Applied Nerve & Muscle Physiology :

Nerve Conduction Study (NCS))and Electromyography (EMG)

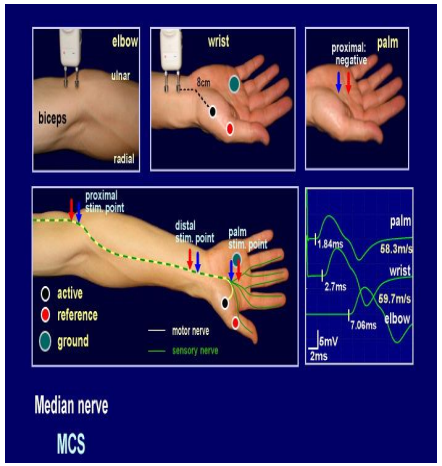
Dr Fawzia ALRouq

Physiology Department

Applied Nerve & Muscle Physiology

Nerve Conduction Study (NCS)

Electromyography (EMG)



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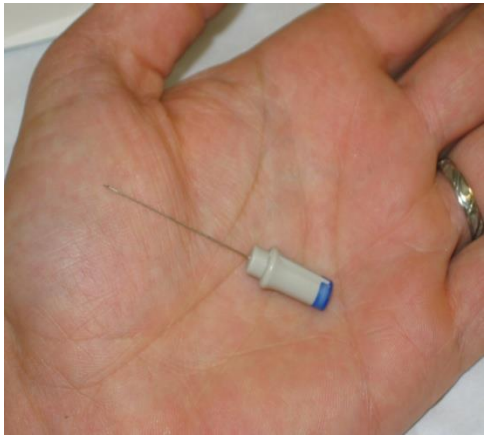
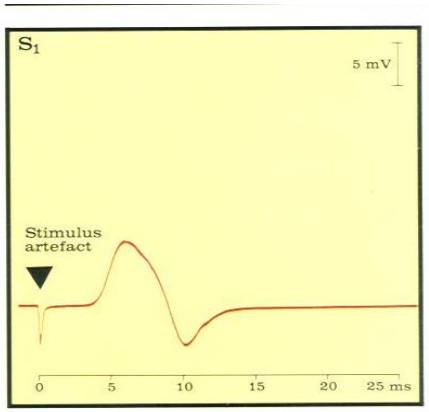
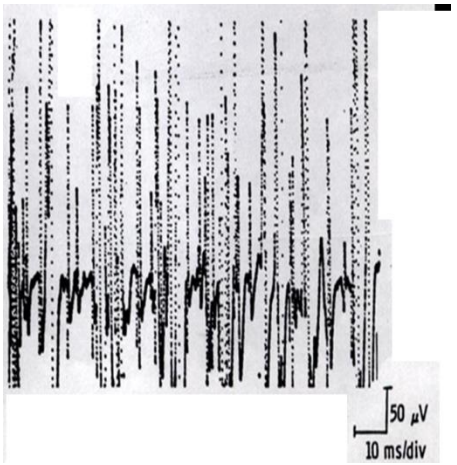




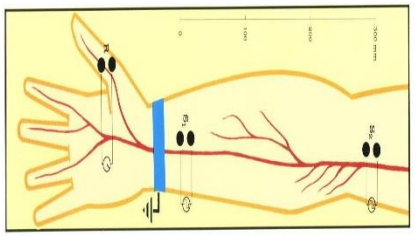


- https://www.youtube.com/watch?v=avl2rS3sii g
- https://www.youtube.com/watch?v=gpgsR5jcl 8M

Objectives

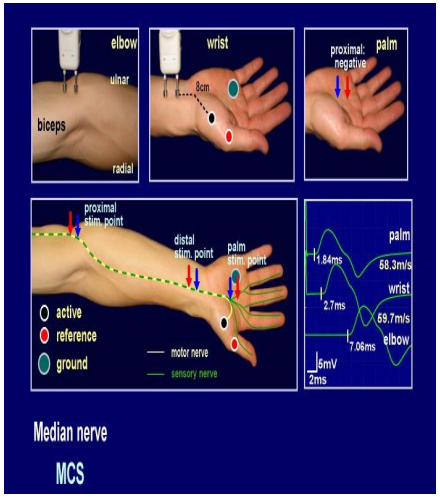
- Define what is nerve conduction study (NCS) and electromyography (emg) .
- Explain the procedure of NCS using Abductor Pollicicis Brevis muscle .
- Define the normal conduction velocity in upper limb and lower limb nerves .
- Define the motor unit potentials (MUPs) and how they are changed in muscle and nerve diseases .

Nerve Conduction Study (NCS)



- A nerve conduction study (NCS) is an electrophysiology test test commonly used to evaluate the function of peripheral nerves of the human body.
- It could be motor nerve conduction study (motor NCS) , sensory nerve conduction study or mixed nerve conduction study .
- In this lecture, because of time constraint, only motor nerve conduction study will be discussed
- In the motor test the recorded response is the muscle CMAP (compound muscle action potential)

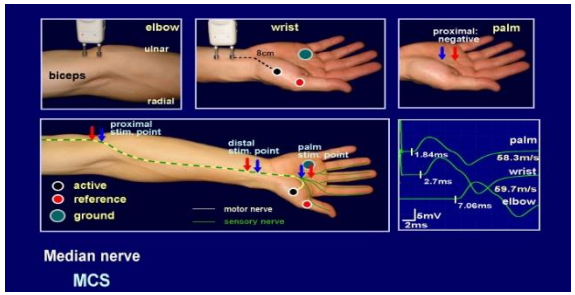
Procedure

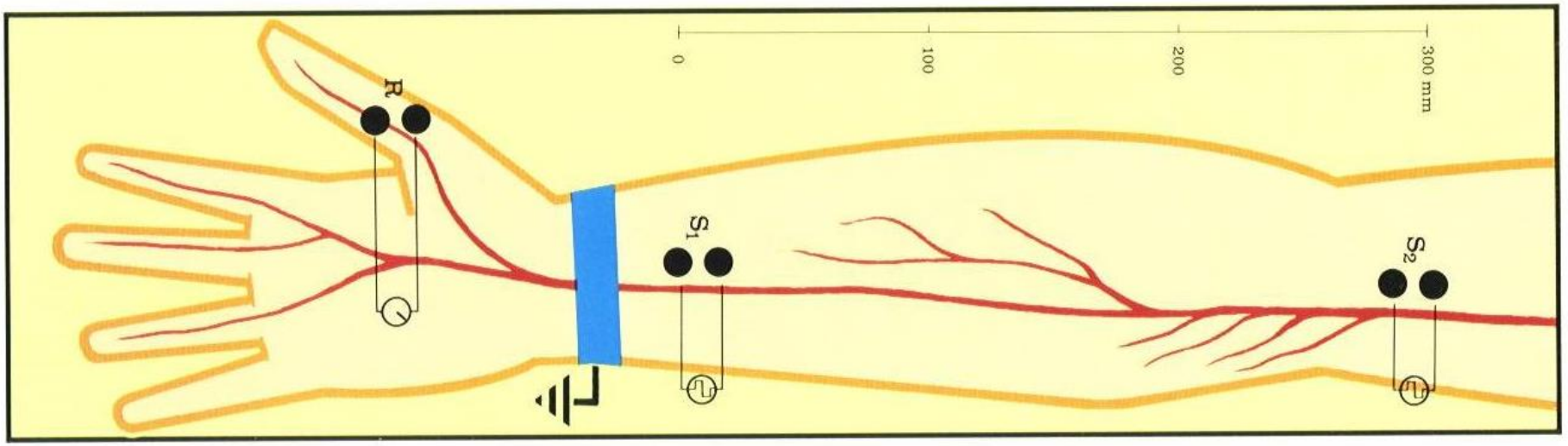


- An electrical stimulus is applied over a nerve (e.g., median nerve) and a recording electrode is place over the muscle supplied by that motor nerve .
- The stimulus is applied at two sites : a distal site

  (wrist) and a proximal one (antecubital fossa , elbow) .
- The muscle usually chosen in this routine test is the Abductor Pollicis Brevis
- The active recording electrode (G1) is place over the thenar eminence which overlies the muscle .
- And the reference recording electrode (G2) about 3 cm away .
- The oscilloscope (CRO) sweep speed is

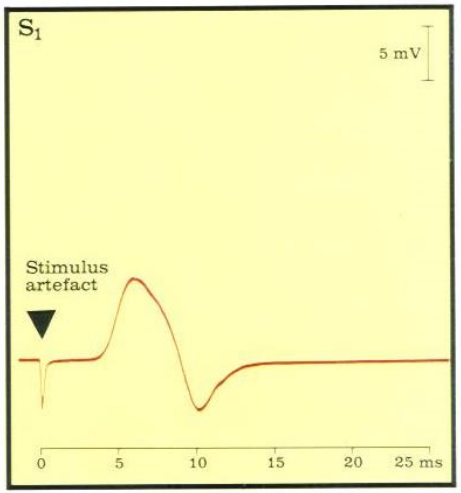
- The stimulus duration used is 0.2 ms and stimulus frequency to 1 / sec.
- Apply the stimulus and record the response from stimulation at the wrist .
- Store the CMAP (compound muscle action potential) in the first channel of the oscilloscope .
- Change the stimulating site from wrist to antecubital fossa (elbow) .
- Stimulate the nerve & record the CMAP for median nerve stimulation at the elbow .





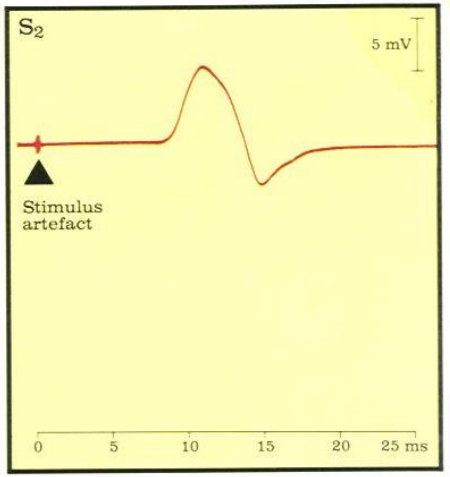
Distance

d = 284 mm



L1 Latency At wrist

= 3.5 ms

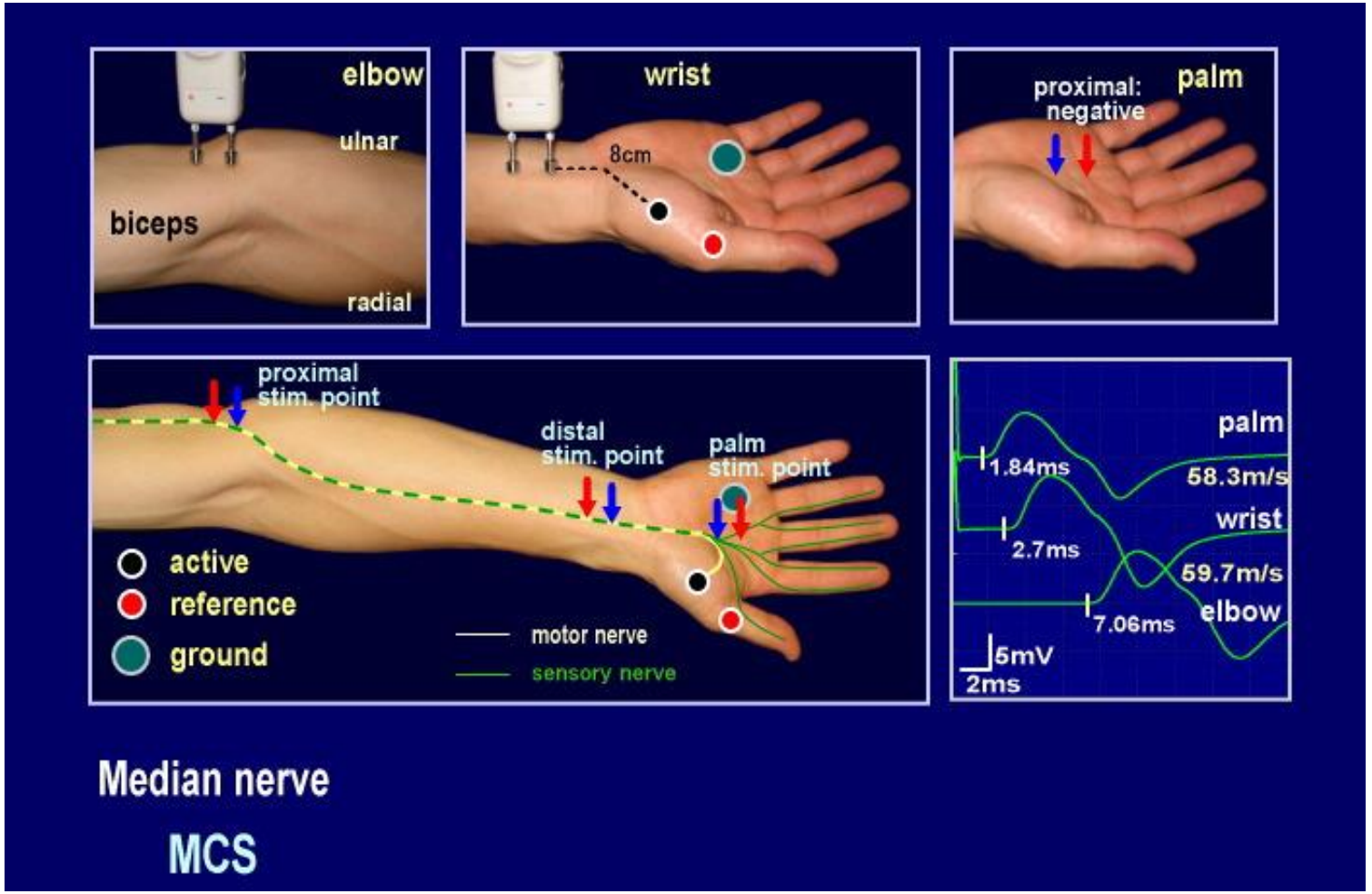


L2 Latency At elbow

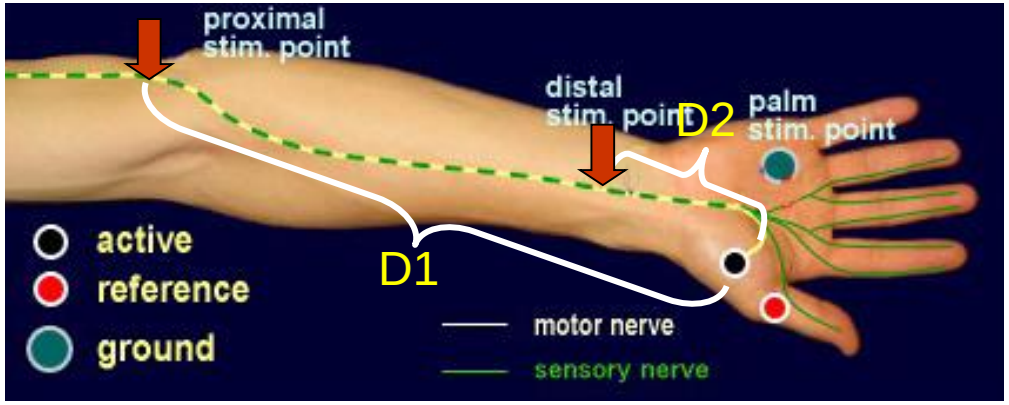
= 8.5 ms

- Measure the distance from elbow to wrist with a measuring tape.
- Measure the latency in first CMAP & in the next CAMP.
- Enter the distance between the elbow and wrist

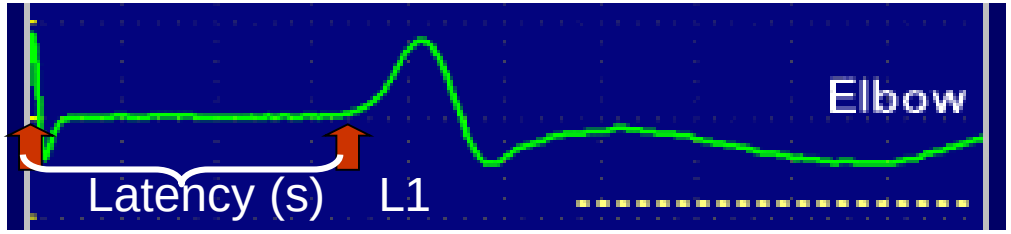
Motor conduction study: Median nerve

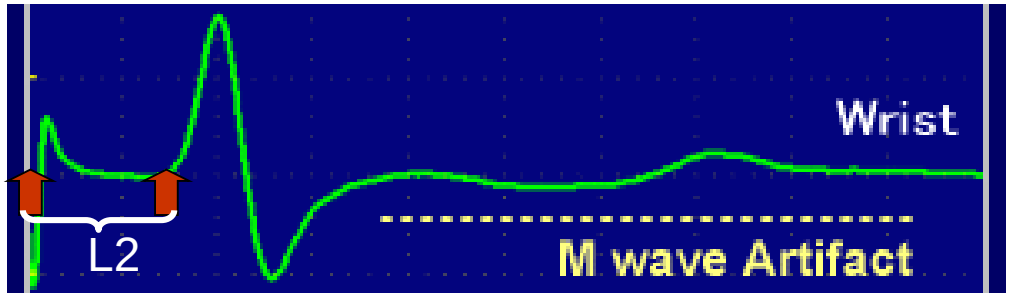


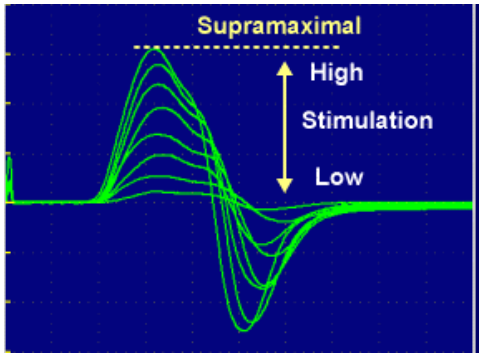
Nerve conduction velocity

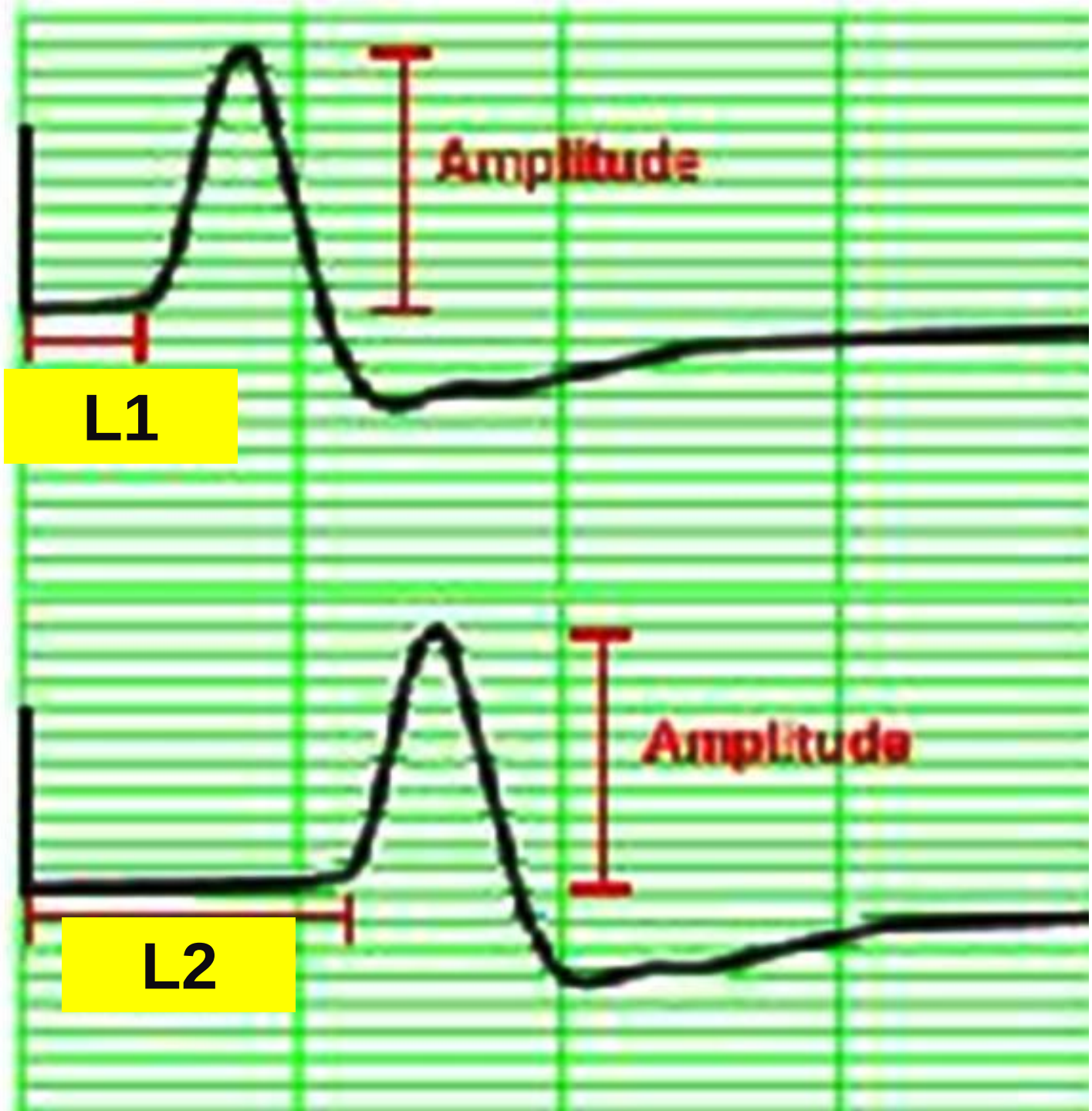


$$NCV = \frac{D1-D2}{L1-L2}$$








Amplitude
L1
Amplitude
L2

MNCV

- MNCV will appear.
- It can also be calculated by formula

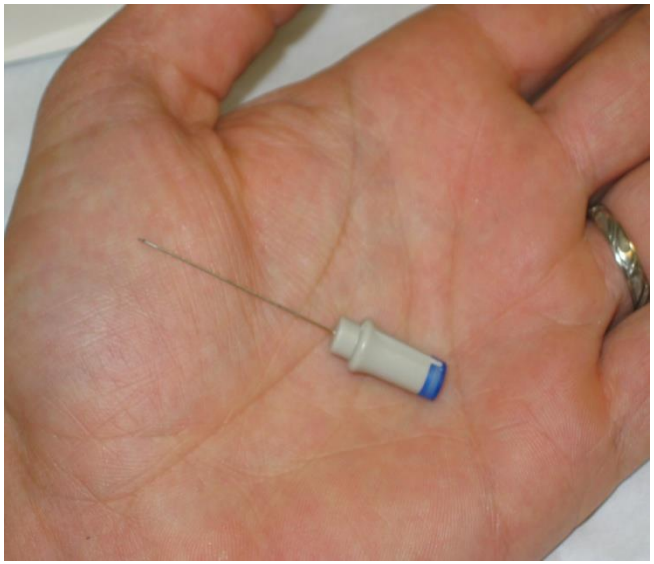
- MNCV (m/sec)= $\frac{\text{Distance (mm)}}{\text{L2-L1 (ms)}}$

- L1 = latency at wrist
- L2 = latency at elbow

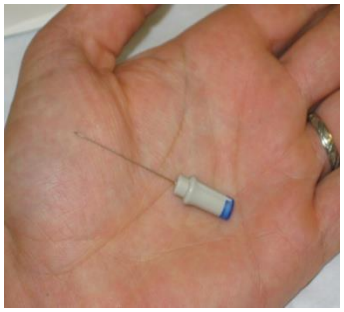
Normal values for conduction velocity

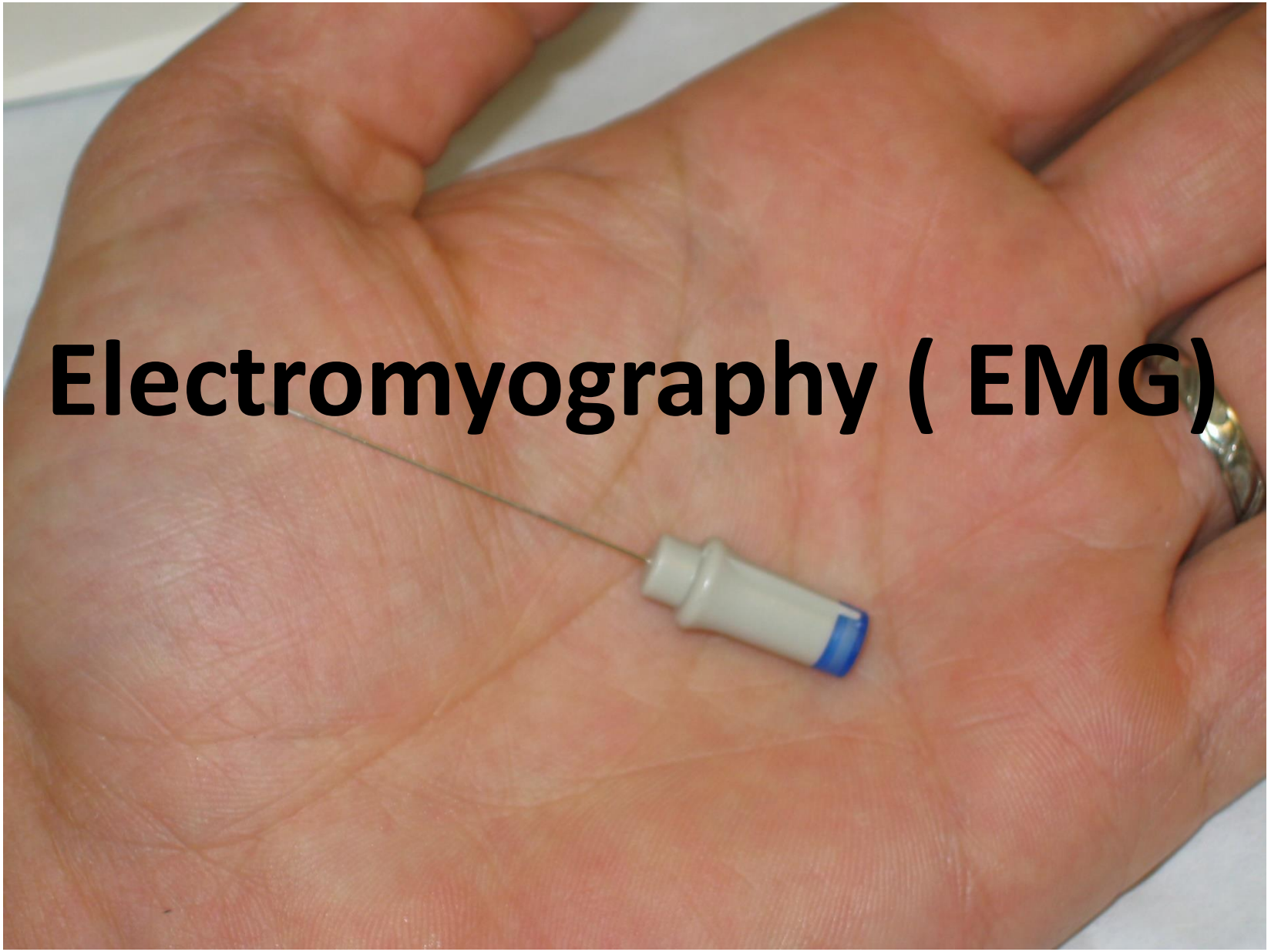
- ✓ In arm
  - 50 – 70 m / sec.
- ✓ In leg
  - 40 – 60 m / sec.

Electromyography (EMG)

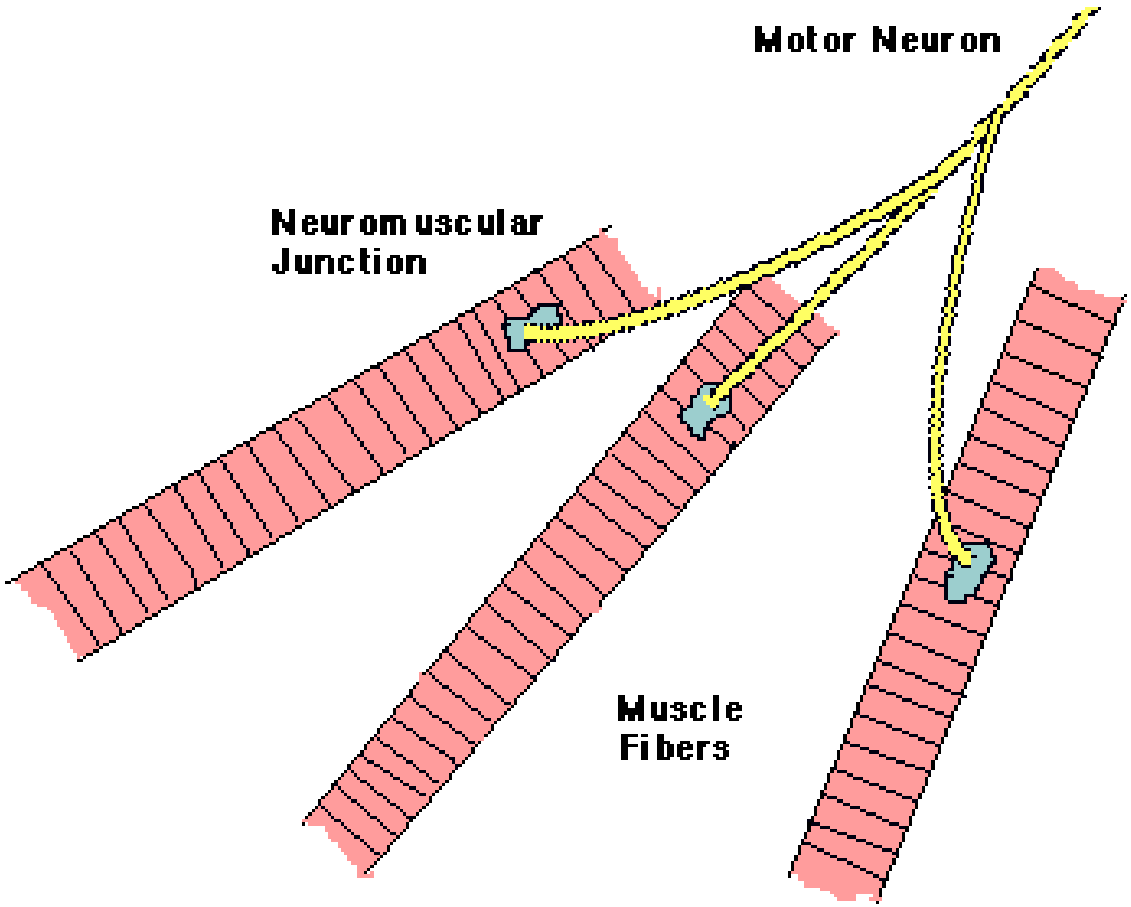


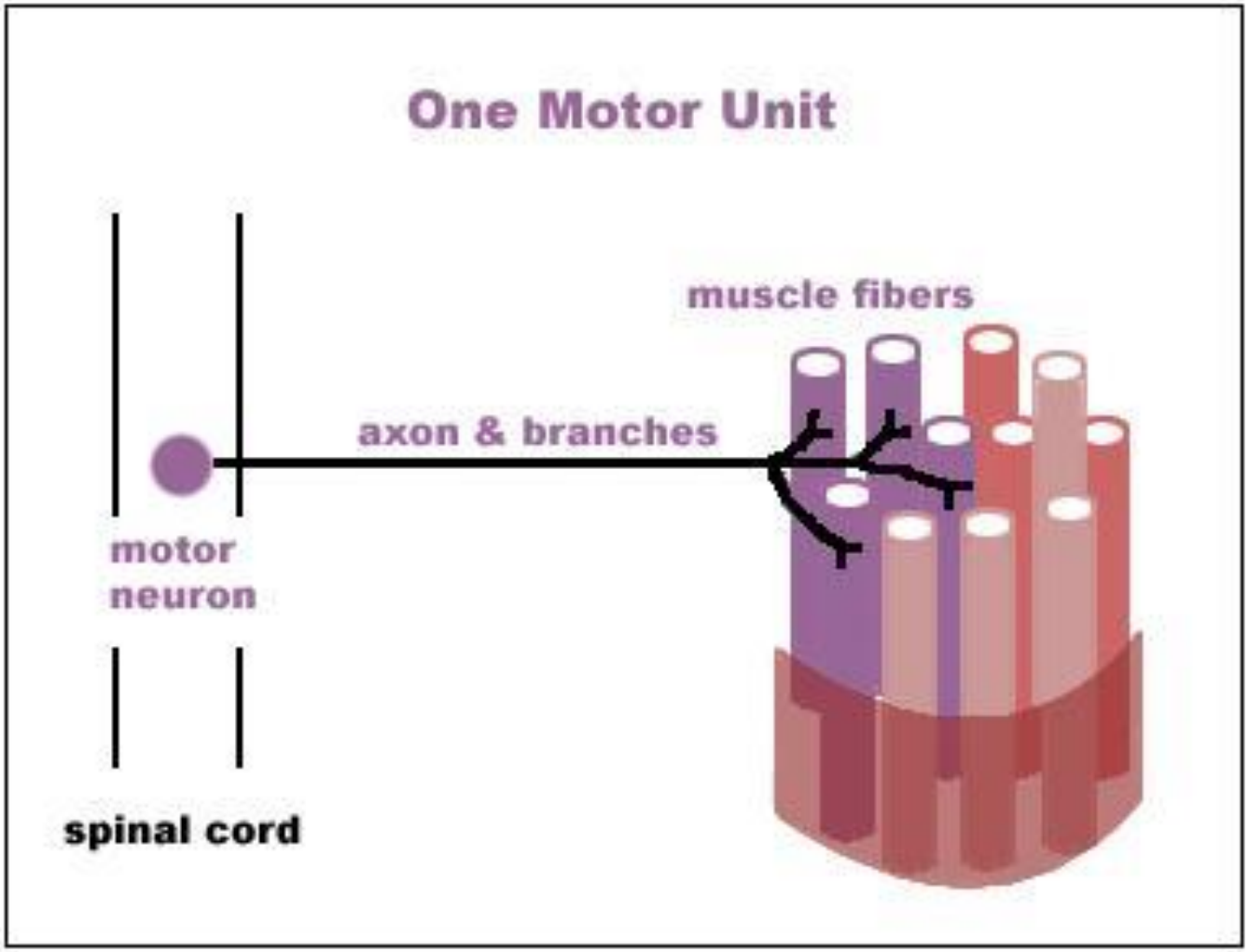
- Electromyography (EMG) is a technique for evaluating and recording physiologic properties of muscles at rest and while contracting.
- It's a recording of electrical activity of the muscle by inserting needle electrode in the belly of the muscles (needle emg) or by applying the surface electrodes (surface emg)
- The potentials recorded in needle emg are derived from motor units of the muscle, hence known as motor unit potentials (MUPs).
- Q: Define what is a " motor unit "?




Electromyography (EMG)

- A motor unit is defined as one motor neuron and all of the muscle fibers it innervates.



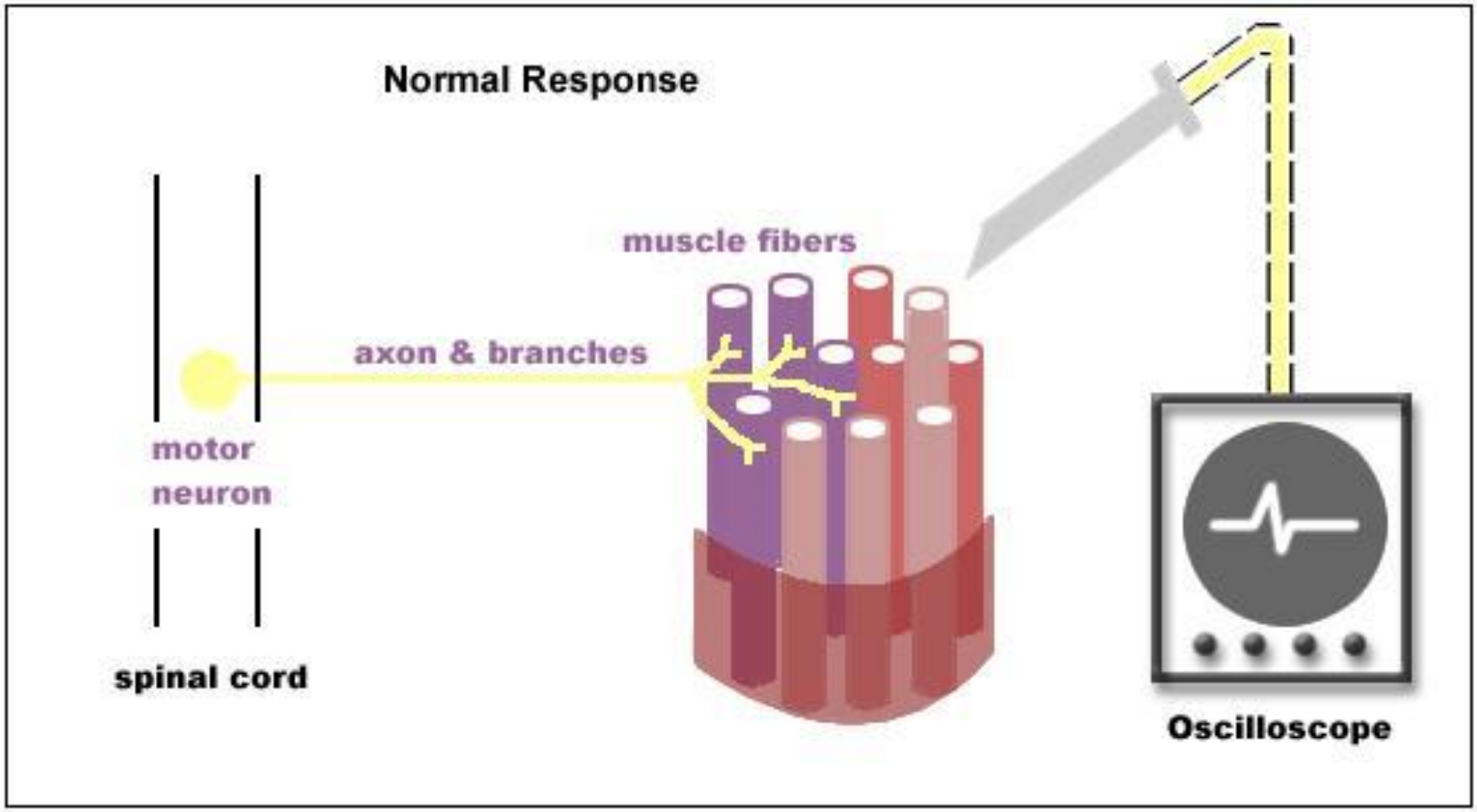

One Motor Unit
muscle fibers
axon & branches
motor
neuron
spinal cord

Analysis

EMG

- Spontaneous activity
  - The skeletal muscle is silent at rest, hence spontaneous activity is absent.

NORMAL EMG

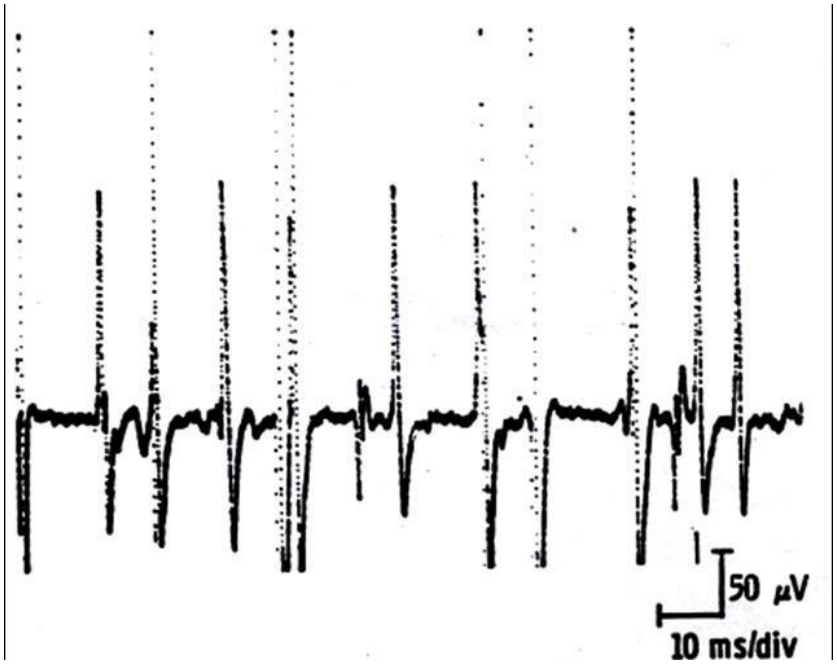

Normal Response
muscle fibers
axon & branches
motor
neuron
spinal cord
Oscilloscope

Normal MUPs

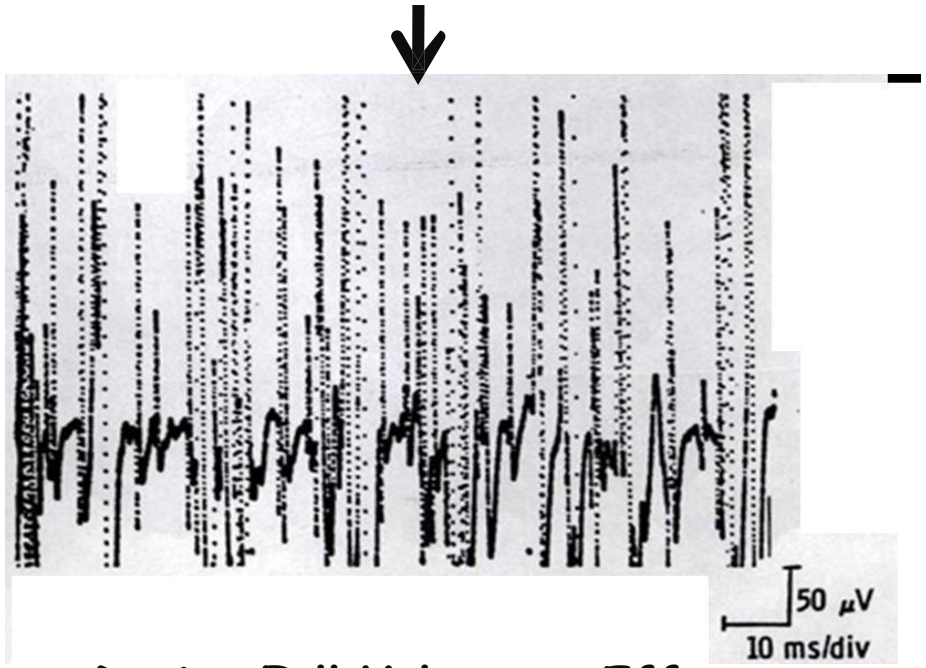
- Bi – Triphasic
- Duration – 3 – 15 mSec.
- Amplitude – 300µV – 5 mV

MUPs (2)

During Mild Effort

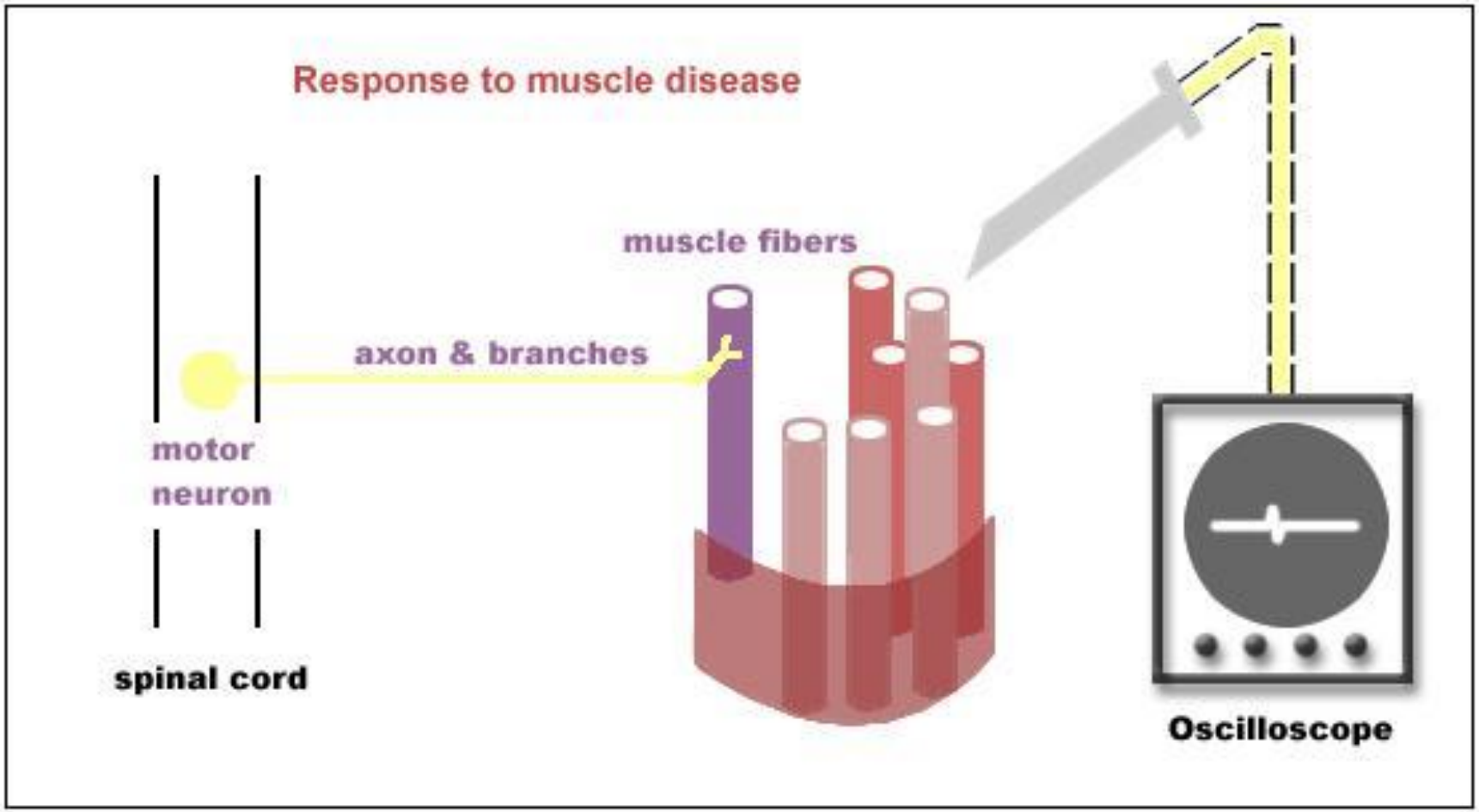


During Moderate Effort → note recruitment of additional motoneurons



During Full Voluntary Effort . There is full recruitment (you can not see the baseline)

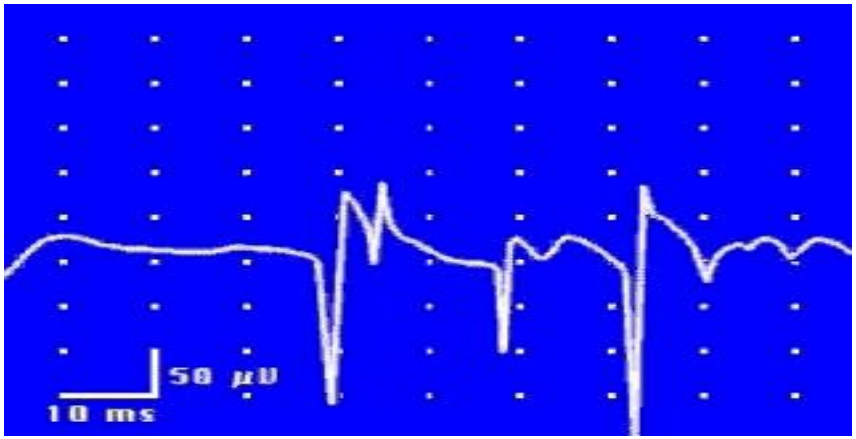
MYOPATHY


Response to muscle disease
muscle fibers
axon & branches
motor
neuron
spinal cord
Oscilloscope

Abnormal MUPs

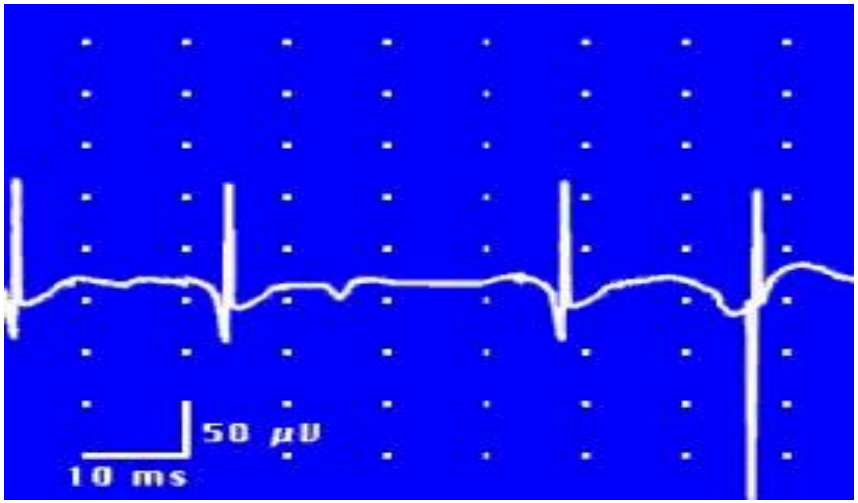
In neurogenic lesion or in active myositis, the following spontaneous activity is noted

- Positive sharp wave:
  - A small potential of 50 to 100 µV, 5 to 10 msec duration with abrupt onset and slow outset.



Cont…

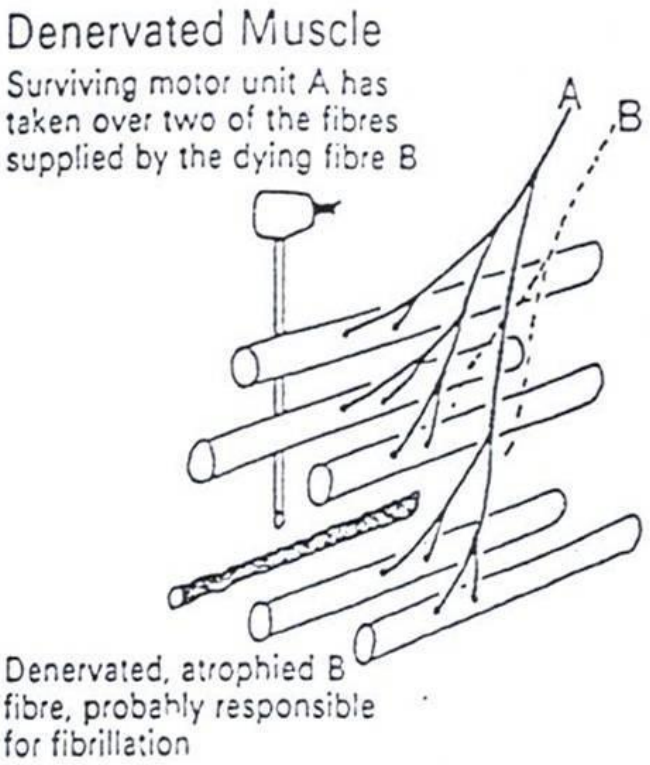
- Fibrillation potential:
  - these are randomly occurring small amplitude potentials or may appear in runs. The audioamplifier gives sounds. These potentials are generated from the single muscle fiber of a denervated muscle, possibly due to denervation hypersensitivity to acetyl choline.

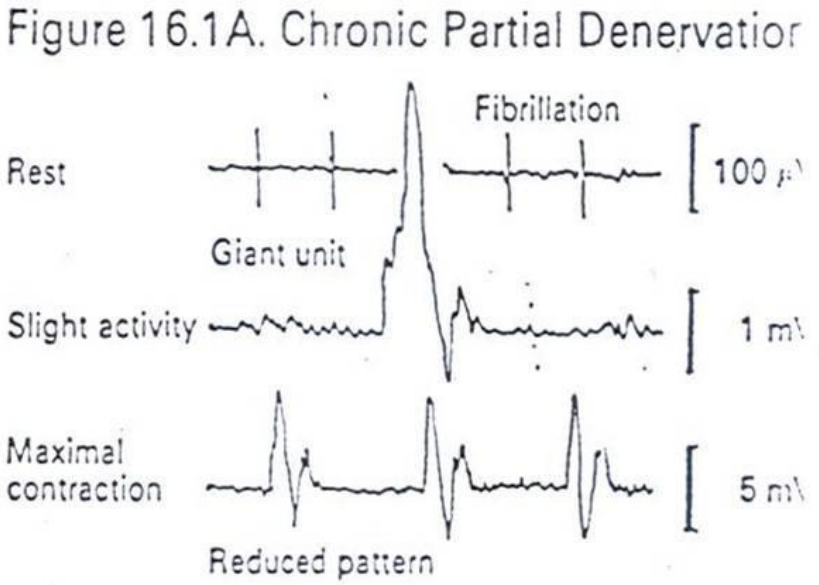


Cont…

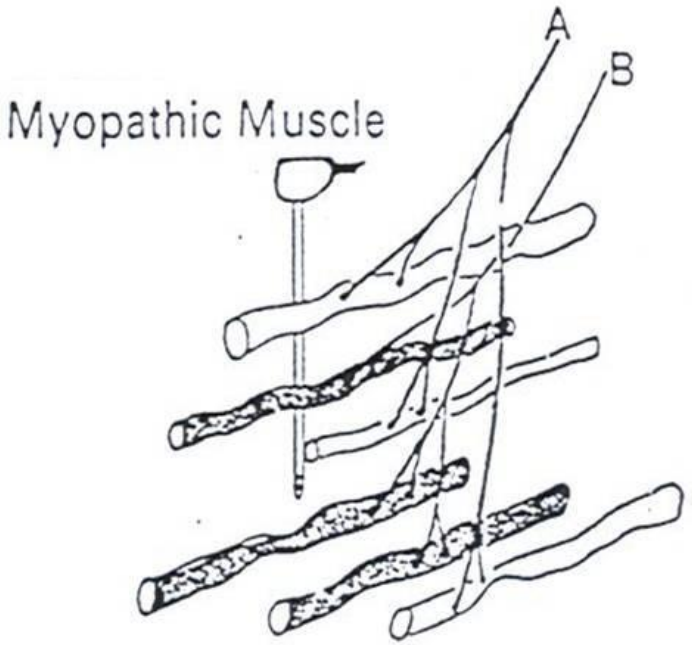
- **Fasciculation potentials:**
  - These are high voltage, polyphasic, long duration potentials appear spontaneously associated with visible contraction of the muscle. They originate from a large motor unit which is formed due to reinnervation of another motor unit from the neighboring motor unit.

Neuropathic EMG changes

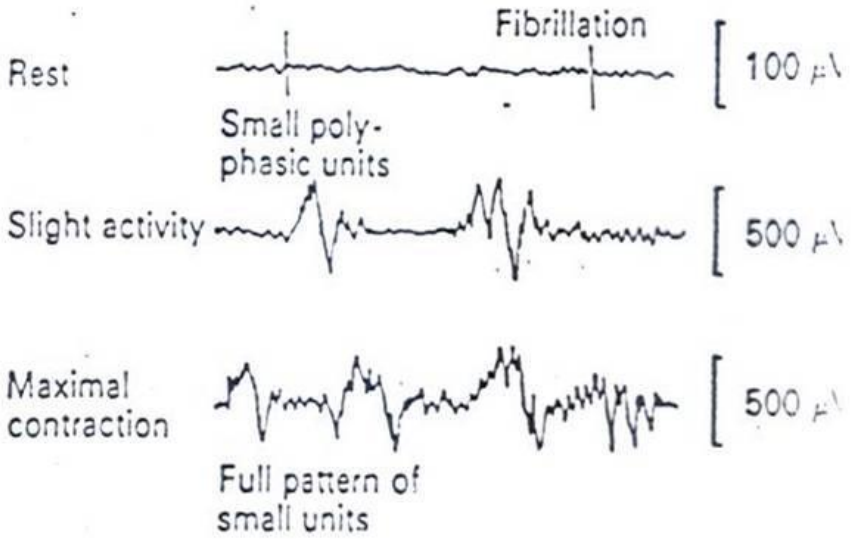




Myopathic EMG changes



Muscle fibres supplied by both A and B are indiscriminately affected, although both nerve fibres are normal



Analysis of a motor unit potential (MUP)

MUP	NORMAL	NEUROGENIC	MYOPATHIC
Duration msec.	3 – 15 msec	longer	Shorter
Amplitude	300 – 5000 µV	Larger	Smaller
Phases	Biphasic / triphasic	Polyphasic	May be polyphasic
Resting Activity	Absent	Present	Present
Interference pattern	full	partial	Full

Typical MUAP characteristics in myopathic, neuropathic & normal muscle

MUP	Myopathy	Normal	Neuropathy
Duration	< 3 msec	3 – 15 msec	> 15 msec
Amplitude	< 300 µV	300-5000 µV	> 5 mV
configuration	polyphasic	triphasic	Polyphasic

In nerve diseases : Giant MUPs due to reinnervation > 5 mV
In muscle disease : Small MUPs < 300µV


Thank you