

Carpal Tunnel syndrome

Dr Manju Setia Khowal

RMT, BAMS

Carpal Tunnel

The carpal tunnel is located **at the wrist just distal** to the wrist creases. It is a fibrous canal, with the floor formed by the carpal bones and the roof formed by the flexor retinaculum, also referred to as the **transverse carpal ligament**.

- This ligament is a dense **fibrous band**, approximately 1 to 2 millimetres thick.
- It attaches to the pisiform and the hook of the hamate bone on the **ulnar side** of the wrist;
- on the **radial side**, it attaches to the scaphoid tubercle and the trapezium.
- The median nerve becomes increasingly **superficial** as it approaches the carpal tunnel.
- Before passing through the tunnel, it gives off a nerve branch called the **palmar cutaneous branch**. This branch generally travels superior to, *not* through, the carpal tunnel
- This is significant because the palmar cutaneous nerve supplies the **skin over the thenar** eminence. In turn, if the median nerve is compressed in the tunnel, the sensation to the **thenar area is not affected**.

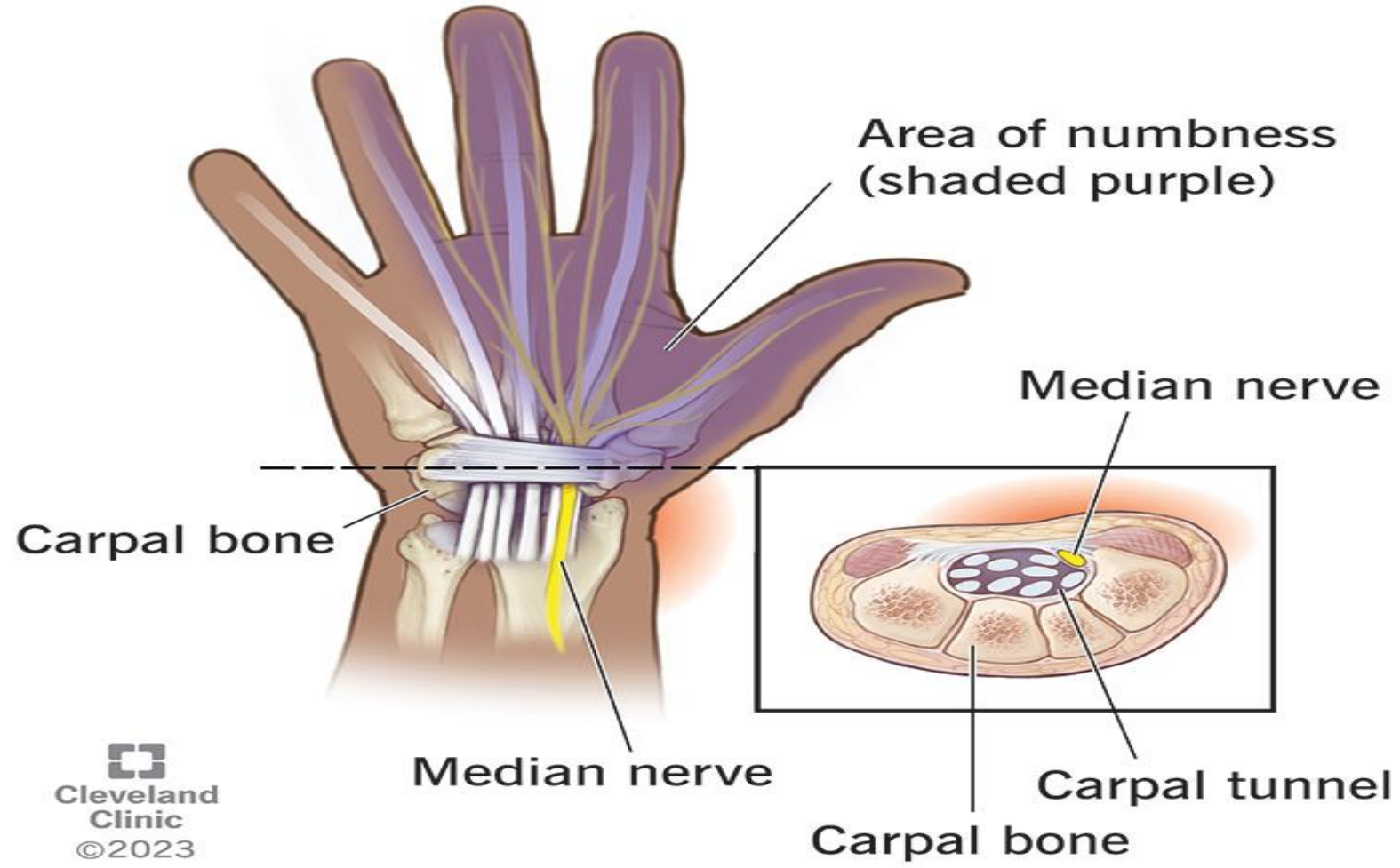
Structures that travel through the carpal tunnel (*Figure 69.1*) are:

- The median nerve;
- The **four** tendons of the flexor digitorum superficialis;
- The **four** tendons of the flexor digitorum profundus;
- The **tendon** of the flexor pollicis longus.

Definition

- Carpal Tunnel Syndrome (CTS) = compression of the **median nerve** at the wrist
- Occurs within the **carpal tunnel**
- Leads to:
 - Numbness
 - Tingling in **lateral 3½ digits**
- Most common **entrapment neuropathy of the arm**

Carpal tunnel syndrome



- **Incidence & Risk Factors**

- Seen in ~1% of population

- Higher risk in:

- Repetitive wrist activities
- Keyboard workers, butchers, assembly workers

- Often:

- Unilateral (dominant hand)
- Can be bilateral

- **Causes**

- Repetitive strain / overuse (most common)
- Edema (pregnancy, hormonal changes)
- Rheumatoid arthritis
- Space-occupying lesions / bony changes
- Occupational factors (keyboard, tools)

Causes

- **Chronic Causes**

- Repetitive wrist flexion/extension → edema → fibrosis
- Thickening of flexor retinaculum
- Systemic conditions:
 - Diabetes
 - Rheumatoid arthritis
 - Pregnancy

Space-occupying causes

- Ganglion, cyst, lipoma
- Bony changes or fractures

Acute Causes

- Trauma (fracture/dislocation)
- Infection
- Hematoma

Contributing Factors

- Vitamin B6 deficiency
- Familial tendency (small tunnel)
- Double crush syndrome (proximal + distal compression)

Symptoms

Sensory Symptoms:

- Numbness & tingling in median nerve distribution
- Nocturnal dysesthesia (key feature)
- Pain: Wrist → forearm → elbow → sometimes shoulder
- Limited wrist movement due to pain
- Thenar muscle wasting (late stage)

Client relief by:

- Shaking hand
- Massage
- Water immersion

- **Functional Issues**

- Weak grip
- Difficulty with fine motor tasks (e.g., buttoning)

- **Tissue & Structural Changes**

- Swelling (edema)
- Hypertonic forearm flexors
- Trigger points (forearm, scalenes, subscapularis)
- Adhesions at flexor retinaculum
- **Thenar atrophy (late stage)**

Assessment: Palpation

- Tenderness over carpal tunnel and median nerve
- Boggy tissue at wrist
- Dense forearm muscles (metabolic waste)
- Hypertonicity + fascial restrictions
- Thenar atrophy (chronic cases)
- Range of Motion (ROM)
- ↓ Wrist flexion and extension
- Possible ↓ ulnar deviation
- End feel: often empty

Empty end feel is a type of end feel felt during passive movement testing.

An empty end feel occurs when: Movement is stopped before the normal range, There is no true mechanical resistance. The motion is limited mainly due to pain or patient guarding, not tissue restriction

B. Range of Motion (ROM)

- ↓ Wrist flexion and extension
- Possible ↓ ulnar deviation
- End feel: often **empty**

C. Strength Testing

- Weakness in **abductor pollicis brevis** (chronic CTS)

Special Tests:

- **Phalen's Test** – positive
- **Reverse Phalen's** – positive
- **Tinel's Sign** – tingling in median nerve
- **Cyriax test** – positive
- **Tourniquet test** – less reliable

Differential Diagnosis

- **C6–C7 radiculopathy**
 - Neck pain present
 - Reflex changes
- **Thoracic outlet syndrome**
 - Medial forearm + medial digits symptoms
- **Pronator teres syndrome**
 - Pain with elbow movement

Medical Treatment

- Wrist splint (neutral position, especially at night)
- Anti-inflammatories / diuretics
- Steroid injections (temporary relief)
- Vitamin B6
- Surgery (moderate–severe cases):
 - Flexor retinaculum release
 - 50–65% success rate

Treatment Goals

- Reduce:
 - Edema
 - Fascial restrictions
 - Hypertonicity
 - Trigger points
 - Stress
- Decrease:
 - Sympathetic nervous system activity

Hydrotherapy

- Acute: **cold applications**
- Chronic: **contrast bath**
- Heat:
 - Before deep work
 - After trigger point therapy

Massage Techniques

- **Proximal Work**

- Neck, shoulder, axillary drainage
- Treat scalenes, subscapularis trigger points

- **Local Wrist & Forearm**

- Effleurage (lymphatic drainage)
- Petrissage (forearm muscles)
- Thumb kneading (flexor retinaculum)
- Frictions (adhesions – if indicated)

Avoid direct compression of median nerve

- **Hand Treatment**

- Fascial spreading (palm)
- Gentle petrissage
- Thenar muscle work (if healthy)

Joint Techniques

- Joint play (elbow, wrist, metacarpals)
- Passive ROM
- Rhythmic movements

Acute vs Chronic

- **Acute:**
 - No local work
 - Focus proximal + cold therapy
- **Chronic:**
 - Combine relaxation + specific techniques
 - Pain may temporarily increase

Self-Care Plan

- **A. Postural Education**
- Neutral wrist position
- Proper workstation ergonomics
- Avoid repetitive strain

- **Hydrotherapy**
- Ice during activity
- Contrast baths (10°C difference)
- **Stretching**
- Forearm flexors & extensors
- Hold 10–20 seconds
- Pain-free
- **Strengthening**
- Thenar muscles
- Gradual progression
- Daily exercises

Key Clinical Points

- Nocturnal symptoms = hallmark sign
- Thenar atrophy = late stage
- Always rule out **cervical + TOS causes**
- Massage = **symptomatic + functional relief**, not structural cure

Contraindications

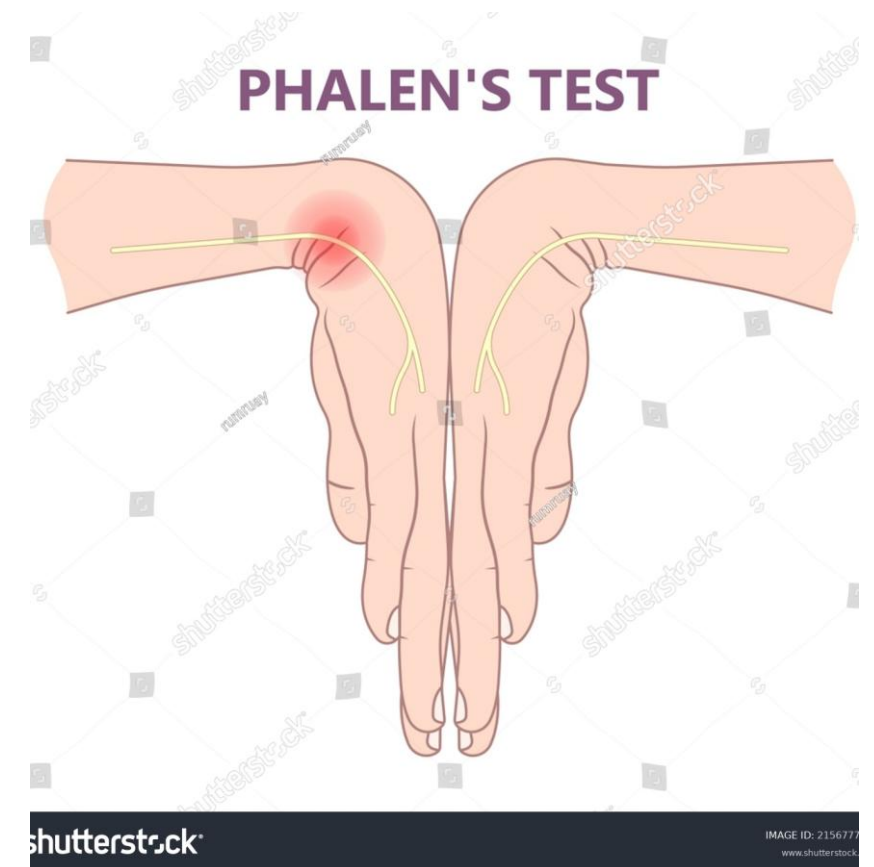
- No frictions if:
 - Rheumatoid arthritis
 - Edema present
 - Diabetes with poor tissue health
 - Anti-inflammatory use
- Avoid:
 - Vigorous joint play (instability, pregnancy)
 - Local massage after corticosteroid injection (10 days)

Difference: Pronator Teres Syndrome vs Carpal Tunnel Syndrome

Feature	Pronator Teres Syndrome (PTS)	Carpal Tunnel Syndrome (CTS)
Site of Compression	Median nerve compressed at pronator teres (proximal forearm)	Median nerve compressed in carpal tunnel (wrist)
Onset	Gradual, insidious	Often gradual, may worsen with repetitive use
Pain Location	Anterior forearm pain	Wrist and hand pain
Pain Trigger	↑ with repetitive elbow movement (pronation)	↑ with wrist activity / repetitive hand use
Nocturnal Symptoms	✗ Absent	✓ Present (classic sign)
Sensory Symptoms	Numbness in thumb & index finger	Numbness in lateral 3½ digits
Thenar Atrophy	Mild or less common	Common in chronic CTS
Weakness	Thenar weakness possible	Thenar weakness (abductor pollicis brevis)
Tenderness	At proximal forearm (pronator teres)	At carpal tunnel (wrist)
Special Tests	Pain with resisted pronation	Positive Phalen's, Tinel's
Effect of Wrist Position	Not significant	Symptoms worsen with wrist flexion

Phalen's Test : CTS

- **Procedure**
- Ask the patient to **flex both wrists maximally** (pushing the dorsal surfaces of the hands together).
- Maintain this position for **30–60 seconds**.
- Observe and ask the patient if they experience **tingling, numbness, or pain** in the median nerve area.
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- **Interpretation**
- **Positive Test:** Tingling, numbness, or pain in the median nerve distribution.
- **Negative Test:** No symptoms reproduced.



Reverse Phalen/Prayer Test:CTS

Purpose

- To **assess median nerve compression** at the wrist.
- It is essentially the **opposite of the standard Phalen's Test**.

Procedure

- Ask the patient to **extend both wrists fully**, with the **palms facing downward** (like a prayer position turned downward).
- Maintain this position for **30–60 seconds**.
- Observe for **tingling, numbness, or pain** in the median nerve area (thumb, index, middle, lateral half of ring finger).

Interpretation

- **Positive Test:** Tingling, numbness, or pain in the median nerve distribution.
- **Negative Test:** No symptoms reproduced.

Reverse Phalen's Test



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Cyriax Test / Carpal Compression Test

Definition

- A **special test used to detect median nerve compression** in the carpal tunnel
- Mentioned as **positive in CTS cases**

Procedure :Patient is seated or standing

- Therapist **applies direct pressure over the carpal tunnel** (anterior wrist, over flexor retinaculum) Pressure is held for **~30 seconds**

Positive Sign: Reproduction of: **Pain ,Tingling ,Paresthesia In median nerve distribution (lateral 3½ digits)**

Negative Sign:No reproduction of symptoms

- **Clinical Significance**
- Indicates **median nerve irritation/compression**
- Helps confirm **Carpal Tunnel Syndrome**



Tinel's Sign

- **Purpose**

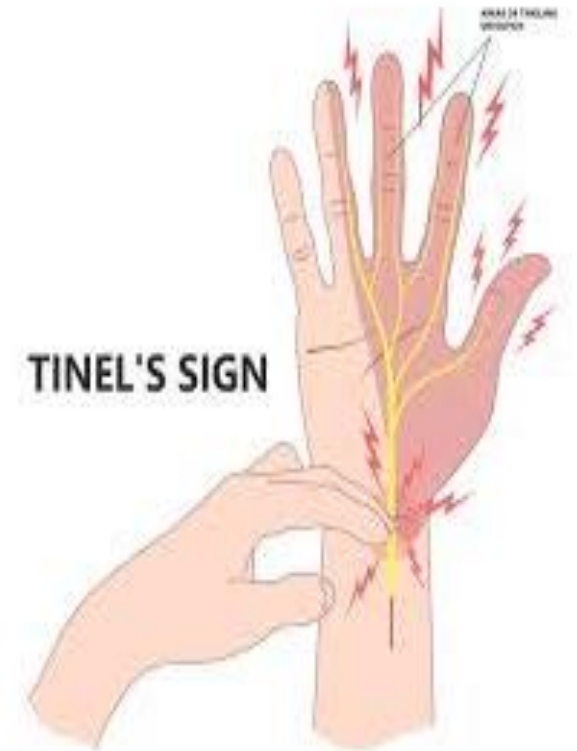
- To detect **irritation or compression of the median nerve** at the wrist.
- Helps **localize the site of nerve compression**.

Procedure

- The patient's **forearm is relaxed and resting**.
- The examiner **taps gently over the median nerve** at the **volar aspect of the wrist** (just proximal to the flexor retinaculum).
- Observe for **tingling, “pins-and-needles,” or pain** radiating into the median nerve distribution (thumb, index, middle, lateral half of ring finger).

Interpretation

- **Positive Tinel's Sign:** Tingling or pain in the median nerve distribution.
- **Negative Tinel's Sign:** No symptoms reproduced



Thank you 😊