

# Electromyography (EMG)

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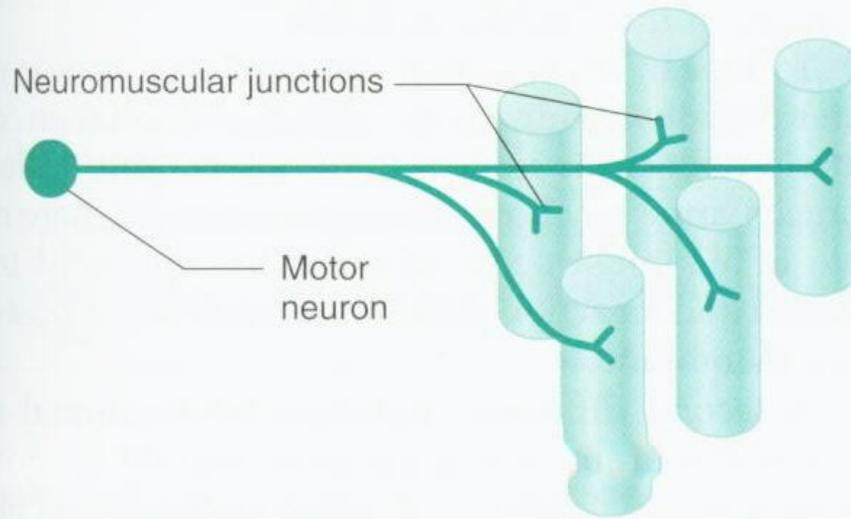
# Motor Nerve Conduction Velocity Study (MNCV)



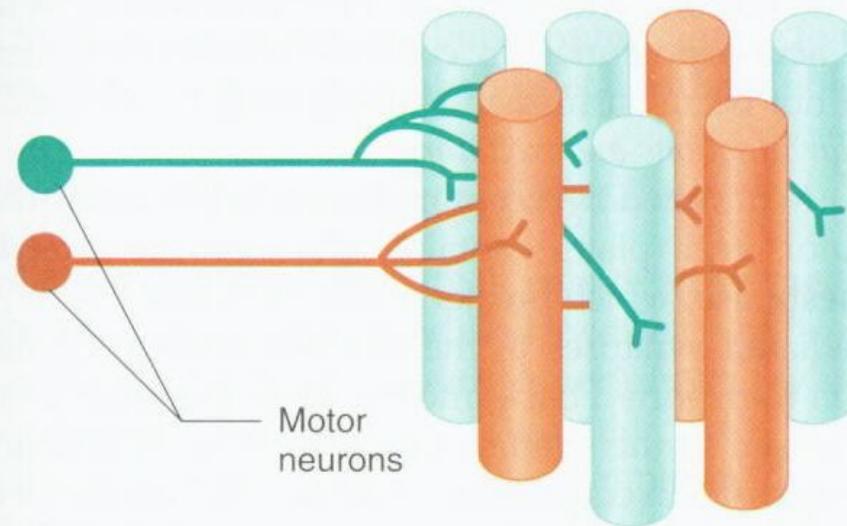
# Motor Unit

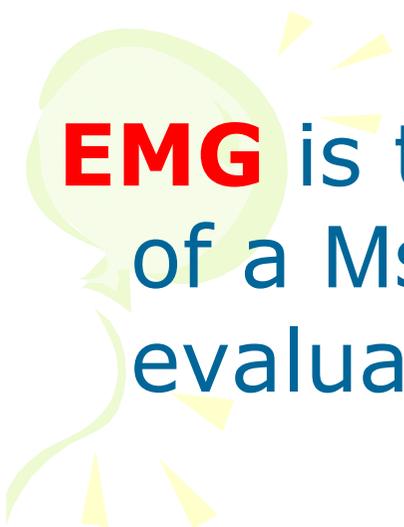
- ❖ consists of **a motor neuron and all the muscle fibers it innervates**
- ❖ When an action potential occurs in a motor neuron, all the Msl fibers in its MU are stimulated to contract

(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)

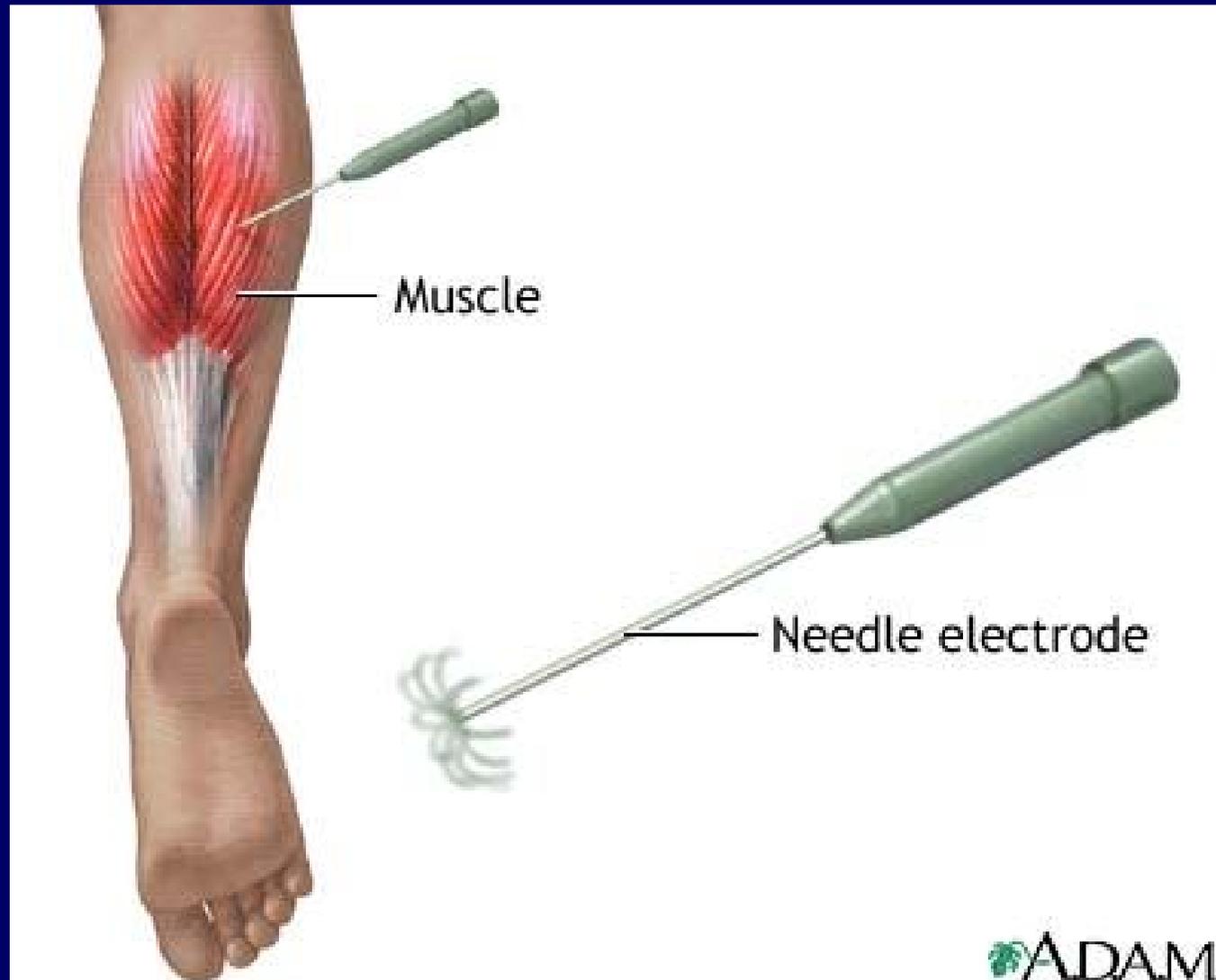
■ Activity is amplified and displayed on an oscilloscope

**Instrument** : electromyograph

**Record**: electromyogram

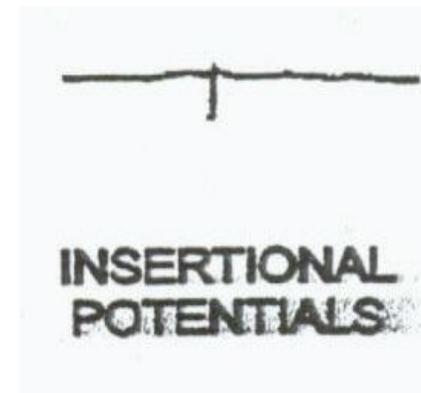


■ A concentric needle Ede inserted into the belly of the Msl .



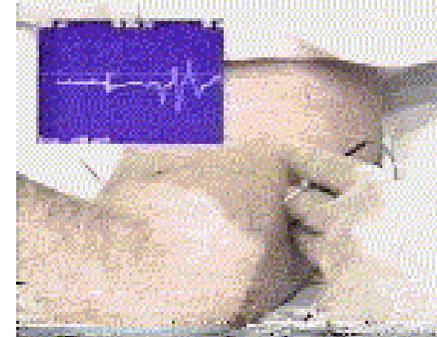
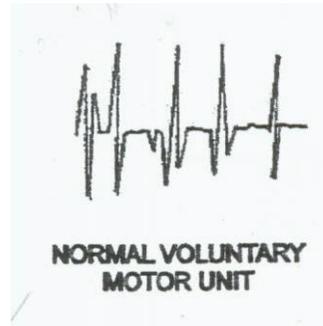
Needle EMG does not introduce any electrical stimulation instead it records the **intrinsic electrical activity of skeletal muscle fibers.**

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  **$\mu$ sI fibers** belonging to the **MU**

- The amplitude of a MUAP is determined by the nb of muscle fibers recorded with the needle

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

# 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

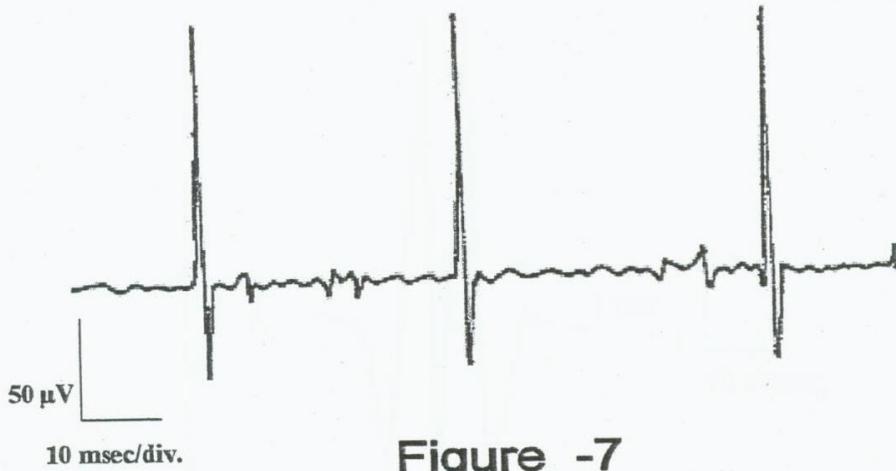
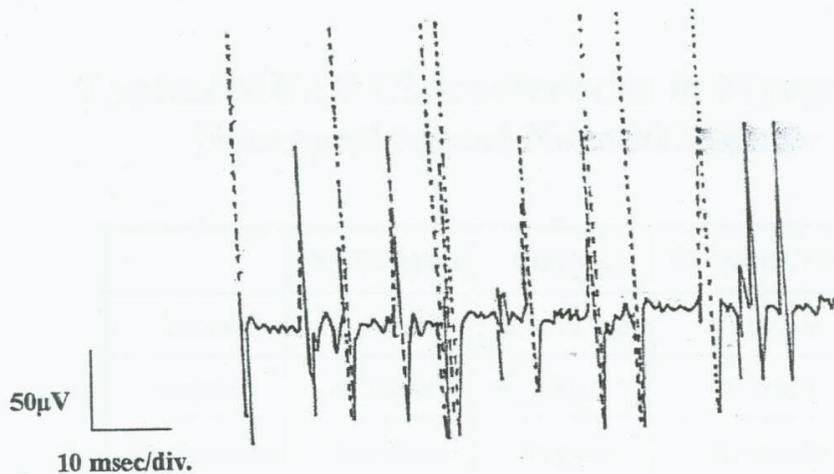


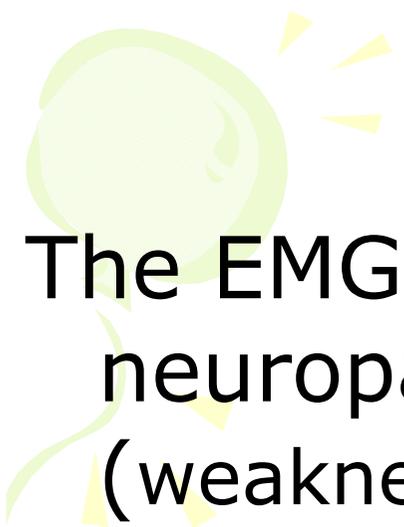
Figure -7

### MOTOR UNIT POTENTIAL DURING MODERATE EFFORT



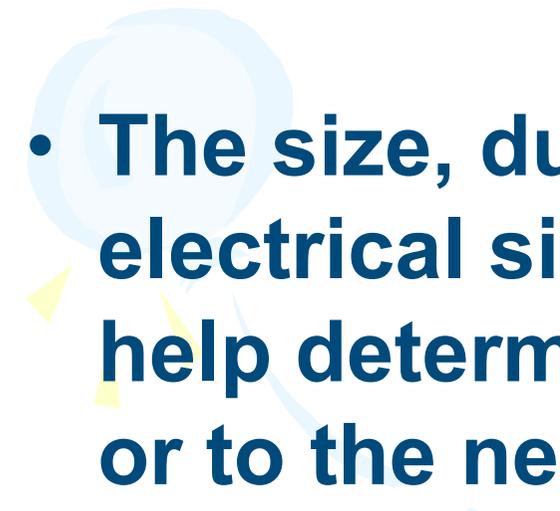
### MOTOR UNIT POTENTIAL AT FULL VOLUNTARY EFFORT





# 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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- A decorative graphic on the left side of the slide features three balloons: a light green one at the top, a light blue one in the middle, and a light purple one at the bottom. Each balloon has a string and is surrounded by several small yellow triangular shapes, resembling streamers or confetti.
- **Myopathy**: progressive degeneration of skeletal muscle fibers

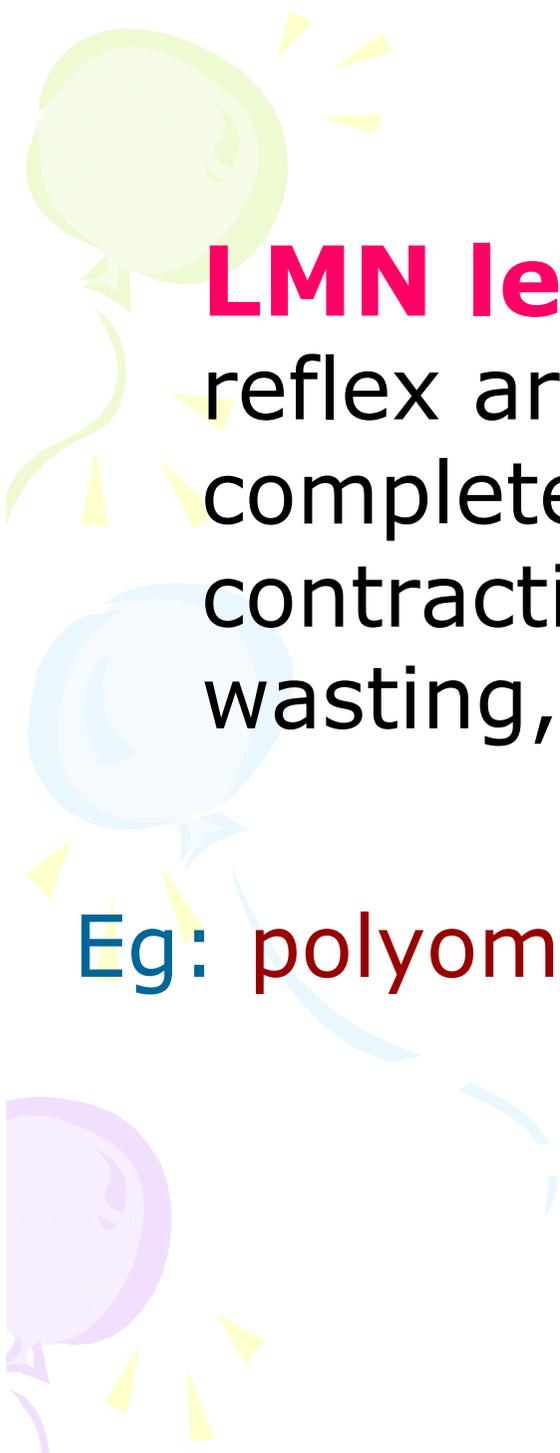
Eg: Duchenne Muscular dystrophy

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



Most common etiologies:

- **Guillain Barré syndrome**
  - **Diabetes mellitus**
  - **Alcohol abuse**
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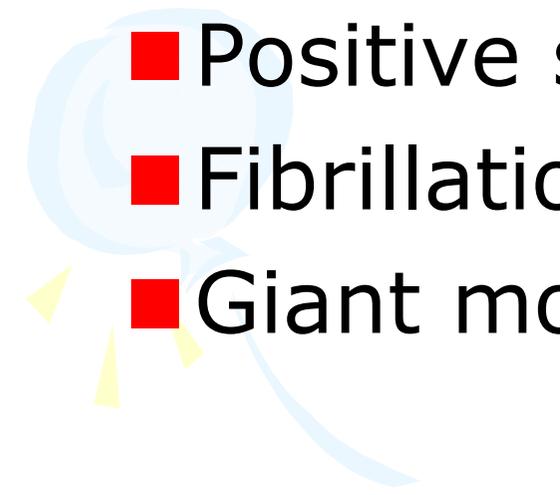


**LMN lesions:** interrupt the spinal reflex arc ( a motor N) → Partial or complete loss of voluntary contraction , muscle wasting, ↓reflexes, fasciculation

Eg: polyomyelitis



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

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

## ◆ **Fibrillation potentials:**

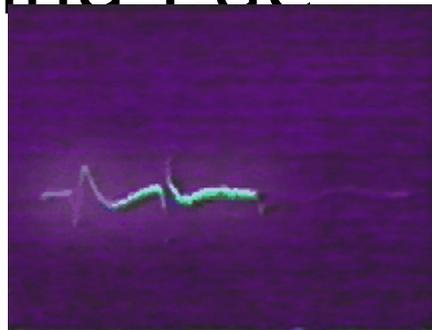
Low amplitude, short duration potentials, correspond to the spontaneous discharge of a **denervated single muscle fiber** due to denervat<sup>o</sup> hypersensitivity to acetylcholine

Fine invisible, irregular contraction of individual muscle fibers.

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

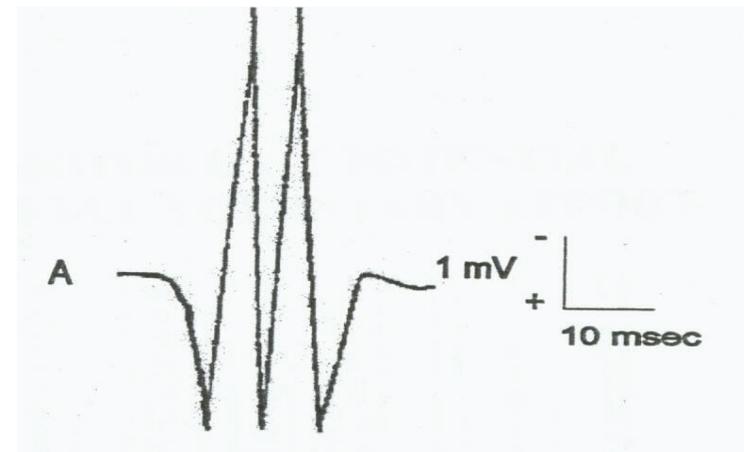
## ◆ **Positive sharp waves**

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

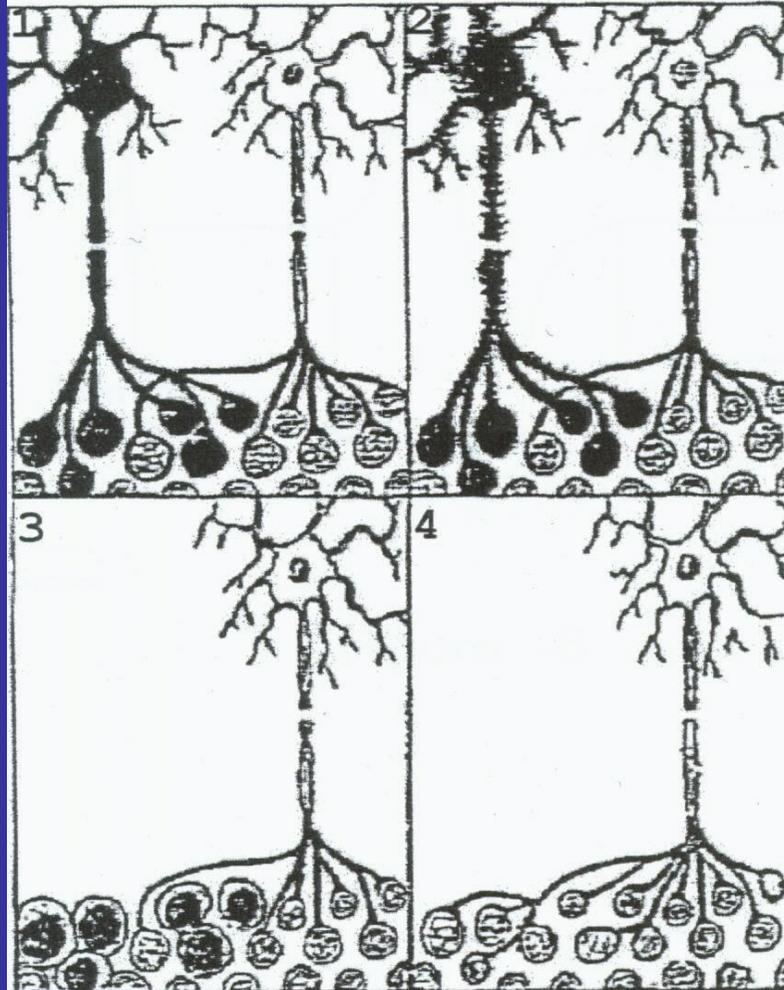


◆ **Fasciculation potentials** Spontaneous discharge of a **MU** at **rest**, can be **seen** and **felt** by the patients

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

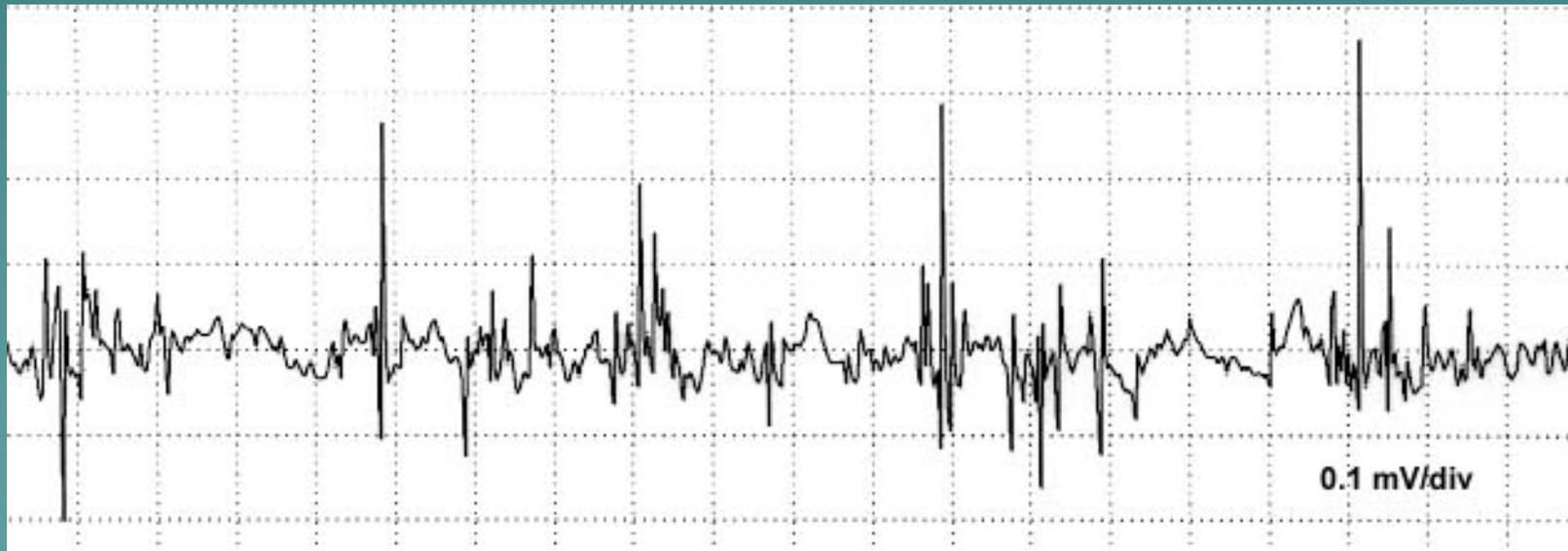


# REINNERVATION



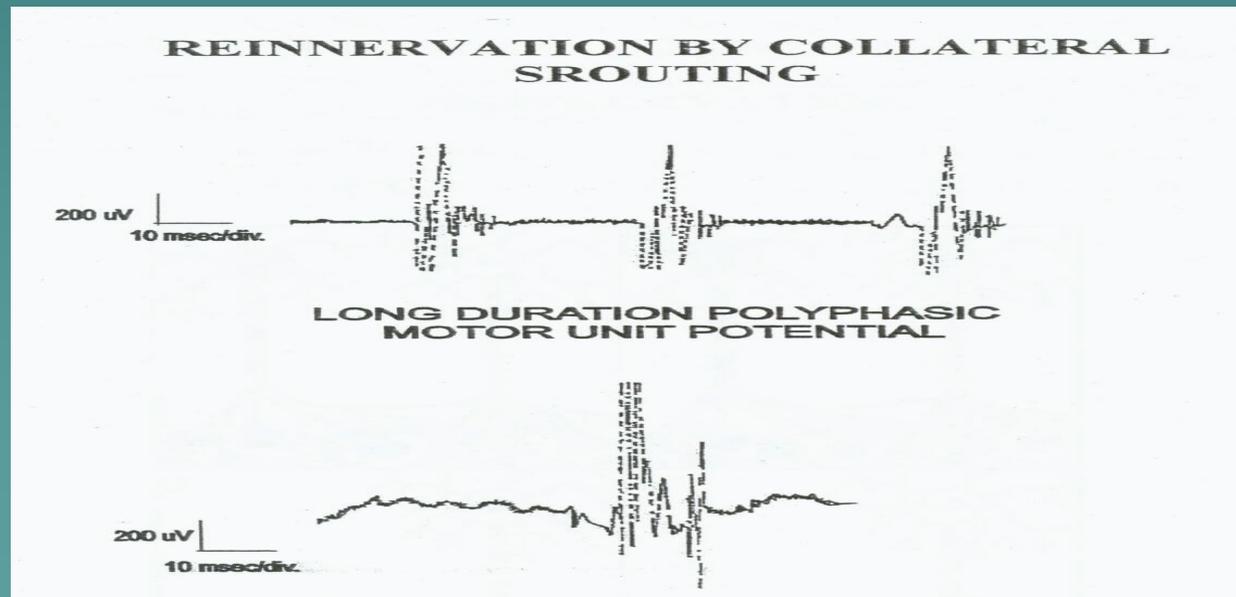
# Myopathic alteration of the EMG:

Polyphasia , short duration , reduced voltage of MUPs

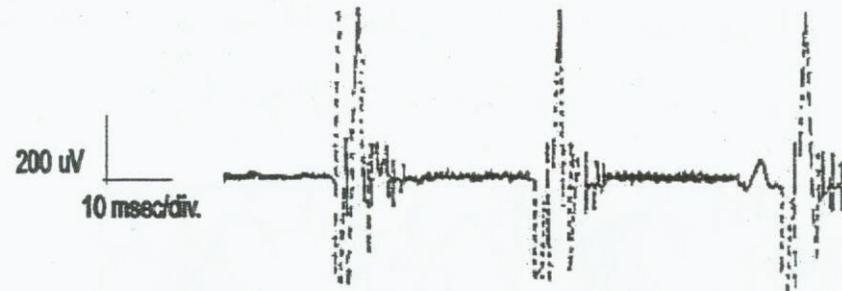


# Neuropathic alteration of the EMG:

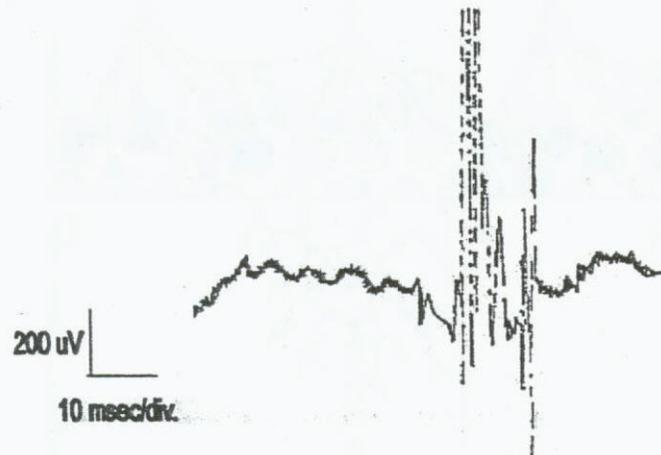
- ◆ Polyphasia , long duration , high voltage of MUPs



## REINNERVATION BY COLLATERAL SROUTING



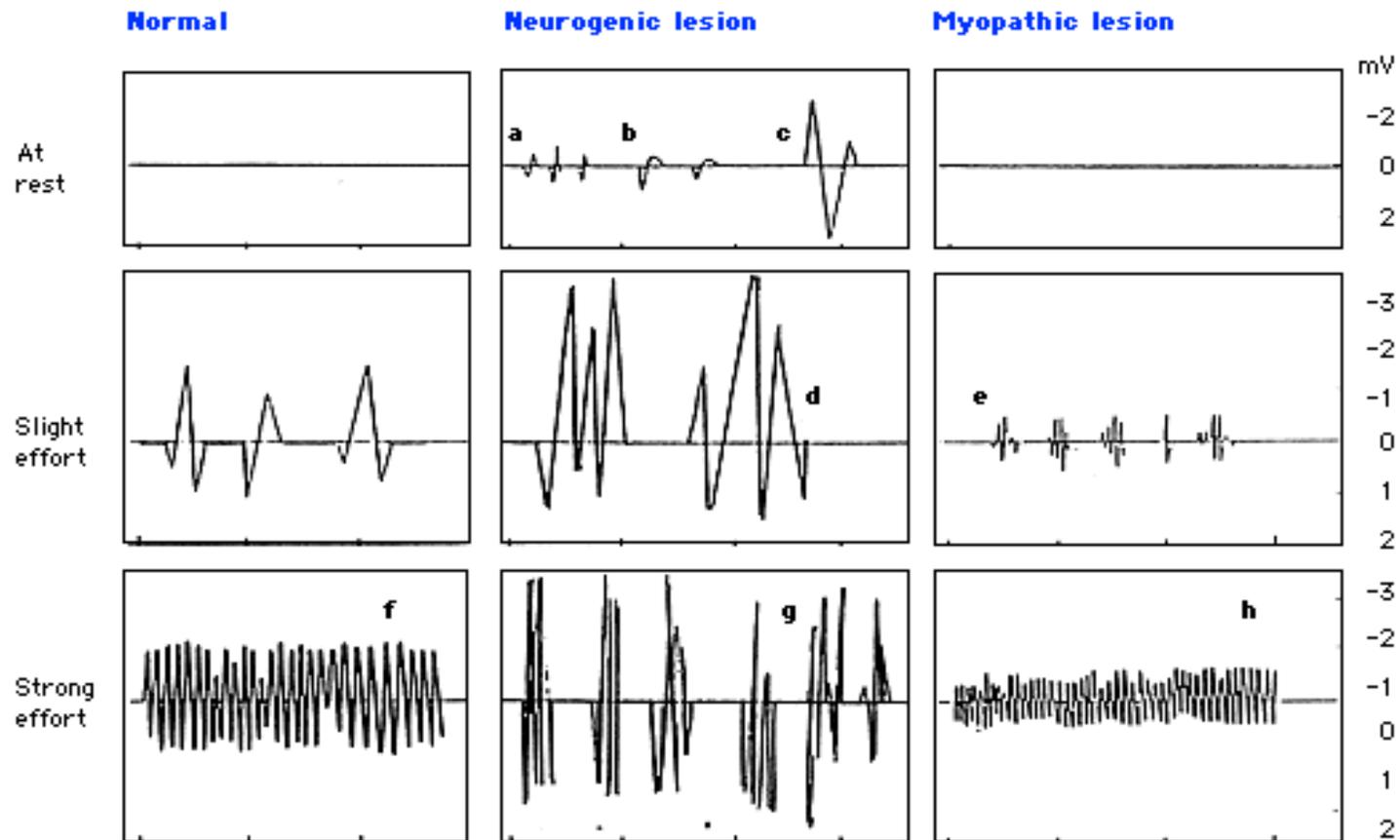
## LONG DURATION POLYPHASIC MOTOR UNIT POTENTIAL



# 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\*



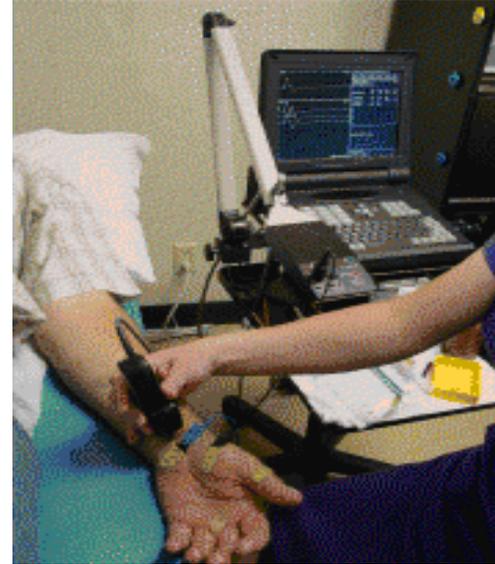
1. At rest (spontaneous activity): a. fibrillations, b. positive sharp waves, c. fasciculation.
  2. Slight effort (motor unit potentials): d. giant polyphasic, e. BSAPS (brief-small-abundant polyphasic).
  3. Strong effort (interference pattern); f. full, g. reduced units, h. reduced amplitude.
- \* (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.

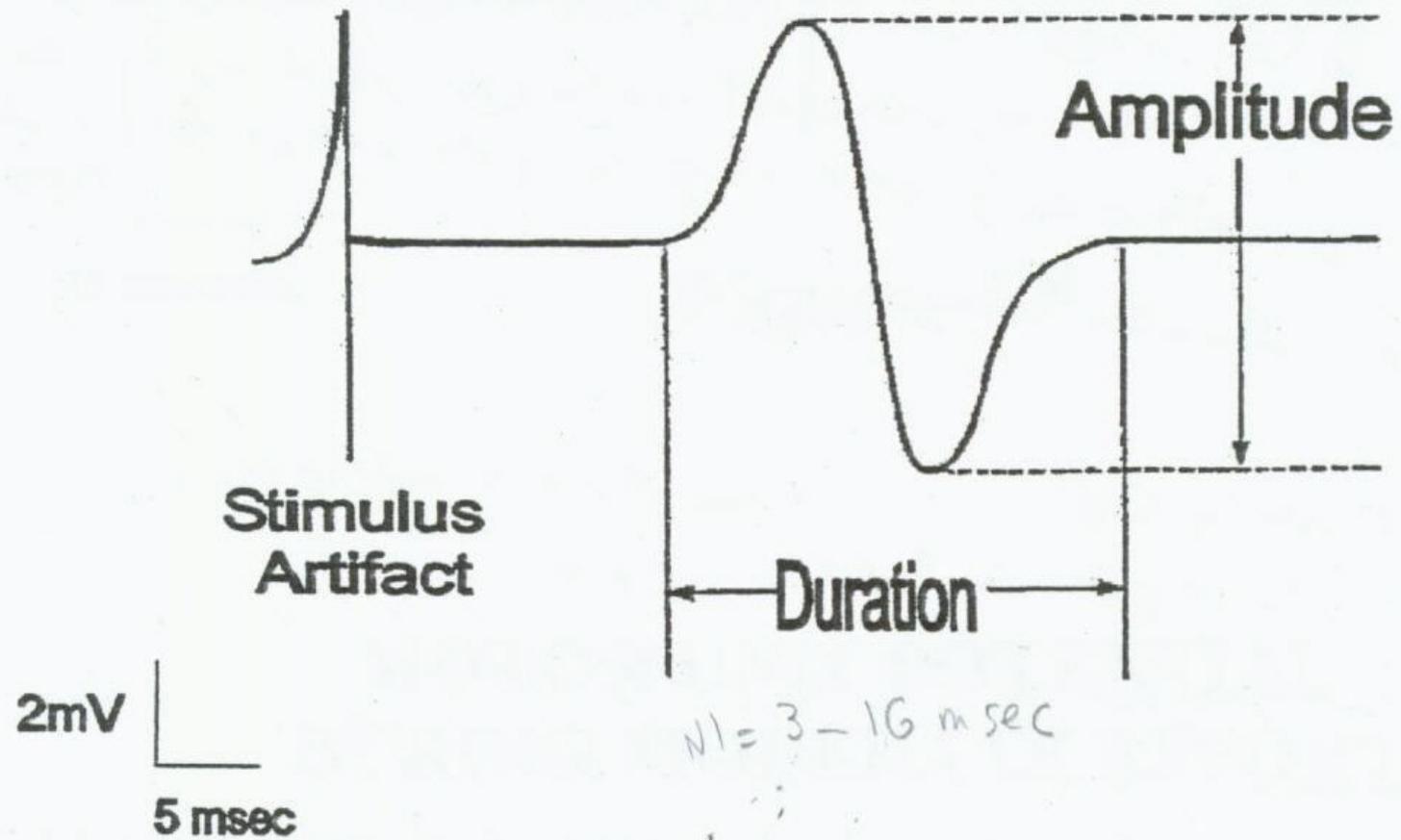
# Motor Nerve Conduction Study

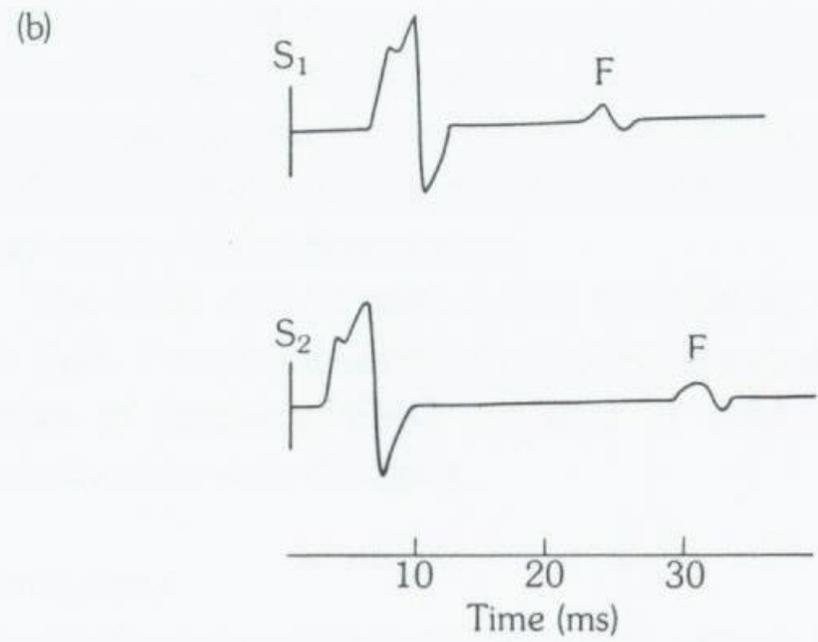
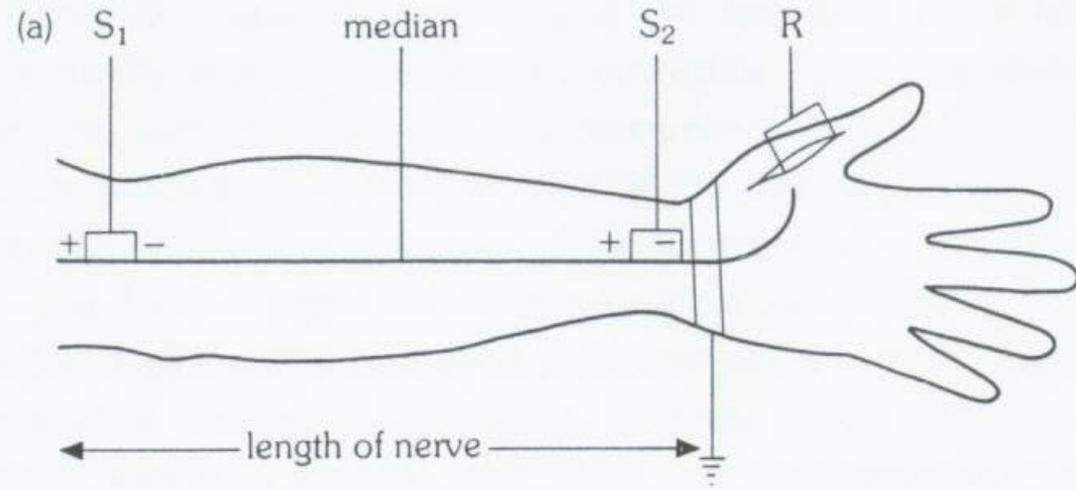
- Stimulat<sup>o</sup> of median nerve until visible muscle contract<sup>o</sup> is seen and a reproducible Compound Muscle A P is recorded



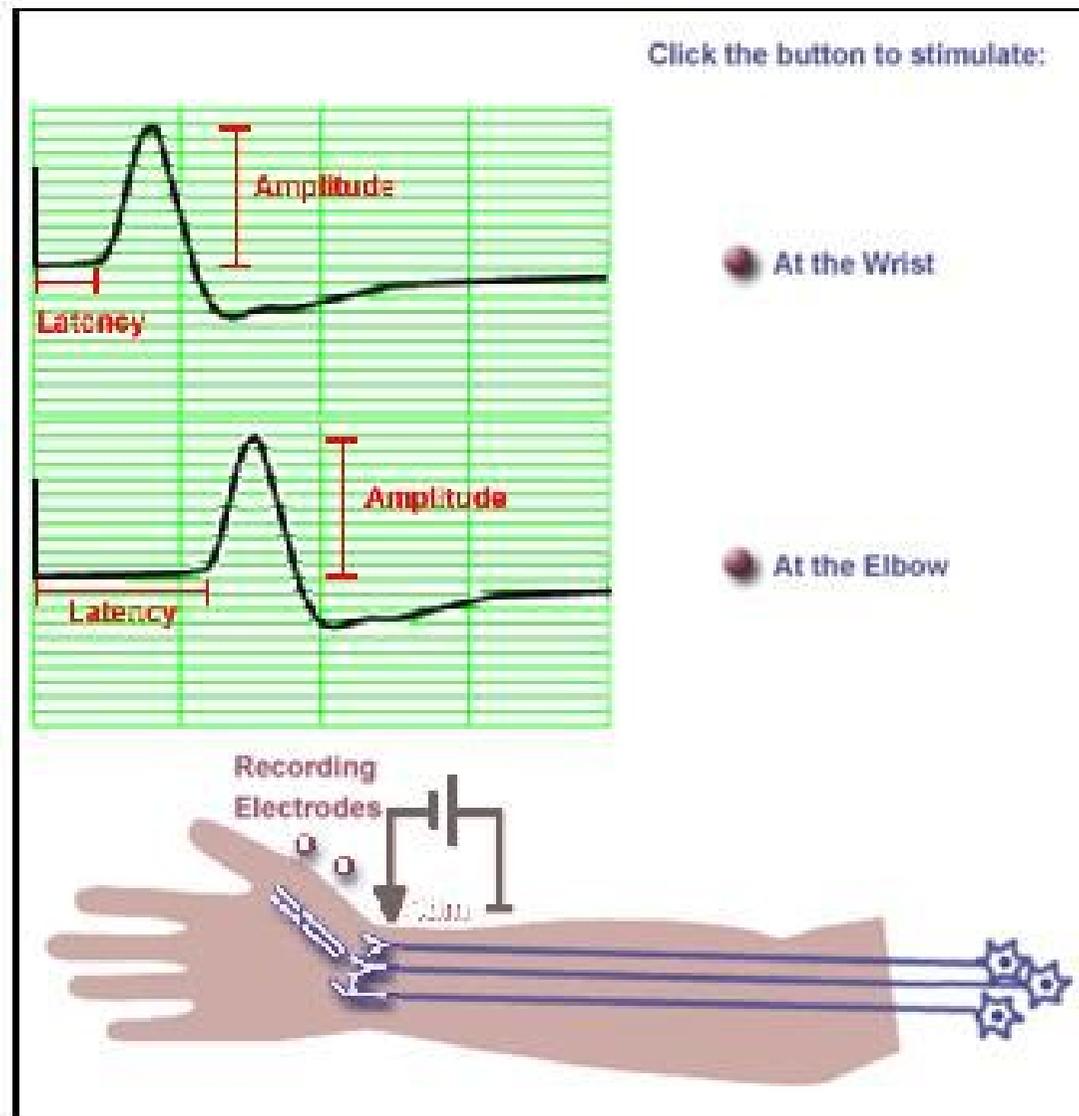
**CMAP:** summated potentials from all Motor Units in a muscle

# COMPONENTS OF THE CMAP





# MOTOR NERVE CONDUCTION VELOCITY (MNCV)





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

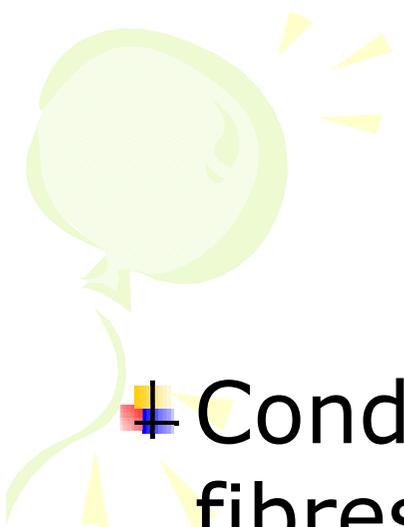
$l_1$  = latency at elbow.

$l_2$  = latency at wrist

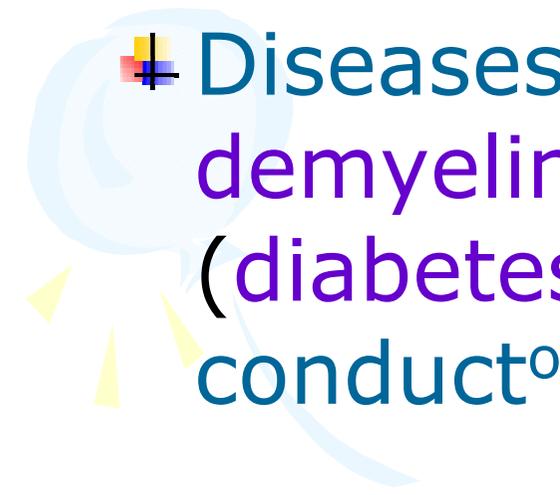
Distance between the two stimulating electrodes



**+ 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)

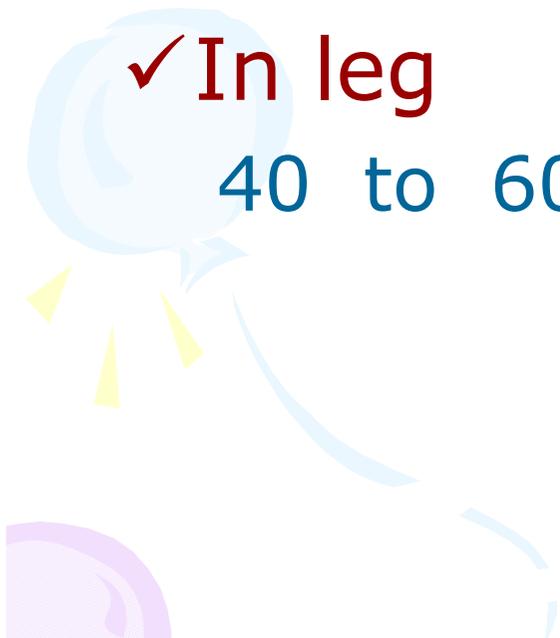




# Normal values for conduction velocity

✓ In arm

50 to 70 m / sec.



✓ In leg

40 to 60 m / sec.