

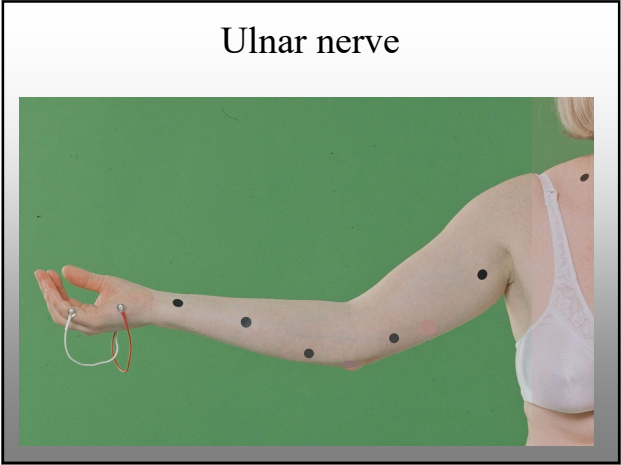
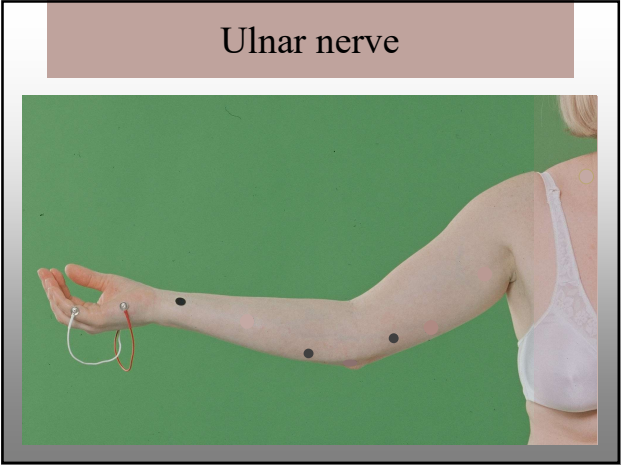
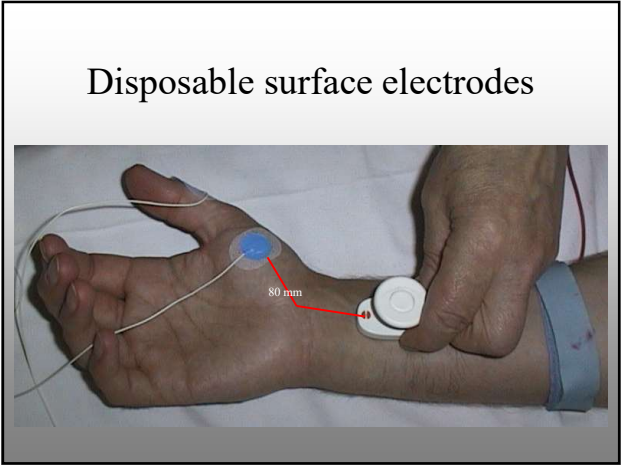
# Neurography, Introduction and update

Stålberg

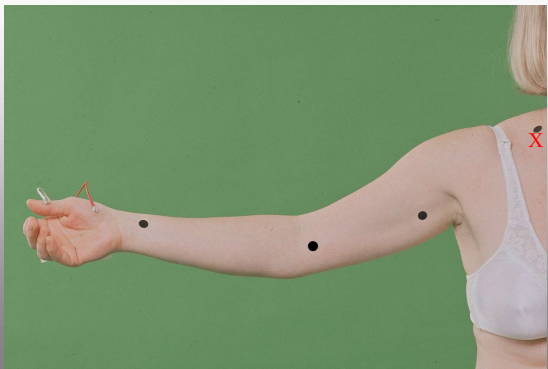
- ### Requirements of methods used in nerve conduction studies
- ◆ Simple and standardized
  - ◆ Little discomfort for the patient
  - ◆ Low cost
  - ◆ Optimal sensitivity and specificity
  - ◆ Reference values available
  - ◆ Examiner should be familiar with method
  - ◆ Tailored to the problem at hand

### What physiological and anatomical functions motor neurography reflects

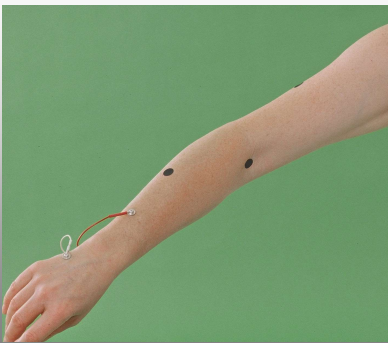
Amplitude	<ol style="list-style-type: none"> <li>1. Number of Mus</li> <li>2. Size of Mus</li> <li>3. Diameter of muscle fibres</li> <li>4. Dispersion of CV</li> </ol>
Conduction velocity	<ol style="list-style-type: none"> <li>1. State of the myelin</li> <li>2. Axon diameter (MU size)</li> </ol>
Duration	<ol style="list-style-type: none"> <li>1. Dispersion of CV</li> </ol>
Distal latency	<ol style="list-style-type: none"> <li>1. CV in distal segment</li> <li>2. Length of distal segment</li> <li>3. Nm transmission time</li> </ol>
Decay	<ol style="list-style-type: none"> <li>1. Dispersion of CV</li> <li>2. Conduction block</li> </ol>



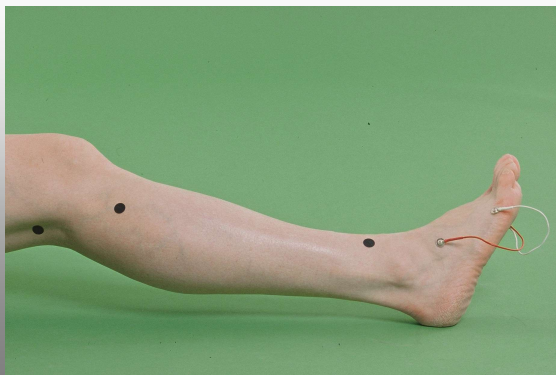
Median nerve



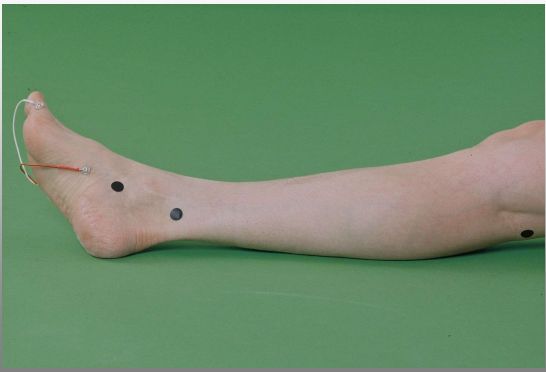
Radial nerve



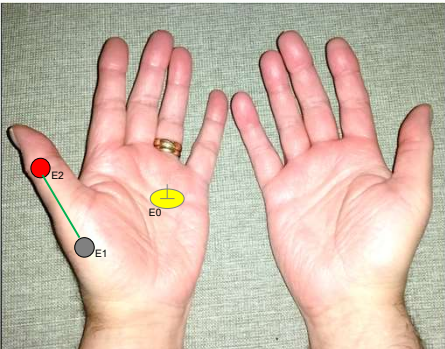
Fibular nerve



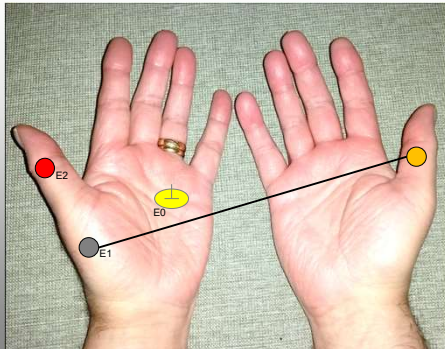
Tibial nerve

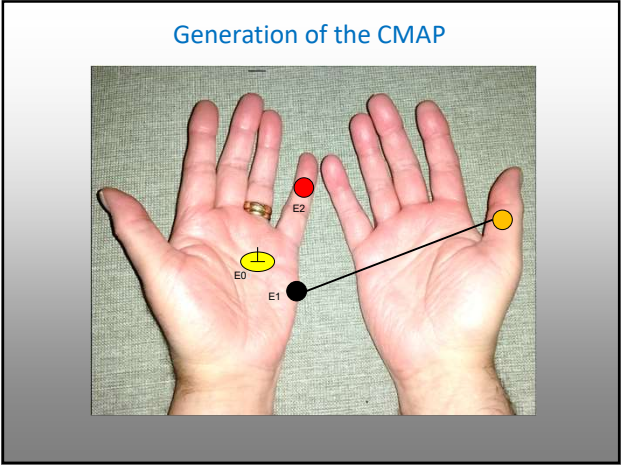
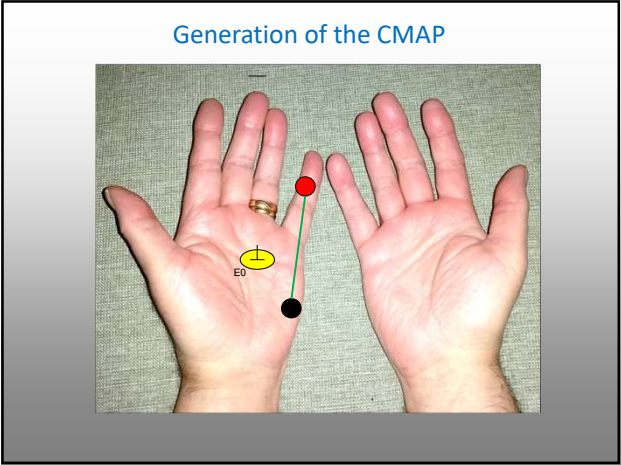
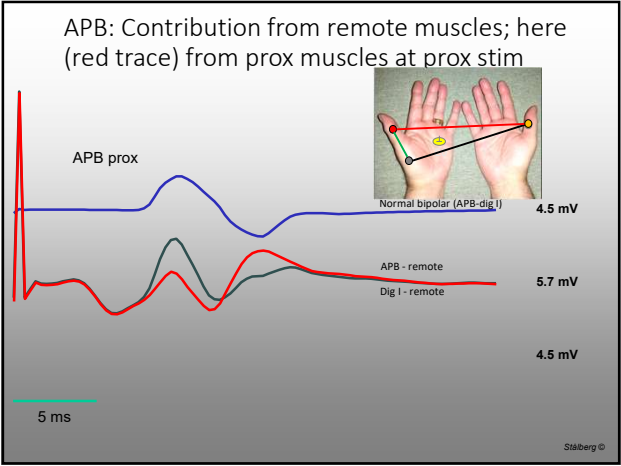
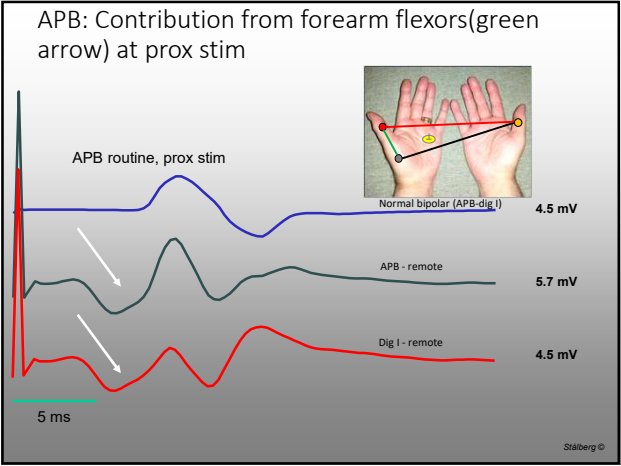
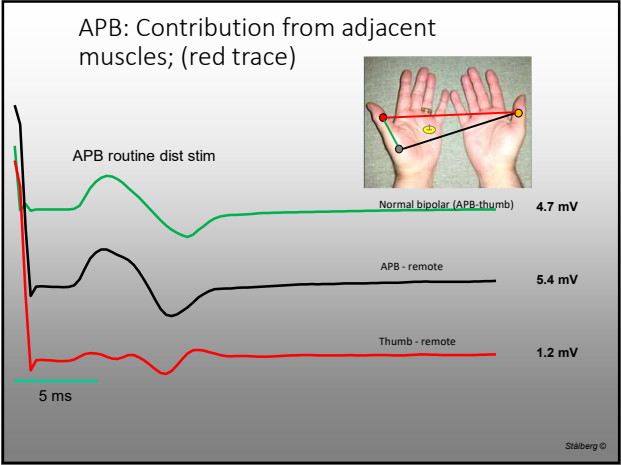
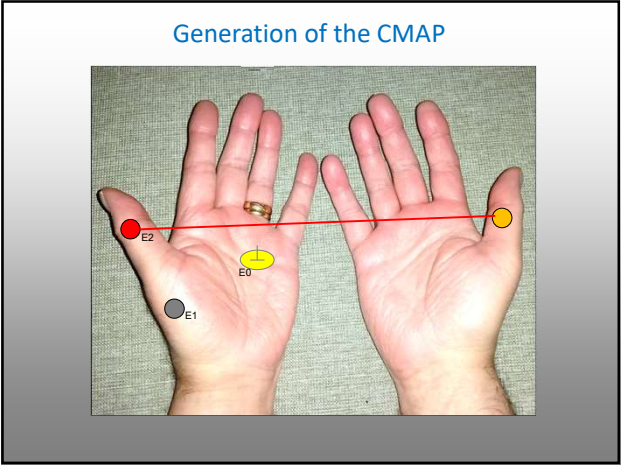


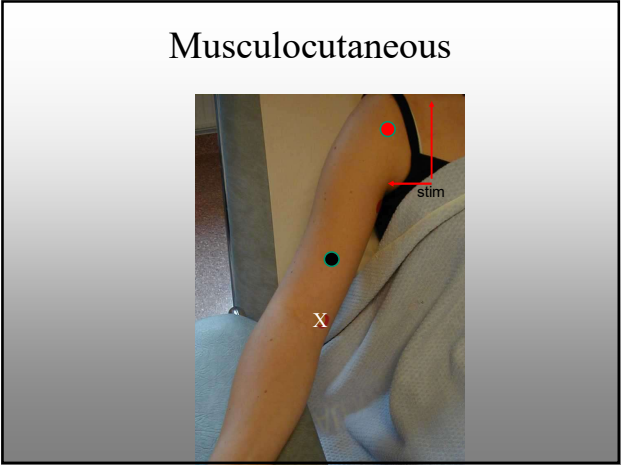
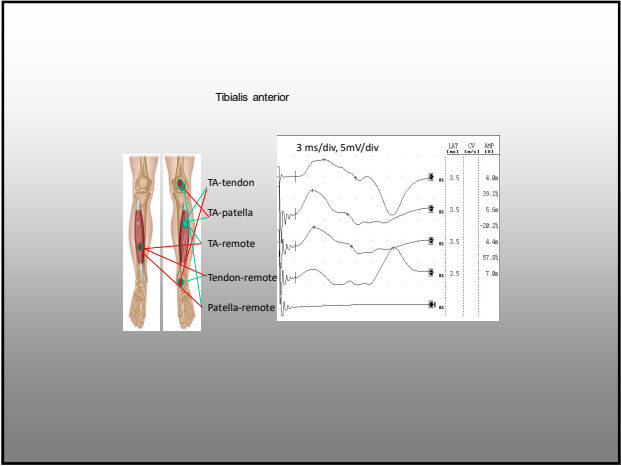
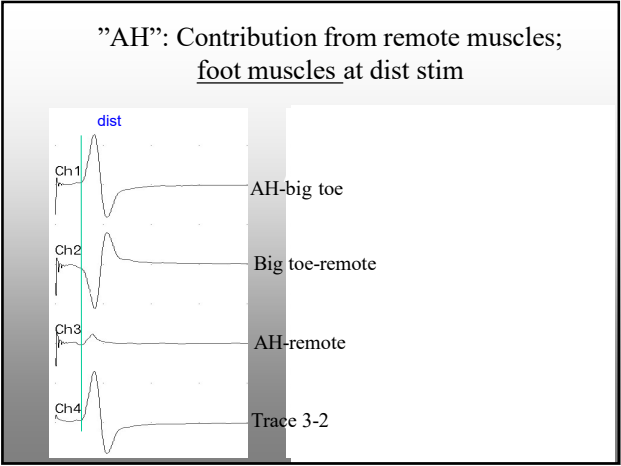
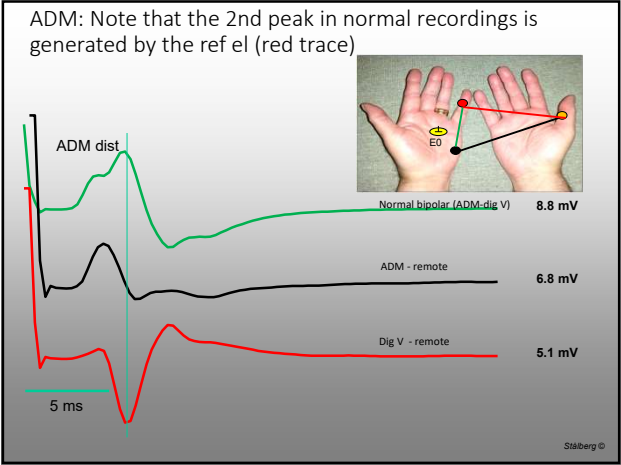
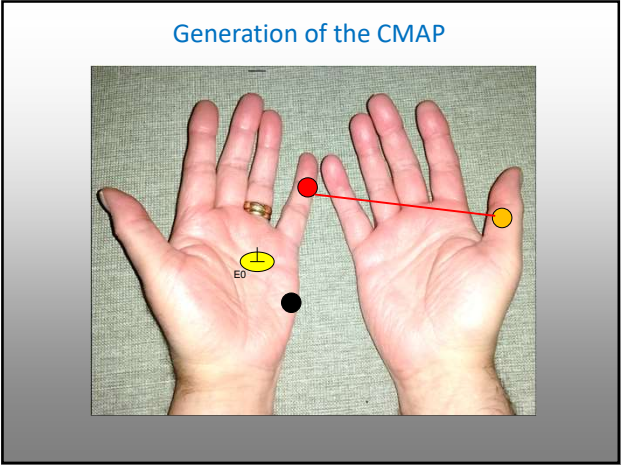
Generation of the CMAP



Generation of the CMAP







- ### Parameters of importance for neurography
- **Technical**
    - Electrode type
    - Electrode position
    - Reference electrode position
    - Muscle length
    - Stim-rec distance
    - Stim strength
    - Distance (sensory)
    - Temperature
    - Volume conduction

### Parameters of importance for neurography

- **Biological**
  - # axons
  - Size of MU
  - N-m transmission
  - Axonal diameter
  - Myelination

### Effect of electrode type

Electrode Type	ΔLAT/CM	AMP	AREA	DUR
17mA	3.2	9.9	33.9	5.8
16mA	24 %	13 %	-3 %	
16mA	3.3	12.3	38.4	5.7
13.2mA	-15 %	-8 %	2 %	
13.2mA	3.3	10.4	35.4	5.8

### Effect of muscle length on the M wave

increasing flexion of thumb ↓

Stimulus	ΔLAT/CM	AMP	AREA	DUR
15.4mA	3.7	7.1	27.9	6.8
15.4mA	28 %	11 %	-6 %	
15.4mA	3.7	8.5	30.9	5.7
15.4mA	11 %	5 %	-1 %	
15.4mA	3.7	9.5	32.5	5.6
15.4mA	11 %	-2 %	-7 %	
15.4mA	3.7	10.6	31.9	5.2
15.4mA	15 %	7 %	-18 %	
16.6mA	3.7	12.2	34.8	4.7

Recording from thenar muscles - median nerve

### Effect of stim-rec distance

5 mV/D 2 ms/D

MOTOR

Same stim sites

(8cm) 45.99mA 6.0

22cm 27.72mA -15 % 5.1

8cm 36.99mA -1 % 5.1

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SENSORY antidromic

20 uV/D 20 uV/D 2 ms/D

(14cm) 71

22cm -49%

8cm 36 -45%

20

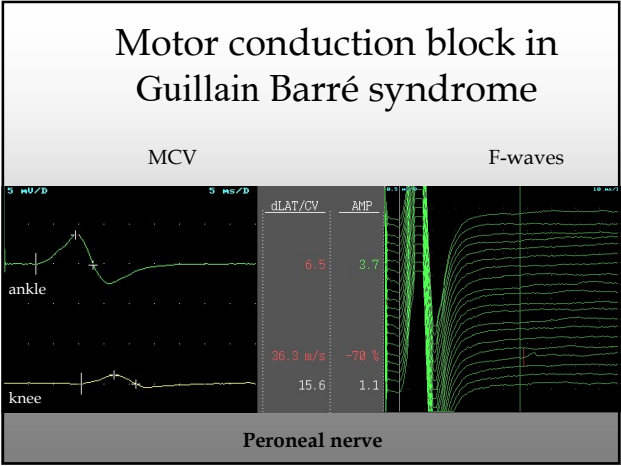
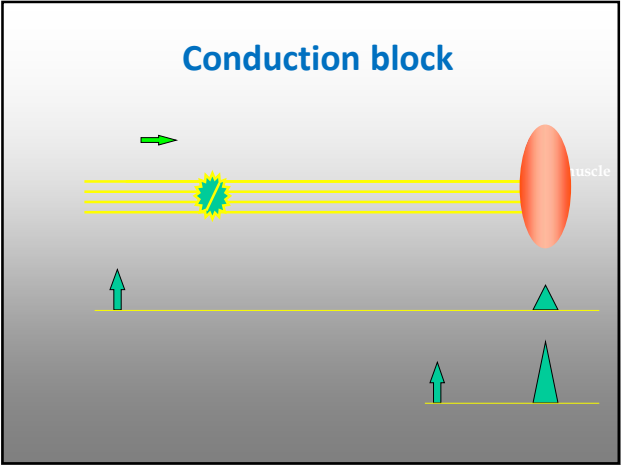
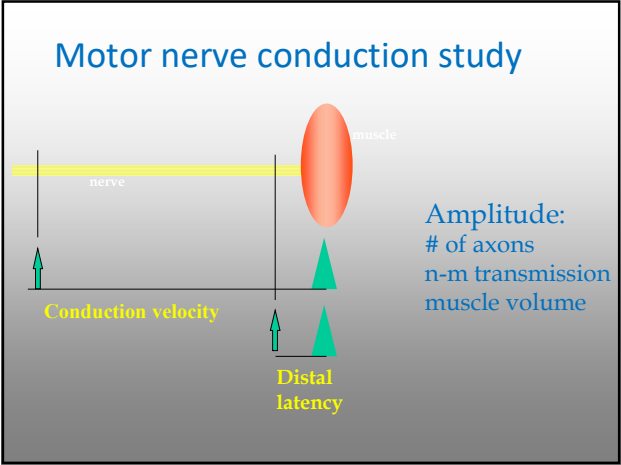
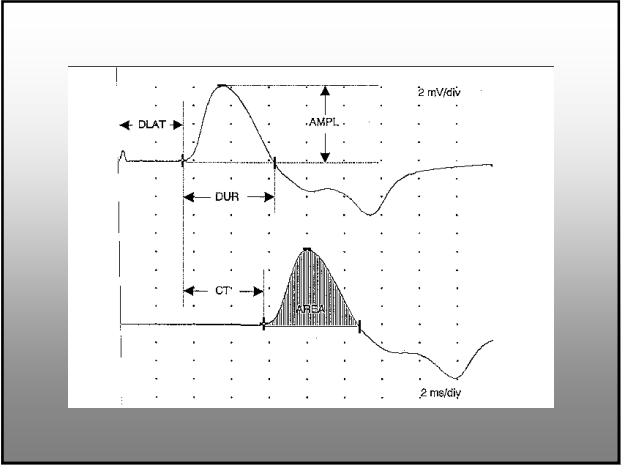
### Dealing with stimulus artefact

1. poor initial baseline
2. ground electrode between stimulating and recording electrodes
3. rotation of the anode of the stimulating electrode
4. biphasic stim pulse

Stimulus	ΔLAT/CM	AMP	AREA	DUR
15.6mA	3.7	7.1	27.9	6.8
15.6mA	28 %	11 %	-6 %	
15.6mA	3.7	8.5	30.9	5.7
15.6mA	11 %	5 %	-1 %	
15.6mA	3.7	9.5	32.5	5.6
15.6mA	11 %	-2 %	-7 %	
15.6mA	3.7	10.6	31.9	5.2
15.6mA	15 %	7 %	-18 %	
16mA	3.7	12.2	34.8	4.7

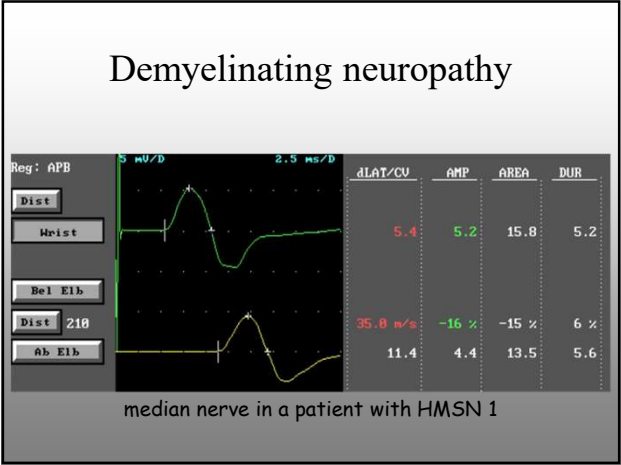
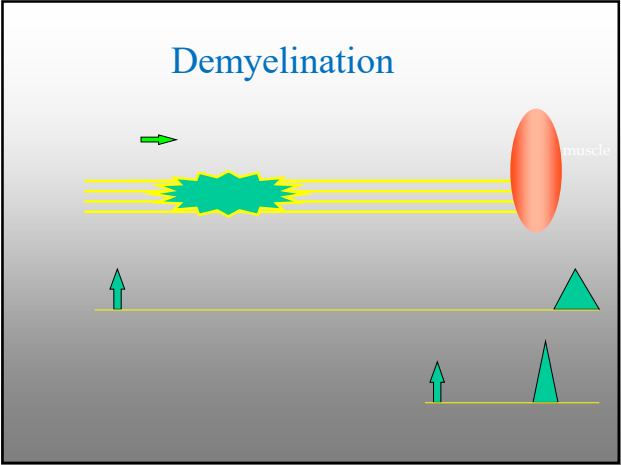
### Remote muscle activity, volume conduction

Site	ΔLAT/CM	AMP	AREA	DUR
EDB dist	4.5	2.5	5.7	4.7
EDB prox	36.0 m/s	-27 %	-8 %	71 %
Tib ant	13.4	1.8	5.2	8.0
Tib ant	-10 %	51 %	25 %	
Tib ant	5.8	1.6	7.9	10.0

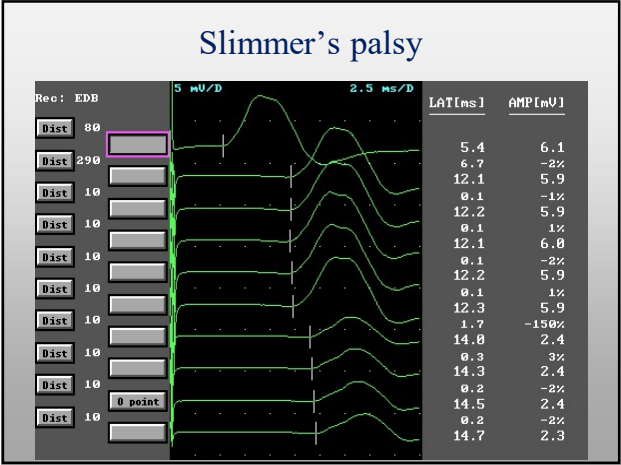
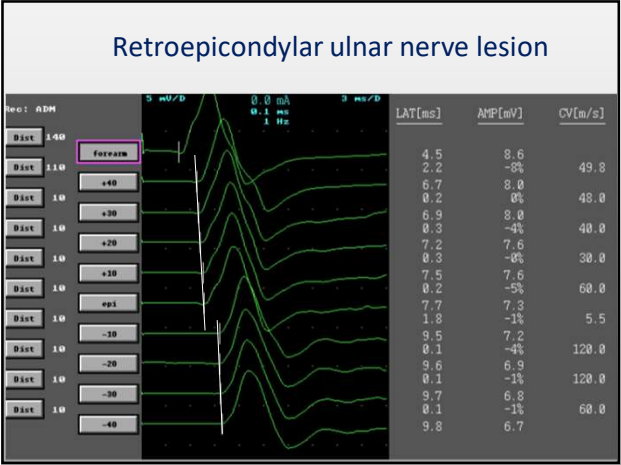


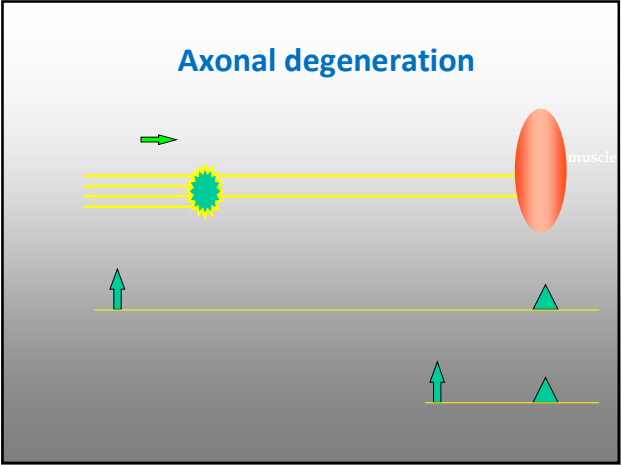
- ### Practical criteria of conduction block Uppsala
- Motor decay abnormal without dispersion
    - Arm: >25% decay and <15% dispersion
    - Leg:
      - Fibular nerve >30% decay and <30% dispersion
      - Tibial nerve >55% decay and <45% dispersion
  - Reduced number of F waves

- ### Block vs temporal dispersion (TD)
- Block is associated with weakness
  - TD not associated with weakness
  - Block is associated with IVIg response

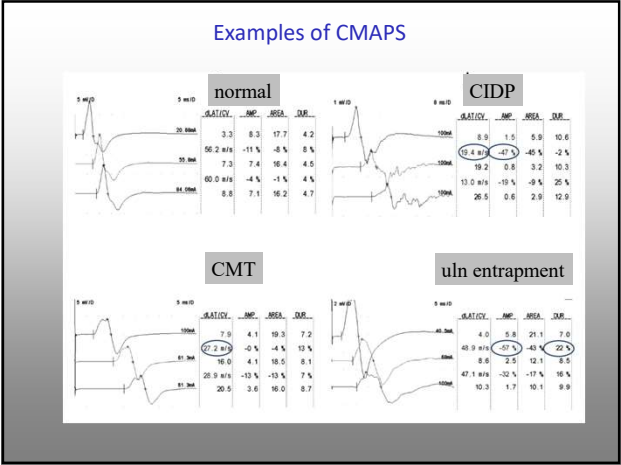
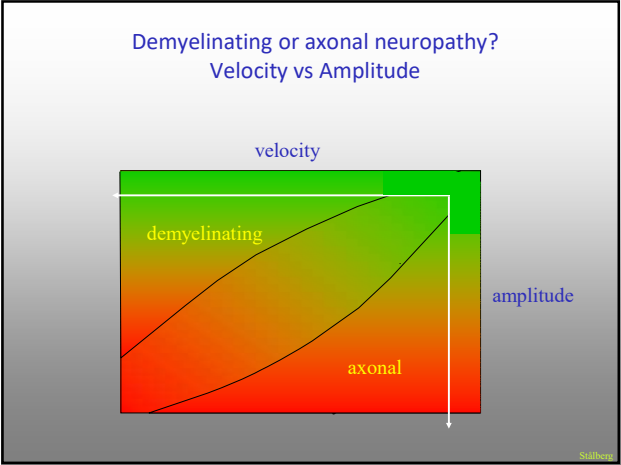
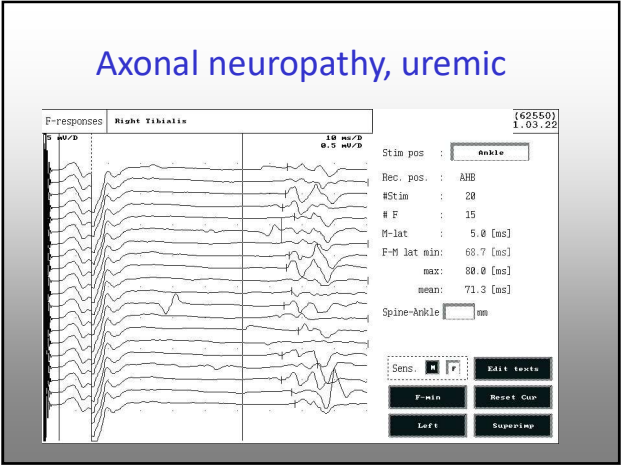
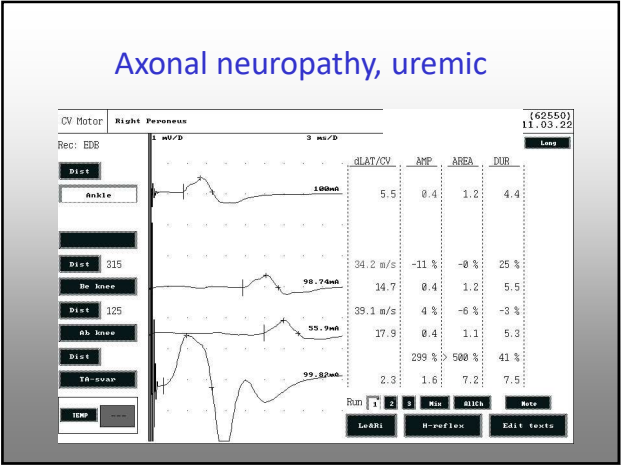


- ### Demyelinating neuropathy
- CV reduced to < 60% mean velocity
    - median nerve CV < 38 m/s
  - distal latency > 7 ms
  - normal or reduced amplitudes

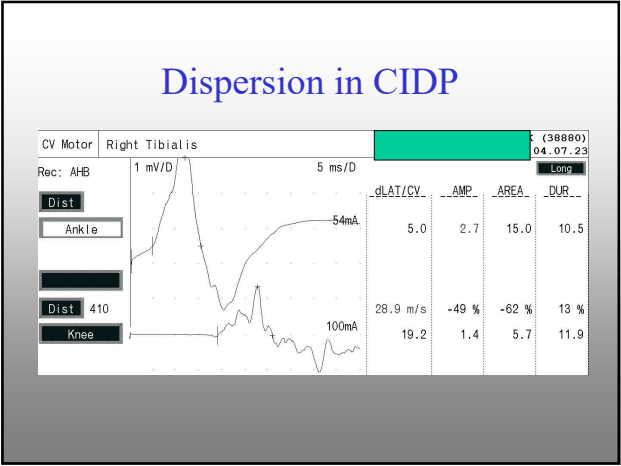
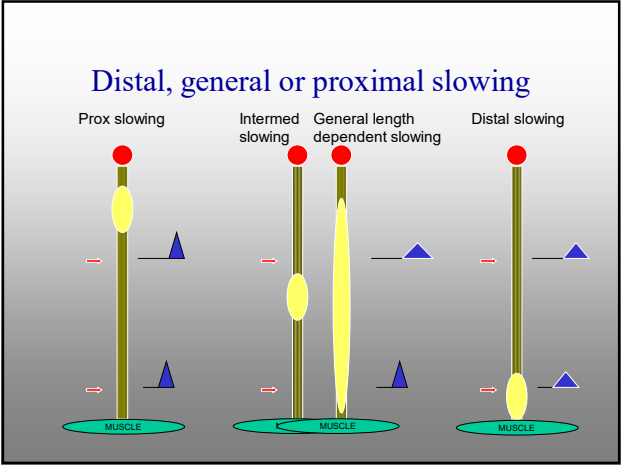
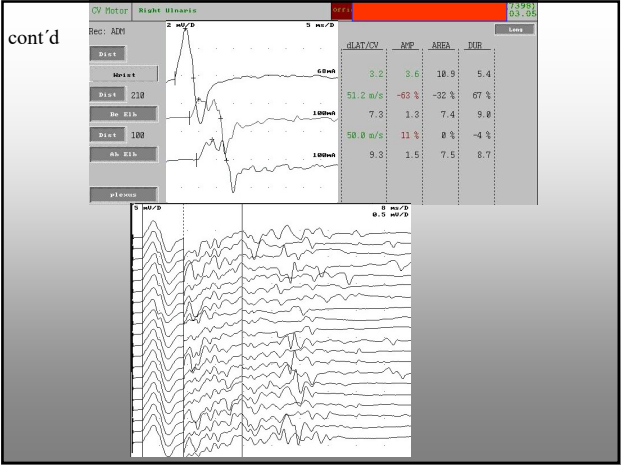




- ### Axonal neuropathy, focal or generalized
- Reduced motor and sensory amplitudes
  - Conduction velocity normal or slightly reduced
    - median motor > 40 m/s
  - Distal latency normal or slightly prolonged
  - No decay



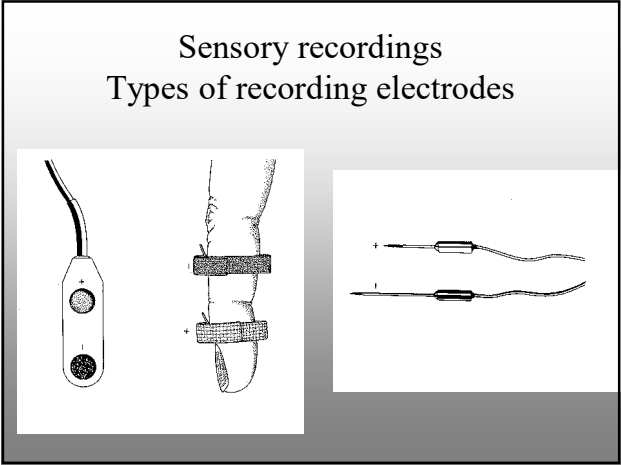




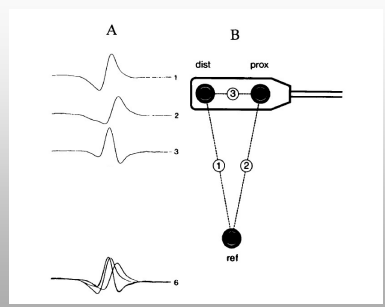
### Sensory recordings

### Orthodromic vs. antidromic SCS

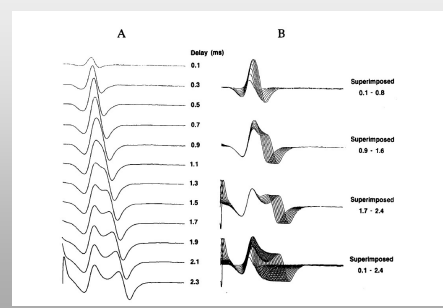
<p><b>Antidromic</b></p> <ul style="list-style-type: none"> <li>: less painful</li> <li>: larger amplitude</li> <li>◆ muscle artifact in mixed nerves</li> </ul>	<p><b>Ortodromic</b></p> <ul style="list-style-type: none"> <li>: no muscle artifact</li> <li>◆ more painful</li> <li>◆ lower amplitude</li> </ul>
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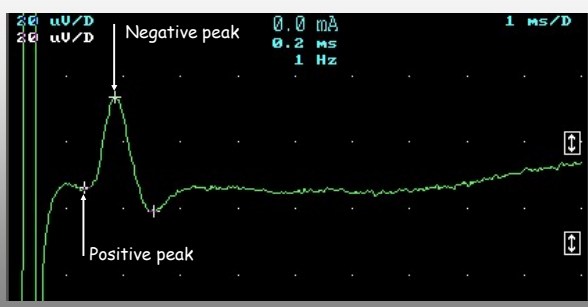
Generation of the sensory action potential, SNAP



Effect of inter-electrode distance or reduced cond vel

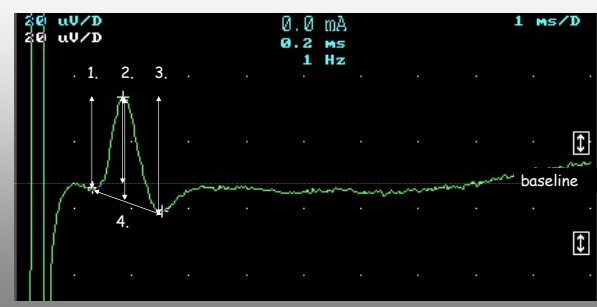


Latency

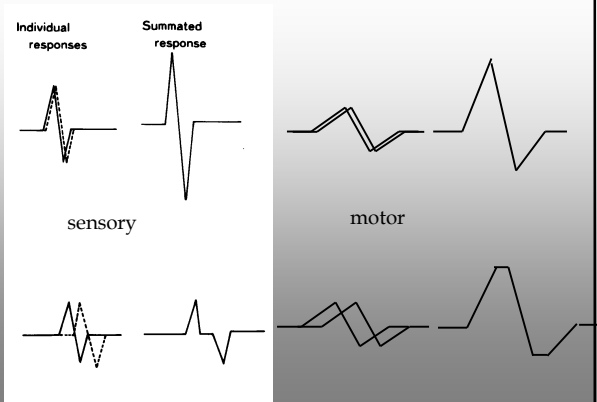


CV to first positive peak

Amplitude



Phase cancellation



Temperature sensory, antidromic dig III

