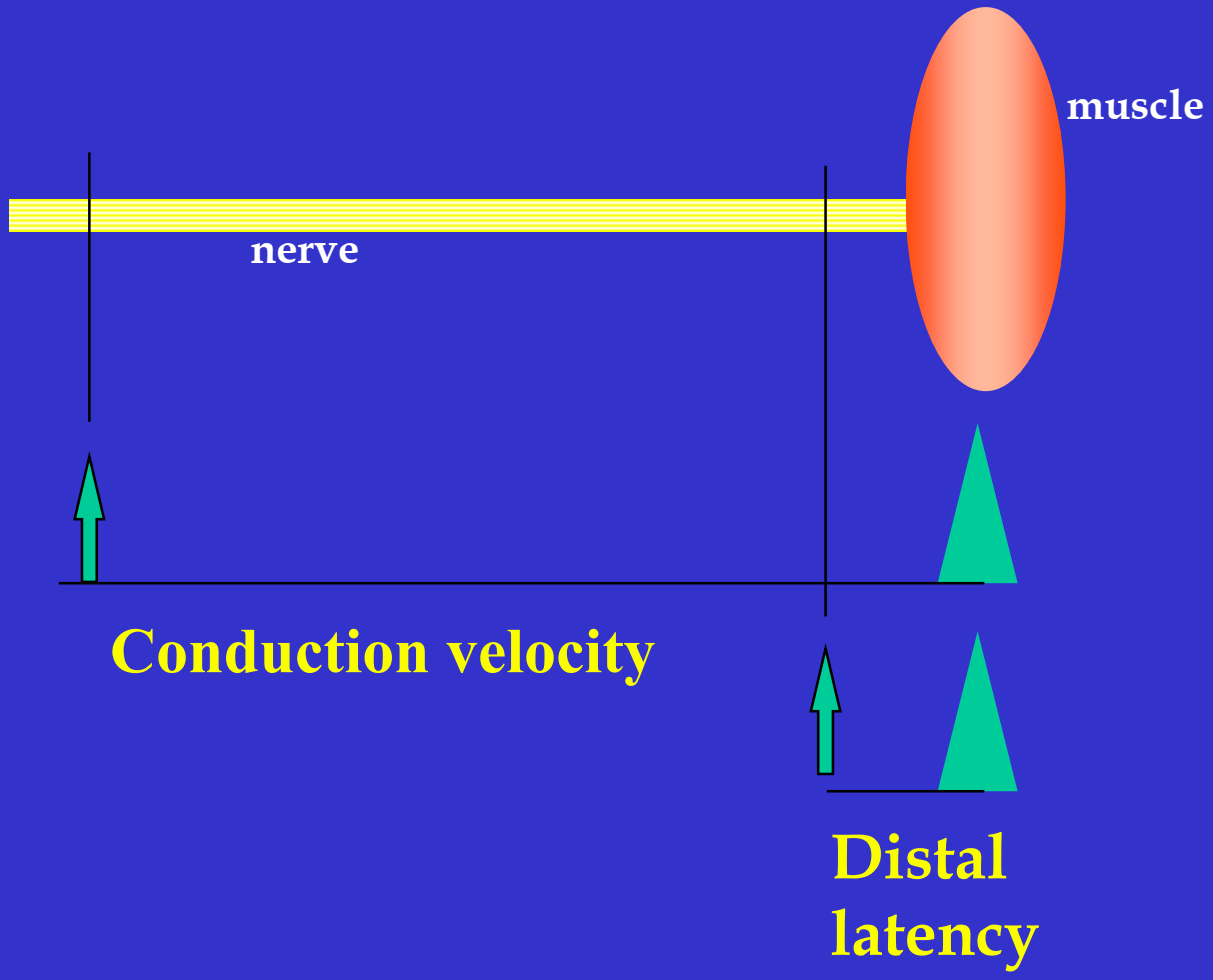
Significance of neurography

- 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

Usefulness of neurography

- Polyneuropathy
  - pathophysiology
  - type of nerve (motor/sens/auton)
  - severity
  - distribution to some extent
- Local neuropathies
  - localization
  - pathophysiology
  - severity

Motor nerve conduction study



Amplitude:

# of axons
n-m transmission
muscle volume

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

Conduction velocity

CV = segment length / conduction time

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

Decay =

decrease in amplitude or area

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

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

Dispersion

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

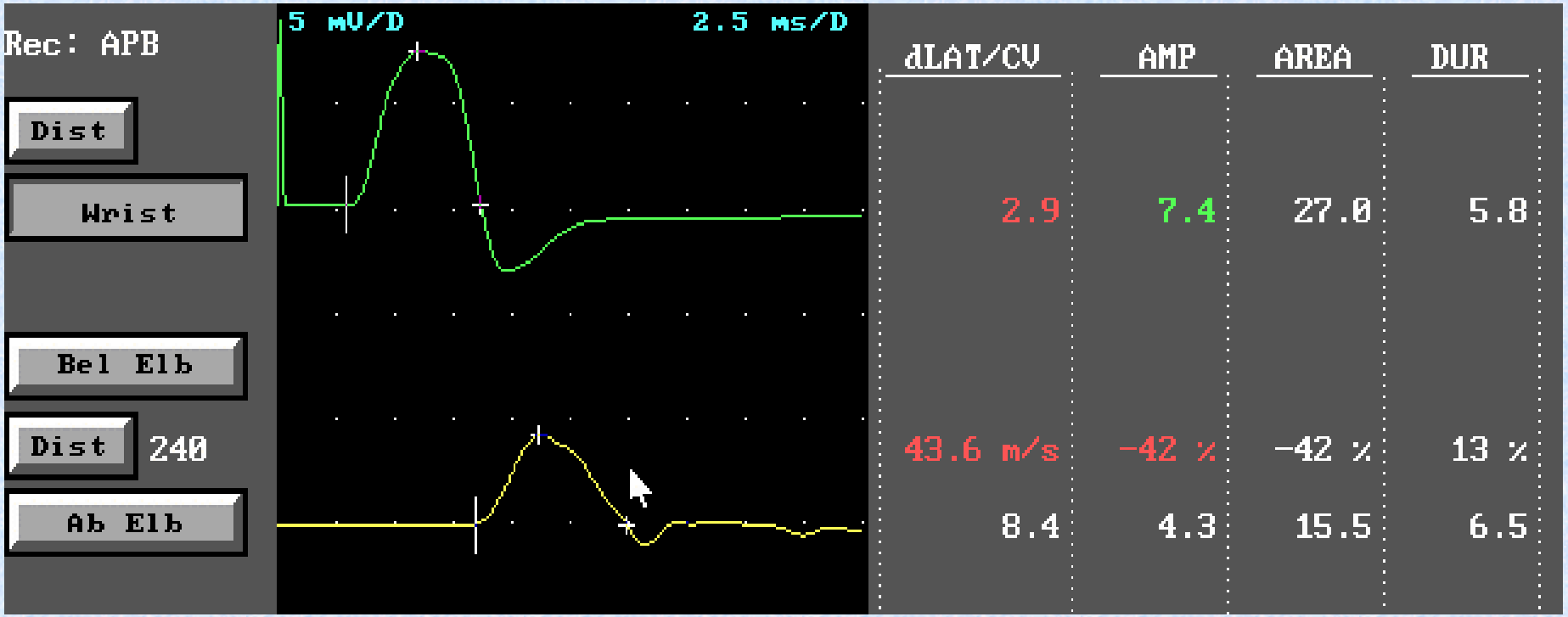
- range of conduction velocities

Changes along the nerve

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

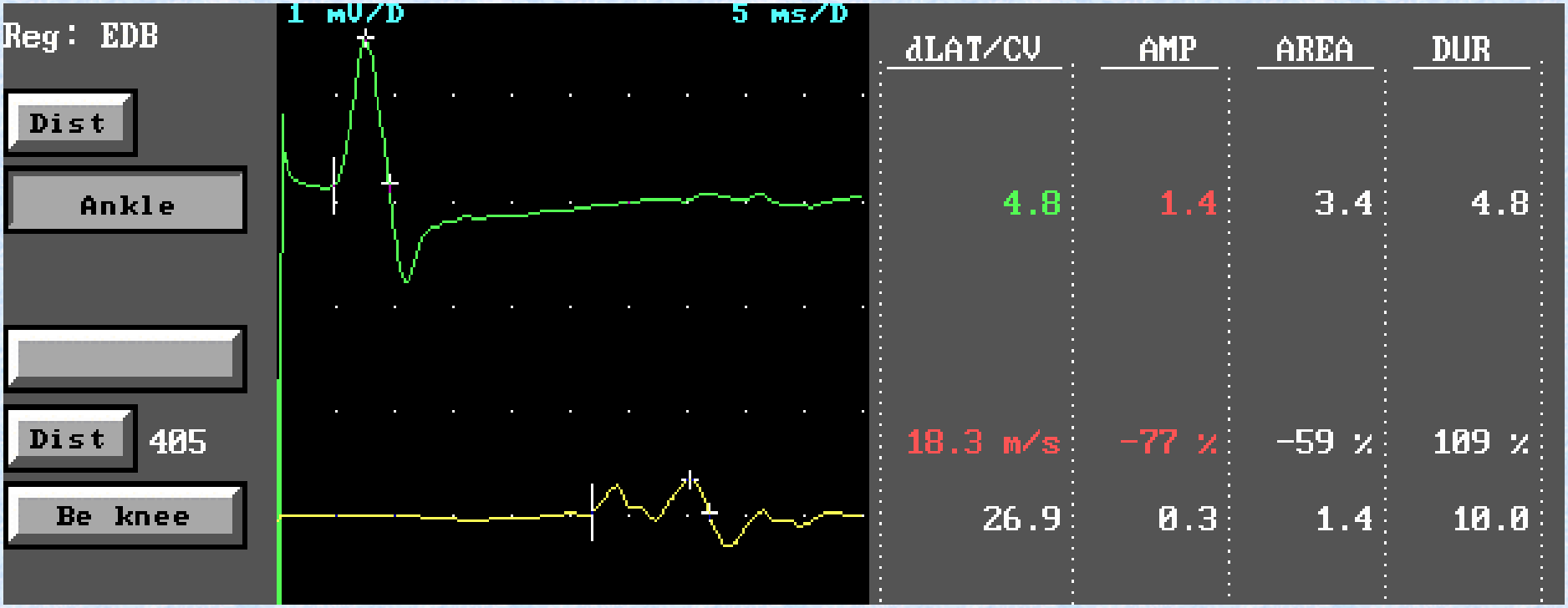
Local conduction block

Conduction block



median nerve, multifocal motor neuropathy with conduction blocks

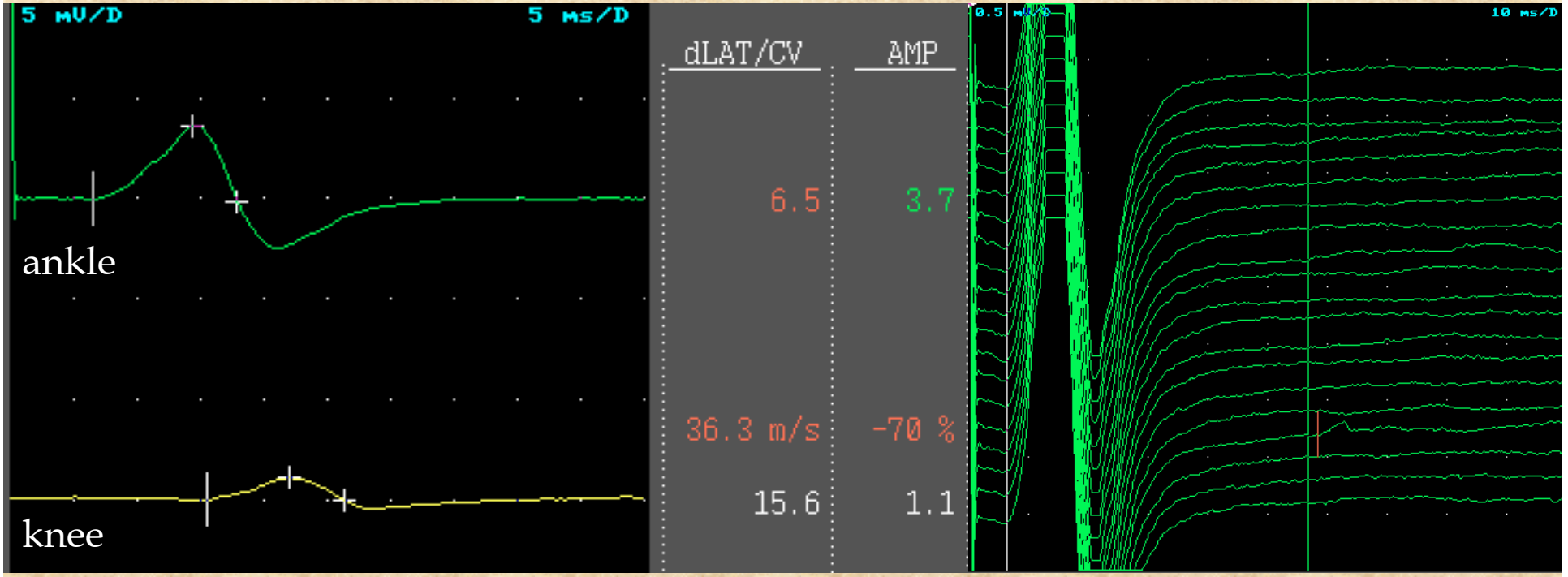
Dispersion of CV and conduction block



peroneal nerve MCV in patient with CIDP

Motor conduction block in Guillain Barré syndrome

MCV F-waves

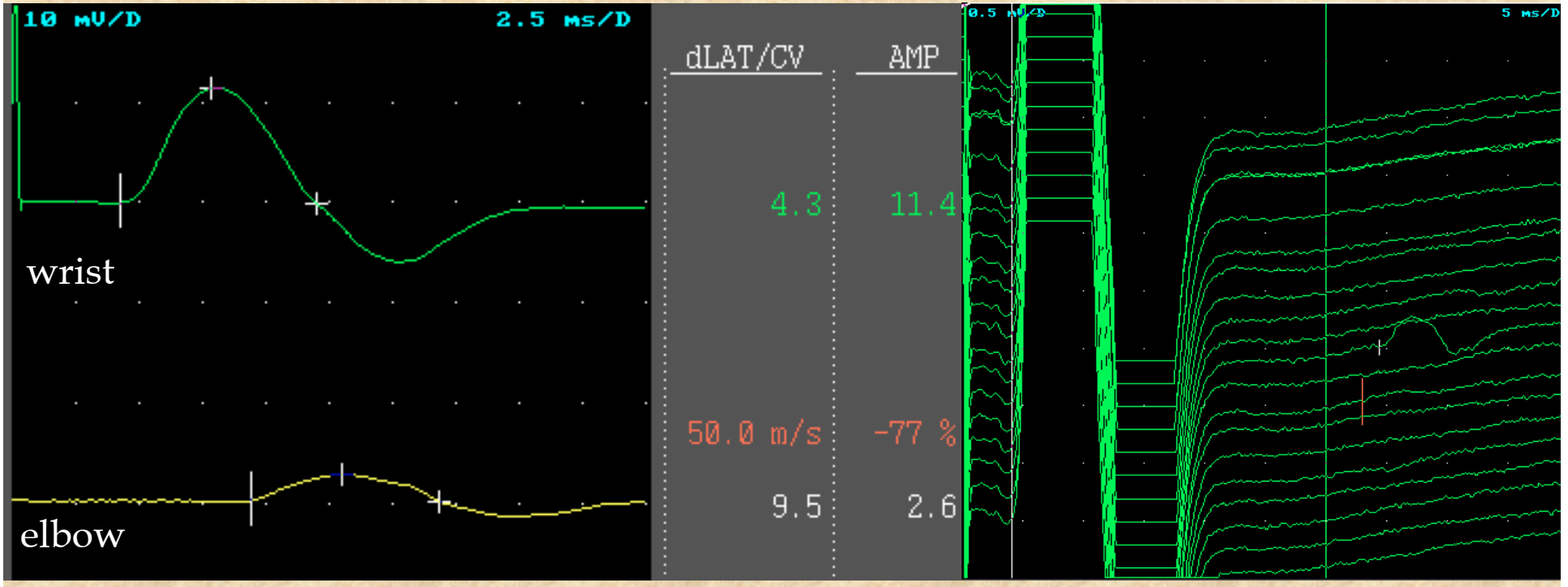


Peroneal nerve

Motor conduction block in Guillain-Barré syndrome

MCV

F-waves



Median nerve

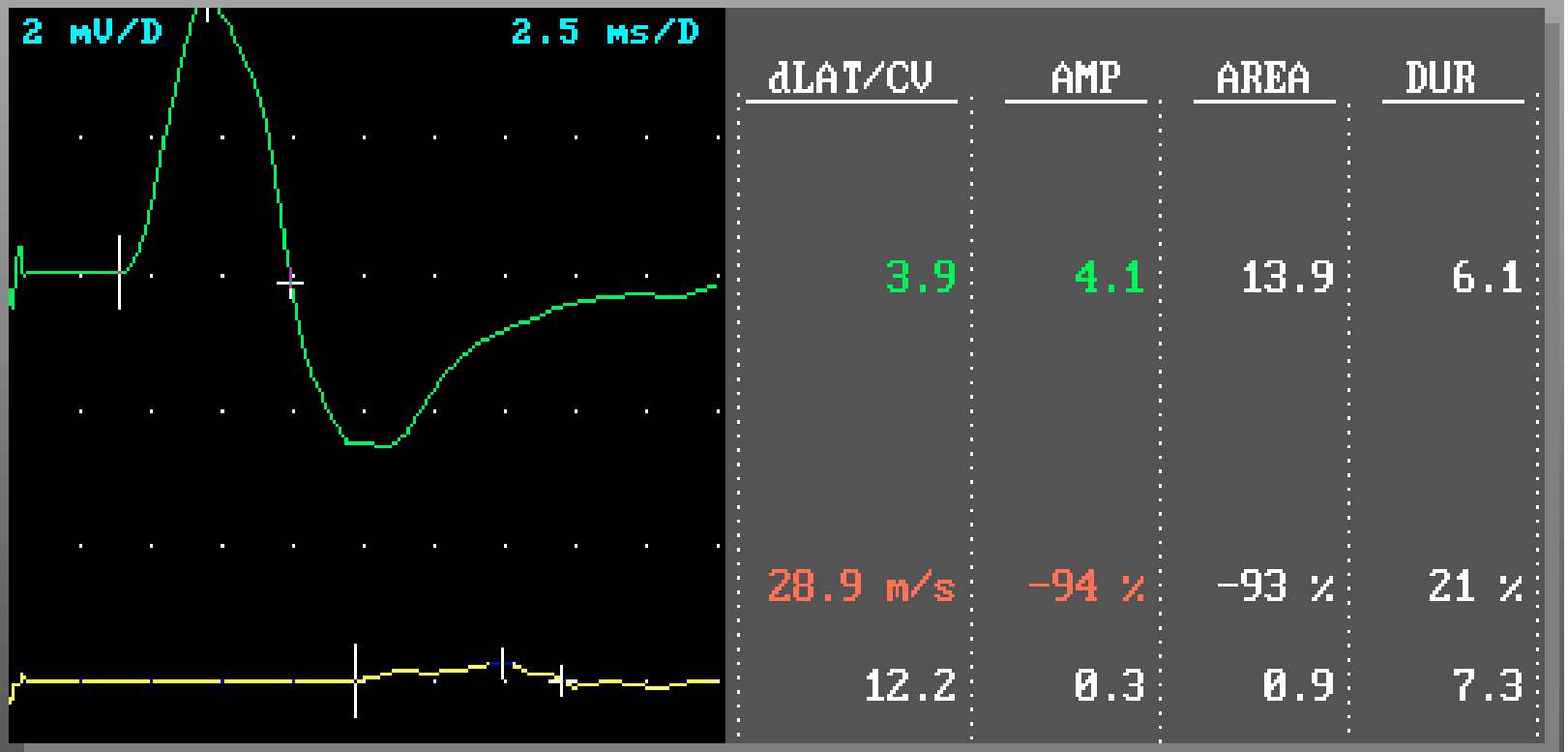
Conduction velocity dispersion

- 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

Polyneuropathies with conduction block

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

MMN, MCV Median nerve



CTS, motor

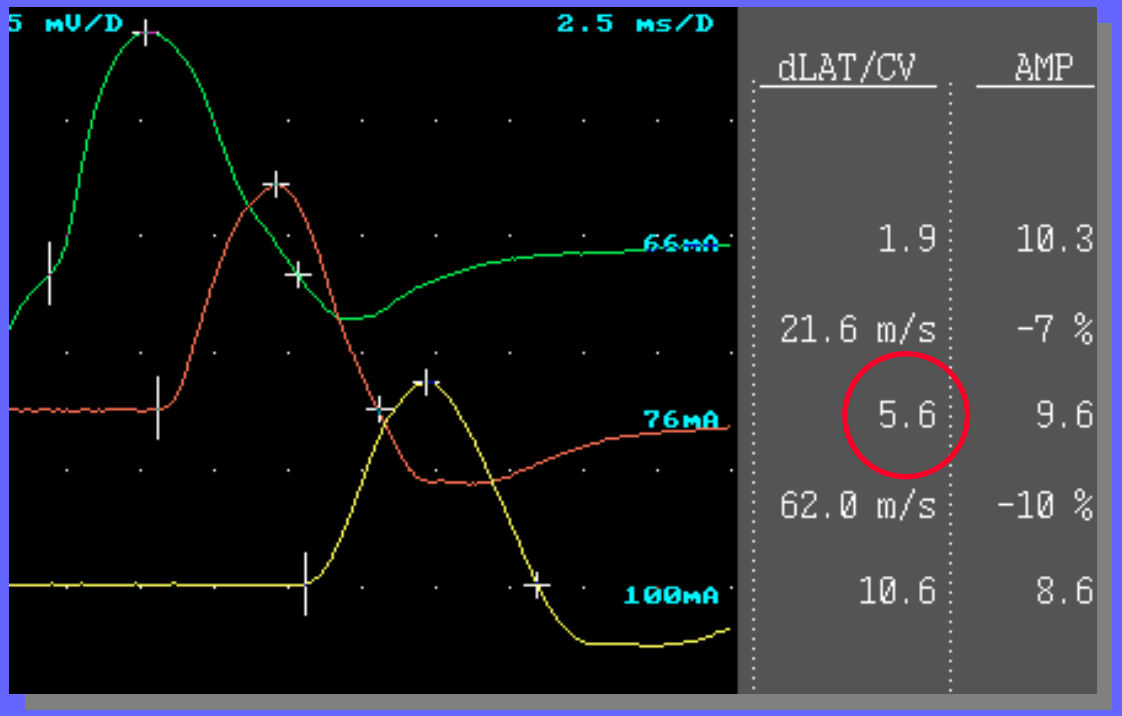
(normal amplitude/increased distal lat. at wrist)

Stimulation site:

palm

wrist

above elbow



Stålberg

Demyelination, no axonal loss

CTS , motor

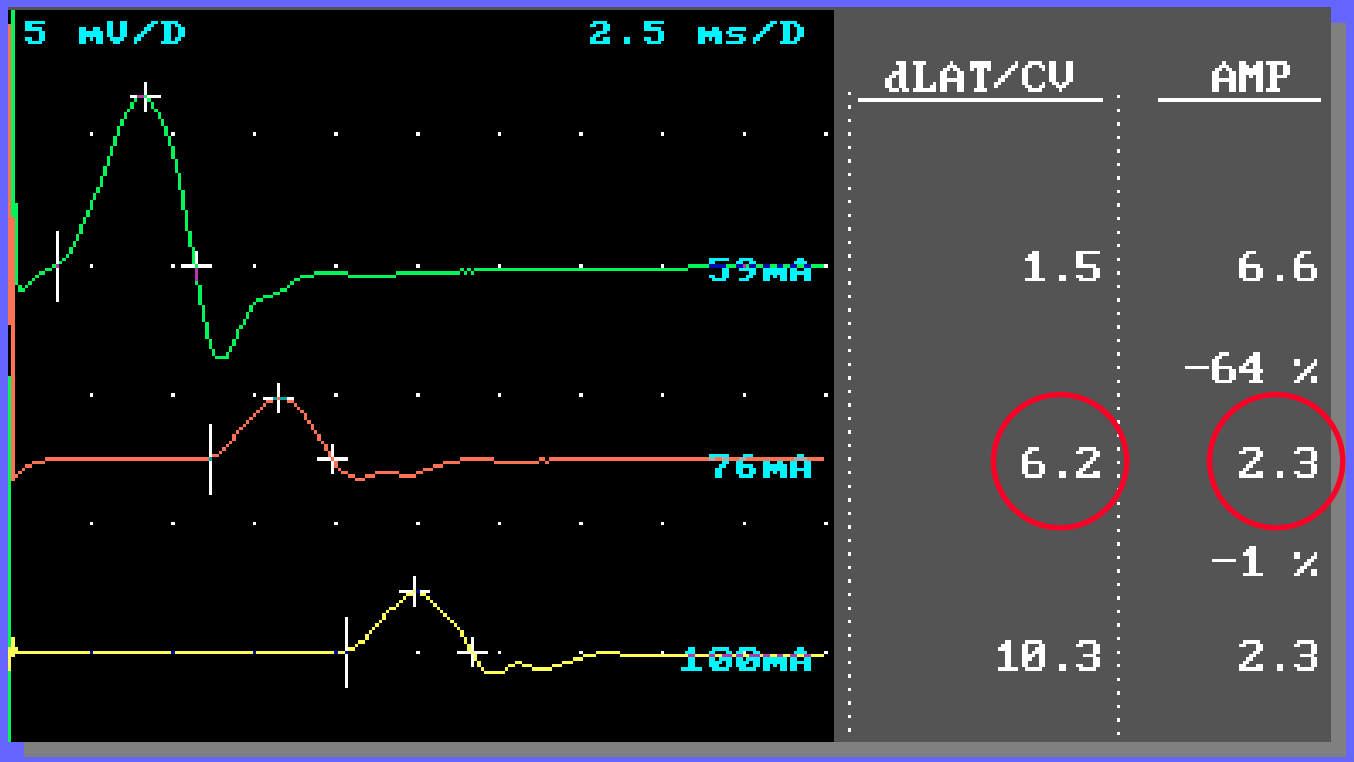
(low amplitude/increased distal lat. at wrist)

Stimulation site:

palm

wrist

above elbow



Stålberg

Demyelination + conduction block

CTS , motor

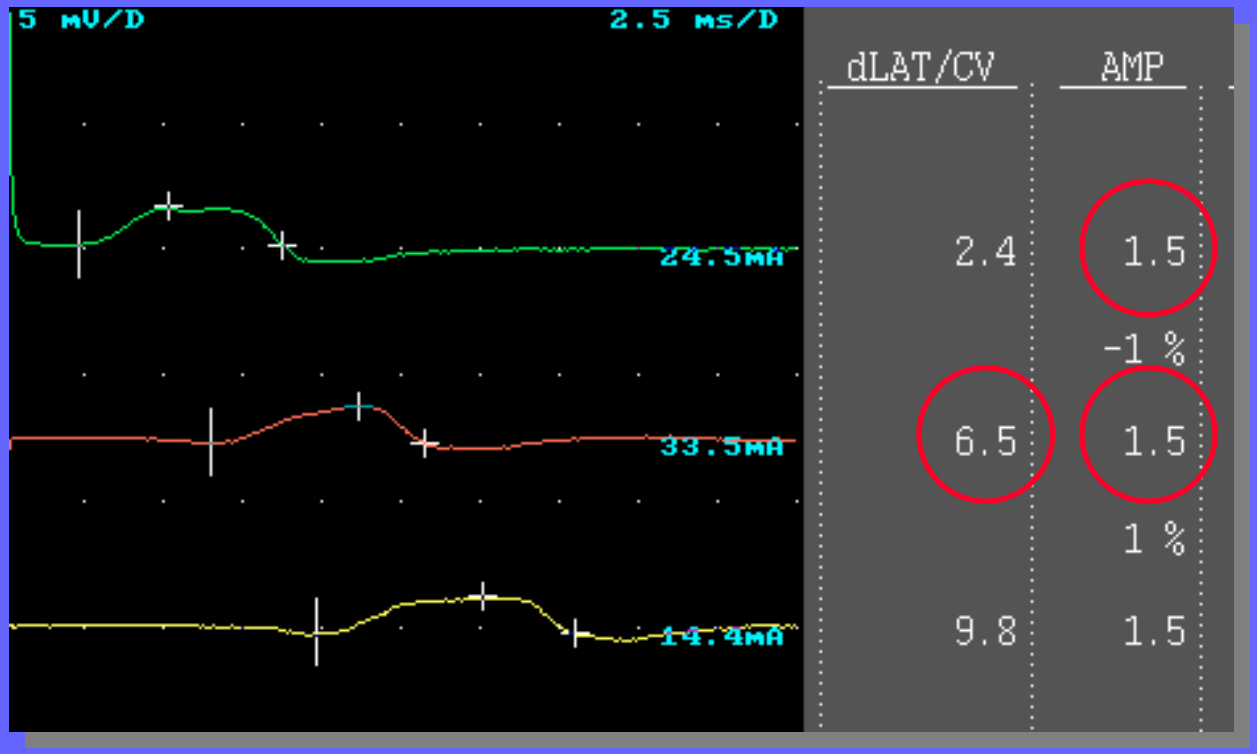
(low amplitude/increased distal lat. at wrist)

Stimulation site:

palm

wrist

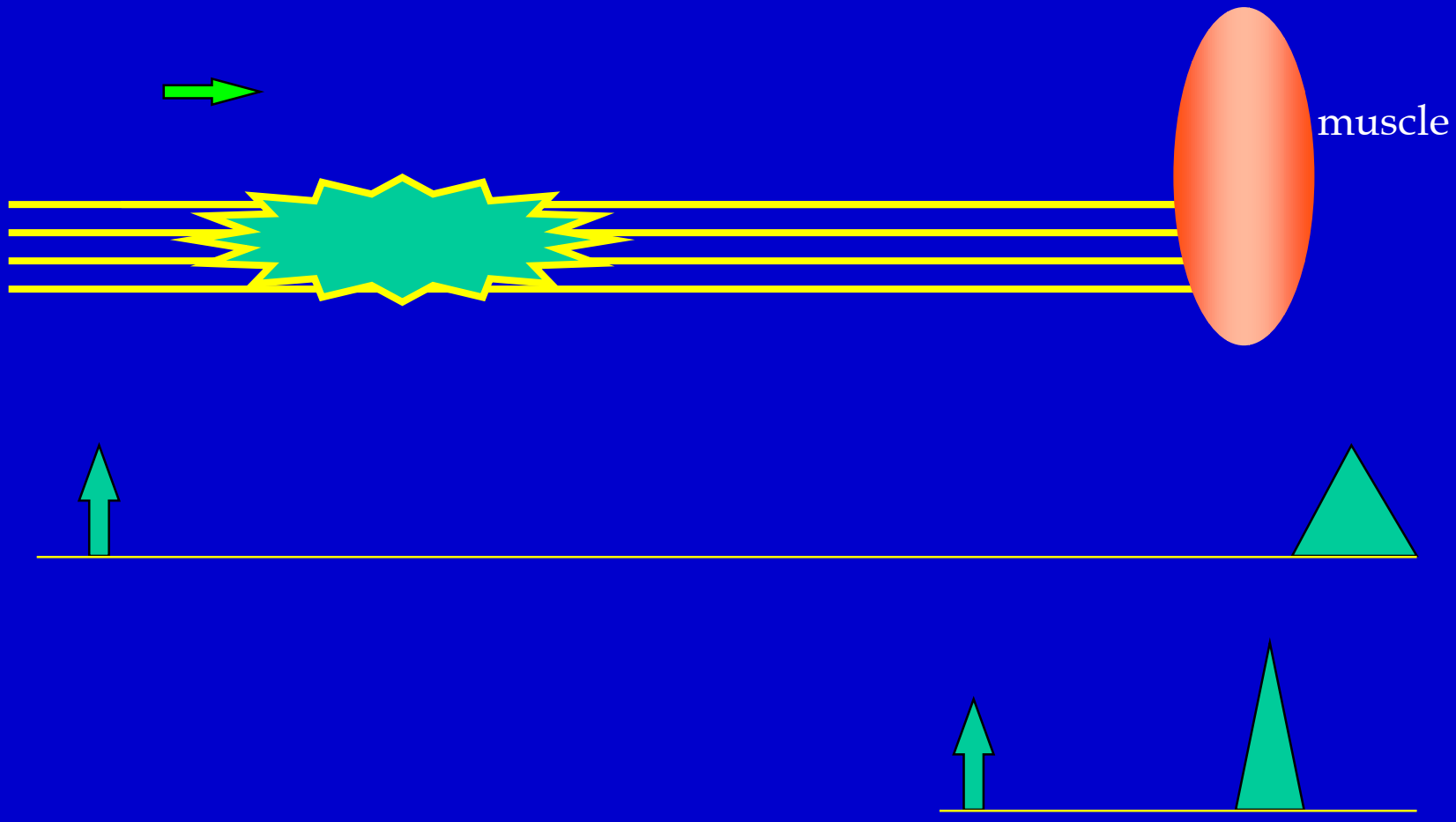
above elbow



Stålberg

Demyelination +severe axonal loss

Demyelination

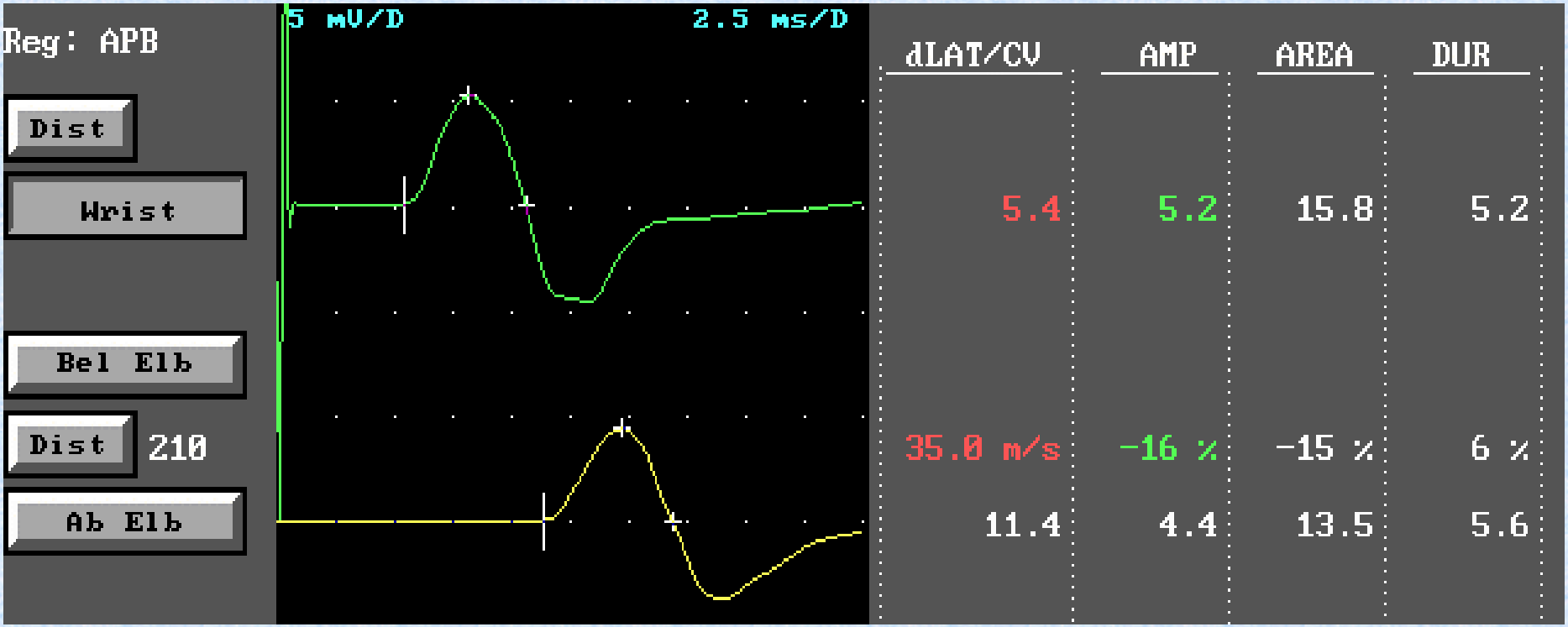


Demyelination = slowing of NCV

Demyelinating neuropathy

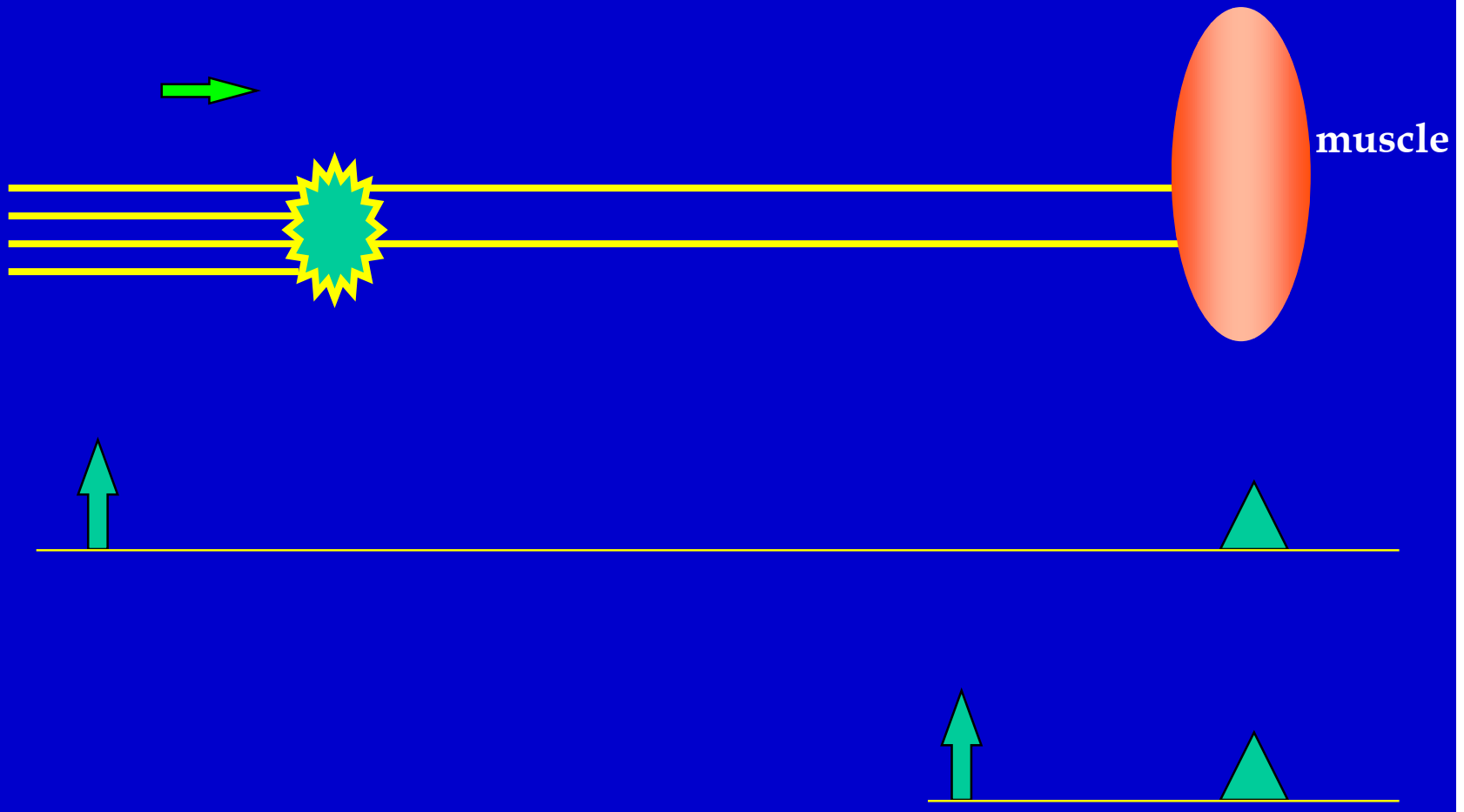
- CV reduced >30%
  - median nerve CV < 40 m/s
- distal latency > 7 ms
- normal or reduced amplitudes

Demyelinating neuropathy



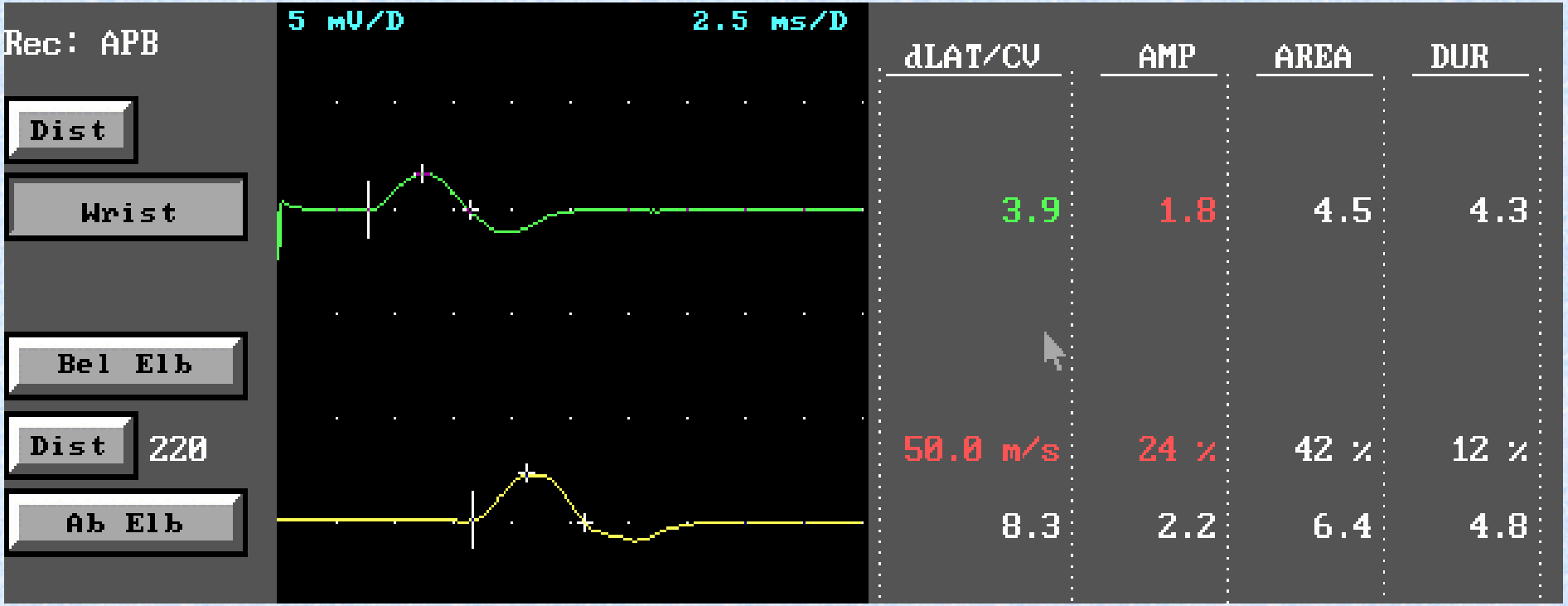
median nerve in a patient with HMSN 1

Axonal degeneration



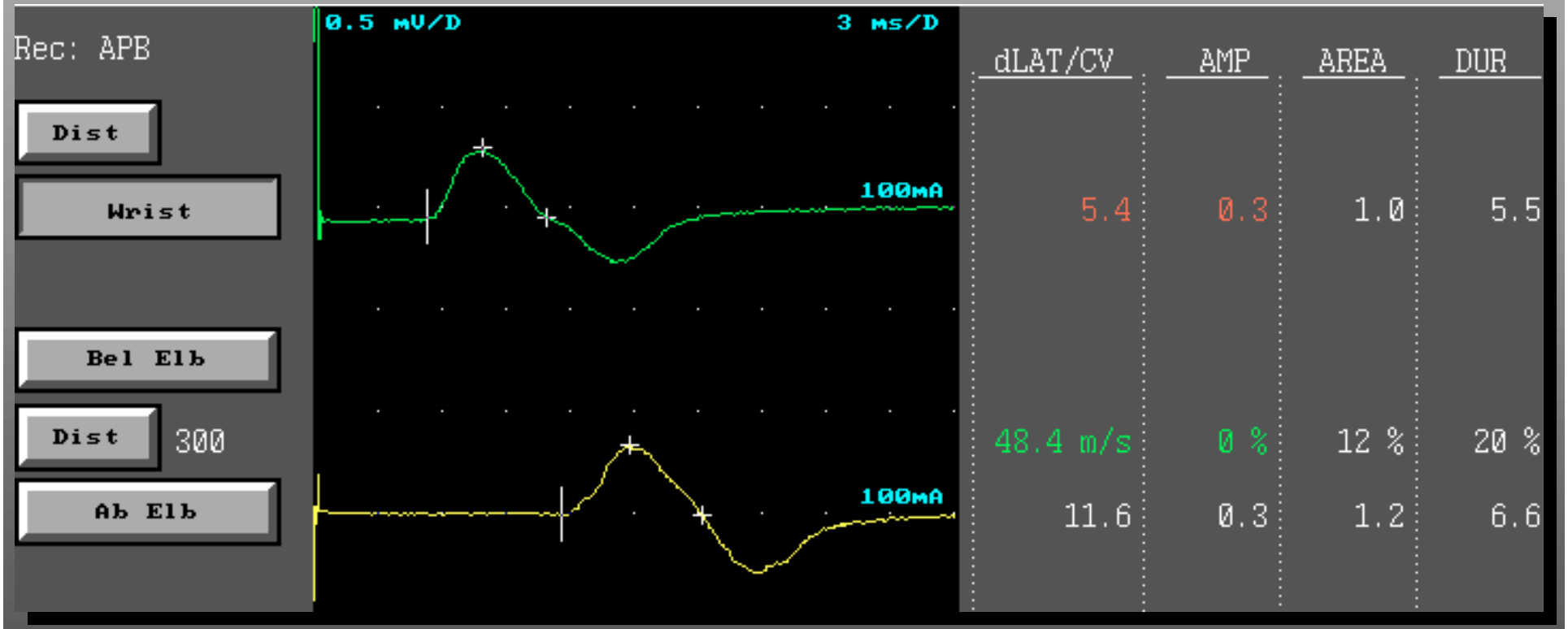
Loss of axons

Axonal neuropathy

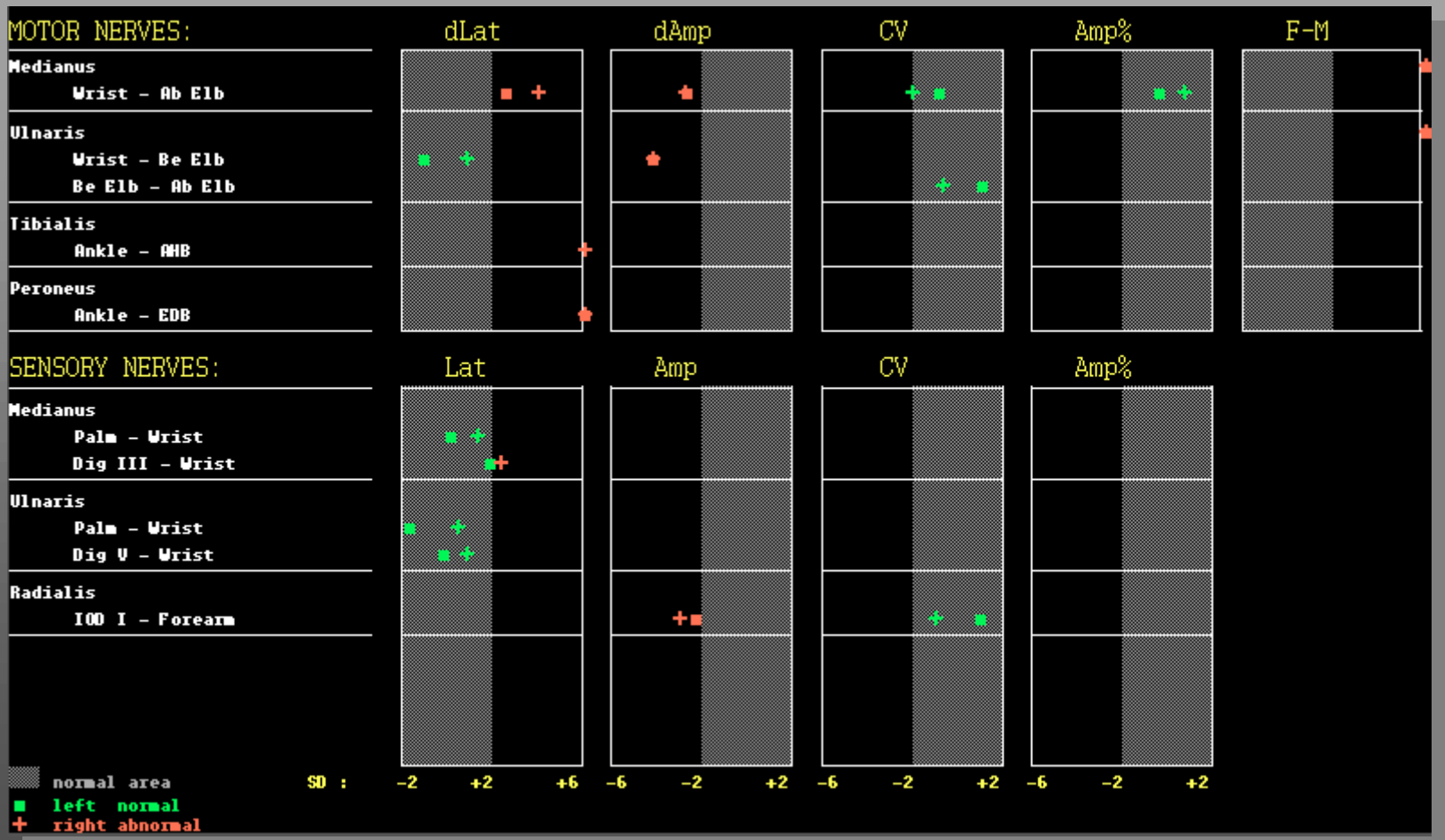


median nerve, patient has Martin-Gruber anomaly

Axonal neuropathy



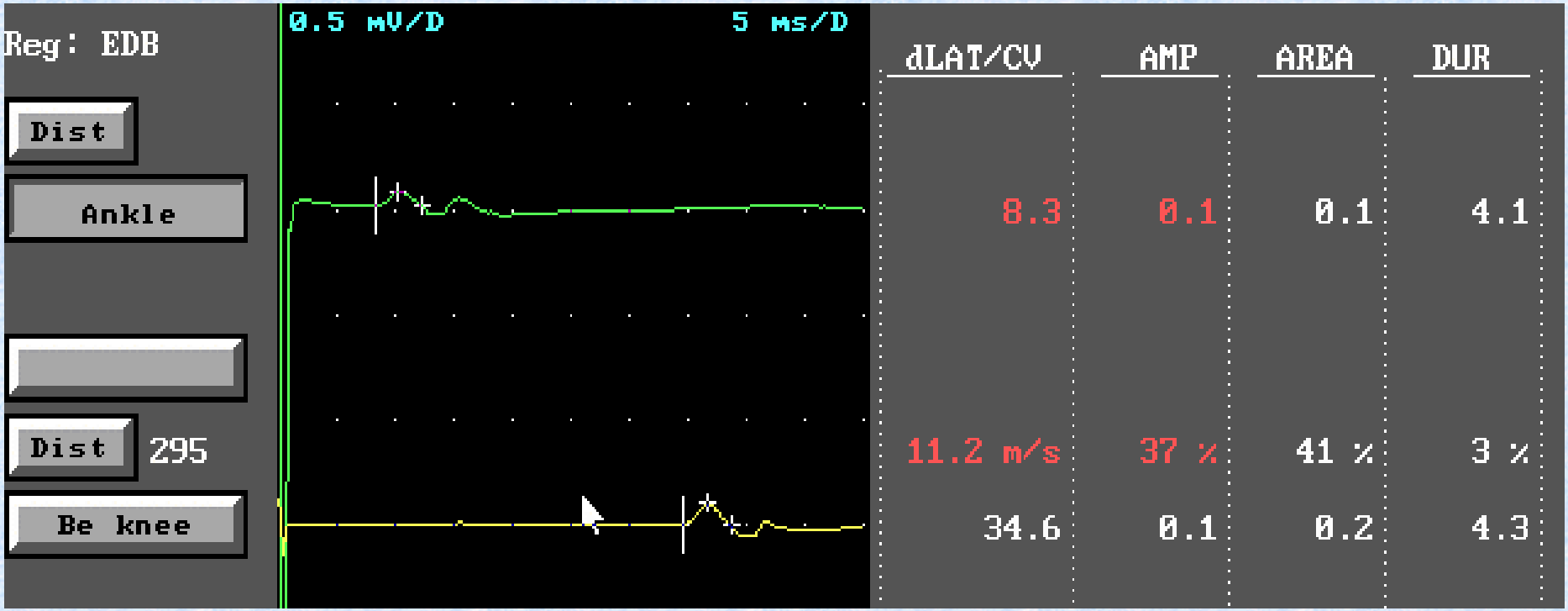
Axonal neuropathy



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

Demyelinating and axonal neuropathy



peroneal nerve in patient with HMSN1

Neurography

parameters to.....

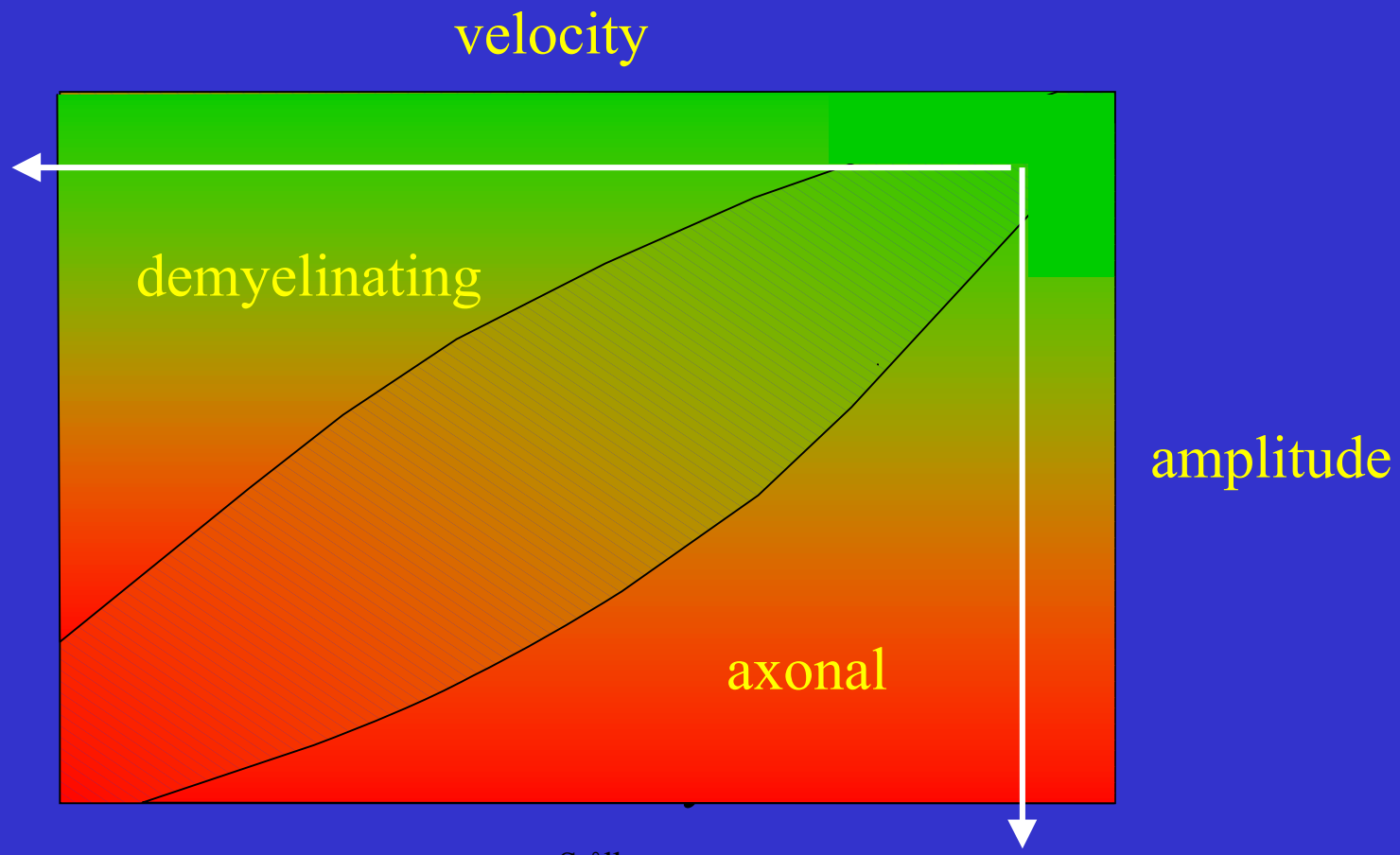
...measure

- Latency
- Amplitude
- Duration
- Area

...calculate

- Conduction velocity
- Ampl. difference
- Temporal dispersion

Demyelinating or axonal neuropathy?
Velocity vs Amplitude



Stålberg

Stålberg

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			-				↓

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			+

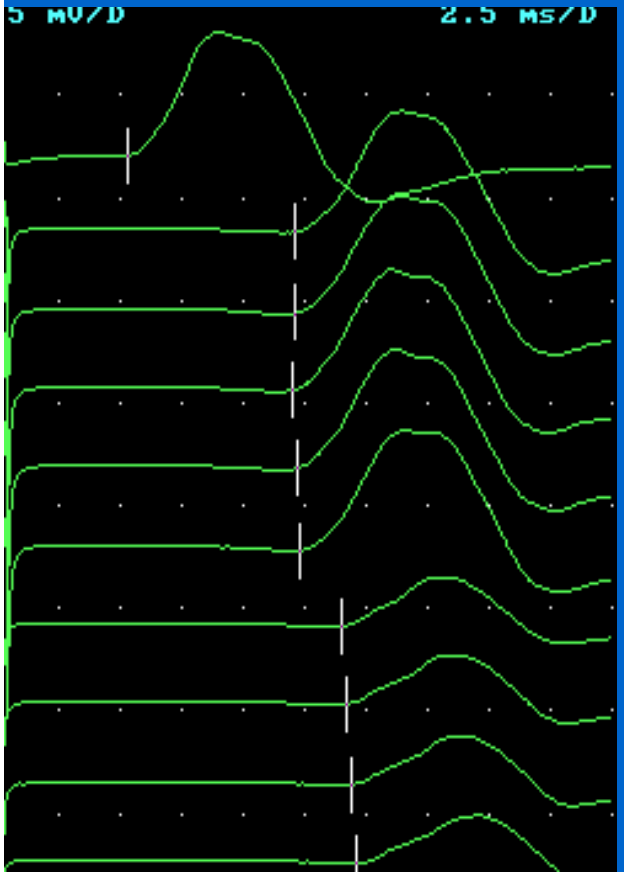
Attrian et al. Clin neurophys March **2001**

Reference line

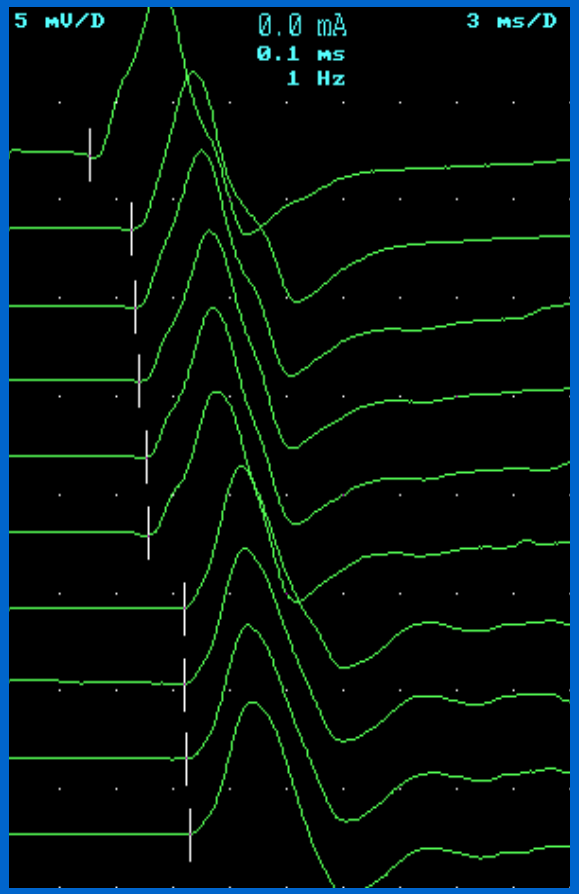
Short segment studies

(10mm)

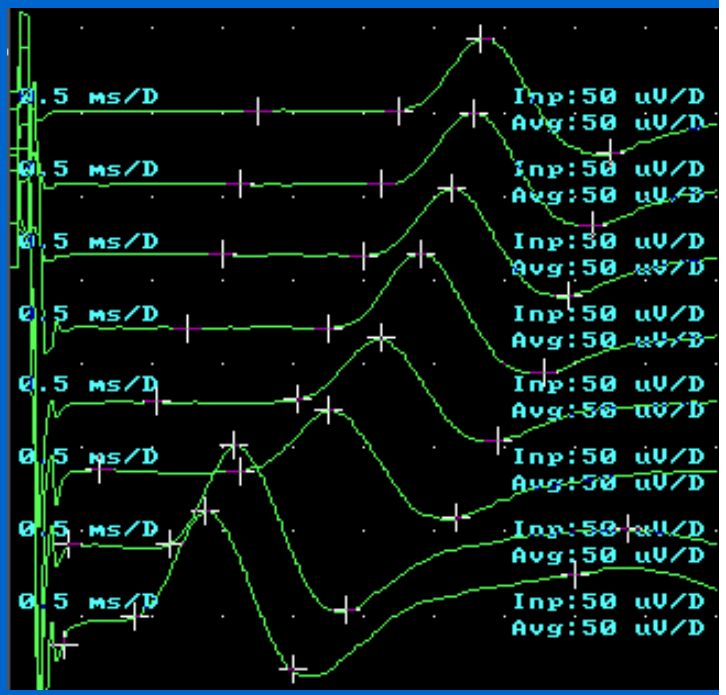
N. Peroneus



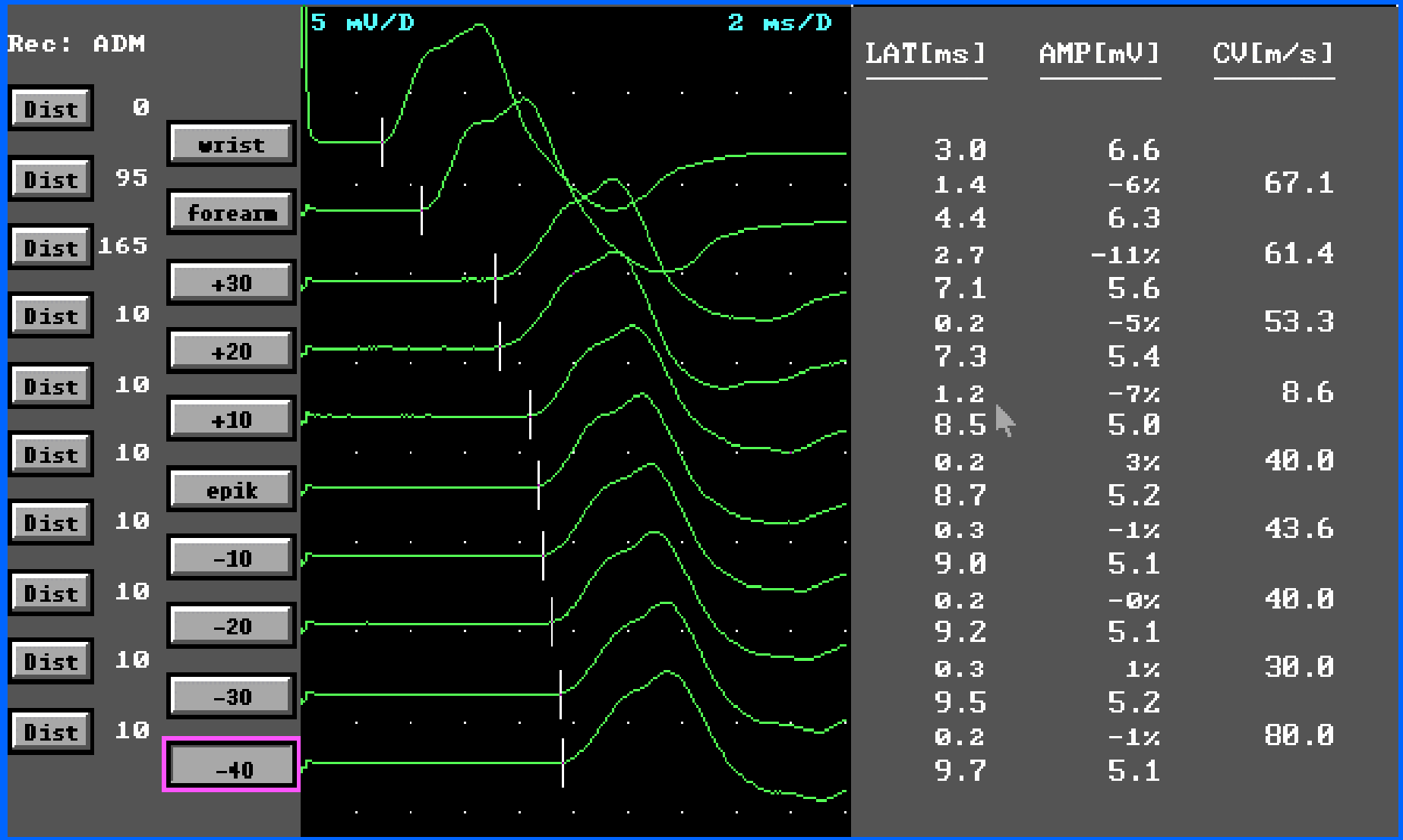
N.Ulnaris



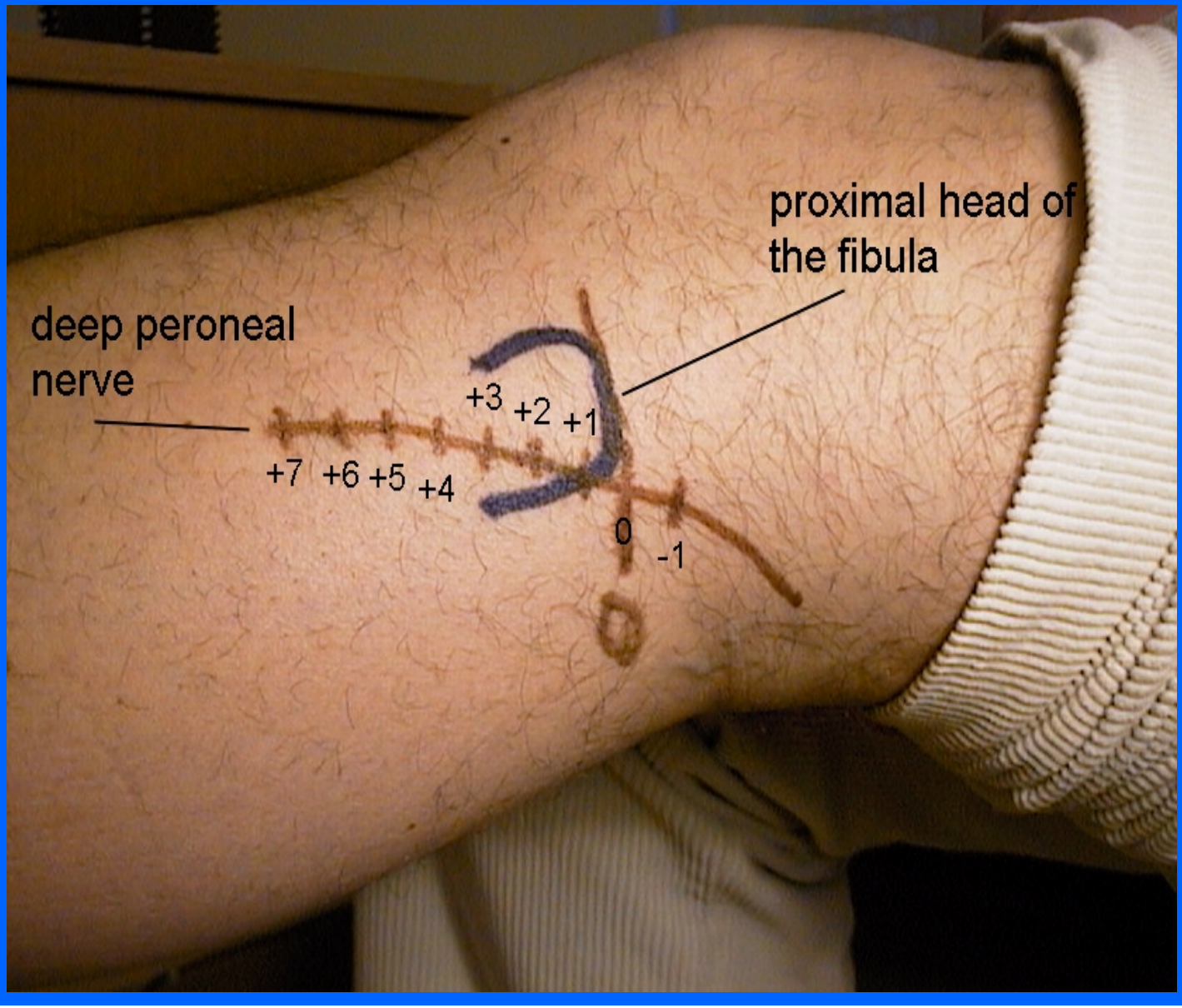
N. Medianus



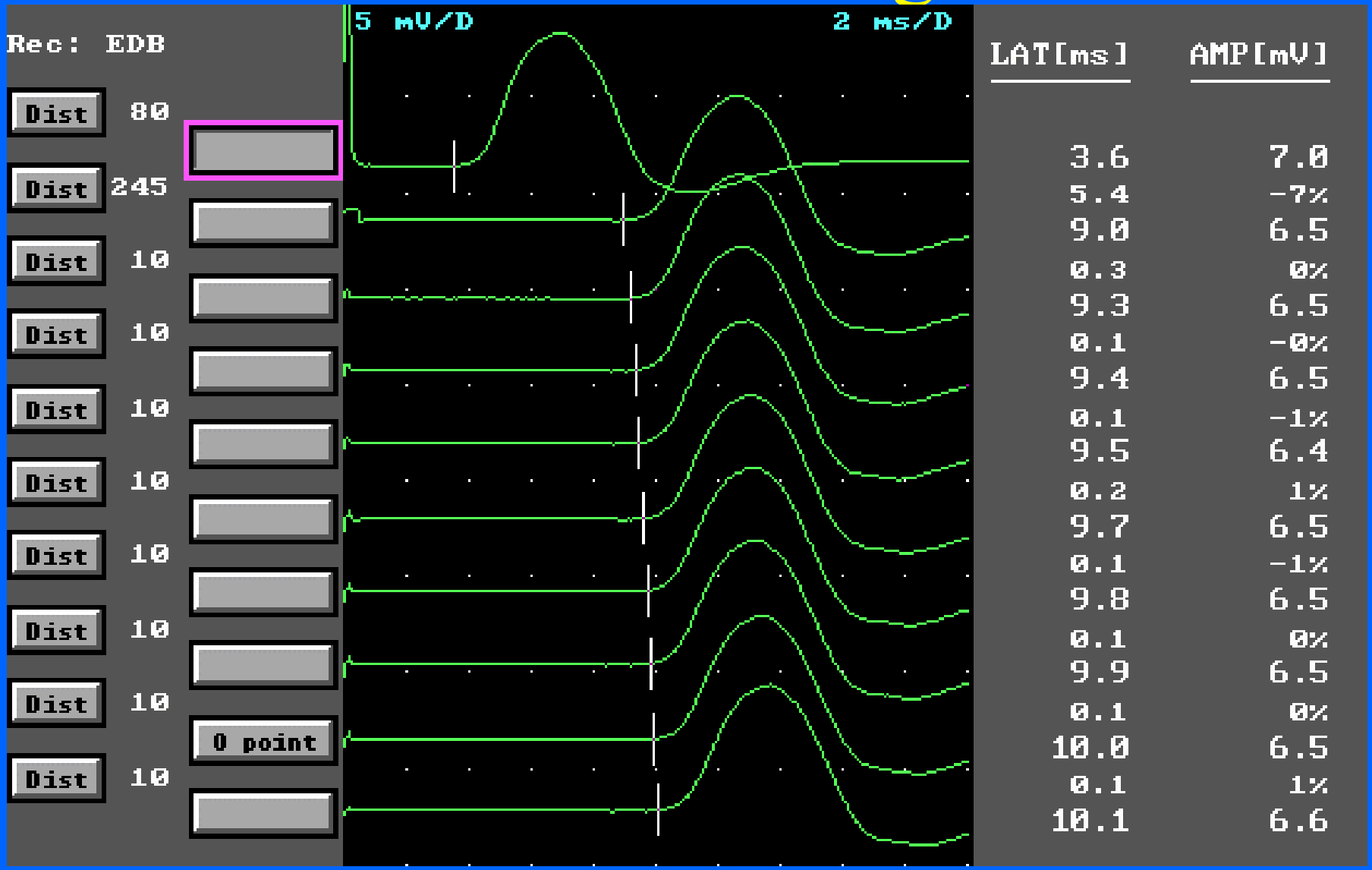
Mild cubital tunnel syndrome



Stimulation sites



Peroneal nerve inching - normal



Slimmer's palsy