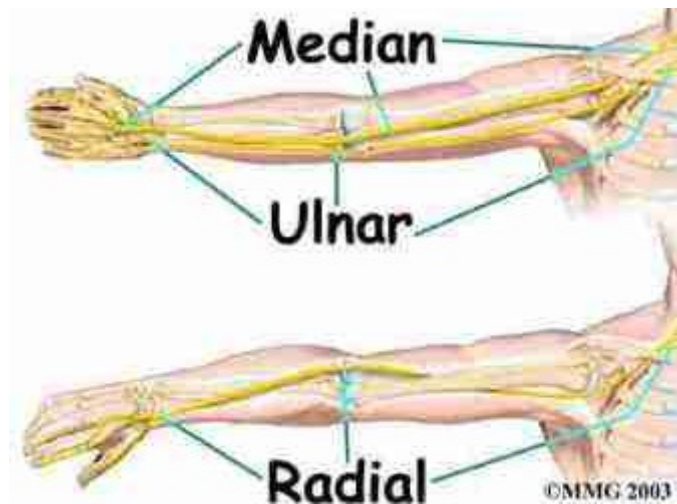


Nerves of the Upper Limb



Mgr. Veronika Mrkvicová (physiotherapist)

Nerves of the Upper Limb

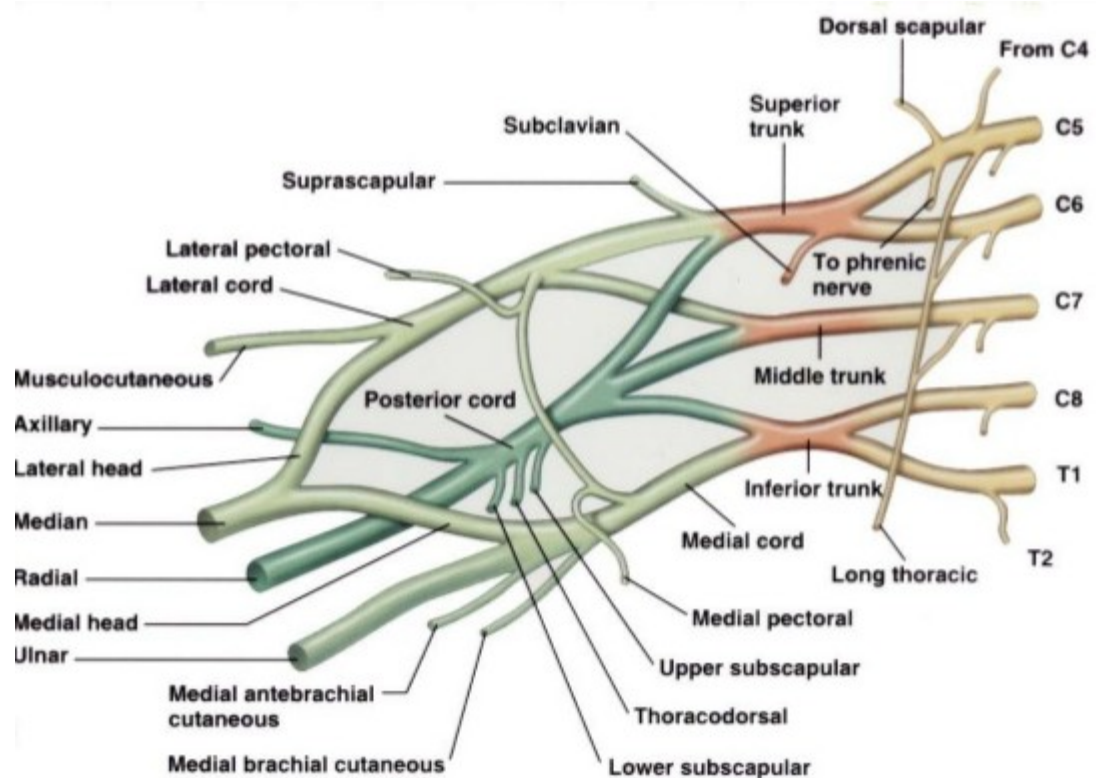
1. Axillary nerve
2. Musculocutaneous nerve
3. Radial nerve
4. Median nerve
5. Ulnar nerve

Brachial plexus

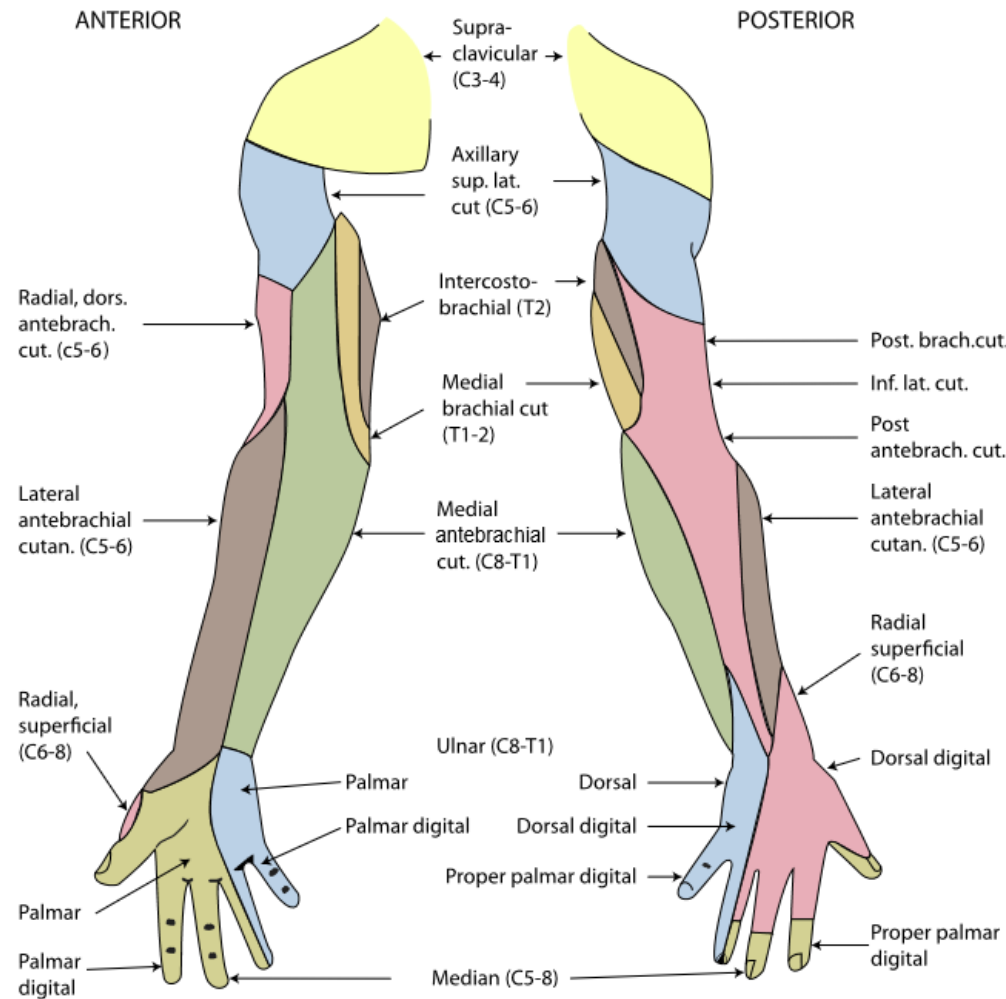
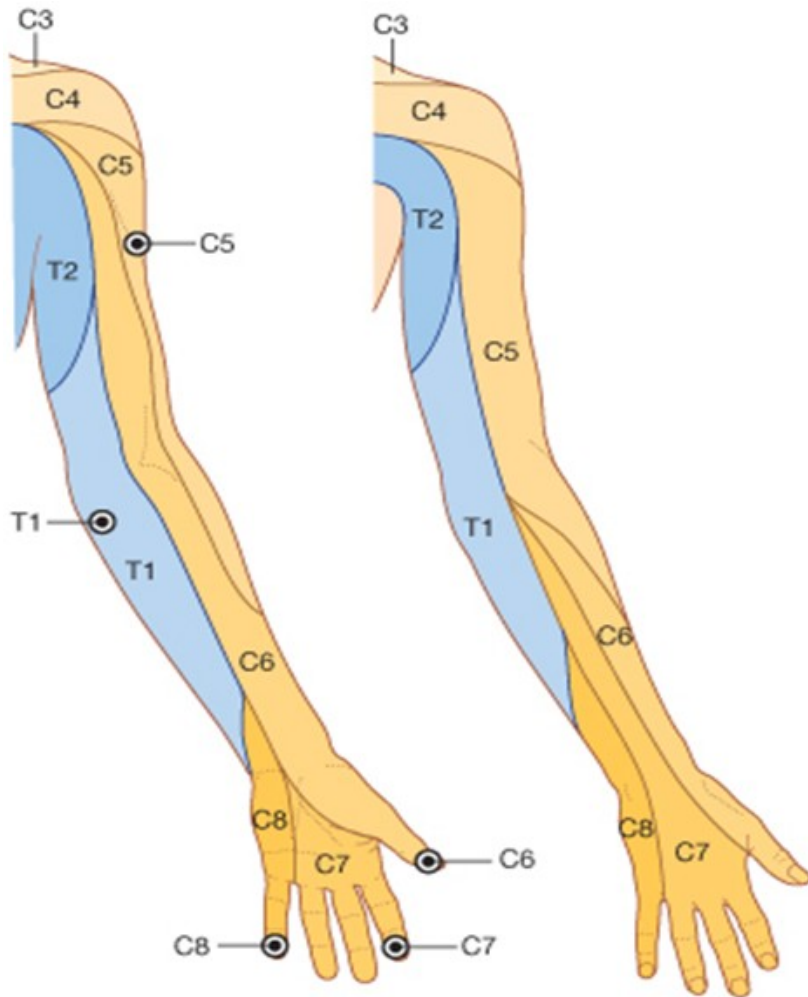
- Networking of spinal nerves, formed by ventral (anterior rami) of cervical spinal nerves C5-C8 and thoracic spinal nerves T1
- It is responsible for cutaneous (sensory) and muscular (motor) innervation of the entire upper limb

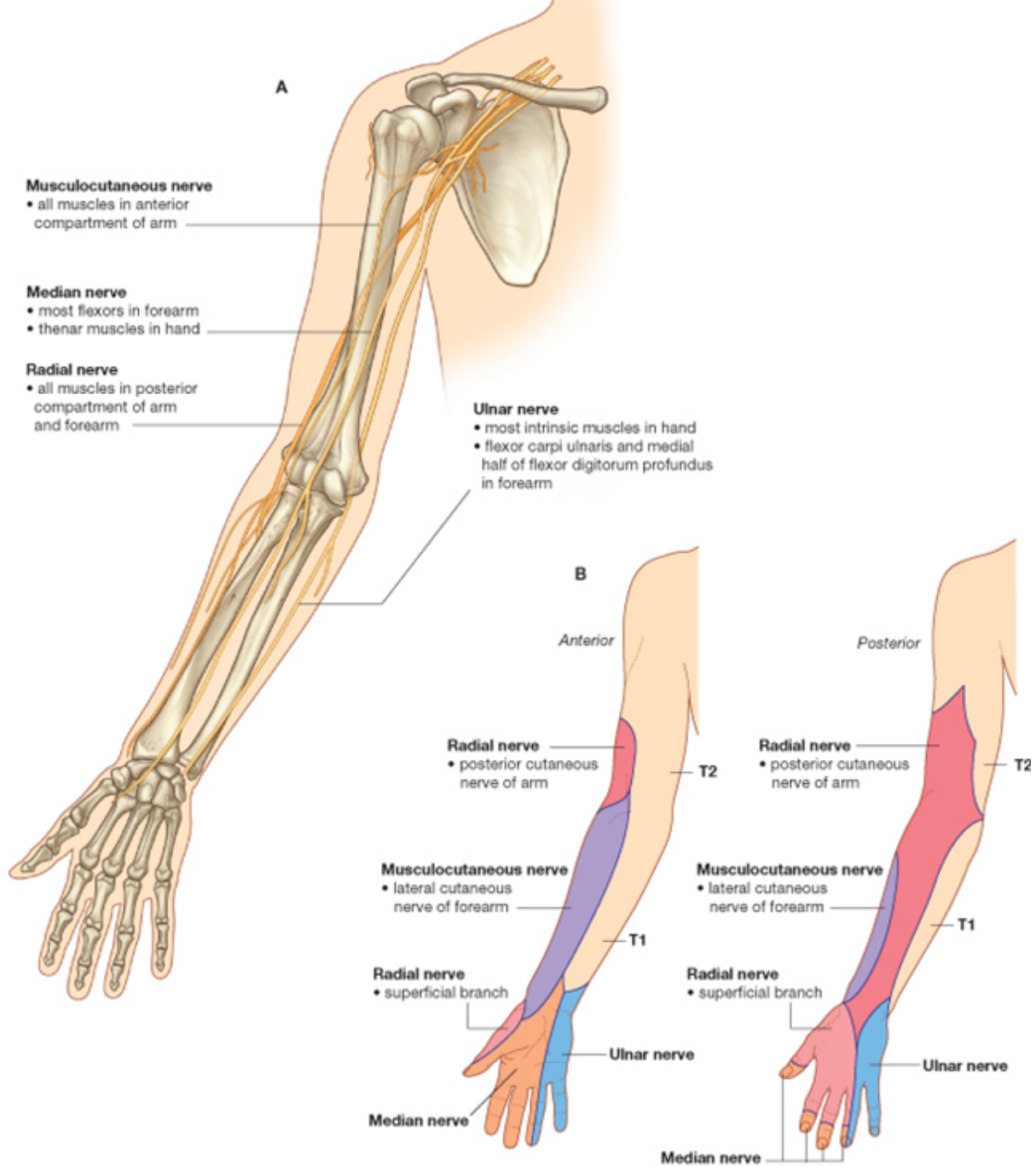
Brachial plexus

- 5 main nerves arise from brachial plexus:
 1. Axillary nerve
 2. Musculocutaneous nerve
 3. Radial nerve
 4. Median nerve
 5. Ulnar nerve

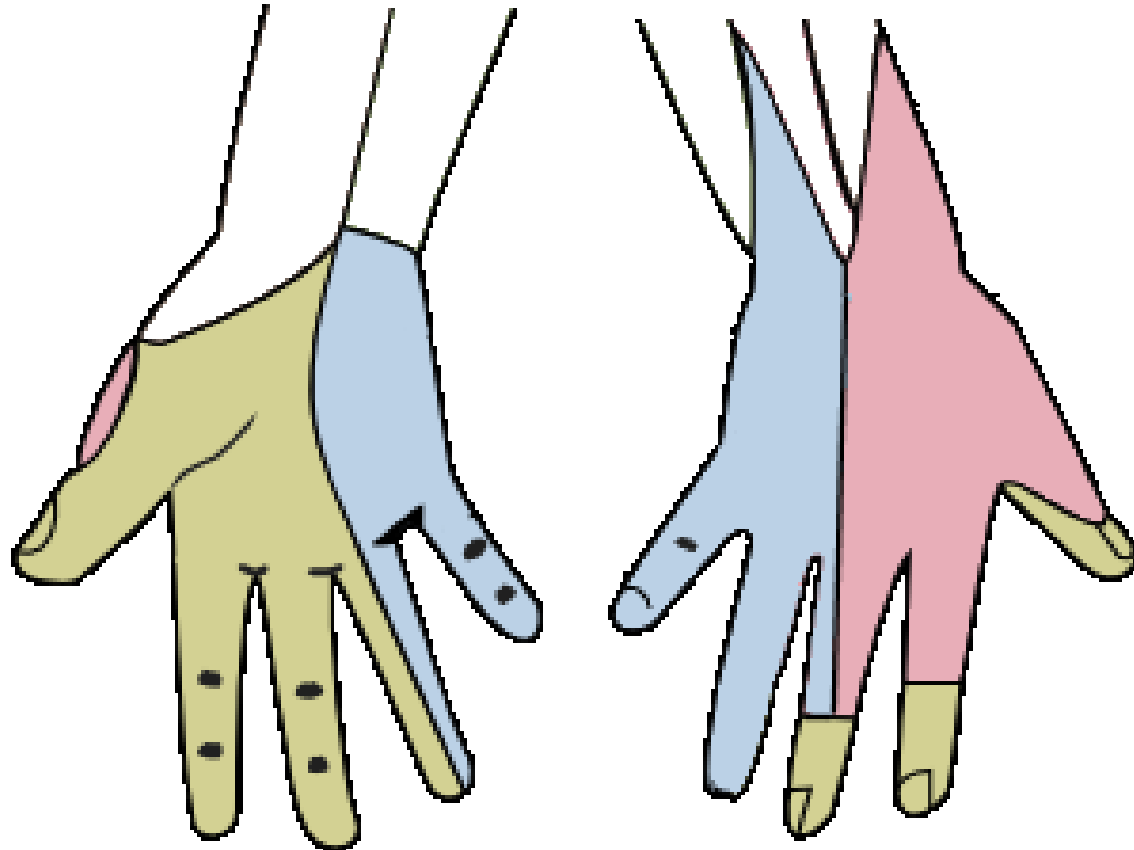


Nerves of the Upper Limb - sensitivity





The cutaneous innervation of the right hand

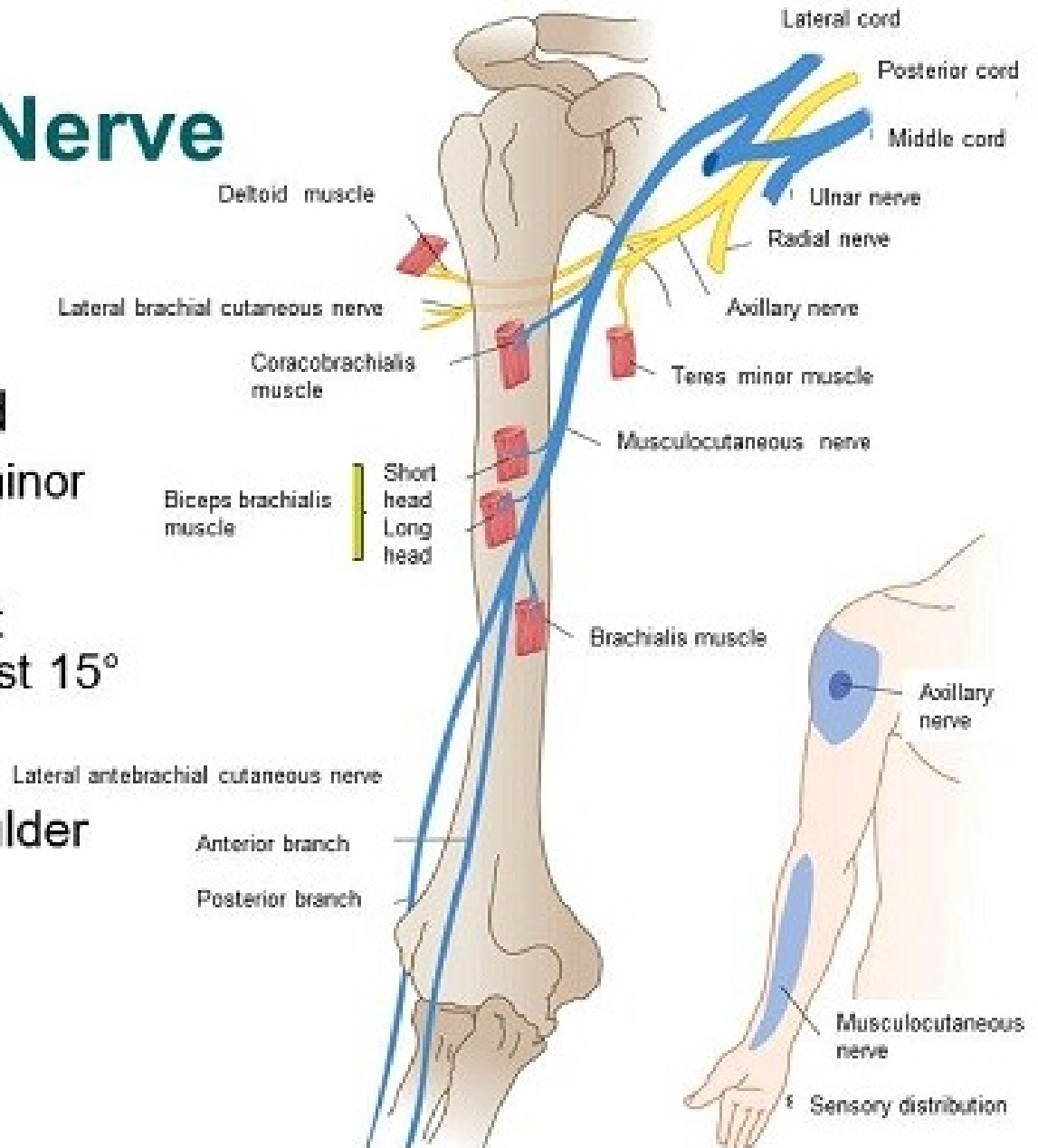


Axillary nerve

- From root C5-C6
- Arise from posterior cord of brachial plexus at the level of axilla

The Axillary Nerve

- Muscles innervated
 - Deltoid and teres minor
- Motor functions
 - Abduction of arm at shoulder beyond first 15°
- Sensory
 - Skin over the shoulder



Innervations of the Axillary nerve

Muscular innervations:

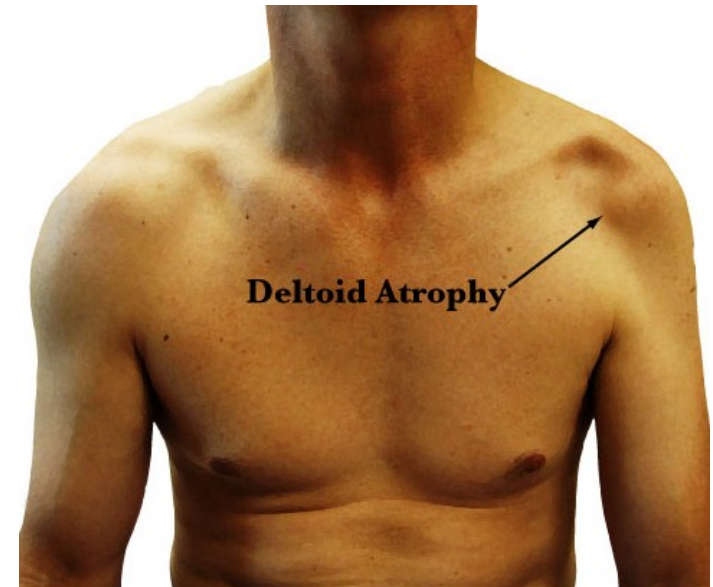
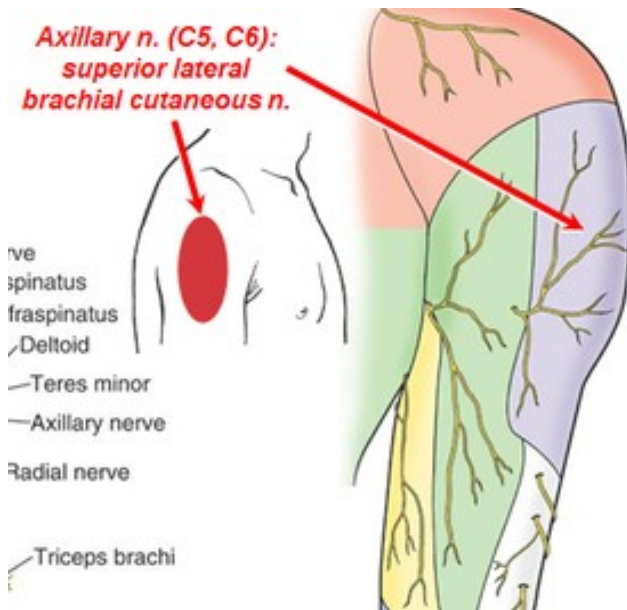
- Anterior branch – anterior and lateral fiber of deltoid muscles
- Posterior branch – teres minor and posterior fiber of deltoid

Cutaneous innervation:

- Superior lateral brachial cutaneous nerve
- Carry information from the shoulder joint
- Skin covering inferior region of deltoid muscles

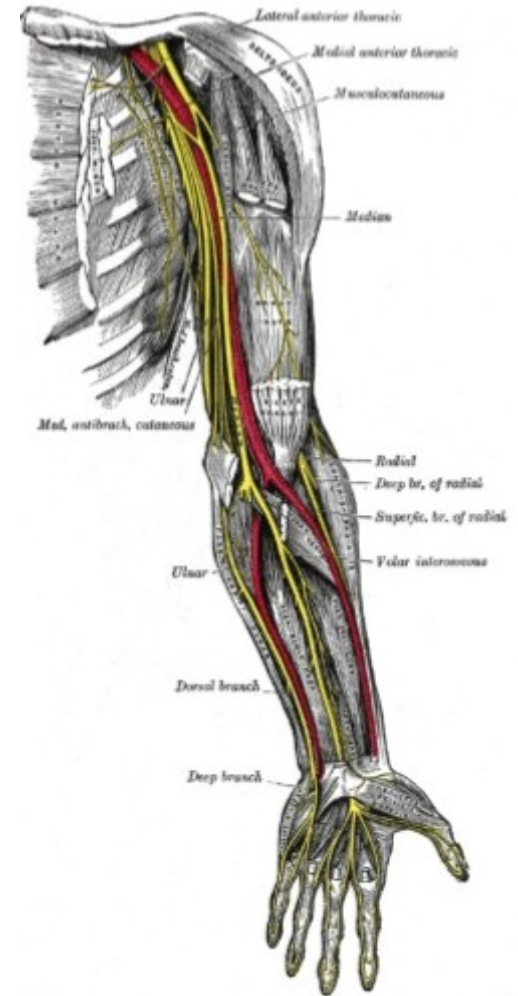
Axillary nerve paralysis

- Frequently injured due to shoulder dislocation because of the proximity of this joint
- Paralysis of the deltoid and teres minor – it results in weakness of the arm abduction



Musculocutaneous nerve

- Arise from lateral cord of brachial plexus
 - Opposite to the lower border of pectoralis minor
 - Arise from root C5, C6 and C7.
-
- Penetrate coracobrachialis and pass obliquely between biceps brachii and the brachialis to the lateral side of the arm.
 - Then continue in the forearm as the lateral antebrachial cutaneous nerve.

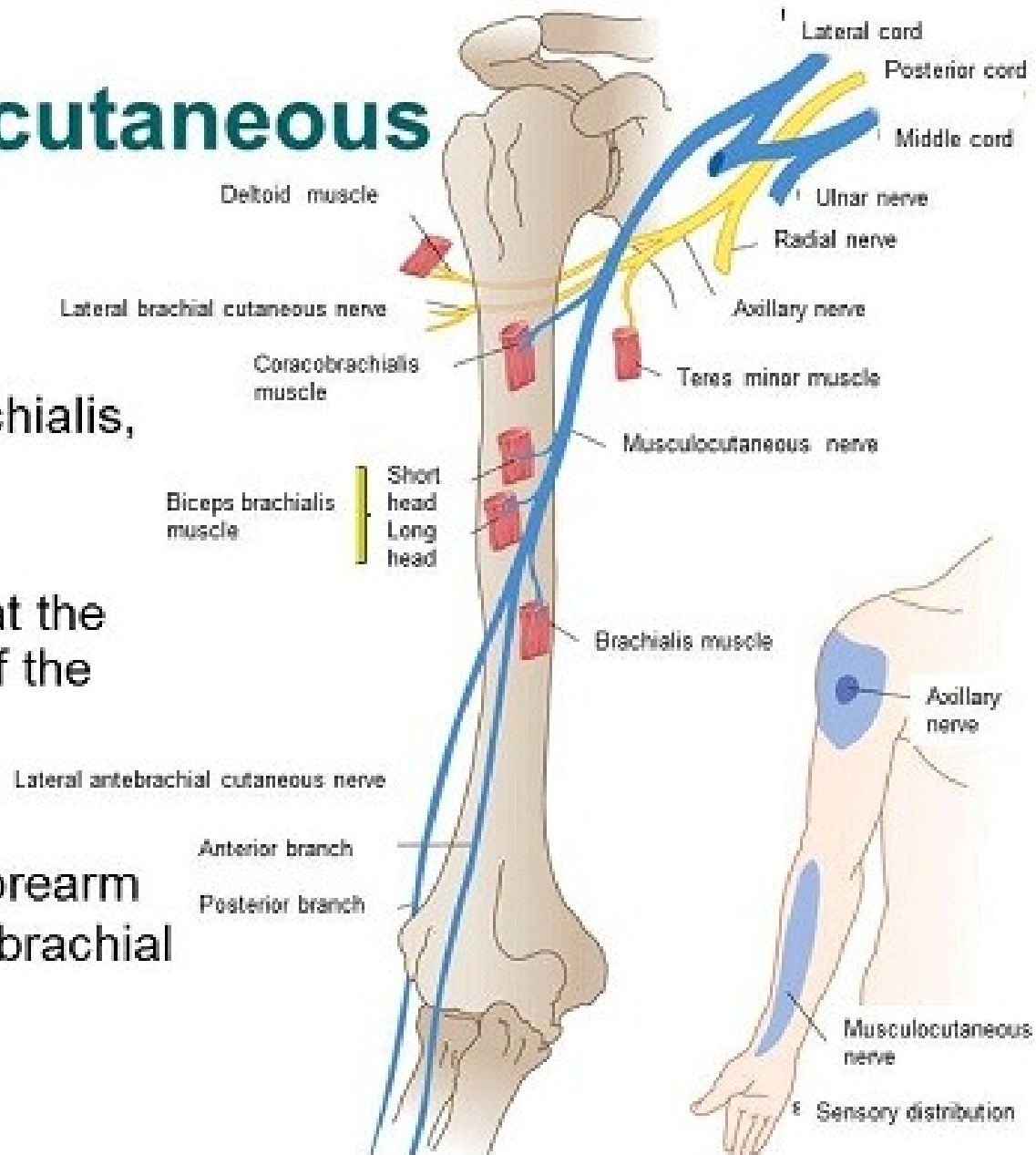


Innervation of the Musculocutaneous nerve

- Muscular innervation
 - Supply coracobrachialis, biceps brachii and brachialis
- Cutaneous innervation.
 - **Lateral antebrachial cutaneous** nerve divide into anterior and posterior branch.
 - Anterior branch – skin of anterolateral surface of forearm as far as ball of the thumb
 - Posterior branch – skin of posterolateral surface of forearm.

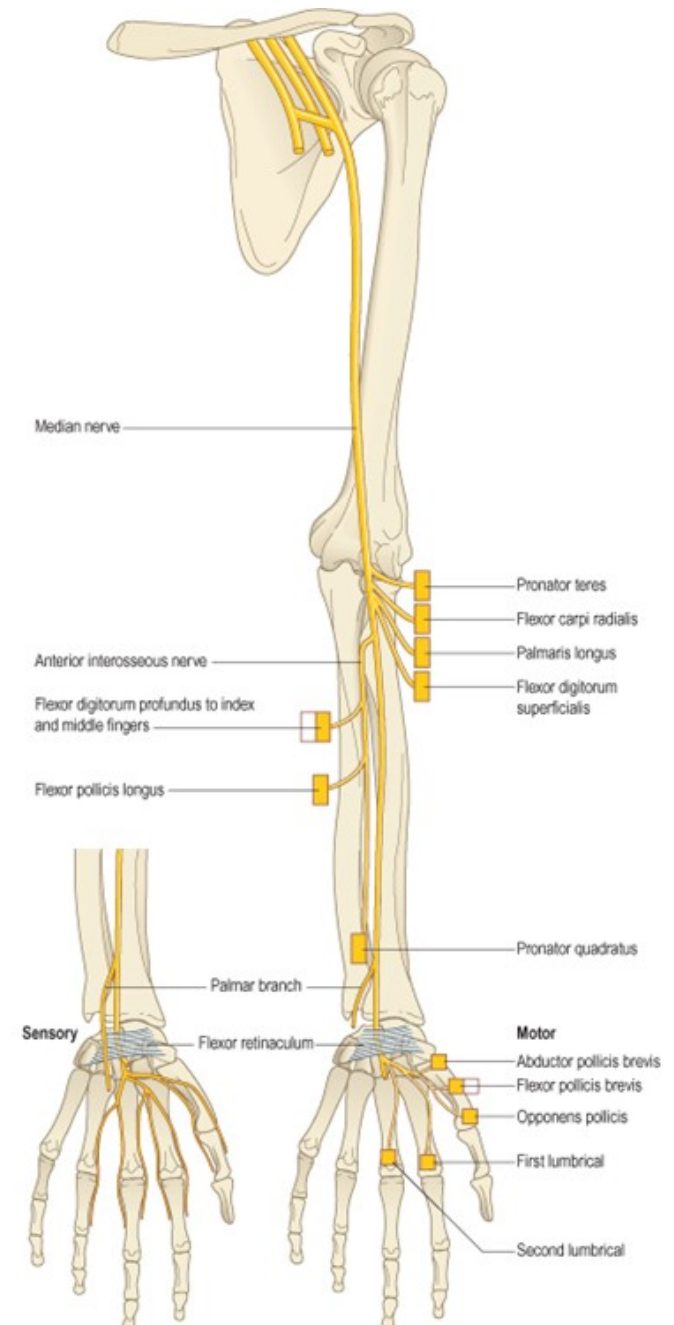
The Musculocutaneous Nerve

- Muscles innervated
 - BBC = Biceps, Brachialis, Coracobrachialis
- Motor functions
 - Flexion of the arm at the elbow, supination of the forearm
- Sensory
 - Lateral surface of forearm through lateral antebrachial cutaneous nerve



Median nerve

- The **median nerve** is one of the 5 main nerves originating from the [brachial plexus](#)
- It originates from the lateral and medial cords of the brachial plexus, and has contributions from ventral roots of [C5](#) and [C6](#) (lateral cord) and [C8](#) and [Th1](#) (medial cord)
- The median nerve is the only nerve that passes through the [carpal tunnel](#)

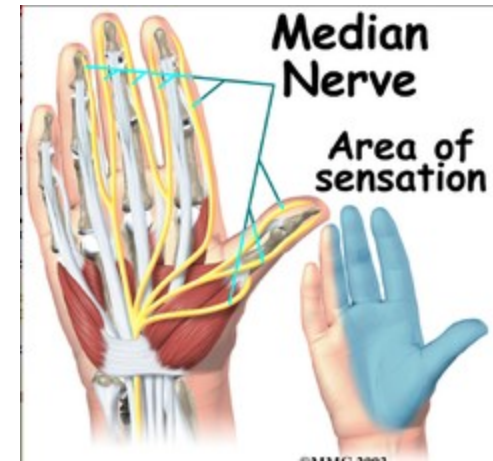


Median nerve

- **origin:**
 - lateral root - lateral cord of the brachial plexus
 - medial root - medial cord of the brachial cord
- **course:** laterally to the axillary artery, descends in the arm between biceps brachii and triceps brachii muscles, courses through the forearm with the ulna nerve and vessels before entering the carpal tunnel to the hand
- **major branches:** anterior interosseous nerve, palmar cutaneous branch, motor branch in the hand
- **motor supply:** flexor compartment of the forearm, thenar and intrinsic hand muscles
- **sensory supply:** palmar aspect of the thumb, index, middle and radial half of the ring fingers

Median nerve – branches:

- **anterior interosseous nerve** supplies all the flexor muscles of the forearm apart from flexor carpi ulnaris and the ulnar half of flexor digitorum profundus
- **motor branch in the hand** - supplies thenar muscles and the radial two lumbricals
- **palmar cutaneous branch** - cutaneous innervation to the palmar aspect of the thumb, index and middle fingers and the radial half of the ring finger
- **articular branches** to the elbow, wrist, carpal and phalangeal joints



The Median Nerve

- Muscles innervated

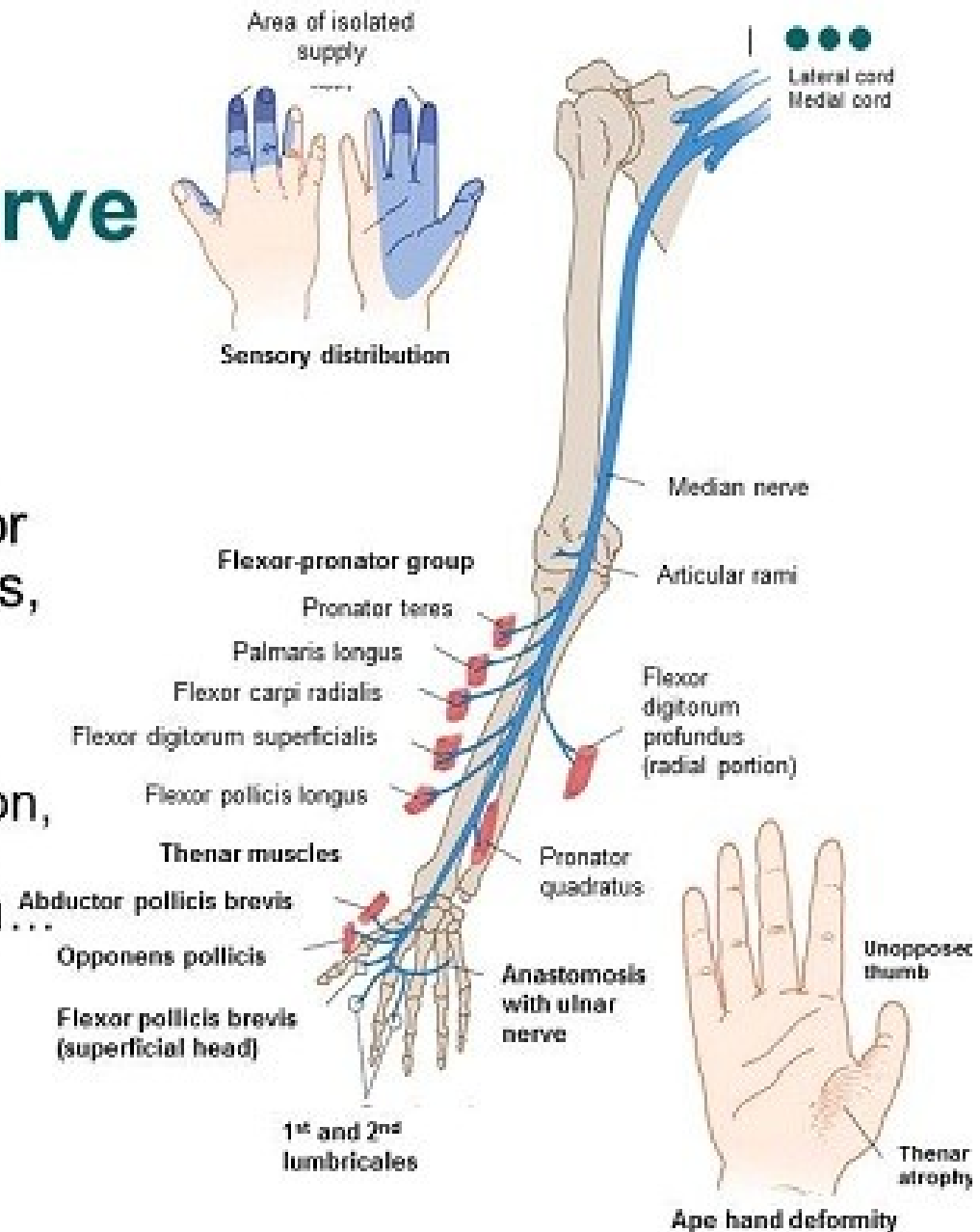
- Flexor carpi radialis, palmaris longus, pronator quadratus, pronator teres, digital flexors

- Motor functions

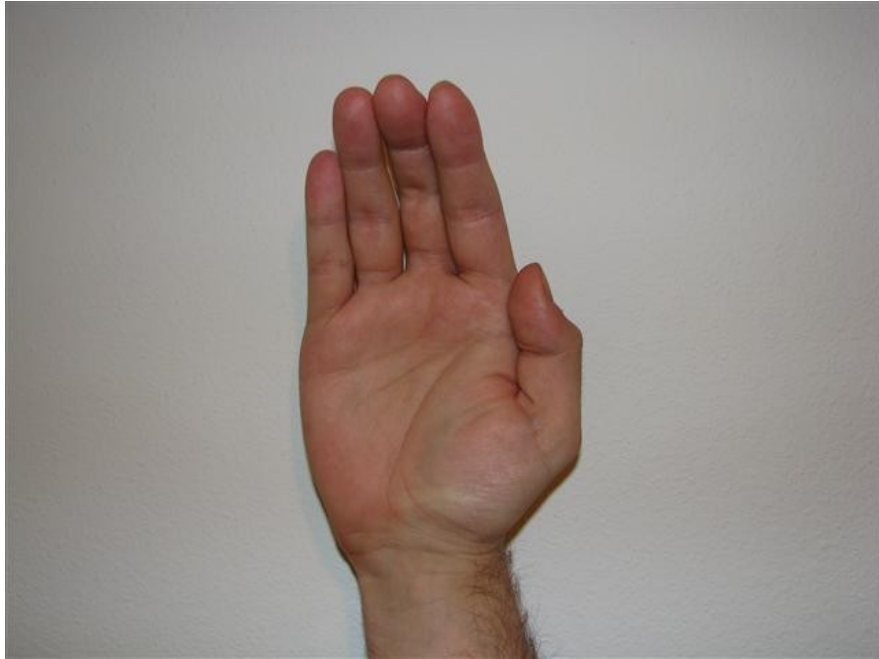
- Thumb flexion and opposition, flexion of digits 2 & 3, wrist flexion and abduction, forearm pronation

- Sensory

- Skin over anterolateral surface of hand



Median nerve palsy



[ape-hand deformity](#)

Median nerve palsy – signs and symptoms:

- Lack of ability to abduct and oppose the thumb due to **paralysis of the thenar muscles**. This is called "[ape-hand deformity](#),"
- **Sensory loss** in the thumb, index finger, long finger, and the radial aspect of the ring finger
- **Weakness** in forearm pronation and wrist and finger flexion
- Difficulties in [Activities of daily living](#) (ADL) such as brushing teeth, tying shoes, making phone calls, turning door knobs and writing

Median nerve palsy – causes:

- deep, penetrating injuries to the arm, forearm, or wrist
- or blunt force trauma or neuropathy

Can be separated into 2 subsections - high and low MNP:

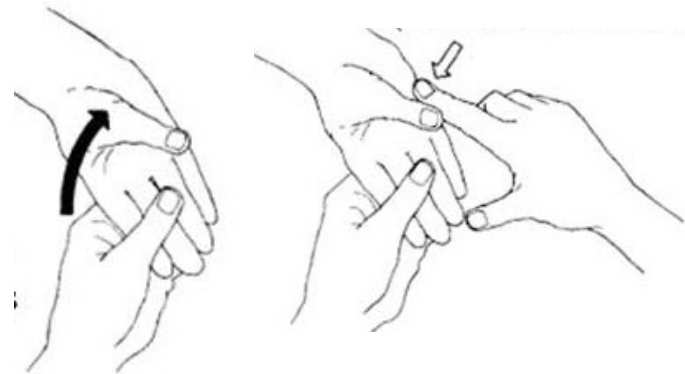
- **High MNP** involves lesions at the elbow and forearm areas
- **Low MNP** results from lesions at the wrist
- compression at the different levels of the [median nerve](#) produce variable symptoms and/or syndromes, the areas are:
 - Underneath [Struthers' ligament](#)
 - Passing by the [bicipital aponeurosis](#) (also known as lacertus fibrosus)
 - Between the two heads of the [pronator teres](#)
 - Compression in the carpal tunnel causes [carpal tunnel syndrome](#)

Tests of median nerve function

- Thumb „circles“



- Thumb opposition



- Thumb flexion



Flexion

- Fingers flexion



JOHN A. CRAIG, MD

MEDIAN NERVE BELOW THE ELBOW

BENEDICTION SIGN

- Anterior interosseous nerve palsy.
- Arises from the median nerve 4-6 cm below the elbow. Entire motor nerve
- Supply to FPL, FDP (Radial half), PQ.
- Compression from tendinous band - accessory muscles, vascular pathology.
- Symptoms: pain - weakness of pinch.
- During pinch the distal phalanges of the thumb and index finger stay in extension.
- Benediction sign: Inability to flex thumb - index finger (FDP to the middle finger many times gets innervation from the ulnar nerve).



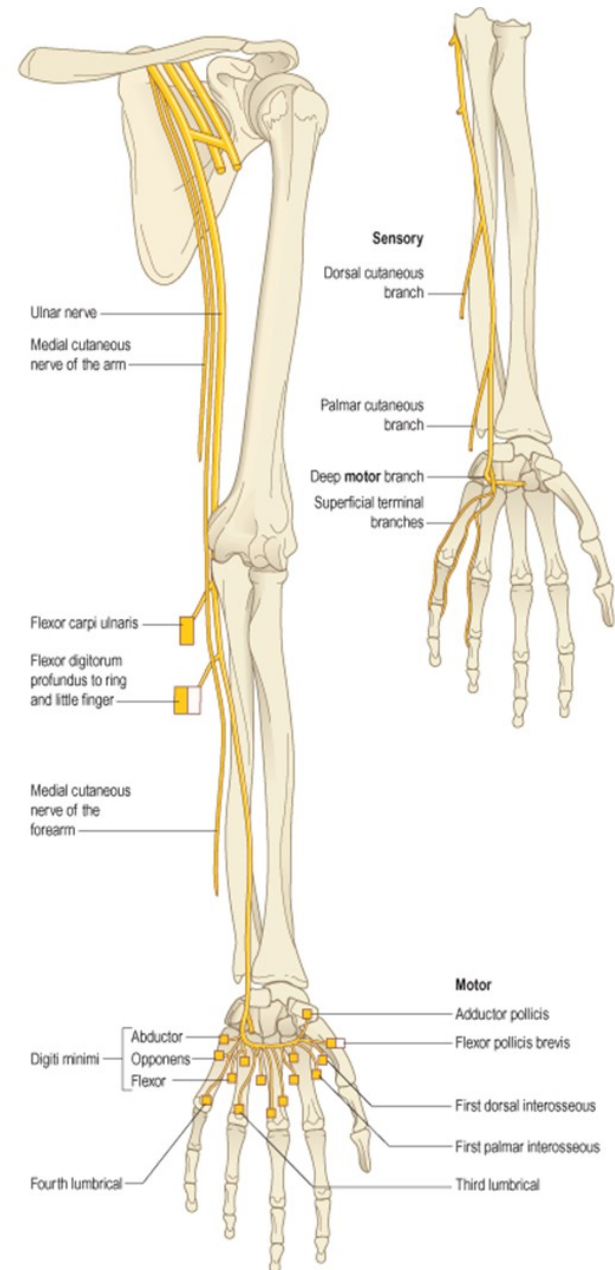
Carpal tunnel syndrome

- Compression median nerve at the carpal tunnel
- Patient will experience numbness, tingling, or burning sensation at the thumb, index, middle and radial half of the ring finger.
- If untreated – weakness or atrophy of the thenar muscles.



Ulnar nerve

- It originates from the C8-T1 nerve roots (and occasionally carries C7 fibres) which form part of the medial cord of the brachial plexus, and descends on the posteromedial aspect of the humerus



Ulnar nerve – motor innervation

- In the forearm, via **the muscular branches of ulnar nerve**:
 - [Flexor carpi ulnaris](#)
 - [Flexor digitorum profundus](#) (medial half)
- In the hand, via **the deep branch of ulnar nerve**:
 - [hypothenar](#) muscles
 - [Opponens digiti minimi](#)
 - [Abductor digiti minimi](#)
 - [Flexor digiti minimi brevis](#)
 - The third and fourth [lumbrical muscles](#)
 - [Dorsal interossei](#)
 - [Palmar interossei](#)
 - [Adductor Pollicis](#)
 - [Flexor pollicis brevis](#) (deep head)
- In the hand, via **the superficial branch of ulnar nerve**:
 - [Palmaris brevis](#)

Ulnar nerve – sensory innervation

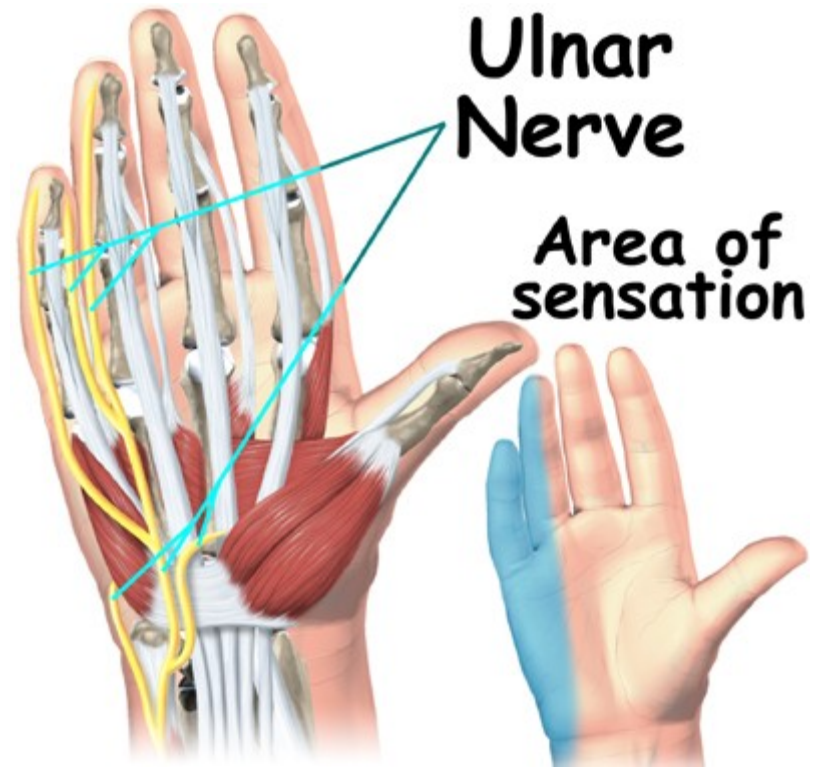
Sensory innervation to the V. digit and the medial half of the IV. digit, and the corresponding part of the palm:

Palmar branch of ulnar nerve:

cutaneous innervation to the anterior skin and nails

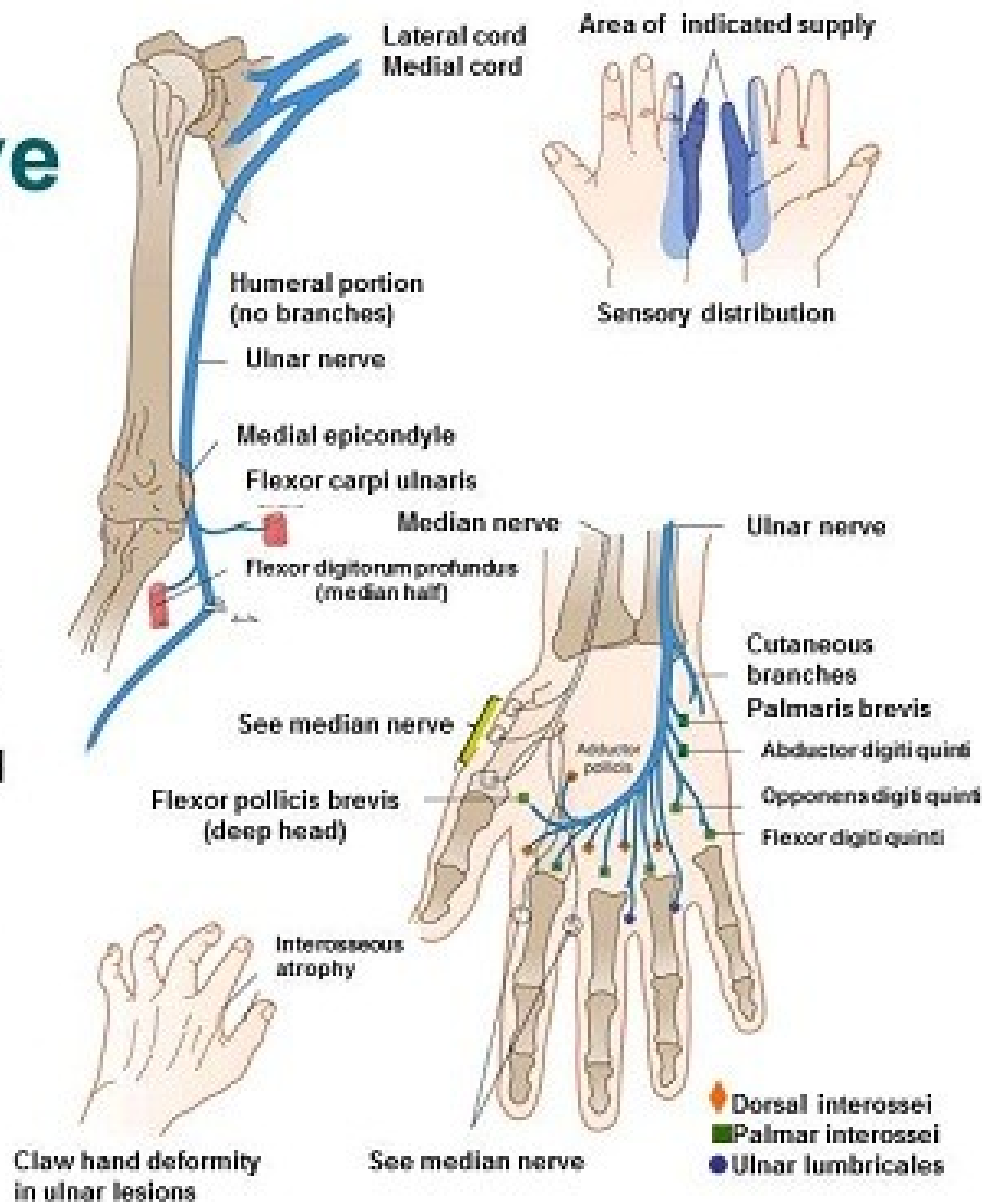
Dorsal cutaneous branch of ulnar nerve:

cutaneous innervation to the dorsal medial hand and the dorsum of the medial 1.5 fingers



The Ulnar Nerve

- Muscles innervated
 - Flexor carpi ulnaris, flexor digitorum profundus, adductor pollicis, small digital muscles
- Motor functions
 - Finger adduction and abduction other than thumb; thumb adduction, flexion of digits 4 & 5; wrist flexion and adduction
- Sensory
 - Skin over medial surface of the hand through the superficial branch

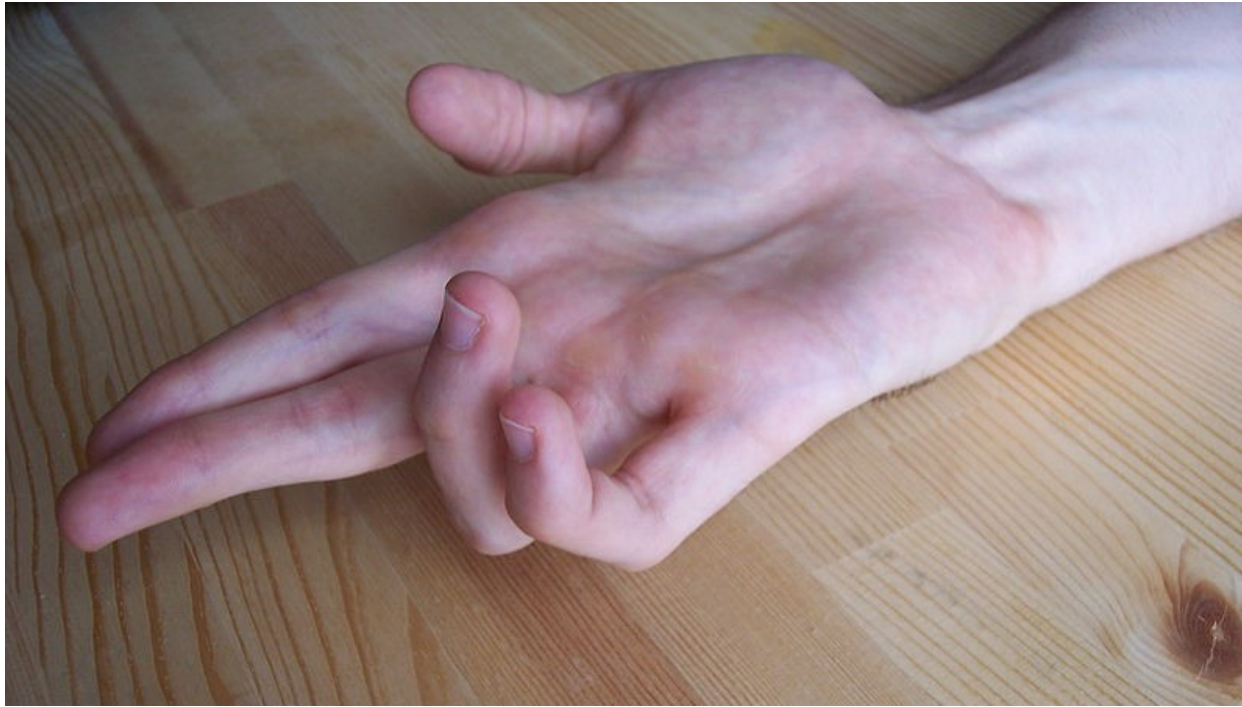


Ulnar nerve palsy

- The ulnar nerve can suffer injury anywhere between its proximal origin of the brachial plexus all the way to its distal branches in the hand
- It is the most commonly injured nerve around the elbow
- Although it can be damaged under various circumstances, it is commonly injured by local trauma or physical impingement ("pinched nerve")
- Injury of the ulnar nerve at different levels causes specific motor and sensory deficits

Ulnar nerve palsy – position of the hand

The [metacarpophalangeal joints](#) of the 4th and 5th fingers are extended and the [Interphalangeal](#) joints are flexed, thumb IP flexion



An ulnar claw (or claw hand, or 'Spinster's Claw')

Ulnar nerve palsy

- The hand will show hyper-extension of the MCP and flexion of the distal and proximal IP joints of the 4th and 5th digits
- The clawing will become most obvious when the person is asked to flex the digits from an extended position as the 4th and 5th digits can not flex
- 1st, 2nd and 3rd digits will partially flex giving them a "claw-like" appearance, this happens because the Thenar muscles (Abductor pollicis brevis, Flexor Pollicis brevis and Opponens pollicis) are innervated by the median nerve as the first two lumbricals of digit 2 and 3 are

Froments' test (Froments' sign)

- Tests for the action of adductor pollicis
- A patient is asked to hold a flat object (a piece of paper), between their thumb and index finger (pinch grip)
- The examiner then attempts to pull the object out of the subject's hands
- A normal individual will be able to maintain a hold on the object without difficulty
- With ulnar nerve palsy, the patient will experience difficulty maintaining a hold and will compensate by flexing the FPL (flexor pollicis longus) of the thumb to maintain grip pressure causing a pinching effect

Normal

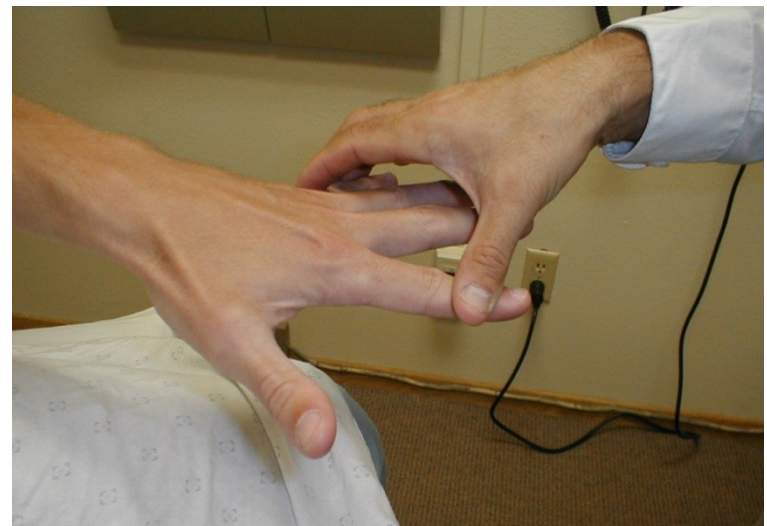


Froment's positive



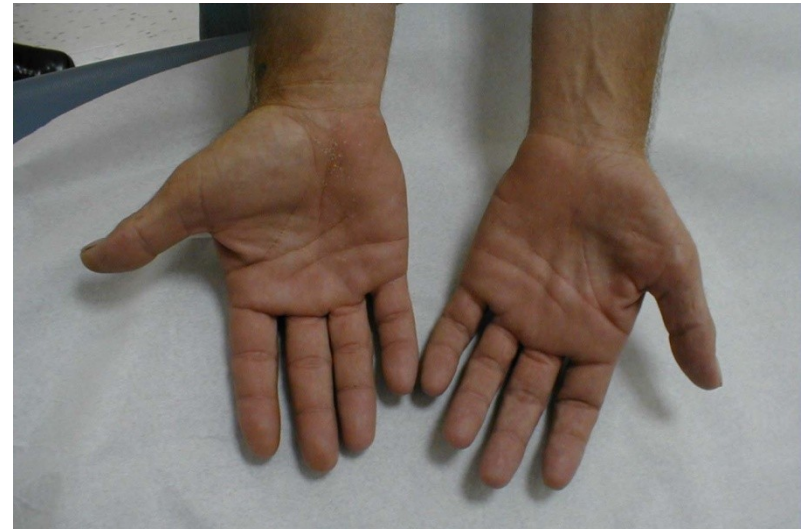
Ulnar nerve palsy – fingers abduction

- Unability to spread (abduct) or pull together (adduct) the fingers against resistance (because the ulnar nerve innervates the palmar and dorsal interossei of the hand)



Ulnar nerve palsy – muscles atrophy

- Patients with this deficit will become increasingly easy to identify over time as the paralyzed first dorsal interosseous muscle atrophies, leaving a prominent hollowing between the thumb and forefinger



Ulnar entrapment

- It is a condition where the ulnar nerve becomes **trapped or pinched** due to some physiological abnormalities
- It is **classified by location** of entrapment
- The ulnar nerve passes through several small tunnels and outlets through the medial upper extremity, and at these points the nerve is **vulnerable to compression or entrapment** - a so-called "pinched nerve,,
- The nerve is particularly vulnerable to injury when there has been **a disruption in the normal anatomy**

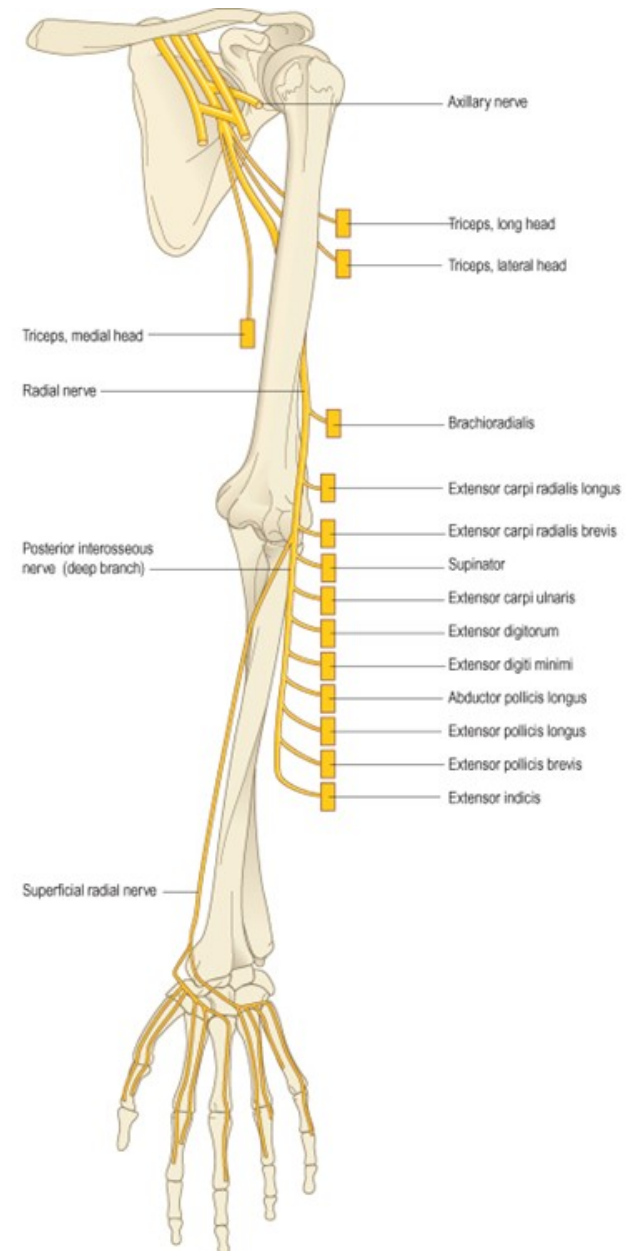
Ulnar entrapment

It can be classified by specific local causes, including:

- **Problems originating at the neck:** thoracic outlet sy, cervical spine pathology, tight anterior scalene muscles
- **Problems originating in the chest:** tight pectoralis minor muscles
- **Brachial plexus abnormalities**
- **Elbow pathology:** fractures, growth plate injuries, cubital tunnel sy, flexorpronator aponeurosis, arcade of Struthers
- **Forearm pathology:** tight flexor carpi ulnaris muscles
- **Wrist pathology:** fractures, ulnar tunnel sy, hypothenar hammer sy

Radial nerve

- The **radial nerve** supplies the posterior portion of the upper limb
- It innervates the medial and lateral heads of the triceps brachii muscle of the arm, as well as all 12 muscles in the posterior osteofascial compartment of the forearm and the associated joints and overlying skin
- It originates from the brachial plexus, carrying fibers from the ventral roots of spinal nerves C5, C6, C7, C8 & Th1



Radial nerve

- **origin:** one of the two posterior cords of the brachial plexus
- **course:** posteromedially with the axillary vessels, behind the humerus, then anteriorly towards the elbow where it divides into superficial and deep branches
- **terminal branches:** posterior interosseous (deep) and superficial radial nerve
- **motor:** wrist and finger extension
- **sensory:** dorsal aspect of the thumb, index and middle fingers

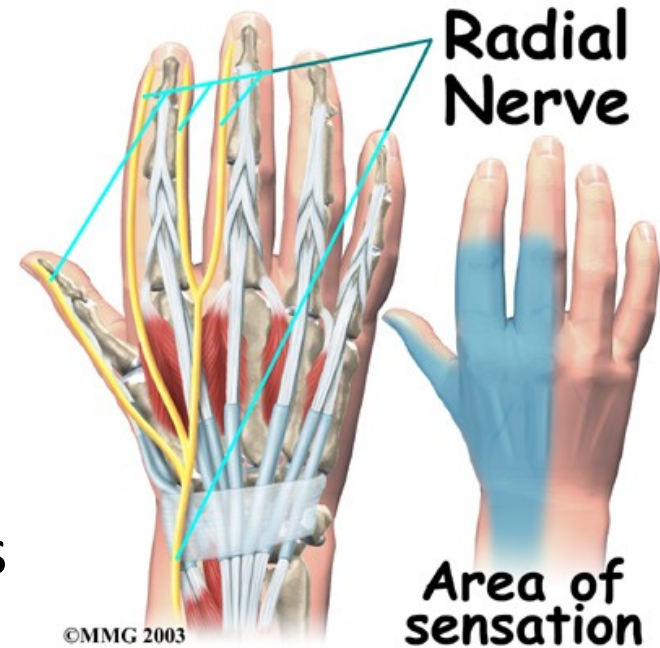
Radial nerve – branches

- **muscular twigs in the arm** – triceps brachii and anconeus muscles

- **superficial branch** - supplies cutaneous sensation to the dorsal aspect of the hand and dorsal aspect of the first to third digits and the dorsal lateral aspect of the fourth finger

- **deep branch** - posterior interosseous nerve - extensor muscles in the forearm as well as brachioradialis

- **articular twigs** to the elbow and wrist joints



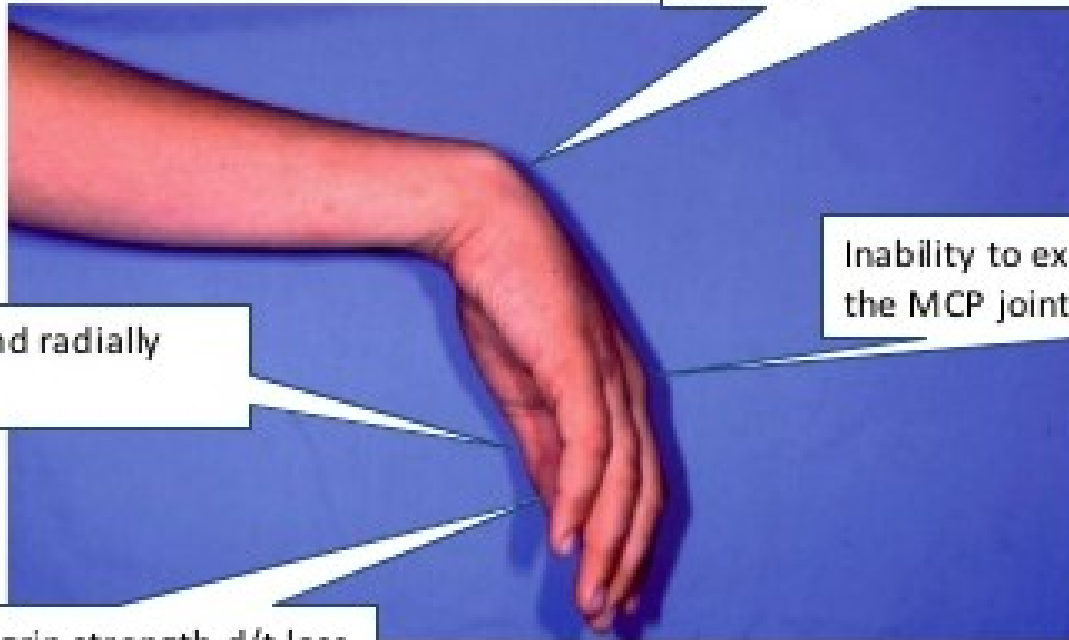
Functional motor deficit

Inability to extend the wrist (in case of injury at level of PIN, wrist extension is weak with radial deviation since ECRL innervation is intact)

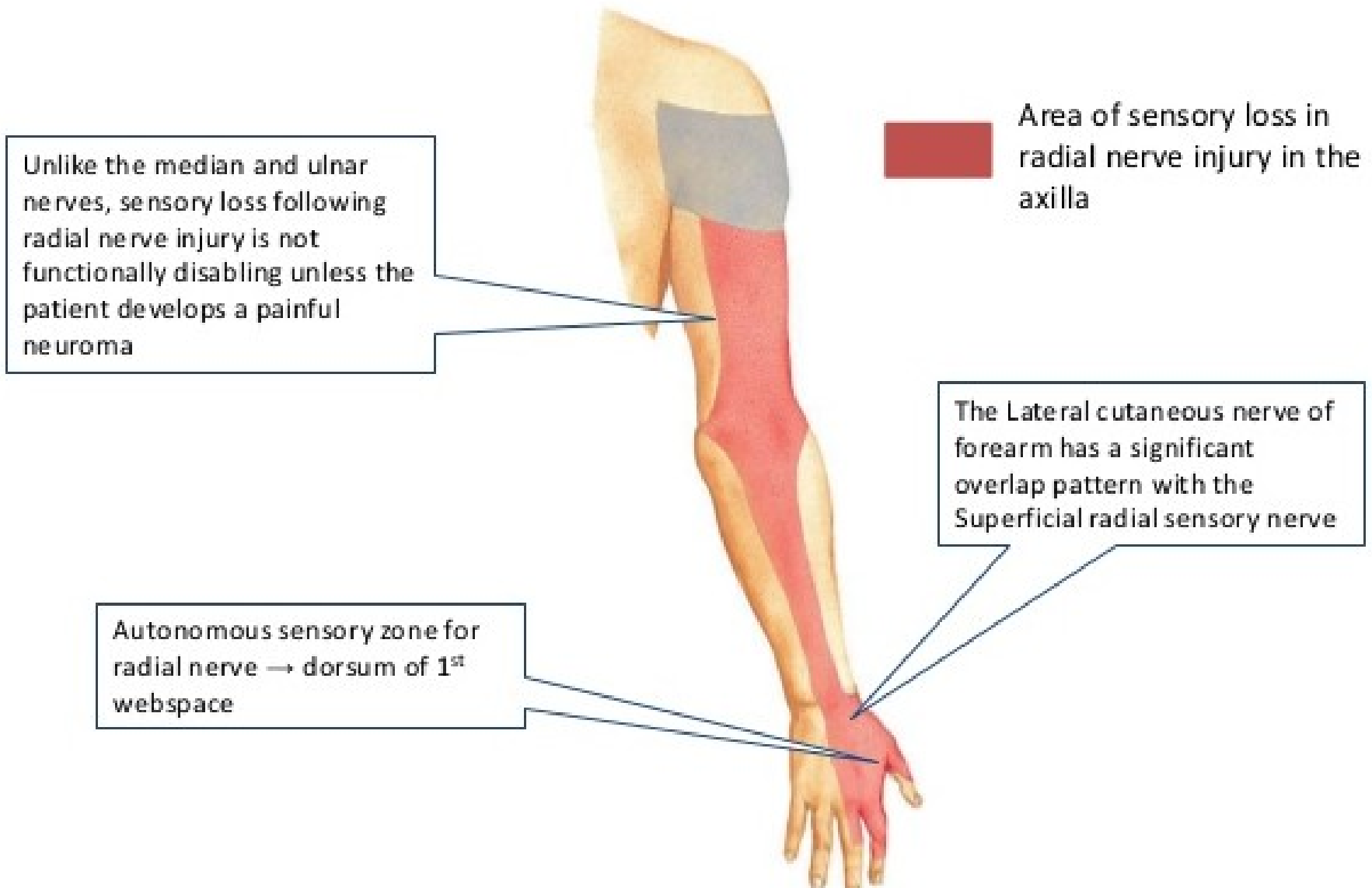
Inability to extend the fingers at the MCP joints

Inability to extend and radially abduct the thumb

Weakness of grip strength d/t loss of mechanical advantage that wrist extension provides for grasp and power grip



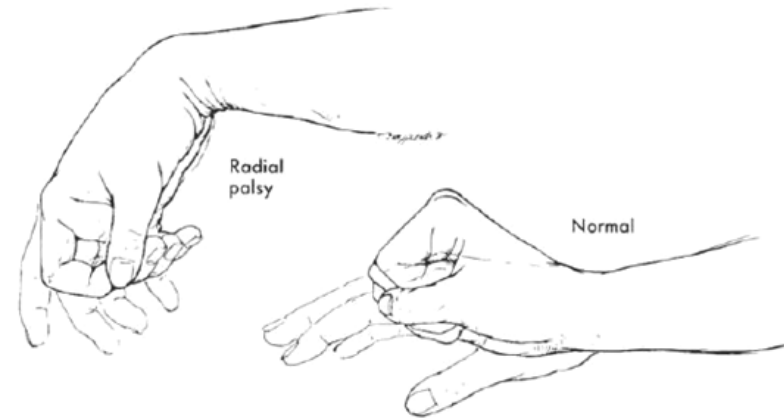
Sensory Loss



Radial nerve injury

- The radial nerve is often injured in its course close to the humerus, either from fracture or pressure from direct blow to the humerus (incorrect use of a crutch)
- Triceps usually escapes because derivation of the nerve giving off high in arm, but total paralysis of the extensor of the wrist and digits leads to **the dropped wrist deformities**

Radial nerve palsy



- Drop hand

Tests for extensors



- Thumb extensors



- Wrist extensors

Brachial plexus injury

- Obstetric brachial plexus palsy
- Injury to all or portion of a child brachial plexus occurring at that time of the delivery.
- Excessive lateral traction on the head so that the head is pulled away from the shoulder.
- Divide into :
- Erb's Duchenne Palsy
- Klumpke's Palsy

Erb's Duchenne Palsy



- This posture occurs because of paralysis and atrophy of:
- Deltoid
- Biceps brachii
- Brachialis
- brachioradialis

- Involving upper roots (C5, C6 and C7)
- Affecting the musculature of the upper arm
- Shows the “waiter tips” posture of the paralyze limb.
- The arm lies medial rotation at the side of the chest
- The elbow is extended (paralyzed C5, C6)
- Forearm is pronated
- Wrist and digits are flexed



Klumpke's Palsy



- Rare
- Involving lower root (C8 and T1)
- Affecting forearm and hand
- Characterize by paralysis and atrophy of the small hand muscles and flexor of the wrist.
- Claw hand



Literature, e-sources

- <http://criticalcaremcqs.com/tag/aipgmee-mcqs/page/15/>
- www.graysanatomyonline.com
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- <http://www.slideshare.net/hermizan84/peripheral-nerves-of-upper-limb?related=1>
- <https://meded.ucsd.edu/clinicalmed/neuro2.htm>
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- <http://www.slideshare.net/hermizan84/peripheral-nerves-of-upper-limb?related=1>

Thank you for your attention 😊

