PERIPHERAL NERVE ENTRAPMENTS

CTS

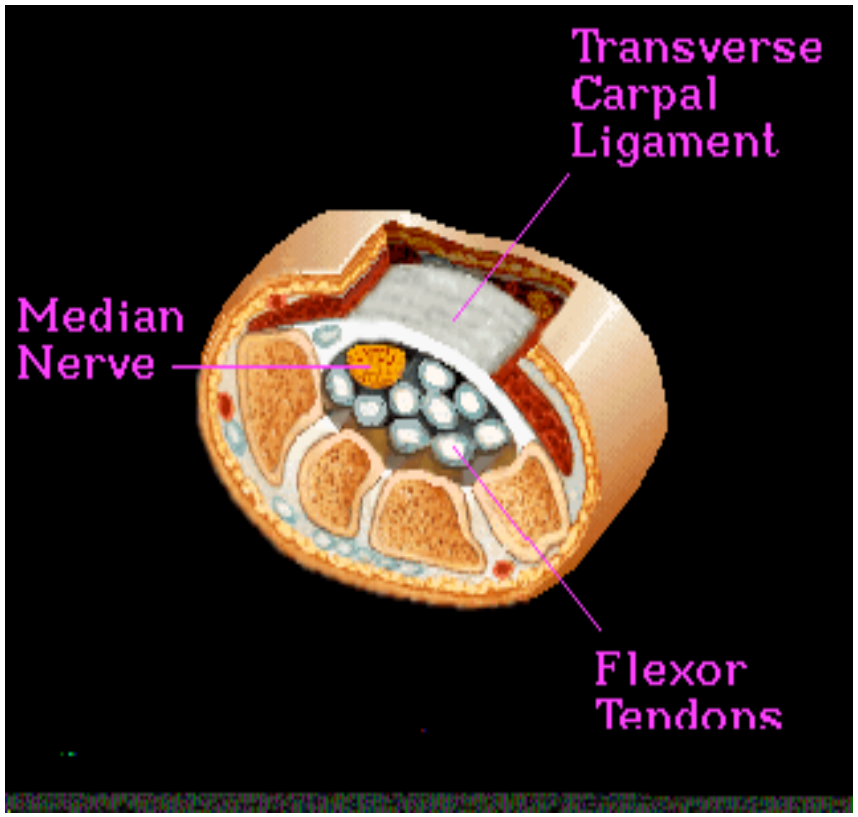
Ulnar Neuropathy at elbow

CARPAL TUNNEL SYNDROME

- Compression of the median nerve in a fibro-osseus canal on the palmar surface of the wrist: the carpal tunnel.
- Most common entrapment neuropathy
- 2-3% of the population.
- Variations in prevalence data is likely due to variations in occupational exposure.
- 90% have a good outcome and are able to work again and 10 % are permanently disable.

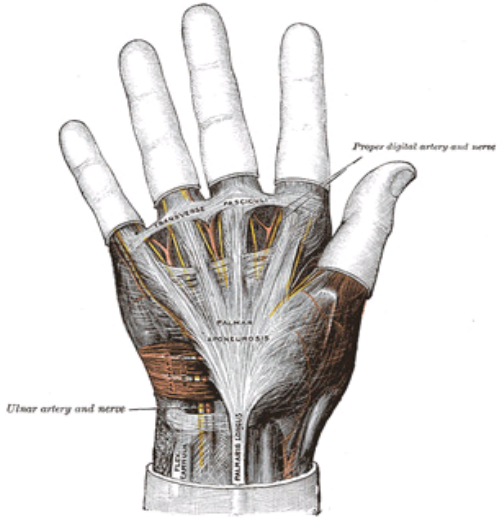
Carpal Tunnel Anatomy

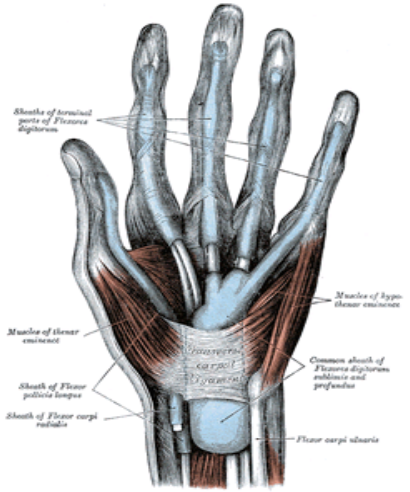
- Fibro-osseus tunnel bounded by the carpal bones, the interosseus ligaments and the transverse carpal ligament (the flexor retinaculum).
- Content:
  Median nerve, tendons of flexor digitorum superficialis (FDS), tendons of flexor digitorum profundus (FDP), and tendon of flexor pollicis longus (FPL).



The Flexor Retinaculum

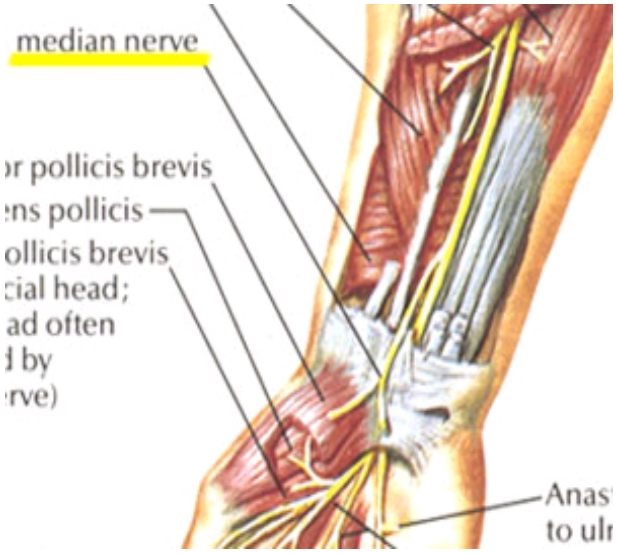
- Extends 1 cm or more proximal to the most distal wrist crease distally at least 3 to 4 cm into the palm.
- Constituted by the fusion of the TCL and deeper transverse fibers of the palmar aponeurosis.

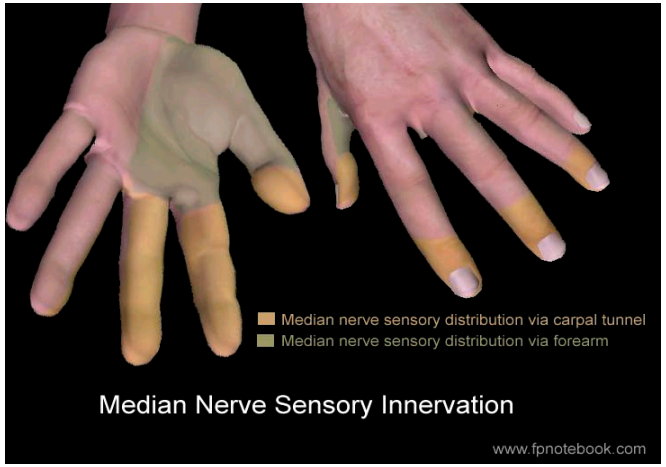




Palmar Cutaneous Branch

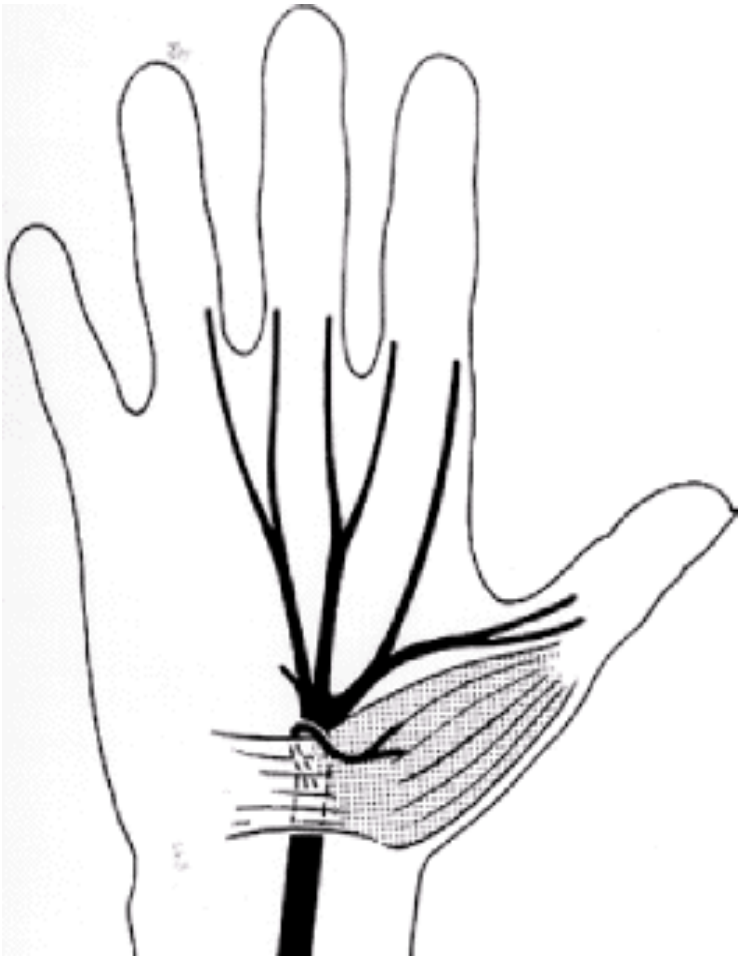
- Originates from the median nerve before it enters to the carpal tunnel.
- Exits the median nerve along its anterolateral quadrant about 3 to 4 cm above the distal wrist crease.
- Passes superficial to the TCL.
- Supplies sensation to the proximal surface of the thenar eminence.





Recurrent Motor Branch

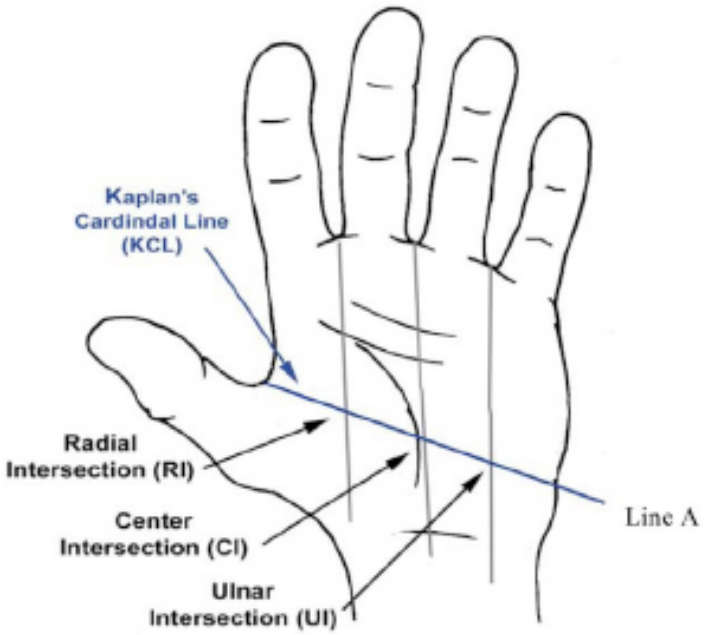
- Leaves the radial side of the median nerve distal to the flexor retinaculum.
- Curves back around to enter the thenar muscle mass.
- Multiple anatomical variations.
- 31% of cases: leaves the ulnar side of the median nerve beneath the TCL
- 20 % of cases: transligamentous course.



Surgical Anatomy

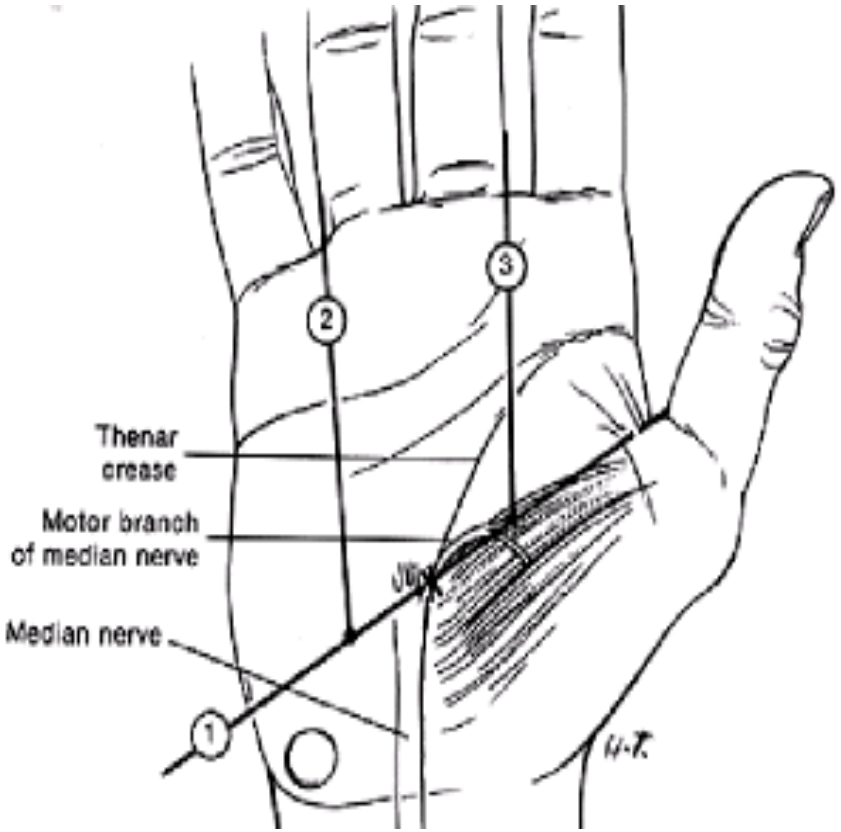
Kaplan's Cardinal Line:

- Apex of the First web space (between the thumb and index finger)
- Parallel with the proximal palmar crease.
- Intersects a line drawn as a continuation of the ulnar border of the ring finger at the hook of hamate.



- Recurrent motor branch of median nerve:

1. Emerges at the intersection of the KCL with a line drawn through the axis of the long finger.
2. Enters into the thenar musculature at the intersection of KCL with the proximal continuation of the radial border of the long finger.



Median Nerve within the Carpal Tunnel

- Radial Component:
  Sensory branches to the palmar surfaces of the 1st and 2nd fingers.
  Motor branches to the abductor pollicis brevis, opponens pollicis, and superficial head of flexor pollicis brevis.
- Ulnar component:
  Sensory branches to the palmar surface of 2nd , 3rd , and radial side of the 4th finger.
- Additionally, the median nerve can supply the dorsal surfaces of the 2nd , 3rd , and 4th fingers distal to the interphalangeal joint.

Causes and Associated Disorders

- More comnon in women: ratio of 2.5:1
- Middle age: 40-60 years.
- Occupational factors.
- The dominant hand is most often involved.
- 10% of patients have bilateral compromise.
- Predisposed patients: congenital small carpal tunnel cannal.
- Common cause: thickening or fibrosis of the flexor synovialis.
- Conditions that increase the volume of the contents of the carpal tunnel: ganglion cyst, benign mass, amyloid infiltration (multiple myeloma or amyloidosis).
- 15% of patients have DM.
- Rheumatoid arthritis: synovial overgrowth and alterations in carpal bone alignment.
- Acromegaly.
- Hyper and hypothyroidism.
- Pregnancy: 62% of pregnant women report symptoms. Usually resolve following delivery.

Clinical Symptoms and Signs

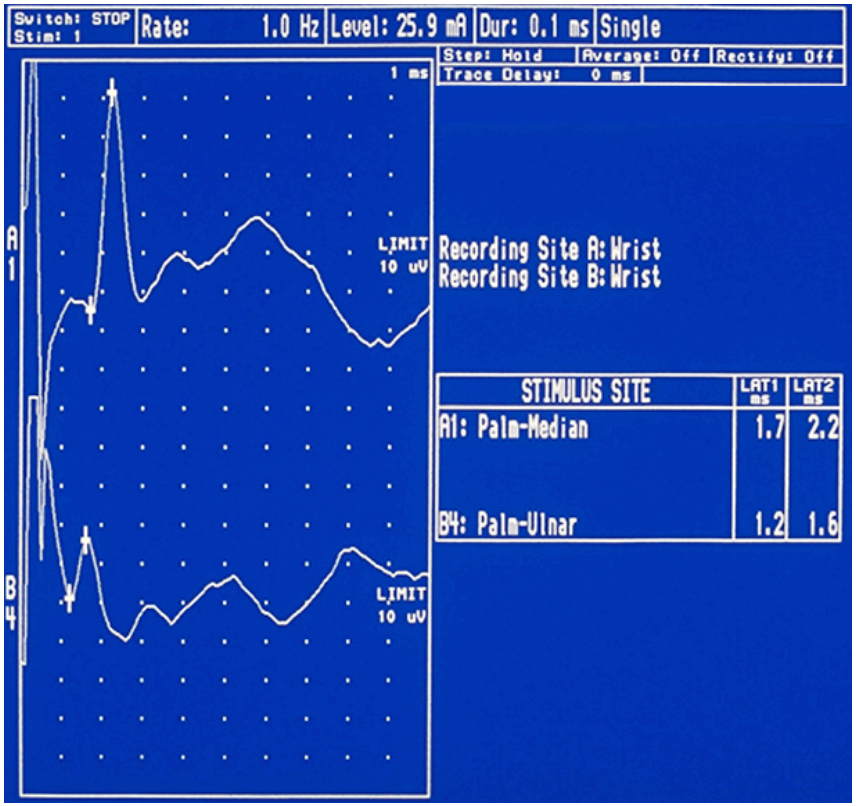
- Sensory complaints:
  80-100% of patients.
  Numbness and tingling in any of the sensory areas supplied by Median nerve.
  Night pain that awakens the patient.
- Motor complaints:
  Problems grasping or pinching.
  Thenar atrophy.
- Acute CTS: severe pain, wrist or hand swelling, cold hand, or decreased finger motion.

Tests

- Seek to reproduce pain or paresthesias in the median nerve's distribution within 30-60 seconds.
- Tinel's sign: Percussion over the TCL. Sensitivity 80%.
- Phalen's test: Maximal flexion of the wrist. Sensitivity 80%.
- Wormser's test (reverse Phalen's): Hyperextension of the wrist.
- Tourniquet: Significant damage if paresthesias appear in 15 seconds. Sensitivity 83%.
- Durkan's test: Carpal compression test. Pressure of 20 Kpa (150 mmHg) as long as 30 seconds.

Electrical Studies

- Important role in the differentiation among the possible affected areas: roots in the cervical spine, brachial plexus, or along the arm.
- Sensory nerve conduction studies are the most sensitive in confirming the diagnosis: increase in distal latency due to focal slowing of conduction across the carpal tunnel.
- Sensitivity and specificity: 90%



Conservative Treatment

- Underlying condition is self-limited: pregnancy.
- Mild symptoms.
- Occupational factor that could be modified.
- Wrist splint: Slight wrist extension. During sleep.
- Steroid injections: Intraneural injection must be avoided.

Conventional Carpal Tunnel Release

- Indications: Continued or disabling symptoms with abnormal electrical studies, evidence of muscle weakness or atrophy, and increased two point discrimination.
- Local anesthesia: 50%-50% combination of lidocaine and marcaine without epinephrine.
- Incision: ulnar to the palmaris longus at the distal wrist crease extended distally in a line trajectory between 3rd and 4th fingers until the base of the thumb (length: 4 cm).
- Avoid injury of any banches of the palmar cutaneous nerve.
- Sectioning of the palmar aponeurosis.
- Identification and sectioning of the transverse carpal ligament.
- Identify anomalous position of the motor branch.
- Avoid injury of the vascular arch while sectioning the distal segment of the transverse carpal ligament.
- Motor branch decompression if significant motor weakness and atrophy are present.
- Neurolysis if it is a reintervention and fibrosis is the presumable cause of failure.

Endoscopic Carpal Tunnel Release

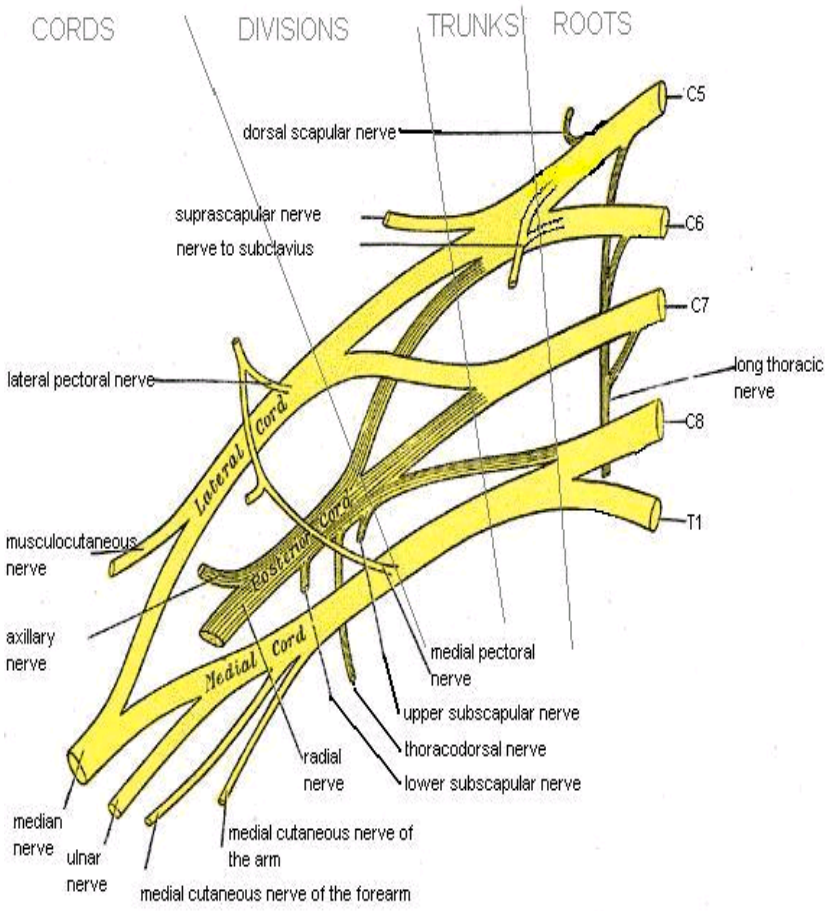
- Similar indications but more limited.
- NO indicated in: rheumatoid arthritis, significant tenosynovitis, recurrent CTS, concurrent ulnar tunnel syndrome, or space occupying lesion.
- Pain seems to be less.
- Strength improves earlier but overall, no significant benefit over the open release.
- Most common complication: incomplete release.
- Other complications: median nerve injuries, superficial vascular arch injuries, and tendon injuries.

ULNAR NERVE ENTRAPMENT AT THE ELBOW

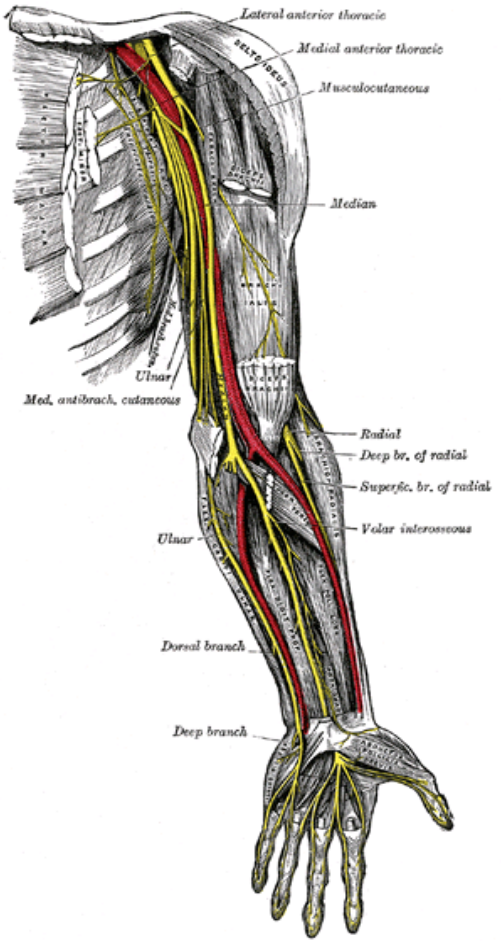
- AKA cubital tunnel syndrome.
- Second most common nerve entrapment syndrome of the upper extremitiy.
- Compression of the ulnar nerve in a sulcus on the posterior surface of the medial humeral epicondyle.

Surgical Anatomy

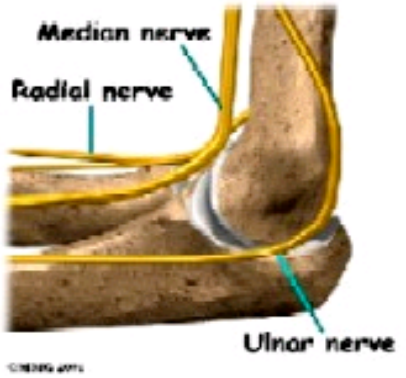
- Nerve roots C7, C8, and T1 contribute to the ulnar nerve.
- Ulnar nerve is a terminal branch off the medial cord of the brachial plexus.

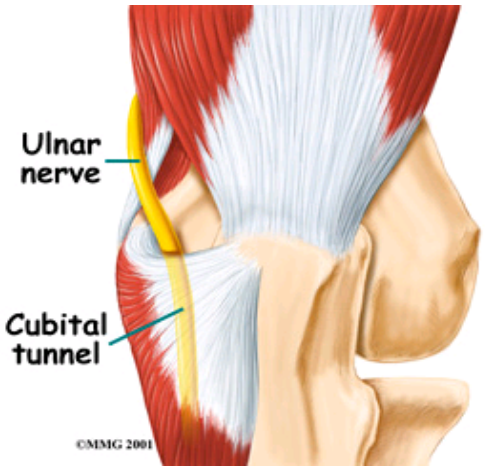


- Runs posterior and medial to the brachial artery in the upper arm.
- Travels between the brachialis and medial head of the triceps



- At the elbow, UN runs posterior to the medial epicondyle in the postcondylar groove of the olecranon.
- Bounded by two bony prominences: medially by the medial epicondyle and laterally by the olecranon.
- The cubital tunnel begins with the fascia b/w the medial epicondyle and the olecranon and ends at the area b/w the two heads of the flexor carpi ulnaris muscle.





- Provides sensation to the ulnar aspect of the hand including the small finger and the ulnar aspect of the ring finger.
- Provides NO motor branches in the upper arm.
- Provides motor function in the upper fore-arm: flexor carpi ulnaris and flexor digitorum profundus to the small and ringer fingers.
- Provides motor function at the hand: hypothenar, palmar and dorsal interosseus, 3rd and 4th lumbrical, adductor pollicis, and deep head of the flexor pollicis brevis.

Etiology

- Trauma and rheumatic changes in the region of the medial epicondyle can compress the ulnar nerve by narrowing the fibro-osseus tunnel.
- Trauma: 20-30 years. Repetitive microtrauma of some activities. Supracondylar fractures, distal humeral fractures, elbow dislocations, callus formation, and surgical exploration
- Rheumatic and degenerative joint disease: 50-60 years.
- Idiopathic in one quarter to one third of cases.
- Sometimes the compression is caused by displacement of the UN from the olecranon groove: Subluxation of the ulnar nerve. This is not a true tunnel syndrome but it has similar clinical presentation.

Clinical Diagnosis

- Numbness or tingling involving the small and ringer fingers.
- Pain on the medial forearm or elbow.
- Sensory changes happened after prolonged periods of elbow flexion.
- Weakness or loss of fine motor skills: difficulty writing, clumsiness, or dropping objects.
- Intrinsic muscle atrophy occurs later.
- Positive Tinel's sign: axonal damage or regeneration. Patients with neuropraxia do not have Tinel's sign.
- Elbow flexion-pressure test: elbow is flexed with the forearm and hand in neutral position. Manual pressure is applied proximal to the cubital tunnel for 30 seconds.
- Tinel's sign over the Guyon's canal indicates compression of the UN at the wrist.
- Brachial plexus nerve compression: symptoms are reproduced raising the arm overhead with the elbow extended and the wrist in neutral position.
- Spurling's test: can identify nerve root impingiment. Head is placed in one side with mild extension and axial compression is applied.

Electrodiagnostic Evaluation

- Valuable tool to confirm the diagnosis.
- Evaluation of the disease severity.
- Useful in patients who are difficult to examine or who cannot communicate.
- Standard study includes sensory and motor evaluation.
- Motor conduction velocity across the elbow is useful to define management: < 40 m/second – probable surgical management.

Nonoperative Treatment

- Mild to moderate severity.
- Patient education.
- Physical activity modifications: avoiding of prolonged elbow flexion, headset telephones, use of elbow pads while working.
- Rigid night splints: uncomfortable.
- Soft elbow pads

Surgical Management

- Simple decompression: Release of flexor carpi ulnaris fascia that spans the olecranon and the medial epicondyle.
- Minimally traumatic.
- Easy to perform.
- Complications are extremely low.
- Good results: 75-90%
- Disadvantages: possible incomplete release, continued dynamic stress with elbow flexion, and dislocation of the ulnar nerve, risk of postoperative fibrosis.

Medial Epicondylectomy

- The ulnar nerve is transposed without a formal dissection.
- Preserves the blood supply and proximal branches to the ulnar nerve.
- Good results: 70-90%.
- Complications: medial elbow instability, incomplete epicondylectomy, pain at the operative site, elbow flexion contracture, and persistent symptoms.

Transpositions

Submuscular transposition

Subcutaneous transposition

Intramuscular transposition

** NO convincing difference in outcome from simple decompression based on at least 3 recent RCTs **