

Upper Limb Nerve Injuries: Carpal Tunnel Syndrome (Median Nerve Compression), Ulnar Claw (Claw Hand), Median Nerve Palsy and More

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In this article, you get an overview of the pathology of the brachial nerves and understand how a hand of benediction or a median claw hand, an ulnar claw and a hand extension loss with the radial nerve paralysis may develop.



Median Nerve Lesions

Definition

The median nerve originates from C5 to T1 nerve roots and emerges from the medial and lateral cords of the [brachial plexus](#). It is the only nerve that passes through the **carpal tunnel** of the wrist.

The median nerve innervates all the flexors in the forearm except the **flexor carpi ulnaris** and the ulnar portion of the **flexor digitorum profundus**. In the hand, the nerve supplies the **lumbricales I and II, abductor pollicis brevis, opponens**

pollicis, and the superficial head of the **flexor pollicis brevis**. It provides cutaneous innervation for the palmar surface of the hand, thumb, index, and middle fingers.

Etiology

The causes of the median nerve lesion are diverse, depending on the lesion location:

Location of lesions:	Lesions:
Lesions in the axilla	Median nerve palsy by arterial punctures
Lesions in the upper arm	Fracture of a supracondylar process; bone spur; a supracondylar process can cause irritation of the nerve without trauma
Lesions in the elbow area	Fractures of the distal humerus; puncture and injection
Lesions in the forearm	Due to chronic irritation, it can cause pain and spasms in the volar forearm and paresthesias of the radial fingers.
Lesions in the wrist	Cut injuries; rare distal radius fractures; tumors such as schwannoma or fibrolipoma; compression within the carpal tunnel .

Symptoms

Common symptoms are:

- An oath or monkey hand
- Atrophy of the thenar muscles (**thenar atrophy**): depression in the lateral side of a thenar eminence; thenar atrophy is generally diagnosed with a carpal tunnel syndrome
- Sensory disturbance
- A positive “bottle sign” test - the patient cannot close the hand around a bottle
- Trophic-vegetative disorder: edematous changes in the hand and fingers, pain and hyperpathia, failure of sweat glands and moisturizing of the respective skin areas
- Inability to flex the thumb and forefinger, a patient fails to make an “O” with the thumb and forefinger.



Image: “Untreated carpal tunnel syndrome” by Dr. Harry Gouvas, MD, PhD, License: [Public Domain](#)

Note: An **oath** or a **monkey hand** arises due to the failure of muscles innervated by the median nerve so that a patient cannot make a full fist. The index finger and part of the middle finger cannot be bent. There is no flexion of the thumb in the metacarpophalangeal and terminal joints. Ring and little fingers, however, can be flexed because they are innervated by the **ulnar nerve**.

Diagnosis

Median nerve palsy can be diagnosed by testing the muscles innervated by it.

The muscles innervated by the median nerve are:

- Pronator teres and pronator quadratus
- Flexor carpi radialis
- Palmaris longus
- Flexor digitorum superficialis
- Flexor digitorum profundus of fingers II and III
- Flexor pollicis longus
- Lumbricals 1 and 2
- Opponens pollicis
- Abductor pollicis brevis
- Flexor pollicis brevis

Electrophysiological findings can be helpful but are not always reliable.

Differential diagnosis

Rupture/injury of muscles or tendons resulting in symptoms similar to median nerve palsy.

Therapy

Carpal tunnel syndrome – conservative treatment such as wrist splinting and rest. Surgical treatment such as carpal tunnel release.

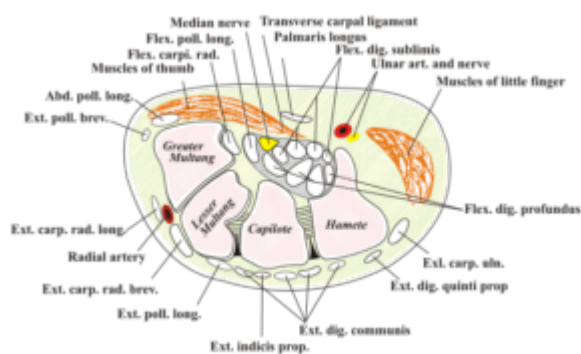


Image: "Transverse section of the wrist. Based off Gray's anatomy diagram of the same." by DoPhotoShop - <http://dophotoshop.com/carpal-tunnel-exercises.php>, License: [CC BY-SA 3.0](https://creativecommons.org/licenses/by-sa/3.0/)

Carpal Tunnel Syndrome

Definition

The carpal tunnel is formed anteriorly by the **flexor retinaculum** and posteriorly by the carpal bones. The median nerve and the tendons of the **flexor digitorum longus** travel to the fingers through the carpal tunnel. Carpal tunnel syndrome occurs from narrowing of the tunnel and subsequent compression of the structures within it.

Causes

The causes of carpal tunnel syndrome include:

- The inflammatory response in the tendon sheaths
- Fluid retention
- Overexertion
- Infection
- Trauma
- Repetitive movements that bend the hand (e.g. typing on a keyboard)

Symptoms

On the lateral side of the hand, compression of the median nerve may cause sensory disturbances and lead to thenar muscles atrophy. Symptoms also include pain, numbness, and/or tingling of the affected fingers.

Diagnosis

Carpal tunnel syndrome can be diagnosed by physical exam. Two tests include:

1. **Tinel's sign:** In this test, the examiner lightly taps the carpal canal of the patient. If this elicits a sensation of tingling or "pins and needles" in the distribution of the nerve, Tinel's sign is "positive".
2. **Phalen's maneuver:** The examiner flexes the patient's wrist for 30 - 60 seconds. The examiner makes sure that fingers are kept straight. The test is positive if the patient feels burning, tingling, or numbness over the thumb, index, middle, and/or ring fingers.

Electrophysiological tests can also be done. These are focused on the extension of the **motor latency** to the thenar muscles and the delay of the sensory conduction velocity in the **distal segment**.

Therapy

Conservative treatment includes **NSAIDs, wrist splinting, handrails,** and **corticosteroid injections**.

If conservative treatment fails, carpal tunnel release surgery can be done.

Ulnar Nerve Lesions

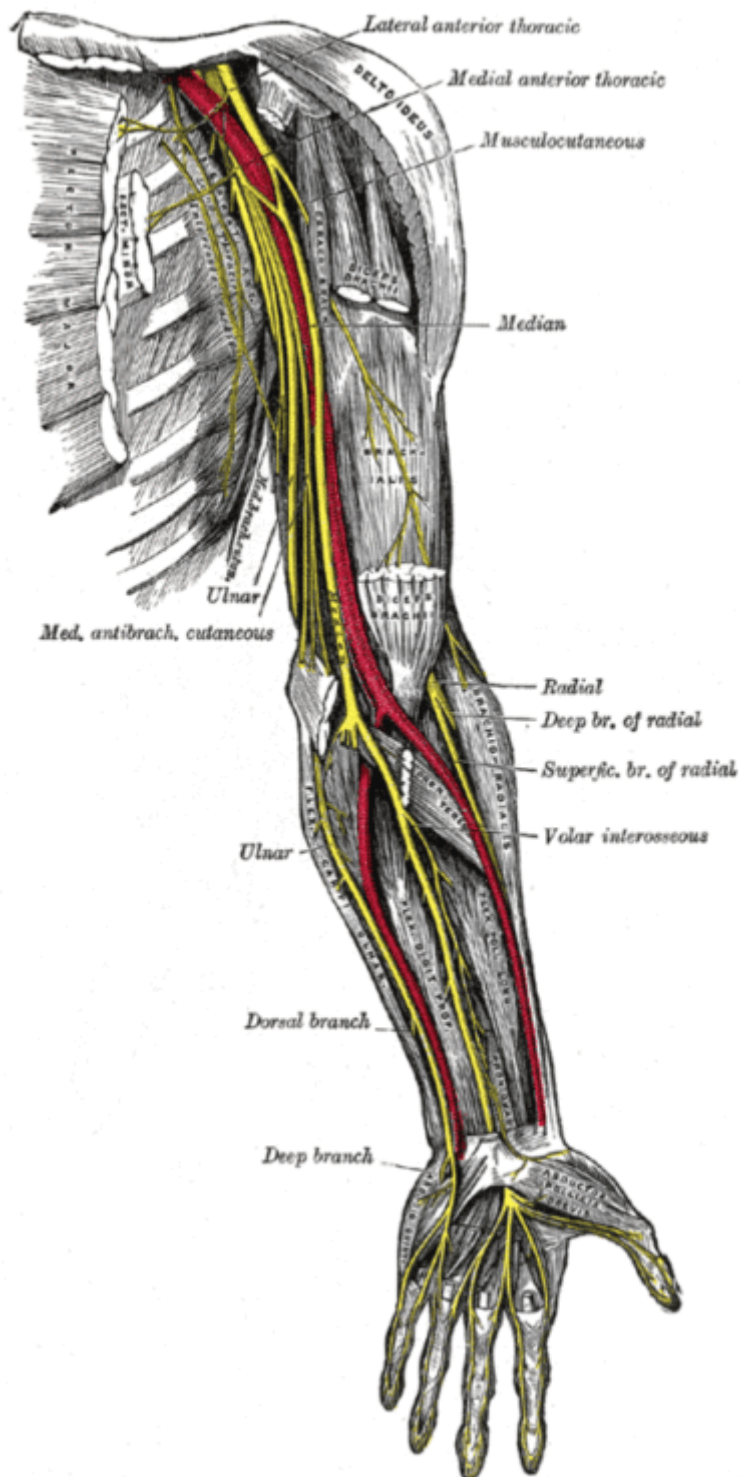


Image: "Nerves of the left upper extremity" by Henry Vandyke Carter, Henry Gray (1918) in Anatomy of the Human Body, Plate 816. License: [Public Domain](#)

Definition

The ulnar nerve originates from C8 - T1 spinal nerve roots, it emerges from the medial cord of the [brachial plexus](#). It contains both motor and sensory nerve fibers.

It descends the arm at the posteromedial aspect of the **humerus** and enters the forearm under the **flexor carpi ulnaris aponeurosis** posterior to the medial epicondyle of the humerus.

The ulnar nerve innervates the following muscles:

- Flexor carpi ulnaris
- Flexor digitorum profundus (ulnar portion)
- Hypothenar muscles
 - Opponens digiti minimi
 - Abductor digiti minimi
 - Flexor digiti minimi brevis
- Part of the thenar muscles
- Adductor pollicis
- Lumbricals III and IV

The ulnar nerve innervates the skin over the little finger and the corresponding region on the **ulnar side of the back of the hand**. It also completely innervates the little finger and the **ulnar half of the ring finger**.

Etiology

Common causes of lesions/injury differ according to their location.

Lesions in the Axilla and Upper Arm

Usually from direct trauma.

Lesions in the Elbow Area

- Direct trauma to the medial elbow
- Lacerations
- Fractures of the medial condyle
- Fracture of the trochlea
- Supracondylar fracture
- Secondary paresis
- Pressure lesions: they are the most common cause of the **ulnar paresis** in the elbow. Approximately 10 % to 25 % of all the ulnar paresis occur after general anesthesia.

Dislocation of the Ulnar Nerve from the Sulcus

An ulnar subluxation usually resolves. Symptoms include:

- Paresthesia over the ulnar dermatome
- Dupuytren's contracture
- Small finger deformities
- Knuckle pads or "Heloderma"

Lesions in the Forearm

Lesions of the dorsal branch of the ulnar nerve can be caused by:

- Surgical procedures of the distal forearm such as shunt operations
- Tight watches or handcuffs

Lesions in the Wrist

Wrist lesions may occur due to the following reasons:

- Direct trauma such as blunt force
- Penetrating trauma
- Guyon's cyst
- Chronic stress of the wrist from manual labor

Digital Nerves Lesions

Digital nerves lesions usually result from trauma or external compression.

Symptoms

The following symptoms characterize ulnar nerve lesions:

- A "claw hand"
- Atrophy of the little finger
- A restricted ulnar deviation of the hand and an incomplete fist: the fourth and the fifth fingers do not fully flex because of failure of the ulnar part of the flexor digitorum profundus
- A lack of adduction of the thumb - Froment's sign
- A loss of sensation in the small finger

Claw Hand

4th and 5th finger hyperextension at metacarpophalangeal joints and flexion of the interphalangeal joints. Also known as the "hand of benediction".

Diagnosis



Hand movement:
Palmar interossei

Image: "Palmar interossei animation" by Niwadare - Own work. License: [CC BY-SA 4.0](#)

Tests include:

- Asking the patient to adduct the thumb - Froment's sign.
- Asking the patient to spread his fingers to test the dorsal interossei.

Differential Diagnosis

- Brachial plexus injury
- Nerve root damage to C8 - T1
- Damage to the brachial plexus
- Spinal cord injury
- Chronic spinal muscular atrophy of the **Aran-Duchenne** type
- Amyotrophic lateral sclerosis
- Tumors

Therapy



Image: "Ulnarisparesis" by Dr. Jochen Lengerke - Praxis Dr. Lengerke, License: [CC BY-SA 3.0 DE](https://creativecommons.org/licenses/by-sa/3.0/de/)

Ulnar Nerve Palsy

Surgery involves shifting the ulnar nerve to the anterior aspect of the elbow joint.

Ulnar Nerve Dislocations

Ulnar nerve dislocations can usually be treated conservatively, aimed at avoiding compression. This includes wearing of padding at the elbow and reducing elbow flexion. Rarely, in the case of **recurrent dislocation**, the nerve is surgically relocated to the **volar** side.

Radial Nerve Lesions

Definition

The radial nerve originates from C5 to T1 nerve roots and emerges from the posterior cord. It has a motor and sensory nerve fibers and innervates the extensors of the arm and hand. In the upper arm, it innervates the **triceps brachii** and the **anconeus**. In the lower arm, it innervates the **brachioradialis**, the **extensor indicis**, and the **supinator muscle**.

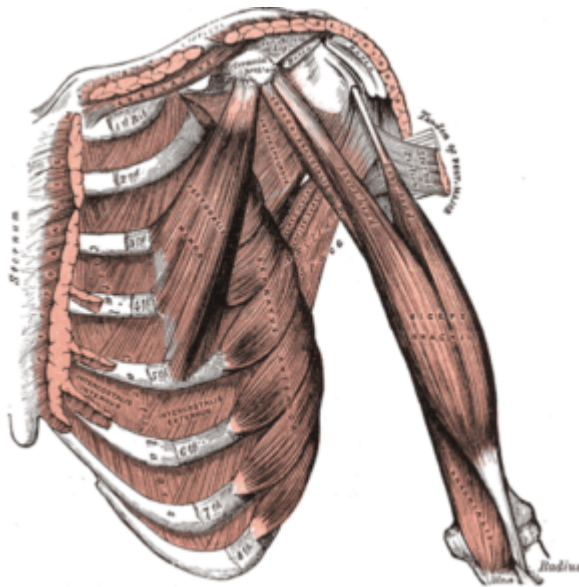


Image: "Deep front muscles of the arm" by Henry Vandyke Carter, Henry Gray (1918) in Anatomy of the Human Body/Gray's Anatomy, Plate 411. License: [Public Domain](#)

The nerve provides sensory innervation of the skin on the extensor surfaces of the upper and lower arm and dorsal side of the proximal and middle phalanges of the radial 2½ fingers. The sensory innervation takes place via the **dorsal antebrachial cutaneous nerve**, the **inferior lateral brachial cutaneous nerve**, and the **dorsal antebrachial cutaneous nerve**.

Etiology

Common causes of radial nerve lesions are:

- Use of crutches: paralysis occurs due to the pressure of crutches at the axilla
- Humeral shaft fracture
- Reduction of the humeral shaft fracture

Symptoms

- "Drop hand": loss of dorsiflexion of the wrist
- Loss of extension of all the fingers except the thumb
- Loss of extension of the thumb at the metacarpophalangeal joint
- Loss of reflexes at the triceps brachii and/or brachioradialis

Drop Hand

Diagnosis

- MRI
- Triceps and/or brachioradialis reflex or muscle strength
- Strength testing of:
 - Extensors carpi (radial and ulnar)
 - Extensor digitorum communis and extensor indicis
 - Abductor pollicis longus
 - Extensor pollicis brevis

Treatment

Nerve palsies from humeral shaft fractures **usually resolve** so no treatment is needed.

Axillary Nerve Lesions

Definition

The axillary nerve originates from C5 and C6 and originates from the **posterior cord** of the **brachial plexus**.

It innervates the **deltoid and teres minor**. It innervates the skin at the upper lateral and dorsal are of the upper arm through the **superior lateral brachial cutaneous nerve**.

Etiology

Common causes:

- Shoulder dislocation
- A fracture of the surgical neck of the humerus
- A scapular fracture
- External compression, i.e., from sleeping on the stomach with arms folded over the head

Assessment after **shoulder dislocation** can be difficult because the arm cannot be moved before it is reduced. Approximately 10—15 % of axillary nerve lesions occur as a result of a shoulder dislocation.

Symptoms

The following symptoms are typical of the axillary nerve lesion:

- Deltoid atrophy and damage to the nerve trunk (a protruding edged shoulder and visible contours on the acromion and humeral head)
- Failure of the deltoid (loss of elevation of the arm from 0 to 15 degrees of abduction)

Diagnosis

If you suspect the axillary nerve lesion, the examiner may use the following measures:

- Nerve conduction velocity measurements
- Electromyography
- X-ray
- MRI
- Muscle function testing

Physical Examination of the deltoid muscle

The deltoid abducts the arm from 0—15°. With your hand on the patient's shoulder, ask him to try abducting his arm and feel if the deltoid muscle twitches.

Differential diagnosis

- Muscular dystrophy – bilateral deltoid muscles affected
- Spinal muscular atrophy – unilateral deltoid atrophy
- Rotator cuff tear – causing pain or loss of arm abduction

Treatment

Conservative management includes **physiotherapy exercises**.

Surgical nerve transplantation is possible in cases of isolated axillary nerve lesions from blunt trauma.

Review Questions

The answers can be found below the references.

1. Which brachial nerve is concerned with a “positive bottle sign”?

- A. Ulnar nerve
- B. Axillary nerve
- C. Median nerve
- D. Radial nerve
- E. Brachial cutaneous nerve

2. Which clinical signs indicate carpal tunnel syndrome?

- A. Tinel’s test and Dupuytren’s contracture
- B. Tinel’s test and Phalen’s maneuver
- C. Froment’s sign and Phalen’s maneuver
- D. Kernig’s sign and Froment’s sign
- E. Dupuytren’s contracture and Kernig’s sign

3. Which hand position is typical in radial nerve lesions?

- A. Oath/benediction or monkey hand
- B. Scratch hand
- C. Claw hand
- D. Drop hand
- E. None of the answers above is correct

References

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Correct answers: 1C, 2B, 3D

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Notes