

430 SURGERY TEAM



PERIPHERAL NERVE INJURIES

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Green: Doctor's notes & explanation during the lecture.

Blue: Further explanation & team's notes.

Red: important notes.

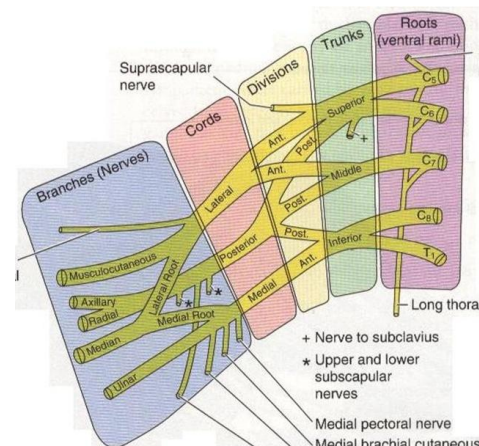
1 TYPES OF INJURIES

1.1.1 PERIPHERAL NERVE INJURIES

- Axillary nerve
- Musculocutaneous nerve
- Median nerve
- Ulnar nerve
- Radial nerve

2 BRACHIAL PLEXUS INJURIES

2.1 BASIC ANATOMY



- ❖ It is formed from the union of the anterior rami of the 5th, 6th, 7th, 8th cervical and 1st thoracic nerves (C5, C6, C7, C8, T1)
- ❖ The plexus is divided into Roots, Trunks, divisions, cords and terminal branches

2.2 CLASSIFICATION OF BRACHIAL PLEXUS INJURIES

- ❖ **Open injuries** (stab wounds or gunshot wounds):
 - Can be at any level (roots, trunks, divisions, etc...)
 - Classified into:
 1. Supraclavicular (roots, trunks, divisions)
 2. Infraclavicular (divisions, cords, terminal branches)
- ❖ **Closed injuries:**
 - More common than open injuries
 - Injury is most commonly at the root level
 - Caused by car accidents, outstretching of the shoulder like when playing sports or during difficult deliveries where the baby is pulled in emergency situations
 - Examination of closed injuries: Nerves are not examined, Roots are examined by examining dermatomes and myotomes

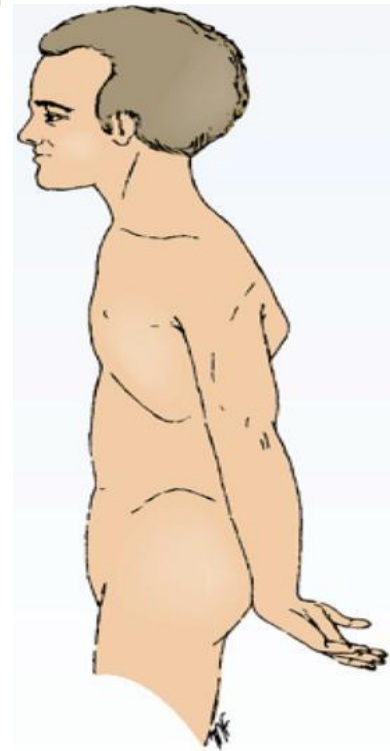
Root	Dermatome	Myotome
C5	Shoulder tip + lateral arm	Shoulder abduction + external rotation
C6	Lateral forearm + thumb and index finger	Elbow flexion
C7	Middle finger	Wrist extension
C8	Ring and little finger + lower aspect of medial forearm	Making a fist
T1	Upper aspect of medial forearm + medial arm	Finger crossing

Please memorize the table in order to understand the symptoms of each lesion.

2.3 TYPES OF CLOSED BRACHIAL PLEXUS INJURIES

2.3.1 UPPER BRACHIAL PLEXUS LESION

- Called **Erb's palsy** (Erb-Duchenne Palsy)
- Injury to C5, C6 and C7
- C5: loses the ability to abduct the shoulder and external rotation
- C6: loses the ability to flex elbow
- C7: loses the ability to extend the wrist
 - ❖ **Clinically**:
 - The patient will have (opposite to the normal function of the damaged nerves):
 - shoulder adduction
 - internal rotation
 - extension of the elbow
 - wrist flexion
 - this is called **waiter's tip position**
 - ❖ **Associated injuries**:
 - injury to the phrenic nerve which arises from the 3rd, 4th, and 5th cervical roots, so half of the diaphragm will be paralyzed
 - in adults X-ray will show elevated hemi diaphragm
 - in children the intercostals are not strong enough to compensate so the baby will have breathing problems (obstetric palsy)



2.3.2 LOWER BRACHIAL PLEXUS LESION

- **Called Klumpke's palsy**
- Injury to C8 and T1
 - C8: loses the ability to make a fist
 - T1: loses the ability to cross fingers
- **Clinically**: The patient will have simian hand and **clawing of all fingers**
- **Associated injuries**:
 - Sympathetic nerves to the face come from a branch of the first thoracic nerve T1
 - **If T1 is injured** then **sympathetic to the face are lost** on one side and that will result in **Horner syndrome**, which is:
 1. **Ptosis** (dropping of the upper eyelid)
 2. **Miosis** (constricted pupil)
 3. **Anhydrosis** (inability to sweat)

2.3.3 TOTAL PALSY

- Injury to all roots C5, C6, C7, C8, T1
- Patient is unable to move entire limb: **flail limb**

Quick clinical hints:

- Upper lesion (C5, C6, C7) → **Erb's palsy** and **phrenic nerve** symptoms (**waiter's tip**)
- Lower lesion (C8, T1) → **Klumpke's palsy** and **Horner's syndrome** (**clawing of all fingers**)

- Total lesion (C5,C6,C7,C8,T1) → **flail limb** and both phrenic and sympathetic symptoms

3 PERIPHERAL NERVE INJURIES

3.1 AXILLARY NERVE

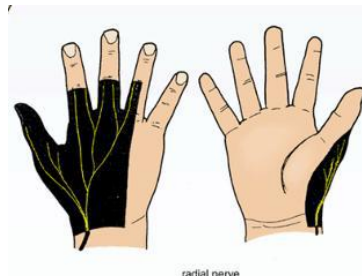
- Isolated injuries to the Axillary nerve most commonly happens with **shoulder dislocation** or **by surgical mistake**.
- Supplies the Deltoid and Teres minor muscle
- Clinical features:
 - **Motor:**
 - To the **deltoid muscle** so the patient will not be able to abduct his shoulder
 - The patient can still initiate abduction (action of supraspinatus)
 - It also supplies teres minor that does external rotation which is the same action of infraspinatus, so the patient can still externally rotate his arm
 - **Sensory:**
 - loss of sensation over the skin of the lateral arm on lower half of the deltoid
- **Summary:** **loss of shoulder abduction** and **sensation** over the **lateral arm** (deltoid)

3.2 MUSCULOCUTANEOUS NERVE

- Isolated injuries usually happen with **stab wounds** or gunshots
- Supplies coracobrachialis, biceps, brachialis muscles
- Clinical features:
 - **Motor:**
 - Coracobrachialis and brachialis are not important clinically
 - **Biceps:**
 - ✓ Weak supination (because the supinator muscle can compensate)
 - ✓ Loss of flexion
 - **Sensory:**
 - loss of sensation over the lateral forearm and the thumb
- **Summary:** **loss of elbow flexion** (Biceps) and **sensation** over the **lateral forearm** (lateral cutaneous nerve of forearm) + weak supination

3.3 RADIAL NERVE

- Runs in the spiral groove so injuries happen in humerus bone fractures
- **Distribution:**
 - **4 motor movements:**
 - *Elbow extension*
 - *Wrist extension*
 - *Fingers extension*
 - *Thumb extension*



- **1 sensory:**
 - 3 and ½ of the dorsum of the hand
- Radial nerve will change its name the *Posterior interosseous nerve* which actually give rise to the last two movements (*Fingers and thumb extension*)
- **Clinical features:**
 - Humours fracture in spiral groove with radial nerve injury (*Mid-shaft fracture*):
 - *Normal elbow* (triceps is supplied higher)
 - No wrist extension (**wrist drop**)
 - No thumb and finger extension
 - Numbness or loss of sensation
 - **Posterior interosseous nerve injury:**
 - Stab wound in the forearm
 - *Elbow and wrist are normal*
 - *Thumb and finger extension are lost*
 - Finger muscles:
 - metacarpophalangeal (MP) joints
 - Extension is by the radial nerve
 - Flexion is by the ulnar nerve by the interossei and lumbrical
 - Intraphalangeal joints (IP)
 - Extension is by the ulnar nerve by the interossei and lumbrical muscles
 - Flexion by the long flexors of the forearm
 - No sensory symptoms!!! Pure motor nerve
 - **Saturday night palsy:**
 - Very high injury of the radial nerve due to compression of the nerve *in the axilla*
 - *Everything is affected* (every movement out of the 4 and the sensation will be lost) (*wrist, elbow, fingers, thumb extension and sensation*)
 - Called like this because drunk people sleep with an arm behind the chair that causes the compression
 - Not common in KSA
 - **Summary:**
 - Remember where the lesion happened
 - Injury to the radial nerve in the axilla: all motor and sensory functions are lost
 - Injury to the nerve in the spiral groove: triceps is spared and everything else is lost
 - Injury in the forearm to the posterior interosseous nerve: elbow, wrist and sensation are normal.

3.4 FOREARM

3.4.1 MUSCLES

- **5 superficial muscles:**
 1. Pronator teres → pronation of the forearm

2. Flexor carpi radialis → wrist flexion
3. Palmaris longus → wrist flexion
4. Flexor carpi ulnaris → wrist flexion
5. Flexor digitorum superficialis → flexion of the proximal Intrapalangeal joints (PIP) so flexes the middle phalanx

- **3 deep muscles:**

1. Flexor digitorum profundus
2. Flexor pollicis longus
3. Pronator quadratus

3.4.2 NERVE SUPPLY

- All of these muscles are supplied by the median nerve **except 1 and a half** are supplied by the ulnar nerve:
 - Flexor carpi ulnaris
 - Half of flexor digitorum profundus to the little and ring finger
- The median nerve has **2 branches**
 - Superficial which supplies the superficial group
 - Deep (anterior interosseous nerve) which supplies the deep 2 and a half muscles (**PURE MOTOR**)

3.4.3 HAND MUSCLES

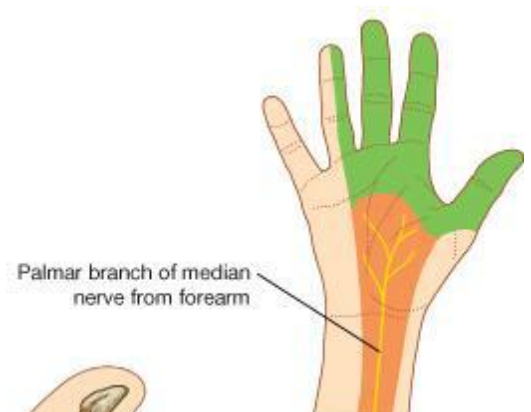
- Hypothenar: opposition of the little finger
- Thenar: opposition of thumb + adduction of the thumb (adductor pollicis)
- Interossei: abduction and adduction of the fingers + MP flexion + IP extension
- Lumbricals: MP flexion + IP extension

3.4.4 NERVE SUPPLY

- **The hand has 20 muscles**
 - 15 supplied by the ulnar nerve (3 hypothenar + 8 interossei (dorsal and palmar) + 2 lumbricals + adductor pollicis + Palmaris brevis)
 - 5 by the median nerve (3 thenar + 2 lumbricals (1st and 2nd))
- All the actions are from the ulnar nerve except 2 are from the median nerve:
 - Opposition of the thumb
 - Index and middle lumbricals

3.5 MEDIAN NERVE

- **Motor:**
 - Superficial flexors except flexor carpi ulnaris
 - Deep flexors except half of flexor digitorum profundus to little and ring finger
 - Thenar muscles
 - Index and middle lumbricals



- **Sensory:** lateral 3 and a half fingers on the palmar side
- **Clinically:**
 - **Anterior interosseous nerve injury:**
 - Affects the deep 2 and half muscles:
 - Half of Flexor digitorum profundus
 - Flexor pollicis longus
 - Pronator quadrates (pronation is not lost because of pronator teres)
 - Sign: **the patient “cannot make a perfect O”** with the thumb, index and middle fingers because he can’t flex the tips of the index and middle finger (DIP joint: this is the action of the flexor digitorum profundus muscle)
 - **No sensory loss**
 - **Median nerve injury at level of wrist:**
 - **Common in patients who attempt suicide**
 - **Loss of opposition of the thumb**
 - **Loss of sensation 3 and a half lateral**
 - Lumbricals are lost but interossei do the job
 - They still can make an “O”, bend the wrist and flex the PIP
 - Carpal tunnel syndrome:
 - Loss of sensation first
 - If untreated weakness of opposition
- **Summary:**
 - injury to median nerve at level of the wrist: loss of opposition and loss of sensation
 - injury to anterior interosseous branch of median nerve: patient cannot make an O + normal sensation

3.6 ULNAR NERVE

- **Motor:**
 - Flexor carpi ulnaris
 - Medial half of flexor digitorum profundus
 - Lumbricals + interossei + hypothenar + adductor pollicis
- **Sensory:** medial 1 and a half fingers front and back of the hand
- **Clinically:**
 - **Ulnar nerve injury:**
 - loss of flexor carpi ulnaris and half of flexor digitorum profundus
 - loss of sensation
 - all of the hand muscles
 - cannot oppose the little finger
 - atrophy of hypothenar muscles
 - Cannot adduct or abduct the fingers
 - Ends up with ulnar **claw hand**
 - **Ulnar nerve injury at the wrist:**
 - Sensation is lost
 - All hand muscles:

- Hypothenar atrophy
- No opposition of the little finger
- Cannot adduct or abduct the fingers
- Loss of thumb adduction resulting in froment's sign
- Froment's sign: you ask the patient to hold a pen with his thumb but he cannot so he contracts the flexor pollicis longus because the adductor pollicis is lost
- **Summary** of ulnar nerve injury:
 - Ulnar claw
 - Loss of sensation
 - Hypothenar atrophy
 - Positive froment's sign
 - Cannot adduct or abduct the fingers

3.7 MEDIAN AND ULNAR NERVE INJURY AT THE WRIST

- Loss of intrinsic muscles
- Loss of sensation
- Clawing of all the fingers = ape hand (semian hand)
- It will look like klumpke's palsy but you differentiate between them by the sensory loss.

4 QUESTIONS

4.1 MULTIPLE CHOICE QUESTIONS

1. **Erb's palsy:**
 - a. C5 and C6
 - b. C7 alone
 - c. C8 and T1
 - d. Total palsy
 - e. Lower brachial plexus injury
2. **The abductor pollicis longus muscle is supplied by:**
 - a. Median nerve
 - b. Ulnar nerve
 - c. Anterior interosseous nerve
 - d. Radial nerve
 - e. Axillary nerve
3. **The main action of the C6 root of the brachial plexus is:**
 - a. Making a fist
 - b. Crossing the fingers
 - c. Elbow flexion
 - d. Wrist extension
 - e. Elbow extension
4. **The intrinsic muscles of the hand are supplied by:**
 - a. C5
 - b. C6
 - c. C7
 - d. C8
 - e. T1

5. **Klumpke's palsy has all the following characteristics except:**
 - a. Can result from motor cycle injury
 - b. Anhidrosis
 - c. Loss of dermatomes
 - d. Phrenic nerve palsy
 - e. Miosis
6. **A patient with posterior interosseous nerve palsy:**
 - a. Unable to extend his wrist.
 - b. Can extend the IPJs of the fingers.
 - c. Can extend the MPJs of the fingers.
 - d. The sensation over the radial half of the hand is lost.
 - e. None of the above.
7. **Lateral cutaneous nerve of the forearm is a branch of which nerve:**
 - a. Axillary
 - b. Radial
 - c. Musculocutaneous
 - d. Ulnar
 - e. None of the above
8. **In a patient with anterior interosseous nerve palsy, what is false:**
 - a. Can pronate the forearm
 - b. Can flex the PIP of the index
 - c. Have positive O sign
 - d. Can flex the IPJ of the thumb
 - e. All of the above are true

5 ANSWER KEY

5.1 MCQS

1. **Erb's palsy:**
 - (a) C5 and C6
2. **The abductor pollicis longus muscle is supplied by:**
 - (d) Radial Nerve
3. **The main action of the C6 root of the brachial plexus is:**
 - (C) Elbow flexion
4. **The intrinsic muscles of the hand are supplied by:**
 - (e) T1
5. **Klumpke's palsy has all the following characteristics except:**
 - (d) Phrenic nerve palsy.
6. **A patient with posterior interosseous nerve palsy:**
 - (b) Can extend the IPJs of the finger.
7. **Lateral cutaneous nerve of the forearm is a branch of which nerve:**
 - (c) Musculocutaneous
8. **In a patient with anterior interosseous nerve palsy, what is false:**
 - (d) can flex the IPJ of the thumb