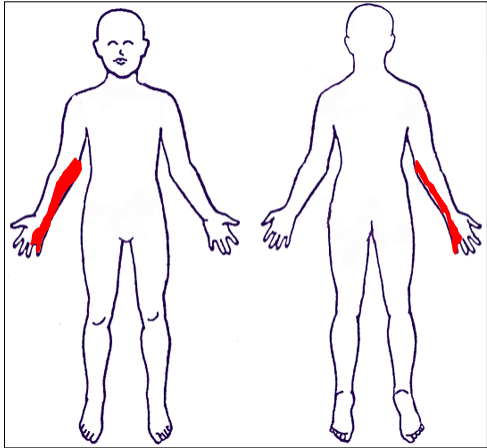




# UPPER EXTREMITY NEURODYNAMICS

**Kristin Kelley, PT, DPT, OCS, FAAOMPT**

Orthopaedic Manual Physical Therapy Series  
Charlottesville 2017-2018



## Body Chart Initial Hypothesis?

- Medial epicondylalgia
- UCL injury
- Ulnar nerve entrapment/Cubital Tunnel Syndrome
- TOS
- C8, T1 nerve root/radiculopathy
- Elbow Joint dysfunction: UH or prox RU
- Muscular strain: wrist flexor
- Pronator Teres Syndrome



## Subjective Exam

- 60 y.o. female admin assistant with diagnosis of “Medial Elbow Pain”
- Pt states she has had this type of pain on and off for years but lately she also has began waking w/pain and numbness/tingling almost daily
- CCO right medial elbow and medial arm pain worst sitting at her desk during computer work and when she leans on her elbow or talks on her phone
- Difficulty opening jars and bottles lately



## Subjective Exam

- Aggravating factors: elbow flexion, wrist extension, leaning on her elbow, sleeping
- Easing factors: R elbow UE extended position, NSAIDs
- R UE dominant
- PMH: unremarkable for R UE
- She has to now take NSAIDs by mid day when working at her computer and at night time to sleep



## Subjective Asterisks

- Pain/tingling with elbow flexion, wrist extension
- Alleviation of pain with elbow extension
- Medial 2 digit tingling with sleeping, leaning on elbow and w/prolonged computer use
- Pain with holding her phone
- Difficulty opening jars, gripping
- Previous similar symptoms “over the years”



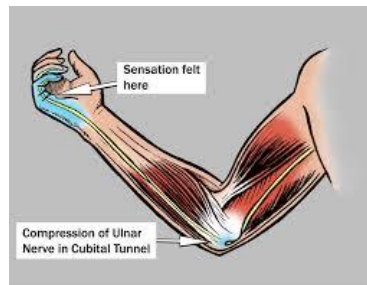
## Structure at Fault

- Joints:
  - UH, prox RU, C7-T1 facet
- Myofascial Tissue:
  - UCL, Common Flexor Tendon, Triceps, CTJ paraspinals and multifidus
- Neural Tissue:
  - Ulnar nerve, C8 (possibly T1), Medial antebrachial cutaneous nerve
- Other structures:
  - Osteophytes at joint



## Primary Hypothesis After Subjective Exam

- Cubital Tunnel Syndrome



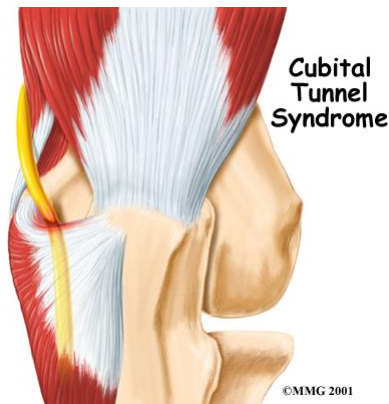
## Differential Diagnosis

- TOS
- Cervical Radiculopathy



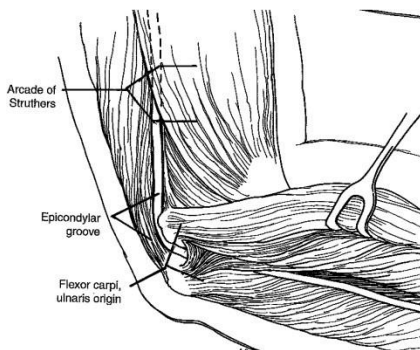
## Cubital Tunnel Syndrome

- History
  - 2nd most common neuropathy in UE
  - Sensory changes 4th-5<sup>th</sup> digits
  - Medial elbow pain
- Physical Exam
  - Elbow Flexion Test
  - Wartenberg's Sign
  - Ulnar Nerve Compression Test
  - Froment's Sign



# Cubital Tunnel Syndrome

- Differential Diagnosis
  - Cervical Radiculopathy
  - TOS
  - Ulnar compression at wrist
  - 1st rib syndrome
- Treatment
  - Rest, avoid elbow flexion ADLs
  - Night splinting in elbow flex  $< 30$  deg 4-6 weeks
  - Neurodynamic treatment



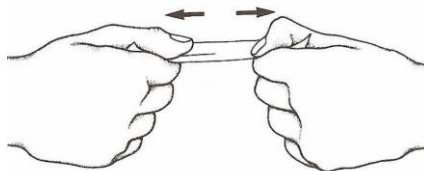
## Cubital Tunnel Syndrome Special Tests

- Elbow Flexion Test
  - 60 second hold, (+) for paresthesias
    - Sn .75, -LR .25
    - Sp .99, +LR .75
- Wartenberg's Sign
  - Inability to adduct 5th digit
  - Pt may complain that the little finger gets caught on the edge of the pants pocket when he or she tries to place the hand into the pocket



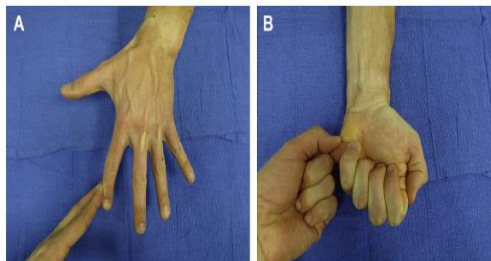
## Cubital Tunnel Syndrome Special Tests

- Ulnar Nerve Compression Test (Novak, 1994)
  - Pressure to nerve in 20 deg flexion for 60 seconds
  - Sn .89, -LR .11
  - Sp .98, +LR 44.5
- Froment's Sign
  - Key chuck grip of paper b/w thumb and index finger
  - Weakness of Adductor Pollicis and 1st Dorsal Interosseous allows paper to be pulled



## Intrinsic Muscle Testing

- (A) Testing the first dorsal interosseus muscle: Resistance is held against the fully abducted index finger.
- (B) Testing the deep flexor of the small finger: The patient is asked to make a fist around the examiner's finger, and resistance is applied against the flexed distal interphalangeal joint of the small finger.



## McGowan Classification of Ulnar Nerve Dysfunction

- Grade I: Sensory neuropathy only
- Grade II: Sensory and motor neuropathy, without muscle atrophy
- Grade III: Sensory and motor neuropathy, muscle atrophy present



## Objective Exam

- Posture
  - Significant forward head, rounded shoulders
- Cervical Clearing
  - ROM WFL—mod limitation in bilateral SB, min limitation bilateral rotation
  - (-)Spurlings/Quadrant testing
  - (-)Distraction
- R Shoulder Clearing
  - AROM, MMT WNL





## Objective Exam- Elbow

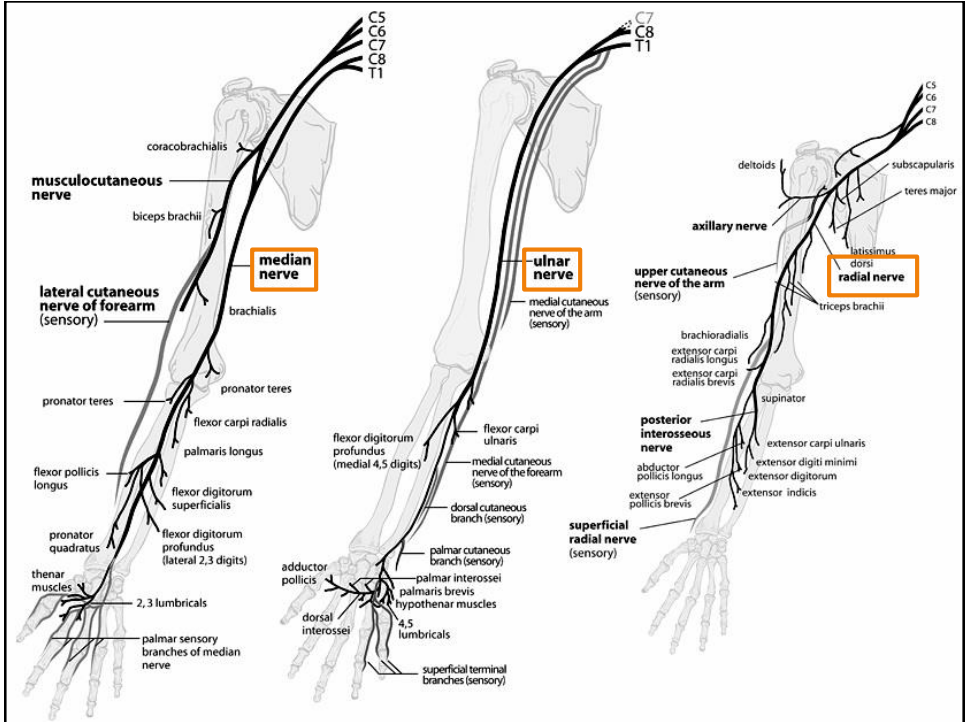
- Palpation
  - TTP posteromedial olecranon at cubital tunnel
- Elbow AROM: R flexion pain limited
- Wrist AROM: R Ext pain limited
- Special Test:
  - (-) Valgus test
  - (-) Varus test
  - (+) Ulnar Nerve Tinel's
  - (+) Froment's sign
  - (+) Wartenberg's Sign
  - (+) Ulnar Nerve Compression Test



## Objective Exam- Elbow

- Joint mobility testing:
  - UH, -painful UD of Ulna vs humerus
  - RH WNL
- MMT:
  - Elbow, Wrist WNL
  - First dorsal interosseous muscle: 3/5
  - Deep flexor of the small finger: 3/5
- Sensation:
  - Diminished light touch, medial forearm and medial 2 digits





# The Ulnar Nerve

- Muscles innervated
  - Flexor carpi ulnaris, flexor digitorum profundus, adductor pollicis, small digital muscles
- Motor functions
  - Finger adduction and abduction other than thumb; thumb adduction, flexion of digits 4 & 5; wrist flexion and adduction
- Sensory
  - Skin over medial surface of the hand through the superficial branch

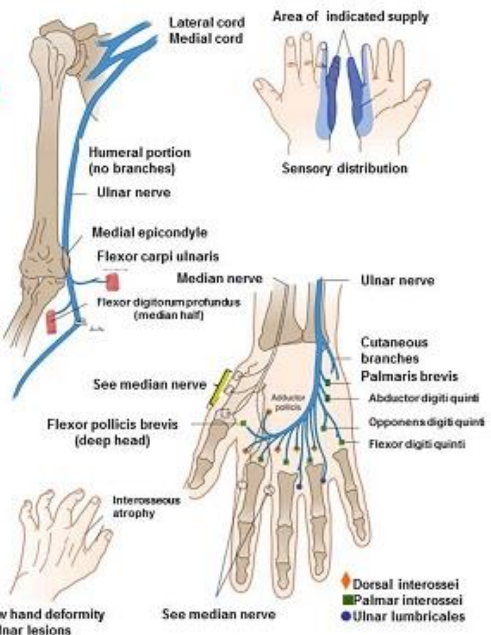
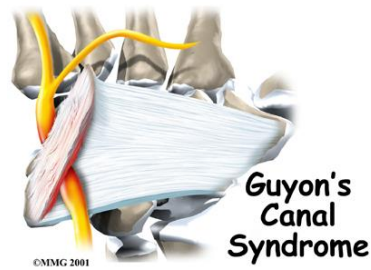
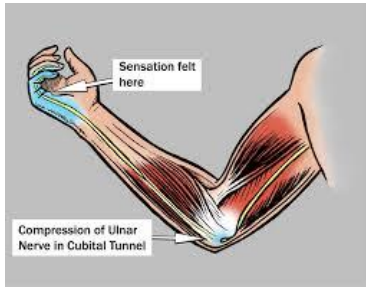


Figure 28-9 The ulnar nerve (C8, T1). In: Waxman SG. Clinical Neuroanatomy, 26th ed. <http://www.accessphysiotherapy.com>. Accessed May 10, 2011.

# Ulnar Nerve Entrapment Sites

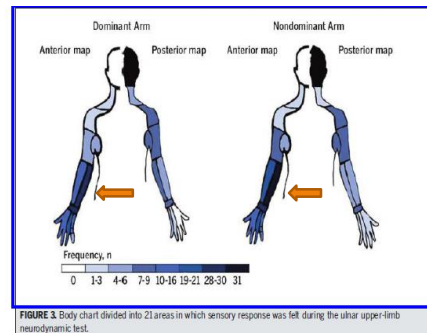
- Cubital tunnel
- Guyon's Canal



## Ulnar Nerve Neurodynamic Test: Study of the Normal Sensory Response in Asymptomatic Individuals

- Investigated normal Ulnar Nerve ANTT responses in asymptomatic individuals
- Only 6° less shoulder abduction angle in dominant vs nondominant UE
- Women displayed higher pain response and lesser shoulder abduction angle vs men

### Ulnar Nerve Symptom Location



## Ulnar Neurodynamic Test

1. Starting position-pt arm straight, abducted as little as possible. Perform shoulder depression taking up slack in nerves, NOT stretching.
2. Wrist and finger extension/pronation
3. Elbow flexion



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## Ulnar Neurodynamic Test

4. Glenohumeral external rotation
  5. Glenohumeral Abduction
- \*\*Structural differentiation**—release a small amt of scapular depression

### Normal Response:

Symptoms: pulling in medial elbow sometimes extending into the forearm. Sometimes stretching in the ulnar border of the wrist/hypothenar eminence

ROM: anything btw 20-55 deg abduction



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## The Radial Nerve

- Muscles innervated
  - Triceps, extensor carpi radialis and ulnaris, supinator, extensor pollicis
- Motor functions
  - Extension at all arm, wrist, and proximal finger joints below the shoulder; forearm supination; thumb abduction in plane of palm

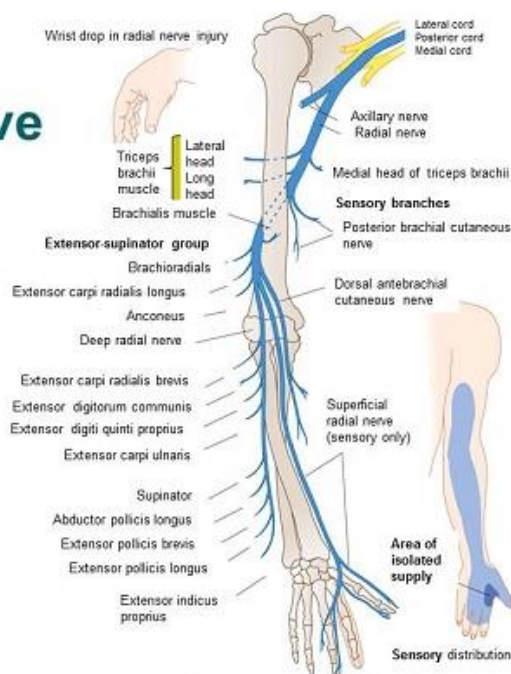
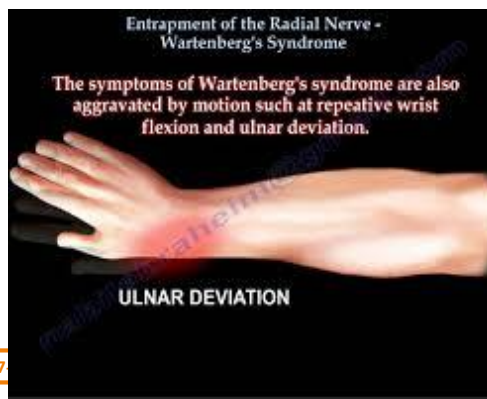
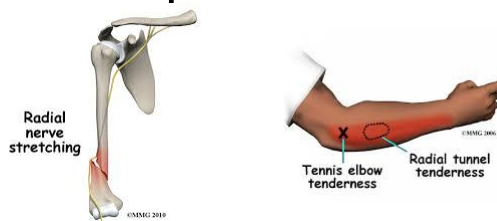


Figure 28-7. The radial nerve (C6-8; T1). In: Waxman SG. Clinical Neuroanatomy, 26<sup>th</sup> ed. <http://www.accessphysiotherapy.com>. Accessed May 10, 2011.

## Radial nerve entrapment sites

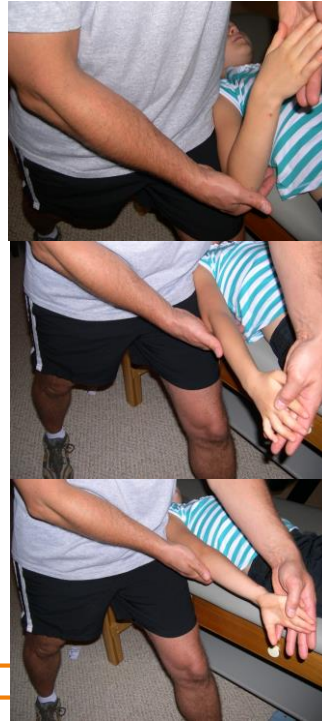
- Juncture of the middle and distal third of the arm (especially with fractures of the humerus),
- Radial tunnel
- Proximal to the wrist between the brachioradialis and ECRL (Wartenberg's Syndrome)
  - numbness, tingling, and weakness of the posterior aspect of the thumb



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## Radial Neurodynamic Test

1. Starting position-pt arm by side, elbow 90 deg, neutral wrist/finger. Perform shoulder depression with anterior hip taking up slack in nerves, NOT stretching.
2. Elbow extension
3. Internal Rotation/pronation



## Radial Neurodynamic Test

4. Wrist/finger flexion
5. Shoulder abduction

### \*\*Structural differentiation

Distal symptoms: release small amt of scapular depression

Prox symptoms: release wrist flexion

### Normal Response:

Symptoms: pulling lateral elbow into forearm, sometimes stretching into posterior wrist

ROM: anything btw 0-45° abduction



# The Validity of Upper-Limb Neurodynamic Tests for Detecting Peripheral Neuropathic Pain

- (+) ULNT should at least partially reproduce symptoms
- Median nerve test helps determine cervical radiculopathy
- Median nerve test does **not** help diagnose CTS
- Case study evidence linking ulnar nerve test to cubital tunnel syndrome

JOURNAL OF ORTHOPAEDIC & SPORTS PHYSICAL THERAPY | VOLUME 42 | NUMBER 5 | MAY 2012 |



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## CONCORDANCE OF UPPER LIMB NEURODYNAMIC TESTS WITH MEDICAL EXAMINATION AND MAGNETIC RESONANCE IMAGING IN PATIENTS WITH CERVICAL RADICULOPATHY: A DIAGNOSTIC COHORT STUDY

Journal of Manipulative and Physiological Therapeutics  
Volume xx, Number

Martina Apelby-Albrecht, DN,<sup>a</sup> Linda Andersson, DN,<sup>a</sup> Ingrid W. Kleiva, DN,<sup>a</sup> Kristian Kvåle, DN,<sup>b</sup> Eva Skillgate, DN, PhD,<sup>b</sup> and Anna Josephson, MD, PhD<sup>c</sup>

- n = 51
- ULNT (1-3 used combined) showed the highest sensitivity 0.97 and a specificity of 0.69
  - ULNT corresponded with MRI in 88.2% of cases
  - Most credible way to identify subjects with cervical radiculopathy
  - ULNT 1 (Median) showed the highest validity
  - ULNT 3 (Ulnar) had highest specificity compared with MRI
  - ULNT 2b (Radial) had lowest validity

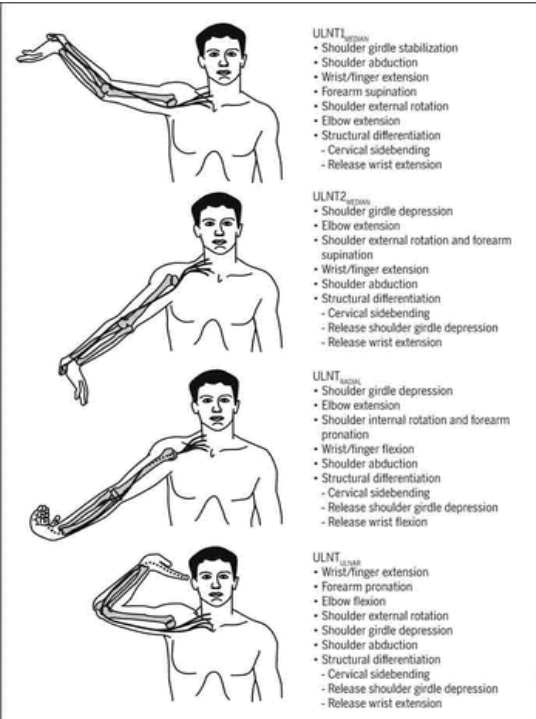
Table 5. Validity of ULNT; separately and as a test composition

Variable	Sn (95% CI)	Sp (95% CI)	NPV (95% CI)	PPV (95% CI)	κ
ULNT	0.97 (0.85-1.00)	0.69 (0.41-0.89)	0.92 (0.62-1.00)	0.87 (0.73-0.96)	0.71
ULNT1 median	0.83 (0.66-0.93)	0.75 (0.48-0.93)	0.67 (0.41-0.87)	0.88 (0.72-0.97)	0.56
ULNT2a median	0.66 (0.48-0.81)	0.75 (0.48-0.93)	0.50 (0.29-0.71)	0.85 (0.66-0.96)	0.36
ULNT2b radial	0.43 (0.26-0.61)	0.75 (0.48-0.93)	0.37 (0.21-0.56)	0.79 (0.54-0.94)	0.14
ULNT3 ulnar	0.71 (0.54-0.85)	0.87 (0.62-0.98)	0.58 (0.37-0.78)	0.93 (0.76-0.99)	0.52



Ortho

CI, confidence interval; Sn, sensitivity; Sp, specificity; ULNT, upper limb neurodynamic test.



**ULNT1<sub>RIGHT</sub>**

- Shoulder girdle stabilization
- Shoulder abduction
- Wrist/finger extension
- Forearm supination
- Shoulder external rotation
- Elbow extension
- Structural differentiation
  - Cervical sidebending
  - Release wrist extension

**ULNT2<sub>RIGHT</sub>**

- Shoulder girdle depression
- Elbow extension
- Shoulder external rotation and forearm supination
- Wrist/finger extension
- Shoulder abduction
- Structural differentiation
  - Cervical sidebending
  - Release shoulder girdle depression
  - Release wrist extension

**ULNT3<sub>RIGHT</sub>**

- Shoulder girdle depression
- Elbow extension
- Shoulder internal rotation and forearm pronation
- Wrist/finger flexion
- Shoulder abduction
- Structural differentiation
  - Cervical sidebending
  - Release shoulder girdle depression
  - Release wrist flexion

**ULNT4<sub>RIGHT</sub>**

- Wrist/finger extension
- Forearm pronation
- Elbow flexion
- Shoulder external rotation
- Shoulder girdle depression
- Shoulder abduction
- Structural differentiation
  - Cervical sidebending
  - Release shoulder girdle depression
  - Release wrist extension

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## Objective Exam- Asterisks

- TTP posteromedial elbow at cubital tunnel
- Significant forward head, rounded shoulders
- Limited and painful Elbow Flexion and Wrist Extension ROM
- (+) Ulnar Nerve Tinel’s
- (+) Froment’s sign
- (+) Wartenberg’s Sign
- (+) Ulnar Nerve Compression Test
- (+) Ulnar Nerve ANTT





## Clinical Reasoning

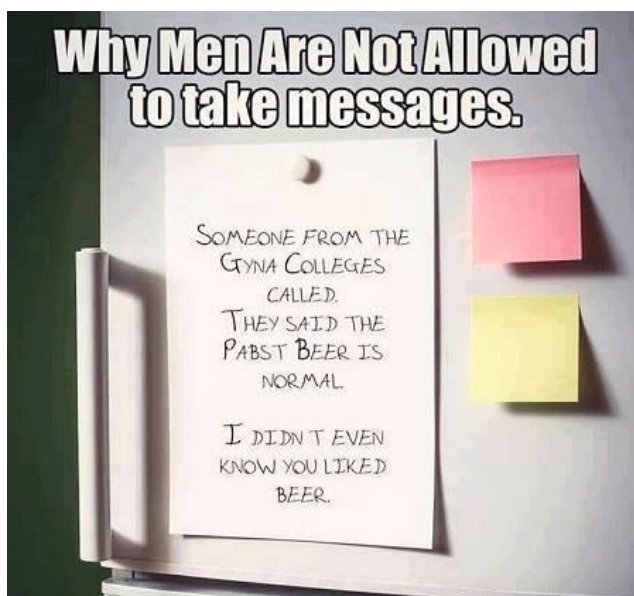
- Are the relationships between the areas on the body chart, the interview, and physical exam consistent? **yes**
- “Do the “Features Fit” a recognizable clinical pattern?” – If “Yes” – what : **\_Cubital Tunnel Syndrome\_\_\_\_\_**
- **Identify any potential risk factors** (Yellow, Red flags, non MSK involvement, biopsychosocial) **None**



## PICO

- **Patient/Problem Intervention Comparison Outcomes**
- **In patients with Cubital Tunnel Syndrome, does nerve gliding improve elbow symptoms?**
- **Assessment of Evidence**





## Research on Neurodynamics Treatment to improve Cubital Tunnel Syndrome

### CASE REPORT

#### **NEURODYNAMIC MOBILIZATION IN THE CONSERVATIVE TREATMENT OF CUBITAL TUNNEL SYNDROME: LONG-TERM FOLLOW-UP OF 7 CASES**

Deran Oskay, PT, PhD,<sup>a</sup> Aydın Meriç, PT, PhD,<sup>b</sup> Nuray Kırdı, PT, PhD,<sup>c</sup> Tüzün Firat, PT, PhD,<sup>d</sup>  
Çiğdem Ayhan, PT, MSc,<sup>e</sup> and Gürsel Leblebicioğlu, MD<sup>f</sup>



## Research on Neurodynamics treatment to improve Cubital Tunnel Syndrome

- 7 Pts with Gr I and II Ulnar nerve entrapment (McGowan Grading)
- Nerve gliding and tensioning used in addition to standard treatment
- 8 week f/u: improvement in grip, pinch and pain scale (VAS)
- 8 weeks to 12 month f/u: improvement in grip, pinch, pain scale, functional status (DASH), sensation
- Small study, multiple treatments provided to all



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(J Manipulative Physiol Ther 2010;33:156-163)m

## Research on Neurodynamics Treatment to Improve Cubital Tunnel Syndrome

### CASE REPORTS

#### **INCORPORATING NERVE-GLIDING TECHNIQUES IN THE CONSERVATIVE TREATMENT OF CUBITAL TUNNEL SYNDROME**

Michel W. Coppieters, PhD,<sup>a</sup> Katrien E. Bartholomeeusen, PT,<sup>b</sup> and Karel H. Stappaerts, PhD<sup>c</sup>

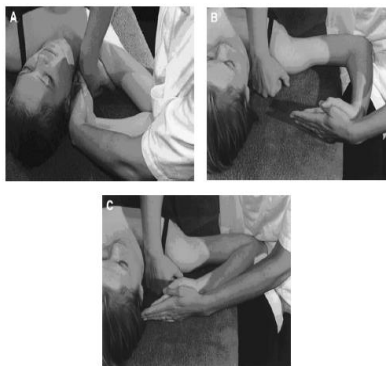


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(J Manipulative Physiol Ther 2004;27:560-568)m

## Research on Neurodynamics treatment to improve Cubital Tunnel Syndrome

- 17 y.o pt w/traumatic cubital tunnel injury
- Treatment: 6 sessions of ulnar nerve gliding, cervical joint mobilization, and HEP of ulnar nerve glides
- Improvement in pain scale functional test, ROM and overall functional status
- Total resolution of symptoms at 10 month f/u

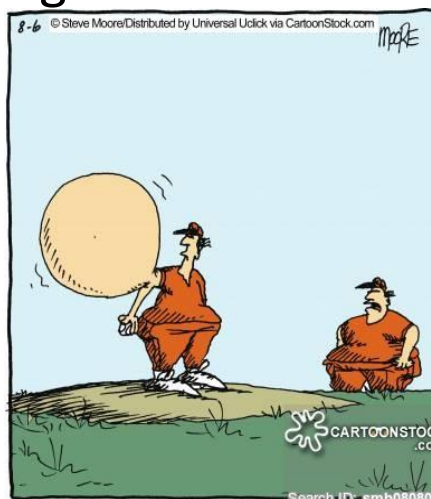


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(J Manipulative Physiol Ther 2004;27:560-568)

## Pattern Recognition

- Subjective
  - Medial elbow and medial 2 digit pain/paresthesia
  - Typically present w/elbow flexion (sleeping, phone use) and elbow WB



"Swelling, Babcock, is our body's way of telling us that something's wrong. But if you insist on staying in the game, hey, it's your elbow."



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## Pattern Recognition

- Physical Exam
  - TTP cubital tunnel
  - Sensory deficits medial forearm and medial 2 digits
  - Motor deficits, observed as clawing of the 4<sup>th</sup>&5<sup>th</sup> digits (due to ulnar intrinsic muscle paralysis w/intact long flexors)
    - \*\*If the branch of the ulnar nerve to the flexor digitorum profundus is also affected, clawing may be less apparent or not occur.
  - (+)Wartenburg's sign: posturing of the little finger in abduction secondary to a weak interosseus muscle.
  - (+)Froment's sign; hyperflexion of the thumb when pinching secondary to a weak adductor pollicis



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## Initial Evaluation Treatment

- Education:
  - Anatomy and positions of Aggs/Ease for Ulnar Nerve
    - Pt will become better historian w/better eval education
  - Healing process and time/prognosis
  - Compliance with attendance, HEP, and activity modification
  - Posture—impact on current dysfunction and correction for work/home



" You're supposed to sneeze on your own elbow. "



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## Initial Evaluation Treatment

- Treatment progression
  - Level 2 patient presentation
    - Cervical treatment with UE in neural slack position
      - Static Opening—position pt in contralateral SB for foraminal opening
      - Dynamic Opening—perform Gr I,II contralateral SB or sideglide for foraminal opening



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## ND Sequence

- A. Tension Contralateral UE statically
  - Use left median nerve for contralateral tension
  - Ipsilateral ulnar nerve can be kept in slack to further desensitize affected side
- B. Tension Contralateral UE statically
  - Move ipsilateral ulnar nerve into neutral then progress to tension positions



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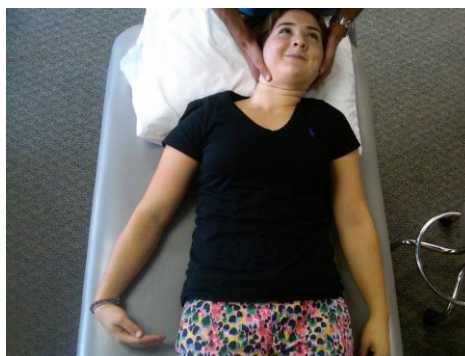
## Sliders

- Can be used to relieve pain and improve dynamics in the nervous system at all levels of problem
  - Reduce pain at level 1
  - Reduce treatment soreness btw or after treatment at higher levels (2,3)
  - Do not produce much tension in nervous system—very safe



## UE Slider-Lateral translation of C-Spine

- Begin by loading the portion of the nerve track most distant to symptoms (in this case—cervical)
  - Contralateral cervical translation (loading ulnar nerve)
- Perform unloading on symptomatic area (elbow)
  - Elbow ext, Wrist flex (unloading ulnar nerve)
- \*\*As symptoms improve, begin loading symptomatic area (elbow flex, wrist ext) and unload less symptomatic area (ipsilateral side glide)



## UE Slider-Lateral flexion of C-Spine

- Begin by loading the portion of the nerve track most distant to symptoms (in this case—cervical)
  - Contralateral cervical translation (loading ulnar nerve)
- Perform unloading on symptomatic area (elbow)
  - Elbow ext, Wrist flex (unloading ulnar nerve)



## Ulnar nerve slider

- Ulnar nerve sliding
  - (B) wrist ext (loading) combined with elbow movement to ext (unloading)
  - (C) elbow flex (loading) combined with wrist movement toward flexion (unloading)





## UE Tensioner Progression for Ulnar Nerve

- Contralateral cervical SB (tension ulnar n.)
- Shoulder maintained in neutral to limit elevation
- Shoulder 90 deg abd and ER
- Elbow 90 deg flexion
- Forearm pronation (A) tension ulnar n.
- Supination (B), de-tension ulnar n.
- PROM to tolerance



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## UE Tensioner Progression for Ulnar Nerve

- Contralateral cervical SB (tension ulnar n.)
- Shoulder maintained in neutral to limit elevation
- Shoulder 90 deg abd and ER
- Forearm pronation, elbow PROM flexion from 90° (A) to pt tolerance (B) (further tension ulnar n.)



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## UE Tensioner Progression for Ulnar Nerve

- Contralateral cervical SB (tension ulnar n.)
- Shoulder maintained in neutral to limit elevation
- Forearm pronation, elbow 90 deg flexion
- Shoulder 90 deg abd, ER(A)
- PROM shoulder abd to tolerance (B) (further tension ulnar n.)



## Tensioner Dosage?

- Looking for **small improvements** to prevent adverse latent response (may only see 5-10 deg improvement in SLR per session)
- Should not enter into highly symptomatic portion of ROM, withdraw at low tension (**\*off loading more than loading**)
- Perform a few times to see pt response—will dictate treatment
- HEP **after 24 hr** response noted
- Frequency of HEP depends on irritability
- Pt is educated that symptoms must settle completely btw movement

