



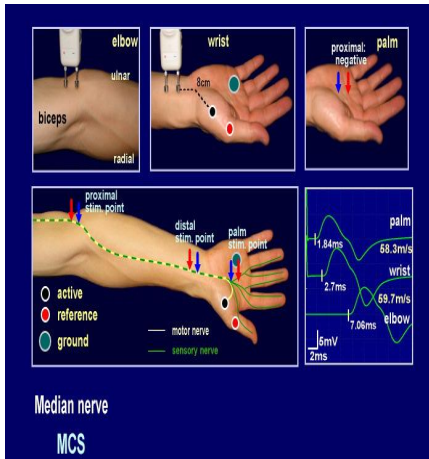
**Applied Nerve & Muscle  
Physiology :  
Nerve Conduction Study ( NCS) )and  
Electromyography ( EMG)**

Dr Fawzia ALRouq  
Physiology Department

# Applied Nerve & Muscle Physiology

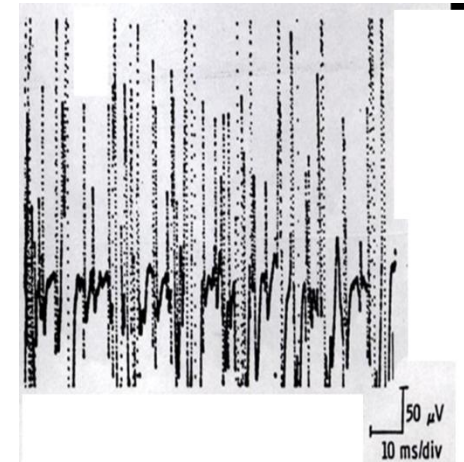
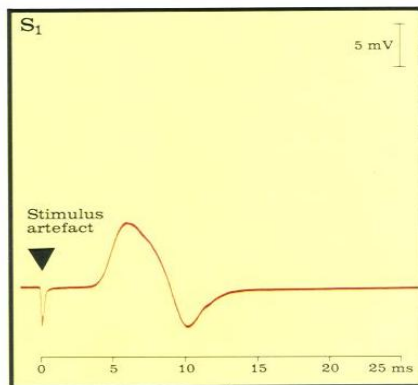
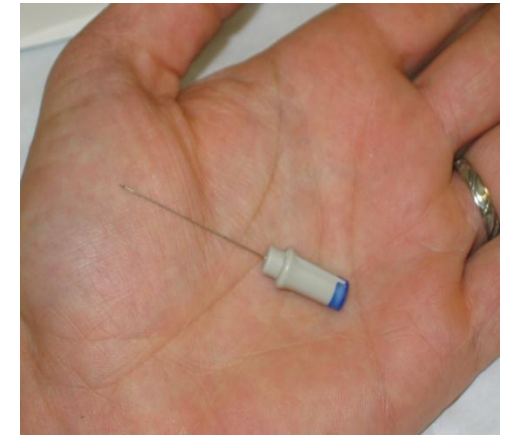
Nerve Conduction Study (NCS)

Electromyography (EMG)



Physiology  
Department

Dr Fawzia ALRouq

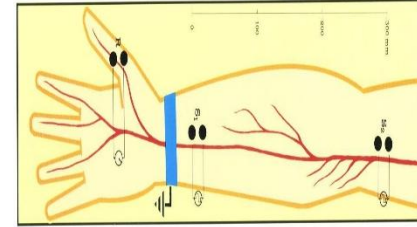


- <https://www.youtube.com/watch?v=avl2rS3sii>  
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- <https://www.youtube.com/watch?v=gpgsR5jcl>  
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# Objectives

- 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 .

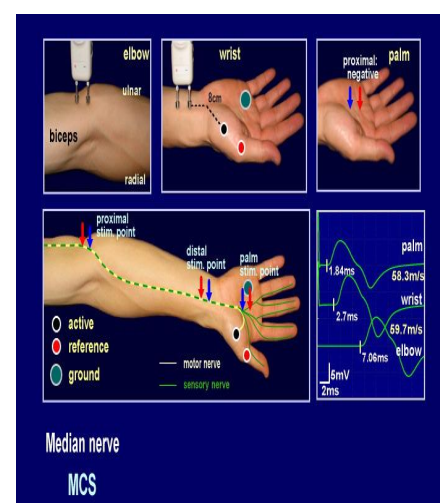
# Nerve Conduction Study ( NCS)



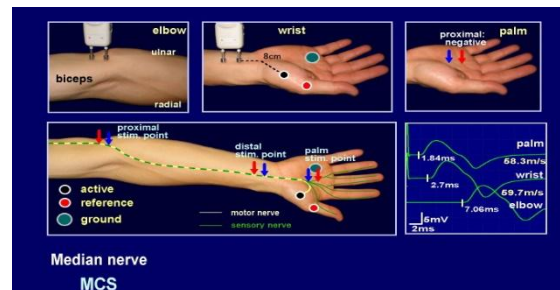
- A nerve conduction study (NCS) is an electrophysiology test commonly used to evaluate the function of peripheral nerves of the human body.
- It could be motor nerve conduction study ( motor NCS) , sensory nerve conduction study or mixed nerve conduction study .
- In this lecture, because of time constraint,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

# Procedure

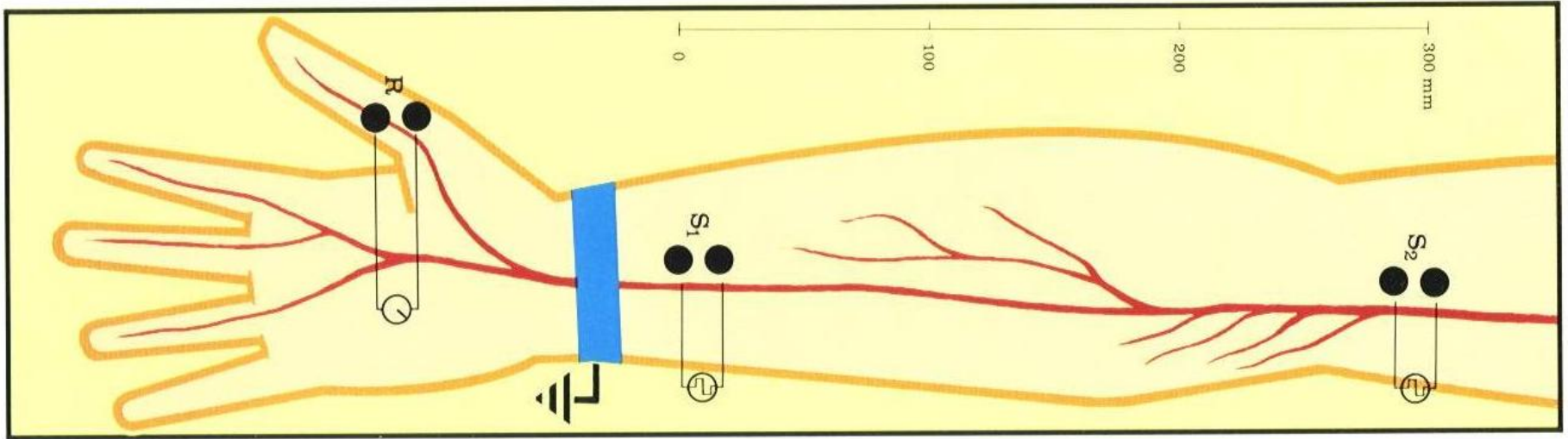
- An electrical stimulus is applied over a nerve ( e.g., median nerve ) and a recording electrode is place over the muscle supplied by that motor nerve .
- The stimulus is applied at two sites : a distal site ( wrist ) and a proximal one ( antecubital fossa , elbow ).
- The muscle usually chosen in this 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



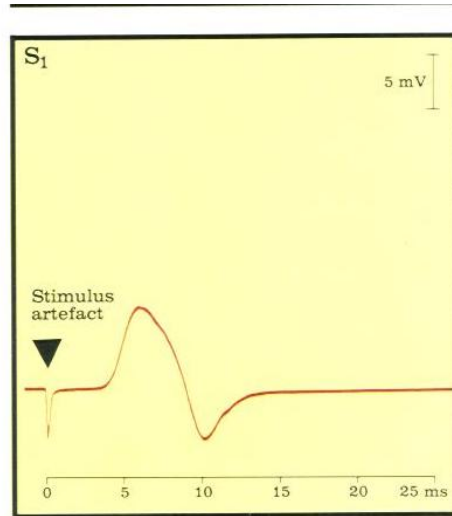
- The stimulus duration used is 0.2 ms and stimulus frequency to 1 / sec.
- Apply the stimulus and record the response from stimulation at the wrist .
- Store the CMAP ( compound muscle action potential ) in the first channel of the oscilloscope .
- Change the stimulating site from wrist to antecubital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



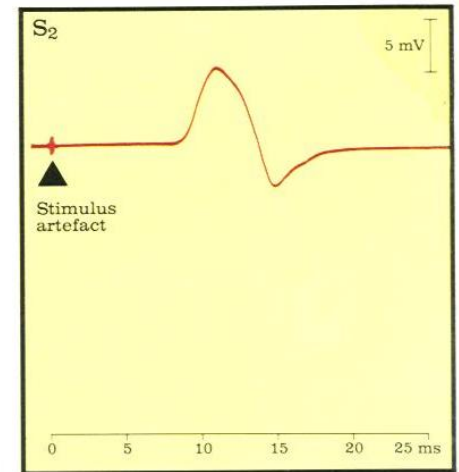




**Distance**  
**d = 284 mm**



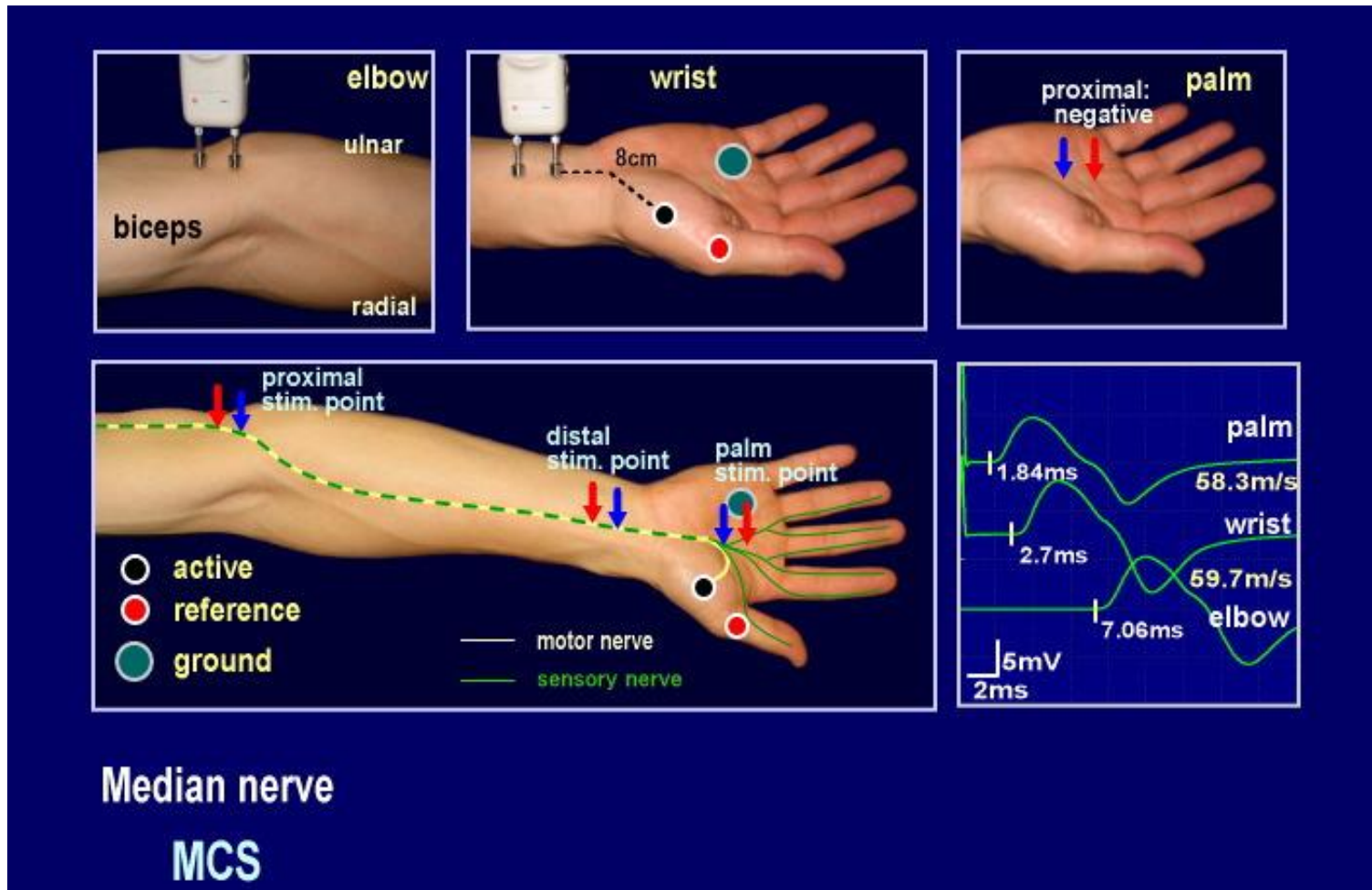
**L1 Latency At**  
**wrist**  
**= 3.5 ms**



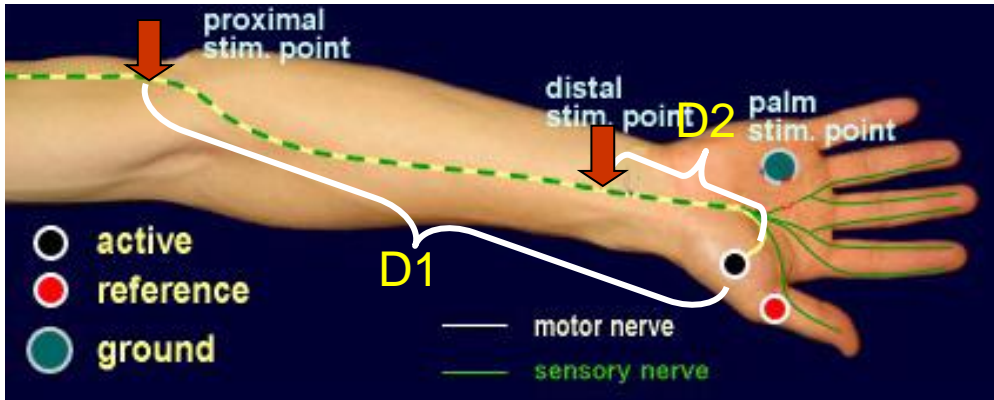
**L2 Latency At**  
**elbow**  
**= 8.5 ms**

- 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

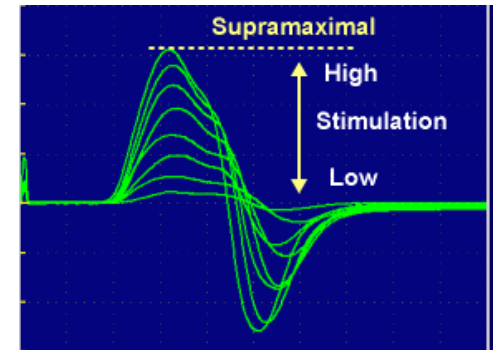
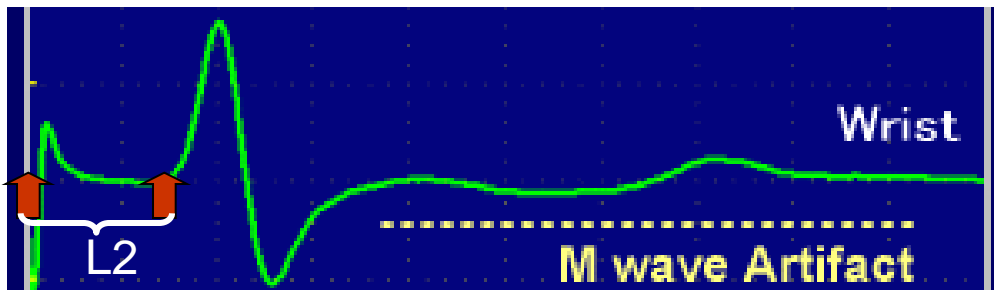
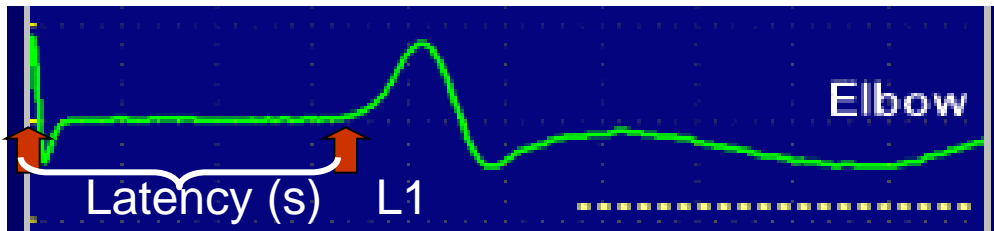
# Motor conduction study: Median nerve

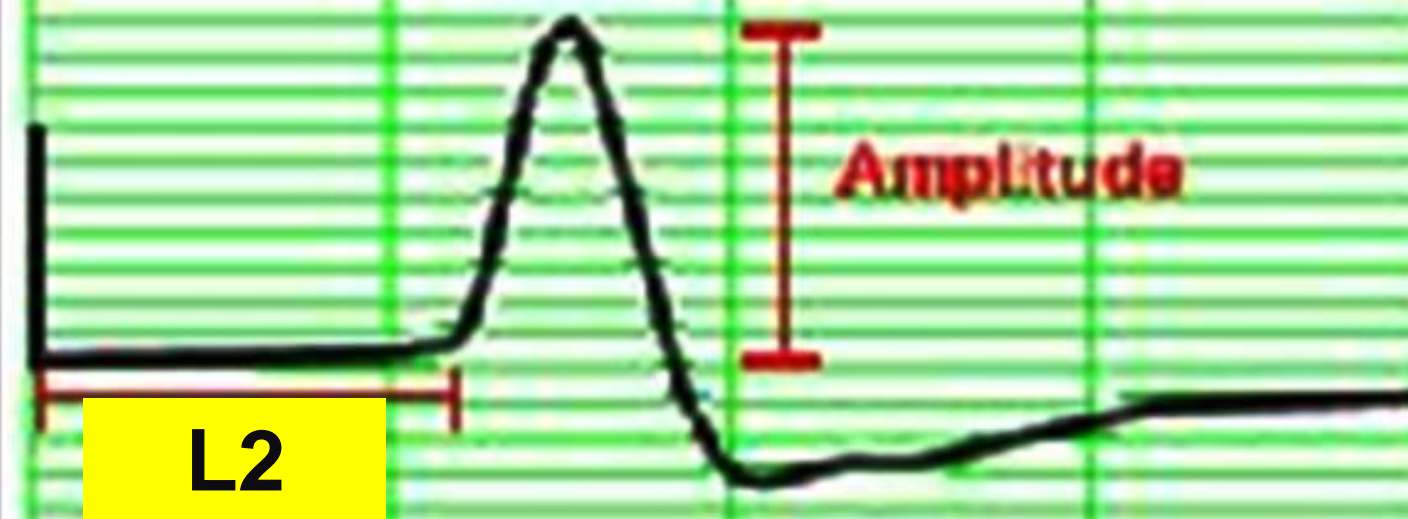
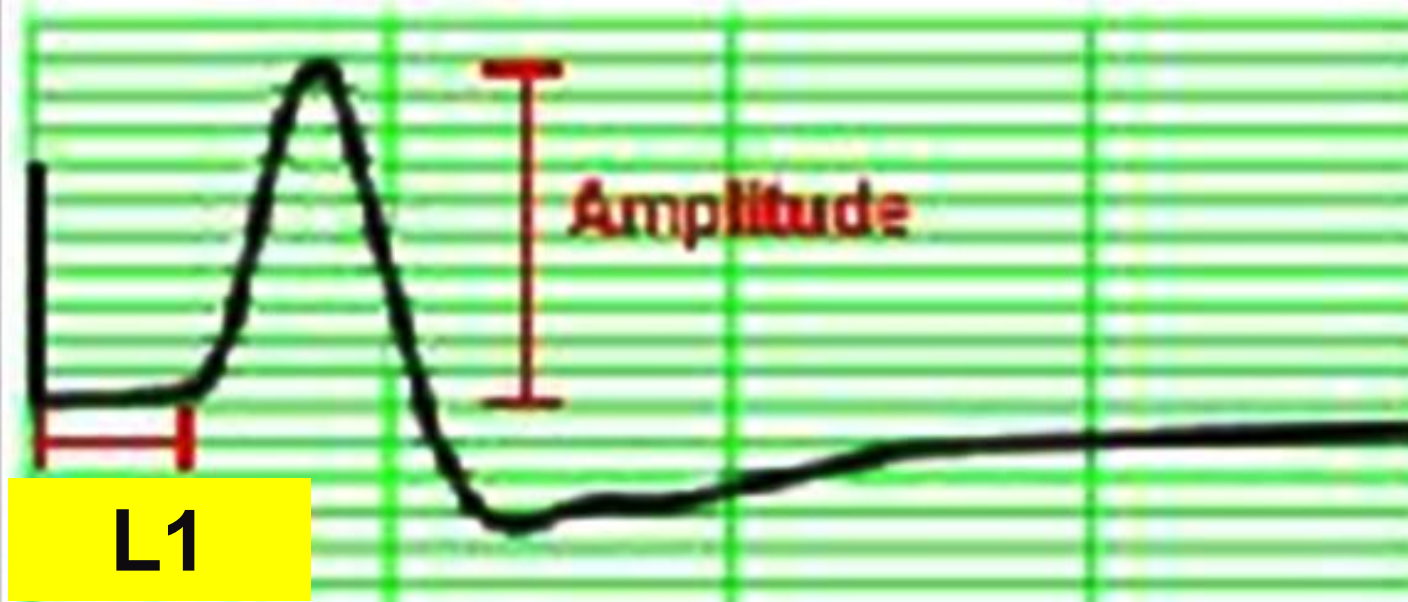


# Nerve conduction velocity



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





# MNCV

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

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

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

# Normal values for conduction velocity

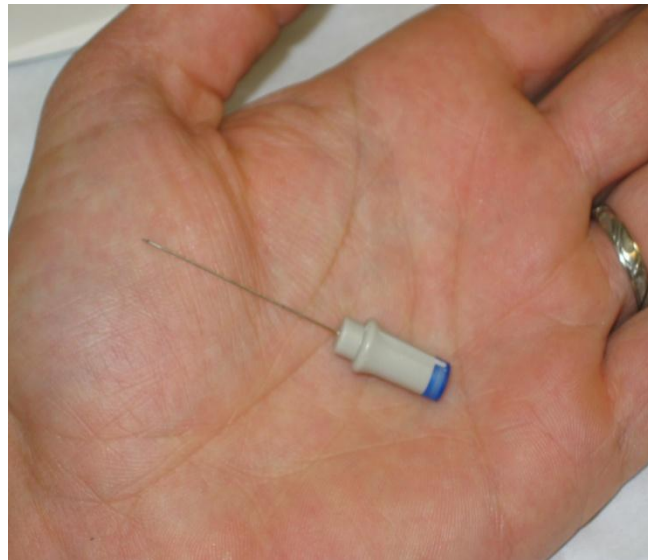
✓ In arm

– 50 – 70 m / sec.

✓ In leg

– 40 – 60 m / sec.

# Electromyography ( EMG )



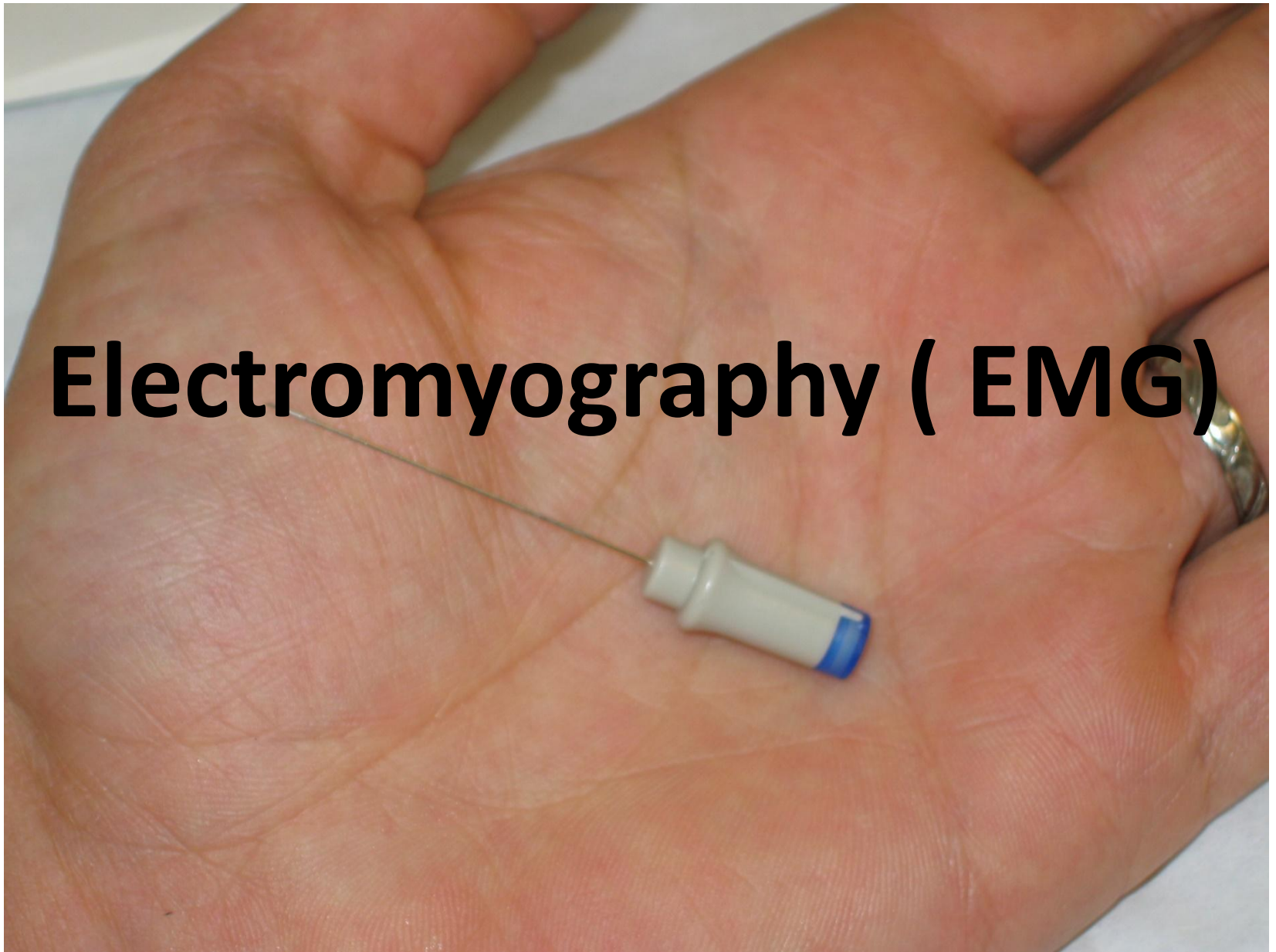


- Electromyography (EMG) is a technique for evaluating and recording physiologic properties of muscles at rest and while contracting.
- It's a recording of electrical activity of the muscle by inserting needle electrode in the belly of the muscles ( needle emg ) or by applying the surface electrodes ( 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 "?

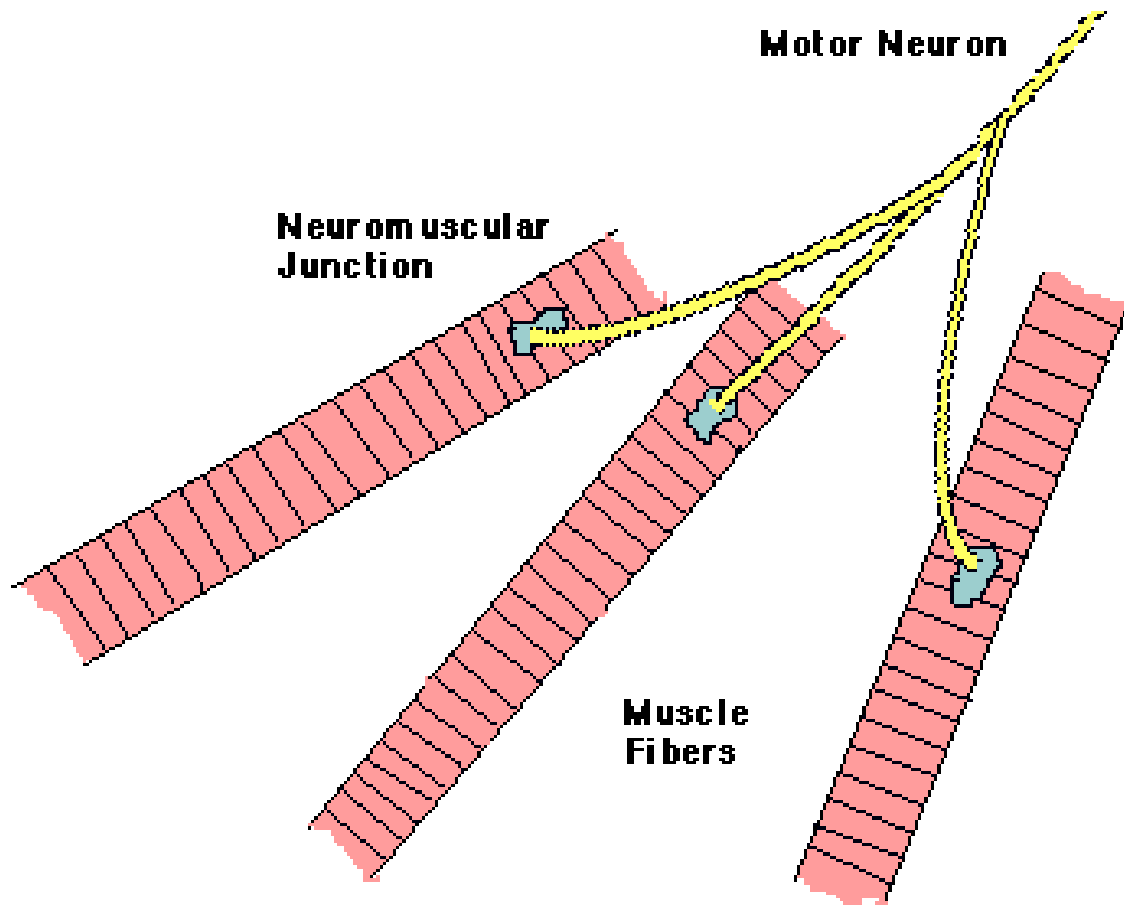


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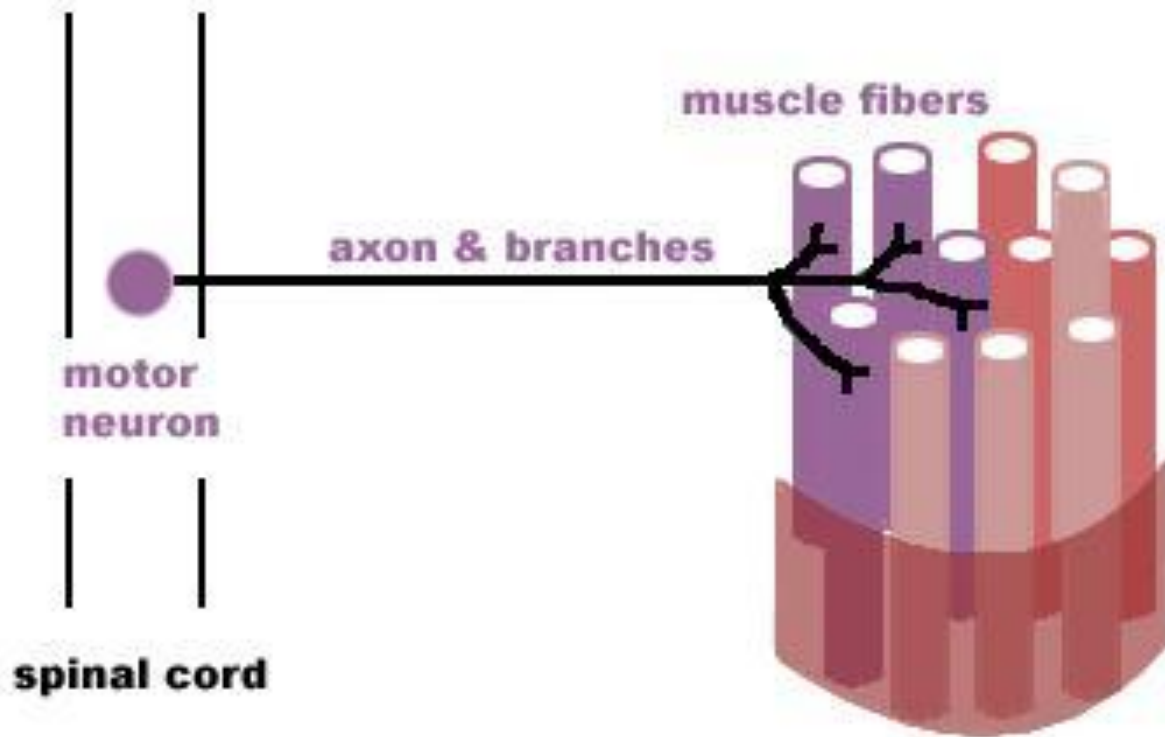
# Electromyography ( EMG )



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



## One Motor Unit

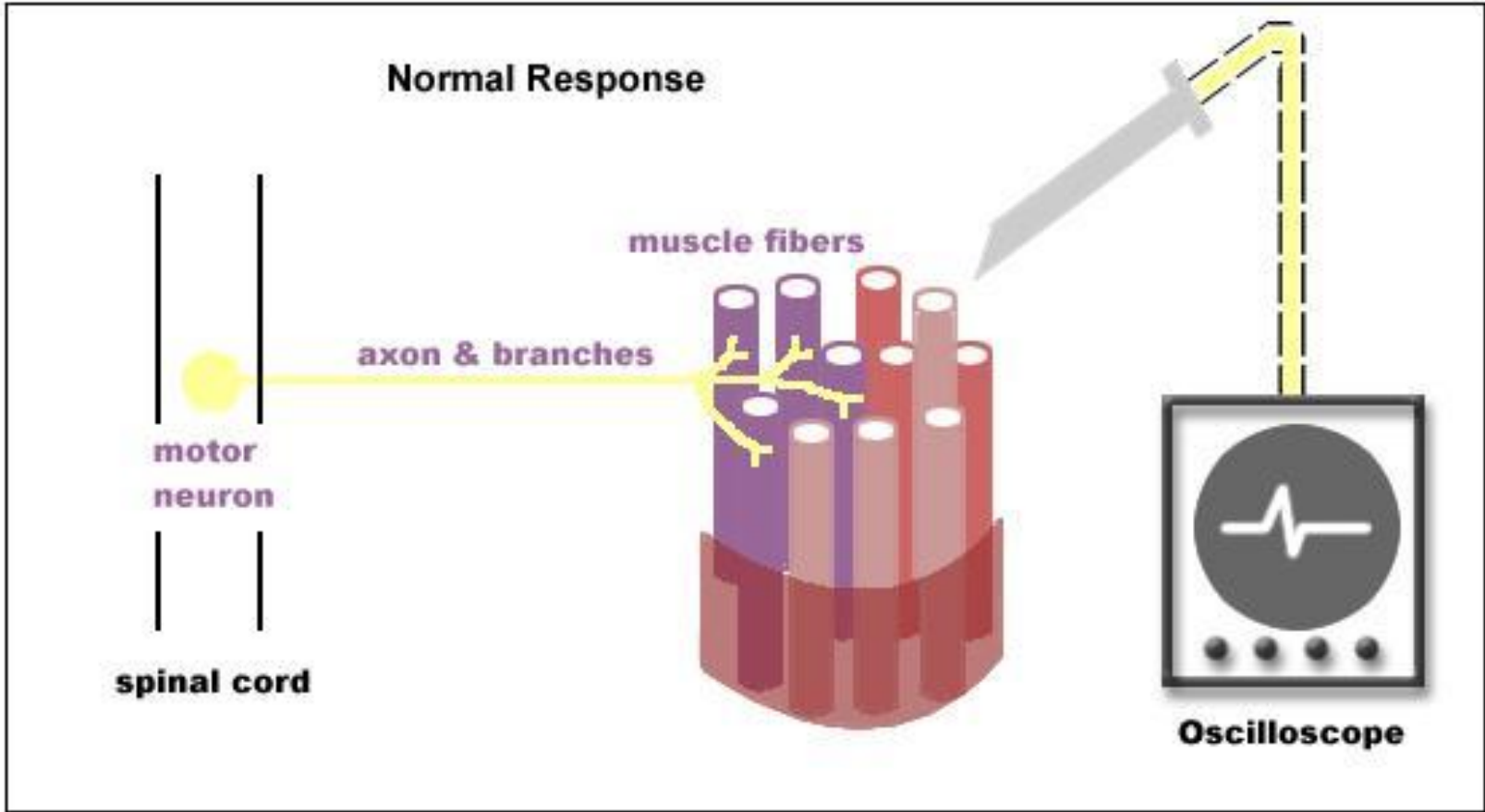


# Analysis

## EMG

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

# NORMAL EMG

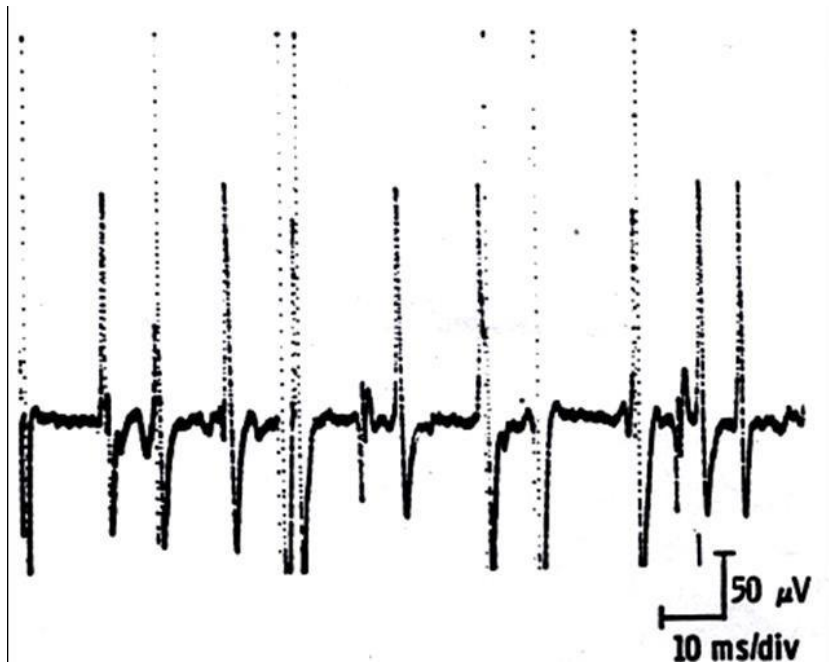


# Normal MUPs

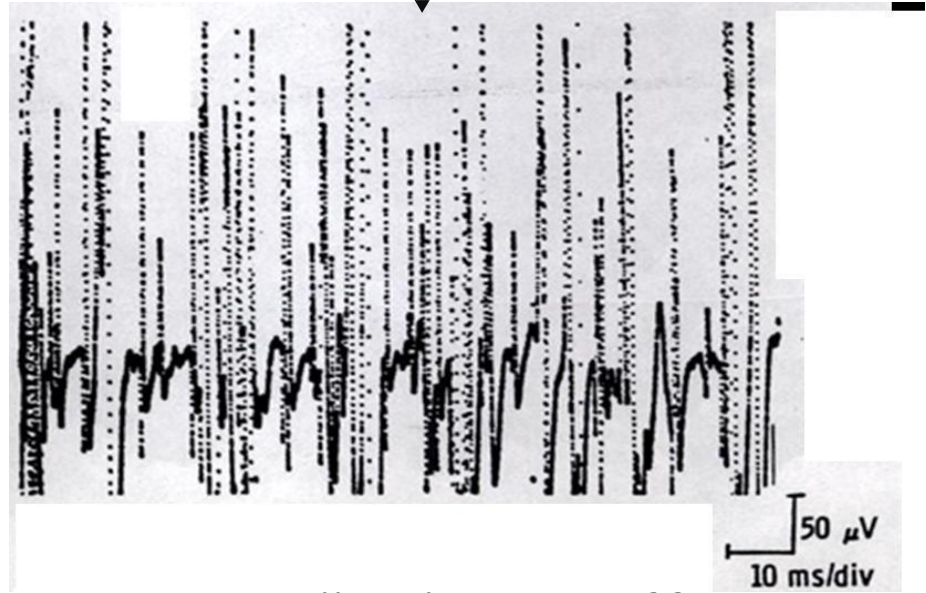
- Bi – Triphasic
- Duration – 3 – 15 mSec.
- Amplitude – 300 $\mu$ V – 5 mV

## MUPs (2)

During Mild Effort



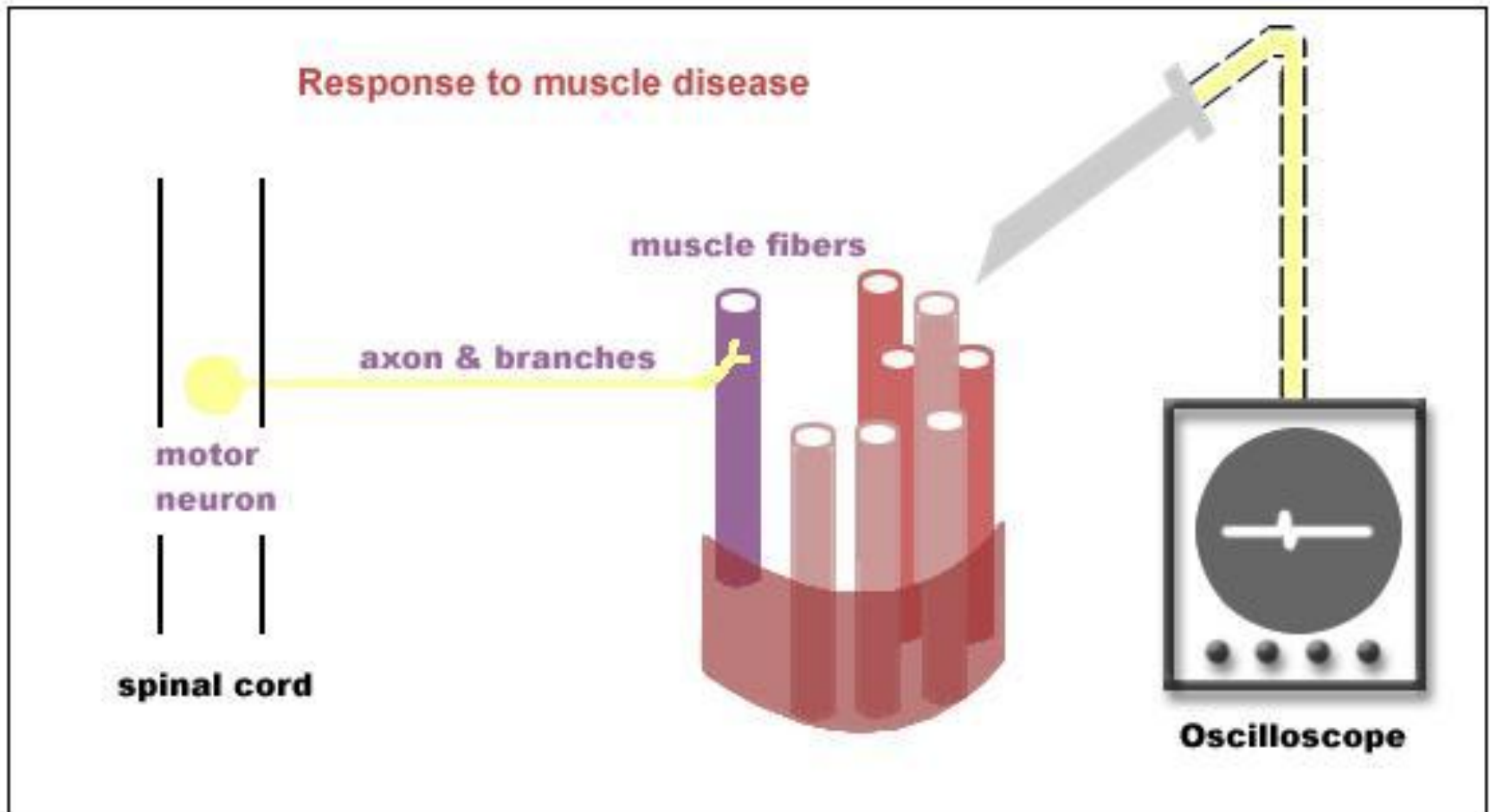
During Moderate Effort  $\rightarrow$  note recruitment of additional motoneurons



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



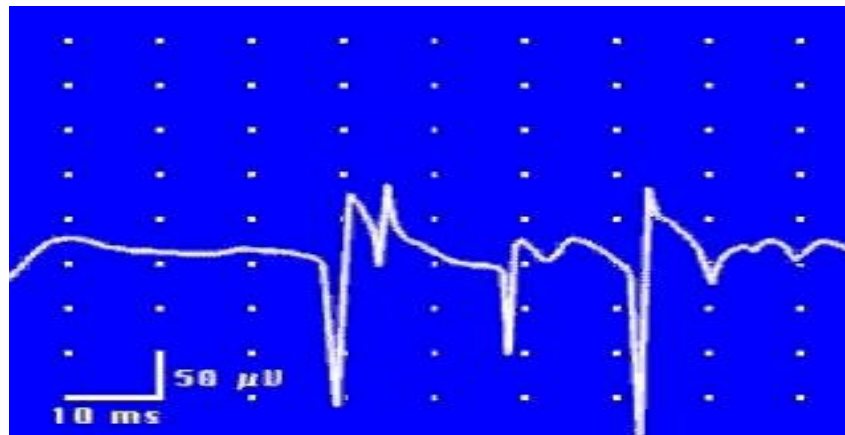
# MYOPATHY



# Abnormal MUPs

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

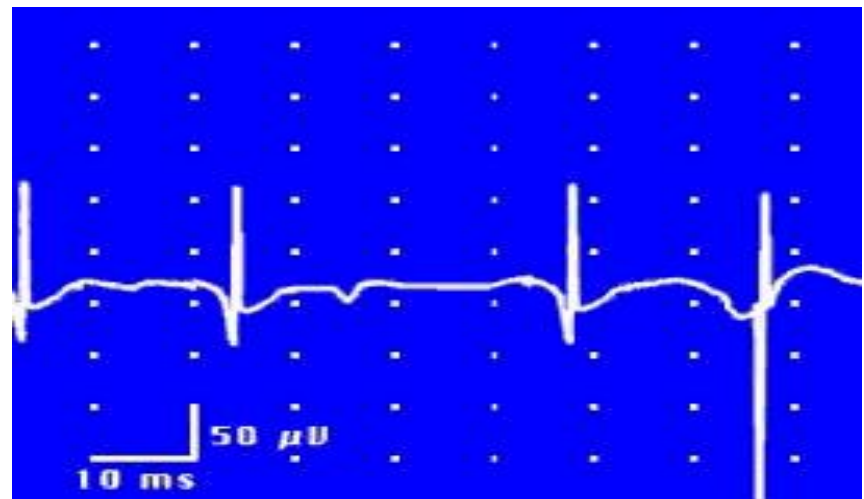
- ❑ Positive sharp wave:
  - ❑ A small potential of 50 to 100  $\mu\text{V}$ , 5 to 10 msec duration with abrupt onset and slow outlet.



# 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...

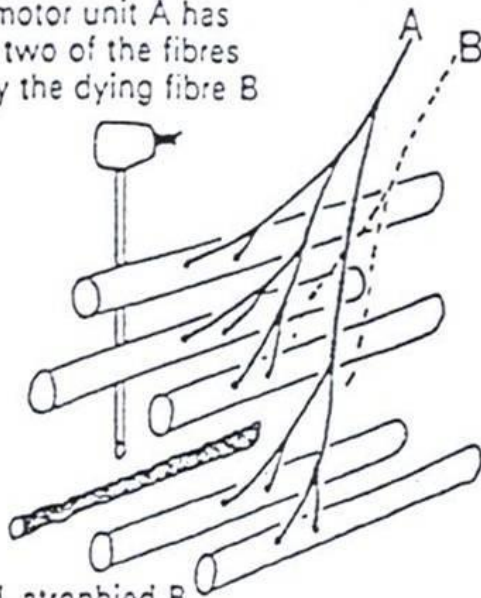
## ❑ Fasciculation potentials:

- ❑ 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

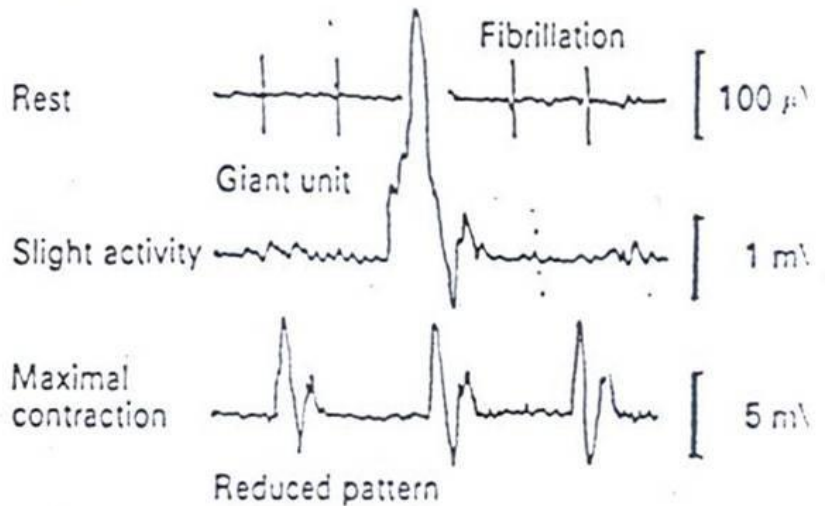
## Denervated Muscle

Surviving motor unit A has taken over two of the fibres supplied by the dying fibre B

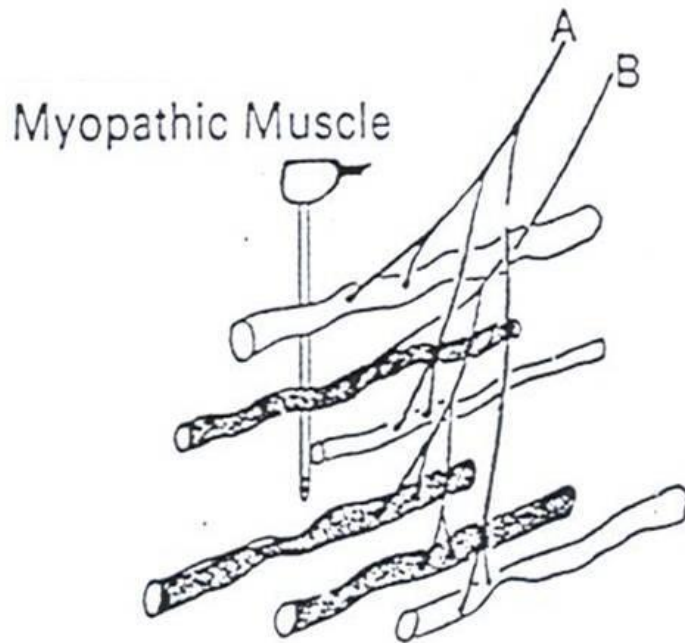


Denervated, atrophied B fibre, probably responsible for fibrillation

Figure 16.1A. Chronic Partial Denervation

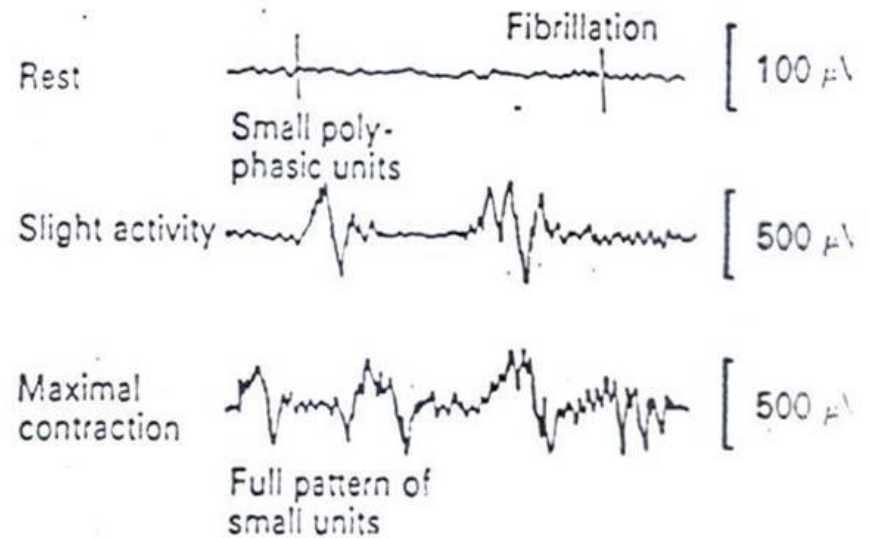


# Myopathic EMG changes



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

Figure 16.1B. Myopathic E.M.G.



# Analysis of a motor unit potential (MUP)

<b>MUP</b>	<b>NORMAL</b>	<b>NEUROGENIC</b>	<b>MYOPATHIC</b>
Duration msec.	3 – 15 msec	longer	Shorter
Amplitude	300 – 5000 $\mu\text{V}$	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

<b>MUP</b>	<b>Myopathy</b>	<b>Normal</b>	<b>Neuropathy</b>
Duration	< 3 msec	3 – 15 msec	> 15 msec
Amplitude	< 300 $\mu$ V	300-5000 $\mu$ V	> 5 mV
configuration	polyphasic	triphasic	Polyphasic

In nerve diseases : Giant MUPs due to reinnervation > 5 mV

In muscle disease : Small MUPs < 300 $\mu$ V



Thank you



