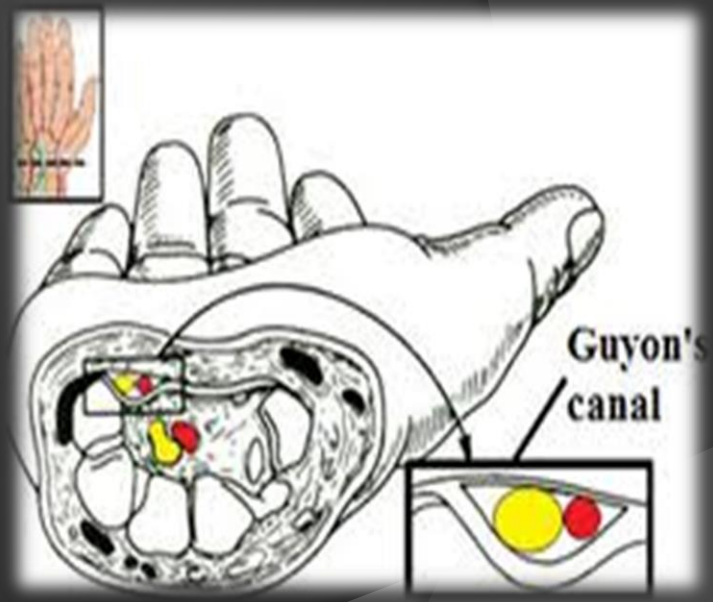
EZQMECEU.COM AND THE AMERICAN COLLEGE OF CHIROPRACTIC ORTHOPEDISTS (ACCO) PRESENT....

UPPER EXTREMITY IMPAIRMENTS – PERIPHERAL NERVE ENTRAPMENTS



Perry J. Carpenter D.C. QME
Fellow, Academy of Chiropractic Orthopedics

PRESENTED BY:

Perry J. Carpenter DC QME

Diplomate, Academy of Chiropractic Orthopedists (DACO)

Board Eligible, Chiropractic Neurology

Board Eligible, Chiropractic Sports

Certified Chiropractic Sports Physician (CCSP)

Certified Chiropractic Extremity Practitioner (CCEP)

Certified Strength & Conditioning Specialist (CSCS*D)

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Additional Programs Available from EZQMECE.COM:

- Medical-Legal Report Writing and Technique of the QME Examination (6 hours)
- Gait Disturbance & Assistive Devices (3 hours)
- The Non-Physiologic Examination (3 hours)
- The Deposition Matrix (6 hours)
- 21 Secrets of the Most Persuasive QME's
- Lower Extremity Impairments due to Peripheral nerve lesions

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Medical-Legal Report Writing and Technique of the QME Examination (6 hours)

Section 1 - Medical Legal Report Writing

- "Substantial Medical Evidence"
- QME Reports and Required Elements as described in the 2001 Physician's Guide
- QME Reports and Required Elements of the Permanent Impairment Evaluation as described in the AMA Guides- 5th Edition
- QME Reports using a "hybrid format" to include required elements for all dates of injury

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Section 2 The QME Panel Process

- Labor Codes that Govern the QME Panel Process
- LC 5402 ($10,000 rule)
- LC 4060
- LC 4061
- LC 4062
- Am I the AME, the APQME, or the QME?

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Section 3 Technique of the QME Evaluation

- Observation of the Examinee
- Gait analysis and assistive devices
- Effective Communication Skills for the Doctor
- Obtaining the “History” and the “Relevant Medical History”

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Section 3 (cont.) Technique of the QME Examination

- The Importance of the Neurologic Examination
- Neuroanatomy Review
- Components of the Neurologic Exam by Body Region
- Tools and Instruments required for the Neurologic Examination

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Gait Disturbance & Assistive Devices:

Topics Include:

- AMA Guides - Descriptions of Gait Disturbances in Chapters 13 and Chapters 17 and Permanent Impairments due to gait disturbance under the *strict* application of the AMA Guides
- Procedure for the Gait Analysis and Observation

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Section 2 Gait Disturbance & Assistive Devices Topics (cont.):

- Description of the Phases of “Normal” Gait and “Pathologic” Gait
- Causes of Deviations from the Normal Gait
- Named Gait Signs
- Assistive Devices – canes, crutches, pick up frames, ankle foot orthosis, knee ankle foot orthosis
- Gait Conclusions

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The Non-Physiologic Examination

Topics Include:

- Practical Considerations for the Quantification of Pain
- Activities of Daily Living Assessments – a Practical Method
- Malingering – Waddell's Signs and DSM-IV (Diagnostic and Statistical Manual of Mental Disorders) Criteria
- Medical Records, and Interview Findings of Inconsistency
- Physical Examination Findings of Inconsistency

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The "Deposition Matrix" - Topics:

Philosophy: Reasons <u>why</u> Depositions are called – Applicant Attorney vs. Defense Attorney

- Rules for Deposition: Combination of tips and suggestions from 1) my own experience plus 2) communication tips from a Certified Court Reporter
- Case Examples:
  - Mechanism of Injury:
  - Clinical Course:
  - Permanent Impairment/Apportionment Opinions
  - Deposition Questions and the responses

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21 Secrets of the Most Persuasive QME's

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21 Secrets of the Most Persuasive QME's

PERSUASIVE

Merriam Webster – adj. – able to cause people to do or to believe something.

Wikipedia – adj. – tending to persuade, or to use persuasion:

- Persuasion: The influence of beliefs, attitudes, intentions, motivations, or behaviors. Persuasion is a process aimed at changing a person's (or a group's) attitude or behavior toward some event, idea, object, or other person(s), by using written or spoken words to convey information, feelings, or reasoning, or a combination of them.

Chinese Proverb:

"The tongue can paint what the eye cannot see."

21 Secrets of the Most Persuasive QME's

Topics:

- Section 1 - Preparatory Secrets of the Most Persuasive QME's
  - Secret # 1 - Prepare, prepare, prepare
  - Secret #2 – Review the Medical Records
  - Secret #3 – Prepare the Tone of the Examination

21 Secrets of the Most Persuasive QME's

Topics:

- Section 2 - Interview/Physical Examination Secrets of the Most Persuasive QME's
  - Secret #1 - Do Activities of Daily Living Interview as part of the face to face evaluation
  - Secret #2 – Know the Impairments and Examine for them
  - Secret #3 – Perform every single Objective Test
  - Secret #4 – Perform a formal Gait Analysis
  - Secret #5 – Perform a Non-Physiologic Exam
  - Secret #6 – Focus on the Neurologic Exam
  - Secrets #-7-9: Diagnostic Studies:
    - #7 - Order Appropriate Diagnostic Studies
    - #8 – Consult with the Radiologist
    - #9 – Analyze for "Loss of Motion Segment Integrity"
  - Secret #10 – Do a formal Pain Impairment Analysis

21 Secrets of the Most Persuasive QME's

Topics:

- Section 3 - Report Writing Secrets of the Most Persuasive QME's
  - Secret #1 – Format Report Clearly
  - Secret #2 – Do a thorough Review of Records
  - Secret #3 – Convey "Certainty"
  - Secret #4 – State the Reasons for your opinion(s)

21 Secrets of the Most Persuasive QME's

Topics:

- Section 4 - Deposition Secrets of the Most Persuasive QME's
  - Secret # 1 - Know the Codes
  - Secret #2 – Know why Depositions are scheduled
  - Secret #3 – Know Apportionment as it applies to your case
  - Secret #4 – Review your Permanent Impairment opinion
  - Secret #5 – Defend your Report as Substantial Medical Evidence

21 Secrets of the Most Persuasive QME's

Topics:

- Section 5 – Final Thoughts
  - That's 21 secrets in all – all accumulated from the combined wisdom of thousands and thousands of injured worker evaluations.
  - Plus, 2 bonus secrets that will bring together all of the material – given at the end of the Program.

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Lower Extremity Impairments – Peripheral Nerve Lesions

Topics Include:

Neurology 101

Entrapment Neuropathies

Exam Procedures

Impairment Calculations

Case Examples

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UPPER EXTREMITY IMPAIRMENTS – PERIPHERAL NEUROPATHIES

Topics Include:

- Neurology 101
- Entrapment Neuropathies
- Exam Procedures
- Impairment Calculations
- Case Examples

UPPER EXTREMITY IMPAIRMENTS – PERIPHERAL NEUROPATHIES

Topics:

- Neurology 101
  - Development of the Nervous System
  - Layout of the Nervous System
  - Differentiation of the Somites
  - Spinal Nerve Roots
  - Brachial Plexus

UPPER EXTREMITY IMPAIRMENTS – PERIPHERAL NEUROPATHIES

Topics:

- Entrapment Neuropathies
  - Radial Nerve
  - Median Nerve
  - Ulnar Nerve

UPPER EXTREMITY IMPAIRMENTS – PERIPHERAL NEUROPATHIES

Topics:

- Exam Procedures:
  - Sensory Exam:
    - Exam Procedures for 1) pain, 2) light touch, and 3) two point discrimination
    - Review of Sensory Receptors
      - Free Nerve Endings, Meissner's corpuscles, Krause end bulbs, golgi tendon organs, etc.

UPPER EXTREMITY IMPAIRMENTS – PERIPHERAL NEUROPATHIES

Topics:

- Permanent Impairment Calculation
  - Determining Sensory Deficit
  - Determining Motor Deficit
  - Determining Final Whole Person Impairment Rating

UPPER EXTREMITY IMPAIRMENTS – PERIPHERAL NEUROPATHIES

Topics:

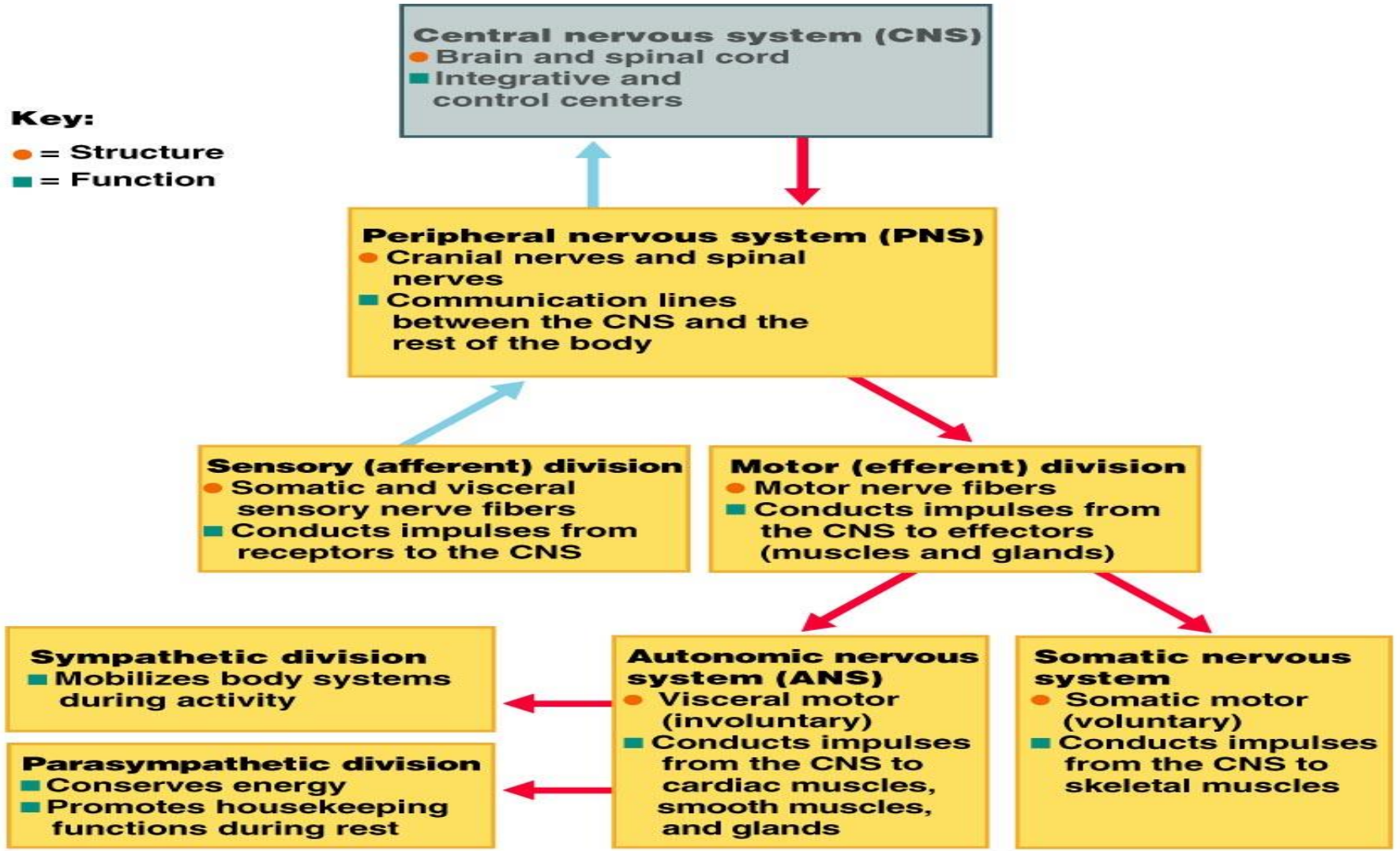
- Case Examples

PERIPHERAL NEUROPATHIES

AMA Guides (page 480): “Excellent knowledge of the morphologic anatomy and physiology of the nervous system is a prerequisite.

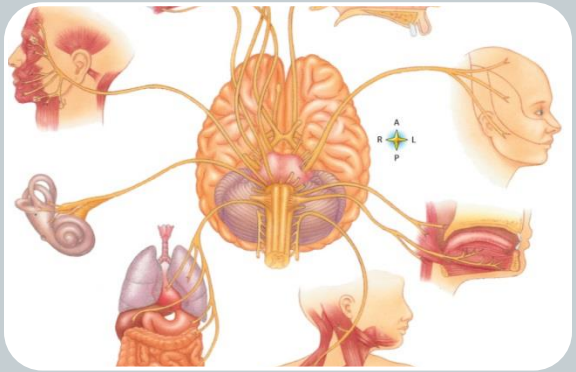
Brief Review of the Nervous System:

NERVOUS SYSTEM REVIEW

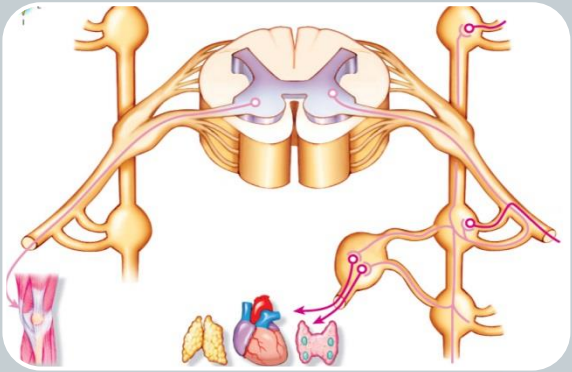


ENTRAPMENT NEUROPATHIES

Brief Review – So, we have the CNS and the PNS as the 2 major divisions of the nervous System.

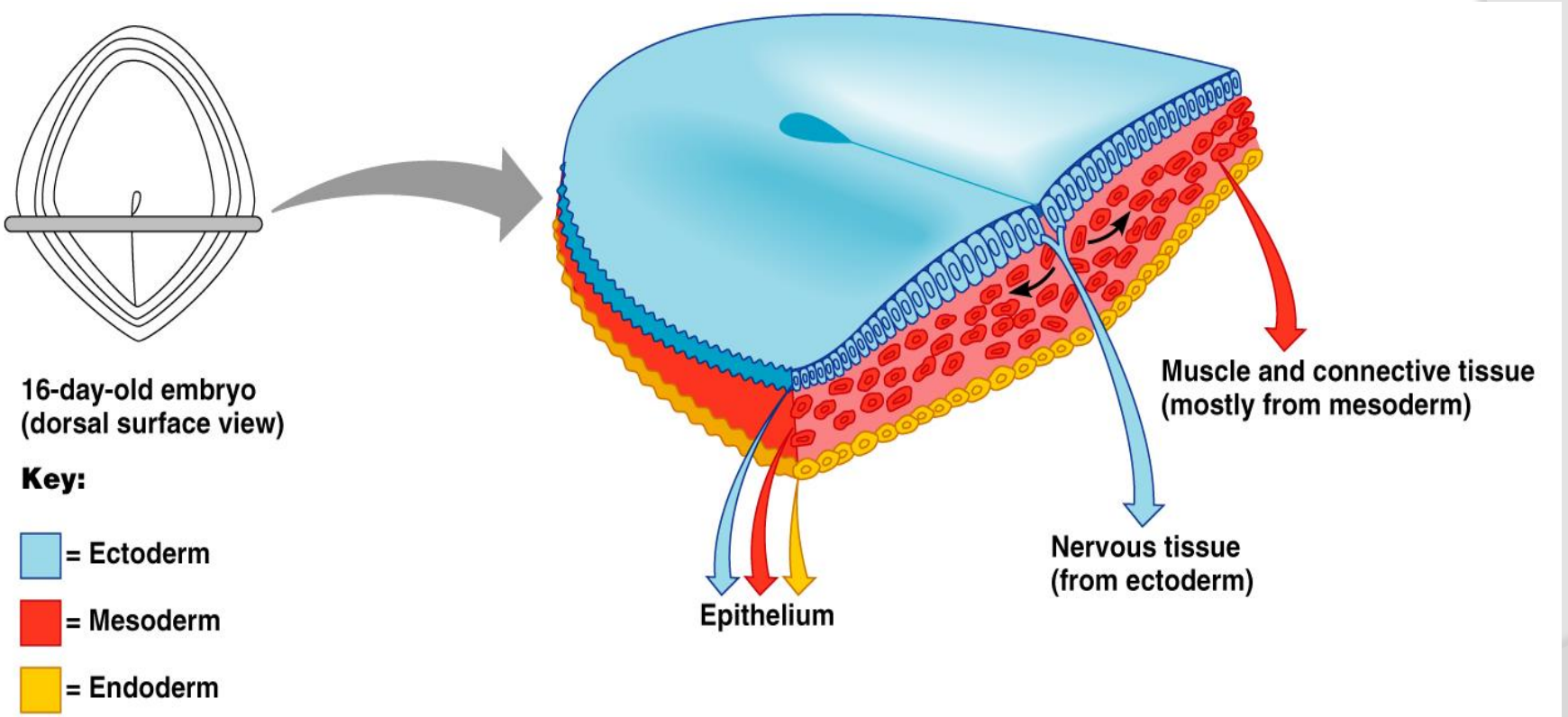


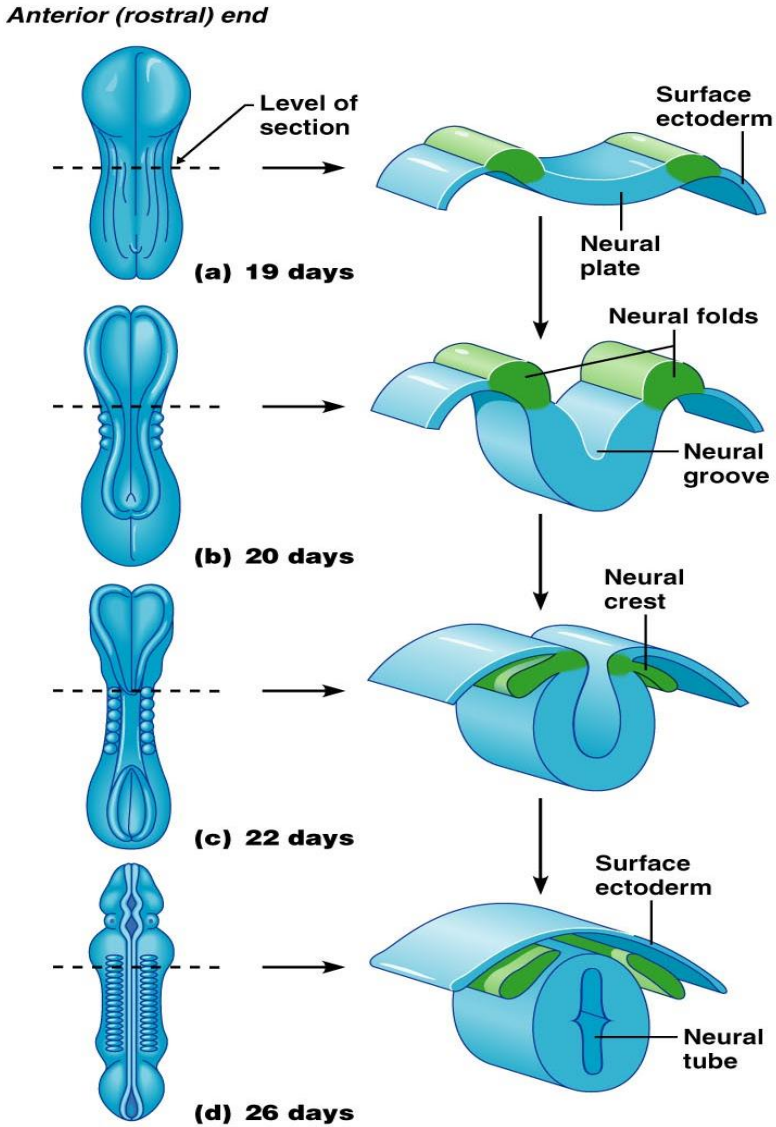
PNS Consists of the Cranial Nerves (12 pairs) and the Spinal Nerves (31 pairs)



PNS is divided into sensory (afferent) divisions and motor (efferent) divisions. Later on in the Program, we are going to discuss the examination procedures for both the sensory and motor divisions of the named upper extremity peripheral nerves.

Embryonic Development

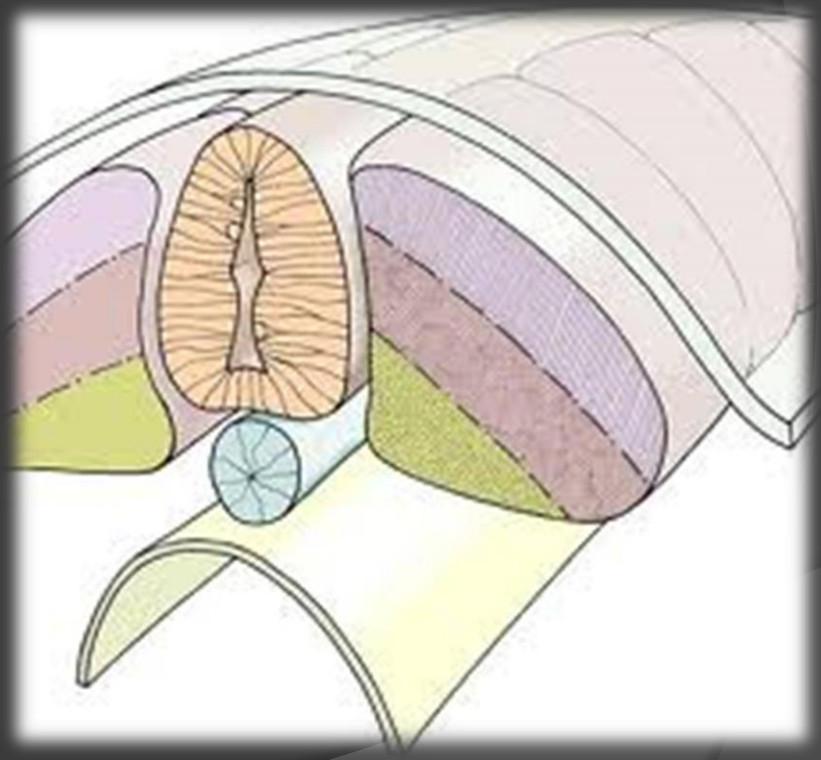


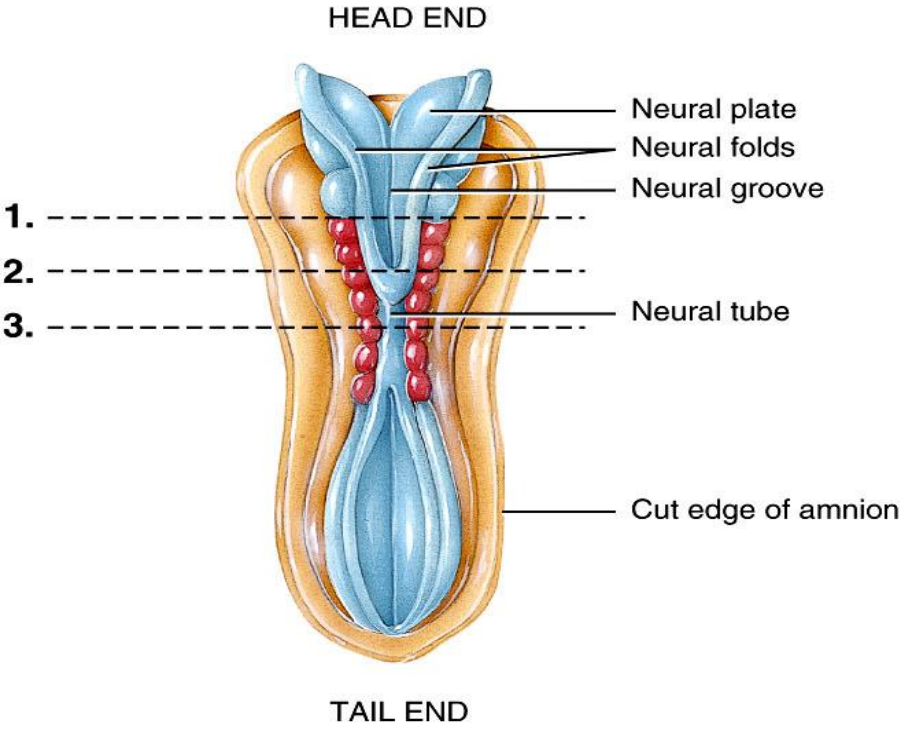

Anterior (rostral) end
Level of section
Surface ectoderm
Neural plate
(a) 19 days
Neural folds
Neural groove
(b) 20 days
Neural crest
(c) 22 days
Surface ectoderm
Neural tube
(d) 26 days

DERMATOMES AND MYOTOMES

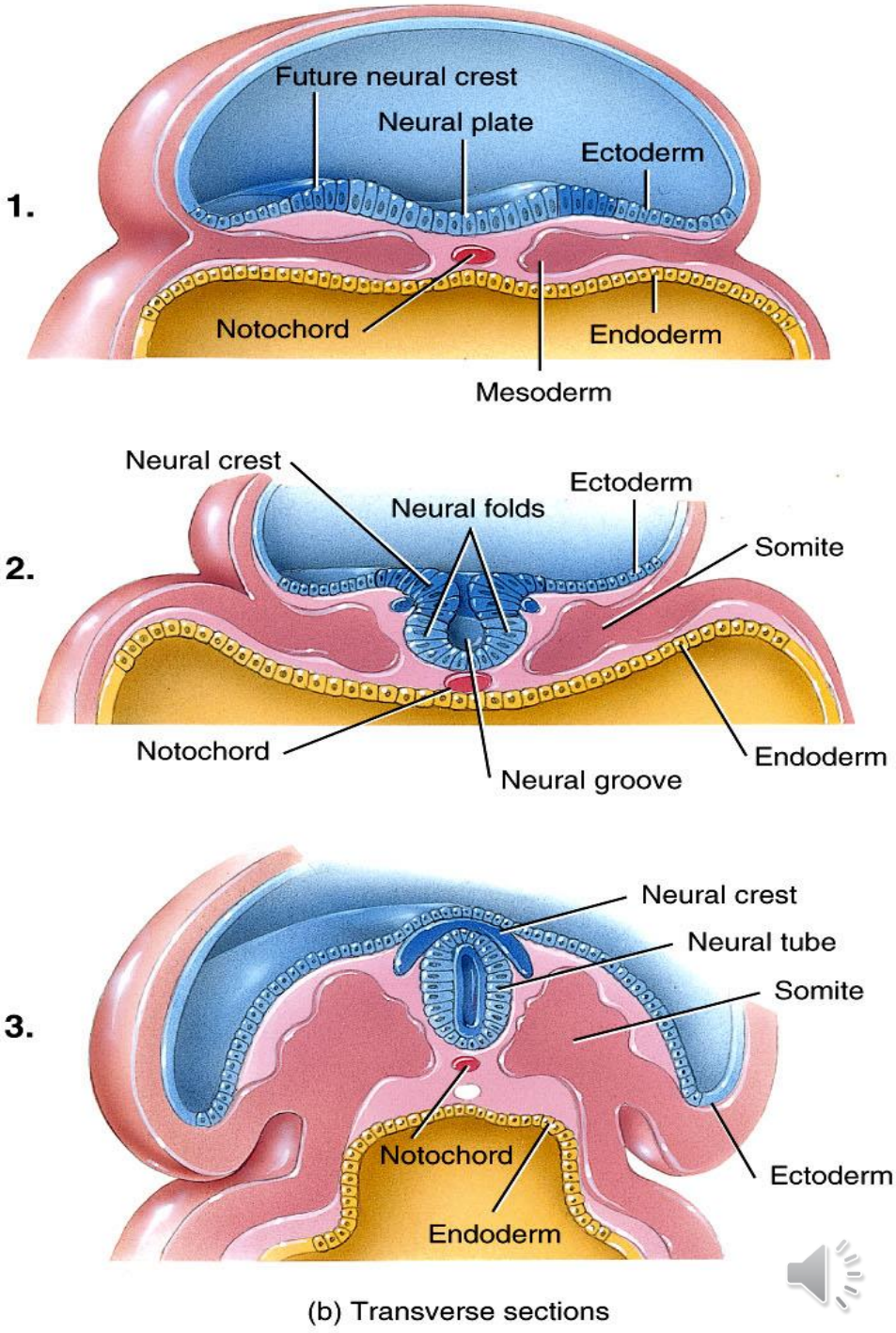
Embryonic Somites - Development of dermatomes and myotomes

- A somite is a mass of mesoderm distributed along the two sides of the neural tube that will eventually differentiate and divide into the dermis (giving us the dermatomes), the skeletal muscle (giving us the myotomes), and the sclerotome (which becomes the vertebrae of the spine and bones of axial and appendicular skeleton)

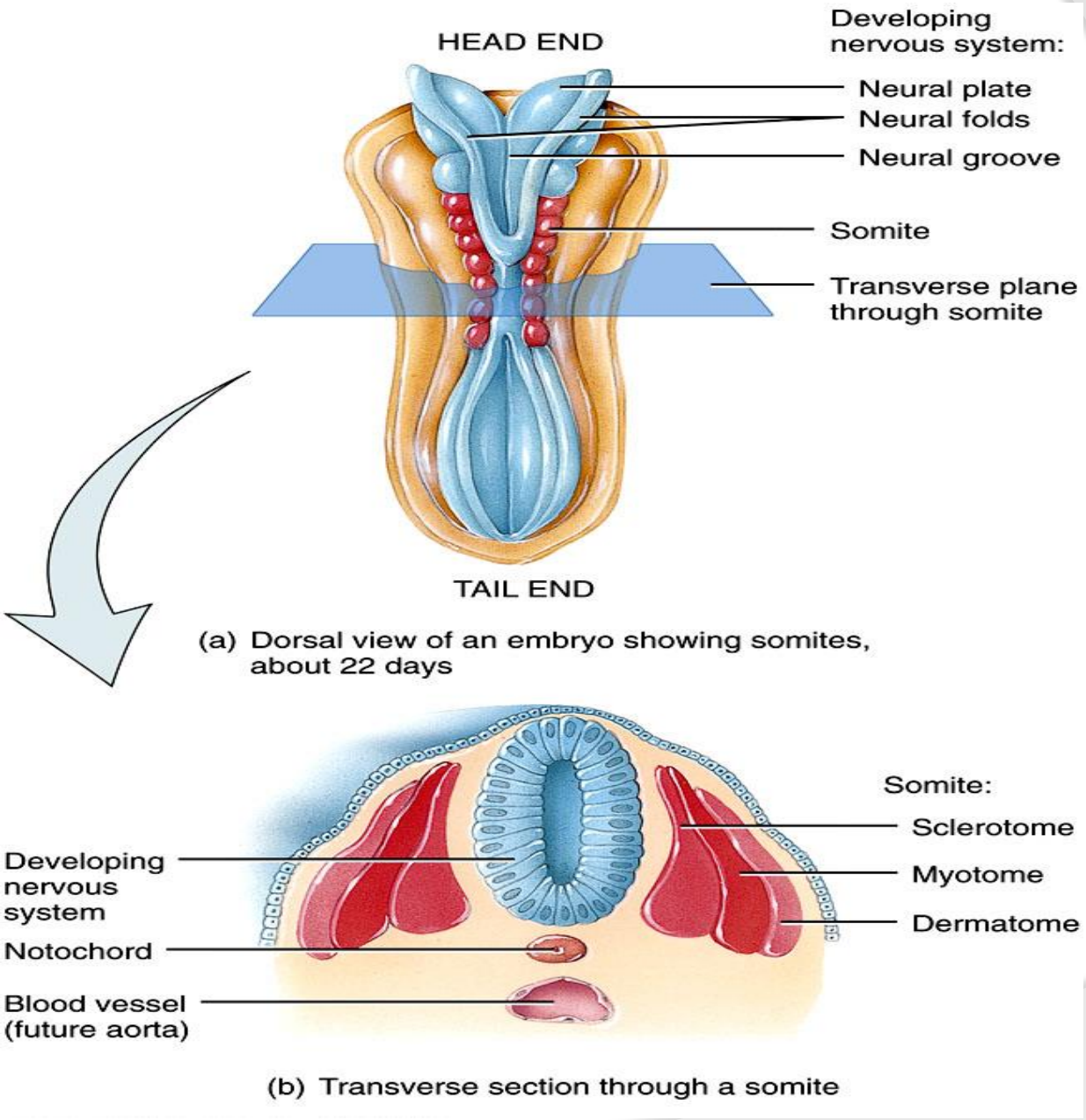




(a) Dorsal view



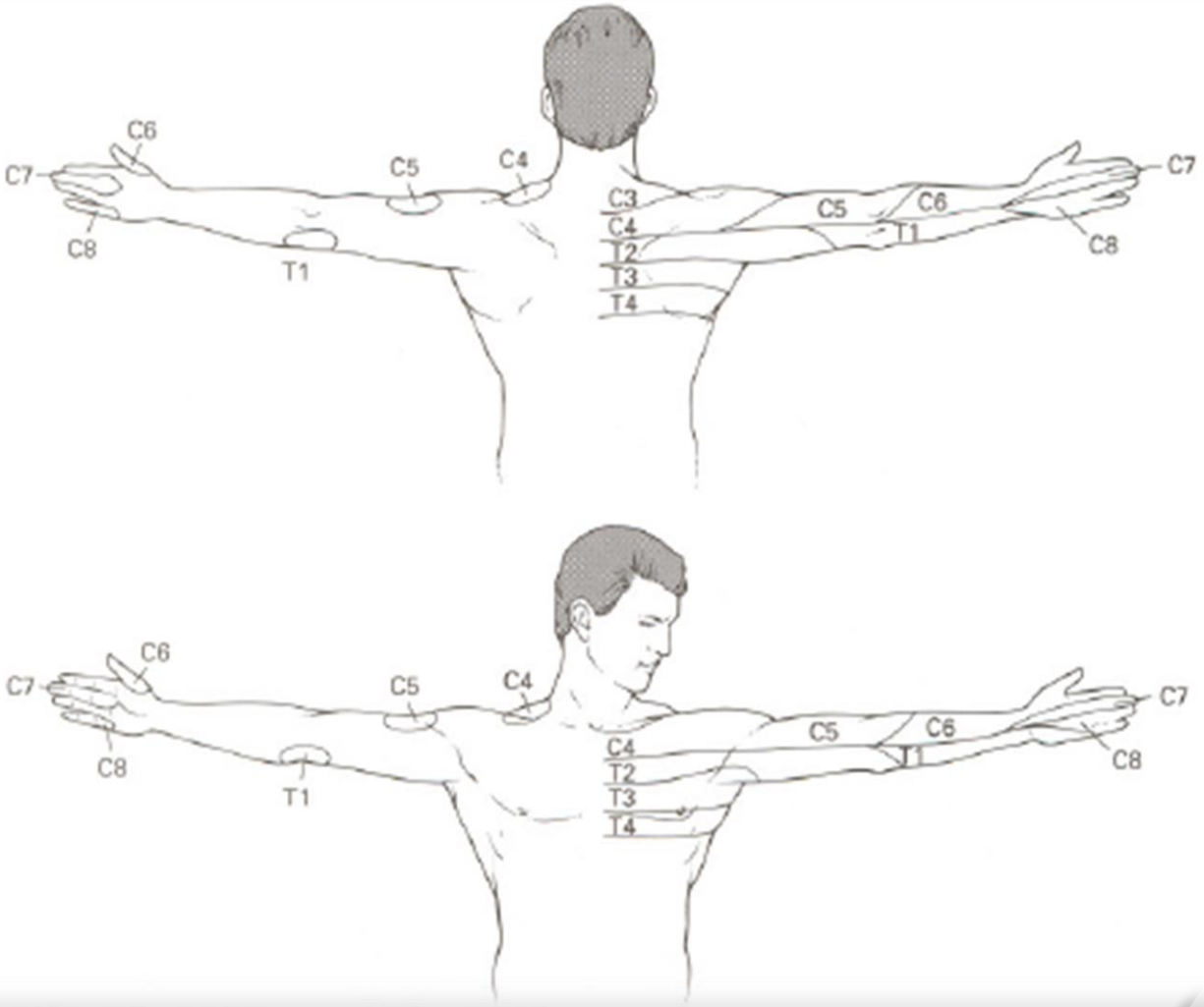
(b) Transverse sections


HEAD END
Developing nervous system:
Neural plate
Neural folds
Neural groove
Somite
Transverse plane through somite
TAIL END
(a) Dorsal view of an embryo showing somites, about 22 days
Somite:
Sclerotome
Myotome
Dermatome
Developing nervous system
Notochord
Blood vessel (future aorta)
(b) Transverse section through a somite

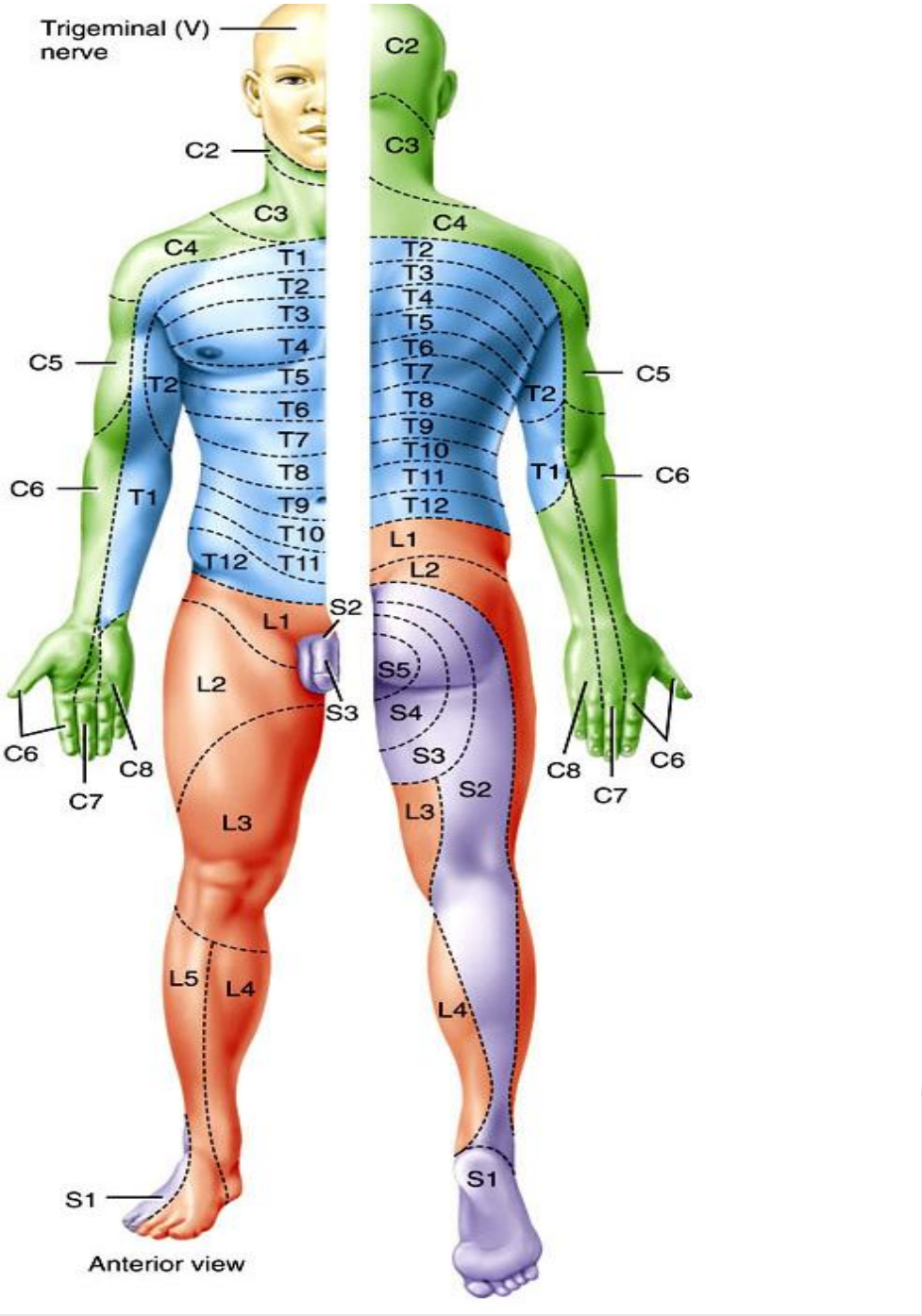
DERMATOMES

- A “**dermatome**” is an area of skin that is supplied by a single spinal nerve. There are eight cervical nerves, twelve thoracic nerves, five lumbar nerves and five sacral nerves. Each of these nerves relays sensation (including pain) from a particular region of skin to the brain.

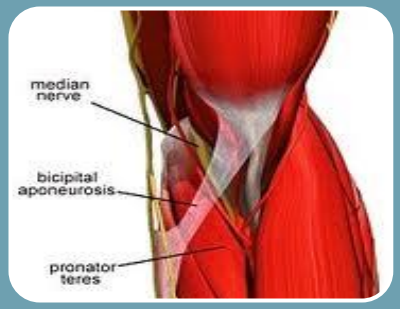
UPPER EXTREMITY DERMATOMES (P. 377)



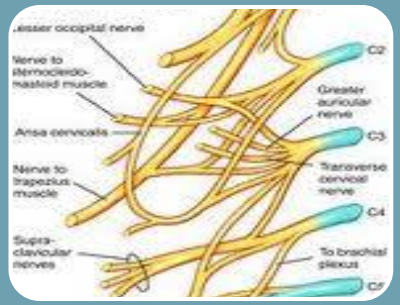
LOWER EXTREMITY DERMATOMES (P. 377)


Trigeminal (V) nerve
C2
C3
C4
C5
C6
C7
C8
T1
T2
T3
T4
T5
T6
T7
T8
T9
T10
T11
T12
L1
L2
L3
L4
L5
S1
S2
S3
S4
S5
Anterior view

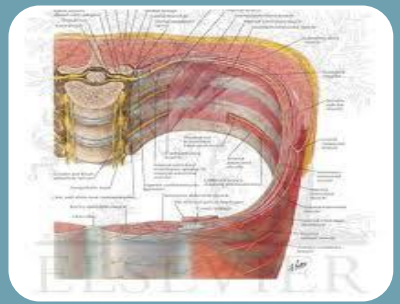
MYOTOMES



M**yotome -** In vertebrate embryonic development, a **myotome** is a group of tissues formed from somites that develop into the body wall muscle. We use the term "myotome" to describe all the muscles served by a single spinal nerve root. It is the motor equivalent of a dermatome.



Law of Original Innervation: Wherever a somite derivative (dermatome/myotome/sclerotome) migrates it retains its original somite nerve (For example, the myotomes of cervical somites 3, 4, and 5 migrate and combine to form the *diaphragm – they migrate to the level of T12 and drag their somite nerves, united as the phrenic nerves along with them)* Even when a muscle or bone receives contributions from several somites, each spinal nerve continues to innervate only the tissue that derived directly from its original somite.



Because of a lack of limbs, the thoracoabdominal wall retains all the nerves, muscles, ribs, and intercostal vessels in their primordial somite sequences without migrating.

SPINAL NERVE ROOTS

So we test the dermatomes with our sensory examination. We test the myotomes with our motor examination.

Dermatomes transmit impulses to the spinal cord via the sensory neurons. Myotomes receive impulses from the spinal cord via motor neurons. Sensory and motor neurons travel in the same spinal nerve root.

SPINAL NERVE ROOTS

AMA Guides (page 480):

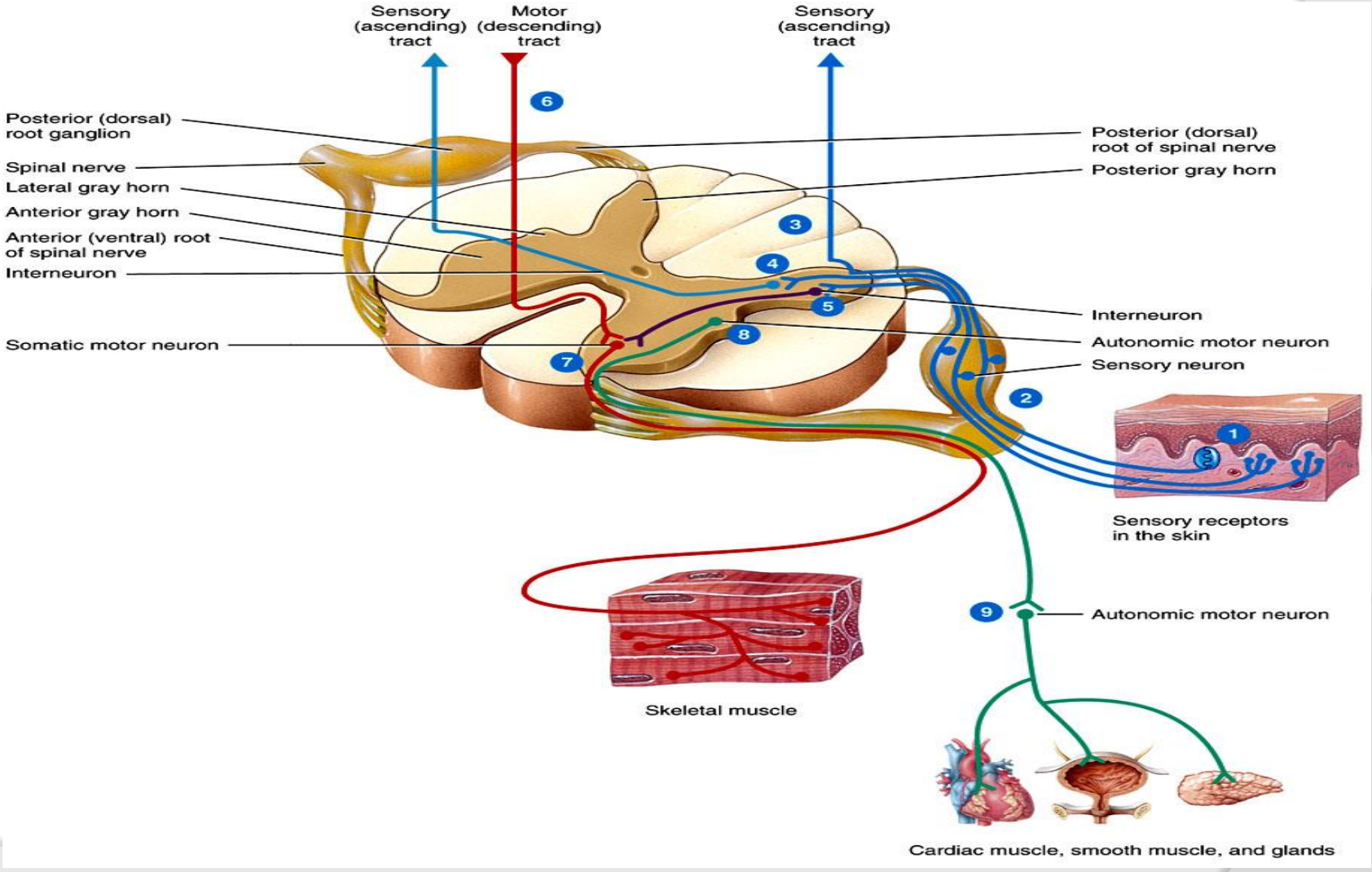
- The spinal nerves (31 pairs) contain 3 main groups of fibers:
  - Sensory (afferent) fibers that carry to the CNS impulses arising from various receptors in the skin, muscles, tendons, ligaments, bones (periosteum/mineralized bone/bone marrow), and joints (mechanoreceptors). (Afferent fibers from the dermatome, myotome, and sclerotome with all cell bodies located in the dorsal root ganglion). GSA = general somatic afferent.

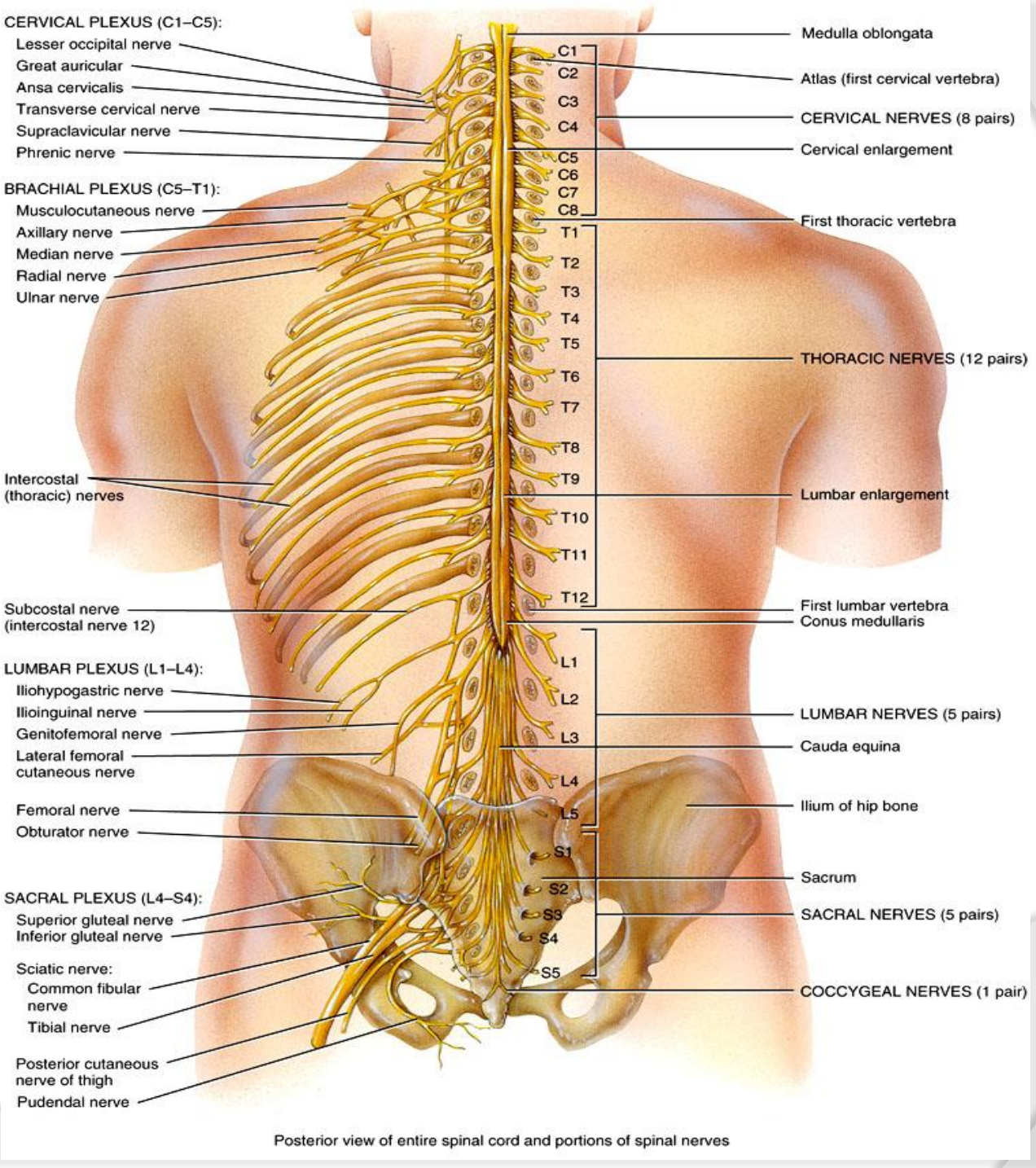
SPINAL NERVE ROOTS

AMA Guides (page 480):

- The spinal nerves (31 pairs) contain 3 main groups of fibers:
  - Motor (efferent) fibers, which include large *alpha* motor neuron fibers conducting impulses from the spinal cord to skeletal muscles fibers, and smaller *gamma* motor neuron fibers carrying impulses to muscle spindles for feedback control and,
  - Autonomic system fibers, which are efferent and are concerned with the control of smooth muscles and glands. (Not mentioned are that there are autonomic sensory fibers from the viscera – GVE = general visceral efferent – either sympathetic or parasympathetic).

Spinal Nerve Root

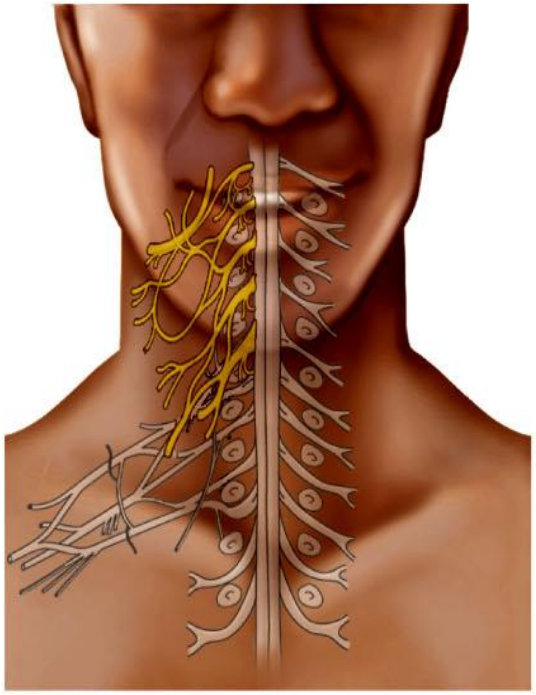


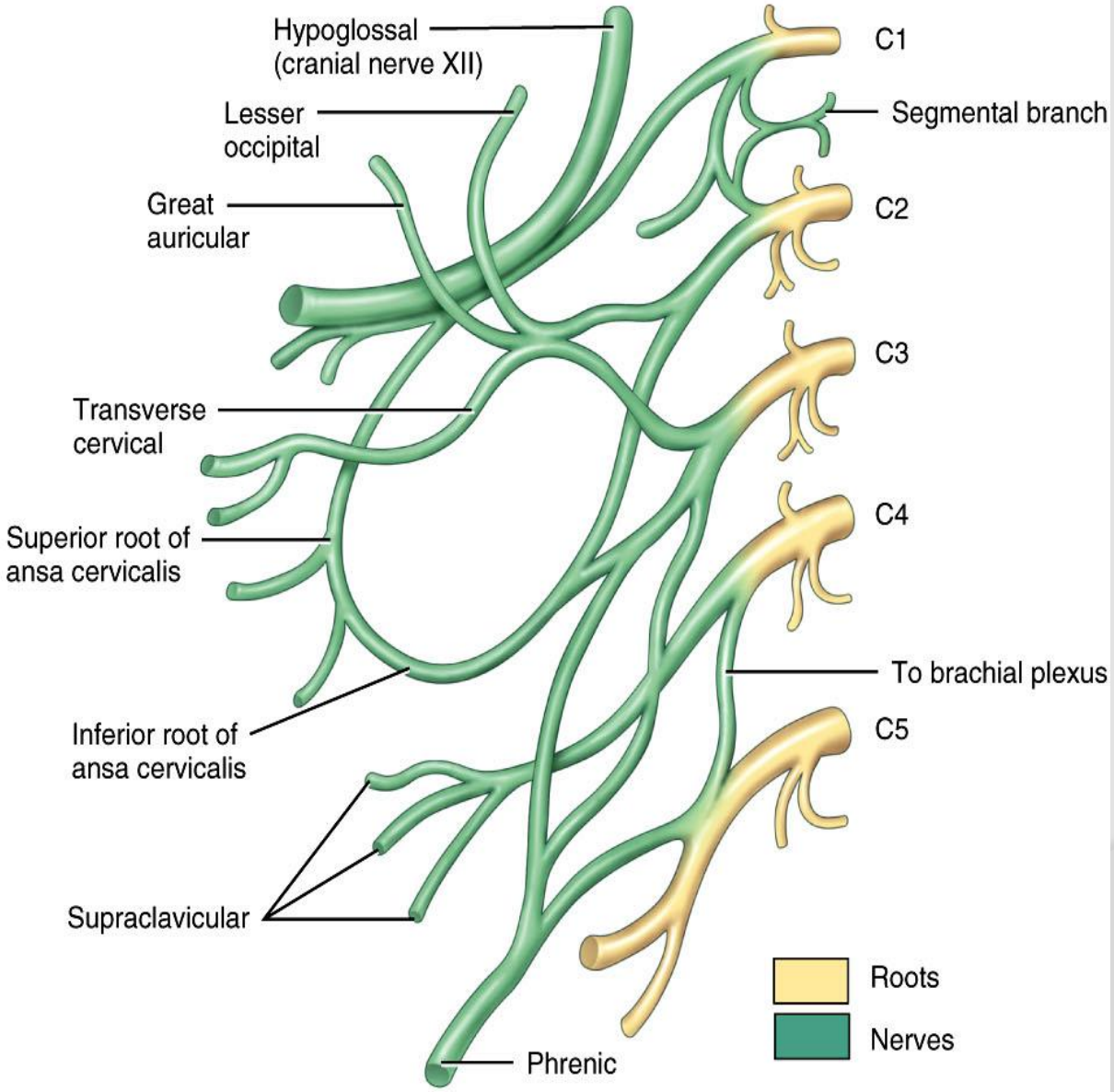


Posterior view of entire spinal cord and portions of spinal nerves

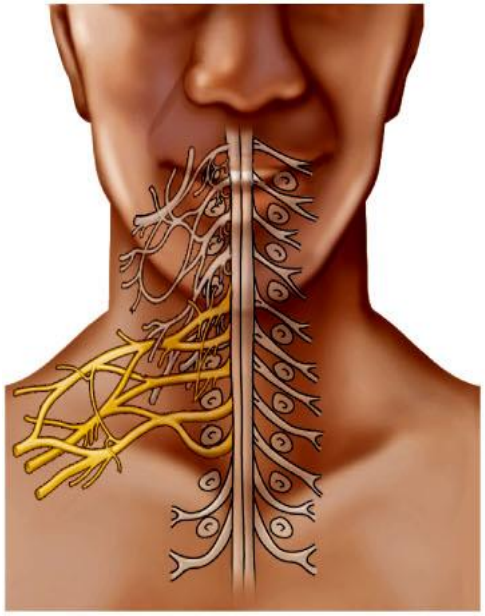
SPINAL NERVE ROOTS

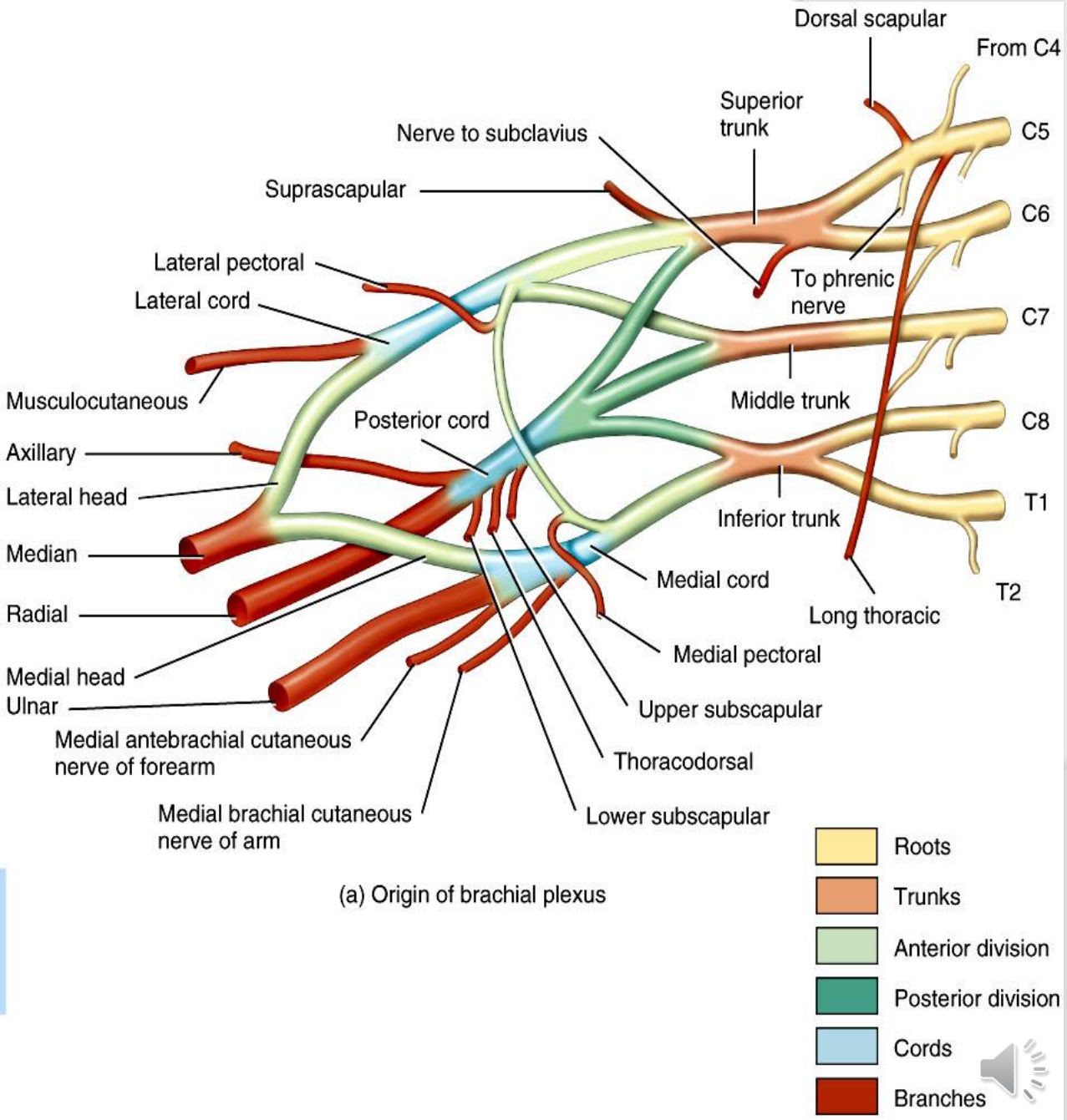
- Spinal Nerve Roots coalesce into the named Peripheral nerves of the Upper Extremities through either 1) the cervical plexus (C1-C5 plus a branch from CrN XII, or 2) the brachial plexus (C4/C5 – T1/T2). All of these nerve roots are mixed in that they carry all 3 (or even 4) types of fibers (Somatic – sensory/motor, Autonomic – sensory/motor)





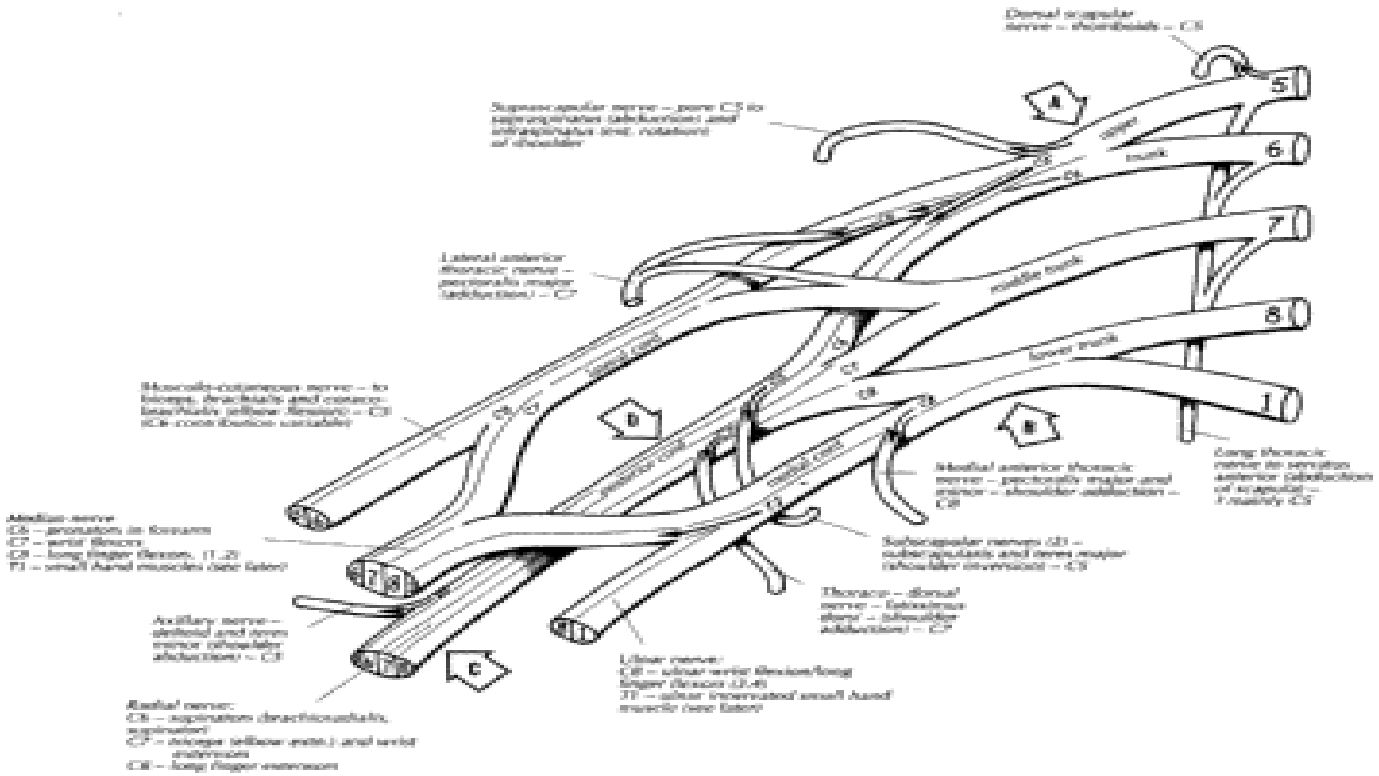
Origin of cervical plexus





(a) Origin of brachial plexus

MNEMONIC for subunits of the brachial plexus:
Risk **T**akers **D**on't **C**autiously **B**ehave.
Roots, **T**runks, **D**ivisions, **C**ords, **B**ranches



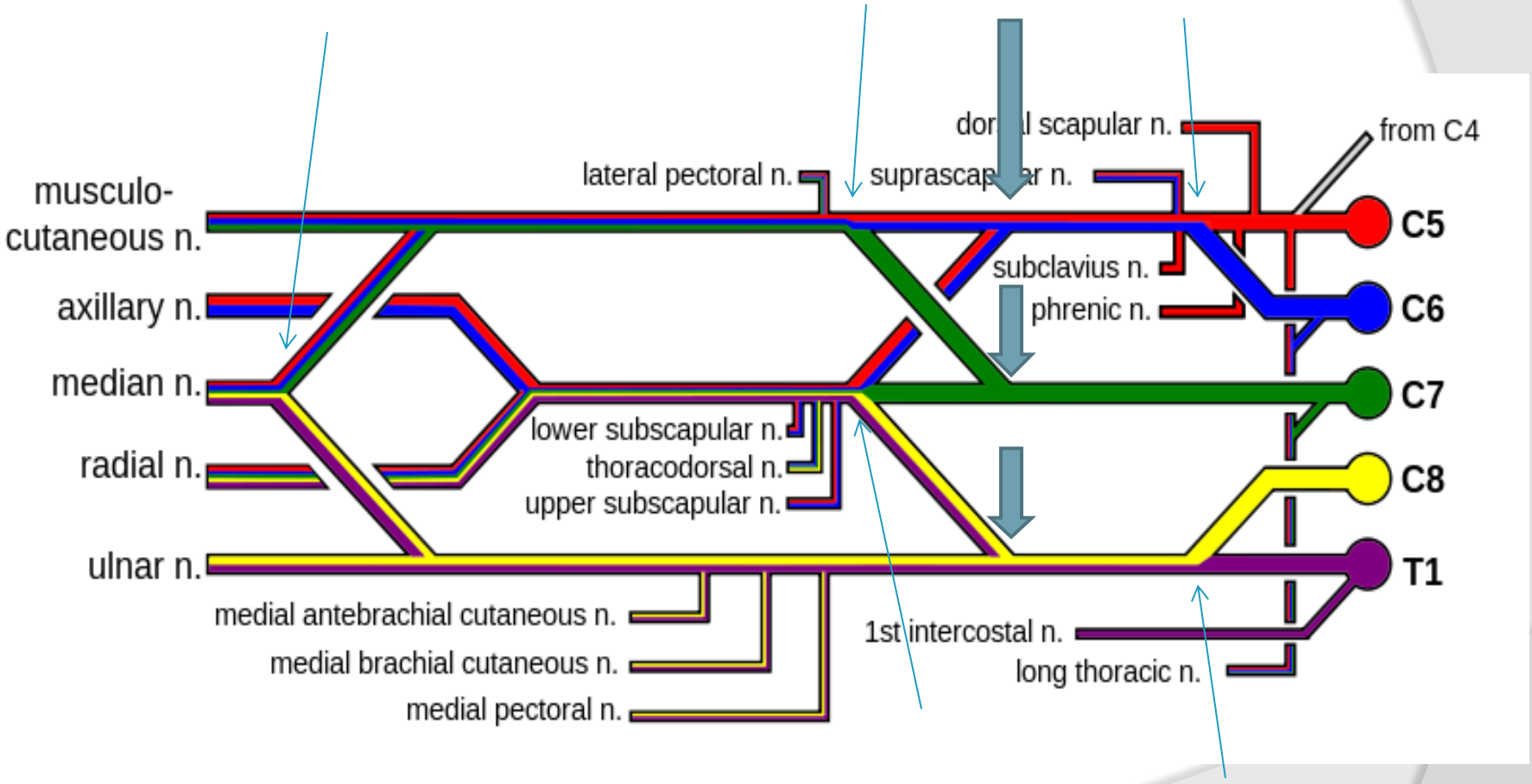
16.10 Anatomy of the brachial plexus, showing the eventual destinations of all root components.

the shoulder, elbow flexion and radial wrist extension owing to weakness in the extensor carpi radialis longus and brevis. The biceps and supinator jerks are absent. Note that as the lesion is distal to the roots it will spare the rhomboid muscles, which are supplied by a branch from the C5 root, and the serratus magnus, which is supplied by branches also arising from the C5, C6 and C7 roots via the long thoracic nerve.

Lesions of the Lower Trunk (B)

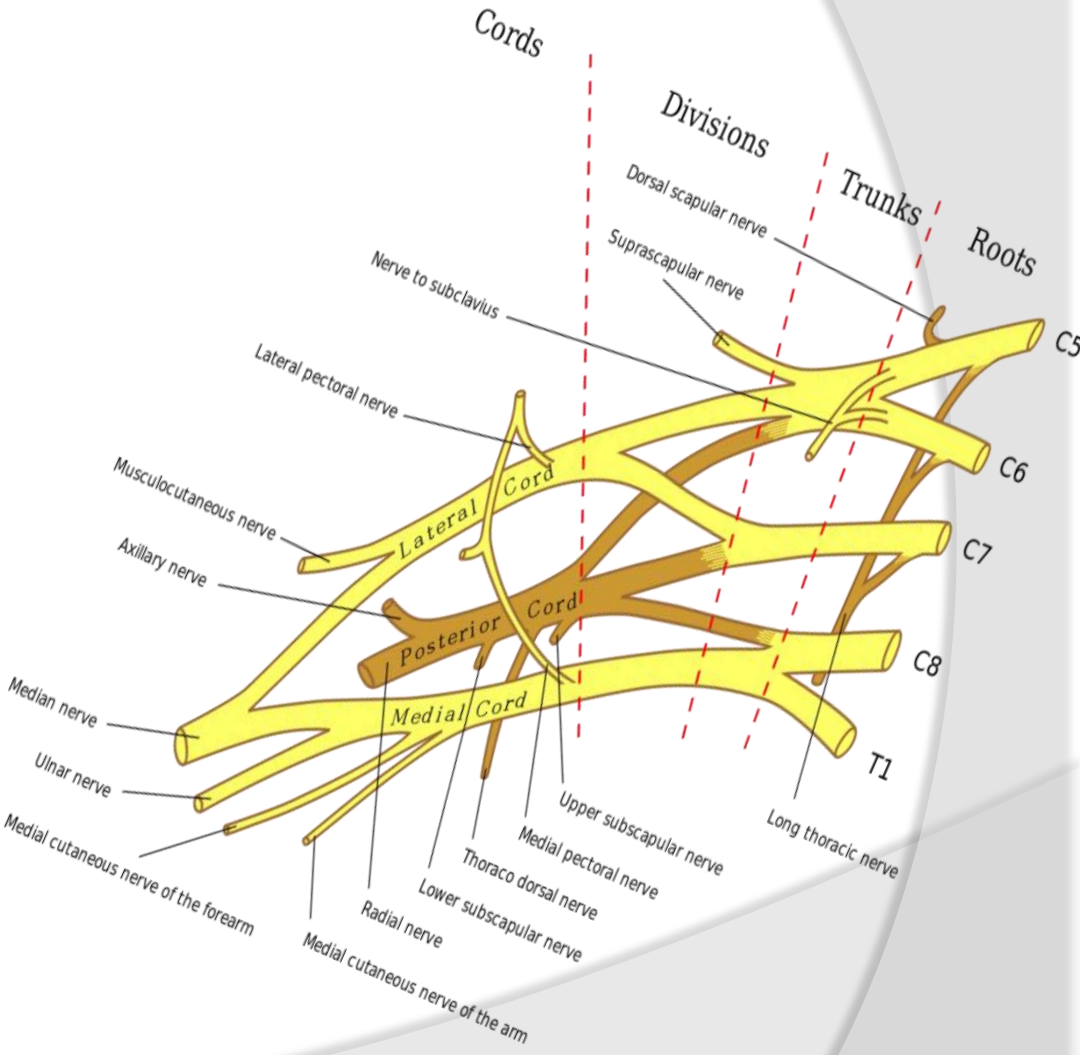
Damage to this area has already been described to some extent in connection with cervical rib syndrome. This is also the area of the plexus that can be damaged by carcinoma of the lung apex extending through the apical pleura (Pancoast's syndrome) and metastatic disease in the axillary glands, from malignant disease in the breast or elsewhere. The clinical picture consists of severe pain in the shoulder, which is particularly severe when lying in bed at night and which may drive the patient to sleep sitting up. This will be accompanied by tingling and numbness down the medial arm and forearm into the little and ring fingers. Weakness of the finger flexors and extensors and the intrinsic muscles of the hand follows.

“MIXING” OF NERVE ROOTS



BRACHIAL PLEXUS

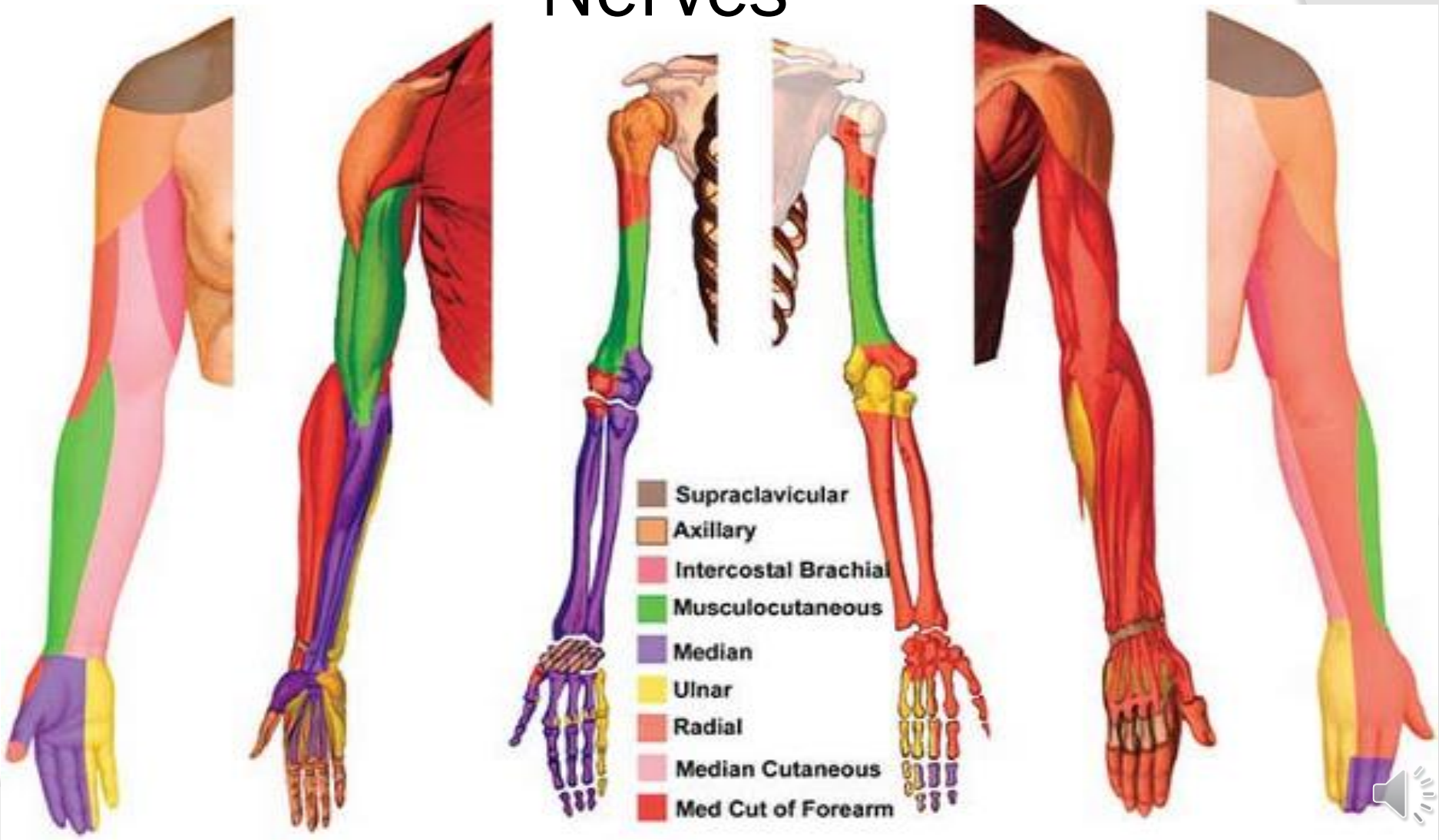
- The *posterior cord* is formed from the three posterior divisions of the trunks (C5-C8,T1)
- The *lateral cord* is the anterior divisions from the upper and middle trunks (C5-C7)
- The *medial cord* is simply a continuation of the anterior division of the lower trunk (C8,T1)

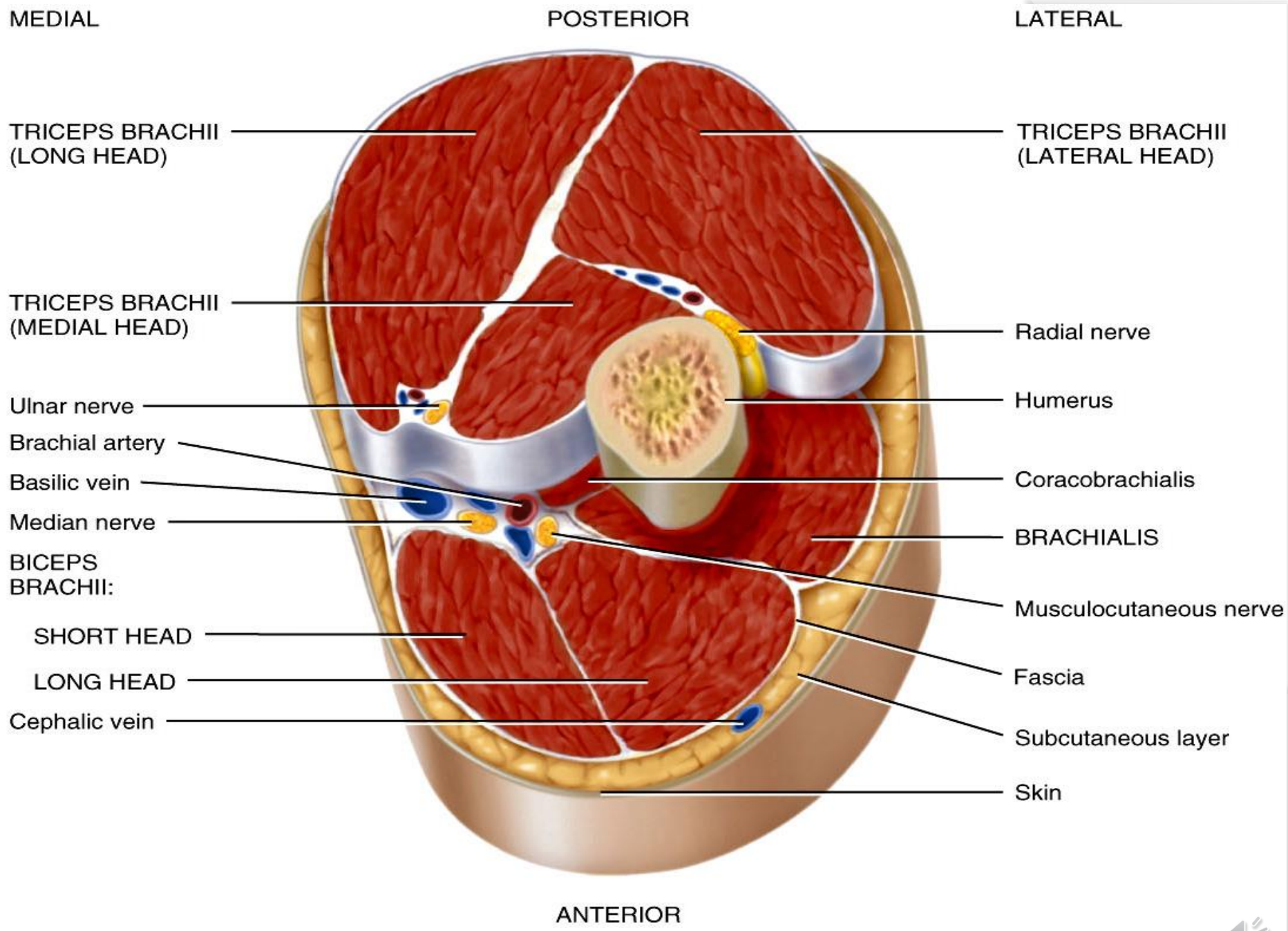


ENTRAPMENT NEUROPATHIES

- Most Common Nerves Affected:
  - Median Nerve – C6-T1
  - Radial Nerve – C5-C8
  - Ulnar Nerve – C8-T1

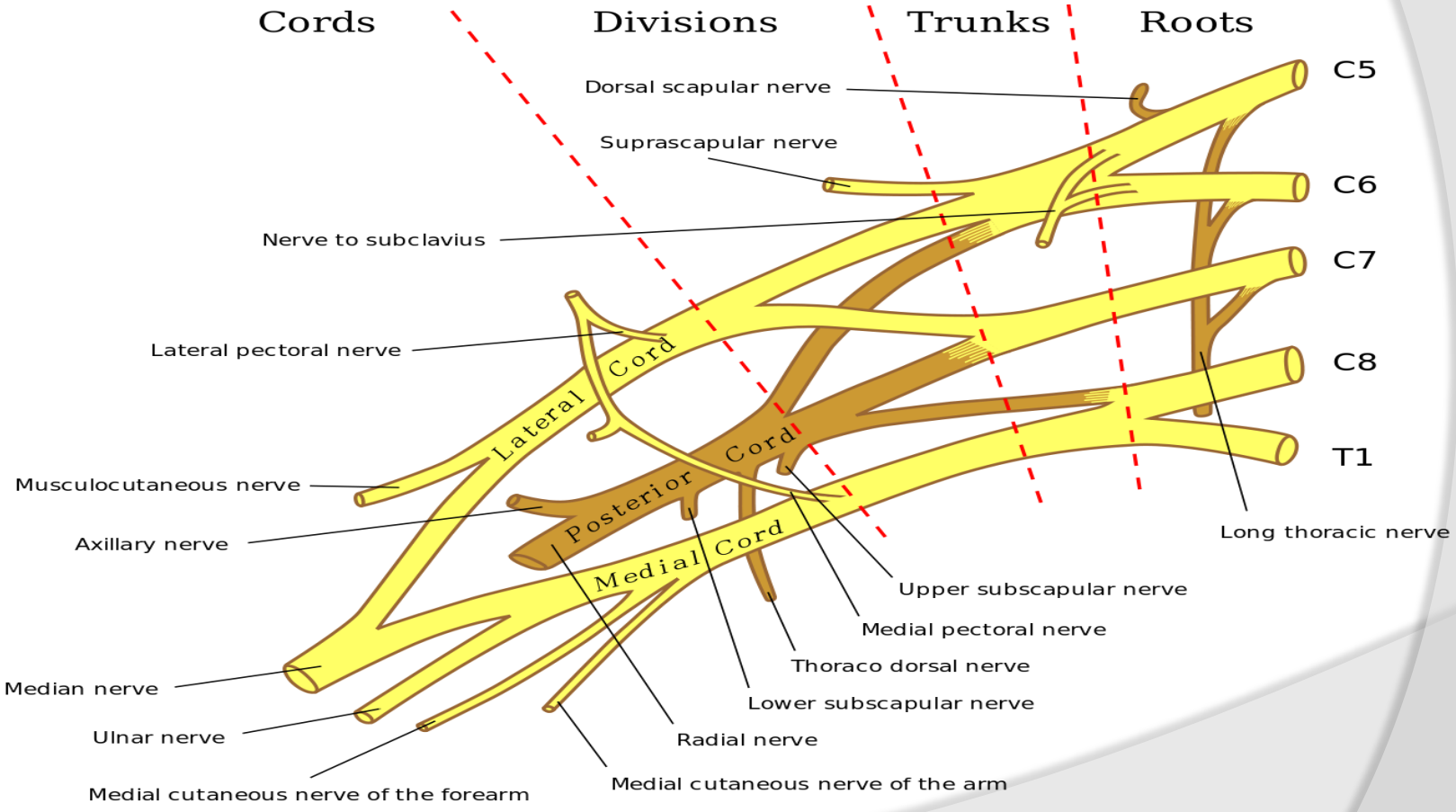
Skin, Muscle, Bone & Joint Innervations of the Peripheral Nerves

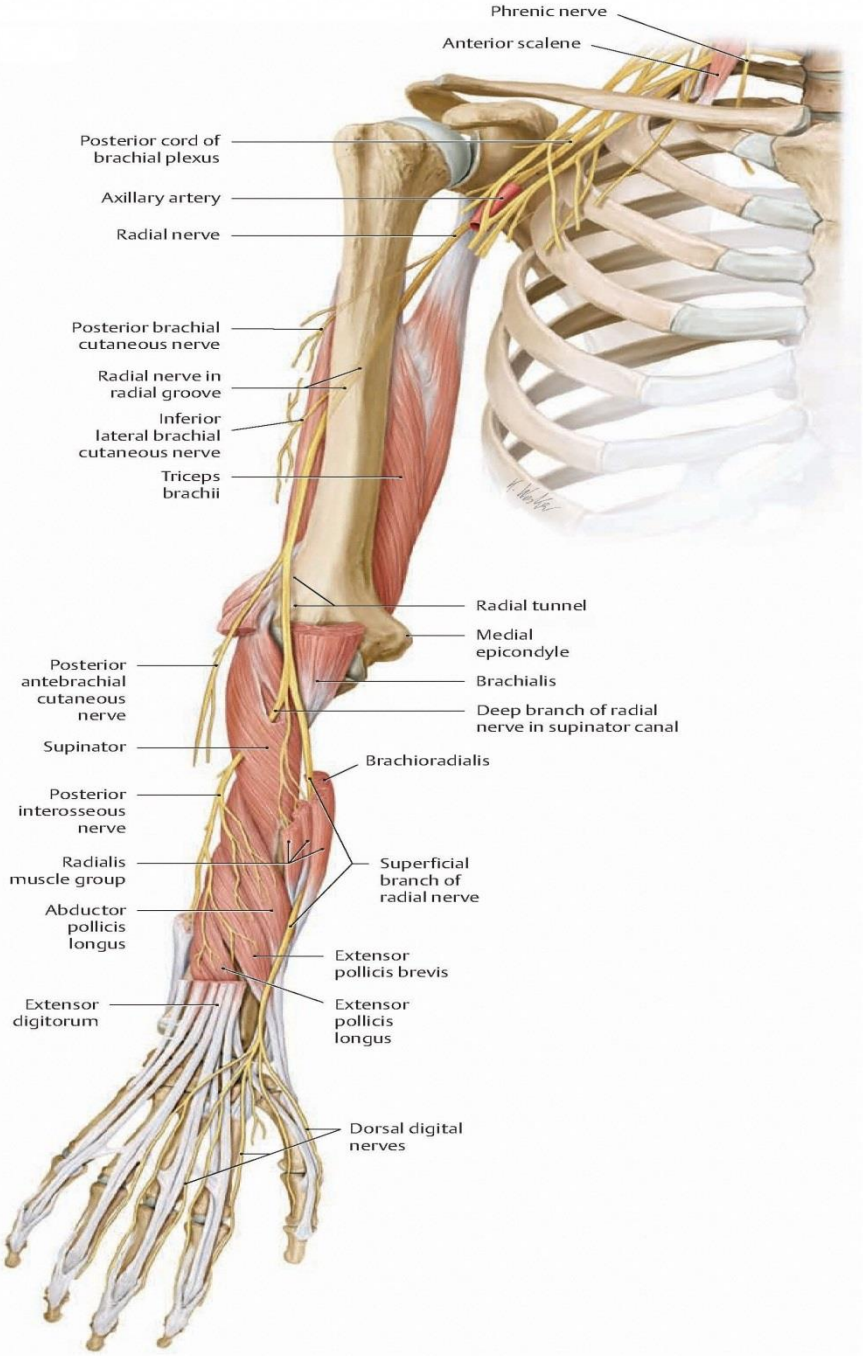




(c) Superior view of transverse section of arm

RADIAL NERVE




Phrenic nerve
Anterior scalene
Posterior cord of brachial plexus
Axillary artery
Radial nerve
Posterior brachial cutaneous nerve
Radial nerve in radial groove
Inferior lateral brachial cutaneous nerve
Triceps brachii
Radial tunnel
Medial epicondyle
Posterior antebrachial cutaneous nerve
Brachialis
Deep branch of radial nerve in supinator canal
Supinator
Brachioradialis
Posterior interosseous nerve
Radialis muscle group
Superficial branch of radial nerve
Abductor pollicis longus
Extensor pollicis brevis
Extensor digitorum
Extensor pollicis longus
Dorsal digital nerves

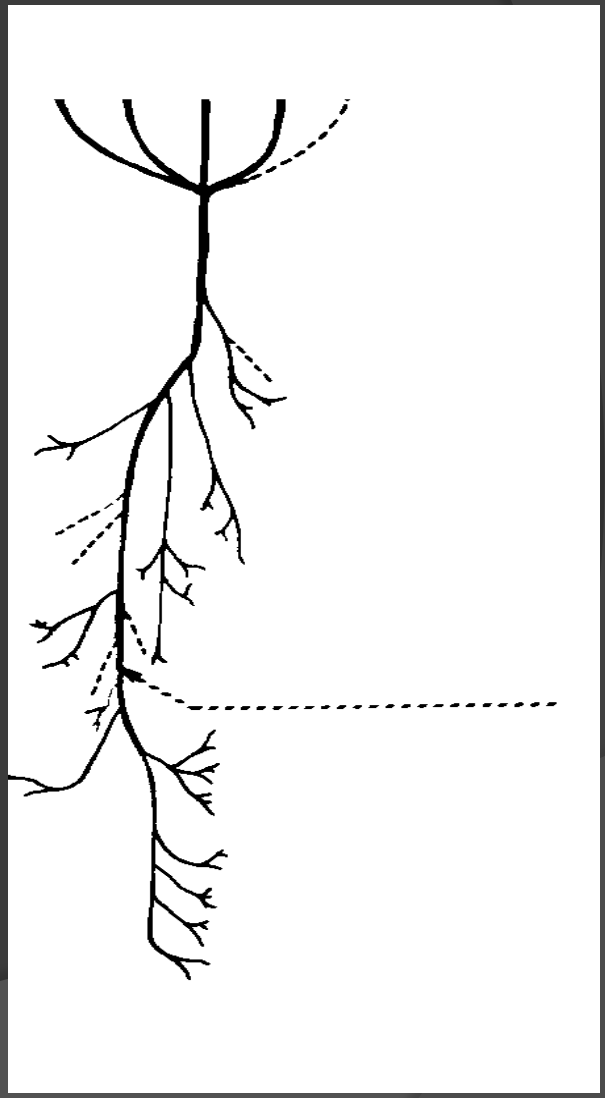
Peripheral Nerve	Associated Nerve Roots	Muscles Supplied	Muscle Action
Radial Nerve	C5	Brachioradialis	Forearm flexion with wrist in neutral position
	C6	Supinator Brachioradialis	Forearm supination Forearm flexion with wrist in neutral position
	C7	Triceps Extensor carpi radialis longus Extensor carpi ulnaris	Elbow extension Wrist extension Wrist extension
	C8	Extensor Digitorum Extensor Indicis Extensor Pollicis (longus & brevis)	Extension of all fingers

Peripheral Nerve	Motor Branch	Muscle
Radial Nerve (above elbow) (C5-C8)	Branch to Brachioradialis (C6)	Brachioradialis – elbow flexion from the mid pronated position
	Branch to Anconeus	Anconeus – elbow extension
	Branch to Extensor Carpi Radialis Longus (C7)	ECRL – Radial wrist extension
Below elbow – Posterior Interosseous NN. (Deep Branch of Radial)	ECRB EDC EDM ECU APL EPL EPB EIP	Wrist/Finger/Thumb extension

Peripheral Nerve	Branch	Skin Supplied
Radial Nerve – below elbow Above wrist	Superficial Radial NN. – Dorsal Sensory Branches	Central proximal surface of palm
Below wrist	Branches to 1st (dorsal) web space)	Sensory to 1st web space, and dorsal surfaces of thumb (both sides) and index (radial side)
	Branches to 2nd (dorsal) web space	Sensory to 2nd web space dorsal surfaces of ulnar index and radial middle fingers
	Branches to 3rd (dorsal) web space	Sensory to 3rd web space dorsal surfaces of ulnar middle and radial ring fingers

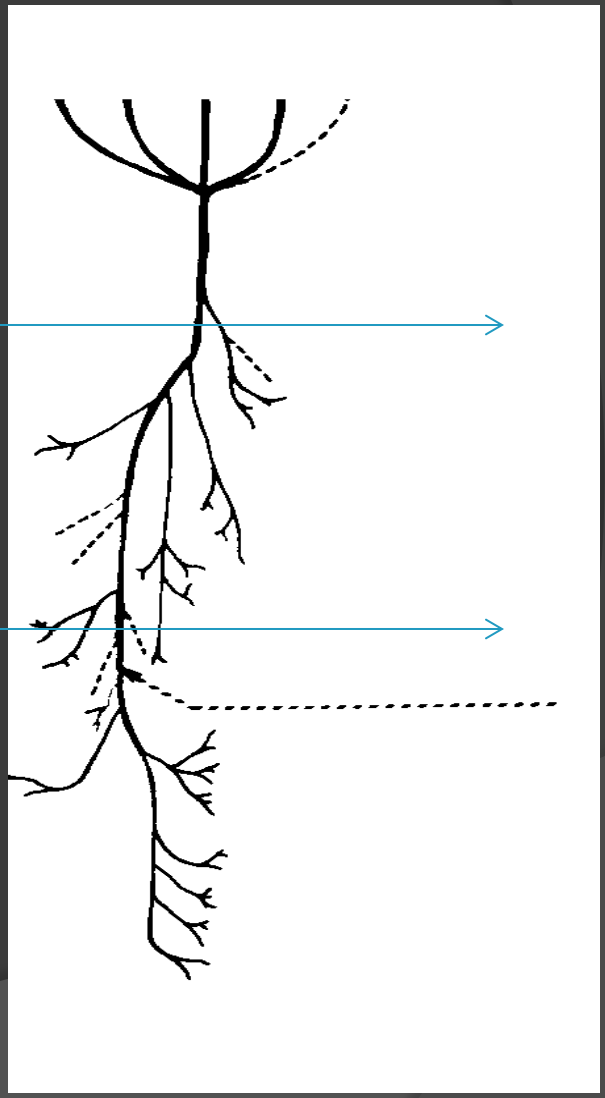
RADIAL NERVE

- ANATOMIC COURSE (AMA GUIDES pg. 487
- Above Elbow:
  - Branches to (3 heads) of Triceps
  - Branches to brachioradialis
  - Branches to ECRL
  - Branch to anconeus



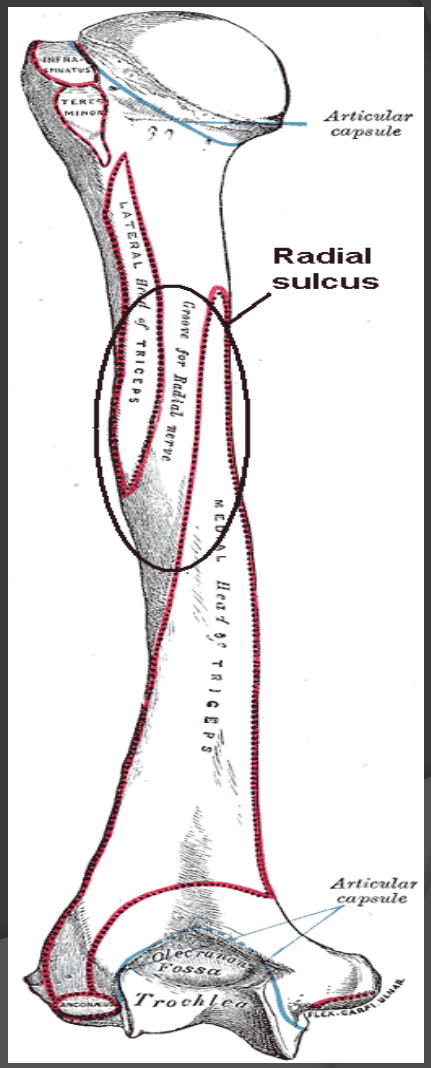
RADIAL NERVE

- ANATOMIC COURSE (AMA GUIDES pg. 487
- Below Elbow as the Posterior Interosseous nerve:
  - ECRB
  - Supinator
  - EDM/EDC/EDU
  - APL
  - EPB
  - EPL



RADIAL NERVE COMPRESSION/IRRITATION

- Above Elbow:
- Axilla: Crutch Palsy – patient takes their whole weight in the axilla.
- High Medial Aspect of Arm: “Saturday Night Palsy”
- Fractures of Mid-Shaft of humerus – (spares triceps)
- Spiral Groove of humerus (a.k.a radial groove) – direct blow or fracture

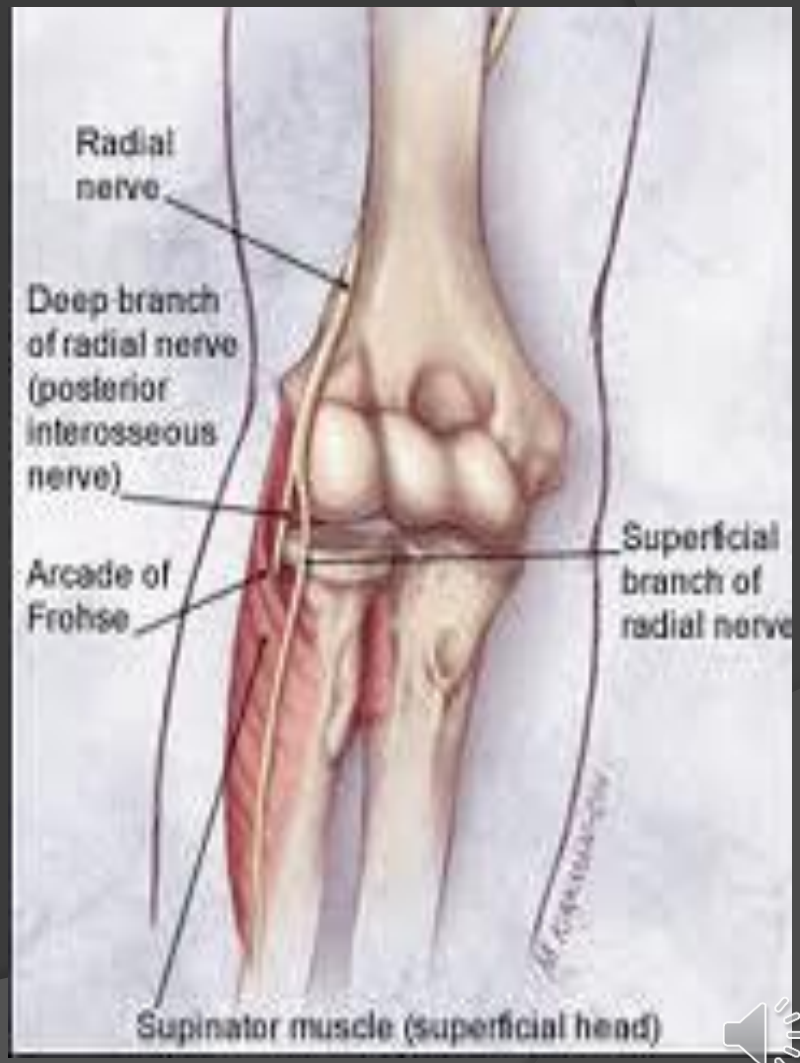


RADIAL NERVE COMPRESSION/IRRITATION

- Below Elbow:
- 4 Potential Locations of Entrapment -
  - Arcade of Frohse:
  - Fibrous bands anterior to radial head:
  - Fan shaped arcade of vessels (Radial Recurrent artery)
  - Tendinous edge of the ECRL

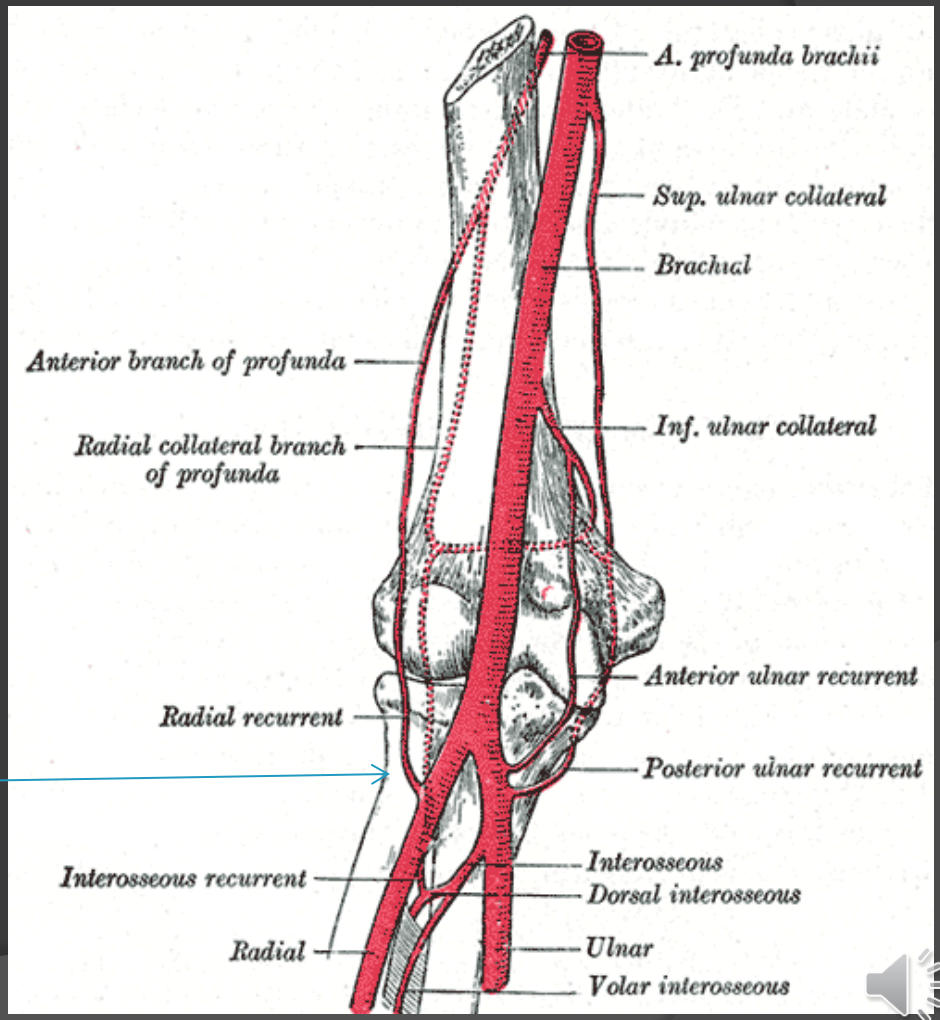
RADIAL NERVE COMPRESSION/IRRITATION

1. Arcade of Frohse: Fibrous arch over the posterior interossesous nerve at the superior border of the supinator muscle – unaccustomed heavy use of a screwdriver or other twisting movements of forearm



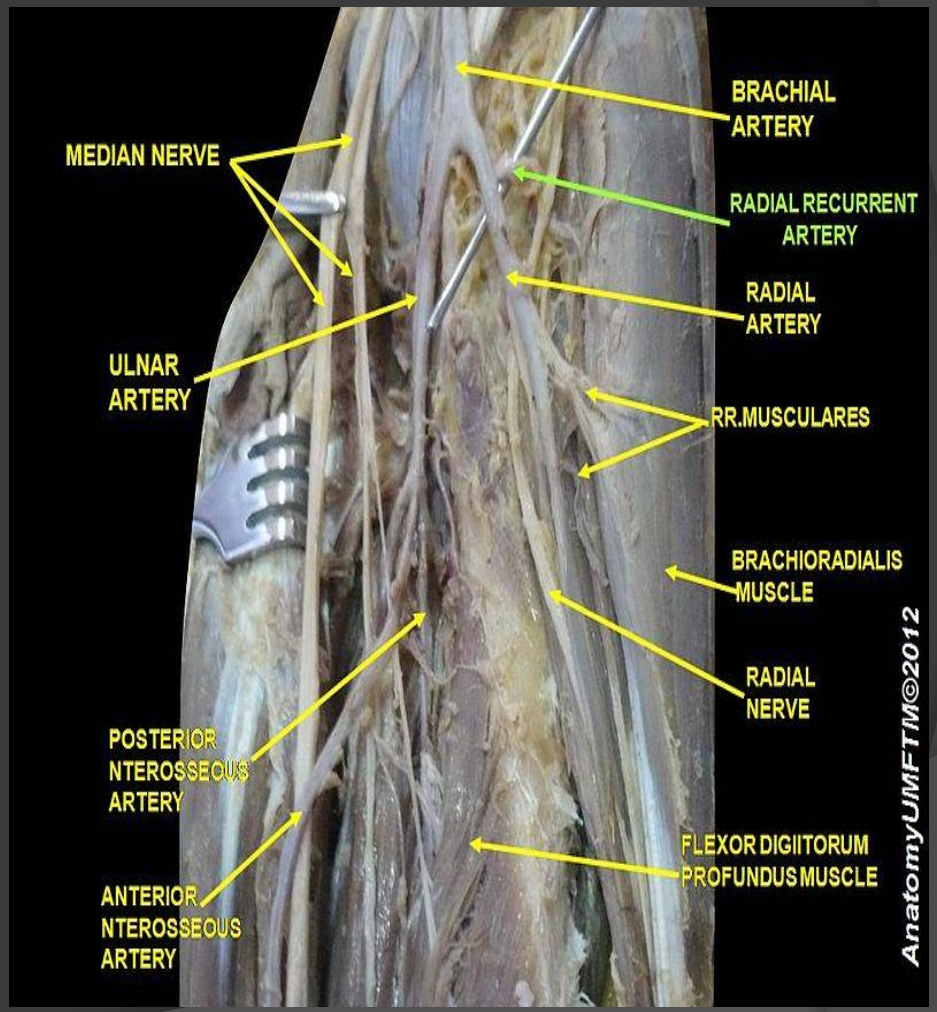
RADIAL NERVE COMPRESSION/IRRITATION

- Elbow:
  2. Fibrous bands anterior to radial head:
  3. Fan shaped arcade of vessels (Radial Recurrent artery) anterior to radial head (radial nerve passes over RRA but under radial artery



RADIAL NERVE COMPRESSION/IRRITATION

- Elbow:
  3. Fan shaped arcade of vessels (Radial Recurrent artery) anterior to radial head (radial nerve passes over RRA but under radial artery
  4. Tendinous edge of the ECRL/ECRB

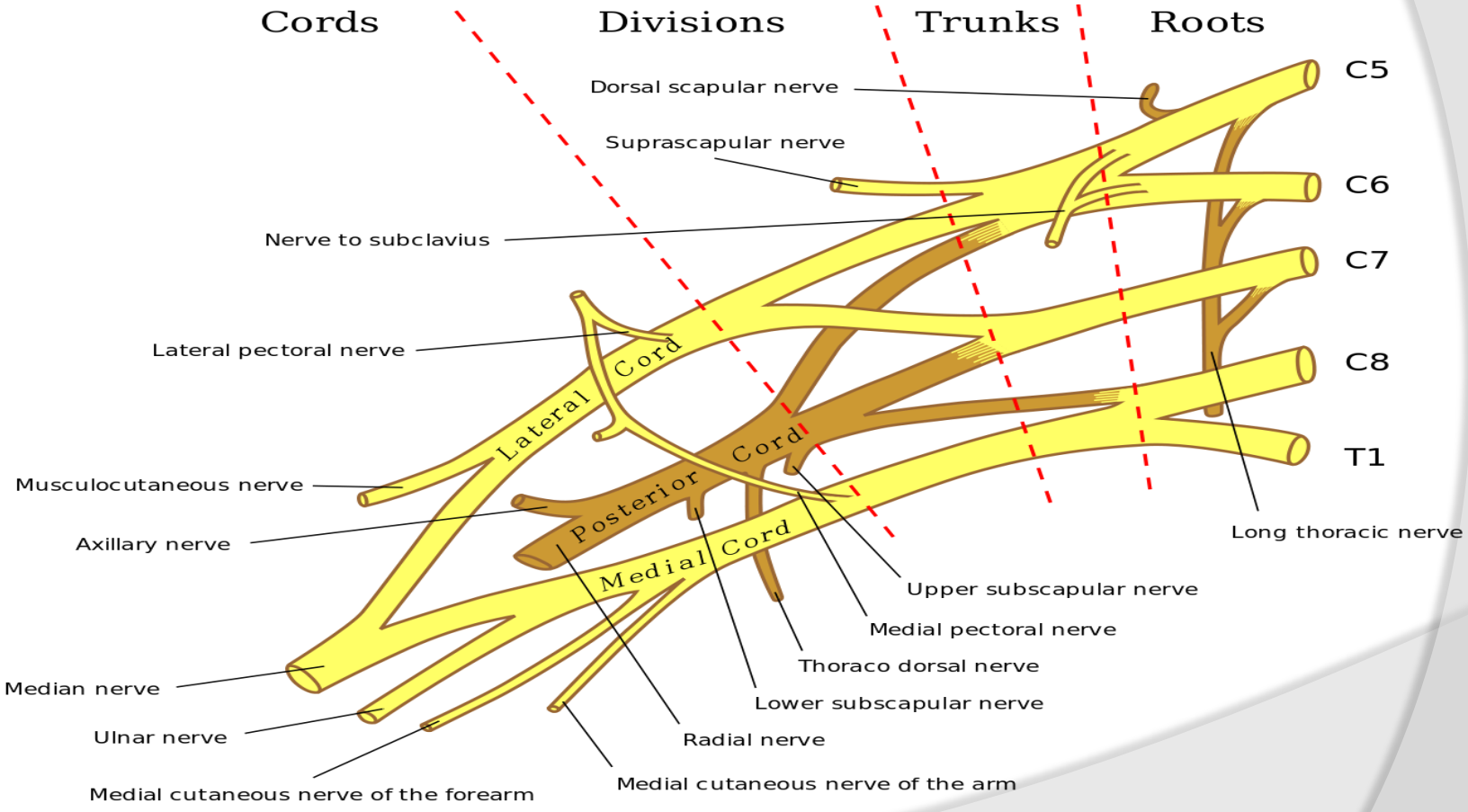


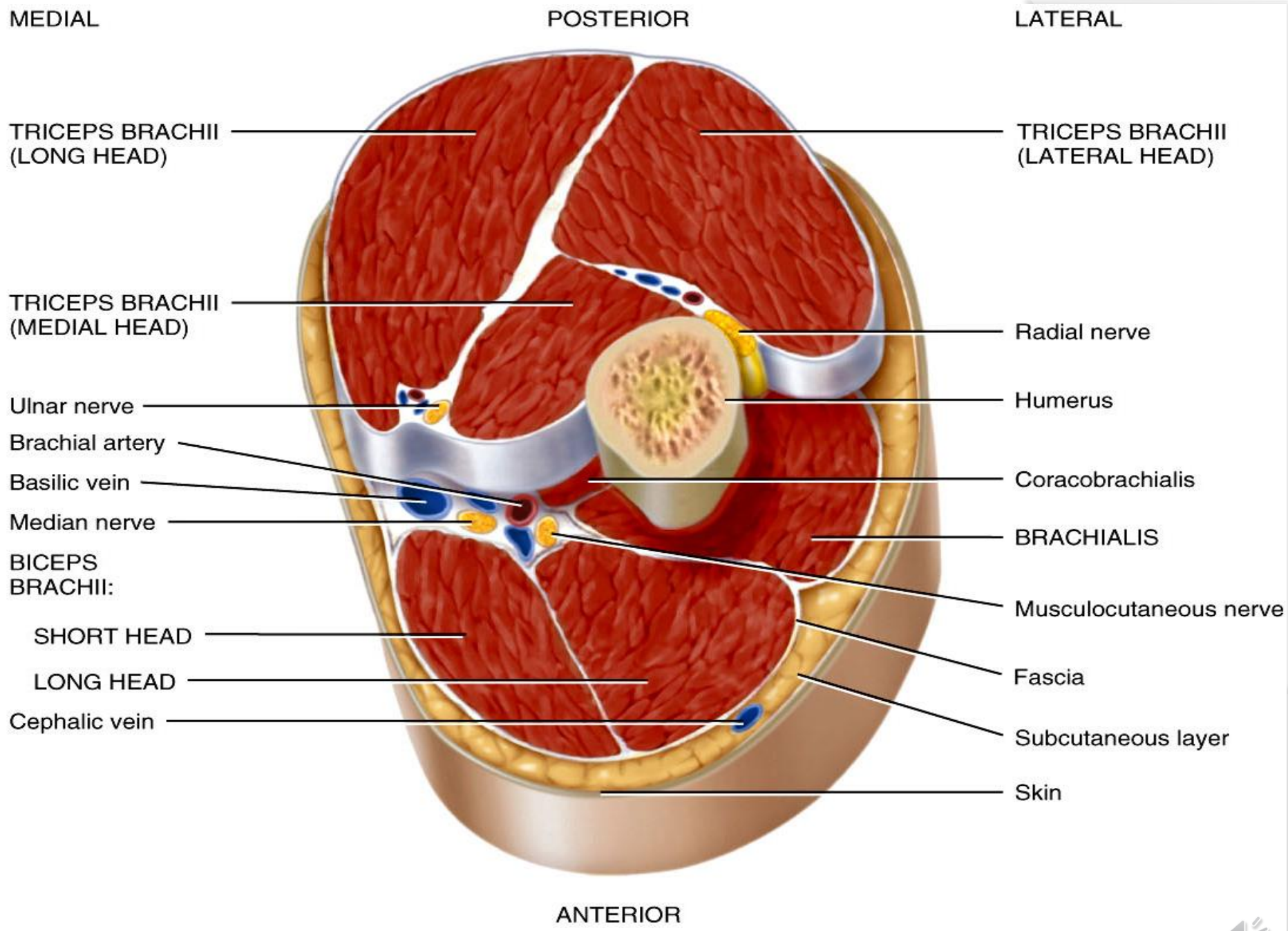
RADIAL NERVE ENTRAPMENT SYNDROME

- Deficit of Functions of Radial Nerve
  - Motor:
    - Weakness of 1) elbow extension, 2) wrist extension (radial and ulnar extension), 3) flexion of semipronated forearm, 4) supination, 5), finger (proximal phalanges) extension (especially index and thumb)
    - For each of the above, where would the lesion be located?
  - Sensory:
    - Pain/Burning along anterolateral arm, lateral aspect of forearm, aching/tingling/numbness, sensory loss (rare) over the dorsum of the 1st web space.
  - Autonomic:
    - Unknown (Although probably gives articular branches to posterior aspect of the elbow – by Hilton's Law

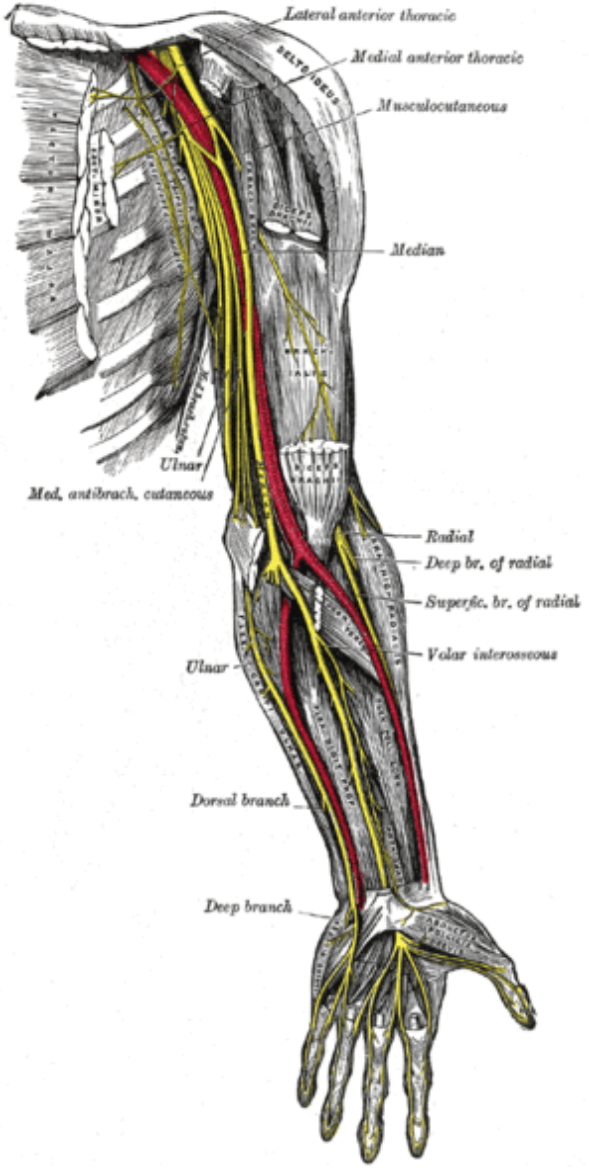
Location of Entrapment	Physical Exam Finding	Explanation
Axilla/Medial arm/Mid shaft of humerus	Paralysis of all extensors of the wrist and digits, as well as the forearm supinators. Very proximal lesions also may affect the triceps. Numbness occurs on the dorsoradial aspect of the hand and the dorsal aspect of the radial 3 ½ digits – especially over the 1st web space.	High lesions affect the nerve prior to its bifurcation into motor (posterior interosseous) and sensory (superficial radial) nerves and so will cause both motor and sensory findings
Radial Tunnel	Pain over the anterolateral proximal forearm in the region of the radial neck. The maximum tenderness is located 4 fingerbreadths distal to the lateral epicondyle, as compared with lateral epicondylitis, in which maximum tenderness is usually directly over the epicondyle. Symptoms are intensified by extending the elbow and pronating the forearm. In addition, resisted active supination and extension of the long finger cause pain. Weakness	

ULNAR NERVE


Cords
Divisions
Trunks
Roots
C5
C6
C7
C8
T1
Dorsal scapular nerve
Suprascapular nerve
Nerve to subclavius
Lateral pectoral nerve
Lateral Cord
Posterior Cord
Medial Cord
Musculocutaneous nerve
Axillary nerve
Median nerve
Ulnar nerve
Medial cutaneous nerve of the forearm
Long thoracic nerve
Upper subscapular nerve
Medial pectoral nerve
Thoraco dorsal nerve
Lower subscapular nerve
Radial nerve
Medial cutaneous nerve of the arm



(c) Superior view of transverse section of arm


Lateral anterior thoracic
Medial anterior thoracic
Musculocutaneous
Median
Ulnar
Med. antibrach. cutaneous
Radial
Deep br. of radial
Superfic. br. of radial
Volar interosseous
Ulnar
Dorsal branch
Deep branch

ULNAR NERVE ENTRAPMENT SYNDROME

- Review of Functions of Ulnar Nerve
  - Motor:
  - Sensory:
  - Autonomic:

Peripheral Nerve	Associated Nerve Roots	Muscles Supplied	Muscle Action
Ulnar Nerve - forearm	C7/C8	Flexor Carpi Ulnaris Flexor Digitorum Profundus (3rd & 4th)	Ulnar wrist flexion/adduction Flexion of distal phalanges of distal ring and pinky fingers
Ulnar Nerve - hand	C8/T1	Hypothenar muscles (3) Dorsal (4) & Palmar (3) interossei Adductor Pollicis FPB (ulnar head) Medial 2 lumbricals	Adduction & Opposition of 5th finger Abduction/Adduction of 2nd – 4th fingers Thumb adduction Flexion proximal thumb phalanx Extension of middle phalanges of ring and pinky

Peripheral Nerve	Motor Branch	Muscle
Ulnar Nerve (below elbow) (C7/C8/T1)	Branch to Flexor Carpi Ulnaris	Flexor carpi ulnaris – ulnar wrist flexion with wrist adduction (ulnar deviation)
	Branch to Flexor Digitorum Profundus	Flexion of distal phalanges of ring and pinky fingers
Below Wrist (tunnel of Guyon)	Hypothenar Branch: 1. Abductor digiti minimi 2. Flexor digiti minimi 3. Opponens digiti minimi Deep Branch: 1. 4 dorsal interossei 2. 3 Volar interossei 3. Adductor pollicis 4. Flexor pollicis brevis (ulnar head)	1. Pinky abduction 2. Pinky flexion of the MCP joint 3. Pinky opposition 4. 2^{nd}-4^{th} finger abduction 5. 2^{nd}-4^{th} finger adduction 6. Thumb adduction against 2^{nd} finger 7. Flexion of 1^{st} thumb phalanx

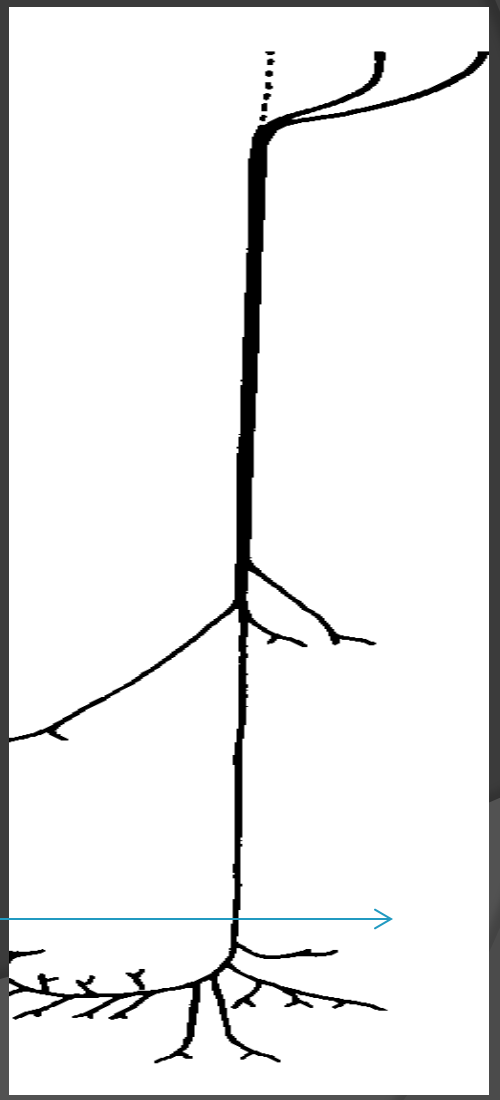
Peripheral Nerve	Branch	Skin Supplied
Ulnar Nerve – below elbow	Dorsal Sensory Branch (5cm. Proximal to wrist)	Ulnar surface of pinky finger 4th web space: • Radial surface of pinky finger • Ulnar surface of ring finger
Below wrist	Dorsal Sensory Branch	Ulnar surface of pinky finger 4th web space: • Radial surface of pinky finger • Ulnar surface of ring finger Motor branch to 3rd/4th lumbricals

ULNAR NERVE

- ANATOMIC COURSE (AMA GUIDES pg. 487
- Below Elbow:
  - FCU
  - FDP (ring/pinky)

ULNAR NERVE

- ANATOMIC COURSE (AMA GUIDES pg. 487
- Below Wrist:
  - Palmaris brevis
  - 3 hypothenar mm.
  - Lumbricals to digits 4 & 5
  - All 7 interossei
  - Adductor Pollicis
  - Flexor pollicis

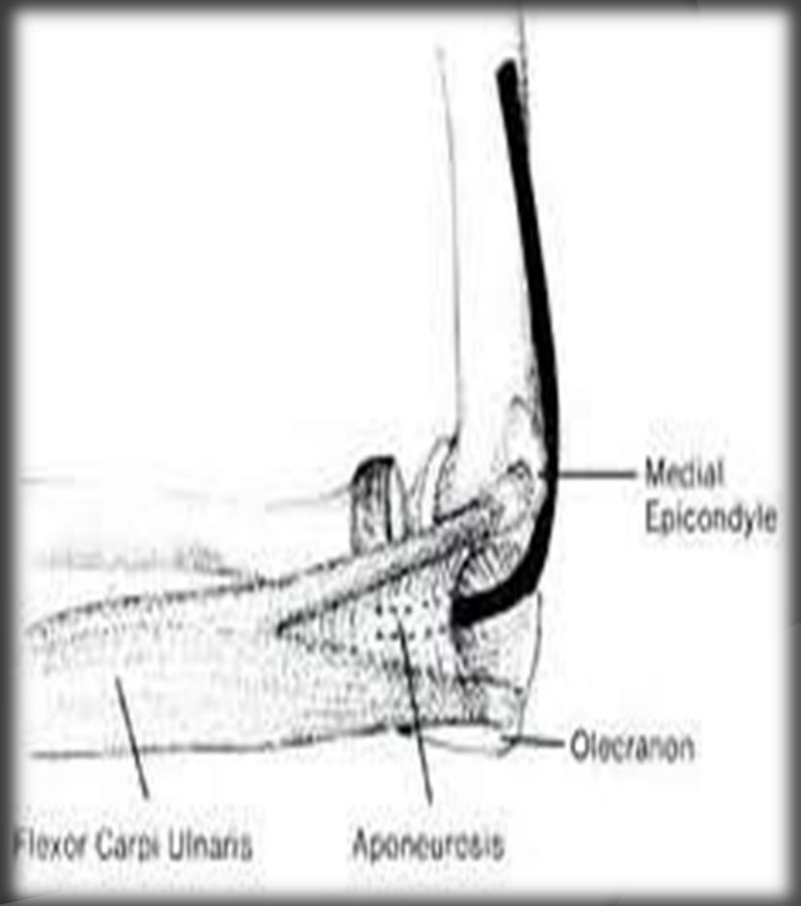


ULNAR NERVE COMPRESSION/IRRITATION

- 3 Possible Locations of Entrapment:
- Below Elbow:
  - Cubital tunnel:
    1. Arcuate Ligament
    2. Head of Flexor Carpi Ulnaris mm.
- Below Wrist:
  - Tunnel of Guyon:
    3. Hook of hamate and pisiform

ULNAR NERVE COMPRESSION/IRRITATION

- Cubital Tunnel:
  - Borders:
  - Medially is bordered by the medial epicondyle
  - Laterally by the olecranon process
  - Floor is formed by MCL
  - Covered by:
    - Ulnar collateral ligament
    - Aponeurotic roof
    - Tendon of FCU (Arcuate Ligament/Osborne's ligament)

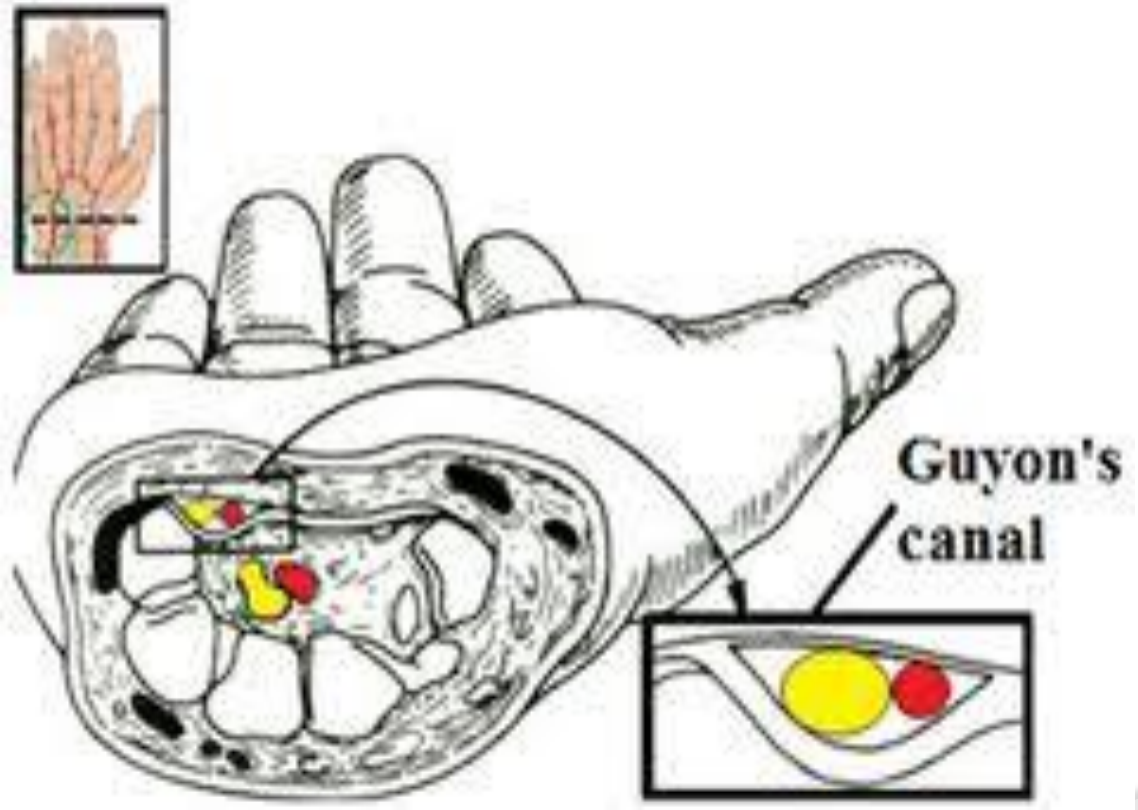


CUBITAL TUNNEL SYNDROME

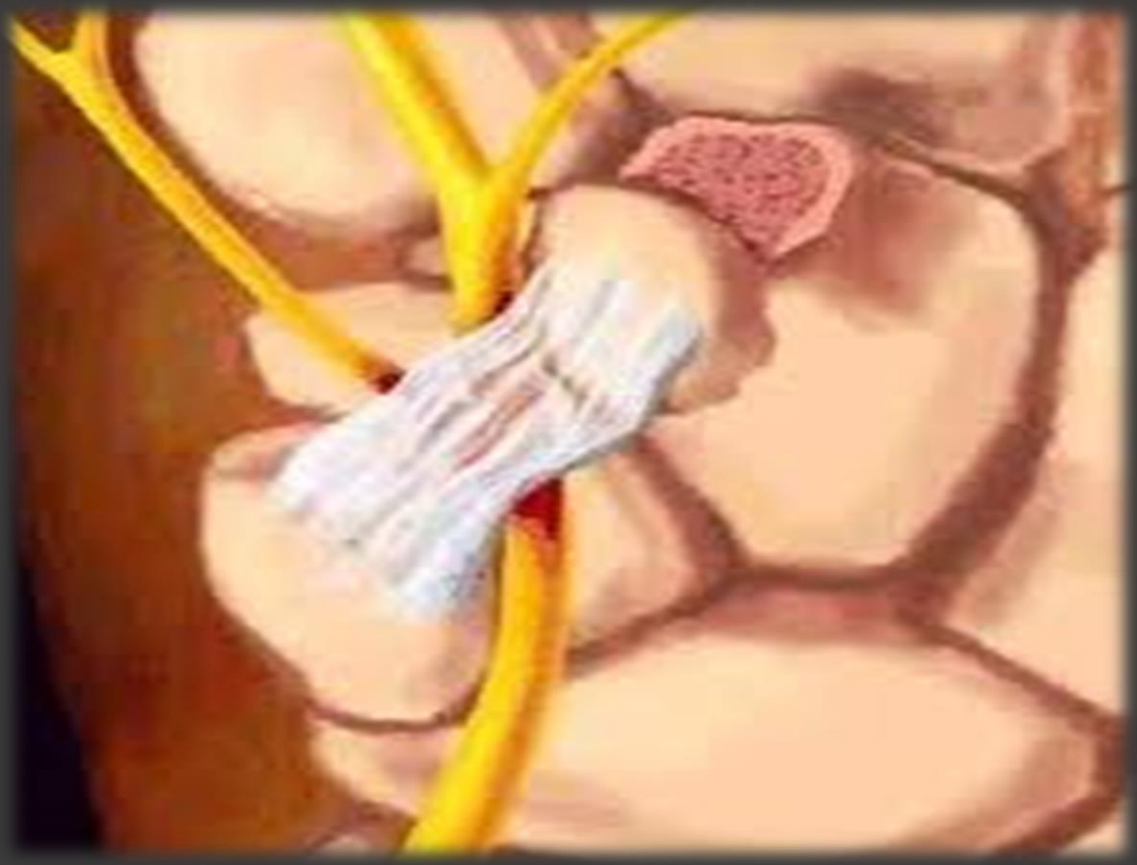
- Cubital tunnel is slack during extension and become progressively more taut during flexion, contributing to ulnar nerve symptoms. - point of constriction is 1.5-3.5 cm. distal to epicondyle
- FCU and FDP usually spared
- Aching pain at the medial elbow – sensory findings at 4^{th} (ulnar side) & 5^{th} finger, motor findings rare/late

ULNAR NERVE COMPRESSION/IRRITATION

- Tunnel of Guyon:
- Approximately 4 cm long
- Begins at the proximal extent of transverse carpal ligament - ends at the aponeurotic arch of hypothenar muscles
- Depression between pisiform & hook of hamate is converted into fibrosseous tunnel (the tunnel of Guyon) by pisohamate ligament;
- Roof is formed by volar carpal ligament and pisohamate ligament;
- The ulnar nerve bifurcates within the canal into superficial (more ulnar and sensory) and deep (more radial and motor) branches;

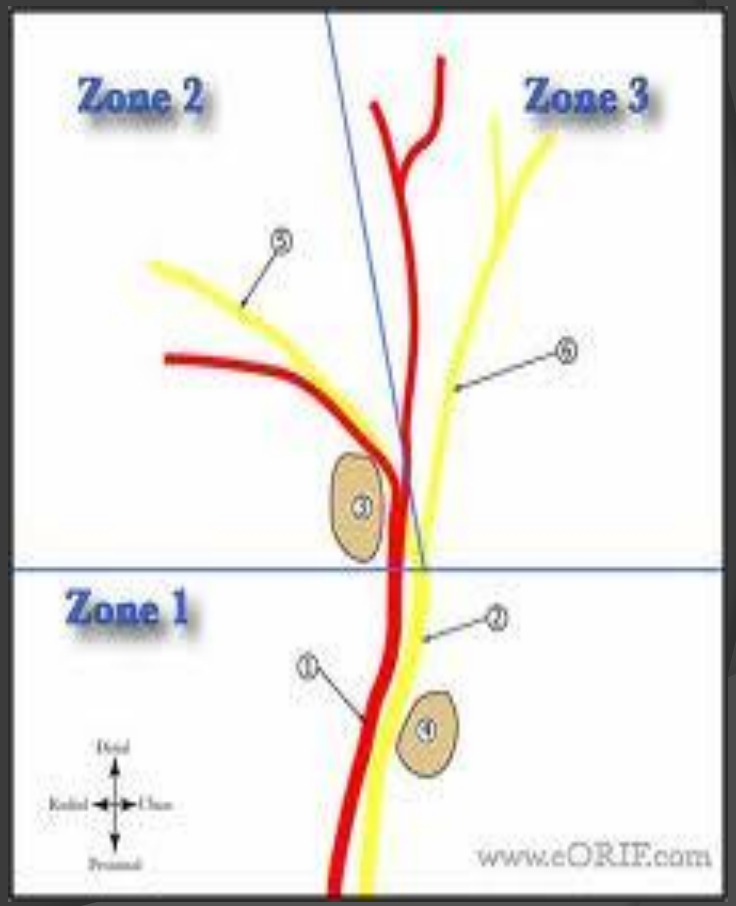

Guyon's
canal


Ulnar motor branch to hypothenar ms.
Ulnar sensory branch
Hamate
Deep ulnar branch
Pisiform
Ulnar nerve
Pisohamate ligament
Volar carpal ligament



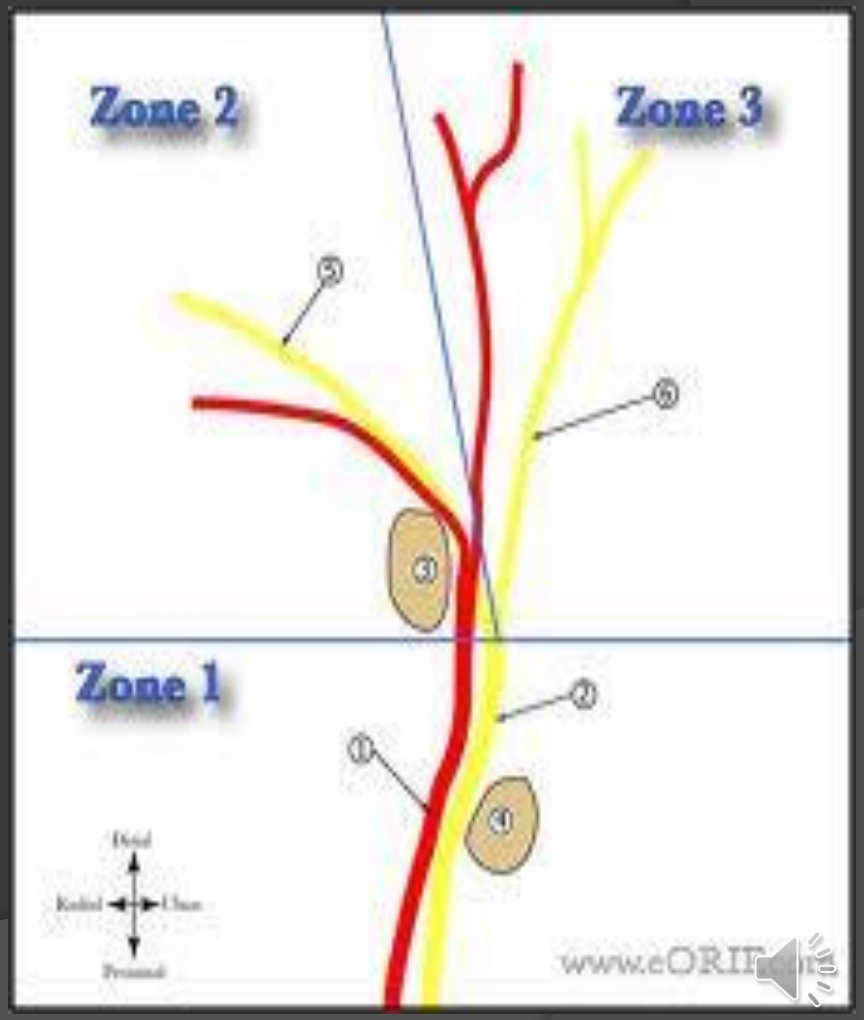
ULNAR NEUROPATHY AT GUYON'S CANAL

- **Type I**
  - Proximal compression (proximal edge of palmar carpal ligament prior to the bifurcation of Ulnar Nerve into sensory and deep motor branches) leads to motor weakness in all of the intrinsic muscles of the hand which are innervated by the ulnar nerve. There is also sensory loss in the territory of the hand served by the ulnar nerve. Most common lesions = ganglions and hook of hamate fracture.



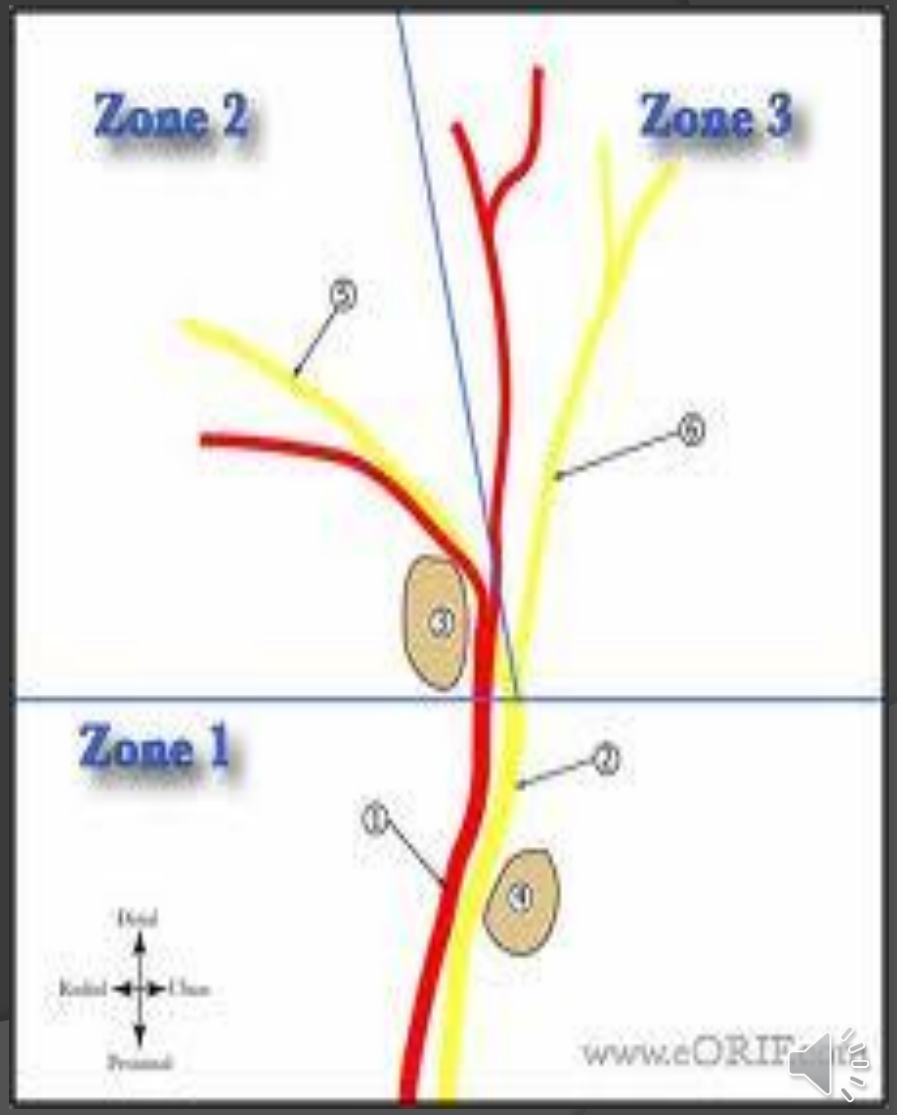
ULNAR NEUROPATHY AT GUYON'S CANAL

- **Type II**
  - Compression at the bifurcation of the ulnar nerve just distal to the fibrous arch of the hypothenar muscles. This is the most common type of Guyon's canal syndrome. This results in symptoms associated with Type I (*above*), however the sensory branch to the dorsal part of the hand and the motor supply to the muscles of the base of the palm are unaffected. Therefore Type II involves an impairment in motor function of the hand, with sensory innervation unaffected. Most common lesions = ganglions and hook of hamate fracture.



ULNAR NEUROPATHY AT GUYON'S CANAL

- **Type III**
- This is the least common type of Guyon's canal syndrome, and is caused by compression of the superficial branch of the ulnar nerve at the distal portion of Guyon's canal. Type III results in a loss of sensation from the cutaneous territory of the hand which is served by the ulnar nerve. Deep motor branch is spared and there is no motor function impairment. Most common lesions = Ulnar artery thrombosis.

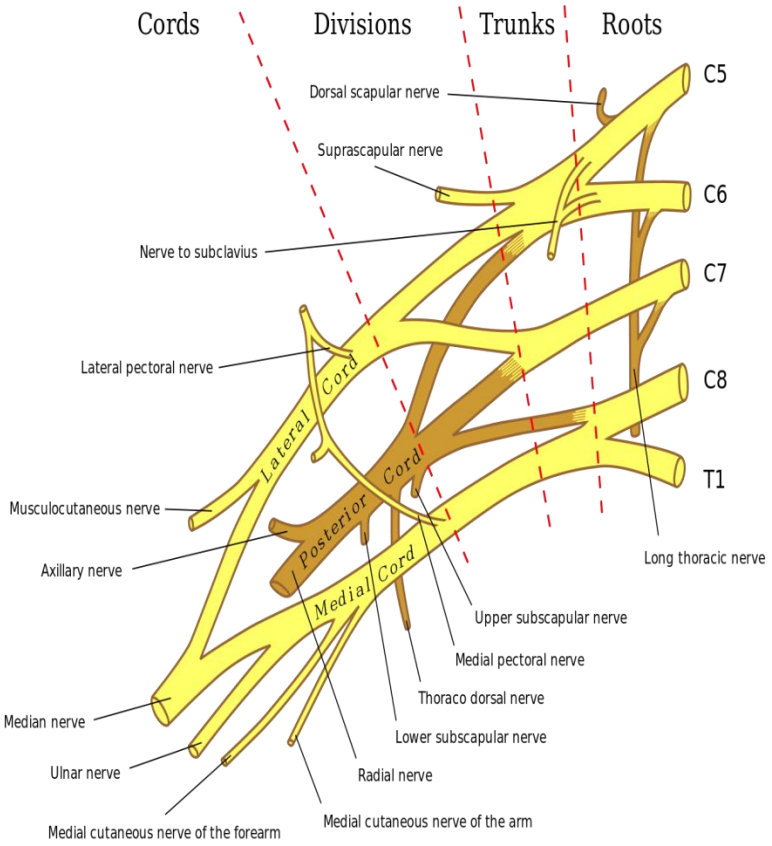


ULNAR NERVE ENTRAPMENT SYNDROMES

- Deficits of Function of Ulnar Nerve:
  - Motor:
    - Weakness of wrist flexion/adduction
    - Weakness of finger flexion (DIP joints of 4^{th} & 5^{th})
    - Wasting and weakness of small hand muscles
  - Sensory: Tingling/numbness in ring and pinky fingers
  - Autonomic: Unknown but likely related to blood vessels and sweat glands

Location of Entrapment	Physical Exam Finding	Explanation
Cubital Tunnel	Sensory findings in 4th (ulnar side) & 5th fingers. May see autonomic changes as well. Motor findings uncommon. Positive Tinel's sign at the elbow. Positive forearm flexion test. Positive Fromet's sign (weakness of adductor pollicis). Positive Wartenburg sign (failure of palmar adductors).	Unknown as to how motor lesions are spared in early disease but may become profound in late disease.
Guyon's Tunnel	?????????	

MEDIAN NERVE



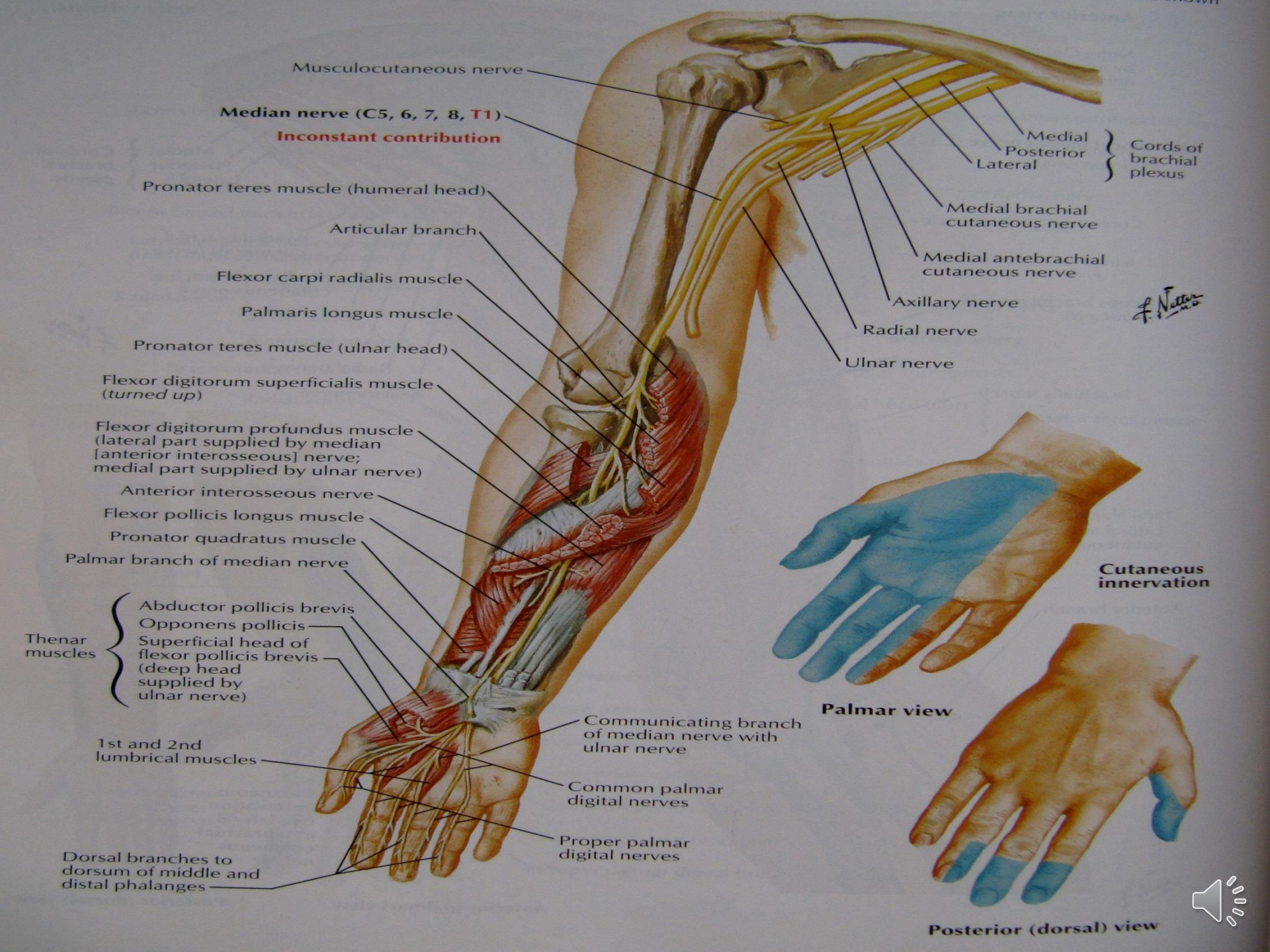
- Formed from a branch from the lateral cord (C5, C6, and C7), and a branch from the medial cord (C8, and T1)

COURSE OF MEDIAN NERVE

- **Course in the upper arm and cubital fossa**
  - After receiving inputs from both the lateral and medial cords of the brachial plexus, the median nerve enters the arm from axilla at the inferior margin of the teres major muscle. it then passes vertically down and courses with brachial artery on medial side of arm between biceps brachii and brachialis.
  - Inside the cubital fossa the median nerve passes medial to the brachial artery, in front of the point of insertion of the brachialis muscle and deep to the biceps.
  - A branch to pronator teres may arise from the median nerve immediately proximal to the elbow joint. The median nerve gives off an articular branch in the upper arm as it passes the elbow joint.

COURSE OF MEDIAN NERVE

- **Course and branches in the forearm**
  - The median nerve arises from the cubital fossa and passes between the two heads (humeral head and ulnar head) of pronator teres. It then travels between flexor digitorum superficialis and flexor digitorum profundus before emerging between flexor digitorum superficialis and flexor pollicis longus.


Musculocutaneous nerve
Median nerve (C5, 6, 7, 8, T1)
Inconstant contribution
Pronator teres muscle (humeral head)
Articular branch
Flexor carpi radialis muscle
Palmaris longus muscle
Pronator teres muscle (ulnar head)
Flexor digitorum superficialis muscle (turned up)
Flexor digitorum profundus muscle (lateral part supplied by median [anterior interosseous] nerve; medial part supplied by ulnar nerve)
Anterior interosseous nerve
Flexor pollicis longus muscle
Pronator quadratus muscle
Palmar branch of median nerve
Thenar muscles
Abductor pollicis brevis
Opponens pollicis
Superficial head of flexor pollicis brevis (deep head supplied by ulnar nerve)
1st and 2nd lumbrical muscles
Dorsal branches to dorsum of middle and distal phalanges
Communicating branch of median nerve with ulnar nerve
Common palmar digital nerves
Proper palmar digital nerves
Medial
Posterior
Lateral
Cords of brachial plexus
Medial brachial cutaneous nerve
Medial antebrachial cutaneous nerve
Axillary nerve
Radial nerve
Ulnar nerve
Cutaneous innervation
Palmar view
Posterior (dorsal) view

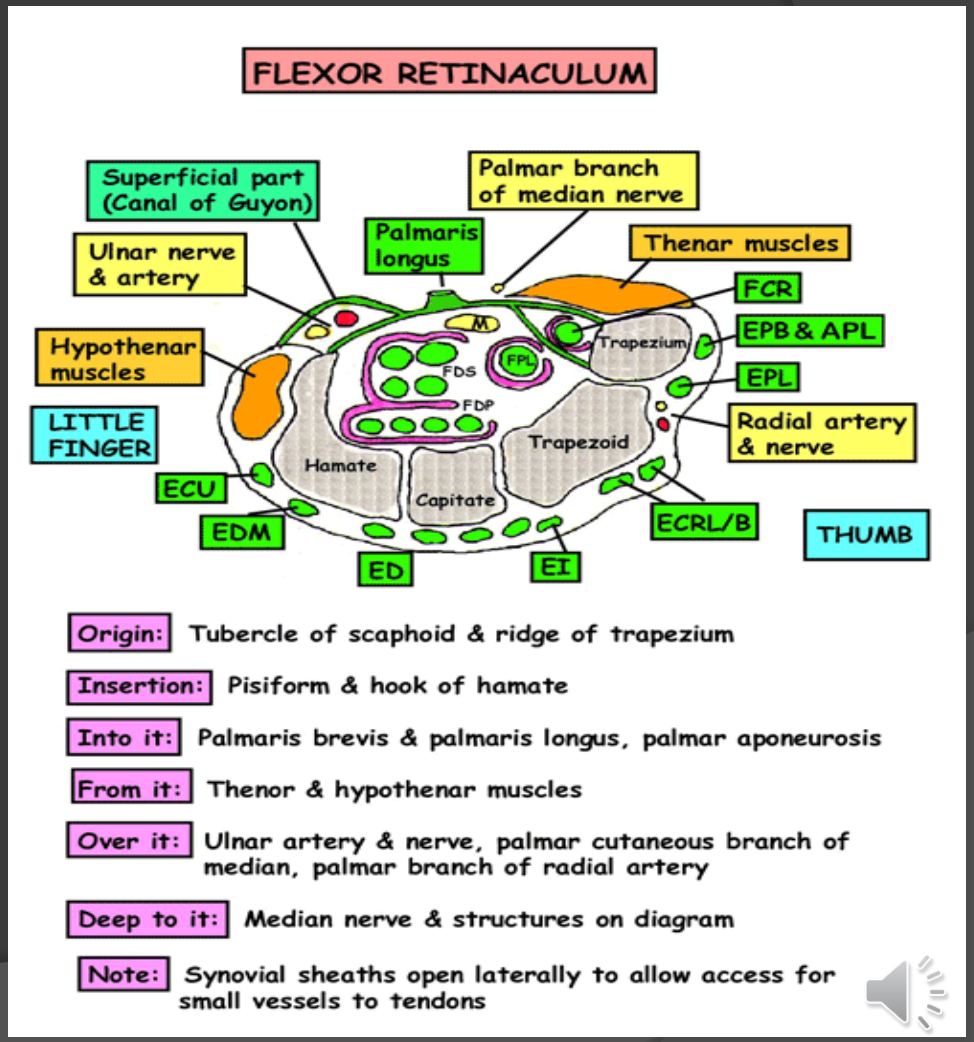
Peripheral Nerve	Associated Nerve Roots	Muscles Supplied	Muscle Action
Median Nerve (C5-T1)	C5	Minimal contribution from C5 because most of C5 has already split off to the 1) Axillary Nerve, and 2) the Musculocutaneous nerve	
Median Nerve	C6	Pronator Teres Pronator Quadratus	Forearm pronation
	C7	Flexor carpi radialis longus/brevis	Radial Wrist flexion
	C8	Flexor digitorum profundus (1&2)	Flexion of DIP joints
	T1	Abductor pollicis brevis, opponens pollicis (thenar muscles)	Thumb abduction and opposition

COURSE OF MEDIAN NERVE

- **Course and branches in the forearm**
  - The unbranched portion of the median nerve (which arises from the cubital fossa) innervates muscles of superficial and intermediate groups of the anterior compartment except flexor carpi ulnaris.
  - Then, it gives off two branches as it courses through the forearm:
    - The *anterior interosseous branch* courses with the anterior interosseous artery and innervates all the muscles of the deep group of the anterior compartment of the forearm except the medial (ulnar) half of flexor digitorum profundus and flexor carpi ulnaris muscle. It ends with its innervation of pronator quadratus.
    - The *palmar cutaneous branch* of the median nerve arises at the distal part of the forearm. It supplies sensory innervation to the lateral aspect of the skin of the palm (but not the digits).

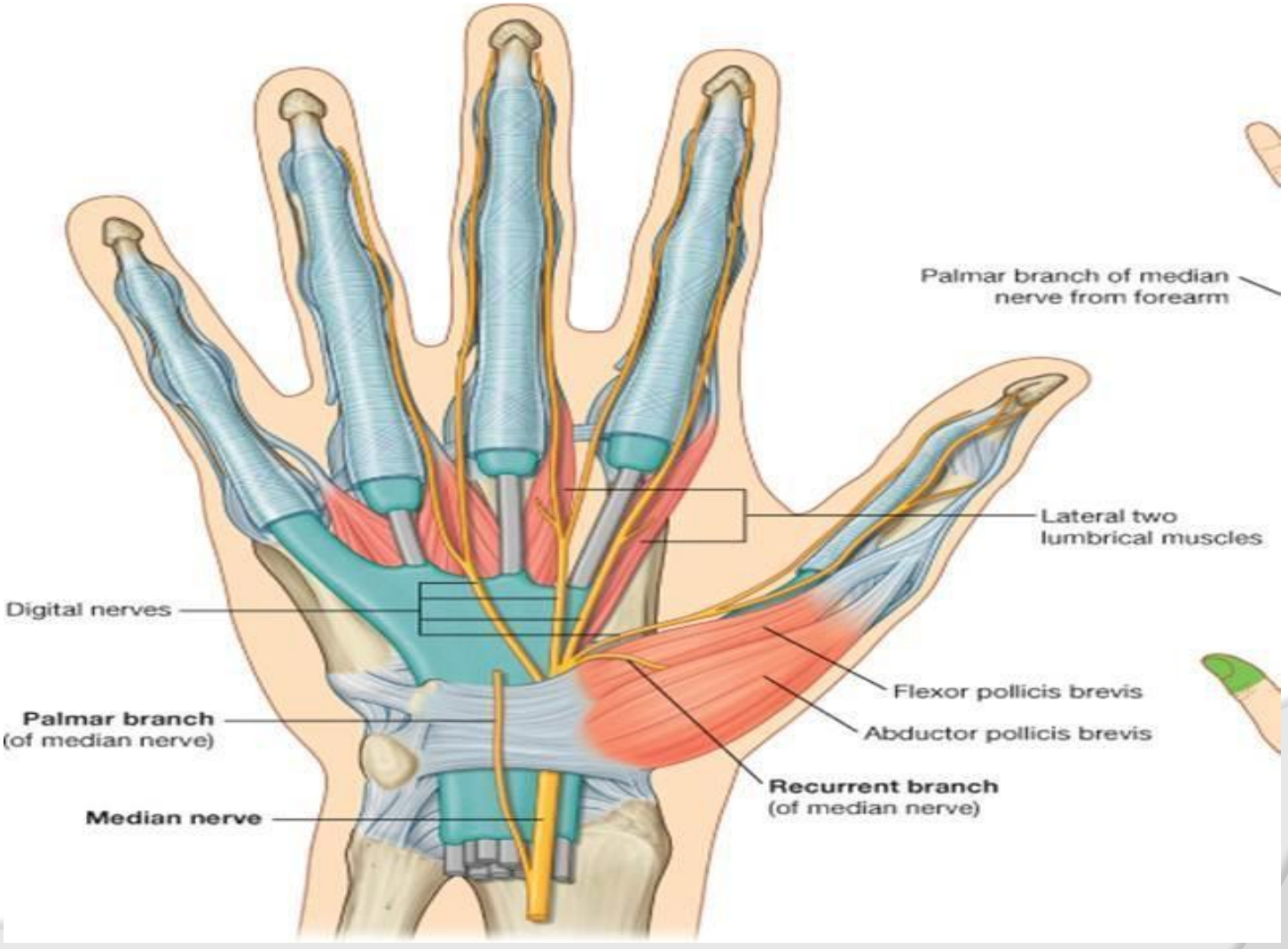
COURSE OF MEDIAN NERVE

- **Branches in the hand**
  - The median nerve enters the hand through the carpal tunnel, deep to the flexor retinaculum along with the tendons of flexor digitorum superficialis, flexor digitorum profundus, and flexor pollicis longus.



COURSE OF MEDIAN NERVE

- **Branches in the hand**
  - From there it sends off several branches:
  - 1. *Recurrent branch* to muscles of the thenar compartment (the recurrent branch is also called "the million dollar nerve"). Here it provides motor innervation to opponens pollicis, abductor pollicis brevis and flexor pollicis brevis.
  - 2. *Digital cutaneous branches* to *common palmar digital branch* and *proper palmar digital branch* of the median nerve which supply the:
    - a) lateral (radial) three and a half digits on the palmar side
    - b) tips of index, middle and ring finger on dorsum of the hand
  - 3. *Branches* to the first and second Lumbricals of the hand.

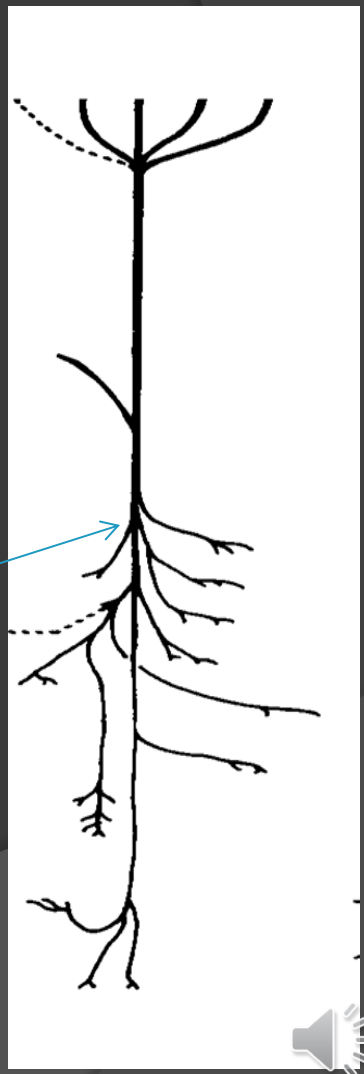

Palmar branch of median nerve from forearm
Lateral two lumbrical muscles
Digital nerves
Flexor pollicis brevis
Abductor pollicis brevis
Palmar branch (of median nerve)
Recurrent branch (of median nerve)
Median nerve

Peripheral Nerve	Motor Branch	Muscle
Median Nerve (C6-T1)	Branch to pronator teres	Pronator teres – forearm pronation (weak elbow flexion)
Below elbow	Branch to flexor carpi radialis	Flexor carpi radialis – radial wrist flexion, radial deviation
	Branch to Palmaris longus	Wrist flexion
	Branch to flexor digitorum superficialis	Flexion of PIP joints of all fingers
Anterior Interossesous Nerve	Branch to FDP (to index & middle finger) Branch to FPL Branch to pronator quadratus	Flexion of DIP joints of index & middle finger Flexion of distal phalanx of thumb Forearm pronation

Peripheral Nerve	Branch	Skin Supplied
Median Nerve (C6-T1) – Above wrist	Palmar cutaneous	Central proximal surface of palm
Below wrist	Proper palmar digitals (3 branches)	Sensory to 1st web space (palmar), palmar, and distal dorsal surfaces of thumb (both sides) and index (radial side)
	Proper Palmar digitals (2 branches)	Sensory to 2nd web space (palmar), palmar, and distal dorsal surfaces of contiguous sides of index and middle fingers
	Proper Palmar digitals (2 branches)	Sensory to 3rd web space (palmar), palmar, and distal dorsal surfaces of contiguous sides of middle and ring fingers

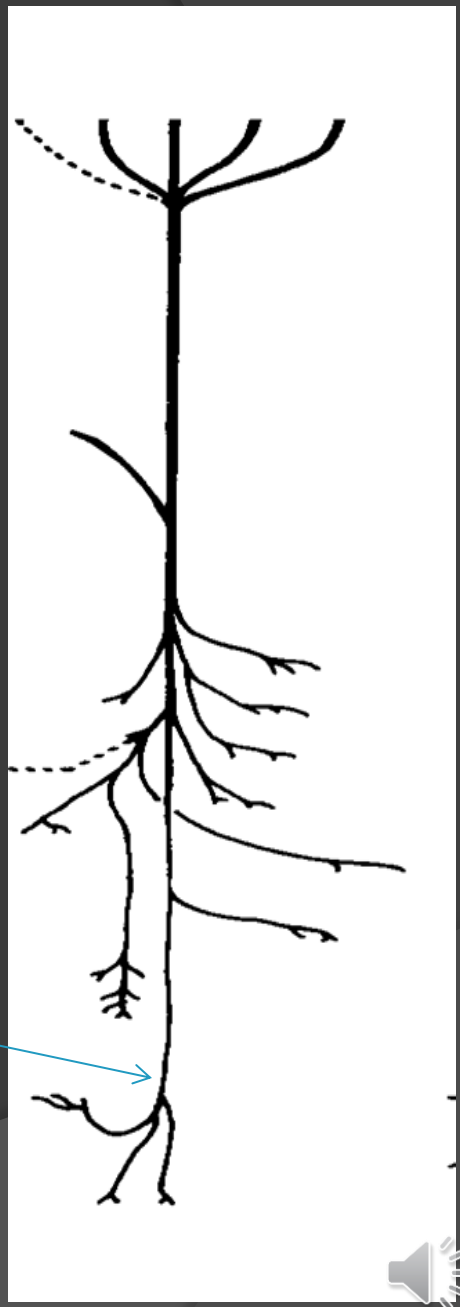
MEDIAN NERVE

- ANATOMIC COURSE (AMA Guides page 487):
- Above Elbow: Branch to Pronator teres
- Below Elbow: Branches to 1) Flexor carpi radialis, Palmaris Longus, Flexor Digitorum Superficialis
- Anterior Interossesous Nerve:
  - FDP (Index & Middle)
  - Flexor Pollicis Longus
  - Pronator Quadratus



MEDIAN NERVE

- ANATOMIC COURSE:
- Above Wrist: Palmar Cutaneous Branch (Sensory)
- Recurrent Motor Branch ("Million Dollar Nerve") to thenar muscles (abductor pollicis brevis, opponens pollicis, flexor pollicis brevis)
- Sensory Branches (not shown in AMA Guides)
  - 1st web space:
    - Thumb (radial & ulnar)
    - Index:
      - Sensory to radial half
      - Motor to 1st lumbrical
  - 2nd web space:
    - Index:
      - Sensory to ulnar half
      - Motor to 2nd lumbrical
    - Middle finger:
      - Sensory to radial half
  - 3rd web space:
    - Middle finger:
      - Sensory to ulnar half
    - Ring finger:
      - Sensory to radial half



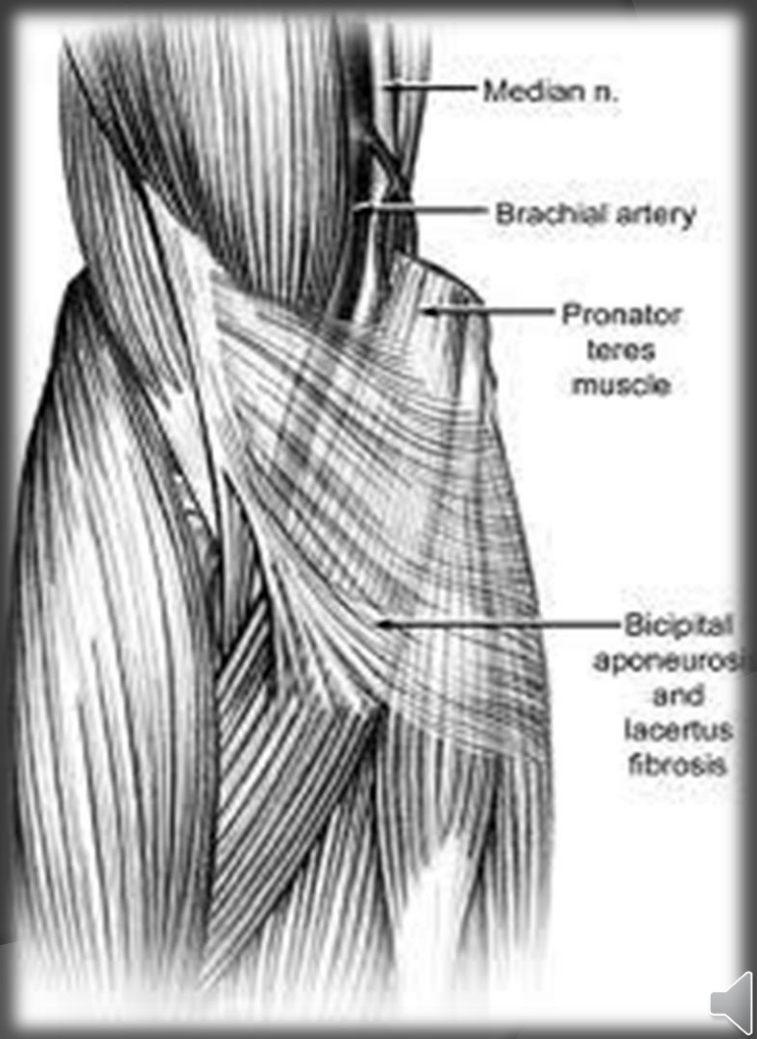
MEDIAN NERVE COMPRESSION/IRRITATION

- 2 Main Locations of Compression:

1. Elbow (Pronator Syndrome):
   - Lacertus Fibrosus
   - Pronator Teres
   - Flexor Digitorum Superficialis
   - Others: Ligament of Struthers or enlarged bicepital bursa
2. Wrist (Carpal Tunnel Syndrome):
   - Flexor Retinaculum

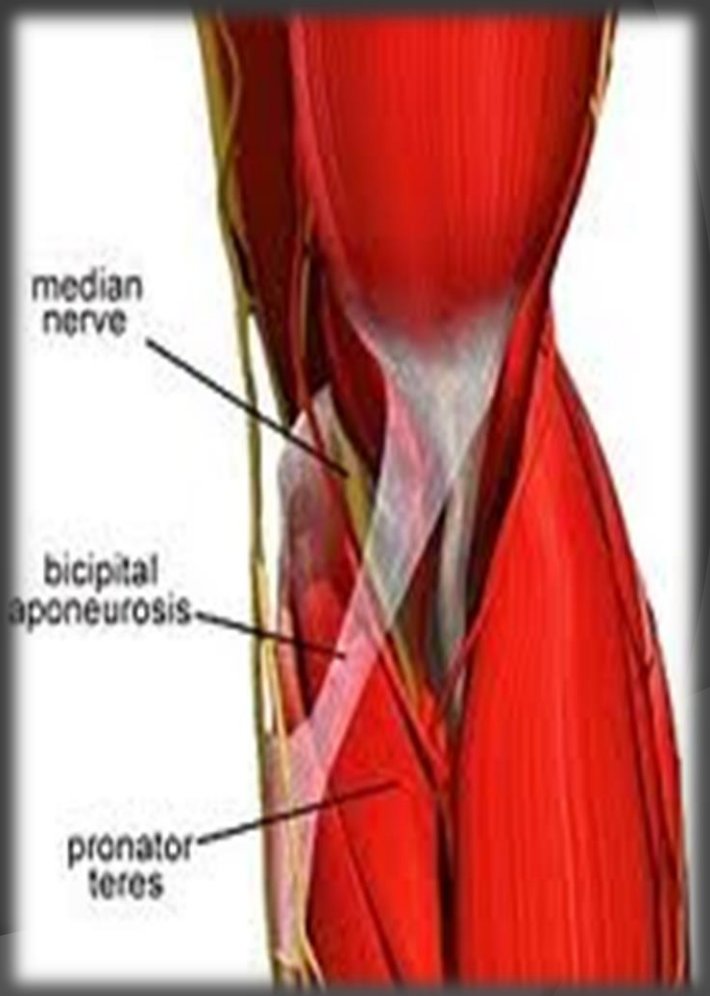
MEDIAN NERVE COMPRESSION/IRRITATION

- Lacertus Fibrosus – a.k.a. bicipital aponeurosis
- Median nerve passes under the bicipital aponeurosis (lacertus fibrosus) into the antecubital region, medial to both the biceps tendon and brachial artery



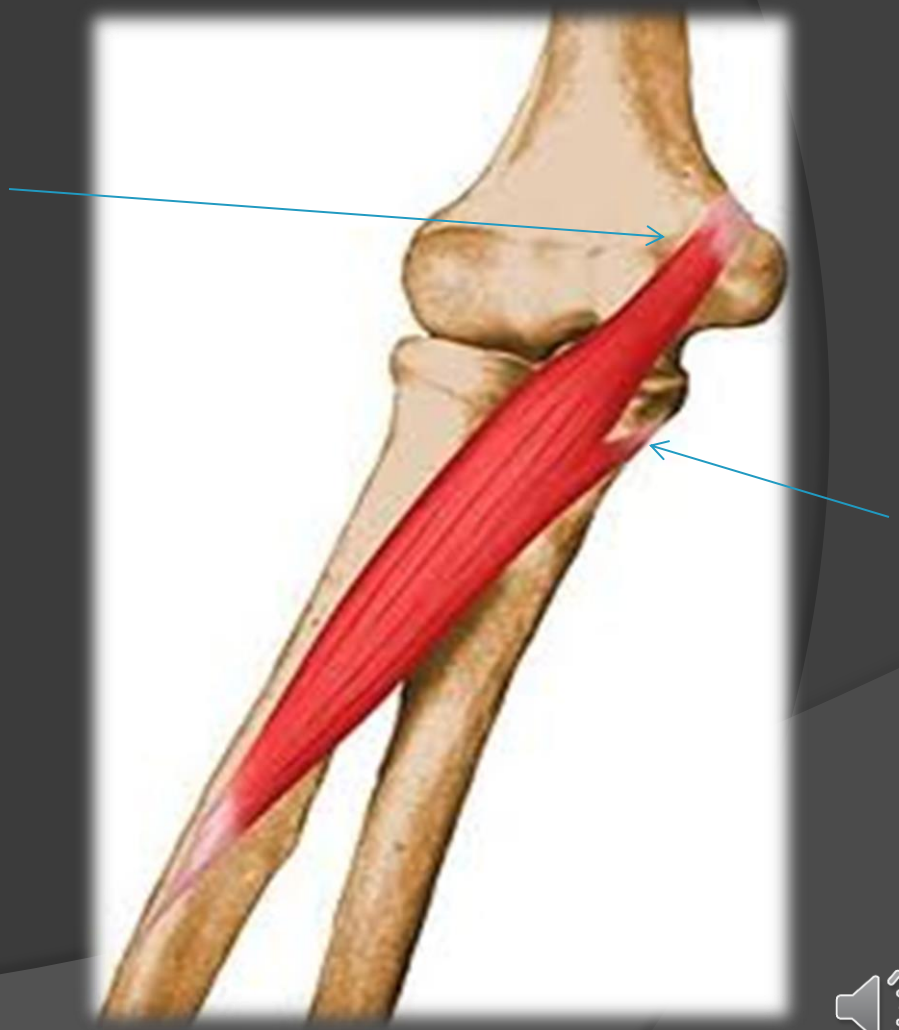
MEDIAN NERVE COMPRESSION/IRRITATION

- Lacertus Fibrosus – a.k.a. bicipital aponeurosis



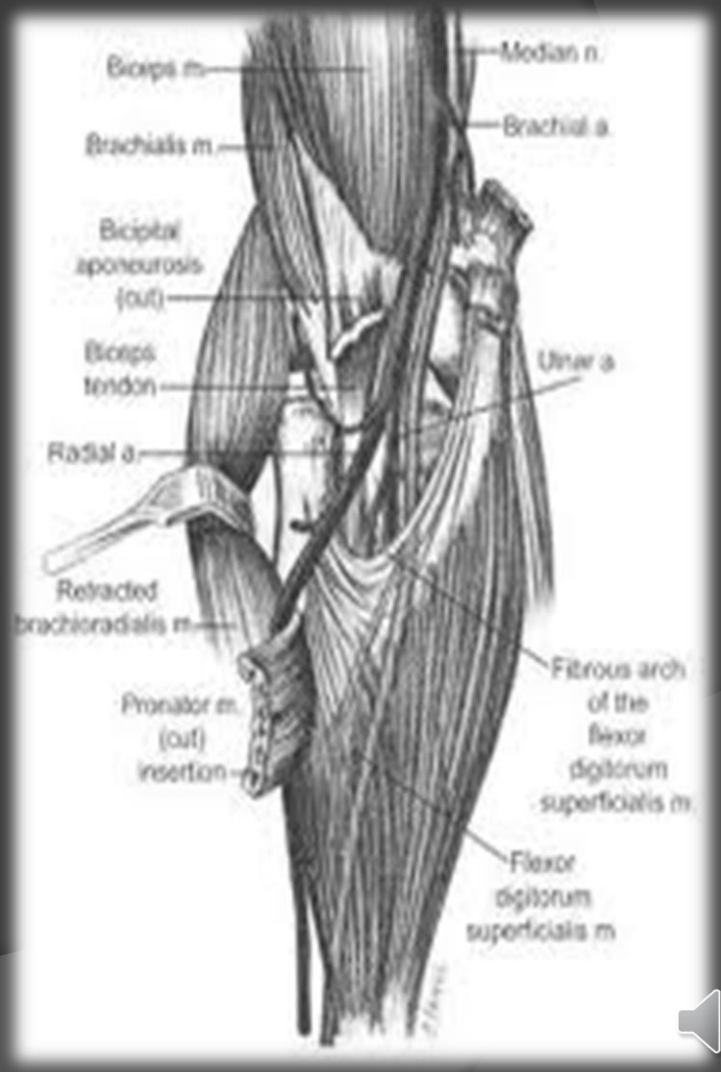
MEDIAN NERVE COMPRESSION/IRRITATION

- Pronator Teres:
- Origin:
  - Humeral Head: Medial epicondyle of humerus
  - Ulnar Head: Anterior upper aspect of ulna
- The median nerve passes between the 2 heads of the pronator teres, deep to the humeral head and superficial to the ulnar head; (rarely the ulnar head may be absent)
- Insertion: Anterolateral upper 1/3 of radius
- Action: Pronate forearm



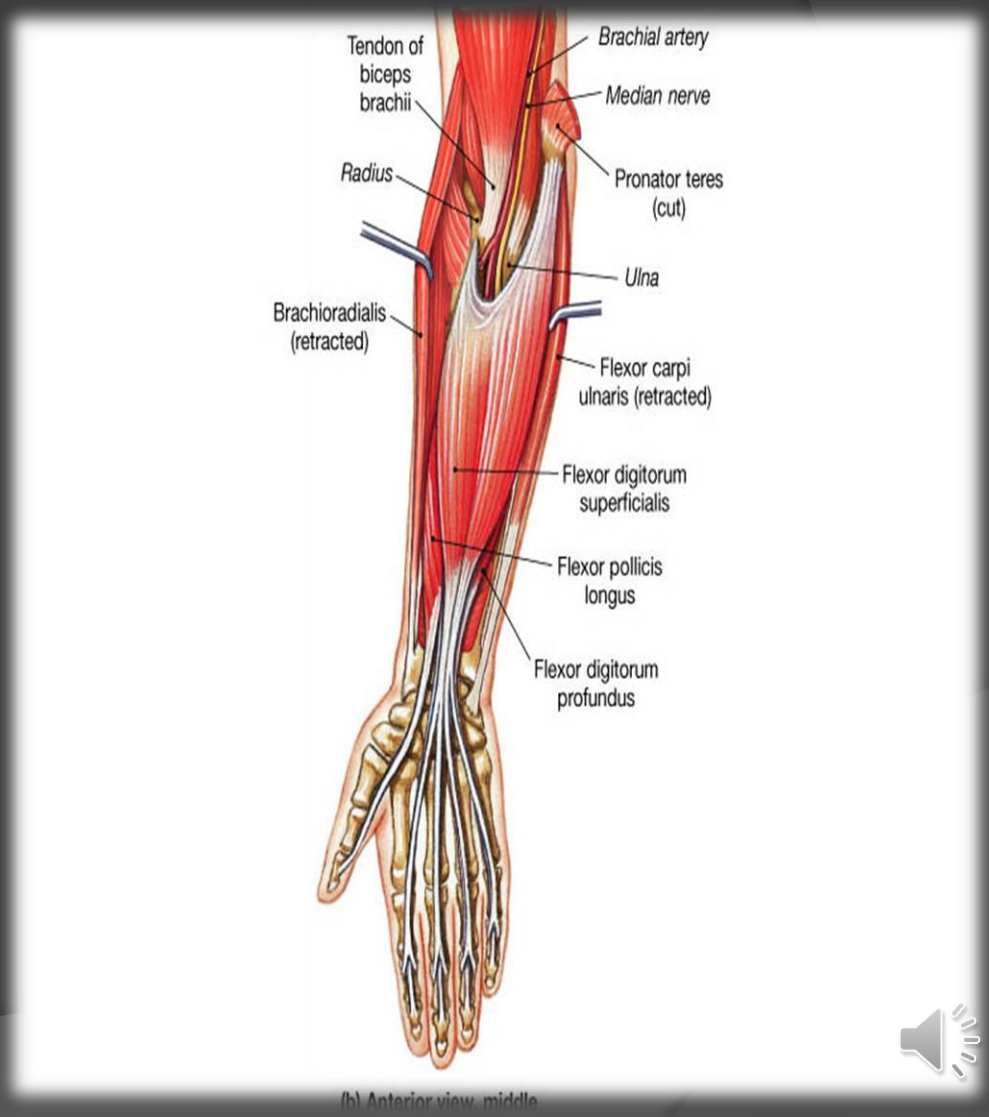
MEDIAN NERVE COMPRESSION/IRRITATION

- Flexor Digitorum Superficialis
- Median nerve travels deep to the proximal fibrous arch of the flexor digitorum superficialis (FDS) before continuing its course through the forearm between the FDS and the flexor digitorum profundus (FDP)



MEDIAN NERVE COMPRESSION/IRRITATION

- Flexor Digitorum Superficialis



MEDIAN NERVE ENTRAPMENT SYNDROME

- Deficit of Functions of Median Nerve
  - Motor:
    - Weakness of 1) wrist flexion, 2) finger flexion of thumb, index, and middle finger, and 3) thumb abduction
  - Sensory:
    - Pain/Loss of sensation of lateral palm, index finger, middle finger, and radial half of ring finger
    - Retrograde pain up the forearm to elbow, even to shoulder (reason unknown)
  - Autonomic:
    - Sympathetic fibers to blood vessels of 1) brachial artery and 2) all the fingers of the hand (fingers blanch and appear to be swollen)

Location of Entrapment	Physical Exam Finding	Explanation
Lacertus Fibrosus	Pain in proximal forearm is increased by resisted supination/elbow flexion (demonstrate)	Activation of the biceps brachii tightens the aponeurosis and compresses the median nerve from superior
Pronator Teres	Pain in proximal forearm is increased with resisted forearm pronation/wrist flexion	Squeezes nerve between heads of pronator teres, and from FCR inferiorly
Fibrous arch of flexor digitorum superficialis	Pain in proximal forearm is increased with resisted flexion of the PIP joint of the middle finger	Activation of the FDS tightens the fibrous arch and compresses the nerve between the FDS and FDP
Ligament of Struthers	Anomalous ligament above the elbow from supracondylar eminence to medial epicondyle (through with pass the medial nerve and the brachial artery	
Bicepital bursa		

MEDIAN NERVE COMPRESSION/IRRITATION

- Wrist (Carpal Tunnel Syndrome):
  - Caused by a combination of genetic and environmental factors. Some of the predisposing factors include: diabetes, obesity, pregnancy, hypothyroidism, and heavy manual work or work with vibrating tools, but not lighter work - even if repetitive.
  - The main symptom of CTS is intermittent numbness of the thumb, index, long and radial half of the ring finger.

IS CTS WORK RELATED??

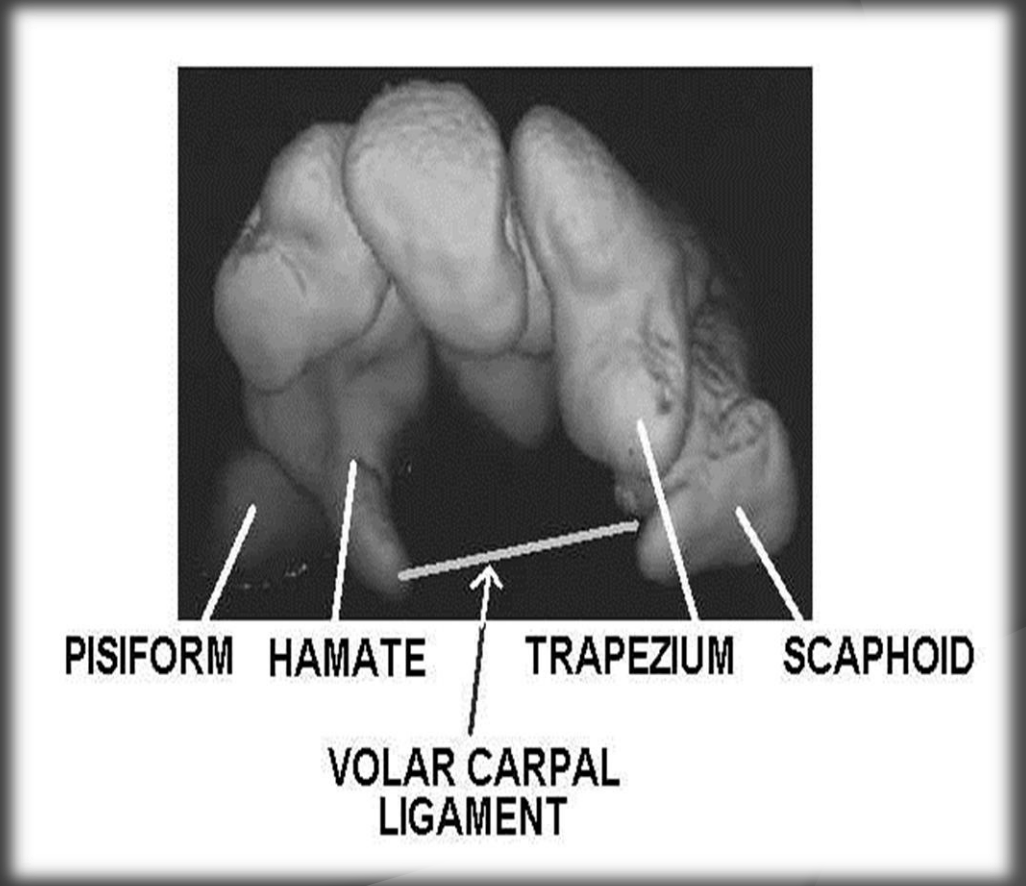
- The international debate regarding the relationship between CTS and repetitive motion in work is ongoing. The Occupational Safety and Health Administration (OSHA) has adopted rules and regulations regarding cumulative trauma disorders. Occupational risk factors of repetitive tasks, force, posture, and vibration have been cited. However, the American Society for Surgery of the Hand (ASSH) has issued a statement claiming that the current literature does not support a causal relationship between specific work activities and the development of diseases such as CTS.[23]
- The relationship between work and CTS is controversial; in many locations, workers diagnosed with carpal tunnel syndrome are entitled to time off and compensation.[24] In the USA, carpal tunnel syndrome results in an average of $30,000 in lifetime costs (medical bills and lost time from work).[25]
- Some speculate that carpal tunnel syndrome is provoked by repetitive movement and manipulating activities and that the exposure can be cumulative. It has also been stated that symptoms are commonly exacerbated by forceful and repetitive use of the hand and wrists in industrial occupations,[26] but it is unclear as to whether this refers to pain (which may not be due to carpal tunnel syndrome) or the more typical numbness symptoms.[27]

IS CTS WORK RELATED??

- A review of available scientific data by the National Institute for Occupational Safety and Health (NIOSH) indicated that job tasks that involve highly repetitive manual acts or specific wrist postures were associated with incidents of CTS, but causation was not established, and the distinction from work-related arm pains that are not carpal tunnel syndrome was not clear. It has been proposed that repetitive use of the arm can affect the biomechanics of the upper limb or cause damage to tissues. It has also been proposed that postural and spinal assessment along with ergonomic assessments should be included in the overall determination of the condition. Addressing these factors has been found to improve comfort in some studies.[28]
- Speculation that CTS is work-related is based on claims such as CTS being found mostly in the working adult population, though evidence is lacking for this. For instance, in one recent representative series of a consecutive experience, most patients were older and not working.[29] Based on the claimed increased incidence in the workplace, arm use is implicated, but the weight of evidence suggests that this is an inherent, genetic, slowly but inevitably progressive idiopathic peripheral mononeuropathy.[30]

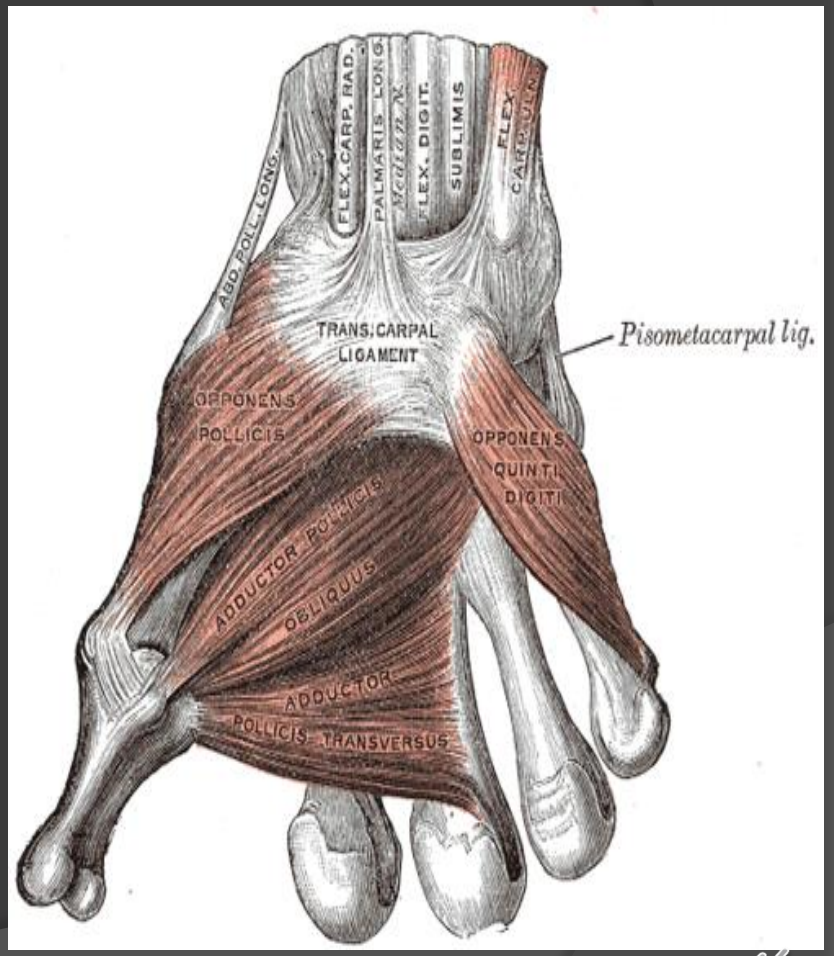
MEDIAN NERVE COMPRESSION/IRRITATION

- Borders:
- Carpal bones posteriorly
- Transverse Carpal ligament anteriorly
- Hook of Hamate medially
- Tubercle of scaphoid medially



Flexor Retinaculum

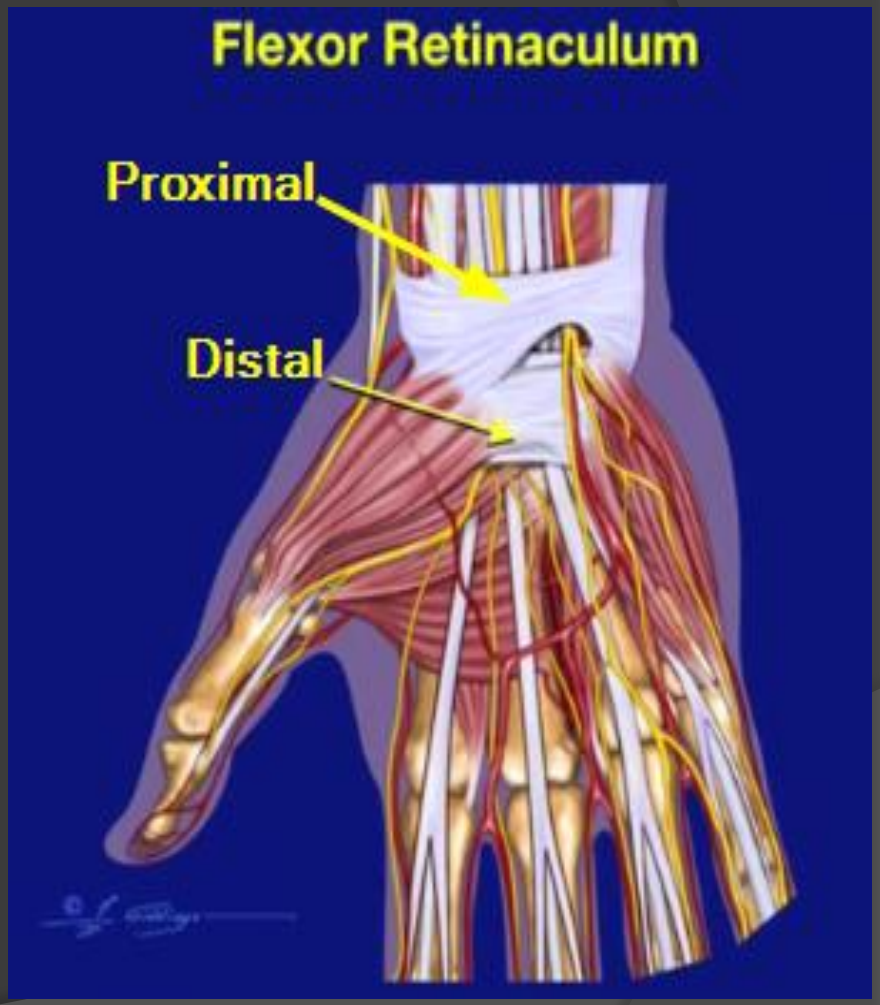
- AKA – “Transverse carpal ligament”
- Attached, medially, to the pisiform and the hamulus of the hamate bone; laterally, to the tubercle of the scaphoid, and to the medial part of the volar surface and the ridge of the trapezium.
- On its volar surface the tendons of the palmaris longus and flexor carpi ulnaris are partly inserted; below, it gives origin to the short muscles of the thumb and little finger (thenar and hypothenar muscles.



Flexor Retinaculum

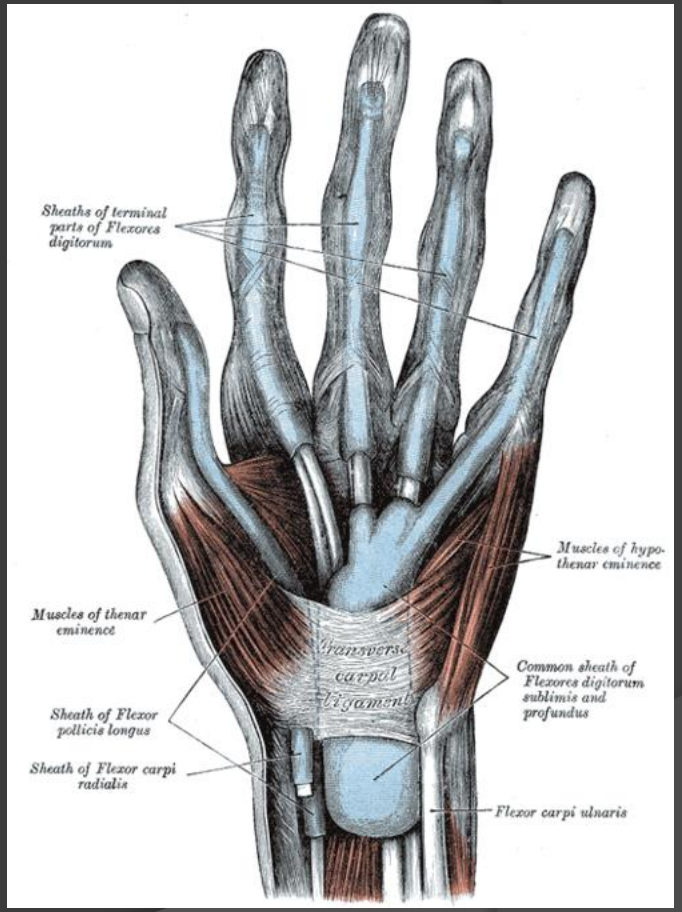
- Volar Carpal Ligament:
- AKA _ “Palmar Carpal Ligament”
- The volar carpal ligament is a different structure than the flexor retinaculum of the hand, but the two are frequently confused. The palmar carpal ligament lies superficial and proximal to the flexor retinaculum. The ulnar nerve and the ulnar artery run through the ulnar canal, which is deep to the palmar carpal ligament and superficial to the flexor retinaculum.

- The flexor retinaculum is continuous, superficially, with the volar carpal ligament; and deep, with the palmar aponeurosis. It is crossed by the ulnar vessels and nerve, and the cutaneous branches of the median and ulnar nerves



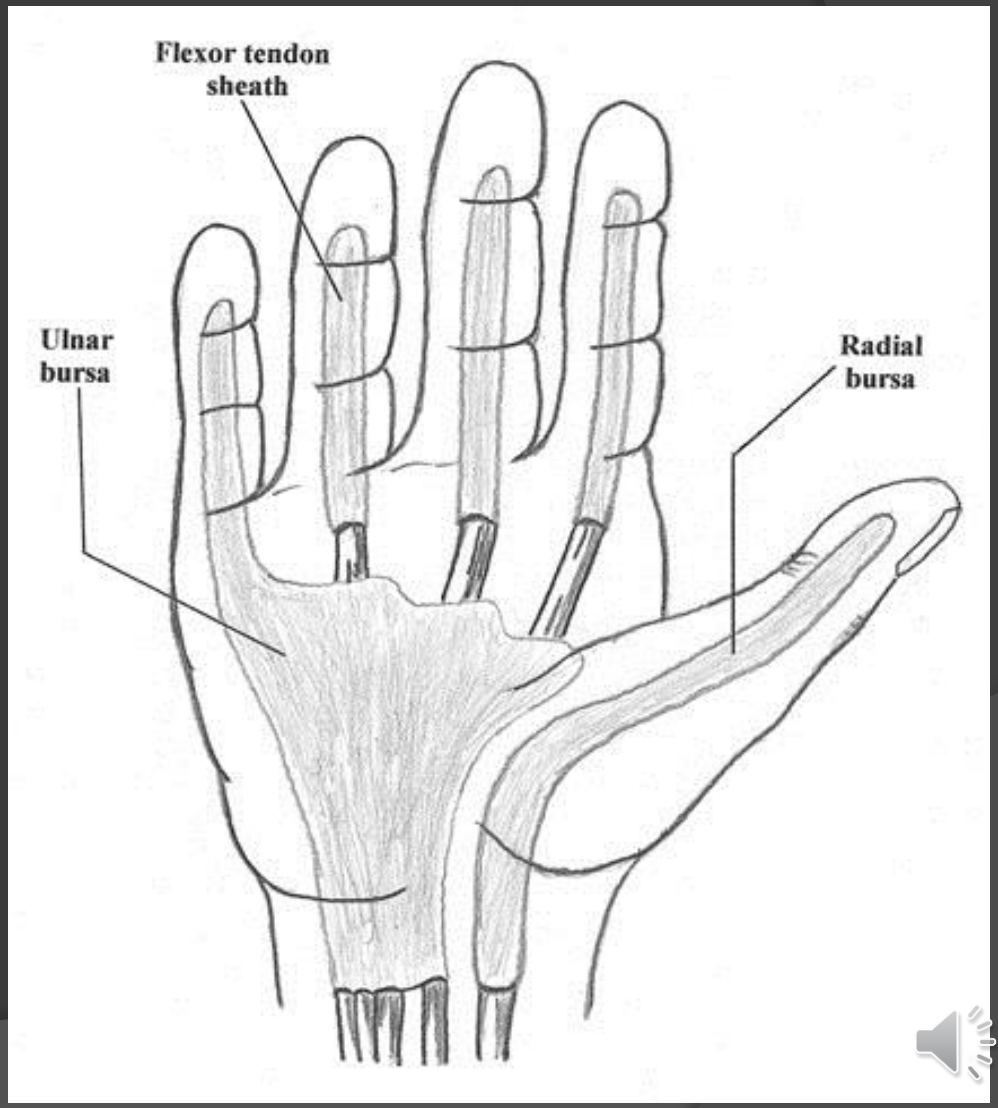
DEEP TO TRANSVERSE CARPAL LIGAMENT

- 9 Finger flexor tendons (of all fingers)
- Synovial sheaths - The **common synovial sheath for the flexor tendons** (a.k.a. "**ulnar bursa** is a synovial sheath in the carpal tunnel.
- It contains tendons of the FDS and the FDP (but not the FPL – which has its own tendon sheath).
- The sheath which surrounds the flexores digitorum extends downward about halfway along the metacarpal bones, where it ends in blind diverticula around the tendons to the index, middle, and ring fingers. It is prolonged on the tendons to the little finger and usually communicates with the mucous sheath of these tendons.



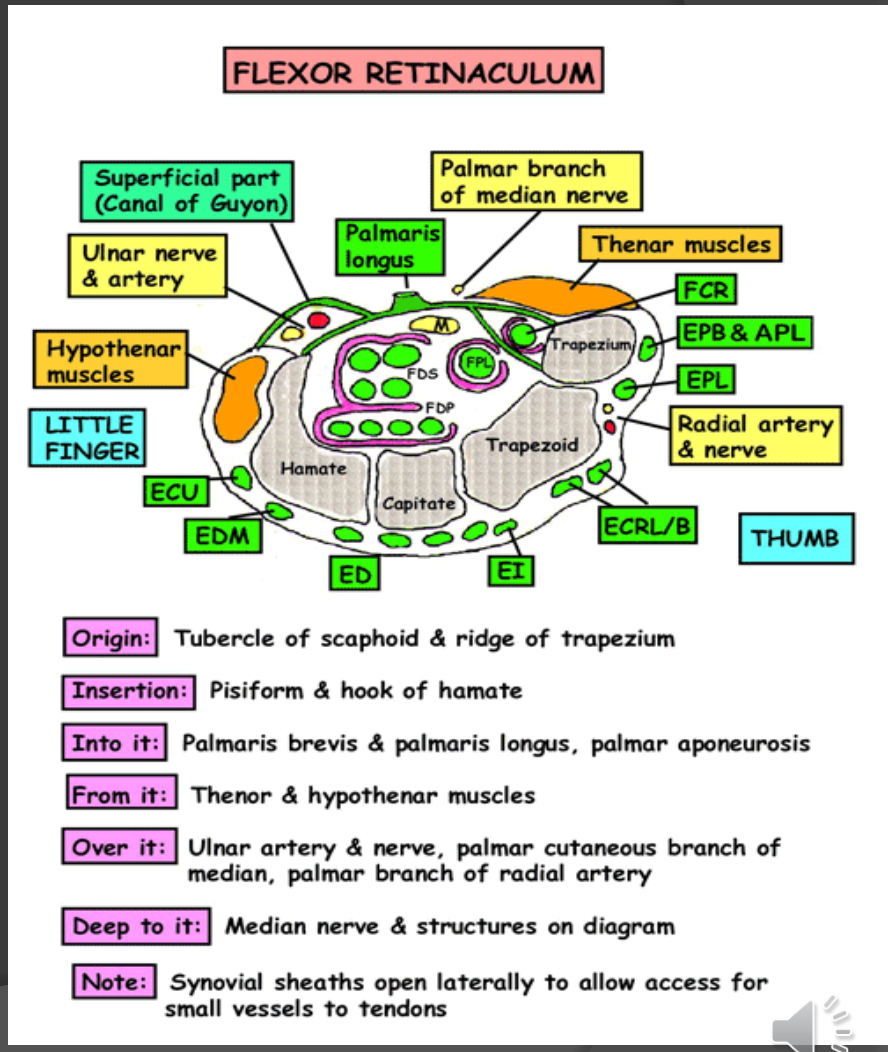
DEEP TO TRANSVERSE CARPAL LIGAMENT

- Radial Bursa:
- Is a continuation of the flexor pollicis longus tendon sheath through the flexor retinaculum to a level 2.5 cm above the wrist joint. This frequently communicates with the ulnar bursa.
- With tenosynovitis , the whole hand is edematous, the palm is moderately swollen, and there may a fullness immediately above the flexor retinaculum. Flexed fingers resist extension, particularly the little finger.



CARPAL TUNNEL CONTENTS

- Median Nerve
- 4 tendons of FDS
- 4 tendons of FDP
- 1 tendon of FPL



CARPAL TUNNEL SYNDROME

- Symptoms – both sensory and motor:
  - Frequent burning, tingling, or itching numbness in the palm of the hand and the fingers, especially the thumb and the index and middle fingers.
  - Fingers feel useless and swollen (clumsy), even though little or no swelling is apparent.
  - The symptoms often first appear in one or both hands during the night, since many people sleep with flexed wrists. A person with carpal tunnel syndrome may wake up feeling the need to "shake out" the hand or wrist. As symptoms worsen, people might feel tingling during the day.
  - Decreased grip strength may make it difficult to form a fist, grasp small objects, or perform other manual tasks. In chronic and/or untreated cases, the muscles at the base of the thumb may waste away. Some people are unable to tell between hot and cold by touch.

Summary of Function of Median, Radial, and Ulnar Nerves	Nerve	Simplified Tests of Muscle Action
	Median Nerve	Thumb abduction (APB) Thumb opposition (OP)
	Radial Nerve	Thumb extension (EPL & EPB)
	Ulnar Nerve	Thumb adduction (Adductor Pollicis)

	Ulnar Claw Hand	Benediction Hand
Nerve Involved	Ulnar nerve at the wrist	Median Nerve at the elbow or wrist
Typical Presentation	Appears in long standing case of nerve damage	Appears when examinee attempts to make a fist
Digits Affected	Little and ring	Middle and index
Muscles Paralyzed	Medial Two lumbricals (flex MCP joints and extend IP joints)	FDP to 1st and 2nd fingers
Movements Involved	Unopposed extension at the MCP joints Unopposed flexion at the IP joints	Inability to flex the MCP and IP joints of the 1st and 2nd fingers
		

QME EXAM PROCEDURES

- Upper Extremity Examination:
  - Neurologic Components
    - Sensory Exam – light touch, pain, two point discrimination
    - Motor Exam – manual muscle testing of the muscles innervated by the named peripheral nerves
    - Reflex Exam – biceps/brachioradialis/triceps
    - Girth measurements – 10 cm. above and 10 cm. below the elbow joint.

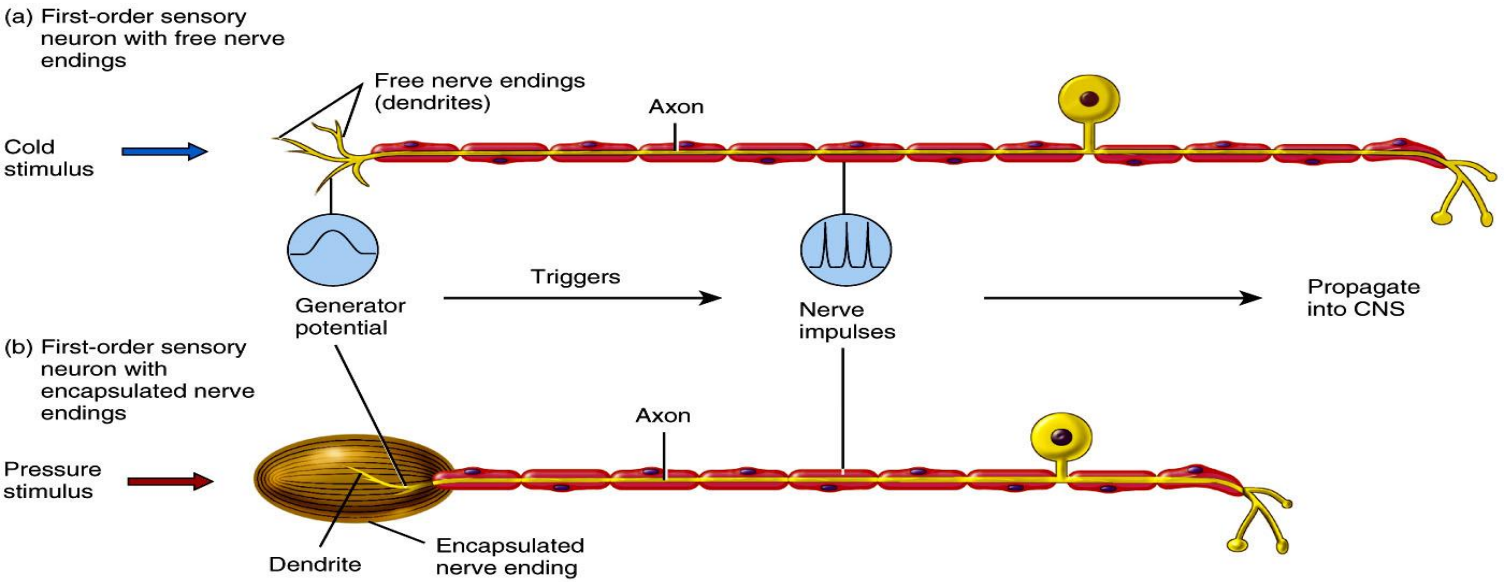
QME EXAM PROCEDURES – SENSORY EXAM

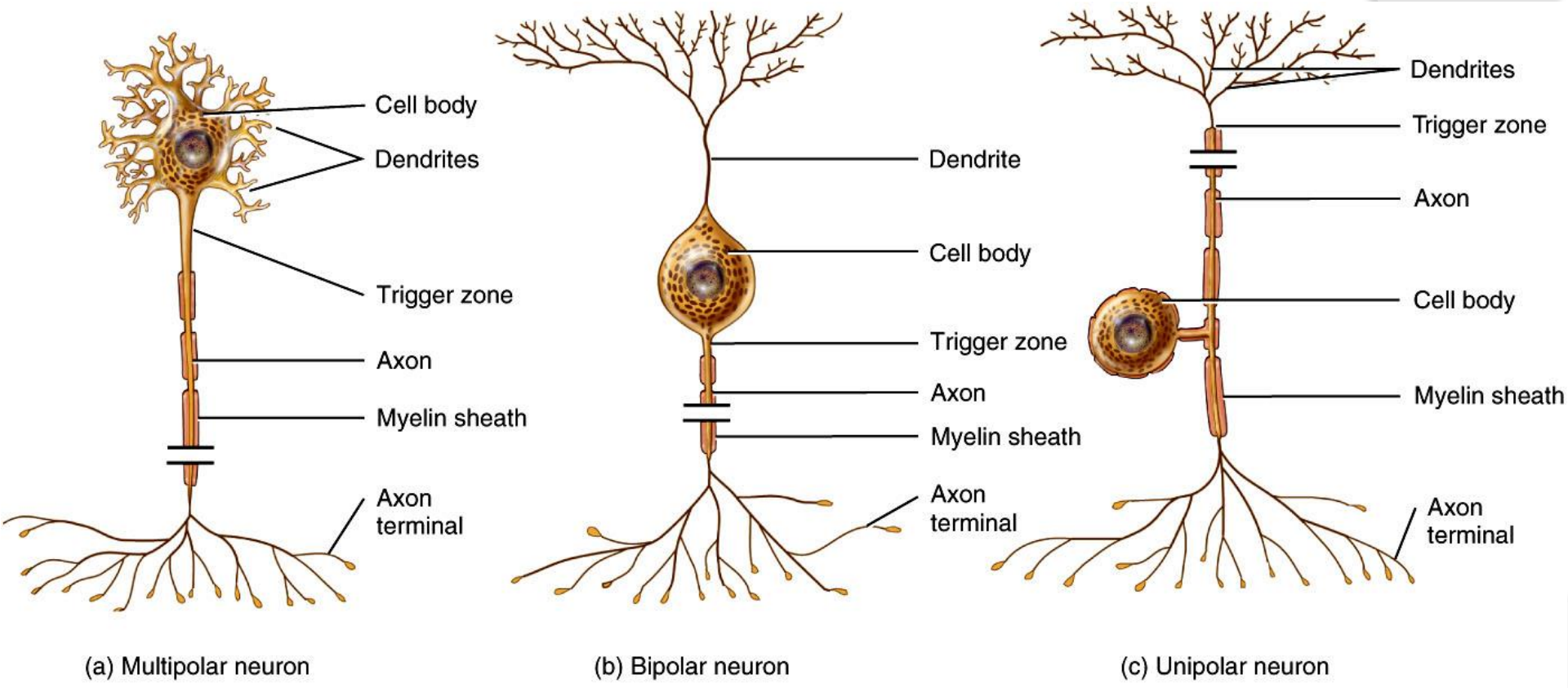
- Sensory examination:
- 2 basic classifications of sensory receptors that we will be involved with –

1. Unencapsulated Receptors
2. Encapsulated Receptors

QME EXAM PROCEDURES – SENSORY EXAM

- Brief Review of Sensory receptors
  - Unencapsulated Receptors
    - Free Nerve Endings
  - Encapsulated Receptors
    - Meissner corpuscles
    - Ruffini corpuscles
    - Pacini corpuscles
    - Krause end bulbs
    - Golgi tendon organs
    - Muscle spindles


(a) First-order sensory neuron with free nerve endings
Free nerve endings (dendrites)
Axon
Cold stimulus
Generator potential
Triggers
Nerve impulses
Propagate into CNS
(b) First-order sensory neuron with encapsulated nerve endings
Axon
Pressure stimulus
Dendrite
Encapsulated nerve ending



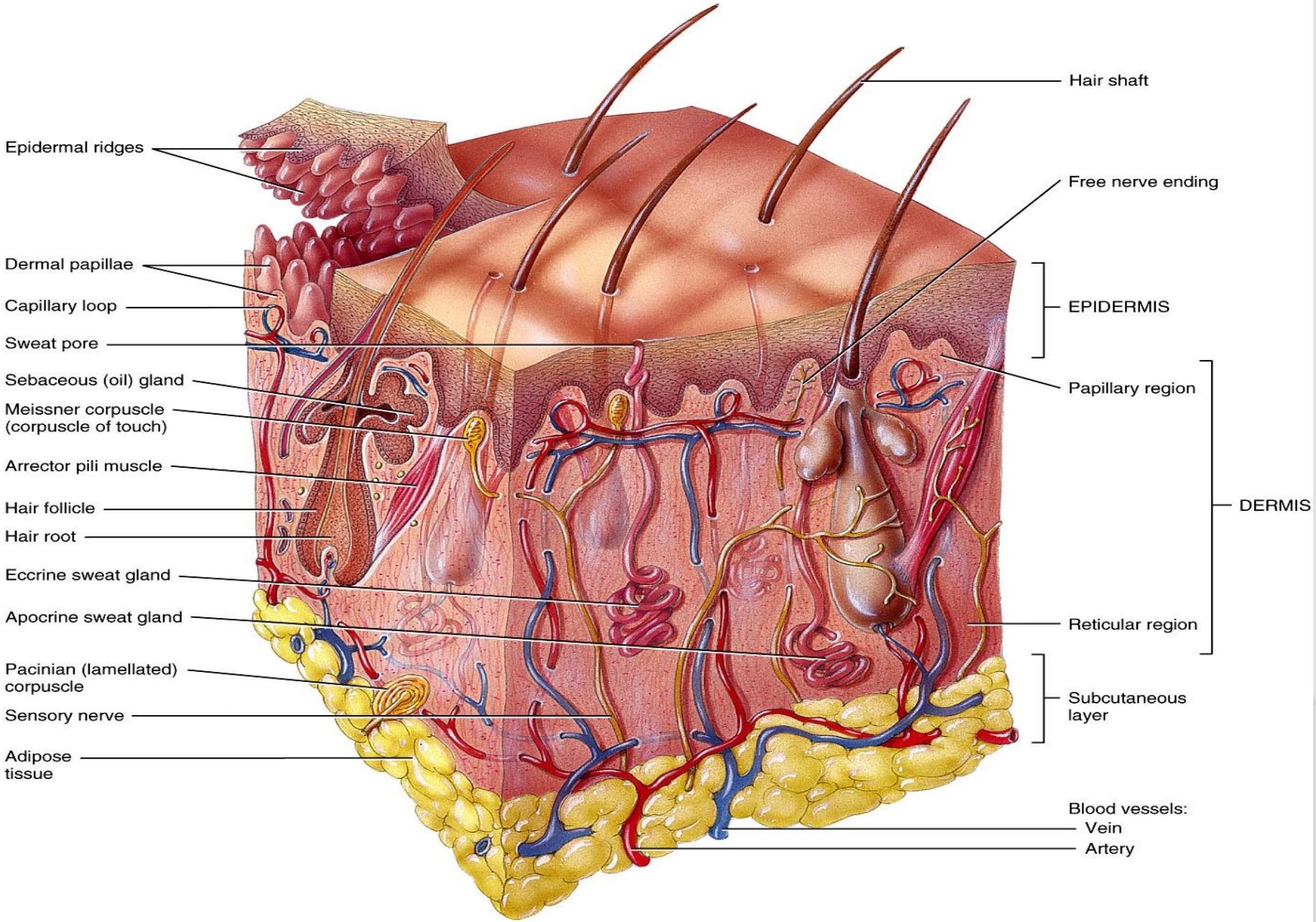
(a) Multipolar neuron

(b) Bipolar neuron

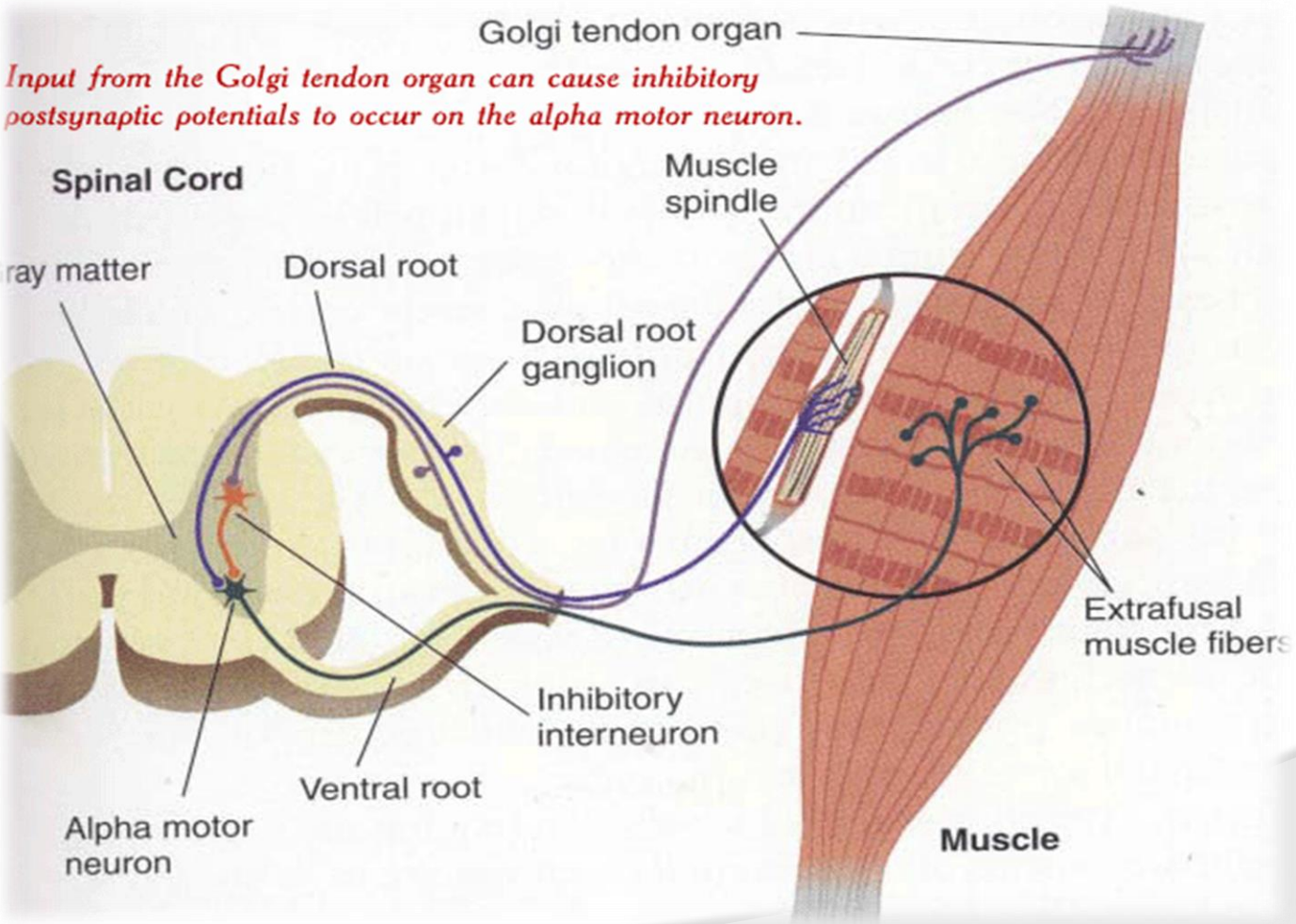
(c) Unipolar neuron

Free NN. Endings (unencapsulated)	Skin & Mucosa (Epithelial layer)	Pain, crude touch, temp., itch, tickle
Meissner Corpuscles (encapsulated)	Skin (papillae of dermis), fingertips/lips	Fine touch, low freq. vibration
Ruffini corpuscles (encapsulated)	Skin (dermis) and subcutaneous tissue of fingertips	Touch and pressure
Pacini corpuscles (encapsulated)	Subcutaneous tissues, around joints	Pressure and high freq. vibration

Krause End Bulbs (encapsulated)	Skin (dermis), subcutaneous tissue, mucosa of lips, eyelids, external genitals	Touch
Golgi Tendon Organs	Musculotendinous junction	Proprioception (sense of muscle tension)
Muscle Spindles	Skeletal muscles	Proprioception (sense of muscle length and sense of rate of change of length)



(a) Sectional view of skin and subcutaneous layer


Golgi tendon organ
Input from the Golgi tendon organ can cause inhibitory postsynaptic potentials to occur on the alpha motor neuron.
Spinal Cord
Muscle spindle
ray matter
Dorsal root
Dorsal root ganglion
Extrafusal muscle fibers
Inhibitory interneuron
Ventral root
Alpha motor neuron
Muscle

QME EXAM PROCEDURES – SENSORY EXAM

The Sensory Examination consists of procedures to test the sensory modalities of light touch, pain, two point discrimination, and joint position sense as follows:

Superficial Tactile Sensibility (Light Touch) – This Sensory Exam was performed using a Semmes Weinstein monofilament.

Pain - This Sensory Exam was performed using the Whartenburg pinwheel with sharp and dull sides.

Two Point Discrimination – This Sensory Examination was performed using the Aesthesiometer (Instrument) (Normal 2-4 mm. on the fingertips, 4-6 mm. on the dorsum of the fingers, 8-12 mm. on the palm, and 20-30 mm. on the dorsum of the hand.

Radial Nerve: Sensory

Normal sensation to light touch at the dorsal web space between thumb and index finger bilaterally.

Normal sensation to pinwheel and dull testing at the dorsal web space between thumb and index finger bilaterally.

Two point discrimination testing was xxx at the dorsal web space between thumb and index finger bilaterally.

QME EXAM PROCEDURES – SENSORY EXAM

Superficial Tactile Sensibility (Light Touch) – This Sensory Exam was performed using a Semmes Weinstein monofilament.

Pain - This Sensory Exam was performed using the Whartenburg pinwheel with sharp and dull sides.

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Ulnar Nerve: Sensory

Normal sensation to light touch at the distal ulnar aspect of the little finger bilaterally.

Normal sensation to pinwheel and dull testing at the distal ulnar aspect of the little finger bilaterally.

Two point discrimination testing was at the distal ulnar aspect of the little finger bilaterally.

Median Nerve: Sensory

Normal sensation to light touch at the distal radial aspect of the index finger bilaterally.

Normal sensation to pinwheel and dull testing at the distal radial aspect of the index finger.

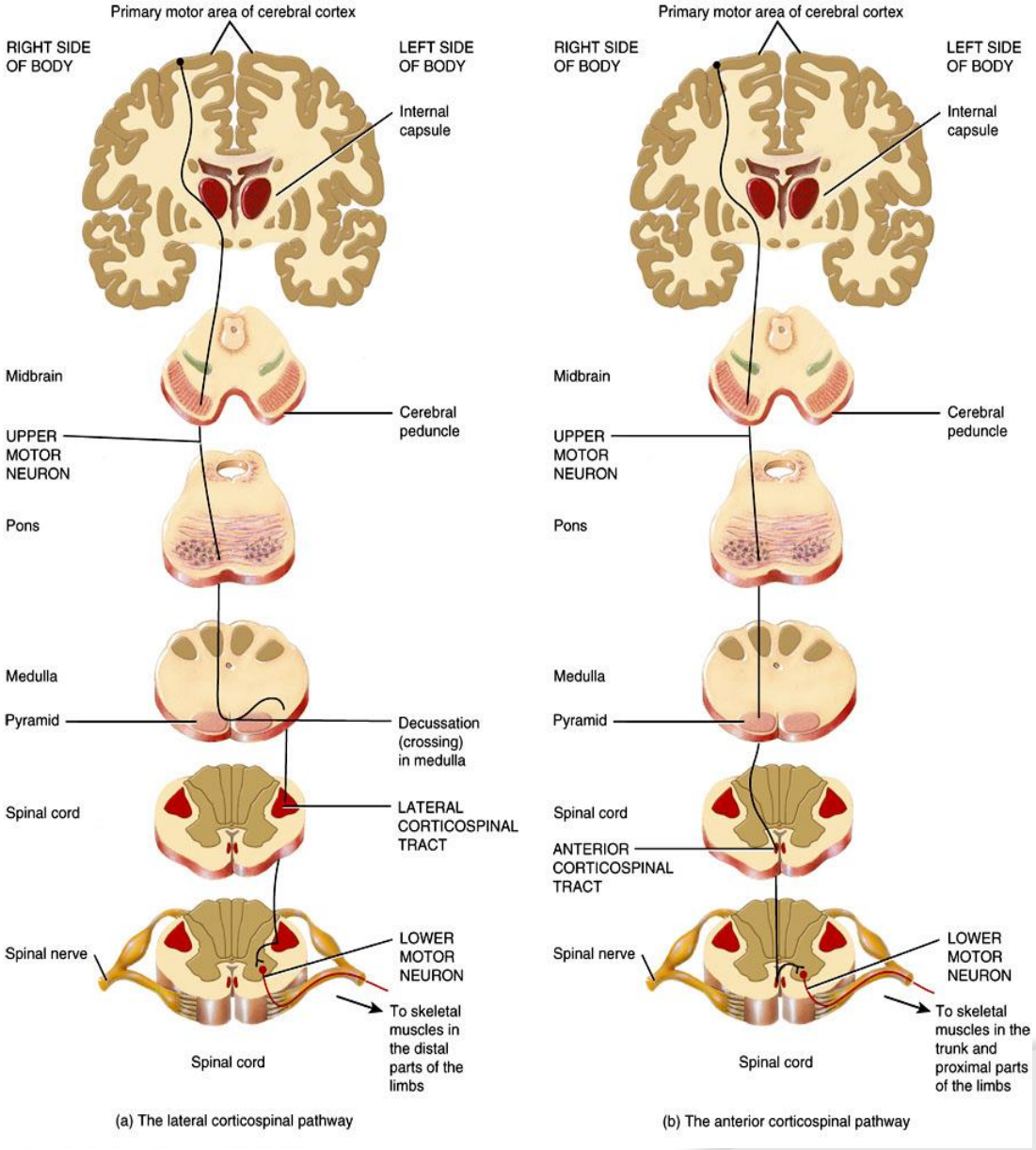
Two point discrimination testing was at the distal radial aspect of the index finger bilaterally.

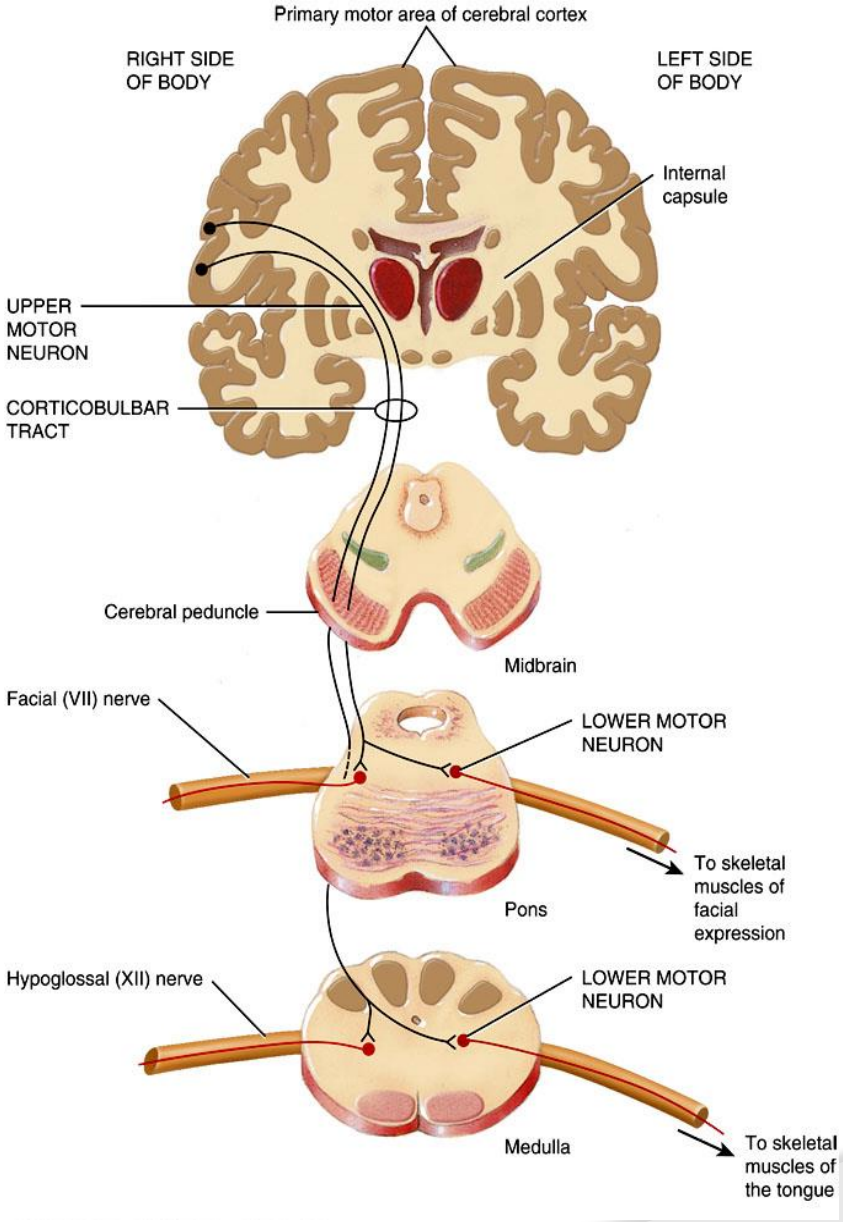
QME EXAM PROCEDURES – MOTOR EXAM

- Motor Examination – consists of:
  - Manual muscle testing)
  - Reflexes
  - Pathologic reflexes
  - Girth measurements.

QME EXAM PROCEDURES – MOTOR EXAM

- Manual muscle testing
  - AMA Guides: No specific mention of the technique for manual muscle testing
  - Other References:
  - Technique of the Neurologic Examination - DeMeyer
  - Fundamentals of Musculoskeletal Assessment Techniques – Palmer & Epler
  - Muscles: Testing and Function, with Posture and Pain – Florence Kendall (2005)
  - Muscle Testing – Techniques of Manual Examination – Daniels and Worthingham


Primary motor area of cerebral cortex
RIGHT SIDE OF BODY
LEFT SIDE OF BODY
Internal capsule
Midbrain
Cerebral peduncle
UPPER MOTOR NEURON
Pons
Medulla
Pyramid
Decussation (crossing) in medulla
Spinal cord
LATERAL CORTICOSPINAL TRACT
Spinal nerve
LOWER MOTOR NEURON
To skeletal muscles in the distal parts of the limbs
Spinal cord
(a) The lateral corticospinal pathway
Primary motor area of cerebral cortex
RIGHT SIDE OF BODY
LEFT SIDE OF BODY
Internal capsule
Midbrain
Cerebral peduncle
UPPER MOTOR NEURON
Pons
Medulla
Pyramid
Spinal cord
ANTERIOR CORTICOSPINAL TRACT
Spinal nerve
LOWER MOTOR NEURON
To skeletal muscles in the trunk and proximal parts of the limbs
Spinal cord
(b) The anterior corticospinal pathway


Primary motor area of cerebral cortex
RIGHT SIDE OF BODY
LEFT SIDE OF BODY
Internal capsule
UPPER MOTOR NEURON
CORTICOBULBAR TRACT
Cerebral peduncle
Midbrain
Facial (VII) nerve
LOWER MOTOR NEURON
To skeletal muscles of facial expression
Pons
Hypoglossal (XII) nerve
LOWER MOTOR NEURON
Medulla
To skeletal muscles of the tongue

QME EXAM PROCEDURES – MOTOR EXAM

- Procedures for Manual Muscle Testing:
- General Principles:
  1. Select movements for the examinee to resist that would just about match your arm and hand strength. Select movements that are neither too strong for you to possibly overcome nor too weak for you to judge their resistance.

QME EXAM PROCEDURES – MOTOR EXAM

- Manual Muscle Testing (cont.):

  2. Understand that muscles are strongest when acting from their shortest length, and have little or no strength when acting from their longest position. Therefore, to test muscle of weak or modest strength, start with the muscle in a position of strength. To test very strong muscles, place the muscle in a position of disadvantage to bring them within your own range of strength.

Technique of the QME Examination

- Manual Muscle Testing (cont.):

3. Engage the examinee and get their competitive spirit into the game. Encourage them to put forth their best effort.
4. Test in a repeatable superior to inferior direction.
5. Always stabilize the proximal joint to prevent muscle substitution.
6. Specific manual muscle tests for the spine and for the upper and lower extremity examinations and their methods are described in another module.

REPORTING YOUR FINDINGS

- The Motor Nerve Examination was completed with the use of resisted manual muscle testing of upper extremity muscles.

- Radial Nerve: Motor
- Resisted wrist extension using the extensor carpi radialis longus and brevis was strong and symmetric bilaterally with no evidence of weakness or give way. This tests the motor portion of the peripheral radial nerve.
- Resisted finger using the extensor digitorum communis, indicis and minimi were strong and symmetric bilaterally with no evidence of weakness or give way. This tests the motor portion of the peripheral radial nerve.

- Ulnar Nerve: Motor
- Resisted abduction of the little finger using the dorsal interossei and abductor digiti minimi was strong and symmetric bilaterally with no evidence of weakness or give way. This tests the motor portion of the peripheral ulnar nerve.
-

REPORTING YOUR FINDINGS

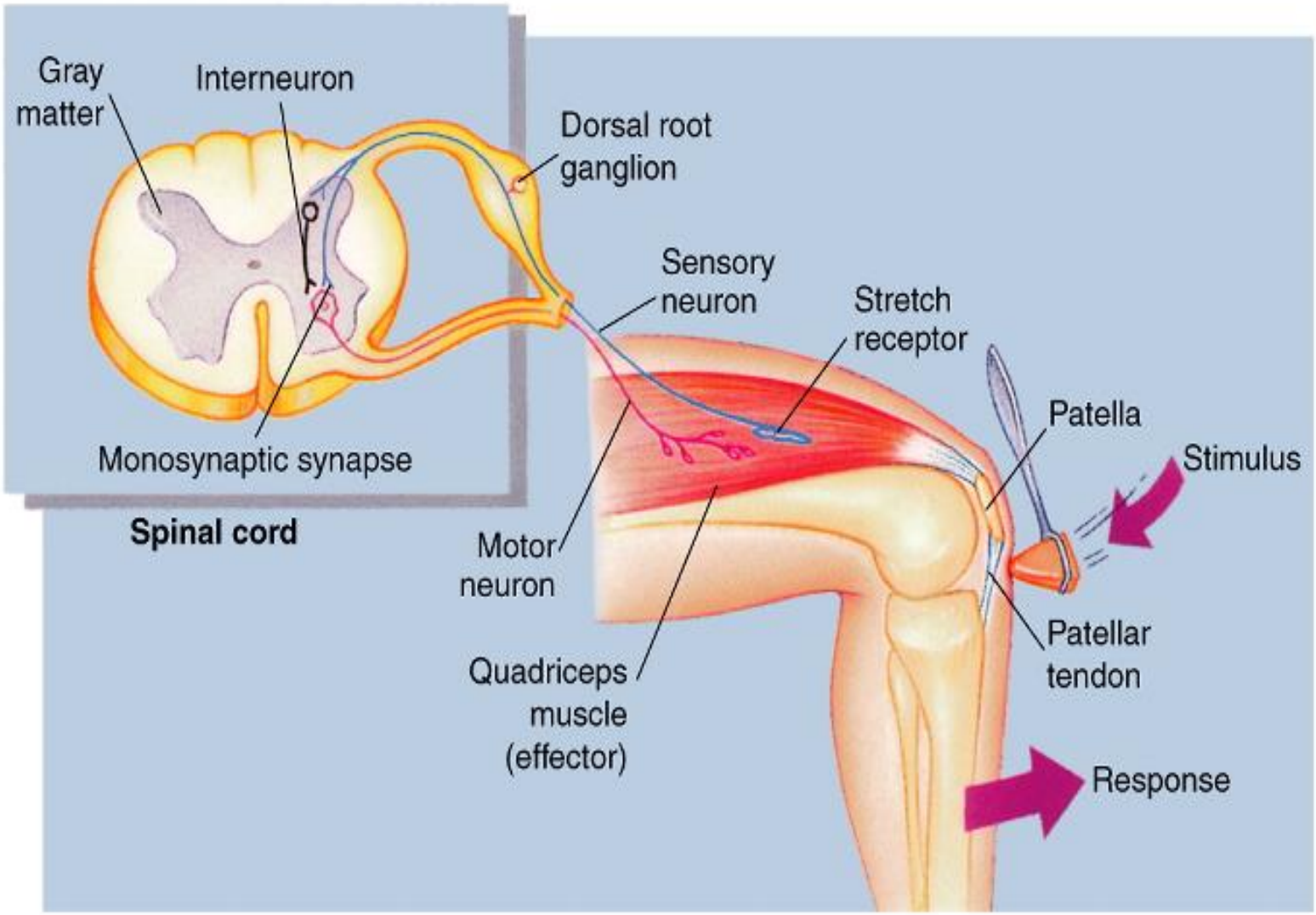
- Median Nerve: Motor
- Resisted thumb pinch using the lumbricales and interosseous muscles as well as the long flexors and extensors of the thumb and index finger was strong and symmetric bilaterally with no evidence of weakness or give way. This tests the motor portion of the peripheral median nerve.
- Resisted thumb opposition using the opponens pollicis and opponens digiti minimi was strong and symmetric bilaterally with no evidence of weakness or give way. This tests the motor portion of the peripheral median nerve.
- Resisted thumb adduction using the adductor pollicis (obliquus and transversus) was strong and symmetric bilaterally with no evidence of weakness or give way. This tests the motor portion of the peripheral median nerve.
-
- Axillary Nerve:
- Resisted arm abduction using the deltoid and supraspinatus muscles was strong and symmetric bilaterally with no evidence of weakness or give way. This tests the motor portion of the peripheral axillary nerve.
-
- Musculocutaneous Nerve.
- Resisted arm flexion using the biceps, brachialis and brachioradialis muscles was strong and symmetric bilaterally with no evidence of weakness or give way. This tests the motor portion of the peripheral musculocutaneous nerve.

QME EXAM PROCEDURES – MOTOR EXAM

- Upper Extremity Reflexes
- Components of a Reflex Arc:
  - 1. Stimulus – rapid stretch of muscle/tendon
  - 2. Receptors – muscle spindle in muscle (specialized dendrite)
    - Detect stimulus

Technique of the QME Examination

- 3. Sensory Nerve – impulses travel up dendrite to the nerve cell body – located (???) – axon ends in the spinal cord
- 4. Control center (brain or spinal cord) - Decides the correct response
- 5. Motor nerve – carries impulse back to the effector (muscle) – chemicals released from NMJ
- 6. Effector - A muscle or gland that carries out the response (quadricep – in the case of the knee reflex - muscle shortens)


Gray matter
Interneuron
Dorsal root ganglion
Sensory neuron
Stretch receptor
Patella
Stimulus
Monosynaptic synapse
Spinal cord
Motor neuron
Quadriceps muscle (effector)
Patellar tendon
Response
S
P
D
I

REFLEX	LEFT	RIGHT
Biceps (C5/Musculocutaneous nerve):	+2 (normal)	+2 (normal)
Extensor Digitorum (C6/Radial nerve):	+2 (normal)	+2 (normal)
Triceps (C7/Radial nerve):	+2 (normal)	+2 (normal)

REPORTING YOUR FINDINGS

The upper extremity reflexes were symmetric bilaterally. This indicates normal function of:
Left and right biceps muscle spindles (stretch receptors)
Left and right extensor digitorum muscle spindles (stretch receptors)
Left and right triceps muscle spindles (stretch receptors)
Left and right C5 sensory nerve root function
Left and right musculocutaneous (C5, C6, and C7) nerve sensory function
Left and right C6 sensory nerve root function
Left and right radial (C5, C6, C7, C8, T1) nerve sensory function
C5 level of spinal cord function
C6 level of spinal cord function
C7 level of spinal cord function
Left and right C5 motor nerve root function
Left and right musculocutaneous (C5, C6, C7) nerve motor function
Left and right C6 motor nerve root function
Left and right C7 motor nerve root function
Left and right radial (C5, C6, C7, C8, T1) motor nerve function
Left and right biceps muscle function
Left and right extensor digitorum muscle function
Left and right triceps muscle function.

This indicates preserved and intact function of cervical spine nerve roots and upper extremity peripheral nerves.

QME EXAM PROCEDURES – MOTOR EXAM

- Girth Measurements:
- 10 cm. above and 10 cm. below elbow -

QME EXAM PROCEDURES

- Special Tests for ULNAR NERVE:
  - Cubital Tunnel:
    - Tinel's Sign: Tapping/even palpating over the nerve
    - Elbow Flexion Test: Maximum forearm flexion with slight overpressure
  - Guyon's Canal:
    - Tinel's Sign:
    - Fromet's Sign
  - Muscle Tests:
    - Resisted abduction of the little finger using the abductor digiti minimi.

QME EXAM PROCEDURES

- Special Tests for RADIAL NERVE:
  - Muscle Tests:
    - Resisted elbow flexion testing the brachialis (musculocutaneous small branch of radial nerve, and C5 and C6 nerve roots), and the brachioradialis (radial nerve, and C6 and C7 nerve roots).
    - Resisted elbow extension testing the triceps brachii (radial nerve, and C7 and C8 nerve roots) and the anconeus (radial nerve, and C7 and C8 nerve roots).
    - Resisted elbow supination testing the supinator (radial nerve, and C5 and C6 nerve roots).
    - Resisted wrist extension using the extensor carpi radialis longus and brevis.
    - Resisted finger extension using the extensor digitorum communis, extensor indicis, and extensor digiti minimi.

CTS EXAMINATION MANEUVERS - QME

- Observation: Atrophy of the thenar pads of either hand. Examinee observed to shake out or wring hands at periodic intervals?
- Hand Pain Diagram (see above ACTIVITIES OF DAILY LIVING ASSESSMENTS & SYMPTOM QUESTIONNAIRES):
- Phalen's Test: positive/negative for wrist pain, or numbness/tingling/paresthesia in the hand?
- Reverse Phalen's sign – positive/negative for wrist pain, or numbness/tingling/paresthesia in the hand.
- Tinel's Test: positive/negative for distal pain or tingling sensation into the hand.
- Durkan’s Compression Test – positive/negative for distal pain or tingling sensation into the thumb, index, middle, or lateral half of the ring finger.
- Three-Jaw Chuck Test: positive/negative for wrist pain or numbness/tingling/paraesthesia in the hand.

CTS EXAMINATION MANEUVERS - QME

- Square Wrist Sign: Thickness of the wrist was mm. Width of the wrist was mm. The ratio of the thickness of the wrist divided by the width (thickness/width) of the wrist was . According to the ACOEM Guides (page 261), this ratio should be less than .7.
- Thumb Abduction Strength: Grade muscle strength from +5 to 0. 5 = Complete active range of motion against gravity and full resistance. 4 = Complete active range of motion against gravity and some resistance. 3 = Complete active range of motion against gravity only, with no resistance. 2 = Complete active range of motion with gravity eliminated. 1 = Evidence of slight contractility, no joint motion. 0 = No evidence of contractility.
- Thumb Opposition Strength: Grade muscle strength from +5 to 0.
- Median Nerve Sensory Examination:
  - Normal sensation to light touch at the distal radial aspect of the index finger bilaterally.
  - Two point discrimination testing was 6 mm. at the distal radial aspect of the index fingers bilaterally. This is a normal finding.

QME EXAM PROCEDURES

- Special Tests for CTS:
  - Muscle Tests (Median Nerve Motor):
    - Resisted thumb pinch using the lumbricales and interosseous muscles as well as the long flexors of the thumb and index finger.
    - Resisted thumb opposition using the opponens pollicis and opponens digiti minimi.
    - Resisted thumb abduction using the abductor pollicis brevis.

DETERMINING PERMANENT IMPAIRMENT DUE TO UPPER EXTREMITY PERIPHERAL NEUROPATHIES

The Neurologic Examination

- Necessary Tools:
- Cloth Measuring Tape – for measuring circumferences, length of extremities, etc.
- Tuning Fork (256 cps) – for testing vibratory sensation, for testing temperature discrimination, for testing hearing
- Semmes-Weinstein Filaments – 2.36 gauge, and others up to 6.31 gauge
- Pinwheel – for testing pain sensation
- Aesthesiometer – for testing 2 point discrimination
- Reflex hammer – for testing muscle stretch reflexes

PERMANENT IMPAIRMENT DUE TO ENTRAPMENT NEUROPATHIES

- AMA Guides (page 493):
  - “Only individuals with an objectively verifiable diagnosis should qualify for a permanent impairment rating. The diagnosis is made not only on believable symptoms but, more important, and on the presence of positive clinical findings and loss of function.
  - The diagnosis should be documented by electromyography as well as sensory and motor nerve conduction studies.
  - …There is no correlation between the severity of conduction delay on nerve conduction velocity testing and the severity of either symptoms or impairment rating.”

PERMANENT IMPAIRMENT DUE TO ENTRAPMENT NEUROPATHIES

- AMA Guides (page 480):
- "The evaluation of Permanent Impairment resulting from peripheral nerve disorders is based on the anatomic distribution and severity of loss of function resulting from:
  1. Sensory deficits, or PAIN
  2. Motor deficits (DEFINE "MOTOR DEFICITS") or LOSS OF POWER

PERMANENT IMPAIRMENT DUE TO ENTRAPMENT NEUROPATHIES

- AMA Guides (page 480):
- Impairments due to Peripheral Nerve lesions stand alone. Already considered in the Impairment are:
  - Loss of range of motion
  - Atrophy
  - Vasomotor and trophic changes
  - Reflex changes

- "Vasomotor and/or Trophic changes:
  - The radial and ulnar pulses were equal and bounding bilaterally.
  - There were no Physical signs (localized blanching of one or more of the fingers, cyanosis, and/or erythema) of Raynaud's disease of the hands or upper extremities .
  - There was no edema in the forearms, wrist, hands, or fingers bilaterally.
  - There were no signs (loss of subcutaneous tissue of the fingertips, dilation of veins or arteries, or ulcerations) of vascular damage of either upper extremity.
  - Allen's vascular fill test was normal (less than 5 seconds) bilaterally.

PERMANENT IMPAIRMENT CALCULATION

- AMA Guides page 481:
  - Grade severity of sensory deficit (Table 16-10a on page 482)
  - Grade severity of motor deficit (Table 16-11a on page 484)
  - Combine Impairments (using Combined Values Chart on page 604):
    - Combine 1) Sensory Impairments with 2) Motor Impairments for nerves with motor & sensory fibers
    - Combine Sensory and/or motor impairments of one nerve with sensory and/or motor impairments of another nerve in the event of multiple nerve involvements
  - Convert Upper Extremity Impairment to WPI with Table 16-3.

GRADING SENSORY DEFICIT

- Steps 1&2: Identify area of involvement (Figure 16-48). Identify the nerve structure(s) innervating that area.
  - Anterior aspect of upper extremity:
    - Supraclavicular nerve
    - Axillary Nerve
    - Intercostobrachial nerve
    - Medial brachial cutaneous
    - Medial antebrachial cutaneous
    - Musculocutaneous nerve (Lateral antebrachial cutaneous branch)
    - Radial nerve
    - Median nerve
    - Ulnar nerve

GRADING SENSORY DEFICIT

- Steps 1&2: Identify area of involvement (Figure 16-48). Identify the nerve structure(s) innervating that area.
  - Posterior aspect of upper extremity:
    - Supraclavicular nerve
    - Axillary nerve
    - Medial brachial cutaneous
    - Posterior brachial cutaneous
    - Inferior lateral brachial cutaneous
    - Medial antebrachial cutaneous
    - Posterior antebrachial cutaneous
    - Musculocutaneous (Lateral antebrachial cutaneous branch)
    - Ulnar
    - Radial
    - Median

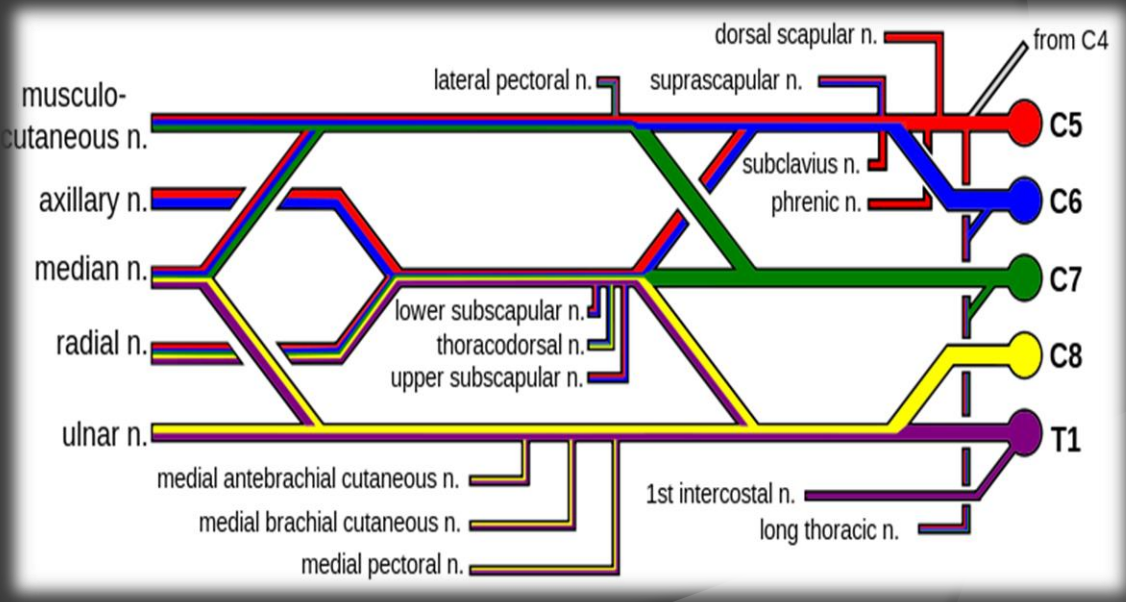
GRADING SENSORY DEFICIT

- Step 3: Grade *severity* of the sensory deficit – or pain – according to Table 16-10a on page 482

Grade	Description of Sensory Deficit, or Pain – Table 16-10a	% Sensory Deficit
5	No loss of sensibility, abnormal sensation, or pain	0%
4	Distorted superficial tactile sensibility (diminished light touch), with or without minimal abnormal sensations or pain, that is forgotten during activity.	1-25%
3	Distorted superficial tactile sensibility (diminished light touch and diminished two point discrimination), with some abnormal sensations, or slight pain, that interferes with some activities. Normal two point discrimination is 2-4 mm. on the fingertips, 4-6 mm. on the dorsum of the fingers, 8-12 mm. on the palm, and 20-30 mm. on the dorsum of the hand. For median nerve, test on the distal radial tip of the index finger (should be 2-4 mm.). For the ulnar nerve, test on the distal ulnar tip of the pinky finger. For radial nerve, test on the dorsal 1st web space (should be 4-30 mm. = large range). Make sure to compare bilaterally.	26-60%
2	Decreased superficial cutaneous pain and tactile sensibility (decreased protective sensibility), with abnormal sensations or moderate pain, that may prevent some activities.	61-80%
1	Deep cutaneous pain sensibility present, absent superficial pain and tactile sensibility (absent protective sensibility), with abnormal sensations or severe pain, that prevents most activity.	81-99%
0	Absent sensibility, abnormal sensations, or severe pain that prevents all	100%

GRADING SENSORY DEFICIT

- Step 4: Determine the maximum upper extremity impairment value (for the particular nerve(s) involved) due to sensory deficit or pain according to Table 16-15. Example – Medial Pectoral Nerve



Pure Sensory Nerves	Pure Motor Nerves	Combined Sensory and Motor Nerves
Medial antebrachial cutaneous	Medial Pectoral Nerve	Axillary Nerve
Medial brachial cutaneous	Lateral Pectoral Nerve	Median (above mid forearm)
Median Nerve (palmar digitals)	Dorsal scapular nerve	Median (below mid forearm)
Ulnar Nerve (palmar digitals)	Long Thoracic Nerve	Musculocutaneous
	Median (anterior interosseous branch)	Radial (with loss of triceps)
	Subscapularis	Radial (no loss of triceps)
	Thoracodorsal	Suprascapular
		Ulnar (above midforearm)
		Ulnar (below midforearm)

GRADING SENSORY DEFICIT

- Step 5: Multiple the % *severity deficit* (Step 3) by the maximum upper extremity impairment value (Step 4) to obtain the Upper Extremity Impairment.
- Step 6: Do this for each nerve structure involved.

GRADING MOTOR DEFICIT

Steps 1&2: Identify the *Motor Deficit.* AMA Guides describe "Motion Involved" (meaning the loss of motion) – to determine which muscles, and therefore, which nerves, are involved. This would also apply to other aspects of "motor deficits."

Use Table 16-12 to determine which muscle, and therefore, which nerve is involved.

Example: Loss of shoulder abduction (middle deltoid). Table 16-12 tells us this is the "anterior branch" of the axillary nerve.

GRADING MOTOR DEFICIT

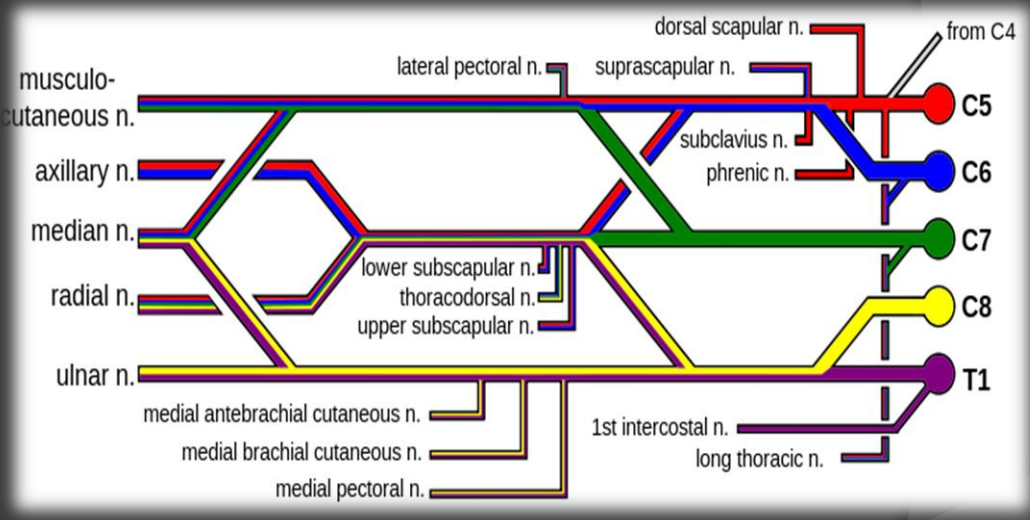
Step 3:

- Grade the *severity* of the motor deficit of each of the individual muscles involved.

Grade	Description of Muscle Function	% Motor Deficit
5	“Complete active range of motion” against gravity with full resistance (may be modified in cases where ROM is not “full” although the restriction to ROM is not due to dysfunction of the nerve.	0%
4	“Complete active range of motion” against gravity with some resistance	1-25%
3	“Complete active range of motion” against gravity only, without resistance	26-50%
2	“Complete active range of motion” with gravity eliminated	51-75%
1	Evidence of slight contractility: no joint movement	76-99%
0	No evidence of contractility	100%

GRADING MOTOR DEFICIT

- Step 4:
  - Determine the maximum upper extremity impairment value (for the particular nerve(s) involved) due to motor deficit (loss of power) according to Table 16-15. Example – Medial Antebrachial Cutaneous Nerve – has no motor deficit because it is a sensory only nerve



Pure Sensory Nerves	Pure Motor Nerves	Combined Sensory and Motor Nerves
Medial antebrachial cutaneous	Medial Pectoral Nerve	Axillary Nerve
Medial brachial cutaneous	Lateral Pectoral Nerve	Median (above mid forearm)
Median Nerve (palmar digitals)	Dorsal scapular nerve (rhomboids/levator scapulae)	Median (below mid forearm)
Ulnar Nerve (palmar digitals)	Long Thoracic Nerve (serratus anterior)	Musculocutaneous
	Median (anterior interosseous branch) (FDP to index & middle finger)	Radial (with loss of triceps)
	Subscapularis (teres major and subscapularis)	Radial (no loss of triceps)
	Thoracodorsal (latissimus dorsi)	Suprascapular
		Ulnar (above midforearm)

GRADING MOTOR DEFICIT

- Step 5:
  - Multiply the % *severity of the motor deficit* (Step 3) by the maximum upper extremity impairment value (Step 4) to obtain the Upper Extremity Impairment.
- Step 6: Do this for each nerve structure involved.

TOTAL UPPER EXTREMITY IMPAIRMENT

- Combine Impairments (using Combined Values Chart on page 604):
  - Combine 1) Sensory Impairments with 2) Motor Impairments for nerves with motor & sensory fibers
  - Combine Sensory and/or motor impairments of one nerve with sensory and/or motor impairments of another nerve (with sensory and/or motor impairments) in the event of multiple nerve involvements
- Convert Upper Extremity Impairment to WPI with Table 16-3.

PERMANENT IMPAIRMENT RATINGS DUE TO ENTRAPMENT NEUROPATHIES

- Final Note (AMA Guides page 484):
  - “The examiner must use clinical judgment to estimate the appropriate percentage of motor deficits and loss of power within the range of values shown for each severity grade. It is important to ascertain that weakness is due to loss of nerve function before using these Tables. Weakness may be due to many causes, including pain, and Table 16-11 is not to be used for rating weakness that is not due to a diagnosed injury of a specific nerve or nerves. A diagnosis of nerve injury can usually be made by a careful physical examination done by an examiner who has sufficient knowledge of the anatomy and function of the part. …Note that Grade 4 covers a wide range of weakness, from minimal detectable weakness to severe weakness in which the muscles are functional through a full range with only very slight resistance. The degree of weakness should be rated from 1% to 25% depending on the degree within this grade.”

FINAL REMINDER

- This is Dr. Perry Carpenter. I want to thank you for joining me. I hope you enjoyed the course and I look forward to being with you again for a future course. If ever our paths shall met, I look forward to speaking with you and learning some of your best QME Secrets. For now, I have 2 final instructions:
- 1. When you are done with your Course Examination, fax (530-295-9196) or email (admin@ezqmece.com) your Examination and your credit for the course will be immediately processed.
- 2. Remember to visit www.ezqmece.com for products designed to make your QME Reports more powerful and persuasive.