Diagnosis and Treatment of Carpal Tunnel Syndrome

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Overview of Peripheral Neuropathies
Peripheral Neuropathy (Neuritis)
- Damage or destruction of nerves outside brain and spinal cord
- Axonal loss
- Myelin loss
- Mixed loss
- Usually begins distally and progresses proximally
Clinical Terminology

- **Radiculopathy**
  - Any disease of the spinal nerve roots and spinal nerves
  - Synonymous with radiculitis
Common Causes

- **Entrapment**
  - Adjacent soft tissue structures
  - Aberrant bone growths
  - Fluid cysts
  - Edema
  - Prolonged poor positioning
  - Poor fitting orthotics
- **Direct Injury**
- **Systemic disease**
Clinical Terminology

- **Motor neuropathy**
  - Motor axons affected

- **Sensory neuropathy**
  - Sensory fibers affected

- **Sensorimotor neuropathy**
  - Most common form of neuropathy
  - Sensory and motor axons affected
Loss of Sensory Fibers

- Perception of abnormal sensations
- Decreased sensation
- Lack of sensation
- Proprioceptive changes
Loss of Motor Fibers

- Impairs movement or function
- Weakness, decreased movement or control of movement
- Structural changes in muscle, bone, skin, hair, nails, and body organs
- Atrophy
Loss of Autonomic Fibers

- Anhidrosis
  - absence of sweating
- Decreased ability to regulate temperature
Clinical Terminology

- **Mononeuropathy**
  - Damage to single nerve or nerve group

- **Polyneuropathy**
  - Damage to multiple nerves
Clinical Terminology

Mononeuropathy Multiplex

- At least 2 nerve areas
- Axonal destruction caused by lack of oxygen to local blood vessels
- Common causes are polyarteritis nodosum, diabetes mellitus, systemic lupus erythematosus, Wegener’s granulomatosis, or rheumatoid arthritis
- Pain in multiple peripheral nerve distributions
Upper Extremity Entrapment Neuropathy

Multiple Sites and Multiple Causes
Differential Diagnosis

- Radiculopathy
- Plexopathy (Thoracic Outlet Syndrome)
- Cubital Tunnel Syndrome
- Radial - Spiral Groove Tunnel
- Pronator Syndrome
- Guyon’s Canal
Cervical Radiculopathy

- Spinal nerve root dysfunction - Root compression from protruded or herniated cervical intervertebral disc
  - Nerve root signs - paresthesias, decreased reflexes, sensory loss, and weakness in distribution of compressed nerve root
  - Spinal cord compression - spastic paraparesis with hyperactive DTRs (MSRs)
  - Neck pain, muscle spasm
  - C7 most common (31-81%)
  - C6 (19-25%), C8 (4-10%), C5 (2-10%)
Brachial Plexus

The brachial plexus travels between the clavicle and the upper ribs
Plexopathies

- **Erb-Duchenne palsy** - upper trunk (C5-6)
  - “porter’s tip position”
  - Forceful separation of the head and shoulder
    - Motorcycle accidents
    - Worse prognosis than infra-clavicular injuries

- **Klumpke-Dejerine palsy** (C8-T1)
  - Loss of muscles in the hand, loss sensation of ulnar nerve
  - Horner’s syndrome (hyposympathetonia)
    - Ptosis, miosis, anhidrosis
    - Apical lung tumor, Pancoast tumor
Plexopathies

- Brachial plexus neuritis
  - Neuralgic amyotrophy, Parsonage-Turner Syndrome
- Abrupt onset
  - Shoulder and neck pain (often beginning at night), worse by arm movement
  - Pain subsides then note paralysis
  - Often associated with preceding illness or stress
Thoracic Outlet Syndrome

- Controversy in providing precise definition
- Neuropathy of the brachial plexus
- Compression vasculopathy of subclavian vessels
- Musculoskeletal dysfunction can involve: cervical rib, 1st rib and clavicle, scalenes (anterior, middle, and minimus), pectoralis minor (and major), scapula protraction, serratus anterior, subscapularis
Ulnar Nerve Entrapment

Elbow

- 2nd most common entrapment neuropathy
- Entrapment at the ulnar groove or cubital tunnel (two heads of the flexor carpi ulnaris)
- Sensory changes of 4th and 5th digits
- Failure of active finger extension in ring (3rd) and “pinky” (4th)
- Clawhand if loss of all intrinsics

Hypothenar eminence

- Guyon’s canal
Ulnar Nerve Entrapment

- Hypothenar eminence
  - Less common
  - Guyon’s canal
Radial Neuropathy

- Wrist drop
- Difficulty with extension of fingers
- Pressure on radial nerve in axilla or upper arm
- Crutch palsy and Saturday night palsy
Median Nerve Entrapment

Not Just Carpal Tunnel Syndrome
Median Nerve Entrapment

- **Shoulder** – rare, usually traumatic
- **Elbow Region**
  1. Ligament of Struthers
  2. Pronator Syndrome
  3. Anterior Interosseous Nerve
- **Wrist**: Carpal Tunnel Syndrome
Ligament of Struthers

- Runs from medial epicondyle to aberrant bone spur 5cm above medial epicondyle.
- Present in 0.7 to 2.7% of population.
- Pain above elbow and local tenderness in region of ligament. Usually vague, mild, nonspecific symptoms.
- X-ray for supracondylar process.
Pronator Syndrome

- Compression of median nerve as it passes:
  - Beneath the lacertus fibrosis
  - Between the superficial and deep head of the pronator teres
  - Beneath the flexor superficialis arch

- Classic findings:
  - Exercise induced arm pain
  - Tender pronator teres
  - Positive Tinel’s over proximal forearm
  - Palmar cutaneous and median n. hypesthesias
Carpal Tunnel Syndrome

It results from compression/injury of the median nerve at the wrist within the compartment defined by the transverse carpal ligament (aka flexor retinaculum).
Epidemiology & Demographics

- **Carpal Tunnel Syndrome is the most common entrapment neuropathy**
  - 2-3 Million in U.S
  - 10% Lifetime Incidence
  - 1% of Adult Population, 15% of High Risk Pop
  - Female (30-60); Male Industrial (35-40)
  - Prevalent sex: Females 5x’s > Males
  - Bilateral up to 50%
Carpal Tunnel Syndrome

- **Sensory component involved earlier than motor component**

- **Autonomic disturbances are common**
  - 55% of CTS
  - Occurring with increasing severity of electrophysiologic findings
  - Consisted of swelling of the fingers, dry palms, Raynaud’s phenomenon, and blanching of the hand
Natural Hx: Duration of Symptoms

- 32% less than 6 months
- 20% 6 months to 2 years
- 48% greater than 2 years
History & Physical Findings

- Nocturnal pain
- Median nerve paresthesia (often only index & long finger)
- Positive Tinel’s
- Two-point discrimination >5mm
- Positive Phalen’s (1 min. of gentle flexion)
- Wormser (Reverse Phalen)
- Carpal compression
- Thenar atrophy: long standing cases
Mild/Moderate CTS

- Intermittent pain and numbness in the fingers (1st–2nd)
- Pain and numbness:
  - Often occurs at night
  - Diminishes with gentle hand activity
    - but rapidly returns with grasping or pinching
Severe CTS

- Constant numbness
- Severe pain
- Pinch becomes clumsy and weak
- Thenar/thumb muscle atrophy
Observation

- Coarse hair, dry skin, thick fingernails, myxedema facies
- Asymmetry of carrying angle at the elbows
- Thenar wasting, edema
- Erythema
- Rheumatoid nodules, ulnar drift of digits
- Heberden’s (DIP) and Bouchard’s (PIP) nodes
Screening Exam

- Joint line tenderness
- Trigger/tender points in forearm and hand
- Tension in palmar fascia
- Tissue texture changes
- Screening for significant somatic dysfunction from C-spine to distal upper extremity
- Range of Motion: Cervical spine, shoulders, elbows, wrist, hand (% fist)
Screening Exam

### Neurological Exam
- Foraminal compression (Spurling’s) test
- Distraction test
- DTR’s (MSR’s)
  - biceps (C5)
  - brachioradialis (C6)
  - triceps (C7)

### Muscle Strength:
- deltoid (C5)
- biceps (C5/C6)
- wrist extensors (C6)
- triceps (C7)
- wrist flexors (C7)
- finger flexors (C8)
- interossei (C8/T1)
Muscle Stretch Reflexes (DTRs)

- **Upper motor neuron signs and symptoms**
  - Hyper-reflexia, clonus, spasticity

- **Lower motor neuron signs and symptoms**
  - Weakness, atrophy, fasciculations, hypo-reflexia
Screening Exam

- **Sensory Testing**
- **Special Testing**
  - Opponens Strength Test
  - Tinel’s Sign
  - Phalen’s and Reverse Phalen’s Test

- **Checking sensation**
  - Light touch, vibration, proprioception
  - Pain, pinprick, temperature

- **Secondary sensations**
  - Stereoagnosis
    - loss or lack of the ability to understand the form and nature of objects that are touched
  - Double simultaneous stimulation
  - Graphesthesia
    - the sense by which figures or numbers are recognized when written on the skin with a dull-pointed object.
Palpation

Palpate for tension in transverse carpal ligament by inducing hyperextension at the proximal and distal carpal rows.
Palpation

Palpate for tension in transverse carpal ligament by inducing thenar hyperextension.
Somatic Dysfunction

- **Ulnohumeral Joint**
  - Abduction - olecranon process glides medially
  - Adduction - olecranon glides laterally
Ulnar Treatment
Somatic Dysfunction

- **Proximal Radial Head**
  - reciprocal motion of radial head relative to distal radius
  - *pronated hand*: proximal radius head glides posteriorly (PP)
  - *supinated hand*: opposite occurring with anterior glide at the proximal radial head
Proximal Radial Head Treatment

Muscle energy for posterior radial head:

Supinate to restrictive barrier. Pronate against physician counterforce.
Somatic Dysfunction

Radioulnar Interosseous Membrane

- Functional symmetry & stability
- Fibers extend cephalad from ulna to proximal radius
- Allows bones to share forces of compression from hand upward or shoulder downward
Interosseous Treatment

Gently separate the radius and ulna while patient attempts to supinate their hand against physician counterforce.

Somatic Dysfunction

Radiocarpal Joint

- Flexion: carpal bones glide dorsally (posterior)
- Extension: bones glide ventrally (anterior)
- Abduction: bones glide medially
- Adduction: bones glide laterally
Somatic Dysfunction

Intercarpal Joints

- 8 carpal bones
- compression component to many different facet facings
- from fall on outstretched hand
- diagnose by locating pain with wrist compression & check ant./post. med/lat glide
Articular Treatment

Gently squeeze area over dysfunction
Then take wrist through an articular range of motion

Differential Diagnosis

- Cervical radiculopathy
- Thoracic Outlet Syndrome
- Chronic tendinitis
- Muscular trigger points
- Vascular occlusion
- Reflex sympathetic dystrophy
- Osteoarthritis
- Other entrapment neuropathies
Etiology

- Idiopathic (most common)
- Space-occupying lesions (tenosynovitis, ganglia, aberrant m.)
- Hypothyroidism
- Diabetes
- Pregnancy

- CHF
- Mechanical overuse
- Rheumatoid arthritis
- Trauma
- Multiple myeloma
- Chronic renal failure
- Amyloidosis
- Acromegaly
Studies

- Routine roentgenograms (X-rays)
  - may be helpful in r/o other conditions
    (ligament of Struthers)
- Nerve conduction velocity &
  electromyography studies
- MRI and ultrasound
- Appropriate lab tests for secondary CTS
Treatment of CTS

- **Standard**
  1. NSAIDs-oral/topical
  2. Orthoses
  3. Rest
  4. Steroids (oral, injection)
  5. Surgery

- **Osteopathic manipulation**

- **Activity modification** - work site, ergonomics, etc

- **Stretching exercise**
  1. Manual, self-stretch, devices (the CTS)
  2. Nerve and tendon “gliding”

- **Physical medicine modalities**:
  1. Ultrasound - 3mhz; around edges of canal
  2. Iontophoresis - directly over nerve
Oral Therapy

Chang MH, et. al., Neurology, Aug ‘98

- Placebo-controlled, double-blinded (73 pt.)
- Diuretic vs. NSAID vs. Steroid
- Prednisone 20mg qd x 2 wks then 10mg x 2 wk
- Only pt’s in steroid group had significant symptom improvement
Manipulation

- C-spine
- Upper T-spine
- Thoracic Inlet
- Ribs

- Upper extremity
  - Clavicle (SC & AC)
  - Scapula
  - Glenohumeral joint
  - Elbow
  - Interosseous membrane
  - Wrist
Techniques

- Treat articular and fascial dysfunction in the region
- Direct Release of Transverse Carpal Ligament
- Treat sympathetics to upper extremities T2-7
- Trigger Points
  - Spray & stretch
- Injection
- Counterstrain, MET, HVLA, etc
Trigger Points

- Brachioradialis
- Radial wrist extensors
- Flexor carpi radialis
- Pronator teres
- Opponens pollicis
- Adductor pollicis
- Palmaris longus
Direct Techniques

1. Transverse carpal extension
2. Thenar myofascial release
3. Hyperextension of wrist and fingers
4. Guy wire
5. Combined technique

Techniques involve direct stretch for 1-2 minutes
Transverse Carpal Extension

- Apply three point pressure
  - Medial border of the carpal ligament
  - Lateral border of carpal ligament
  - Radial abduction with extension of the thumb

- May be performed at proximal or distal carpal rows

Sucher BM: Myofascial release of carpal tunnel syndrome. JAOA 93:93, 1993.
Thenar Myofascial Release

Add the following:

- Lateral axial rotation
  (opponens roll)

Sucher BM: Myofascial release of carpal tunnel syndrome. JAOA 93:93, 1993.
Hyperextension of wrists and fingers

Add the following:

Hyperextension of wrists and fingers

Sucher BM: Myofascial release of carpal tunnel syndrome. JAOA 93:93, 1993.
Guy-Wire Technique

- Adds additional extension and abduction of fifth digit
- Without axial rotation of the thumb
Combined Technique

- Adds additional extension and abduction of fifth digit
- Adds Axial rotation of the thumb
Osteopathic Manipulation

Sucher, et. al., JAOA, Dec. ‘93

- Myofascial release of CTS: Documentation with MRI
- Showed improvement in nerve conduction velocity (NCV), MRI and subjective symptoms
- Small study (larger study in progress)
Self Stretches: Thenar Technique

Induce thenar abduction and extension by reaching over or under forearm
Self Stretches - Knee

1. Hyperextend wrist
2. Abduct and extend thumb
3. Axial rotation of thumb
Self Stretches - Wall

- Fingers together - Target the forearm
- Fingers apart - Target the wrist
Treatment and Self Stretches

- Focus on where tension is greatest
  - Distal carpal
  - Proximal carpal row
  - Thenar tension
  - Forearm tension
  - Articular restrictions
September 1995, Journal of Hand Surgery

- 1 minute of hand and wrist exercises
- Significantly decreased carpal tunnel pressures
- Authors rec. brief intermittent wrist and hand exercises before, during and after work
Ebenbichler GR, et al. BMJ, Mar ‘98

- Randomized, placebo controlled (34 pt)
- Ultrasound (US) therapy qDaily x 10 days then 2X/wk x 5 wks
- 74% of treated group: satisfactory improvement to complete relief of sx’s with motor and sensory improvement on EMG
- 20% of “sham” group
- Study was followed for 6 months
Surgical Release

Morgenlander JC, et. al., Neurology, Oct’97

- Retrospective study of 32 patients with PN
- Nocturnal paresthesias, pain and weakness relieved almost universally
- Pt’s in study stated they would have the same procedure done again
- Indications: persistent numbness, weakness &/or thenar atrophy
Surgical Treatment


- Pre-operative neurophysiological grade 2-4 demonstrated the best outcomes with surgical treatment.
Pre-operative neurophysiological grade

Pre-operative neurophysiological grade

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Indications electro diagnostic evaluation and/or surgery

- Persistent numbness
- Severe pain
- Weakness – opposition, clumsy pinch
- Thenar atrophy
- Failure of conservative tx