Common Upper Extremity Conditions Part 1: Compression Neuropathies

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Compression Neuropathies of the Upper Extremity

- Objectives
  - Discuss Pathology of compressive Neuropathies
  - Discuss the most common UE nerve compression syndromes
    - Carpal Tunnel Syndrome (CTS)
    - Cubital Tunnel Syndrome (CuTS)
    - Ulnar Tunnel Syndrome

Compression Neuropathy Defined

- Dysfunction of a peripheral nerve caused by pressure
- Symptoms manifested
  - Sensory
  - Motor
  - Autonomic

Background

- Nerve compression occurs at many locations
  - Intrinsic Compression
    - Intraneural lipoma
    - Schwannoma/Neurofibroma
    - Hamartoma
  - Extrinsic Compression
    - Swelling
    - Fascia
    - Masses (ganglion, aberrant anatomy)
- Most Common: Carpal Tunnel
  - Ulnar, radial, other branches also possible
Intrinsic Compression - Lipoma of Median Nerve

Courtesy of ASSH

Median Nerve Schwannoma

Lipofibromatous Hamartoma

Courtesy of ASSH
Lipofibromatous Hamartoma

Extrinsic Compression

Guyon's Canal Ganglion

Ulnar Artery Thrombosis

Nerve Compression Pathophysiology

- Altered Signal Conduction:
  - Ischemia and impaired venous return
  - Intraneural edema
  - Decreased axoplasmic transport
  - Membrane instability
  - Fibrosis

• Membrane instability
• Fibrosis

Compression
PATHOLOGY
• Localized swelling
• Abscess formation
• Nerve fibrosis
• Axonal degeneration
• Loss of function

Compression of the ulnar nerve at the Guyon's canal may cause nerve compression and lead to symptoms of ulnar nerve compression syndrome.
Risk Factors

- Genetics***
- Obesity
- Hypothyroidism
- Diabetes
- Pregnancy
- Renal disease
- Inflammatory arthritis
- Acromegaly
- Mucopolysaccharidosis

- Amyloidosis
- Multiple myeloma
- Gender (Women>Men)
- Age (> 50 y/o)
- Smoking
- Occupational exposure**

Pathophysiology: Multifactorial

- Systemic disease creates “at risk” environment
  - Diabetes, hypothyroidism, smoking
  - Microvascular disease
- Symptoms develop when pressure exceeds nerve threshold

General Principles of Diagnosis

- History & Physical
- Testing: No test is 100% specific and sensitive
  - EMG/NCS
  - Ultrasound
  - Hand diagrams
  - Static 2-point discrimination
  - Semmes-Weinstein
  - Provocative maneuvers
  - Physical findings (atrophy, clawing, etc.)

General Principles: EMG/NCS

- Not always positive in early stages
- False negative results may occur
- Operator dependent
- Allows localization of lesion
- Can follow progression
- Values may never normalize after decompression
Imaging

• Generally of Limited Use
• Ultrasound: becoming more popular
• Plain Radiographs: 2 views (orthogonal) to rule out:
  • Post-traumatic deformity
  • Arthritic changes
• CT or MRI
  • Rarely indicated
  • Rule out suspected soft tissue mass
  • Rule out occult fractures

Ultrasound

• Median Nerve enlargement > 10 mm at CTS inlet
• Sensitivity as high as 97.9%
• Can also be used to guide injection

Carpal Tunnel Syndrome

• Most common compressive neuropathy
• Affects 0.1-10% of the general population
• 200,000+ surgeries performed annually

Anatomy of the Carpal Tunnel

• Contents:
  • Median nerve
  • FDP (flexor digitorum profundus) X 4
  • FDS (flexor digitorum superficialis) X 4
  • FPL (flexor pollicis longus)

Courtesy of ASSH
**Symptoms of CTS**

- Numbness, paresthesia in median distribution
- Worse with work or at night
- Relieved by shaking hand, dependent positioning
- May include ulnar digits
- May radiate up forearm or even to shoulder
- Swelling of hand
- Weakness, clumsiness, dropping objects

**Signs of CTS**

- Tinel’s test

**Signs of CTS**

- Phalen’s test

**Signs of CTS**

- Durkan’s Test

Courtesy of ASSH
Signs of CTS

- Thenar muscle wasting

Sensory Testing for CTS

- 2-point discrimination
- Monofilament
- Vibration

CTS - Diagnosis

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity</th>
<th>Specificity</th>
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<tbody>
<tr>
<td>Phalen</td>
<td>10-88%</td>
<td>47-100%</td>
</tr>
<tr>
<td>Tinel</td>
<td>26-79%</td>
<td>40-100%</td>
</tr>
<tr>
<td>Durkan</td>
<td>87%</td>
<td>90%</td>
</tr>
<tr>
<td>Semmes-Weinstein</td>
<td>Up to 91%</td>
<td>Up to 80%</td>
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Diagnostic Testing

- Nerve conduction study/EMG
  - Motor latency 4.5 ms or 1 ms > opposite hand
  - Sensory latency 3.5 ms or 1 ms > opposite hand
- Ultrasound

Courtesy of ASSH
NCS vs Ultrasound

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
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<tbody>
<tr>
<td>NCS/EMG</td>
<td>Painful</td>
</tr>
<tr>
<td>R/O other pathology</td>
<td>False negative</td>
</tr>
<tr>
<td>Can compare serial exams</td>
<td></td>
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<tr>
<td>(pre and post surgery)</td>
<td></td>
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<tr>
<td>Indicates severity</td>
<td></td>
</tr>
<tr>
<td>Ultrasound</td>
<td>Does not evaluate other</td>
</tr>
<tr>
<td></td>
<td>causes Operator dependent</td>
</tr>
<tr>
<td>Can be done at same visit</td>
<td></td>
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<tr>
<td>in office</td>
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<tr>
<td>Can use to guide injections</td>
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Median Nerve Compression: Differential Diagnosis

- Peripheral Neuropathy
- Cervical Spine
- Thoracic Outlet
- Arm/Forearm
  - Ligament of Struthers
  - Lacertus Fibrosis
  - Pronator Teres

Median Nerve Compression: Differential Diagnosis

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CTS 6 Diagnostic Criteria

1) Numbness in the Median nerve distribution
2) Nocturnal numbness
3) Weakness/Atrophy of the Thenar musculature
4) Tinel’s sign
5) Phalen’s test
6) Loss of 2-point discrimination

Carpal Tunnel Grading

- Mild
  - Duration < 1 year
  - Intermittent numbness
  - Normal sensory testing
  - No weakness or atrophy
  - Minimal NCV changes, no denervation
- Moderate
  - Continuous numbness, paresthesias
  - Increased threshold on sensory tests
  - Increased distal motor latency
- Severe
  - Persistent loss sensory+ motor function
  - Thenar atrophy
Treatment of CTS

- Splint

![Splint Image]( Courtesy of ASSH)

Treatment of CTS

- Injection of Steroid

![Steroid Injection Image]( Courtesy of ASSH)

CTS – Predictors of Outcome with Conservative Treatment

- Factors – Age>50 yrs, Duration sx> 10 mo, Constant paresthesias, Stenosing tenosynovitis, Phalen’s + in <30 s (Kaplan et al, JHS 15B, 1990)

<table>
<thead>
<tr>
<th>Factors Present</th>
<th>% Success</th>
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<tr>
<td>0</td>
<td>66</td>
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<tr>
<td>1</td>
<td>40</td>
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<td>7</td>
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<tr>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
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Surgical Treatment of CTS

- Open Carpal Tunnel Release

![Carpal Tunnel Surgery Image]
## Open vs Endoscopic CTR

- 2-3 week earlier return to work with endoscopic versus open CTR
- No substantial difference in final outcome
- No difference in Complication Rates

## What Are Hand Surgeons Doing?

- 70% of hand surgeons who responded use Open or Mini Open CTR
- 26% perform endoscopic release
- Most under local with sedation, but 11% use general anesthesia
  - Only 8% use local only

## Endoscopic Carpal Tunnel Release

![Endoscopic Carpal Tunnel Release](image)
Results

Ulnar Nerve Compression
- Cubital Tunnel
  - Compression: Most commonly
  - Traction: Not well understood
  - Subluxation: Typically younger patients
- Guyon's Canal
  - Compression at 3 Sites
  - Idiopathic
  - Hook of Hamate Fracture
  - Mass/Ganglion Cyst

Cubital Tunnel Syndrome
- Clinical syndrome of numbness, pain, and weakness associated with compression of the ulnar nerve at the elbow.
- C8-T1
- Terminal continuation of the medial cord of the brachial plexus
History and Physical: Cubital Tunnel

- Symptoms
  - Numbness/tingling
  - Night pain
  - Elbow flexion
  - Snapping at elbow
  - Pain at Medial Elbow
  - Weakness with grip/pinch
- Late Symptoms/Signs:
  - Persistent Numbness
  - Progressive weakness
  - Intrinsic Wasting
  - Clawing

History and Physical

- Exam
  - Tinel’s
  - Elbow flexion test
  - Weakness: Froment’s Sign
  - Intrinsic muscle atrophy
  - Ulnar Clawing/Papal Sign

Electrodiagnostic Studies

- Inching technique to localize site of compression
- Confirm diagnosis
- Evaluate degree of denervation
- Evaluate degree of conduction delay
- Rule out proximal involvement
  - Pancoast tumor, cervical radiculopathy, brachial plexopathy, thoracic outlet

Treatment: Conservative

- Nighttime pillow/extension splinting
- Elbow pad/Avoidance of direct trauma, compression
- Activity Modifications
Treatment: Surgery

- Cubital tunnel release with or without transposition of the nerve
  - Submuscular or Subcutaneous

Treatment: Surgical Sites of Compression

Treatment: Surgery – Submuscular Transposition
My Preference – Mini Incision In Situ Release

Indications for Transposition

• Significant Subluxation
• Osteophytes in Cubital Tunnel
• Part of Larger Operation
  • Fixation of Fractures
  • Elbow Arthroplasty

Ulnar Nerve Subluxation
Ulnar Nerve Subluxation
– s/p Transposition

- Compression of the nerve over Guyon’s canal
- Symptoms in fingers but not in dorsal hand
- May present as isolated motor weakness, or paresthesias, or combined sensory/motor

Ulnar Tunnel Syndrome

- Ganglion cysts - most common
- Ulnar Artery Aneurysm or thrombus
- Hamate Hook Fracture
- Lipoma
- Repetitive trauma (bicyclists)

Borders of Canal
- Floor = flexor retinaculum
- Ulnar Border = Pisiform & Abd. Dig. Minimi
- Radial Border = Hook of the Hamate
- Roof = Volar Carpal Lig. & palmaris brevis

Courtesy of ASSH
**Guyon’s Canal Zones**

- Zone 1 = proximal to bifurcation
  - Ganglions (most common), anomalous muscle
  - Fractures of hook of hamate
- Zone 2 = deep motor branch only
  - Hook of hamate fracture, ganglion
- Zone 3 = superficial sensory branch only
  - Ulnar artery thrombosis
  - Synovial inflammation

**Nonsurgical Treatment of Ulnar Tunnel Syndrome**

- Diagnostic Imaging to evaluate vascular lesion - MRA, Doppler, Angiogram, etc.
- MRI/CT scan to r/o masses, fractures
- Activity modification - avoid pressure
- Wrist splints, NSAID’s
- Padded gel gloves

**Surgical Decompression of Guyon’s Canal**

- Indirect decompression done by CTR alone
- Dissection from proximal to distal to protect branching pattern
- Evaluate deep motor branch of ulnar nerve
- Protect palmar cutaneous branch of ulnar nerve
- Removal of mass, pressure

**Ulnar Tunnel Syndrome: Guyon’s Canal**

Right Palm/ Guyon’s Canal

Courtesy of ASSH
Ganglion in ulnar tunnel

Return to work and return to activities after surgery for compression neuropathy

Long-term prognosis after surgery

Non-osseous Conditions of the Upper Extremity: Tendinopathies

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**Agenda**

- Stenosing Tenosynovitis
- De Quervain’s Tenosynovitis
- Intersection Syndrome
- EDC tendonitis
- Snapping ECU
- Lateral Epicondylitis
- Medial Epicondylitis

**Stenosing Tenosynovitis**

- “Trigger Finger”
- Definition:
  - Catching or locking of the finger secondary to A1 pulley thickening

- Size mismatch between flexor tendon & A1 pulley
- Thickened stenotic A1 pulley
- Nodular enlargement of flexor tendons

- Grades:
  - 1. pain only
  - 2. catches but can be actively unlocked
  - 3. catches but must be passively unlocked
  - 4. locked with a PIP joint flexion contracture

Image from American Society for Surgery of the Hand
Stenosing Tenosynovitis

- Exam: tender volarly over A1 pulley and triggering noted
- Causes:
  - Most commonly idiopathic
  - Can be associated with:
    - Diabetes
    - Hypothyroidism
    - Rheumatoid arthritis
    - Recent hand surgery
    - Trauma
    - Female predilection

Stenosing Tenosynovitis

- DDx:
  - Snapping of MCPJ collaterals on osteophyte
  - Sagittal band rupture / snapping extensor tendon
  - Swan neck deformity
  - Slip of FDS catching under the pulley

Stenosing Tenosynovitis

- Treatment options
  - Activity modification
  - Trigger finger splint at night
  - Steroid injections
  - Surgical Release of A1 pulley

Stenosing Tenosynovitis

- Steroid injections
  - 50-70% effective
  - Reportedly equally effective in diabetics
  - Does not need to be within flexor sheath
  - Can alter blood glucose for up to a week
  - May offer a 2nd injection before surgery
**Stenosing Tenosynovitis**

- Surgical release
  - Longitudinal vs oblique vs transverse incision
  - Protect NV bundle
    - Thumb radial digital nerve
  - Completely release A1 pulley
  - Actively flex digit if wide awake
  - Release palmar pulley, vent A2 if necessary.
  - Release ulnar FDS slip if needed

**De Quervain’s Tenosynovitis**

- Extensor compartments
  - 1st: APL & EPB
  - 2nd: ECRL & ECRB
  - 3rd: EPL
  - 4th: EIP & EDC
  - 5th: EDM
  - 6th: ECU

**De Quervain’s Tenosynovitis**

- Definition:
  - Stenosing tenosynovitis of the first dorsal extensor compartment (APL & EPB)
  - Extensor sheath becomes relatively stenotic or narrowed leading to pain

**De Quervain’s Tenosynovitis**

- EPB
  - Distal muscle belly
  - Absent is 5-7% pts
- APL
  - Often Multiple slips
De Quervain’s Tenosynovitis

- Demographics:
  - Overuse of thumb
  - New mothers/parents
  - Elderly
  - 6:1 women

- Atraumatic radial sided wrist pain

- Diagnosis
  - Pain at or just proximal to the radial styloid
  - Worsens with ulnar deviation of the wrist
  - Finkelstein test

- Differential diagnosis
  - Intersection syndrome
  - Thumb CMC joint arthritis
  - Wrist STT arthritis
  - Radioscaphoid arthritis
  - Wartenberg Syndrome

- Treatment:
  - Activity modification, NSAIDs, thumb spica splint
  - Steroid injection
    - Brace shown to improve outcomes after injection
  - Surgical release
De Quervain’s Tenosynovitis

- Injections:
  - 60% success rate
  - I personally offer 2 injections at most
  - May elevate blood glucose for a week
  - Subcutaneous injection is effective

De Quervain’s Tenosynovitis

- Surgical release of first dorsal compartment
  - Indicated if patient dissatisfied with non-operative measures.
  - Division of the fibro-osseous sheath over the first dorsal compartment (dorsal edge)
  - Care must be taken to identify all slips of both APL and EPB tendons

De Quervain’s Tenosynovitis

- Avoid branches of the superficial radial nerve

Intersection Syndrome
Intersection Syndrome

- Pain and swelling due to entrapment of and compression of 2nd compartment where the 1st dorsal compartment intersects it. Approximately 5cm proximal to wrist joint.

Intersection Syndrome: The subtle squeak of an overused wrist. JABFM, July 2017

- History:
  - Common in rowers and weight lifters (repetitive wrist extension)

- Exam:
  - TTP over site of intersection
  - Crepitance at intersection site with resisted wrist and thumb extension

- Imaging:
  - MRI
    - Peritendinous edema
    - Fluid surrounding the 1st/2nd extensor compartments

Intersection Syndrome: The subtle squeak of an overused wrist. JABFM, July 2017

- Treatment:
  - Immobilization
  - Steroid injection
  - Surgical release
    - Longitudinal incision to release 1st and 2nd dorsal compartment and proximal fascia
    - Retinaculum is left open

Intersection Syndrome: The subtle squeak of an overused wrist. JABFM, July 2017

EDC Tendonitis

- Rare
- Drummer's wrist
- Repetitive wrist extension
- Inject, brace, stop drumming

www.pexels.com
ECU pathology

- Ulnar sided wrist pain
- Synergy Test positive
- Stenosing tenosynovitis
  - All Treatment similar to De Quervain’s
- Tendinopathy (enlarged and thickened tendon)
  - Non-operative measures similar
  - Surgically, consider debridement or excision
- ECU subluxation or ECU Snapping

Snapping ECU tendon

- Traumatic or overuse injuries cause attenuation or rupture of ECU subsheath

Snapping ECU tendon

- History:
  - Atraumatic/Asymptomatic
  - Injury sometimes recalled
  - Pain/snapping over dorsoulnar wrist
- Exam:
  - Extension/supination of the wrist elicits a painful snap
  - ECU tendon reduces with pronation
- Imaging:
  - MRI demonstrates peritendinous edema
  - If subsheath incompetent, ECU tendon will snap ulnarly
Snapping ECU tendon

- Differential Diagnosis of Ulnar Sided Wrist Pain:
  - Other ECU pathology
  - TFCC tears
  - DRUJ synovitis/instability
  - Pisotriquetral arthritis/cysts
  - Lunotriquetral tears

Snapping ECU tendon

- Non-Operative Treatment:
  - Wrist splint for tendinitis
  - Long arm cast in pronation

- Operative:
  - ECU subsheath repair (acute) vs reconstruction (chronic)
  - +/- wrist arthroscopy (concurrent TFCC tear in 50% of cases)
  - Change ECU vector by inserting onto ring finger MC base

Lateral Epicondylitis

- “Tennis elbow”
  - anyone and everyone
- Repetitive eccentric overload of common extensor tendon
  - Primarily tendinopathy of ECRB
  - May also involve microtears of ECRL, ECU, and EDC
- Most common cause of elbow pain

Lateral Epicondylitis

- Physical exam
  - Point tenderness at ECRB origin (just distal to lateral epicondyle)
  - Decreased grip strength
  - Provocative tests:
    - Resisted wrist extension with elbow fully extended
    - Resisted extension of the middle finger
Lateral Epicondylitis

- Imaging
  - Plain films usually normal
  - Calcification of extensor origin may be present but doesn't usually change management
- MRI
  - For uncertain diagnoses
  - Increased signal at ECRB origin (~50%); thickening
  - Evaluate LUCL

Lateral Epicondylitis

- DDx:
  - Radial tunnel syndrome (5% concomitant Dx)
    - 3-4 cm distal/anterior to lateral epicondyle
  - LUCL injury / Posterolateral Rotatory Instability (PLRI)
  - Capitellar OCD
  - Radiocapitellar arthritis
  - Radial head fracture
  - Triceps tendinitis
  - Cervical radiculopathy

Lateral Epicondylitis

- Non-operative treatment (95% success)
  - Activity modification (rest), ice, NSAIDs
  - Home Stretching Program
  - Counter-force brace
  - Wrist brace
  - Steroid injections
  - Physical therapy (iontophoresis/phonophoresis)

Lateral Epicondylitis

- Operative treatment
  - Indicated if failed non-op for 6-12mo
  - Open ECRB debridement
    - Stay anterior to LUCL origin
    - Deep/posterior to ECRL
    - Excise degenerative ECRB tendon
    - Decorticate epicondyle
    - Side-to-side tendon repair
  - Arthroscopic ECRB release TENEX

Home exercise program
Medial Epicondylitis

- “Golfer’s elbow”
  - Pitchers, bowlers, racquet sports
  - Tendinosis of flexor/pronator origin
  - Secondary stabilizers to valgus stress
  - PT, FCR, PL, FDS, FCU
  - Traditionally Pronator Teres > FCR
  - Less common and harder to treat vs lateral epicondylitis

Medial Epicondylitis

- Physical Exam
  - TTP 5-10mm distal/anterior to medial epicondyle
  - Pain with resisted pronation & wrist flexion
  - Always check for valgus instability and ulnar

Medial Epicondylitis

- Treatment
  - Non-operative similar to Lateral Epicondylitis
  - Operative:
    - Indicated after 6mo failed non-op
    - Debridement of PT/FCR, reattachment of flexor-pronator group
    - Good to excellent outcomes in 80%
      - Not as good as surgery for lateral epicondylitis
    - Worse outcomes with pre-op ulnar nerve symptoms

JAAOS 2015;23