COMPRESSION NEUROPATHY IN THE UPPER EXTREMITY

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DISCLOSURE

The speaker has nothing to disclose

THE BIG THREE

Median nerve
- Carpal Tunnel
- Anterior Interosseous Syndrome
- Pronator Syndrome
Radial Nerve
- Radial Tunnel Syndrome
- Posterior Interosseous Nerve Syndrome
- Wartenberg’s Syndrome
Ulnar Nerve
- Cubital Tunnel
- Ulnar Tunnel (Guyon’s Canal)
BASIC SCIENCE

- Increased intraneural pressure is a result of disproportion between volume of nerve and the space thru which it passes.
- Degree of axonal injury proportional to duration and magnitude of compression.
- 30 mmHg = Paresthesias
- 50-60 mmHg = Complete sensory/motor block

MEDIAN NERVE

- Carpal tunnel syndrome
- Pronator syndrome
- Anterior interosseous nerve syndrome

CARPAL TUNNEL SYNDROME

- Median nerve compression at the wrist
- Most common compression neuropathy
- U.S. - >$1 billion annual medical costs
- >200,000 surgeries annually
MEDIAN NERVE ANATOMY

- **Motor branch** - variable, but most often extraligamentous
- **Palmar branch** - usually pierces antebrachial fascia to lie superficial to TCL (also variable)

REMEMBER

- Women > Men
- Age > 45-50
- Smoking — No
- Occupation — No

ETIOLOGY OF CTS

- Anatomic abnormalities
- Associated medical conditions
- Inflammatory factors
- Fluid imbalances
- Trauma
- Position
ANATOMIC ABNORMALITIES

- Congenital anomalies
- Persistent median artery
- Proximal lumbral muscles
- Distal sublimus muscles

ASSOCIATED MEDICAL CONDITIONS

- Thyroid disease (hypothyroidism)
- Diabetes
- Pregnancy

INFLAMMATORY FACTORS

- Rheumatoid arthritis
- Gout
- Infection
FLUID BALANCE ABNORMALITIES

- Pregnancy
- Hemodialysis - (high correlation between the side of dialysis access, and side affected with CTS)

TRAUMATIC FACTORS

- Distal radius fractures
- Carpal dislocations
- Hematoma

POSITIONAL FACTORS

- BOTH FULL EXTENSION AND FULL FLEXION DECREASE THE SIZE OF THE CANAL, INCREASING THE PRESSURE IN THE CARPAL CANAL
CLINICAL PRESENTATION

- Numbness, tingling, and pain - radial 3 1/2 digits. Weakness & clumsiness of grip.
- Pain may radiate proximally into forearm, arm, and shoulder
- Frequently awakens pt from sleep (positional)
- Worse with activities - gripping, writing, driving

CLINICAL STAGING

- Early (mild) CTS
  intermittent paresthesias, night sxs
  wrist flexion may elicit sxs
- Intermediate (moderate) CTS
  -more frequent paresthesias, worse with use
  Feeling of numbness, clumsiness
  - +/- weakness
- Advanced (severe) CTS
  constant impaired sensibility, severe pain
  Thenar atrophy, pinch/opposition weakness

PHYSICAL EXAM

- Decreased sensation to moving light touch
- Positive provocative tests
- Weakness of thenar muscles (OP, APB, FPB-sup. head)
- Thenar muscle wasting - late finding
**PROVOCATIVE TESTS**

- Tinel’s
- Phalen’s
- Reverse Phalen’s
- Durkin’s – Sp 90%, Se 87%

**NCV / EMG**

- NCV
  - Distal sensory latency >3.5ms
  - Motor latency >4.5ms
  - Conduction velocity <52m/s
- EMG
  - Fibrillations, positive sharp waves, decreased amplitude of action potentials
- False negative
  - 0-25%
  - Yes, NCV/EMG negative CTS does exist!

**Non- Op Treatment**

- Night splints
  - Effective – wrist in neutral position
  - Not too tight!
- Steroid injections
  - 80% transient relief – days to months
  - Only 20% get long-term relief (1 year)
  - Most successful in pts with mild symptoms
Non-OP Treatment

• Oral therapies
  Vitamin B6 - no evidence to support use
  NSAIDs - no benefit
  Gabapentin - no benefit
  Corticosteroids - maybe short term
  Alpha lipoic acid - maybe short term

SURGICAL OPTIONS

• Considered for patients with persistent or progressive symptoms, despite non-operative treatment.
• Transient improvement following cortisone injection - good prognostic indicator for surgery.
• Motor denervation on EMG
• Thenar weakness/atrophy

SURGICAL OPTIONS

• Classic open release
• Mini open release
• Endoscopic release
Surgical Options

- Risks and long term outcomes equivalent regardless of technique - surgeons pref.
- Arguably less initial post op pain, and possibly earlier return to work with endoscopic procedure
- Most common cause for failure - incomplete release TCL

Surgical Options

- Unnecessary to perform:
  - Internal neurolysis
  - Tenosynovectomy
  - Antebrachial fascia release
  - Concomitant release of Guyon’s canal

Post Op Care

- Splints – not necessary
- Hand therapy – not necessary
- Antibiotics – not necessary (pre or post-op)
- Return to work – controversial
  - Depends on kind of work (Duh…)
  - 2-3 wks for mini-open. Probably sooner with endo (multiple studies)
COMPLICATIONS CTR

- Incomplete division of TCL
- Damage to PCBMN
- CRPS (RSD)
- Hypertrophic painful scar
- Hematoma
- Bowstringing

REVISION CTR

- 50% experience some relief
- Adjunctive procedures
  - hypothenar fat pad flap
  - radial forearm fascial flap
  - radial artery perforator based flap

ANTERIOR INTEROSSEOUS NERVE SYNDROME

- AIN primarily a motor nerve
- Branches from median nerve 4 - 6 cm distal to elbow
- Passes between 2 heads of PT
- Supplies radial half of FDP (index & long), FPL, and PQ
AREAS OF COMPRESSION
- Multiple sites have been implicated
- Deep head of PT
- Origin of FDS – fibrous arch
- Edge of lacertus fibrosis
- Enlarged bicipital tendon bursa
- Accessory head of FPL (Gantzer’s muscle)

CLINICAL PRESENTATION
- Complains of ill defined forearm pain
- Inability to flex IP joint of thumb and DIP of index finger
- EMG/NCS helpful
- Weak forearm pronation

TREATMENT
Complete spontaneous recovery is common may take 6 - 12 months
- Consider surgery if no motor recovery after 3-6 months of observation.
- Surgical release of all potential sites of compression.
- Penetrating trauma – surgery
- Traction injury - observation
**PRONATOR SYNDROME**

- Potential sites of compression:
  - Lacertus fibrosus
  - Ligament of Struthers
  - Origin of FDS – fibrous arch
  - Pronator muscle

**CLINICAL PRESENTATION**

- Numbness and tingling as with CTS
- Numbness may extend to the palm in the PC branch distribution
- Pain can radiate into the volar forearm
- Night pain not typical complaint

**PHYSICAL EXAM**

- Palpate for supracondylar process of distal humerus, proximal to medial epicondyle
- Check for Tinel’s over proximal volar forearm (+/- finding)
- May have some motor weakness
- Provocative maneuvers for each potential site of compression
PROVOCATIVE TESTS

- Lacertus fibrosus - resisted elbow flexion forearm supinated
- Pronator teres - resisted pronation elbow extended
- FDS - resisted flexion long finger PIP

EMG/NCS

- Generally misleading. Usually normal.
- Fibrillation potentials and positive sharp waves in pronator and FDS may aid in dx
- XRAY: Look for supra-condylar process on anterior-medial humerus

TREATMENT

- Activity modification - specifically those involving repetitive flexion/pronation
- Surgical release of all potential sites of compression yields good results.
  - Ligament of Struthers (if present)
  - Lacertus fibrosis
  - Fascia superficial head of pronator
  - Fascial arch of proximal FDS
- Literature reports 90% satisfactory results
RADIAL NERVE

• BRACHIAL COMPRESSION SYNDROME
• POSTERIOR INTEROSSEOUS NERVE SYNDROME
• RADIAL TUNNEL SYNDROME
• SENSORY RADIAL NERVE COMPRESSION

BRACHIAL COMPRESSION

• Compression at the arm, due to: humerus fx, tourniquet palsey, prolonged postural compression.
• Usually spontaneous recovery. If not by 3-4 months, neurolysis, nerve grafting, tendon transfers.
• Explore nerve in open humerus fx at time of ORIF

PIN SYNDROME

• PIN supplies: supinator, ECRB, EDC, ECU, EDM, APL, EPB, EIP, and EPL
• 5 sites of potential compression: fibrous bands at ant. radial head, radial recurrent vessels (Leash of Henry), fibrous edge of ECRB, proximal edge of supinator (Arcade of Frohse; most common site), distal edge of supinator.
ETIOLOGY

• Repetitive forearm motion
  - Monteggia fx/dislocation
  - radial head fx-dislocation
  - blunt trauma
  - masses - lipomas, ganglion cysts,
  - idiopathic.

CLINICAL PRESENTATION

• Motor nerve, therefore no sensory complaints
• Difficulty with extension of MP joints of digits
  and IP joint of thumb (IP joints of fingers intact thru interosseous muscle innervation by ulnar nerve)
• Wrist extension with radial deviation, due to loss of ECU function. ECRL functions due to innervation proximally.

TREATMENT

• Activity modification and splinting first.
• Surgical treatment (after 12 weeks), involves release of involved structures.
• Patients continue to improve for up to 18 months after surgery
RADIAL TUNNEL SYNDROME
• Primarily a pain syndrome, NOT associated with motor or sensory deficits.
• Similar sites of compression to PIN syndrome. Most common site - Arcade of Frohse.
• Precursor to full blown PIN syndrome??

CLINICAL PRESENTATION
• Deep aching pain in the dorsal-radial forearm, in the radial neck region.
• Pain radiates from lateral elbow to dorsal wrist
• Tenderness to palpation of mobile wad over supinator arch.
• Pain with resisted supination - wrist in ext.
• Pain with passive pronation - wrist in flex.
• Night pain

Diagnostic tests
• EMG/NCT typically normal.
• Injection of local anesthetic radial tunnel region- pain relief and wrist drop = diagnostic.
TREATMENT

- Treatment similar to PIN syndrome.
- Conservative first
- Surgery if all else fails

RADIAL SENSORY NERVE COMPRESSION

- AKA: Wartenberg’s Syndrome, Cheiralgia Paresthetica
- Scissor like action of BR and ECRL tendons with pronation compress the nerve.

CLINICAL PRESENTATION

- Paresthesias in dorsal-radial aspect of hand.
- Ill defined pain in radial forearm and wrist.
- Repetitive wrist flexion and ulnar deviation may exacerbate the sxds.
- Tinel’s over nerve
- Pain with forced pronation
- Diagnostic nerve block relieves pain.
- DDx: DeQuervain’s
ETIOLOGY

• Direct blow
• Handcuffs
• Tight cast
• Tight watch band
• Ex.Fix. pins

TREATMENT

• Splinting and NSAIDs
• Steroid injection – 70% successful
• Avoiding offending activities
• Surgery rare, involves neurolysis, and release of fascia between BR and ECRL. 80-85% reported success

ULNAR NERVE

• Cubital tunnel syndrome - elbow most common site of ulnar nerve compression
• Ulnar tunnel syndrome - wrist Guyon’s canal
CUBITAL TUNNEL SYNDROME

- Two most common sites of compression at the elbow:
  - Medial epicondylar groove
  - Two heads of FCU

CLINICAL PRESENTATION

- Numbness and tingling ulnar 2 digits
- Medial elbow pain, night pain, sx worse with elbow flexion
- Wartenberg’s sign - abducted small finger due to weakness of 3rd palmar interosseous m.
- Clawing of ulnar two digits - late finding
- Interosseous wasting - late finding

CLINICAL PRESENTATION

- Froment’s sign - weakness in thumb adduction with compensatory FPL flexion during pinch
- EMG/NCT - Slowing across the elbow and low amplitude sensory and motor action potentials
- Look for subluxation
TREATMENT

- NSAIDs (?) and night extension splints at 45 degrees and neutral rotation
- Surgical options:
  - In situ decompression
  - Medial epicondylectomy
  - Anterior transposition

SURGICAL OPTIONS

- Over the past 15 years, 438 articles
- OUTCOME DATA:
  - In situ: 86%
  - Endo IS: 89%
  - Med. Epi.: 89%
  - A.T. subcut: 75%
  - Intra muscular: 85%
  - Sub muscular: 87%

IMPORTANT STUDY


- Meta-analysis of 4 retrospective clinical trials
- NO difference in clinical outcomes and motor conduction velocity, when in situ decompression and anterior transposition compared
BOTTOM LINE

- **NO STATISTICALLY SUPERIOR TECHNIQUE**
- Decision based on:
  - Surgeon preference
  - +/- subluxing nerve
  - S/P prior elbow surgery
  - Trauma
  - Etiology: DJD, RA, tumor, metabolic neuropathy

REVISION SURGERY

- Submuscular transposition recommended
- Poor results associated with:
  - previous submuscular transposition
  - Age >50
  - EMG evidence of denervation
  - ETOH/diabetes
  - CRPS (RSD)

ULNAR TUNNEL SYNDROME

- Entrapment at the wrist, at Guyon’s canal
- Zone I - proximal to bifurcation
- Zone II - from deep motor branch to just past fibrous arch of hypothenar muscles
- Zone III - involves only superficial sensory branch
CLINICAL PRESENTATION

• No sensory deficit on dorsal aspect of hand (in contrast to cubital tunnel syndrome)
• Symptoms vary according to Zone of compression (Gelberman 1985)
• Zone I - sensory symptoms and motor weakness
• Zone II - only motor symptoms
• Zone III - only sensory symptoms

Etiology

• Ganglion cysts - most common cause
  - Zone I - 86%
  - Zone II - 88%
• Repetitive trauma - bicycles, walkers
• Other - lipomas, ulnar artery thrombosis, hook of hamate fx, pisiform dislocation, inflammatory arthritis, congenital/fibrous bands

DIAGNOSTIC TESTS

• EMG/NCT - valuable in confirming diagnosis
• Xrays – carpal tunnel view
• MRI useful if xrays don't confirm fx or if ganglion present
TREATMENT

- Padded gloves, splints
- NSAIDs +/-
- Avoiding provocative activities
- Surgical decompression of Guyon’s canal +/- release of hypothenar muscle origin
- Removal of space occupying lesions

OTHERS

- Lateral antebrachial cutaneous n. compression
- Thoracic outlet syndrome
- Suprascapular nerve compression
- Musculotaneous nerve compression
- Long thoracic nerve entrapment
- Spinal accessory nerve entrapment
- Axillary nerve entrapment (quadrilateral space)

THANK YOU!