

Practical aspects of the EDX examination and Some recording principles

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Planning of an EDX examination

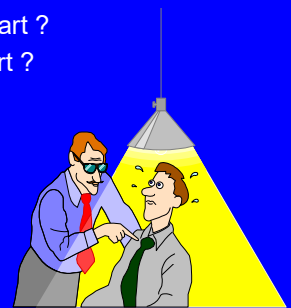
- referral
- symptom chart
- history
- clinical findings
- patient files

Practical approach

- Often we start with neurography
 - sometimes this is enough
 - supplement with short segment study (SSS)
 - autonomic tests
 - TMS
 - quantitative sensory testing
- Second step is EMG
- Successive steps depend on findings
 - RNS
 - SFEMG, Macro EMG

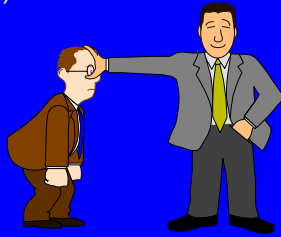
History is very important

- when did it start ?
- how did it start ?
- paresthesia
- weakness
- pain
- course of symptoms



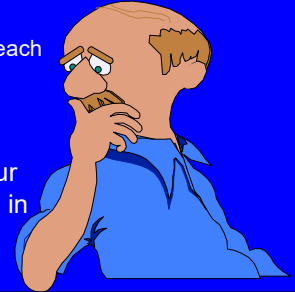
Clinical examination

- stretch reflexes
- muscle strength
- sensibility (unreliable)
- inspection
 - scars
 - tumors
 - swelling



Differential diagnosis

- what alternatives need to be considered
 - likelihood of each alternative
- don't forget consider the alternative your colleague has in his referral



Plan

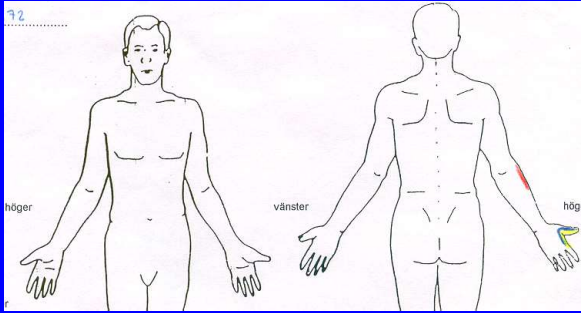


- "Go where the money is"
 - start with the most likely alternatives
- when you think you have arrived at a diagnosis, rule out those alternatives that are differential diagnostic alternatives

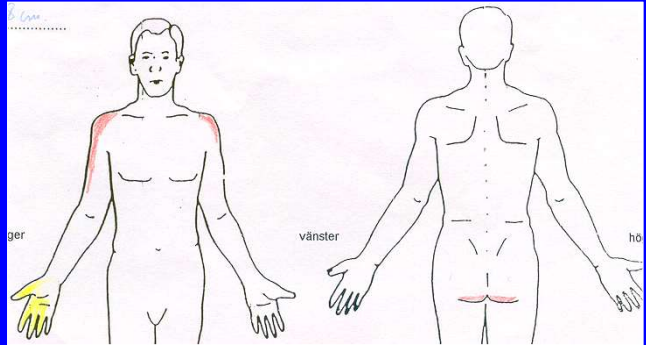
Tricks to use when you do not know what to do

- When nothing else helps - think!
 - logical thinking
 - lateral thinking
 - consult literature/internet
- Check to opposite side and other limbs
- Are the electrodes and equipment working?
- Consult a colleague before the patient leaves

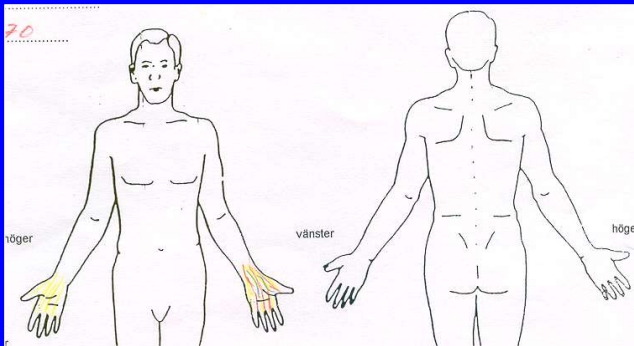
Examples of the use of symptom chart



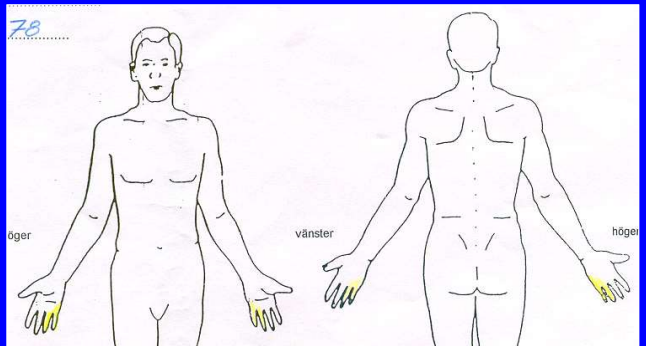
Conduction block, radial nerve



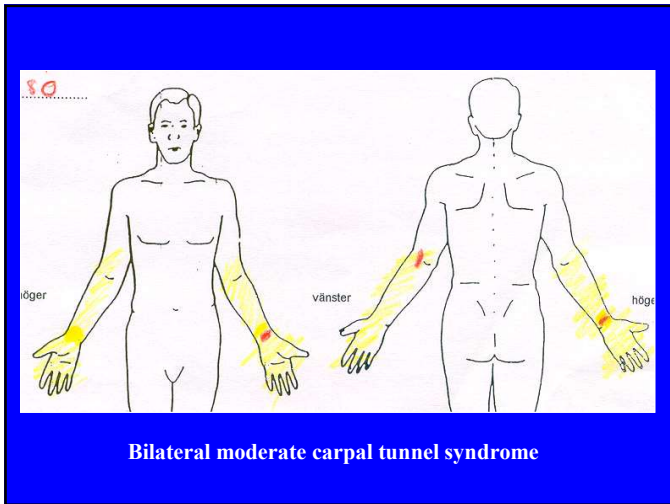
Severe unilateral carpal tunnel syndrome



Bilateral carpal tunnel syndrome, left severe, right moderate



Ulnar conduction block at the elbow, right side low sens ampl dig IV and V without motor involvement, left side



Neurography; general

Neurography often the first test to be performed
Focus on the clinical question

pathophysiology	demyelinating/axonal/CB
fiber type	sensory/motor/autonomic
fiber size	large/small
distribution	distal/proximal
severity	

Follow strict methodological standards (el.type, positions)
Use reference values adapted to your methods (or vice versa)
Require maximal signal quality (baseline, noise, anomalies)
Adjust stim strength (and duration)
Collaborate with Technicians for Neurography

Neurography; MCS

Ascertain "maximal quality" of the CMAP;
(stim strength, noise, el.)
Check evoked muscle twitch (tendon rupture, abn reflexes)
Add tests if you suspect anomalous innervation or LEM

Neurography; SCS

Prepare skin and electrodes
Do not start averaging sensory signals unless you see a response
Ask the patient about evoked sensation

- signal but no sensation – prox CB, spinal cord
- sensation but no response – technical or distal CB

EMG

Practical hints - the patient

- inform the patient about reason for EMG
- explain expected discomfort
- do not display the electrode
- term "pin" (or similar) better than needle
- keep bloody tissues away
- do not state number of remaining muscles
- inform about soreness for 1-2 days
- inform the patient about next step

Practical hints - the examiner

- medical consultation
- read referral before you see the patient
- check history, phys exam
- formulate strategy
- inform the patient about the progress
- have all supplies ready before exam
- use gloves

Practical hints - the investigation

- no skin preparation is necessary
- support your hand on the area of needle insertion
- hold the electrode like a pen
- small but brisk insertion through the skin
- do not go very deep, just beneath the fascia
- investigate the muscle at
 - rest (denervation),
 - slight contraction (MUP) and
 - strong contraction (IP)

Practical hints - the investigation

- Hold the electrode like a pen
- Support your hand on the patient close to the intended muscle
- Avoid end-plate regions
- Make a small rel. brisk insertion after notifying the patient
- Start with the electrode 2-10 mm under the fascia, i.e. not just under the fascia, and not deep
- Move the needle to different positions, separated by 2 mm-5 mm
- Record during rest, slight, increasing and strong activity
- Remove the electrode slowly

Muscle at rest

- After electrode insertion, keep the electrode still for 10 seconds and listen carefully
- Then move the electrode, to 5 positions in 2 skin insertions, separated laterally by 2 cm
- Sometimes tapping of the muscle can provoke myotonic discharges

Slight contraction

- Ask for *slight* contraction. Move the electrode a little to reach "focus", sharp signals
- Move the needle to new position
 - 2 mm deeper
 - 2 mm deeper
 - out and then new direction--pyramid
- 2-3 skin insertions, total 30 MUPs
- Use the trigger and delay!




Increasing and strong contraction

- If you study pattern **during increasing contraction**, keep the electrode with one hand and give resistance to muscle shortening with the other
- Go to successively stronger contraction
- Remove the electrode during the strong contraction


- If you study just activity **at moderate-strong contraction (IP)**, then insert the electrode when the muscle is active
- Make recordings from a few sites
- Remove the electrode during contraction

*Strategy
that may change dynamically as
findings evolve*

Acute polyradiculitis
(Guillain-Barré Syndrome, GBS, AIDP) 

Strategy

- demonstrate acute motor and sensory neuropathy
- demonstrate conduction block
- assess: severity, pathology, distribution

Acute polyradiculitis, GBS
-expected findings 

Expected abnormal findings

Neurography, MCS

- conduction block
- F waves delayed and few
- DL prolonged
- reduced MCV, sometimes normal initially
- distal amplitude normal/low

Neurography, SCS

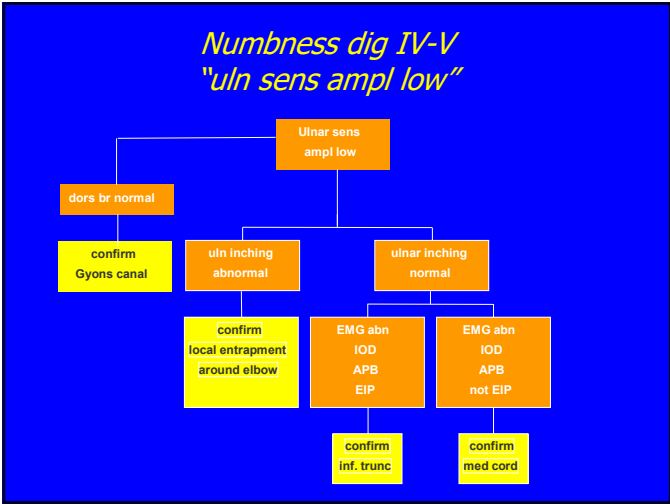
- reduced amplitude

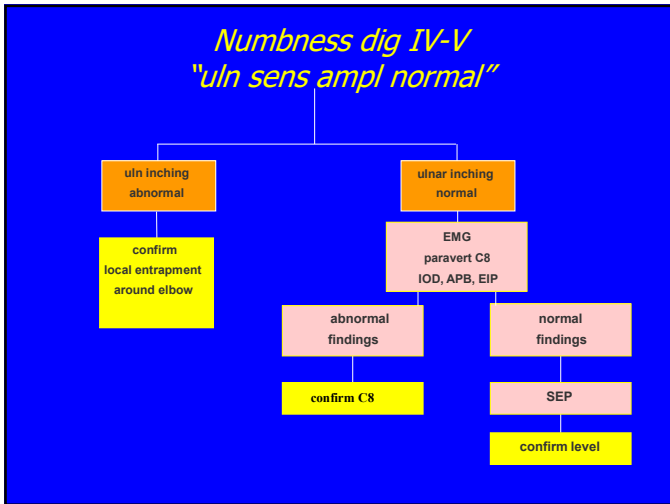
EMG

- reduced IP, later acute neurogenic EMG findings

Autonomic tests

- often abnormal





Results must harmonize

- ampl decay and normal # F
- prox ampl higher than dist
- jitter/ blocking but no weakness
- good strength - low CMAP
- low strength – normal CMAP

- techn
- anomal.inn, overstim
- techn
- bad stim or inexcitability
- tendon rupture

NOTE
Be open for the unexpected

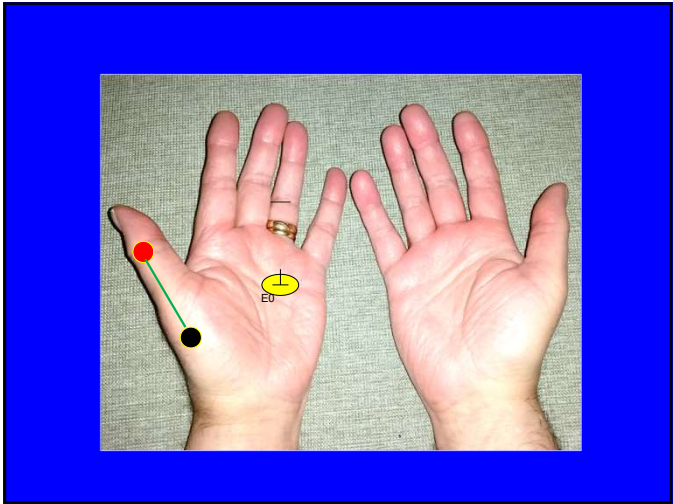
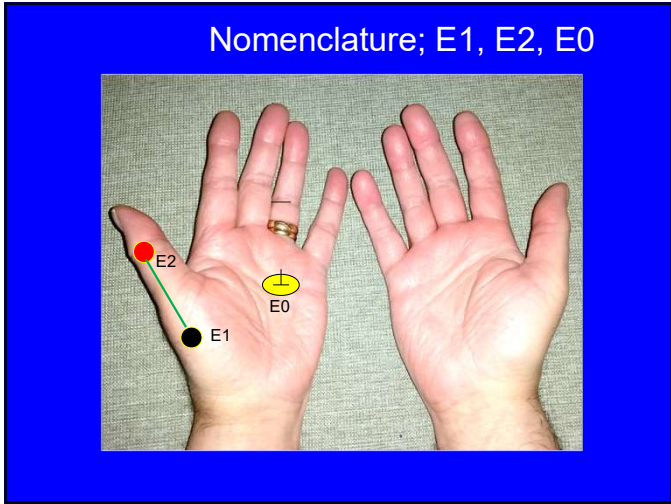
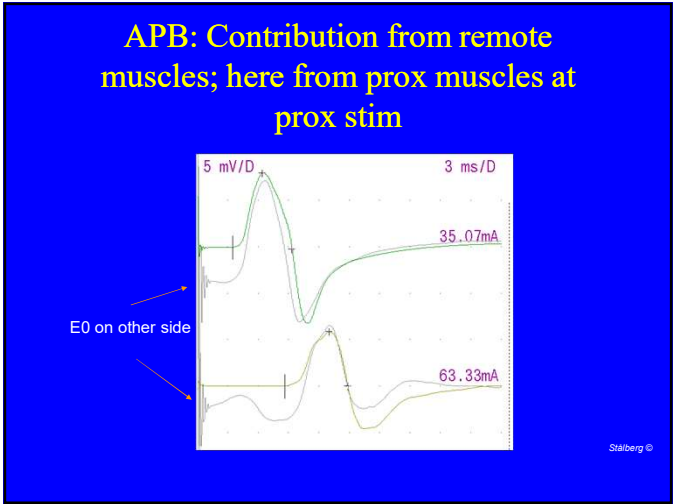
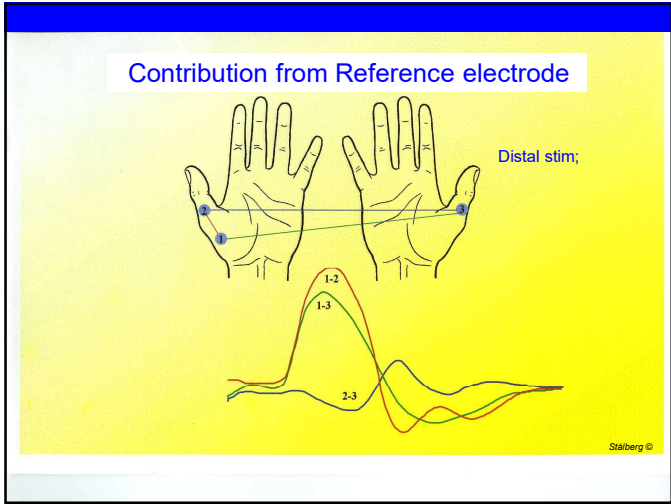
Results must harmonize cont'd

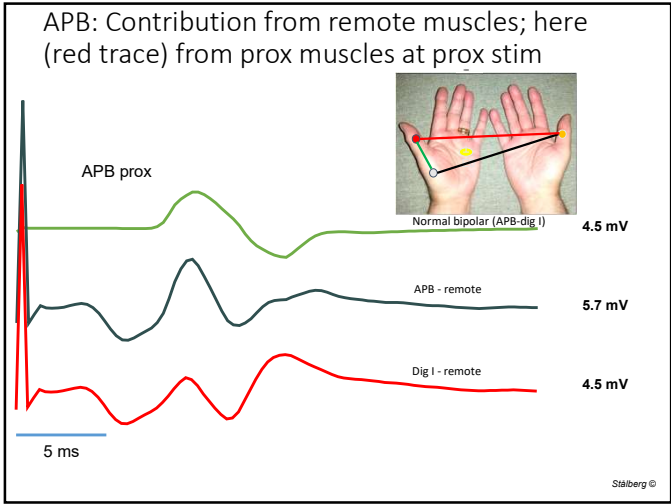
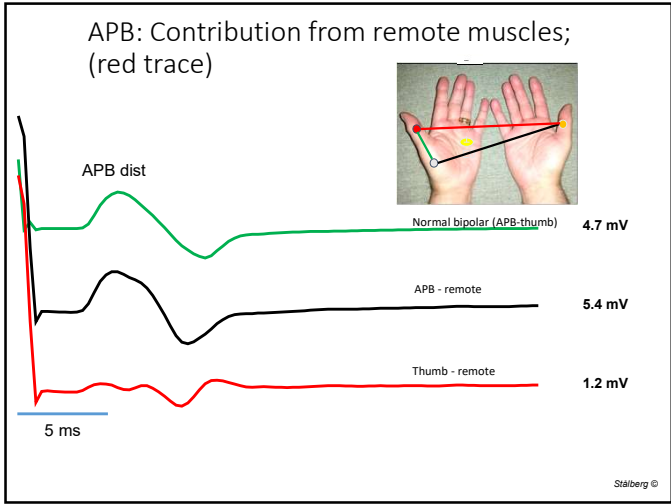
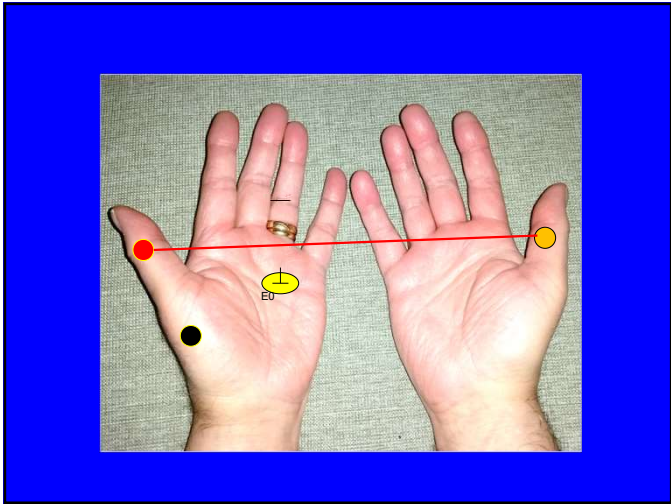
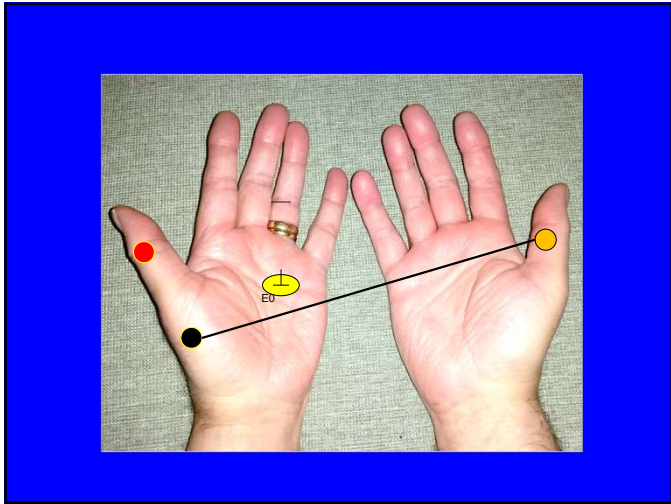
- high F waves - normal MUPs
- biopsy type grouping - normal FD
- high MUPs in GBS day 3,
- late responses in median stim with F-waves remaining even with minimal stim (nearly 0 mV CMAP)

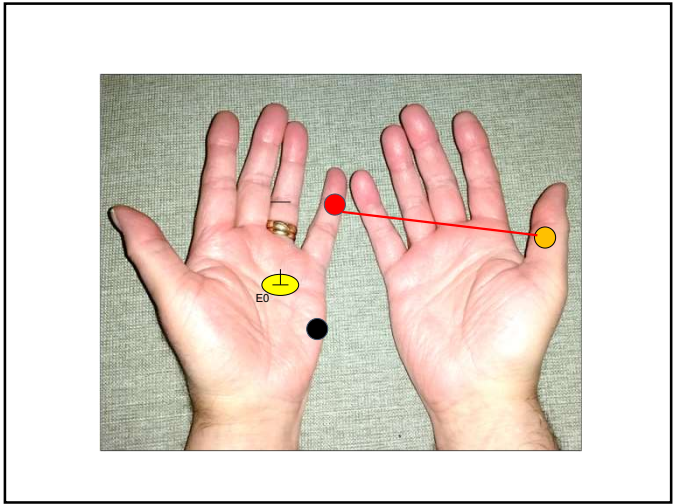
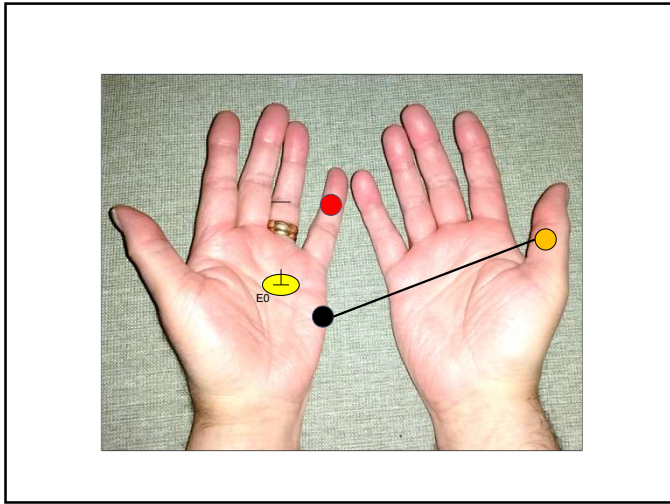
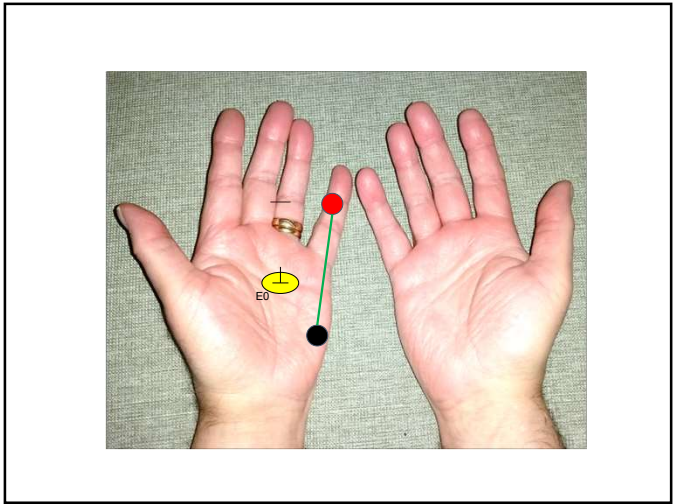
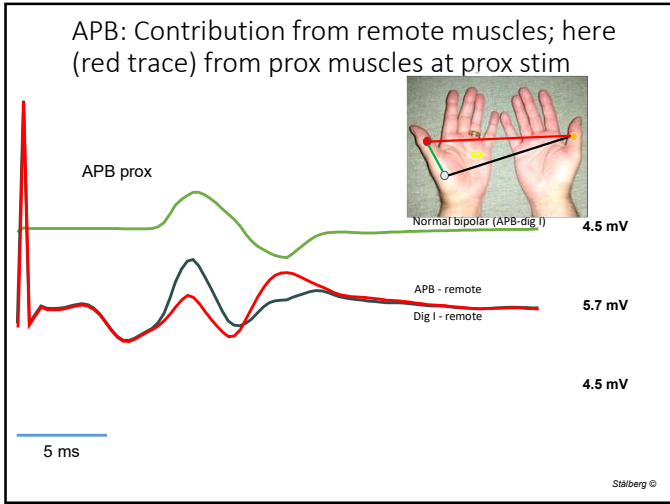
- central hyperexcitability
- cong myopathy
- no reinnervation (FD normal)
- loss of small Mus
- H-reflex in spasticity

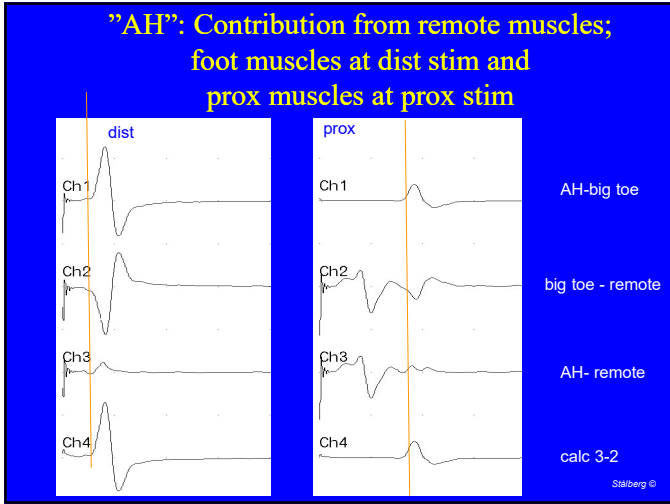
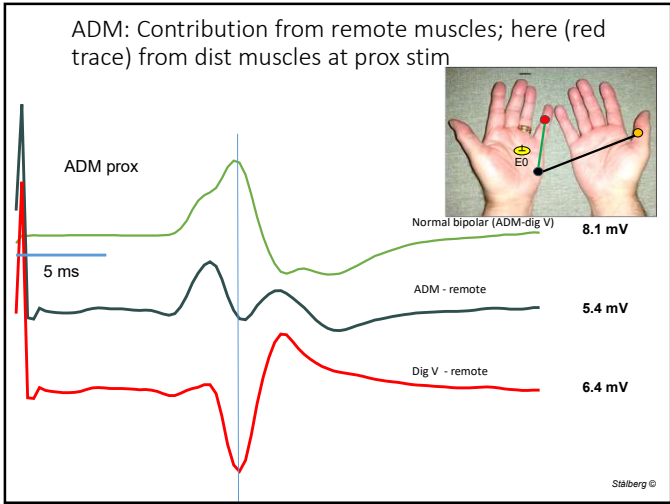
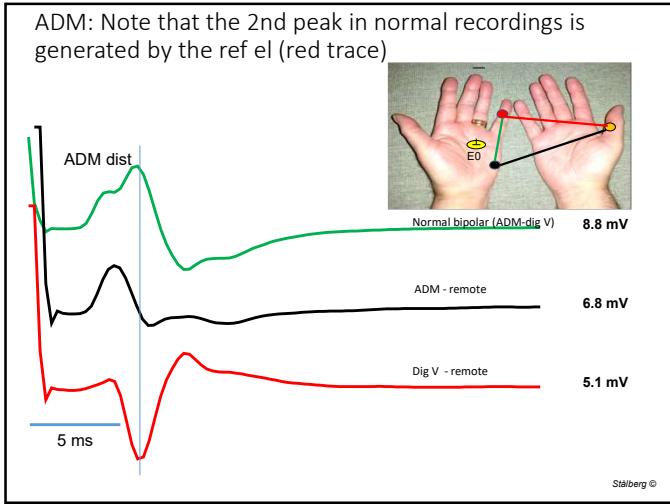
Recording principles

Motor
Sensory
EMG









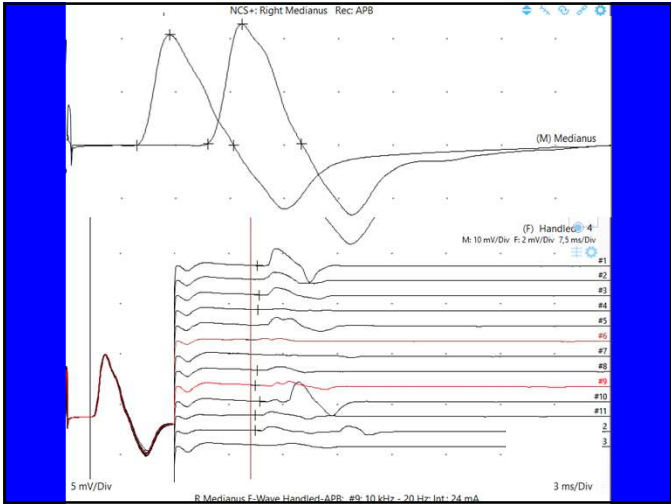
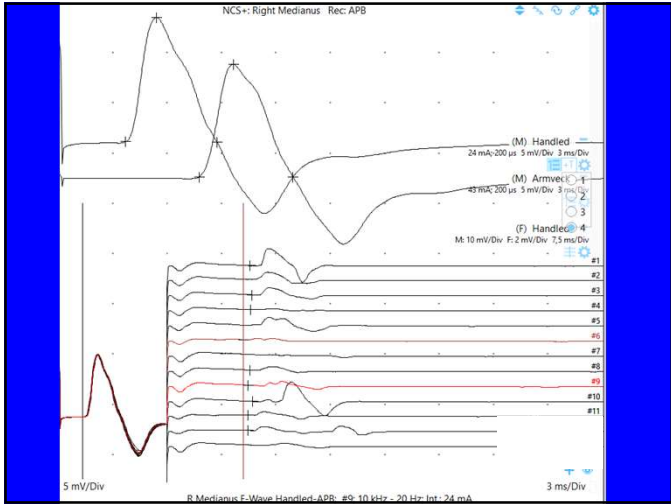
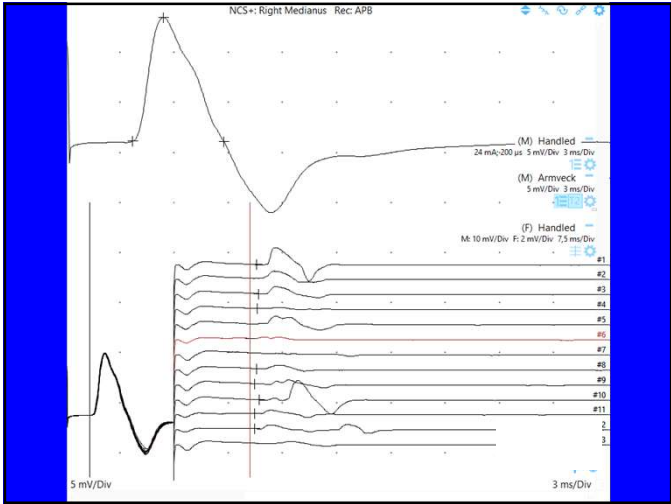
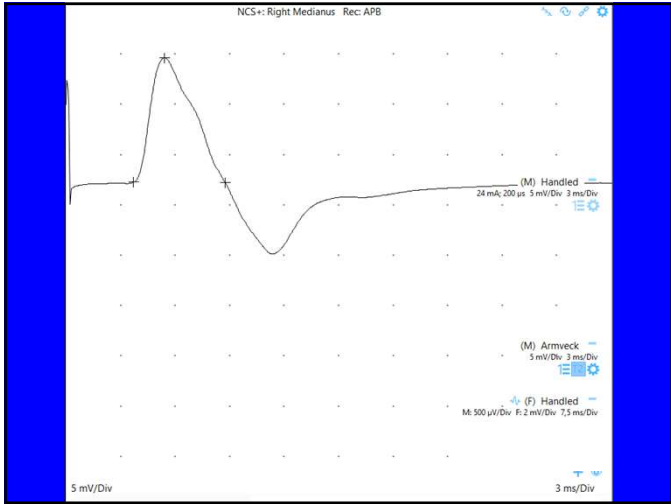
F wave studies

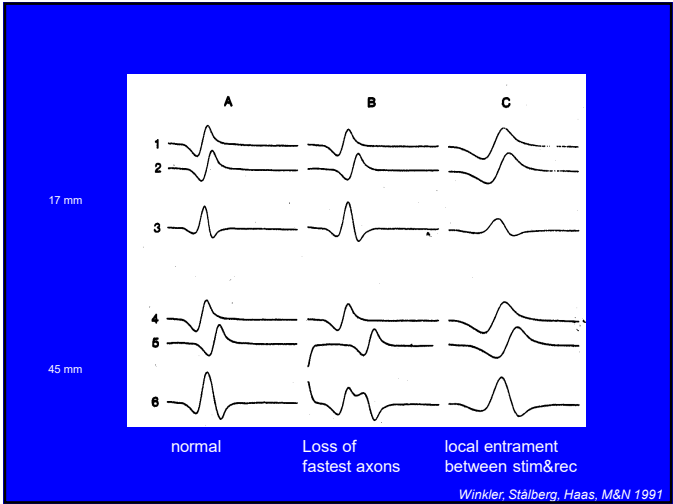
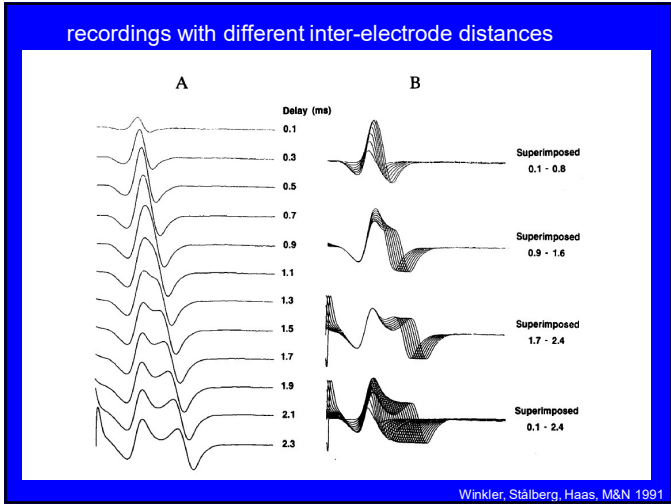
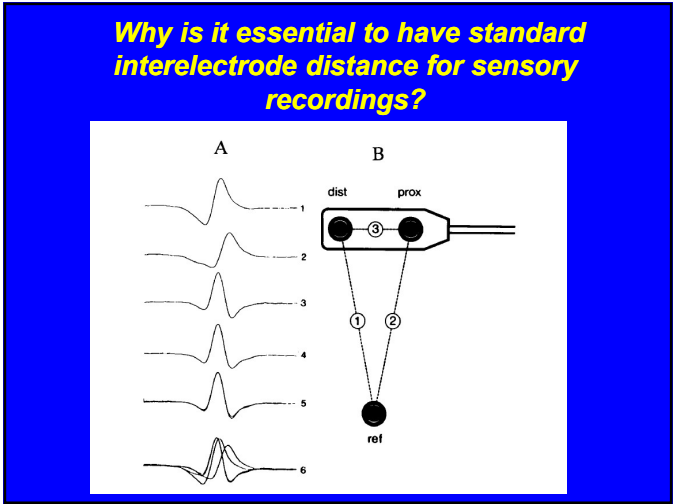
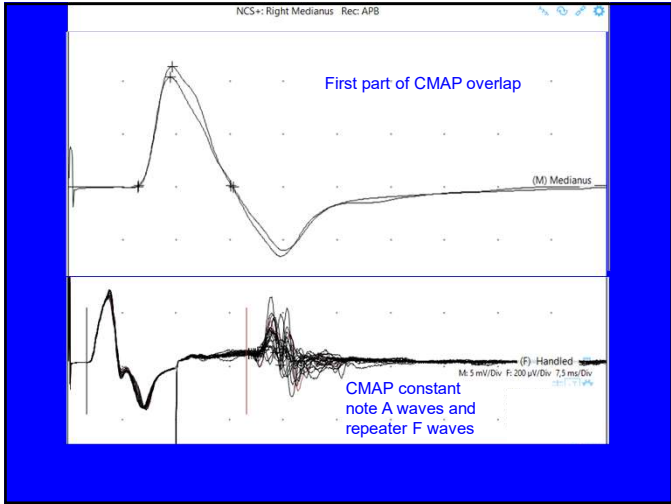
Same stim position as for MCS. No need to invert polarity – anode is a weak stimulator compared to the cathode. No stimulation or anodal block is seen with conventionally used stim strength

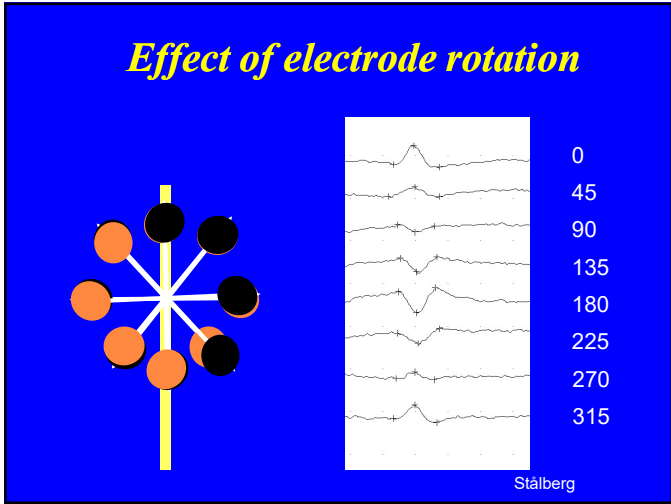
Suggested efficient protocol

1. distal stimulation
2. 20 stimuli with same stimulator position
3. proximal stimulation for MCS

Practical aspects of EMG, Stålberg







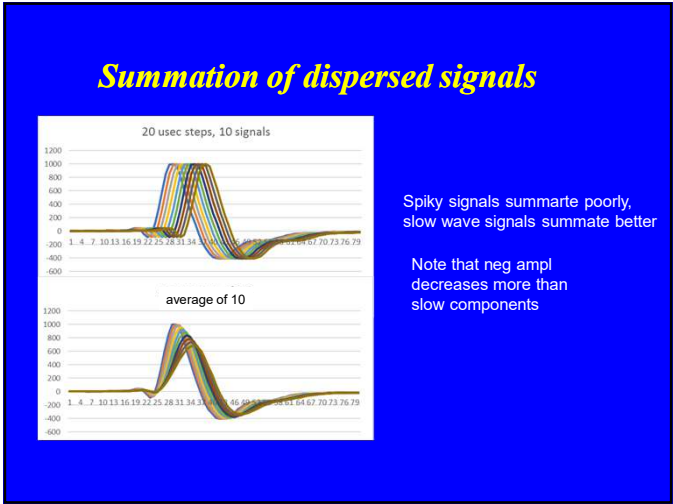
Motor unit potentials from two monopolar electrodes subtract in a complex manner

Monopolar recording.

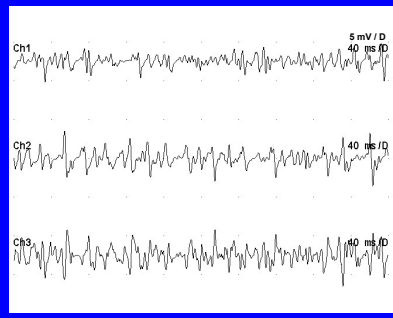
With small interelectrode distance (<1 cm) the electrodes record to some extent activity from the same MUPs, (blue) which are cancelled.

With separate electrodes, you will get a subtraction of completely asynchronous activity from the two.

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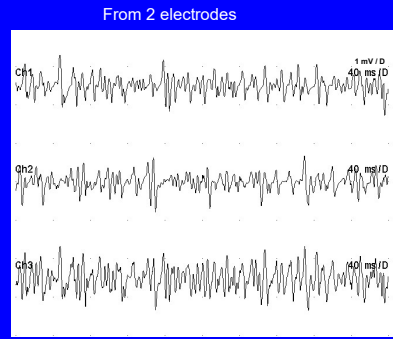
Subtraction of surface EMG from 2 separated electrodes



Since signals are asynchronous and of short duration the net difference is not lower ampl, but more phases

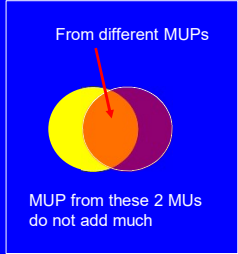
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Summation of EMG



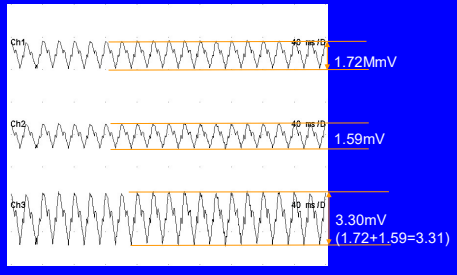
From 2 electrodes

More turns, but similar envelope amplitude



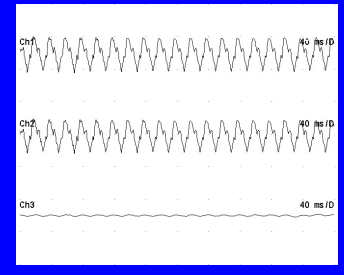
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Summation of sine waves



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Subtraction of sine waves

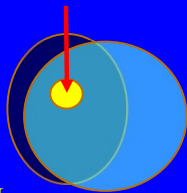


Due to a small amplitude difference in the sine waves, their difference is not 0

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Can you detect the “size principle” with conventional needle electrodes?

No, the uptake area of mono/con electrodes is about 2 mm and the MUP often 5-10 mm in diameter, so you do not know if you are recording from a small or large MU.



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