

# Carpal Tunnel Syndrome: What's New

ICS-US

April 25-27, 2024

Robert Van Demark, Jr. MD



UNIVERSITY OF  
SOUTH DAKOTA  
SANFORD SCHOOL OF MEDICINE

**SANFORD**  
ORTHOPEDICS  
SPORTS MEDICINE

The Alternative Title is



# **Nerve Conduction Studies for Carpal Tunnel Syndrome: Gold Standard or Unnecessary Evil?**

John R. Fowler, MD

# Disclosures

None

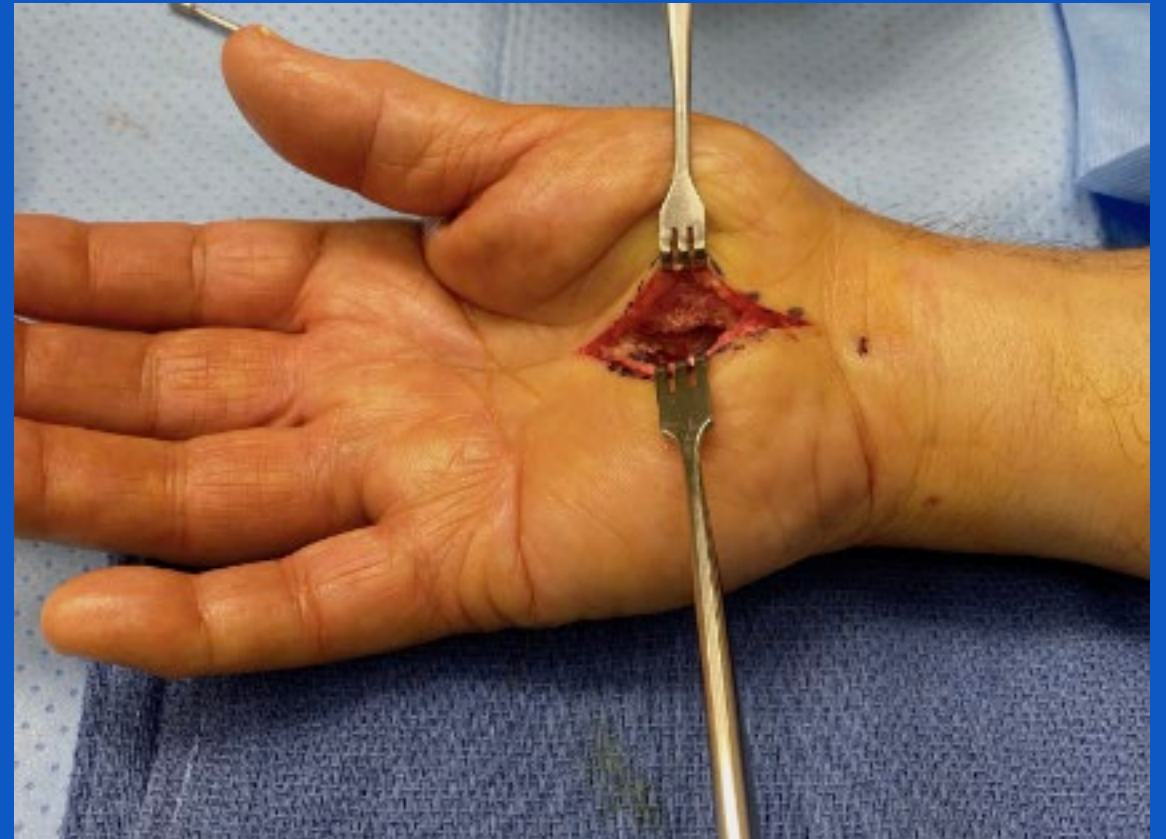
# Goals

Carpal tunnel

How to diagnose it

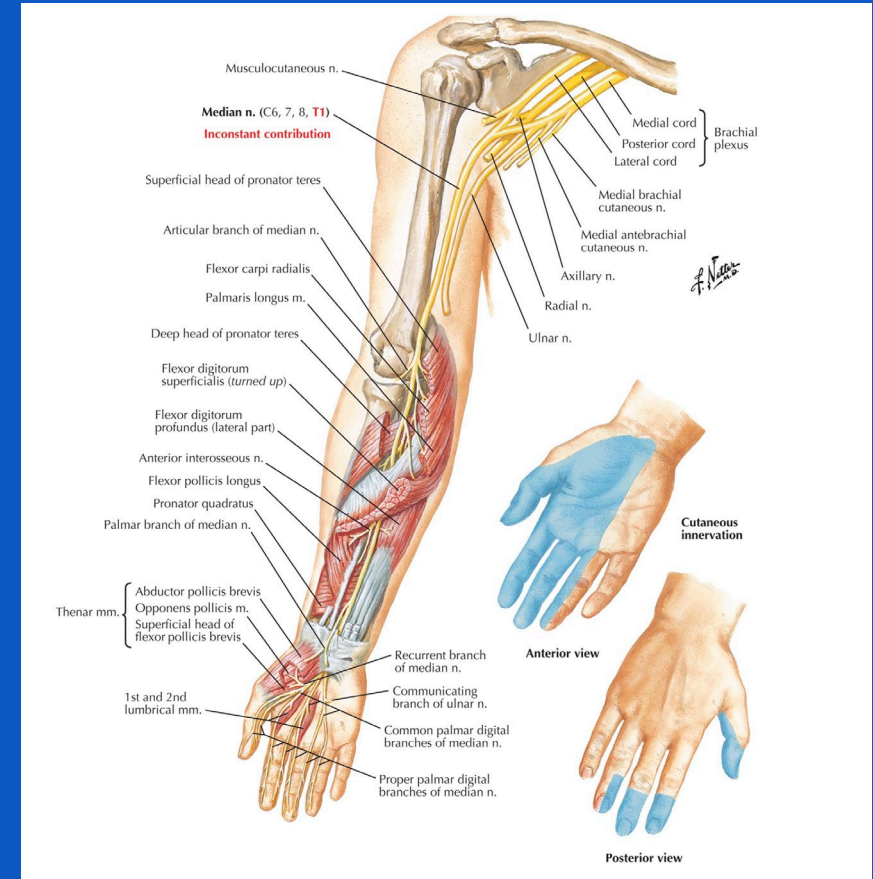
What is the CTS-6?

Do you need nerve studies?

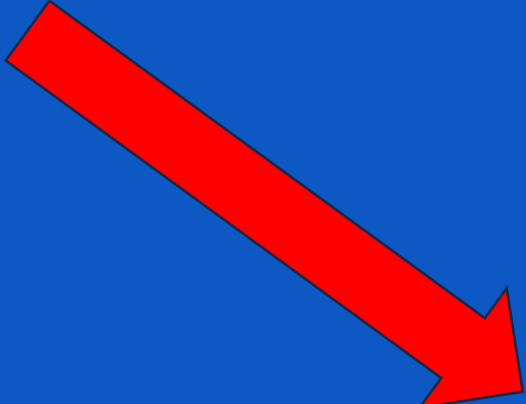




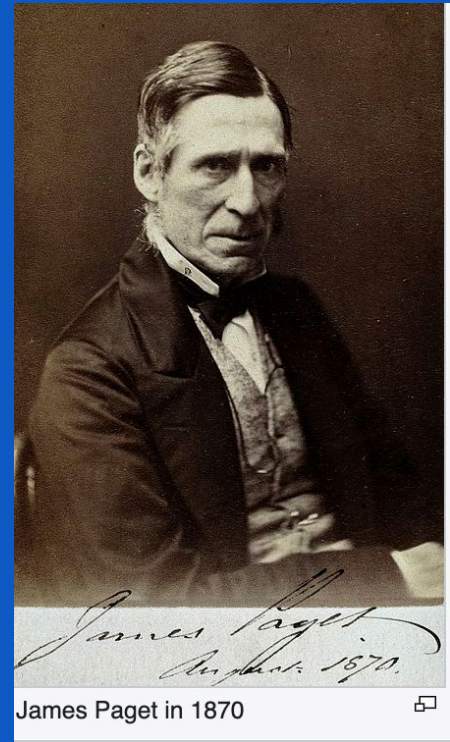
# What's New???



# 1854: Sir James Paget



2024



Google Scholar

carpal tunnel syndrome

Articles

About 199,000 results (0.04 sec)

Any time

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Since 2023

Since 2020

Custom range...

**Electrodiagnostic evaluation of carpal tunnel syndrome**

RA Werner, M Andary - Muscle & nerve, 2011 - Wiley Online Library

... It is the most commonly reported nerve compression **syndrome**, accounting for 0.2% of all ...

**carpal tunnel** releases in 2006.2 The impairment of the median nerve within the **carpal tunnel** ...

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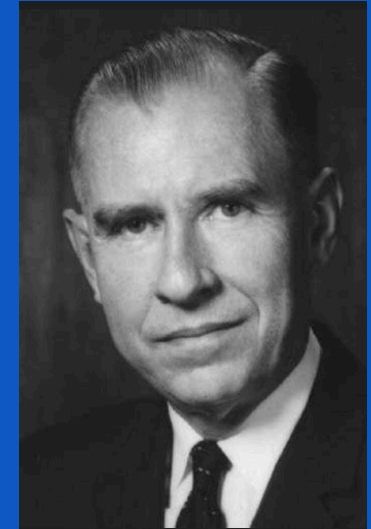
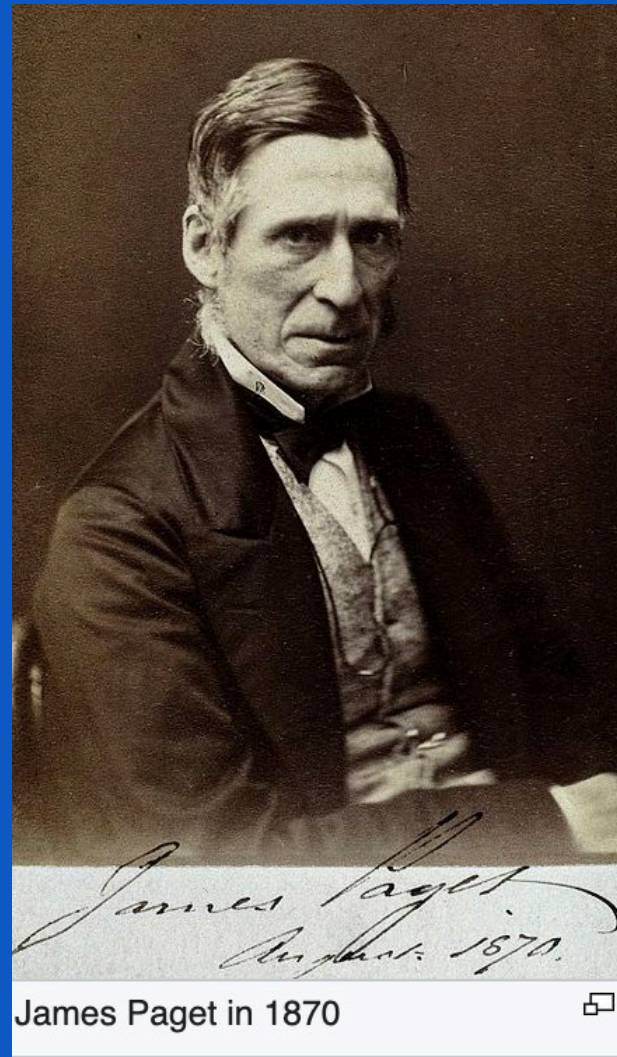
1854: Sir James Paget

1880: Putnam  
37 pts

1893: Schultz  
“acroparesthesia”

1924: Galloway  
First CTR

1946: Cannon and Love  
“Tardy Median Palsy”



1950: George Phalen

1950: **12** cases of carpal tunnel surgery



**SPONTANEOUS COMPRESSION OF THE MEDIAN NERVE AT THE WRIST**

*George S. Phalen, M.D., Cleveland*

Pain and numbness in the fingers are relatively common complaints. These symptoms are usually of secondary importance and hardly worthy of the physician's serious consideration. There are many patients, however, who come to the physician specifically for relief from pain and numbness in their hands, and who have no other complaints whatsoever. This group of patients often presents a difficult problem in differential diagnosis.

Obviously, pain and hypesthesia in the fingers may be produced by any lesion involving the nerve pathways to the hand. This may be a lesion of the central nervous system, such as a brain tumor, syringomyelia or a degenerative disease of the spinal cord. Much more frequently, however, the lesion is found to be one which produces irritation of the fifth to eighth cervical nerve roots. A protruded cervical intervertebral disk, hypertrophic arthritis of the cervical spine and injuries in-

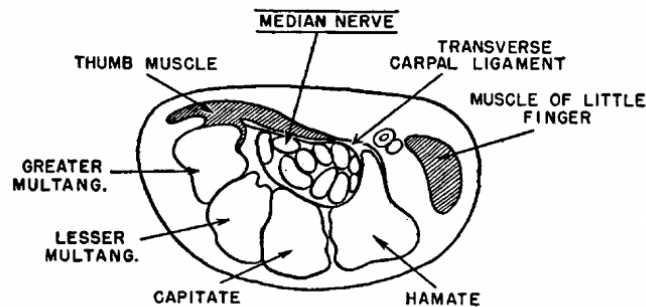


Fig. 1.—A cross section through the carpal tunnel. The median nerve lies immediately beneath the transverse carpal ligament and superficial to the flexor tendons of the fingers.

JAMA. 1951

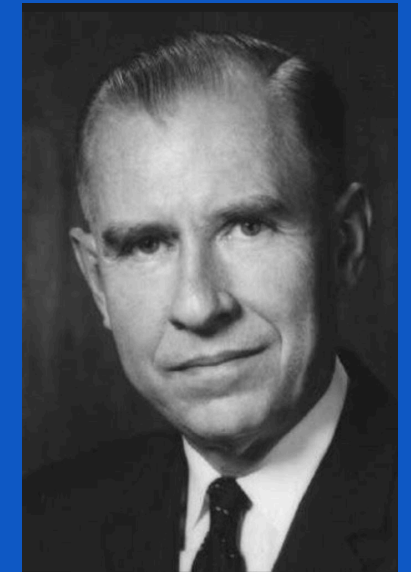
Four cases

**NEUROPATHY OF THE MEDIAN NERVE DUE TO COMPRESSION BENEATH THE TRANSVERSE CARPAL LIGAMENT \***

BY GEORGE S. PHALEN, M.D., W. JAMES GARDNER, M.D., AND ALBERT A. LA LONDE, M.D., CLEVELAND, OHIO

*From the Cleveland Clinic and the Frank E. Bunts Educational Institute, Cleveland*

JBJS. 32-A, 1950



George Phalen

**The Journal of Bone and Joint Surgery**

*American Volume*

VOLUME 48-A, No. 2

MARCH 1966

**The Carpal-Tunnel Syndrome**

SEVENTEEN YEARS' EXPERIENCE IN DIAGNOSIS AND TREATMENT OF SIX HUNDRED FIFTY-FOUR HANDS \*

BY GEORGE S. PHALEN, M.D.†, CLEVELAND, OHIO

*From the Department of Orthopedic Surgery, The Cleveland Clinic Foundation, Cleveland*

JBJS. 48-A, 1966

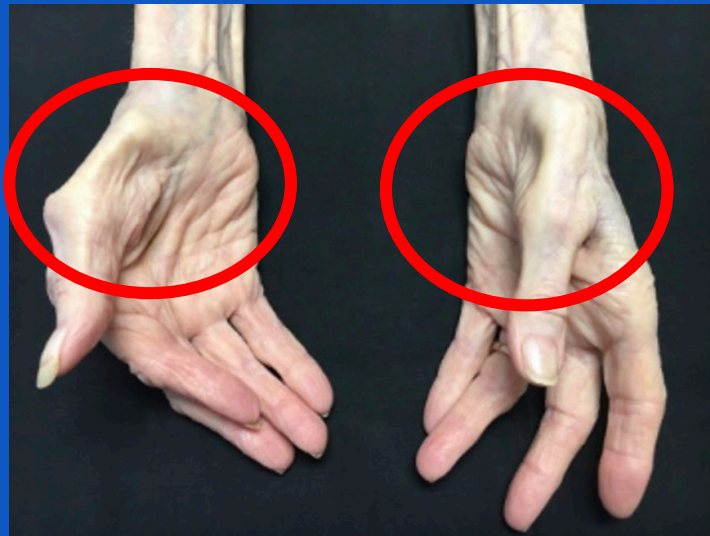
654 hands

# Carpal Tunnel Diagnosis

A **CLINICAL** diagnosis

History

Physical



# Carpal Tunnel

Most common compression neuropathy

Female > Male

Numbness in the Median N distribution

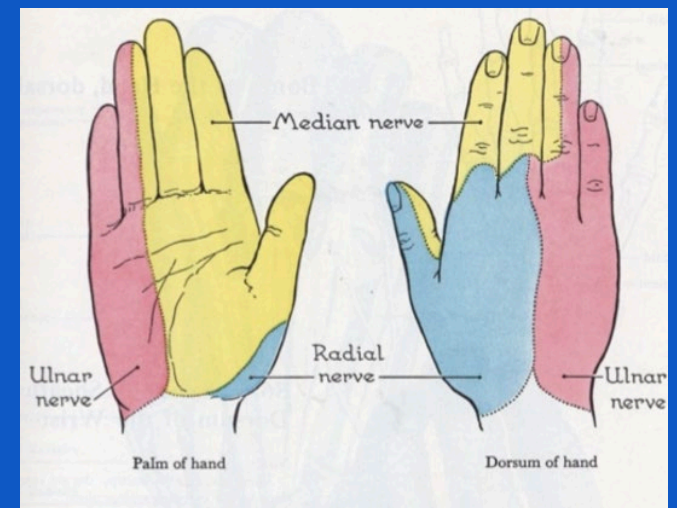
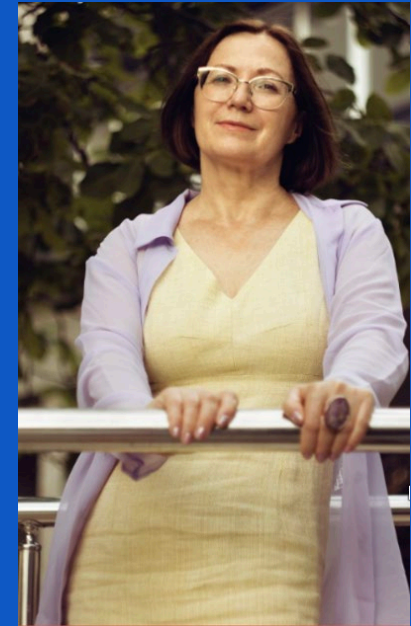
**NIGHT Pain and Numbness**

Aggravated by

driving a car

talking on the phone

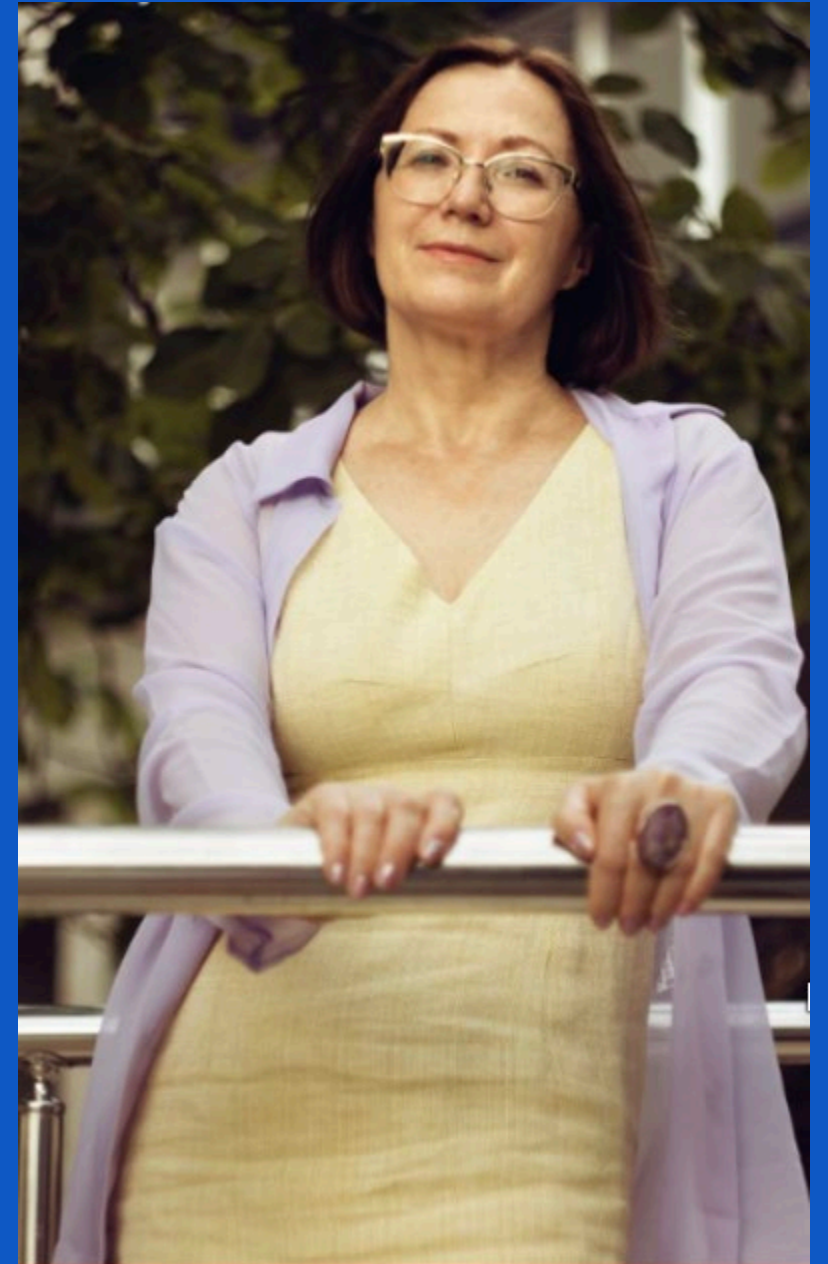
reading the newspaper



# Carpal Tunnel

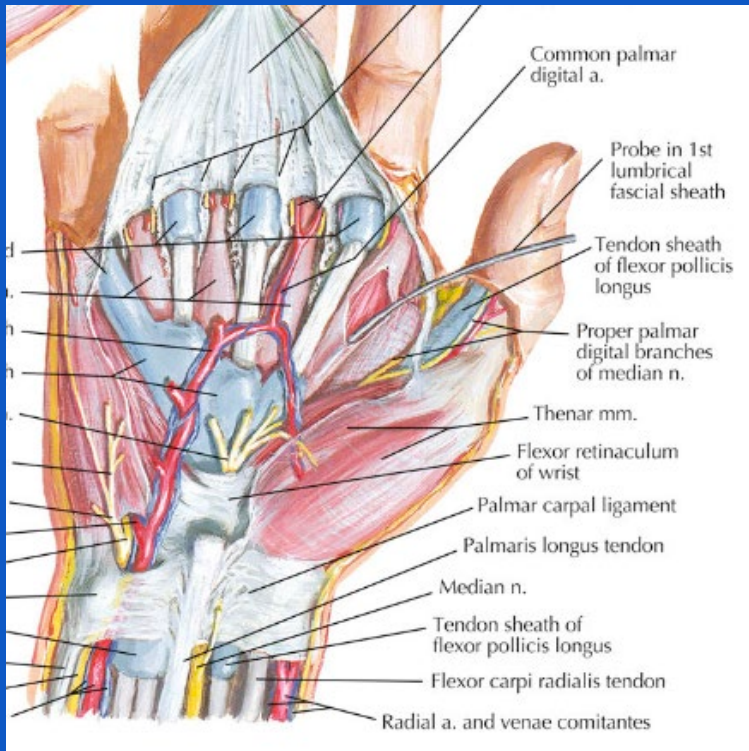
400,000 CTS surgeries/yr

2 Billion dollars/year



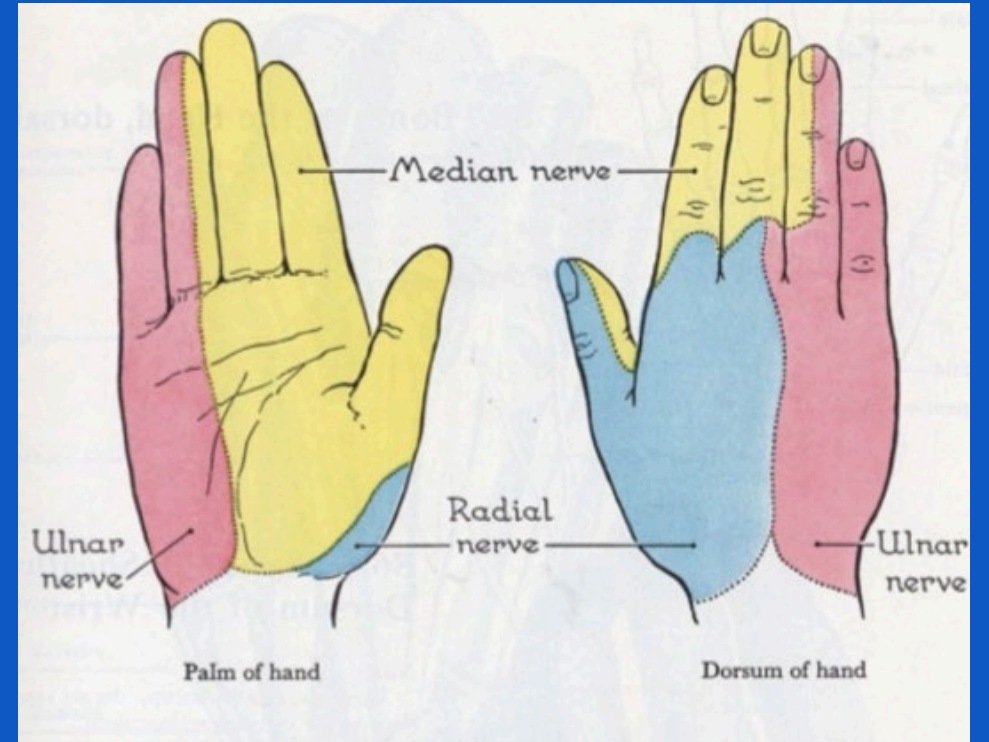
# Median Nerve

## Thenar Muscles



Netter's Atlas

## Sensory Distribution



Grant's Atlas

# Physical Exam: Sensation



2 PPD-late finding



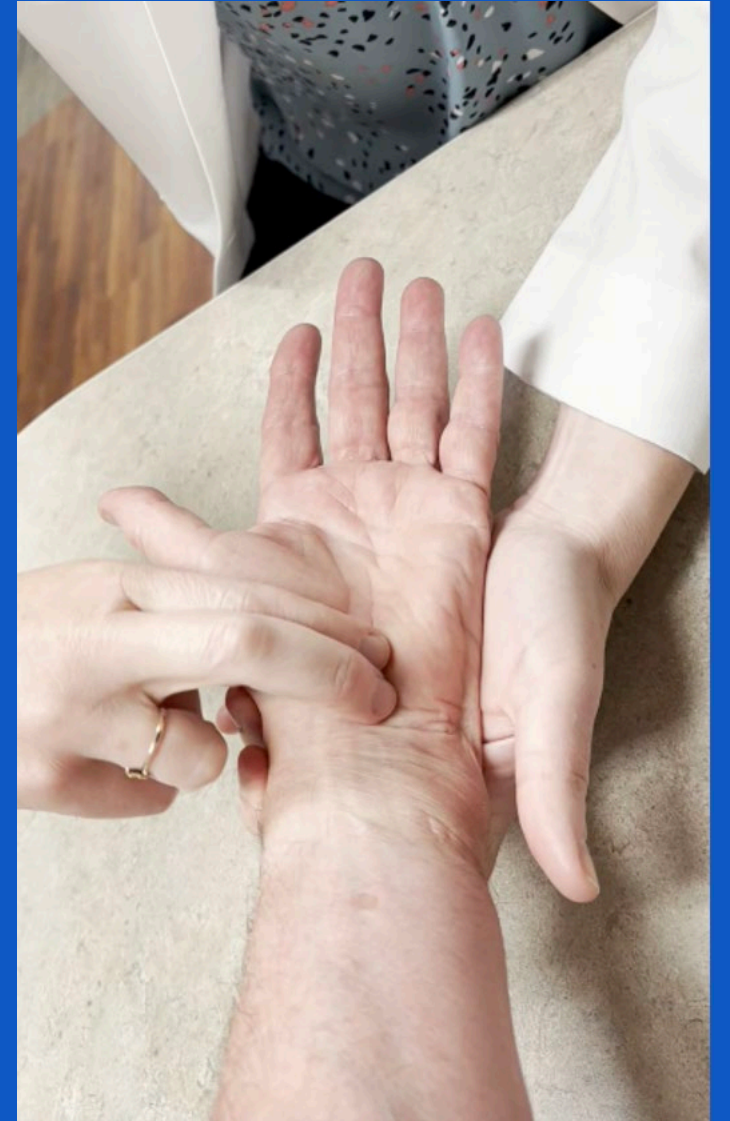
Semmes-Weinstein  
Early detection

# Physical Exam. Motor Testing





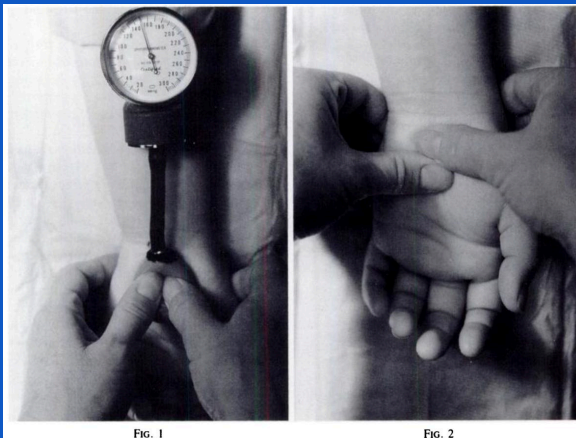
Phalen's



Tinel's



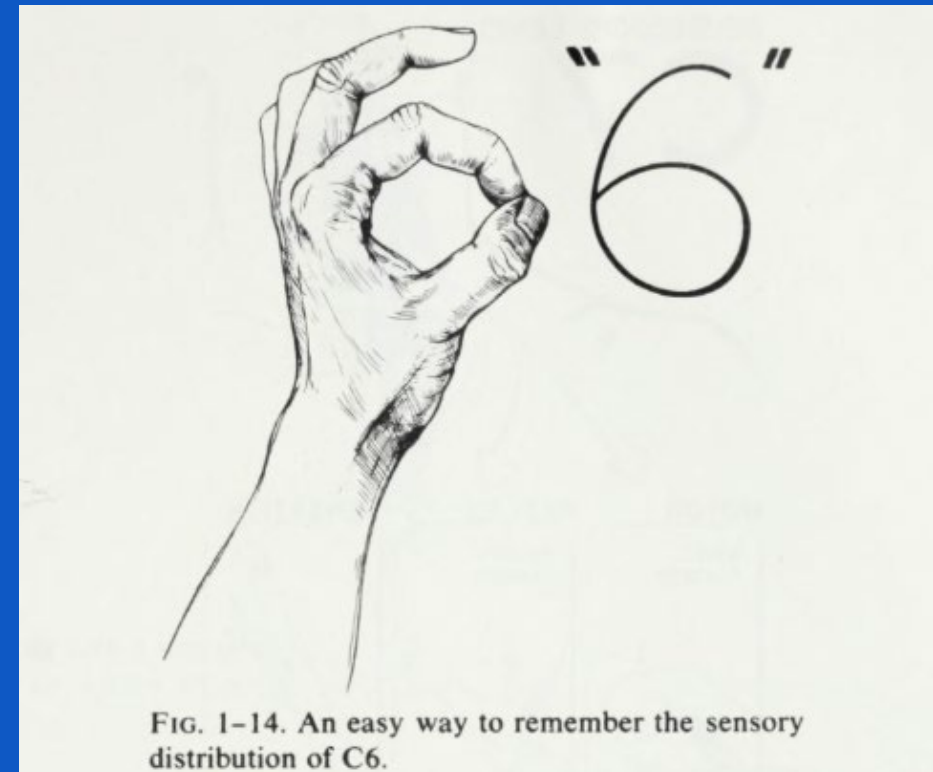
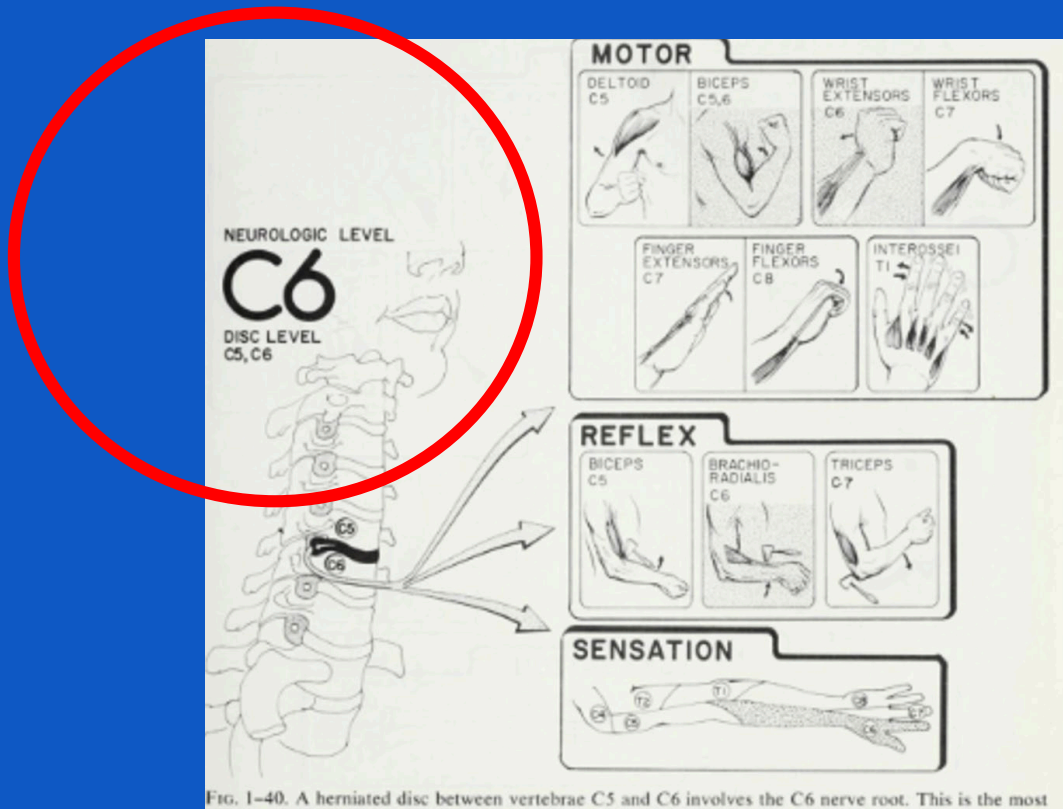
# Physical Exam



Durkan JBJS 1991

\*\*\*Durkan's

# Differential Diagnosis: Cervical Disc Disease

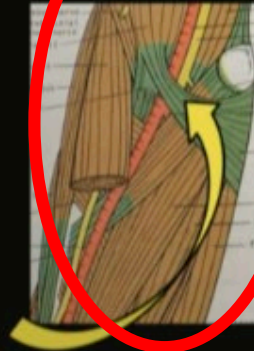


# Differential Diagnosis

Still numb after carpal tunnel release in a person who should have gotten better?

- Pt complains of weakness?
- Measure FPL, FDP2, FCR power
- Press on median nerve under lacertus fibrosis with your thumb tip
- Palm numb?
- Do a wide awake lacertus tunnel Release

Hagert E. Clinical diagnosis and wide-awake surgical treatment of proximal median nerve entrapment at the elbow: a prospective study. *Hand (N Y)*. 2013 Mar;8(1):41-6



Lalonde

Lacertus Syndrome  
(Pronator Syndrome)

# Electrodiagnostic Studies (EDS)

What are they?

Indications

Are they needed for idiopathic CTS?



# EDS

2 components

NCV: nerve evaluation

EMG: evaluate resting membrane potential

Purpose

Confirmatory

Screening tool



Christopher Dy,  
MD, MPH, FACS



## Review Article

### Interpretation of Electrodiagnostic Studies: How to Apply It to the Practice of Orthopaedic Surgery

Christopher J. Dy, MD, MPH, FACS

Berdale S. Colorado, DO, MPH

Andrew J. Landau, MD

David M. Brogan, MD, MSc

#### ABSTRACT

Electrodiagnostic studies may help orthopaedic surgeons to identify and confirm nerve pathology, determine severity of disease, localize the lesion, identify concomitant or alternative pathology, and prognosticate potential outcomes with nonoperative or operative treatment. Surgeons should recognize the indications for electrodiagnostic studies, principles of their performance, and how to assess the primary data generated by the examination and how it can inform their treatment plans.

Dy, et al 2021



# Clinical Use

Carpal tunnel (CTS)

Cubital tunnel (CUTS)

Cervical Radiculopathy

Peripheral Nerve Injury



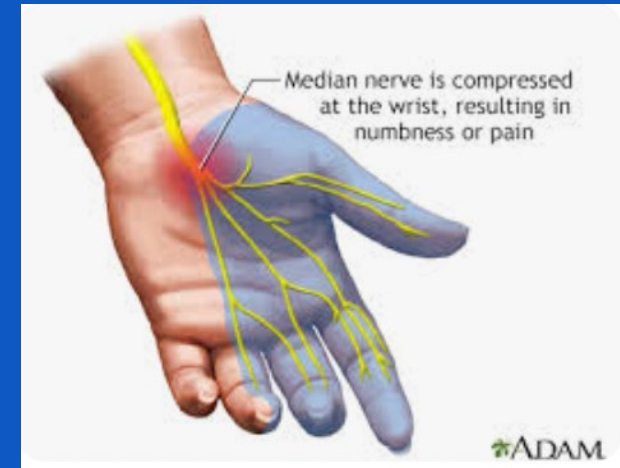
# EDS: How good are they?

## CTS Testing

Sensitivity:82-85%

Specificity:95-99%

**False Neg:10-20%**

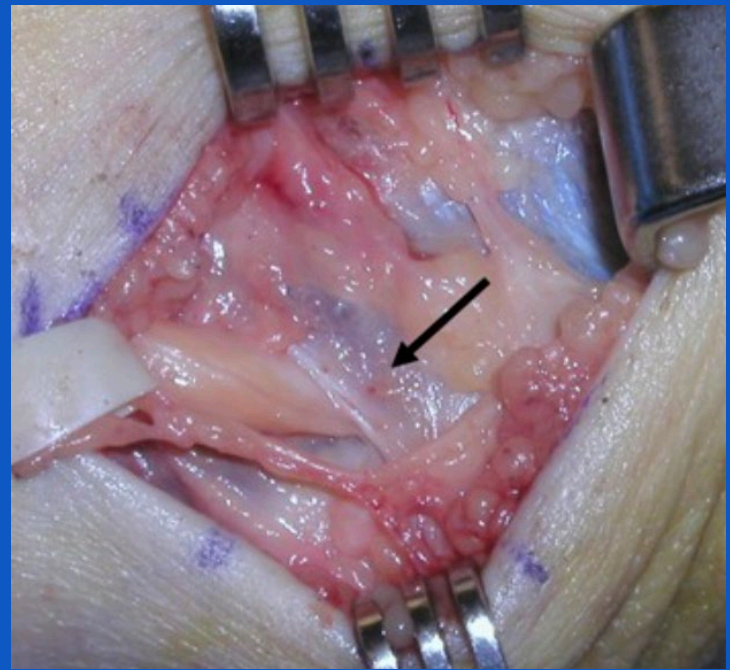


# Cubital Tunnel (CUTS)

## CUTS Testing

Sensitivity:37-86%

Specificity:>95%





# Sensitivity

For both CTS/CUTS

**NCV**>>EMG



# EDS

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Average cost: **\$1,000**

Extra visits

Delay in treatment (3-4 mos)

## Review Article

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Christopher J. Dy, MD, MPH,  
FACS 

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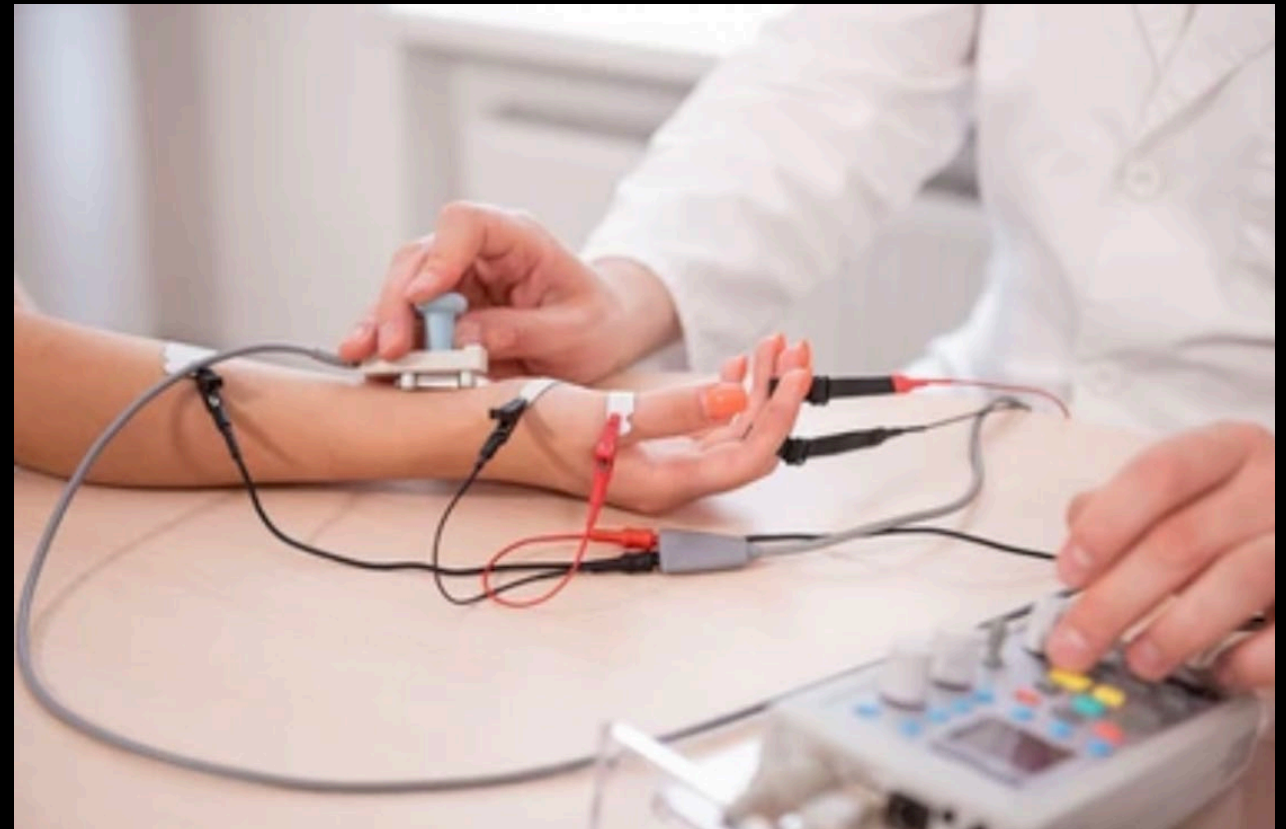
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Dy, et al 2021



What's a CTS-6?



# CTS-6: Diagnostic Questionnaire



Brent Graham

2587

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## The Value Added by Electrodiagnostic Testing in the Diagnosis of Carpal Tunnel Syndrome

By Brent Graham, MD

*Investigation performed at the University Health Network, Toronto Western Hospital, Toronto, Ontario, Canada*

JBJS: 2008

**Conclusions:** For the majority of patients who are considered to have carpal tunnel syndrome on the basis of their history and physical examination alone, electrodiagnostic tests do not change the probability of diagnosing this condition to an extent that is clinically relevant.

**Level of Evidence:** Diagnostic Level I. See Instructions to Authors for a complete description of levels of evidence.

# CTS-6: Diagnostic Questionnaire

## CTS-6

### *A clinical aid for diagnosing carpal tunnel syndrome*

#### **Symptoms and history**

Numbness predominately or exclusively in median nerve territory **3.5**  
*Sensory symptoms are mostly in the thumb, index, middle and/or ring fingers*

Nocturnal numbness **4**  
*Symptoms are prominent when patient sleeps; numbness wakes patient from sleep*

#### **Physical examination**

Thenar atrophy and/or weakness **5**  
*The bulk of the thenar area is reduced or manual motor testing shows strength of grade 4 or less*

Positive Phalen test **5**  
*Flexion of the wrist reproduces or worsens symptoms of numbness in the median nerve territory*

Loss of 2 point discrimination **4.5**  
*A failure to discriminate two points held 5mm or less apart from one another, in the median nerve innervated digits, is a positive test suggestive of CTS*

Positive Tinel sign **4**  
*Light tapping over the median nerve at the level of the carpal tunnel causing radiating paraesthesiae into the median nerve innervated digits (not proximally) is a positive test*

**CTS-6**

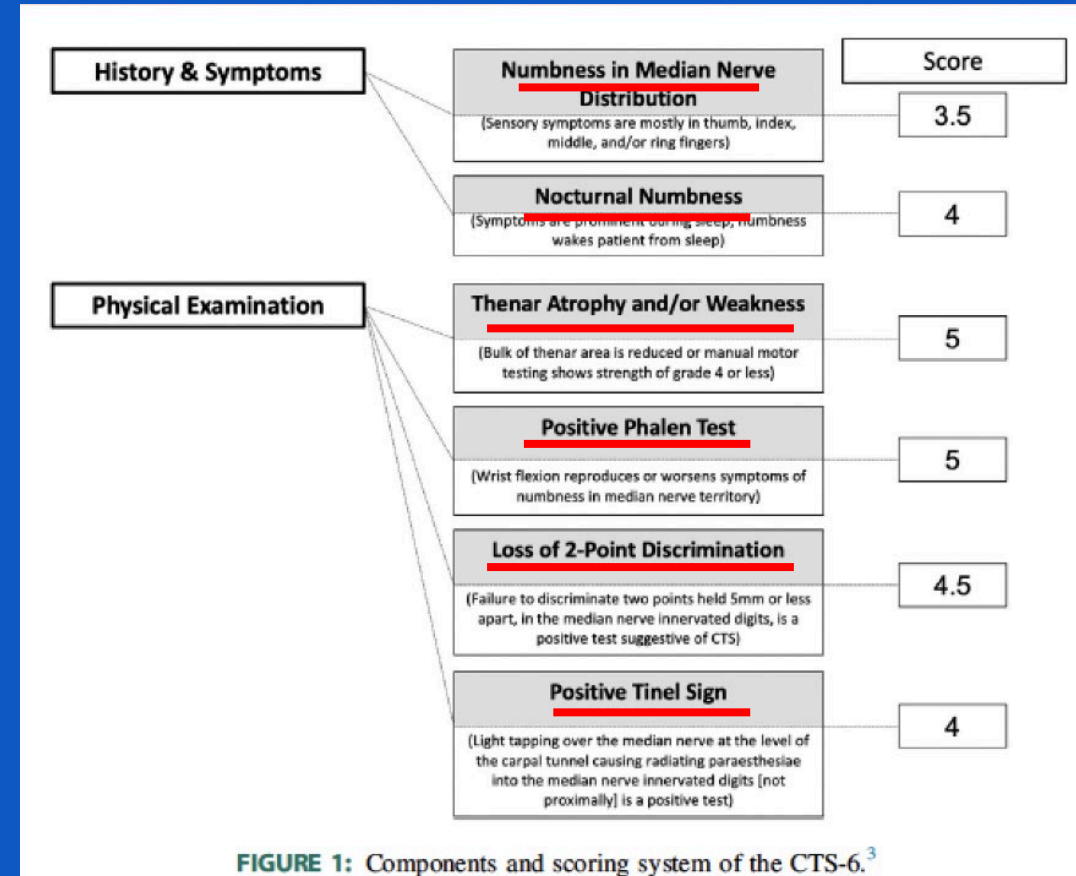
**$\geq 12$  = Carpal tunnel syndrome**

<u>Finding</u>	<u>Points</u>
Numbness predominantly or exclusively in median nerve distribution	3.5
Nocturnal symptoms	4
Thenar atrophy or weakness	5
Positive Phalen test	5
Loss of 2-point discrimination ( $>5\text{mm}$ )	4.5
Positive Tinel sign	4

# CTS-6: 6 parts with points

History/symptoms  
2 parts

Physical  
4 parts



>12 pts: CTS

# CTS-6

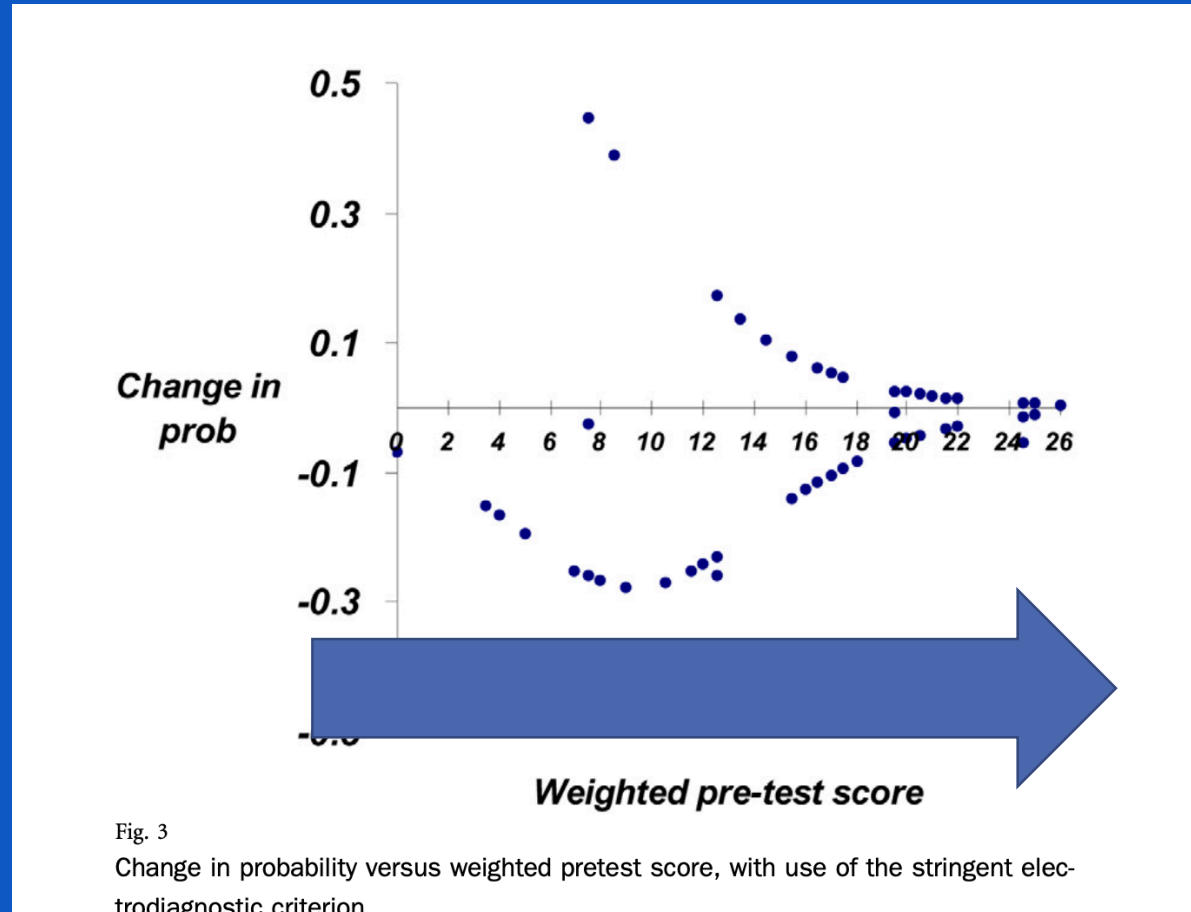


Fig. 3  
Change in probability versus weighted pretest score, with use of the stringent electrodiagnostic criterion.



# Reliability of CTS-6

Medical students

Hand Occupational Therapists

Hand Surgeons

“substantial agreement” in exams

EDITOR'S CHOICE

## **The Reliability of the CTS-6 for Examiners With Varying Levels of Clinical Experience**

Louis C. Grandizio, DO,\* Benchaa Boualam, MS,\* Parker Shea, BS,\* Matthew Hoehn,\* Charlene Cove,\*  
Idorenyin F. Udoeyo, MPH,\* C. Liam Dwyer, MD,\* Joel C. Klana, MD\*

Grandizio, et al JHS .2022

# Diagnostic Testing

EDITOR'S CHOICE

## Utilization of Diagnostic Testing for Carpal Tunnel Syndrome: A Survey of the American Society for Surgery of the Hand

Jessica I. Billig, MD, MS,\* Erika D. Sears, MD, MS†

EDITOR'S CHOICE

## Surgeons' Recommendations for Neurodiagnostic Testing With High Pretest Probability of Idiopathic Median Neuropathy at the Carpal Tunnel

Tom Joris Crijns, MD,\* Carlos Mucharrasz, BS\* Abinaya Paravasthuramesh, BS,\* Teun Teunis, MD, PhD,\* David Ring, MD, PhD,\* Amirreza Fatehi, MD,\* The Science of Variation Group

EDITOR'S CHOICE

## Has the Use of Electrodiagnostic Studies for Carpal Tunnel Syndrome Changed After the 2016 American Academy of Orthopaedic Surgeons Clinical Practice Guideline?

Thompson Zhuang, MD, MBA,\* Lauren M. Shapiro, MD, MS,† Emily A. Schultz, BS,\* Nicole M. Truong, BS,† Alex H. S. Harris, PhD, MS,† Robin N. Kamal, MD, MBA\*

EDITOR'S CHOICE

## Variation in Use of Electrodiagnostic Testing: Analysis From the Michigan Collaborative Hand Initiative for Quality in Surgery

Jessica I. Billig, MD, MS,\* Sandra V. Kotsis, MPH,† Kevin C. Chung, MD, MS,† M-CHIQS Collaborators

AAOS  
AMERICAN ACADEMY OF  
ORTHOPAEDIC SURGEONS

## Management of Carpal Tunnel Syndrome

### Evidence-Based Clinical Practice Guideline

Adopted by:  
The American Academy of Orthopaedic Surgeons Board of Directors  
February 29, 2016

Endorsed by:

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986 pages



2016



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## DIAGNOSTIC SCALES

Moderate evidence supports that diagnostic questionnaires and/or electrodiagnostic studies could be used to aid the diagnosis of carpal tunnel syndrome.

Strength of Recommendation: Moderate Evidence

*Description: Evidence from two or more "Moderate" strength studies with consistent findings, or evidence from a single "High" quality study for recommending for or against the intervention.*

2016

EDITOR'S CHOICE

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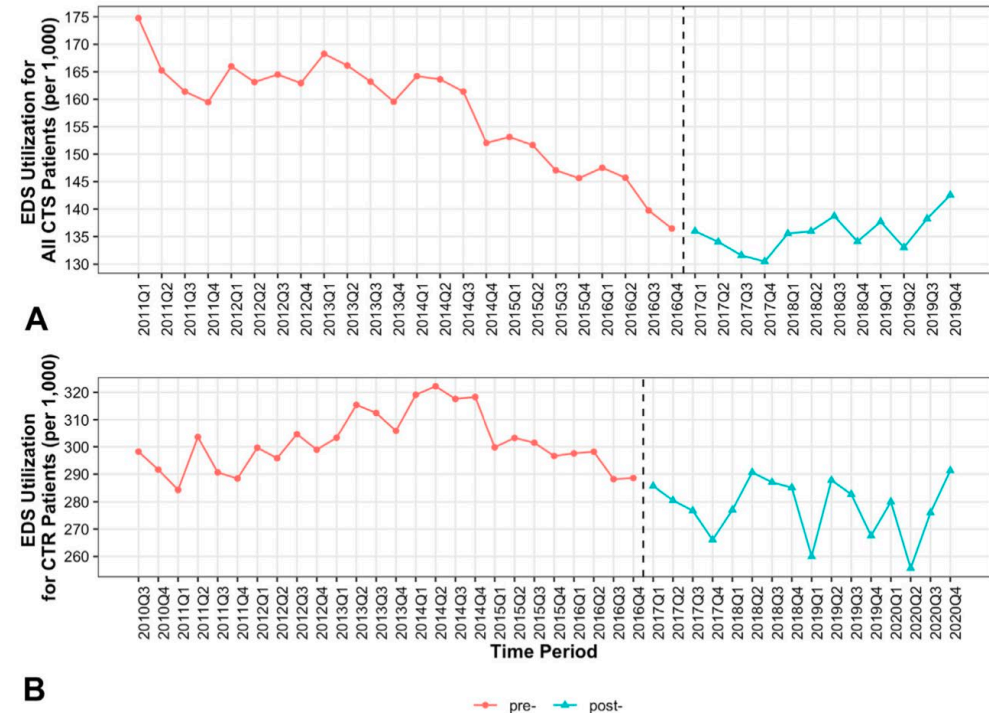
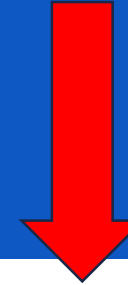
JHS:2023

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2016



**FIGURE 2:** Usage of electrodiagnostic studies **A** for CTS diagnosis or **B** before CTR.

# Who orders EDS?

EDITOR'S CHOICE

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Primary Care:25%

Neurology:13%

Orthopedics:11%

Hand Surgeons:9%

PM&R:6%

Rheum:2%

Other:16%

# Hand Society Survey

EDITOR'S CHOICE

## **Utilization of Diagnostic Testing for Carpal Tunnel Syndrome: A Survey of the American Society for Surgery of the Hand**

Jessica I. Billig, MD, MS,\* Erika D. Sears, MD, MS\*†

JHS, 2022



# ASSH Survey: 770 Hand Surgeons

26%: require EDS prior to office visit

56%: routinely order EDS if not done

**82%** require EDX before an office visit

38%: feel CPG are appropriate

**43%: don't know what the guidelines recommend**

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ORTHOPAEDIC SURGEONS

## Management of Carpal Tunnel Syndrome


**Evidence**

Adopted by  
The American  
February

Endorsed

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Clinical Practice Guideline. Published February 29, 2016.



# Ultrasound

v.

# EDS



# Comparison of Ultrasound and Electrodiagnostic Testing for Diagnosis of Carpal Tunnel Syndrome

## Study Using a Validated Clinical Tool as the Reference Standard

John R. Fowler, MD, Maria Munsch, BS, Rick Tosti, MD, William C. Hagberg, MD, and Joseph E. Imbriglia, MD

*Investigation performed at the Hand & UpperExt Center, Wexford, Pennsylvania*

**Background:** Ultrasound examination is both accurate and cost-effective for the confirmation of a clinical diagnosis of carpal tunnel syndrome. Previous studies have shown electrodiagnostic testing and ultrasound to be similar with regard to sensitivity and specificity. The purpose of this study was to compare the sensitivity and specificity of ultrasound and electrodiagnostic testing by using a validated clinical diagnostic tool as the reference standard.

**Methods:** All consecutive patients referred to an upper-extremity practice for electrodiagnostic testing for any reason over a three-month period were recruited to participate in this study. All patients were evaluated with the use of the Carpal Tunnel Syndrome 6 (CTS-6) clinical diagnostic tool, and a score of  $\geq 12$  was considered positive for carpal tunnel syndrome. A positive finding on ultrasound was considered to be a cross-sectional area of the median nerve, measured just proximal to the level of the pisiform, of  $\geq 10 \text{ mm}^2$ . A positive finding on electrodiagnostic testing was a distal motor latency of  $\geq 4.2 \text{ ms}$  and/or a distal sensory latency of  $\geq 3.2 \text{ ms}$ . Sensitivity, specificity, and accuracy were calculated for ultrasound and electrodiagnostic testing with use of the CTS-6 as the reference standard.

**Results:** With use of the CTS-6 as the reference standard, ultrasound had a sensitivity of 89% and a specificity of 90% in our series of eighty-five patients. Electrodiagnostic testing had a sensitivity of 89% and a specificity of 80%. The positive predictive value of ultrasound was 94% compared with 89% for electrodiagnostic testing. The negative predictive value of ultrasound was 82% compared with 80% for electrodiagnostic testing. Ultrasound was accurate in seventy-six (89%) of the eighty-five cases whereas electrodiagnostic testing was accurate in seventy-three (86%) of the eighty-five cases ( $p = 0.5$ ).

**Conclusions:** While ultrasound will not replace electrodiagnostic testing in complicated or unclear cases, in a select group of patients with a positive CTS-6, ultrasound can be used to confirm the diagnosis of carpal tunnel syndrome with better specificity and equal sensitivity as compared with those of electrodiagnostic testing.

**Level of Evidence:** Diagnostic Level I. See Instructions for Authors for a complete description of levels of evidence.



ELSEVIER



## Ultrasound carpal tunnel syndrome: additional criteria for diagnosis



A.W.H. Ng<sup>a,\*</sup>, J.F. Griffith<sup>a</sup>, R.K.L. Lee<sup>a</sup>, W.L. Tse<sup>b</sup>, C.W.Y. Wong<sup>b</sup>, P.C. Ho<sup>b</sup>

<sup>a</sup>Department of Imaging and Interventional Radiology, Prince of Wales Hospital, The Chinese University of Hong Kong, Hong Kong

<sup>b</sup>Department of Orthopedics and Traumatology, Prince of Wales Hospital, The Chinese University of Hong Kong, Hong Kong

### Surgery Article



HAND  
2020, Vol. 15(1) 64–68  
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DOI: 10.1177/1558947118788642  
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## Ultrasonography Findings in Severe Carpal Tunnel Syndrome

Gideon Nkrumah<sup>1</sup>, Alan R. Blackburn<sup>2</sup>, Robert J. Goitz<sup>2</sup>, and John R. Fowler<sup>2</sup>

### Abstract

**Background:** Increasing severity of carpal tunnel syndrome (CTS), as graded by nerve conduction studies (NCS), has been demonstrated to predict the speed and completeness of recovery after carpal tunnel release (CTR). The purpose of this study is to compare the cross-sectional area (CSA) of the median nerve in patients with severe and nonsevere CTS as defined by NCS. **Methods:** Ultrasound CSA measurements were taken at the carpal tunnel inlet at the level of the pisiform bone by a hand fellowship-trained orthopedic surgeon. Severe CTS on NCS was defined as no response for the distal motor latency (DML) and/or distal sensory latency (DSL). **Results:** A total of 274 wrists were enrolled in the study. The median age was 51 years (range: 18–90 years), and 72.6% of wrists were from female patients. CSA of median nerve and age were comparatively the best predictors of severity using a linear regression model and receiver operator curves. Using cutoff of  $12 \text{ mm}^2$  for severe CTS, the sensitivity and specificity are 37.5% and 81.9%, respectively. **Conclusions:** **Ultrasound can be used to grade severity in younger patients (<65 years) with a CTS-6 score of >12.**

### SCIENTIFIC ARTICLE

## Use of Ultrasound in Patients With Carpal Tunnel Syndrome: A Cost-Effective Solution to Reduce Delays in Surgical Care

Shaquille Charles, MSc,\* Kevin Oommen,\* Joshua Ong,\* John R. Fowler, MD†

# Median Nerve Size

Normal:  $<10 \text{ mm}^2$   
Prominent :  $10-14 \text{ mm}^2$   
Abnormal:  $>14 \text{ mm}^2$

e148(1)

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*Investigation performed at the Hand & UpperExt Center, Wexford, Pennsylvania*

**Background:** Ultrasound examination is both accurate and cost-effective for the confirmation of a clinical diagnosis of carpal tunnel syndrome. Previous studies have shown electrodiagnostic testing and ultrasound to be similar with regard to sensitivity and specificity. The purpose of this study was to compare the sensitivity and specificity of ultrasound and electrodiagnostic testing by using a validated clinical diagnostic tool as the reference standard.

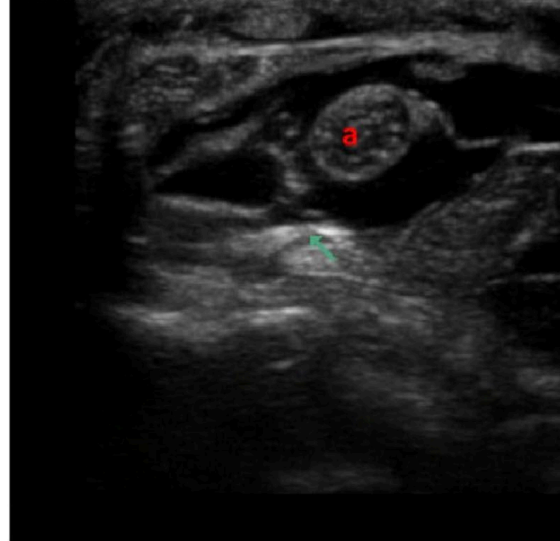
**Methods:** All consecutive patients referred to an upper-extremity practice for electrodiagnostic testing for any reason over a three-month period were recruited to participate in this study. All patients were evaluated with the use of the Carpal Tunnel Syndrome 6 (CTS-6) clinical diagnostic tool, and a score of  $\geq 12$  was considered positive for carpal tunnel syndrome. A positive finding on ultrasound was considered to be a cross-sectional area of the median nerve, measured just proximal to the level of the pisiform, of  $\geq 10 \text{ mm}^2$ . A positive finding on electrodiagnostic testing was a distal motor latency of  $\geq 4.2 \text{ ms}$  and/or a distal sensory latency of  $\geq 3.2 \text{ ms}$ . Sensitivity, specificity, and accuracy were calculated for ultrasound and electrodiagnostic testing with use of the CTS-6 as the reference standard.

**Results:** With use of the CTS-6 as the reference standard, ultrasound had a sensitivity of 89% and a specificity of 90% in our series of eighty-five patients. Electrodiagnostic testing had a sensitivity of 89% and a specificity of 80%. The positive predictive value of ultrasound was 94% compared with 89% for electrodiagnostic testing. The negative predictive value of ultrasound was 82% compared with 80% for electrodiagnostic testing. Ultrasound was accurate in seventy-six (89%) of the eighty-five cases whereas electrodiagnostic testing was accurate in seventy-three (86%) of the eighty-five cases ( $p = 0.5$ ).

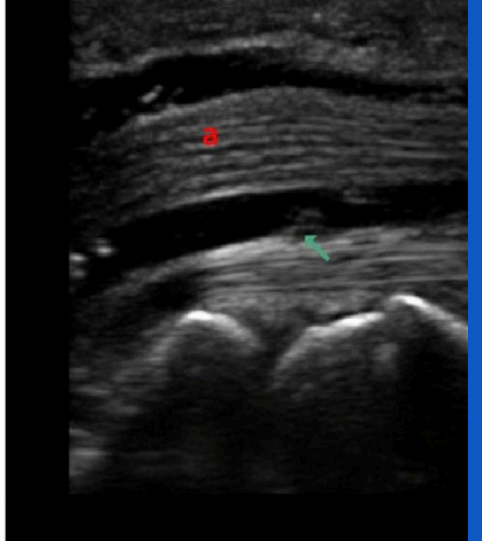
**Conclusions:** While ultrasound will not replace electrodiagnostic testing in complicated or unclear cases, in a select group of patients with a positive CTS-6, ultrasound can be used to confirm the diagnosis of carpal tunnel syndrome with better specificity and equal sensitivity as compared with those of electrodiagnostic testing.

**Level of Evidence:** Diagnostic Level I. See Instructions for Authors for a complete description of levels of evidence.

RIGHT CARPAL TUNNEL



RIGHT CARPAL TUNNEL





<b>TABLE III Outcomes</b>		
	<b>Ultrasound*</b>	<b>Electrodiagnostic Testing*</b>
Sensitivity (%)	89 (77-95)	89 (77-95)
Specificity (%)	90 (72-97)	80 (61-92)
Positive predictive value (%)	94 (83-98)	89 (71-95)
Negative predictive value (%)	82 (64-92)	80 (61-92)

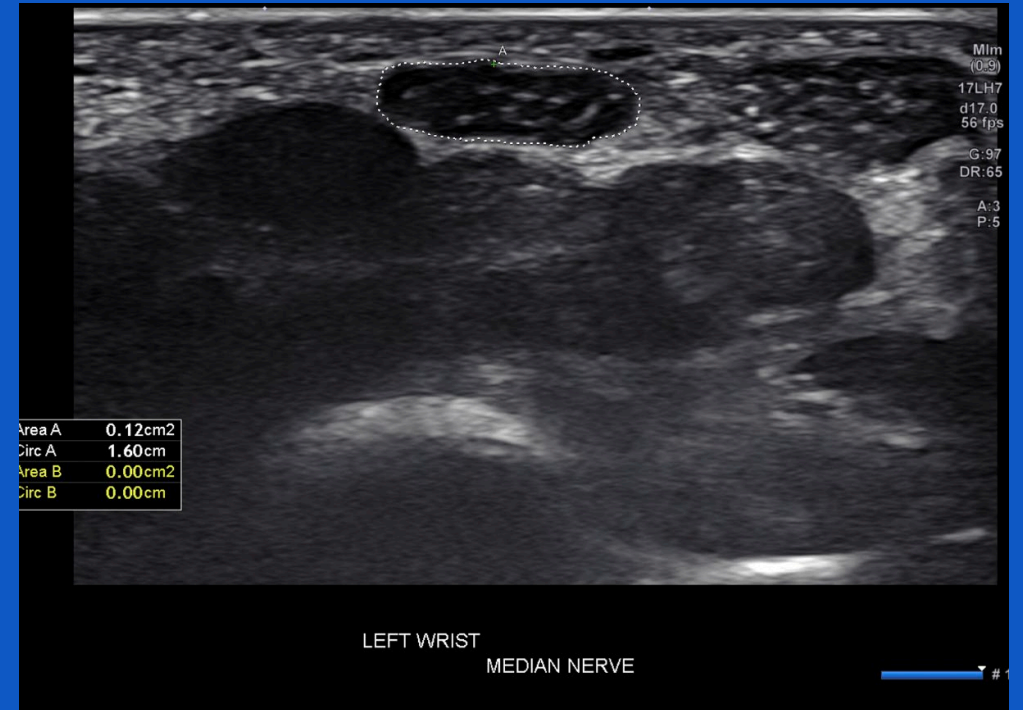
\*The 95% confidence interval is given in parentheses.

# Ultrasound and a positive CTS-6

detected because of the small sample size. The difference, however, is not likely clinically relevant.

Despite a general lack of utilization of ultrasound for the confirmation of a clinical diagnosis of carpal tunnel syndrome, there is a growing volume of literature in support of its use<sup>2,4,7-9</sup>. The findings of the current study similarly demonstrate that **ultrasound has a high sensitivity, specificity, and accuracy in a specific group of patients with a positive CTS-6**. ■

NOTE: The authors thank Jay Irrgang, PhD, for his statistical expertise in the design and analysis of this study.



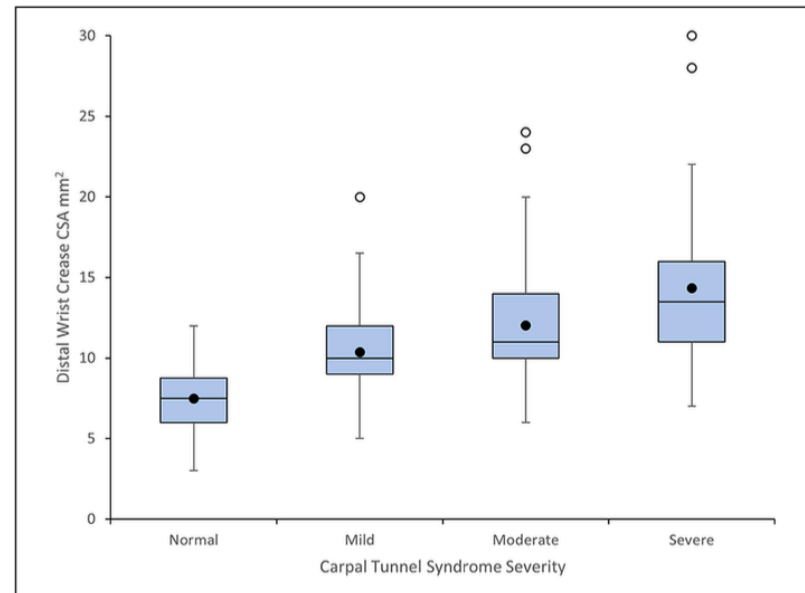
Surgery Article

## Ultrasound Measurements of the Median Nerve at the Distal Wrist Crease Correlate With Electrodiagnostic Studies

Nicholas F. Aloï<sup>1</sup>, Landon M. Cluts<sup>1</sup>, and John R. Fowler<sup>2</sup>



HAND  
2023, Vol. 18(5) 765–771  
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**Figure 2.** Distal wrist crease CSA demonstrates a linear relationship with electrodiagnostic rating of carpal tunnel syndrome severity.

Note. Lower bounds represent  $Q1 - IQR$ . Upper bounds represent  $Q3 + 1.5IQR$ . Black dots represent the mean CSA of each group. Unfilled circles represent the outliers for each group. CSA = cross-sectional area; IQR = interquartile range.



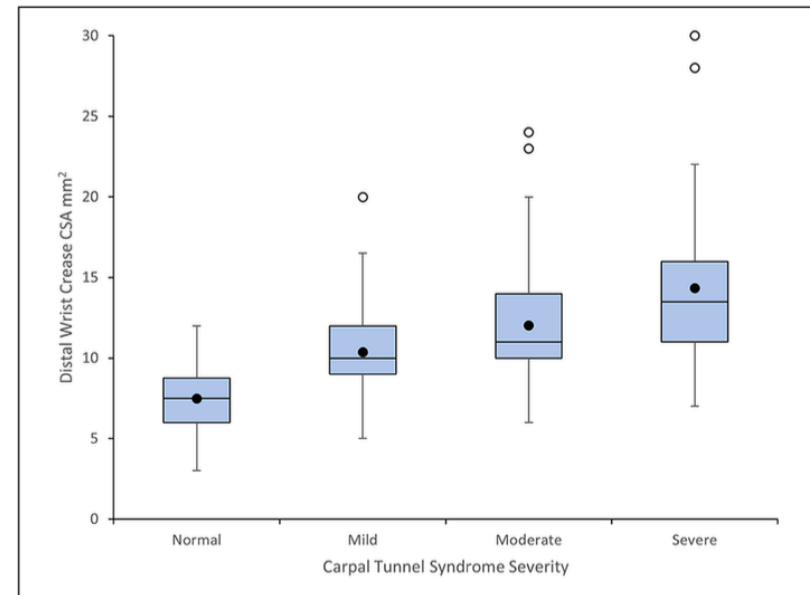
# Ultrasound CSA correlates with EDS Severity

Normal  $<10 \text{ mm}^2$

Mild:  $10\text{-}12 \text{ mm}^2$

Moderate:  $12\text{-}14 \text{ mm}^2$

Severe:  $\geq 14 \text{ mm}^2$



**Figure 2.** Distal wrist crease CSA demonstrates a linear relationship with electrodiagnostic rating of carpal tunnel syndrome severity.

Note. Lower bounds represent  $Q1 - IQR$ . Upper bounds represent  $Q3 + 1.5IQR$ . Black dots represent the mean CSA of each group. Unfilled circles represent the outliers for each group. CSA = cross-sectional area; IQR = interquartile range.

# Ultrasound v. EDS

SCIENTIFIC ARTICLE

## Use of Ultrasound in Patients With Carpal Tunnel Syndrome: A Cost-Effective Solution to Reduce Delays in Surgical Care

Shaquille Charles, MSc,\* Kevin Oommen,\* Joshua Ong,\* John R. Fowler, MD†

1.8 fewer medical visits

Surgery: **3-4 weeks earlier**





# Future Developments?



Original Research

## Ultra-Minimally Invasive Ultrasound-Guided Carpal Tunnel Release

A Randomized Clinical Trial

Jose Manuel Rojo-Manaute MD, PhD ✉

Alberto Capa-Grasa MD, PhD,

Francisco Chana-Rodríguez MD, PhD,

Ruben Perez-Mañanes MD, PhD,

Guillermo Rodriguez-Maruri MD,

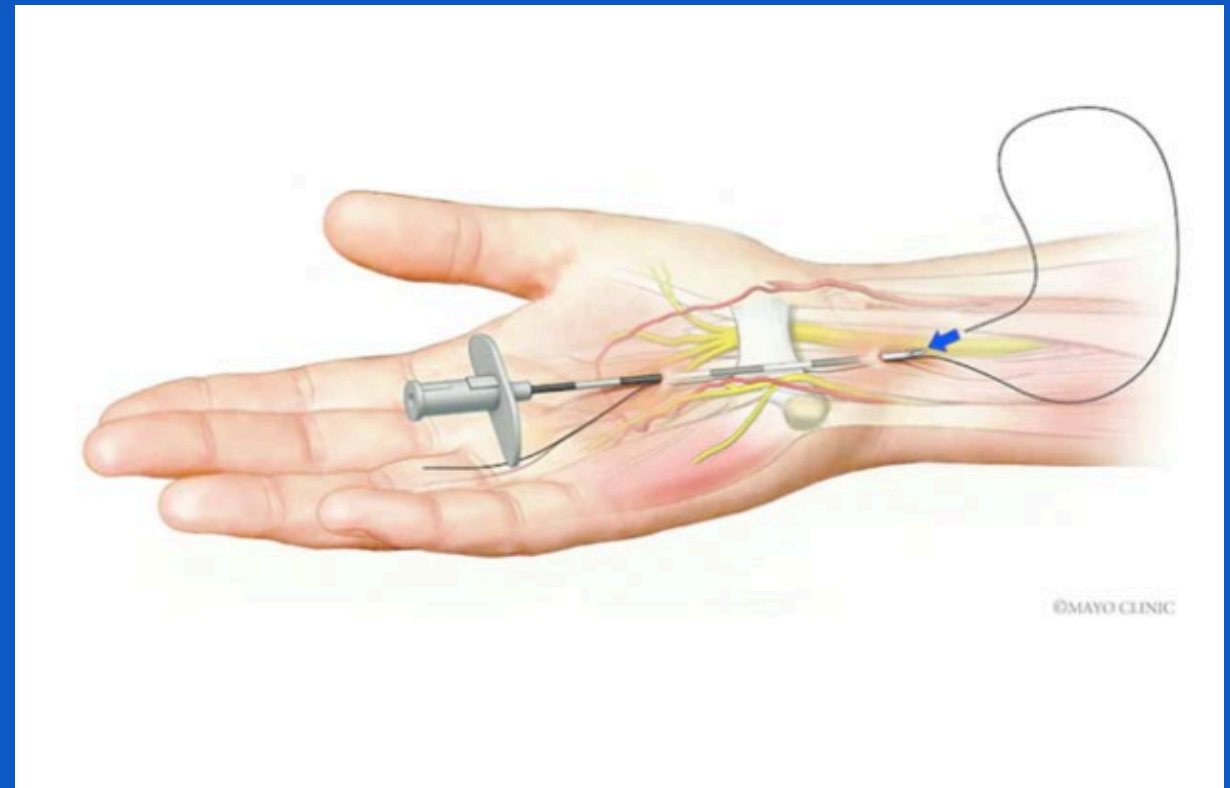
Pablo Sanz-Ruiz MD, PhD, Jorge Muñoz-Ledesma MD,

Mikel Aburto-Bernardo MD,

Luis Esparragoza-Cabrera MD,

Miguel del Cerro-Gutiérrez MD, PhD,

Javier Vaquero-Martín MD, PhD



# Improve Pt. Care



# The Value Equation

## Value-Based Health Care

Based on the research of Professor Michael Porter, **Value-Based Health Care** is a framework for restructuring health care systems around the globe with the overarching goal of value for patients.

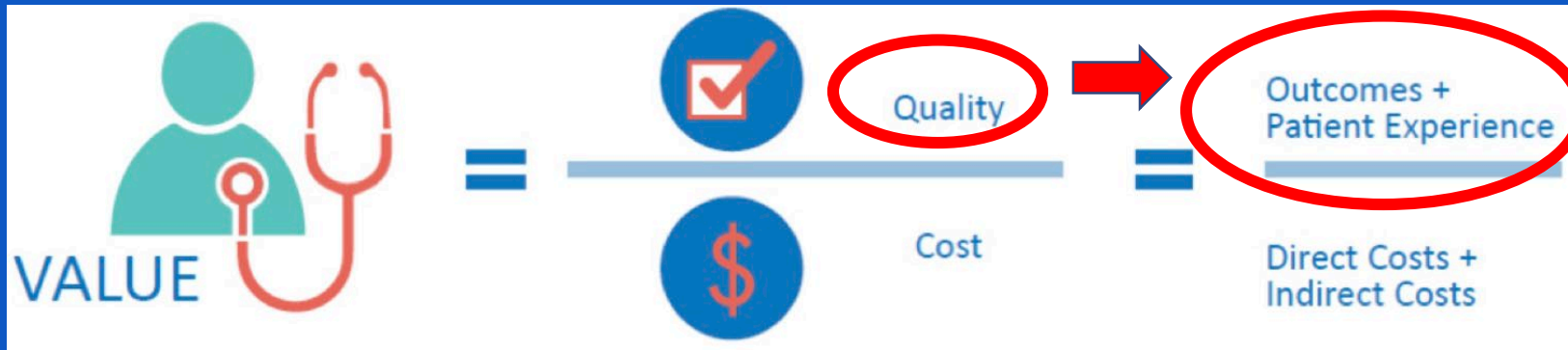


Michael Porter

## The Healthcare Value Equation

$$\text{Value} = \frac{\text{Quality}}{\text{Cost}}$$

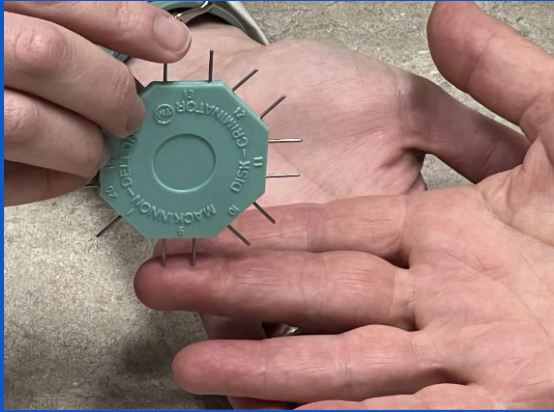








# CTS-6 Physical Exam



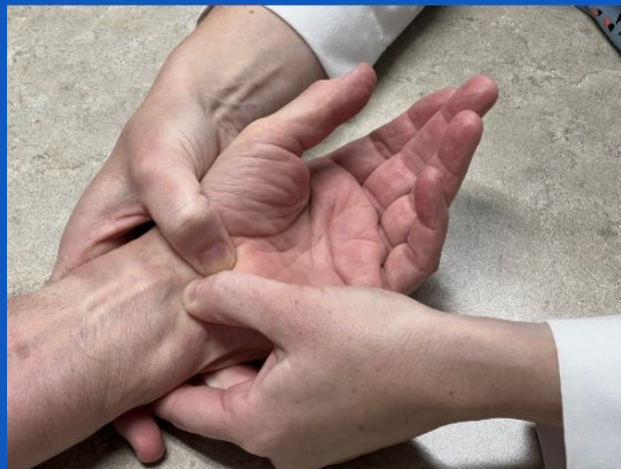
Sensation



Tinel's



Phalen's



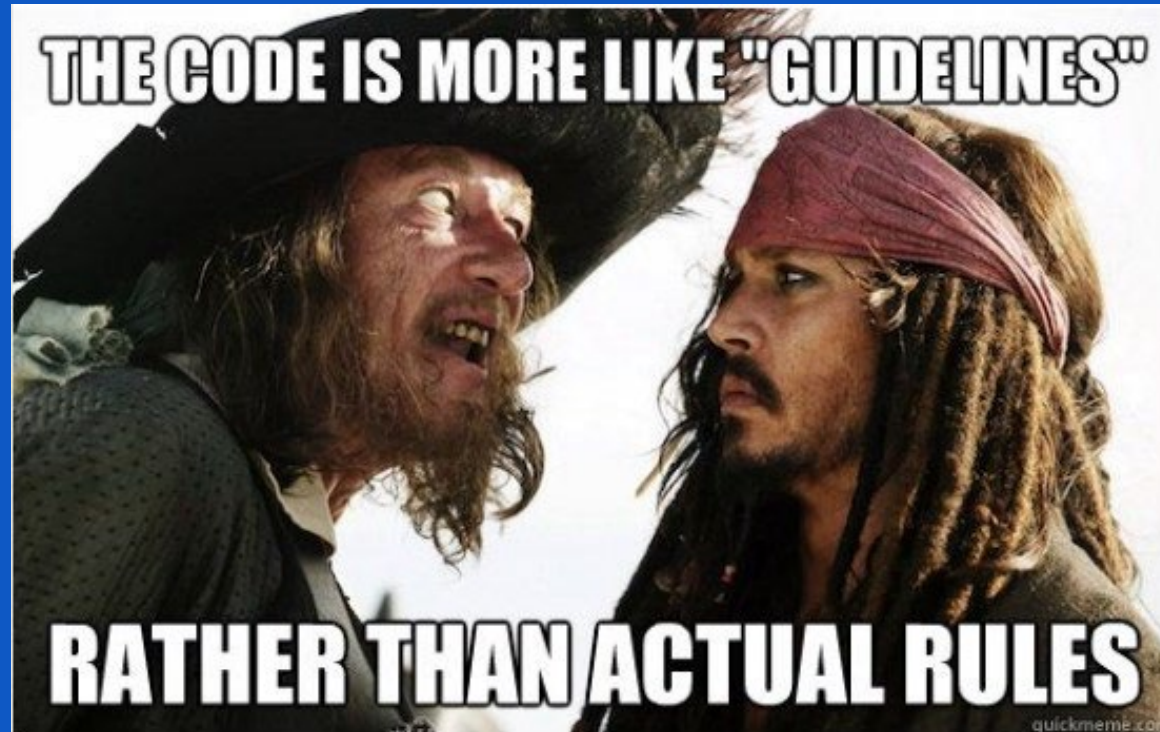
Durkan's



Motor Exam



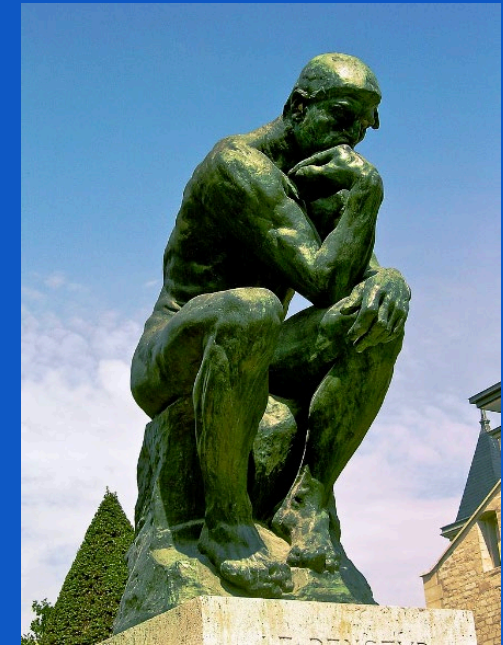
# Rules v. Guidelines?



# My thoughts

Classic CTS story and exam: CTS-6

If you do EDS: **NCV** > EMG



Category	Test Name	Score
History & Symptoms	<b>Numbness in Median Nerve Distribution</b> (Sensory symptoms are mostly in thumb, index, middle, and/or ring fingers)	3.5
	<b>Nocturnal Numbness</b> (Symptoms are prominent during sleep; numbness wakes patient from sleep)	4
Physical Examination	<b>Thenar Atrophy and/or Weakness</b> (Bulk of thenar area is reduced or manual motor testing shows strength of grade 4 or less)	5
	<b>Positive Phalen Test</b> (Wrist flexion reproduces or worsens symptoms of numbness in median nerve territory)	5
	<b>Loss of 2-Point Discrimination</b> (Failure to discriminate two points held 5mm or less apart, in the median nerve innervated digits, is a positive test suggestive of CTS)	4.5
	<b>Positive Tinel Sign</b> (Light tapping over the median nerve at the level of the carpal tunnel causing radiating paraesthesiae into the median nerve innervated digits [not proximally] is a positive test)	4



# EDS:EMG

Cervical Disc disease  
? Neuropathy

Diabetes

ALS

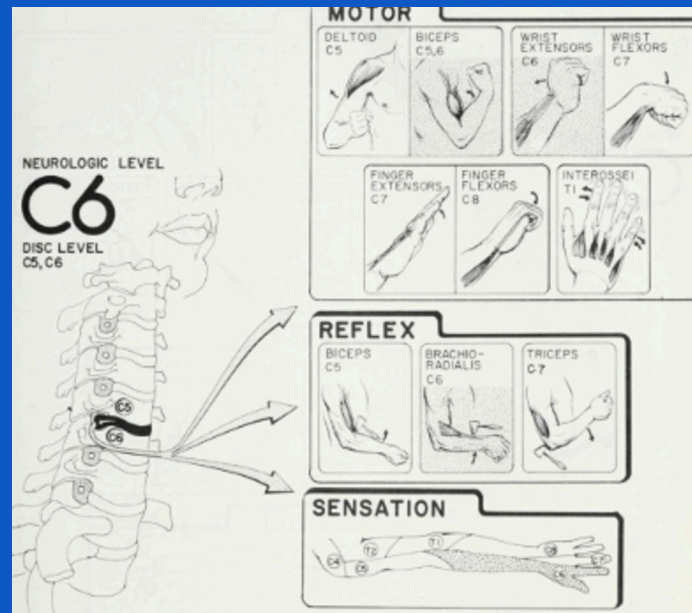
Nerve Injury

Recurrent nerve compression

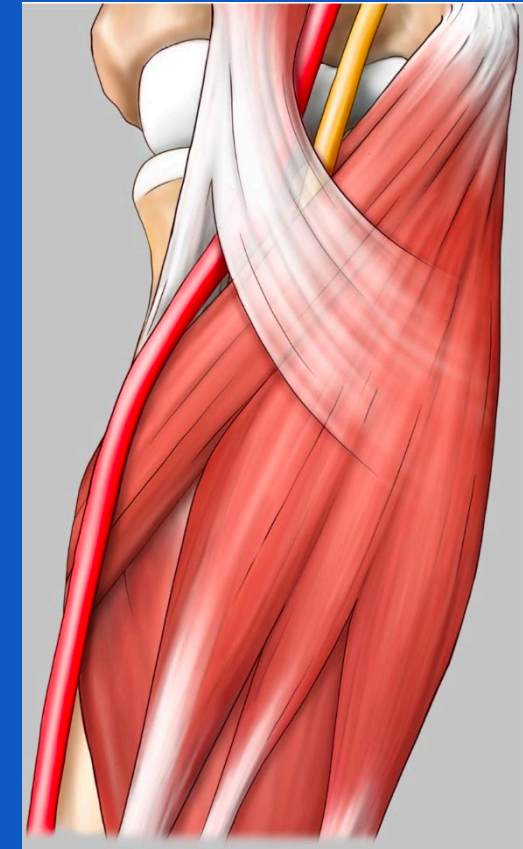
Failed surgery

Unclear clinical picture

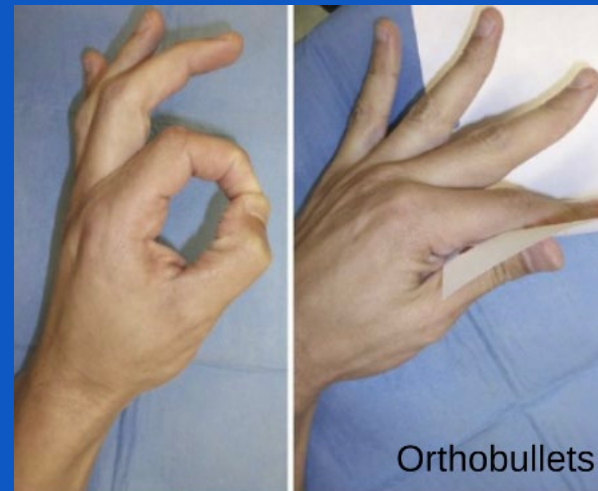
AIN Palsy



Hoppenfeld



Hand Clinics, 2022



Orthobullets

# Conclusions

CTS: most common neuropathy

A **CLINICAL** diagnosis

Role of CTS-6

EDS testing:

? Added expense

Delay in surgery

? Ultrasound + CTS-6

## CTS-6

### *A clinical aid for diagnosing carpal tunnel syndrome*

#### **Symptoms and history**

Numbness predominately or exclusively in median nerve territory **3.5**  
*Sensory symptoms are mostly in the thumb, index, middle and/or ring fingers*

Nocturnal numbness **4**  
*Symptoms are prominent when patient sleeps; numbness wakes patient from sleep*

#### **Physical examination**

Thenar atrophy and/or weakness **5**  
*The bulk of the thenar area is reduced or manual motor testing shows strength of grade 4 or less*

Positive Phalen test **5**  
*Flexion of the wrist reproduces or worsens symptoms of numbness in the median nerve territory*

Loss of 2 point discrimination **4.5**  
*A failure to discriminate two points held 5mm or less apart from one another, in the median nerve innervated digits, is a positive test suggestive of CTS*

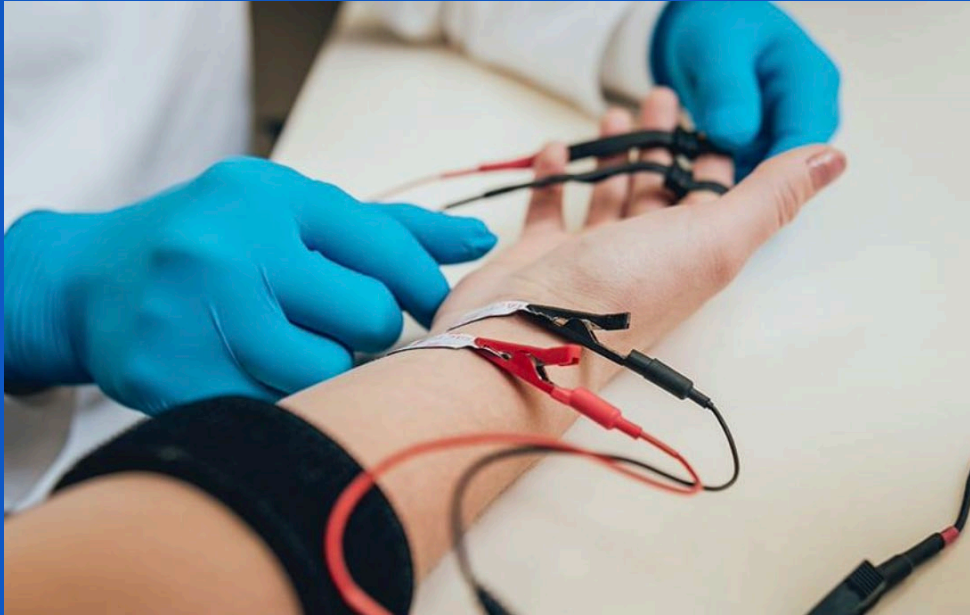
Positive Tinel sign **4**  
*Light tapping over the median nerve at the level of the carpal tunnel causing radiating paraesthesiae into the median nerve innervated digits (not proximally) is a positive test*

# I WANT YOU



CTS-6









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