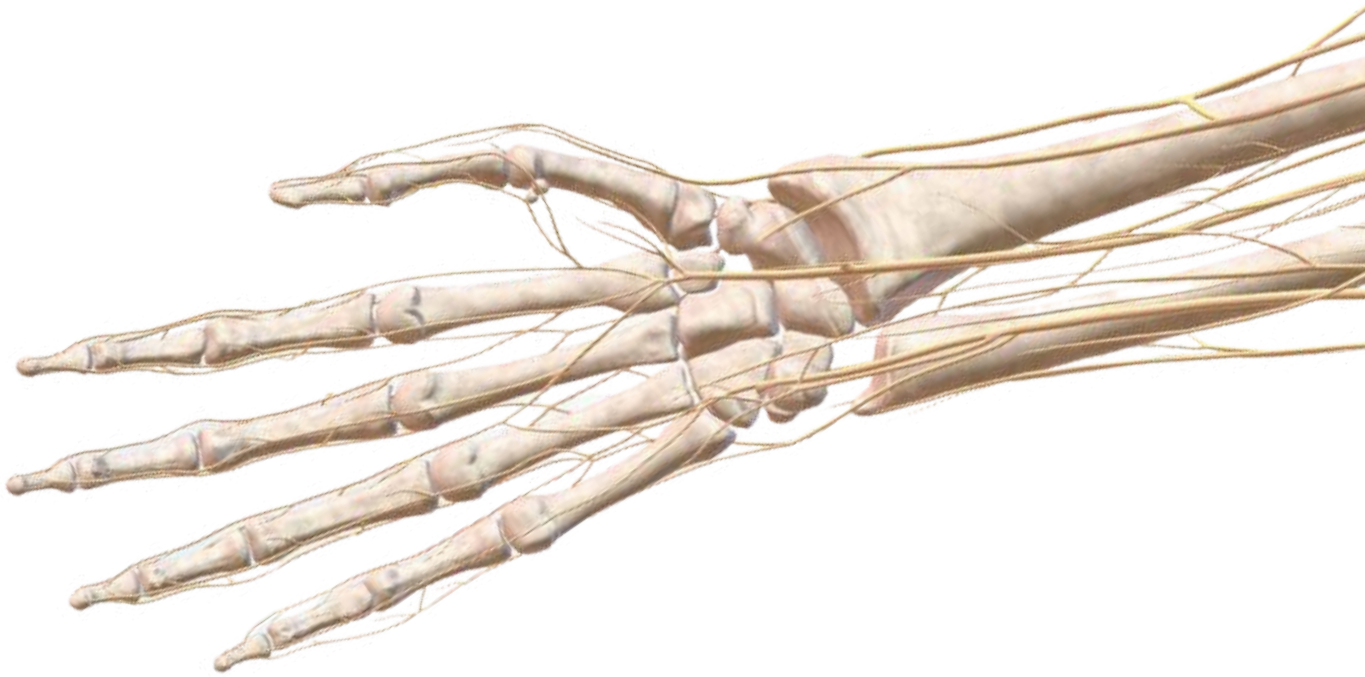


Course Handbook

Wrist and Hand Anatomy BootCamp

Lesson 6: Nerve Supply of the Wrist and Hand



Contents

- 2: Overview: Nerve Supply
- 3: Radial Nerve
- 4: Posterior Interosseous Nerve
- 5-6: Median Nerve and Anterior Interosseous Nerve
- 7-8: Ulnar Nerve
- 9: Membership Resources

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Overview: Nerve Supply

Introduction

In this tutorial, we are going to analyse the nerve supply to the wrist and hand.

We are going to split this tutorial into **two different parts**:

- Nerve supply proximal to the wrist and hand (to understand how these nerves reach the hand which can affect different clinical conditions we see at the hand)
- Nerve supply of the wrist and hand

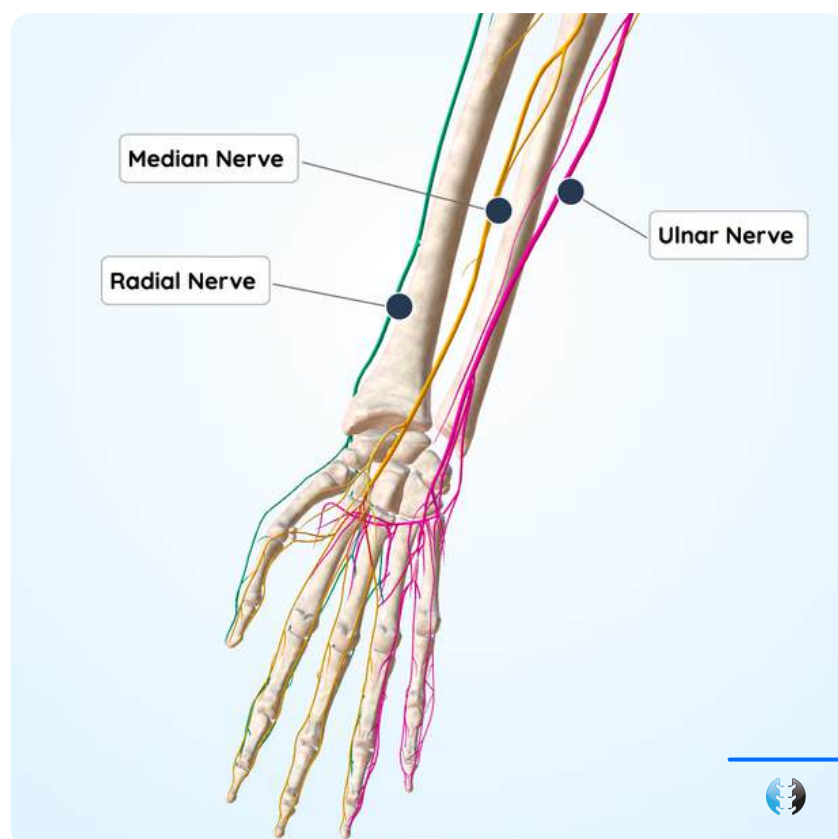
The key nerves that we will be looking at in this tutorial are:

- The Radial Nerve
- The Median Nerve
- The Ulnar Nerve
- The Anterior Interosseous Nerve (key branch of the median nerve)
- The Posterior Interosseous Nerve (key branch of the radial nerve)

The first thing to say as part of the introduction, which may sound quite simple but is actually crucial to mention, is the position of these nerves around the wrist and hand.

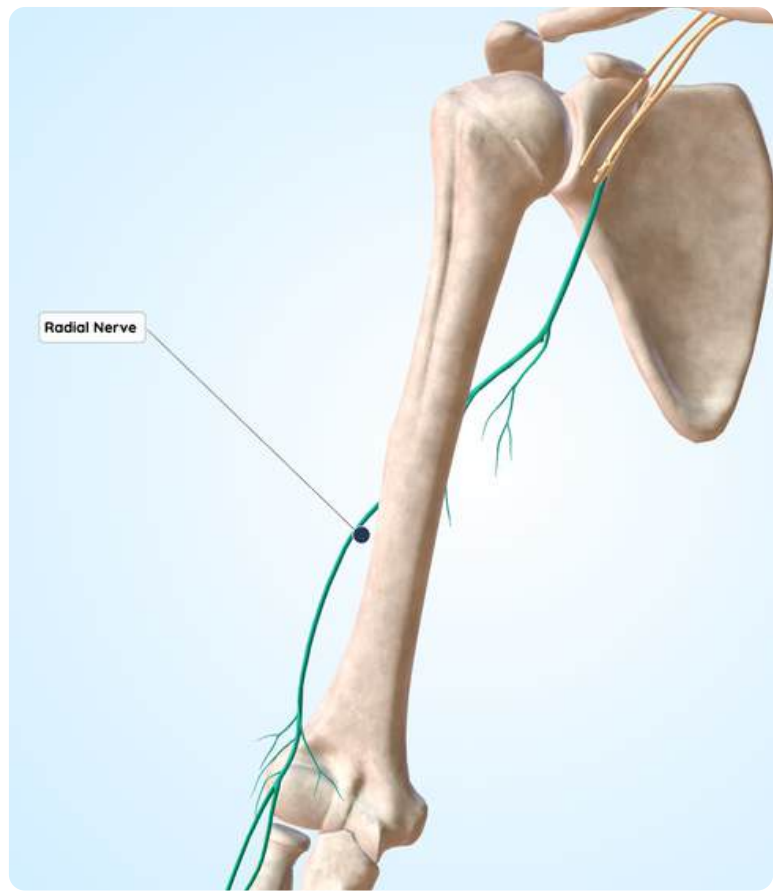
- The Radial Nerve, as the name suggests, runs down the Radius, the lateral side of the forearm and hand
- The Median Nerve, as the name suggests, runs down the Middle of the forearm
- The Ulnar Nerve, as the name suggests runs down the Ulna, the medial side of the forearm and hand

Even these simple thoughts alone can help hugely when we are thinking about the sensory areas innervated by these nerves, the muscles innervated by these nerves, and the pathologies of these nerves that may arise.

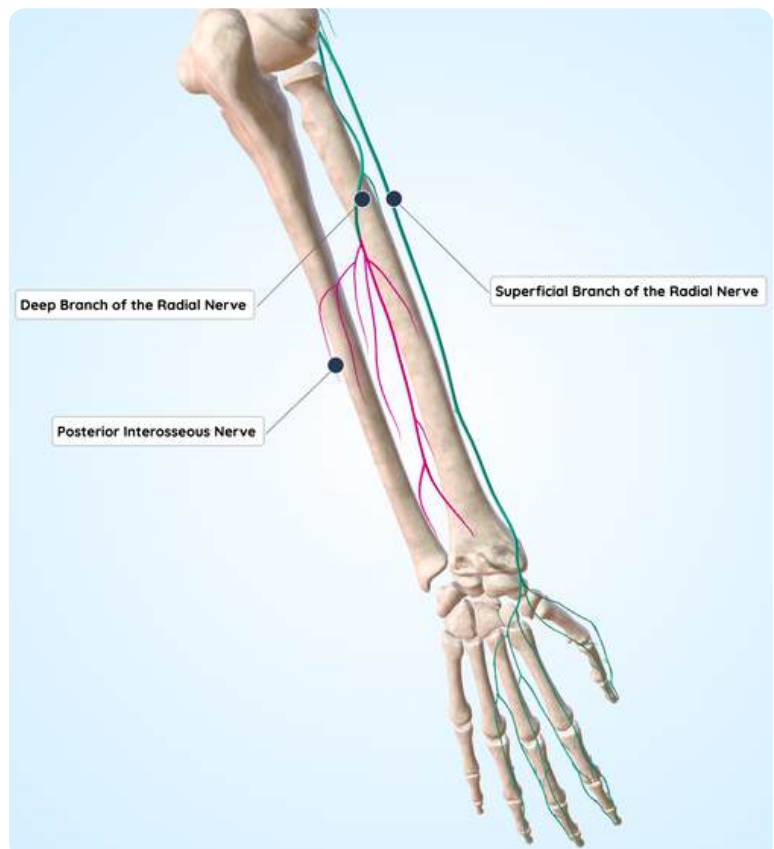


Radial Nerve

- The radial nerve starts medial to the humeral head, and then runs posteriorly behind the humerus, before running around the lateral arm to the **lateral epicondyle** of the humerus.
- The fact that it runs to the lateral epicondyle helps us remember that all of the **wrist extensor muscles** are innervated by the radial nerve, or the key branch of the radial nerve (posterior interosseous nerve).
- This makes sense as so many of the wrist extensors originate at or around the lateral epicondyle.
- A key sign of a radial nerve palsy is a **wrist drop**, where patients are unable to activate wrist extension.

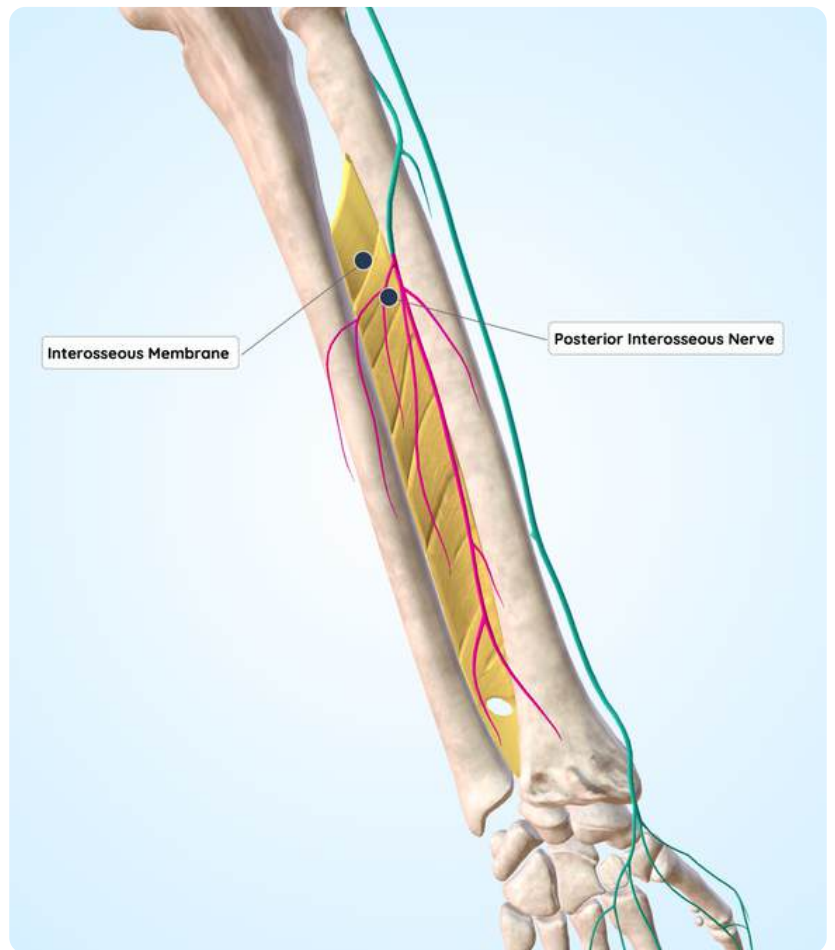


- At the antero-lateral side of the elbow, the radial nerve terminates and branches into the **Superficial Branch of the Radial Nerve**, and the **Deep Branch of the Radial Nerve**
- The **Superficial branch** is the bigger of the two, and continues to run down the radial side of the forearm towards the hand. It has a **mainly sensory function**, and can be tested by assessing whether or not patients have sensation in the posterior webspace between the 1st and 2nd digits
- The **Deep Branch of the Radial Nerve** runs around the radius posteriorly, before terminating into the **Posterior Interosseous Nerve**.



Posterior Interosseous Nerve

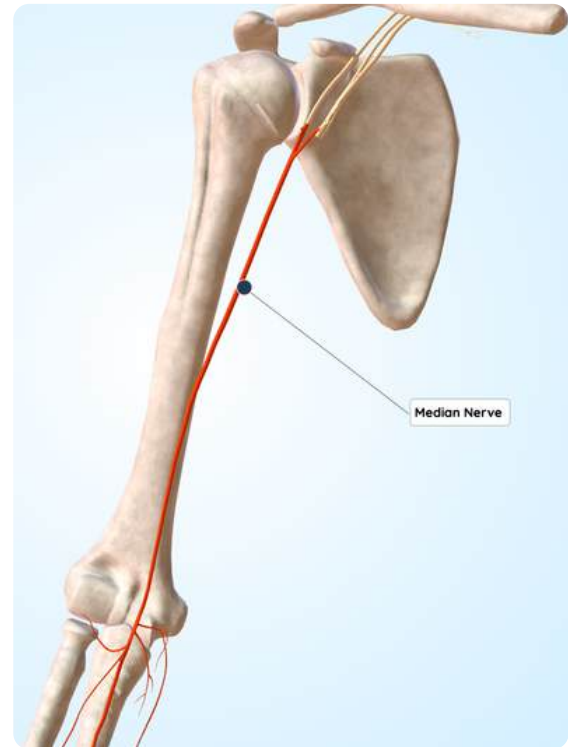
- As mentioned on the previous page, the **Posterior Interosseous Nerve (PIN)** branches from the Deep Branch of the Radial Nerve.
- It runs posteriorly to the **Interosseous Membrane** of the forearm, which is what gives it its name.



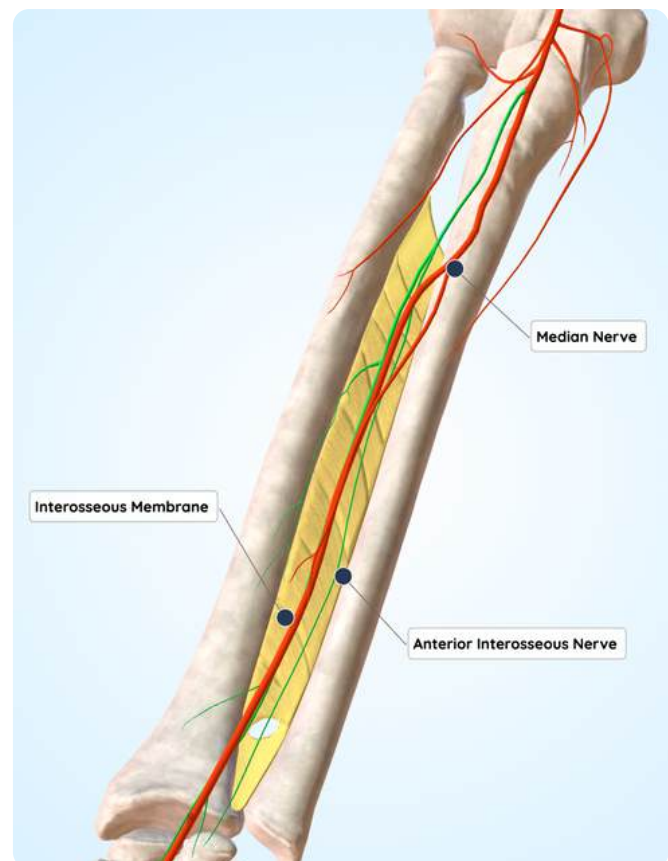
- Think of the **Posterior Interosseous Nerve** as the chief motor assistant of the Radial Nerve.
- When we think of the wrist, the key extensor muscles that are innervated by the radial nerve are Extensor Carpi Radialis Longus and Extensor Carpi Radialis Brevis.
- All the other extensor muscles of the wrist and hand are instead innervated by the Posterior Interosseous Nerve including muscles such as Extensor Carpi Ulnaris, Extensor Digitorum, Extensor Digiti Minimi, Extensor Indicis, Extensor Pollicis Longus, Extensor Pollicis Brevis and Abductor Pollicis Longus.
- As you can see, all of the posterior forearm muscles are innervated by either the Radial Nerve or the Posterior Interosseous Nerve. This totally makes sense as the location of these nerves are around the radial and posterior sides of the forearm.
- Remember that Abductor Pollicis Longus sits on the posterior side of the forearm, and so once again, it helps explain why this muscle as well as the other extensor muscles, are all innervated by these nerves.

Median Nerve and Anterior Interosseous Nerve

- The **Median Nerve** runs down the antero-medial humerus, before running over the anterior surface of the elbow in the cubital fossa.
- Note that everything here is anterior, that's really important to the further path of the median nerve as we will continue to explore.

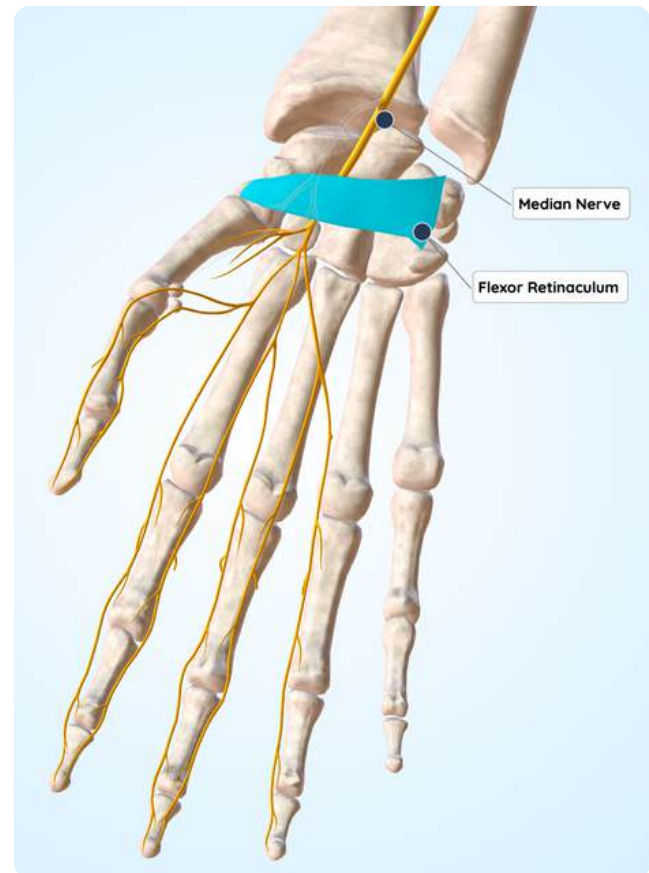


- The key branch of the Median Nerve is the **Anterior Interosseous Nerve (AIN)**
- This nerve branches from the median nerve approximately 1/4 of the way down the forearm and spreads all the way down the anterior forearm as well.
- The Anterior Interosseous Nerve, sits anteriorly to the **Interosseous Membrane**, which explains its name.
- We mentioned on the previous page that the Posterior Interosseous Nerve can be considered as the chief motor assistant of the Radial Nerve... In the same way, we can consider the Anterior Interosseous Nerve as the chief motor assistant of the Median Nerve.



Median Nerve and Anterior Interosseous Nerve

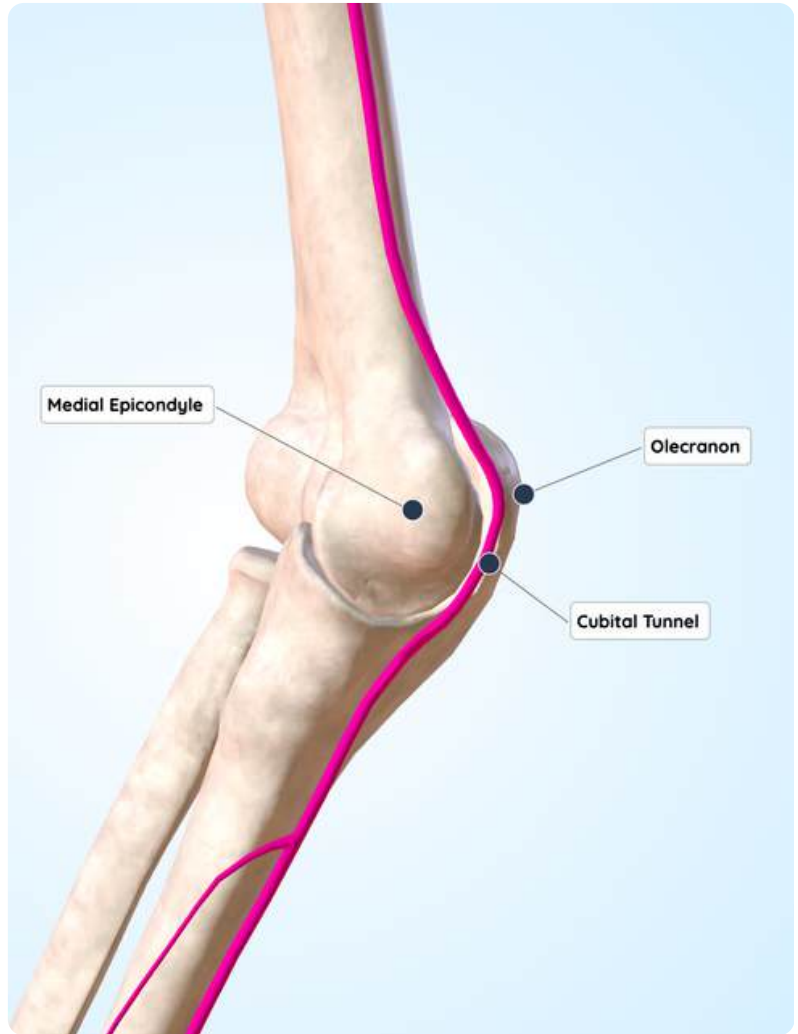
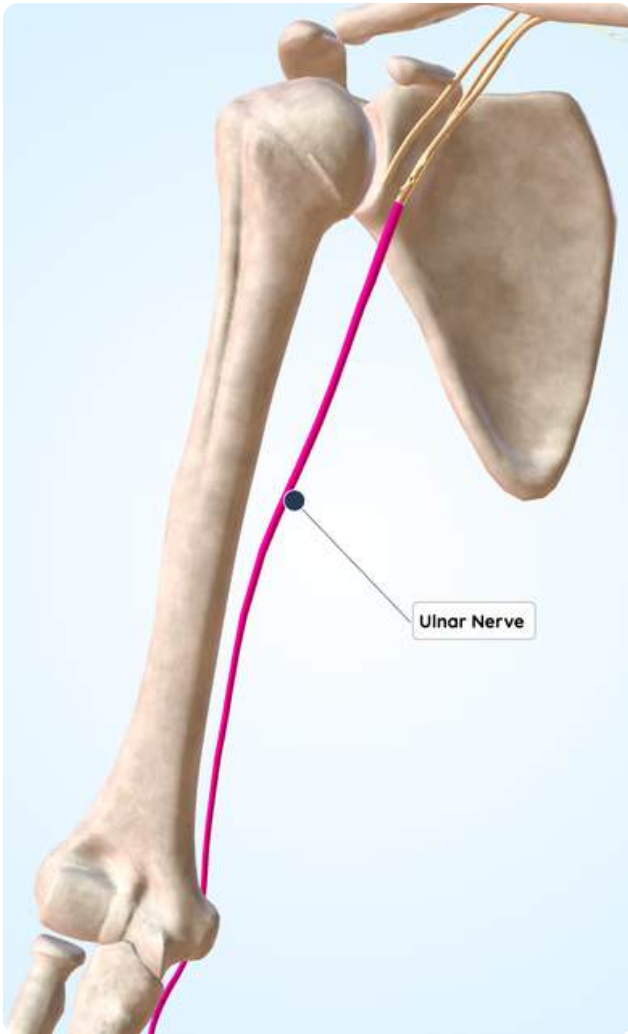
- The most well known pathology of the Median Nerve is **Carpal Tunnel Syndrome**.
- This condition occurs when the median nerve gets compressed underneath the **flexor retinaculum** of the anterior wrist.
- We can see in the attached diagram that the median nerve runs towards the **1st, 2nd, 3rd and the lateral half of the 4th digits of the hand**... this explains why the main symptom of patients with carpal tunnel syndrome is pain and/or paraesthesia of these specific digits.
- In severe cases of carpal tunnel syndrome, patients can experience weakness of some of the key muscles innervated by the median nerve such as abductor pollicis brevis.



- The key muscles of the hand innervated by the median nerve and its chief motor branch the anterior interosseous nerve can be remembered by the acronym the **LOAF Muscles**
- The LOAF muscles are:
 - **L**ateral Two **L**umbricals (1st/2nd lumbricals)
 - **O**pponens Pollicis Longus
 - **A**bductor Pollicis Brevis
 - **F**lexor Pollicis Brevis (specifically the deep head of FPB)
- Thus we can test for weakness of these muscles/movements when we are concerned about a median nerve palsy.

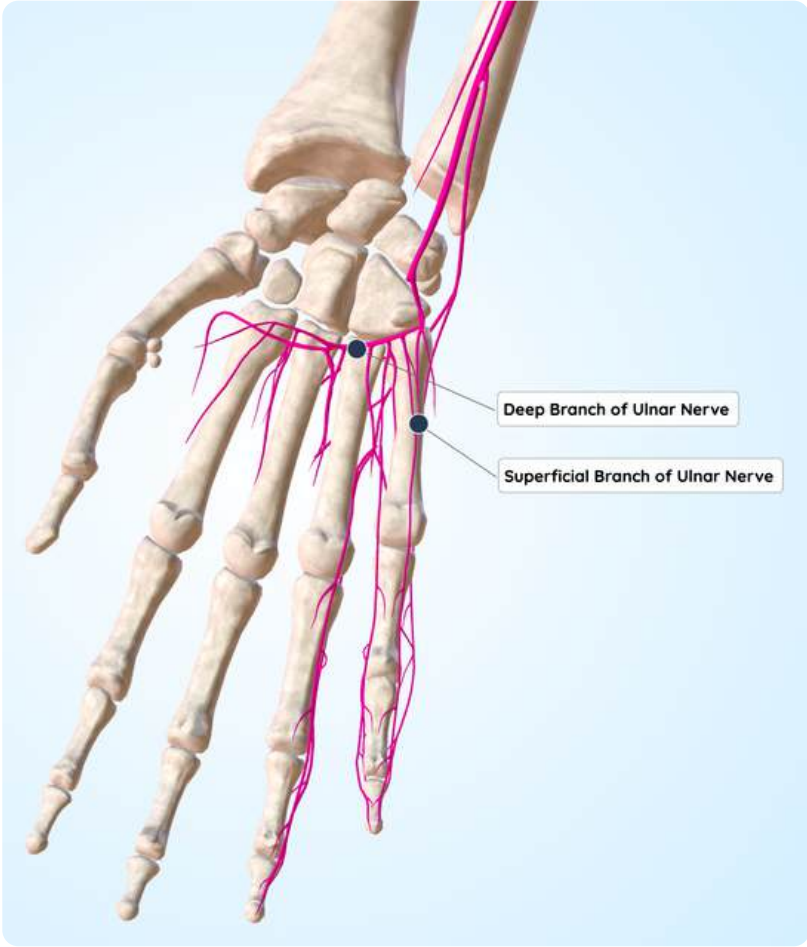


Ulnar Nerve



- The **Ulnar Nerve** runs down the medial side (or ulnar side) of the humerus, before running through the medial elbow.
- At the elbow, it runs through a small gap between the medial epicondyle and the olecranon, which is referred to as the **cubital tunnel**.
- The ulnar nerve can become compressed in the cubital tunnel, which leads to **cubital tunnel syndrome**, where patients may experience pain and/or paraesthesia in the medial forearm, and 4th and 5th fingers (ulnar nerve distribution)
- In severe cases, patients may experience weakness of some of the hand muscles innervated by the ulnar nerve.

Ulnar Nerve

- The **Ulnar Nerve** runs down the ulna bone on the medial side of the forearm before running to the medial side of the hand.
 - The ulnar nerve splits at a point called Guyon's Canal (located at the medial aspect of the carpal bones) into:
 - The Superficial Branch of the Ulnar Nerve, which runs down to the distal 4th and 5th digits
 - The Deep Branch of the Ulnar Nerve, which runs across towards the thumb
 - The deep branch of the ulnar nerve is incredibly important to a lot of the intrinsic muscles of the hand including the 3rd and 4th lumbricals, the palmar interossei and the dorsal interossei.
 - The palmar and dorsal interossei control abduction and adduction of the fingers, and so we can remember that this movement is controlled by the ulnar nerve.
- 
- The diagram illustrates the ulnar nerve's path from the forearm into the hand. It shows the nerve running along the ulna bone, passing through Guyon's Canal at the wrist, and then splitting into a superficial branch that travels to the 4th and 5th digits, and a deep branch that travels towards the thumb. Labels identify the 'Deep Branch of Ulnar Nerve' and the 'Superficial Branch of Ulnar Nerve'.
- The majority of the muscles relevant to the 5th digit specifically are innervated by the ulnar nerve such as opponens digiti minimi, flexor digiti minimi and abductor digiti minimi.
 - Whilst we highlighted earlier that almost all the muscles of the posterior compartment of the forearm are innervated by the radial nerve (and P.I.N), there is a split between the muscles of the anterior forearm and hand between the median and ulnar nerves
 - For example:
 - The 1st and 2nd lumbricals are innervated by the median nerve, whilst the 3rd and 4th lumbricals are innervated by the ulnar nerve.
 - The 2nd and 3rd digit tendons of flexor digitorum profundus are innervated by the median nerve, whilst the 4th and 5th digit tendons of flexor digitorum profundus are innervated by the ulnar nerve.

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