

EMG, Surgery and Carpal Tunnel Syndrome

Ultra EMG 2013
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Improving People's Lives
through innovations in personalized health care



Wexner
Medical
Center

Objectives

- Median nerve recovery after surgery
 - EDX
 - Symptoms
- Surgical complications
 - Early
 - Late
 - EDX post-op
- Surgical Techniques (a bit)



CTS Cochrane Review



- Randomized trials comparing surgery to non-surgical tx favor surgery at 1 year follow-up.
- More complications in the surgery group.
- “Risk” of second surgery is 4%.
- Not enough trial data to select treatment option.

Verdugo RJ, et al. Surgical vs non-surgical...
Cochrane Database Syst Rev 2008 Oct 4;(4):CD001552



CTS Steroid Injection-Outcome



- Improvement in median sensory latency (mean)
- Improvement in median motor amplitude (mean)
- 25% had normal EDX after Tx
- Maintained results for 6 months

Hagebeuk, E. Clinical and electrophysiological follow-up after local steroid...
CTS. *Clinical Neurophysiology* 2004;115:1464.



Post-op CTS (n=30) OSU Outcome 1968 in Severe CTS

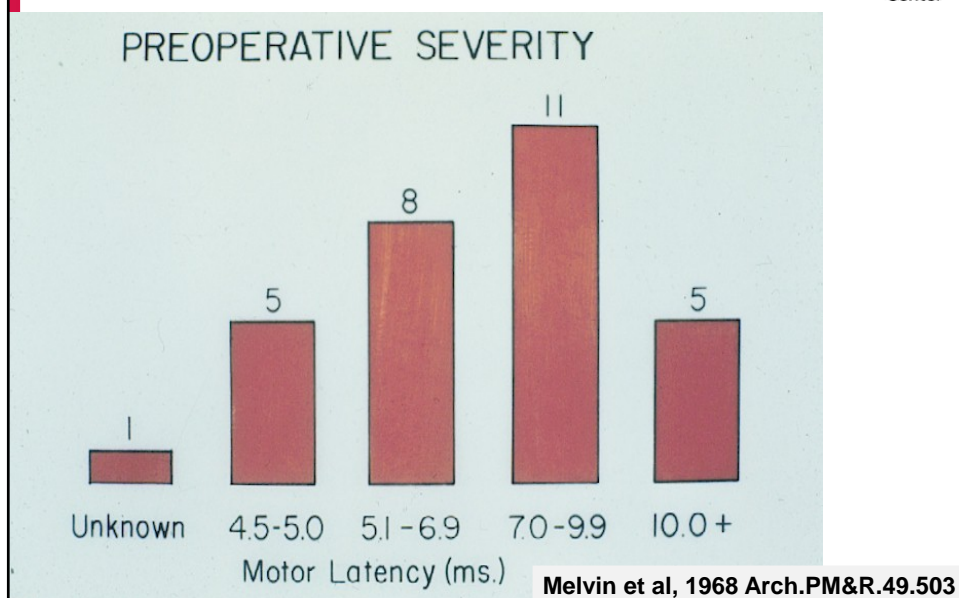


- Immediate improvement - 26
- Limited improvement – 4 (13%)
- Re-operation performed - 2
 - Then – immediate relief
- Note: Up to 1/3 still have EDx abnormalities


Melvin, et al, 1968 Arch.PM&R.49.503 (at OSU)




How Severe were the Cases of CTS? Based upon Pre-Op NCS



Post op CTS 1 yr (n=30)




Symptoms –		Signs –	
none	18	normal	13
tingling	6	sensory deficit	9
numbness	3	weakness	8
aching	2	Tinel +	6
weakness	2	tender scar	2
'asleep'	1	atrophy	2



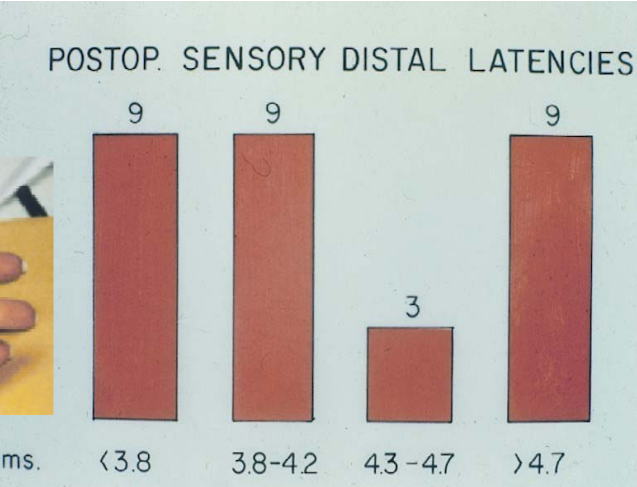
Melvin et al, 1968 Arch.PM&R.49.503

Post-Op Testing at 1 yr Shows Sensory Recovery




- But NOT to Normal

POSTOP. SENSORY DISTAL LATENCIES



Latency Range (ms)	Number of Patients
< 3.8	9
3.8-4.2	9
4.3-4.7	3
> 4.7	9

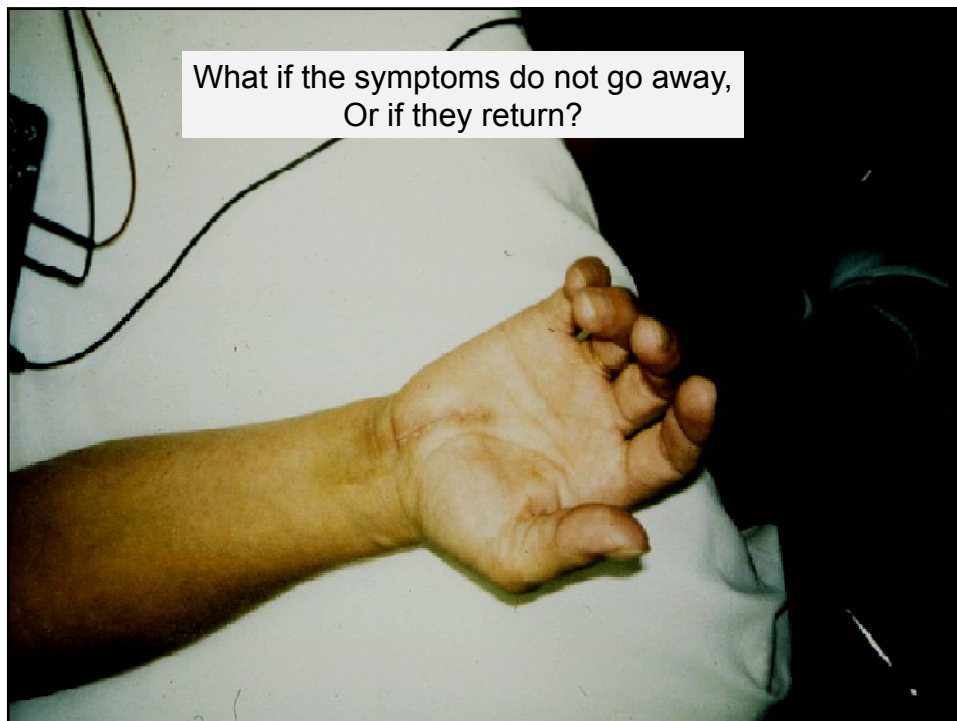
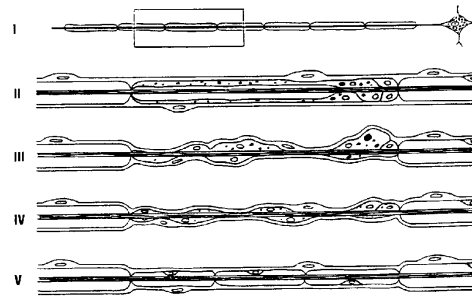


Melvin et al, 1968
Arch.PM&R.49.503

Segmental Demyelination and Remyelination



- Myelin repair is not to normal thickness
- Breakdown of Myelin is followed by proliferation of Schwann cells
- Repair results in several shorter and thinner myelin segments
- Resulting in slower NCV





Recurrent and unrelieved CTS



- | | |
|--|---|
| <ul style="list-style-type: none"> ▪ CASES ▪ 200 secondary operations, 200 patients over 2 years. ▪ 198 had original operations elsewhere. | <ul style="list-style-type: none"> ▪ FINDINGS ▪ 54% incomplete release (distal) ▪ 23% constricting scar and tethering ▪ 8% nerve scarring ▪ 6.5% nerve injury-iatrogenic ▪ 2% benign tumors ▪ 7% no reason ID'd |
|--|---|

Stütz. J Hand Surgery (British), 2006; 31B 1: 68–71



Median Nerve tethering in Post-op CTS



Tethered in scar

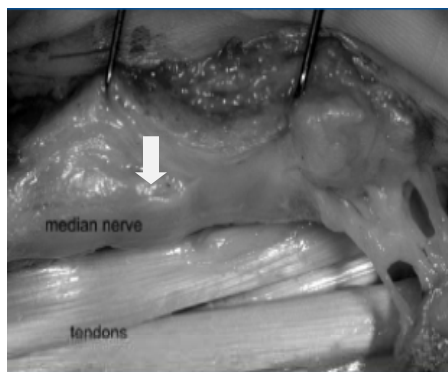


FIGURE 1. Severe tethering of the median nerve resulted from scar adhesion. The nerve is enveloped in scar tissue.

Nerve after release

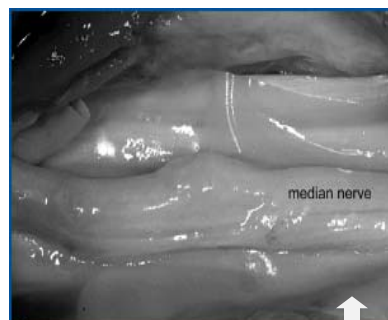


FIGURE 2. Result after external neurolysis of the median nerve.

Stütz. J OPERATIVE NEUROSURGERY
2008;62:ONS194



Recurrent and unrelieved CTS



- 13 iatrogenic nerve injuries
- 7 occurred in 30 endoscopic surg.
- 6 were from 170 open procedures
- Other complications occurred equally in endo vs. open cases



Stütz. J Hand Surgery (British), 2006; 31B 1: 68–71



Iatrogenic Nerve Injury in CTS



- 6 Median Nerve
 - 4 partial
 - All endoscopic
- 3 Motor branch
 - (“Recurrent”)
 - 2 open
- 3 Palmar branch
 - All open



Stütz. J Hand Surgery (British), 2006; 31B 1: 68–71



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Recurrent and unrelieved CTS



- Presentations (time to 2nd surgery)
- Early
 - Incomplete release (distal edge most common)-most had no relief, some lasted as long as 75 d before Sx's-0 to 75d
 - Injury-35d to 1.5y
- Mid-
 - nerve fibrosis 28d to 3yr
 - Masses-1y to 2y
- Late-adherent scar-48d to 12 yr

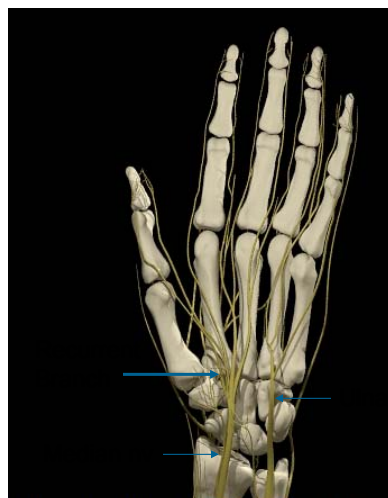
Stütz. J Hand Surgery (British), 2006; 31B 1: 68–71



The Challenge of NCS Evaluation of Median Motor Recurrent Thenar Branch



Interactive Hand 2000 © 2001 Primal Pictures Ltd



Interactive Hand 2000 © 2001 Primal Pictures Ltd

Stimulation Proximal & Distal to Carpal Tunnel



- Distal Motor fibers
 - Wrist stimulation first at 8 cm
 - Recurrent branch to thenar in palm
 - Normal Amplitude increases by less than 20% compared with wrist stimulation
 - **CAUTION** – Shape of CMAP must be similar in both stimulation sites. With increase stimulation intensity Deep Palmar Ulnar nerve can be activated.
 - Watch the muscle movement in the hand while stimulating.

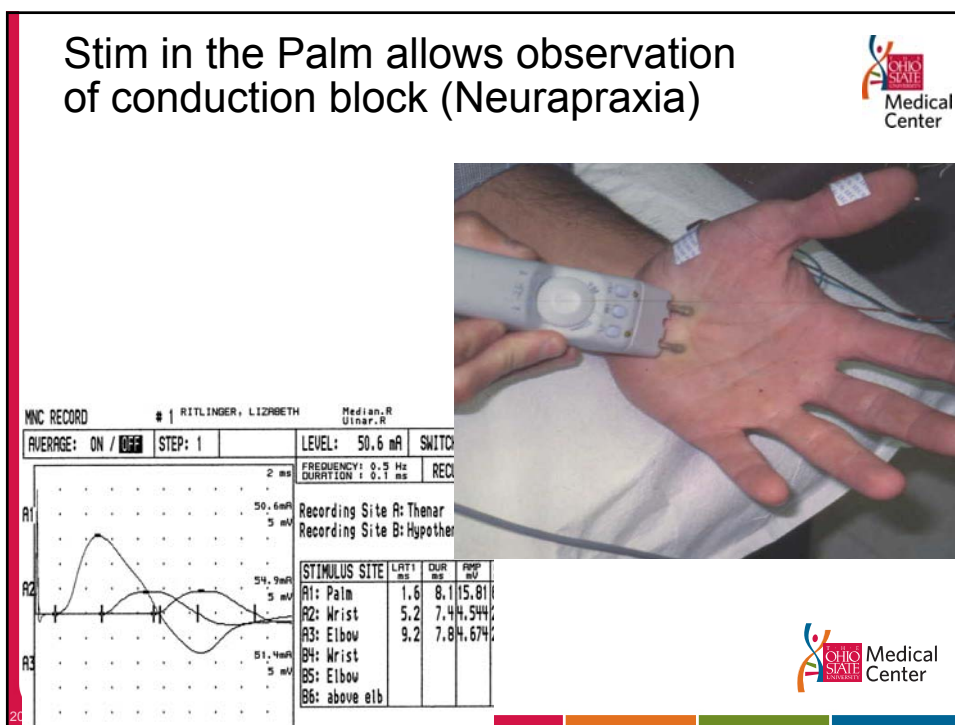


Stimulation Proximal & Distal to Carpal Tunnel



Stimulus point for recurrent
Branch of median nerve
Thenar crease
Ring finger touch

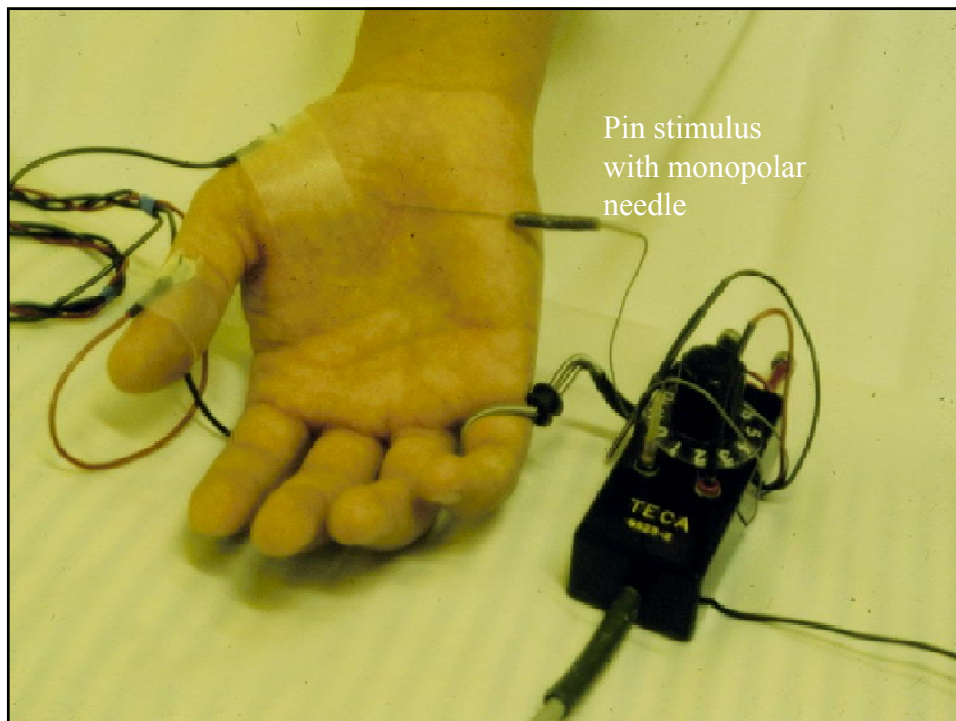
Stim in the Palm allows observation of conduction block (Neurapraxia)



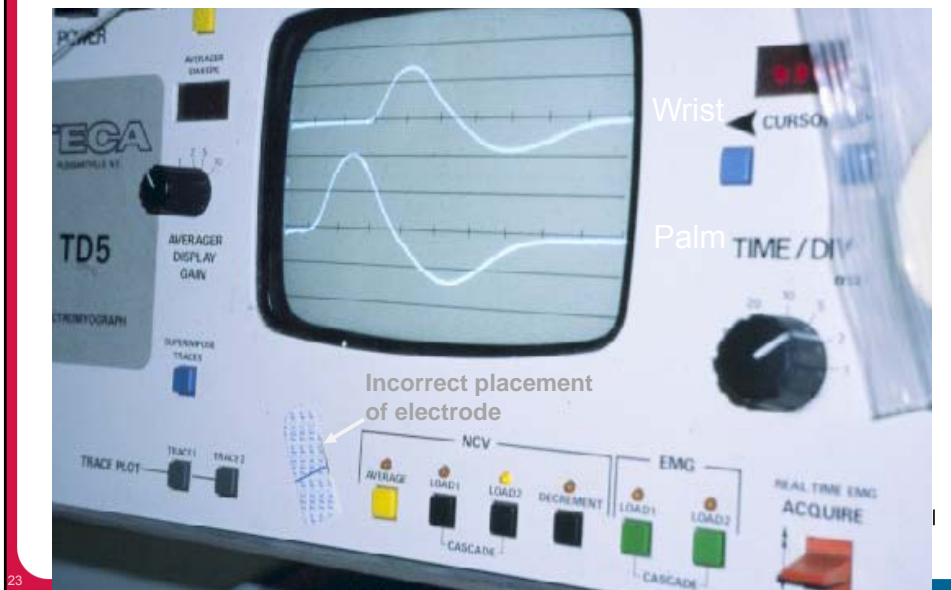
Stimulation in the palm



- 1st: Ulnar nerve stim and adduction of thumb
- Then, proximal move to adjust stim site
- 2nd Median recurrent thenar branch and abduction of thumb
- Watch the muscle move - not the monitor

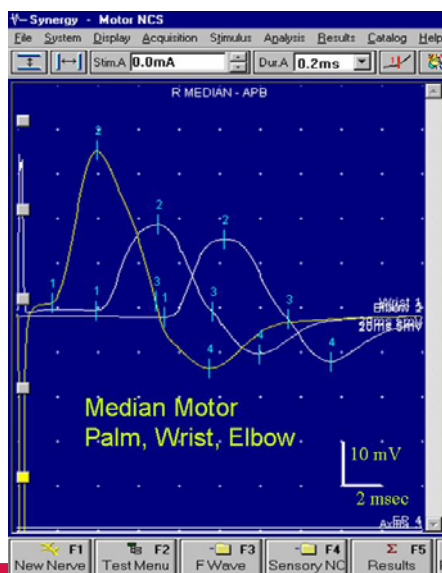


Conduction Block with abnormal DML



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Conduction Block with Normal DML



Motor lat @ 8 cm is 3.8ms (WNL)

Amp of CMAP @ 8 cm is 9.7mV (WNL)

NCV Forearm is 51m/s (WNL)

Amp increase in palm is 70% (only abnormality)

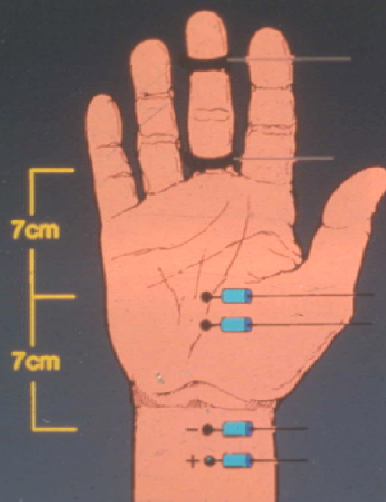
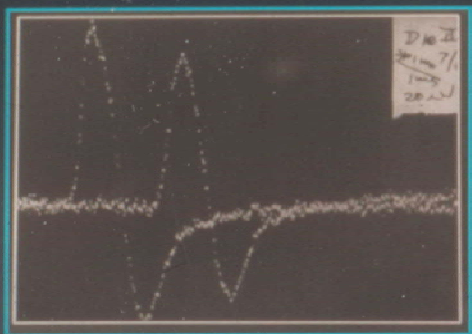


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Stimulation Proximal and Distal to Carpal Tunnel



- Sensory fibers

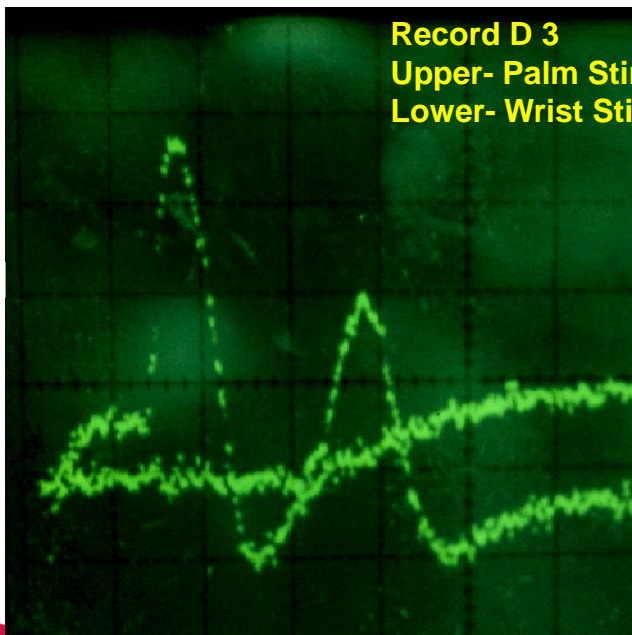


Median Sensory Conduction Block



Record D 3
Upper- Palm Stim
Lower- Wrist Stim

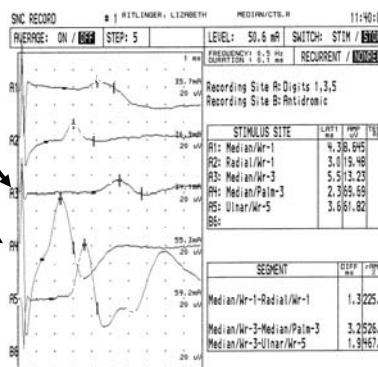
s/p 2mm
DELI
1ma 300
20ms
14-2



Sensory Nerve Neurapraxia



- Wrist stim shows partial block of SNAP (A3)
- With palm stim the SNAP recorded at Digit 3 (A4)
- Abnormal if >40% increase (P v. Wr)
- Better prognosis since little axon loss



Post-op EMG in CTS



- 15/91 residual paresth, 31 with pain at 6 mon.
- Normal motor and sensory NCV was seen in only 21% at one year post-op
- 21% of sensory tests and 4% of motor were unchanged (still abnormal)
- NCV recovery and symptom improvement were not related to severity of pre-op abnormalities.
- Group includes 7 with absent CMAP



Prick. NEUROLOGY 2002;58:1603

Recovery in CTS

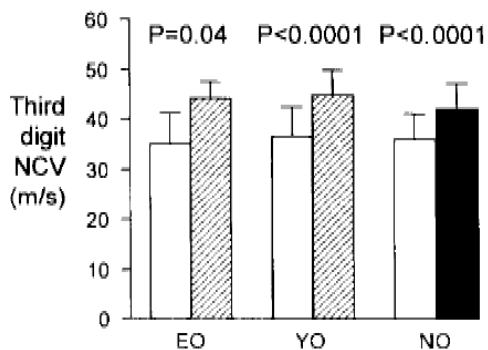
Todnem & Lundemo M&N 2000



- 151 hands seen for f/u EDX (92 pts)
- All EDX +
- 99 surgery
- 52 no surgery
- Mean f/u 14-15 mos.
- Operated hands had ↓SNAP amps and ↑ motor latencies than non-op hands



Recovery in CTS Sensory Conduction



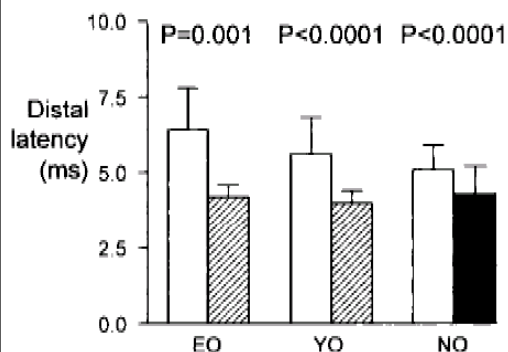
- Sensory nerve CV values recovered to a similar degree in both older and younger groups
- NOT to normal!
- Older showed smaller amplitude pre-op and post-op
- Non-Op also improved!

Pre-op/Post-op; EO ≥ 70yr, YO < 70yr, NO = Non-operated

Todnem & Lundemo M&N 2000



Recovery in CTS Motor Conduction



- Motor latencies (and F waves) improved in Old and Young, but not to normal range
- CMAP and forearm motor NCV did not change

Pre-op/Post-op; EO \geq 70yr, YO<70yr, NO=Non-operated

Todnem & Lundemo M&N 2000



Recovery in CTS Post-op



Hand symptoms	No. (%) of hands	
	Surgery (n = 89)	No surgery (n = 52)
Completely symptom-free	50 (51)	9 (17)
Slight symptoms	45 (45)	28 (54)
Troublesome symptoms [†]	3 (3)	6 (12)
No change or worse [‡]	1 (1)	9 (17)

- Recovery of SNCV and DML values better in operative groups.
- Symptomatic recovery better in operative groups.
- Absent sensory response did **NOT** predict bad outcome.

Todnem & Lundemo.
Muscle Nerve; 2000



CTS Post-Op Open technique in palm



- Symptoms
- Younger <55
 - 52% normal
 - 45% Improved
 - 3% No change
- Older > 55
 - 25 % normal
 - 60 % improved
 - 14 % no change
 - 1 % worse
- EDX
- Younger <55
 - 20% normal
 - 50% Improved
 - 30% No change
- Older > 55
 - 5 % normal
 - 45 % improved
 - 48 % no change
 - 2 % worse

Mondelli M. Carpal tunnel syndrome in elderly patients: results of surgical decompression. *Journal of the Peripheral Nervous System* 9; (2004 Sep): 168-76.



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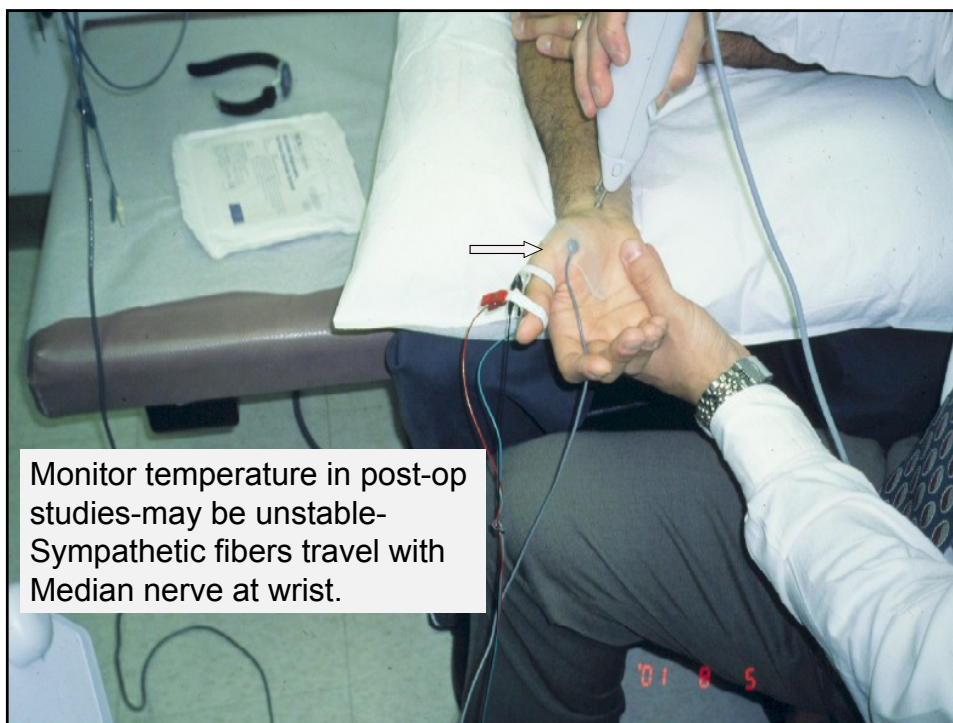
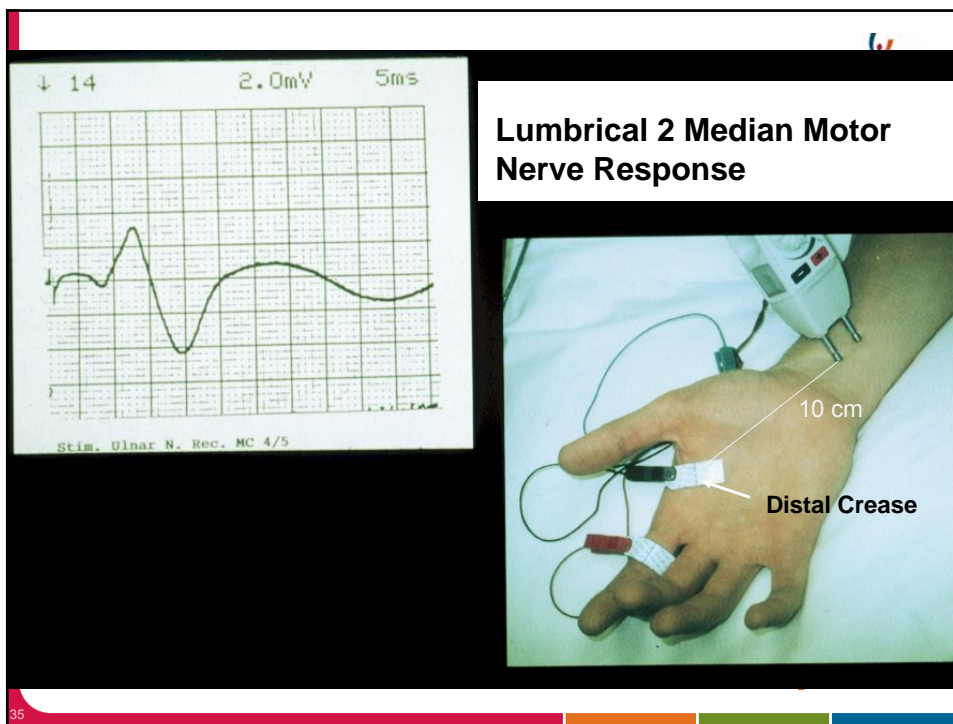
Very-Severe CTS with Absent Median CMAP



- 43/50 Hands had absent APBr CMAP
- All did have responses at 2nd lumbrical (small)
- Results 56% excellent, 32% good, & 12% fair
- Larger amplitude of 2nd-L CMAP predicted better outcome (Latency >10ms predicted poor outcome)

Nobuta, et al. Clinical results in severe CTS ...J Orthop Sci 2005;10:22







Mis-diagnosis* of CTS A cause of persistent symptoms!

- Radiculopathy – C6 or C7
- Thoracic outlet syndrome
- Ulnar nerve entrapment
- Musculoskeletal
 - 'Repetitive muscle strain'
 - Tenosynovitis (de Quervain syndrome)
 - 'Traumatic' fibrositis
 - Enthesitis

* Fully evaluate (Hx & PE) the post-op CTS referral

Open v Endoscopic META Analysis



- “There is no strong evidence supporting the need for replacement of standard open carpal tunnel release by existing alternative surgical procedures for the treatment of carpal tunnel syndrome.”
- Scholten R, et al. Surgical treatment options for carpal tunnel syndrome.

Source

- Cochrane Database of Systematic Reviews. 4, 2009
- 33 studies included in review



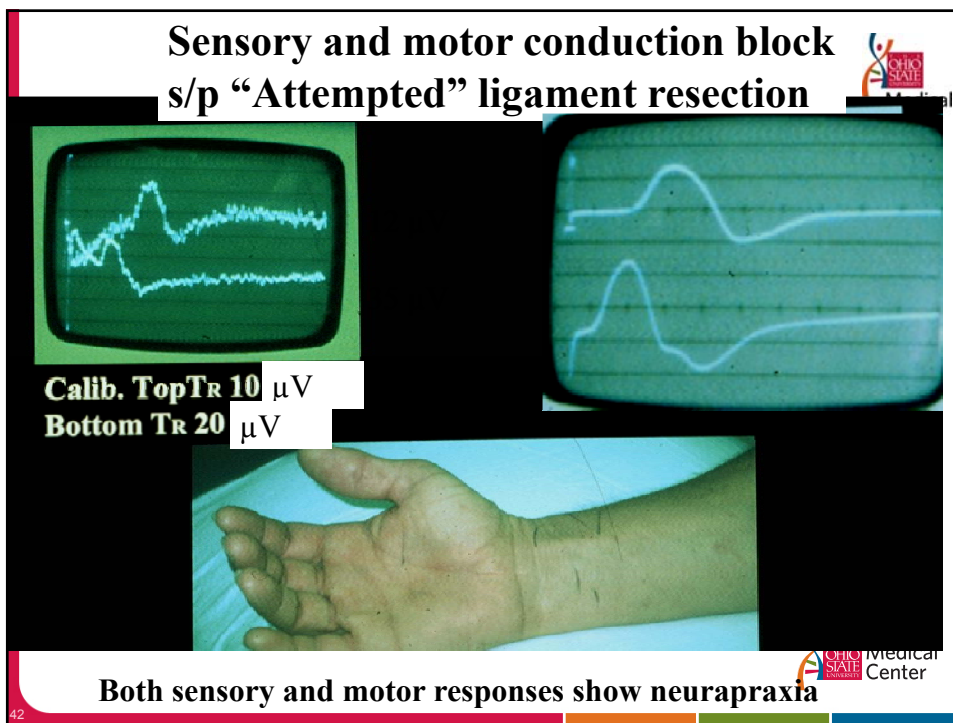
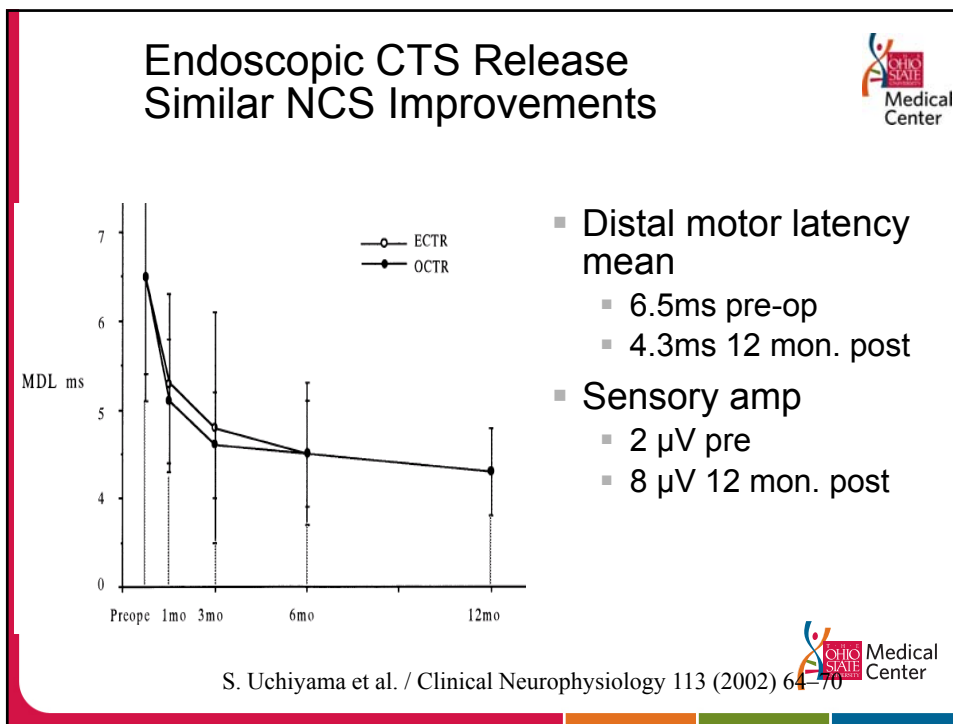
Open v Endoscopic



- **Long-term controlled study of endo v open release shows no benefit in short or long term, 5 years. Similar comp and re-op rate (5%) at 5 yrs.**
- **EMG-confirmed cases**

- Atroshi, I, et al. 2009. J Hand Surg 34A:266. Open Compared With 2-Portal Endoscopic Carpal Tunnel Release: A 5-Year Follow-Up of a Randomized Controlled Trial
- Atroshi, I, et al. 2006. BMJ 332:1473 Controlled trial among employed patients: randomised with open surgery for carpal tunnel syndrome Outcomes of endoscopic surgery compared





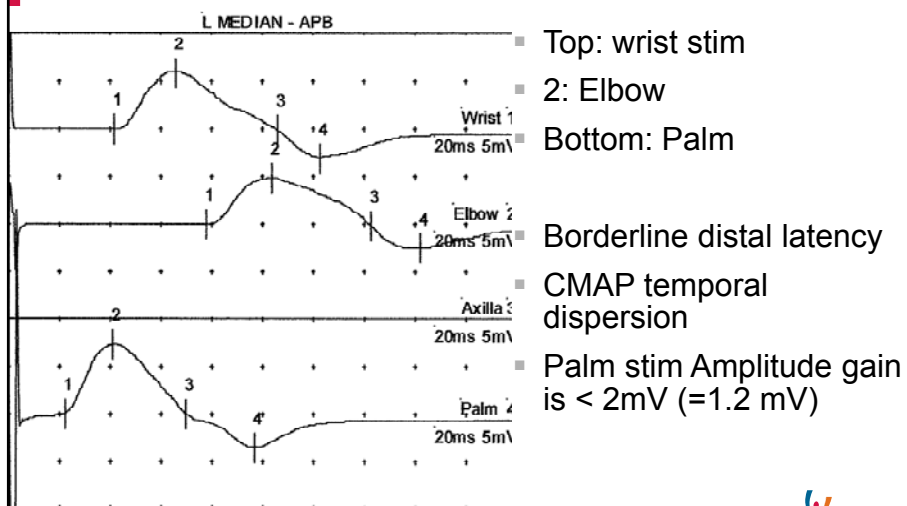
CTS Recurrence



- If ligament section is incomplete
 - Stimulate wrist and mid-palm – CMAP will show conduction block ($>20\% \Delta$)
 - Stimulate 14 and 7 cm – SNAP digit 3 will show block in carpal tunnel ($>40\% \Delta$)
- Without a conduction block it is doubtful that recurrence has occurred
 - When in doubt follow with later EDX study to assess change over time



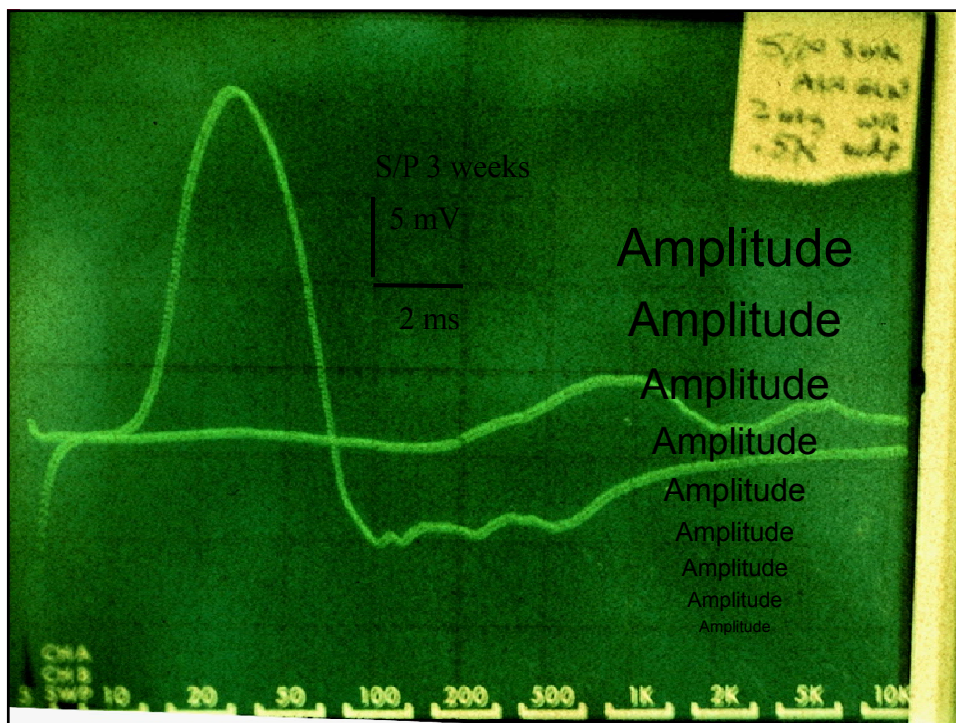
Successful CTS release, Median to APBr



Take Home Message



- **Amplitudes** are most important!
- Ask about work and other activities
- **Monitor** CTS objectively by EDX



Median motor latency recovery after CTS surgery

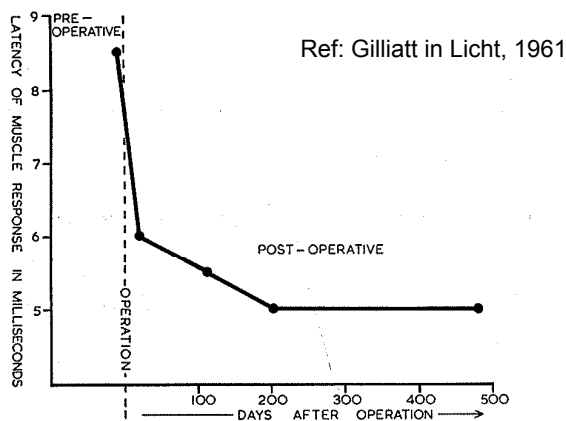


Fig. 152. Recovery of normal motor latency after operative decompression of median nerve in patient with carpal tunnel syndrome. Position of stimulating and recording electrodes as in Fig. 151.



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References

- Hagebeuk, E. Clinical and electrophysiological follow-up after local steroid...CTS. *Clin Neurophysiol* 2004;115:1464.
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- Nobuta, et al. Clinical results in severe CTS ...J Orthop Sci 2005;10:22
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- Muscle Nerve 2000. Todnem K, Lundemo G. Median nerve recovery in carpal tunnel syndrome. *Muscle Nerve* 2000;23(10):1555-60.
- S. Uchiyama et al. *Clin Neurophysiol* 113 (2002) 64–70.
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