

# Electromyography (EMG)

&

# Motor Nerve Conduction Velocity Study (MNCV)

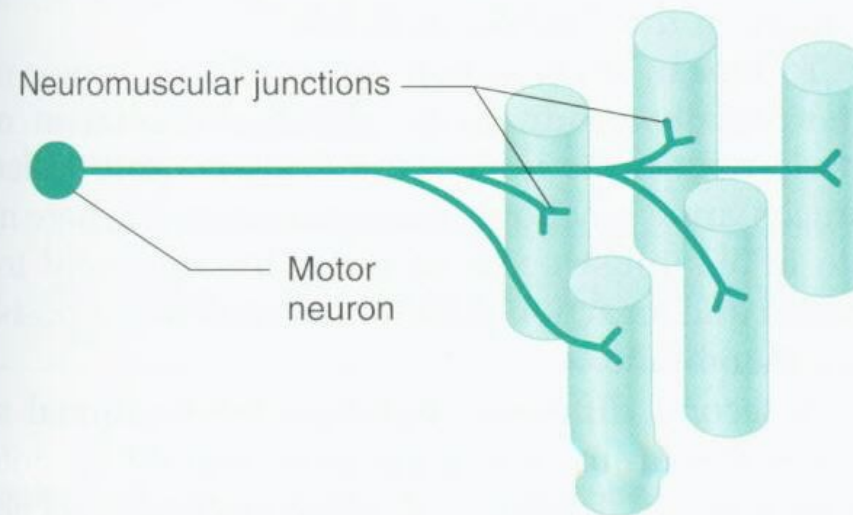


# Motor Unit

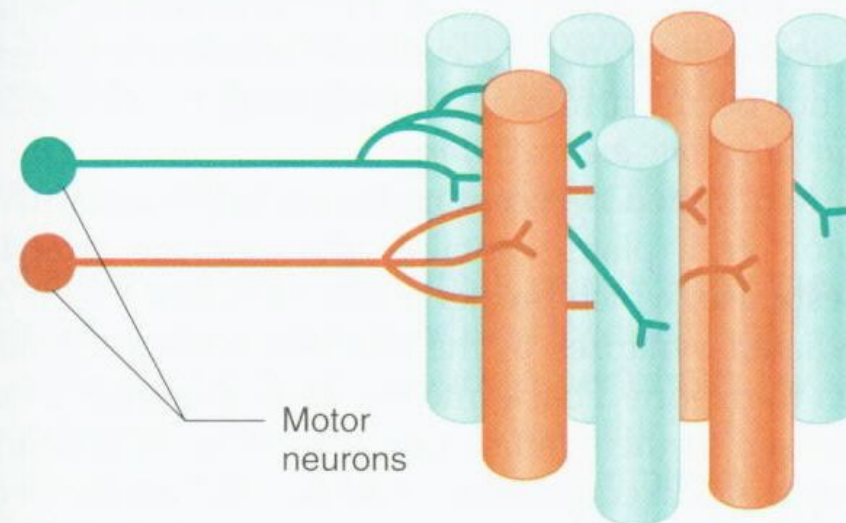
- ❖ consists of **a motor neuron and all the muscle fibers it innervates**

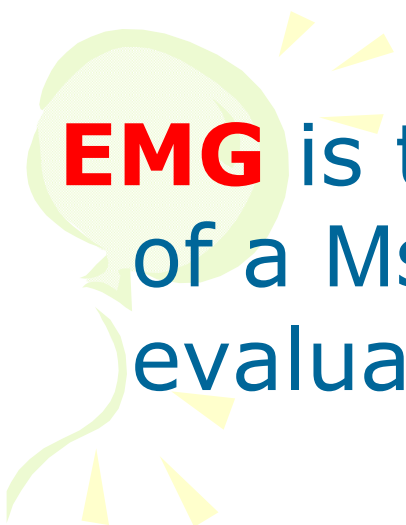
- ❖ When an action potential occurs in a motor neuron, all the Msl fibers in its MU are stimulated to contract

(a) Single motor unit



(b) Two motor units





**EMG** is the recording of electrical activity of a Msl at rest & during contract<sup>o</sup>: (to evaluate the electrophysiology of a MU)



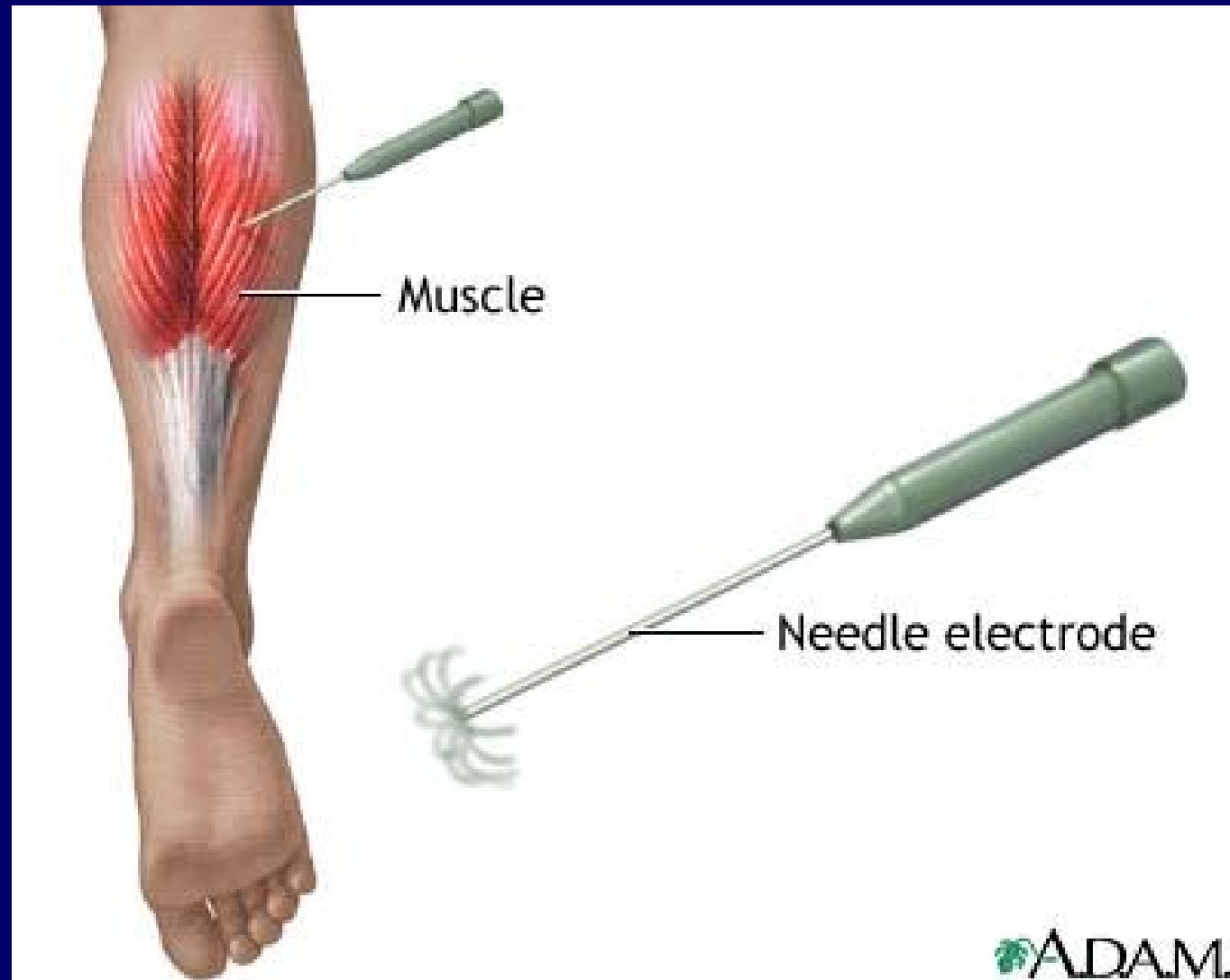
■ Activity is amplified and displayed on an oscilloscope

**Instrument** : electromyograph

**Record**: electromyogram



■ A concentric needle Ede inserted into the belly of the Msl .



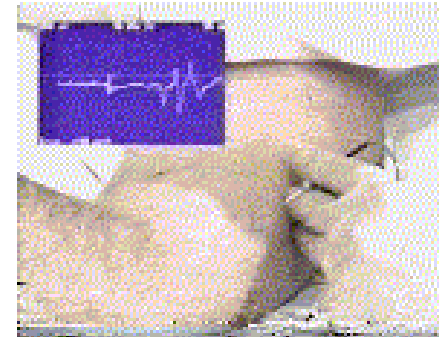
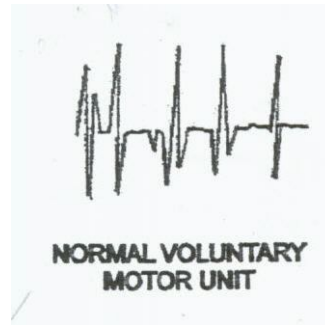
Needle EMG does not introduce any electrical stimulation instead it records the **intrinsic electrical activity of skeletal muscle fibers.**

Normally a muscle is **silent at rest** after **insertional activity** has ceased.



Then the patient is asked to contract the Msl smoothly.

- With muscle contraction, MUs are activated and **MUAPs** appear on the screen




- **Motor unit potential** : represents the summation of the potentials generated by **μsI fibers** belonging to the **MU**
- The amplitude of a MUAP is determined by the nb of muscle fibers recorded with the needle

Three balloons (green, blue, and purple) with yellow streamers and starburst decorations are positioned on the left side of the slide.


# Normal MUPs

- Bi – Triphasic
- Duration – 3 – 16 mSec.
- Amplitude – 300 $\mu$ V – 5 mV






■ With increasing strength of contract<sup>o</sup>  
→ recruitment of MUs → ↑ number & size of MUAPs



■ At full contraction separate MUAP will be indistinguishable resulting in a complete recruitment = **interference pattern**



### MOTOR UNIT POTENTIAL DURING MILD EFFORT

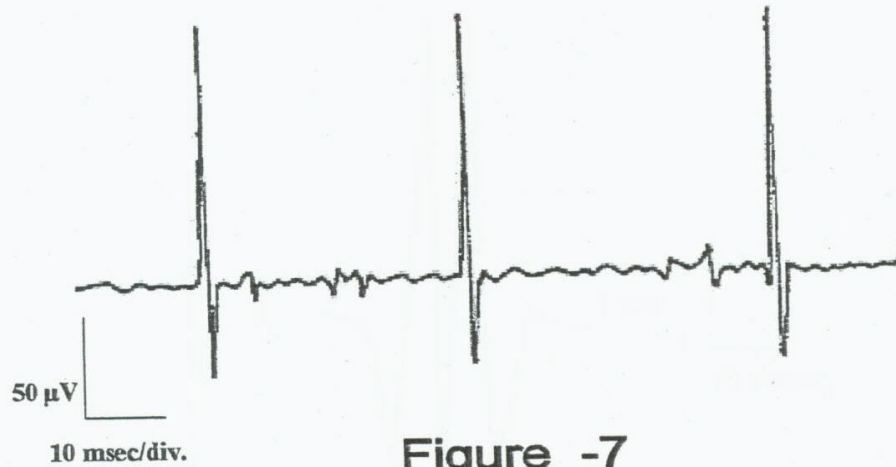
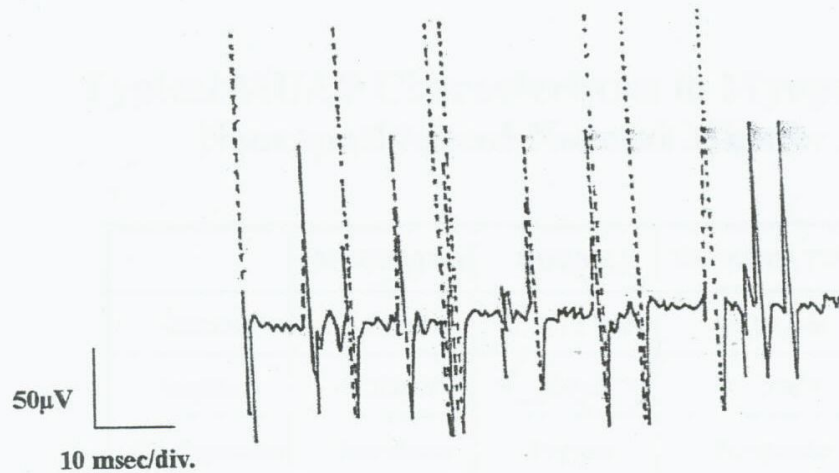


Figure -7

### MOTOR UNIT POTENTIAL DURING MODERATE EFFORT





### MOTOR UNIT POTENTIAL AT FULL VOLUNTARY EFFORT






# Analysis

The EMG is used to investigate both neuropathic and myopathic disorders (weakness, numbness, pain )

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- **The size, duration, frequency of the electrical signals generated by muscle cells help determine if there is damage to the Msl or to the nerve leading to that Msl.**
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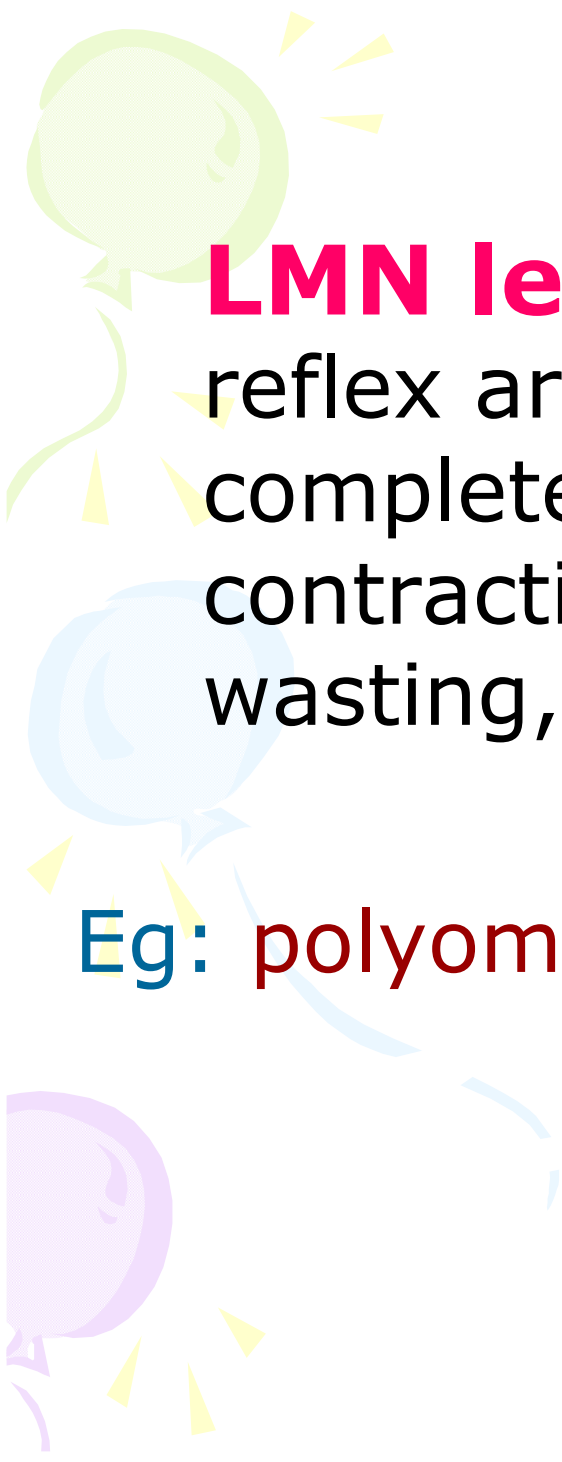
- 
- **Myopathy**: progressive degeneration of skeletal muscle fibers

Eg: Duchenne Muscular dystrophy

- 
- **Neuropathy** : Damage to the distal part of the nerve.  
peripheral neuropathy mainly affects feet & legs

Most common etiologies:

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- Guillain Barré syndrome
  - Diabetes mellitus
  - Alcohol abuse
- 

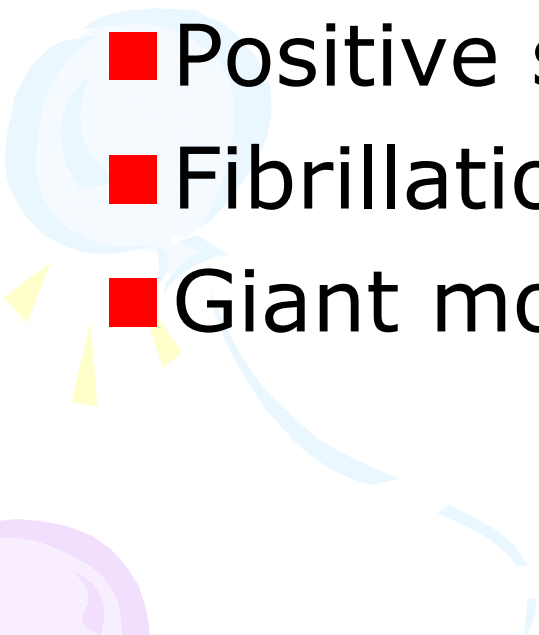

A decorative background featuring three balloons: a green one at the top left, a light blue one in the middle left, and a purple one at the bottom left. Each balloon has a string and several small yellow triangular flags attached to it.

**LMN lesions:** interrupt the spinal reflex arc ( a motor N) → Partial or complete loss of voluntary contraction , muscle wasting, ↓reflexes, fasciculation

Eg: polyomyelitis



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

- 
- Positive sharp waves
  - Fibrillations
  - Giant motor unit potentials
- 



## ◆ **Fibrillation potentials:**

Low amplitude, short duration potentials, correspond to the spontaneous discharge of a **denervated single muscle fiber** due to denervat<sup>o</sup> hypersensitivity to acetylcholine

Fine invisible, irregular contraction of individual muscle fibers.

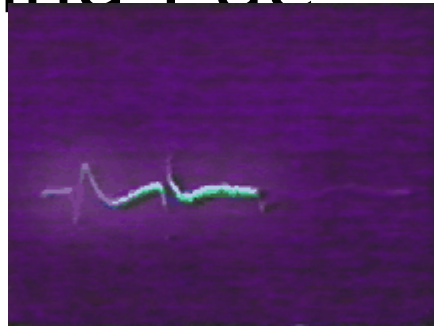


Audio-amplifier: **sound of rain in a tin shade house**



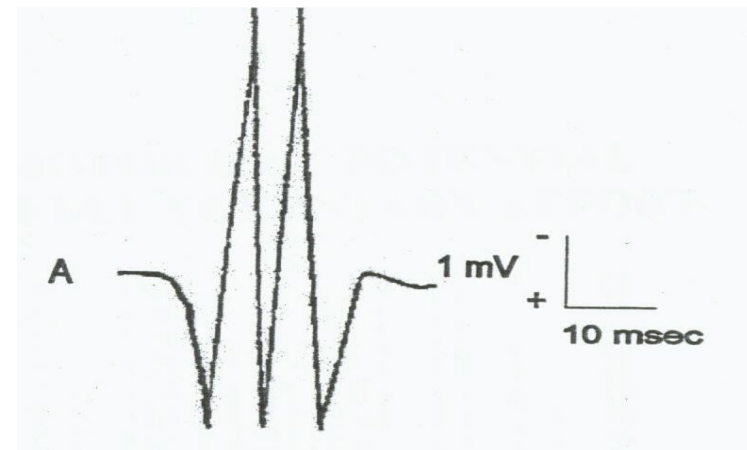
## ◆ **Positive sharp waves**

Small fibrillation APs (50 to 100  $\mu\text{V}$ , 5 to 10 msec duration) whose propagation is blocked at the level of the recording Ede

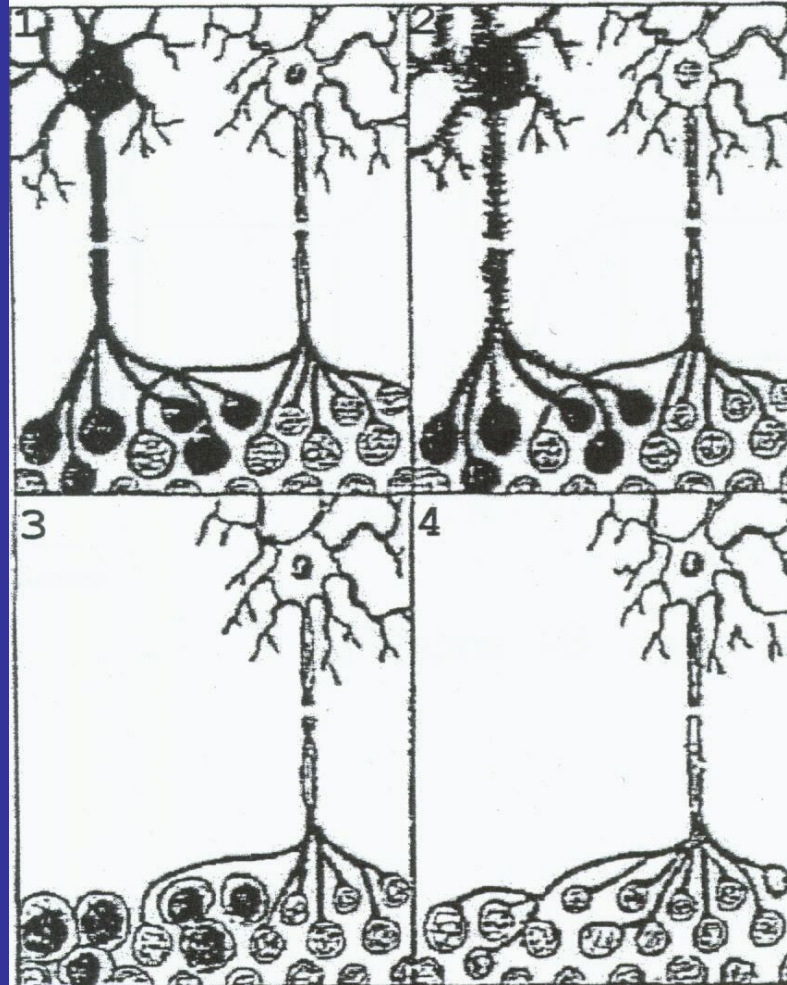


◆ **Fasciculation potentials** Spontaneous discharge of a **MU** at **rest**, can be **seen** and **felt** by the patients

- Partial re-innervation of denervated muscle, by sprouting of the remaining nerve terminals, produces abnormally **large, long polyphasic** potentials (**giant potential**)

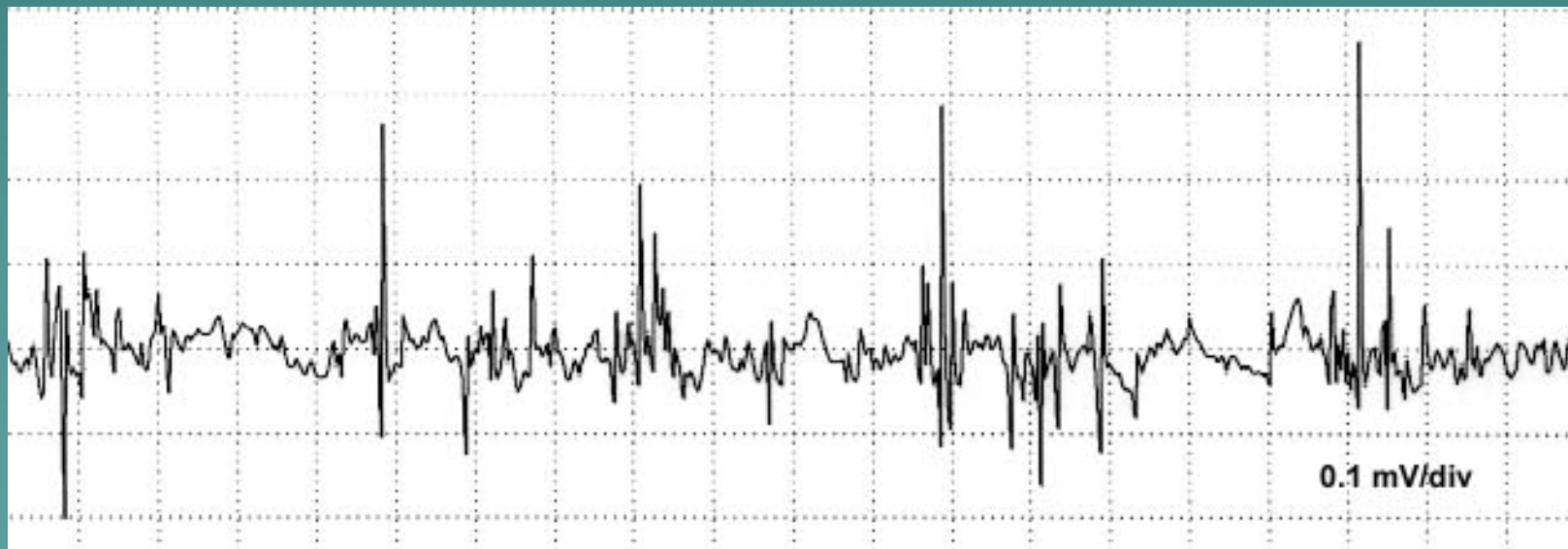


## REINNERVATION



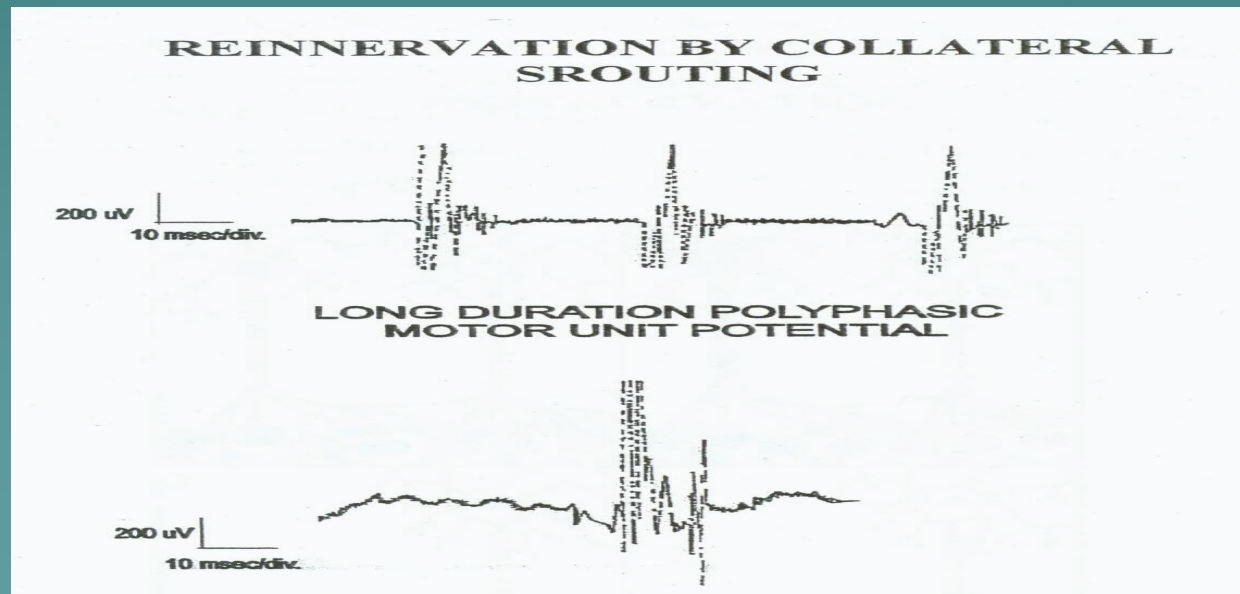
# Myopathic alteration of the EMG:

Polyphasia ,short duration ,reduced voltage of MUPs

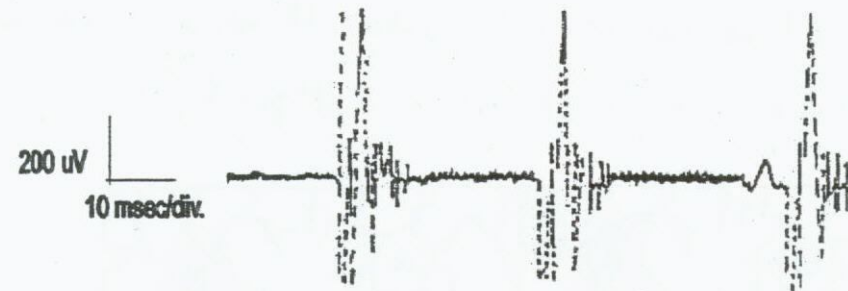


# Neuropathic alteration of the EMG:

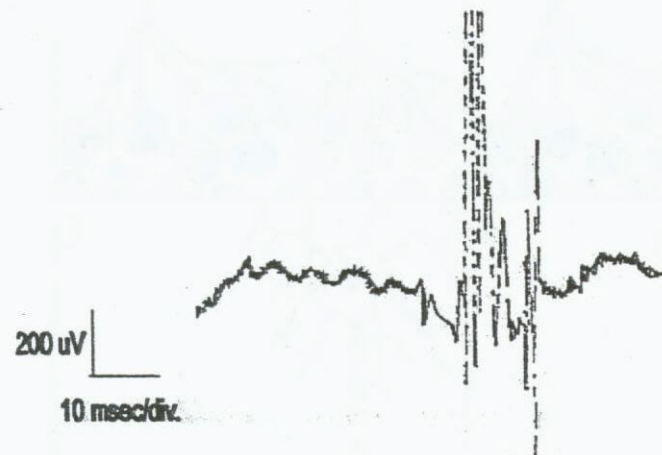
- ◆ Polyphasia , long duration , high voltage of MUPs



## REINNERVATION BY COLLATERAL SROUTING



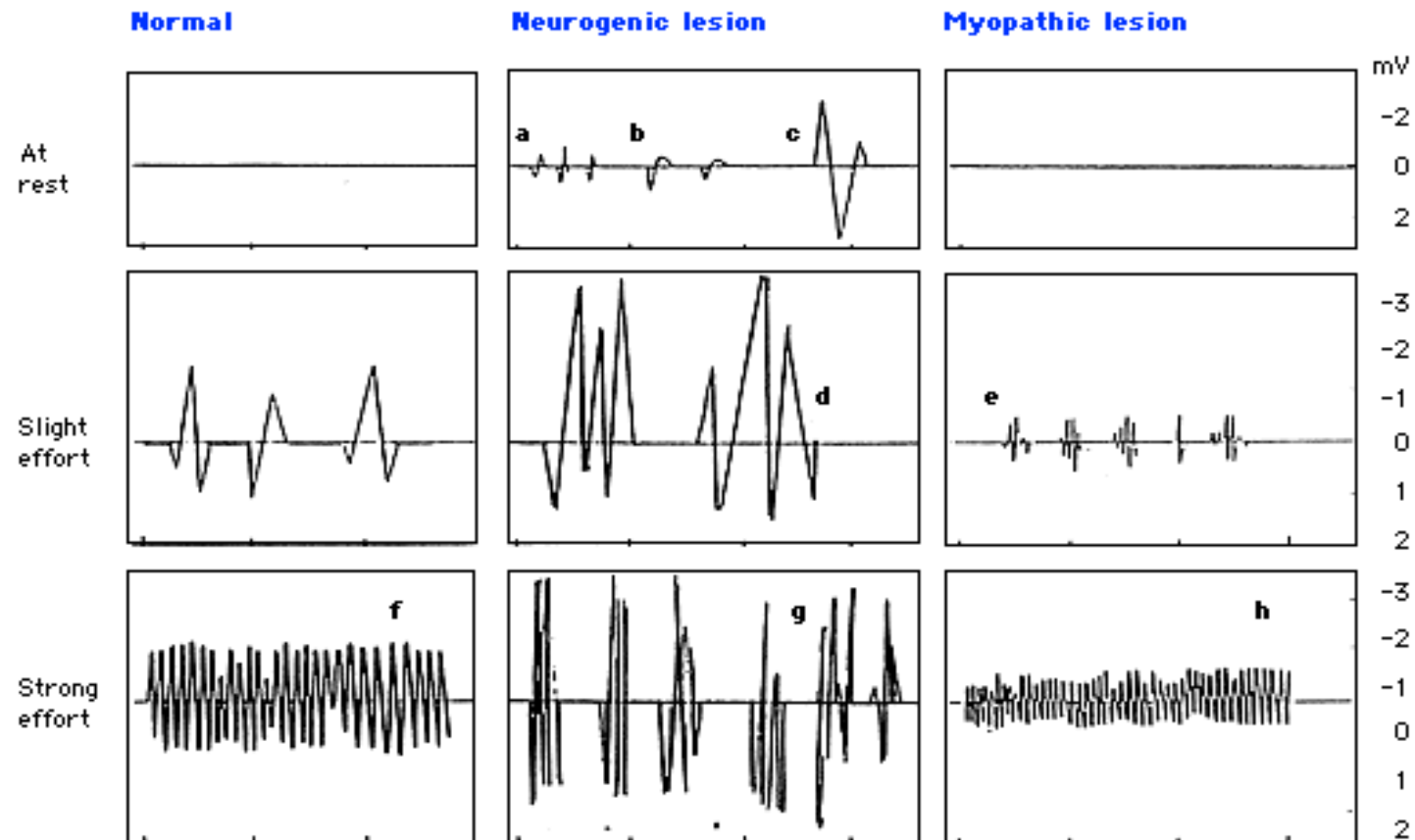
## LONG DURATION POLYPHASIC MOTOR UNIT POTENTIAL



# Analysis of a motor unit potential (MUP)

<b>MUP</b>	<b>NORMAL</b>	<b>NEUROGENIC</b>	<b>MYOPATHIC</b>
<b>Duration msec.</b>	3 – 16 msec	> 16 msec	< 3 msec
<b>Amplitude</b>	300 – 5000 $\mu$ V	> 5 mV	< 300 $\mu$ V
<b>Phases</b>	Biphasic / triphasic	Polyphasic	May be polyphasic
<b>Resting Activity</b>	Absent	Present	Present
<b>Interference pattern</b>	full	partial	full

## Electromyography\*



1. At rest (spontaneous activity): a. fibrillations, b. positive sharp waves, c. fasciculation.

2. Slight effort (motor unit potentials): d. giant polyphasic, e. BSAPS (brief-small-abundant polyphasic).

3. Strong effort (interference pattern); f. full, g. reduced units, h. reduced amplitude.

\* (helpful in selecting denervated muscles [in radiculopathies (myotomal), mononeuropathies (distal to lesion), generalized neuropathies (distal muscles)] and myopathies)

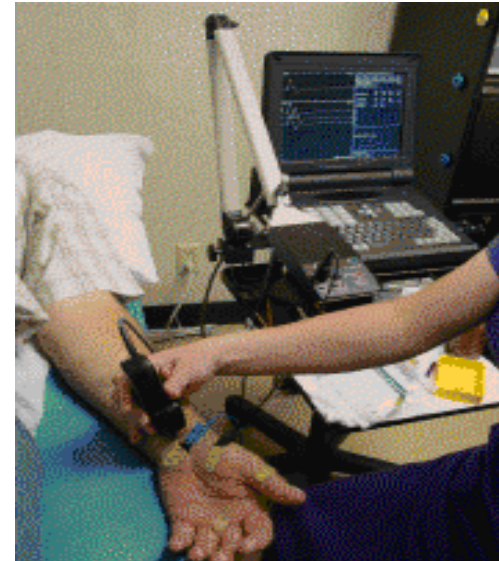


# Nerve Conduction studies

A nerve conduction study (**NCS**) is a test commonly used to evaluate the function, especially the ability of electrical conduction, of the motor and sensory nerves of the human body.

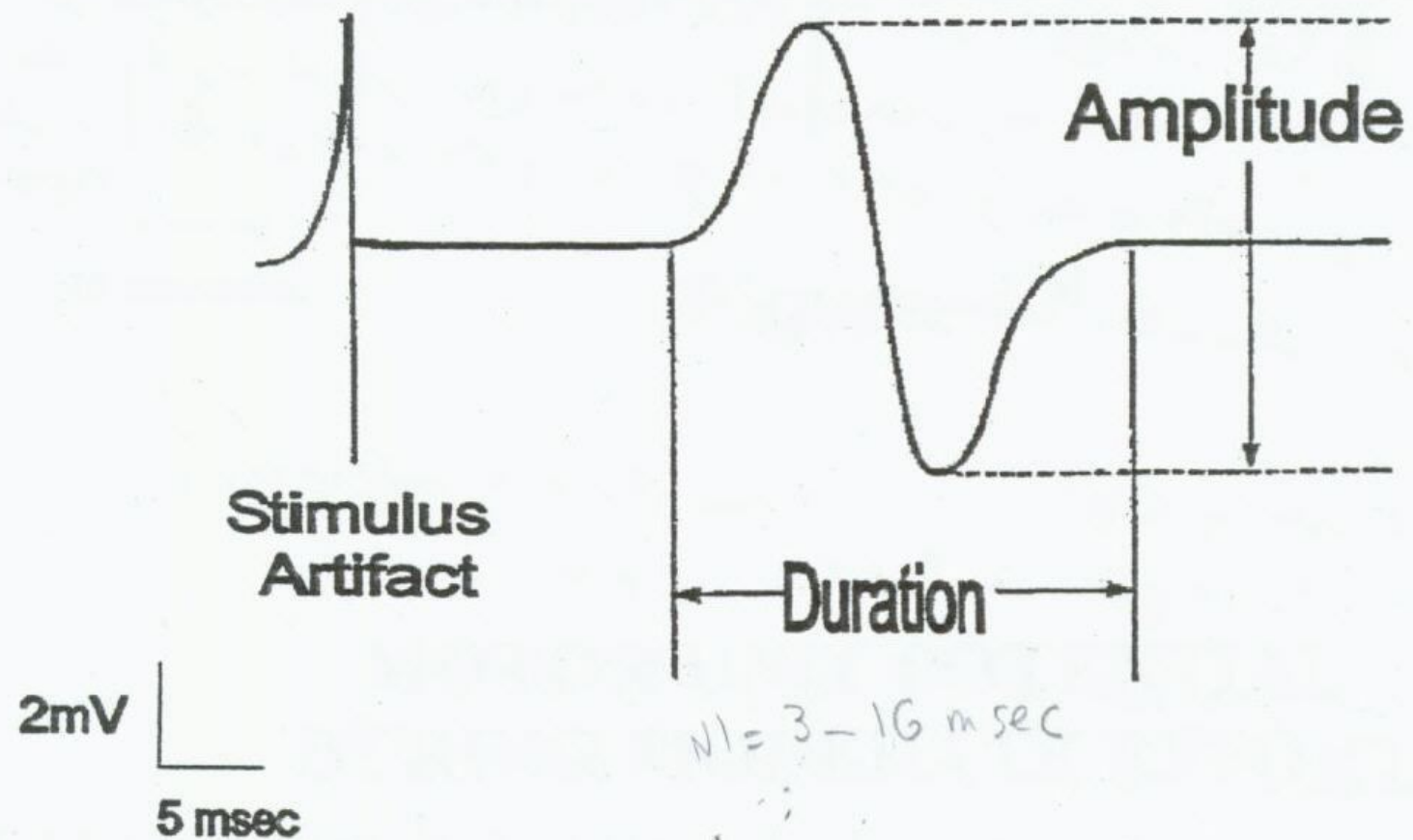
# Motor Nerve Conduction Study

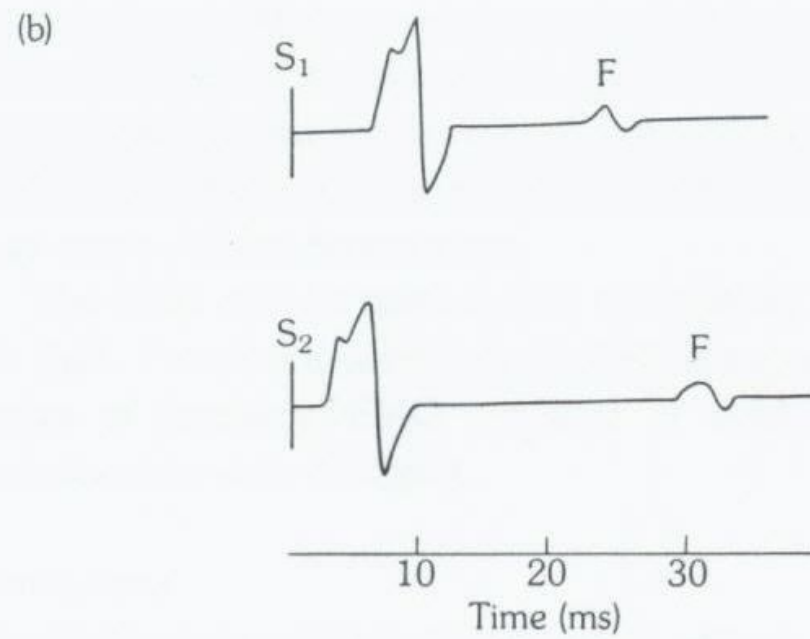
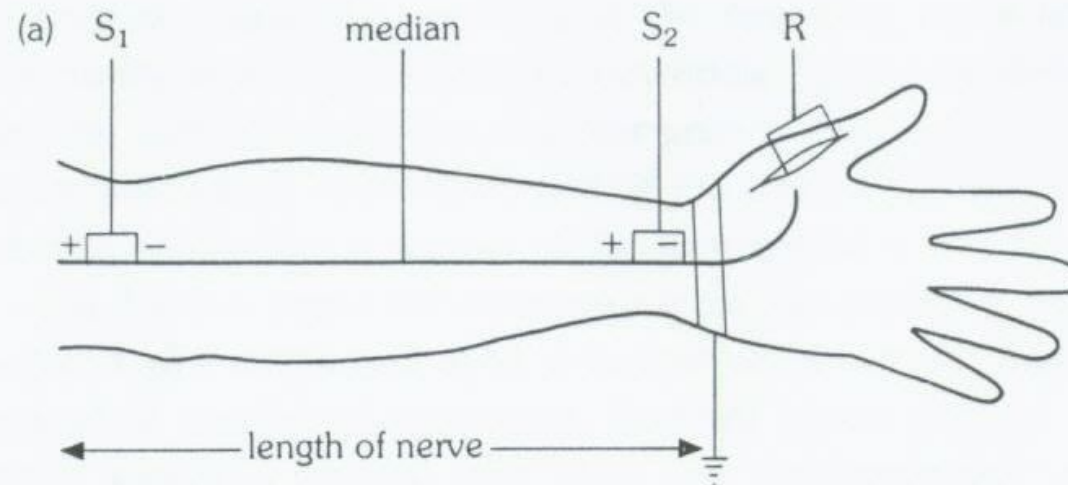
- Stimulat<sup>o</sup> of median nerve until visible muscle contract<sup>o</sup> is seen and a reproducible Compound Muscle A P is recorded



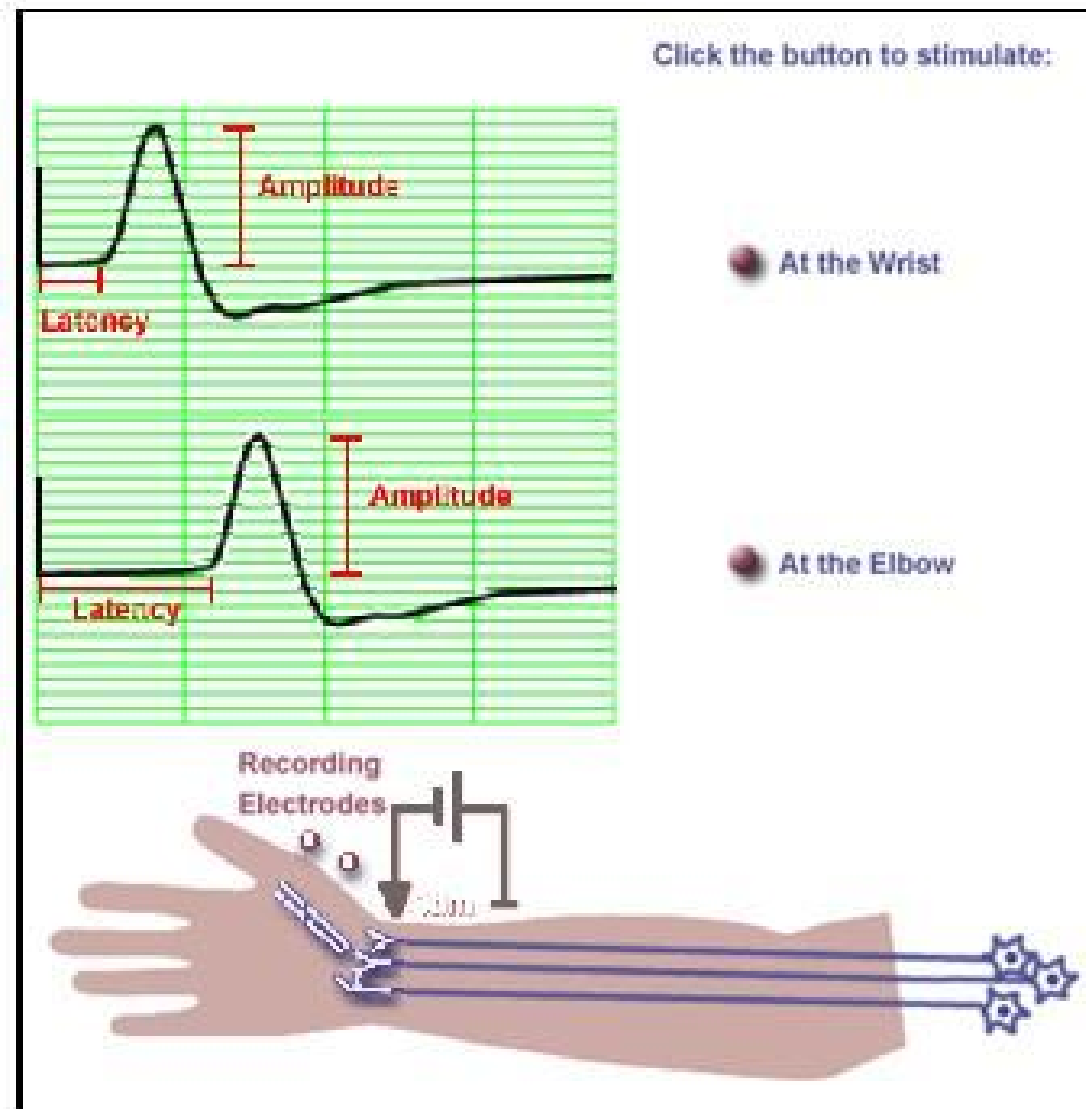
**CMAP:** summated potentials from all Motor Units in a muscle

## COMPONENTS OF THE CMAP





# MOTOR NERVE CONDUCTION VELOCITY (MNCV)




$$\text{+ MNCV} = \frac{\text{distance}}{l_1 - l_2} \quad (\text{m/sec})$$

$l_1$  = latency at elbow.

$l_2$  = latency at wrist

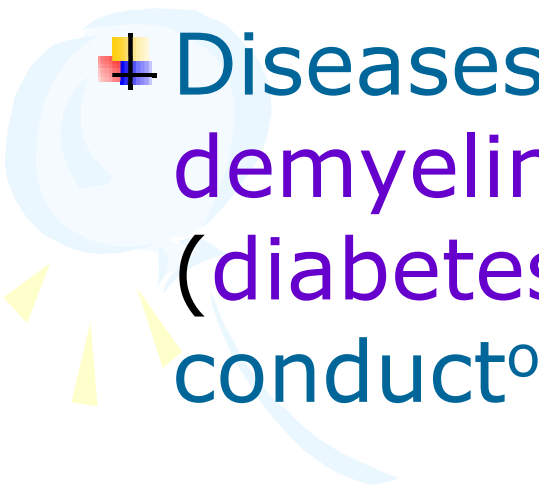
Distance between the two stimulating electrodes



+ abNI if < 40 m/sec



+ Conduction is **faster** in **myelinated** fibres



+ Diseases which produce demyelinated peripheral nerves (diabetes, Gillain Barré) slow the conduct<sup>o</sup> greatly (20-30 m/s)





# Normal values for conduction velocity

✓ In arm

50 to 70 m / sec.

✓ In leg

40 to 60 m / sec.