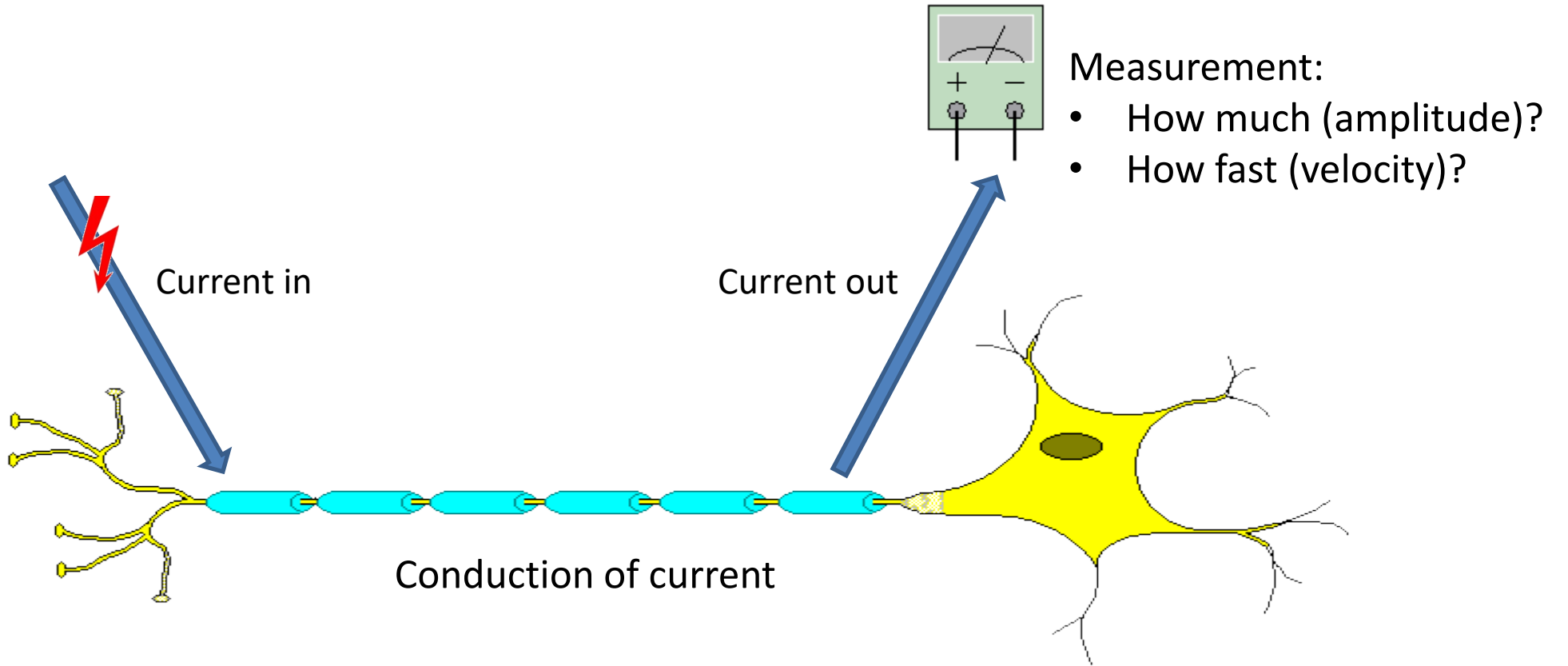


# Electrophysiology, Nerve Sonography

Ludwig Schelosky

Neurologie KSM

# Elektroneurography



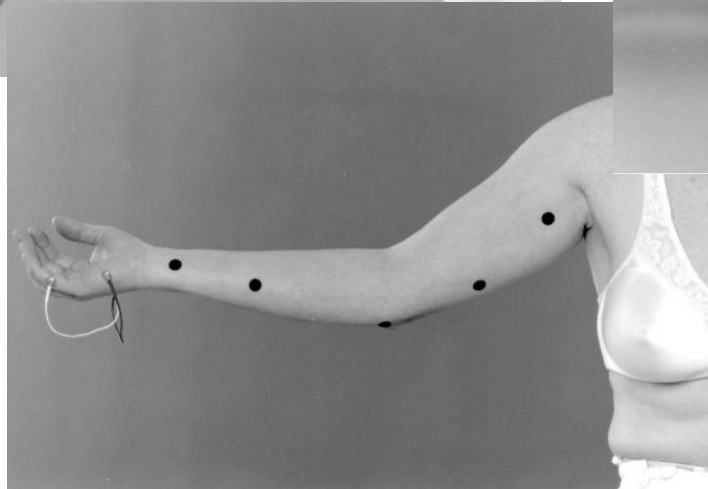
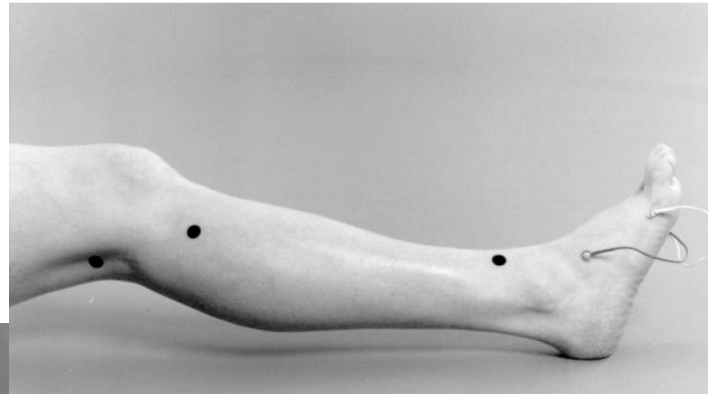
# Why neurography?

- Circumscribed neuropathies
  - Localization
  - Pathophysiology
  - Severity
- Polyneuropathy
  - Pathophysiology
  - Severity
  - Distribution

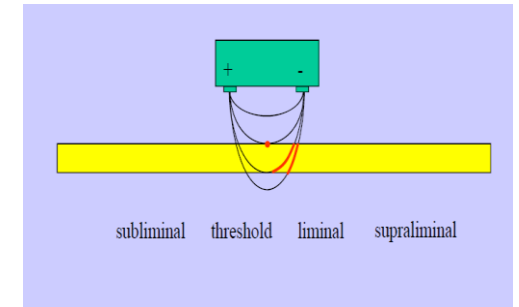
# Neurography - Technique

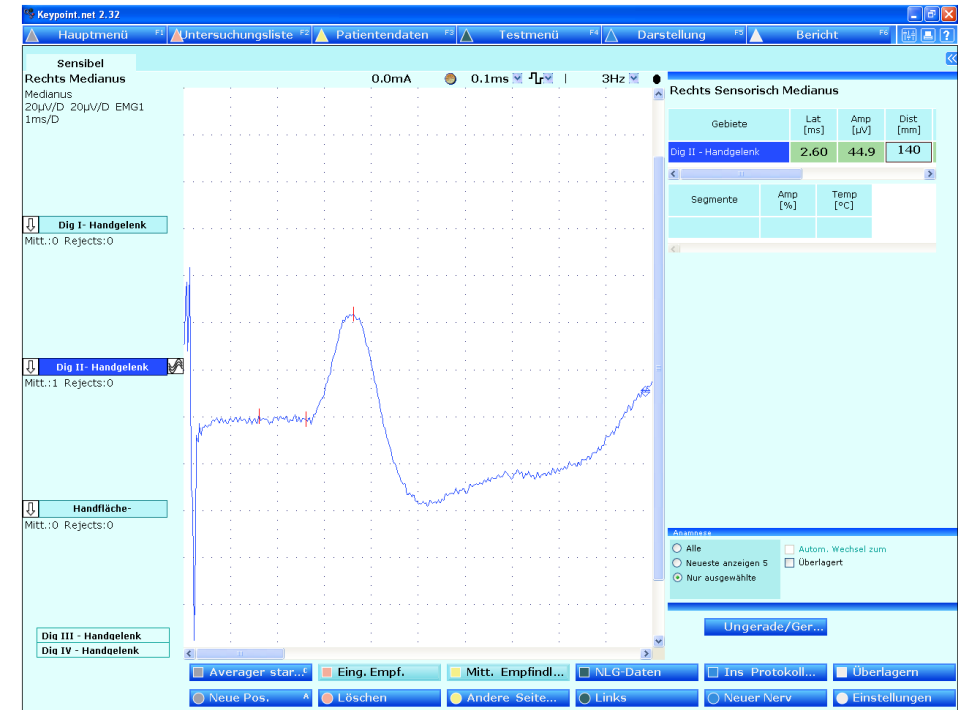
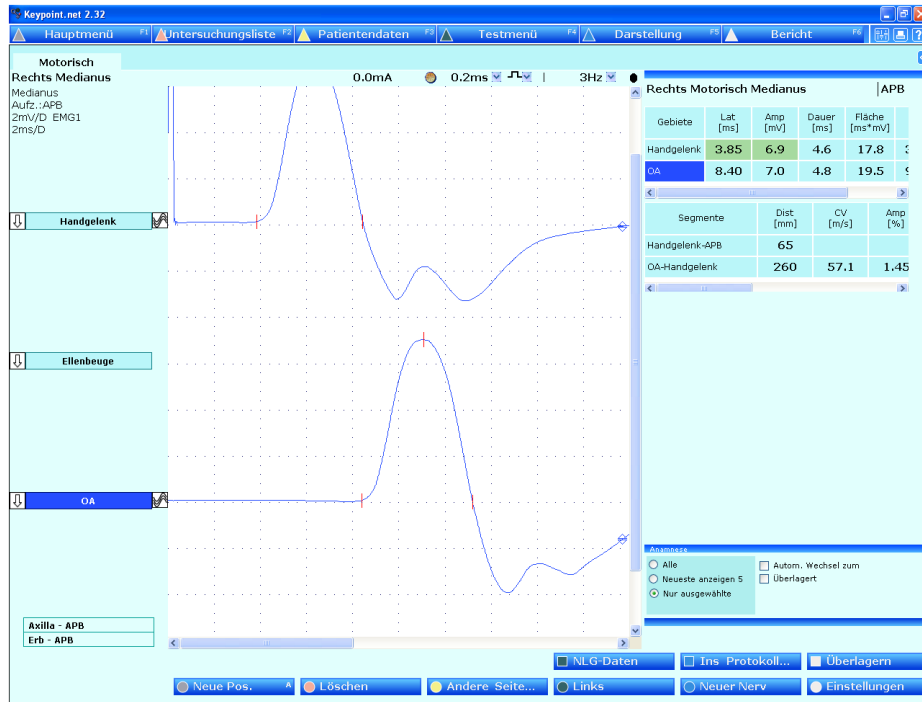


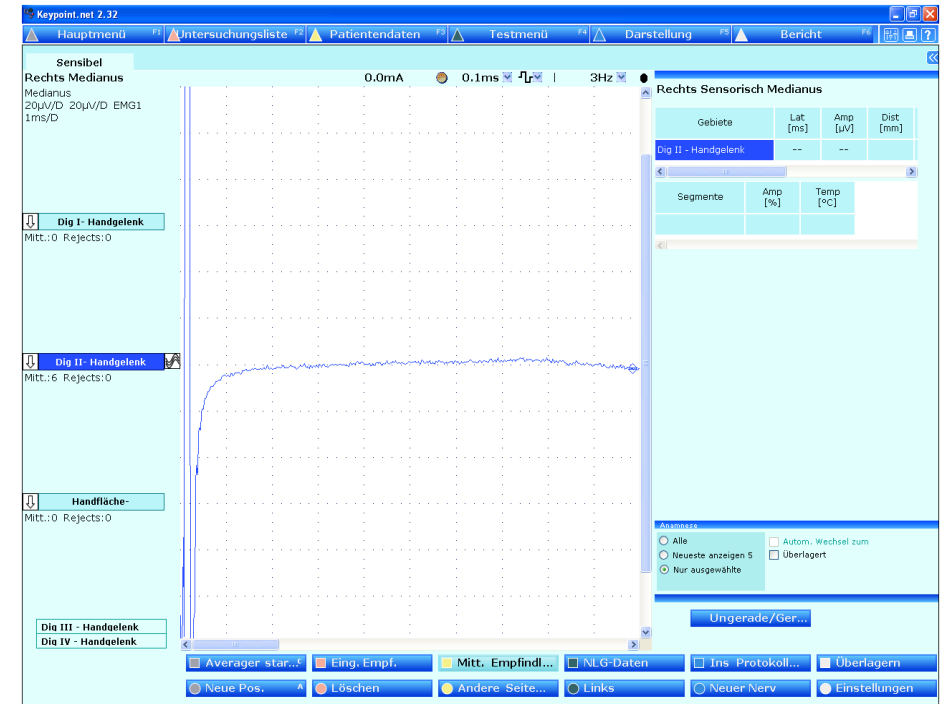
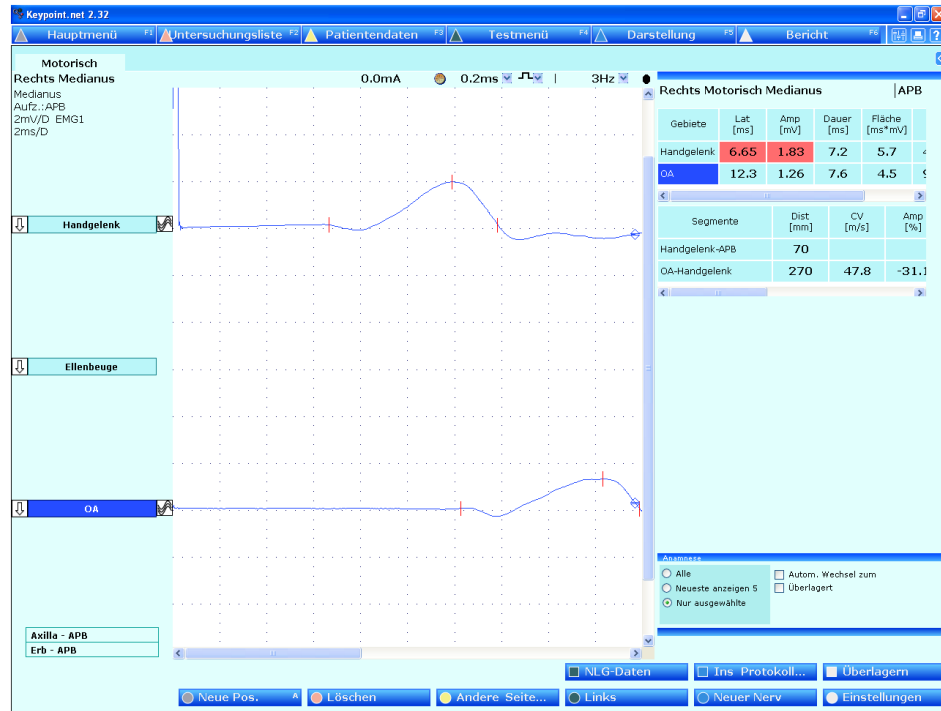
# Stimulation and recording

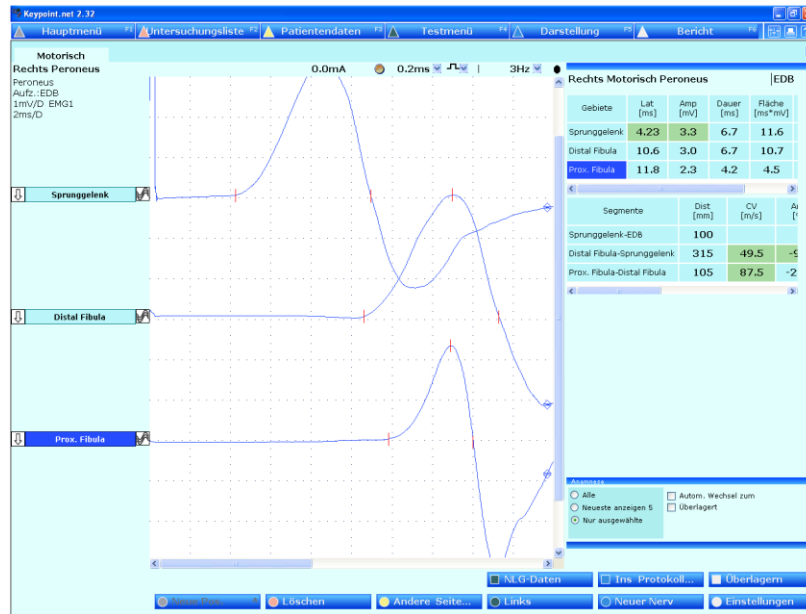
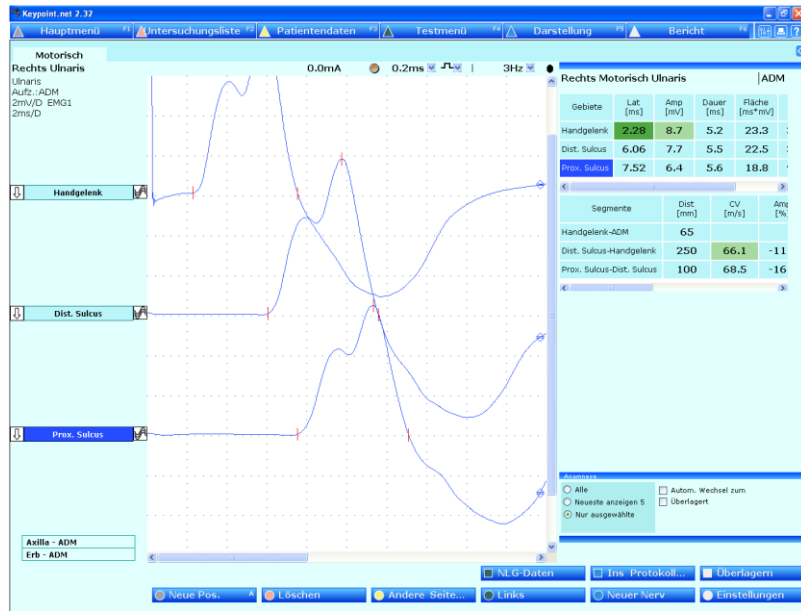


Stimulation Electrode





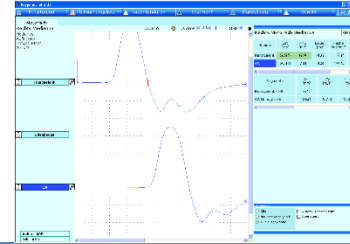






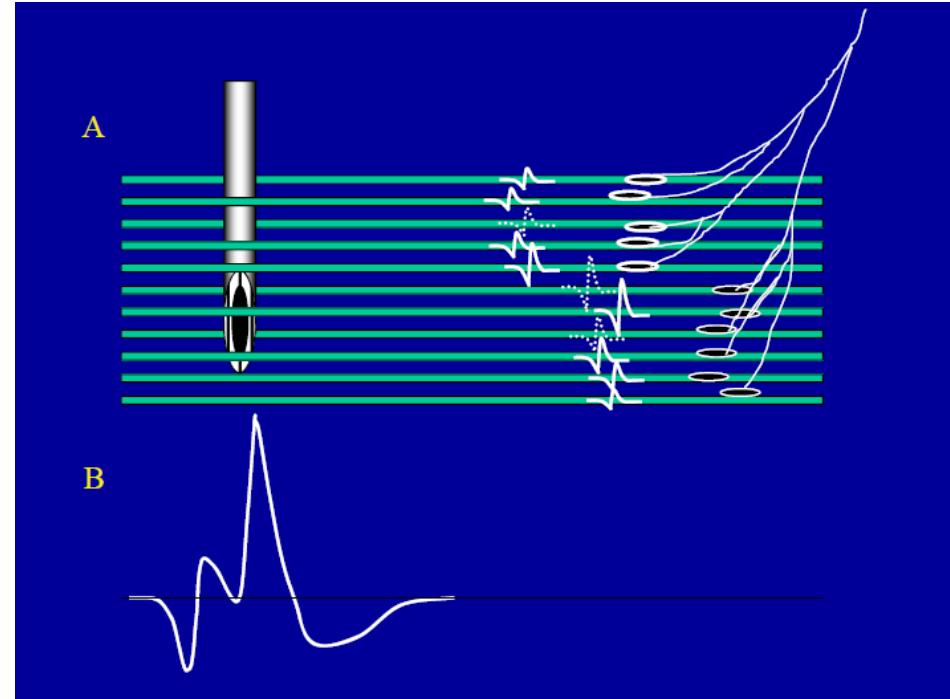
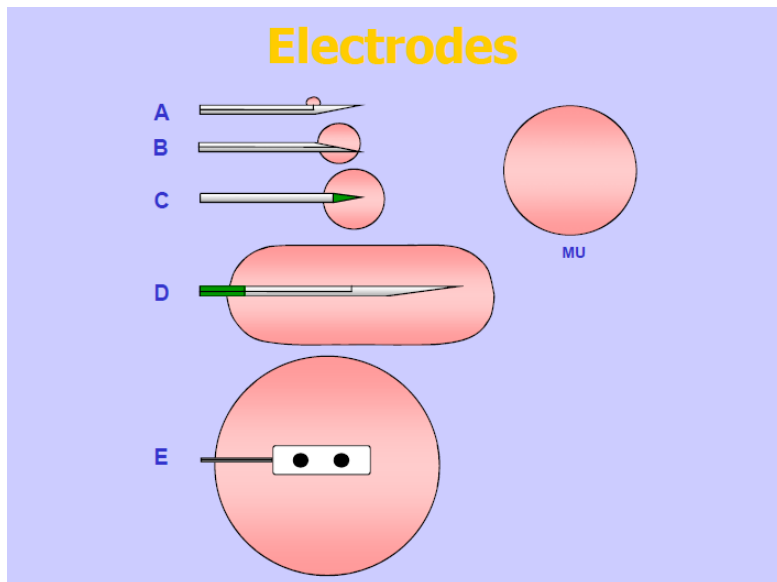
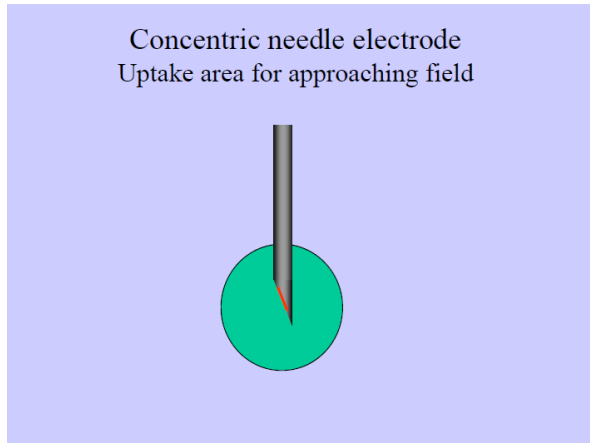
# Summary - what does the graph tell us?

- Amplitude:
  - Number of motor units
  - Temporal dispersion
- Nerve conduction velocity
  - Status of myelin sheath
  - Axon diameter
  - Temperature
- Duration
  - Temporal dispersion
  - Distal latency
- Nerve conduction velocity in the distal segment + time of neuromuscular transmission



Type	Diameter	Function
<b>A<math>\alpha</math></b>	<b>12-20 <math>\mu\text{m}</math></b>	<b>Touch , alfamotoneurons</b>
A $\beta$	5-12 $\mu\text{m}$	Touch
A $\gamma$	3-6 $\mu\text{m}$	Gammamotoneurons
<b>A<math>\delta</math></b>	<b>2-5 <math>\mu\text{m}</math></b>	<b>Cold, pain</b>
B	1-2 $\mu\text{m}$	Autonomic preganglionic
<b>C</b>	<b>0.3-1 <math>\mu\text{m}</math></b>	<b>Pain, heat, autonomic</b>

# Elektromyography



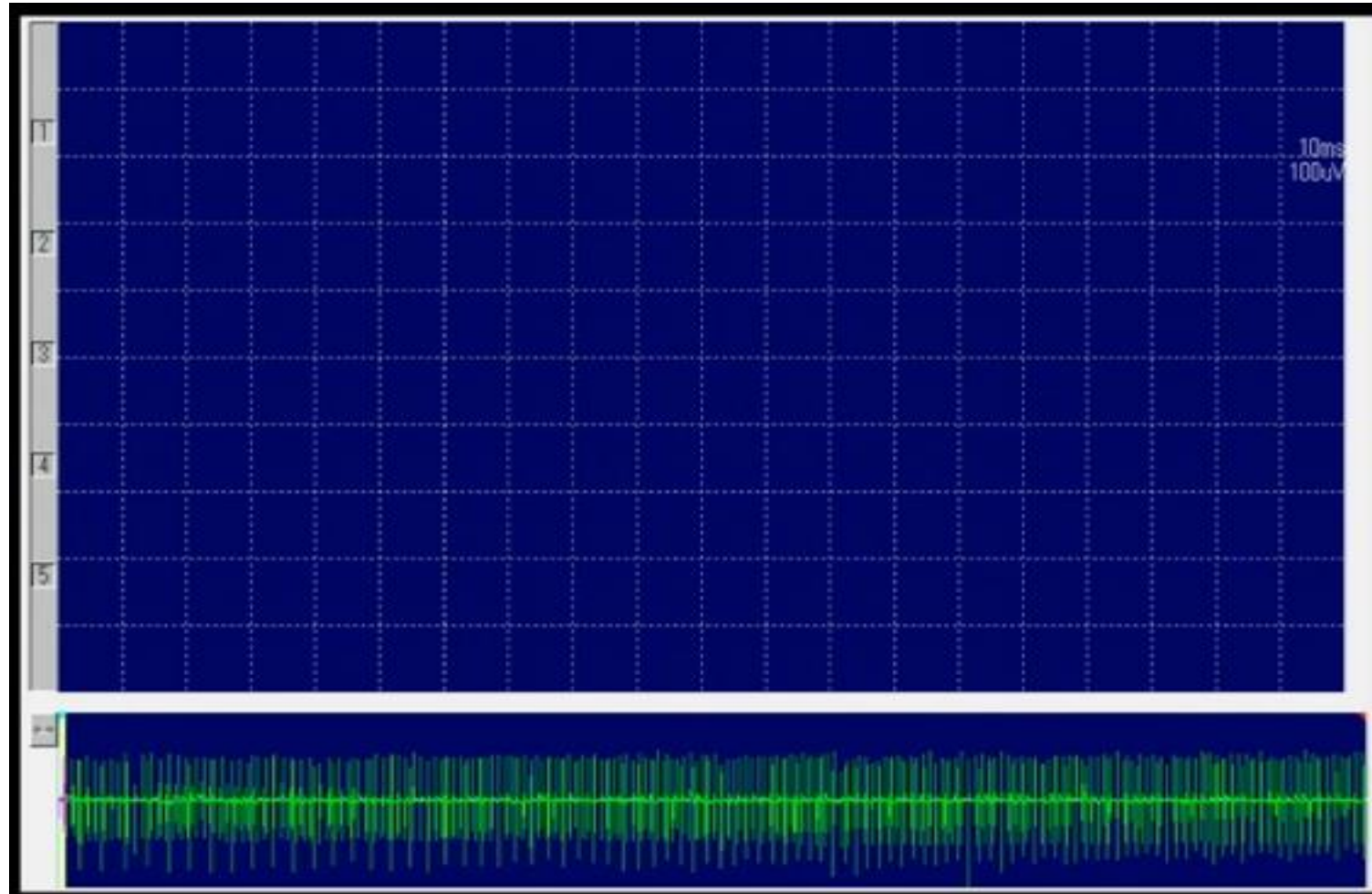
# Elektromyography Technique



# Examination progress in EMG

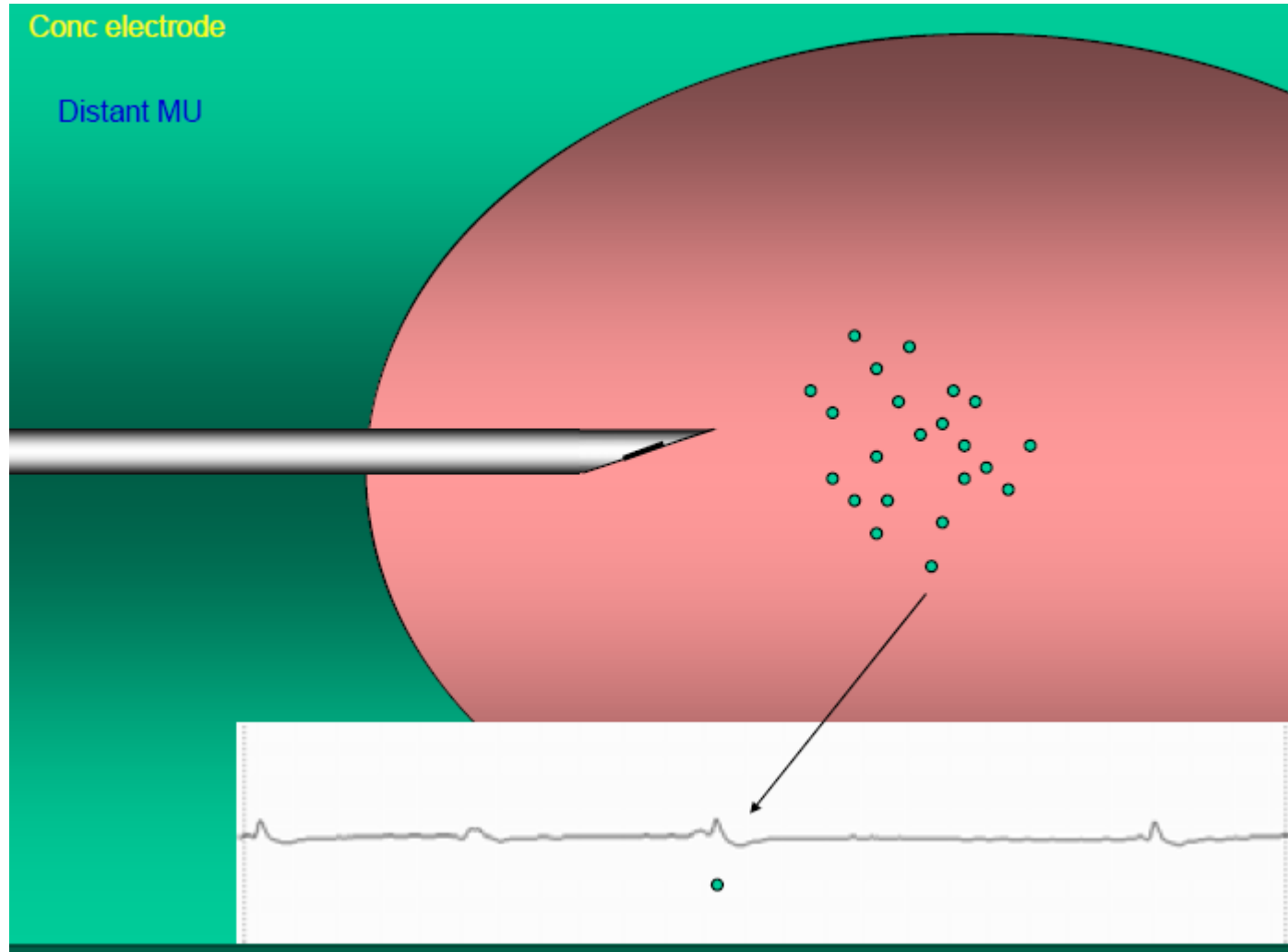
- Spontaneous activity
- Slight voluntary innervation
- Maximum innervation

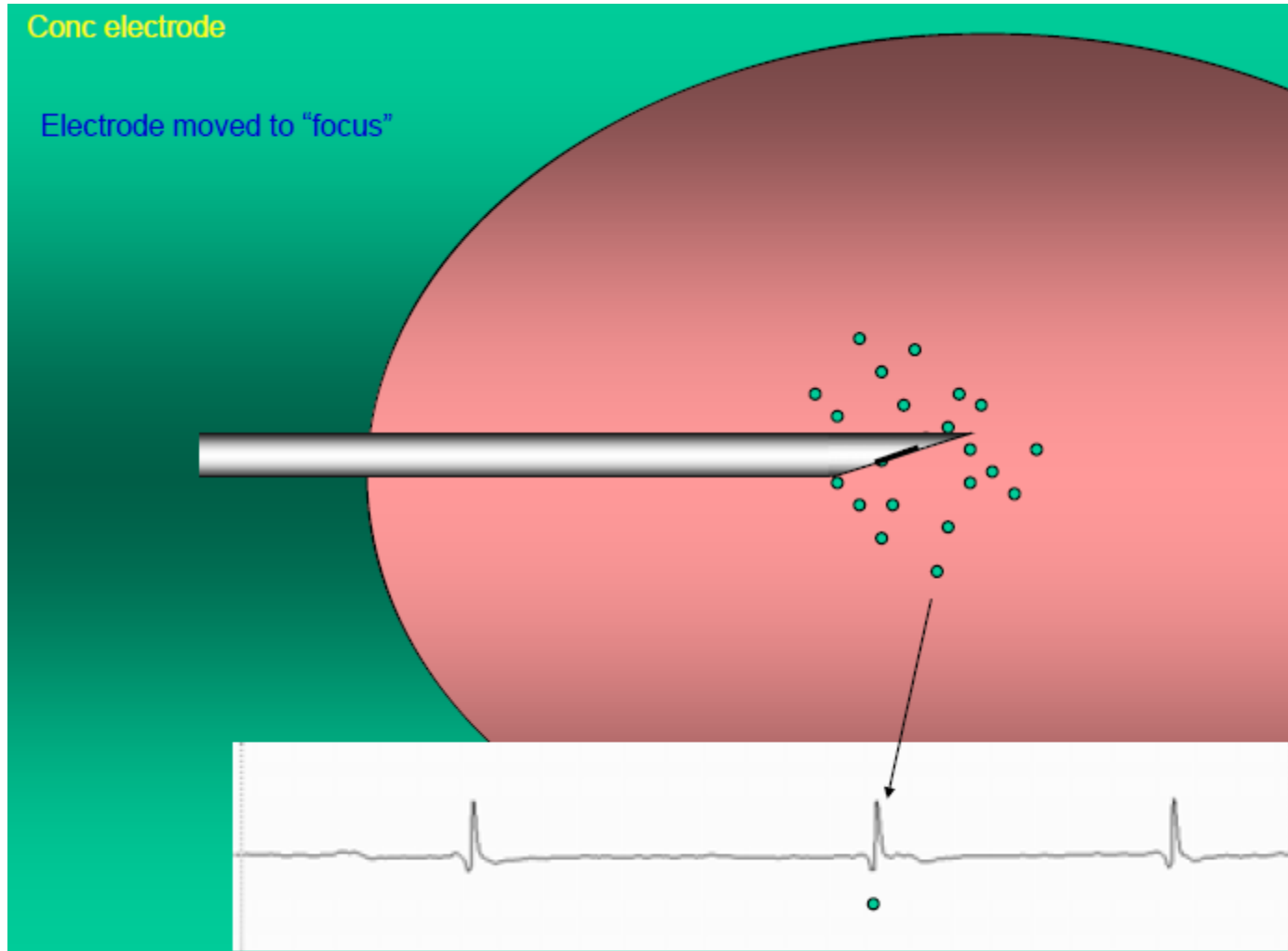
# Spontaneous activity



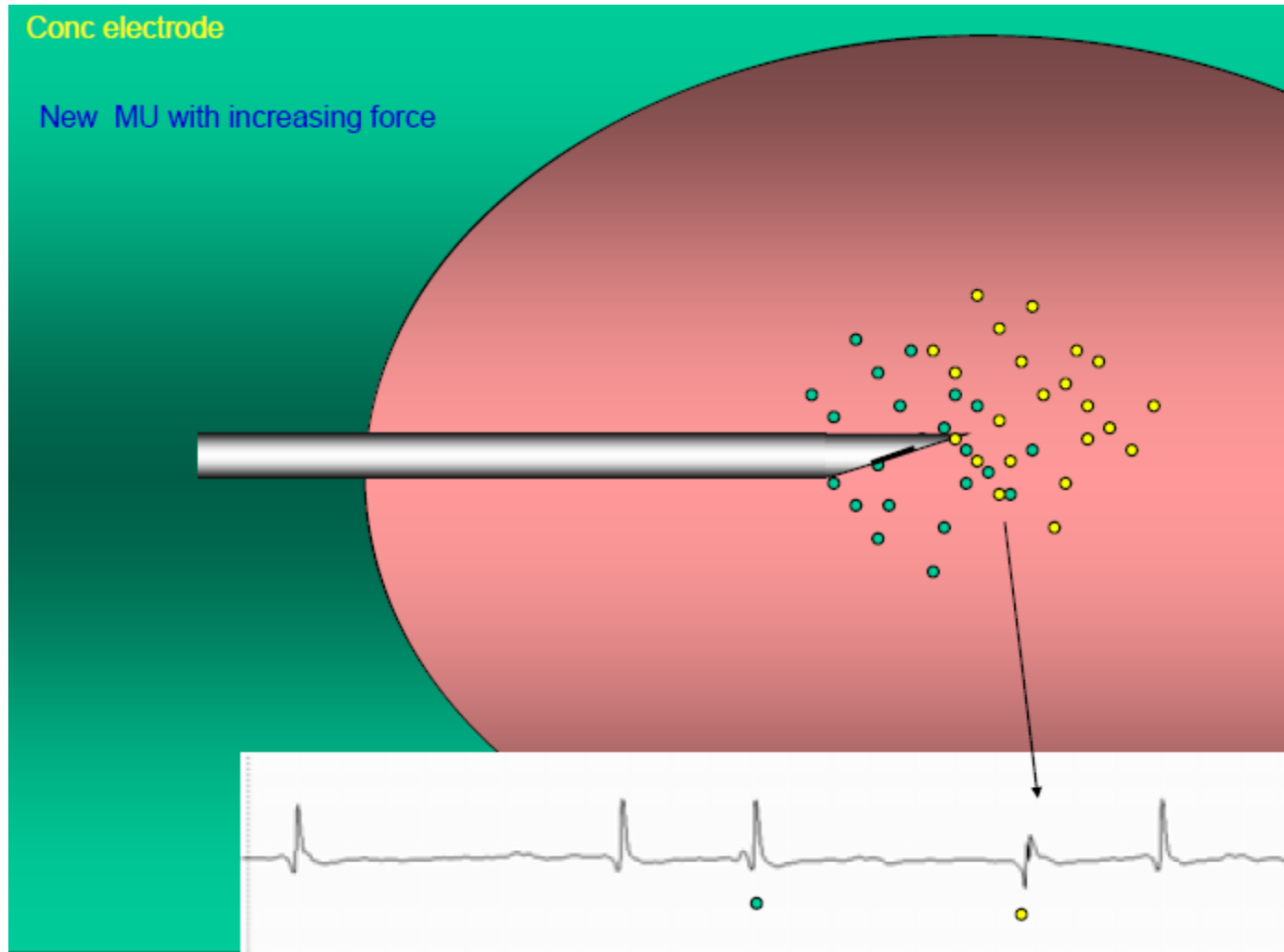
# Examination progress in EMG

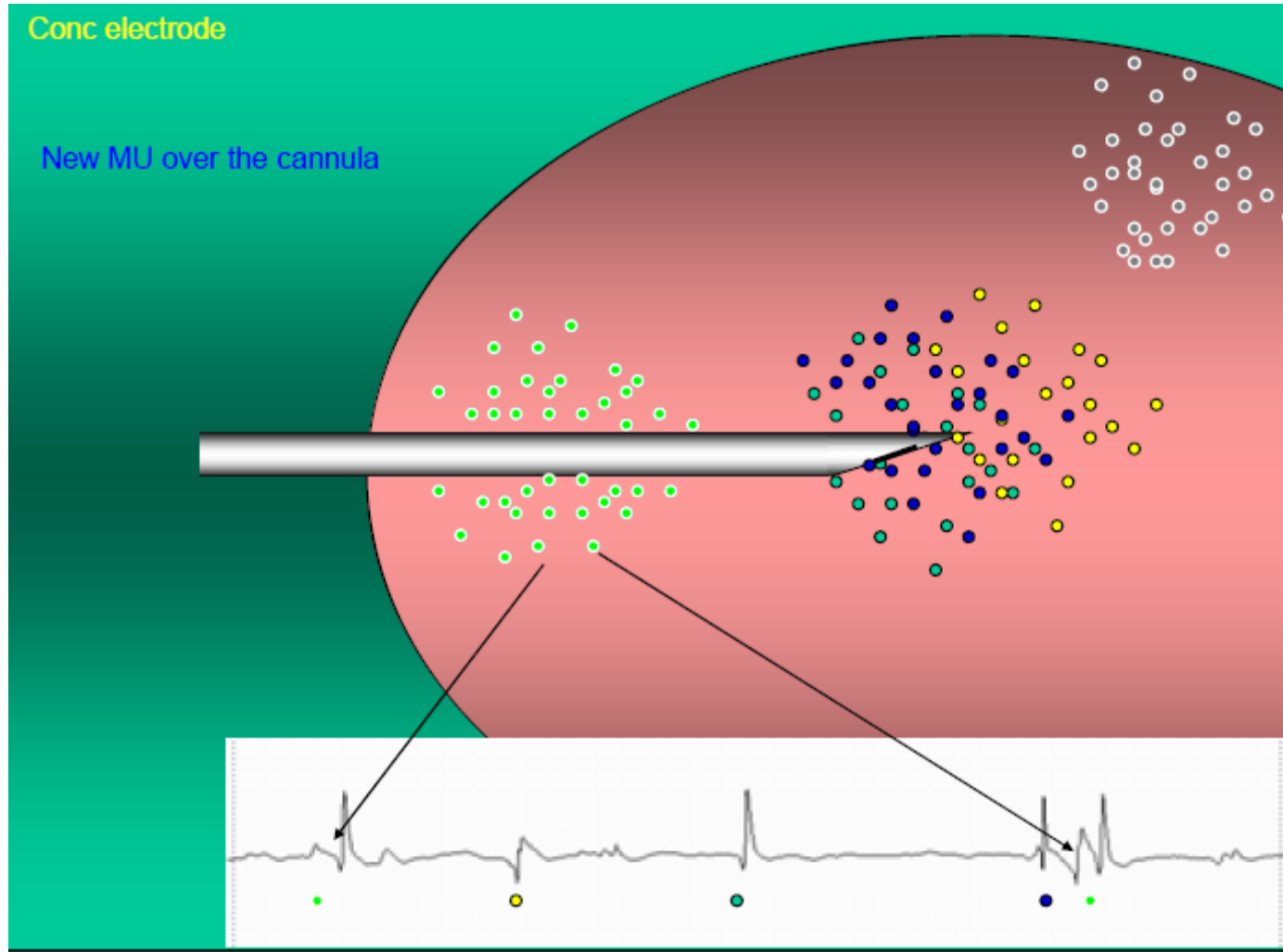
- Spontaneous activity
- Slight voluntary innervation
- Maximum innervation



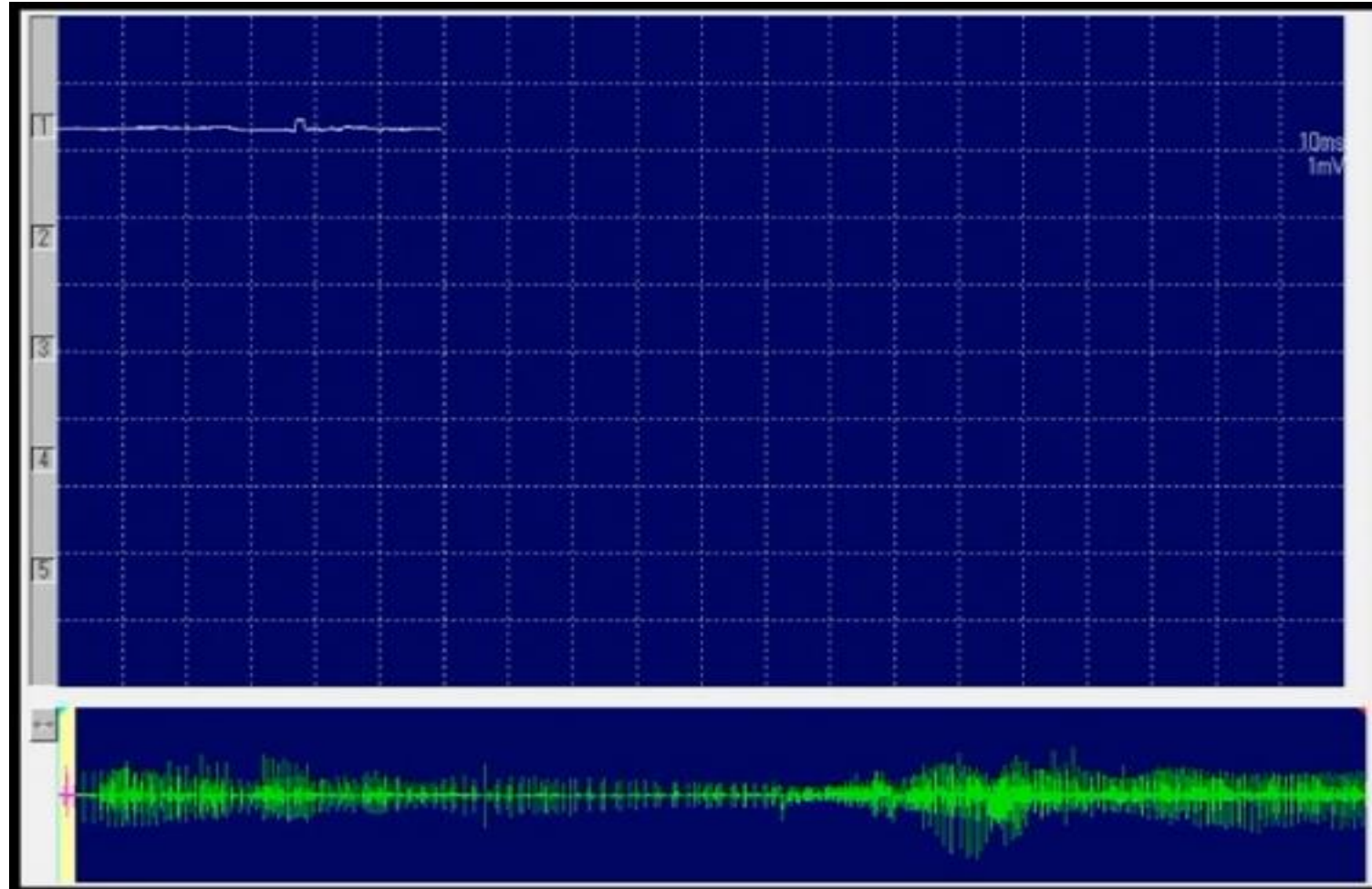




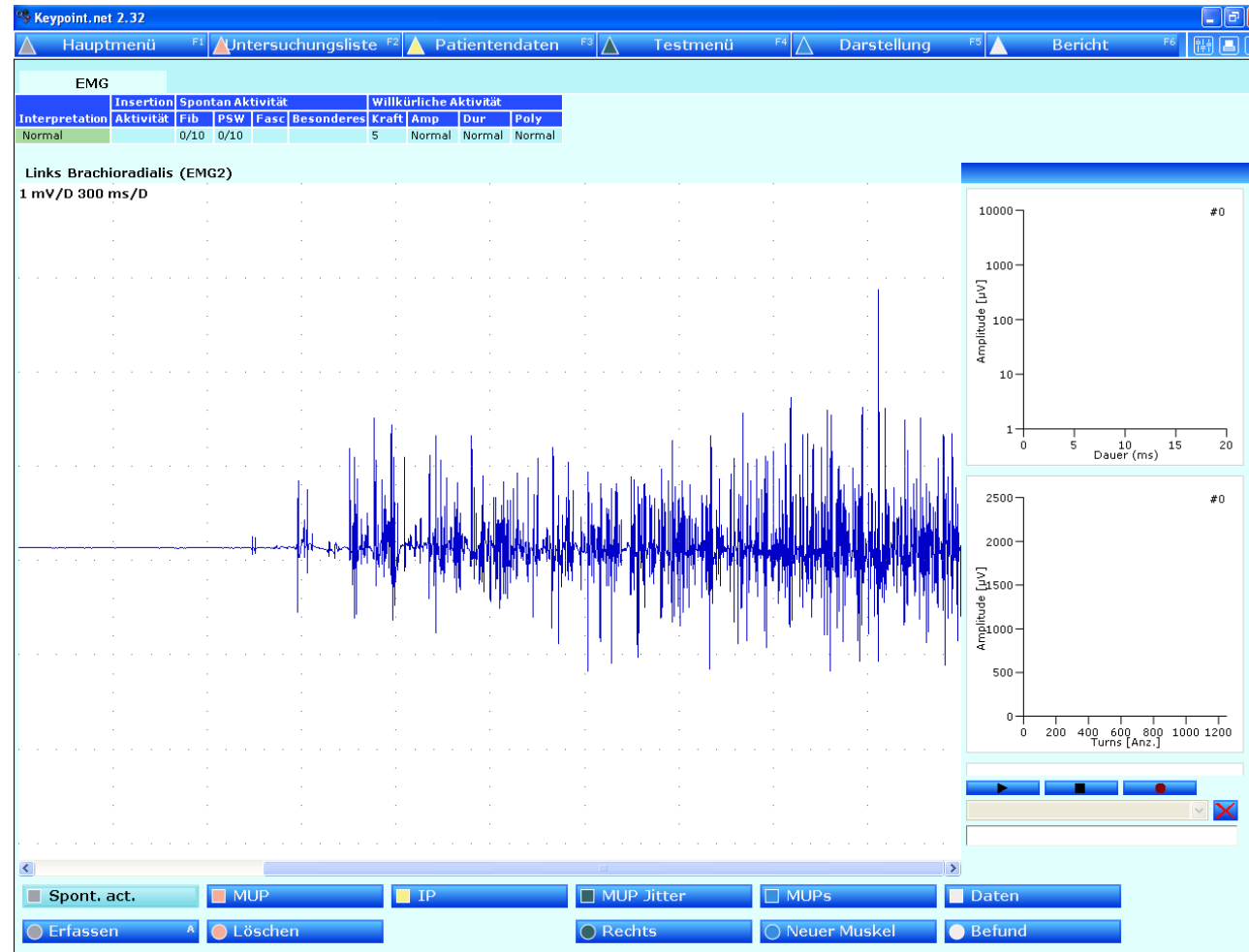




# Slight voluntary activity



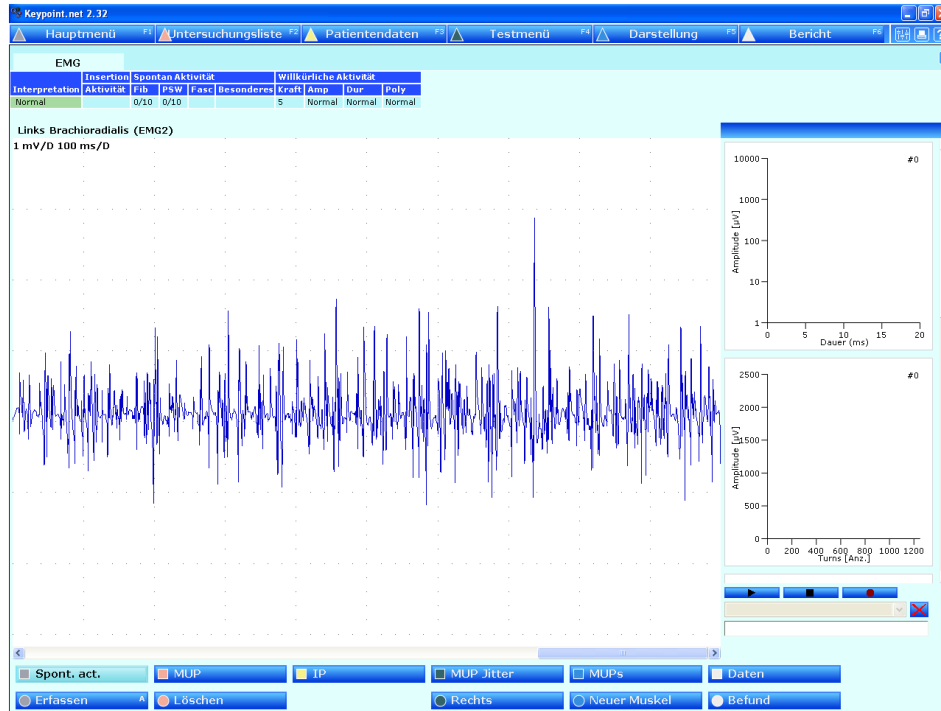
# Maximum innervation - recruitment



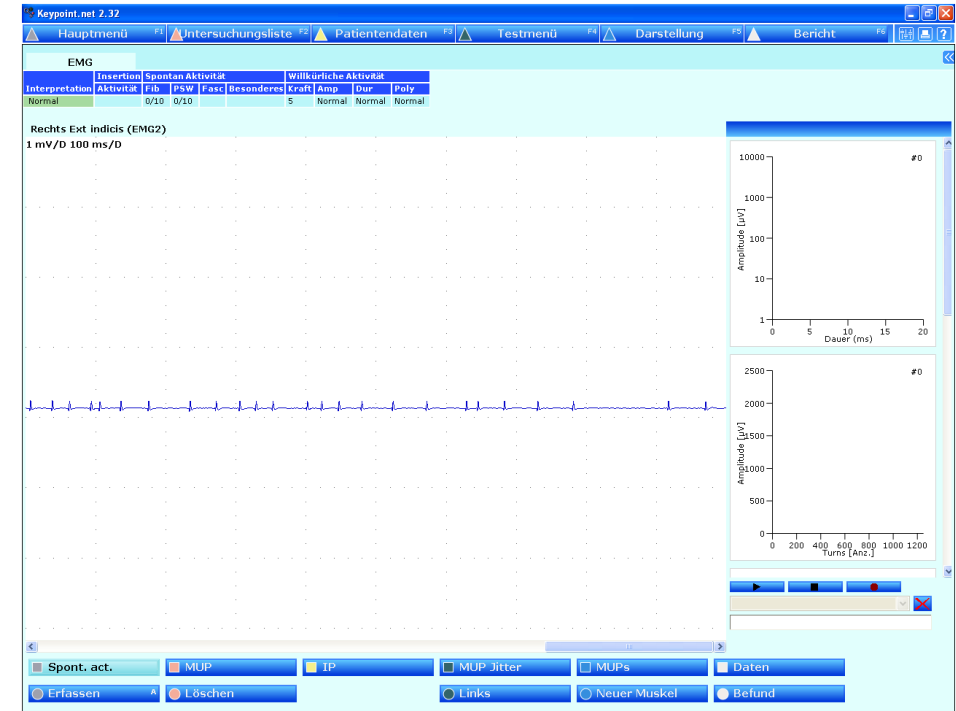
# Polyphasia



# Maximum innervation



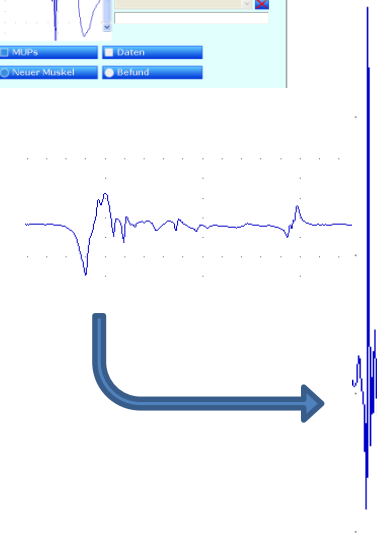
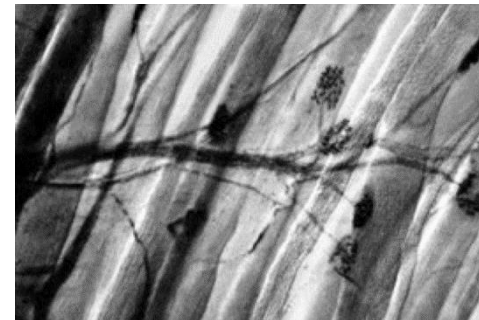
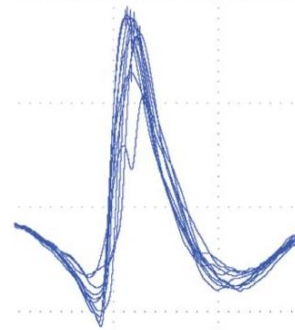
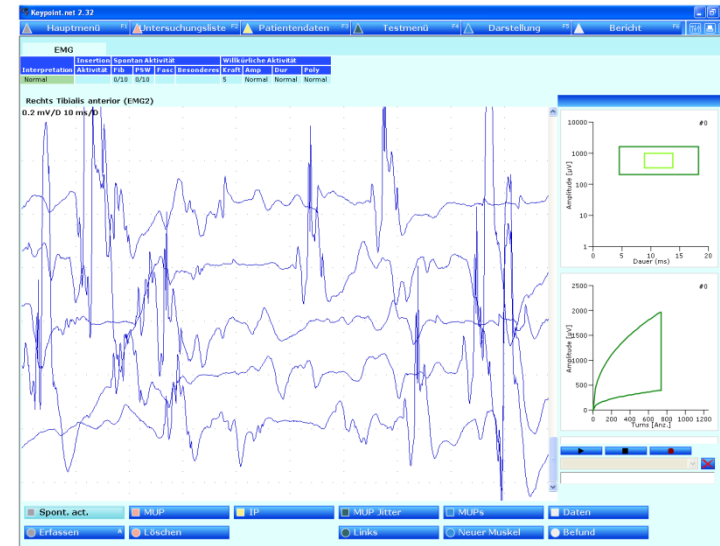
healthy



thinned out

# Summary - what does the graph tell us?

- Amplitude and area:
  - Number of muscle fibers / size of motor units around the needle tip
- Duration, phases, zero line crossing, satellites:
  - State of myelination
- Jitter:
  - Stability of neuromuscular transmission

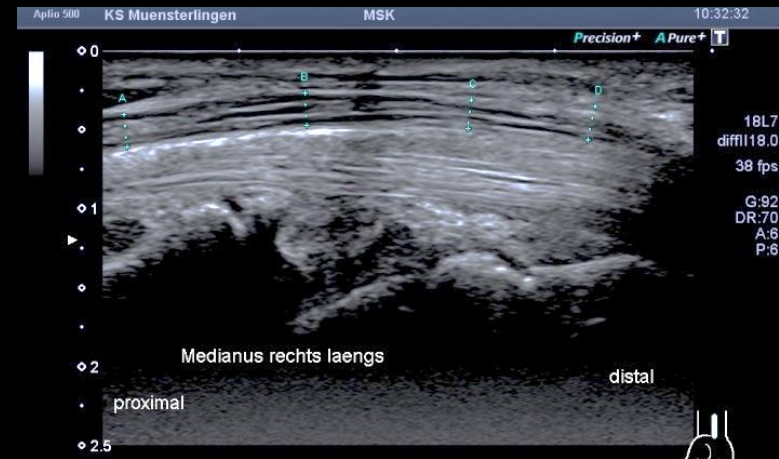
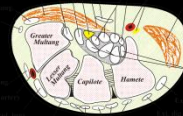


# Why nerve sonography?

- Open questions after neurological and electrophysiological examination
- Early changes
- Comfort for patients
- Localization and movement of muscles
- More precise answer to some neurological questions
- Invasive therapy
- Interaction with the patient



# Anatomy – N. medianus



Dist A	2.1 mm	Dist B	2.1 mm	Dist C	1.8 mm	Dist D	2.2 mm
--------	--------	--------	--------	--------	--------	--------	--------

Area A	0.07 cm <sup>2</sup>	Circ A	10.8 mm
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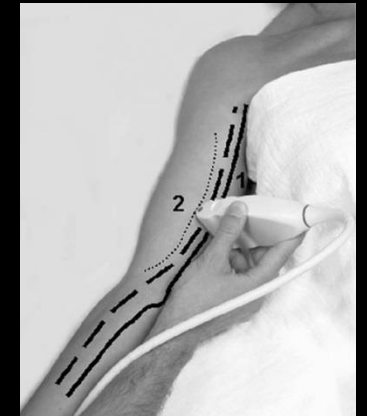
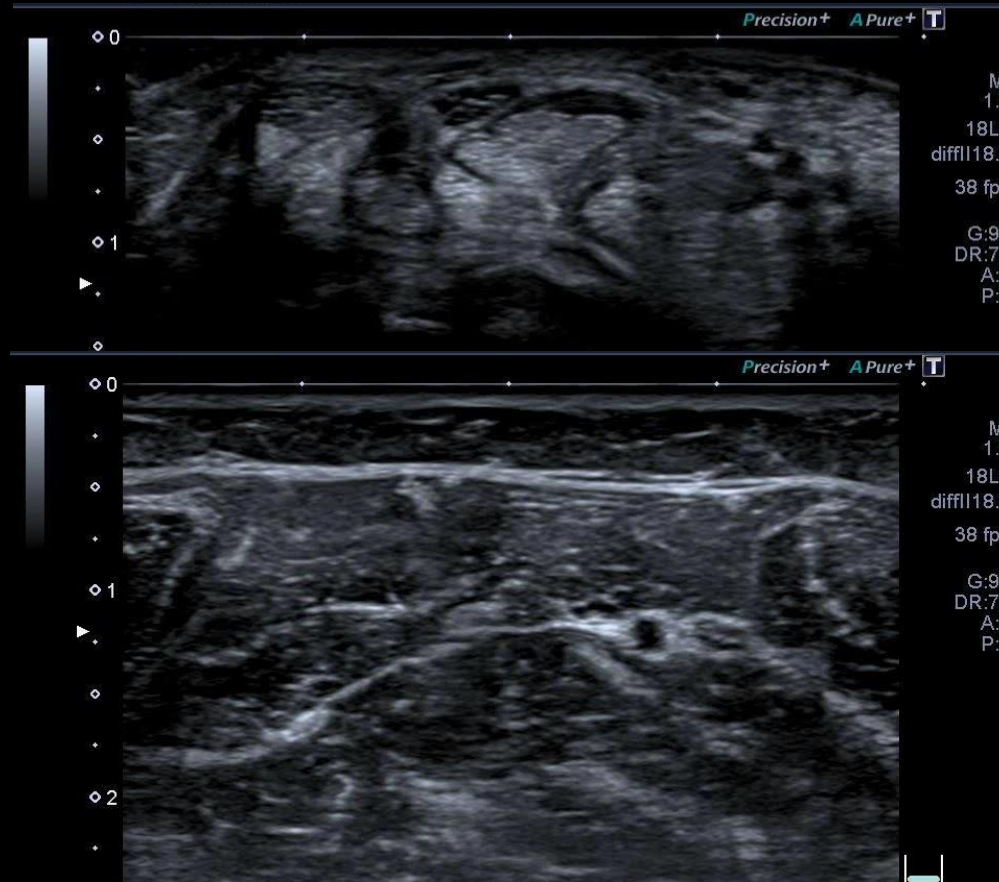
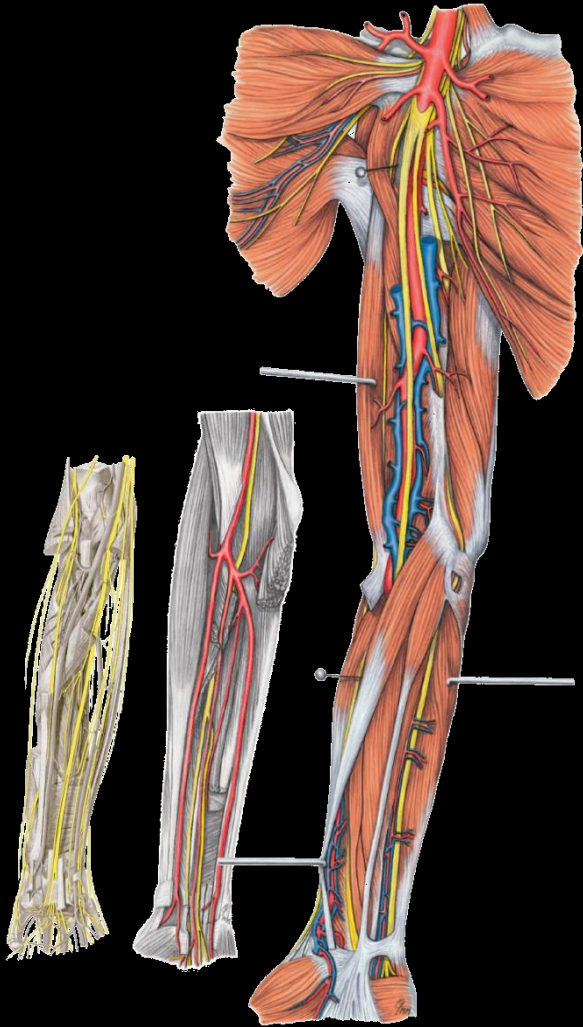


Area A	0.04 cm <sup>2</sup>	Circ A	7.1 mm
--------	----------------------	--------	--------

What do we assess on the nerves?

- Texture
- Caliber change
- Compression
- Vascularization
- Surrounding area

# Anatomy – N. medianus

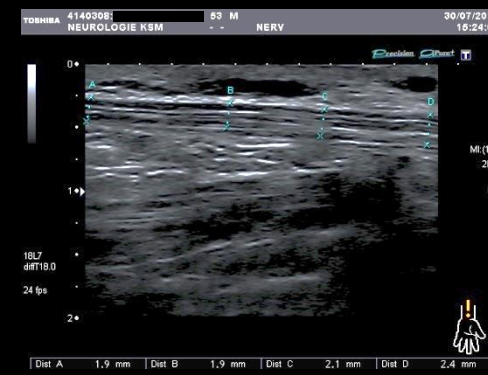
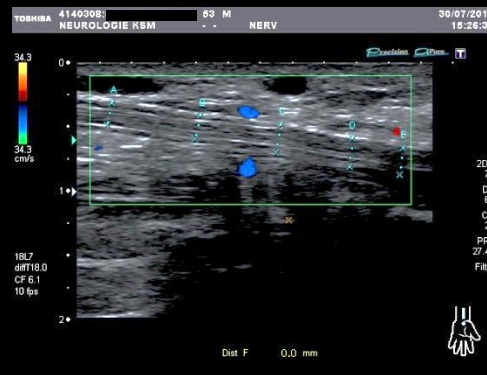
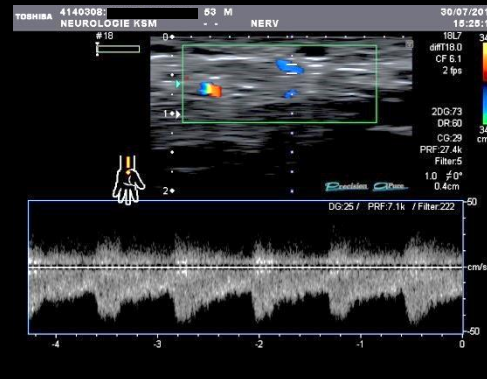


# Case study M.K., \* 1962

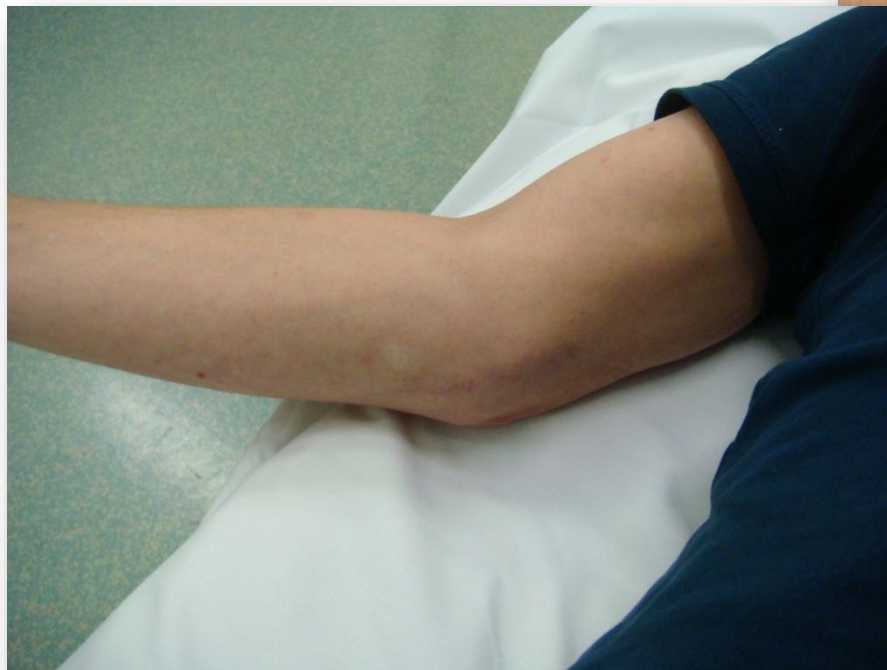
Motorisch			
Nerv	Lat	Amp	CV
	ms	mV	m/s
Medianus Motorisch Links			
Handgelenk - APB	5.64	4.1	
OA-Handgelenk	11.3	3.5	41.3
Medianus Motorisch Rechts			
Handgelenk - APB	3.67	5.2	
OA-Handgelenk	8.44	4.1	50.3
Ulnaris Motorisch Links			
Handgelenk - ADM	2.81	8.6	
Dist. Sulcus-Handgelenk	7.33	8.1	54.2
Ulnaris Motorisch Rechts			
Handgelenk - ADM	2.90	8.3	
Dist. Sulcus-Handgelenk	7.08	8.2	59.8

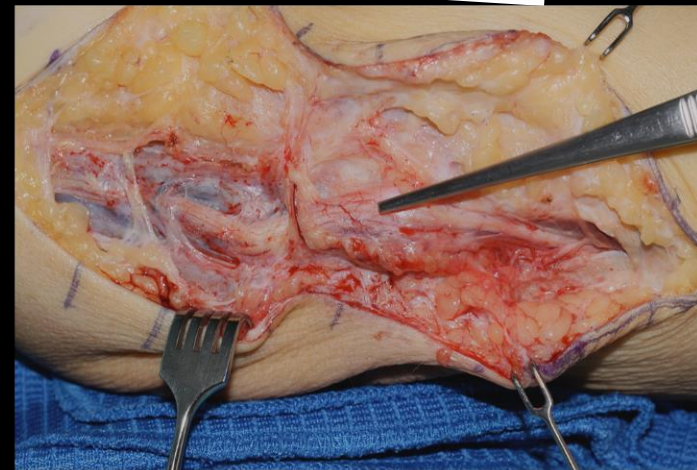
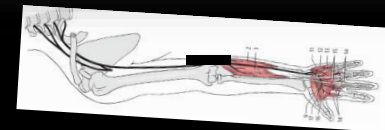
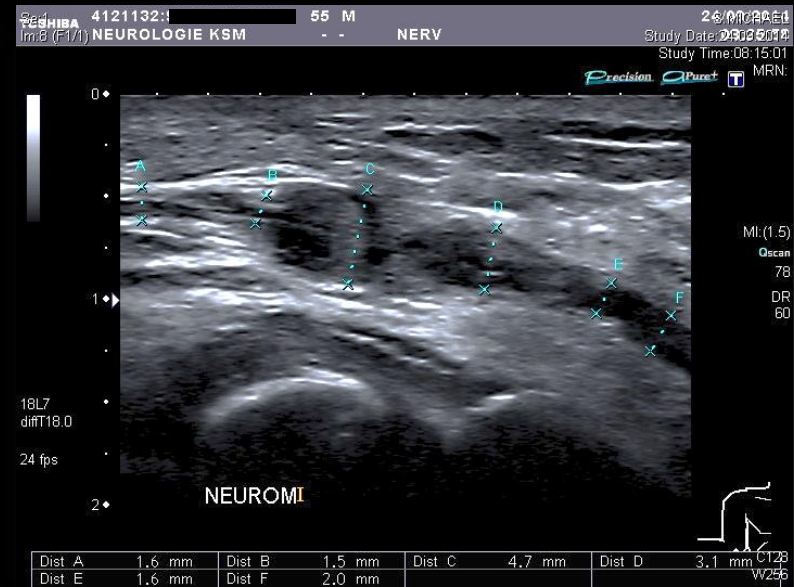
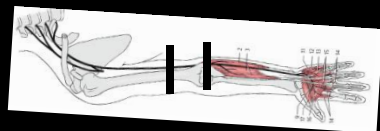
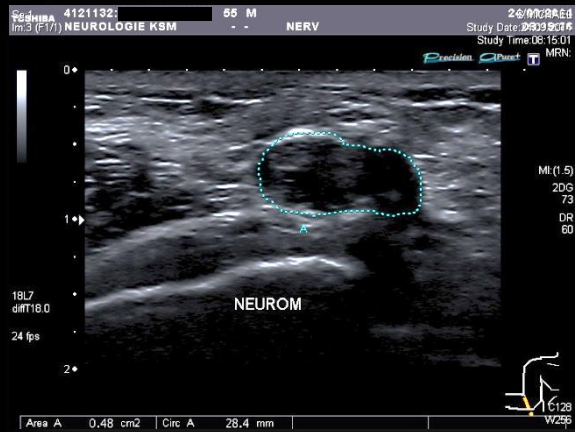
Sensibel			
Nerv	Lat	Amp	CV
	ms	uV	m/s
Medianus Sensorisch Links			
Dig II - Handgelenk	Kein Potential		
Medianus Sensorisch Rechts			
Dig II - Handgelenk	3.96	8.7	63.1
Ulnaris Sensorisch Links			
Dig V - Handgelenk	2.1	14.1	55.9
Ulnaris Sensorisch Rechts			
Dig V - Handgelenk	1.9	12.5	61.1

# Case study M.K., \* 1962

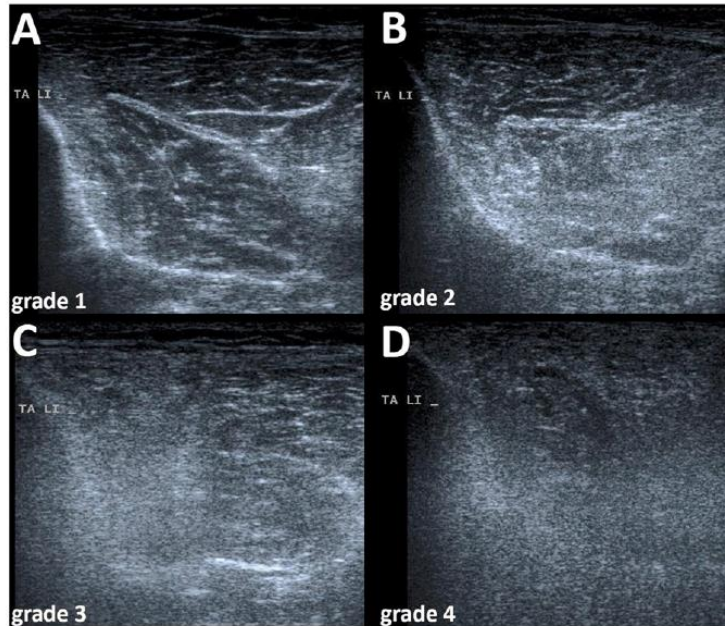


EMG-Befund				
Motorische Neurographie				
Motorisch				
Nerv	Lat	Amp	CV	F-M Lat
	ms	mV	m/s	ms
Ulnaris Motorisch Rechts				
Handgelenk - ADM	4.69	0.92		
Sensible Neurographie				
Sensibel				
Nerv	Lat	Amp	CV	
	ms	uV	m/s	
Ulnaris Sensorisch Rechts				
Dig V - Handgelenk		Kein Potential		





# Heckmatt Score



**Table 1.** Heckmatt score: visual grading scale to classify muscle echo intensity.<sup>39</sup>

Grade	Ultrasound appearance
Grade I	Normal
Grade II	Increased muscle echo intensity with distinct bone echo
Grade III	Marked increased muscle echo intensity with a reduced bone echo
Grade IV	Very strong muscle echo and complete loss of bone echo

Ultrasonic cross-sections through the tibialis anterior muscles showing different grades in echogenicity as defined by the Heckmatt score:

- I. Normal echo intensity with starry-night aspect with distinct bone echo in a healthy control.
- II. Increased echo intensity with normal bone echo in a septic patient at day 4
- III. Increased echo intensity with reduced bone signal in a septic patient at day 14.
- IV. Increased echo intensity and loss of bone signal in a septic patient at day 14