CARPAL TUNNEL SYNDROME

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Anatomy of the Carpal Tunnel

Arteries to hand

Tendons to fingers

Transverse carpal ligament

Median nerve

CROSS SECTION THROUGH CARPAL BONES
Carpal Tunnel Topography

- Proximal border = palmar wrist crease
- Distal border = Kaplan + ring finger axis

Kaplan’s cardinal line:
- distal TCL
- thenar branch
- superficial arch

Superficial palmar arch

Thenar motor branch
Median Nerve

- Originates lateral and medial cords of brachial plexus
- Contributions from C6, C7, C8 & T1 (± C5)
- Motor fascicles (radially oriented)
- Thenar branch variations
CARPAL TUNNEL SYNDROME

- Most frequent nerve entrapment syndrome
- Compression of the nerve at the wrist affecting the median nerve
- Due to excessive use of the hands and occupational exposure to repeated trauma.
Epidemiology

- Incidence of 99 to 148 per 100,000\(^1\)
- Prevalence from 1\% to 10\%\(^2\)
  - occupational prevalence: 17\% to 61\%\(^3\)
    - butchers, grinders, grocery-store workers, frozen-food factory workers (forceful repetitive hand motions, vibration)


- 4th-5th decade (82% > 40yo)
- Female:Male 3:1
- ~50% have bilateral CTS
  - up to 38% contralateral wrists: Asx with abnormal NCV
- ~400,000-500,000 CTR per annum (USA)¹
  - economic cost ~ $2 billion
  - worker’s comp cost 3X other workers
  - worker’s comp cost 5X non-workers

What about Work?

- 22 epidemiologic studies to identify risk factors
  - OR from 1.7 to 34
  - consistent evidence to support association
    - repetitive motion and forceful motion
    - non-neutral wrist postures, vibration
  - cold temperatures
    - did not control for force/repetitive motion
  - synergy for > 2 risk factors
  - dose-response (suggested but not proven)

- No established cause and effect

Stevens, Neurology 2001
No causal relationship
Rates ~ general population
**Other risk factors**

- Obesity
- Hypothyroidism
- Diabetes (prevalence 14%-30% with neuropathy)
- Pregnancy (~50% prevalence)
- Renal disease
- Inflammatory arthritis
- Acromegaly
- Mucopolysaccharidosis
- Genetics (twin study)
- Age (>50)
- Smoking
Pathophysiology

- Disturbed axoplasmic flow
- Endoneural edema
- Impaired neural circulation
- Diminished nerve elasticity
- Decreased gliding
Signs & symptoms

- Nocturnal dysesthesia ➔ “painful numbness” ➔ “shake it out,” or run water over it, or rub hands together to try to relieve the symptoms.
- Subjective complaints ➔ involvement of the underside of the forearm, and radiate proximal to the elbow.
- Onset: insidious, present for months.
Signs & symptoms

- Complaints of hand weakness are common; may include “stiffness,” “clumsiness,” and difficulty with gripping/holding things in affected hand.
- Pain, numbness, burning, loss of sensation in a median nerve-distribution of the palm.
  - Subjective complaints involving any of the first three fingers carries an 80% sensitivity!!!
Most CTS complaints are secondary to sensation changes; even fine motor skill loss is usually more due to loss of sensation than motor weakness.

Muscle atrophy is classically appreciated in the “APB,” Abductor Pollicis Brevis muscle, which provides bulk to the thenar eminence.

Muscle wasting, however, is a LATE finding of CTS. Therefore, just because a patient’s thenar eminence and/or motor exam is normal, does not r/o CTS!
Dysesthesia and pain in the finger ➔ “acroparesthesia” and attribute to cervical ribs

The paresthesias are worse in the night

The pain often radiates into forearm, upper arm and shoulder.

Loss or impairment of superficial sensation affects the thumb, index, and middle fingers and may or may not split the ring finger

Weakness and atrophy of the abductor pollicis brevis and other median innervated muscle ➔ advance cases of entrapment.

Another site entrapment is at the elbow ➔ the nerve passes between the two heads of pronator teres, or behind the bicipital aponeurosis
Physical exam

- Provocative testing
  - ALWAYS, test sensibility first!
  - many described, all based on same concept
    - stress a compromised median nerve to recreate Sx
- 3 most commonly used tests
  - Phalen’s test, Tinel’s test, compression test
- Tourniquet test
  - high false (+) rate
Phalen’s test

- Described in 1951
- Originally: rested elbows on table
  - better without elbow flexion
- Median nerve trapped b/n proximal TCL and underlying flexor tendons & radius
- “reverse” Phalen’s maneuver
- Abnormal = reproduce Sx in 30-60 sec
- Limitations
  - decreased wrist motion, severe CTS
  - wide variation in reported sensitivity (10%-80%) and specificity (40%-100%)
Gently tapping along the median nerve at the wrist
Abnormal = tingling in median nerve dist.
Careful to tap “gently”
Phalen reported 60%-73% of patients with CTS had a Tinel’s sign present
Wide range of sensitivity (26%-79%) and specificity (40%-100%)
Durkan Compression Test

- Gentle pressure directly over carpal tunnel → paresthesias in 30 seconds or less
- Better for wrists with limited motion
- Highest sensitivity/specificity of all physical exam tests
EMG and NCV in CTS

- Electromyography (EMG) looks at the electrical activity of muscles, both at rest and during contraction.
- EMG is abnormal in ~70% of cases of CTS.
- Nerve Conduction Velocities (NCV) measure the speed and efficiency with which nerves are transmitting electrical signals.
- NCV is abnormal in ~75-85% of CTS cases.
Electrodiagnostic Tests

- NOT the gold standard
- Benchmark for validity testing in CTS
  - how physical exam tests are evaluated for accuracy
- Diagnostic bias
  - selection criteria for application of test
  - different methods of performing tests
  - patient selection differs from study to study
- Spectrum bias
  - use of asymptomatic controls for sens/spec
    - goal of test = identify those with disease in a pool of patients with symptoms c/w the disease
Non-operative Treatment

- Mild to moderate disease
  - key is denervation of ABP

- Splinting (nocturnal, neutral)

- Oral agents
  - NSAIDs, Vitamin B6 (?)
  - Neither effective in isolation

- Steroid injection
  - 80% relief short-term, ~10-20% @ 1.5 years
  - (+) response predictive of success with surgery
  - dexamethasone safest
Non-operative Treatment

- **No benefit:**
  - magnets
  - laser
  - acupuncture
  - chiropractic
Operative Treatment

- Indicated when non-operative treatment has failed or thenar motor denervation
- Minimally-invasive **Endoscopic Carpal Tunnel release**
  - Evidence supports success of **Endoscopic Carpal Tunnel release** and suggests earlier return of function compared to open release
Thank you for attention