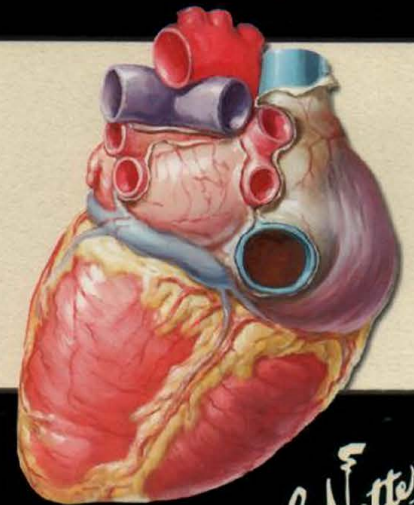
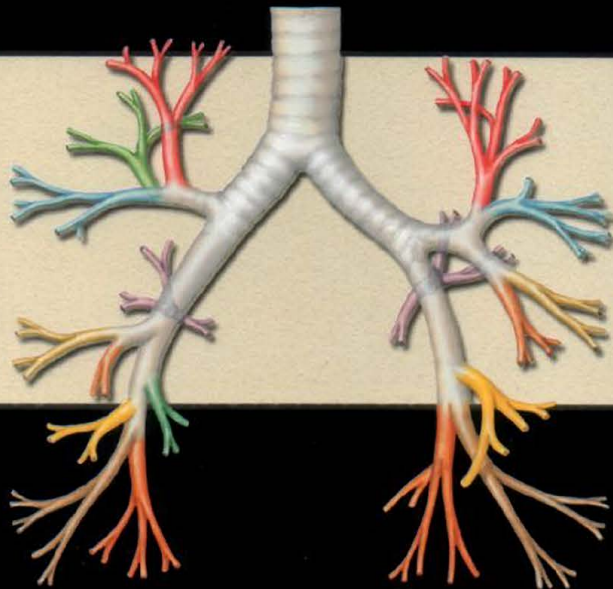


Atlas of Human Anatomy

Third Edition

Frank H. Netter, M.D.



*F. Netter
M.D.*

Atlas of Human Anatomy

*F. Netter
M.D.*

Atlas

Human

of

Anatomy

Third Edition

by Frank H. Netter, M.D.

John T. Hansen, Ph.D., *Consulting Editor*
University of Rochester School of Medicine and Dentistry
Rochester, New York

Icon Learning Systems • Teterboro, New Jersey



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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, M.D.
(1906–1991)



PHOTOGRAPH BY JAMES L. CLAYTON

FRANK H. NETTER, M.D.



FOREWORD

“The release in 1989 of the first edition of Dr. Frank Netter’s ‘personal Sistine Chapel’—the Atlas of Human Anatomy—was a major event in the history of the teaching and learning of anatomy. Almost instantly, the Atlas of Human Anatomy became the top-selling anatomical atlas in the world and clearly became the students’ choice universally.” This quotation from the second edition of the *Atlas of Human Anatomy* still resonates today as the beautifully conceived and rendered artwork of Dr. Netter continues to capture the admiration of students and healthcare professionals.

The skillful editing and publishing teamwork of Novartis Medical Education, in consultation with many of the 20th century’s outstanding anatomists and physicians, have made the first and second editions of the *Atlas* the standard against which all other atlases are compared. This third edition owes much to the Consulting Editors of the earlier editions, Drs. Sharon Colacino (Oberg) (first edition) and Arthur F. Dalley II (second edition), who shepherded their editions with great skill and uncompromising professionalism and thus made my task significantly easier. I am honored to serve as the Consulting Editor of the third edition and to continue the Netter tradition in partnership with Icon Learning Systems as the *Atlas of Human Anatomy* enters the new century.

Perceptive student and faculty response to the earlier editions prompted greater attention to several concepts that are critical to the anatomical basis of clinical practice. Notably, each regional section now begins with a surface anatomy plate, skillfully drawn by Carlos A.G. Machado, M.D. These surface anatomy plates remind us of the value of careful observation in clinical medicine and draw attention to surface features that portend the underlying anatomy.

We also have included a significant number of normal radiographic images in this edition, reflecting the importance of diagnostic imaging in clinical anatomy and medicine. These new images are not meant to be comprehensive of the radiographic knowledge available to today’s clinicians, but rather are starting points for further exploration into the richness of anatomical detail that imaging can provide. I am grateful to Matthew Cham, M.D., and John Wandtke, M.D., of our Department of Radiology for selecting these images and permitting us to use them in this edition.

We balanced the addition of new surface and radiographic anatomy plates largely by eliminating several plates that contributed little to the quality of the *Atlas*. Several plates from *The Netter* (formerly CIBA) *Collection of Medical Illustrations* were added and several plates were altered slightly to correct anatomical errors consistent with our current knowledge. In sum, the third edition has grown by 30 images. Finally, the References and the Index have been updated.

The anatomical terminology is consistent throughout the *Atlas* and conforms to the International Anatomical Terminology (*Terminologia Anatomica*) approved in 1998 by the International Federation of Associations of Anatomists. Common eponyms are retained parenthetically, and the leader lines and labels have been checked and, where necessary, corrected to ensure their accuracy. For reviewing this material I thank Wojciech Pawlina, M.D., Leonard J. Cleary, Ph.D., Daniel O. Graney, Ph.D., and Brian R. MacPherson, Ph.D. Their meticulous examination of each plate has greatly enhanced the accuracy of this atlas.

For the proofreading, editing and designing, I am indebted to Jennifer Surich, Erika Gehringer and Greg Otis at Icon Learning Systems; their keen eyesight, dedication and professionalism buoyed me when I began to drift. A special thank you is reserved for Paul Kelly, Executive Editor, who continues to listen patiently and is a true believer in the power of the visual image to teach.

To all students, past, present and future, the legacy of Dr. Netter's artwork lives in you; his unique ability to "clarify rather than intimidate" is his gift to you. I am both privileged and humbled to have the opportunity to carry forward this tradition of excellence and to contribute to your understanding of human anatomy.

Finally, to my wife, Paula, thank you for giving me the freedom to write and the support to sustain me—in those respects, this book was co-edited.

John T. Hansen, Ph.D.
Professor of Neurobiology and Anatomy
University of Rochester School of Medicine and Dentistry
Rochester, New York

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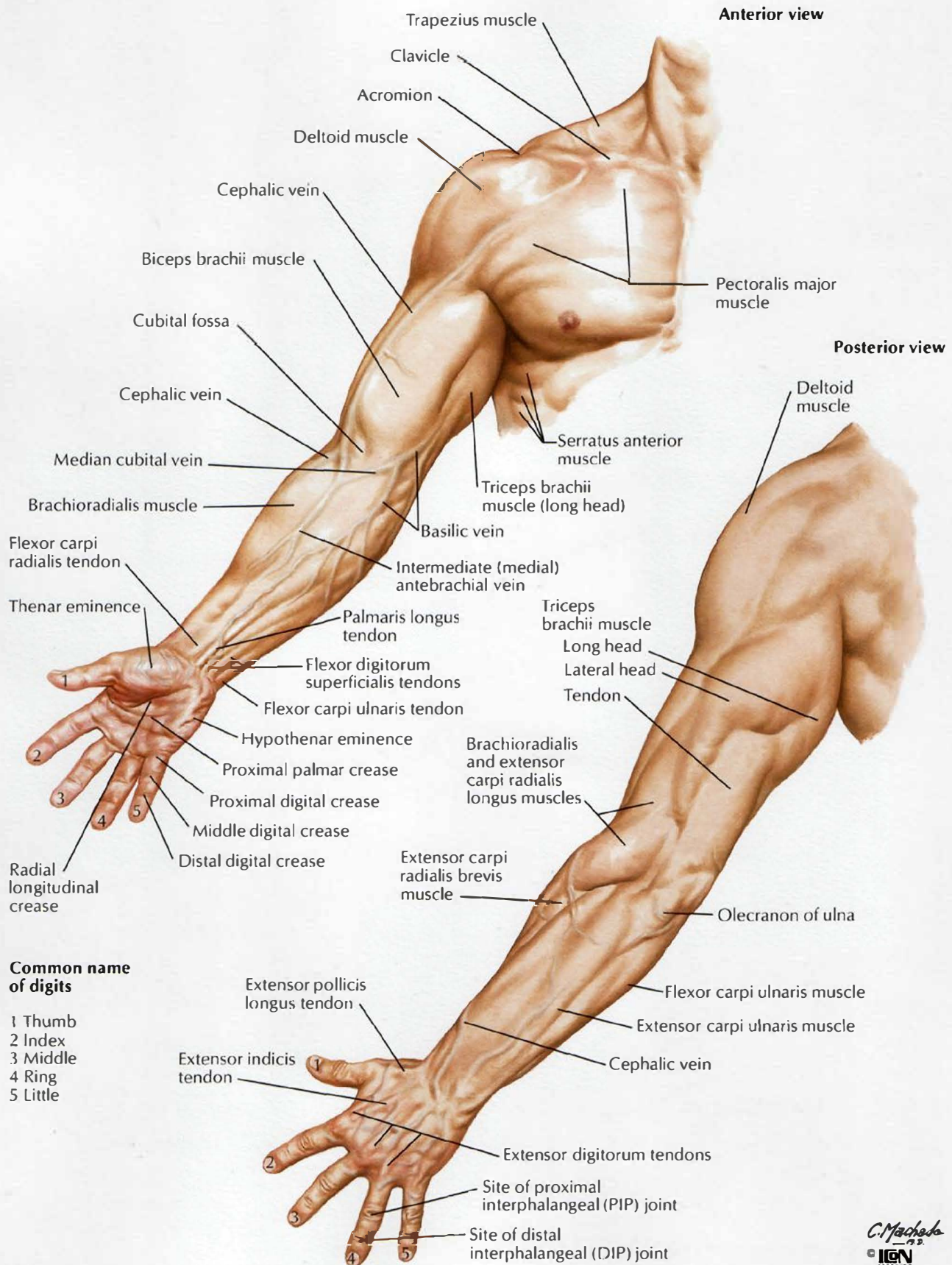
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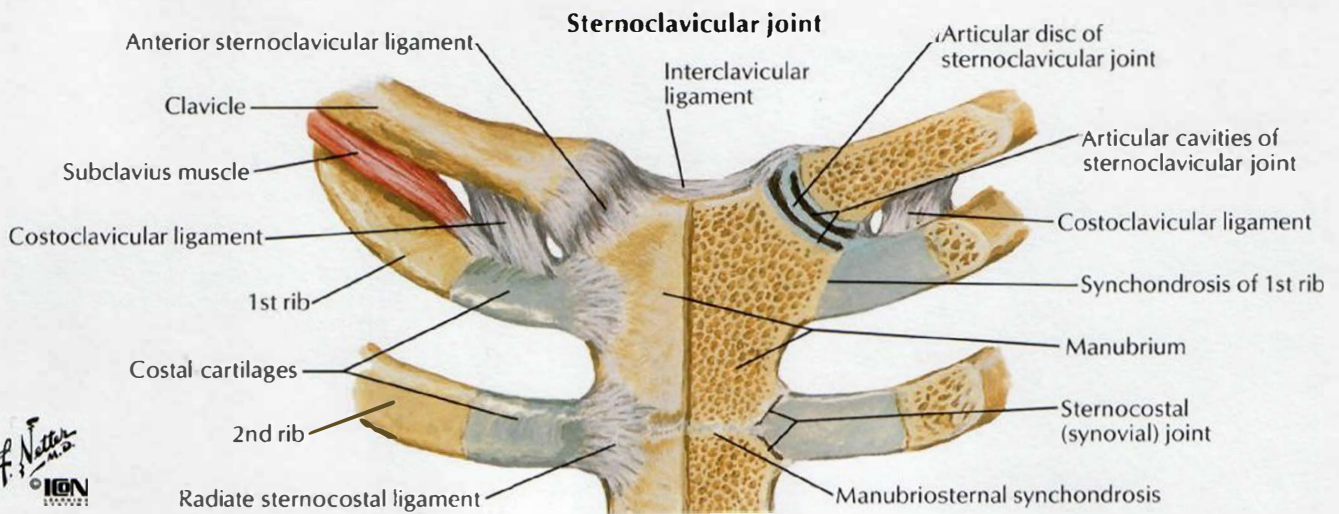
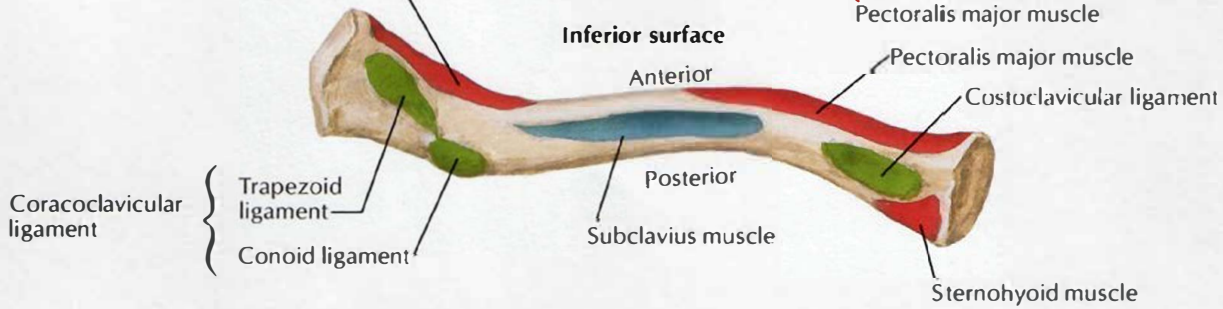
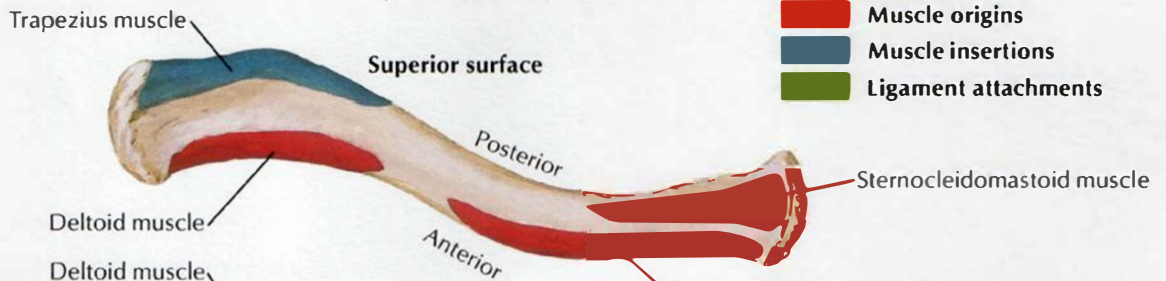
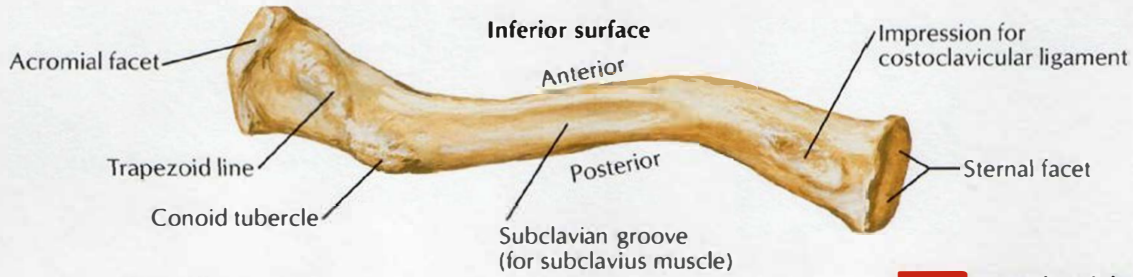
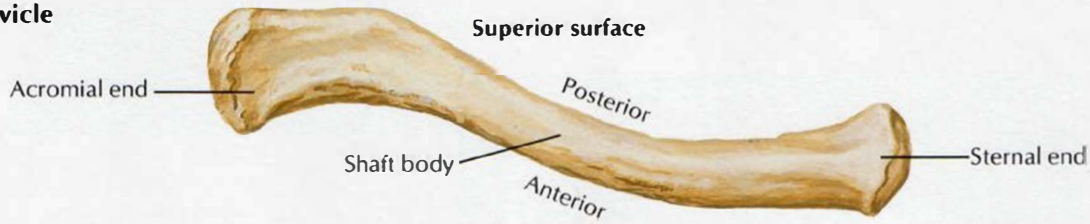
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C. Machado
 ICA

Clavicle and Sternoclavicular Joint

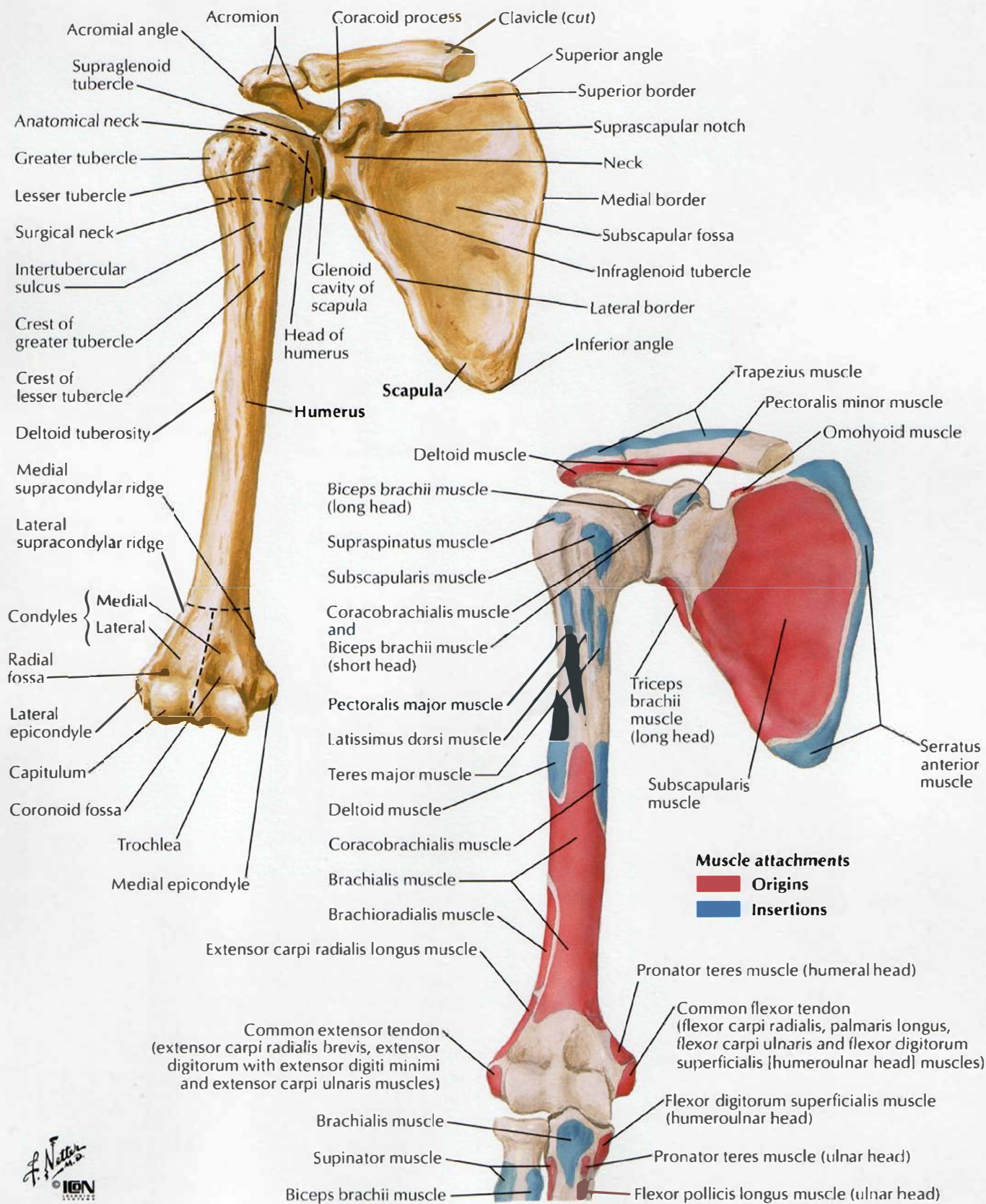
Right clavicle



F. Netter M.D.
 IGM

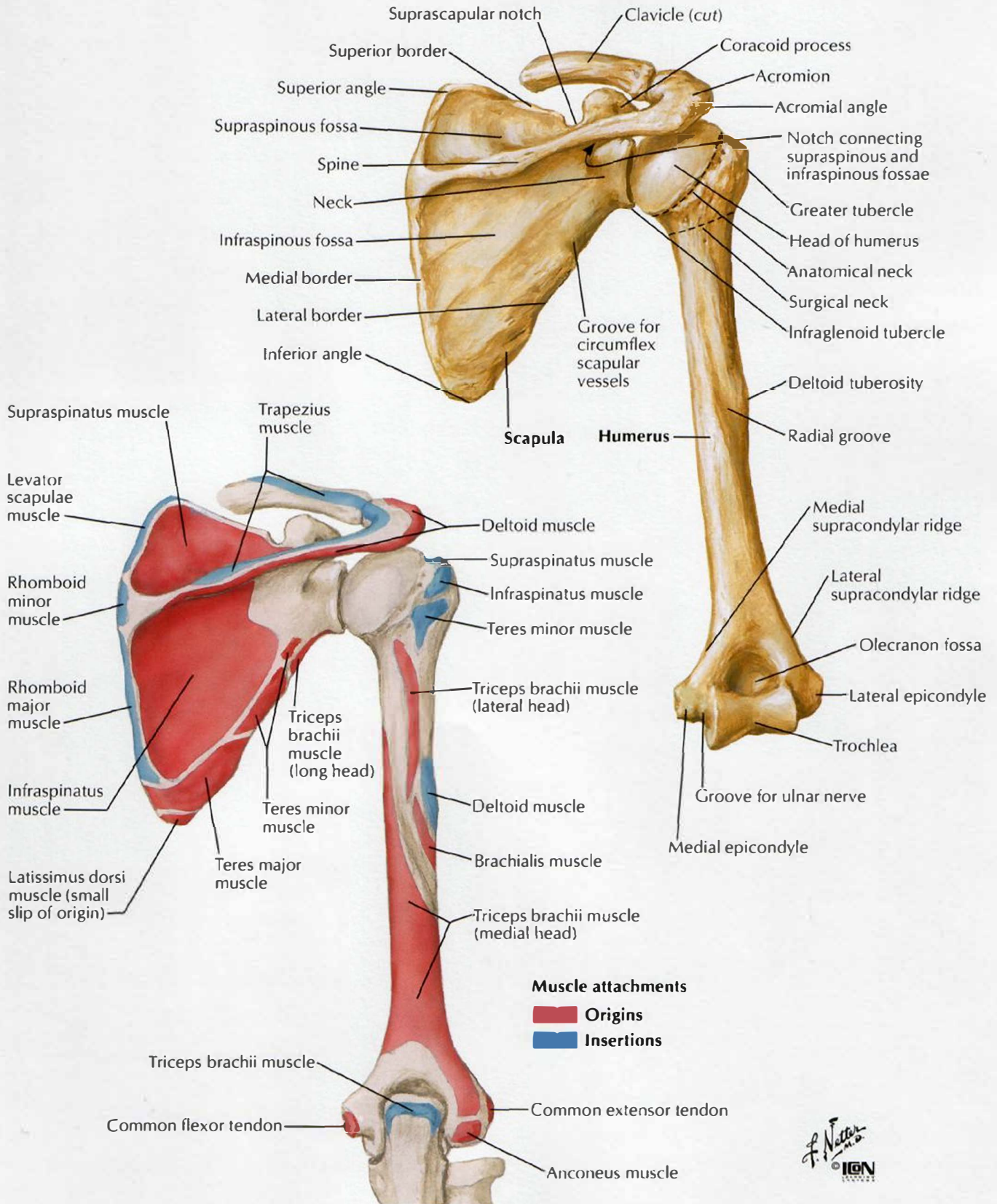
Humerus and Scapula: Anterior Views

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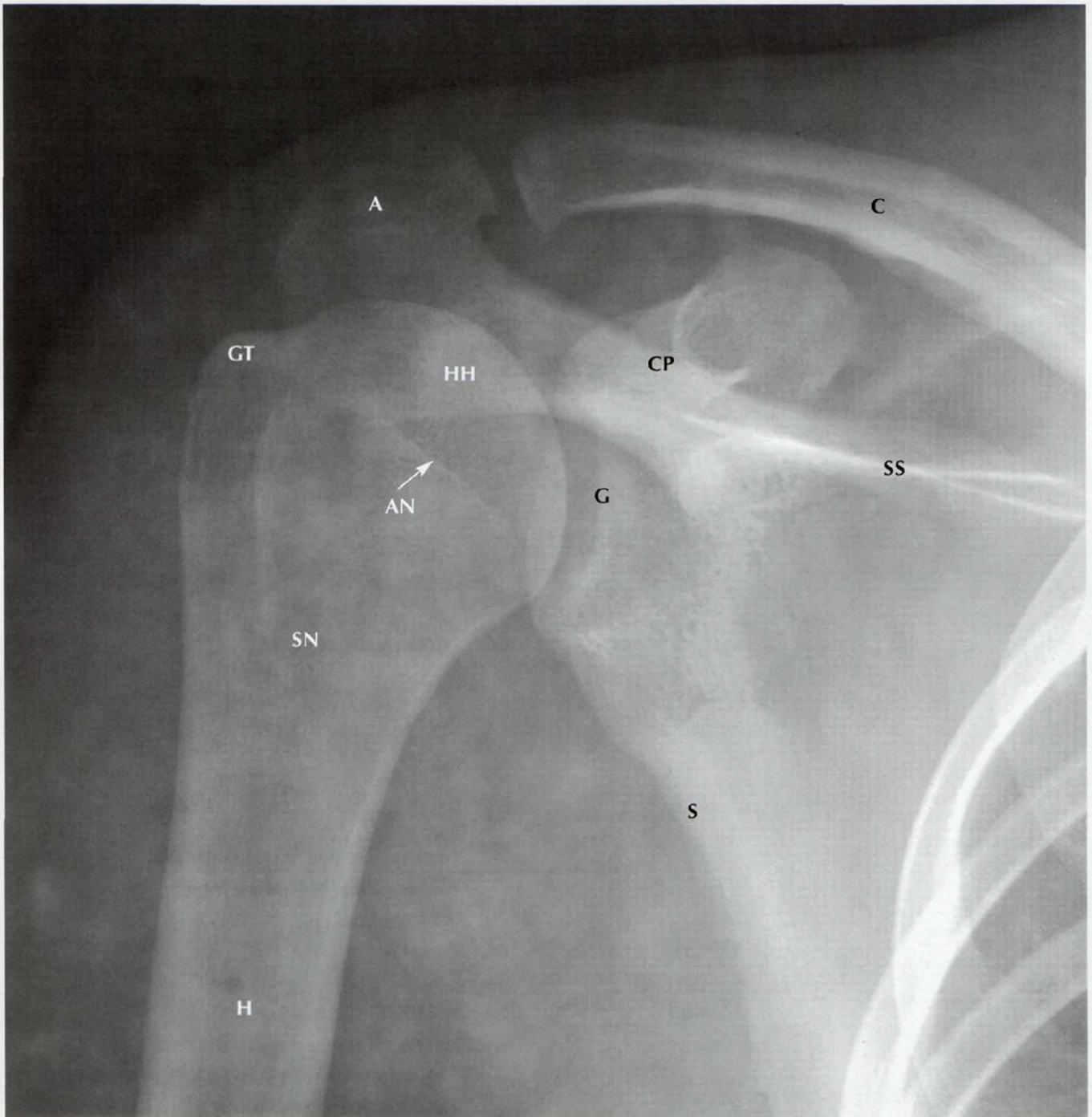
Humerus and Scapula: Posterior Views

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Shoulder: Anteroposterior Radiograph

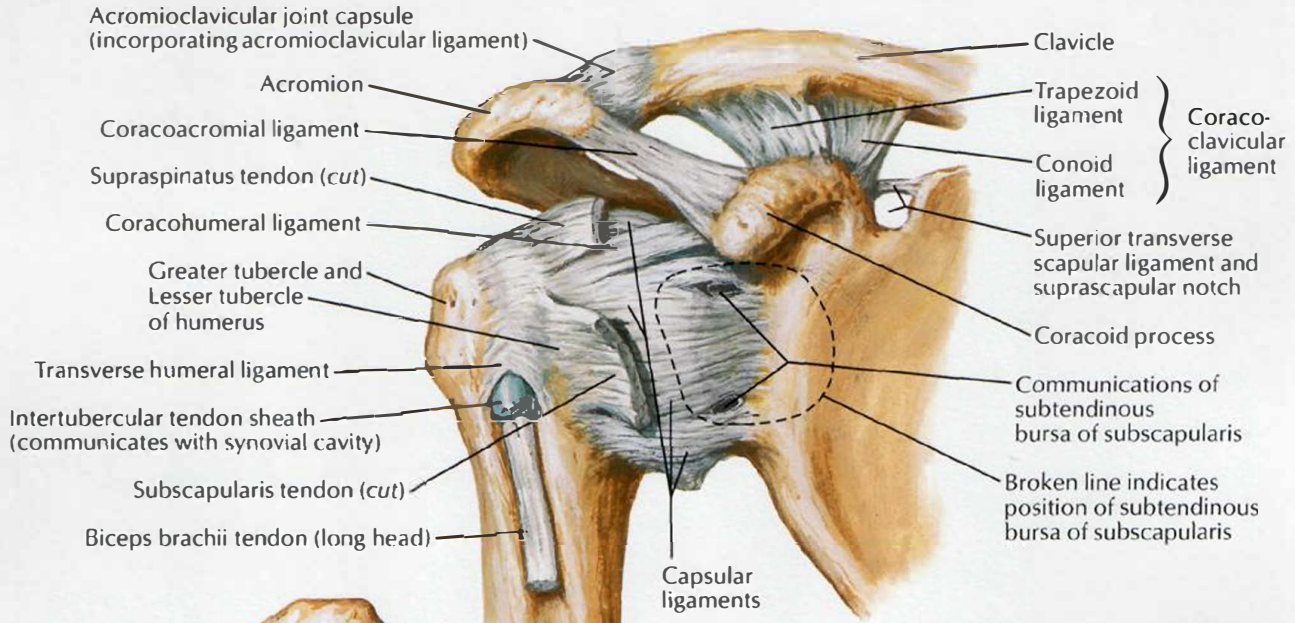
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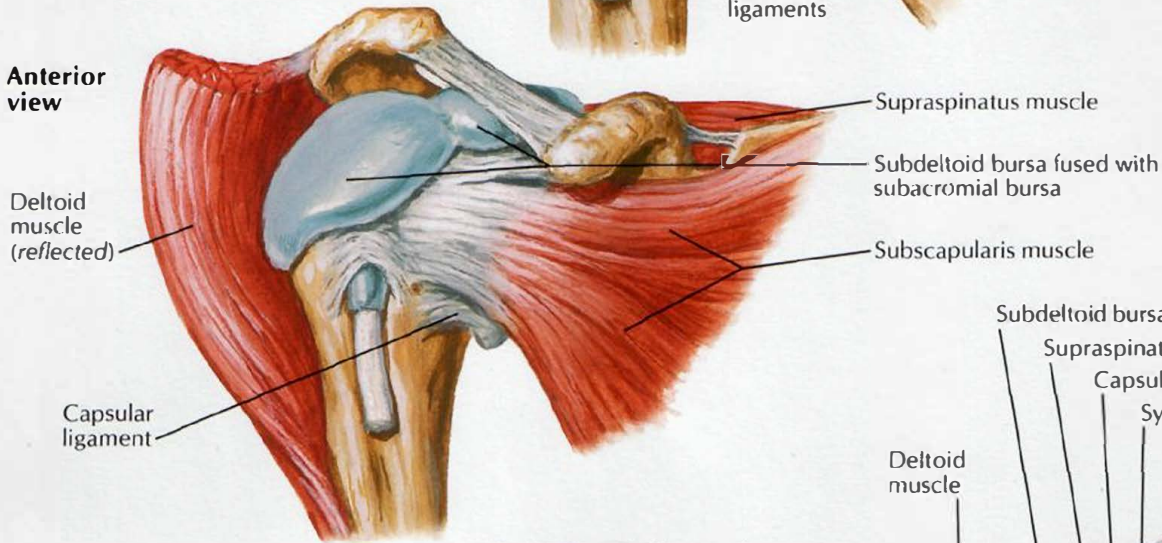
- A** Acromion
- AN** Anatomical neck of humerus
- C** Clavicle
- CP** Coracoid process
- G** Glenoid cavity of scapula
- GT** Greater tubercle
- H** Humerus
- HH** Head of humerus
- S** Scapula (lateral border)
- SN** Surgical neck of humerus
- SS** Spine of scapula

Shoulder (Glenohumeral) Joint

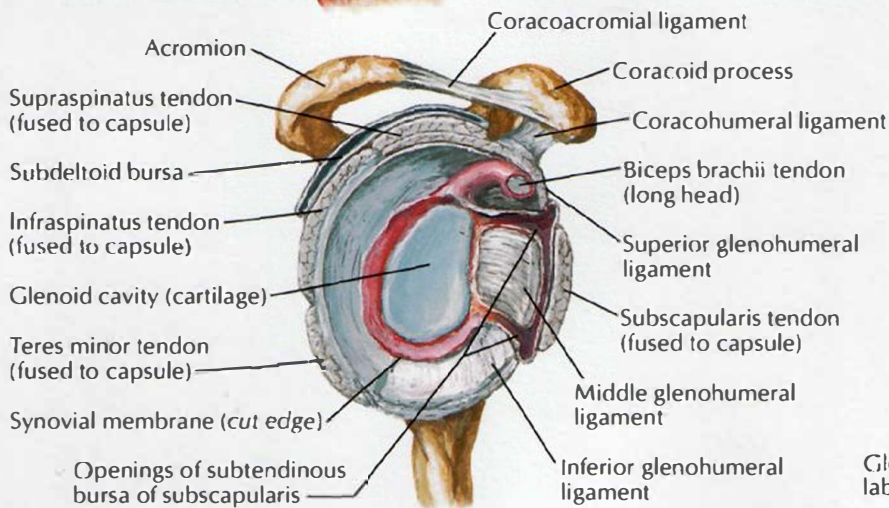
Anterior view



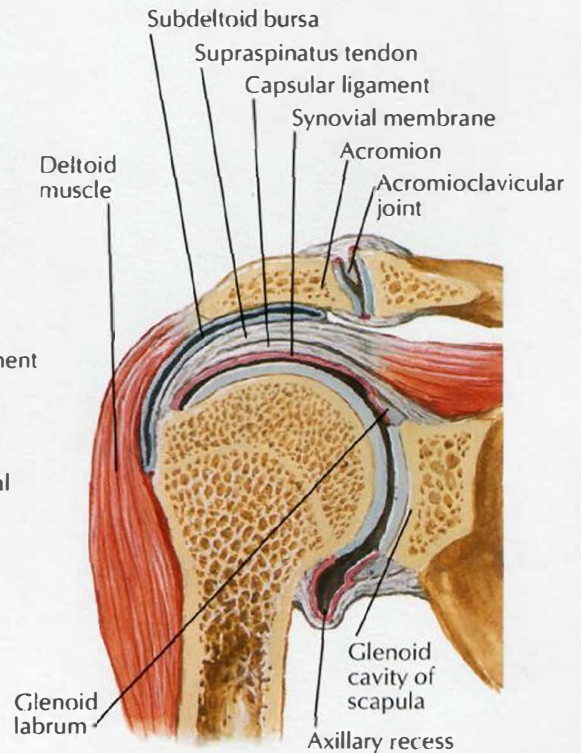
Anterior view



F. Netter M.D.
M.D.



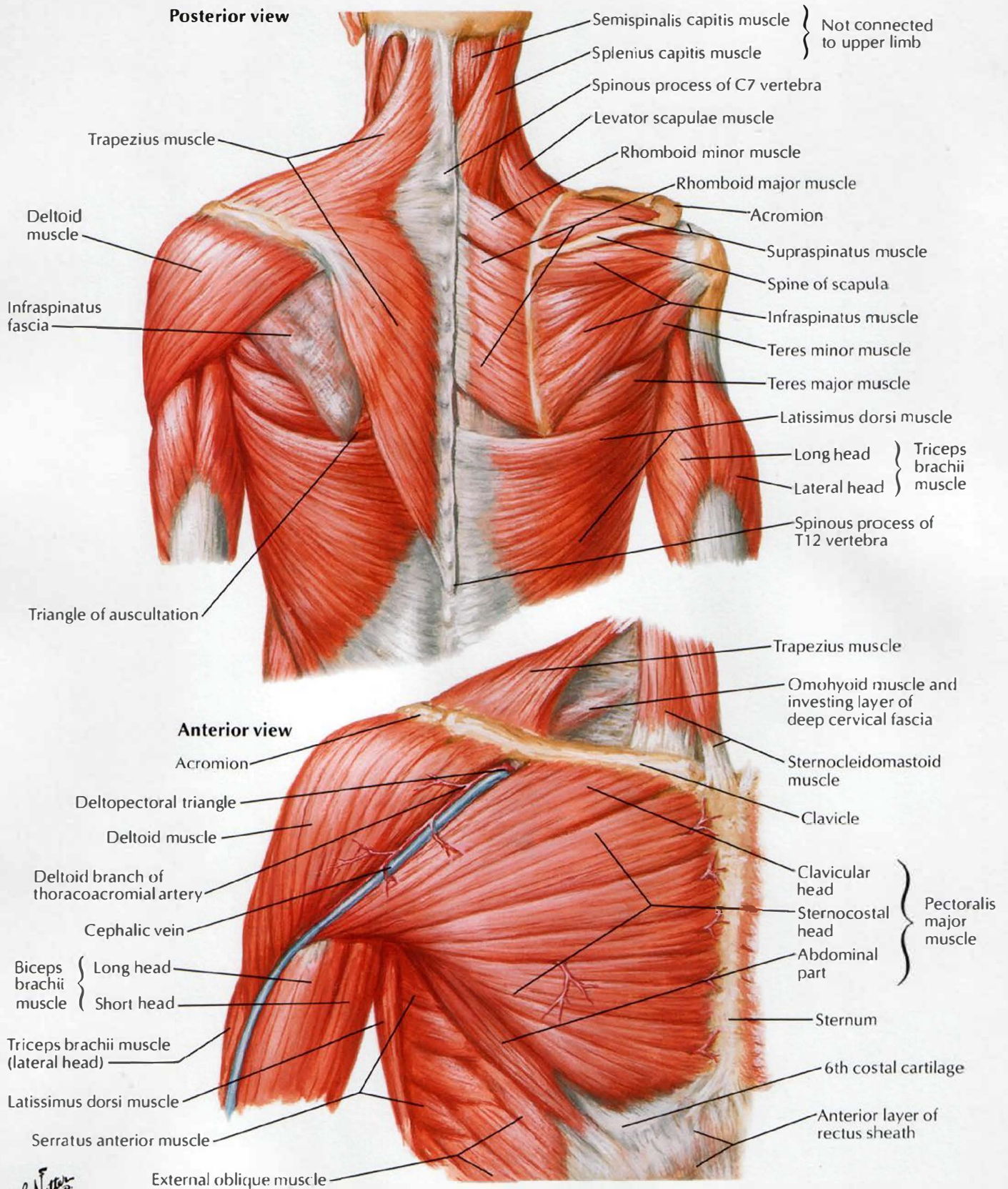
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Coronal section through joint

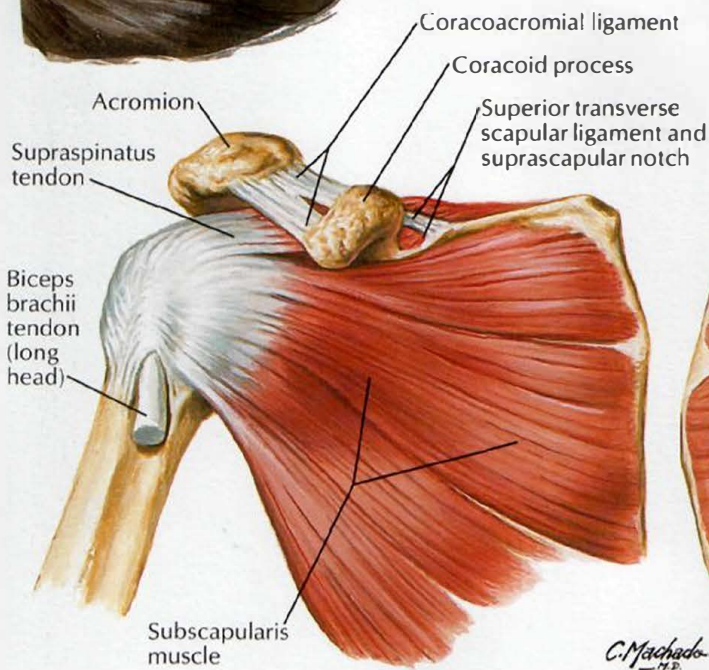
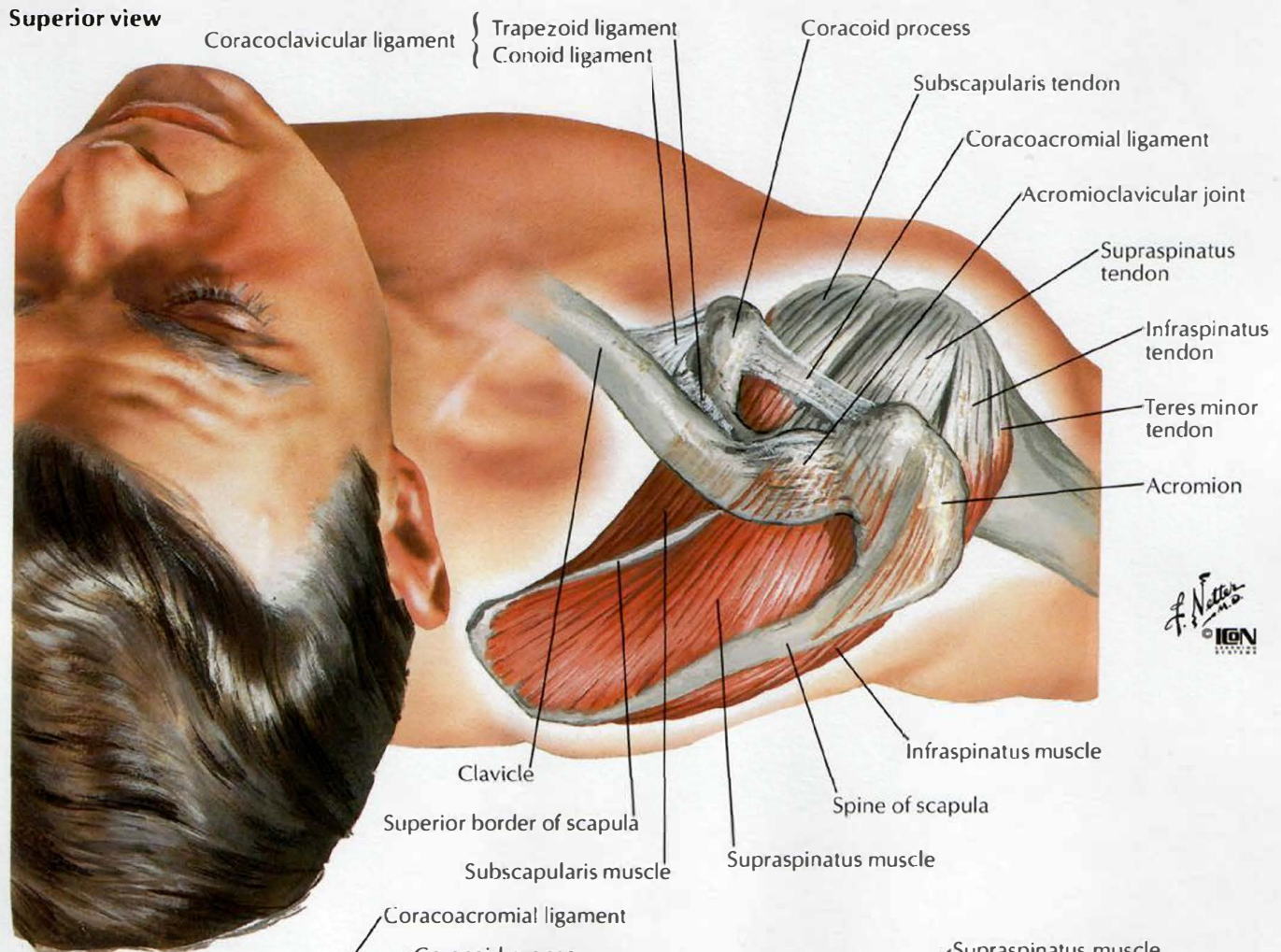
Muscles of Shoulder

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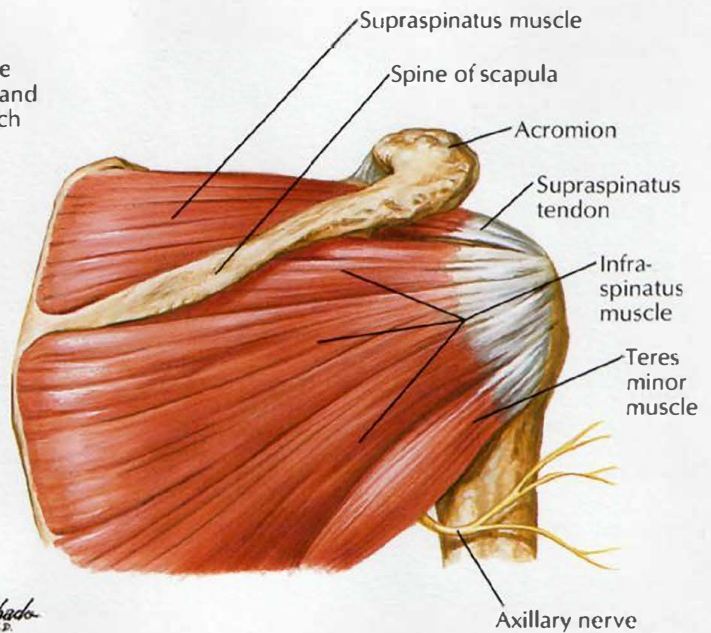


Muscles of Rotator Cuff

Superior view



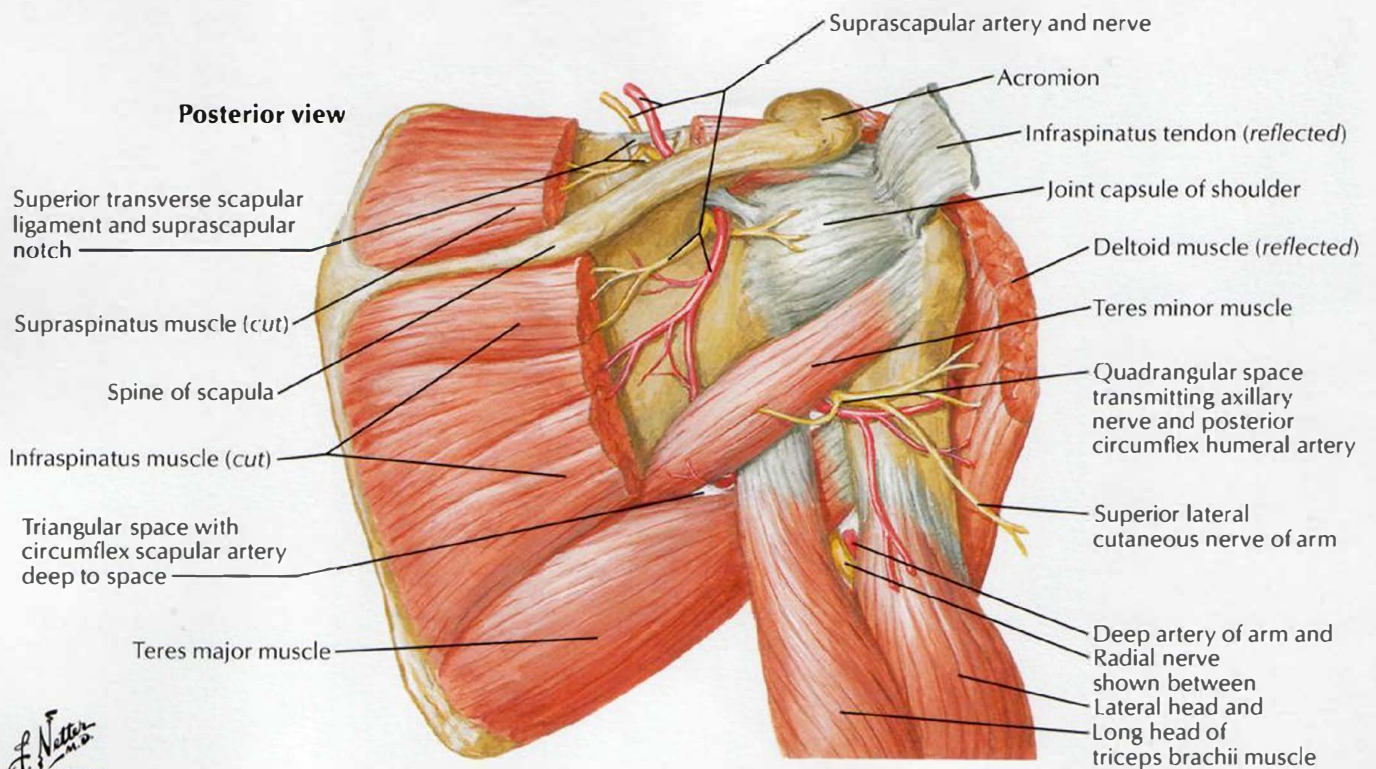
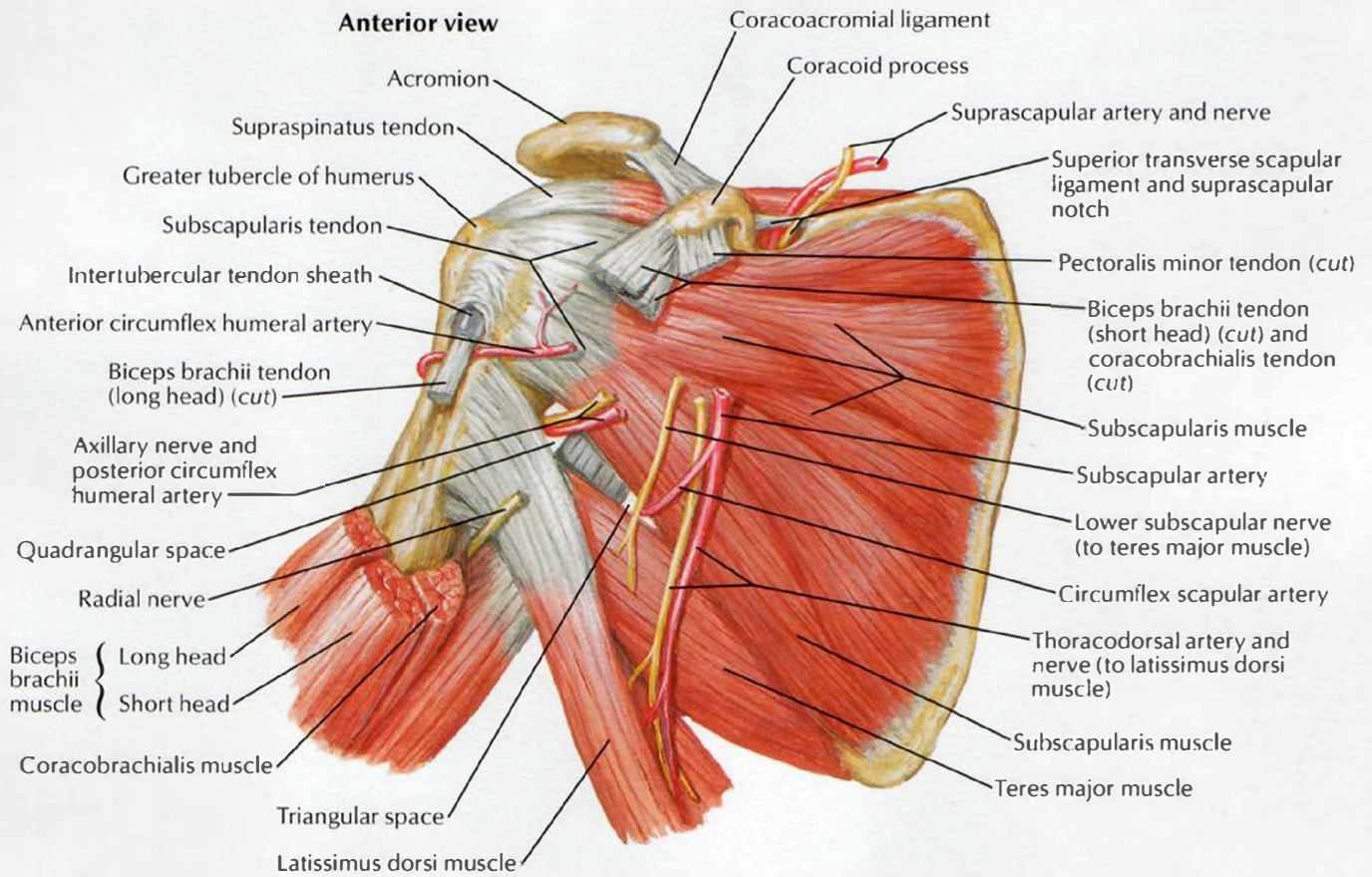
Anterior view



Posterior view

Scapulohumeral Dissection

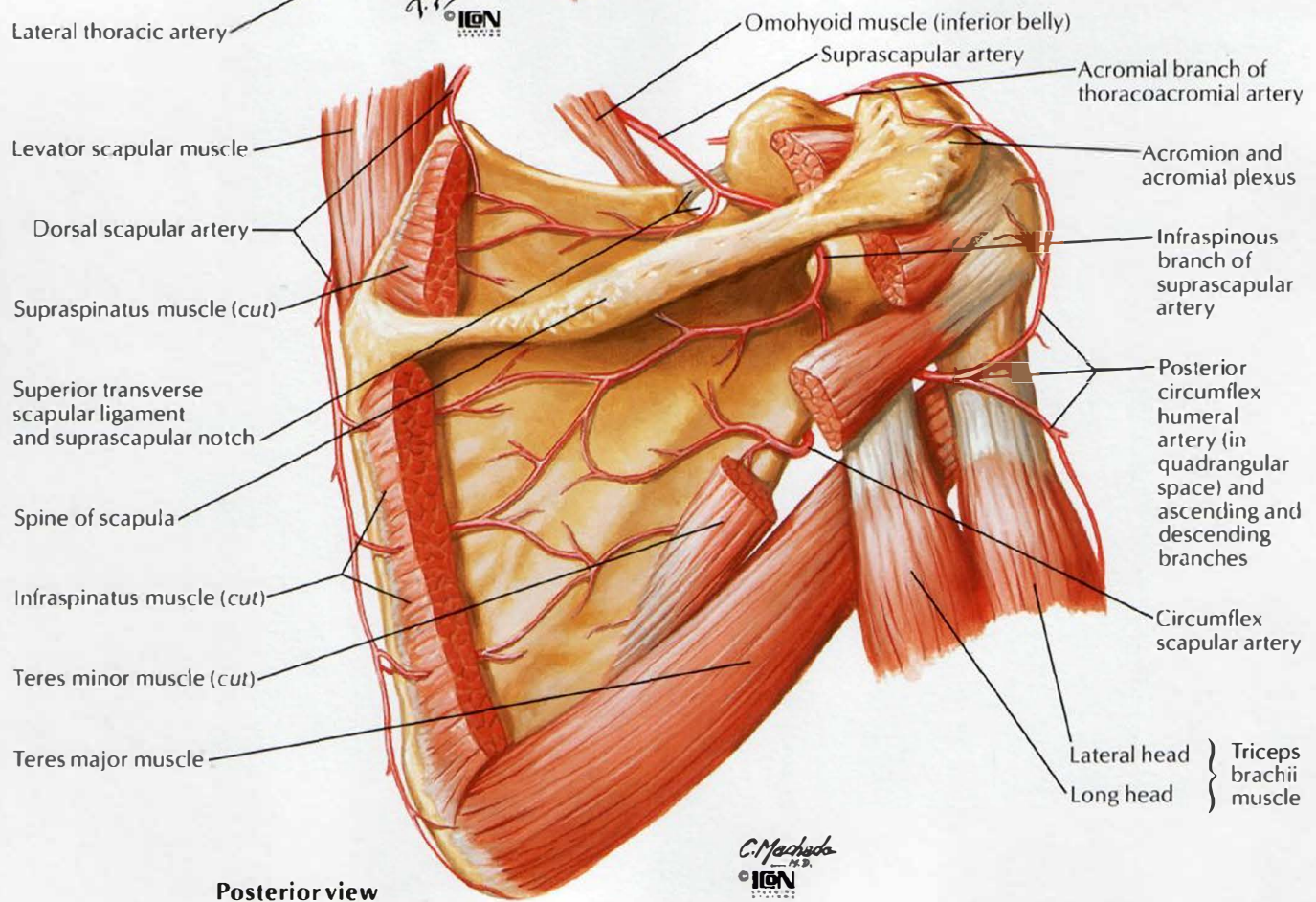
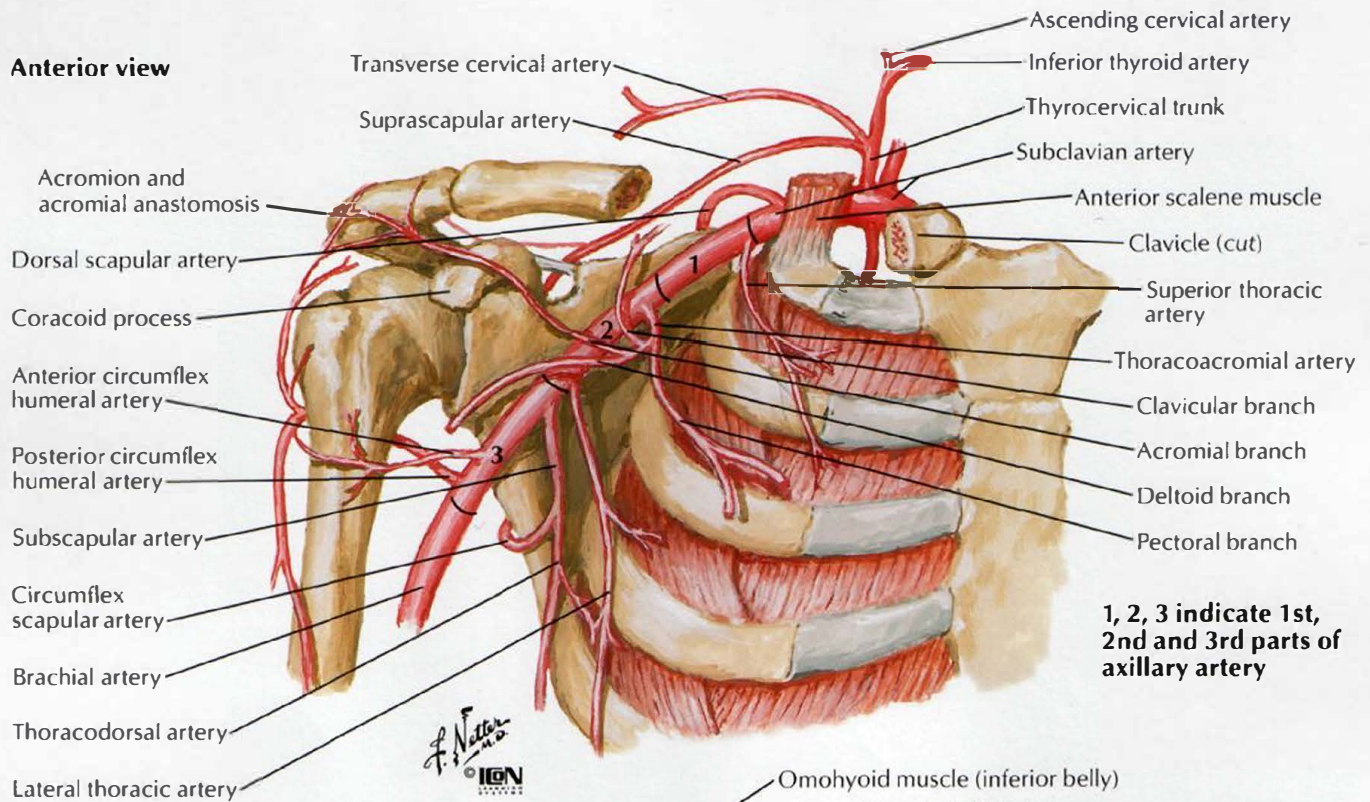
SEE ALSO PLATE 460



Axillary Artery and Anastomoses Around Scapula

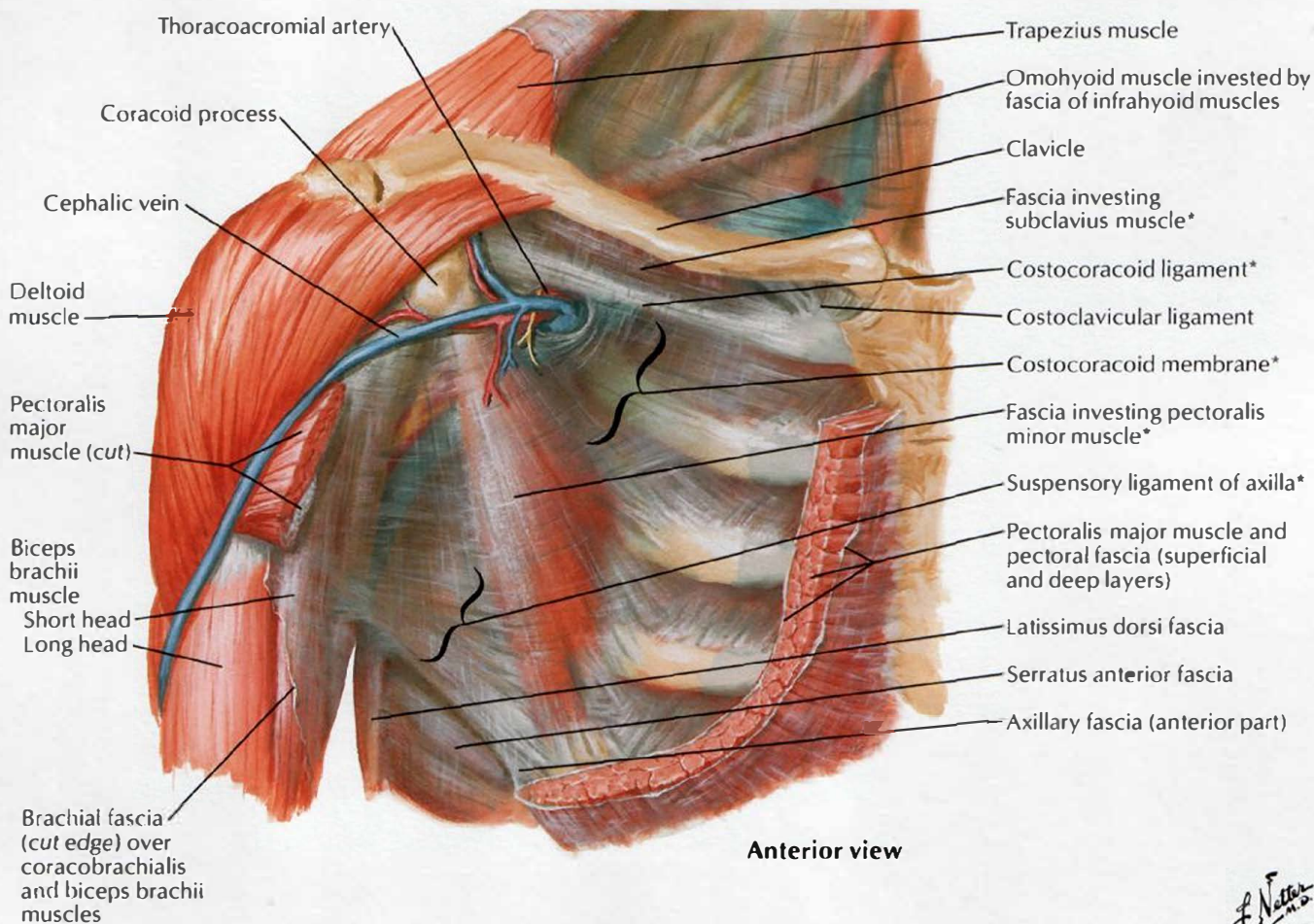
SEE ALSO PLATES 29, 417

Anterior view

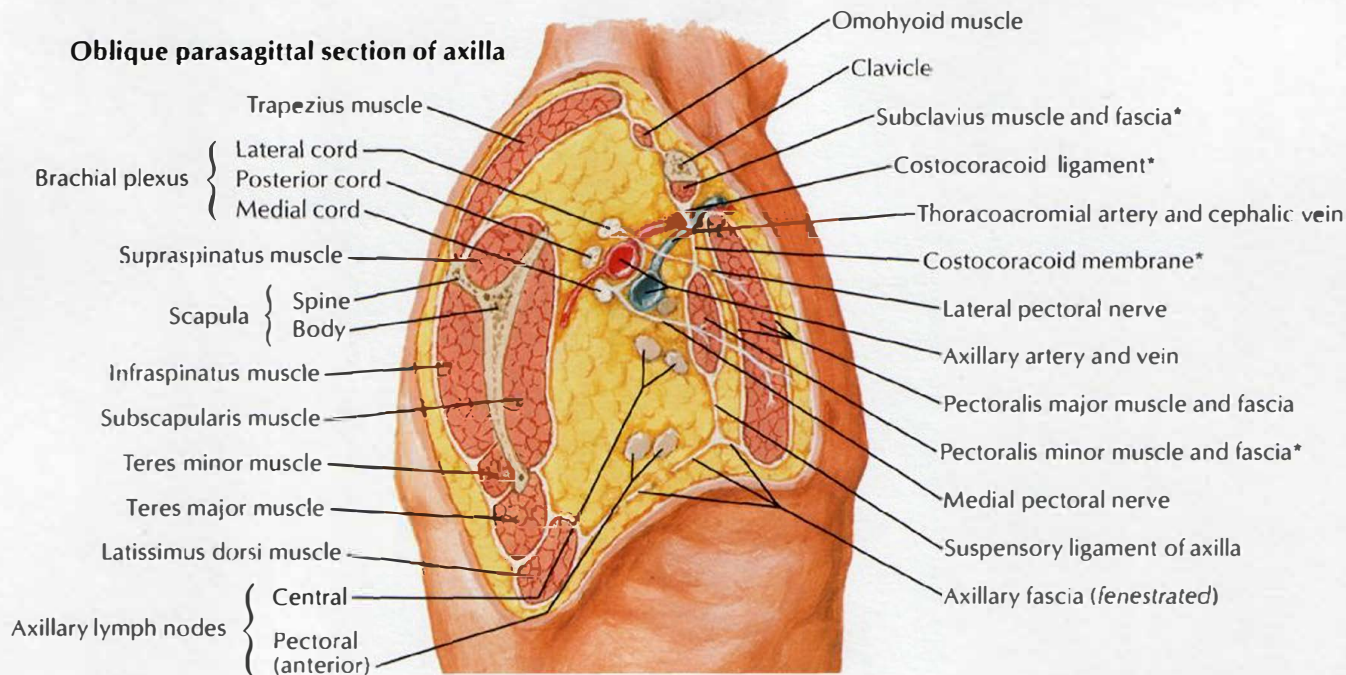


Pectoral, Clavipectoral and Axillary Fasciae

SEE ALSO PLATE 182

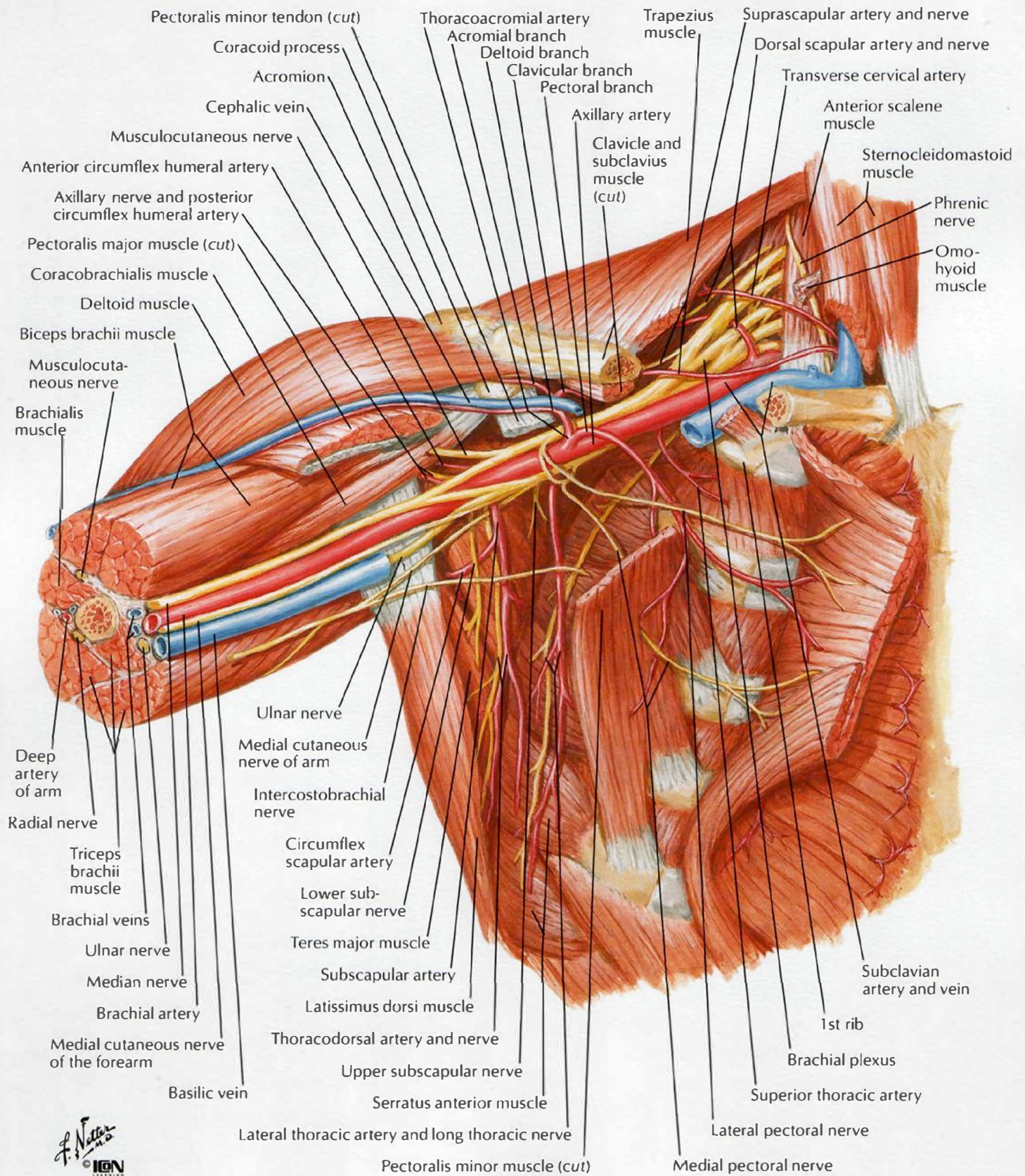


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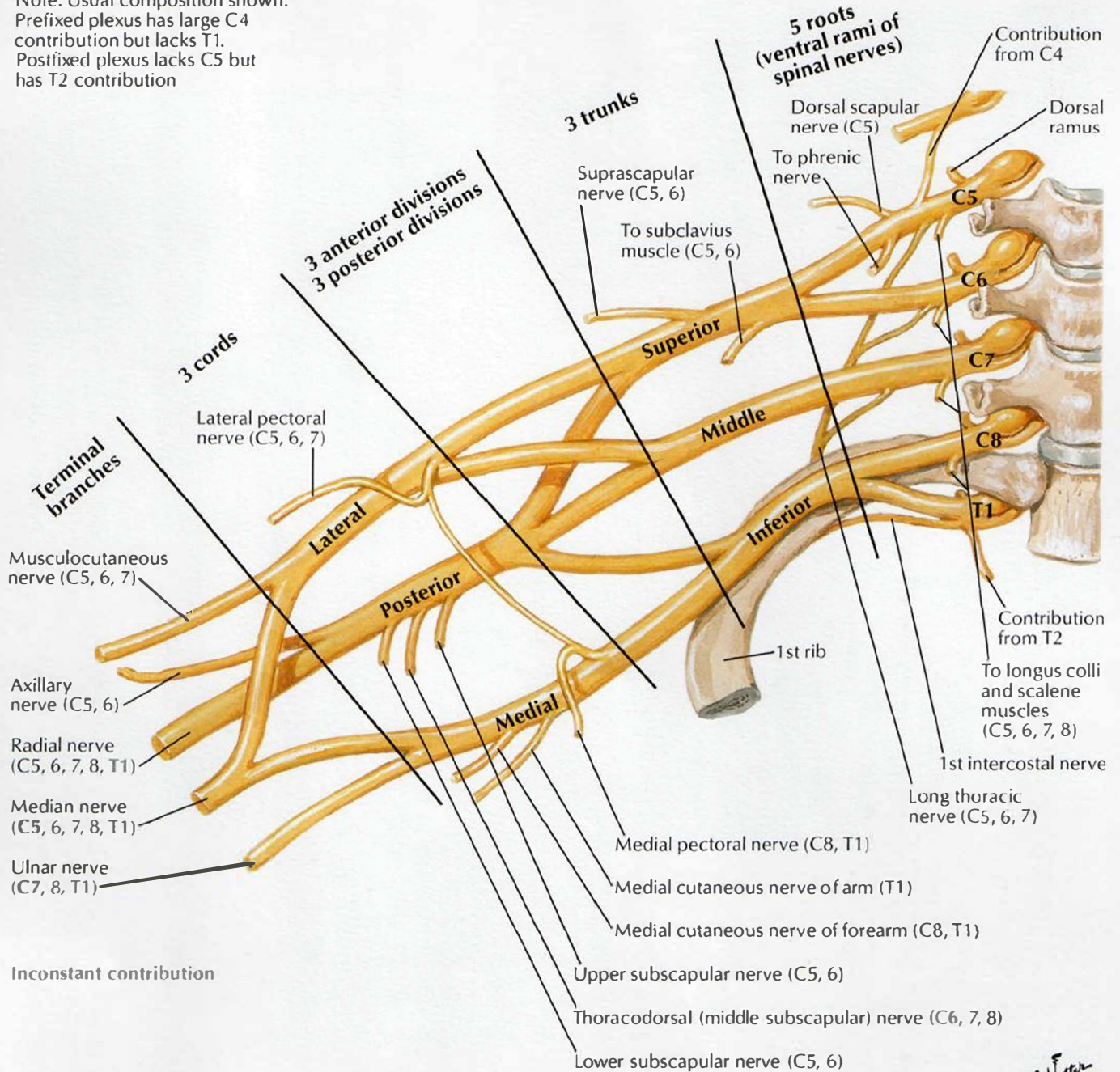
*Components of clavipectoral fascia

Axilla (Dissection): Anterior View



Brachial Plexus: Schema

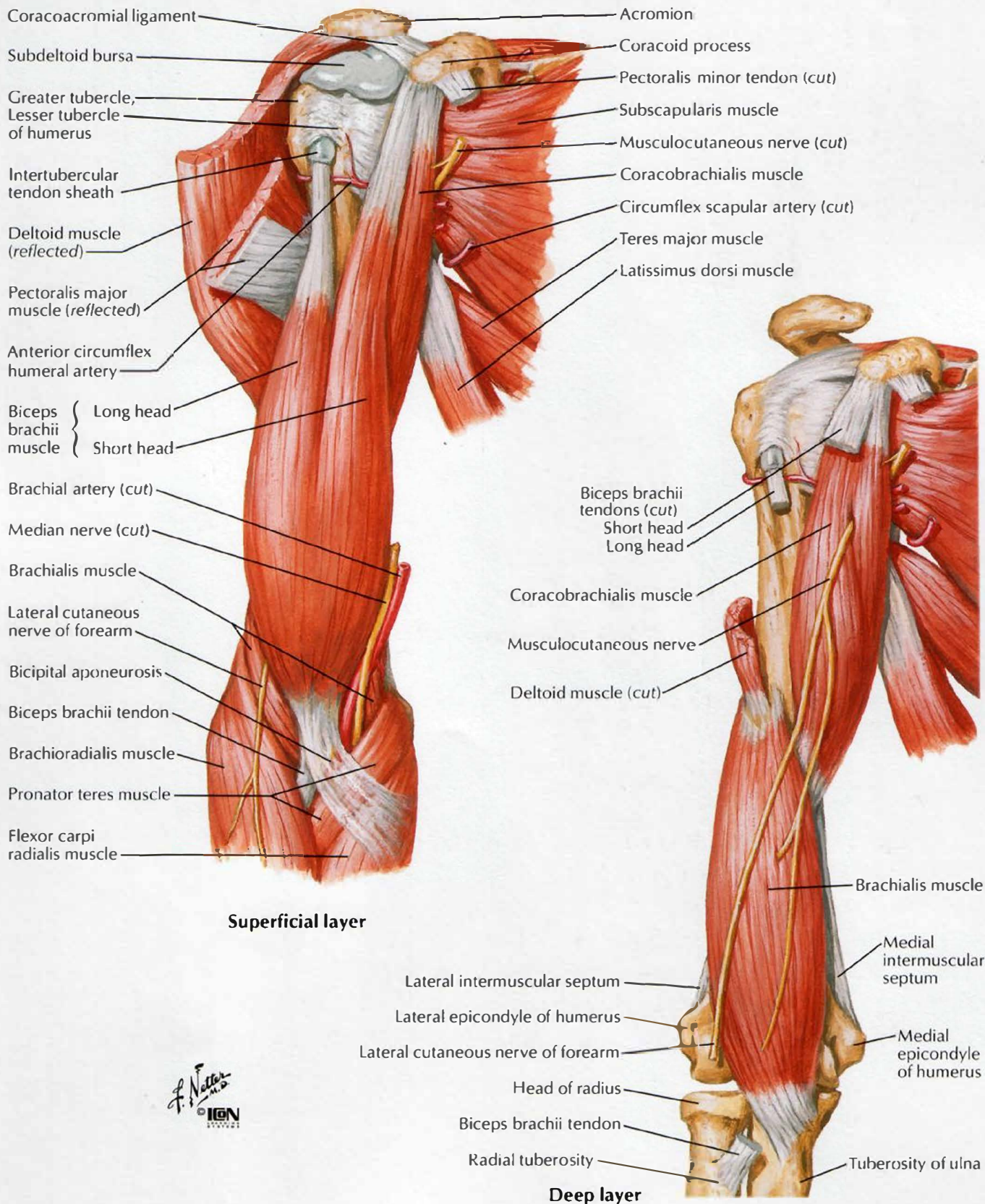
Note: Usual composition shown.
 Prefixed plexus has large C4 contribution but lacks T1.
 Postfixed plexus lacks C5 but has T2 contribution



F. Netter M.D.
 © IGM

Muscles of Arm: Anterior Views

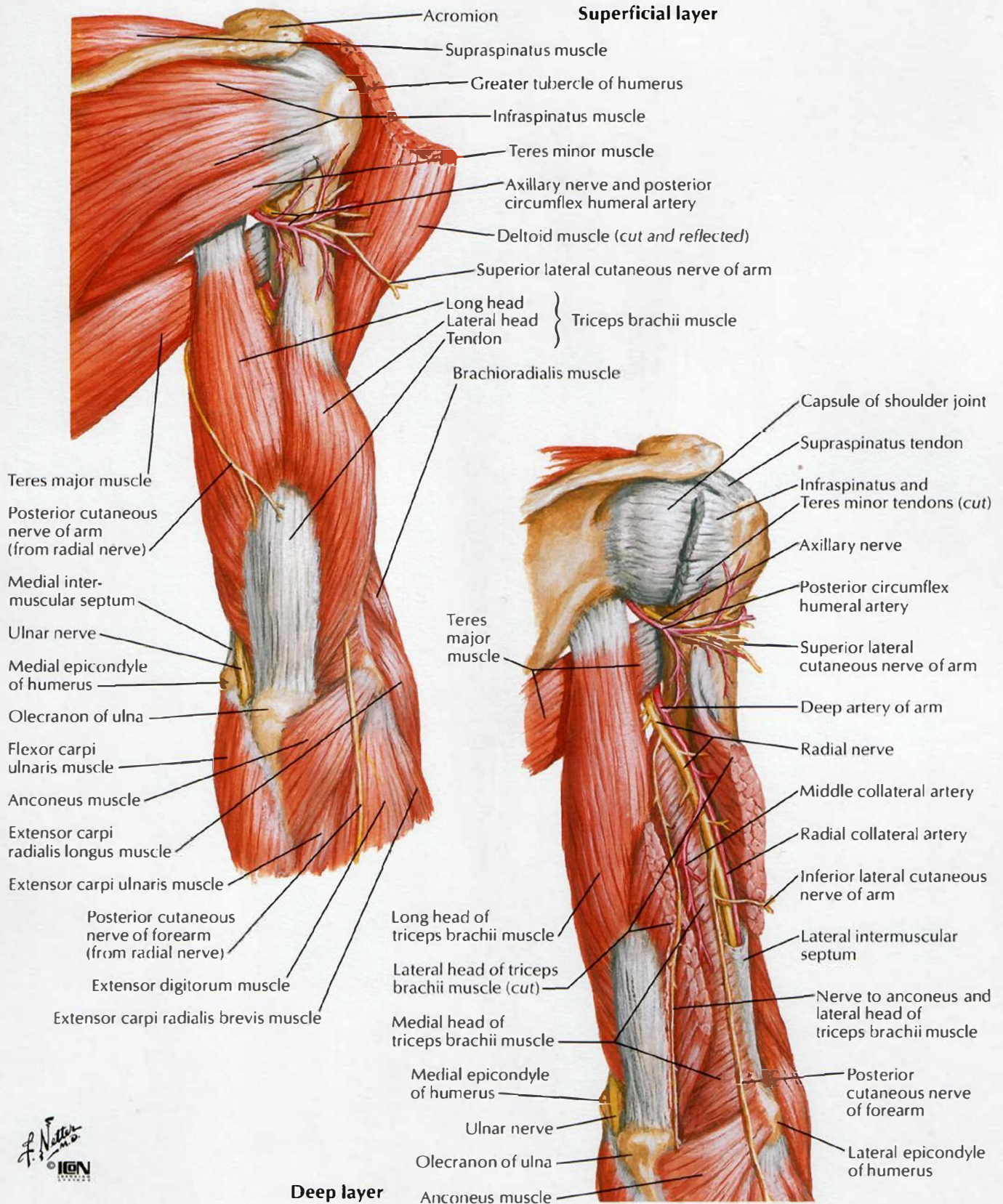
SEE ALSO PLATE 457



F. Netter M.D.
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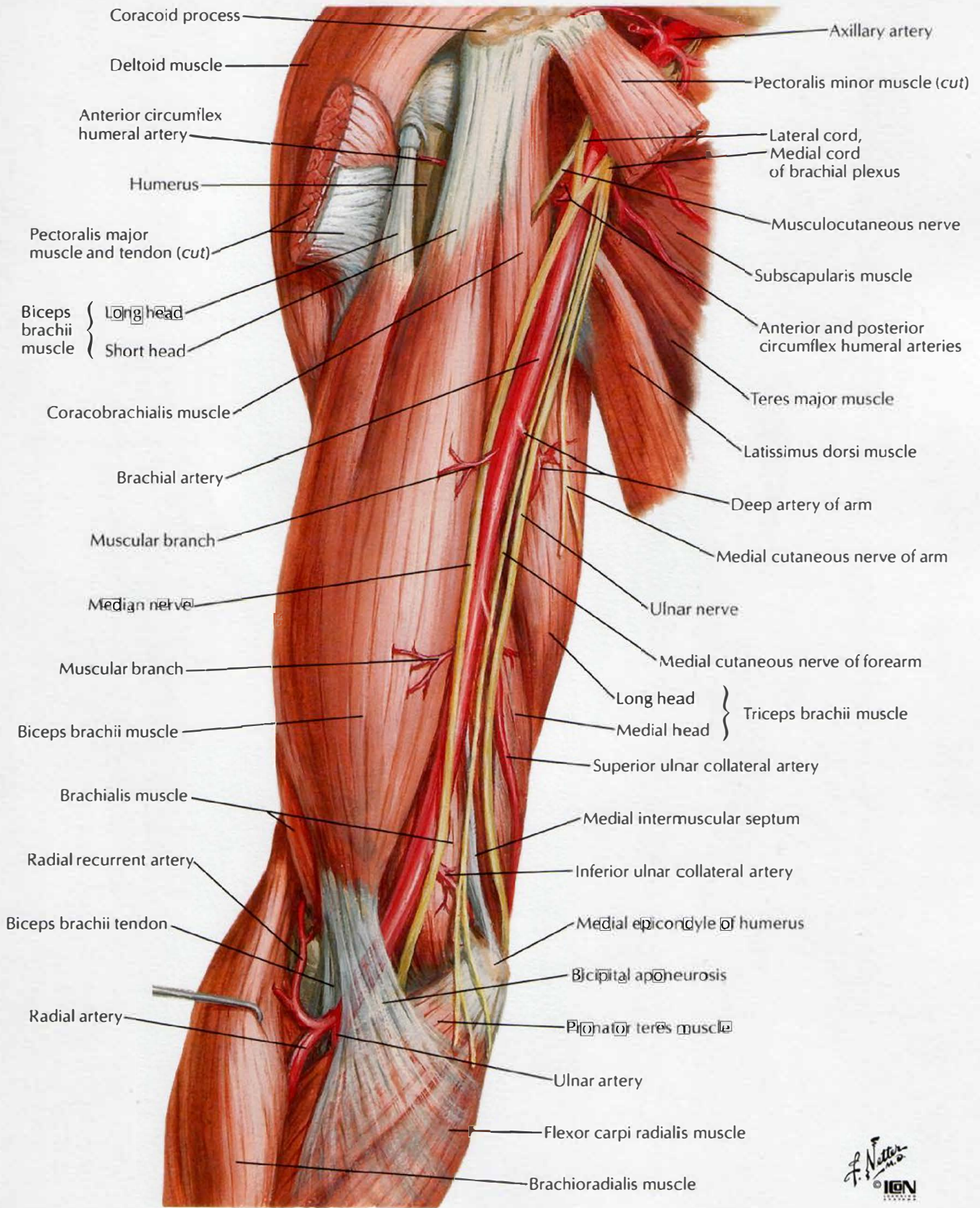
Muscles of Arm: Posterior Views

SEE ALSO PLATE 460



F. Netter M.D.
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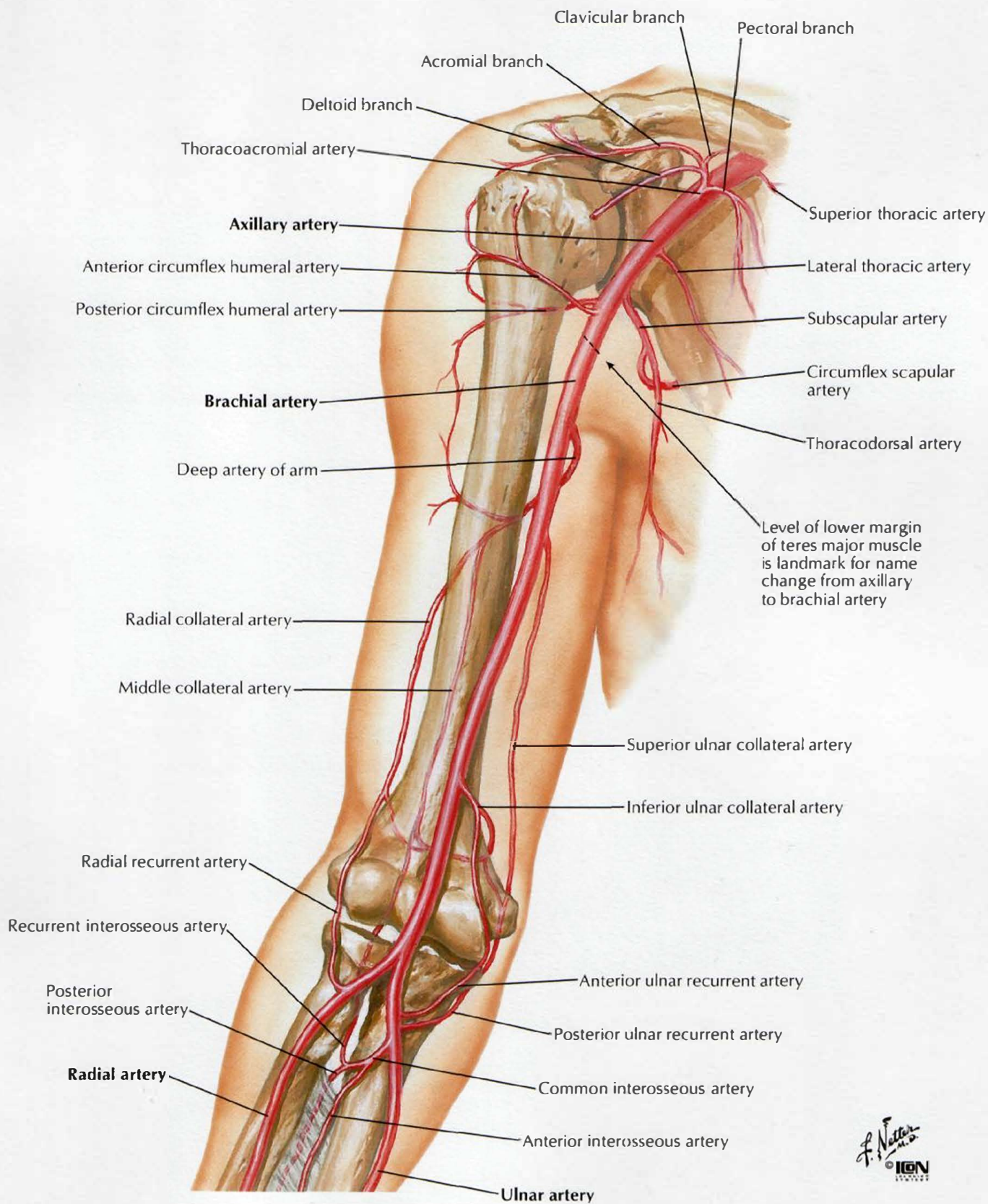
Brachial Artery In Situ



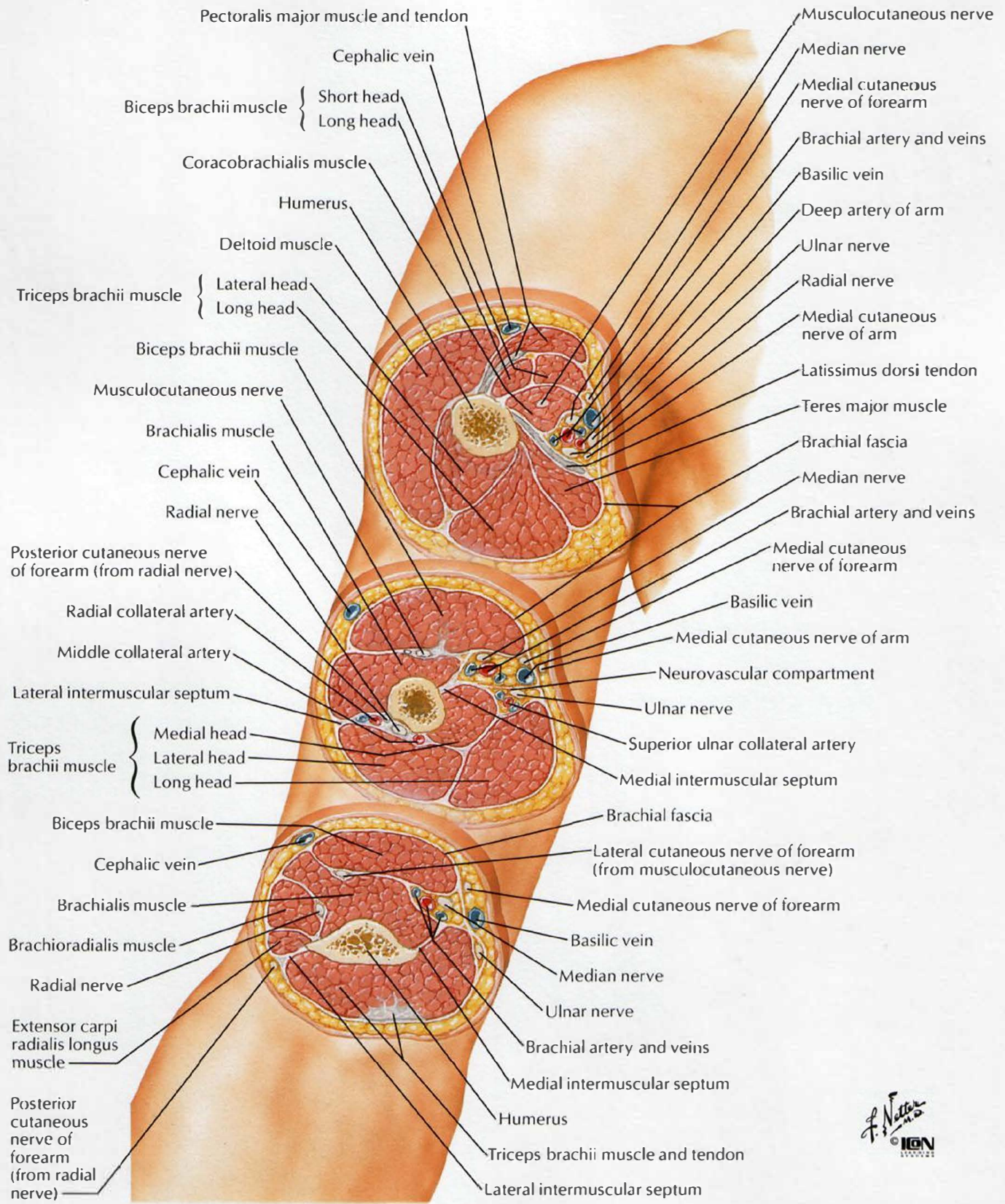
F. Netter M.D.
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Brachial Artery and Anastomoses Around Elbow

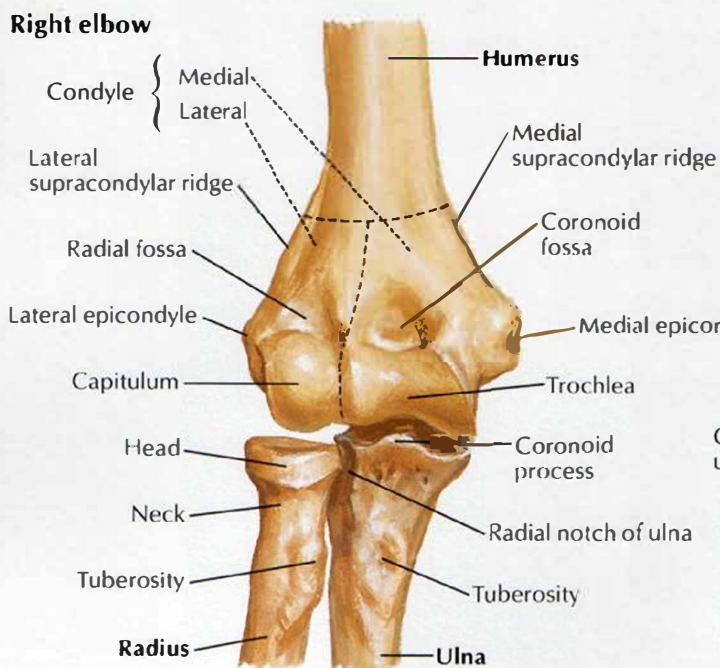
SEE ALSO PLATE 410



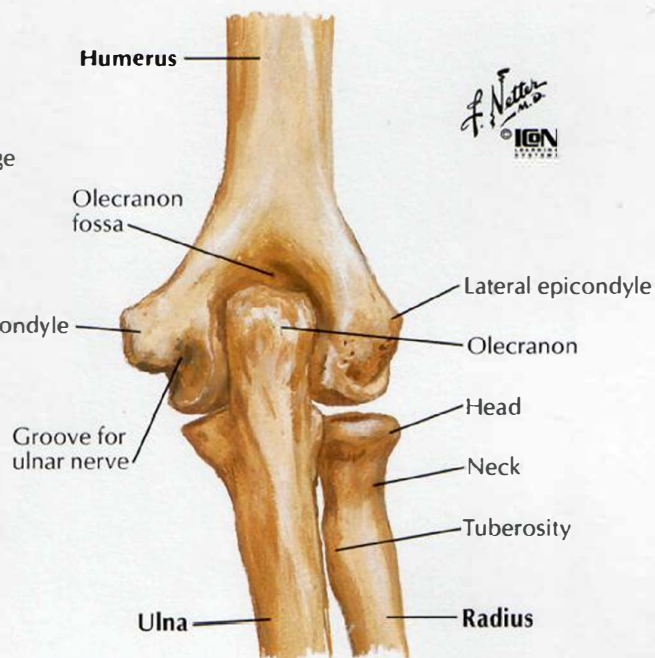
Arm: Serial Cross Sections



Right elbow



In extension: anterior view



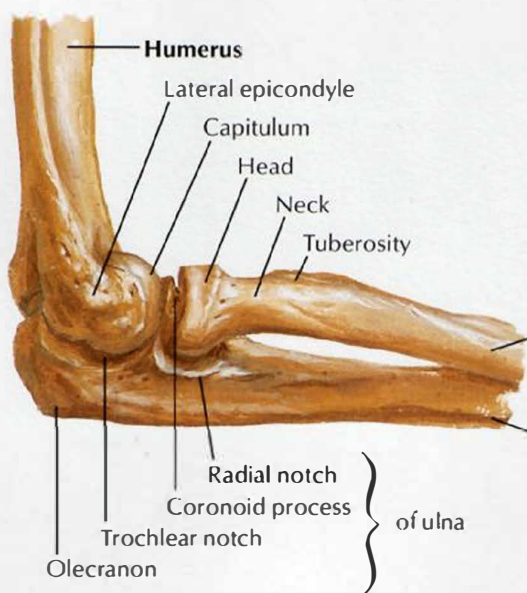
In extension: posterior view



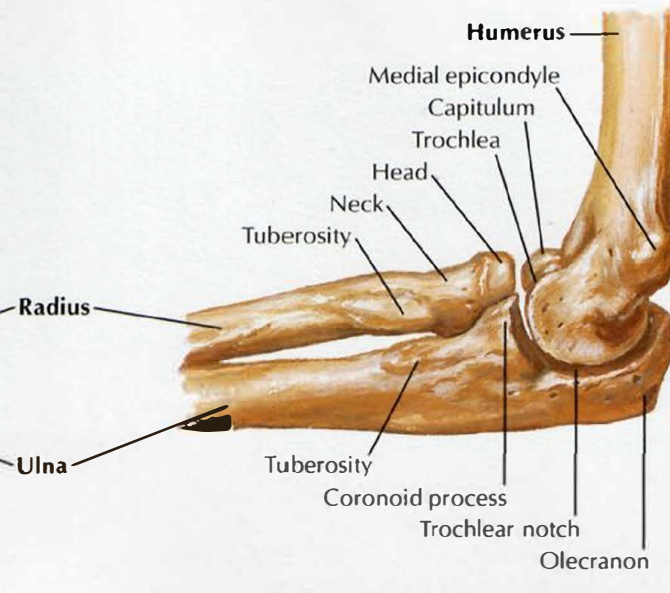
In extension: lateral view



In extension: medial view



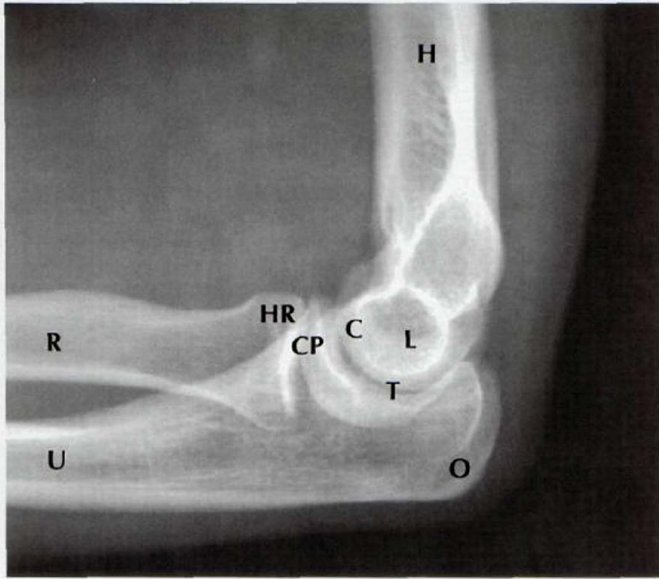
In 90° flexion: lateral view



In 90° flexion: medial view

Elbow: Radiographs

SEE ALSO PLATE 419

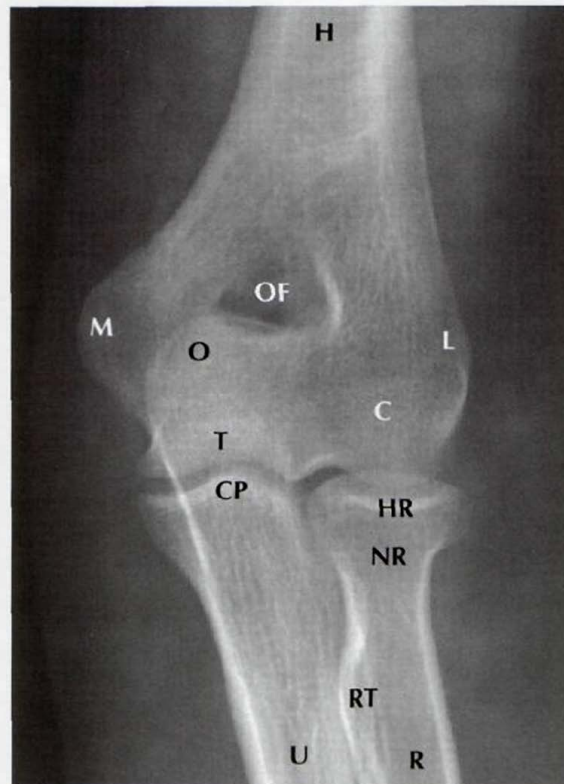


Lateral radiograph

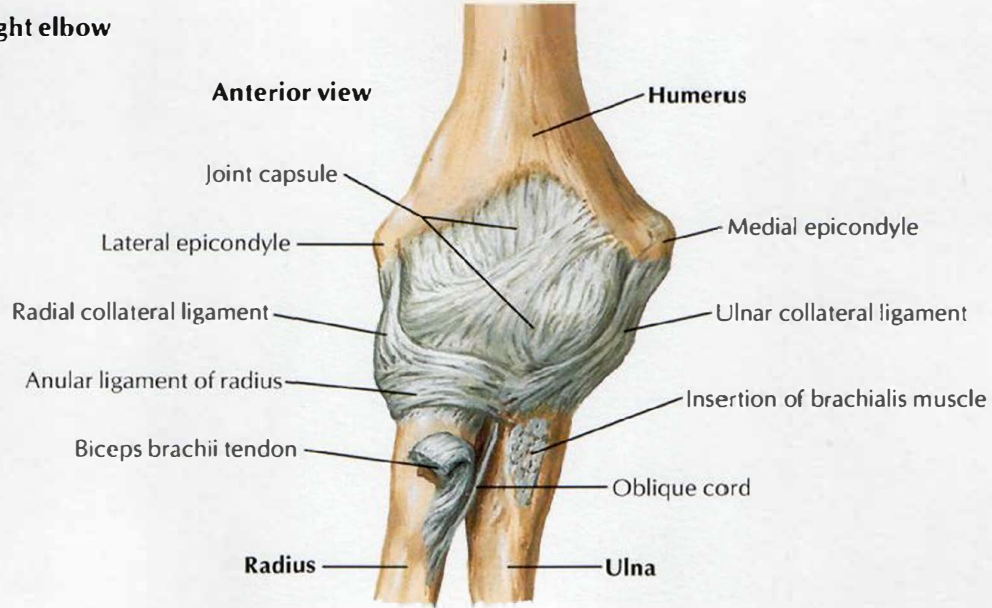
- C Capitulum
- CP Coronoid process of ulna
- H Humerus
- HR Head of radius
- L Lateral epicondyle
- O Olecranon
- R Radius
- T Trochlear notch
- U Ulna

Anteroposterior radiograph

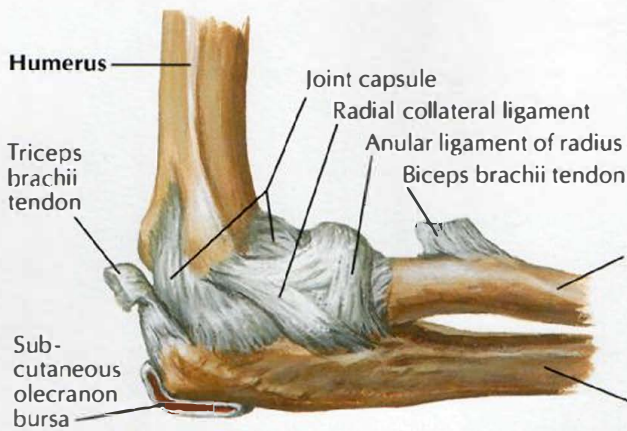
- C Capitulum
- CP Coronoid process of ulna
- H Humerus
- HR Head of radius
- L Lateral epicondyle
- M Medial epicondyle
- NR Neck of radius
- O Olecranon
- OF Olecranon fossa
- R Radius
- T Trochlea of humerus
- RT Radial tuberosity
- U Ulna



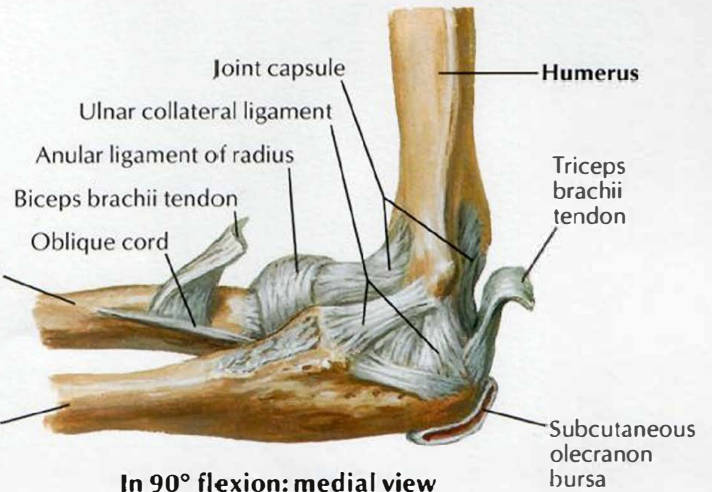
Right elbow



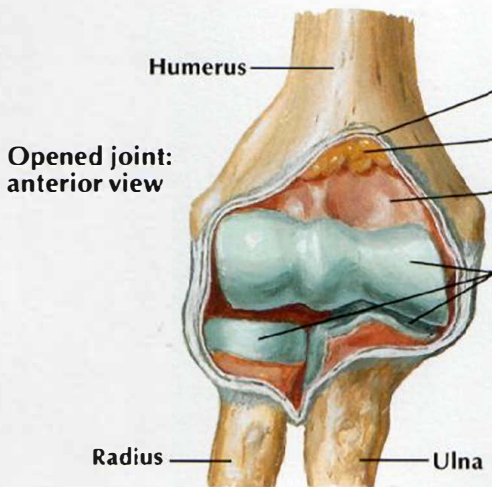
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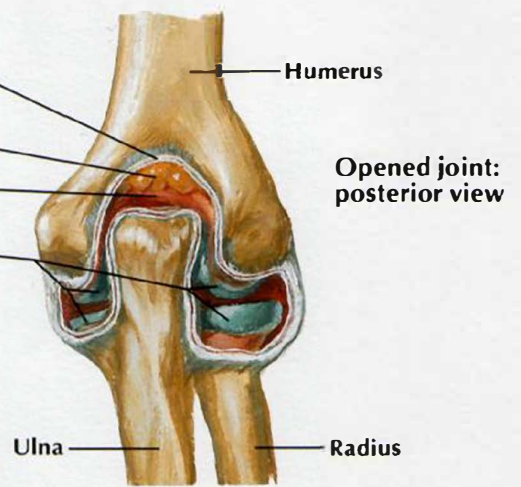
In 90° flexion: lateral view



In 90° flexion: medial view



Opened joint: anterior view

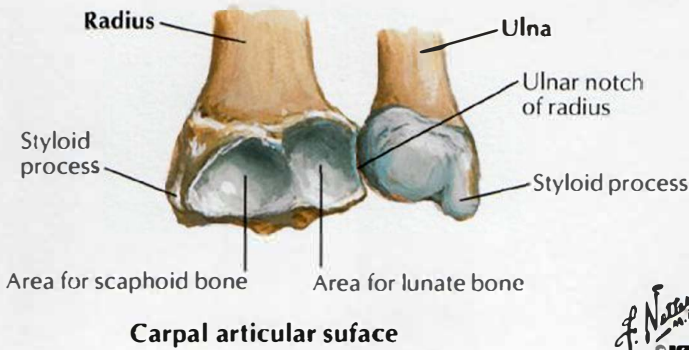
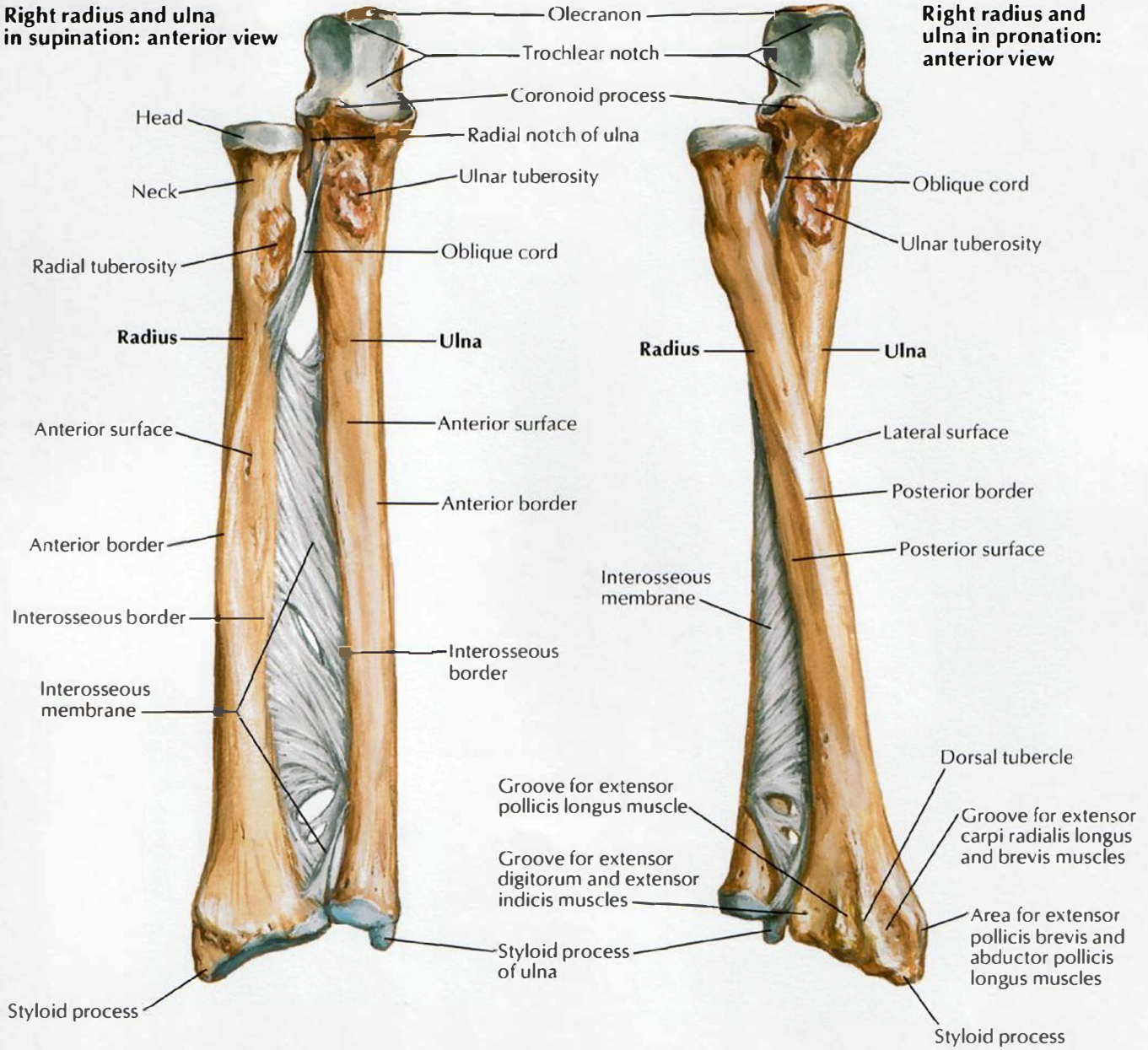


Opened joint: posterior view

Bones of Forearm

Right radius and ulna in supination: anterior view

Right radius and ulna in pronation: anterior view



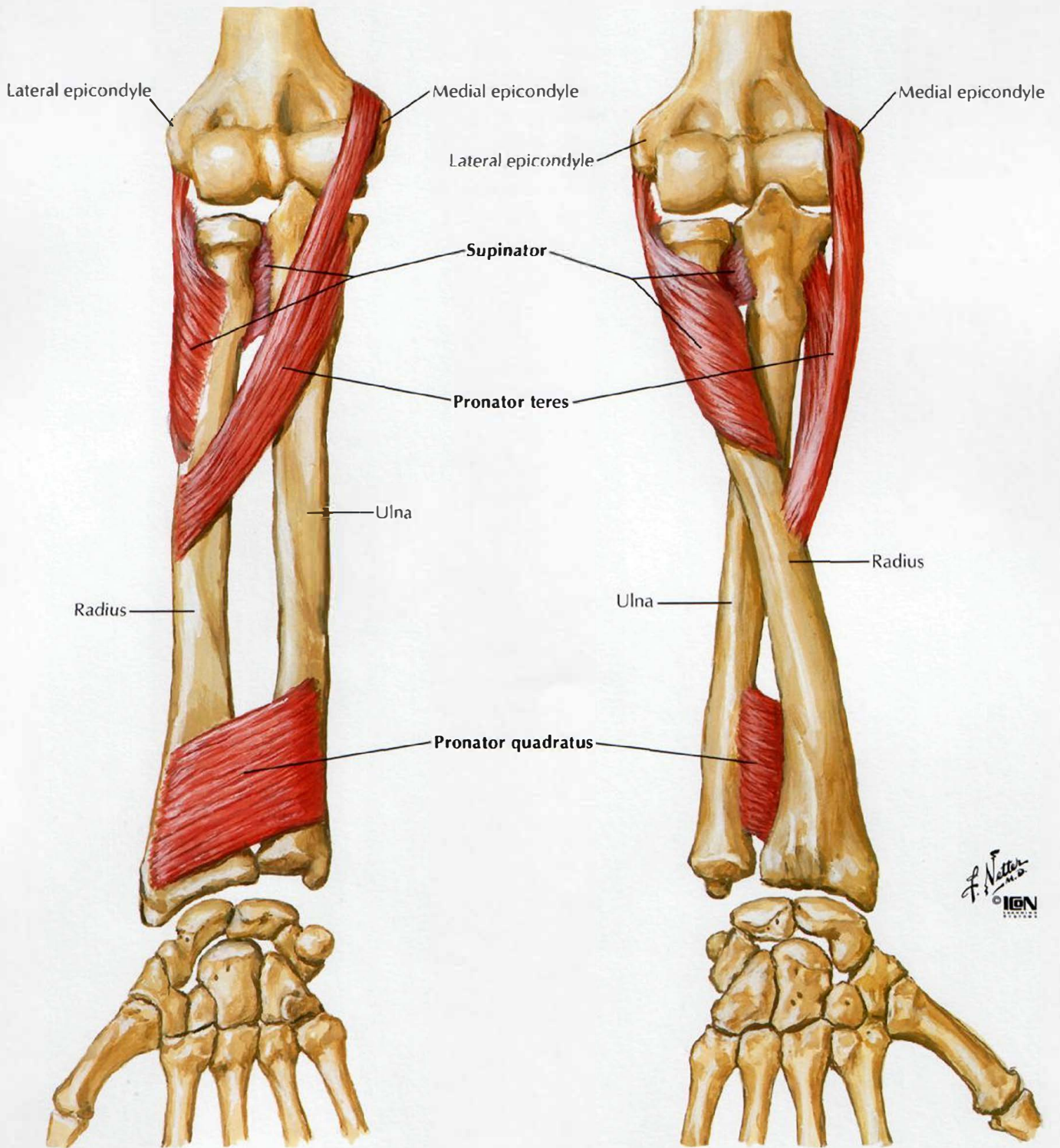
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Individual Muscles of Forearm: Rotators of Radius

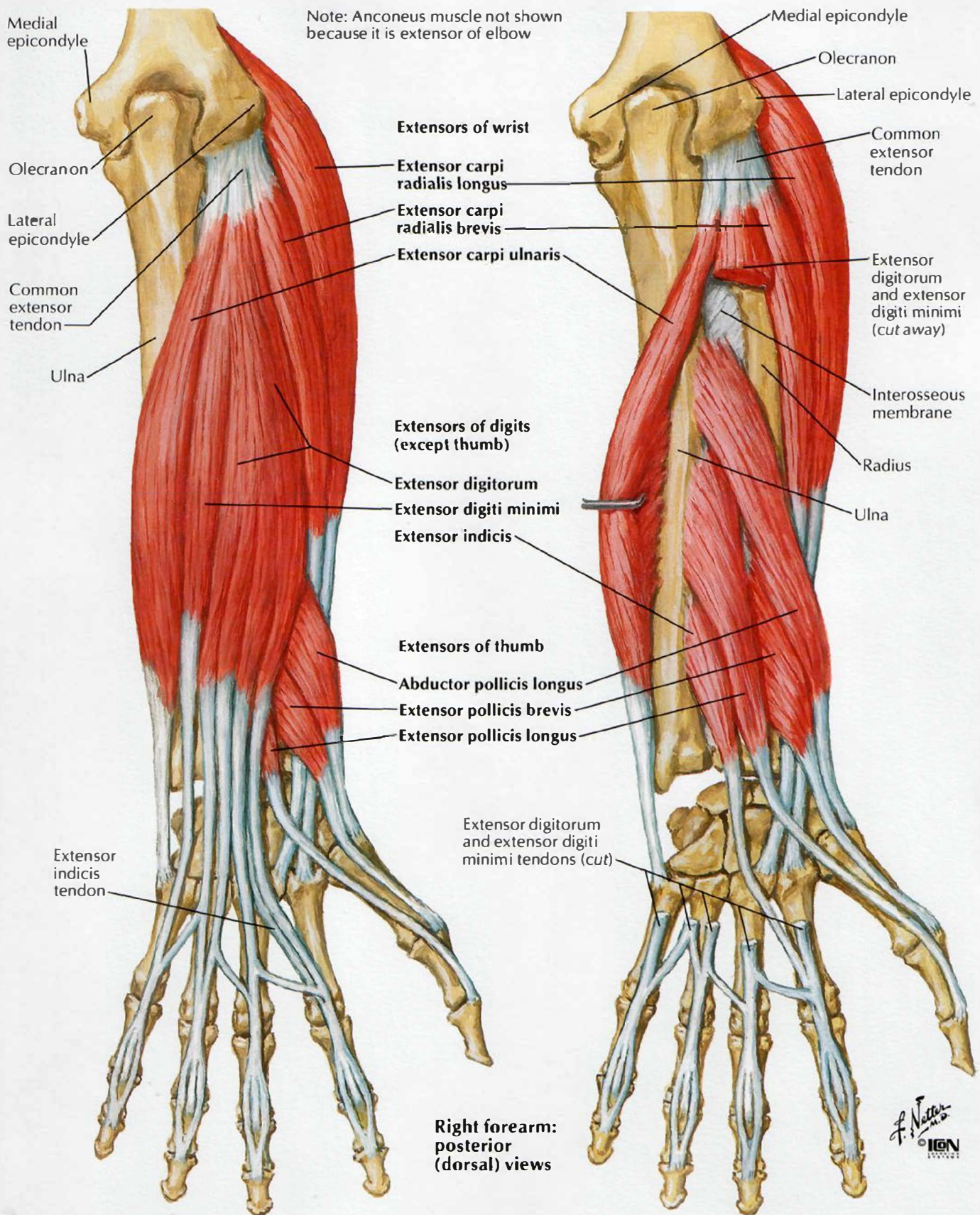
Right forearm: anterior view

Supinated position

Pronated position

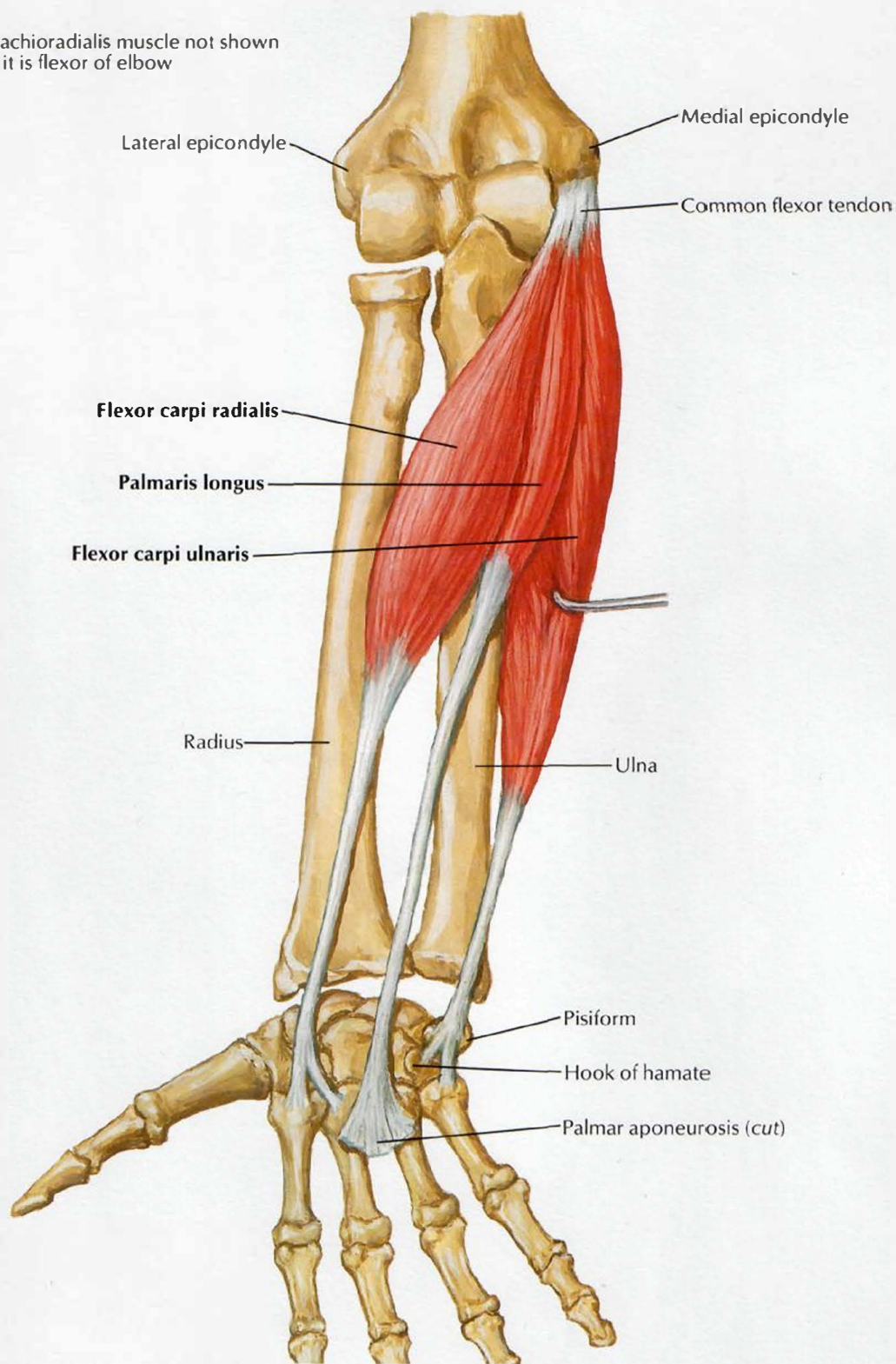


Individual Muscles of Forearm: Extensors of Wrist and Digits



Individual Muscles of Forearm: Flexors of Wrist

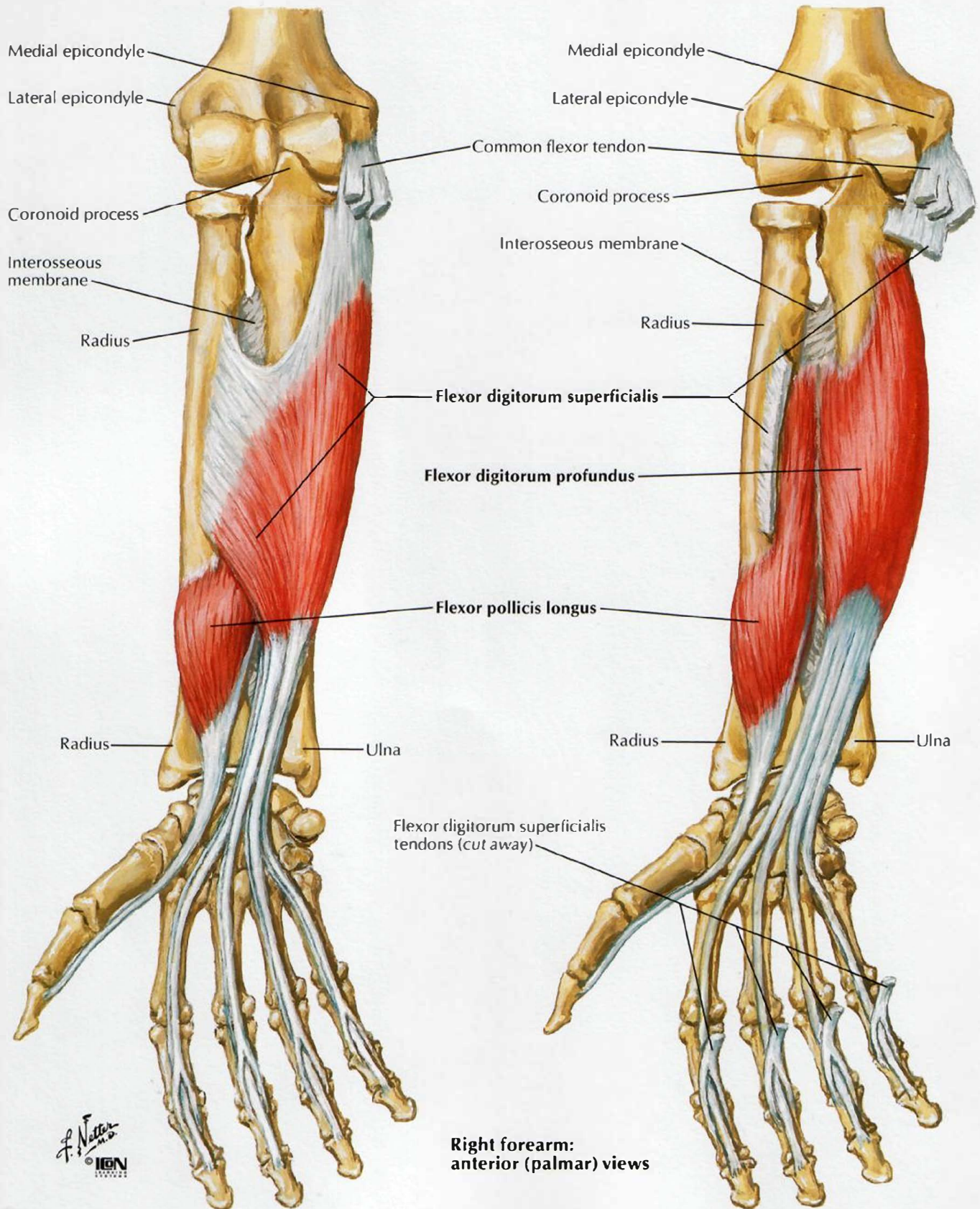
Note: Brachioradialis muscle not shown because it is flexor of elbow



Right forearm:
anterior (palmar) view

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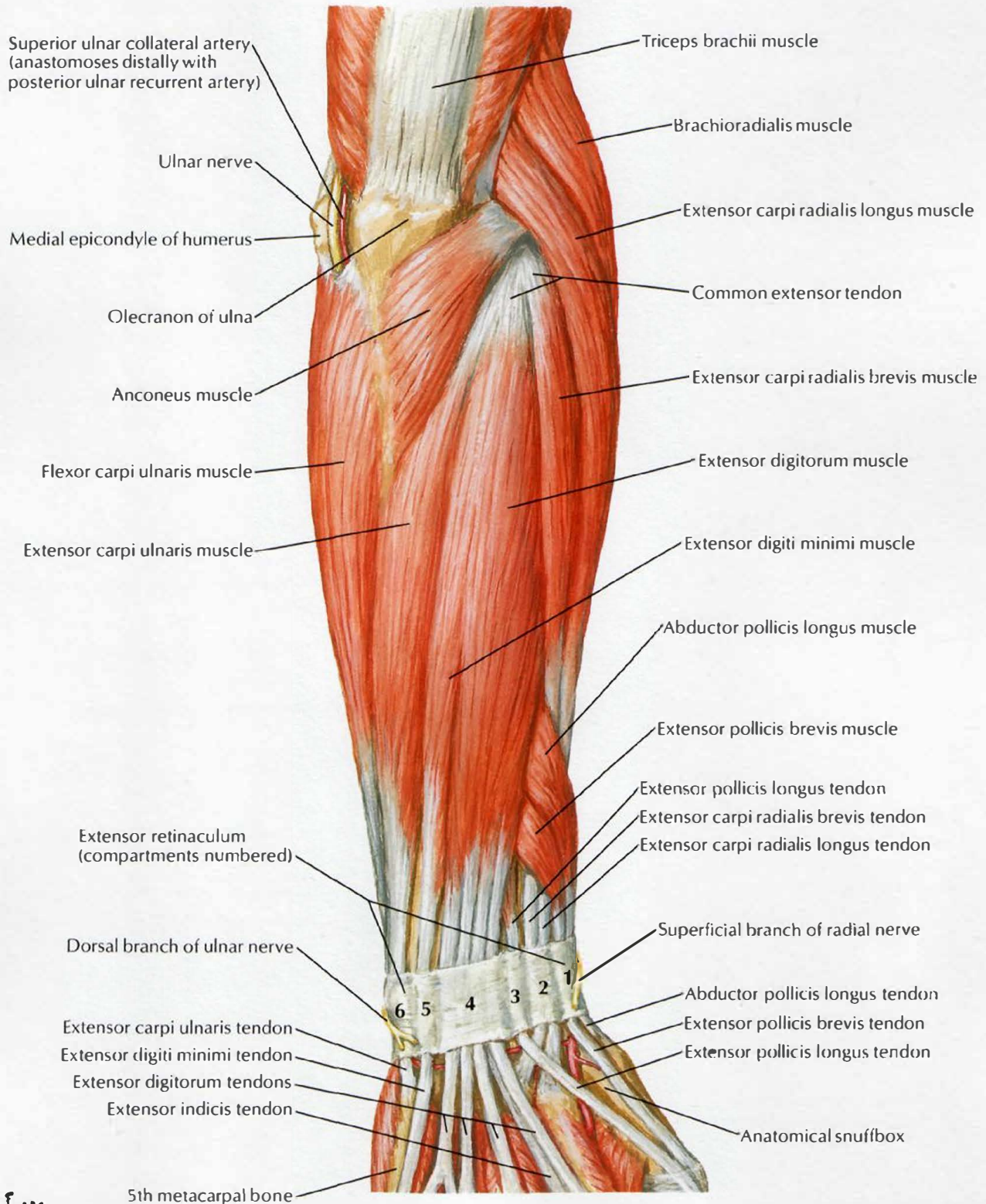
Individual Muscles of Forearm: Flexors of Digits



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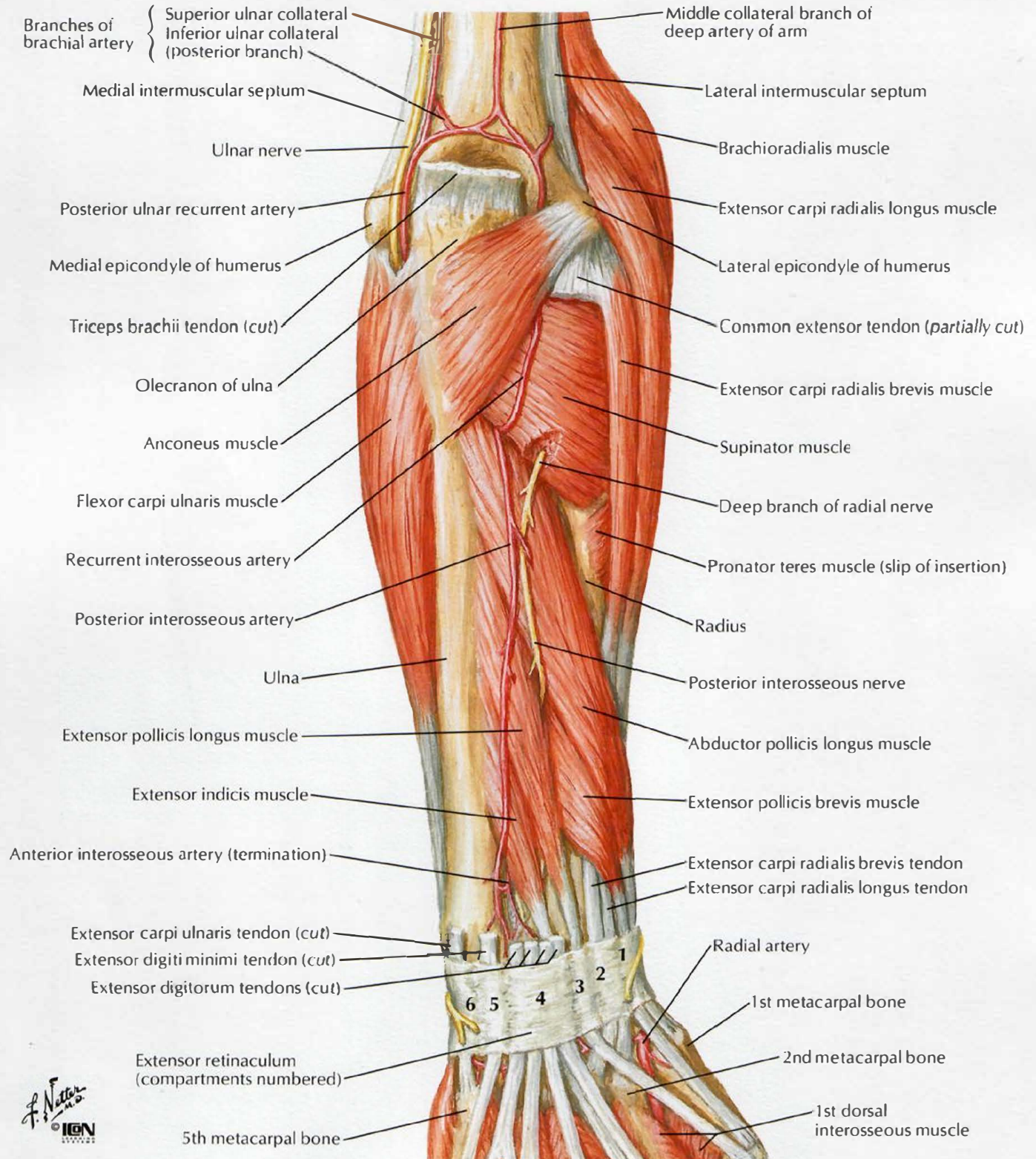
Muscles of Forearm (Superficial Layer): Posterior View

SEE ALSO PLATES 453, 461



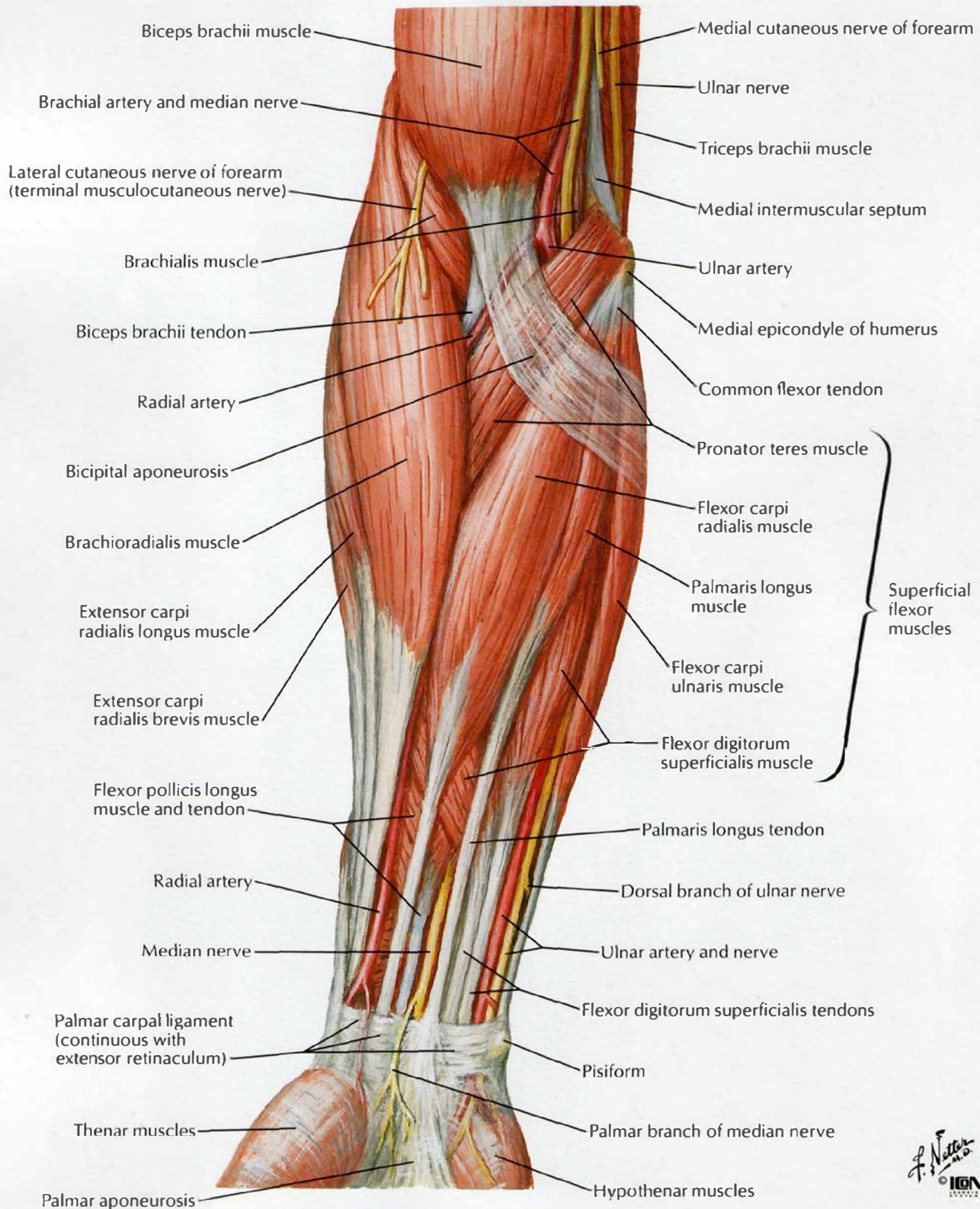
Muscles of Forearm (Deep Layer): Posterior View

SEE ALSO PLATES 453, 461



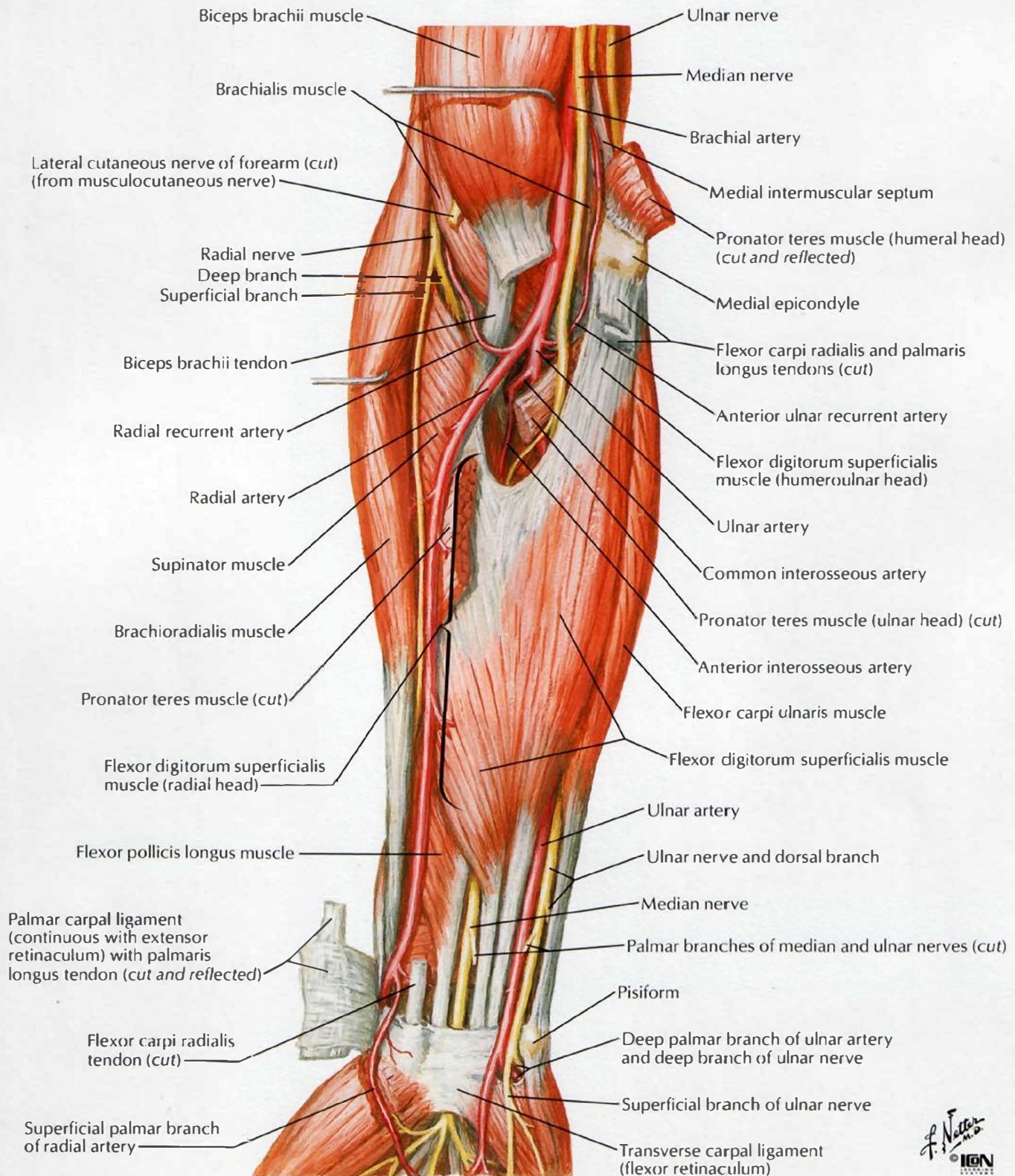
Muscles of Forearm (Superficial Layer): Anterior View

SEE ALSO PLATES 458, 459



Muscles of Forearm (Intermediate Layer): Anterior View

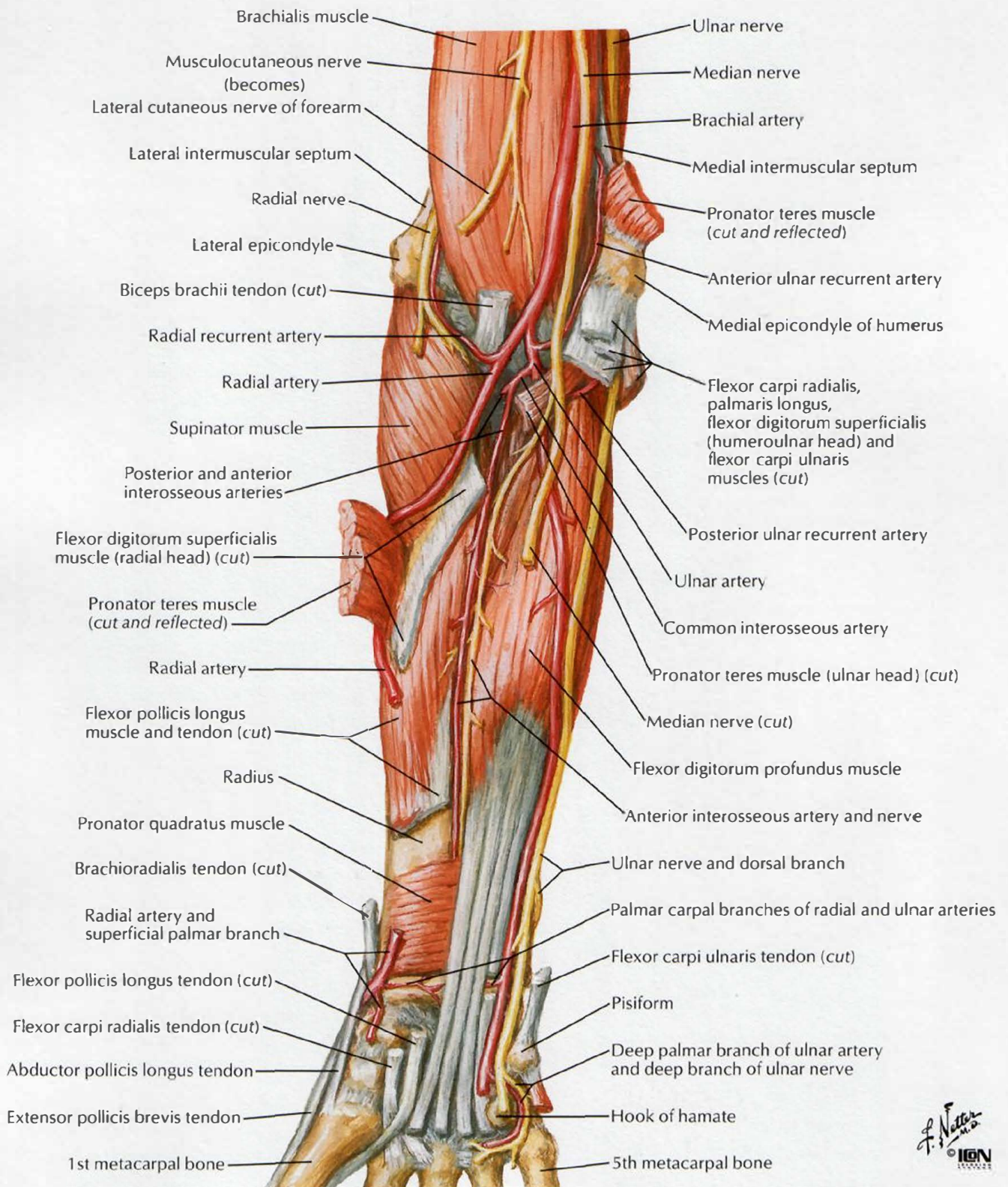
SEE ALSO PLATES 458, 459



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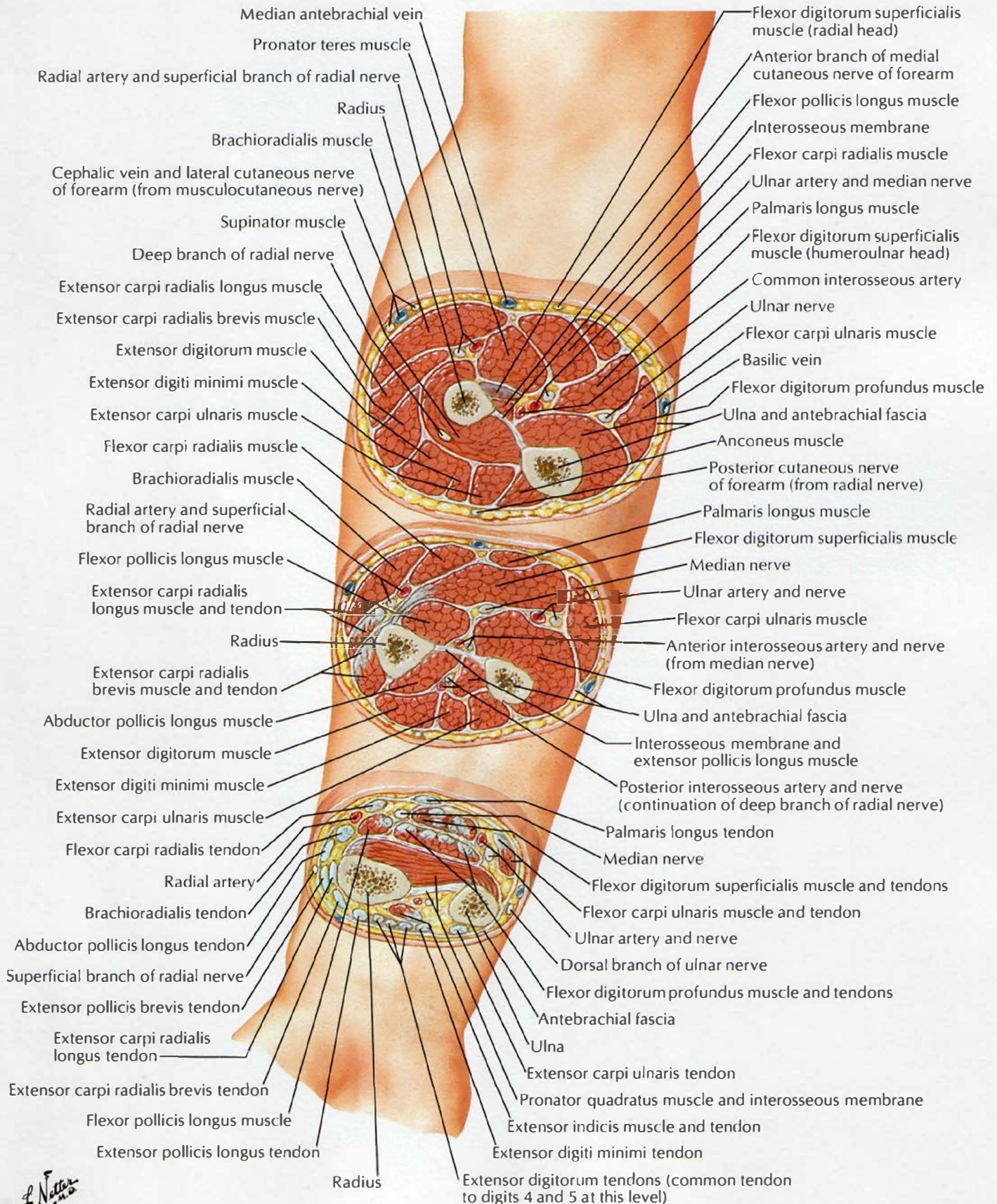
Muscles of Forearm (Deep Layer): Anterior View

SEE ALSO PLATES 458, 459

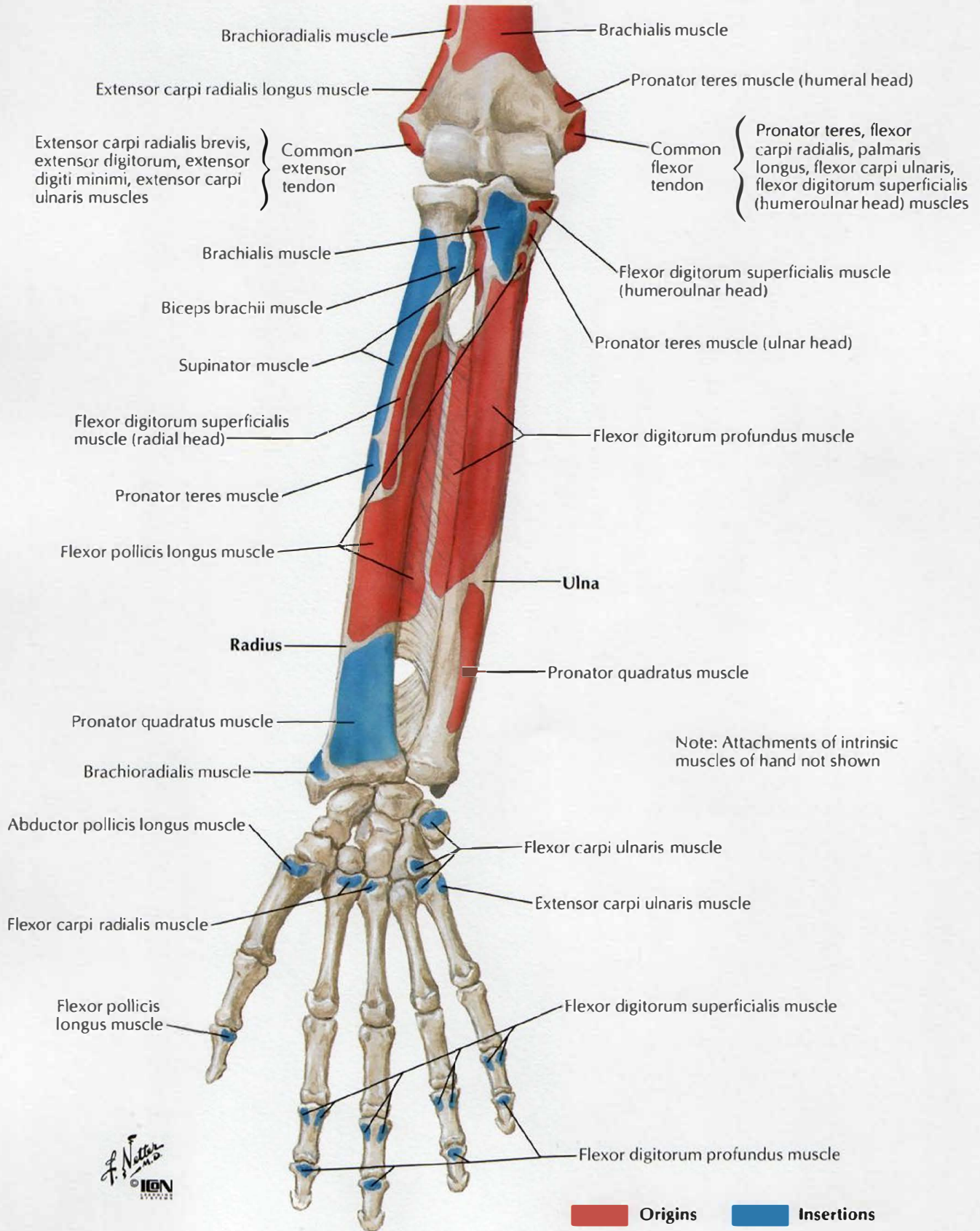


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Forearm: Serial Cross Sections

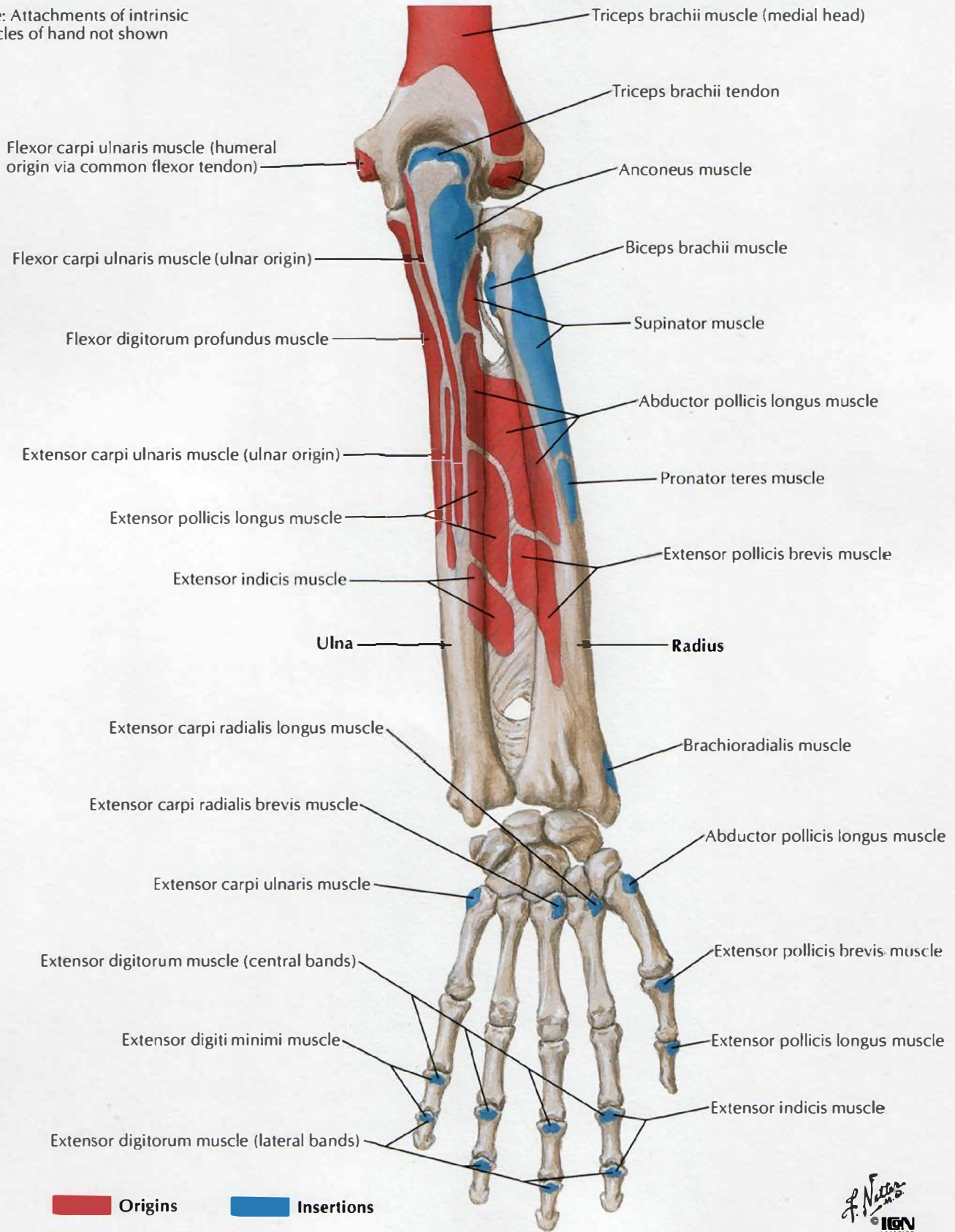


Attachments of Muscles of Forearm: Anterior View



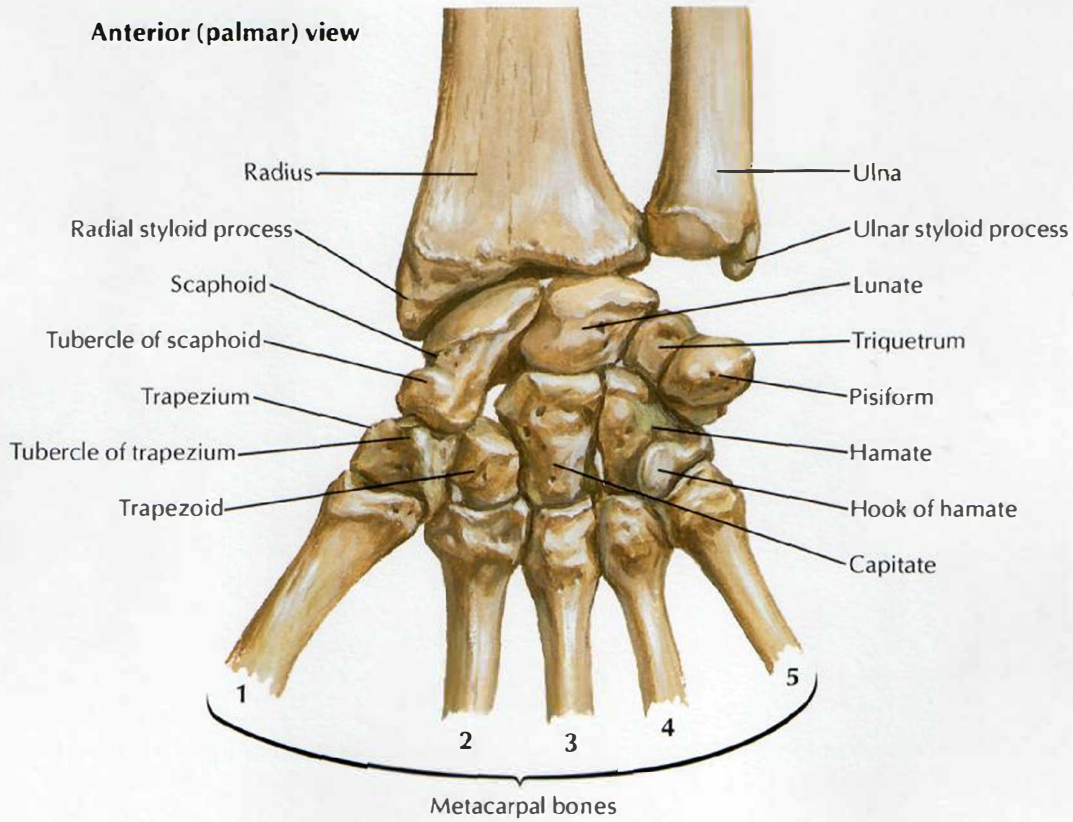
Attachments of Muscles of Forearm: Posterior View

Note: Attachments of intrinsic muscles of hand not shown

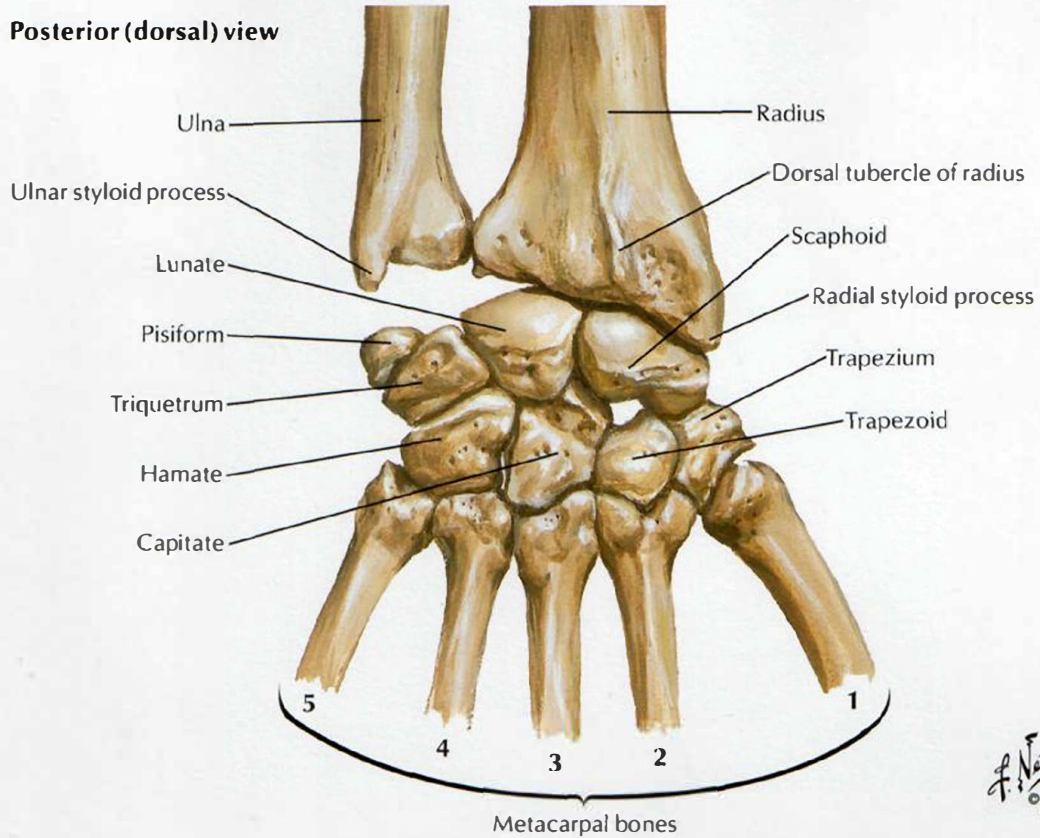


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ILLUSTRATIONS

Anterior (palmar) view

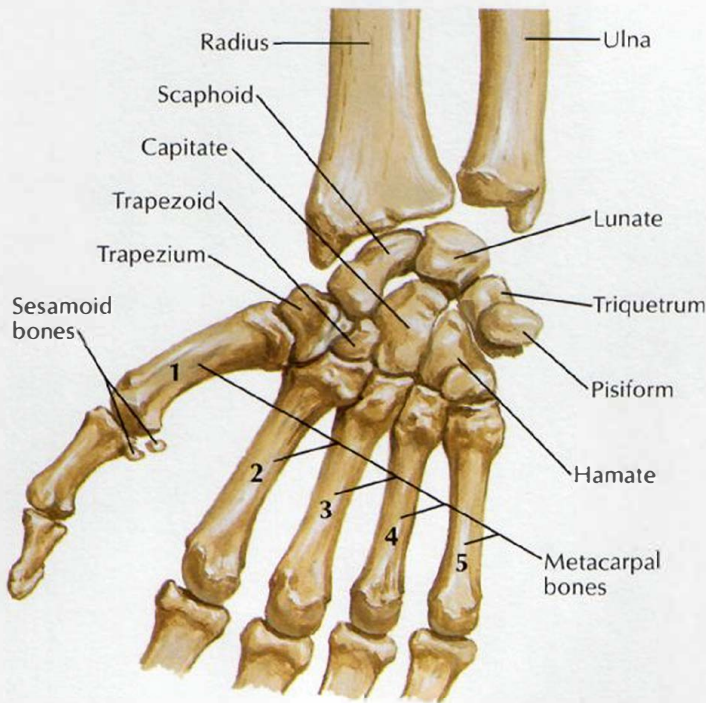


Posterior (dorsal) view

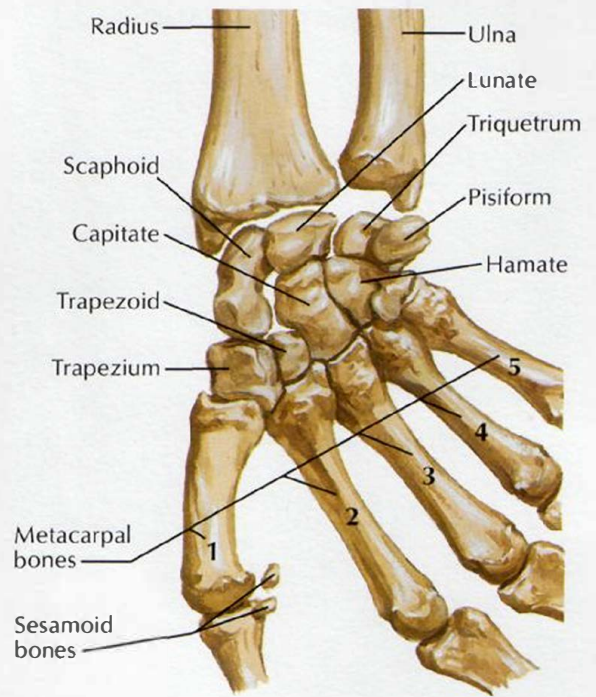


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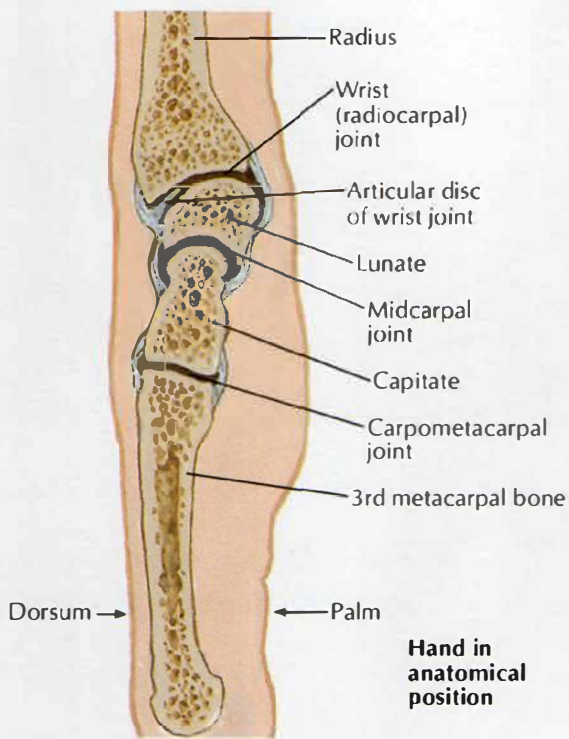
Movements of Wrist



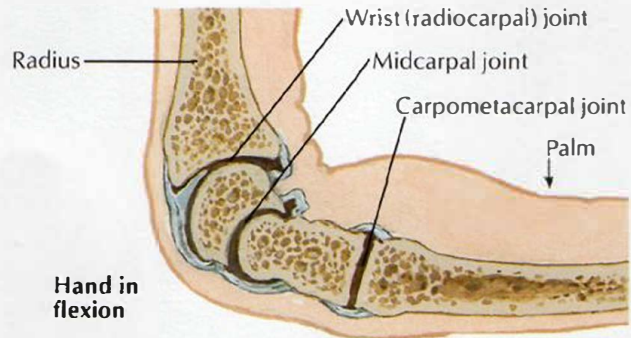
**Position of carpal bones with hand in abduction:
anterior (palmar) view**



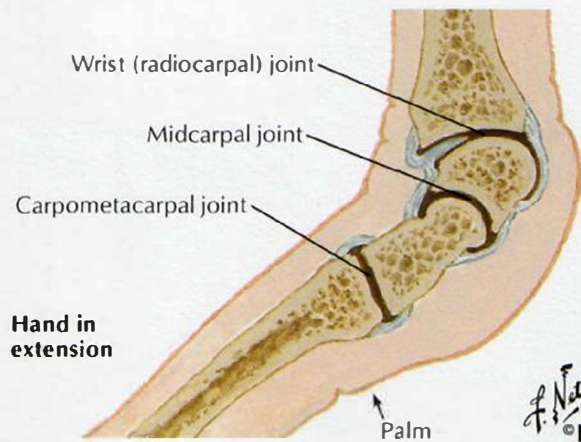
**Position of carpal bones with hand in adduction:
anterior (palmar) view**



**Sagittal sections through wrist and
middle finger**



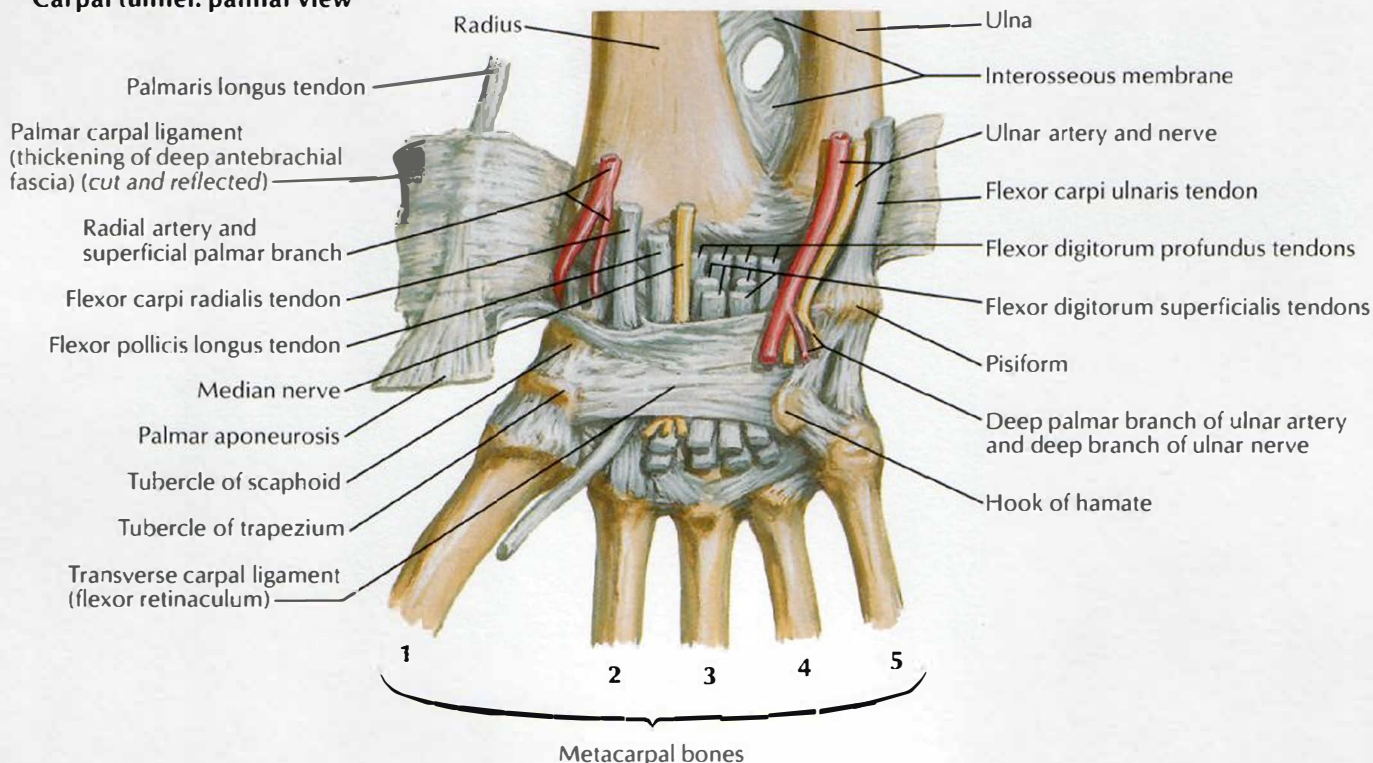
**Hand in
flexion**



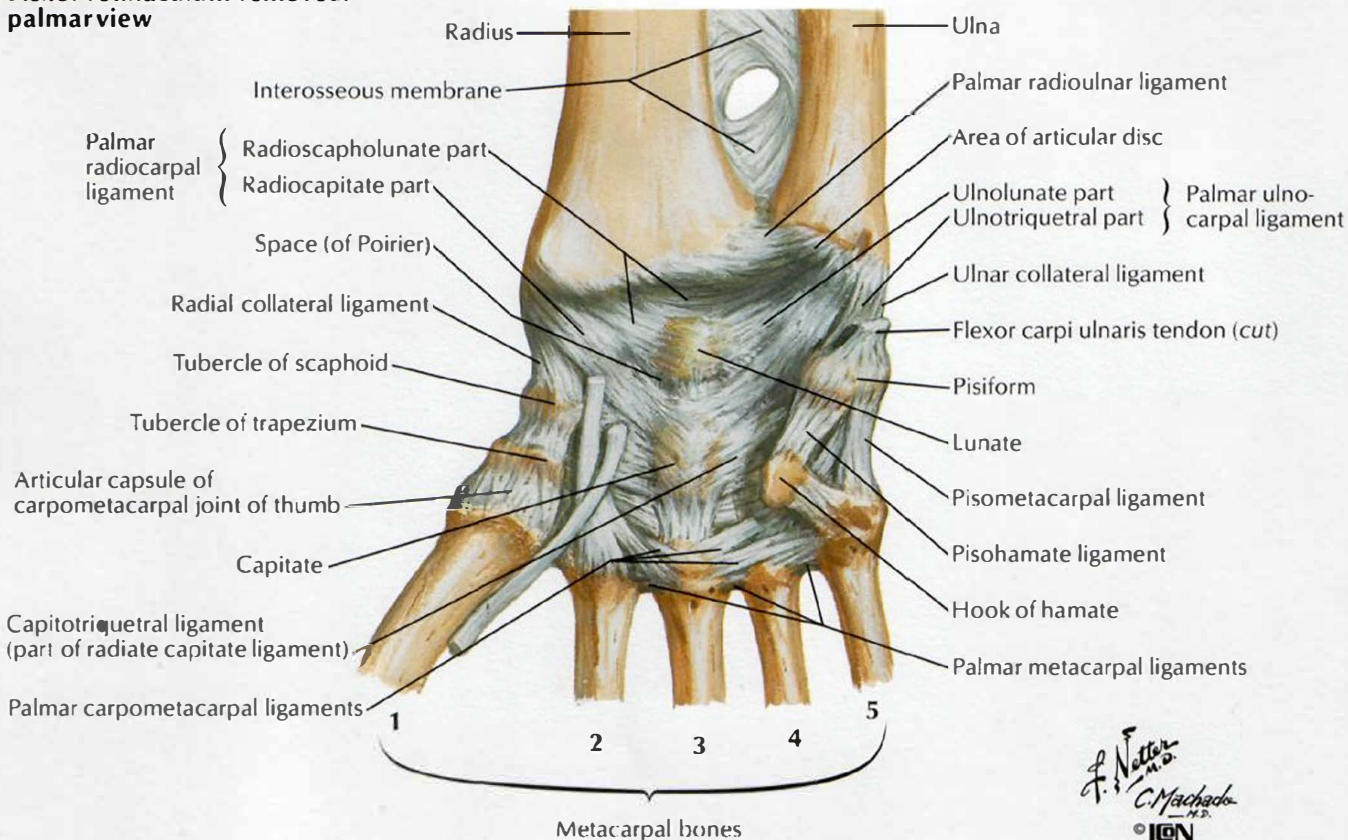
**Hand in
extension**

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Carpal tunnel: palmar view

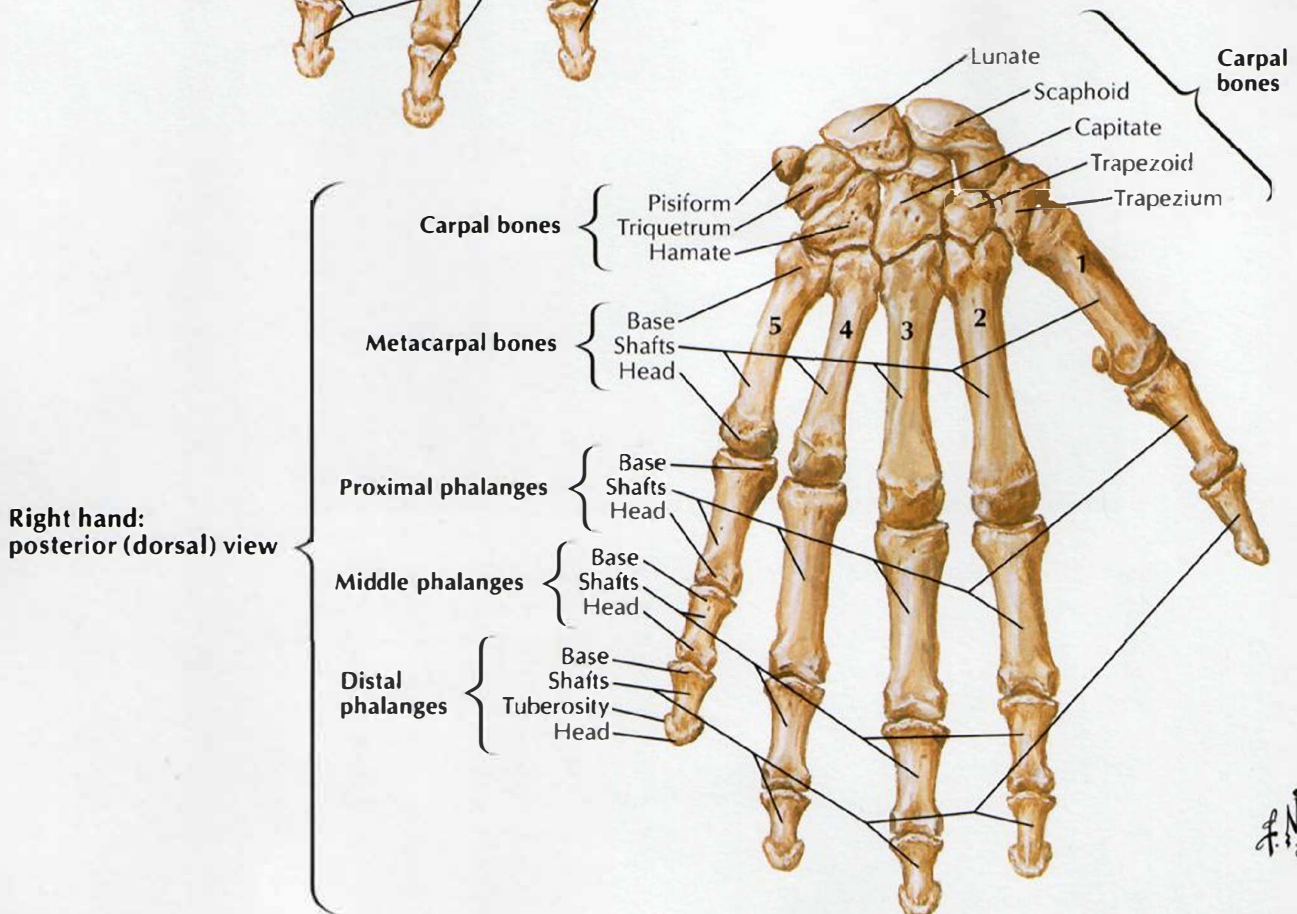
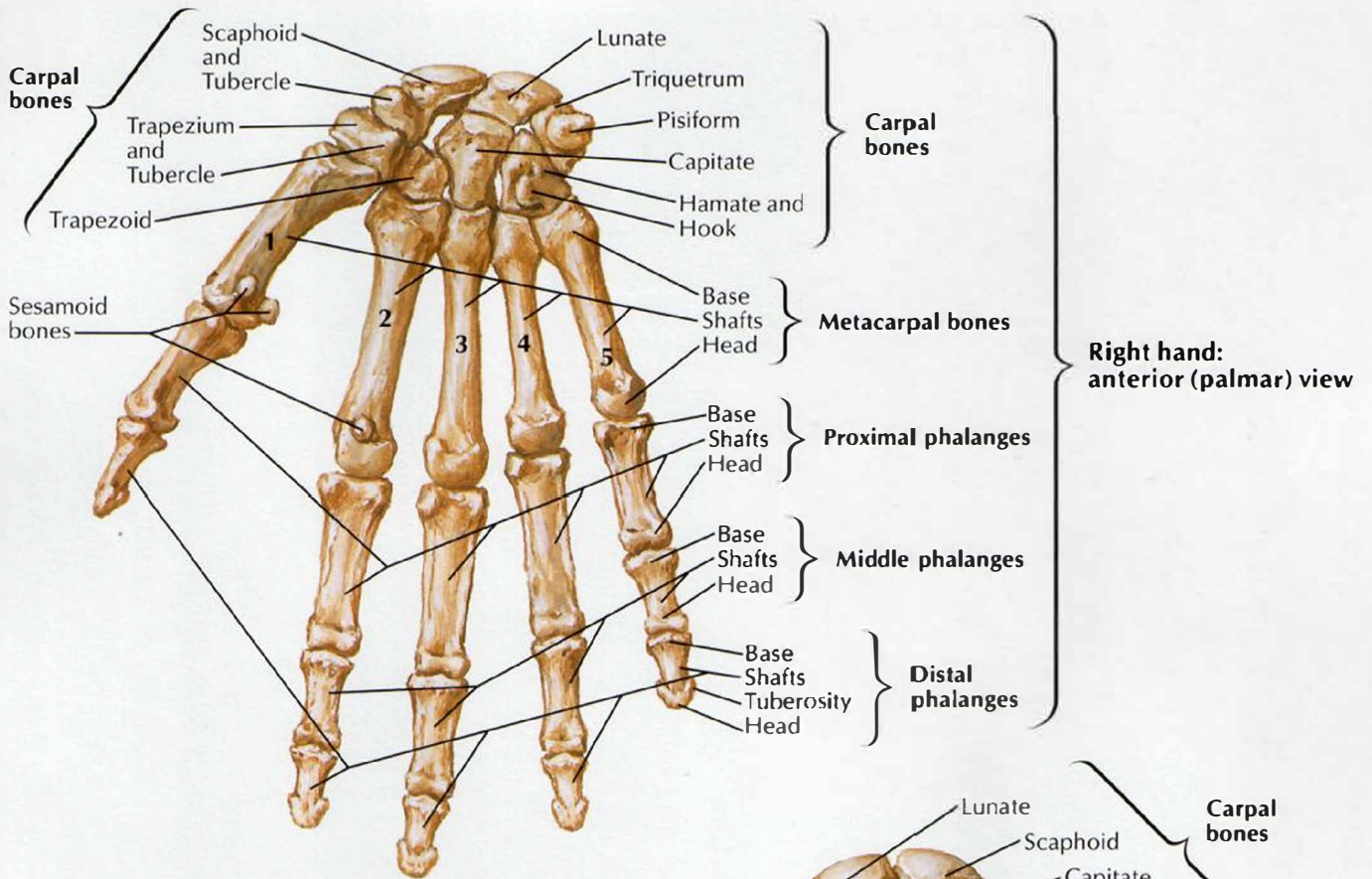


Flexor retinaculum removed: palmar view



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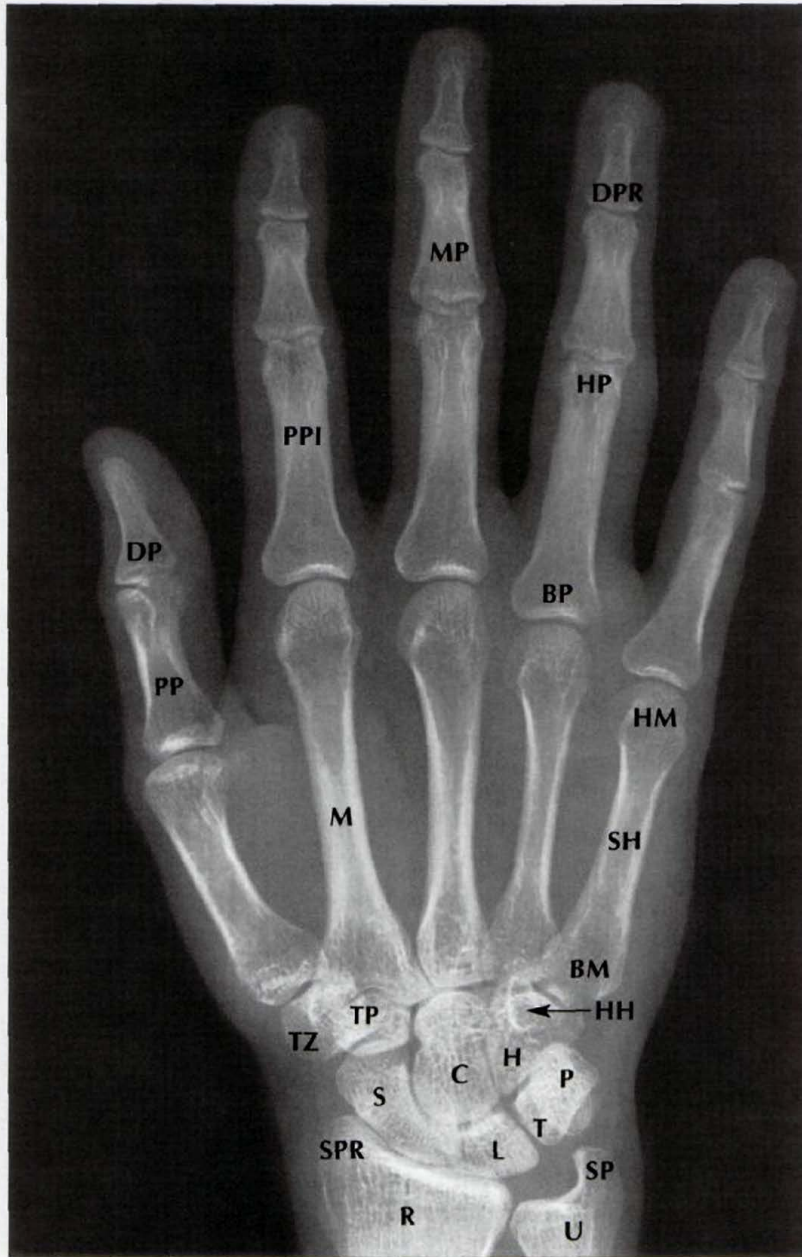
Bones of Wrist and Hand



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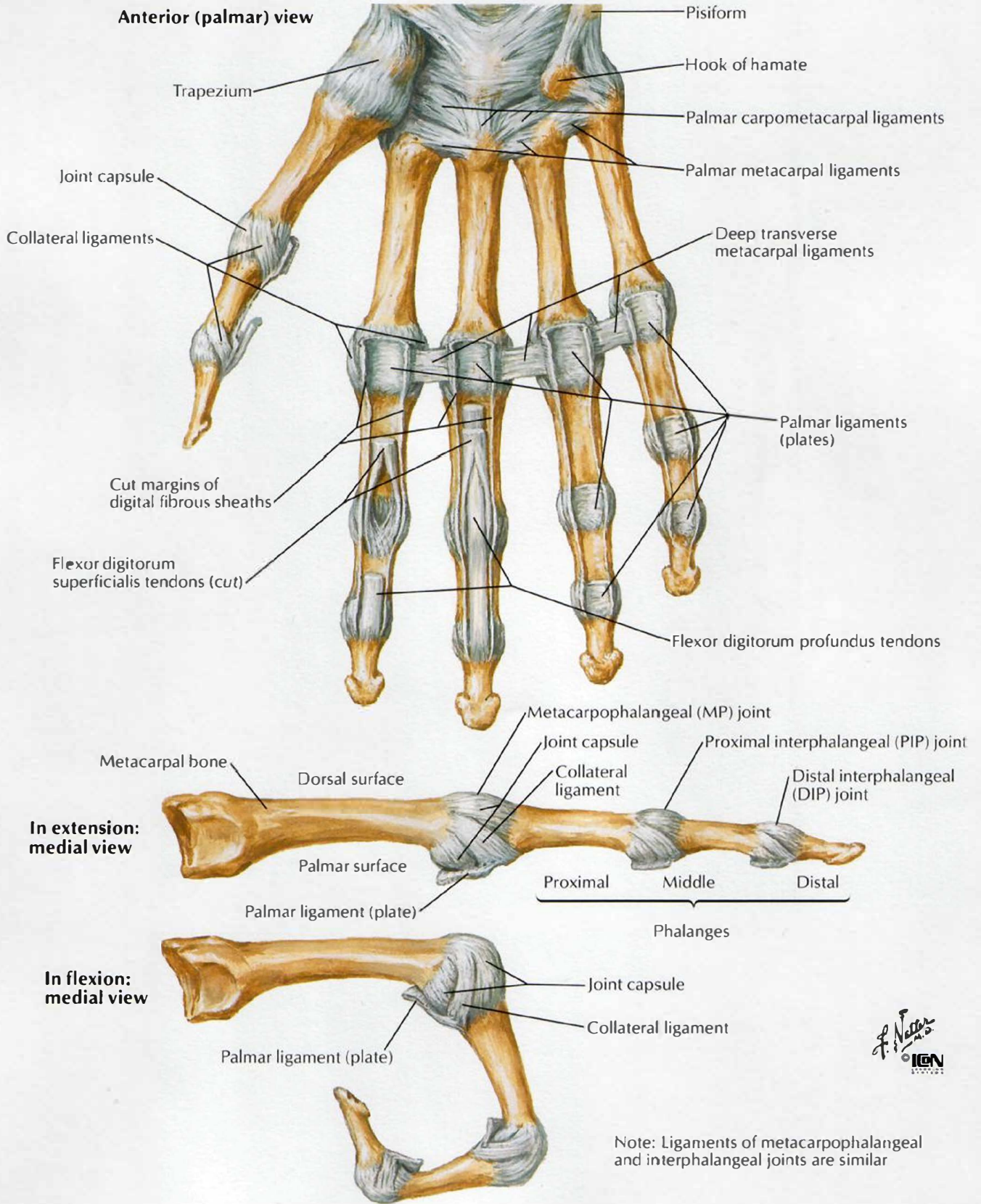
Wrist and Hand: Anteroposterior Radiograph

SEE ALSO PLATE 439

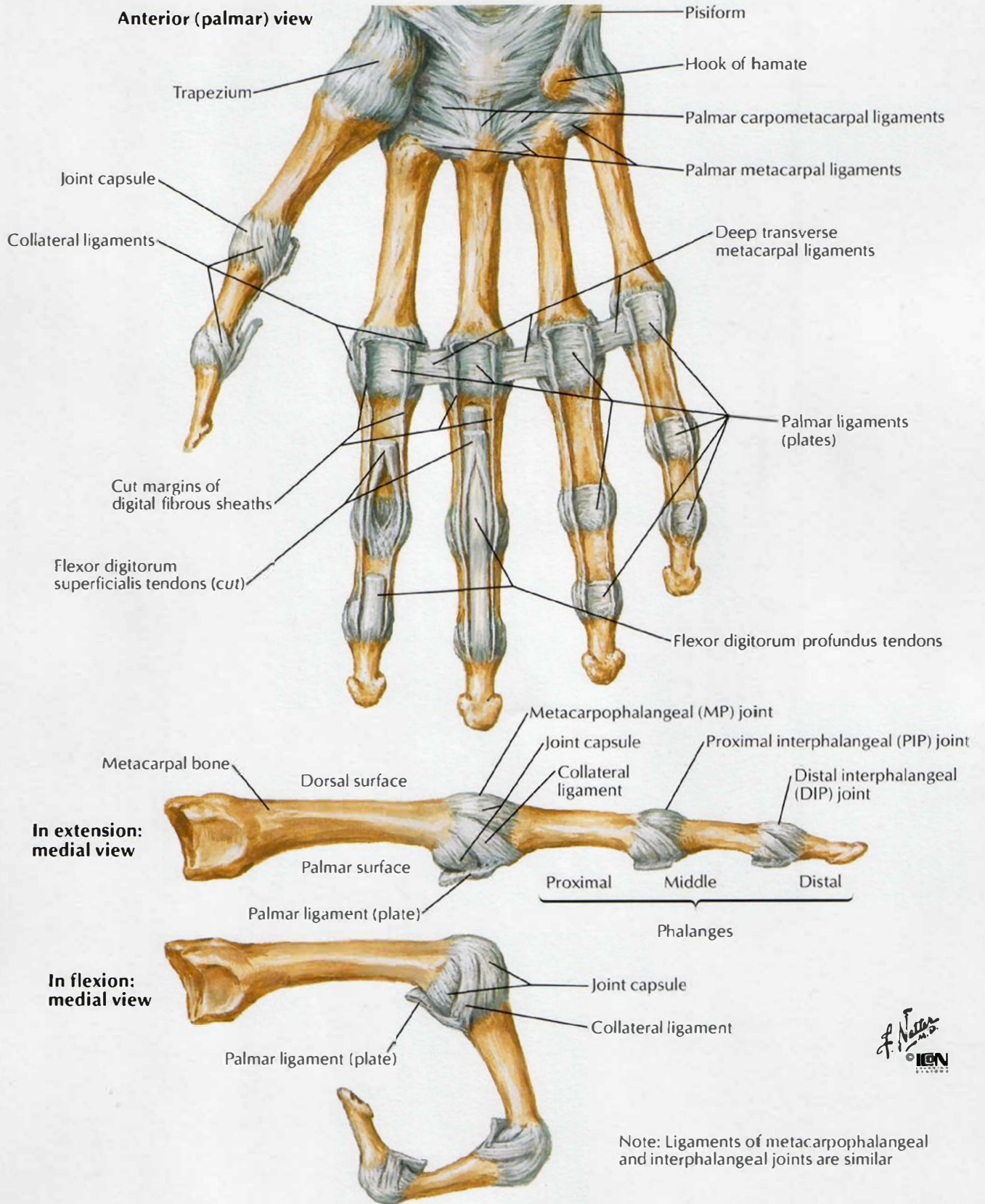


- | | | | |
|------------|---------------------------------|------------|----------------------------------|
| BM | Base of 5th metacarpal | P | Pisiform |
| BP | Base of 4th proximal phalanx | PP | Proximal phalanx of thumb |
| C | Capitate | PPI | Proximal phalanx of index finger |
| DP | Distal phalanx of thumb | R | Radius |
| DPR | Distal phalanx of ring finger | S | Scaphoid |
| H | Hamate | SH | Shaft of 5th metacarpal |
| HH | Hook of hamate | SP | Styloid process of ulna |
| HM | Head of 5th metacarpal | SPR | Styloid process of radius |
| HP | Head of proximal phalanx | T | Triquetrum |
| L | Lunate | TP | Trapezoid |
| M | Metacarpal of index finger | TZ | Trapezium |
| MP | Middle phalanx of middle finger | U | Ulna |

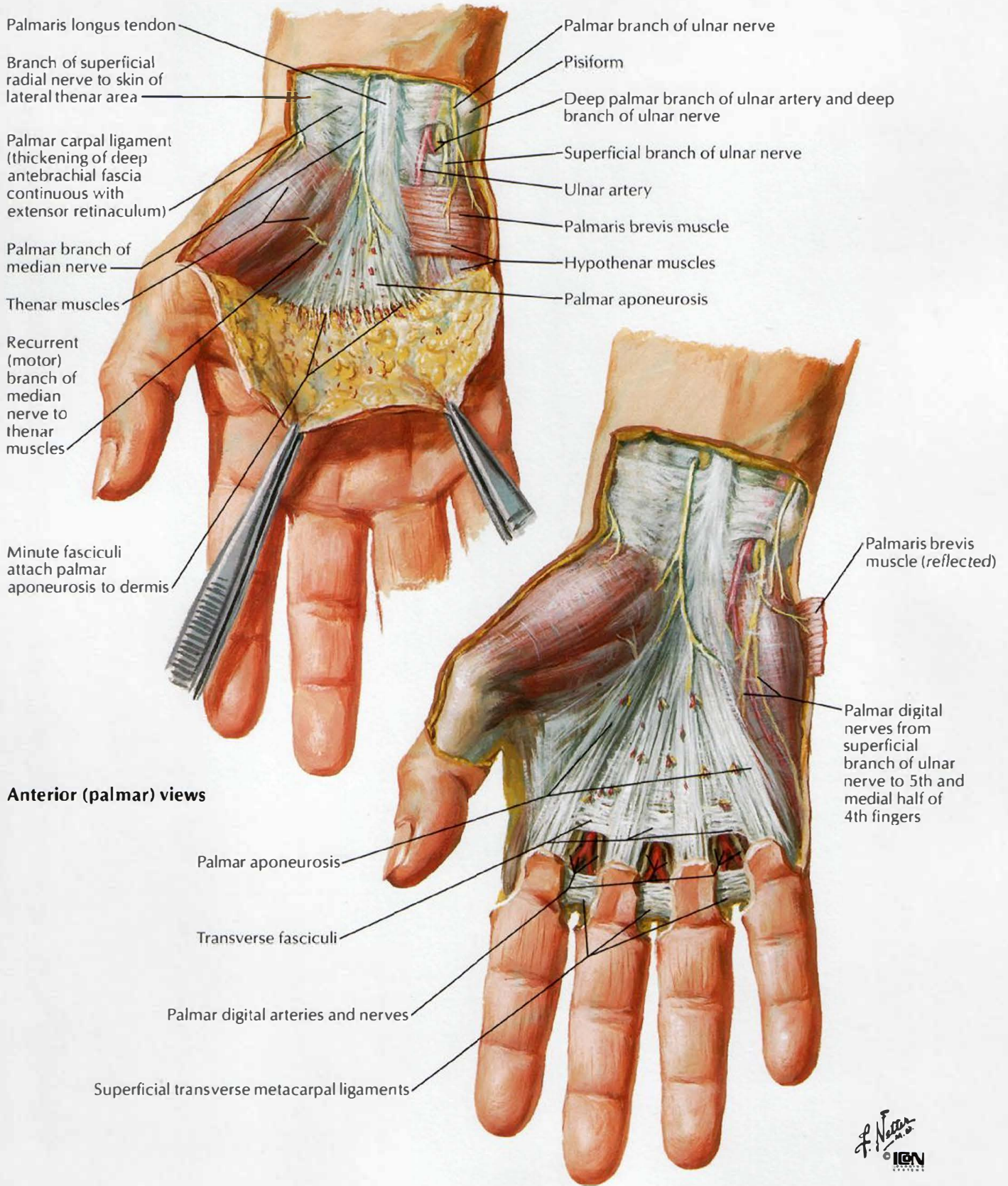
Metacarpophalangeal and Interphalangeal Ligaments



Metacarpophalangeal and Interphalangeal Ligaments

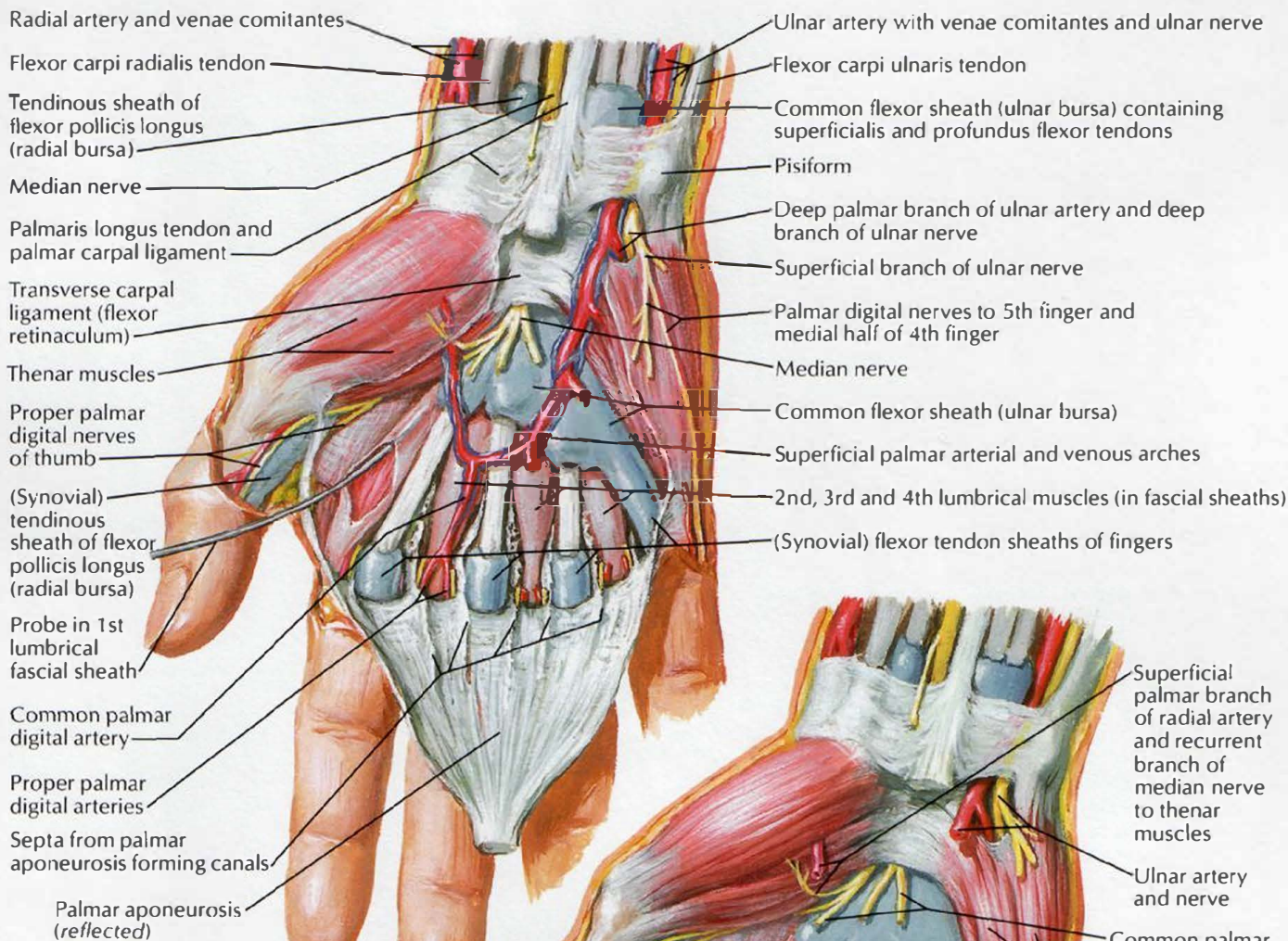


Wrist and Hand: Superficial Palmar Dissections

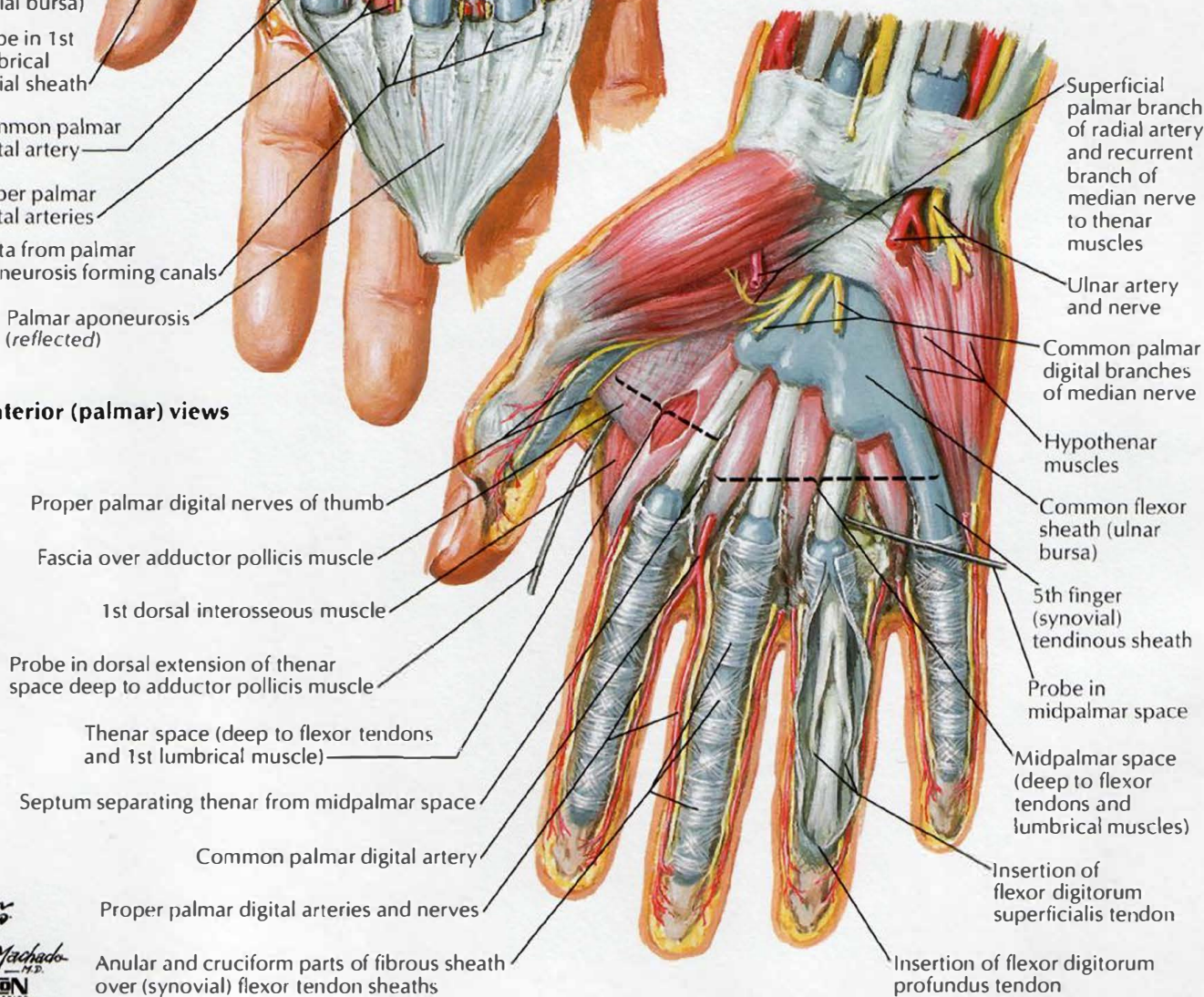


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Wrist and Hand: Deeper Palmar Dissections



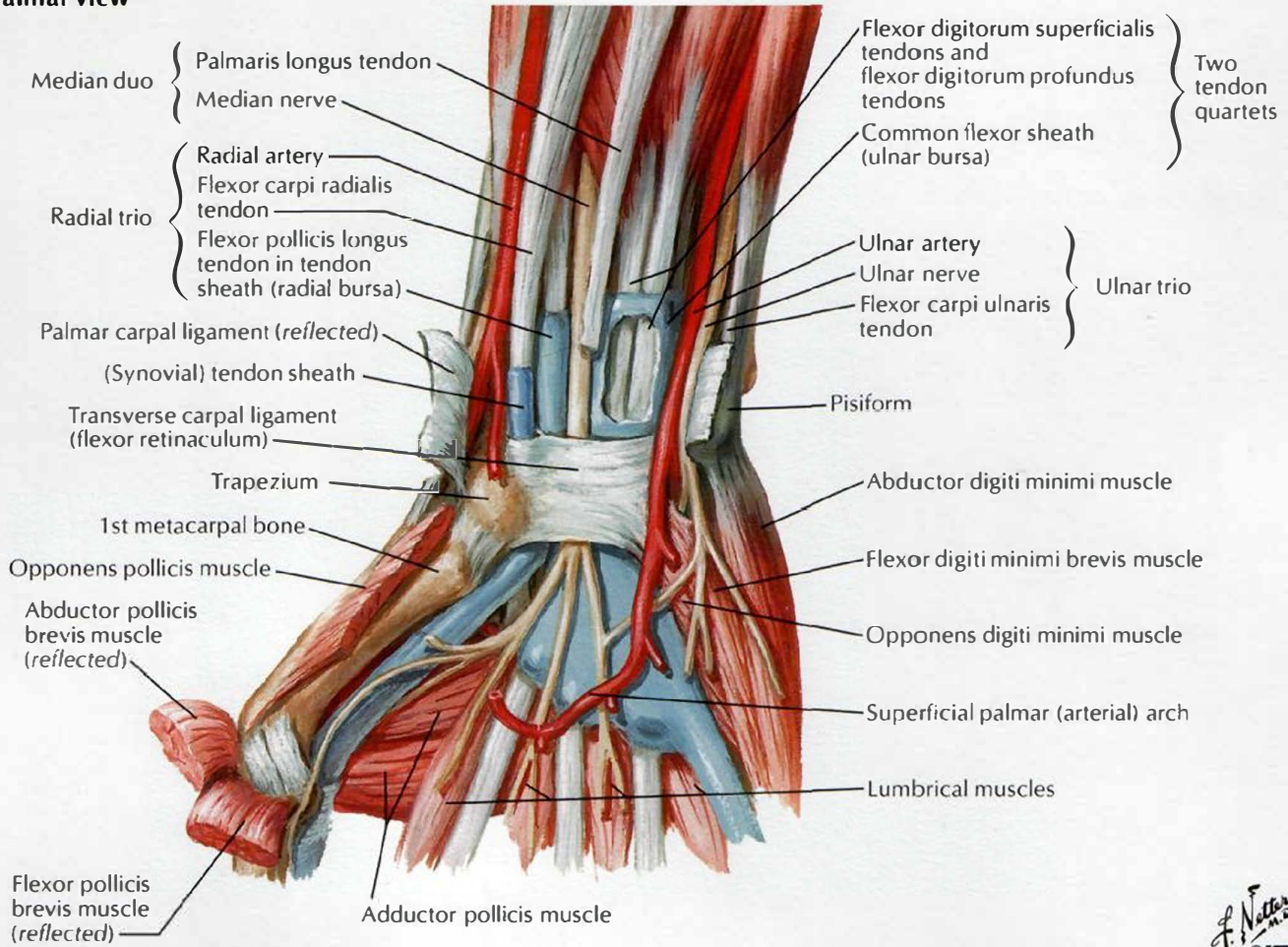
Anterior (palmar) views



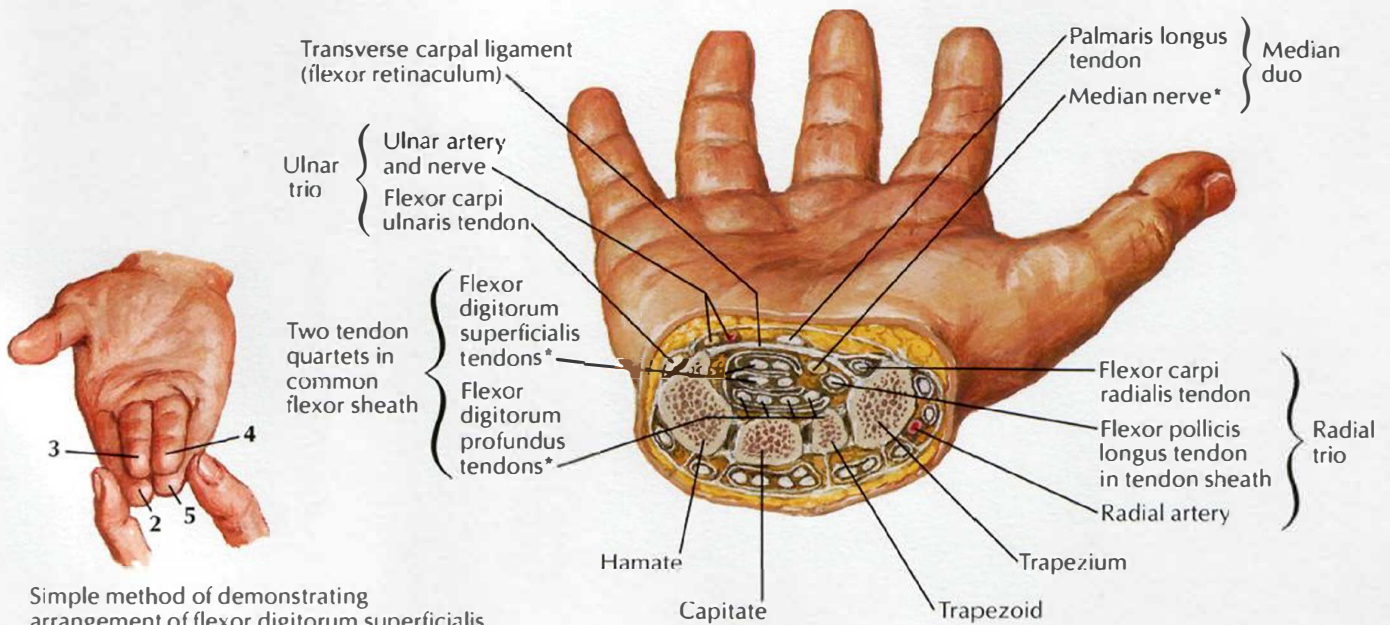
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IGN

Flexor Tendons, Arteries and Nerves at Wrist

Palmar view



Transverse cross section of wrist demonstrating carpal tunnel

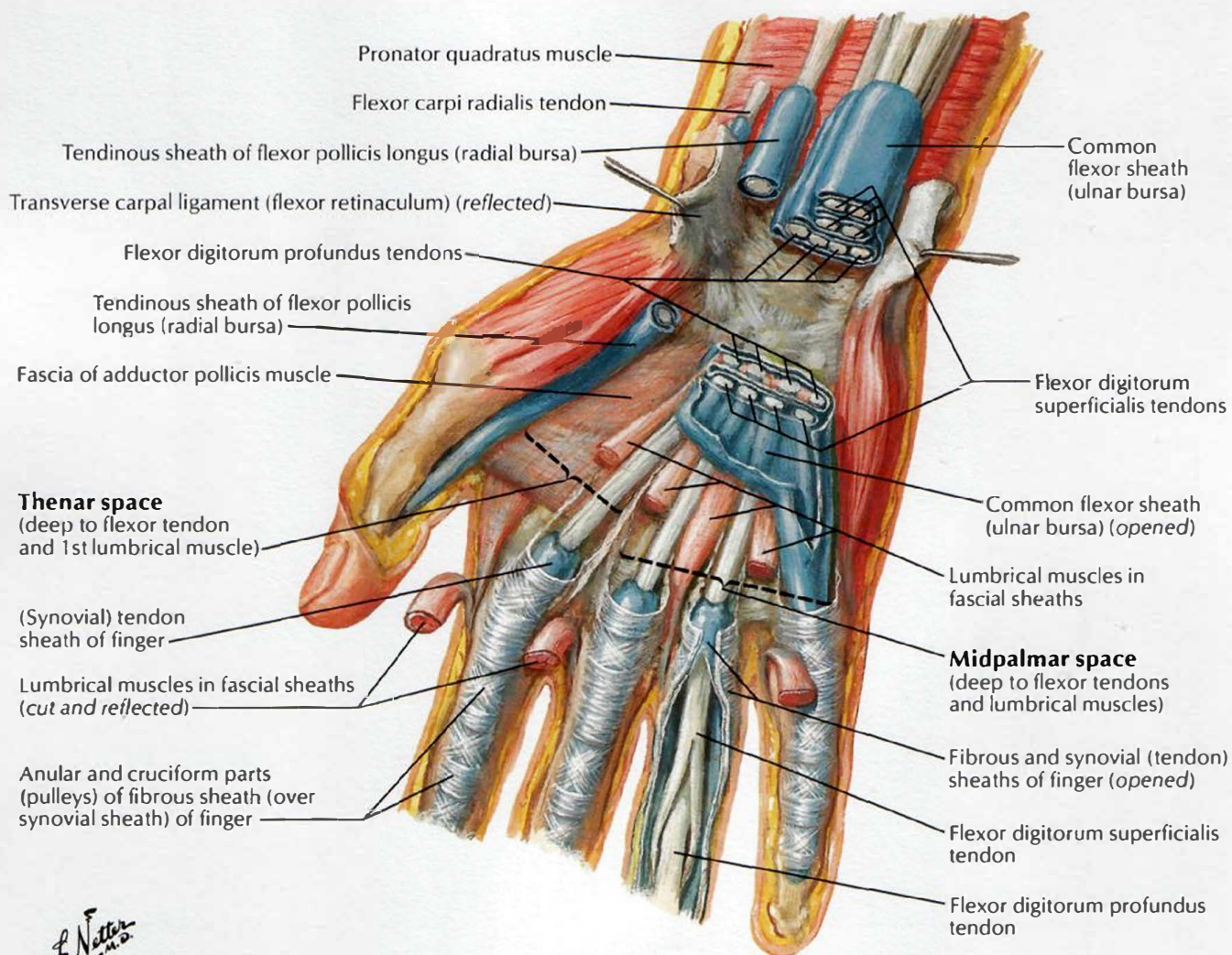


Simple method of demonstrating arrangement of flexor digitorum superficialis tendon quartet within carpal tunnel

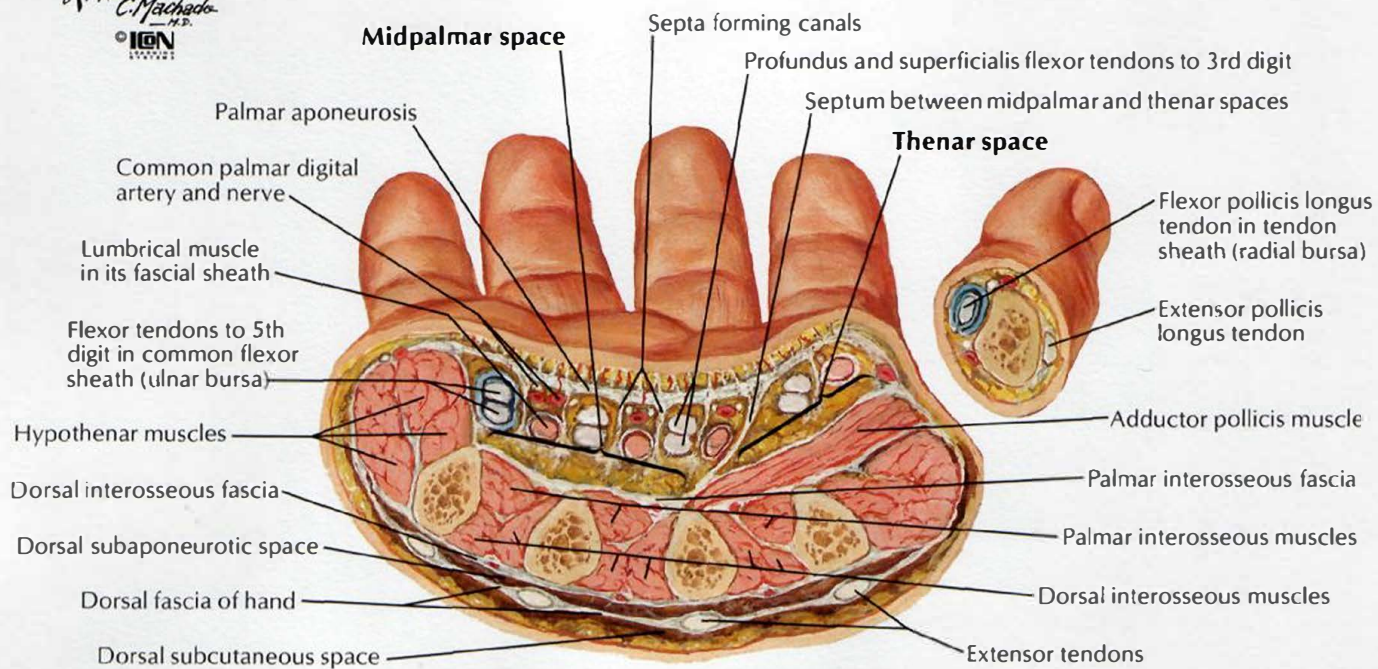
*Contents of carpal tunnel



Bursae, Spaces and Tendon Sheaths of Hand

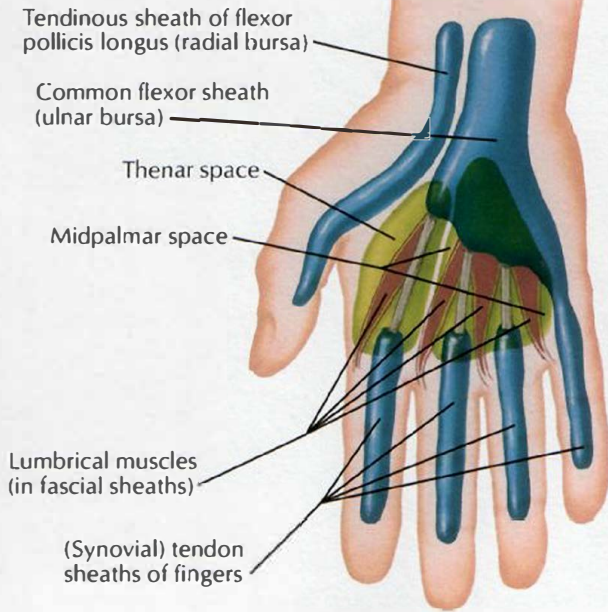


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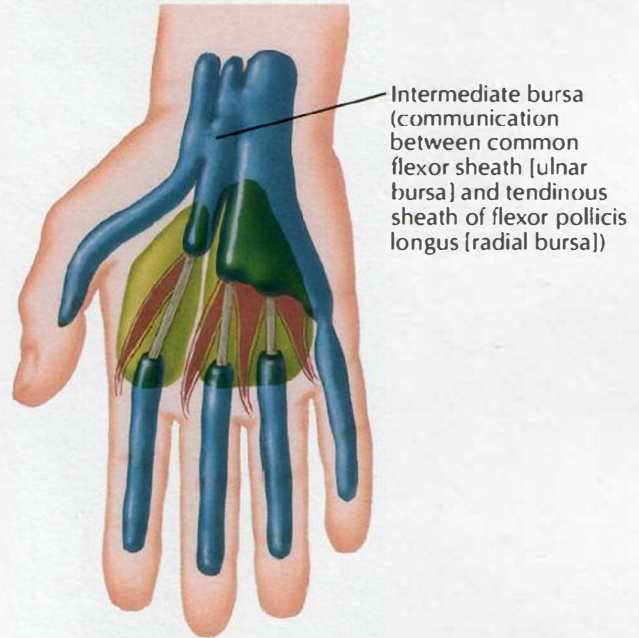


Lumbrical Muscles and Bursae, Spaces and Sheaths: Schema

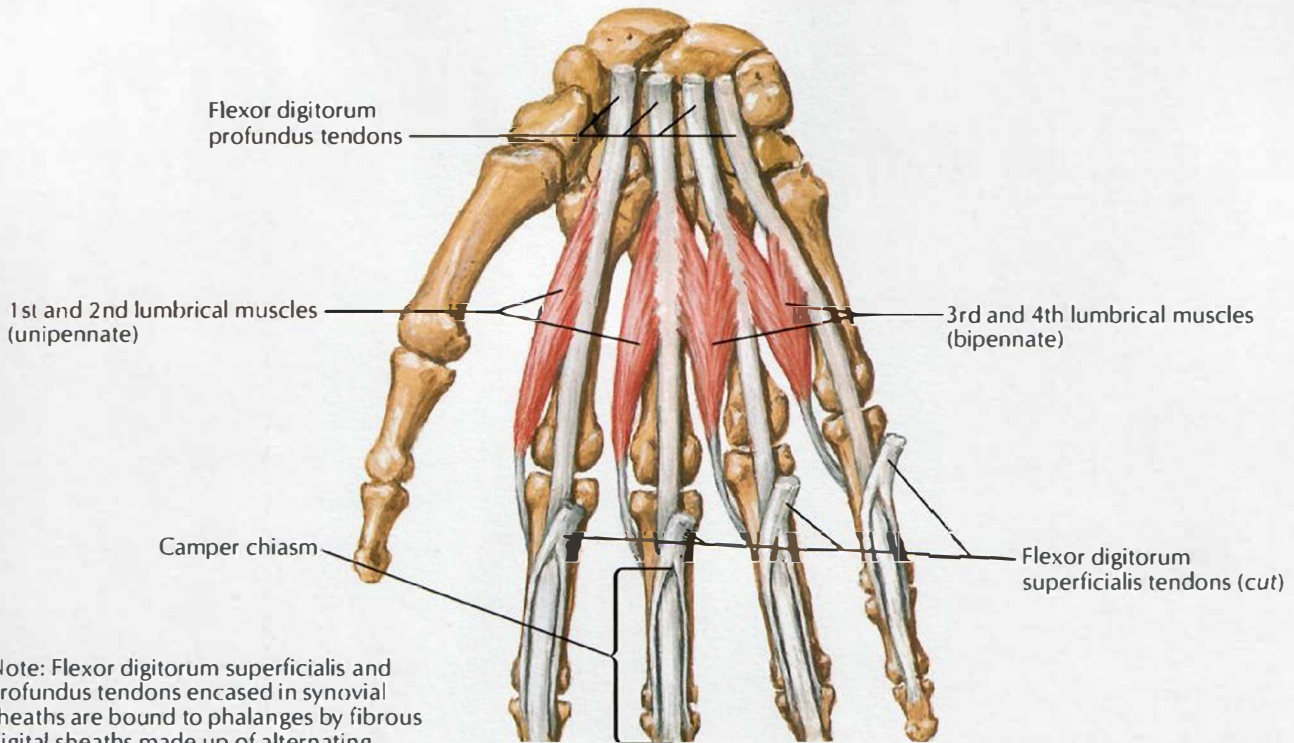
Usual arrangement



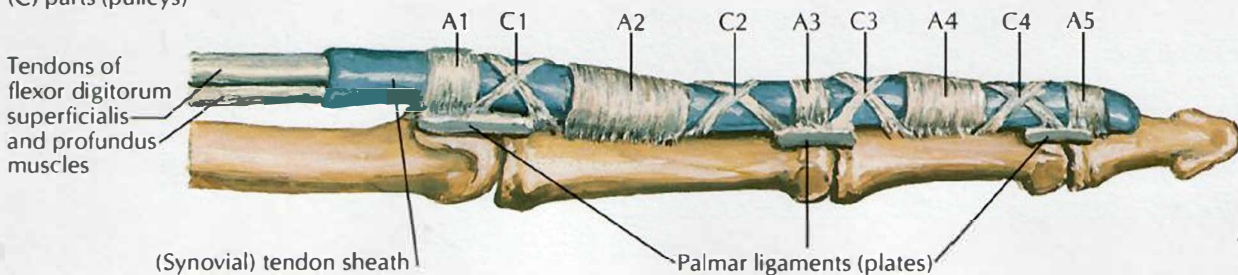
Common variation



Lumbrical muscles: schema

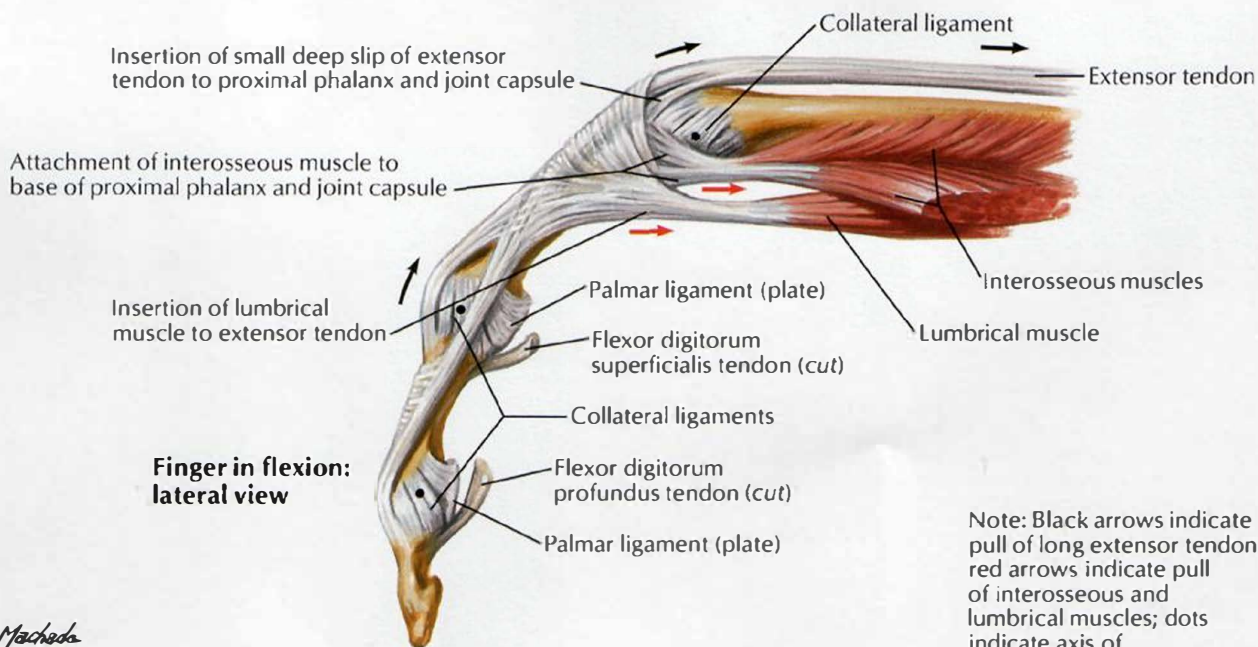
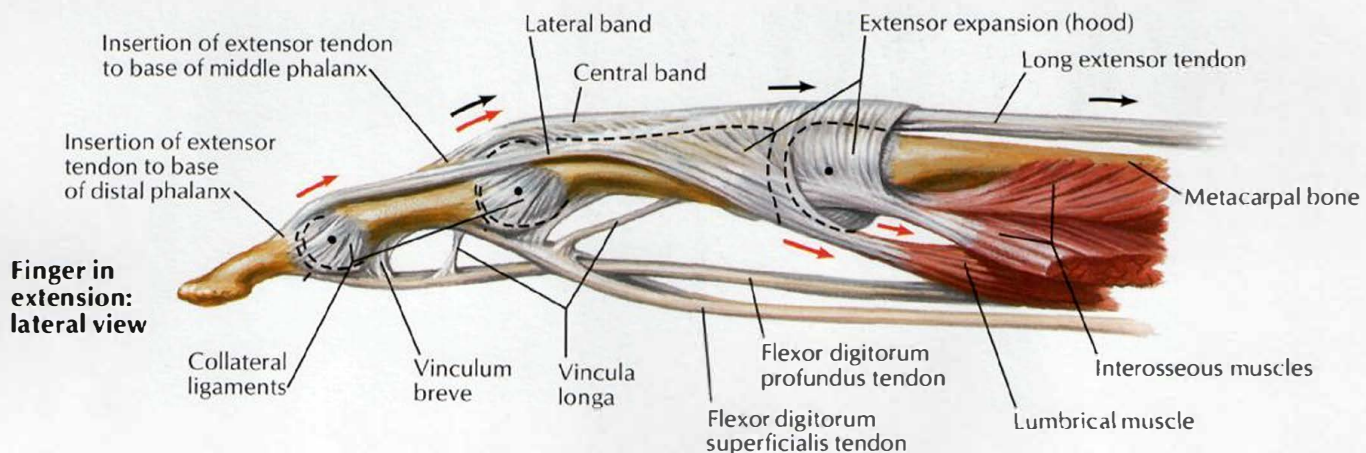
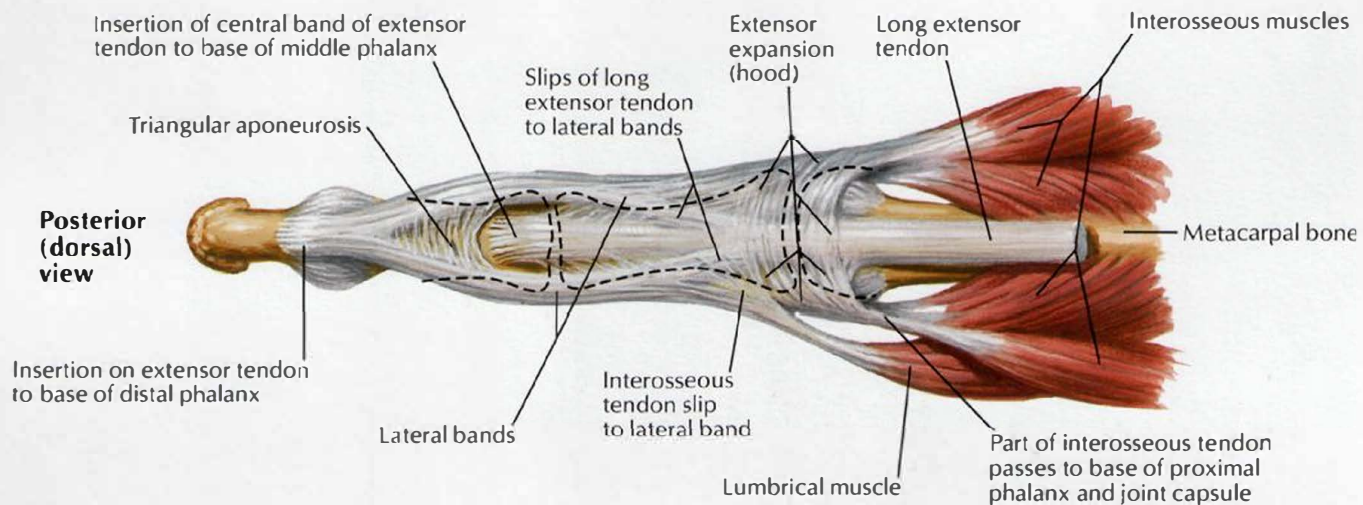


Note: Flexor digitorum superficialis and profundus tendons encased in synovial sheaths are bound to phalanges by fibrous digital sheaths made up of alternating strong anular (A) and weaker cruciform (C) parts (pulleys)



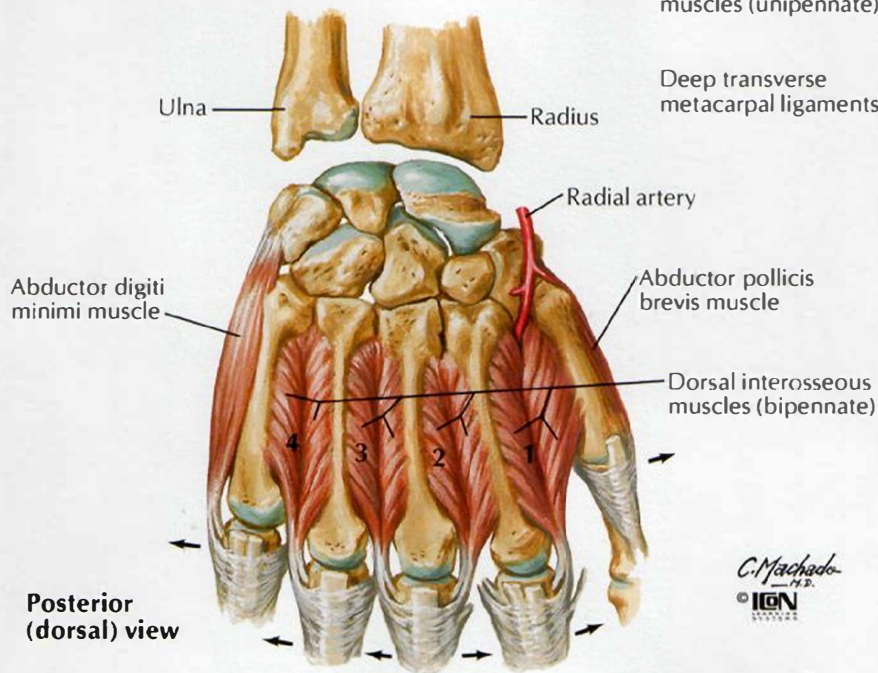
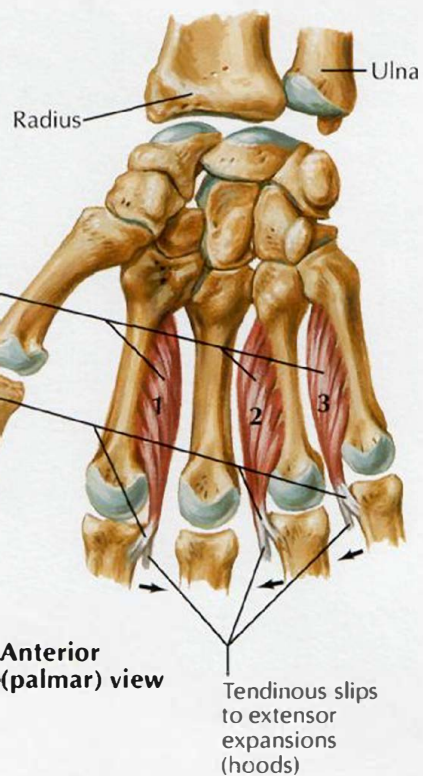
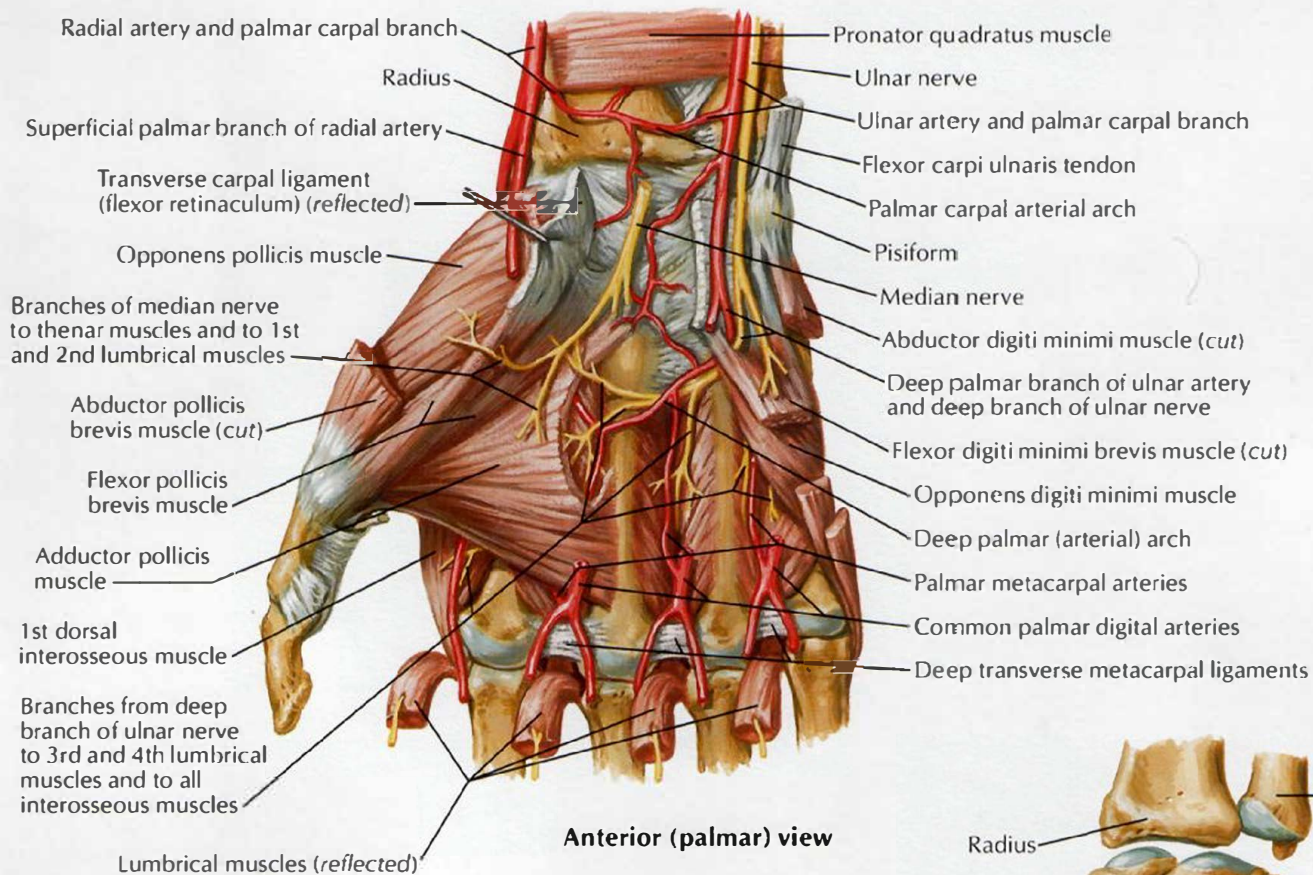
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Flexor and Extensor Tendons in Fingers



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

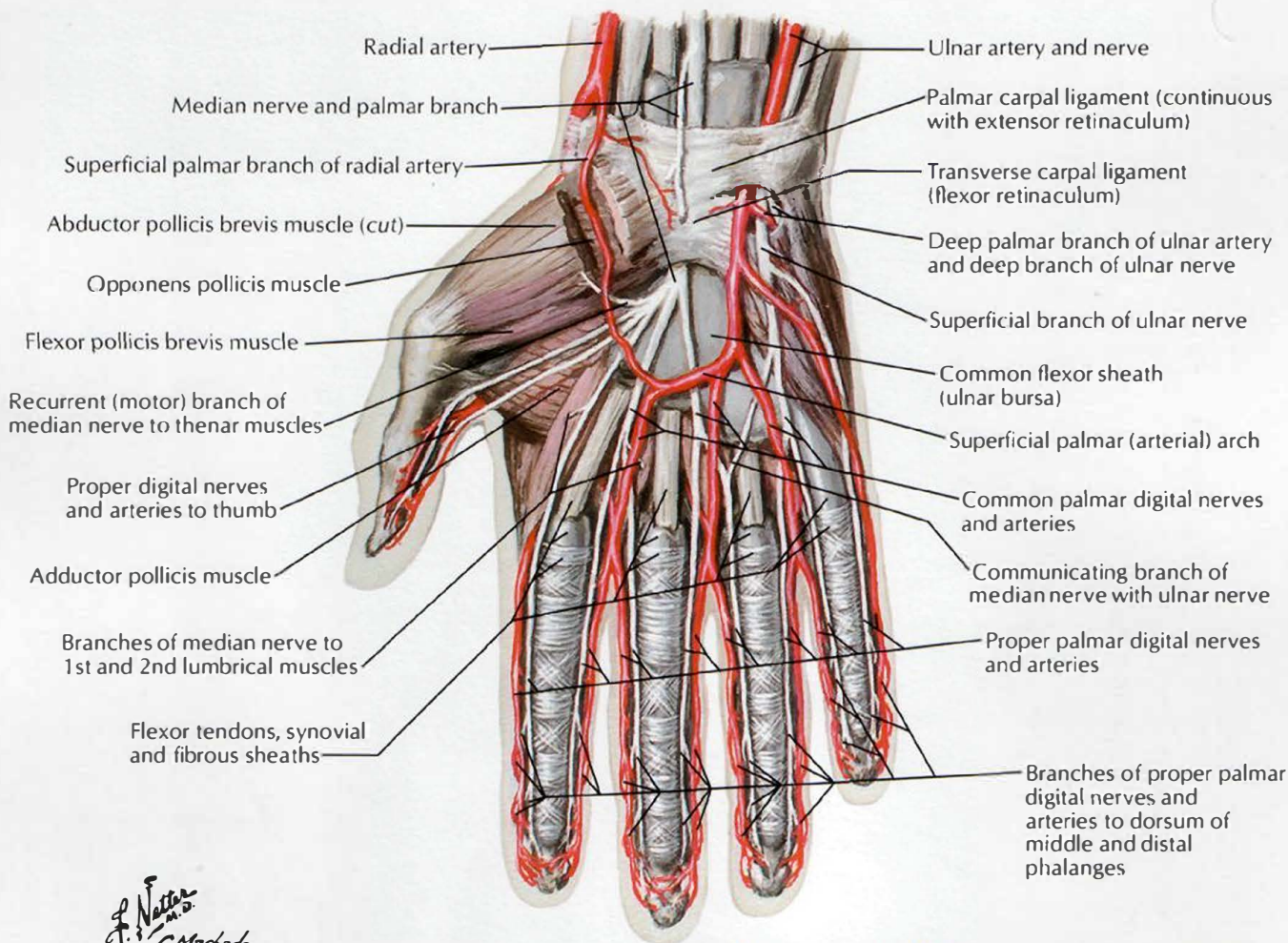
Intrinsic Muscles of Hand



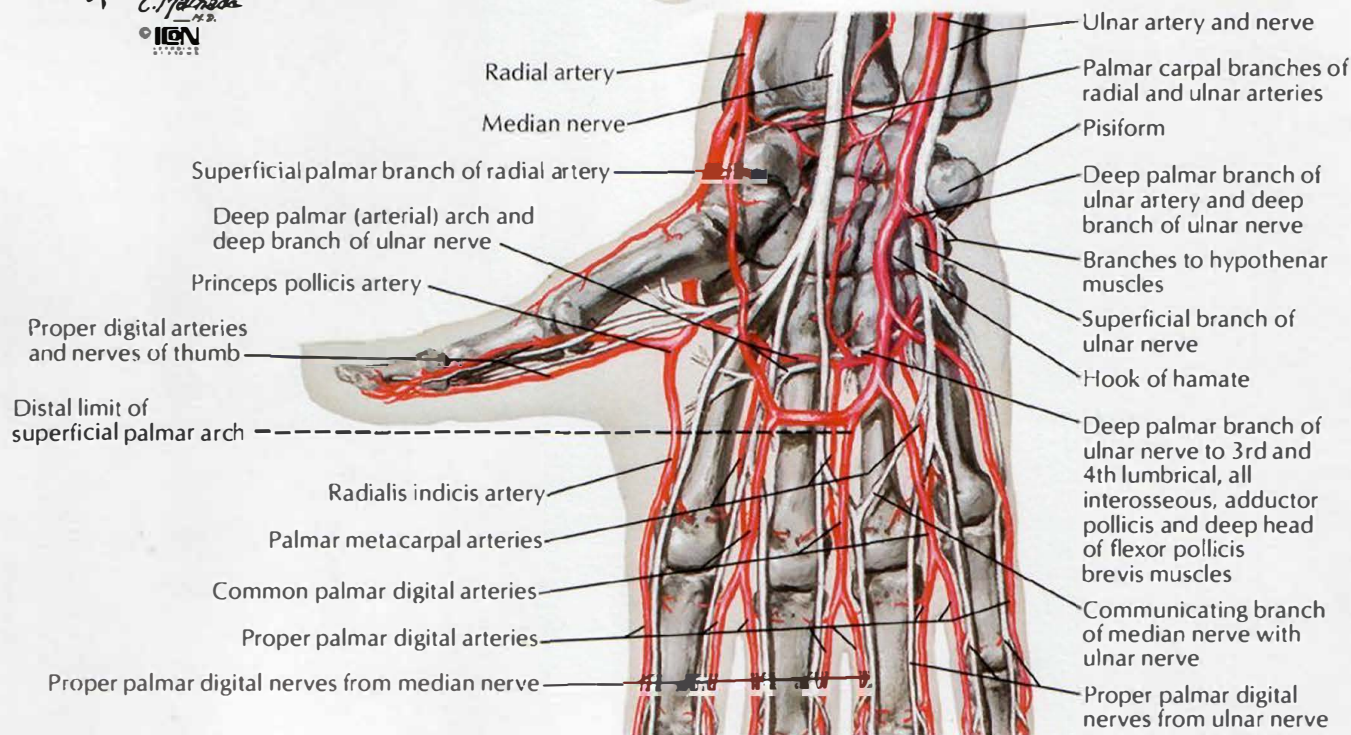
C. Machado
M.D.
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Note: Arrows indicate action of muscles

Arteries and Nerves of Hand: Palmar Views

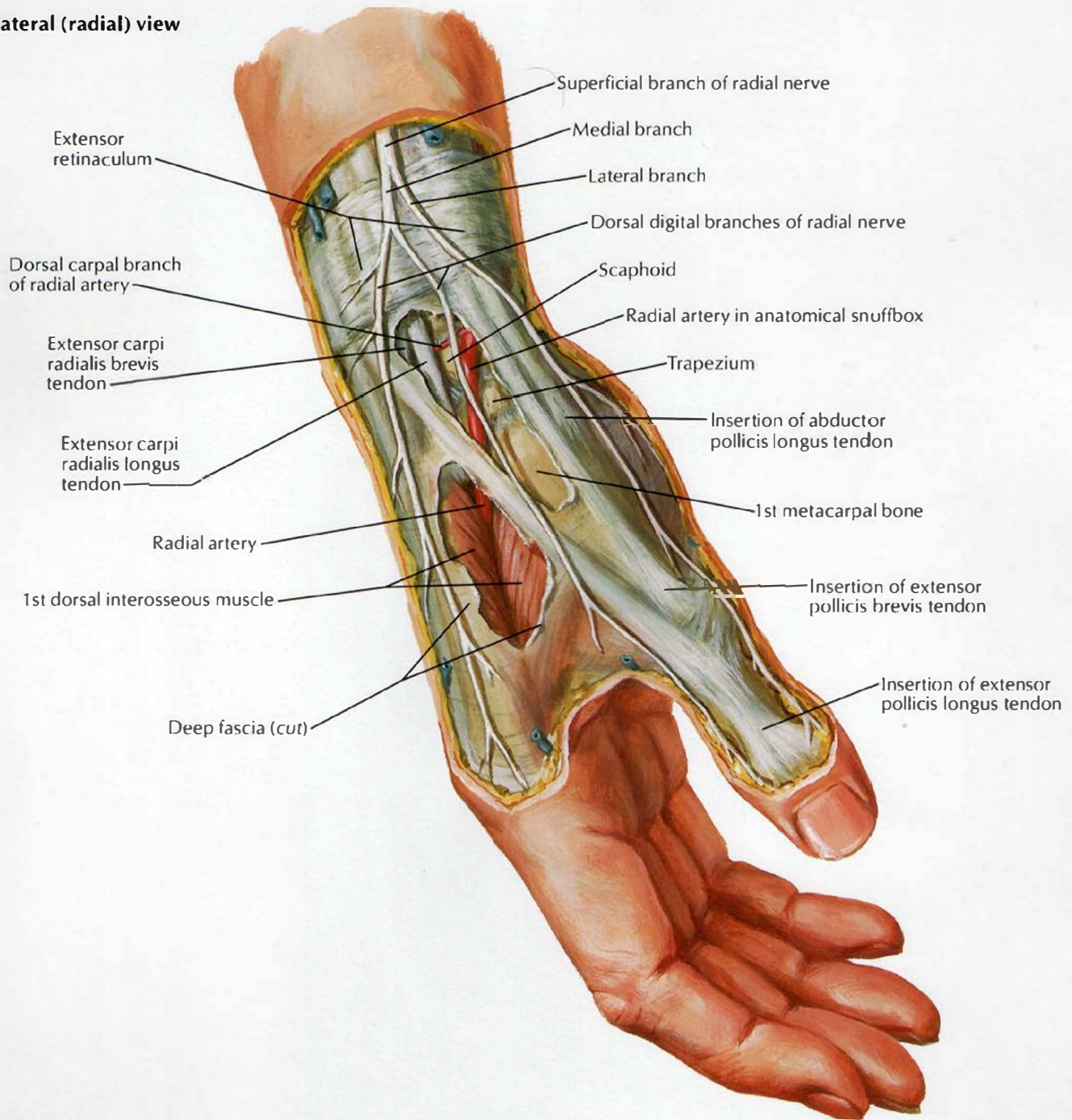


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Wrist and Hand: Superficial Radial Dissection

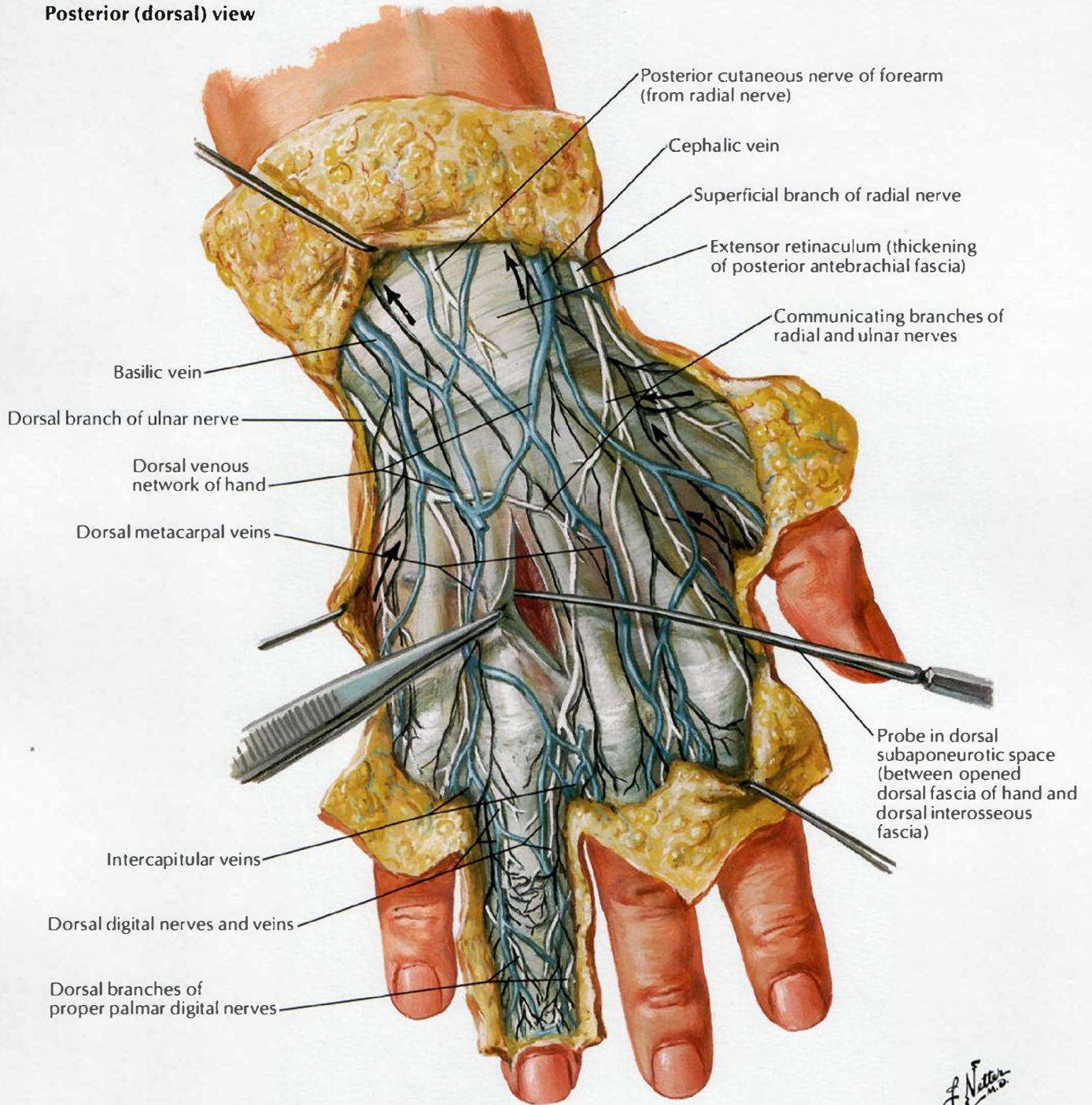
Lateral (radial) view



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Wrist and Hand: Superficial Dorsal Dissection

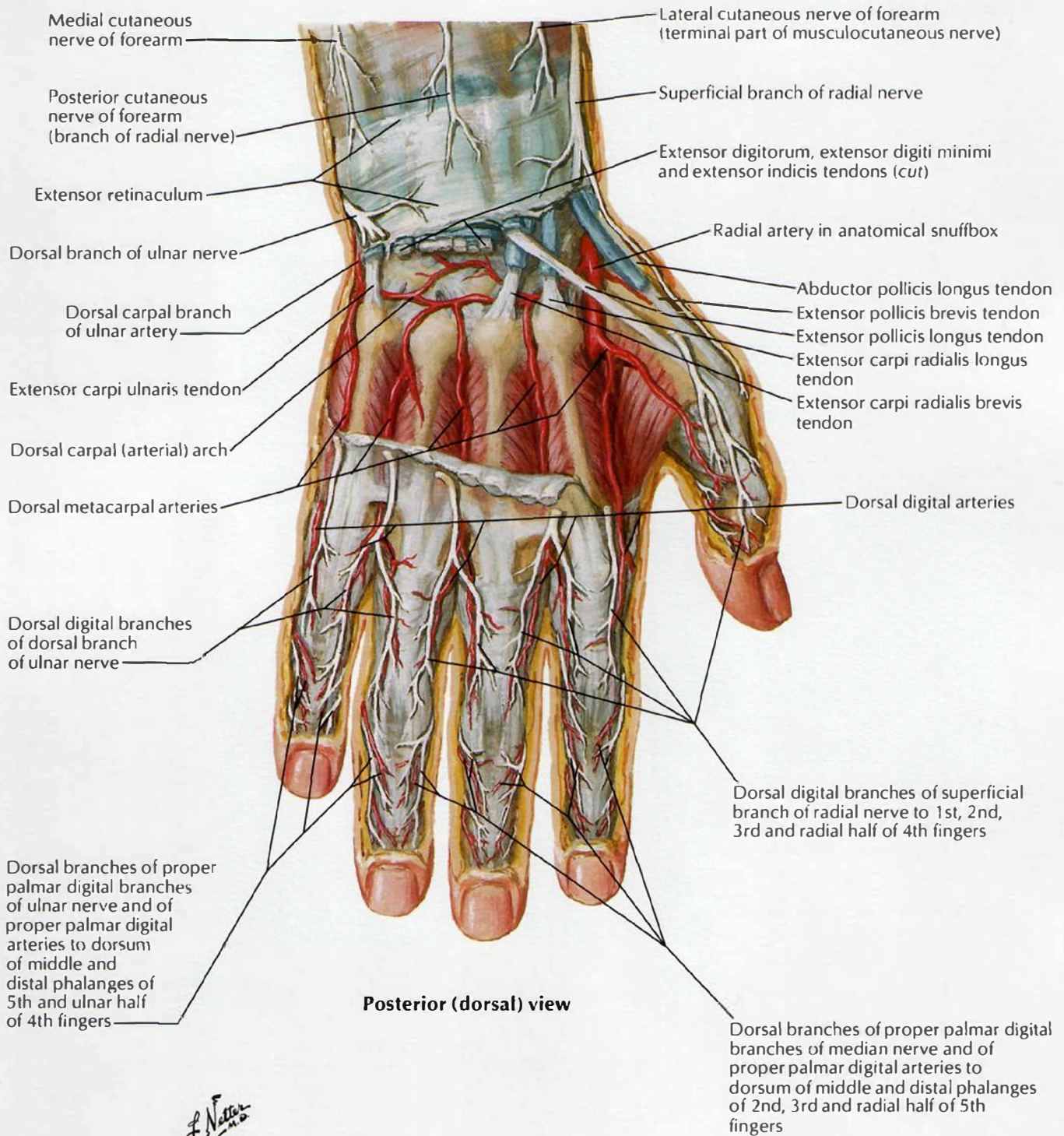
Posterior (dorsal) view



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

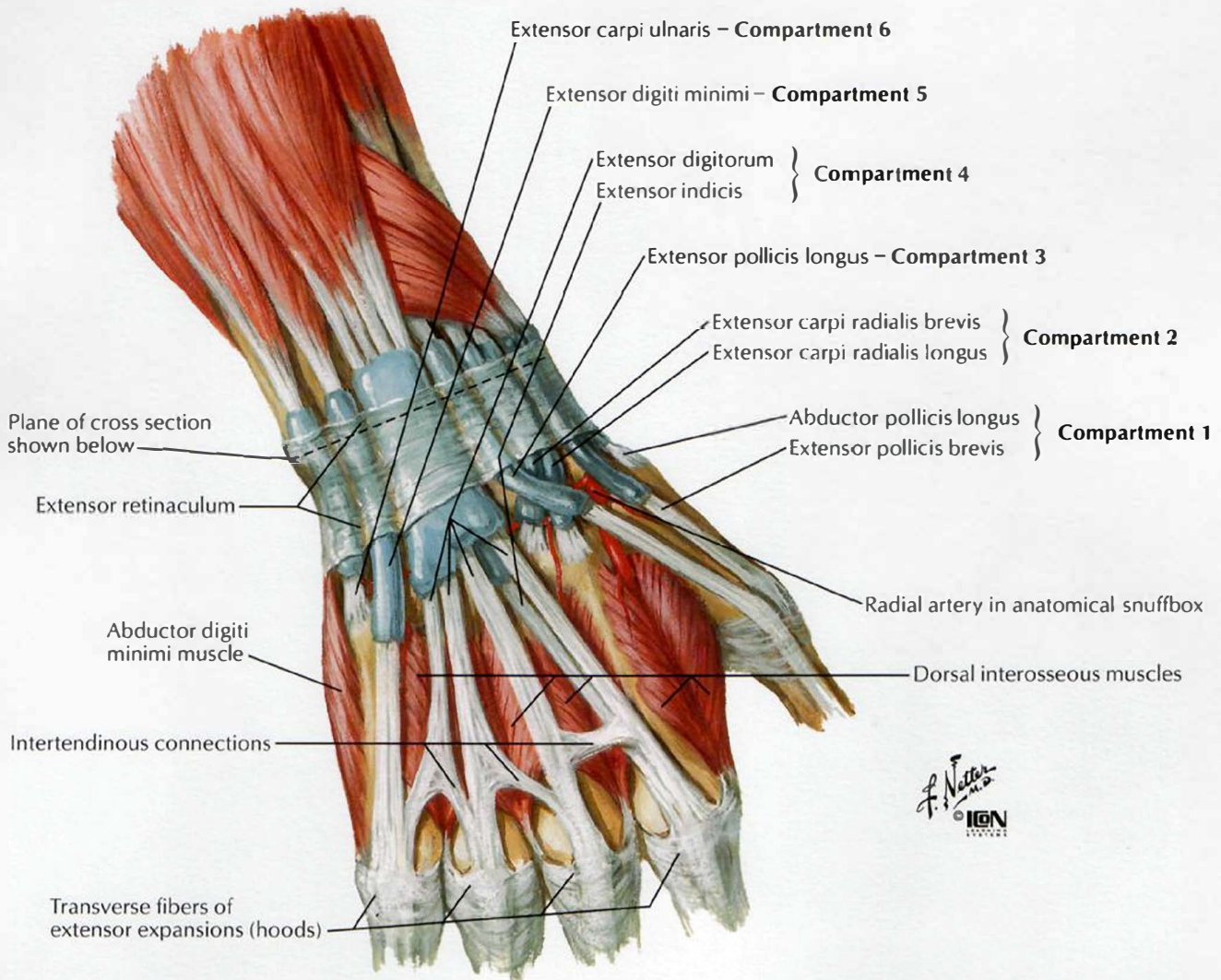
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Wrist and Hand: Deep Dorsal Dissection

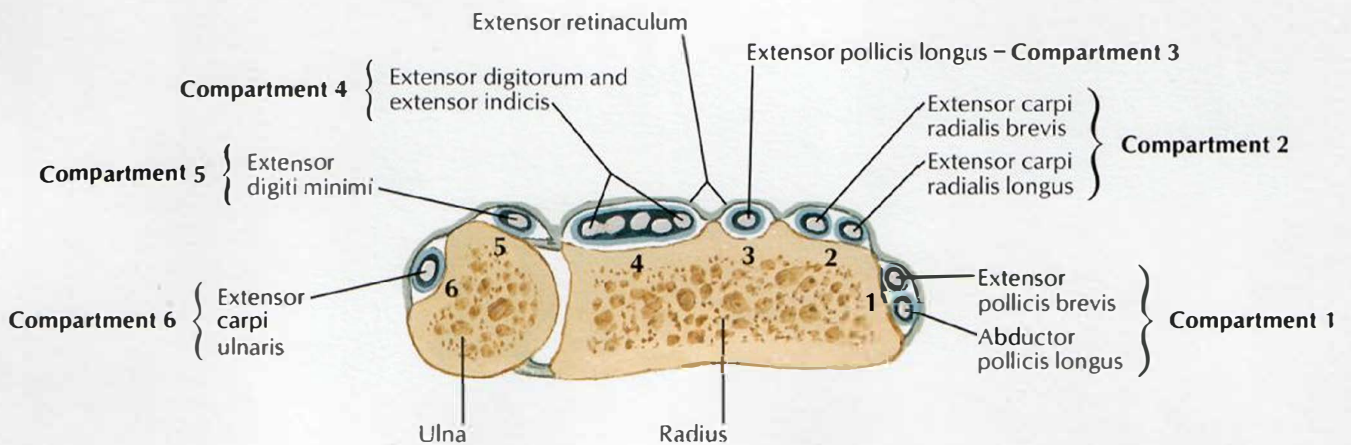


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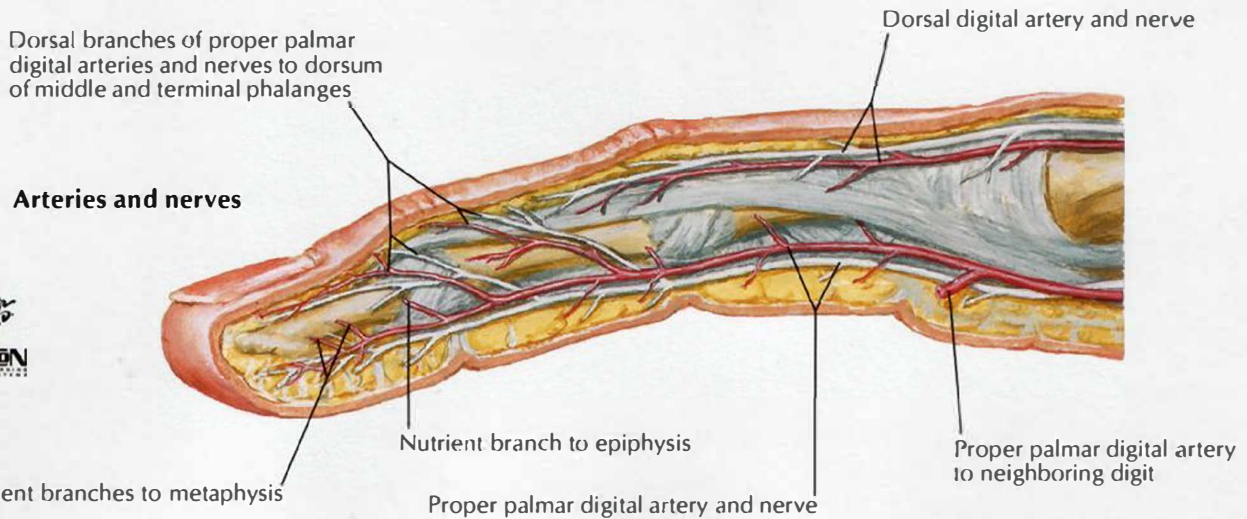
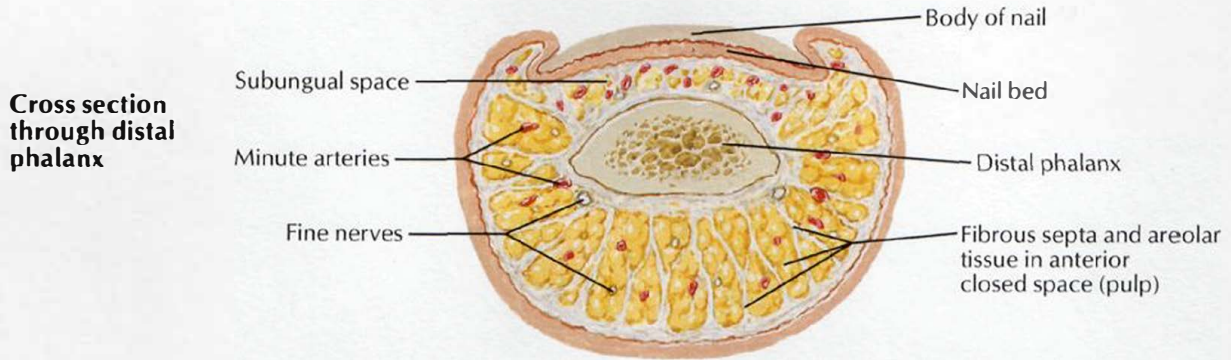
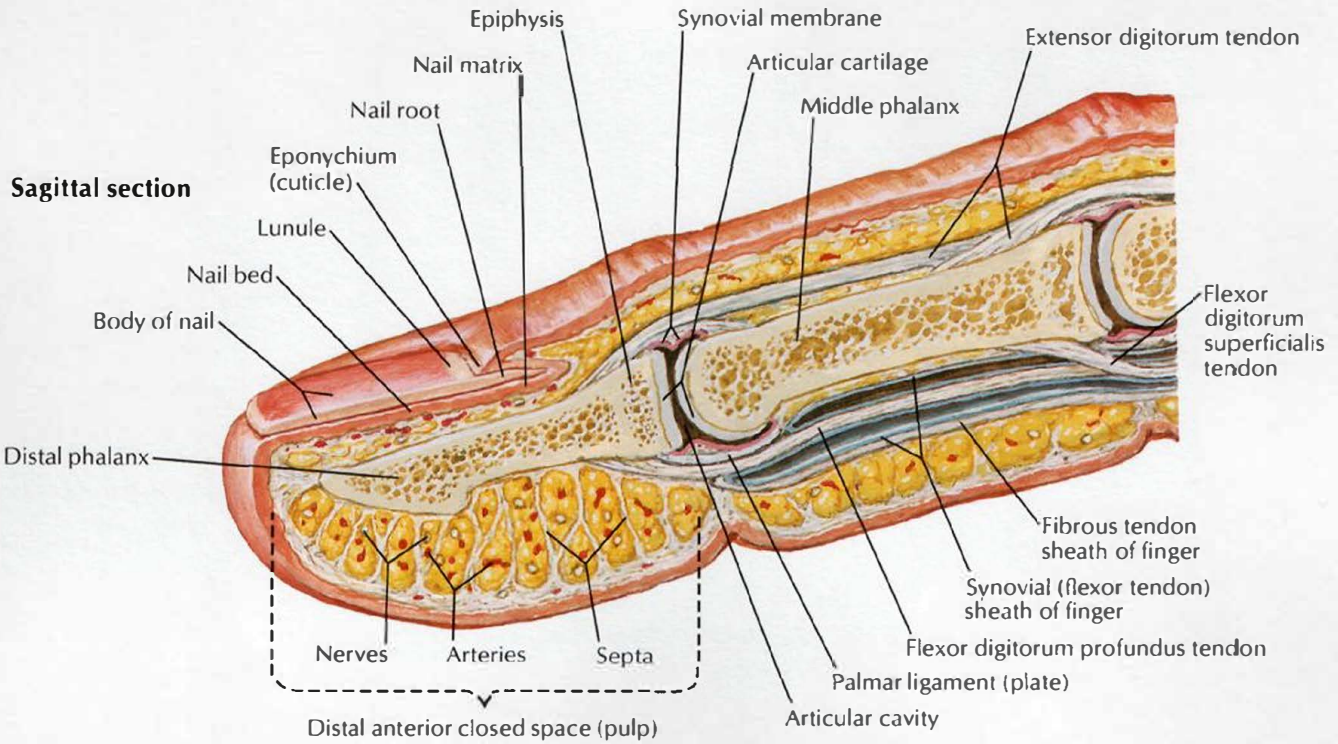
Posterior (dorsal) view



Cross section of most distal portion of forearm



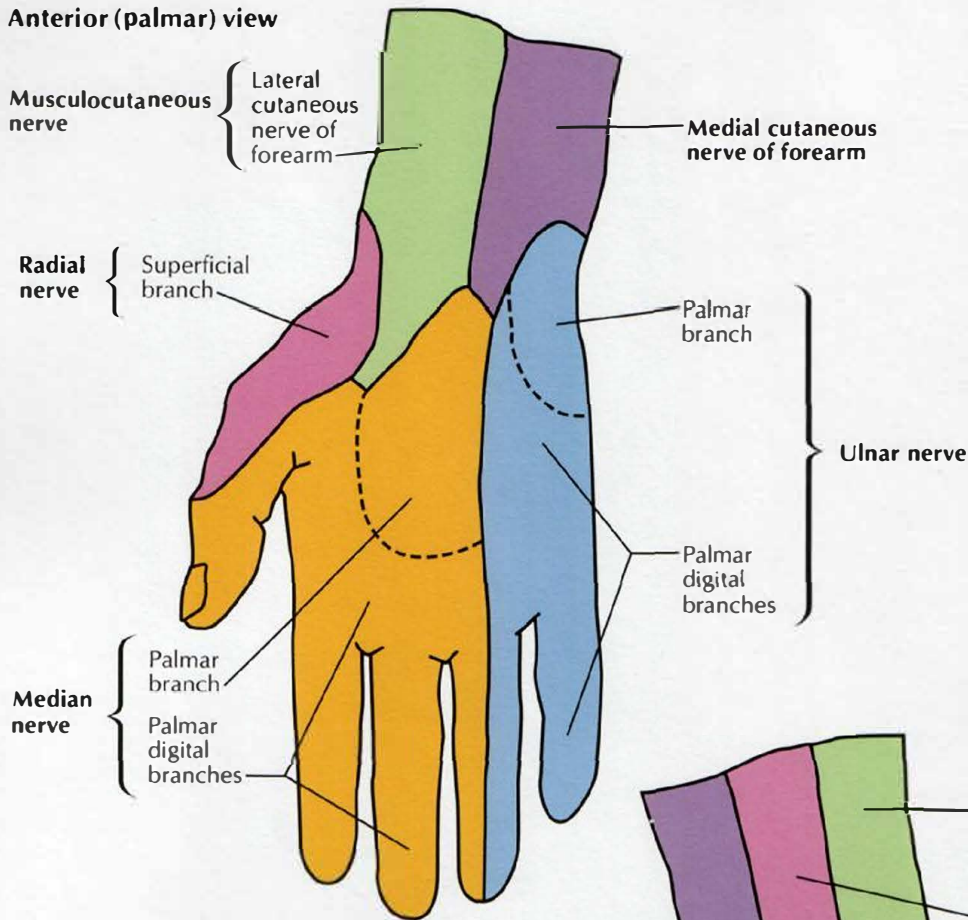
Fingers



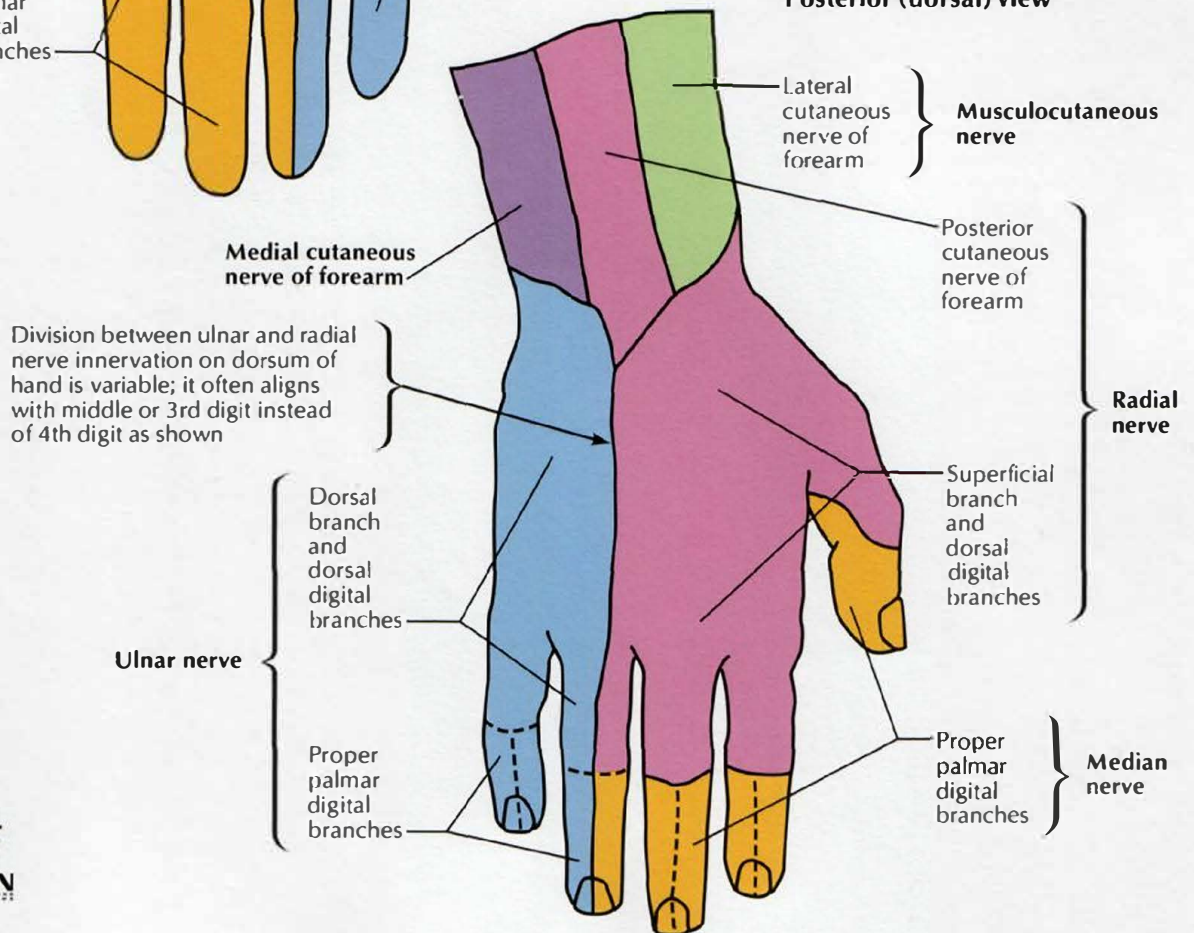
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ILLUSTRATIONS

Cutaneous Innervation of Wrist and Hand

Anterior (palmar) view



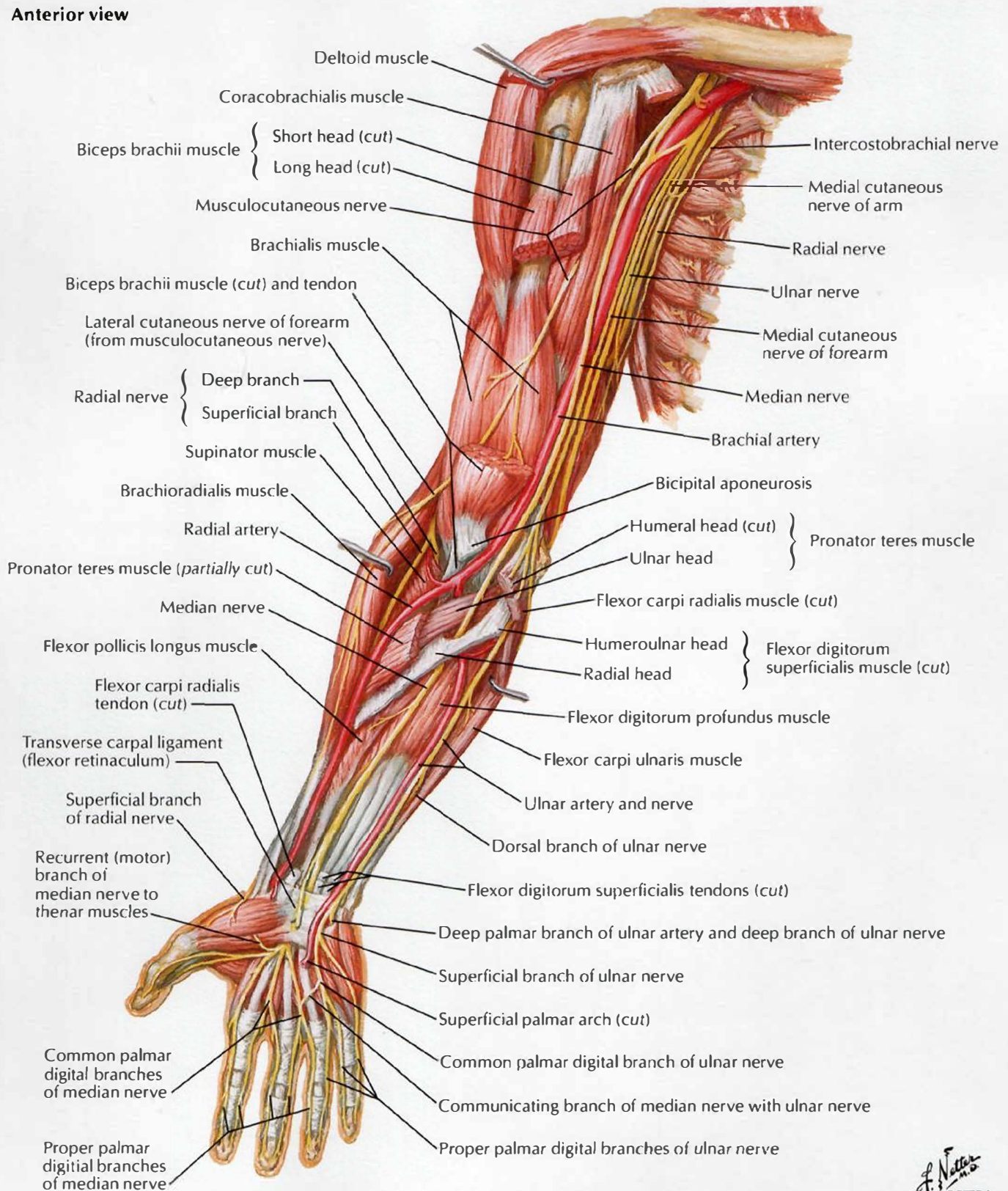
Posterior (dorsal) view



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Arteries and Nerves of Upper Limb

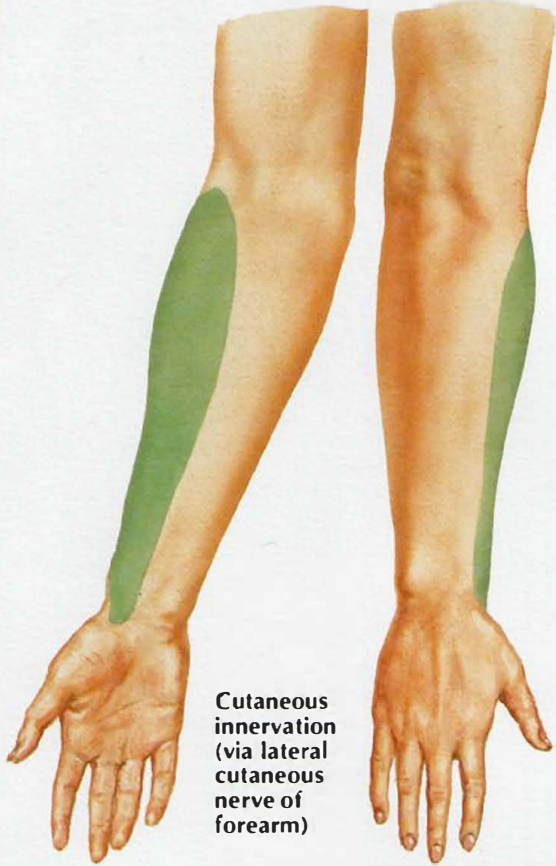
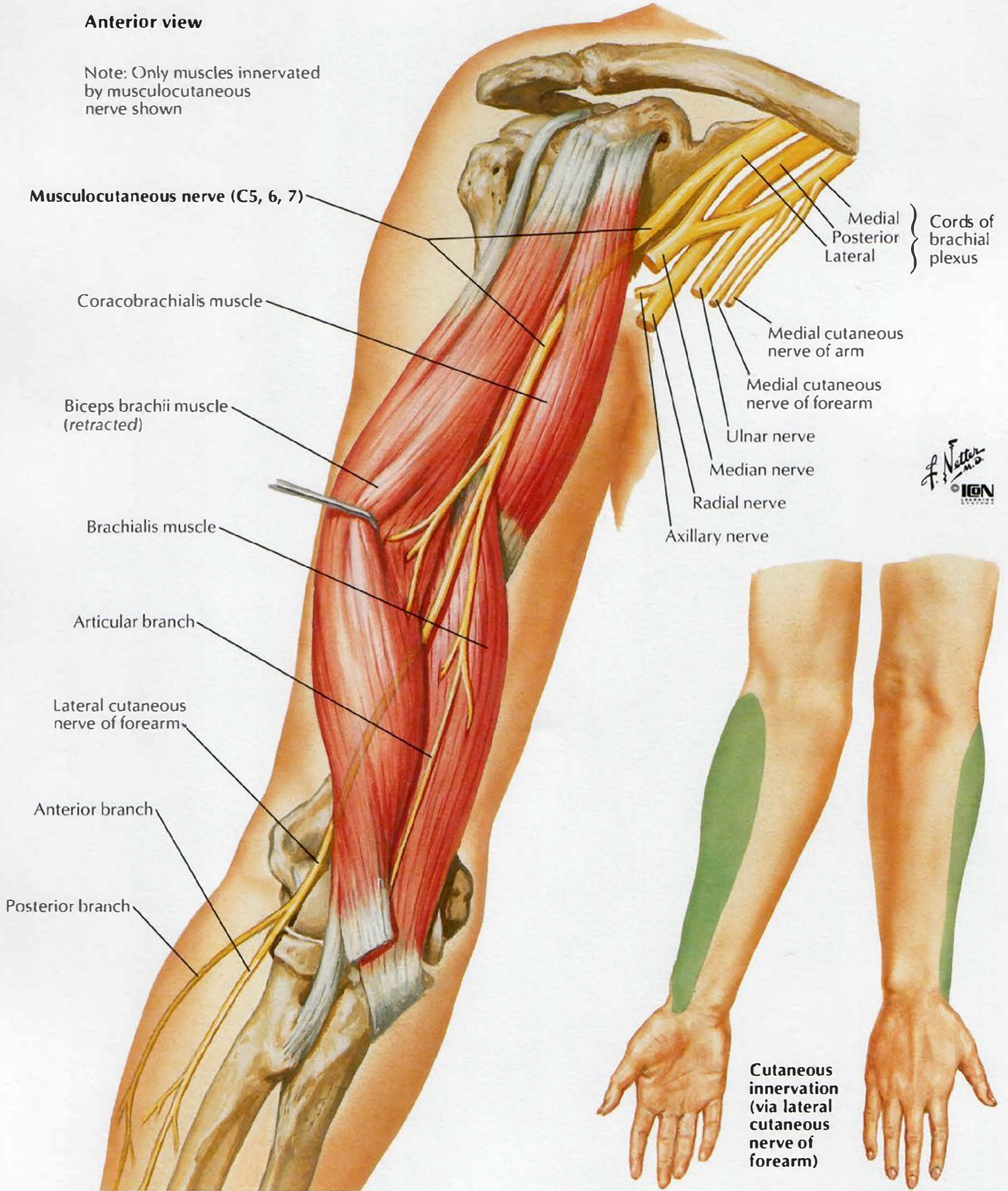
Anterior view



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Anterior view

Note: Only muscles innervated by musculocutaneous nerve shown



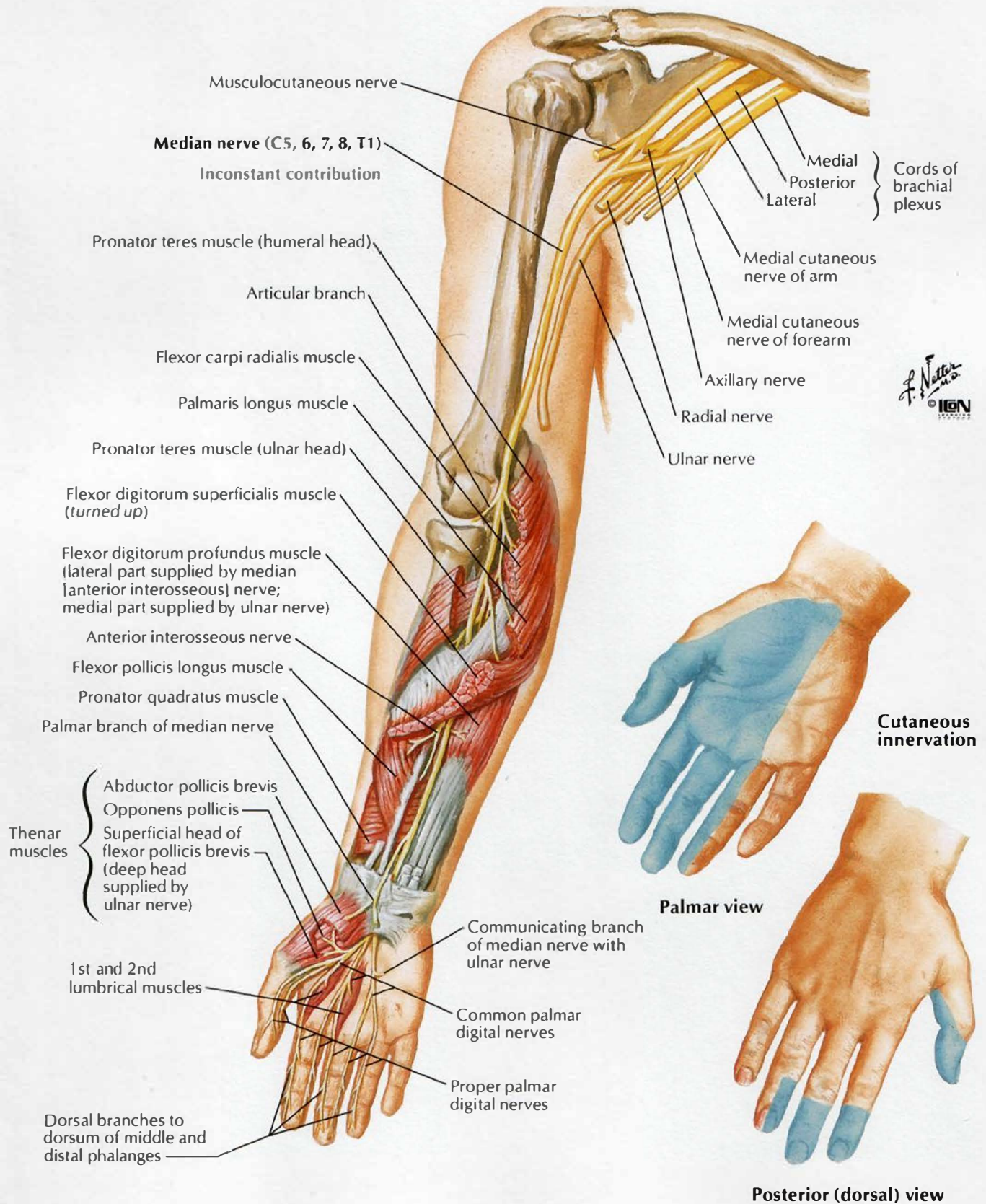
Anterior (palmar) view

Posterior (dorsal) view

Median Nerve

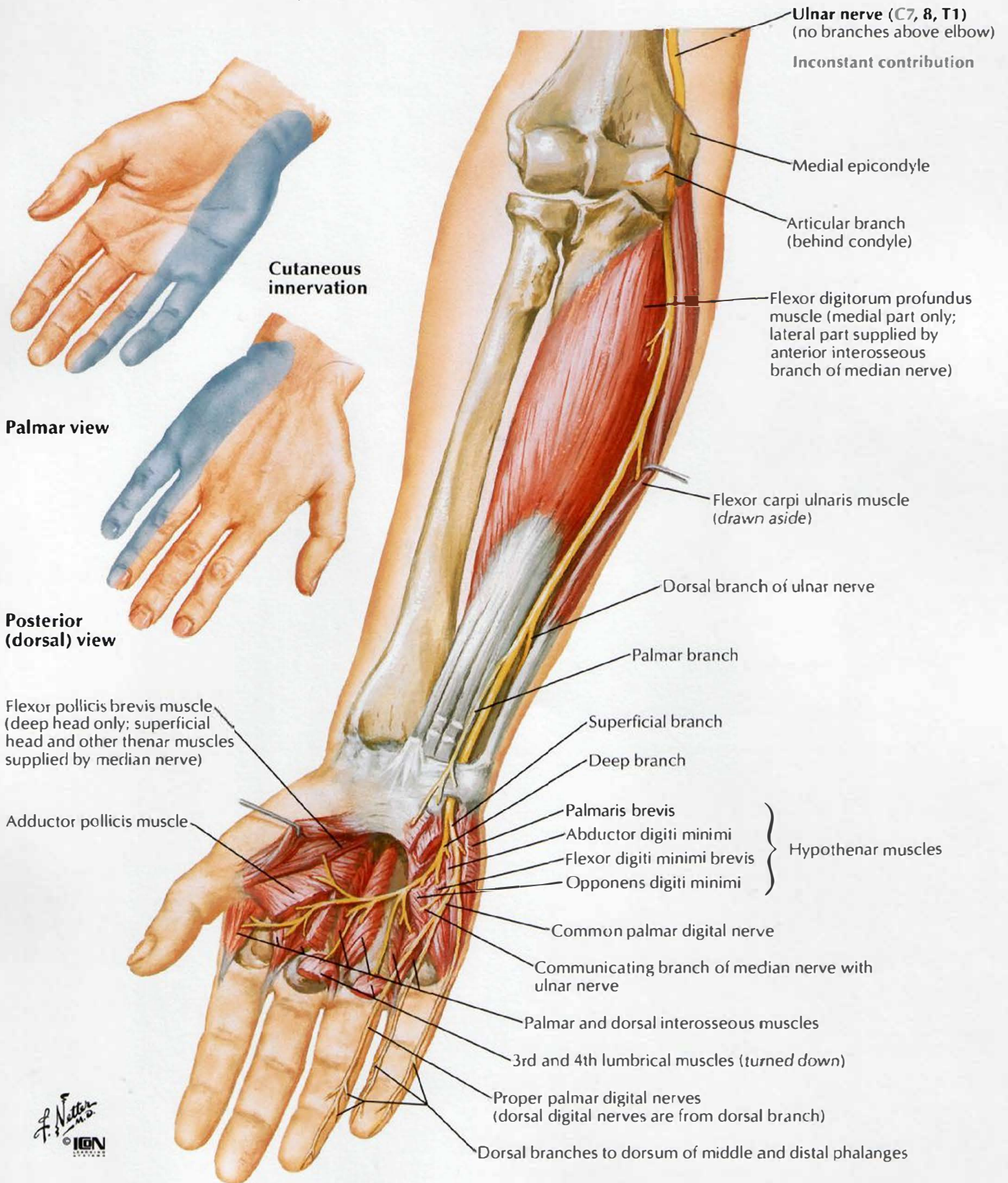
Anterior view

Note: Only muscles innervated by median nerve shown



Anterior view

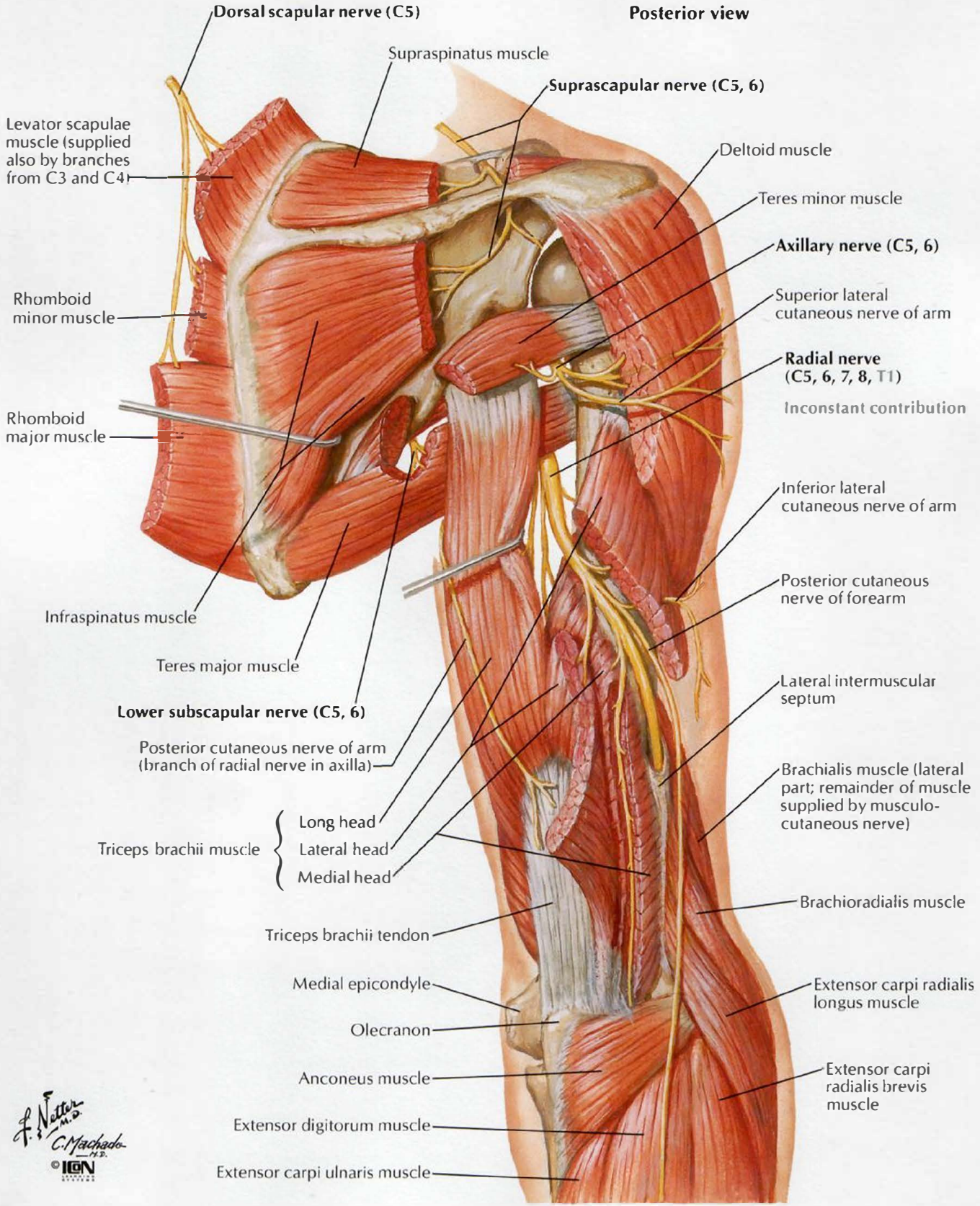
Note: Only muscles innervated by ulnar nerve shown



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Radial Nerve in Arm and Nerves of Posterior Shoulder

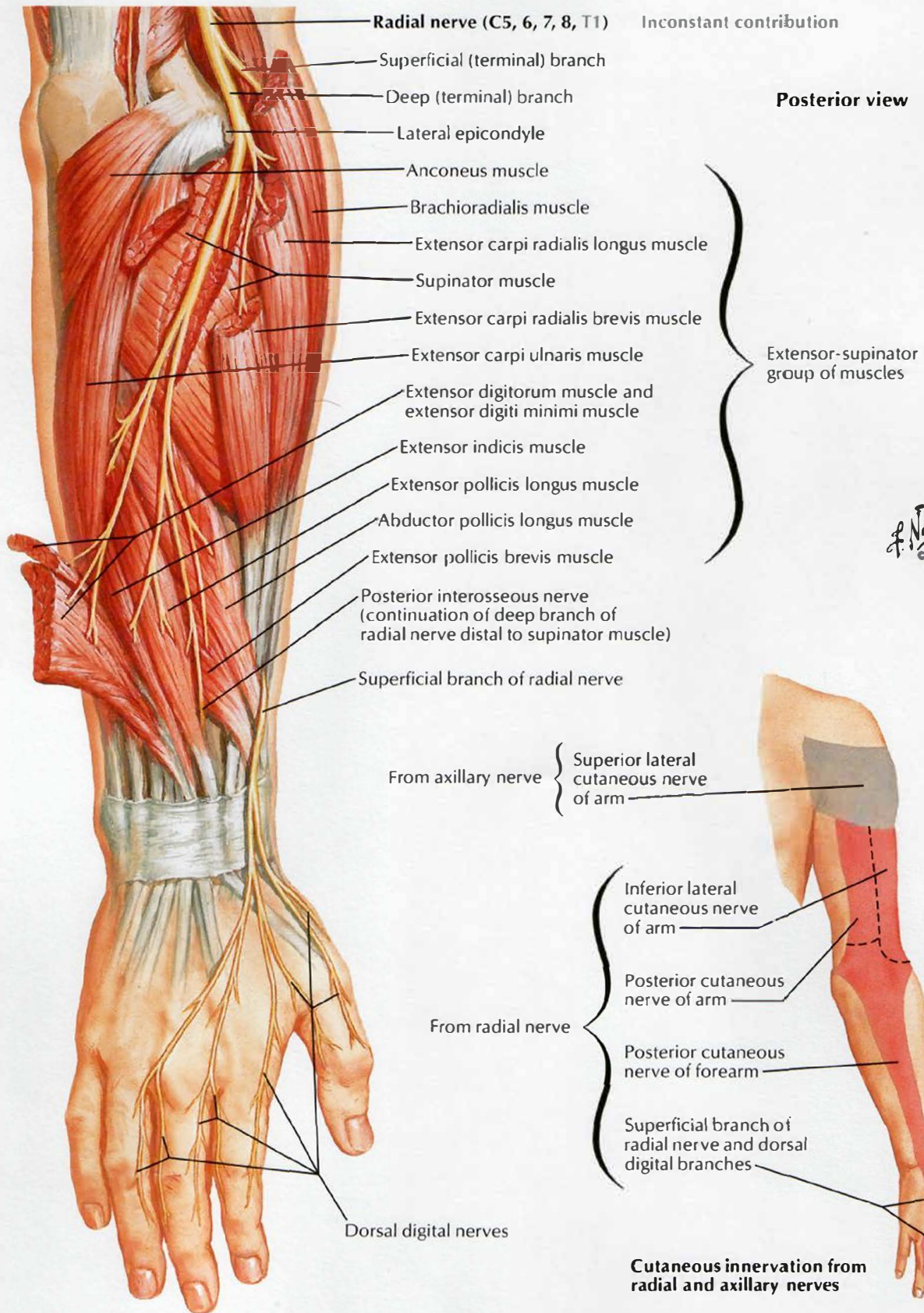
Posterior view



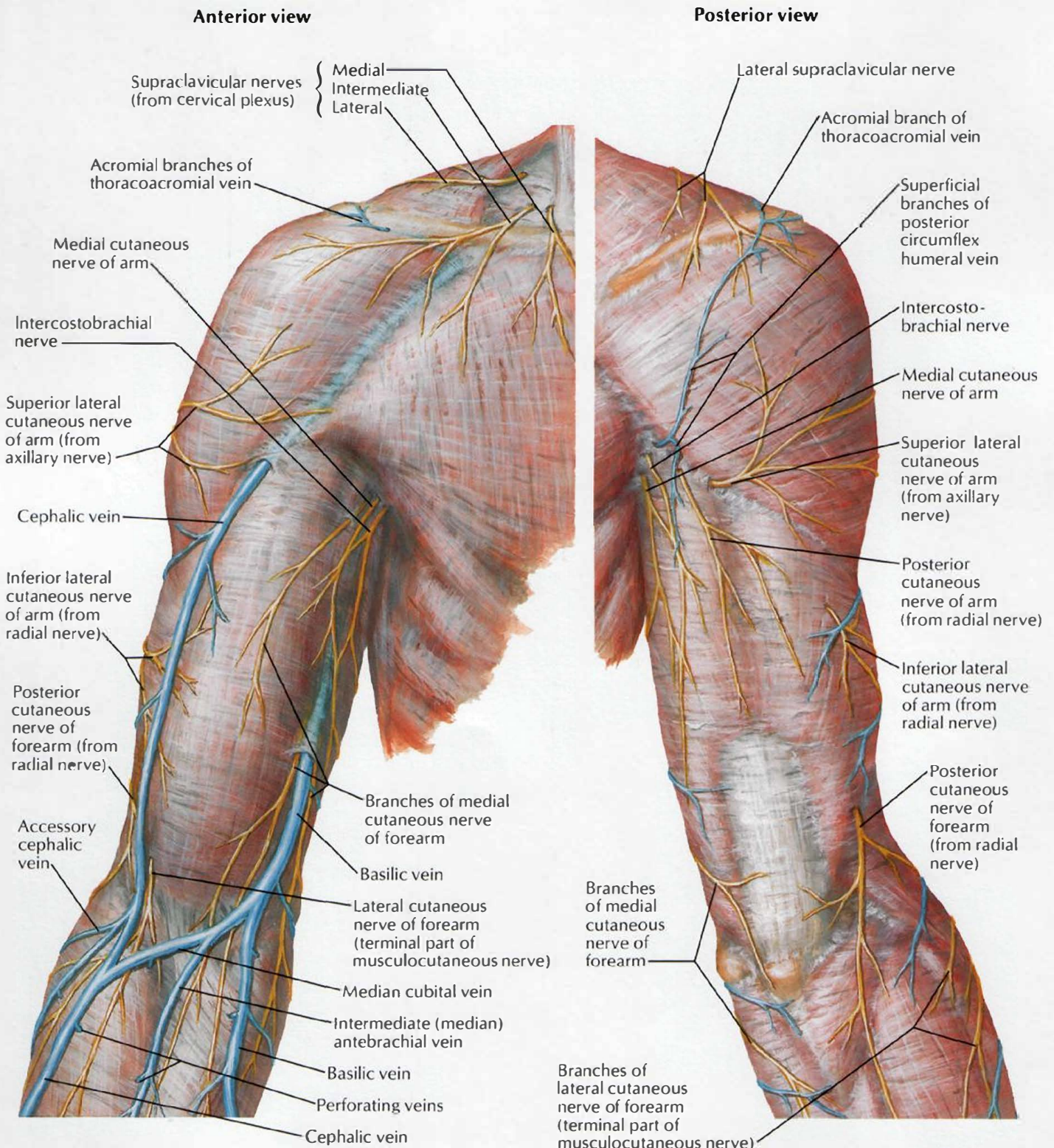
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Radial Nerve in Forearm

SEE ALSO PLATE 450



Cutaneous Nerves and Superficial Veins of Shoulder and Arm

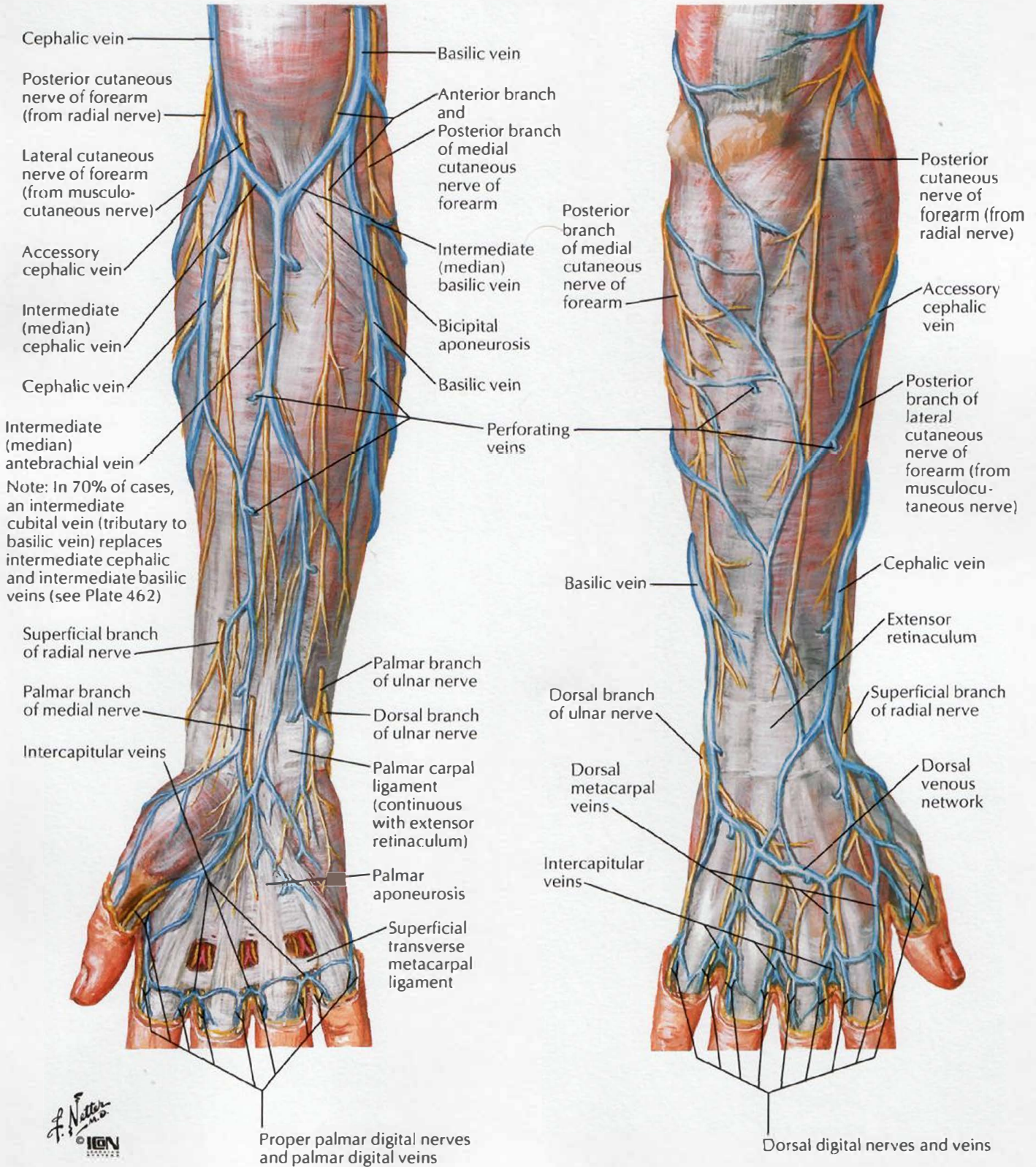


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Cutaneous Nerves and Superficial Veins of Forearm

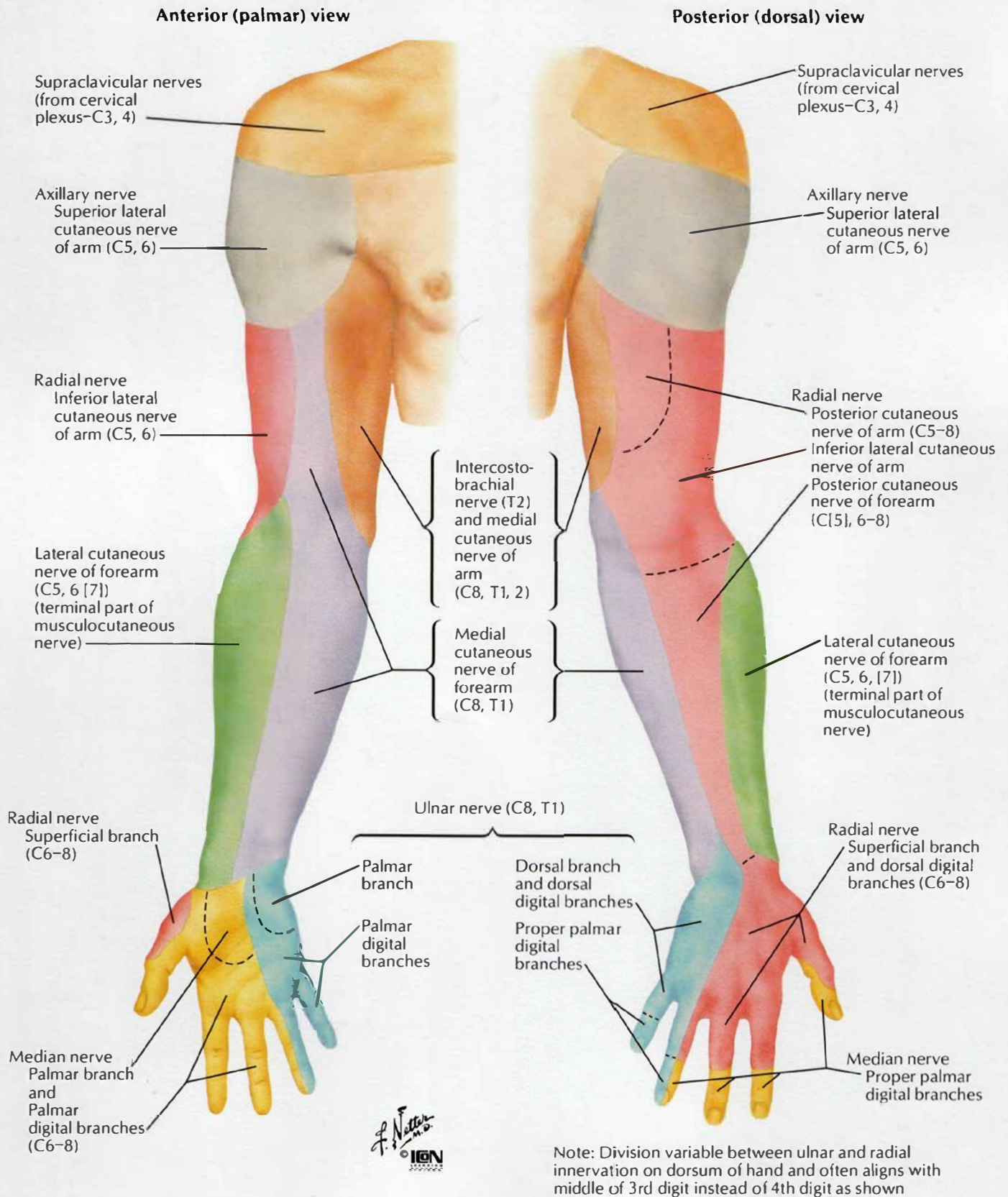
Anterior (palmar) view

Posterior (dorsal) view



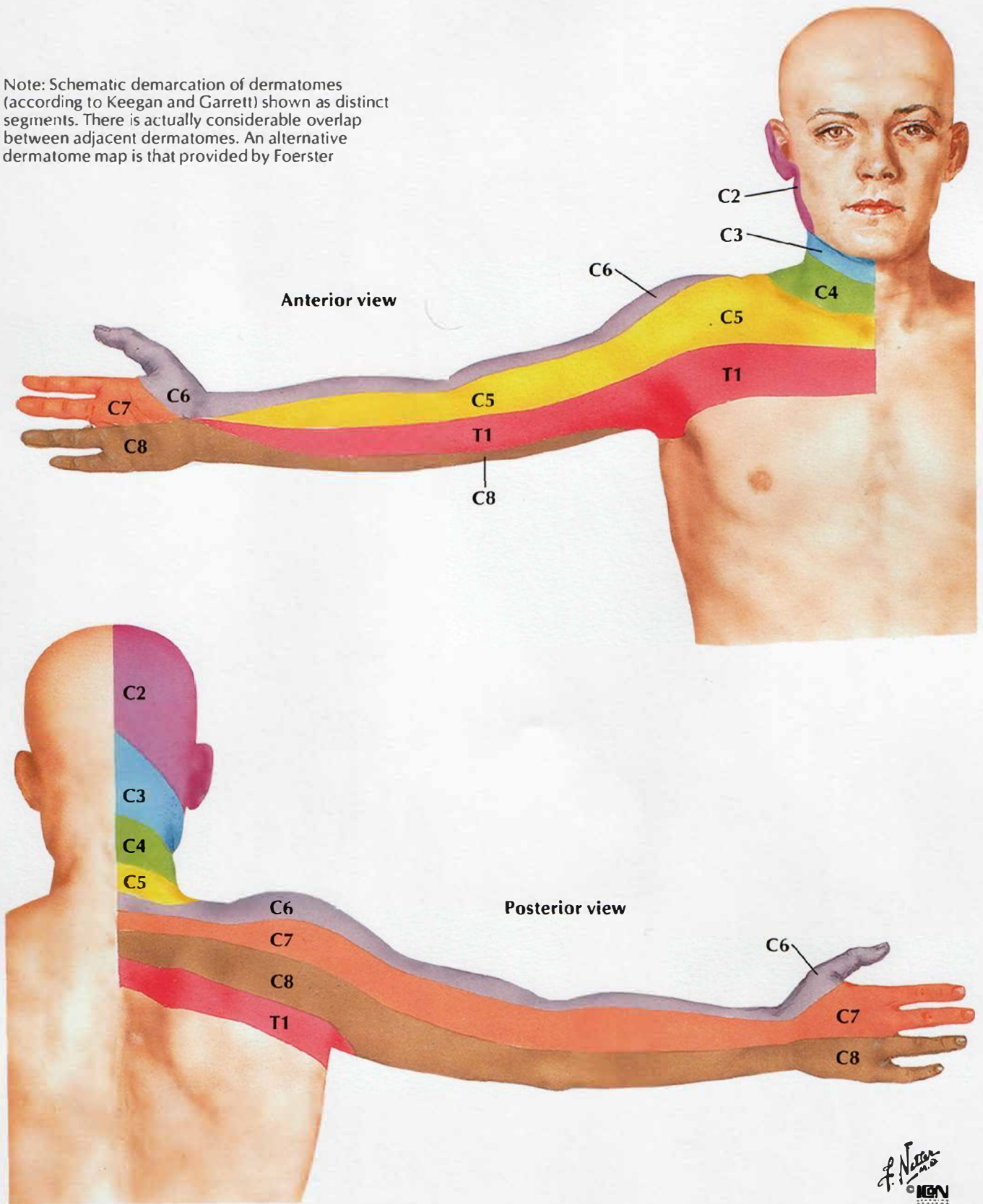
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Cutaneous Innervation of Upper Limb



Dermatomes of Upper Limb

Note: Schematic demarcation of dermatomes (according to Keegan and Garrett) shown as distinct segments. There is actually considerable overlap between adjacent dermatomes. An alternative dermatome map is that provided by Foerster



Lymph Vessels and Nodes of Upper Limb

SEE ALSO PLATES 177, 451

