



**5th Congress of the European Academy of
Neurology**

Oslo, Norway, June 29 - July 2, 2019

Hands-on Course 2/6

Nerve conduction studies (Level 1)

**Motor and sensory nerve conduction
studies. F-wave**

Josep Valls-Sole
Barcelona, Spain

Email:
jvalls@clinic.ub.es

Conflict of interest disclosure

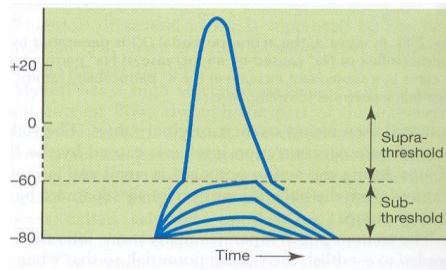
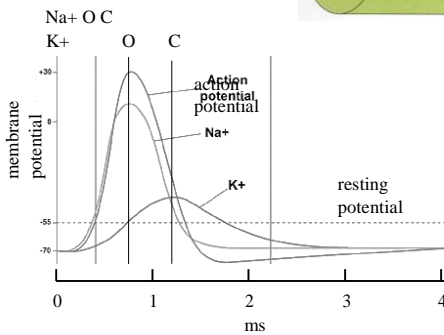
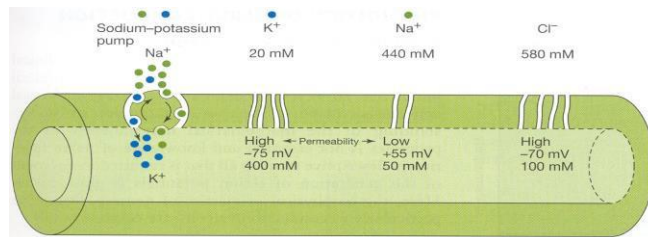
I have no, real or perceived, direct or indirect conflicts of interest that relate to this presentation.

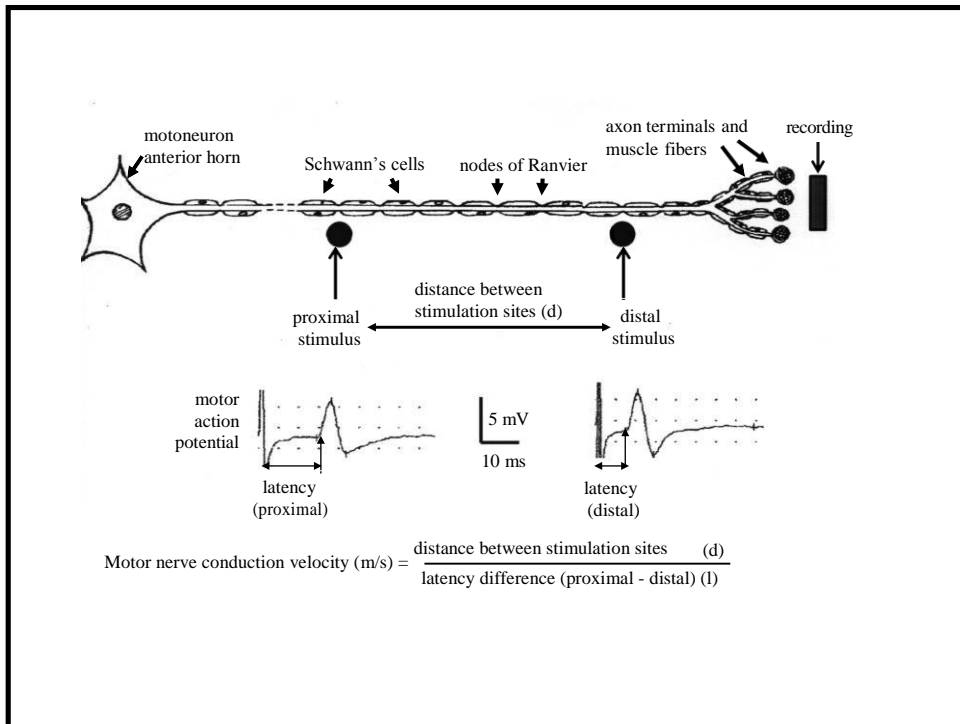
NERVE CONDUCTION STUDIES

Josep Valls-Sole
jvalls@clinic.cat

Generation of action potentials

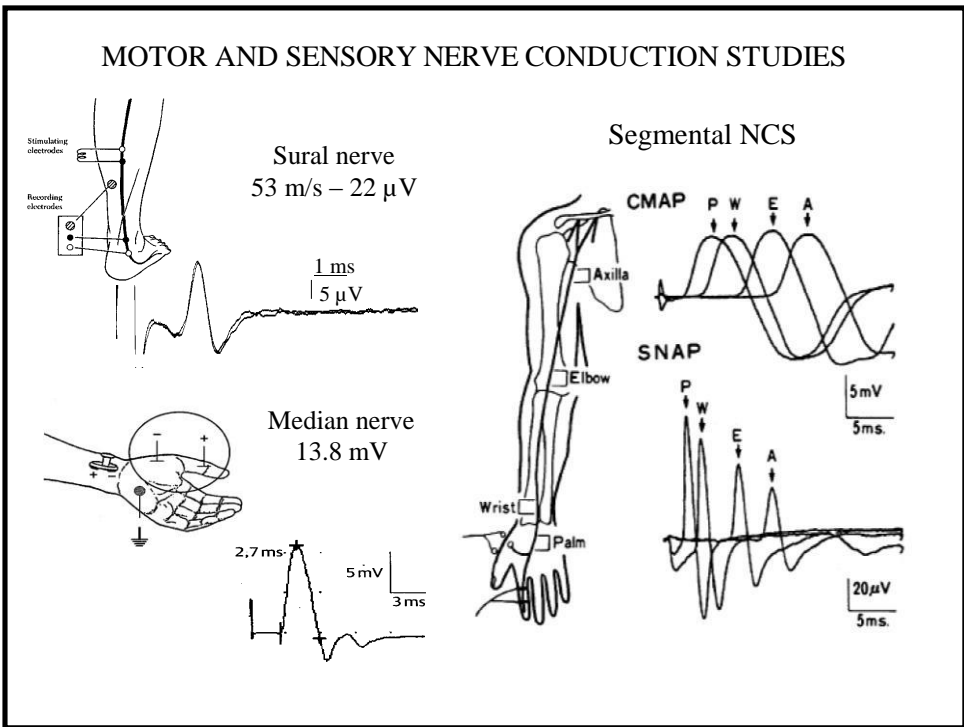
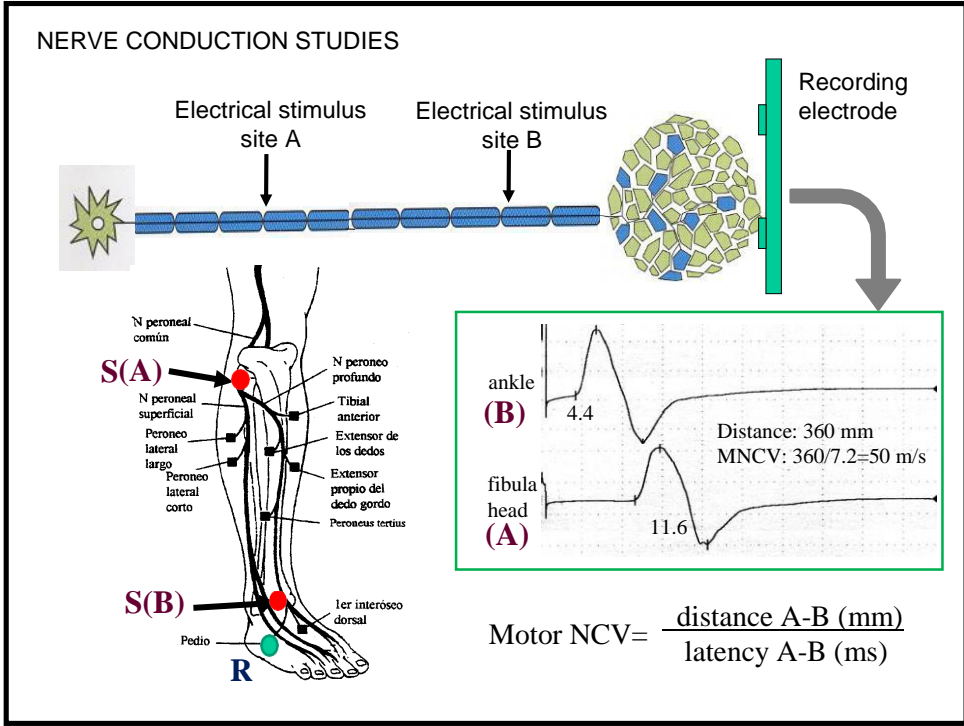
[Na⁺] = 10 times greater outside
 [K⁺] = 30 times greater inside



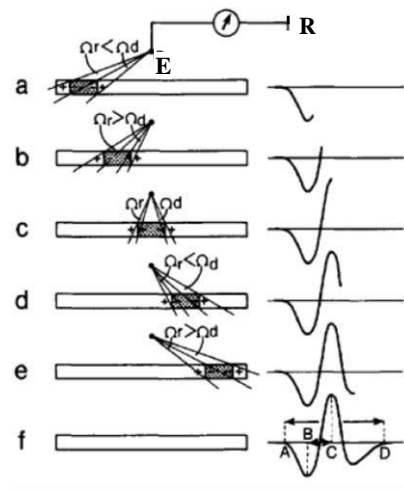
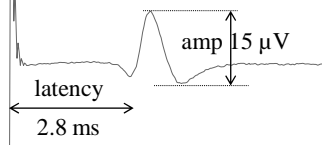
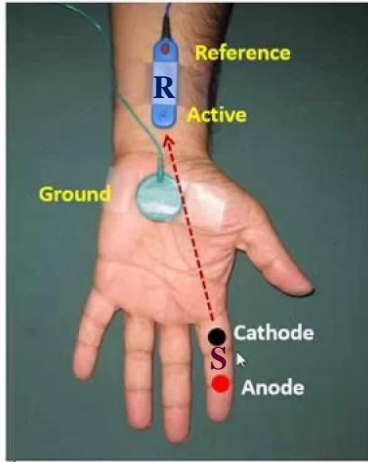


NCV= degree and quality of myelination
in the largest fibers stimulated

AMP= axonal excitability and synchronization
of excitatory volley in available axons



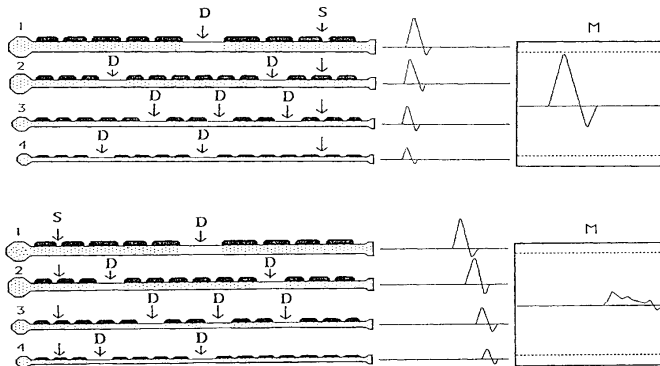
NERVE CONDUCTION STUDIES



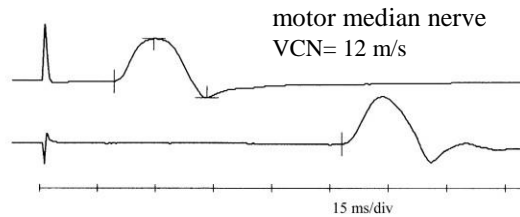
$$\text{Sensory NCV} = \frac{\text{distance S-R (mm)}}{\text{latency S-R (ms)}}$$

Distance: 140 mm
MNCV: 140/2.8 = 50 m/s

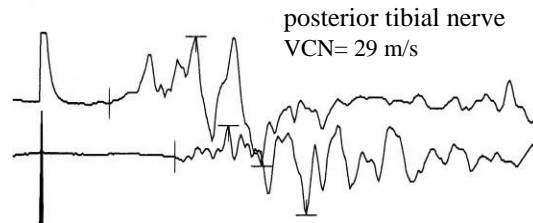
Temporal dispersion



DEMYELINATING POLYNEUROPATHIES



**Hereditary
demyelinating
polyneuropathies**



**Acquired
demyelinating
polyneuropathies**

Albers and Kelly, 1989

1. Reduced conduction velocity in 2 or more nerves:
<75% of LLN.*
2. Partial conduction block or abnormal temporal dispersion in 1 or more nerves:
<70% P/D ratio.†
3. Prolonged distal latency in 2 or more nerves:
>130% of ULN.‡
4. Prolonged F-wave latency in 1 or more nerves:
>130% of ULN.

Meulstee et al., JNNP 1995

Table 3 Criteria for primary demyelination

Proposed and tested set: one of the following abnormalities in at least two nerves should be demonstrated.

- 1 DML > 150% of ULN
- 2 m-NCV < 70% of LLN
- 3 F wave latency > 150% of ULN
- 4 Abnormal CMAP amplitude decay > ULN
- 5 Abnormal distal temporal dispersion: distal CMAP duration > 300% ULN
- 6 Abnormal temporal dispersion: distal to proximal CMAP duration ratio > 150% of ULN

DML = distal motor latency; ULN = upper limit of normal; m-NCV = motor nerve conduction velocity; LLN = laboratory limits of normal; s-NCV = sensory nerve potential; CMAP = compound muscle action potential; CSNAP = compound sensory nerve action potential; SP = single pattern.

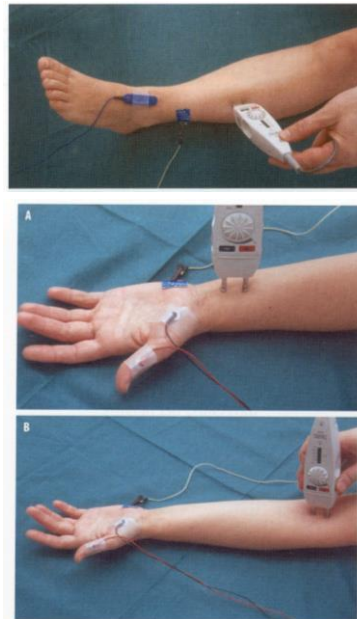
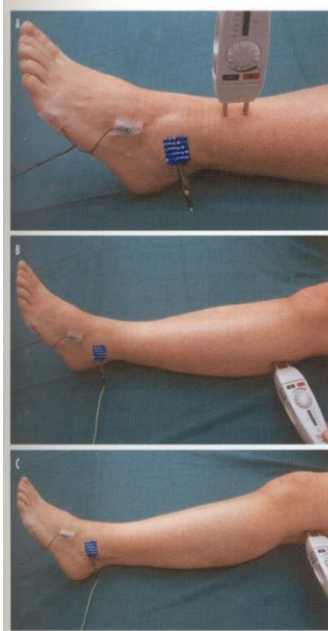
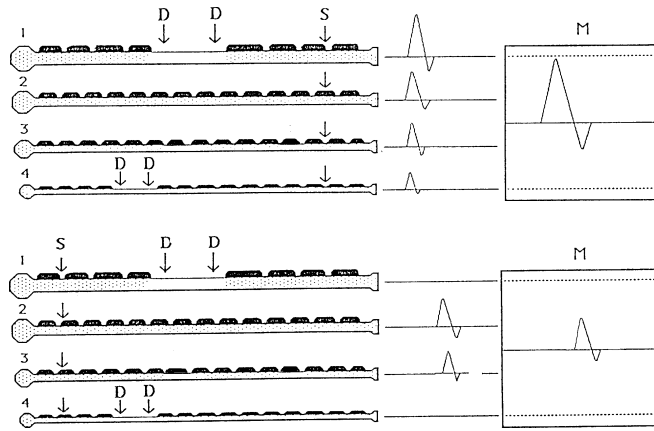
Van den Bergh et al., 2011

≥50 percent prolongation of motor distal latency above the ULN in two nerves

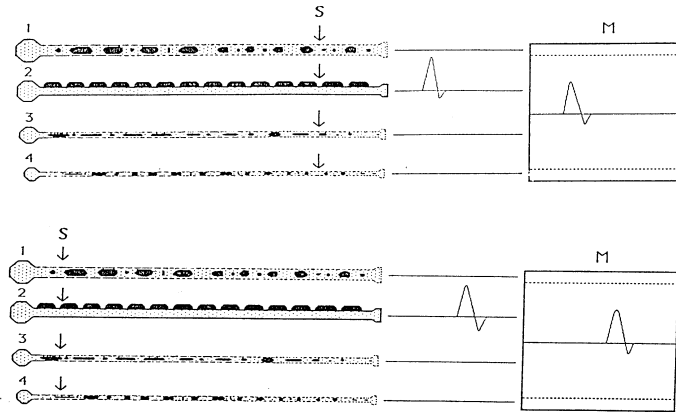
≥30 percent reduction of motor conduction velocity below the LLN in two nerves

≥20 percent prolongation of F-wave latency above the ULN in two nerves, or >50 percent if the amplitude of the distal negative peak CMAP is <80 percent of the LLN

Conduction block

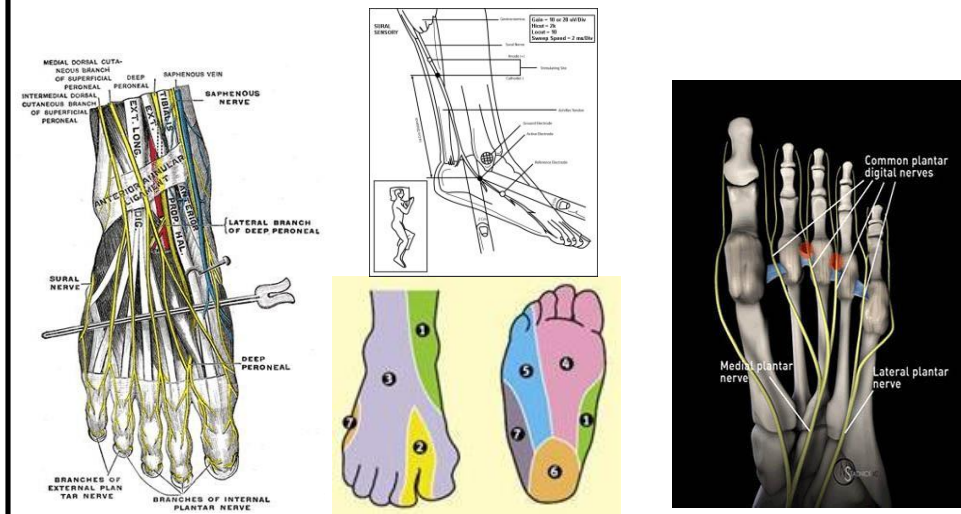


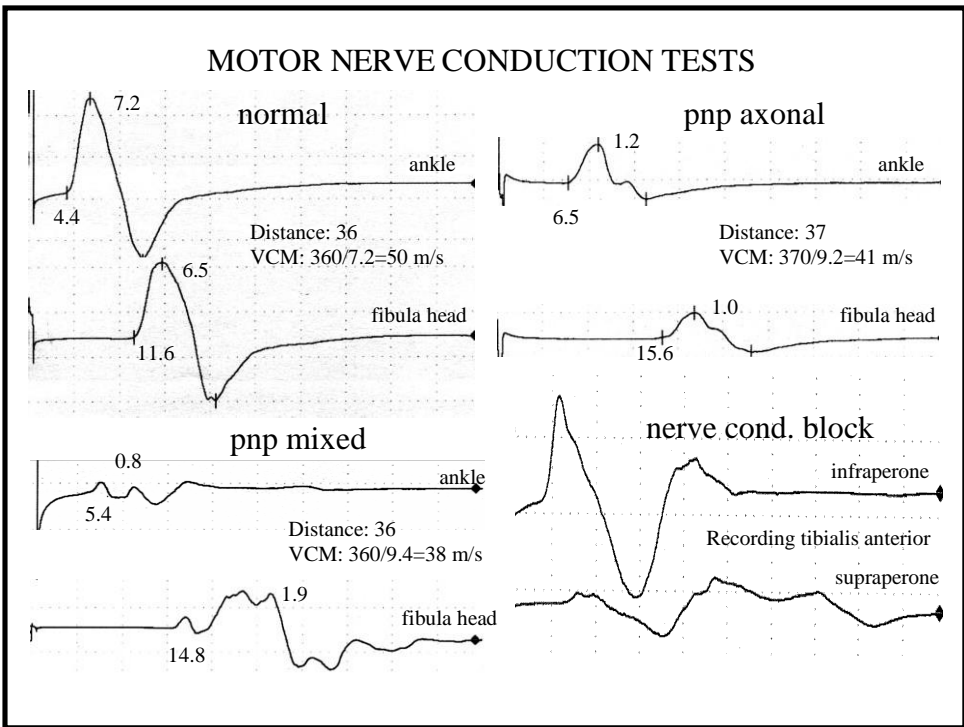
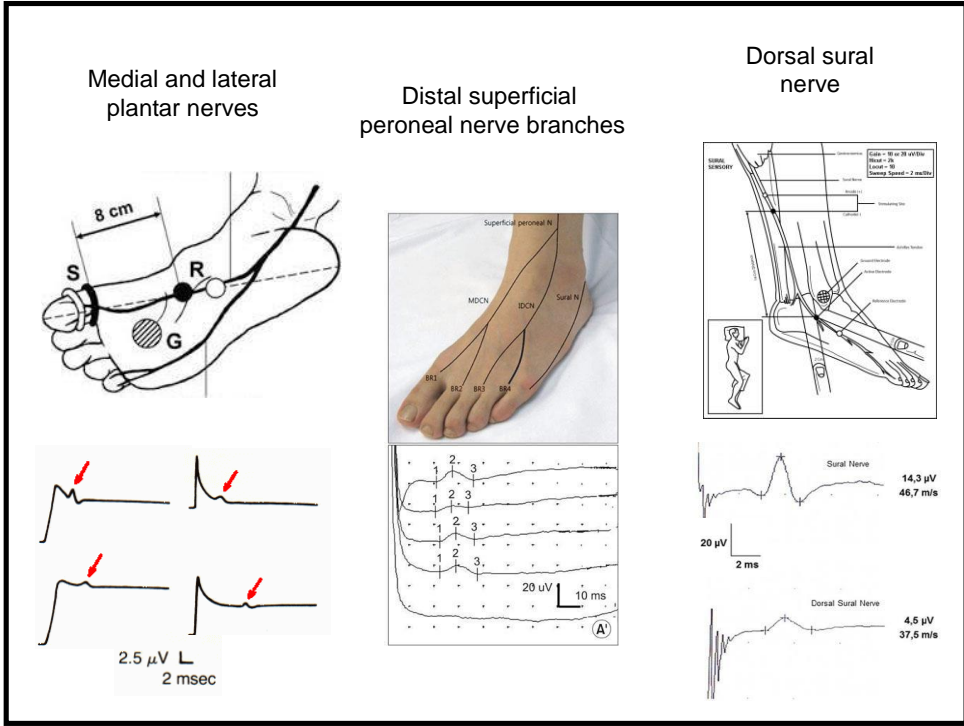
Axonopathy

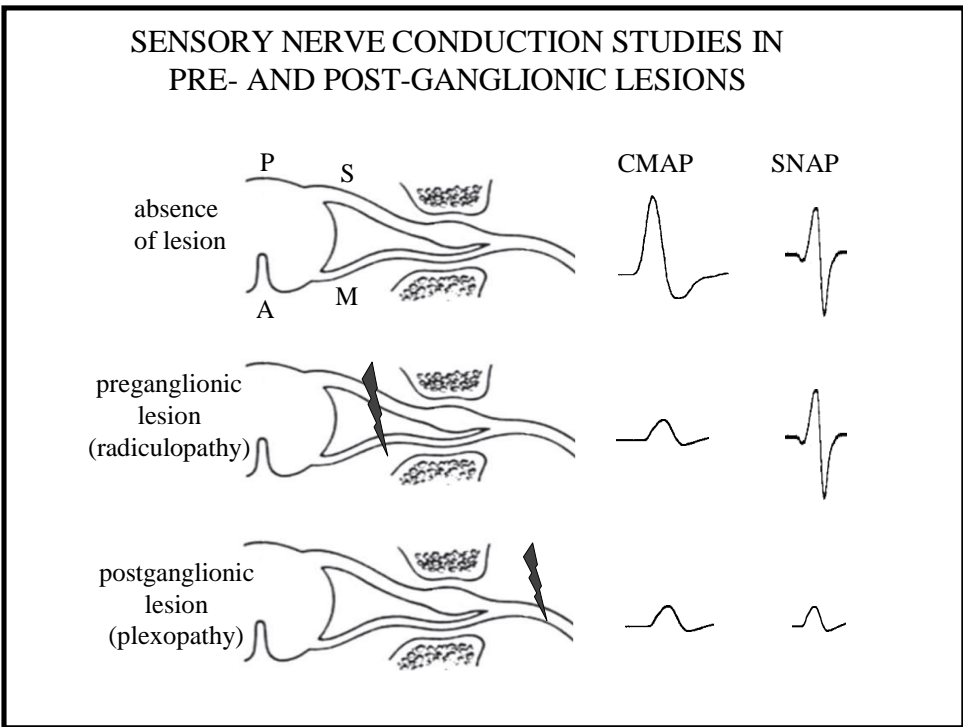
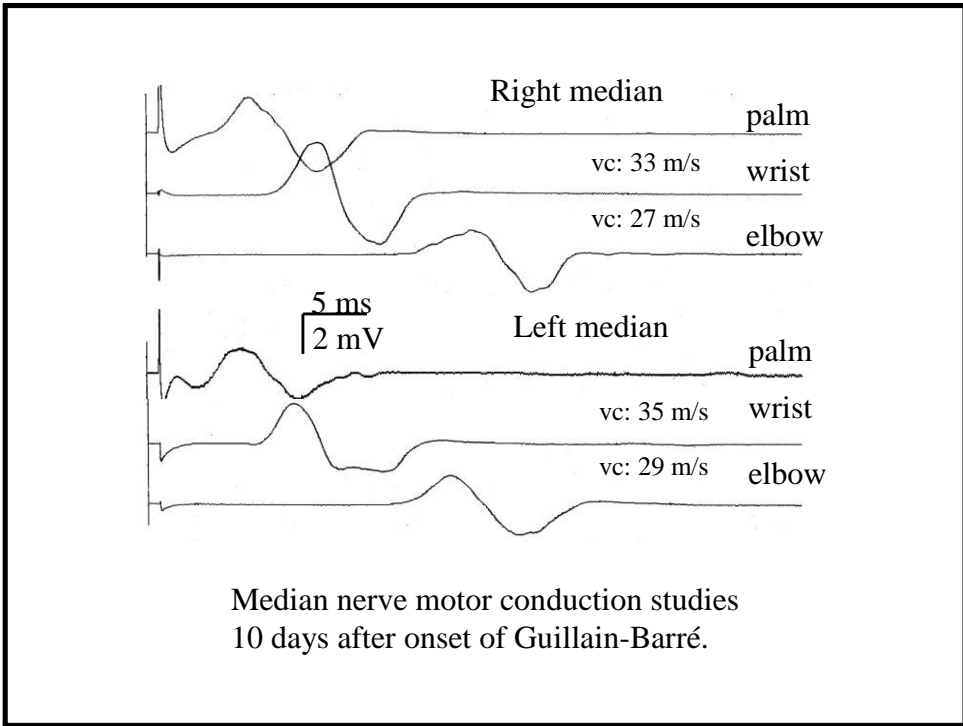


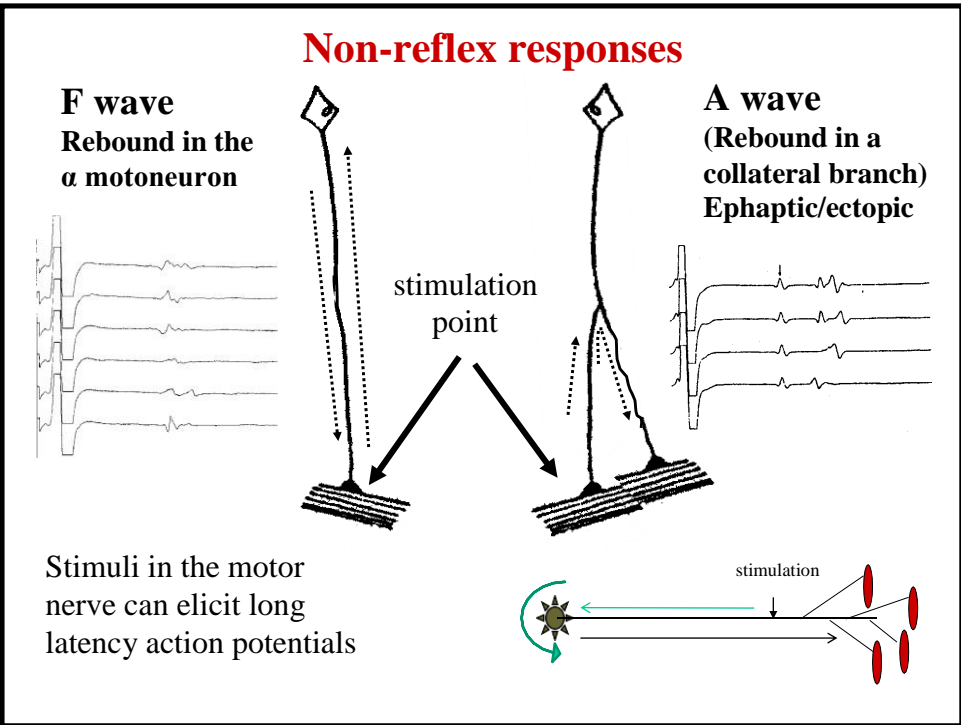
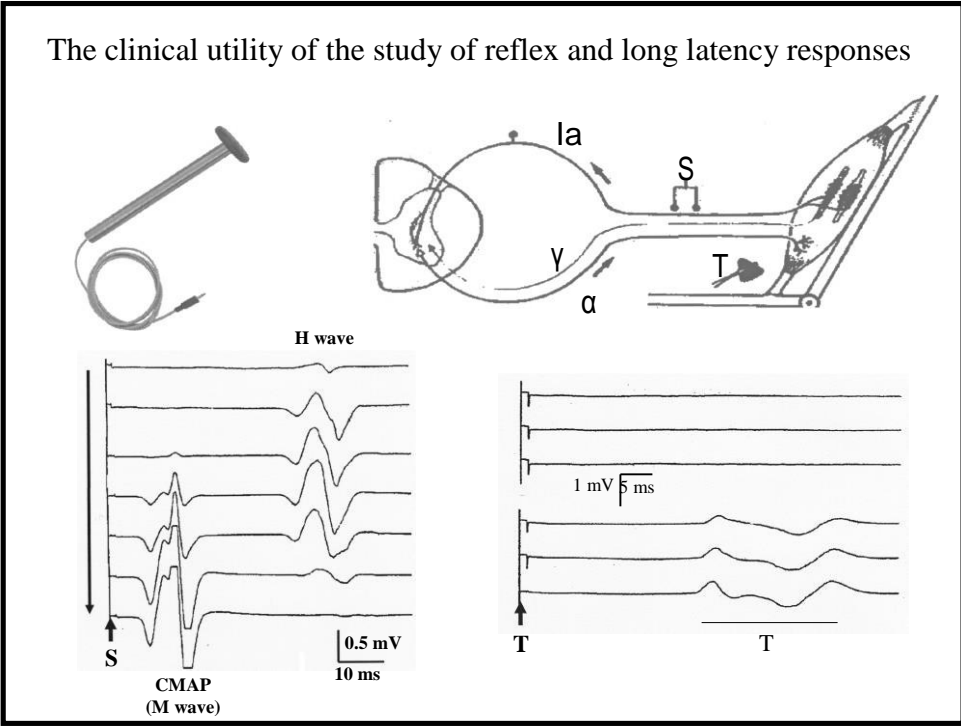
Sensory nerves of the foot for the study of axonal polyneuropathies

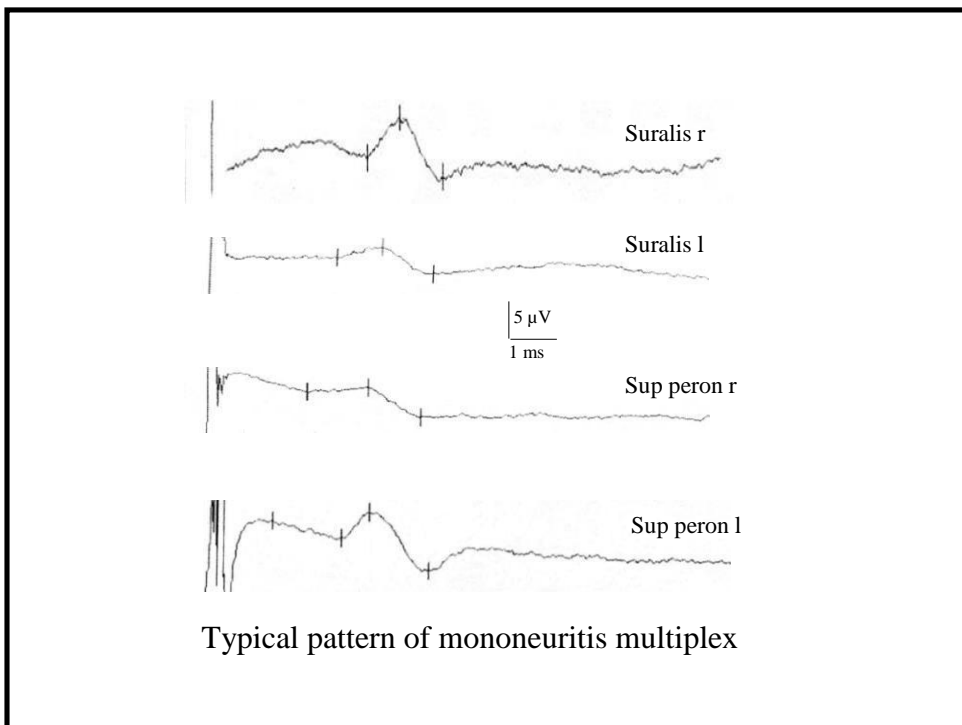
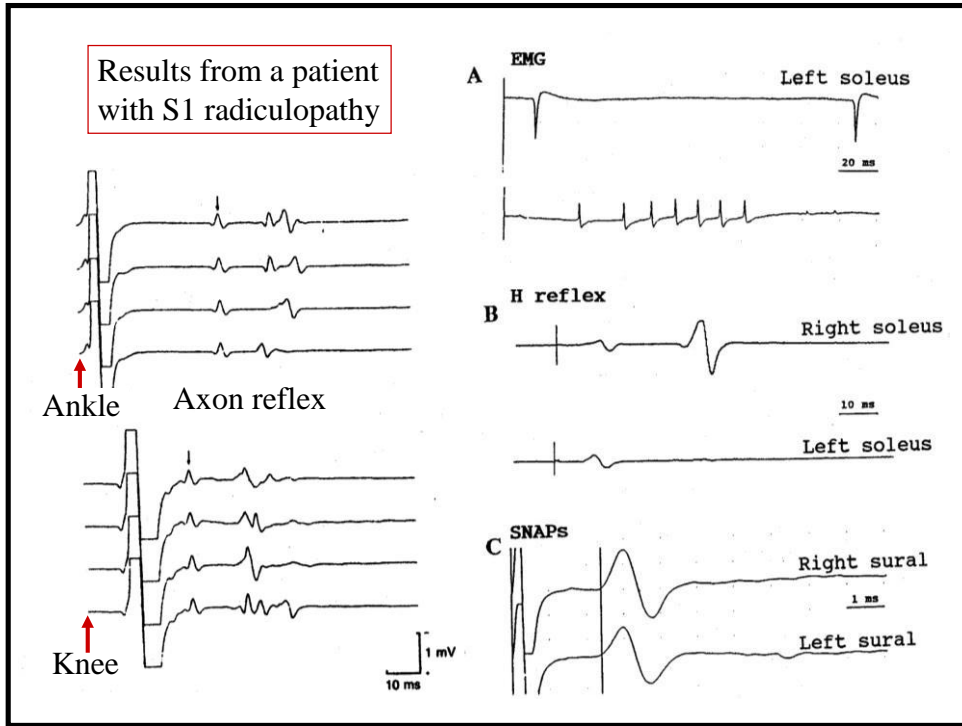
- Plantar nerves (mixed vs cutaneous)
- Dorsal sural nerve (distalmost part of sural nerve)
- Superficial and deep peroneal sensory nerves

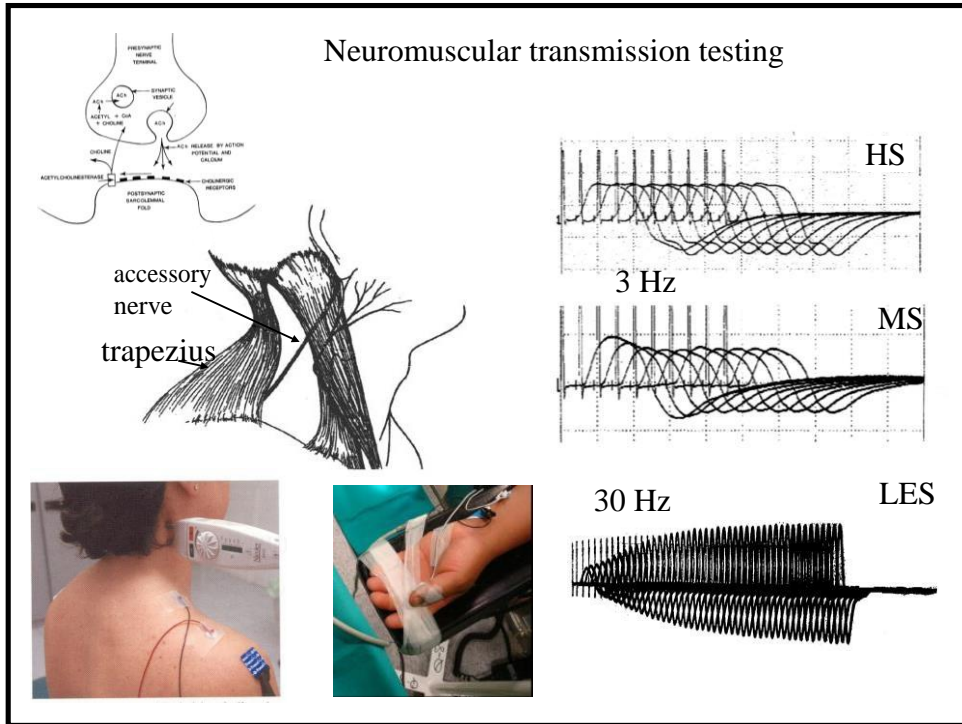








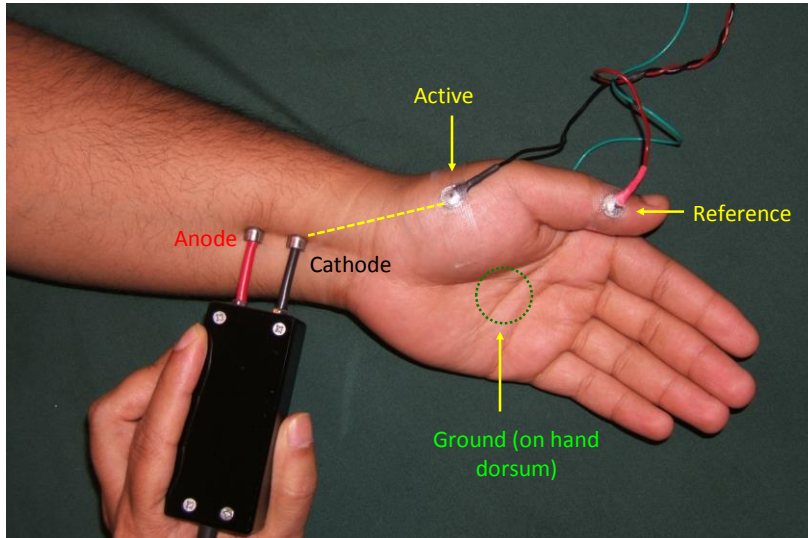




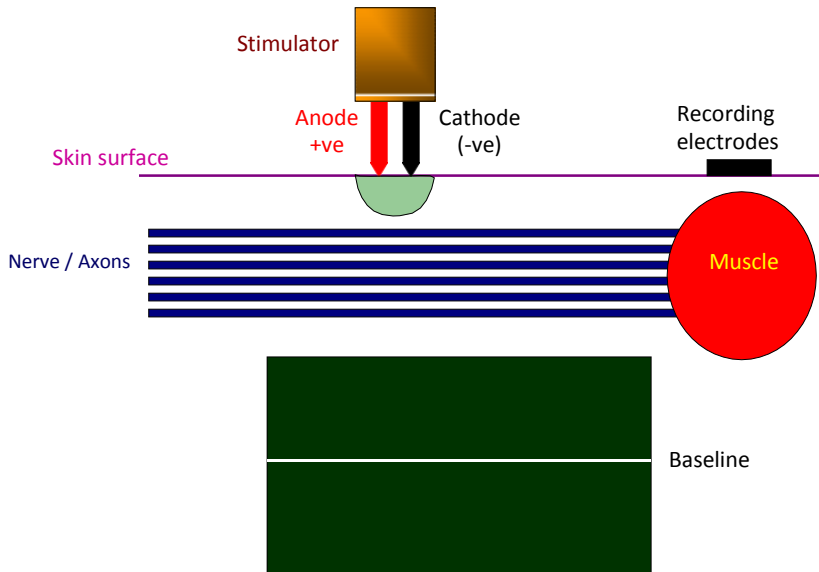
MUNE (Motor Unit Number Estimate) Principle

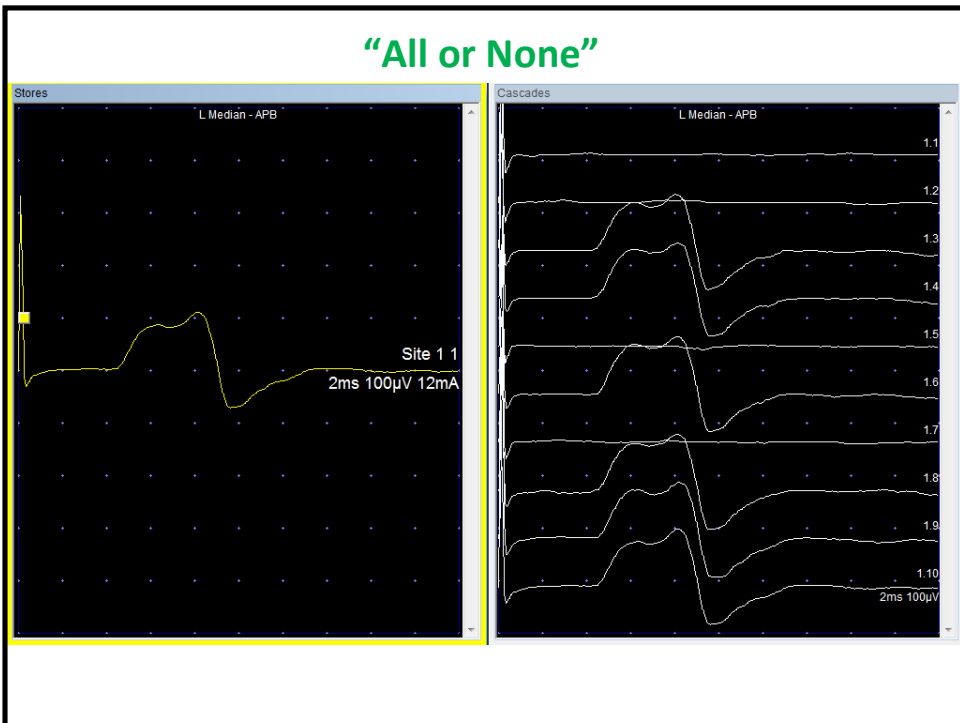
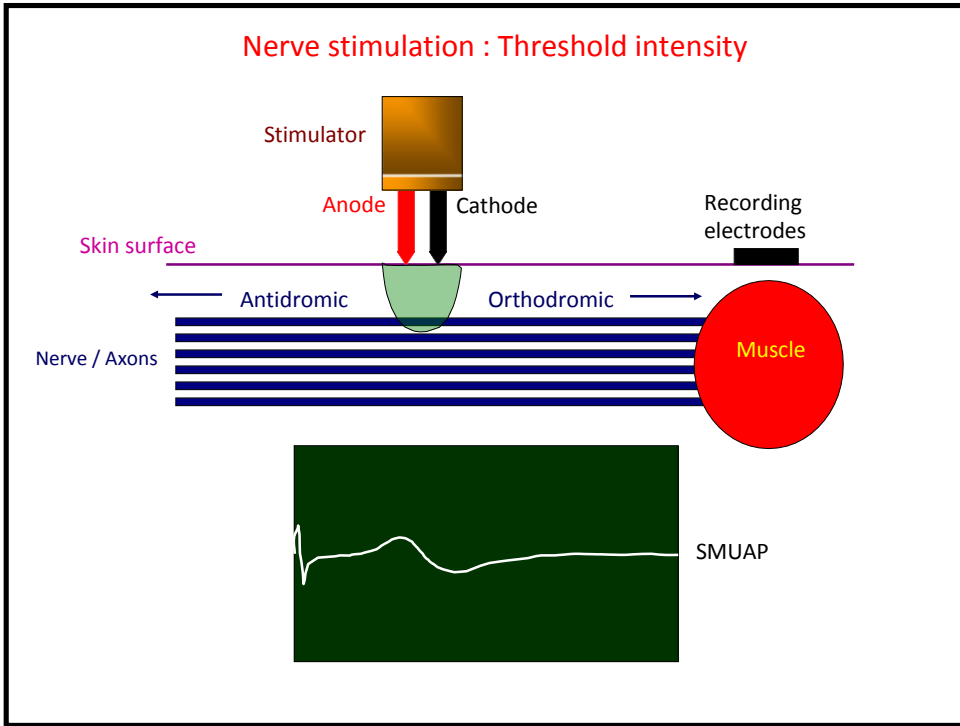
- 1** CMAP Record CMAP and measure its amplitude, e.g. 10000 μV
- 2** SMUAPs Estimate average SMUAP amplitude, e.g. 80 μV
- 3** MUNE = CMAP amplitude / SMUAP amplitude
(10,000 / 80 = 125)

Median Motor NCS: Distal Stimulation



Nerve stimulation : Very low intensity





Incremental Stimulation

Stores

Results Table

L Median - APB

Sites	Latency ms	Amplitude µV
Wrist	3.50	9002

Stores

Results Table

L Median - APB

Sites	Latency ms	Amplitude µV
MU 1		
MUs 1+2		
MUs 1+2+3		
MUs 1+2+3+4		
MUs 1+2+3+4+5		
MUs 1+2+3+4+5+6		
MUs 1+2+3+4+5+6+7	4.35	472

SMUP amplitude =
 $472/7 = 67 \mu\text{V}$

MUNE = 9002 / 67 = 135