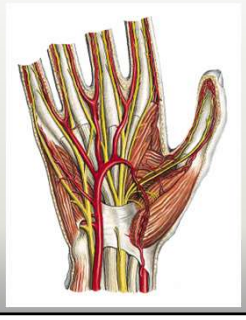
# MEDIAN MONONEUROPATHY AT THE WRIST, MMW

Erik Stålberg

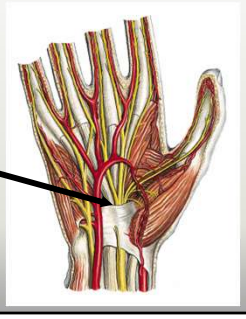
## ANATOMY



Putz and Pabst (ed) Sobotta. Atlas of Human Anatomy. 20 th edition. Urban & Scwarzenberg

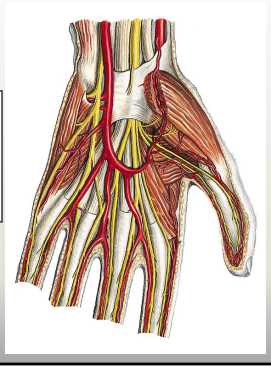
## ANATOMY

Main entrapment site



Putz and Pabst (ed) Sobotta. Atlas of Human Anatomy. 20 th edition. Urban & Scwarzenberg

## DAMAGE TO THE SENSORY PALMAR BRACHES OF MEDIAN NERVE



Putz and Pabst (ed) Sobotta. Atlas of Human Anatomy. 20 th edition. Urban & Scwarzenberg

**Carpal tunnel syndrome, CTS**
Constellation of symptoms due to median nerve compression in the carpal canal

**Median mononeuropathy at the wrist, MMW**
The electrodiagnostic signs of median nerve involvement in the carpal canal



## Diagnosis

- Symptoms
- Clinical findings
- Neurophysiological tests
- Imaging studies
  - CT
  - MRI
  - Ultrasound

## EDX in CTS: pathophysiology

Test motor and sensory Median nerve for :

Demyelination (slowing)

Axonal degeneration (low ampl+ denerv)

Conduction block (prox-dist stim)

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## Definitions of CTS

(Luca Padua)

- Very slight only compared with uln or rad
- Slight only sensory abnormalies
- Moderate sens +motor abnormal
- Pronounced no sens responses
- Very severe no sens or motor responses

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## Most commonly used EDX in CTS

- **Motor testing**
  - APB vs ADM
  - Lumbrical I vs IOD II
- **Sensory testing**
  - Orthodromic
    - From digits to wrist (med, uln)
    - From palm to wrist (med, uln)
    - From dig III vs palm to wrist
  - Antidromic testing
    - From wrist vs palm to dig III, 14-7
    - From wrist to thumb vs rad to thumb

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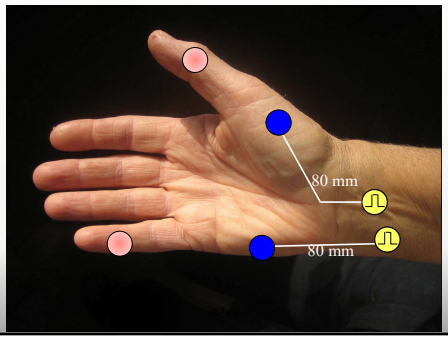
## Motor: APB,ADM




## Stimulation in the palm

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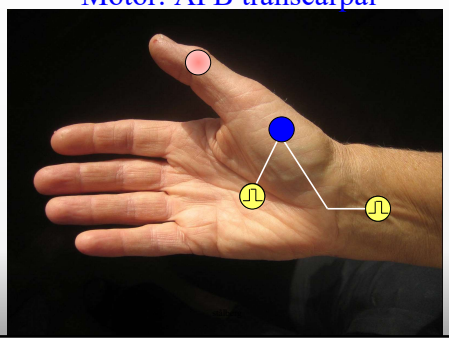
## Motor: APB transcarpal



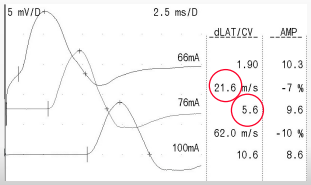
## CTS, motor
## (normal amplitude/increased distal lat. at wrist)

Stimulation site:

palm

wrist

above elbow




Demyelination, no axonal loss

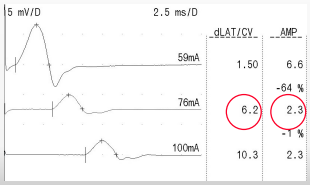
## CTS, motor
## (low amplitude/increased distal lat. at wrist )

Stimulation site:

palm

wrist

above elbow




Demyelination + conduction block

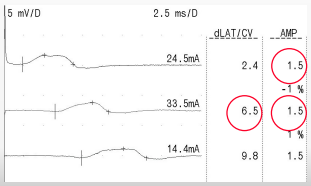
## CTS, motor
## (low amplitude/increased distal lat. at wrist )

Stimulation site:

palm

wrist

above elbow

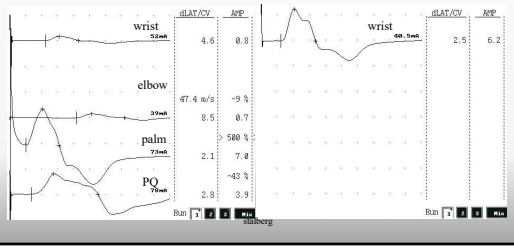



Demyelination +severe axonal loss

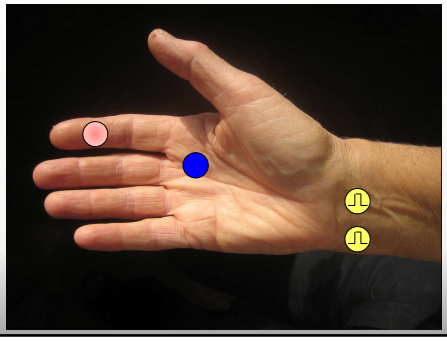
## Motor studies in CTS - conduction block

Median

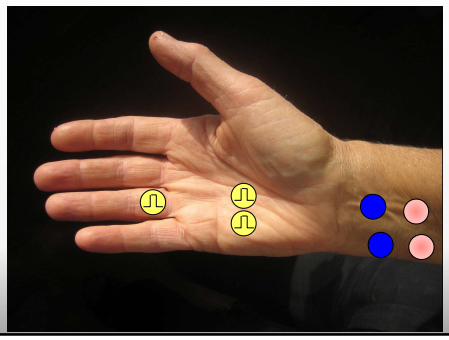
Ulnar



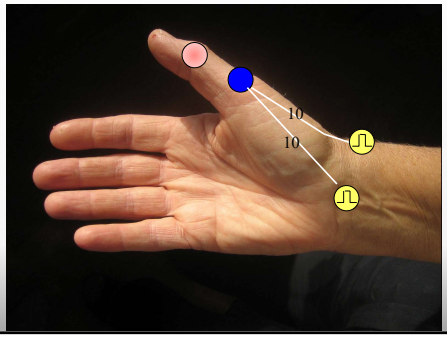

## Motor: Lumbr I-IOD II



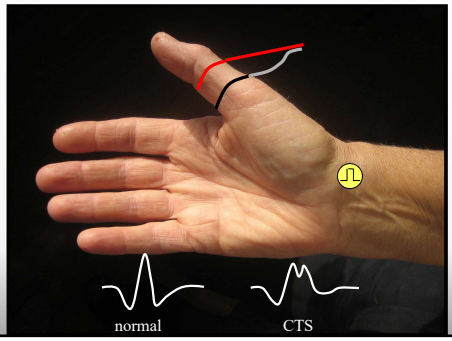
Sensory Median and Ulnar: orthodromic dig IV and mixed from palm



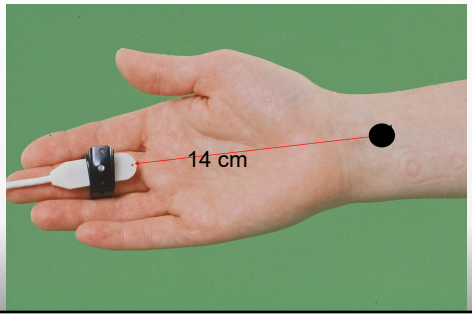
## Sensory antidromic med-rad



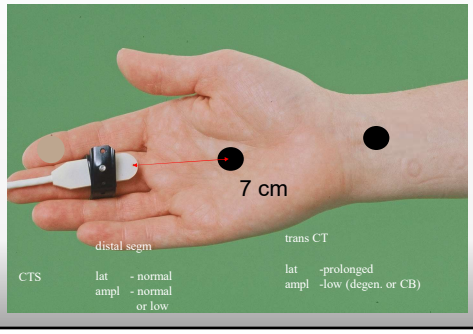

## Sensory antidromic med+rad, Bactrian sign




## Median nerve - antidromic




## Median nerve - antidromic




## Bilat CTS

More LEFT
Antidromic method

Palm-dig III

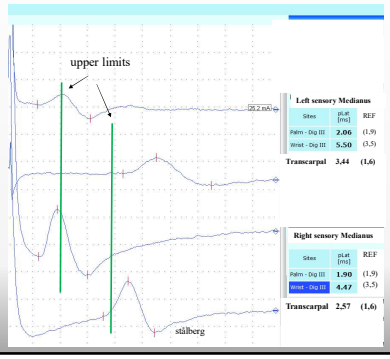
Left

Wrist-dig III

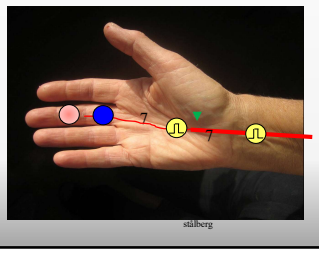
Palm-dig III

Right

Wrist-dig III




## CTS; why has segment palm-dig III low ampl?




Because of axonal degeneration

## Reference values14-7

lat measured to neg peak
ampl measured acc to Uppsala method

| Segment | 95% limit | source |
|---|---|---|
| 140 mm: | ≤3.5 ms | Örebro |
| | ( 3.7 ms | Johnson) |
| palm-digIII | ≤ 1.9 ms | Örebro |
| trans- CT | ≤ 1.6 ms | Dumitru |
| Sens ampl palm | 61+-25 (limit >10 uV) | |

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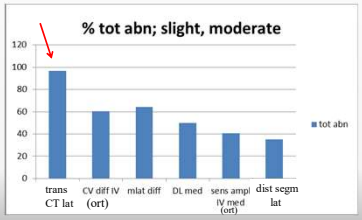
## Comparing antidromic 14-7 (trans) with other CTS parameters




Ahlséen, Åkerlund, Stålberg 2016, unpublished

## Practical approach, alternative:
## Sensory
## Combined Sensory Index, CSI

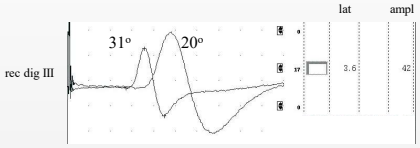
Robinson, Micklesen, Wang, M&N 21:1998, 1166-1171

Sum of latency differences:

med-uln diff palm to wrist 8 cm (orthodromic)
med-uln diff from wrist to dig IV, 14 cm (antidromic)
med-rad diff from wrist to thumb, (antidromic)

Upper limit; ≥ 1.0 ms

## Effect of cold digits, warm wrist. Stim wrist, Rec dig III ANTIDROMT




Rec site is cold.
Increase in ampl due to prolonged opening time of ion channels.
Increase in latency is due to slow cond along digit and distal segment

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## 14-7 antidromic method

**Normal** — Unlikely CTS

**Abnormal** — CTS

**No sens response** — Must do **Ortodr. Sensory** dig IV (uln ampl, to wrist.) + pnp

In addition: perform motor testing to APB and ADM (latency and ampl)

AAEM M&N 2002

## Pooled sensitivity and specificity of EDX techniques for CTS

| | Pooled sensitivity | Pooled specificity |
|---|---|---|
| A Median sensory and mixed nerve conduction: wrist and palm segment compared to forearm or digit segment | 0.85 | 0.98 |
| B Comparison of median and ulnar sensory conduction between wrist and ring finger | 0.85 | 0.97 |
| C Median sensory and mixed nerve conduction between wrist and palm | 0.74 | 0.97 |
| D Comparison of median and ulnar mixed nerve conduction between wrist and palm | 0.71 | 0.97 |
| E Median motor nerve conduction between wrist and palm | 0.69 | 0.98 |
| F Comparison of median and radial sensory conduction between wrist and Thumb | 0.65 | 0.99 |
| G Median sensory nerve conduction between wrist and digit | 0.65 | 0.98 |
| H Median motor nerve distal latency | 0.63 | 0.98 |
| I Median motor nerve terminal latency index | 0.62 | 0.94 |
| J Comparison of median motor nerve distal latency (second lumbrical) to the ulnar motor nerve distal latency (second interosseI) | 0.56 | 0.98 |
| K Sympathetic skin response | 0.04 | 0.52 |

AAEM M&N 2002

## CTS standards, guidelines, options

Median sensory NCS across the wrist (13 cm to 14 cm) (Technique G). If abnormal, compare median sensory NCS to sensory NCS of one other adjacent sensory nerve in the symptomatic limb (Standard).

If the initial median sensory NCS across the wrist (distance greater than 8 cm) is normal, one of the following studies is recommended:

- comparison of median sensory or mixed nerve conduction across the wrist over a short (7 cm to 8 cm) conduction distance (Technique C) with ulnar sensory nerve conduction across the wrist over the same short (7 cm to 8 cm) conduction distance (Technique D) (Standard), or
- comparison of median sensory conduction across the wrist with radial or ulnar sensory conduction across the wrist in the same limb (Techniques B and F) (Standard), or
- comparison of median sensory or mixed nerve conduction through the carpal tunnel to sensory or mixed NCSs of proximal (fore arm) or distal (digit) segments of the median nerve in the same limb (Technique A) (Standard).

Motor NCS of the median nerve recording from the thenar muscle (Technique H) and of one other nerve in the symptomatic limb to include measurement of distal latency (Guideline).

Supplementary NCS:

- comparison of the median motor nerve distal latency (second lumbrical) to the ulnar motor nerve distal latency (second interosse) (Technique J);
- median motor terminal latency index (Technique I);
- median motor nerve conduction between wrist and palm (Technique E);
- median motor nerve compound muscle action potential (CMAP) wrist-to-palm amplitude ratio to detect conduction block;
- median sensory nerve action potential (SNAP) wrist-to-palm amplitude ratio to detect conduction block;
- short segment (1 cm) incremental median sensory nerve conduction across the carpal tunnel (Option).

Needle electromyography (EMG) of a sample of muscles innervated by the C5 to T1 spinal roots, including a thenar muscle innervated by the median nerve of the symptomatic limb (Option).

## Questions, (FAQ) regarding 14-7 antidromic

SENSORY TESTING

| | |
|---|---|
| What about radiculopathy | 14-7 test focused on CTS. Root does not give abn TClat |
| Is it not good to have one more parameter | Has not been shown (should occur for stat reasons) |
| Small hands do not allow 14-7 | Then make 12-6 cm |
| Why measure the distal amplitude | Only way to assess nerve degeneration |
| Bilat test with unilat symptoms? | Yes, often subclinical. As info to pat |
| If dist segment is slow (good ampl), what to do | Check temp. May be neuropathy, test ulnar sens + F |

MOTOR TESTING

| | |
|---|---|
| If motor study is abn and sens is normal, what to do | Reconsider CTS as diagnosis (TOS anomalous inn) |
| When to use lumb/inteross | When APB/ADM cannot be used |
| When do we test palm motor stim | When CMAP to APB is very low |
| Anything more to look for | Long dist lat (>7ms), think antiMAG |
| | Comment on presence of sens "pre-potential" post op |