

## Hand Sensory Deficits

*ICD-9-CM codes:*     354.0             Carpal tunnel syndrome

*ICF codes:*     Activities and Participation Domain codes: **d4301** Carrying in the hands; **d4400** Picking up; **d4401** Grasping; **d4402** Manipulating  
                          Body Structure code: **s73028** Neural structures of hand  
                          Body Functions code: **b2650** Touch functions related to sensing surface quality

### *Common Historical Findings:*

Paresthesia and numbness in Median nerve distribution – weakness develops later (loss of grip strength)  
 Wrist/hand pain – often worse at night  
 Onset associated w/repetitive hand use, vibration, or sustained postures

### *Common Impairment Findings* - Related to the Reported Activity Limitation or Participation Restriction:

Thenar atrophy, weakness  
 Sensory deficits to thumb/index finger

#### Symptoms reproduced with:

Median nerve bias ULTT  
 Provocation of carpal tunnel (inc. Phalen's, Tinel's, and carpal compression test)

### *Physical Examination Procedures:*



Manual Resistive Test  
 Abductor Pollicis Brevis

**Cues:** APB is one of three thenar muscles innervated by the median nerve  
 Isolate APB by having the patient move the shaft of the proximal phalanx toward the pisiform  
 Push the shaft toward the index finger  
 Compare with uninvolved side and with norm for the patient's age, gender, and activity level

### Wrist Mobility Deficits: Description, Etiology, Stages, and Intervention Strategies

The below description is consistent with descriptions of clinical patterns associated with wrist  
**Carpal Tunnel Syndrome** the vernacular term “**Carpal Tunnel Syndrome**”

*Description:* A compression neuropathy of the median nerve at the level of the carpal tunnel, commonly associated with pain, numbness, weakness and/or tingling that frequently disturb sleep. The numbness and tingling is in median nerve distribution of the thumb, index finger, long finger, and radial half of the ring finger. The weakness may result in difficulty with grasping objects or dropping of objects. Symptoms worsen with repetitive flexion or extension of the wrist, sustained wrist flexion, and continued gripping or pinching activities and may be relieved by shaking hands or dangling hand and working the fingers.

*Etiology:* The etiology is presumed to be increased volume in the carpal tunnel caused by edema or tenosynovitis of the flexor tendons or by an alternation in the osseous margins of the carpus, secondary to fractures, dislocations, or arthritis or by thickening of the transverse carpal ligament.

*Non-operative versus Operative Management:* Most patients with CTS improve with conservative treatment and medications. The two main indications for surgical management of CTS are the failure, or expected failure, of nonsurgical treatment and evidence of denervation in the hand as evident in EMG/NCV testing, and/or by a loss of two-point discrimination, and/or thenar muscle atrophy. It has been shown that surgical treatment is 95% effective and results in faster return to work times than nonoperative management. The main reason for surgical failure is an incorrect diagnosis of CTS, meaning the CTS symptoms were a manifestation of a different underlying pathology, which the release surgery did not treat. Thus, nonoperative management should be followed for patients with underlying conditions until they are medically stable. Contraindications for surgery include concomitant ulnar nerve entrapment in Guyon’s canal, and advanced tenosynovitis. Risks of surgery include infection, injury to the median nerve or its branches, failure of the surgery to improve symptoms, and injury to another nerve or vascular structure.

*Surgical Procedure:* Decompression of the nerve is accomplished by severing the TCL. This can be done in two ways:

1. Open technique: a volar incision extending from the mid-palm to about one half inch proximal to the wrist. The skin, subcutaneous tissue, palmar fascia, and palmaris brevis have to be transected to reach the TCL.
2. Endoscopic procedure: release of the TCL by inserting a metal tube through the carpal tunnel via one or two small incisions
  - a. single portal: proximal incision
  - b. two-portal: proximal and distal incision

*Preoperative (and Non-operative) Rehabilitation:*

- Patient Education: The nature of CTS including relevant anatomy and pathology
- Modification/cessation of causative activity with emphasis on decreasing repetitive wrist motions

- Splint immobilization with the wrist positioned in neutral for 6 weeks continuous
- Tendon and nerve gliding exercises
- NSAIDs as prescribed by the MD
- MD may do steroid injection for temporary relief (6-9) months
- CTS associated with pregnancy will usually resolve post-partum

Acute Stage / Severe Condition: Physical Examinations Findings (Key Impairments)

*ICF Body Functions code: **b7101.3** SEVERE impairment of mobility of several joints*

- Sensory deficits and/or pain in the median nerve distribution of the thumb, index finger, long finger, and radial half of the ring finger
- Diminished grip and pinch strength
- Weakness of thumb opposition thumb abduction pollicis brevis.
- Symptoms are reproduced with provocation of carpal tunnel
- Positive median nerve tension test
- Positive Phalen's test
- Positive Tinel's sign
- Positive carpal compression test
- Atrophy of thenar muscle group

Sub Acute Stage / Moderate Condition: Physical Examinations Findings (Key Impairments)

*ICF Body Functions code: **b7101.2** MODERATE impairment of mobility of several joints*

As above with less severe sensory and motor deficits and less signs of nerve irritation without visible thenar muscle group atrophy. For example, the patient may experience intermittent or constant symptoms, which are commonly exacerbated with repetitive gripping or flexion activities of the hand.

Settled Stage / Mild Condition: Physical Examinations Findings (Key Impairments)

*ICF Body Functions code: **b7101.1** MILD impairment of mobility of several joints*

As above with less severe sensory, motor deficits, and less signs of nerve irritation such as without thenar muscle group atrophy, weakness, or sensory deficits. For example, the patient may experience only intermittent symptoms which are commonly exacerbated with repetitive gripping or flexion activities of the hand.

## Intervention Approaches / Strategies

### Non-operative Rehabilitation

#### Acute Stage / Severe Condition:

Goals: Decrease inflammation in the carpal tunnel

Reduce pain

Improve mobility of the wrist and hand

- Physical Agents
  - Iontophoresis
  - Ultrasound
- Therapeutic Exercises
  - Tendon and nerve gliding mobility exercises performed within the patient's pain-free ROM, using high repetition and low resistance motions.
- External Devices (Taping/Splinting/Orthotics)
  - Wrist splint to maintain the wrist in the neutral position. Should be worn continuously for at least 6 weeks to reduce inflammation and pain. Can be taken off for exercises.
- Re-injury Prevention Instruction
  - Temporarily limit activities by resting the involved wrist
  - Reduce aggravating factors by, for example, avoiding sustained hand and wrist flexion or extension postures, gripping or pinching, and repetitive activities
  - Counseling patient to avoid traumatic injuries secondary to diminished sensation

#### Sub Acute Stage / Moderate Condition:

Goals: Avoidance of continued irritation and repetitive trauma

Restore normal strength and mobility of the involved extremity

- Approaches / Strategies listed above
- Therapeutic Exercises
  - Midrange wrist strengthening exercises
- Manual Therapy
  - Soft tissue mobilization to potential median nerve entrapment sites, such as near the pronator teres or wrist flexor myofascia
  - Joint mobilization to restore normal accessory motions of the intercarpal and radiocarpal articulations

- Prevention and wellness Instruction  
Provide body mechanics instructions and modify work area as indicated to prevent symptoms. For example, proper use of adjustable chairs for optimal upper quarter alignment, wrist support for data processing, ergonomically designed hand tools, and use of musculoskeletal rest periods during prolonged recreational/occupational tasks requiring sustained wrist use.

#### Settled Stage / Mild Condition:

Goals: Progress activity tolerance

- Approaches / Strategies listed above
- Therapeutic Exercises  
Progress mobility exercises to full ROM with overpressure as tolerated  
Progress resistance with strengthening exercises  
Maximize muscle performance of the relevant trunk, scapulae, shoulder girdle and upper extremity muscles required to perform the desired occupational or recreational activities – including hand fine motor/dexterity exercises

#### Intervention for High Performance/High Demand Functioning in Workers or Athletes:

Goals: Return to desired occupational or leisure time activities

- Approaches/ Strategies listed above
- Prevention and wellness Instruction  
Progress job/sport specific training depending on the needs and desires and impairments of the worker or athlete

### **Post-Operative Rehabilitation**

#### Acute Stage / Severe Condition: 0-3 Weeks (PT usually begins at 5-7 days postop)

Goals: Control edema

Pain control

Decrease stiffness

- Patient Education  
Elevation/Compression wrap  
AROM of entire involved extremity  
Scar mobilization

Progress with ADLs as able

- External Devices  
Remove bulky dressing and replace with a lightweight removable splint prn
- Therapeutic Exercises  
Nerve mobility exercises in pain free ranges  
Differential tendon gliding exercises
- Manual Therapy  
Soft tissue mobilization – especially focus on potential median nerve entrapment sites in the involved extremity  
Joint mobilization – especially focus on intercarpal articulations that are hypomobile

#### Sub Acute Stage / Moderate Condition: Weeks 3-6

Goals: Continue edema control  
Increase tissue mobility  
Improve grip strength

- Approaches / Strategies listed above
- AROM exercises to include wrist motions
- Initiate gentle grip and pinch strengthening exercises
- Progress in to light resistance if painfree.

#### Settled Stage / Mild Condition: Weeks 4-8

Goals: Return to work  
Normal strength and mobility

- Approaches / Strategies listed above
- Advance as tolerated to progressive resistive exercises (PREs) for all joints
- May use splint for protection for all activities

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## Hand Sensory Deficits

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 Body Structure code: **s73028** Neural structures of hand  
 Body Functions code: **b2650** Touch functions related to sensing surface quality

### *Common Historical Findings:*

Paresthesia, numbness, and pain over ulnar aspect of palm and 5<sup>th</sup> digit intrinsic weakness develops later

Onset associated w/repetitive hand use or sustained pressure over medial palm

### *Common Impairment Findings* - Related to the Reported Activity Limitation or Participation Restriction:

Hand intrinsic atrophy

Sensory deficits in little finger

#### Symptoms reproduced with:

Ulnar nerve bias ULTT

Provocation of Guyon's Tunnel

### *Physical Examination Procedures:*



Provocation of Guyon's Tunnel

Cues:

- 1 = Pisiform
- 2 = Hook of hamate
- 3 = Ulnar nerve



Manual Resistive Test  
1st Dorsal Interosseous

Cues: 1st Dorsal Interosseous is the most distal muscle innervated by the ulnar nerve –abducts index finger (away from middle finger)

### Wrist Mobility Deficits: Description, Etiology, Stages, and Intervention Strategies

The below description is consistent with descriptions of clinical patterns associated with wrist  
**Guyon's Syndrome** the vernacular term "**Guyon's Syndrome**"

*Description:* A compression of the superficial branch of the ulnar nerve at the level of Guyon's canal, commonly associated with numbness and tingling in the ring and little fingers. Weakness may be present in the hypothenar muscles (opponens digiti minimi), interosseous muscles, 3<sup>rd</sup> and 4<sup>th</sup> lumbricals, and the adductor pollicis muscles as a result of compression of the deep ulnar branch of the ulnar nerve. Weakness, numbness and tingling may be present concurrently depending on the type of nerve lesion as shown below:

#### Classification of Guyon's Canal Syndrome

| Type | Location                                                                                                       | Sensory Deficit | Motor Deficit |
|------|----------------------------------------------------------------------------------------------------------------|-----------------|---------------|
| I    | Ulnar nerve just proximal to or in Guyon's canal                                                               | Yes             | Yes           |
| II   | Distal compression in Guyon's Canal or along the deep motor branch of the ulnar nerve after it exits the canal | No              | Yes           |
| III  | Compression of the sensory branch anywhere distal to the distal portion of Guyon's Canal                       | Yes             | No            |

*Etiology:* This disorder develops from pressure on the ulnar nerve within the canal. This pressure can be caused by a neoplastic cyst within the canal, thrombosis or aneurysm of the ulnar artery, fracture of the hamate bone, bursitis, acute trauma, hematoma, anomalous muscle of the abductor digiti minimi, or arthritis of the carpal bones.

#### Acute Stage / Severe Condition: Physical Examinations Findings (Key Impairments)

*ICF Body Functions code:* **b7101.3** SEVERE impairment of mobility of several joints

- Hypothenar atrophy may be present
- Symptoms reproduced with provocative pressure over Guyon's canal (between the pisiform and the hook of the hamate)
- Weakness in the muscles supplied by the ulnar nerve may be present (e.g., 1<sup>st</sup> dorsal interossei, adductor pollicis)  
 Note: Grip Strength tests and Pinch Dynamometer tests can help identify weakness in the muscles supplied by the ulnar nerve
- Diminished sensation may be present to the skin supplied by the ulnar nerve (i.e., volar surface of the little finger and inside half of the ring finger)
- Tenderness is usually felt along the front of the wrist or down into the little finger and inside half of the ring finger. Pain can even spread up the forearm as far as the elbow
- Pain may limit wrist active of flexion/extension wrist, radial/ulnar deviation, and pronation/supination
- Ulnar biased upper limb tension tests reproduce the patient's reported symptoms

Sub Acute Stage / Moderate Condition: Physical Examinations Findings (Key Impairments)

*ICF Body Functions code: **b7101.2** MODERATE impairment of mobility of several joints*

As above – but the movement limitations, strength deficits, sensation deficits are less and the provocatory pain is less intense

Settled Stage / Mild Condition: Physical Examinations Findings (Key Impairments)

*ICF Body Functions code: **b7101.1** MILD impairment of mobility of several joints*

As above – but the movement limitations, strength deficits, sensation deficits are even less noticeable and the provocatory pain is minimal.

### Intervention Approaches / Strategies

Acute Stage / Severe Condition

Goals: Control pain and symptoms

- Physical Agents
  - Ultrasound
  - Iontophoresis
- External Devices (Taping/Splinting/Orthotics)
- Manual Therapy
  - Soft tissue mobilization to potential ulnar nerve entrapment sites, such as restricted myofascial (e.g., flexor carpi ulnaris, abductor digiti minimi) and connective tissue (e.g., pisohamate ligament)
  - Joint mobilization to restore normal accessory motions of the intercarpal articulations (e.g., triquetral-hamate articulation, triquetral-pisiform articulation)
- Therapeutic Exercise
  - Nerve mobility exercises should be performed in pain free ranges to improve mobility of the ulnar nerve.
- Ergonomic Instruction
  - Modify work or recreational environments, postures and tasks (e.g., hand/wrist position while using a jack hammer or while riding a bicycle) to lessen the trauma to the ulnar nerve at Guyon's canal. Handles of tools should be assessed and redesigned to prevent re-injury to the structures which caused the initial symptoms.

### Sub Acute Stage / Moderate Condition

Goal: Restore normal and pain free range of motion

- Approaches/ Strategies listed above

### Settled Stage / Mild Condition

Goal: Maintain or return to functional activities of the wrist and hand

- Approaches / Strategies listed above
- Therapeutic Exercise:  
Add progressive resistive exercises and functional strengthening exercises as tolerated

### Intervention for High Performance / High Demand Functioning in Workers or Athletes

Goal: Return to optimum level of function for work and leisure time activities

- Approaches / Strategies listed above
- External Devices (Taping/Splinting/Orthotics) as needed for protection

### Selected References

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