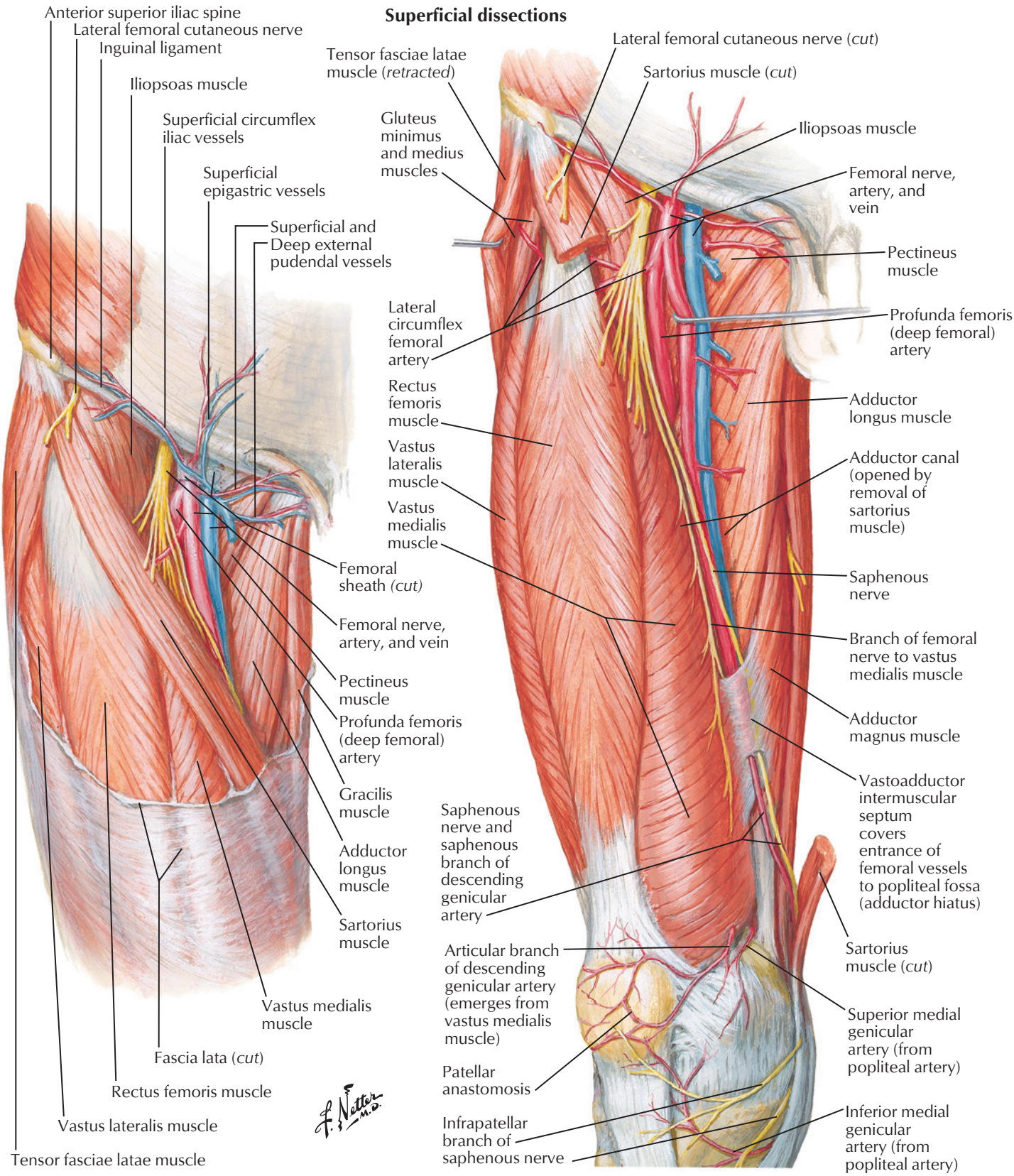
See also Plate 269





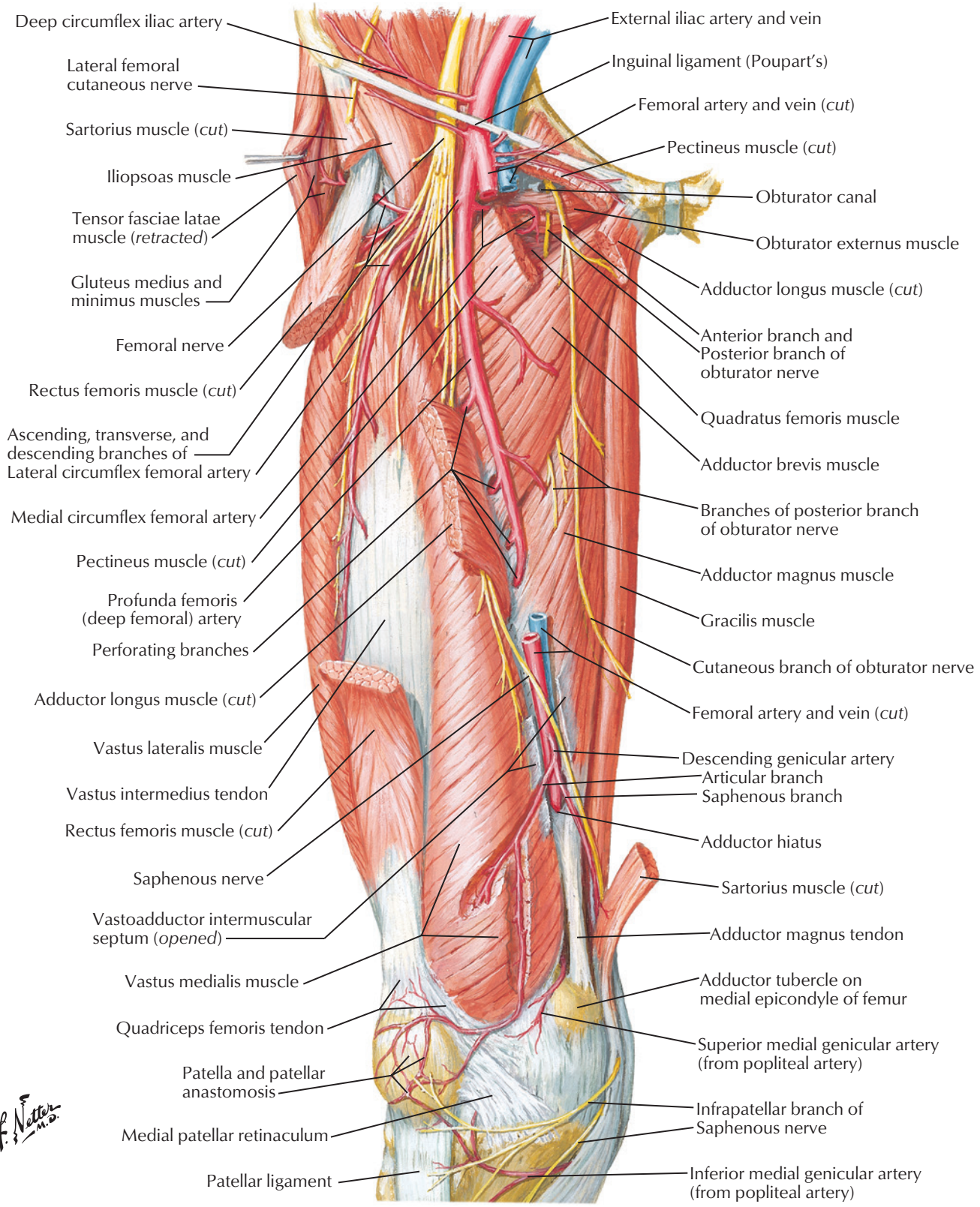
Topography: medial and slightly anterior view of hemisected pelvis

See also Plates 503, 529



See also Plates 529, 530

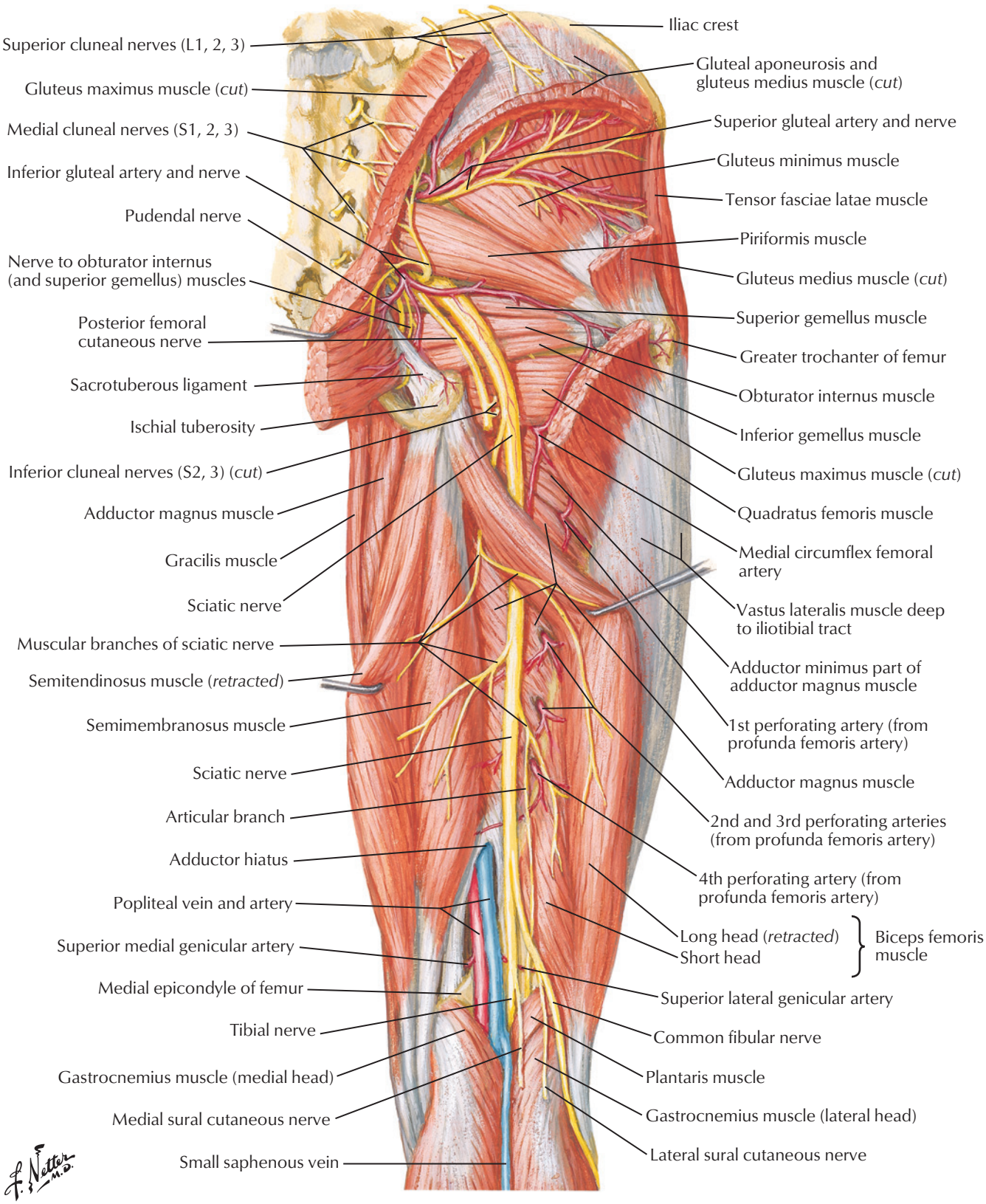
Deep dissection



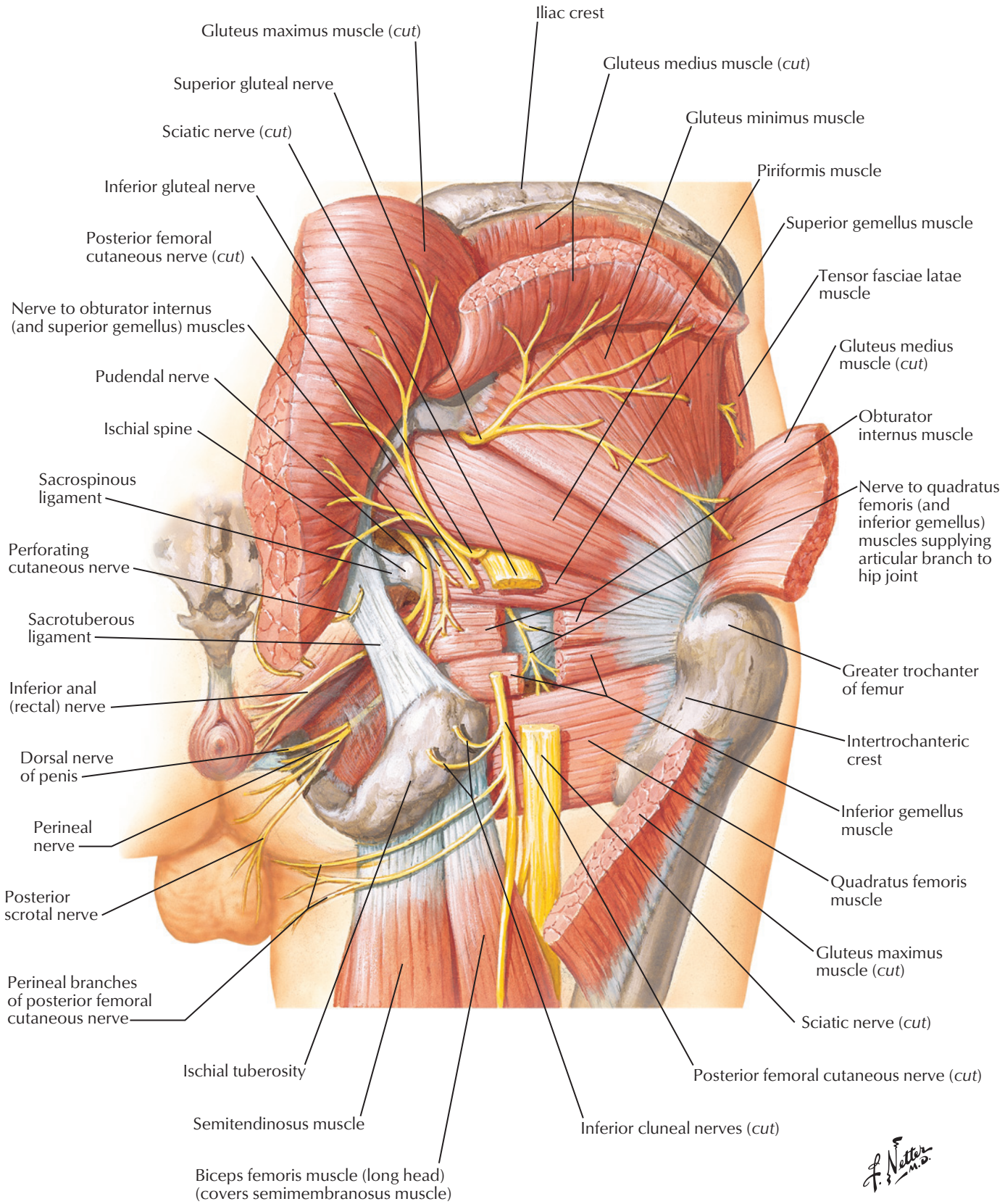
Arteries and Nerves of Thigh: Posterior View

See also Plate 531

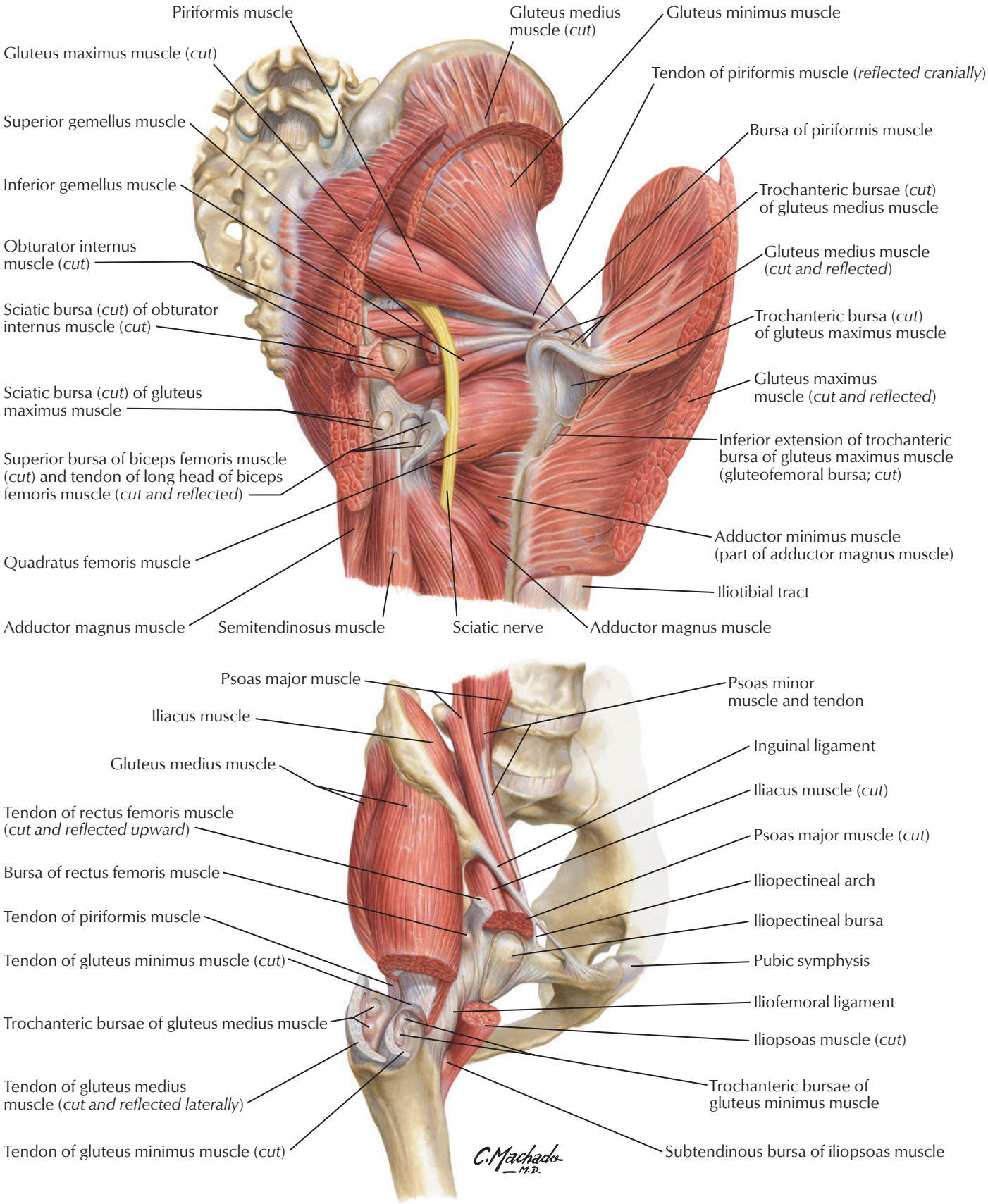
Deep dissection



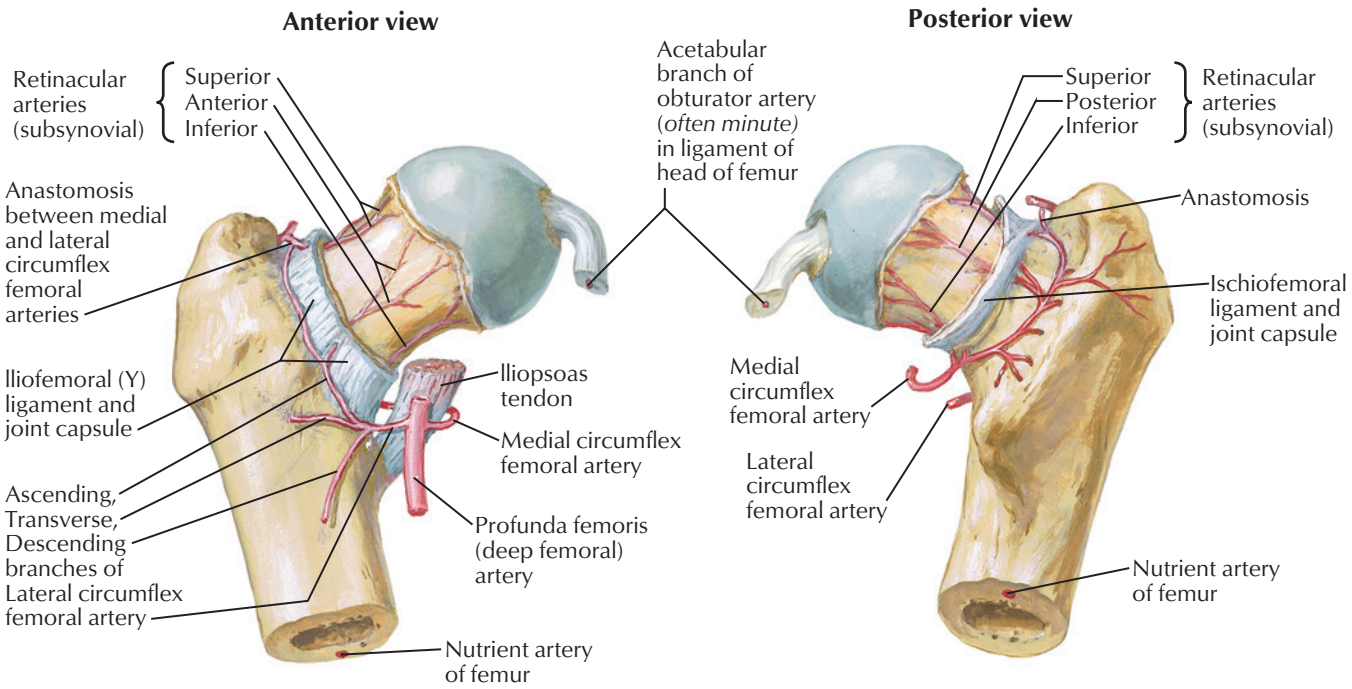
See also Plate 337

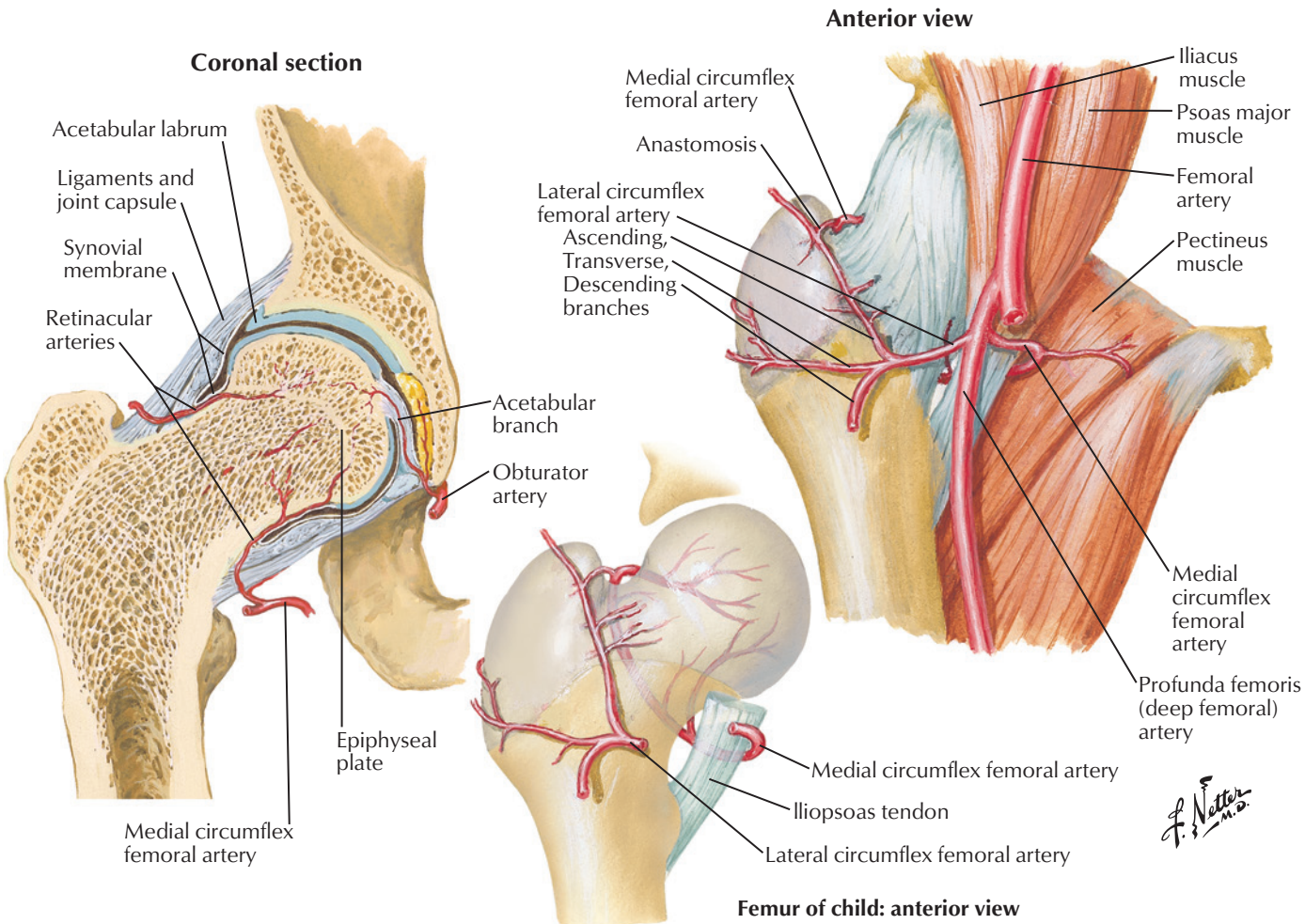


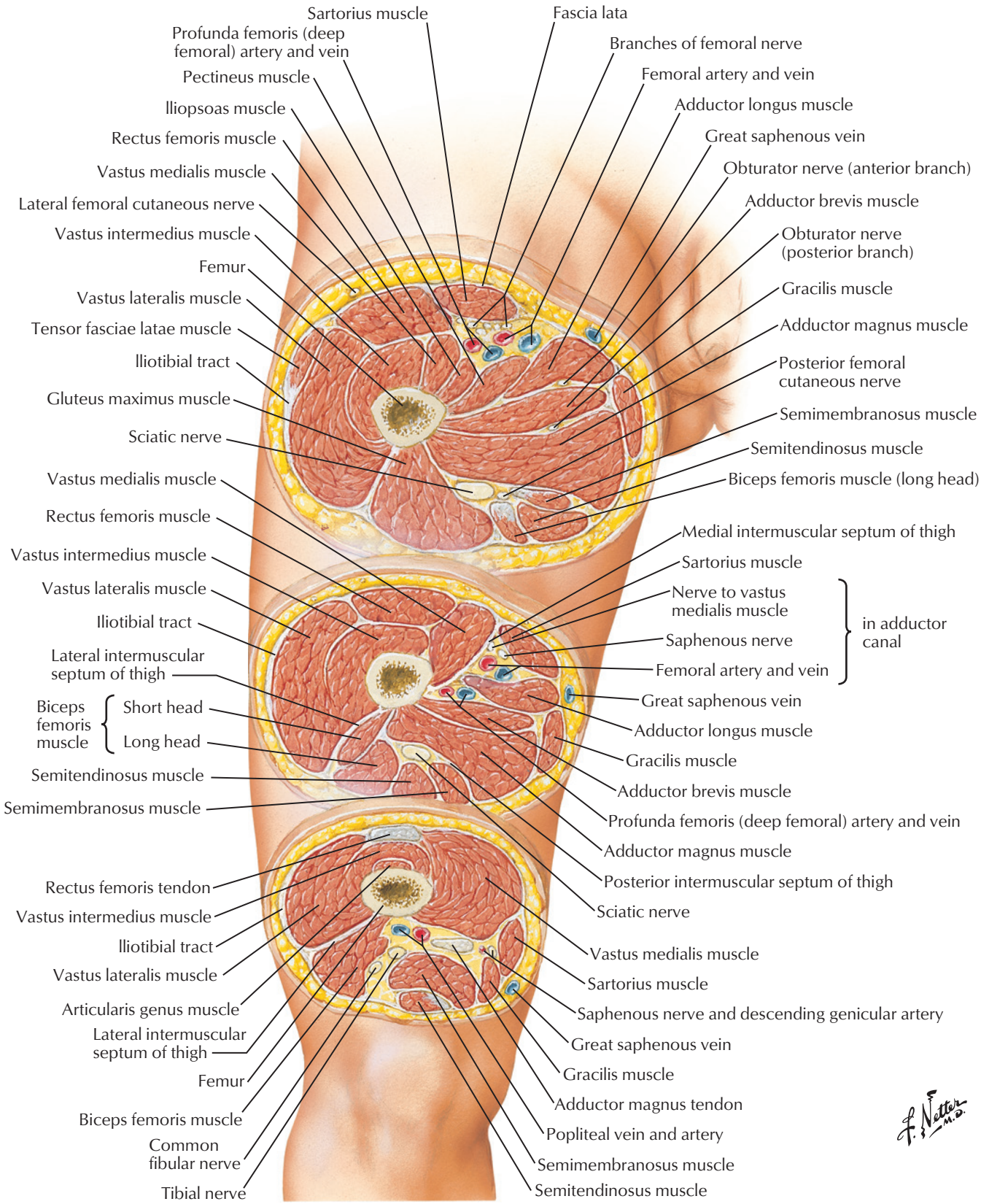
Hip Bursae: Posterior and Anterolateral Views



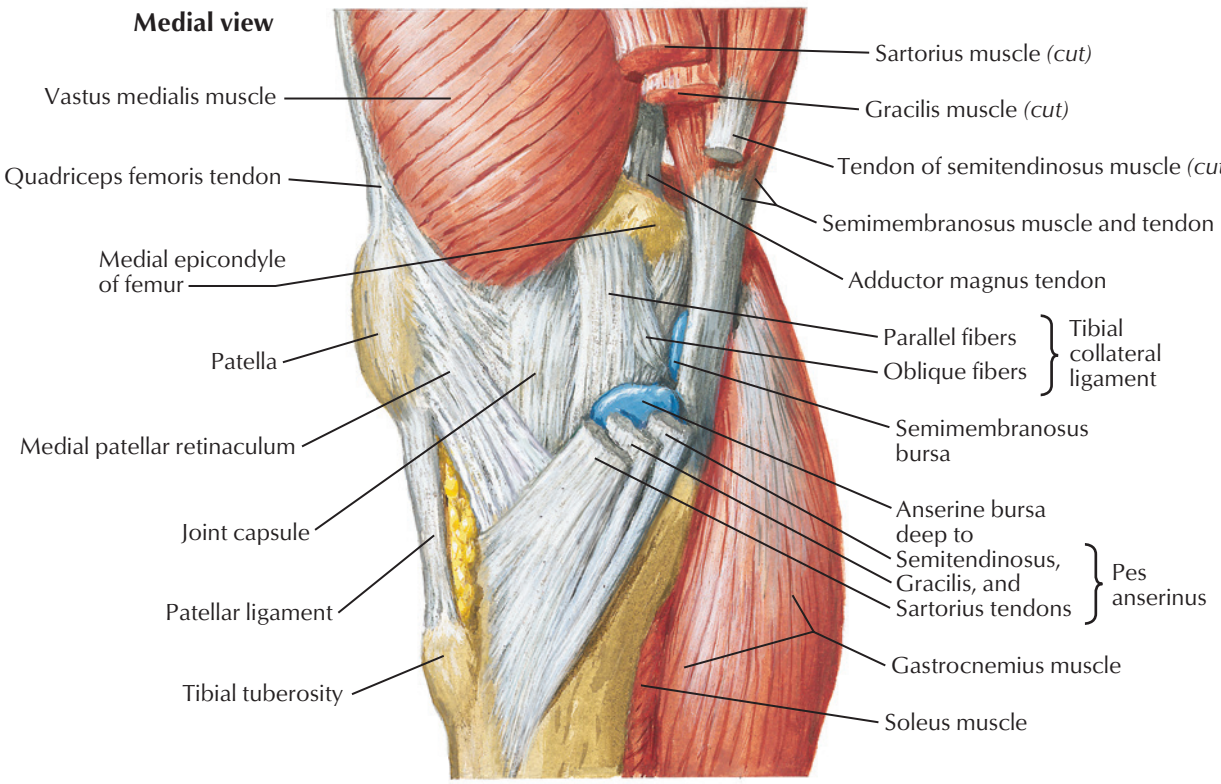
See also Plates 477, 503



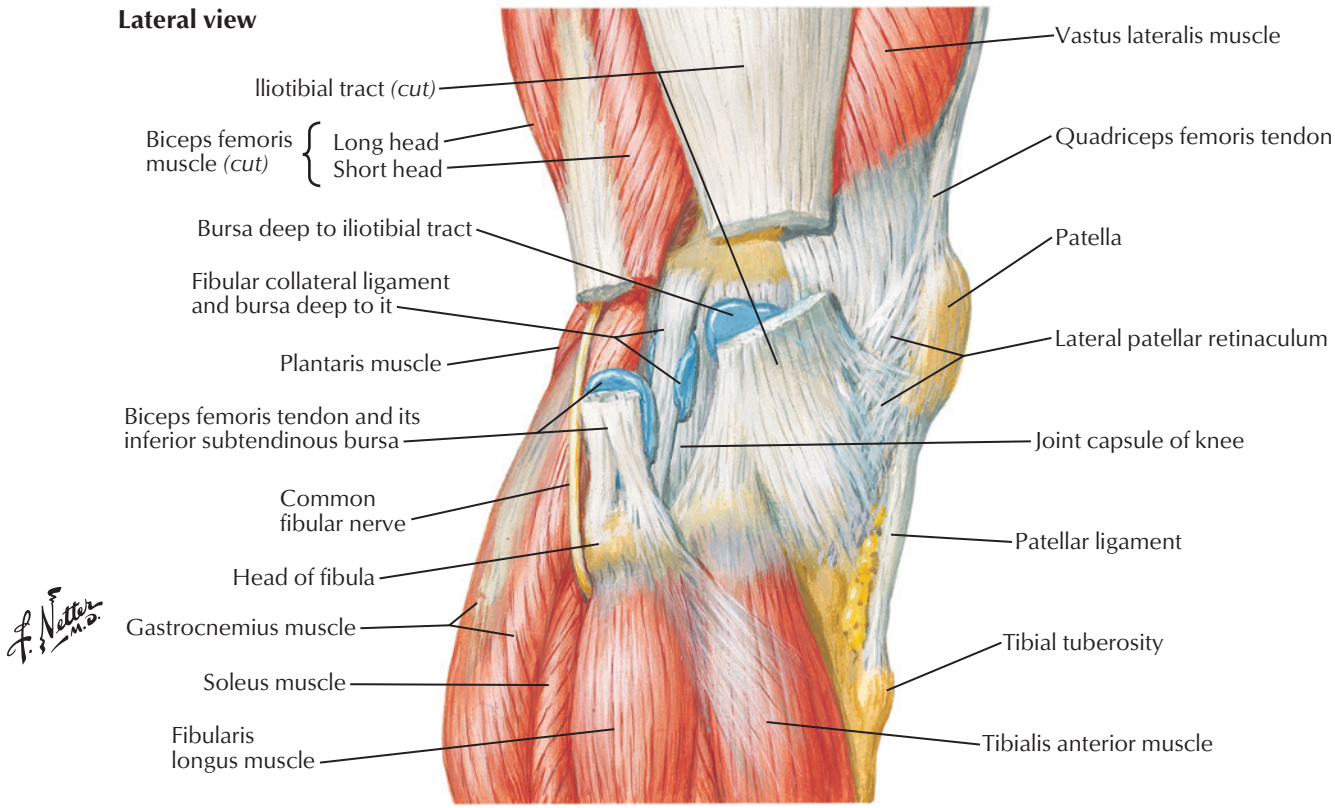



Sartorius muscle
Profunda femoris (deep femoral) artery and vein
Pectineus muscle
Iliopsoas muscle
Rectus femoris muscle
Vastus medialis muscle
Lateral femoral cutaneous nerve
Vastus intermedius muscle
Femur
Vastus lateralis muscle
Tensor fasciae latae muscle
Iliotibial tract
Gluteus maximus muscle
Sciatic nerve
Vastus medialis muscle
Rectus femoris muscle
Vastus intermedius muscle
Vastus lateralis muscle
Iliotibial tract
Lateral intermuscular septum of thigh
Biceps femoris muscle
Short head
Long head
Semitendinosus muscle
Semimembranosus muscle
Rectus femoris tendon
Vastus intermedius muscle
Iliotibial tract
Vastus lateralis muscle
Articularis genus muscle
Lateral intermuscular septum of thigh
Femur
Biceps femoris muscle
Common fibular nerve
Tibial nerve
Fascia lata
Branches of femoral nerve
Femoral artery and vein
Adductor longus muscle
Great saphenous vein
Obturator nerve (anterior branch)
Adductor brevis muscle
Obturator nerve (posterior branch)
Gracilis muscle
Adductor magnus muscle
Posterior femoral cutaneous nerve
Semimembranosus muscle
Semitendinosus muscle
Biceps femoris muscle (long head)
Medial intermuscular septum of thigh
Sartorius muscle
Nerve to vastus medialis muscle
Saphenous nerve
Femoral artery and vein
in adductor canal
Great saphenous vein
Adductor longus muscle
Gracilis muscle
Adductor brevis muscle
Profunda femoris (deep femoral) artery and vein
Adductor magnus muscle
Posterior intermuscular septum of thigh
Sciatic nerve
Vastus medialis muscle
Sartorius muscle
Saphenous nerve and descending genicular artery
Great saphenous vein
Gracilis muscle
Adductor magnus tendon
Popliteal vein and artery
Semimembranosus muscle
Semitendinosus muscle

Medial view

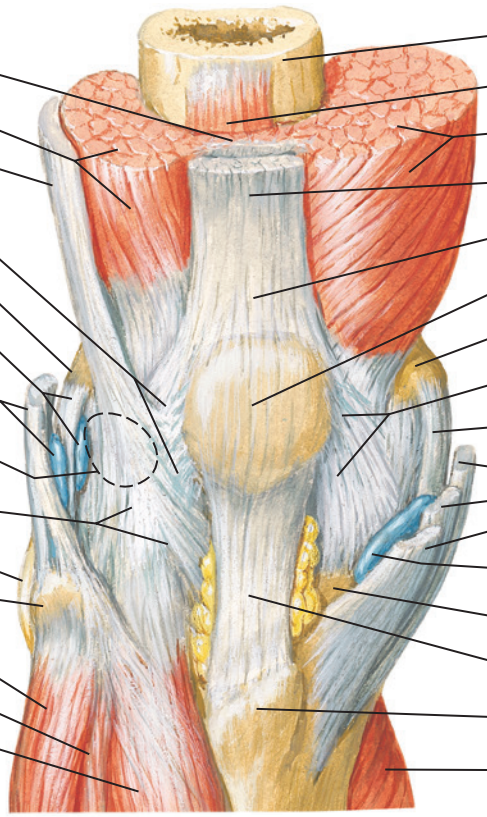


Lateral view

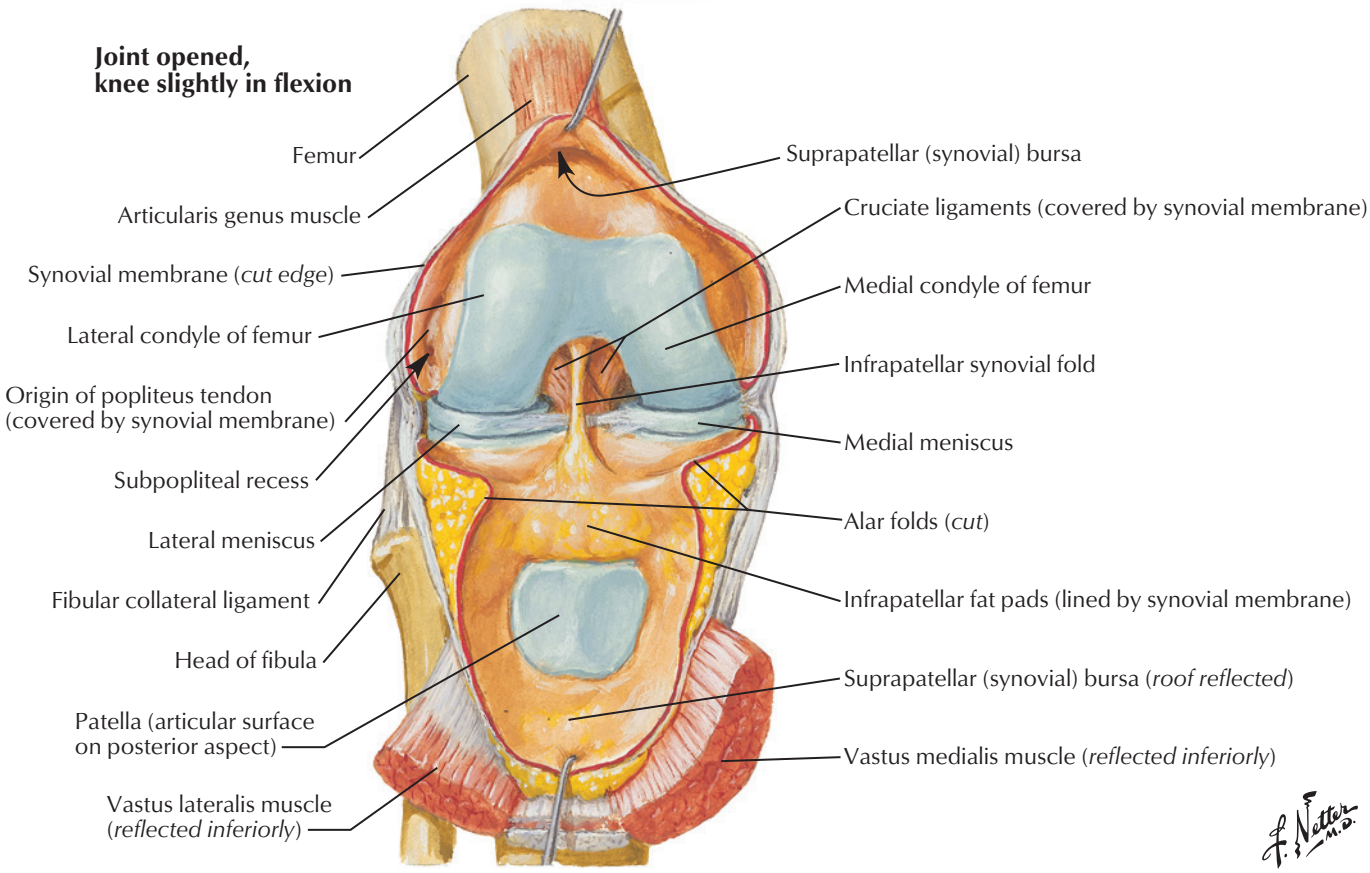


See also Plate 501

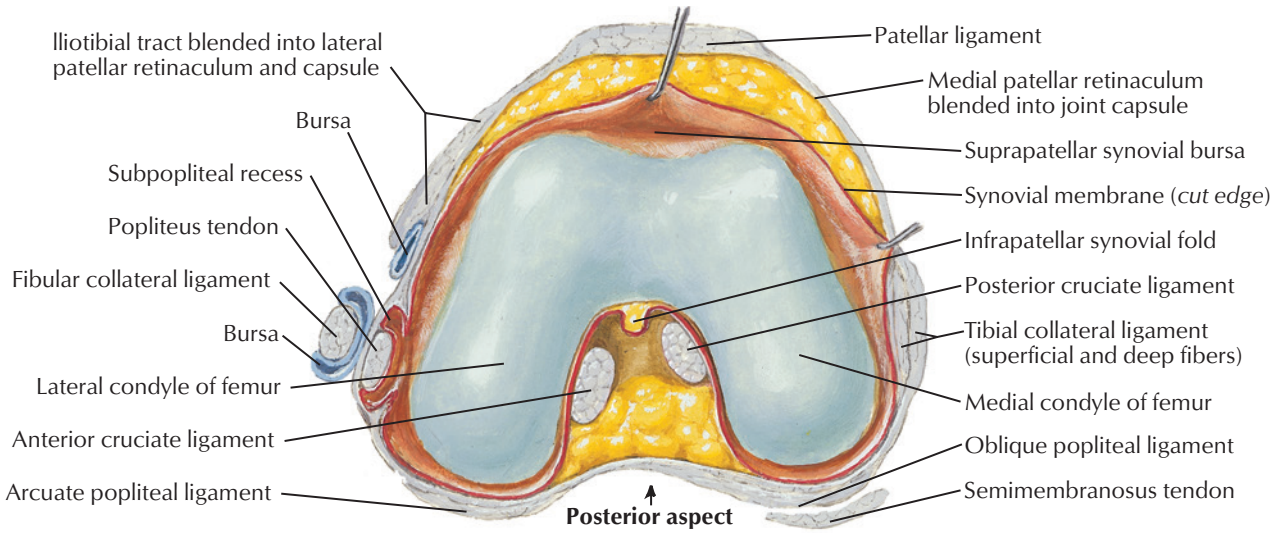
Right knee in extension



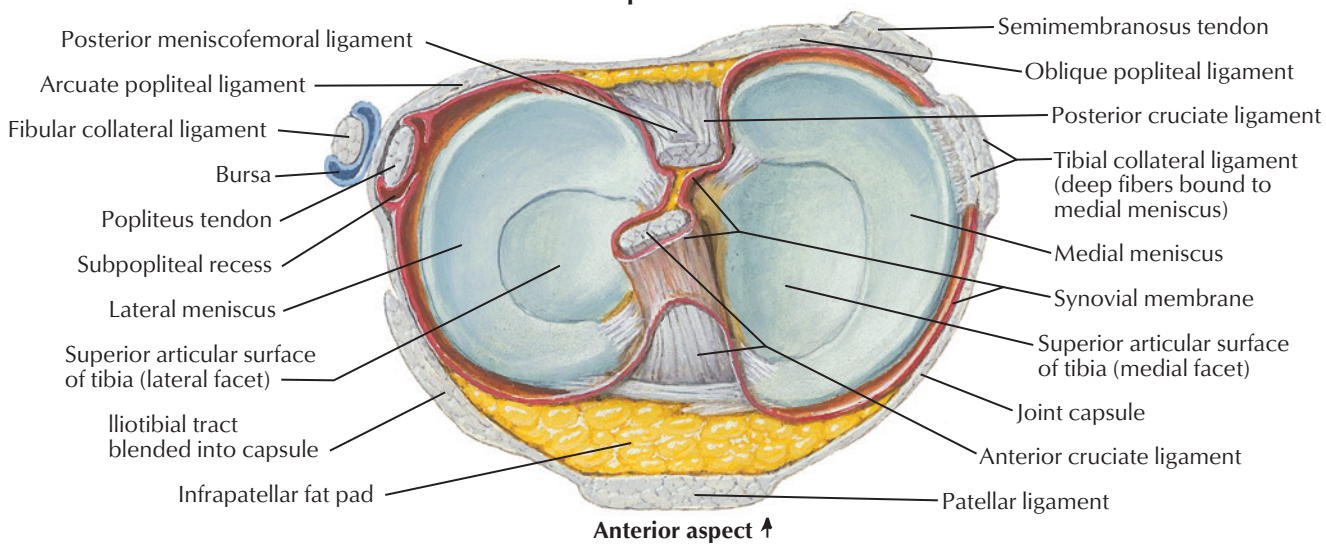
Joint opened, knee slightly in flexion



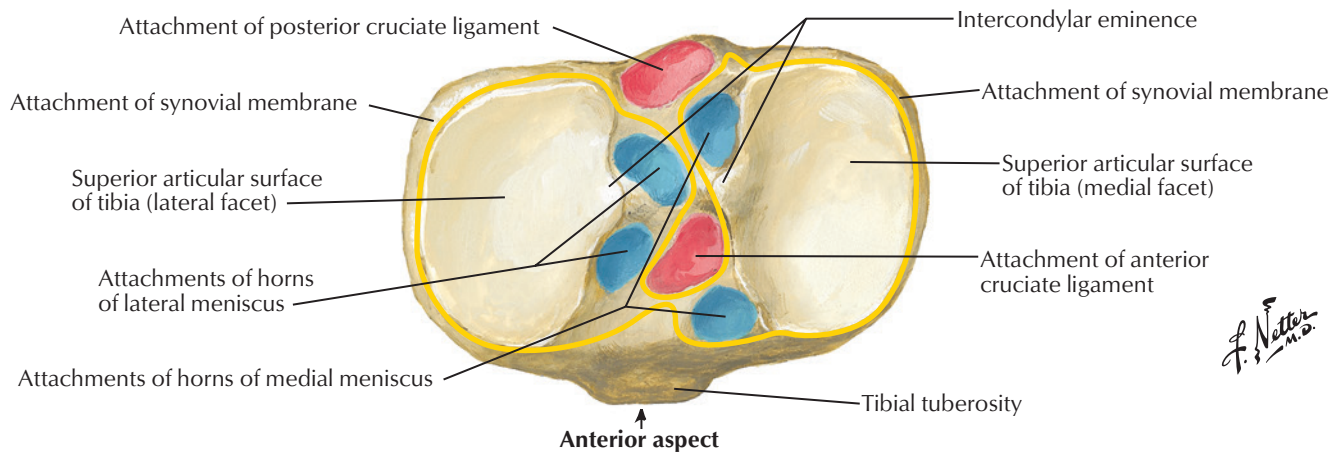
Inferior view



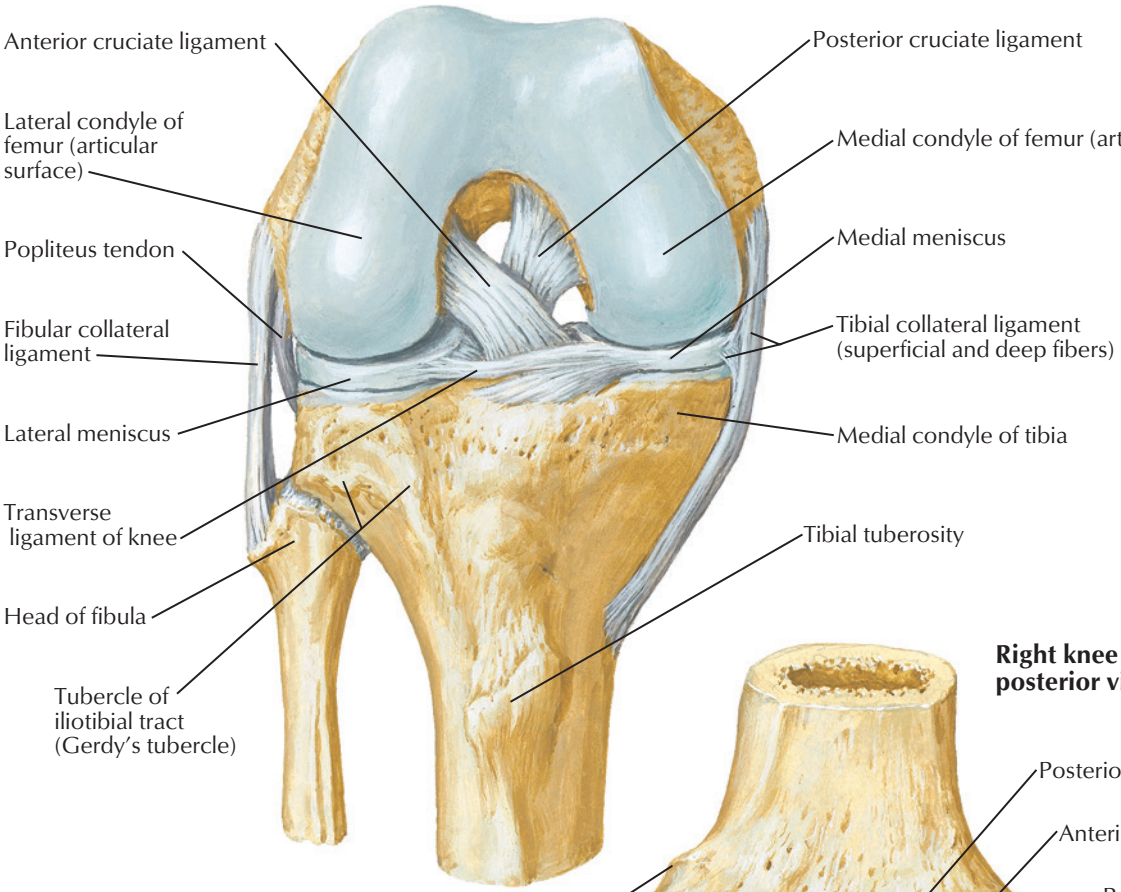
Superior view



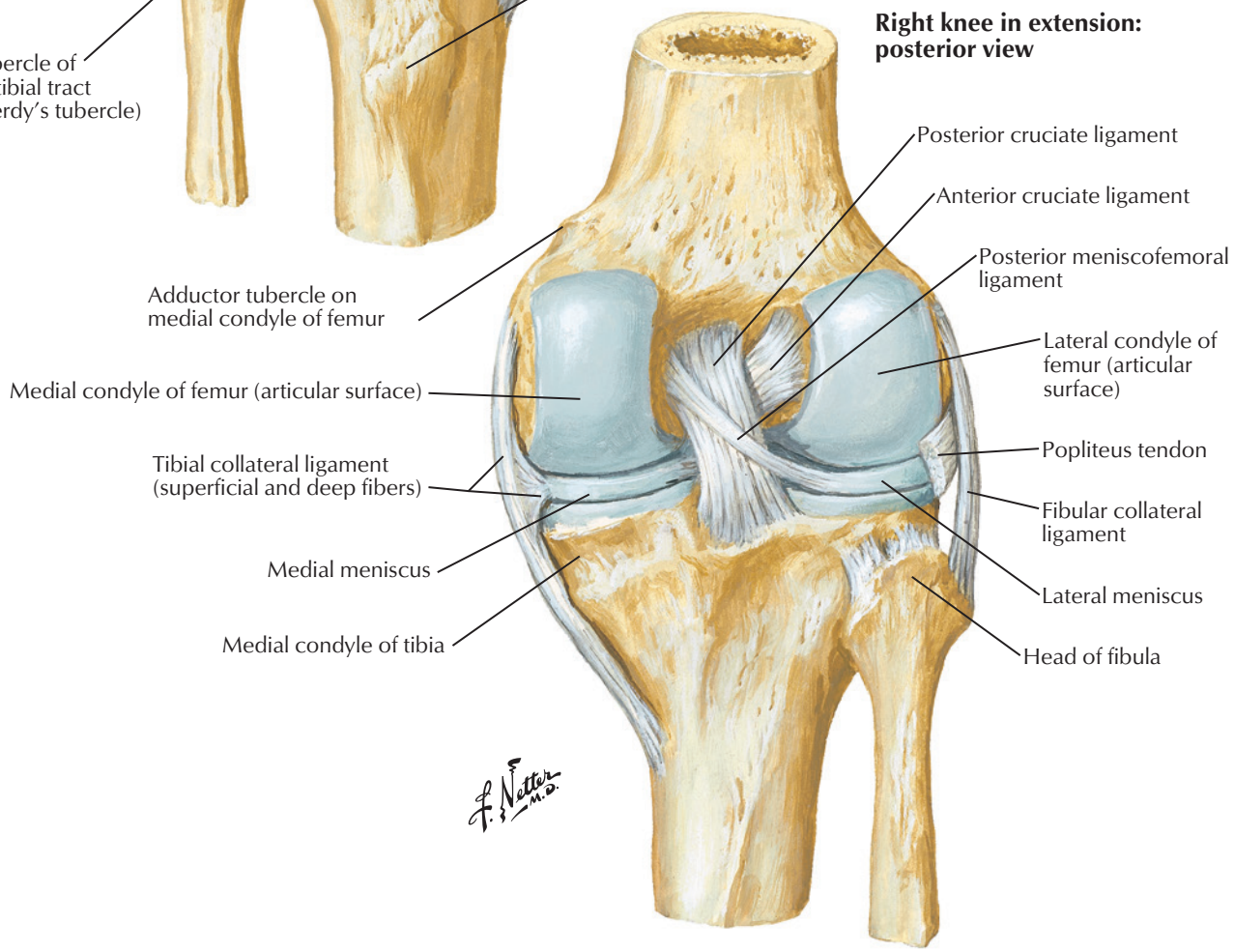
Superior view: ligaments and cartilage removed



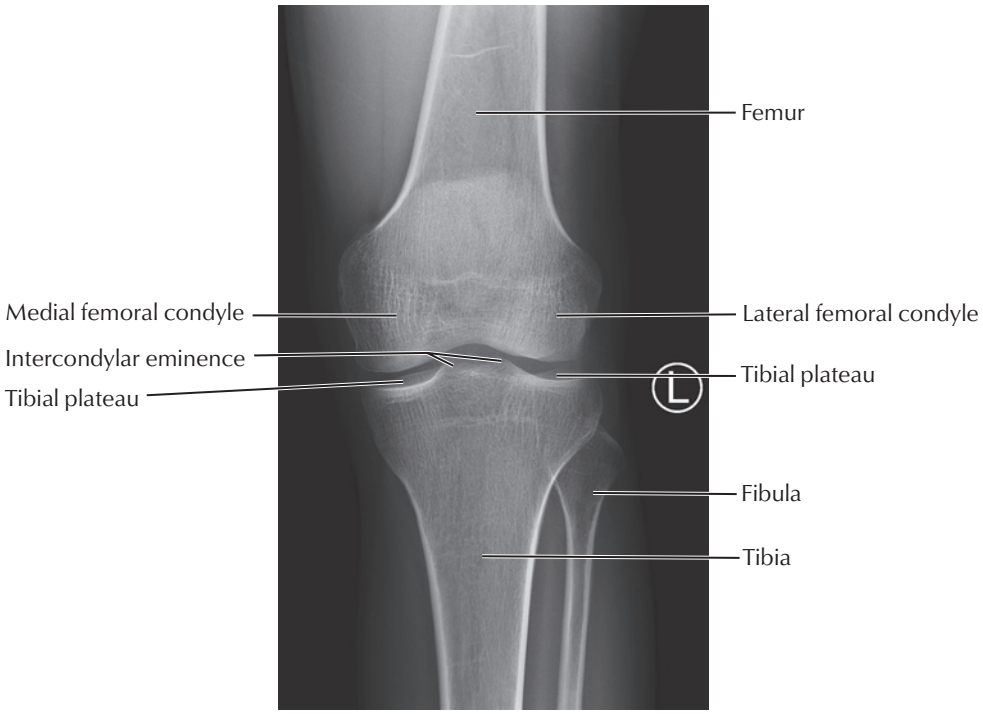
Right knee in flexion: anterior view

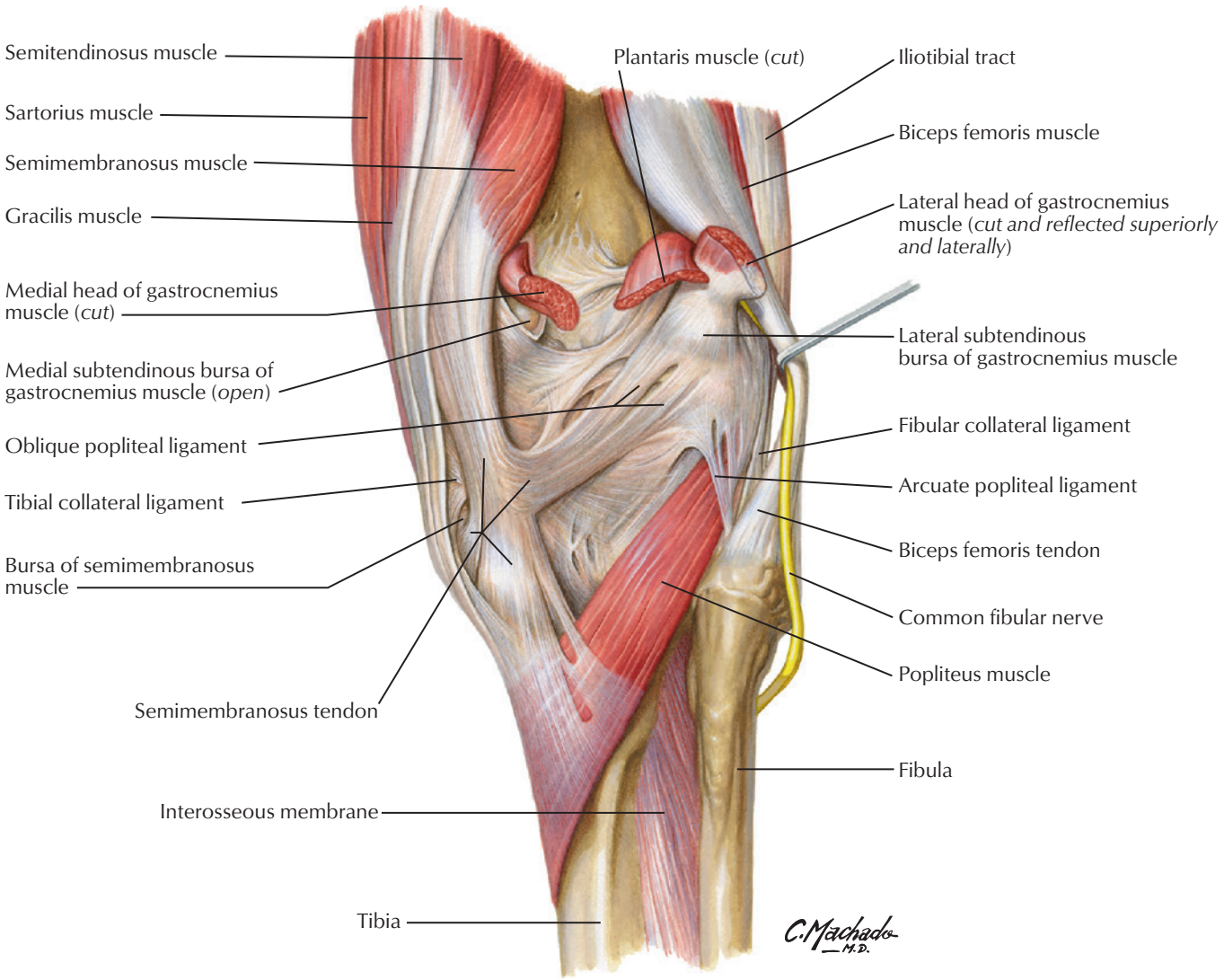


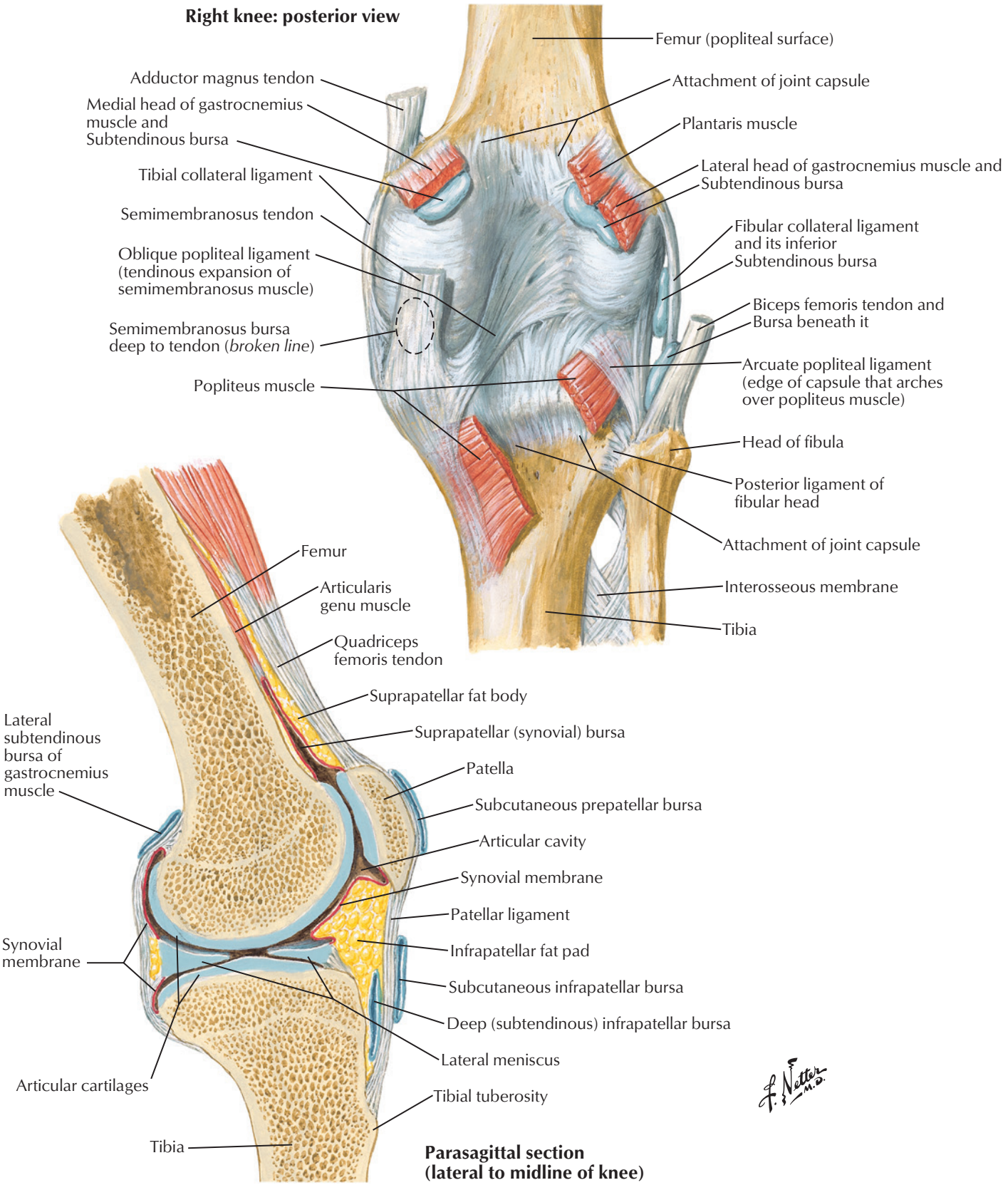
Right knee in extension: posterior view



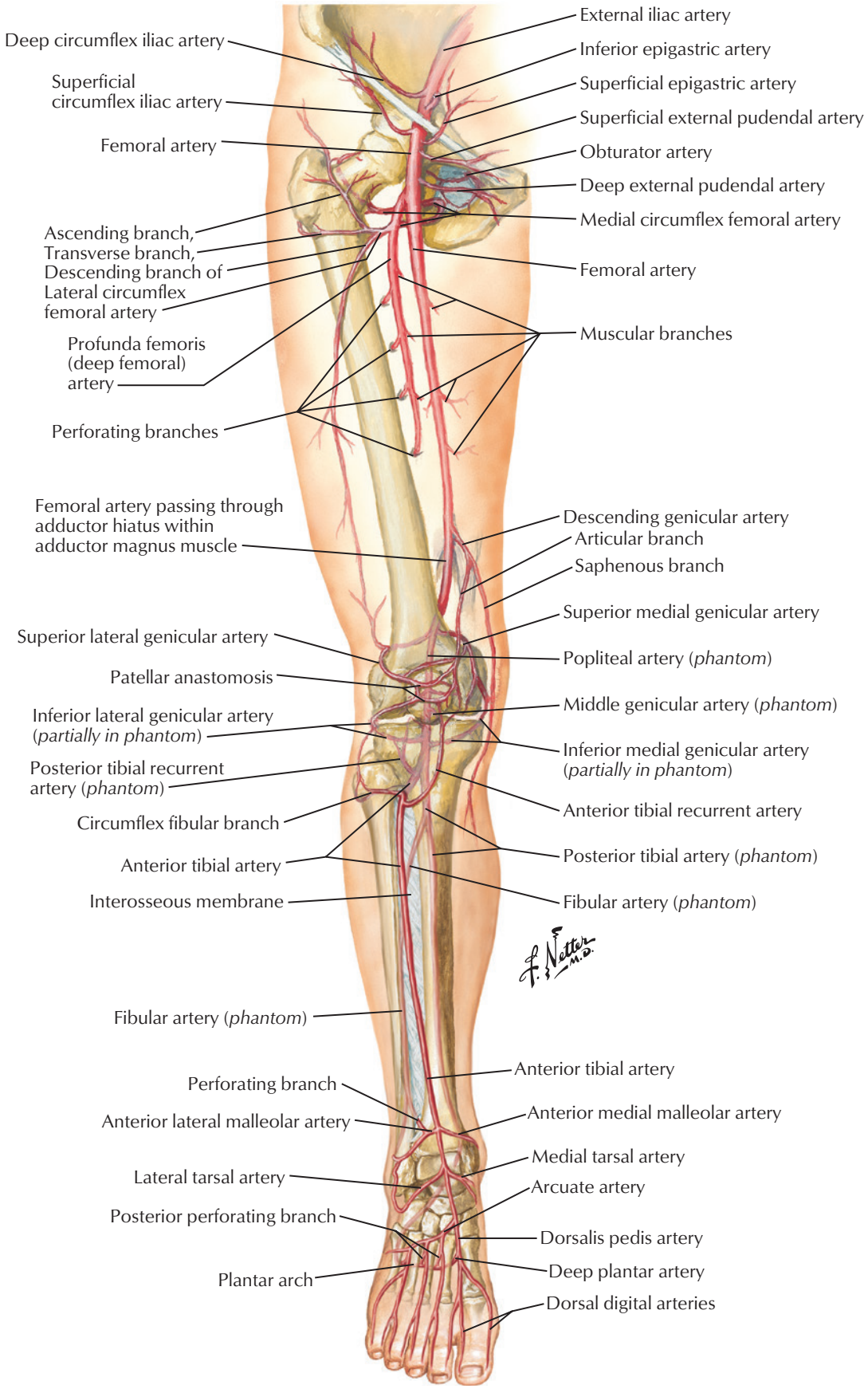
See also Plate 498

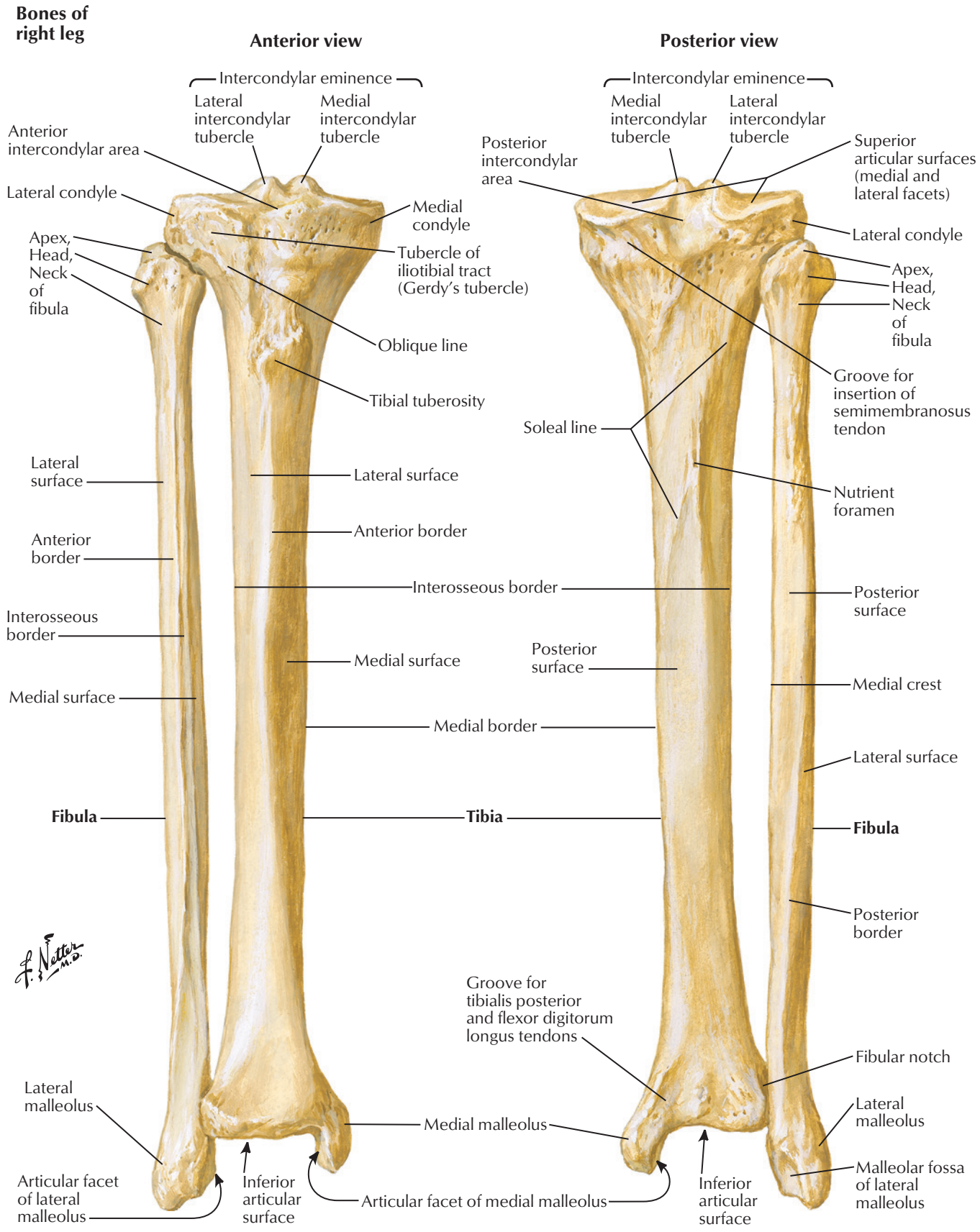




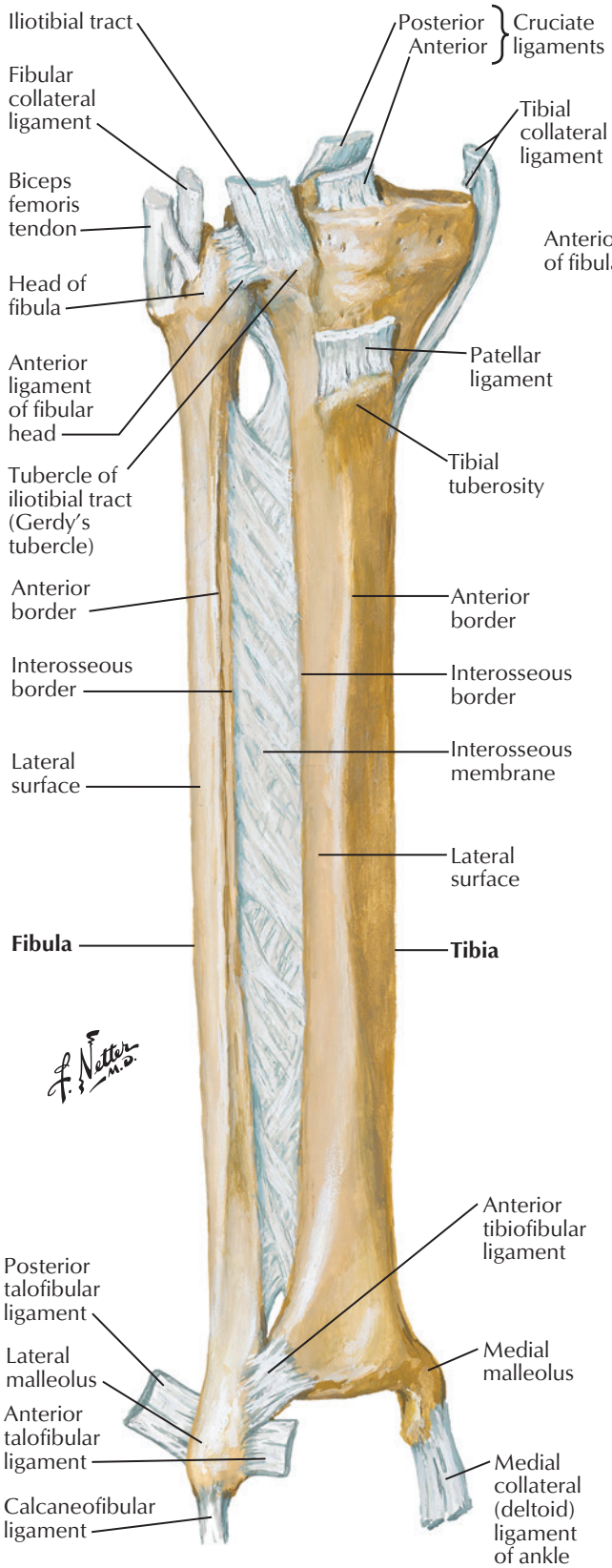

Right knee: posterior view
Femur (popliteal surface)
Adductor magnus tendon
Attachment of joint capsule
Medial head of gastrocnemius muscle and Subtendinous bursa
Plantaris muscle
Tibial collateral ligament
Lateral head of gastrocnemius muscle and Subtendinous bursa
Semimembranosus tendon
Fibular collateral ligament and its inferior Subtendinous bursa
Oblique popliteal ligament (tendinous expansion of semimembranosus muscle)
Biceps femoris tendon and Bursa beneath it
Semimembranosus bursa deep to tendon (broken line)
Arcuate popliteal ligament (edge of capsule that arches over popliteus muscle)
Popliteus muscle
Head of fibula
Posterior ligament of fibular head
Attachment of joint capsule
Femur
Articularis genu muscle
Interosseous membrane
Tibia
Quadriceps femoris tendon
Suprapatellar fat body
Lateral subtendinous bursa of gastrocnemius muscle
Suprapatellar (synovial) bursa
Patella
Subcutaneous prepatellar bursa
Articular cavity
Synovial membrane
Patellar ligament
Synovial membrane
Infrapatellar fat pad
Subcutaneous infrapatellar bursa
Deep (subtendinous) infrapatellar bursa
Lateral meniscus
Articular cartilages
Tibial tuberosity
Tibia
Parasagittal section (lateral to midline of knee)

See also Plates 495, 512

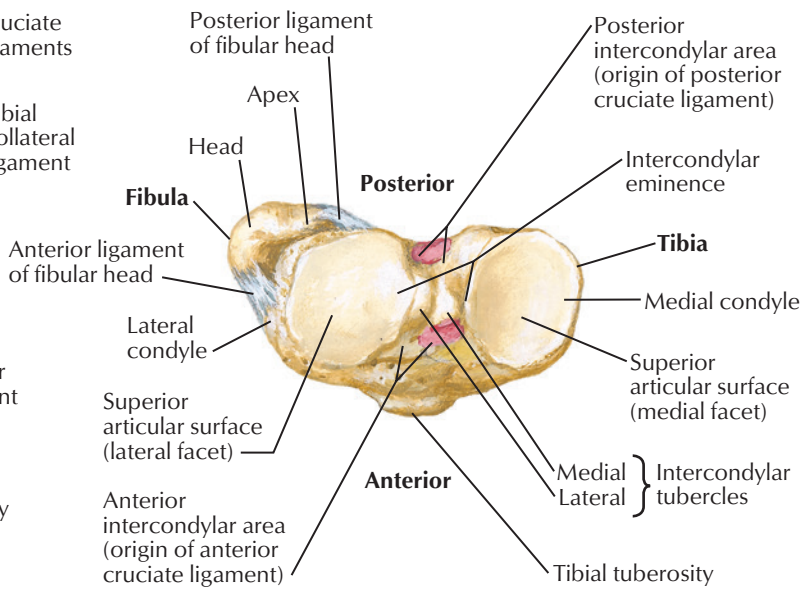



Bones of right leg
Anterior view
Posterior view
Intercondylar eminence
Lateral intercondylar tubercle
Medial intercondylar tubercle
Anterior intercondylar area
Lateral condyle
Medial condyle
Apex, Head, Neck of fibula
Tubercle of iliotibial tract (Gerdy's tubercle)
Oblique line
Tibial tuberosity
Lateral surface
Anterior border
Interosseous border
Medial surface
Fibula
Tibia
Lateral malleolus
Medial malleolus
Articular facet of lateral malleolus
Inferior articular surface
Articular facet of medial malleolus
Posterior intercondylar area
Superior articular surfaces (medial and lateral facets)
Groove for insertion of semimembranosus tendon
Soleal line
Nutrient foramen
Posterior surface
Medial crest
Posterior border
Groove for tibialis posterior and flexor digitorum longus tendons
Fibular notch
Malleolar fossa of lateral malleolus

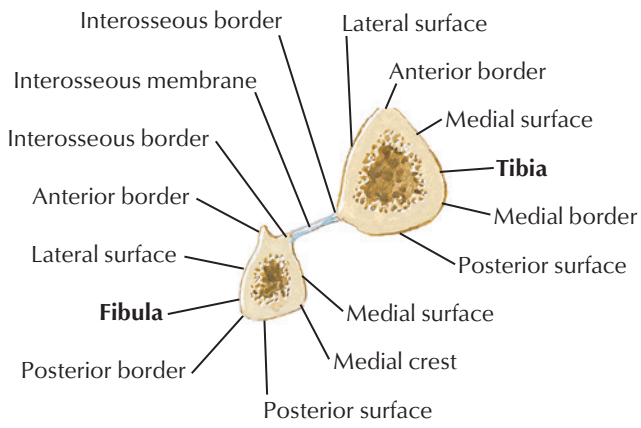
Anterior view with ligament attachments



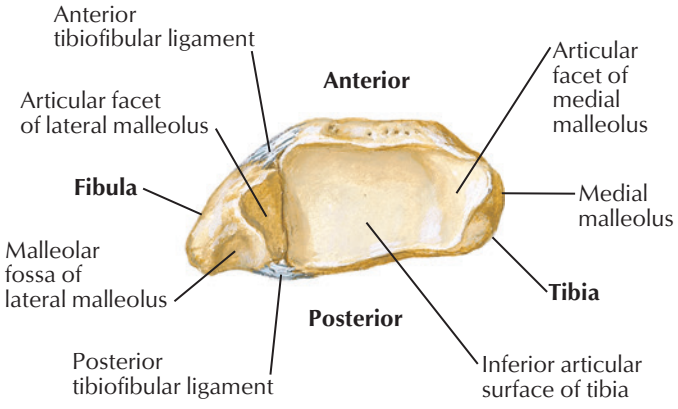
Superior view



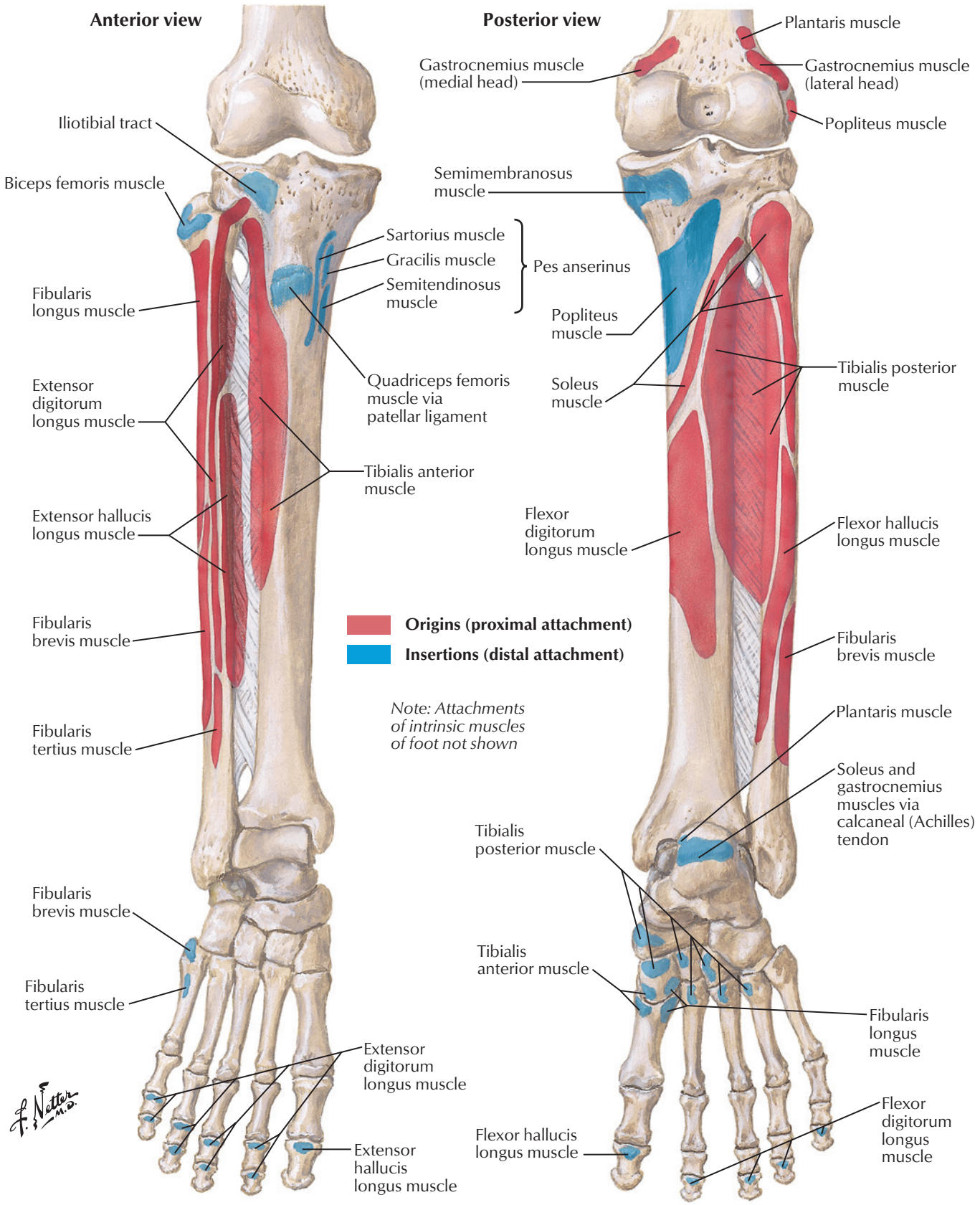
Cross section



Inferior view

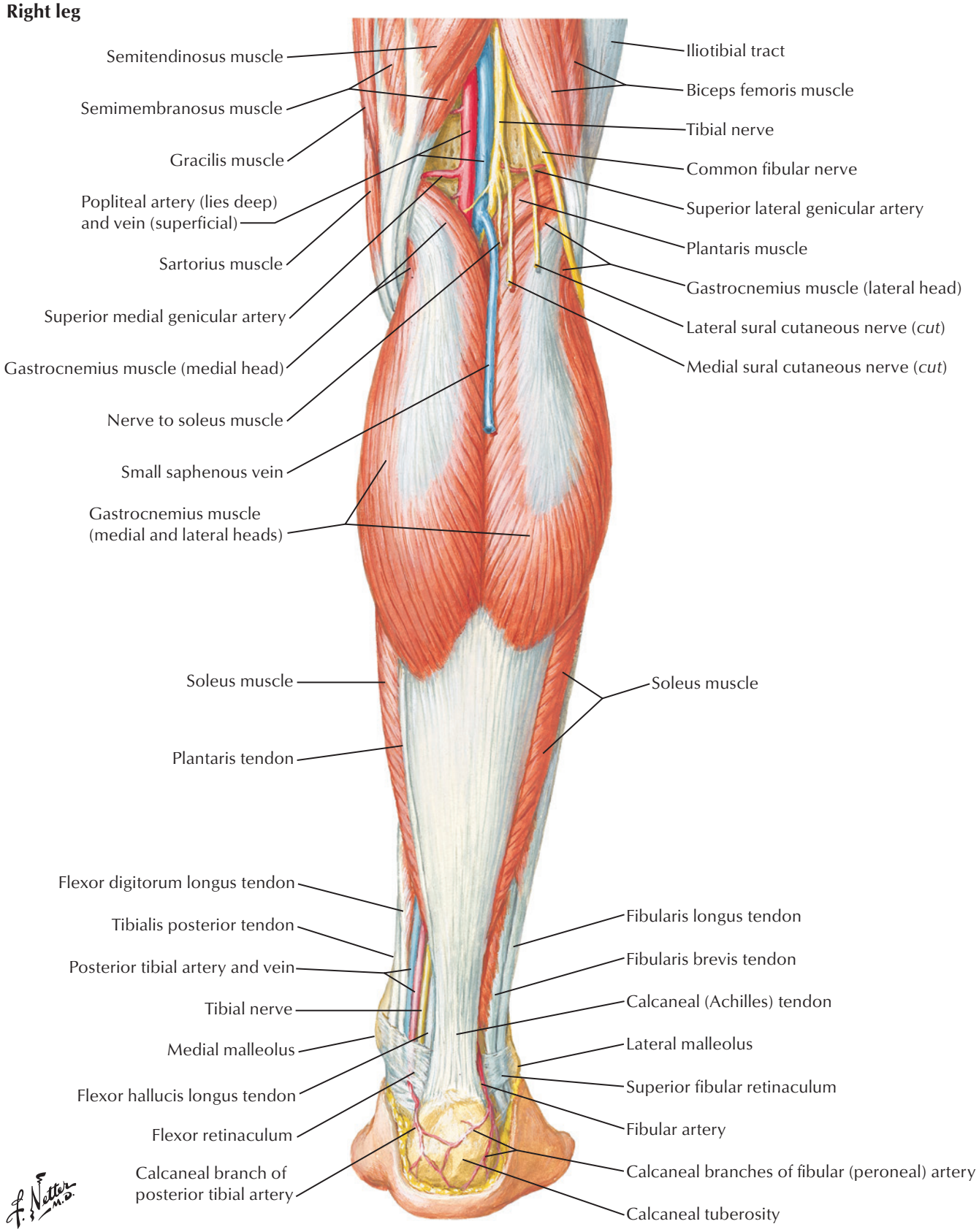


See also Plates 509, 512



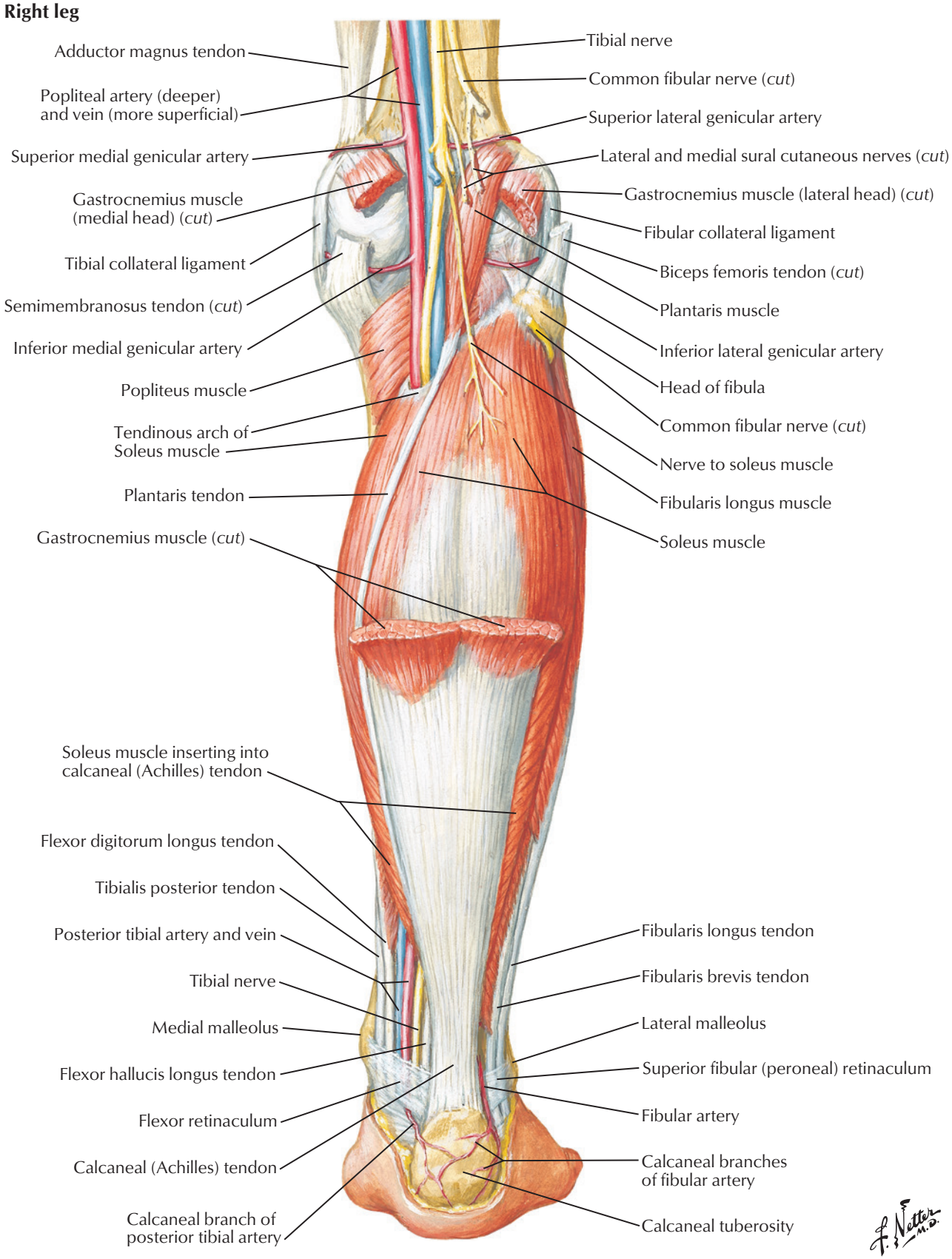
See also Plate 532

Right leg



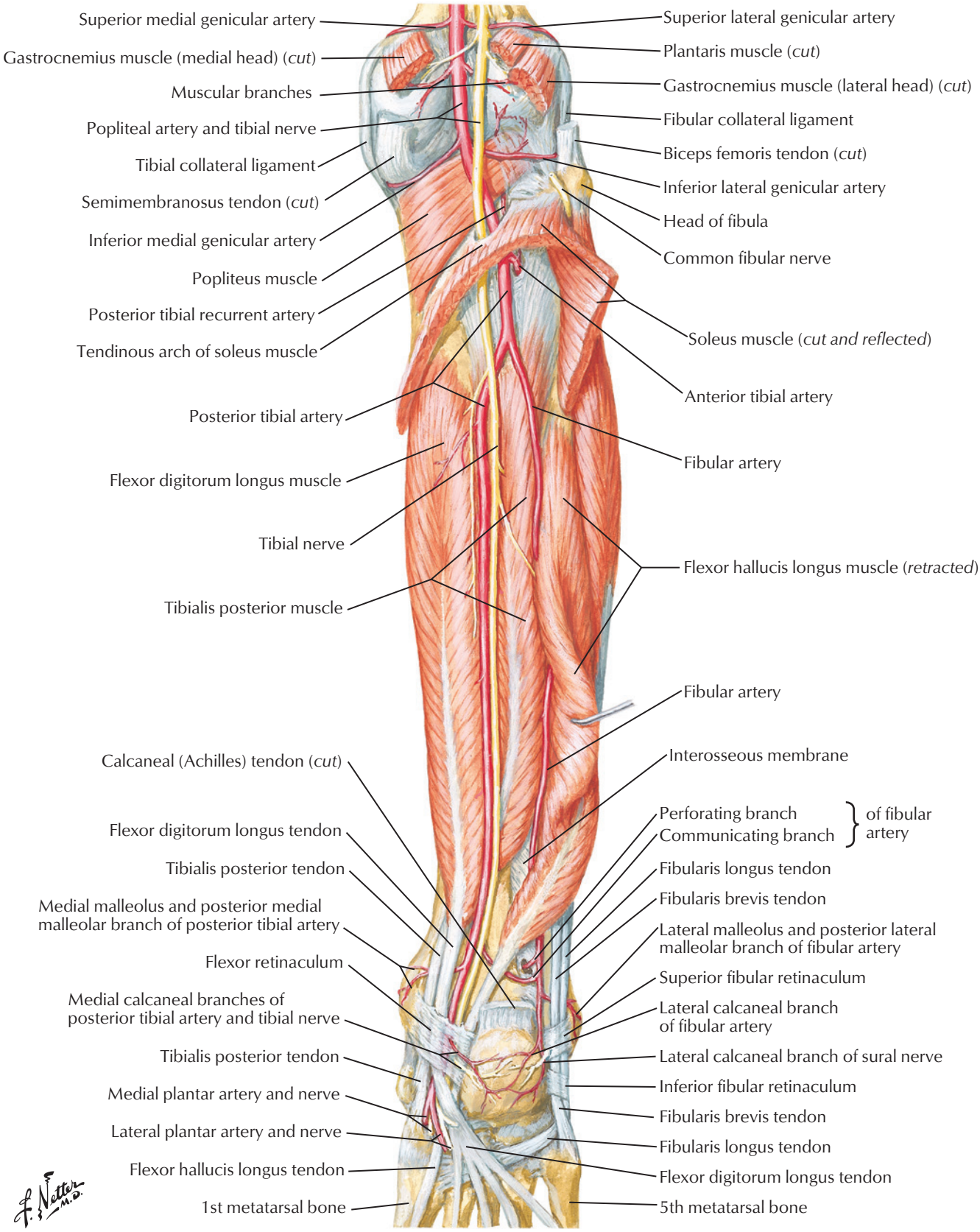
See also Plate 532

Right leg

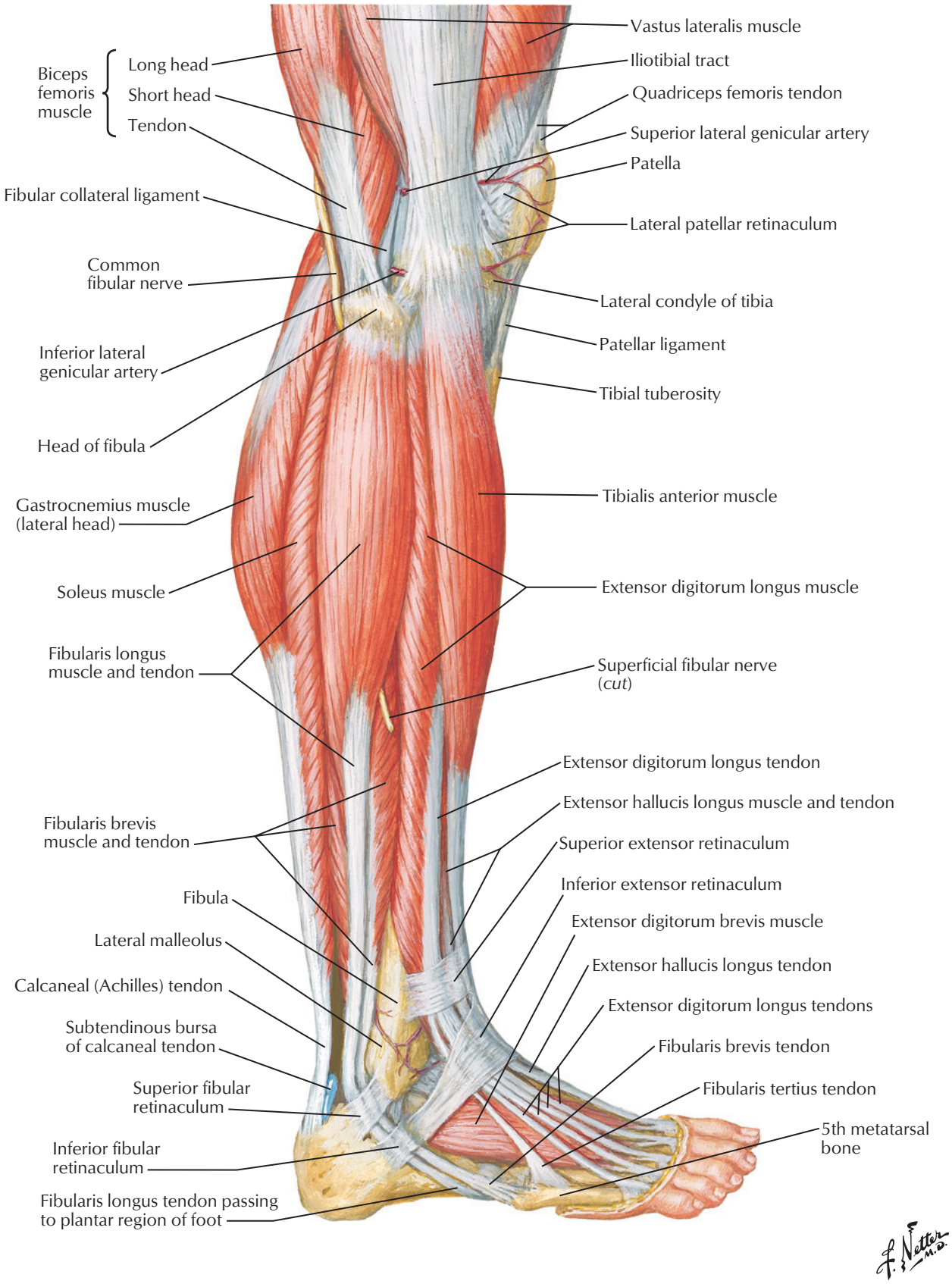


See also Plate 532

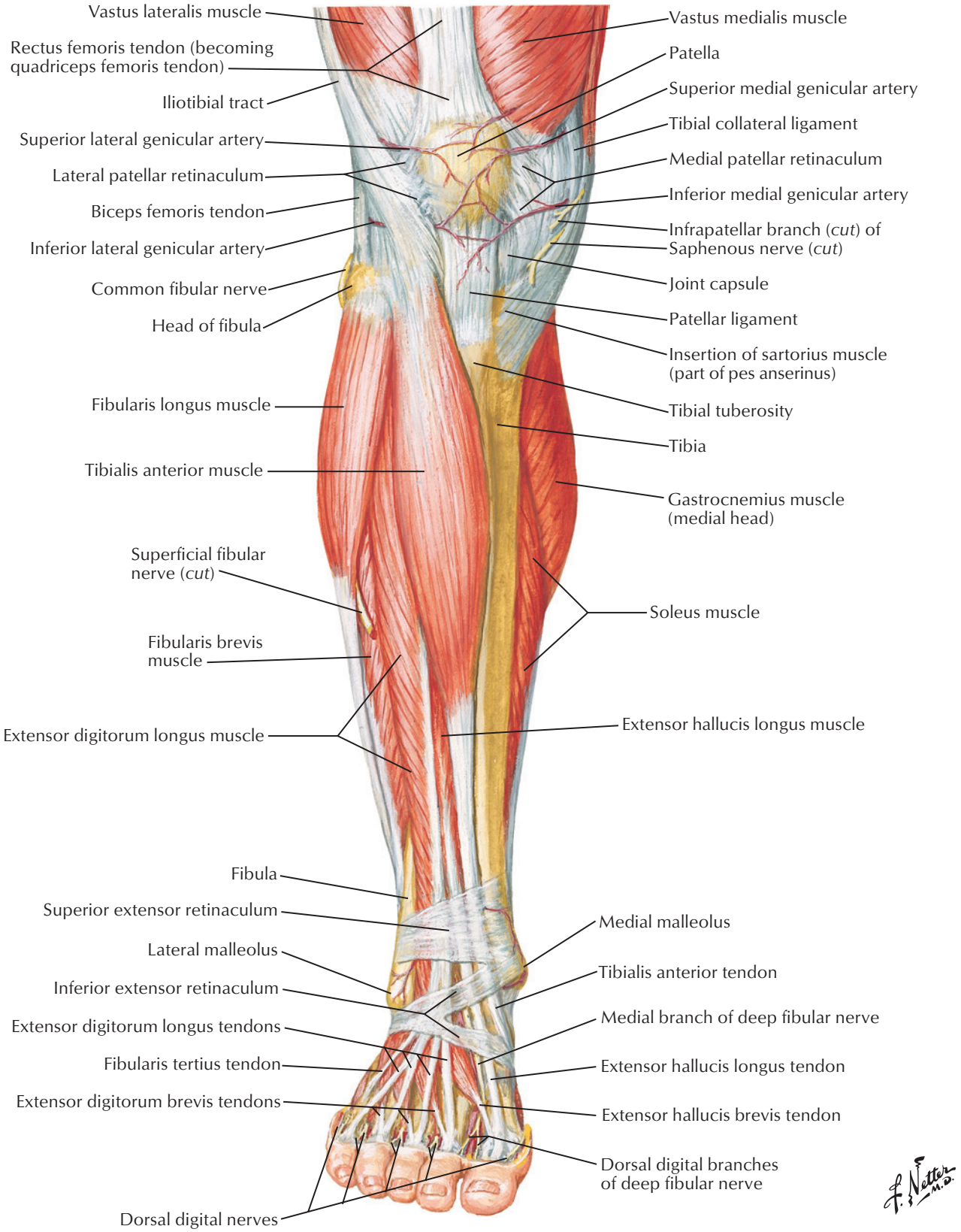
Right leg



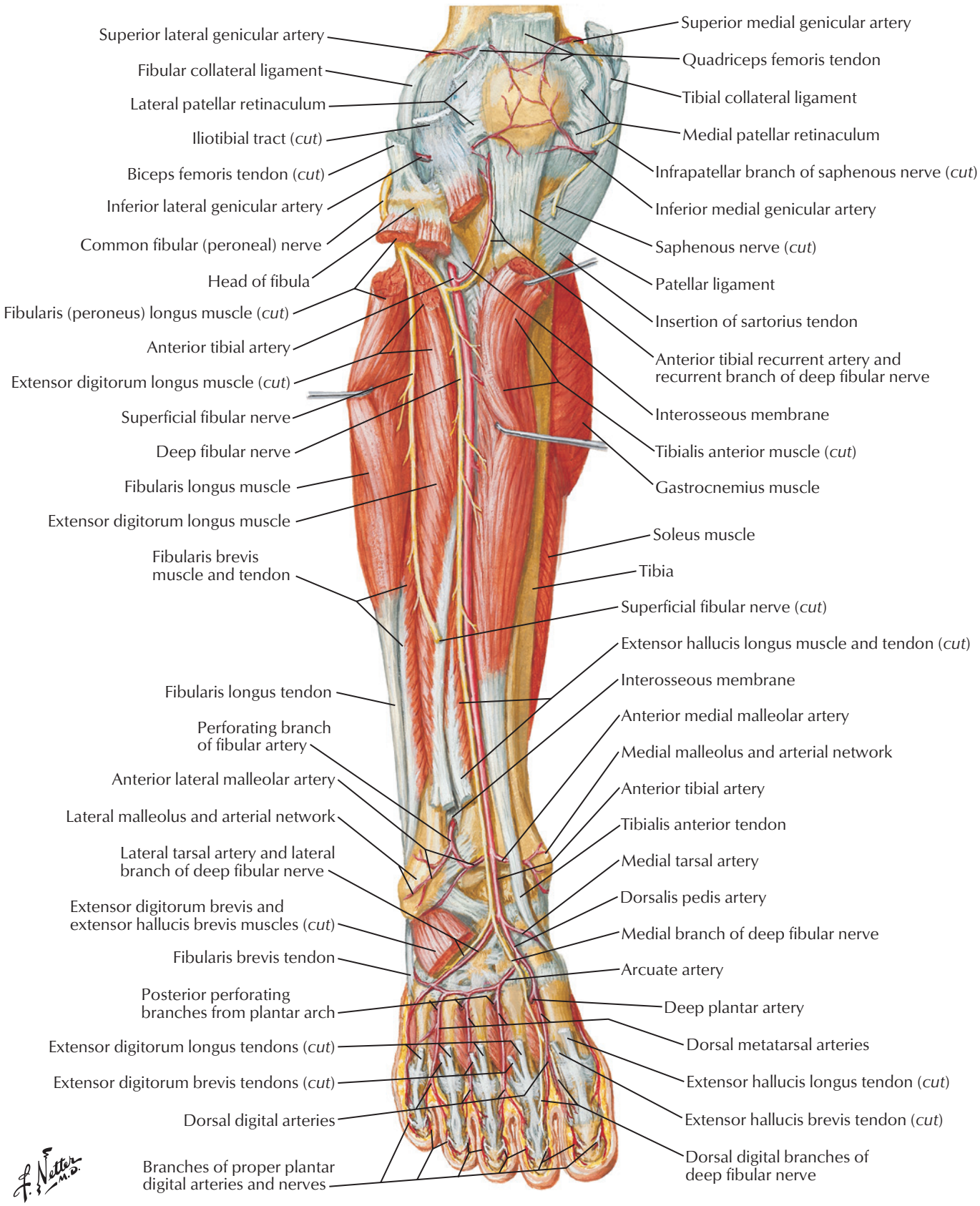
See also Plates 520, 533

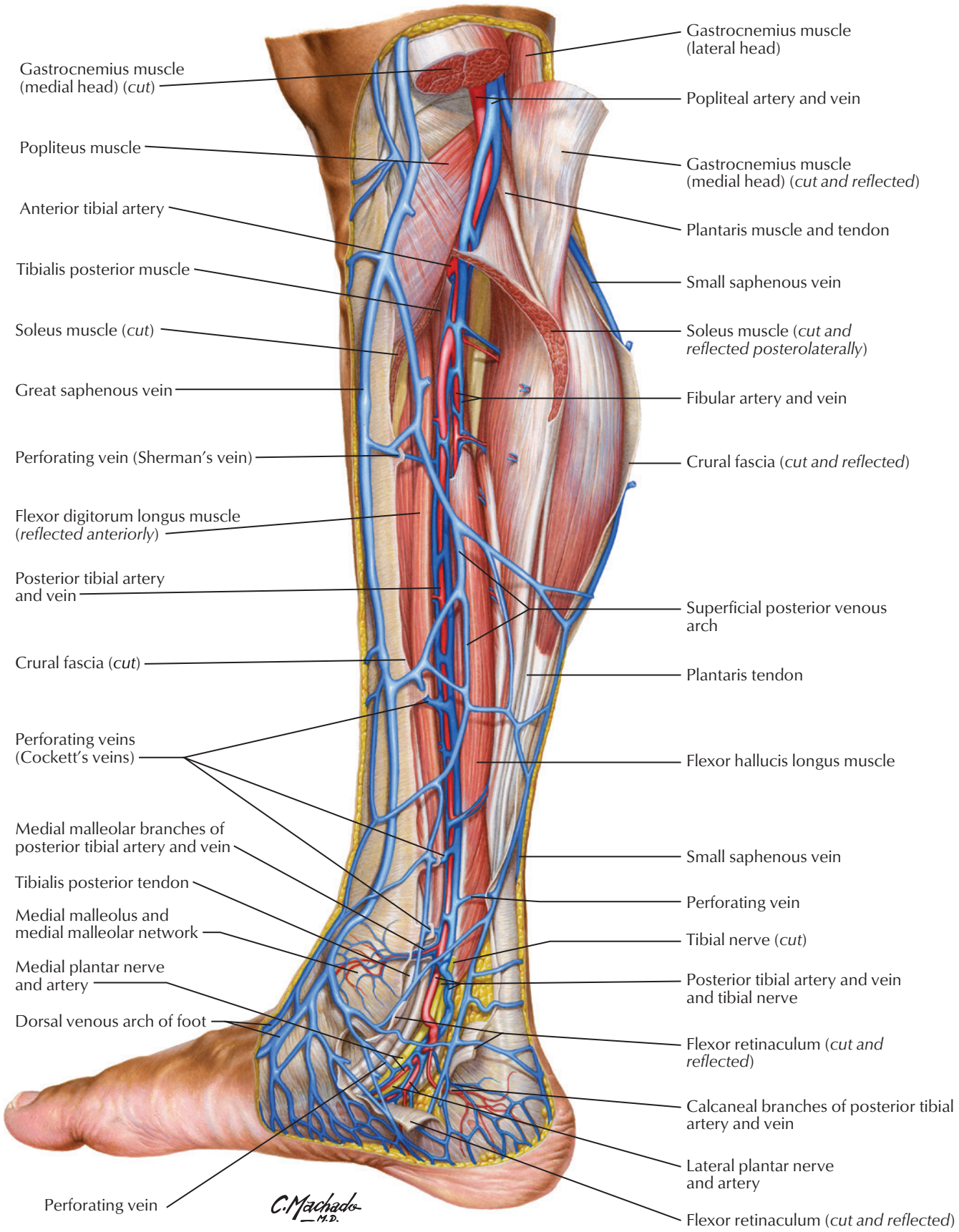


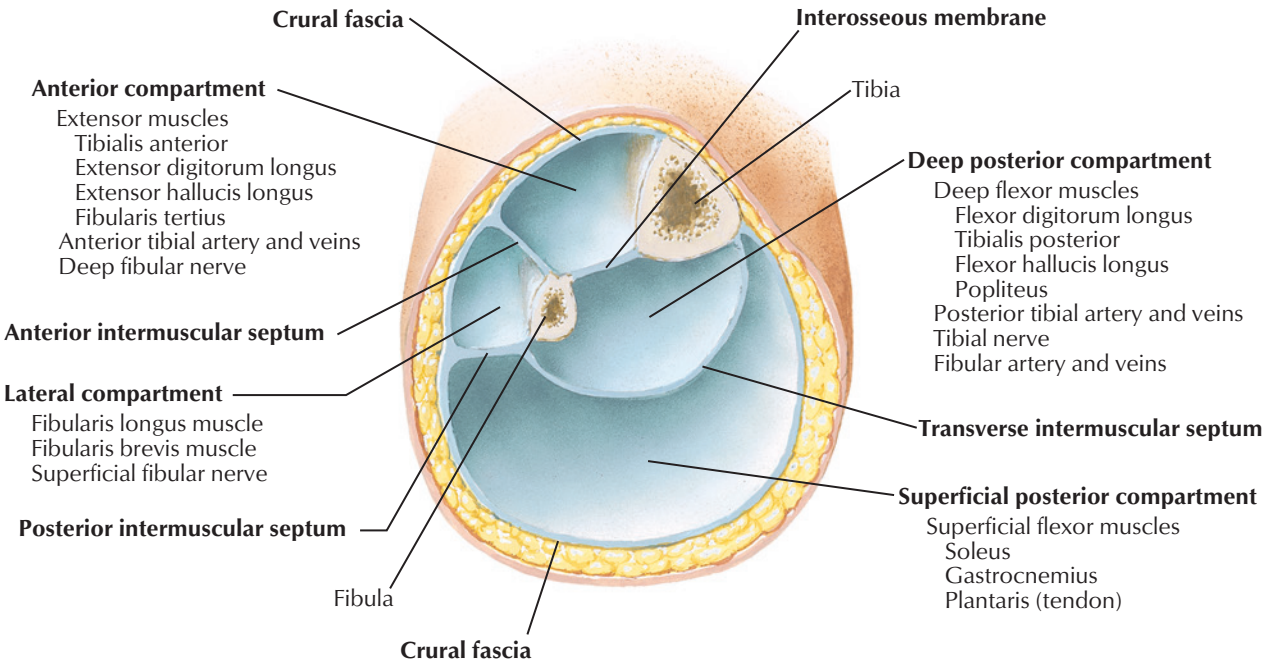
See also Plate 533



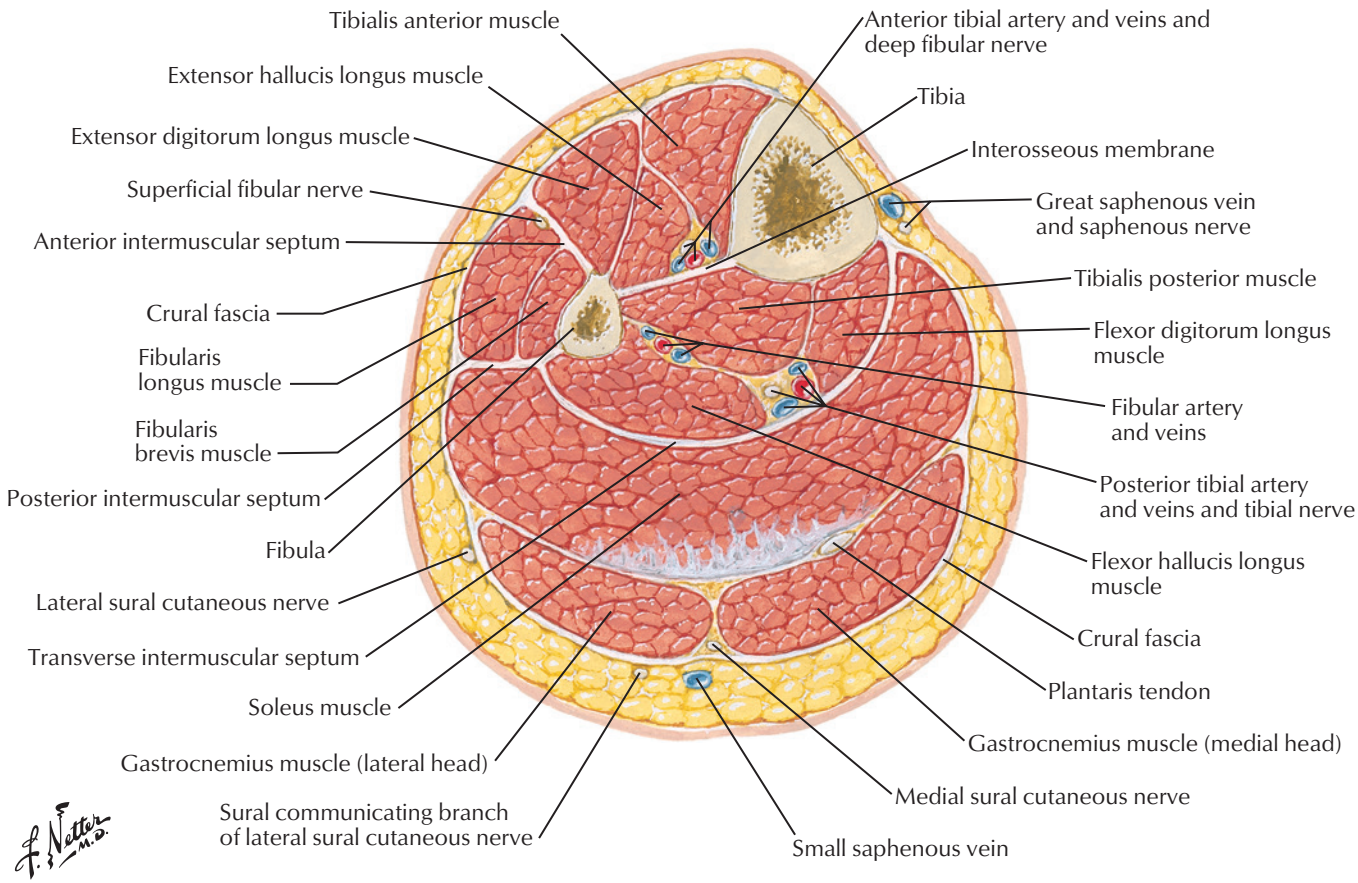
See also Plates 521, 533

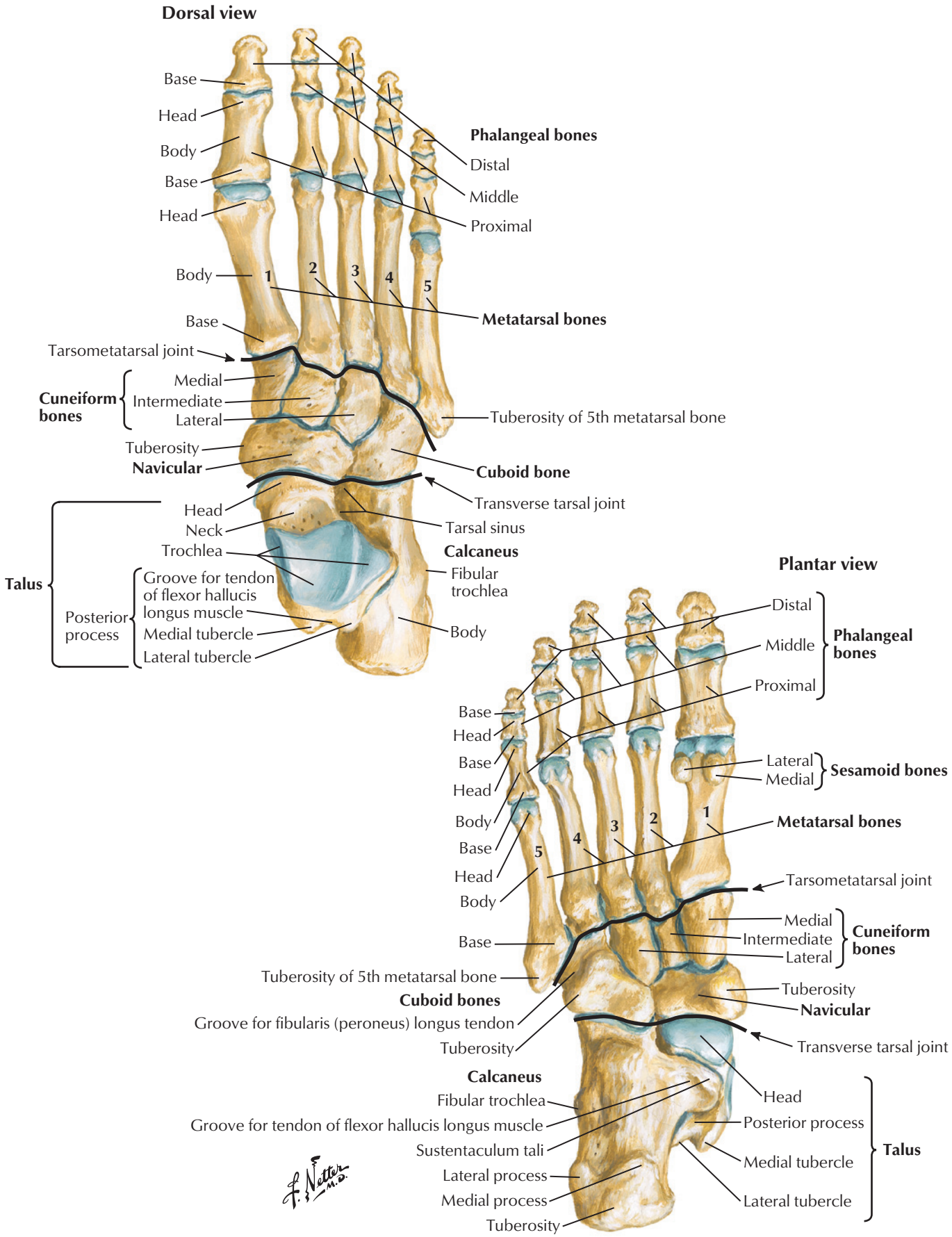



Gastrocnemius muscle (medial head) (cut)
Popliteus muscle
Anterior tibial artery
Tibialis posterior muscle
Soleus muscle (cut)
Great saphenous vein
Perforating vein (Sherman's vein)
Flexor digitorum longus muscle (reflected anteriorly)
Posterior tibial artery and vein
Crural fascia (cut)
Perforating veins (Cockett's veins)
Medial malleolar branches of posterior tibial artery and vein
Tibialis posterior tendon
Medial malleolus and medial malleolar network
Medial plantar nerve and artery
Dorsal venous arch of foot
Perforating vein
Gastrocnemius muscle (lateral head)
Popliteal artery and vein
Gastrocnemius muscle (medial head) (cut and reflected)
Plantaris muscle and tendon
Small saphenous vein
Soleus muscle (cut and reflected posterolaterally)
Fibular artery and vein
Crural fascia (cut and reflected)
Superficial posterior venous arch
Plantaris tendon
Flexor hallucis longus muscle
Small saphenous vein
Perforating vein
Tibial nerve (cut)
Posterior tibial artery and vein and tibial nerve
Flexor retinaculum (cut and reflected)
Calcaneal branches of posterior tibial artery and vein
Lateral plantar nerve and artery
Flexor retinaculum (cut and reflected)
C. Machado M.D.

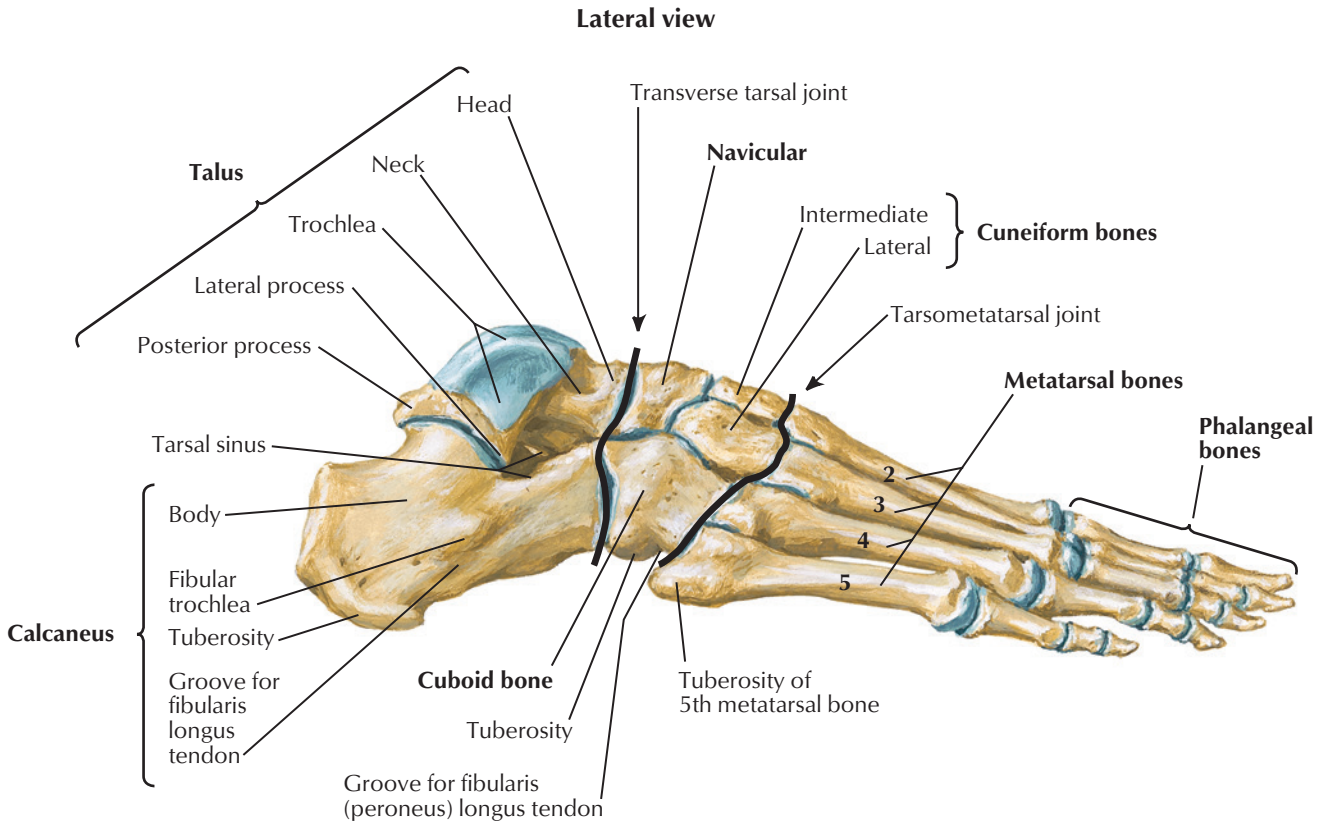


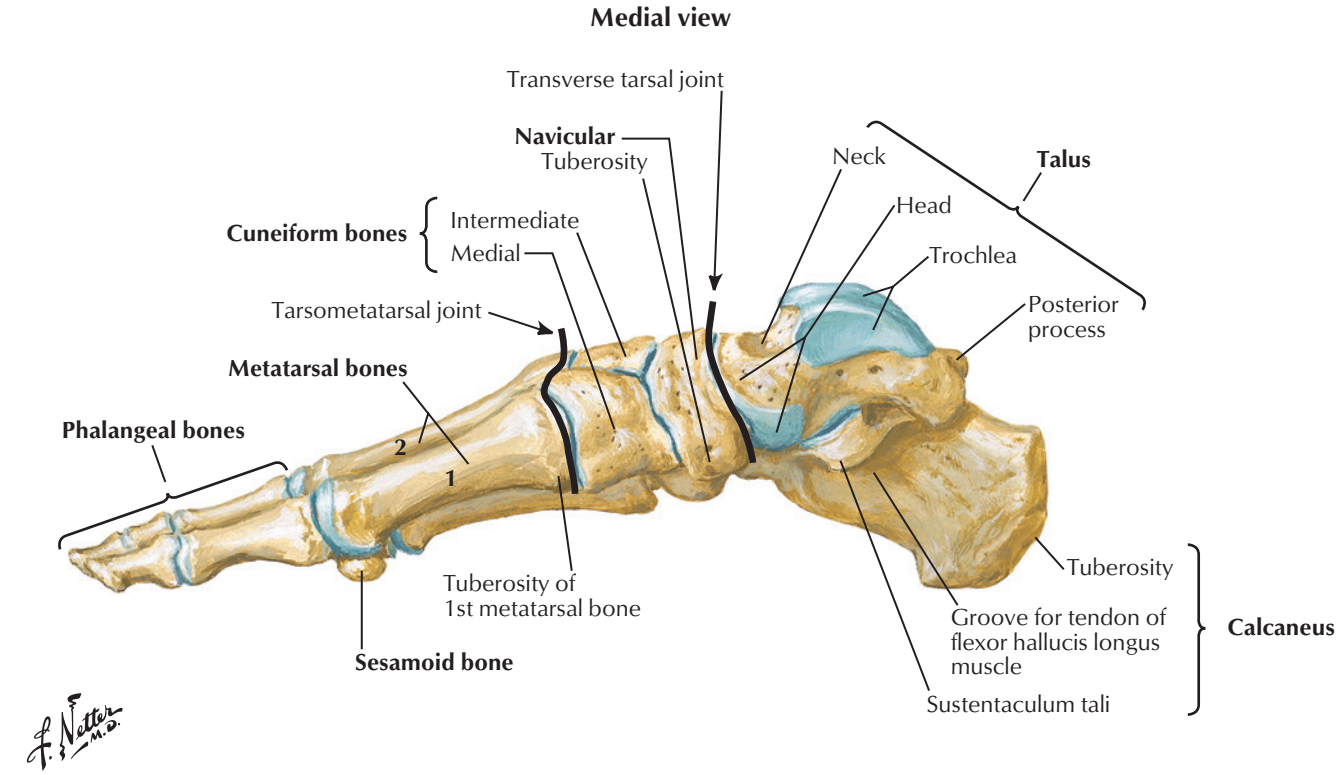
Cross section just above middle of leg



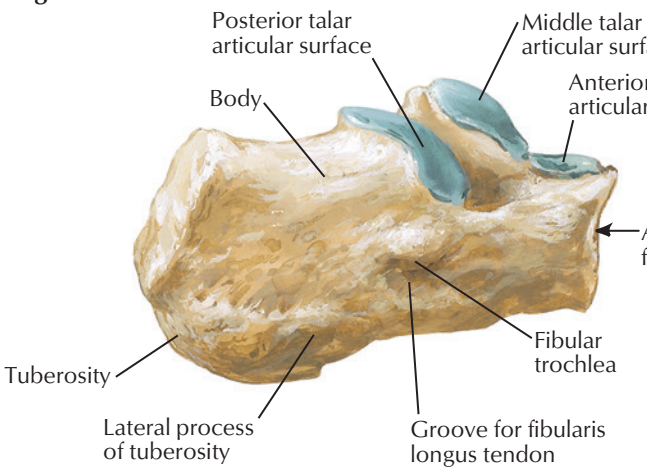

Dorsal view
Base
Head
Body
Base
Head
Phalangeal bones
Distal
Middle
Proximal
Body
1
2
3
4
5
Metatarsal bones
Base
Tarsometatarsal joint
Cuneiform bones
Medial
Intermediate
Lateral
Tuberosity of 5th metatarsal bone
Tuberosity
Navicular
Cuboid bone
Transverse tarsal joint
Head
Neck
Trochlea
Tarsal sinus
Calcaneus
Fibular trochlea
Talus
Posterior process
Groove for tendon of flexor hallucis longus muscle
Medial tubercle
Lateral tubercle
Body
Plantar view
Distal
Middle
Proximal
Phalangeal bones
Base
Head
Base
Head
Lateral
Medial
Sesamoid bones
Body
Base
Head
Body
1
2
3
4
5
Metatarsal bones
Tarsometatarsal joint
Medial
Intermediate
Lateral
Cuneiform bones
Base
Tuberosity of 5th metatarsal bone
Cuboid bones
Groove for fibularis (peroneus) longus tendon
Tuberosity
Tuberosity
Navicular
Transverse tarsal joint
Calcaneus
Fibular trochlea
Groove for tendon of flexor hallucis longus muscle
Sustentaculum tali
Lateral process
Medial process
Tuberosity
Head
Posterior process
Medial tubercle
Lateral tubercle
Talus

See also Plate 535

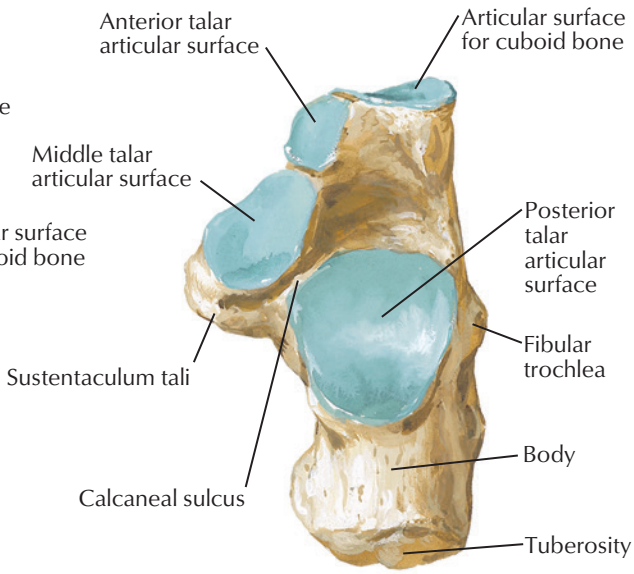




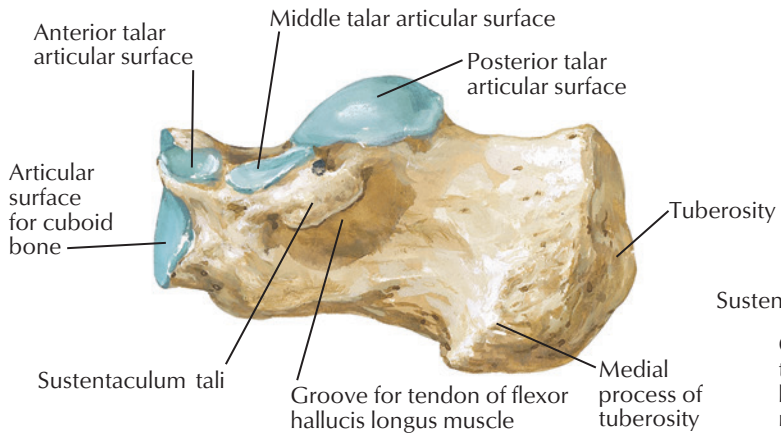
Right foot



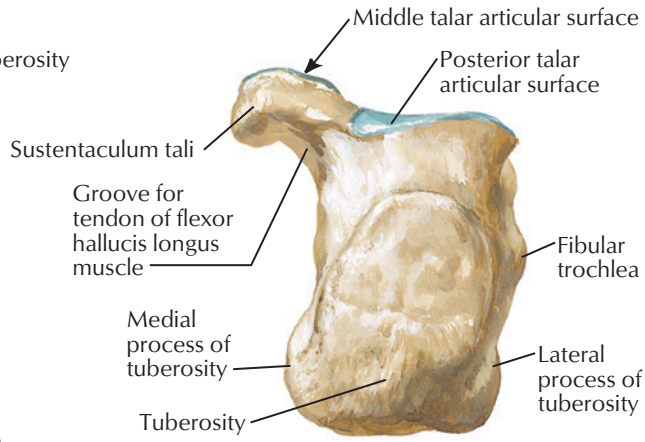
Lateral view



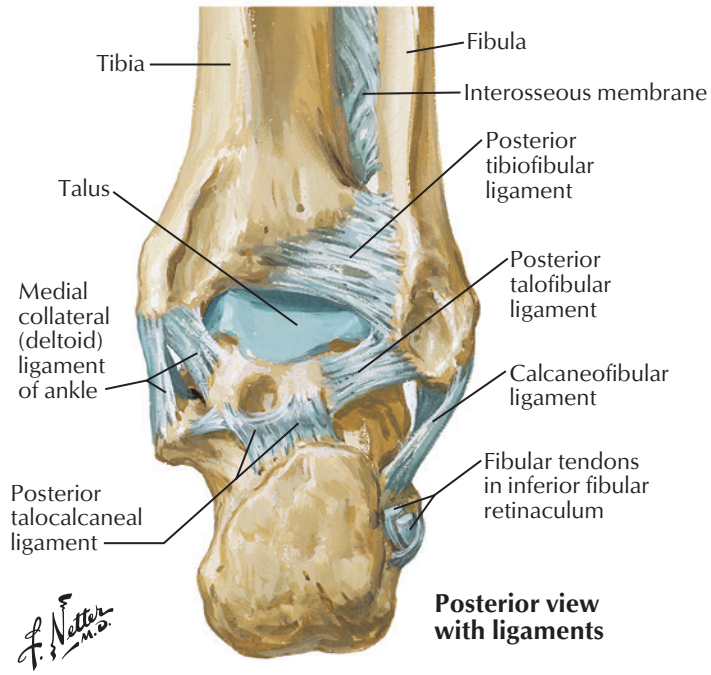
Superior view



Medial view

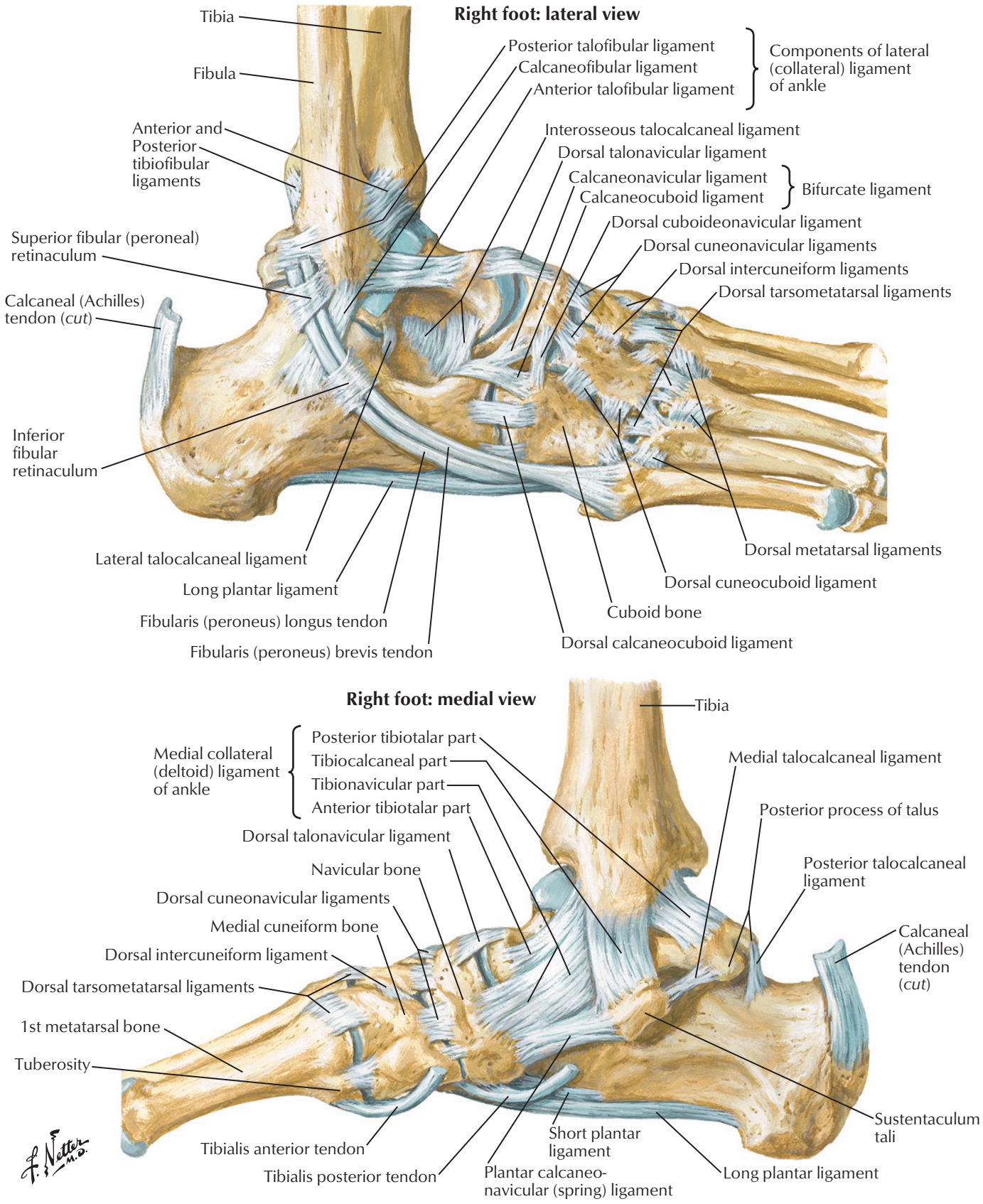


Posterior view

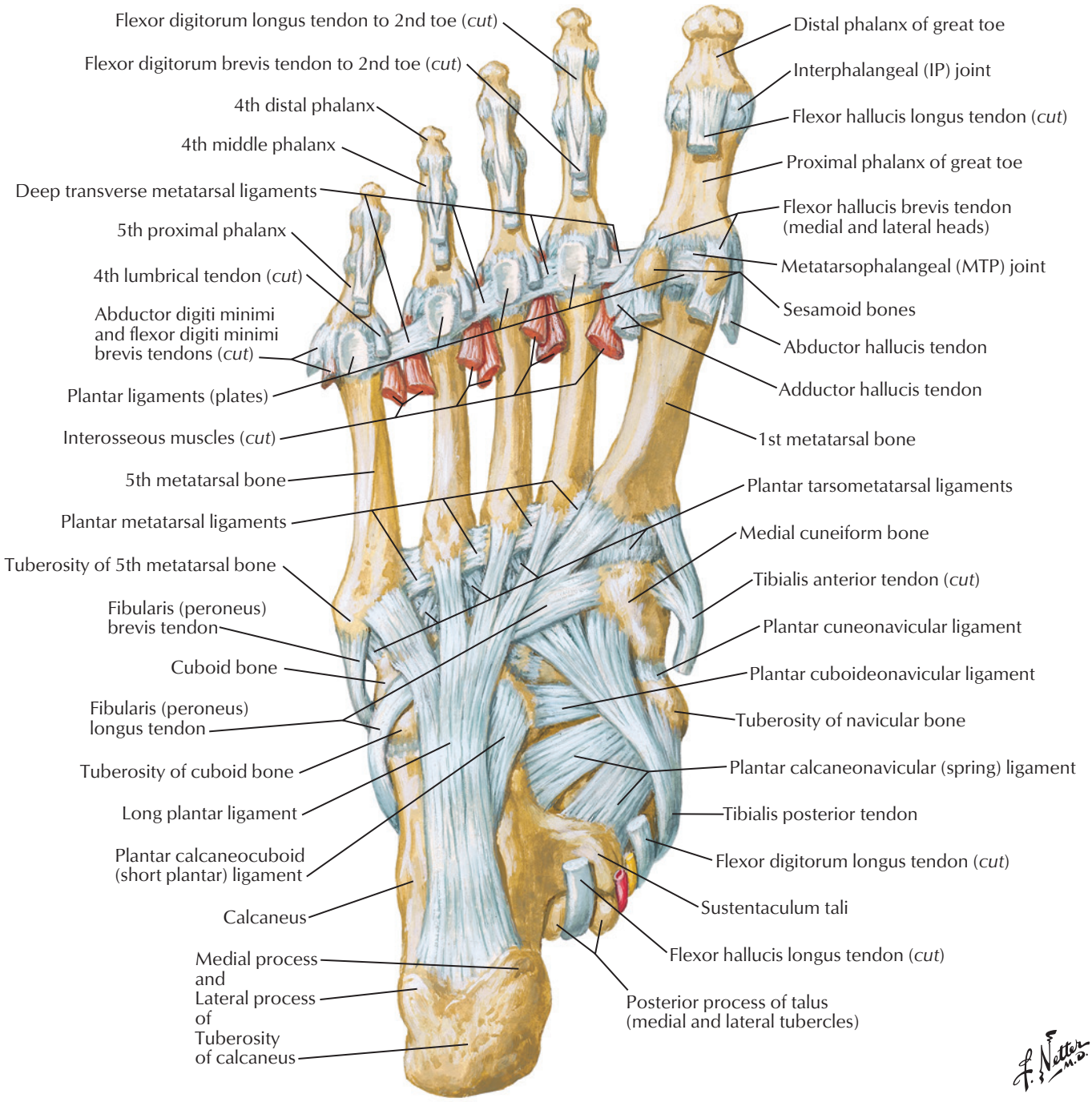


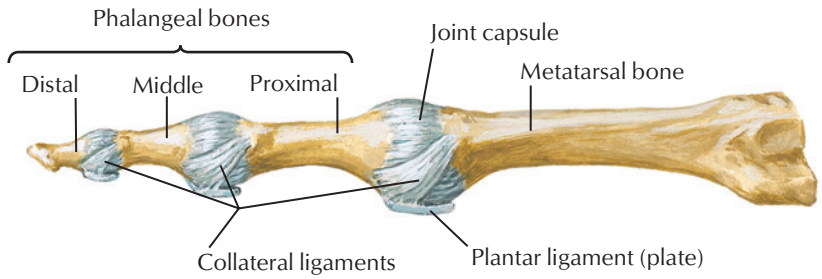
Posterior view with ligaments

See also Plate 535



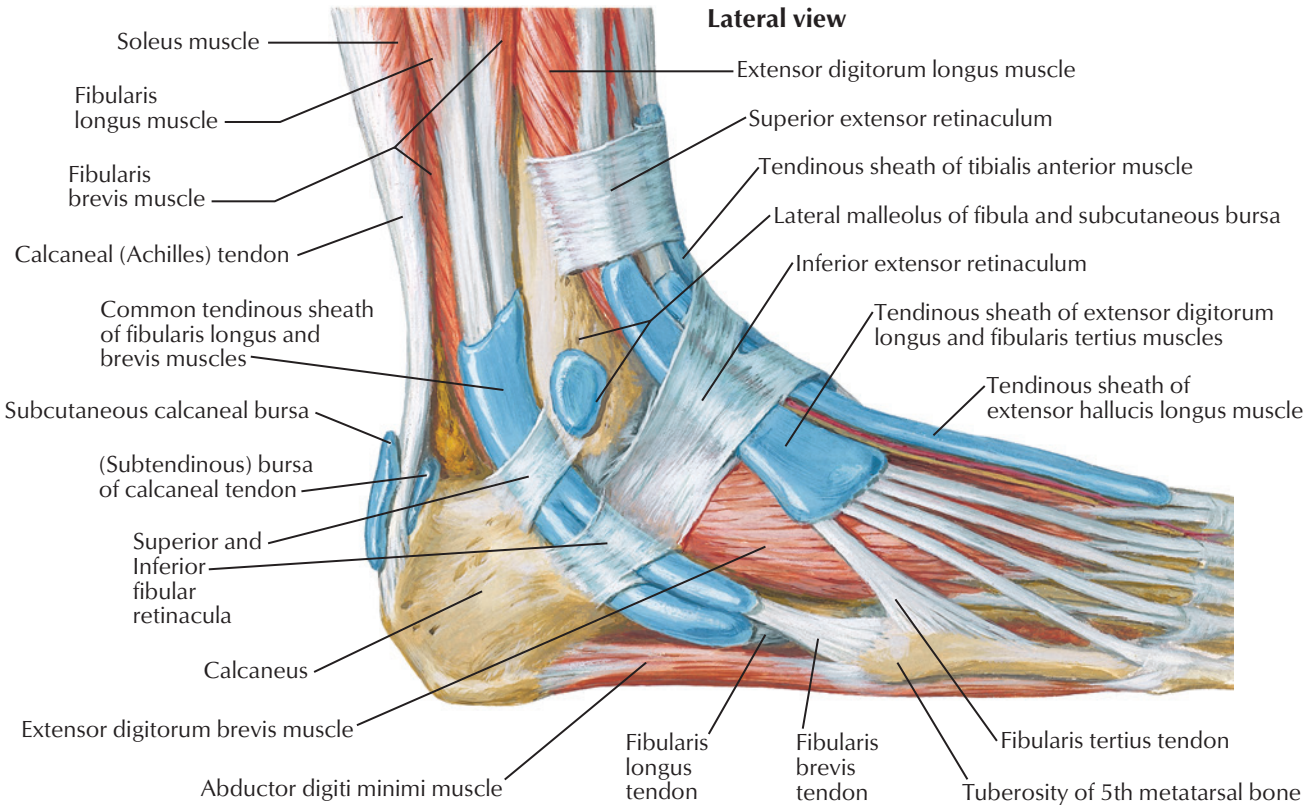
See also Plates 526, 527

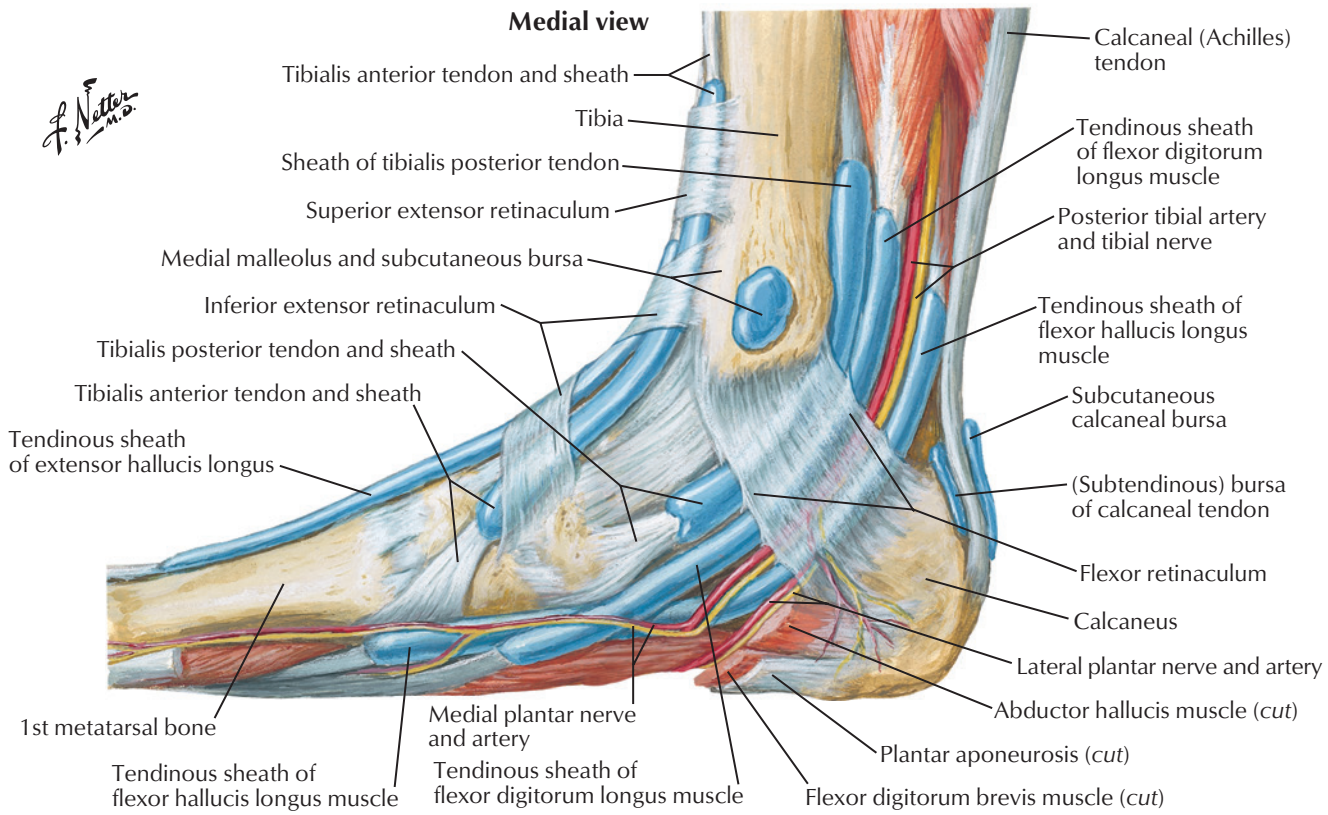




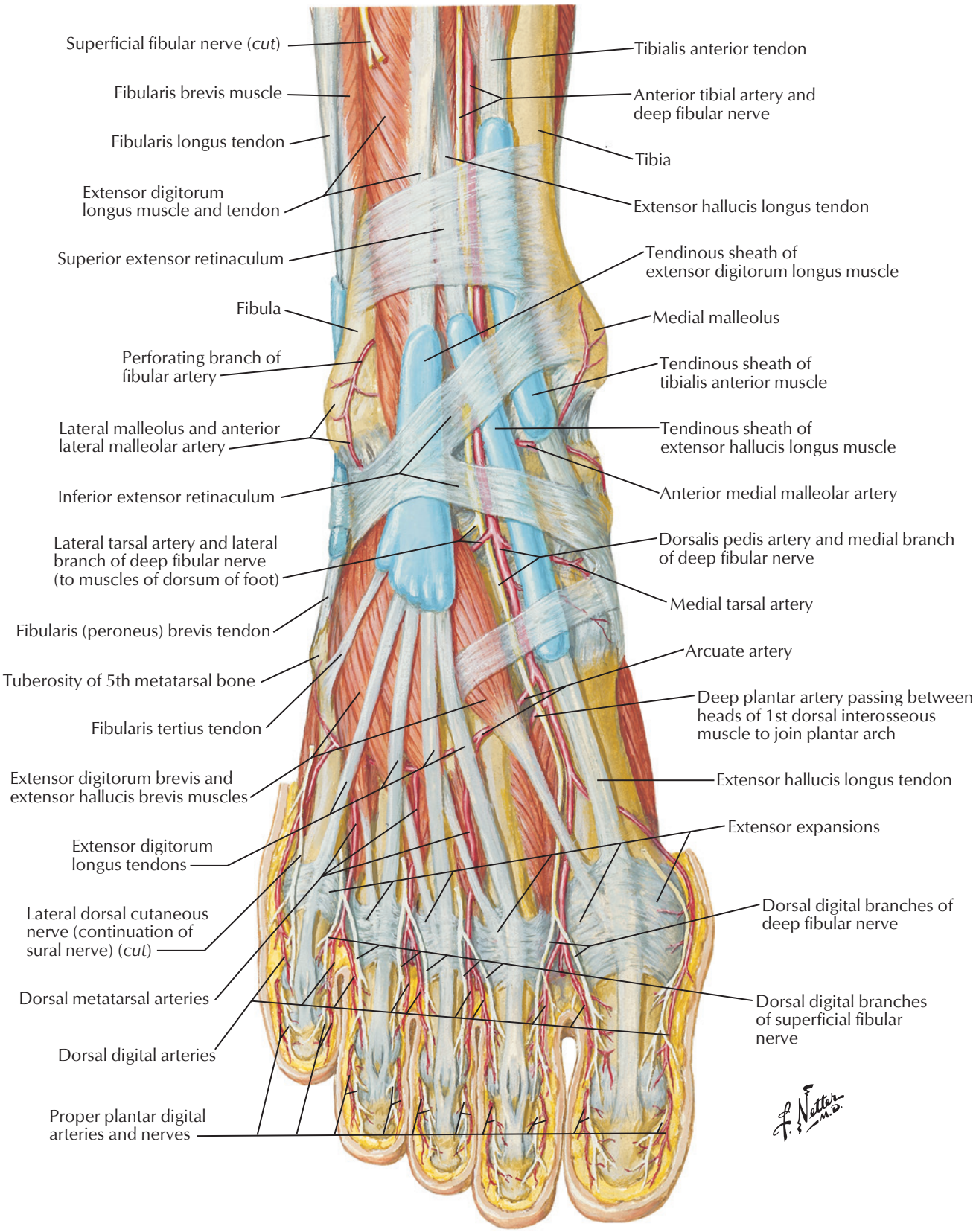
Capsules and ligaments of metatarsophalangeal and interphalangeal joints: lateral view

See also Plate 510

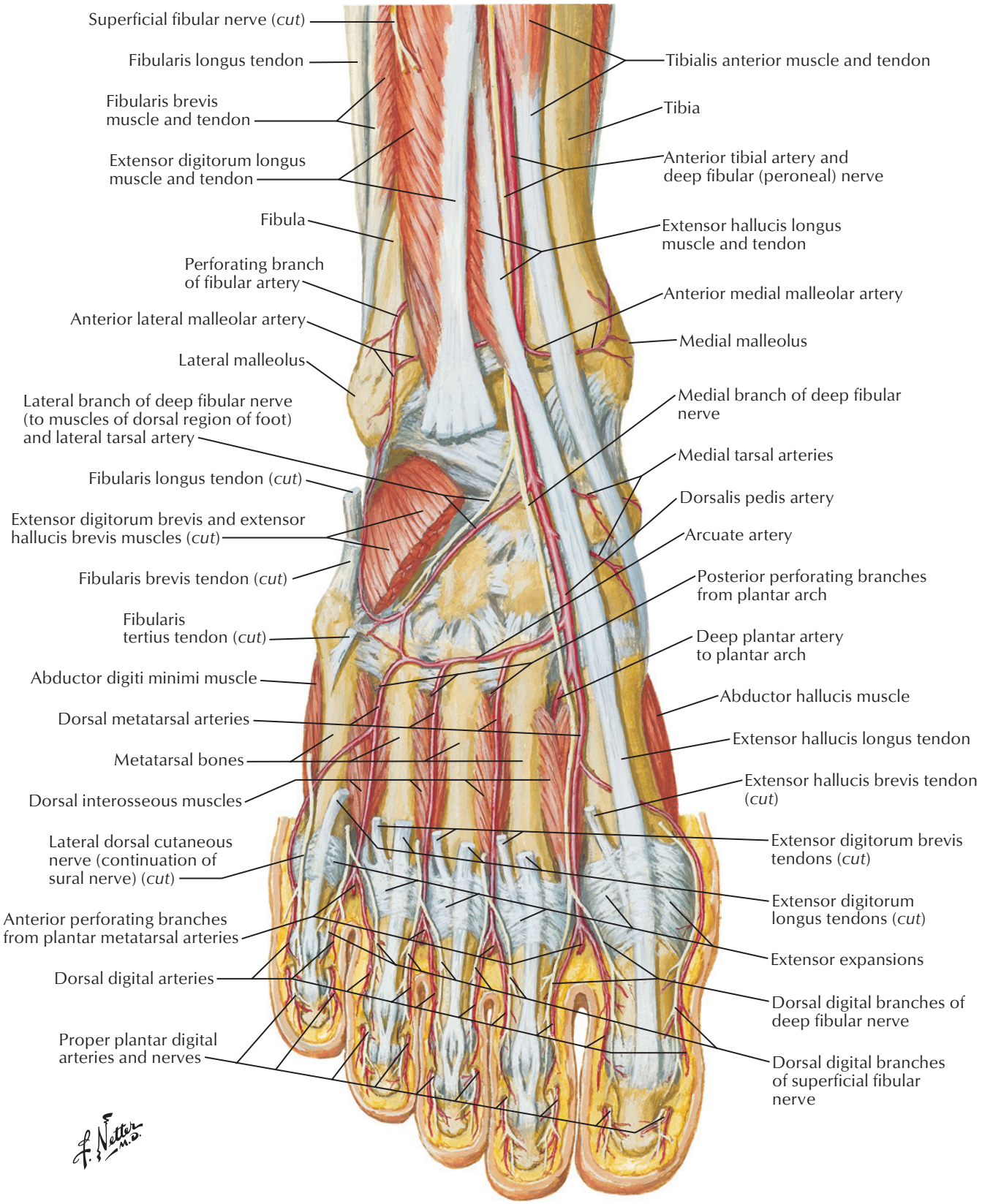


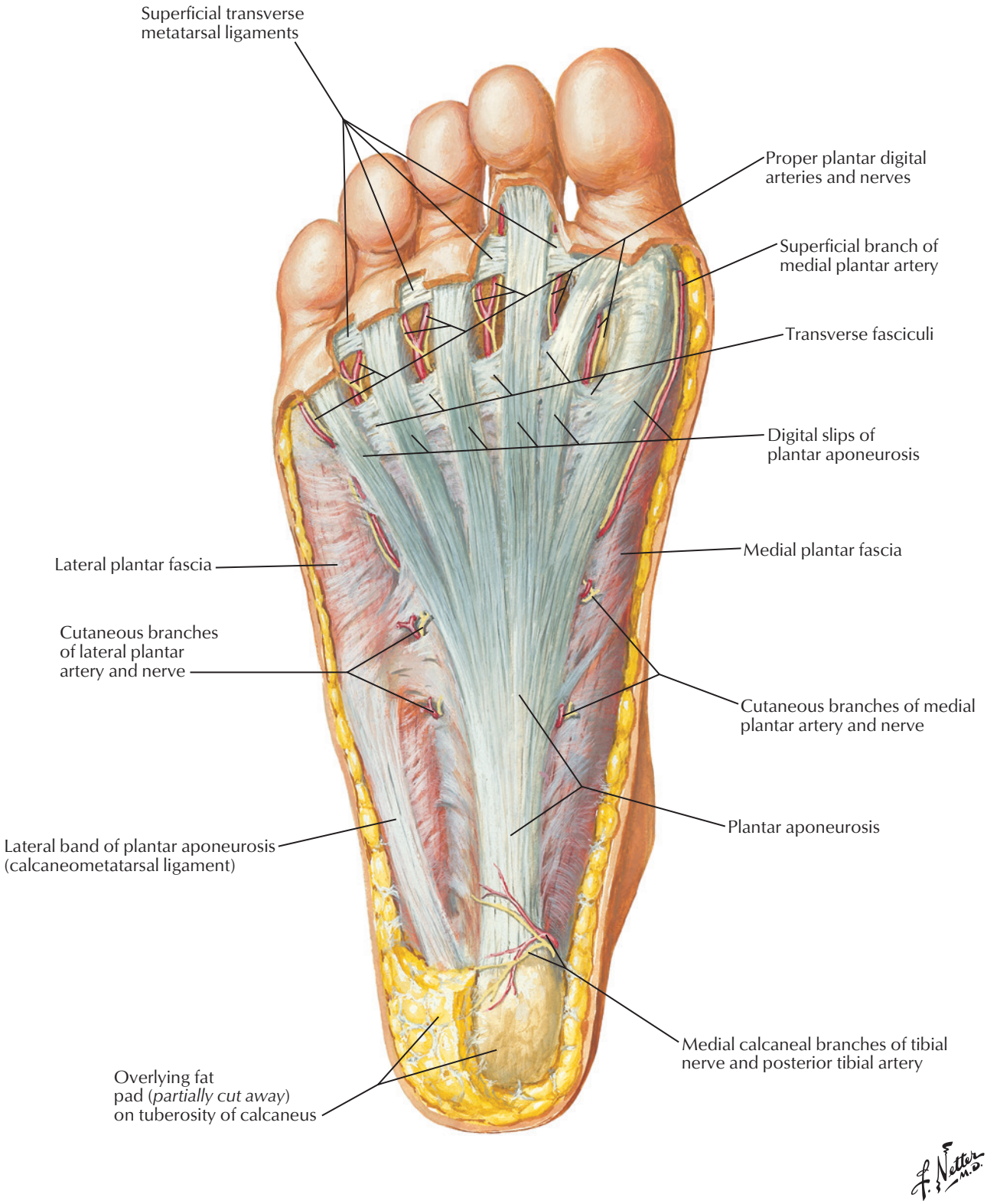


See also Plate 533



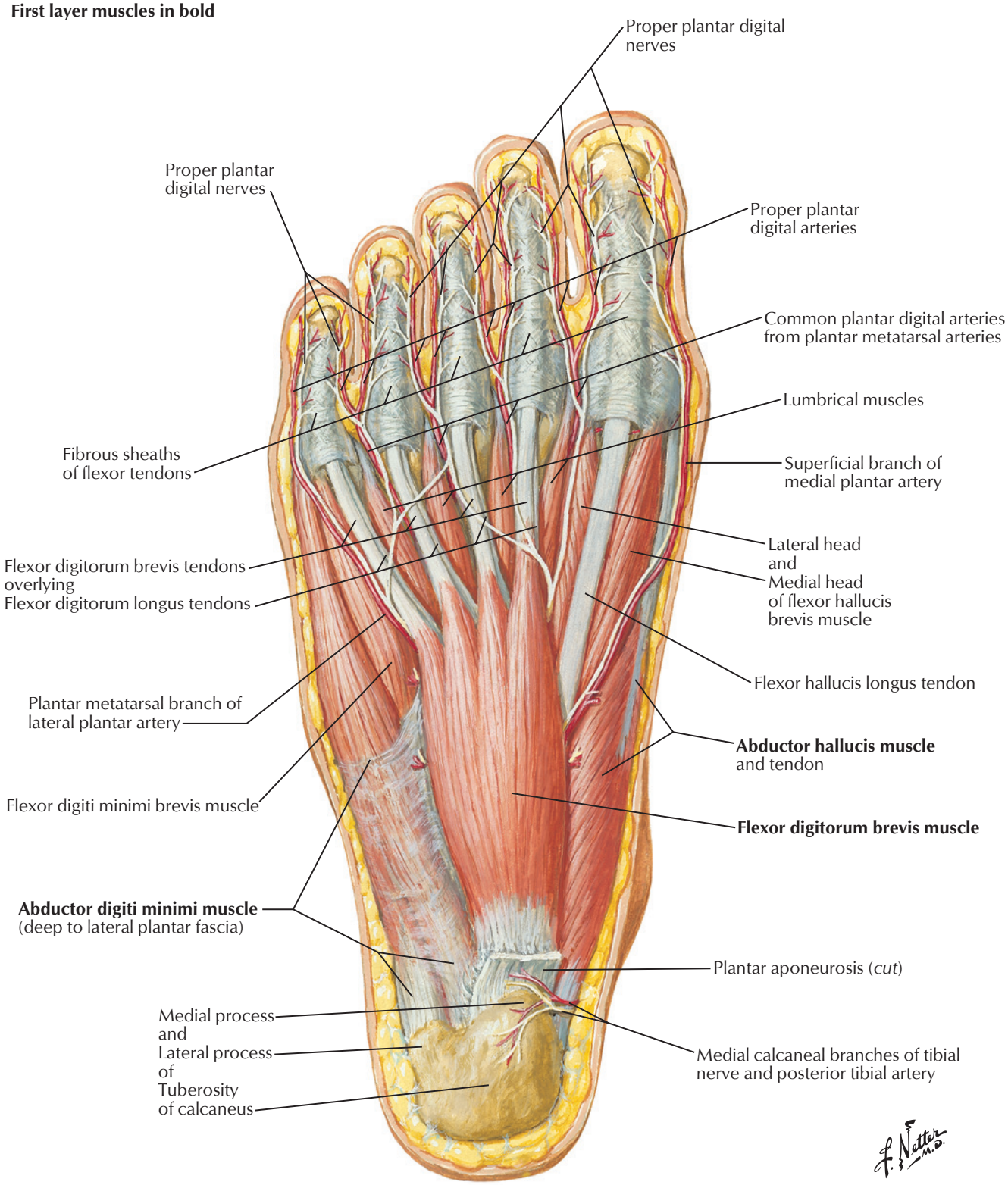
See also Plate 527



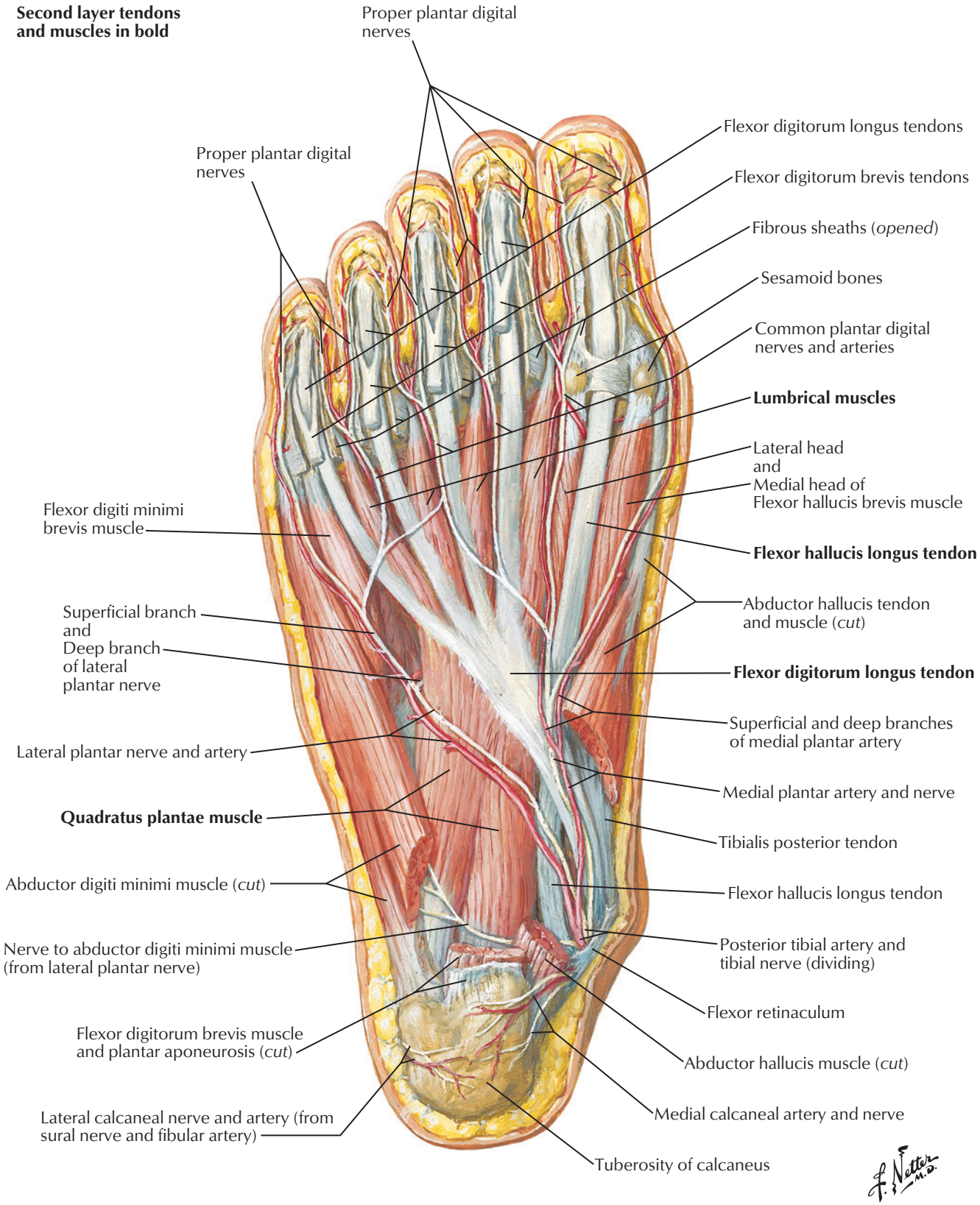

Superficial transverse metatarsal ligaments
Proper plantar digital arteries and nerves
Superficial branch of medial plantar artery
Transverse fasciculi
Digital slips of plantar aponeurosis
Lateral plantar fascia
Medial plantar fascia
Cutaneous branches of lateral plantar artery and nerve
Cutaneous branches of medial plantar artery and nerve
Plantar aponeurosis
Lateral band of plantar aponeurosis (calcaneometatarsal ligament)
Medial calcaneal branches of tibial nerve and posterior tibial artery
Overlying fat pad (*partially cut away*) on tuberosity of calcaneus

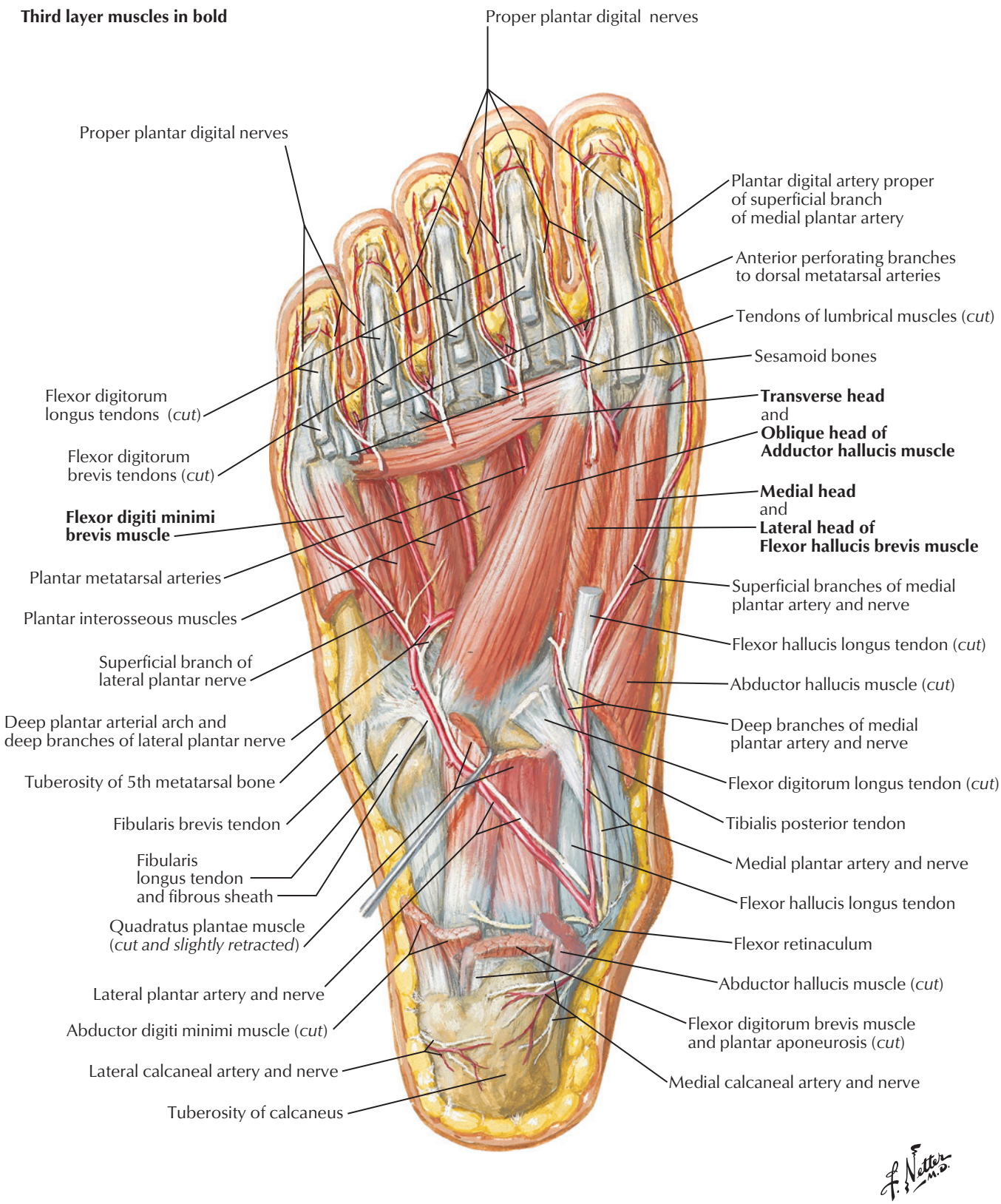
See also Plate 532

First layer muscles in bold



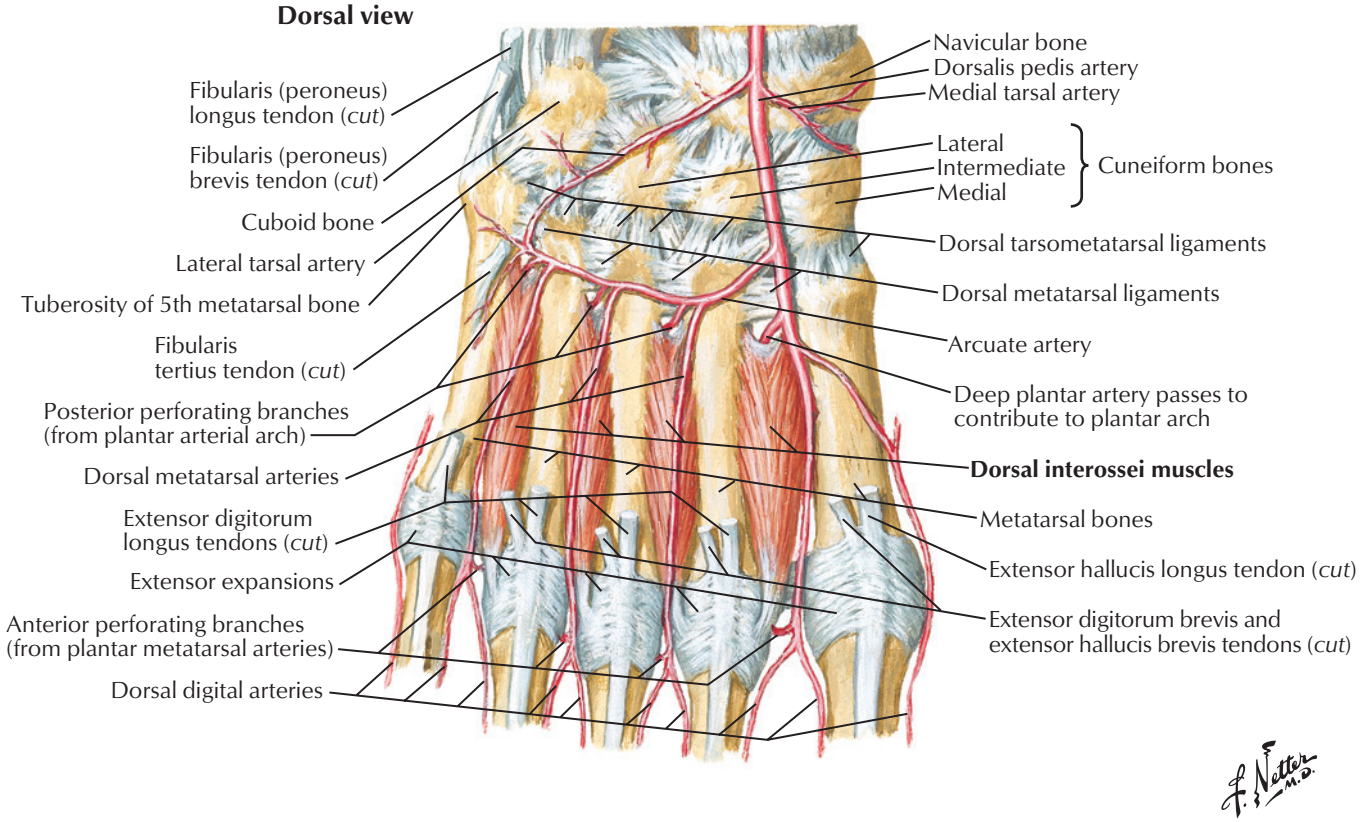
See also Plate 532



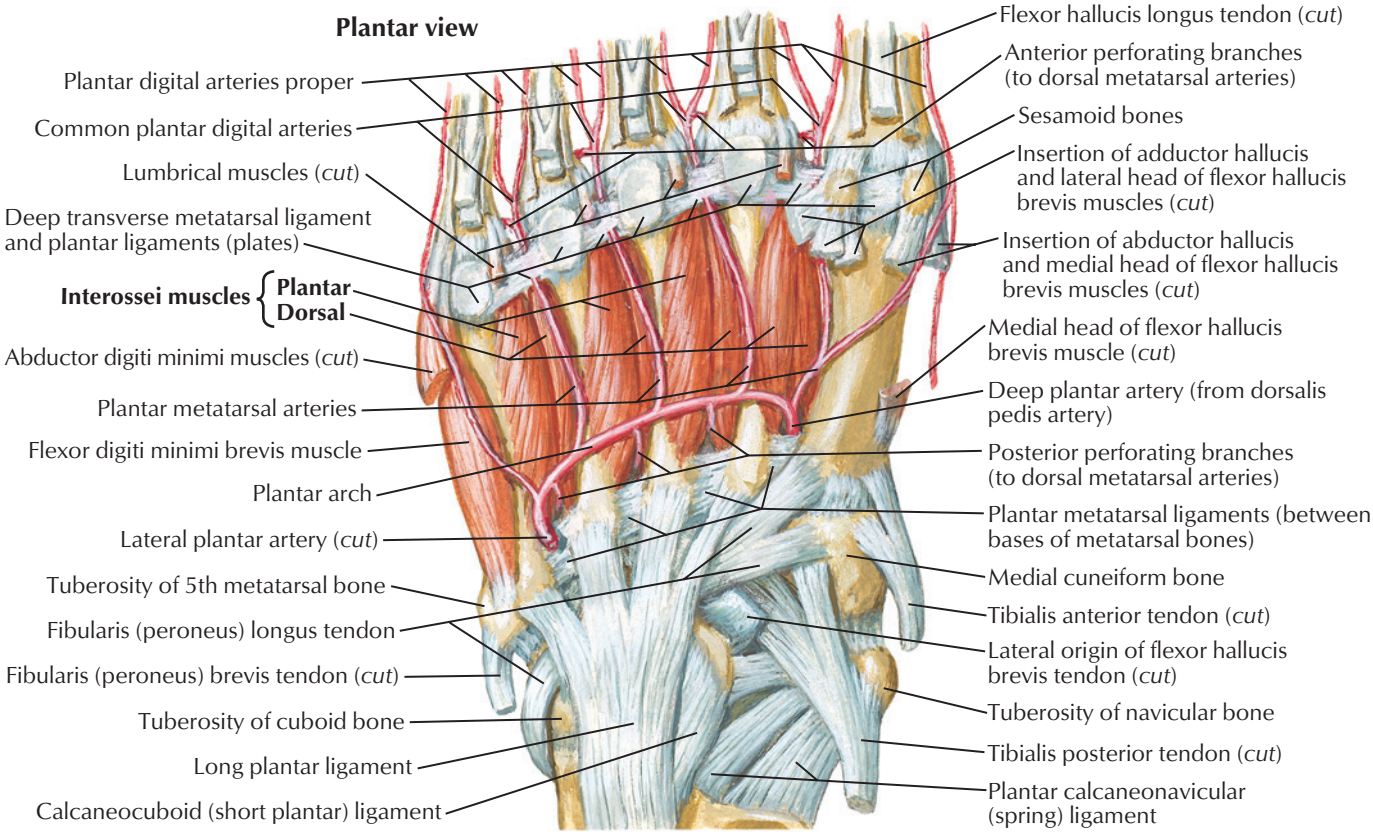

Third layer muscles in bold
Proper plantar digital nerves
Proper plantar digital nerves
Plantar digital artery proper of superficial branch of medial plantar artery
Anterior perforating branches to dorsal metatarsal arteries
Tendons of lumbrical muscles (cut)
Sesamoid bones
Flexor digitorum longus tendons (cut)
Transverse head and Oblique head of Adductor hallucis muscle
Flexor digitorum brevis tendons (cut)
Medial head and Lateral head of Flexor hallucis brevis muscle
Flexor digiti minimi brevis muscle
Plantar metatarsal arteries
Plantar interosseous muscles
Superficial branches of medial plantar artery and nerve
Superficial branch of lateral plantar nerve
Flexor hallucis longus tendon (cut)
Abductor hallucis muscle (cut)
Deep plantar arterial arch and deep branches of lateral plantar nerve
Deep branches of medial plantar artery and nerve
Tuberosity of 5th metatarsal bone
Flexor digitorum longus tendon (cut)
Fibularis brevis tendon
Tibialis posterior tendon
Fibularis longus tendon and fibrous sheath
Medial plantar artery and nerve
Flexor hallucis longus tendon
Quadratus plantae muscle (cut and slightly retracted)
Flexor retinaculum
Lateral plantar artery and nerve
Abductor hallucis muscle (cut)
Abductor digiti minimi muscle (cut)
Flexor digitorum brevis muscle and plantar aponeurosis (cut)
Lateral calcaneal artery and nerve
Medial calcaneal artery and nerve
Tuberosity of calcaneus

See also Plates 512, 522, 526

Dorsal view

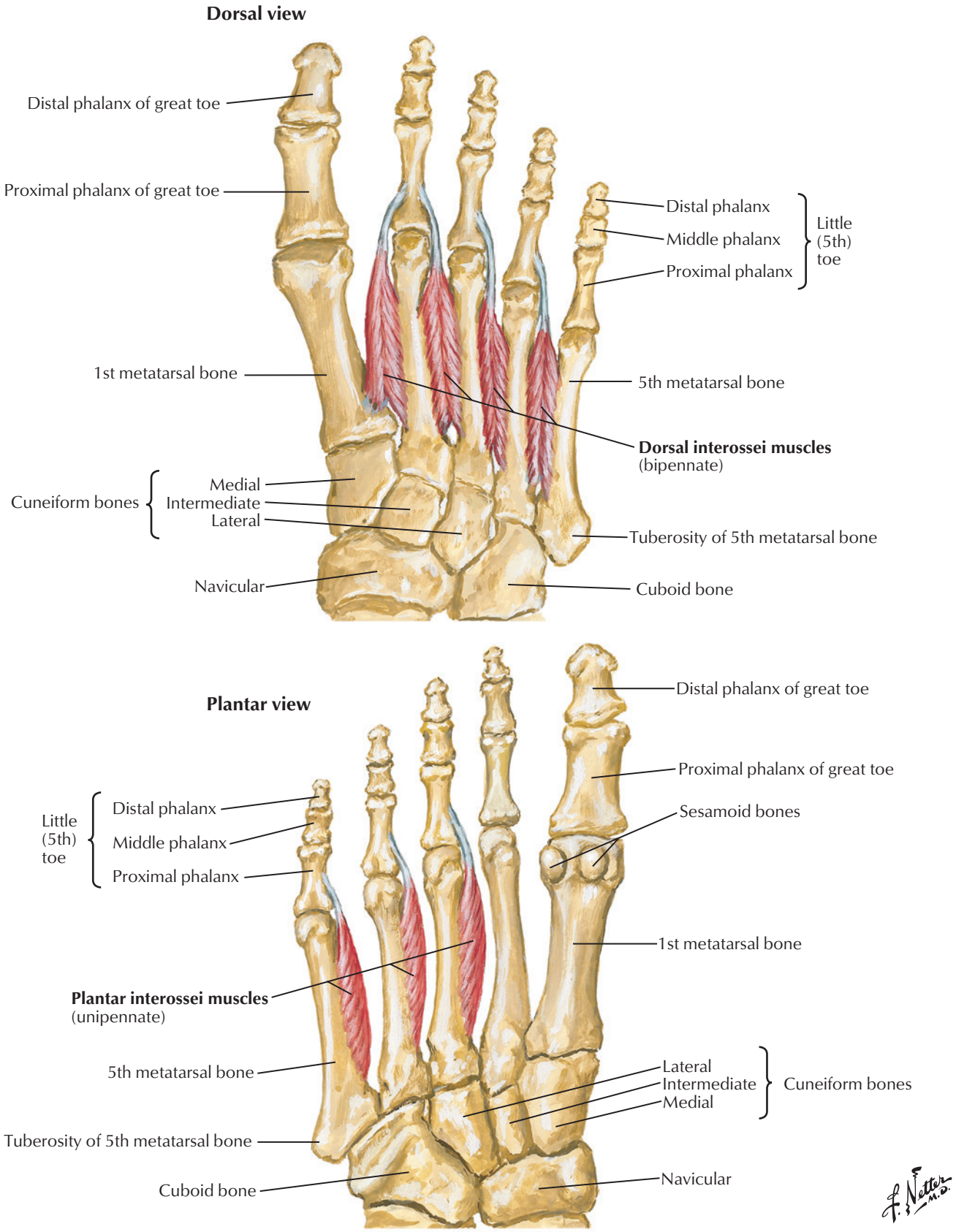


Plantar view

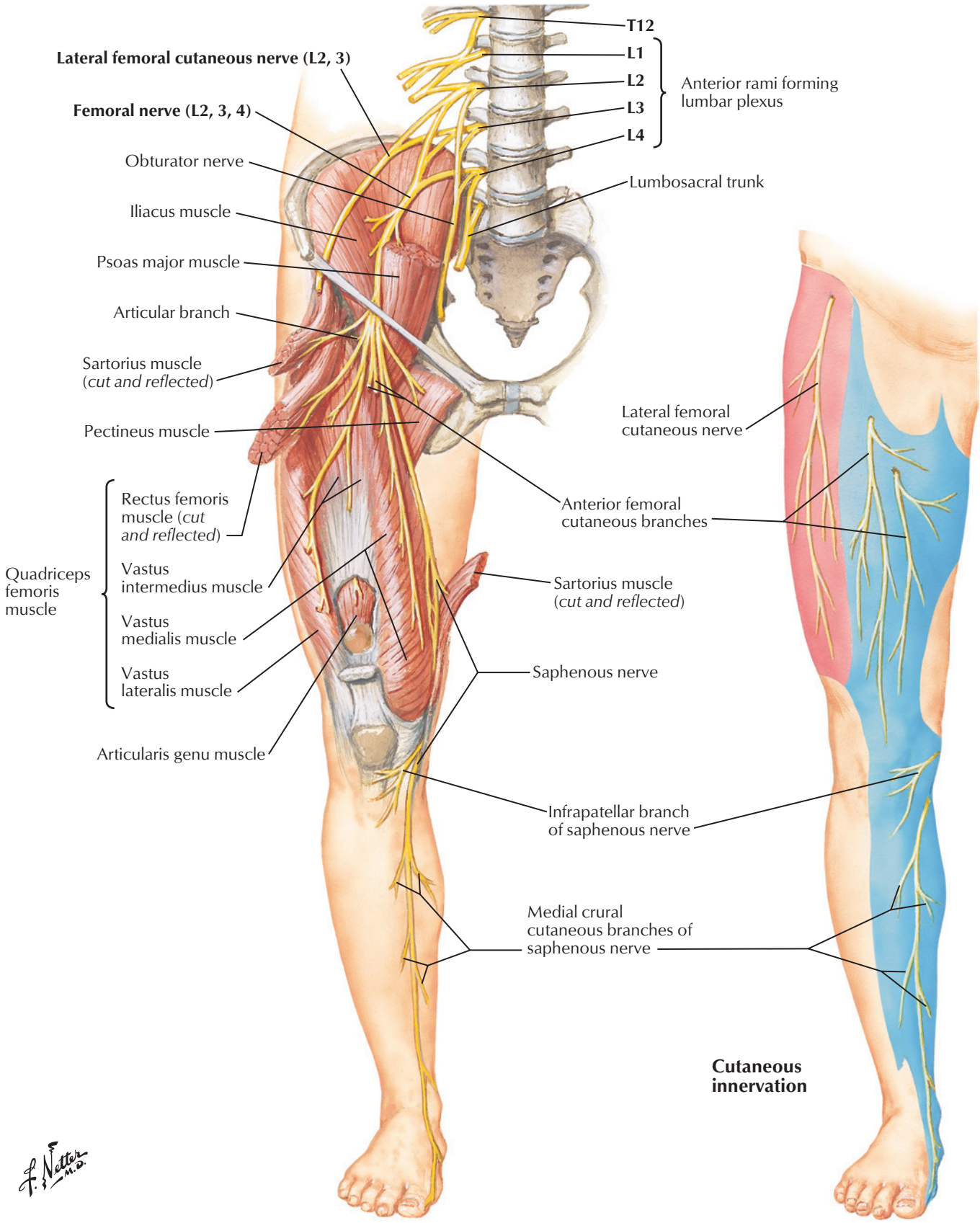


Fourth layer muscles in bold

See also Plate 527

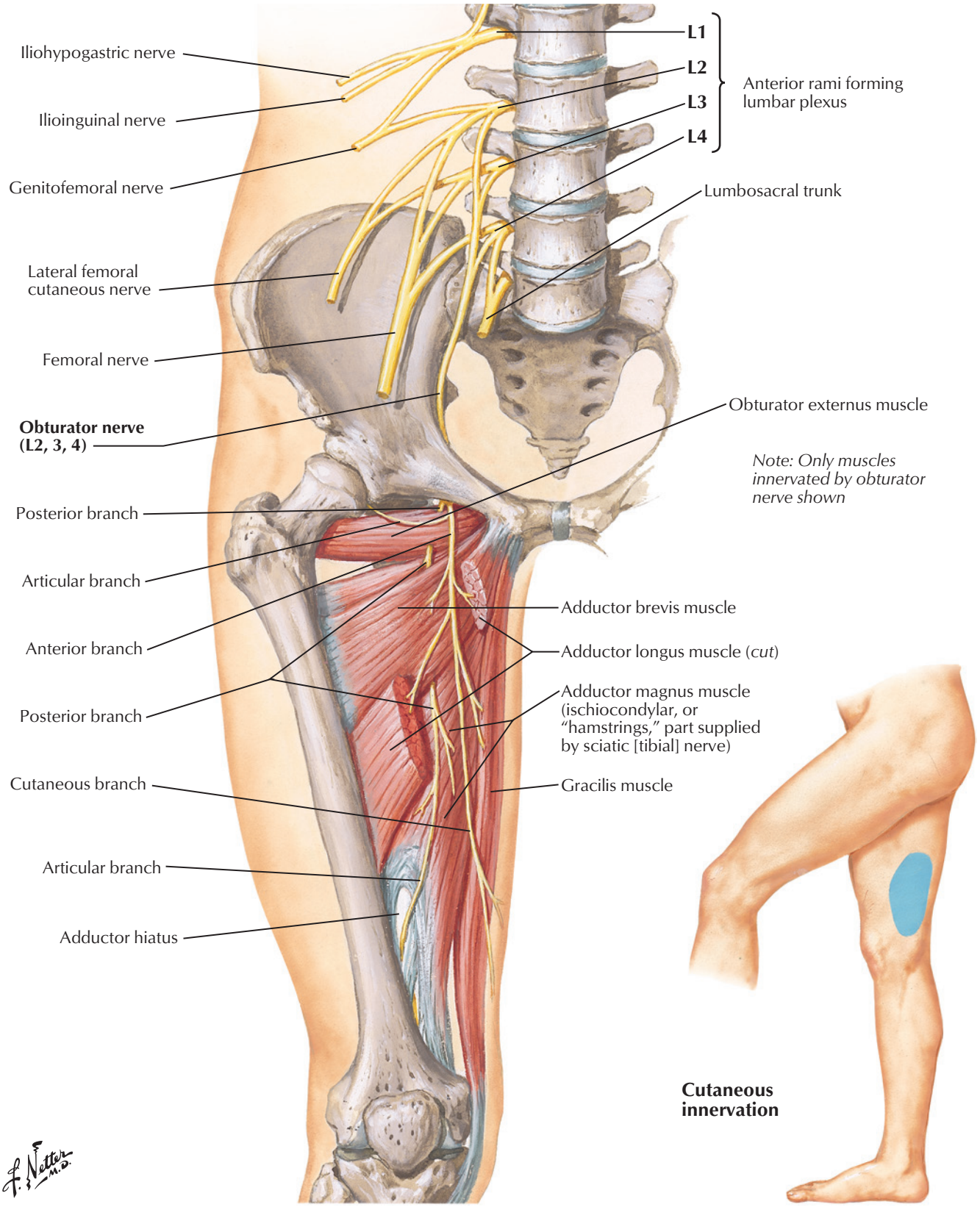


See also Plates 269, 490, 491

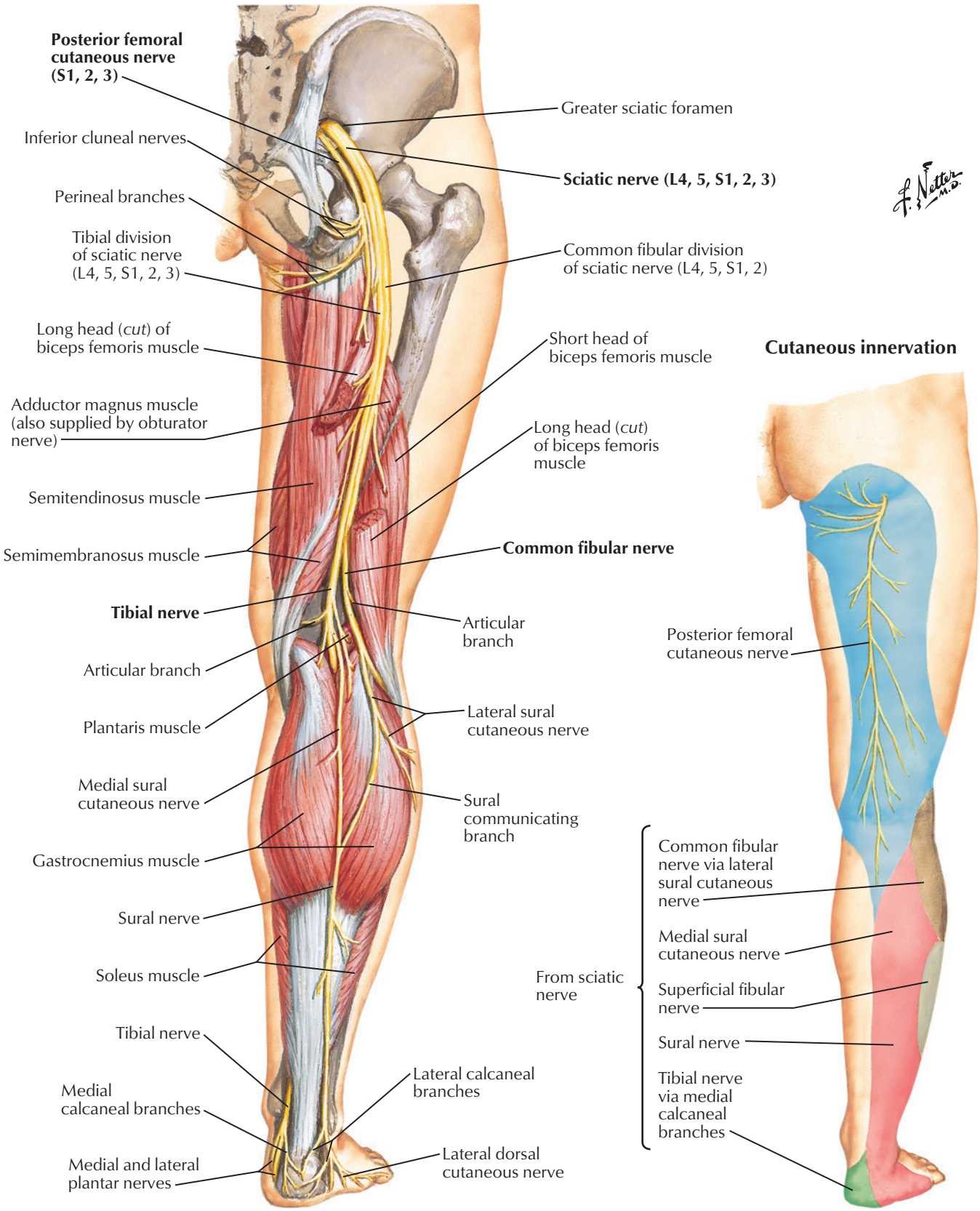


Obturator Nerve

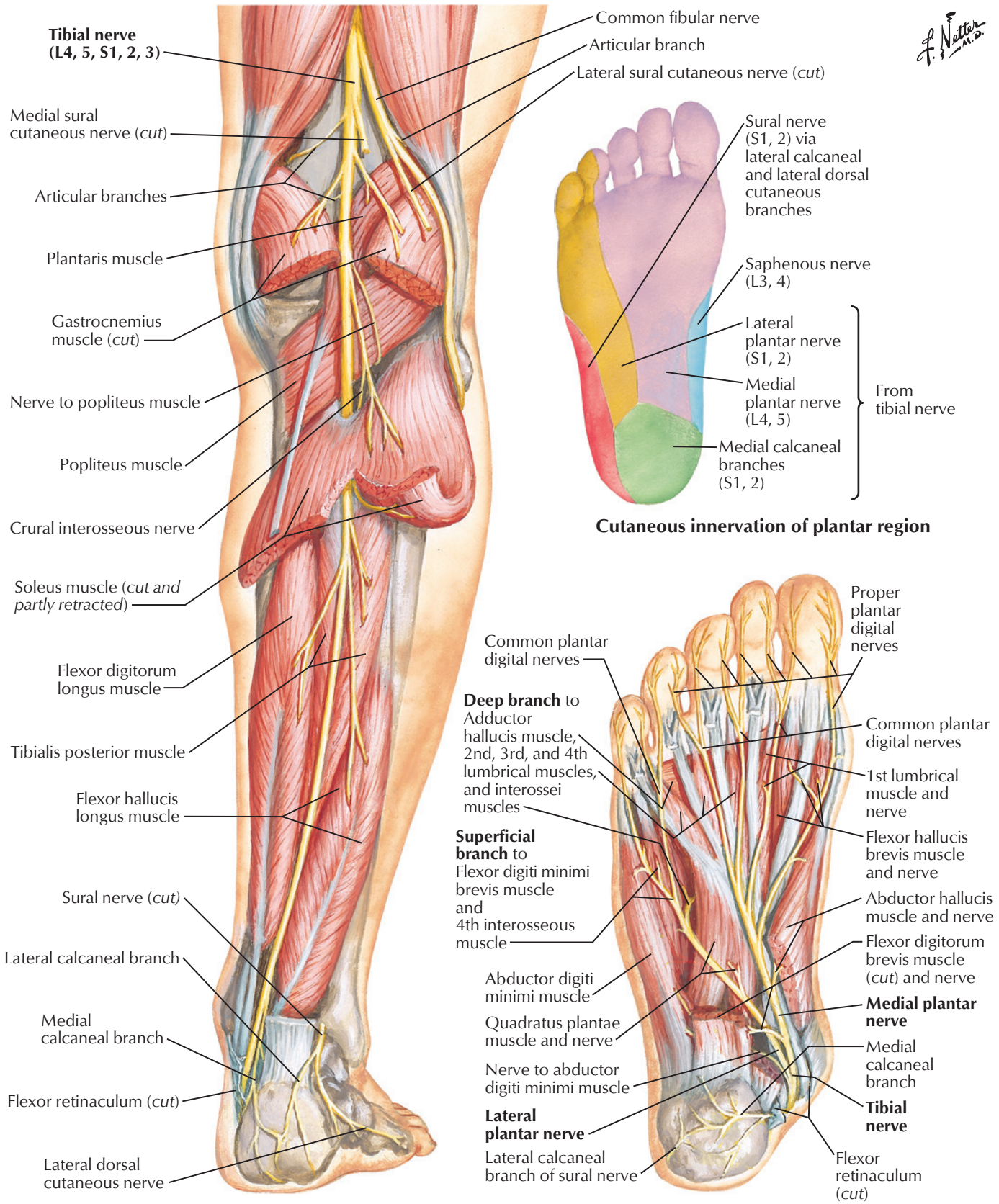
See also Plate 491



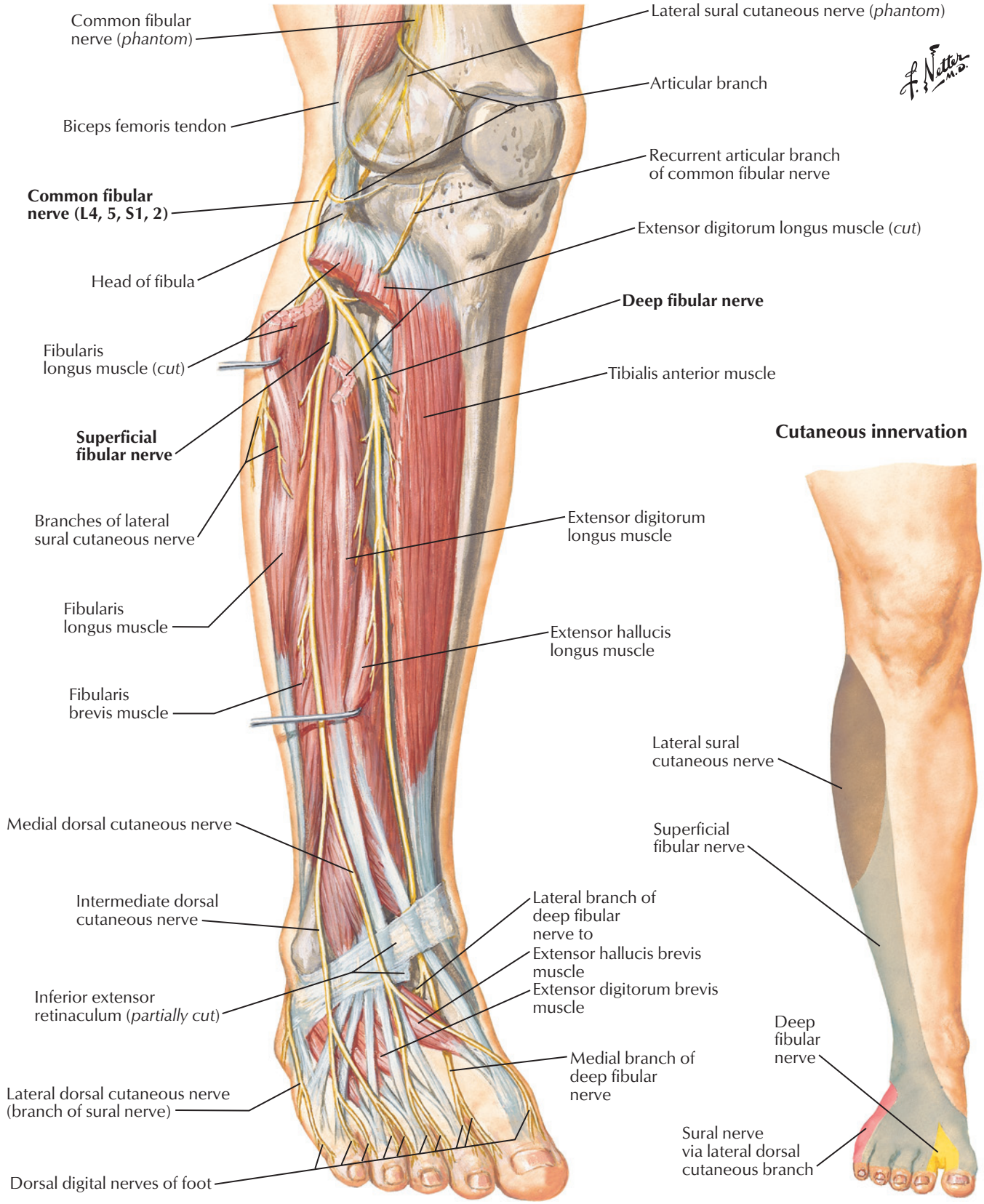
See also Plate 492



See also Plates 507, 524, 525

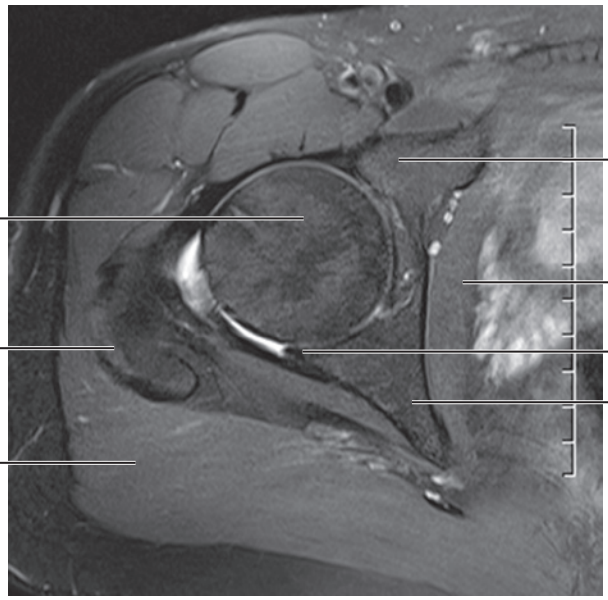


See also Plates 510, 512

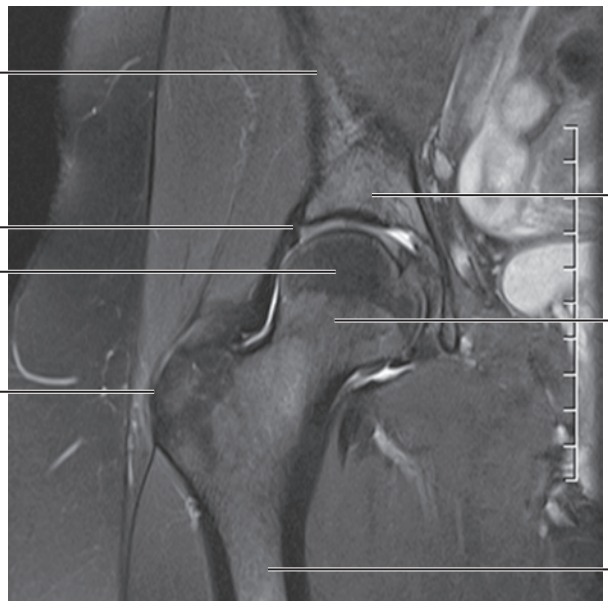


See also Plates 334, 400, 495

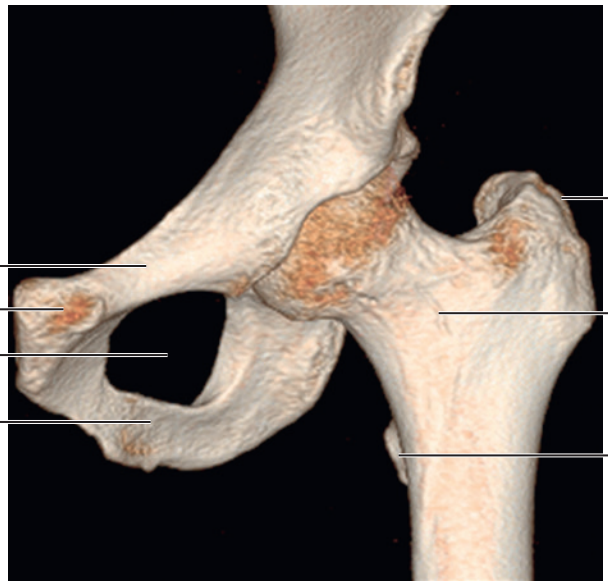
Axial T2-Weighted MRI



Coronal T2-Weighted MRI



3D CT of Hip

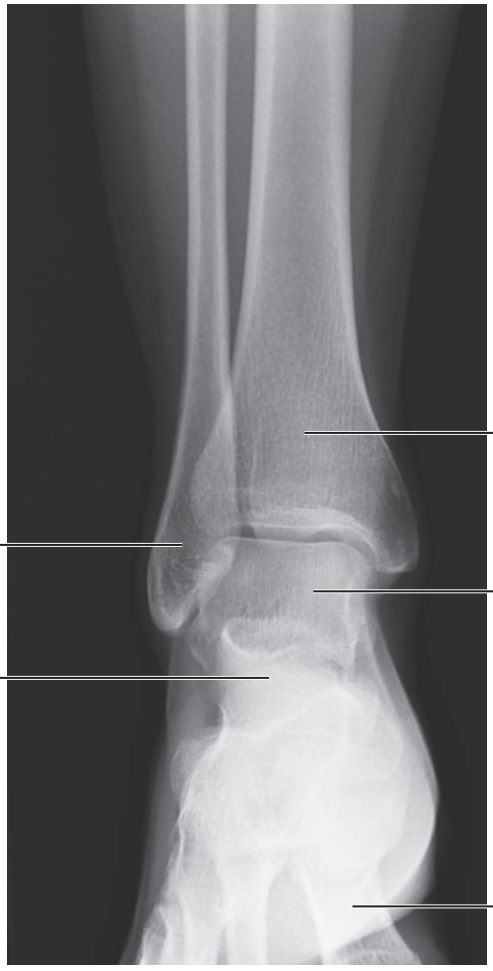


See also Plates 510, 517, 518

Lateral view



Anterior view



ANATOMICAL STRUCTURES	CLINICAL IMPORTANCE	PLATE NUMBERS
SKELETAL SYSTEM		
Neck of femur	Common fracture in elderly persons; can lead to avascular necrosis of femoral head	478, 479, 495
Shaft of femur	The midshaft is a common fracture site in high-energy trauma (motor vehicle accidents)	479
Hip joint	Potential for vascular necrosis of femoral head in hip dislocations or fractures	477, 495
Medial (tibial) collateral ligament, anterior cruciate ligament, and medial meniscus	"Unhappy triad" from blow to lateral aspect of joint in extension; damage to medial collateral and anterior cruciate ligaments and medial meniscus	498, 499, 500
Tibia and fibula	High-energy fractures of shaft (boot-top skiing fracture) from falling forward at high speed	504
First metatarsophalangeal joint	Joint misalignment leading to hallux valgus (bunion), often result of wearing shoes that are too narrow; also, strong genetic component	515
Calcaneus	Most common tarsal bone fracture, usually caused by landing forcefully on heel after falling from height	517
Ankle joint	Most sprains are inversion injuries that occur when foot is plantarflexed; places stress on lateral ligaments of ankle	518
MUSCULAR SYSTEM		
Gracilis, adductor longus, adductor brevis, adductor magnus	Excessive stretching or tearing of thigh adductor muscles is common in sports that require repeated sprints or quick changes in direction (e.g., soccer, hockey)	482, 483
Patellar ligament	Striking patellar ligament with reflex hammer elicits patellar (knee jerk) reflex to test L3 to L4 spinal cord levels (innervation of quadriceps femoris muscle by femoral nerve)	482, 498
Iliotibial tract (band)	Commonly injured in runners as iliotibial tract rubs across lateral femoral epicondyle	484, 497
Semitendinosus, semimembranosus, biceps femoris (long head)	Excessive stretching or tearing of hamstring muscles occurs most often during high-speed running or activities with high kicks	485
Piriformis muscle	Piriformis muscle strain or structural variations (e.g., split piriformis muscle) may produce compression of sciatic nerve	492
Gluteus medius and minimus muscles (superior gluteal nerve)	Paralysis of these muscles results in contralateral pelvic dip due to weakened hip abduction when standing on affected limb (Trendelenburg sign or gait)	493
Calcaneal (Achilles) tendon	Inflammation results from repetitive stress on tendon, often from running on uneven surfaces; extreme stress may cause tendon to rupture	507, 508, 518
Calcaneal (Achilles) tendon	Striking calcaneal tendon with reflex hammer elicits ankle (ankle jerk) reflex to test S1 to S2 spinal cord levels (innervation of superficial calf muscles by tibial nerve)	507, 508, 531
Anterior compartment of leg	Exertional compartment syndromes (midtibial pain; shin splints) usually result from excessive training (swelling, periostitis, or stress fractures occur because of tight fascial boundaries of muscle compartments)	514
Plantar aponeurosis	Inflammation results from increased tension, weight, or overuse, causing heel and foot pain (plantar fasciitis; heel spur syndrome)	523

ANATOMICAL STRUCTURES	CLINICAL IMPORTANCE	PLATE NUMBERS
NERVOUS SYSTEM		
Sural nerve	Nerve is commonly biopsied for peripheral neuropathies and commonly used as donor graft in neurotization procedure	474, 531
Common fibular nerve	Injury to this nerve from blunt trauma or compression by leg cast weakens dorsiflexion and results in foot drop	529, 531, 533
Obturator nerve	Nerve is blocked or transected for adductor muscle spasticity in cerebral palsy; may be injured during pelvic fractures or pelvic surgical procedures such as lymphadenectomy	530
Femoral nerve	Can be compressed from femoral hematoma and can be anesthetized for procedures of the lower limb	488, 490, 529
Saphenous nerve	Can be anesthetized in the adductor canal to provide pain relief after knee replacement	473, 490, 529
CARDIOVASCULAR SYSTEM		
Deep veins of leg	Deep venous thrombosis of deep leg veins is due to venous stasis, vessel injury, and/or coagulation disorders; can lead to thrombus formation and thromboemboli	513
Great saphenous vein	Often used as coronary artery bypass grafts	473
Superficial veins	Varicose veins (dilated tortuous superficial veins connected by perforating veins to deeper veins with incompetent venous valves)	473, 513
Femoral artery in femoral triangle; popliteal artery in deep popliteal region of knee; dorsalis pedis artery on dorsum of foot; posterior tibial artery in tarsal tunnel posterior to medial malleolus	Lower limb pulse points	490, 503, 508, 513
Major arteries of lower limb (femoral artery, popliteal artery, tibial artery, and fibular artery)	Peripheral arterial disease due to atherosclerosis may occur in major arteries of lower limb, resulting in reduced blood flow; patients experience claudication (cramping pain in thigh or calf), especially upon exertion	503
LYMPHATIC SYSTEM		
Superficial inguinal nodes	Superficial inguinal nodes drain the lower limb, gluteal region, lower abdominal region, and perineum; are palpable when enlarged	475
Lymph vessels	Lymphedema (stasis of lymph flow in lymph vessels obstructed by inflammation, fibrosis, tumor, or abnormally small diameter)	475

*Selections were based largely on clinical data as well as commonly covered clinical correlations in gross anatomy courses.

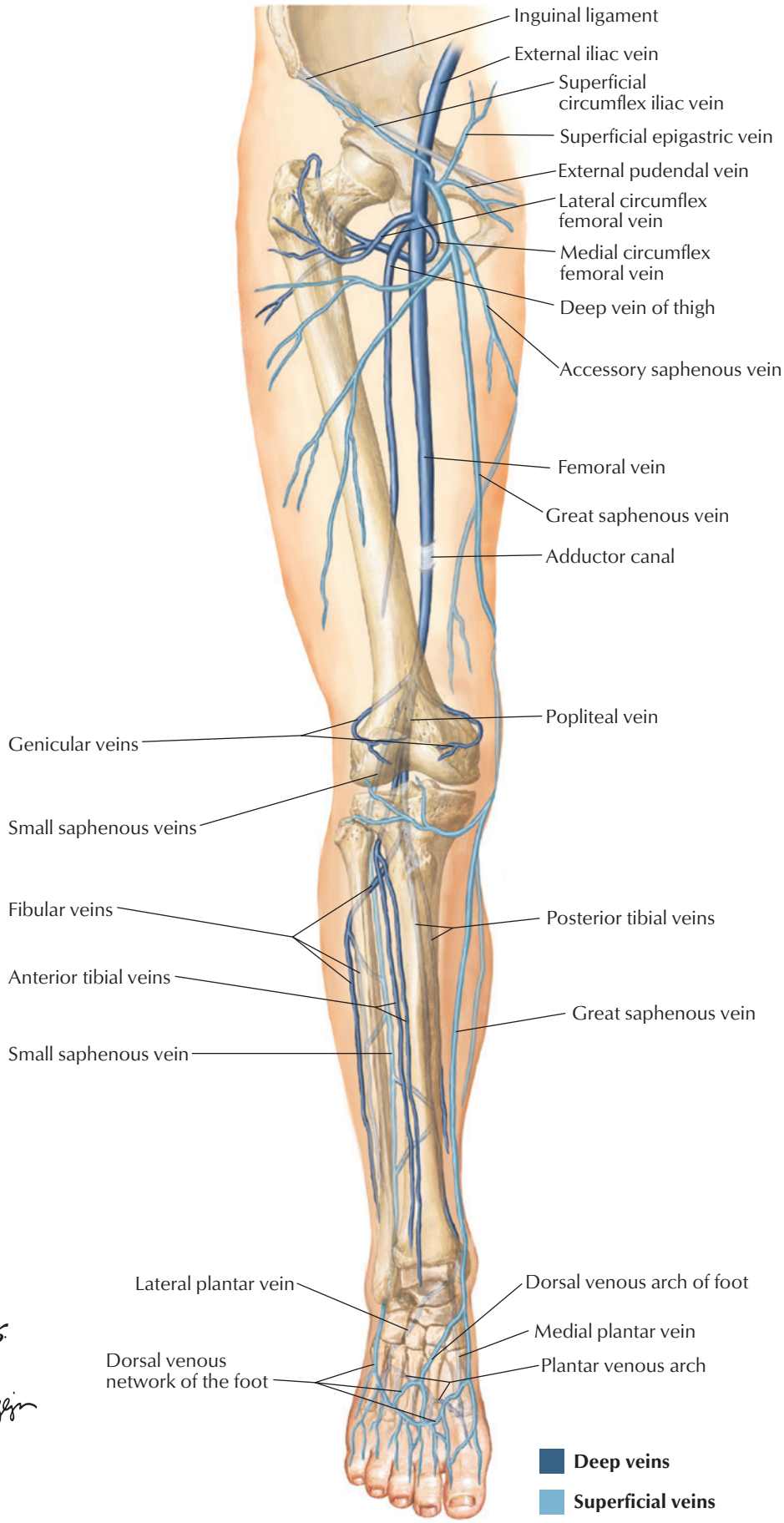
MUSCLE	MUSCLE GROUP	PROXIMAL ATTACHMENT (ORIGIN)	DISTAL ATTACHMENT (INSERTION)	INNERVATION	BLOOD SUPPLY	MAIN ACTIONS
Abductor digiti minimi	Foot	Medial and lateral tubercles of tuberosity of calcaneus, plantar aponeurosis, and intermuscular septum	Lateral side of base of proximal phalanx of 5th digit	Lateral plantar nerve	Mediolateral plantar artery, plantar metatarsal and plantar digital arteries to 5th digit	Abducts and flexes 5th digit
Abductor hallucis	Foot	Medial tubercle of tuberosity of calcaneus, flexor retinaculum, and plantar aponeurosis	Medial side of base of proximal phalanx of 1st digit	Medial plantar nerve	Medial plantar and 1st plantar metatarsal arteries	Abducts and flexes 1st digit
Adductor brevis	Medial thigh	Body and inferior pubic ramus	Pectineal line and proximal part of linea aspera of femur	Obturator nerve	Profunda femoris, medial circumflex femoral, and obturator arteries	Adducts thigh at hip, weak hip flexor
Adductor hallucis	Foot	*Oblique head:* bases of 2nd through 4th metatarsals *Transverse head:* ligaments of metatarsophalangeal joints of digits 3–5	Tendons of both heads lateral to side of base of proximal phalanx of 1st digit	Deep branch of lateral plantar nerve	Medial and lateral plantar arteries and plantar arch, plantar metatarsal arteries	Adducts 1st digit, maintains transverse arch of foot
Adductor longus	Medial thigh	Body of pubis inferior to pubic crest	Middle third of linea aspera of femur	Obturator nerve (anterior division)	Profunda femoris and medial circumflex femoral arteries	Adducts thigh at hip
Adductor magnus	Medial thigh	Inferior pubic ramus, ramus of ischium *Hamstring part*: ischial tuberosity	Gluteal tuberosity, linea aspera, medial supracondylar line *Hamstring part:* adductor tubercle of femur	*Adductor part:* obturator nerve *Hamstring part:* sciatic nerve (tibial division)	Femoral, profunda femoris, and obturator arteries	*Adductor part:* adducts and flexes thigh *Hamstring part:* extends thigh
Articularis genus	Anterior thigh	Distal femur on anterior surface	Suprapatellar bursa	Femoral nerve	Femoral artery	Pulls suprapatellar bursa superiorly with extension of knee
Biceps femoris	Posterior thigh	*Long head:* ischial tuberosity *Short head:* Linea aspera and lateral supracondylar line of femur	Lateral side of head of fibula	*Long head:* sciatic nerve (tibial division) (L5–S2) *Short head:* sciatic nerve (common fibular division)	Perforating branches of profunda femoris, inferior gluteal, and medial circumflex femoral arteries	Flexes and laterally rotates leg, extends thigh at hip
Dorsal interossei (four muscles)	Foot	Adjacent sides of 1st through 5th metatarsals	*1st:* medial side of proximal phalanx of 2nd digit *2nd through 4th*: lateral sides of digits 2–4	Lateral plantar nerve	Arcuate artery, dorsal and plantar metatarsal arteries	Abduct 2nd through 4th digits of foot, flex metatarsophalangeal joints, and extend phalangeal bones
Extensor digitorum brevis and extensor hallucis brevis	Foot	Superolateral surface of calcaneus, lateral talocalcaneal ligament, deep surface of inferior extensor retinaculum	First tendon into dorsal surface of base of proximal phalanx of great toe; other three tendons into lateral sides of tendons of extensor digitorum longus to digits 2–4	Deep fibular nerve	Dorsalis pedis, lateral tarsal, arcuate, and fibular arteries	Aids extensor digitorum longus in extending of 4 medial digits at metatarsophalangeal and interphalangeal joints
Extensor digitorum longus	Anterior leg	Lateral condyle of tibia, proximal 3/4 of anterior surface of interosseous membrane and fibula	Middle and distal phalangeal bones of lateral four digits	Deep fibular nerve	Anterior tibial artery	Extends lateral four digits and dorsiflexes foot at ankle
Extensor hallucis longus	Anterior leg	Middle part of anterior surface of fibula and interosseous membrane	Dorsal aspect of base of distal phalanx of great toe	Deep fibular nerve	Anterior tibial artery	Extends great toe, dorsiflexes foot at ankle

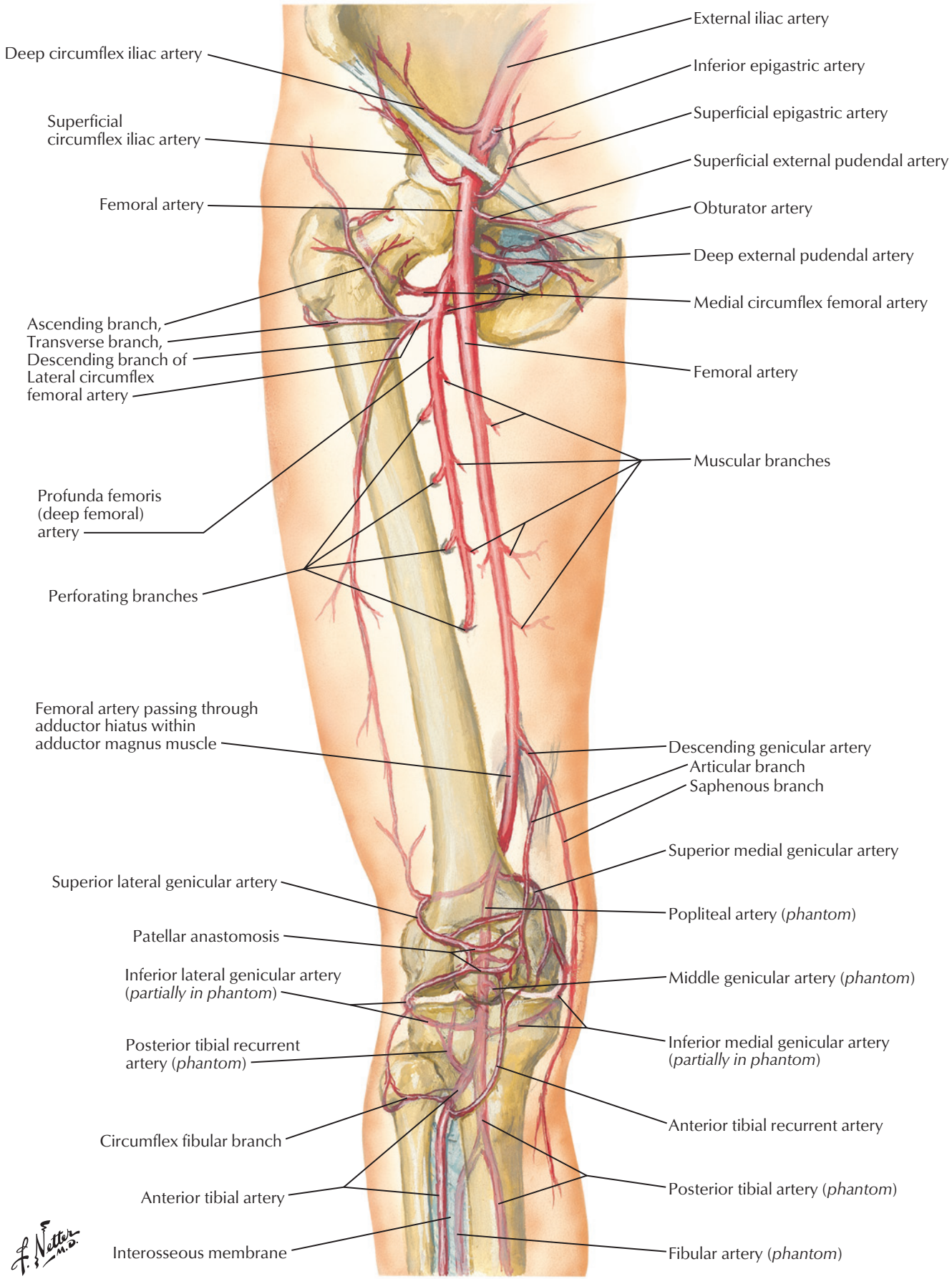
Variations in spinal nerve contributions to the innervation of muscles, their arterial supply, their attachments, and their actions are common themes in human anatomy. Therefore, expect differences between texts and realize that anatomical variation is normal.

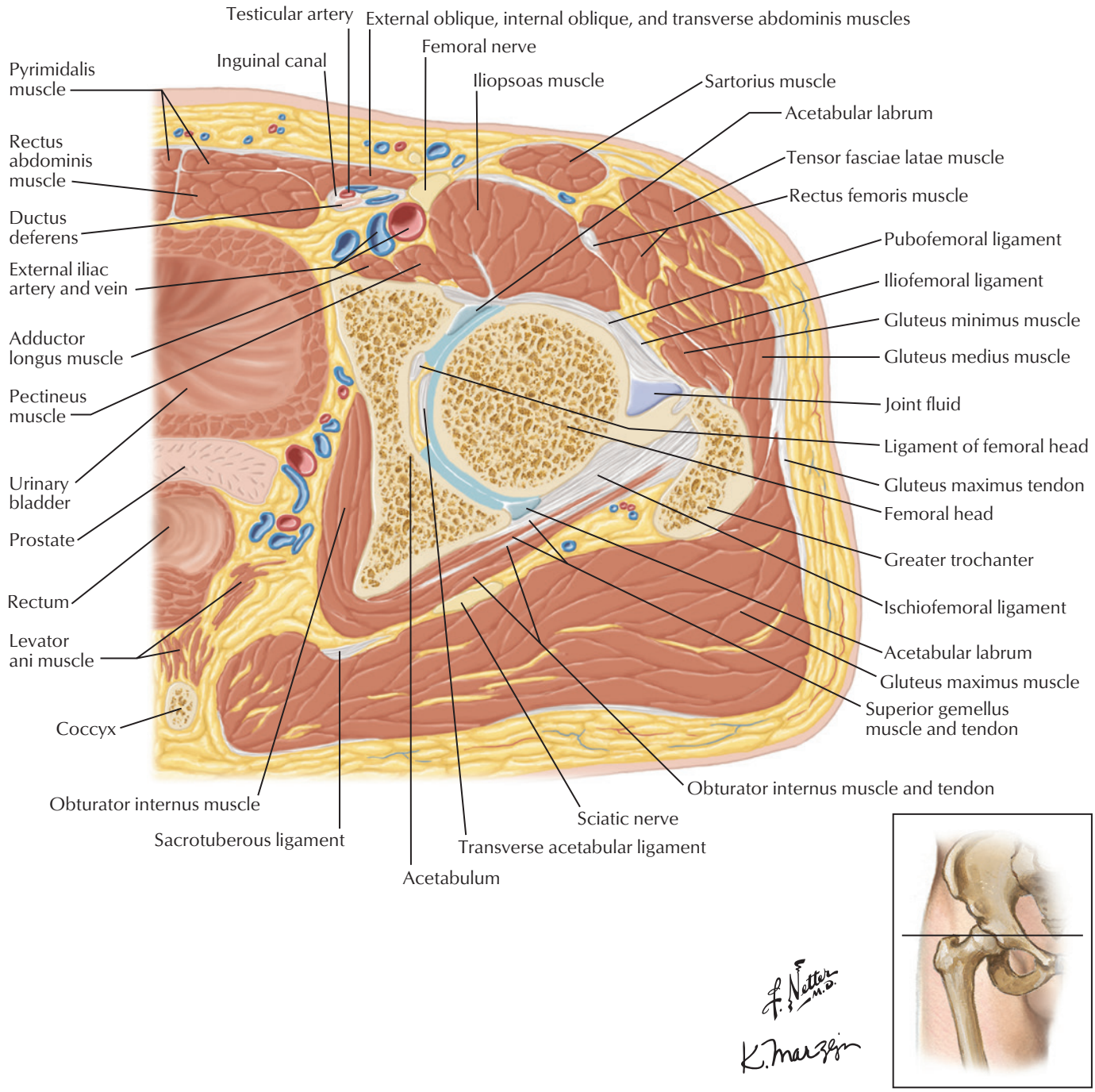
MUSCLE	MUSCLE GROUP	PROXIMAL ATTACHMENT (ORIGIN)	DISTAL ATTACHMENT (INSERTION)	INNERVATION	BLOOD SUPPLY	MAIN ACTIONS
Fibularis brevis	Lateral leg	Distal 2/3 of lateral surface of fibula	Dorsal surface of tuberosity on lateral side of 5th metatarsal	Superficial fibular nerve	Anterior tibial and fibular arteries	Everts foot and weakly plantarflexes foot at ankle
Fibularis longus	Lateral leg	Head and proximal 2/3 of lateral fibula	Plantar base of 1st metatarsal and medial cuneiform bone	Superficial fibular nerve	Anterior tibial and fibular arteries	Everts foot and weakly plantarflexes foot at ankle
Fibularis tertius	Anterior leg	Distal third of anterior surface of fibula and interosseous membrane	Dorsum of base of 5th metatarsal	Deep fibular nerve	Anterior tibial artery	Dorsiflexes foot at ankle and aids in eversion of foot
Flexor digiti minimi brevis	Foot	Base of 5th metatarsal	Lateral base of proximal phalanx of 5th digit	Superficial branch of lateral plantar nerve	Lateral plantar artery, plantar digital artery to 5th digit, arcuate artery	Flexes proximal phalanx of 5th digit
Flexor digitorum brevis	Foot	Medial tubercle of tuberosity of calcaneus, plantar aponeurosis, and intermuscular septum	Both sides of middle phalangeal bones of lateral four digits	Medial plantar nerve	Medial and lateral plantar arteries and plantar arch, plantar metatarsal and plantar digital arteries	Flexes 2nd through 5th digits
Flexor digitorum longus	Posterior leg	Medial part of posterior tibia inferior to soleal line	Plantar bases of distal phalangeal bones of lateral four digits	Tibial nerve	Posterior tibial artery	Flexes lateral four digits and plantarflexes foot at ankle; supports longitudinal arches of foot
Flexor hallucis brevis	Foot	Plantar surfaces of cuboid bone and lateral cuneiform bone	Both sides of base of proximal phalanx of 1st digit	Medial plantar nerve	Medial plantar artery, 1st plantar metatarsal artery	Flexes proximal phalanx of 1st digit
Flexor hallucis longus	Posterior leg	Distal 2/3 of posterior fibula and interosseous membrane	Base of distal phalanx of great toe	Tibial nerve	Fibular artery	Flexes all joints of great toe, weakly plantarflexes foot at ankle
Gastrocnemius	Posterior leg	*Lateral head:* lateral aspect of lateral condyle of femur *Medial head:* popliteal surface above medial condyle of femur	Posterior aspect of calcaneus via calcaneal tendon	Tibial nerve	Popliteal and posterior tibial arteries	Plantarflexes foot at ankle joint, assists in flexion of knee joint
Gluteus maximus	Gluteal region	Ilium posterior to posterior gluteal line, dorsal surface of sacrum and coccyx, sacrotuberous ligament	Most fibers end in iliotibial tract that inserts into lateral condyle of tibia; some fibers insert into gluteal tuberosity of femur	Inferior gluteal nerve	Inferior gluteal arteries mainly, and superior gluteal arteries occasionally	Extends flexed thigh, assists in lateral rotation, and abducts thigh
Gluteus medius	Gluteal region	Lateral surface of ilium between anterior and posterior gluteal lines	Lateral surface of greater trochanter of femur	Superior gluteal nerve	Superior gluteal artery	Abducts and medially rotates thigh at hips; steadies pelvis on leg when opposite leg is raised
Gluteus minimus	Gluteal region	Lateral surface of ilium between anterior and inferior gluteal lines	Anterior surface of greater trochanter of femur	Superior gluteal nerve	Main trunk and deep branch of superior gluteal artery	Abducts and medially rotates thigh at hips; steadies pelvis on leg when opposite leg is raised
Gracilis	Medial thigh	Body and inferior ramus of pubis	Superior part of medial surface of tibia	Obturator nerve	Profunda femoris artery, medial circumflex femoral artery	Adducts thigh, flexes and medially rotates leg
Iliacus (iliopsoas)	Anterior thigh	Superior 2/3 of iliac fossa, iliac crest, ala of sacrum, anterior sacroiliac ligaments	Lesser trochanter of femur and shaft inferior to it, to psoas major tendon	Femoral nerve	Iliac branches of iliolumbar artery	Flexes thigh at hips and stabilizes hip joint, acts with psoas major
Inferior gemellus	Gluteal region	Ischial tuberosity	Medial surface of greater trochanter of femur	Nerve to quadratus femoris muscle	Medial circumflex femoral artery	Laterally rotates extended thigh and abducts flexed thigh

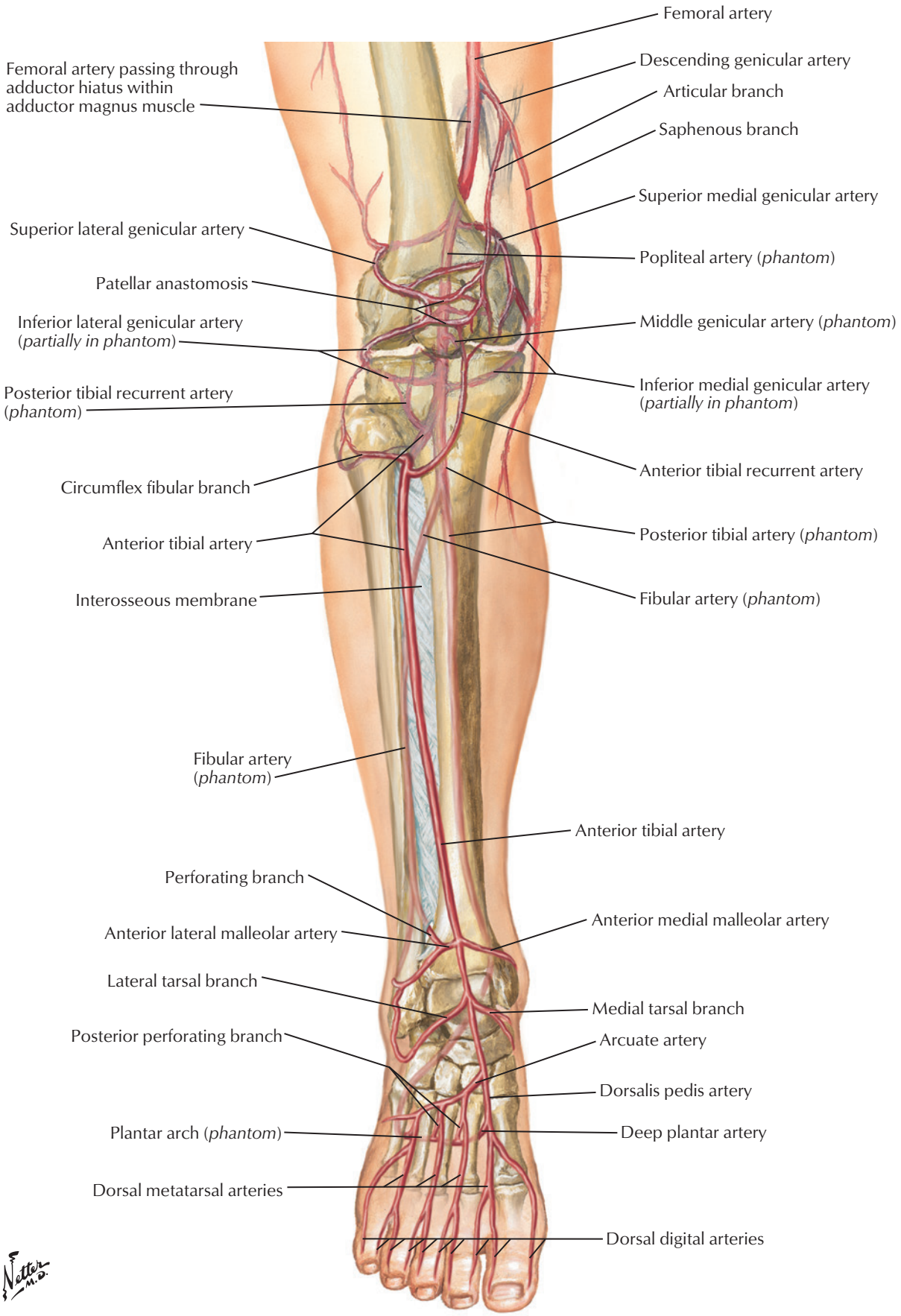
MUSCLE	MUSCLE GROUP	PROXIMAL ATTACHMENT (ORIGIN)	DISTAL ATTACHMENT (INSERTION)	INNERVATION	BLOOD SUPPLY	MAIN ACTIONS
Lumbricals	Foot	Tendons of flexor digitorum longus	Medial side of dorsal digital expansions of lateral four digits	*Medial one:* medial plantar nerve *Lateral three*: lateral plantar nerve	Lateral plantar artery and plantar metatarsal arteries	Flexes proximal phalangeal bones at metatarsophalangeal joint, extends phalangeal bones at proximal interphalangeal and distal interphalangeal joints
Obturator externus	Medial thigh	Margins of obturator foramen, obturator membrane	Trochanteric fossa of femur	Obturator nerve	Medial circumflex femoral artery, obturator artery	Laterally rotates thigh, stabilizes head of femur in acetabulum
Obturator internus	Gluteal region	Pelvic surface of obturator membrane and surrounding bone	Medial surface of greater trochanter of femur	Nerve to obturator internus muscle	Internal pudendal and obturator arteries	Laterally rotates extended thigh, abducts flexed thigh at hip
Pectineus	Medial thigh	Superior ramus of pubis	Pectineal line of femur	Femoral nerve and sometimes obturator nerve	Medial circumflex femoral artery, obturator artery	Adducts and flexes thigh at hip
Piriformis	Gluteal region	Anterior surface of sacral segments 2–4, sacrotuberous ligament (inconstant)	Superior border of greater trochanter of femur	Ventral rami of L5, S1, S2	Superior and inferior gluteal arteries, internal pudendal artery	Laterally rotates extended thigh, abducts flexed thigh at hip
Plantar interossei (three muscles)	Foot	Bases and medial sides of 3rd through 5th metatarsals	Medial sides of bases of proximal phalangeal bones of 3rd through 5th digits	Lateral plantar nerve	Lateral plantar artery and plantar arch, plantar metatarsal and plantar digital arteries	Adduct digits (3-5) and flex metatarsophalangeal joint and extend phalangeal bones
Plantaris	Posterior leg	Inferior end of lateral supracondylar line of femur and oblique popliteal ligament	Posterior aspect of calcaneus via calcaneal tendon	Tibial nerve	Popliteal artery	Weakly assists gastrocnemius
Popliteus	Posterior leg	Lateral aspect of lateral condyle of femur, lateral meniscus	Posterior tibia superior to soleal line	Tibial nerve (L4–S1)	Inferior medial and lateral genicular arteries	Weakly flexes knee and unlocks it by rotating femur on fixed tibia
Psoas major (iliopsoas)	Anterior thigh	Transverse processes of lumbar vertebrae, sides of bodies of T12–L5 vertebrae, intervening intervertebral discs	Lesser trochanter of femur	Anterior rami of first three lumbar nerves	Lumbar branches of iliolumbar artery	Acting superiorly with iliacus, flexes hip; acting inferiorly, flexes vertebral column laterally; used to balance trunk in sitting position; acting inferiorly with iliacus, flexes trunk
Quadratus femoris	Gluteal region	Lateral margin of ischial tuberosity	Quadrate tubercle on intertrochanteric crest of femur	Nerve to quadratus femoris muscle	Medial circumflex femoral artery	Laterally rotates thigh at hip
Quadratus plantae	Foot	Medial and lateral sides of plantar surface of calcaneus	Posterolateral edge of flexor digitorum longus tendon	Lateral plantar nerve	Medial and lateral plantar arteries and deep plantar arterial arch	Corrects for oblique pull of flexor digitorum longus tendon, thus assisting in flexion of digits of foot
Rectus femoris (quadriceps)	Anterior thigh	Anterior inferior iliac spine and ilium superior to acetabulum	Base of patella and to tibial tuberosity via patellar ligament	Femoral nerve	Profunda femoris and lateral circumflex femoral arteries	Extends leg at knee joint and flexes thigh at hip joint
Sartorius	Anterior thigh	Anterior superior iliac spine and superior part of notch below it	Superior part of medial surface of tibia	Femoral nerve	Femoral artery	Abducts, laterally rotates, and flexes thigh; flexes knee joint
Semimembranosus	Posterior thigh	Ischial tuberosity	Posterior part of medial condyle of tibia	Sciatic nerve (tibial division)	Perforating branch of profunda femoris and medial circumflex femoral arteries	Flexes leg, extends thigh

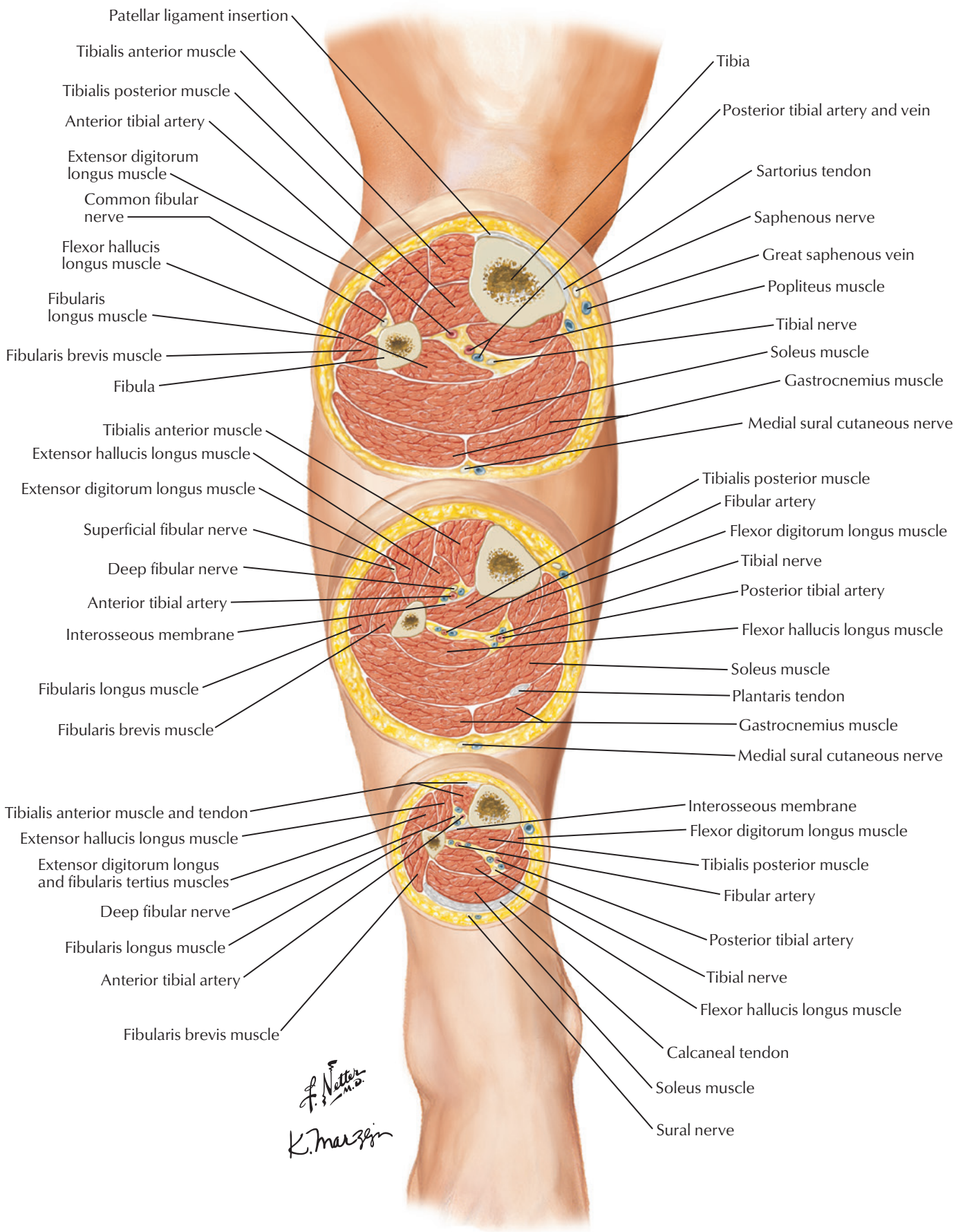
MUSCLE	MUSCLE GROUP	PROXIMAL ATTACHMENT (ORIGIN)	DISTAL ATTACHMENT (INSERTION)	INNERVATION	BLOOD SUPPLY	MAIN ACTIONS
Semitendinosus	Posterior thigh	Ischial tuberosity	Superior part of medial surface of tibia	Sciatic nerve (tibial division)	Perforating branch of profunda femoris and medial circumflex femoral arteries	Flexes leg, extends thigh
Soleus	Posterior leg	Posterior aspect of head of fibula, proximal 1/4 of posterior surface of fibula, soleal line of tibia	Posterior aspect of calcaneus via calcaneal tendon	Tibial nerve	Popliteal, posterior tibial, and fibular arteries	Plantarflexes foot at ankle, stabilizes leg over foot
Superior gemellus	Gluteal region	Outer surface of ischial spine	Medial surface of greater trochanter of femur	Nerve to obturator internus muscle	Inferior gluteal and internal pudendal arteries	Laterally rotates extended thigh and abducts flexed thigh
Tensor fasciae latae	Gluteal region	Anterior superior iliac spine and anterior part of iliac crest	Iliotibial tract that attaches to lateral condyle of tibia	Superior gluteal nerve	Ascending branch of lateral circumflex femoral artery	Abducts, medially rotates, and flexes thigh at hip; helps to keep knee extended
Tibialis anterior	Anterior leg	Lateral condyle, proximal half of lateral tibia, interosseous membrane	Medial plantar surfaces of medial cuneiform bone and base of 1st metatarsal bone	Deep fibular nerve	Anterior tibial artery	Dorsiflexes foot at ankle and inverts foot
Tibialis posterior	Posterior leg	Posterior tibia below soleal line, interosseous membrane, proximal half of posterior fibula	Tuberosity of navicular bone, all cuneiforms, cuboid, and bases of 2nd through 4th metatarsal bones	Tibial nerve	Fibular artery	Plantarflexes foot at ankle and inverts foot
Vastus intermedius (quadriceps)	Anterior thigh	Anterior and lateral surfaces of body of femur	Base of patella and to tibial tuberosity via patellar ligament	Femoral nerve	Lateral circumflex femoral and profunda femoris arteries	Extends leg at knee joint
Vastus lateralis (quadriceps)	Anterior thigh	Greater trochanter, lateral lip of gluteal tuberosity, lateral lip of linea aspera	Base of patella and to tibial tuberosity via patellar ligament	Femoral nerve	Lateral circumflex femoral and profunda femoris arteries	Extends leg at knee joint
Vastus medialis (quadriceps)	Anterior thigh	Intertrochanteric line, greater trochanter, lateral lip of gluteal tuberosity, and lateral lip of linea aspera	Base of patella and to tibial tuberosity via patellar ligament	Femoral nerve	Femoral and profunda femoris arteries	Extends leg at knee joint

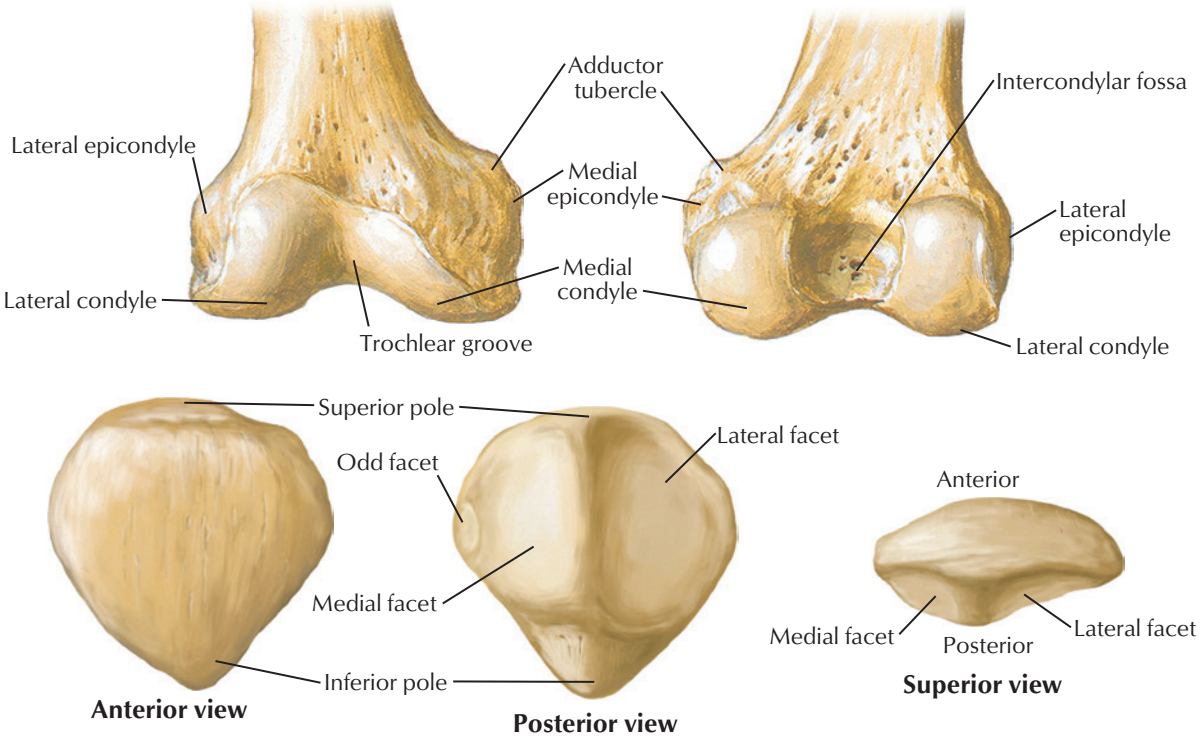

Inguinal ligament
External iliac vein
Superficial circumflex iliac vein
Superficial epigastric vein
External pudendal vein
Lateral circumflex femoral vein
Medial circumflex femoral vein
Deep vein of thigh
Accessory saphenous vein
Femoral vein
Great saphenous vein
Adductor canal
Popliteal vein
Genicular veins
Small saphenous veins
Fibular veins
Posterior tibial veins
Anterior tibial veins
Great saphenous vein
Small saphenous vein
Lateral plantar vein
Dorsal venous arch of foot
Medial plantar vein
Dorsal venous network of the foot
Plantar venous arch
Deep veins
Superficial veins

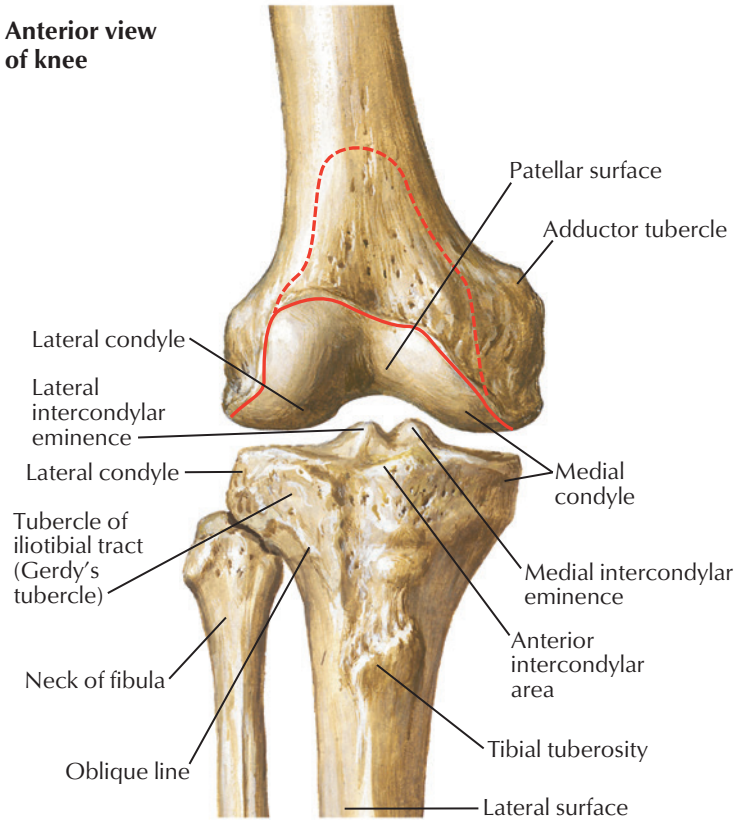

External iliac artery
Deep circumflex iliac artery
Inferior epigastric artery
Superficial epigastric artery
Superficial circumflex iliac artery
Superficial external pudendal artery
Femoral artery
Obturator artery
Deep external pudendal artery
Medial circumflex femoral artery
Ascending branch,
Transverse branch,
Descending branch of
Lateral circumflex
femoral artery
Femoral artery
Muscular branches
Profunda femoris
(deep femoral)
artery
Perforating branches
Femoral artery passing through
adductor hiatus within
adductor magnus muscle
Descending genicular artery
Articular branch
Saphenous branch
Superior medial genicular artery
Superior lateral genicular artery
Popliteal artery (phantom)
Patellar anastomosis
Inferior lateral genicular artery
(partially in phantom)
Middle genicular artery (phantom)
Inferior medial genicular artery
(partially in phantom)
Posterior tibial recurrent
artery (phantom)
Anterior tibial recurrent artery
Circumflex fibular branch
Posterior tibial artery (phantom)
Anterior tibial artery
Interosseous membrane
Fibular artery (phantom)

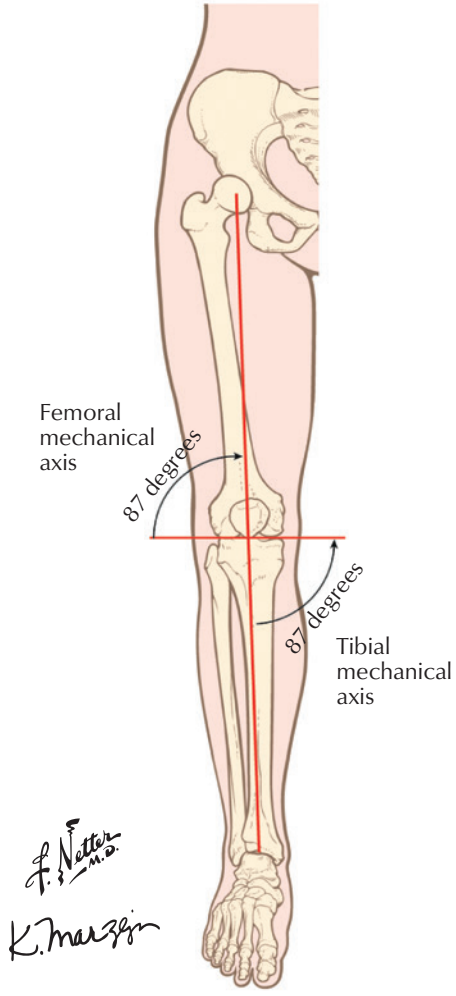

Testicular artery
External oblique, internal oblique, and transverse abdominis muscles
Femoral nerve
Inguinal canal
Iliopsoas muscle
Sartorius muscle
Pyrimidalis muscle
Acetabular labrum
Rectus abdominis muscle
Tensor fasciae latae muscle
Rectus femoris muscle
Ductus deferens
Pubofemoral ligament
External iliac artery and vein
Iliofemoral ligament
Gluteus minimus muscle
Adductor longus muscle
Gluteus medius muscle
Pectineus muscle
Joint fluid
Ligament of femoral head
Urinary bladder
Gluteus maximus tendon
Femoral head
Prostate
Greater trochanter
Rectum
Ischiofemoral ligament
Levator ani muscle
Acetabular labrum
Gluteus maximus muscle
Coccyx
Superior gemellus muscle and tendon
Obturator internus muscle and tendon
Obturator internus muscle
Sciatic nerve
Sacrotuberous ligament
Transverse acetabular ligament
Acetabulum


Femoral artery
Femoral artery passing through adductor hiatus within adductor magnus muscle
Descending genicular artery
Articular branch
Saphenous branch
Superior medial genicular artery
Superior lateral genicular artery
Popliteal artery (*phantom*)
Patellar anastomosis
Inferior lateral genicular artery (*partially in phantom*)
Middle genicular artery (*phantom*)
Inferior medial genicular artery (*partially in phantom*)
Posterior tibial recurrent artery (*phantom*)
Anterior tibial recurrent artery
Circumflex fibular branch
Anterior tibial artery
Posterior tibial artery (*phantom*)
Interosseous membrane
Fibular artery (*phantom*)
Fibular artery (*phantom*)
Anterior tibial artery
Perforating branch
Anterior lateral malleolar artery
Anterior medial malleolar artery
Lateral tarsal branch
Medial tarsal branch
Posterior perforating branch
Arcuate artery
Dorsalis pedis artery
Plantar arch (*phantom*)
Deep plantar artery
Dorsal metatarsal arteries
Dorsal digital arteries


Patellar ligament insertion
Tibialis anterior muscle
Tibialis posterior muscle
Anterior tibial artery
Extensor digitorum longus muscle
Common fibular nerve
Flexor hallucis longus muscle
Fibularis longus muscle
Fibularis brevis muscle
Fibula
Tibia
Posterior tibial artery and vein
Sartorius tendon
Saphenous nerve
Great saphenous vein
Popliteus muscle
Tibial nerve
Soleus muscle
Gastrocnemius muscle
Medial sural cutaneous nerve
Tibialis anterior muscle
Extensor hallucis longus muscle
Extensor digitorum longus muscle
Superficial fibular nerve
Deep fibular nerve
Anterior tibial artery
Interosseous membrane
Fibularis longus muscle
Fibularis brevis muscle
Tibialis posterior muscle
Fibular artery
Flexor digitorum longus muscle
Tibial nerve
Posterior tibial artery
Flexor hallucis longus muscle
Soleus muscle
Plantaris tendon
Gastrocnemius muscle
Medial sural cutaneous nerve
Tibialis anterior muscle and tendon
Extensor hallucis longus muscle
Extensor digitorum longus and fibularis tertius muscles
Deep fibular nerve
Fibularis longus muscle
Anterior tibial artery
Fibularis brevis muscle
Interosseous membrane
Flexor digitorum longus muscle
Tibialis posterior muscle
Fibular artery
Posterior tibial artery
Tibial nerve
Flexor hallucis longus muscle
Calcaneal tendon
Soleus muscle
Sural nerve
F. Netter M.D.
K. Marzejon

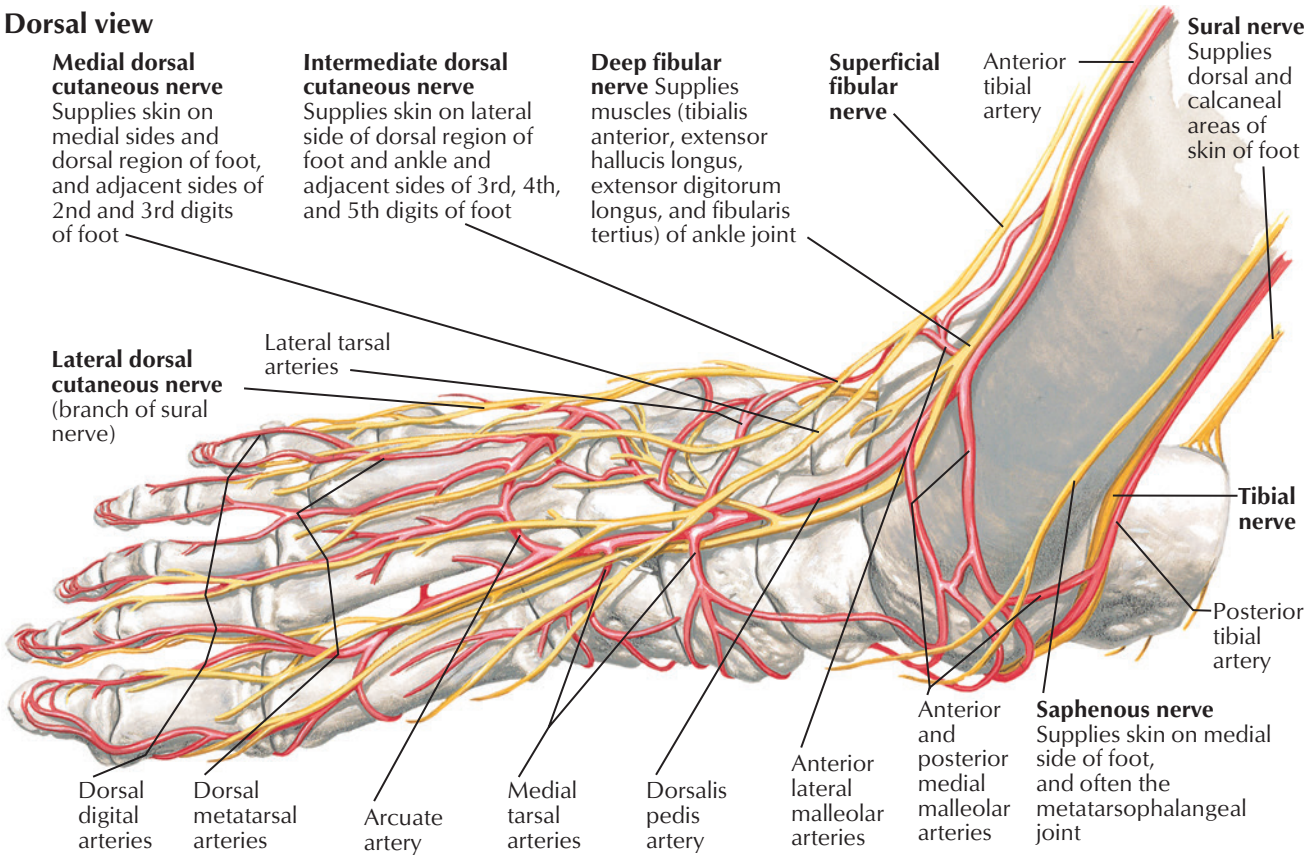

Lateral epicondyle
Adductor tubercle
Medial epicondyle
Lateral condyle
Trochlear groove
Medial condyle
Intercondylar fossa
Lateral epicondyle
Lateral condyle
Superior pole
Odd facet
Lateral facet
Medial facet
Inferior pole
Anterior view
Posterior view
Anterior
Medial facet
Lateral facet
Posterior
Superior view


Anterior view of knee
Patellar surface
Adductor tubercle
Lateral condyle
Lateral intercondylar eminence
Lateral condyle
Tubercle of iliotibial tract (Gerdy's tubercle)
Neck of fibula
Oblique line
Medial condyle
Medial intercondylar eminence
Anterior intercondylar area
Tibial tuberosity
Lateral surface
Line of attachment of synovium (edge of articular cartilage) to distal femur
Line of reflection of synovial membrane

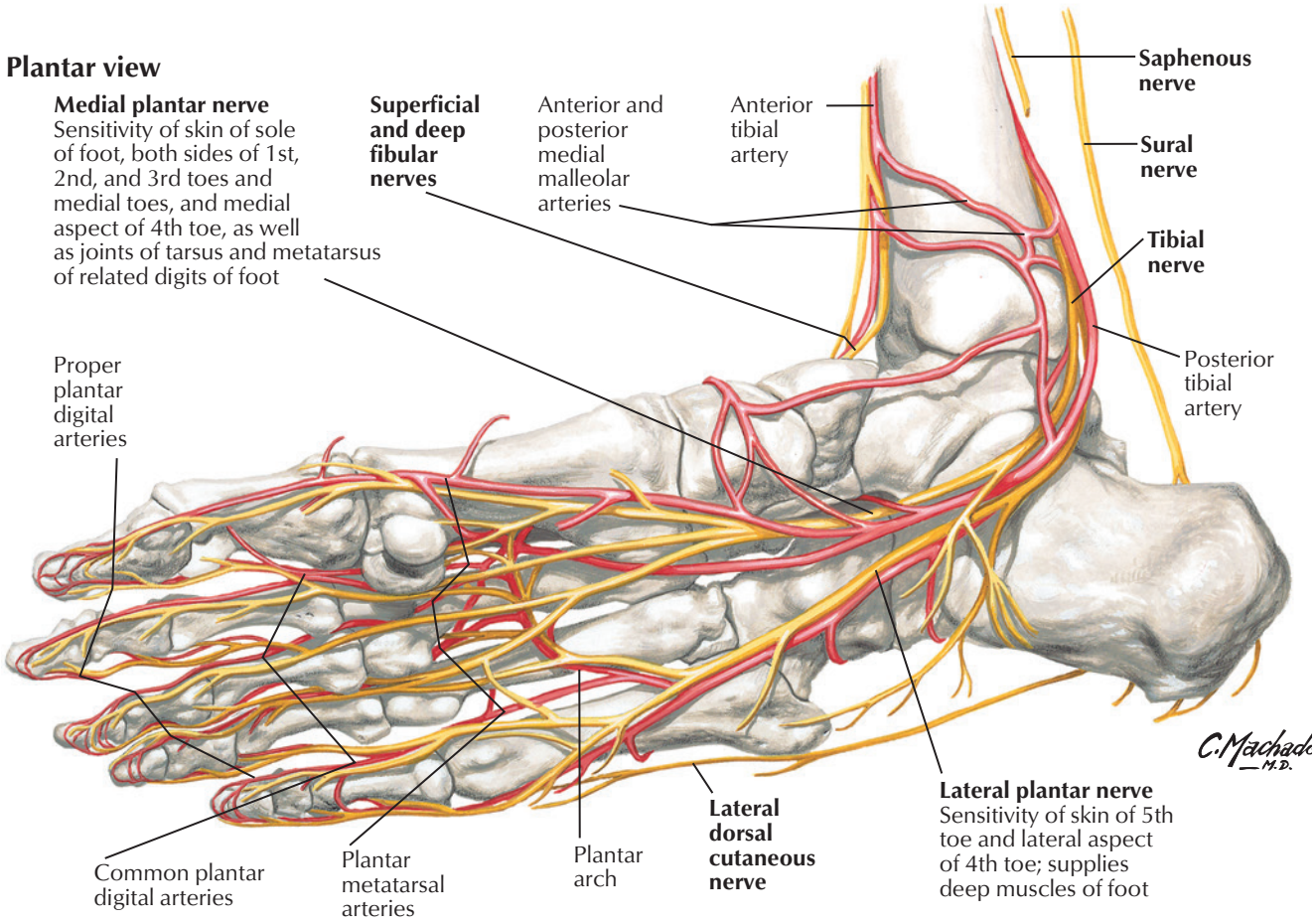

Femoral mechanical axis
87 degrees
87 degrees
Tibial mechanical axis


Femur
Quadriceps tendon
Patella
Patellar ligament
Fibula
L
Tibia

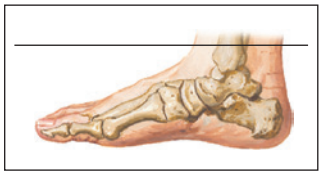
Dorsal view



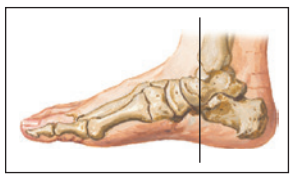
Plantar view

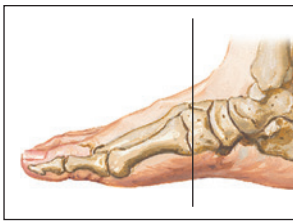


Axial view



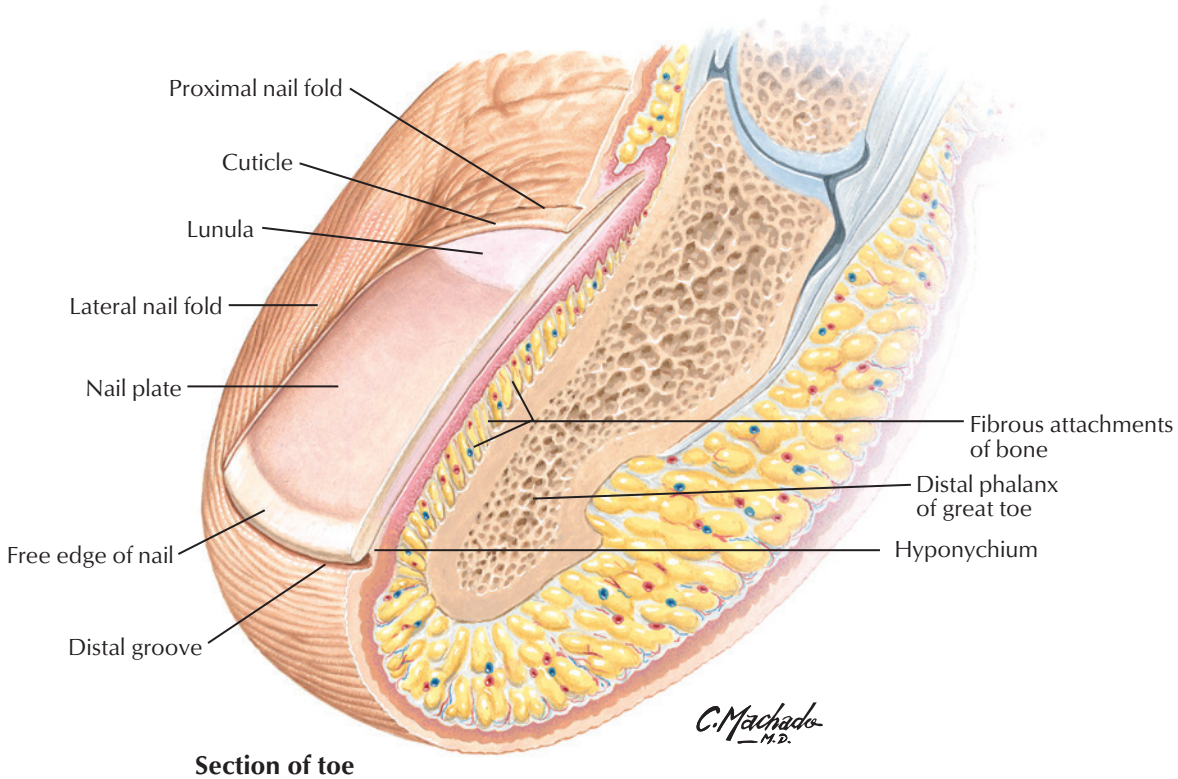
Coronal view



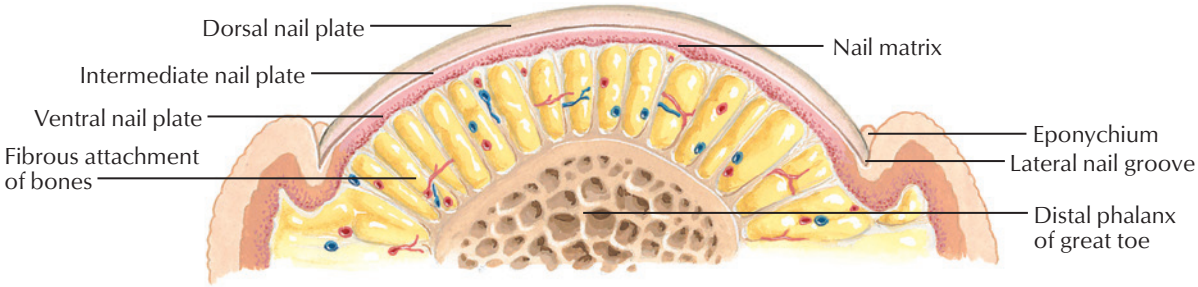


Coronal view

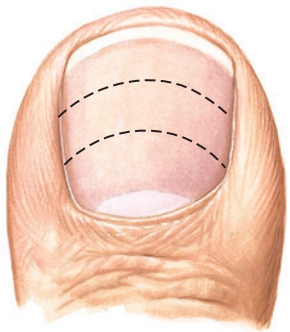
2nd Metatarsal
Extensor hallucis brevis muscle
Medial branch of deep fibular nerve
Flexor digitorum brevis muscle
Dorsalis pedis artery
Extensor digitorum longus tendon
Extensor hallucis brevis tendon
3rd Metatarsal
Joint capsule
Peroneus longus tendon
Flexor digitorum brevis tendon
Extensor hallucis longus tendon
Flexor digitorum brevis tendon
Medial cuneiform
Tibialis anterior tendon
Extensor digitorum longus tendon
Great saphenous vein
Flexor digitorum brevis muscle
Abductor hallu muscle and ten
Extensor digitorum longus tendon
Flexor digitorum brevis tendon
4th Metatarsal
Flexor digitorum longus tendon
Flexor h brevis m medial h
Adductor hallucis muscle, oblique head
Flexor h brevis m lateral h
Quadratus plantae muscle
Flexor hallu longus ten
Deep branches of m plantar artery and ne
5th Metatarsal
Flexor digitorum longus tendc
Flexor digitorum brevis muscle and tend
Plantar arterial arch and deep branch of lateral plantar nerve
Interosseous muscle
Superficial branch of lateral plantar artery and nerve
Flexor digiti minimi brevis muscle and tendon
Abductor digiti minimi muscle and tendon



Section of toe



Cross section of toenail



Toenail growth

The average growth rate of toenails is about 1 mm a month.

The rounded shape of the free edge of the nails is dictated by the shape of the lunula. After avulsion of a nail, the free edge of the new one grows parallel to the lunula.

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