Significance of neurography

- One of the clinically most useful methods in clinical neurophysiology
- Neurography alone can in many cases localize ulnar nerve lesions, carpal tunnel syndrome and peroneal nerve lesions
- In many polyneuropathies neurography alone may be sufficient
- Techologists can do neurography with surface electrodes

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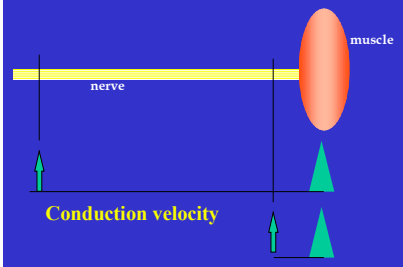
Motor nerve conduction study



Amplitude:
# of axons
n-m transmission
muscle volume

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Distal latency

- conduction time in distal axons
- neuromuscular transmission time
- time to generate muscle action potentials
- if the recording electrode is not over the end-plate region conduction time from end-plate to recording electrode

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Conduction velocity

CV = segment length / conduction time

- fastest axons
- reflects axon diameter
- myelin structure
  - demyelination
  - remyelination
- temperature
- metabolic factors

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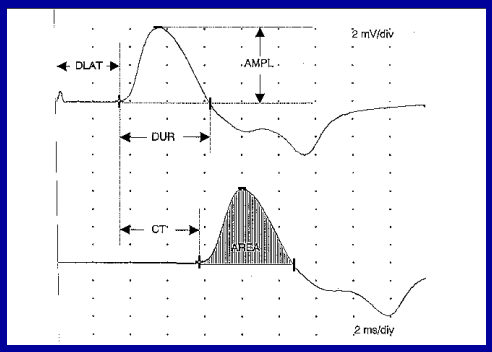

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Nerve simulator normal findings

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Decay =

decrease in amplitude or area

decay = 100*(amplitude$_{distal}$- amplitude$_{proximal}$) / amplitude$_{distal}$

- dispersion of conduction velocities
  - (normal or abnormal)
- conduction block
  - (abnormal)

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Dispersion

dispersion = 100 * (duration$_{proximal}$- duration$_{distal}$) / duration$_{proximal}$

- range of conduction velocities

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Changes along the nerve

- Decay (amplitude and area)
  - % drop compared to distal CMAP
- Temporal dispersion (duration)
  - % increase compared to disal CMAP

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Effect of stim-rec distance in the normal nerve

note: decay due to dispersion

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What physiological and anatomical functions motor neurography reflects

Amplitude	1. Number of Mus
	2. Size of Mus
	3. Diameter of muscle fibres
	4. Dispersion of CV
Conduction velocity	1. State of the myelin
	2. Axon diameter (MU size)
Duration	1. Dispersion of CV
Distal latency	1. CV in distal segment
	2. Length of distal segment
	3. Nm transmission time
Decay	1. Dispersion of CV
	2. Conduction block

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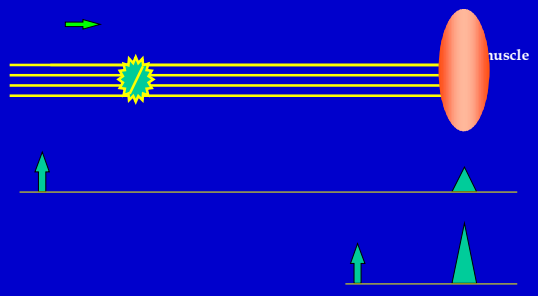
Conduction block



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Local conduction block

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Definition of conduction block

- > 20% amplitude or area decay and less than 15% dispersion
- >50% amplitude or area decay
- both criteria are equally sensitive, but the latter is more specific

Ad hoc committee of the American Academy of Neurology AIDS taskforce, Neurology; 41: 617-618

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Practical criteria of conduction block

- Motor decay abnormal without dispersion
  - Arm: **>25% decay and <15% dispersion**
  - Leg: **>40% decay and <20% dispersion**
- Reduced number of F waves

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Conduction velocity dispersion

- In motor nerves the dispersion of individual motor unit potentials (MUPs) is smaller than the MUP duration, therefore there is no phase cancellation
- with increased CV dispersion the duration of the M wave increases and phase cancellation may reduce the amplitude

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Polyneuropathies with conduction block

- acute polyradicultis (AIDP)
- chronic polyradiculitis (CIDP)
- multifocal motor neuropathy with conduction blocks (MMN)
- diphtheria
- polyneuropathies in gammopathies

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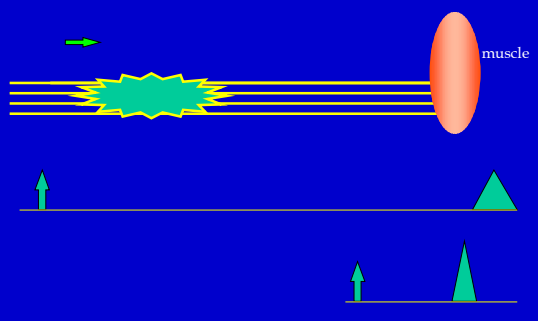
Demyelination



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Demyelination = slowing of NCV

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Demyelinating neuropathy

- CV reduced >30%
  - median nerve CV < 40 m/s
- distal latency > 7 ms
- normal or reduced amplitudes

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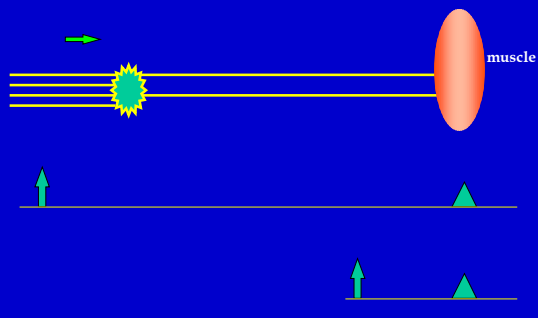
Axonal degeneration



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Loss of axons

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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

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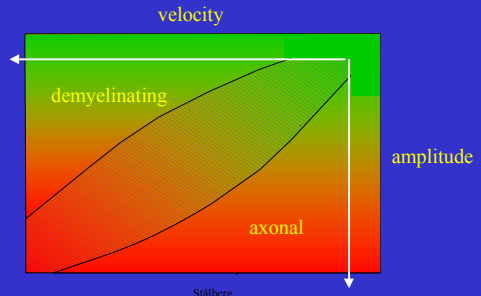
Demyelinating or axonal neuropathy? Velocity vs Amplitude



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Motor nerve parameters

	dlat	cv	ampl	cond.bl	F-lat	#F	Fampl
• demyelin	+	-	-		+		n
• axonal		(-)	-			-	↑
• neurapraxia				+		-	n
• GBS +	(-)	-	+	+	-		n
• ALS	(-)	-			-		↑
• crit ill. neur	+	-	-		+	-	n
• crit ill. Myo			m-s n				↓
• mod CT	+				(+)		
• severe CT	+	-	-		+	-	
• MG			-				n
• myopathy			-				↓

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Interpretation of motor nerve studies

	demyelin.	axonal deg	cond block
CV	↓↓	n/↓	n
dist latency	↑↑	n/↑	n
amplitude	n/↓	↓↓	↓
amplitude decay	n/↑	n	↑
dispersion	↑	n	↑
F-wave latency	↑↑	n/↑	n
# of F-waves	n/↓	↓	↓

Classical findings in neurography at different types of pathology
↑ = increased; ↓ = decreased; n= normal

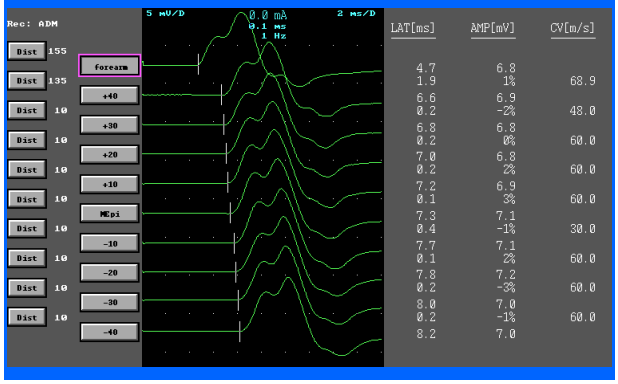
CDP

distribution of conduction slowing
proximal even distal

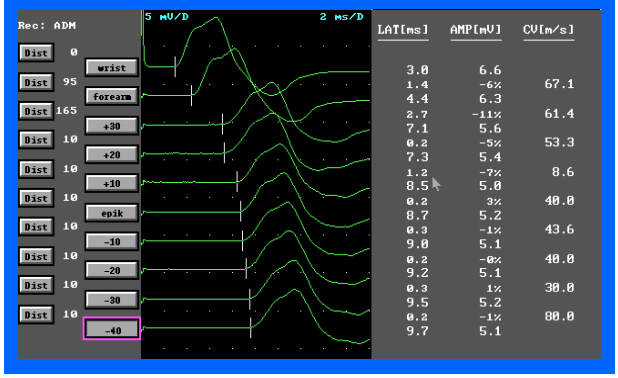
CIDP	+		
CMT1		+	
anti MAG			+

Attrian et al. Clin neurophys March 2001

Ulnar nerve inching - normal



Mild cubital tunnel syndrome



Slimmer's palsy