

Electromyography (EMG)

&

Motor Nerve Conduction Velocity

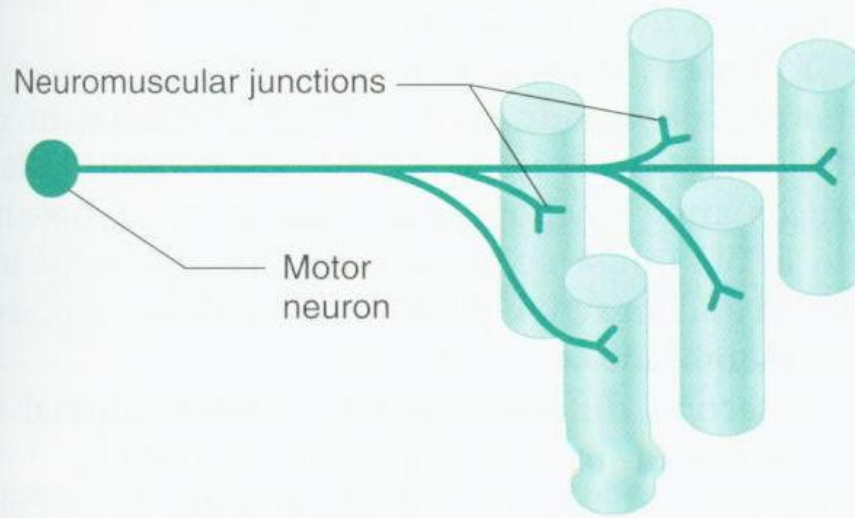
Dr Thouraya



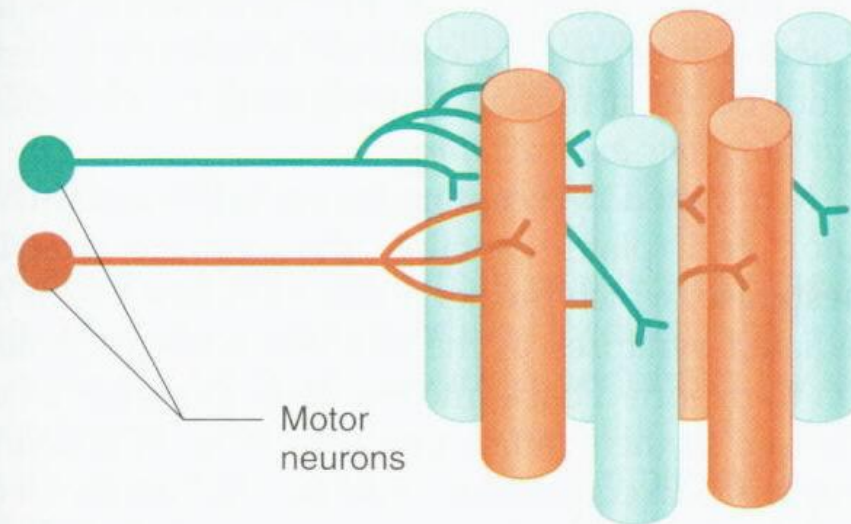
Motor Unit

- ❖ 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 contraction:
(to evaluate the electrophysiology of a MU)



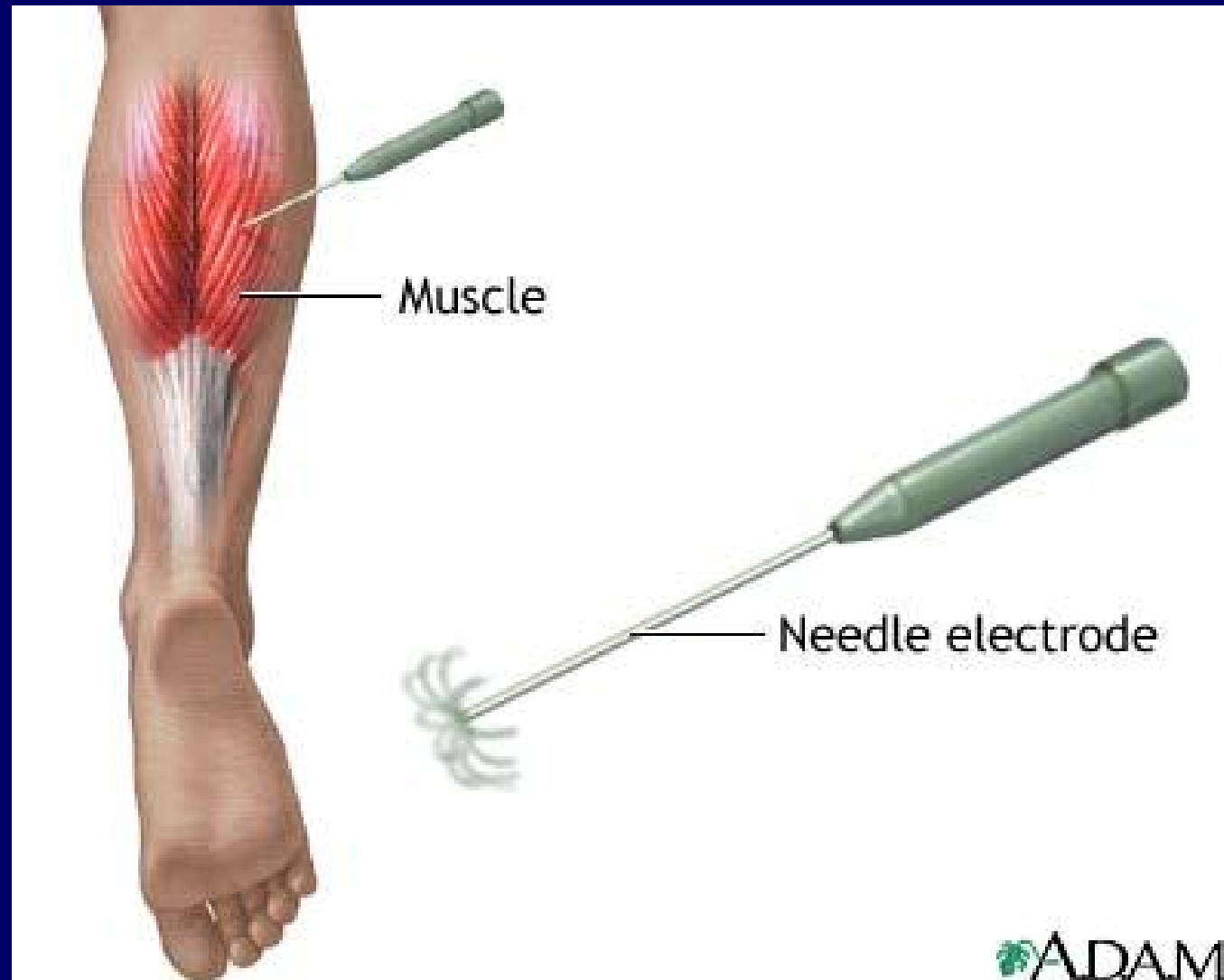
Activity is amplified and displayed on an oscilloscope.

Instrument : **Electromyograph**



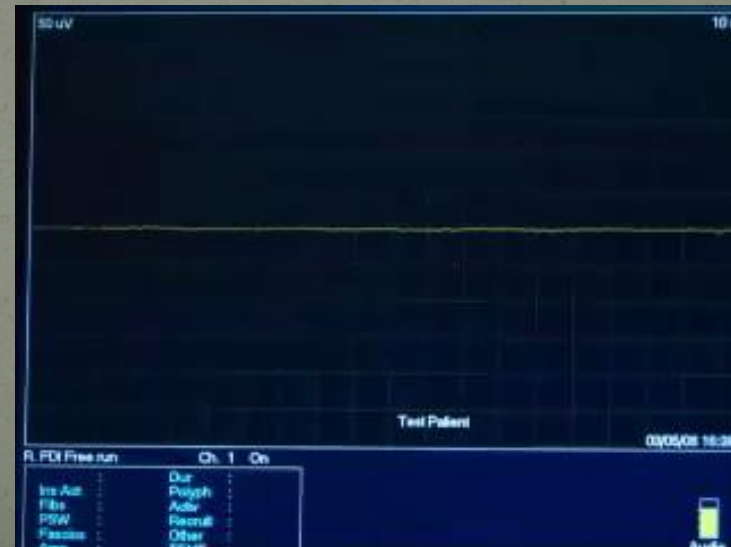
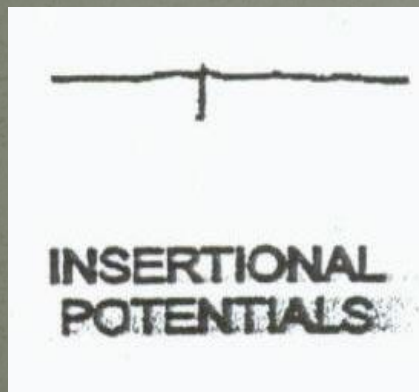
Record: **Electromyogram**

■ 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.

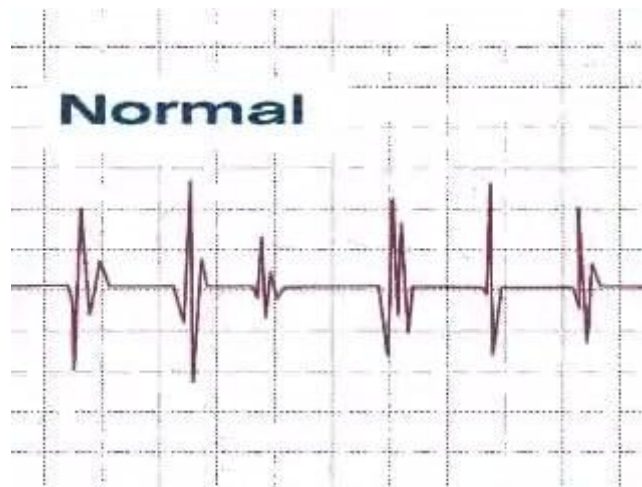
- With muscle contraction, MUs are activated and **MUAPs** appear on the screen:




- **Motor unit potential** : represents the summation of the potentials generated by **μ sl fibers** belonging to the **MU**


Normal MUPs

- Bi – Triphasic
- Duration – 3 – 16 mSec.
- Amplitude – 300 μ V – 5 mV





■ With increasing strength of contract^o
→ 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

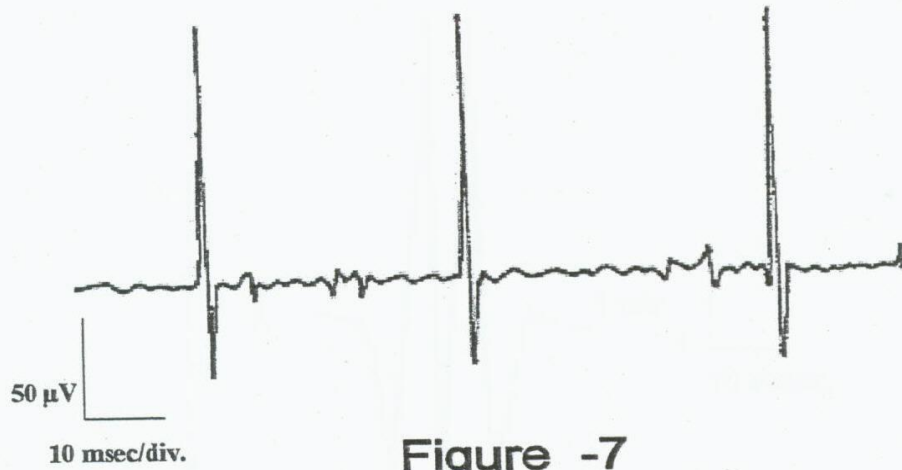
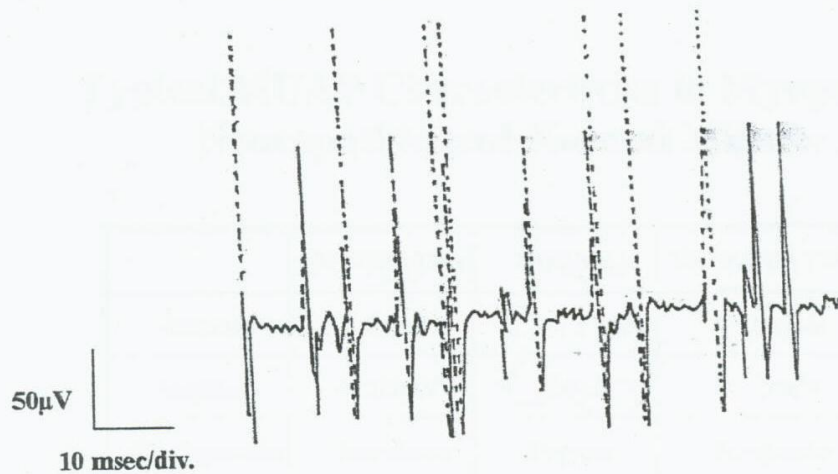


Figure -7

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)

- 
- **The size, duration, frequency of the electrical signals generated by Msl cells help determine if there is damage to the Msl or to the nerve leading to that Msl.**
- 

- 
- 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 that resemble confetti or streamers.
- **Myopathy**: progressive degeneration of skeletal muscle fibers

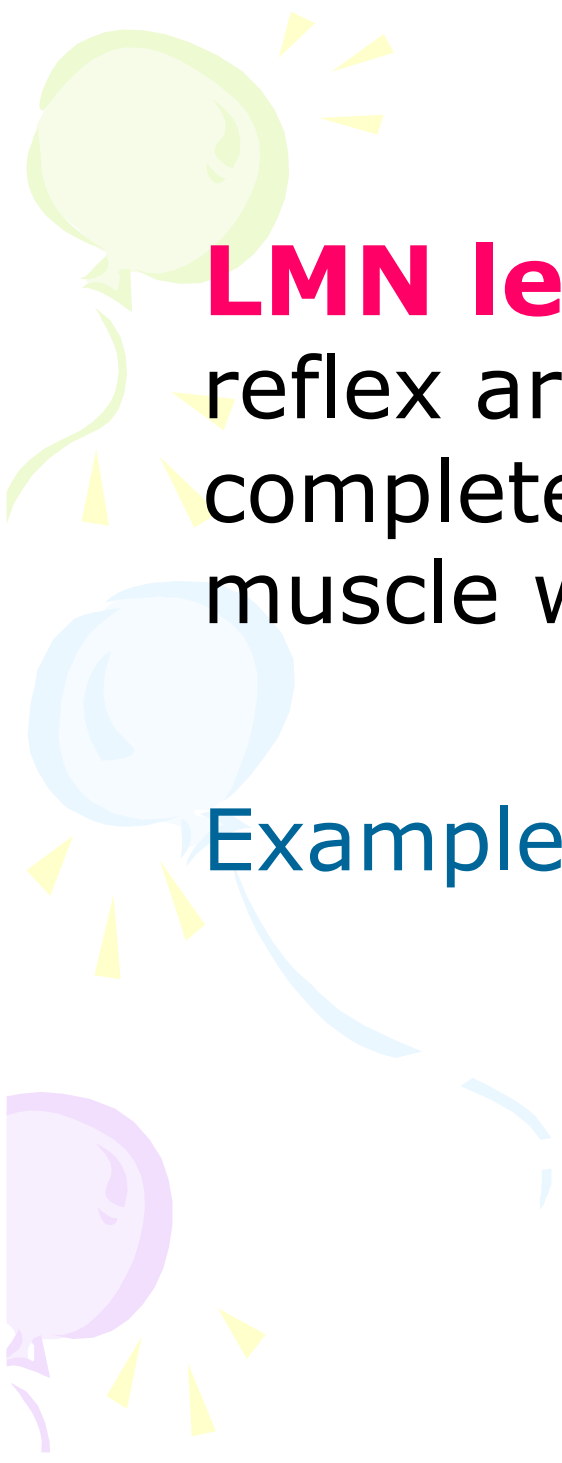
Eg: Duchenne Muscular dystrophy

- 
- **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**
- 

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 shapes radiating from it, resembling a sun or a burst of light.

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

Example: 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^o hypersensitivity to acetylcholine.

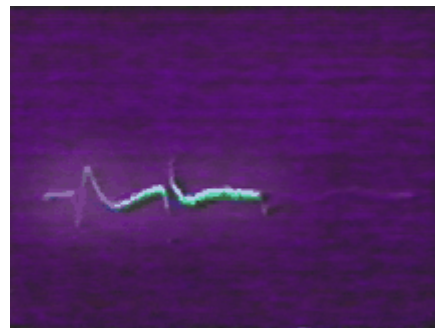


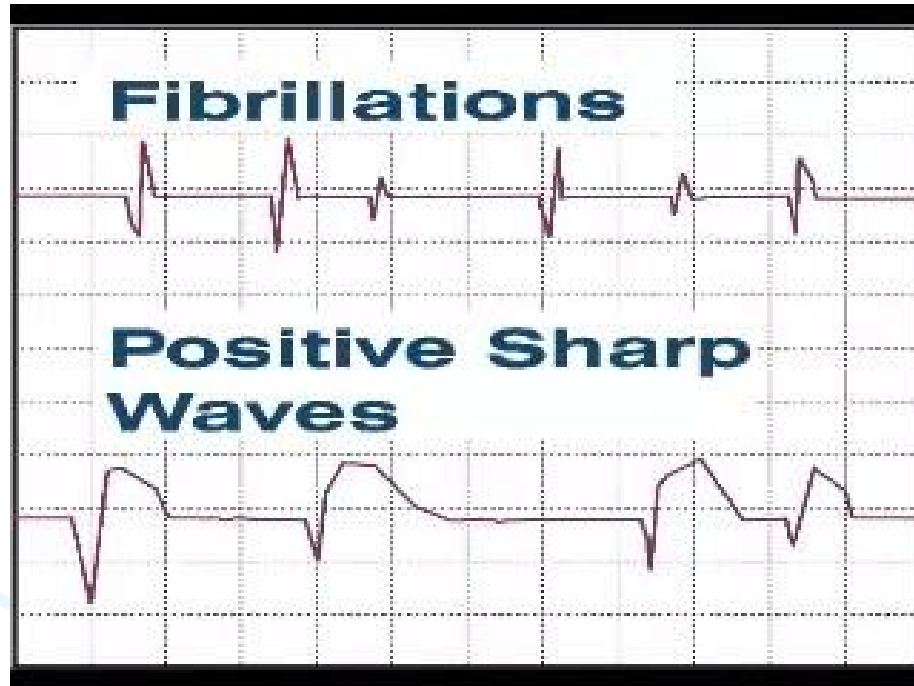
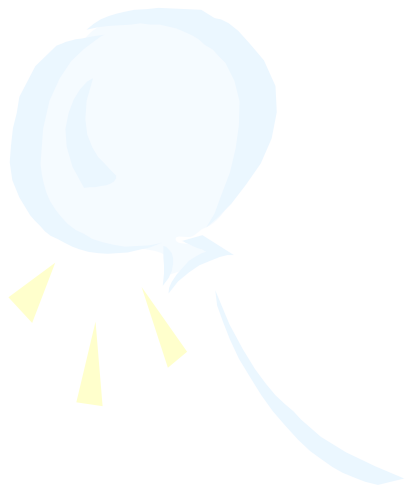
Fine invisible, irregular contractions of individual muscle fibers.



◆ **Positive sharp waves**

Small fibrillation APs (50 to 100 μV , 5 to 10 msec duration) whose propagation is blocked at the level of the recording Ede

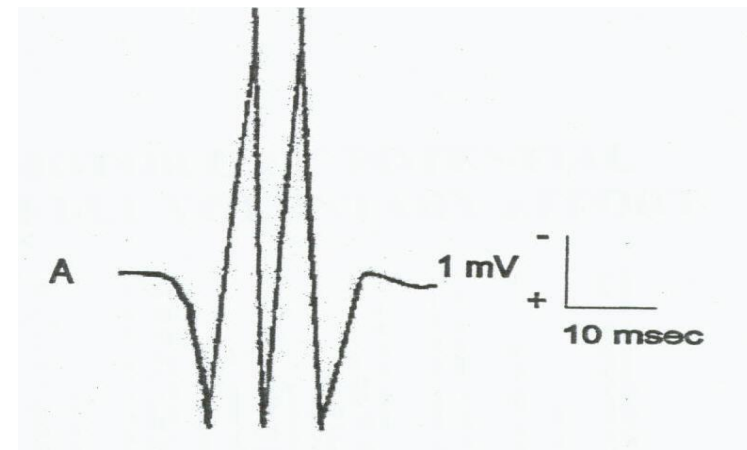




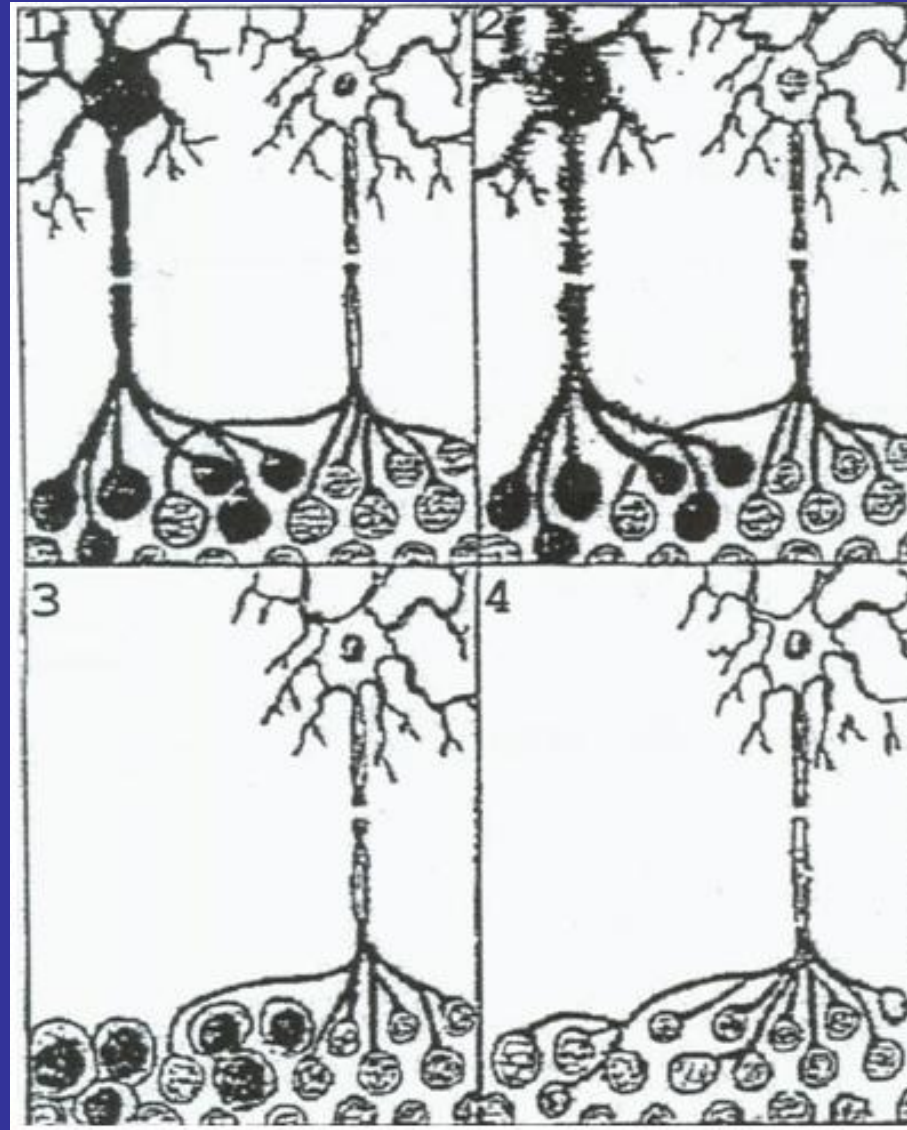
◆ Fasciculation potentials

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**)

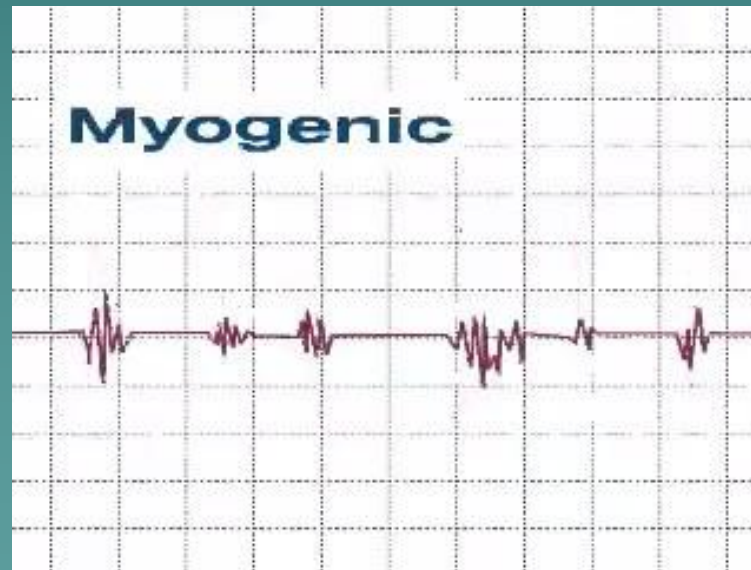


REINNERVATION BY COLLATERAL SROUTING



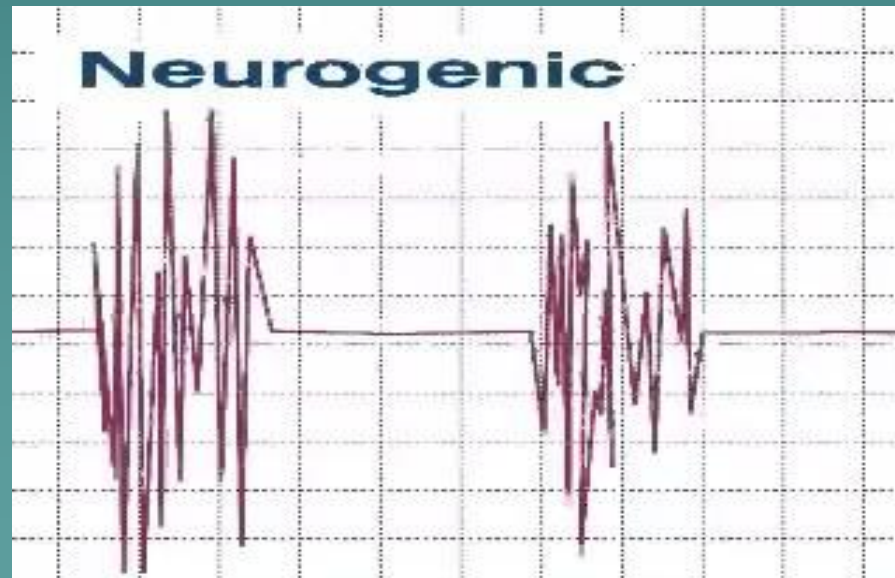
Myopathic alteration of the EMG:

Polyphasia , short duration , reduced voltage of MUPs



Neuropathic alteration of the EMG:

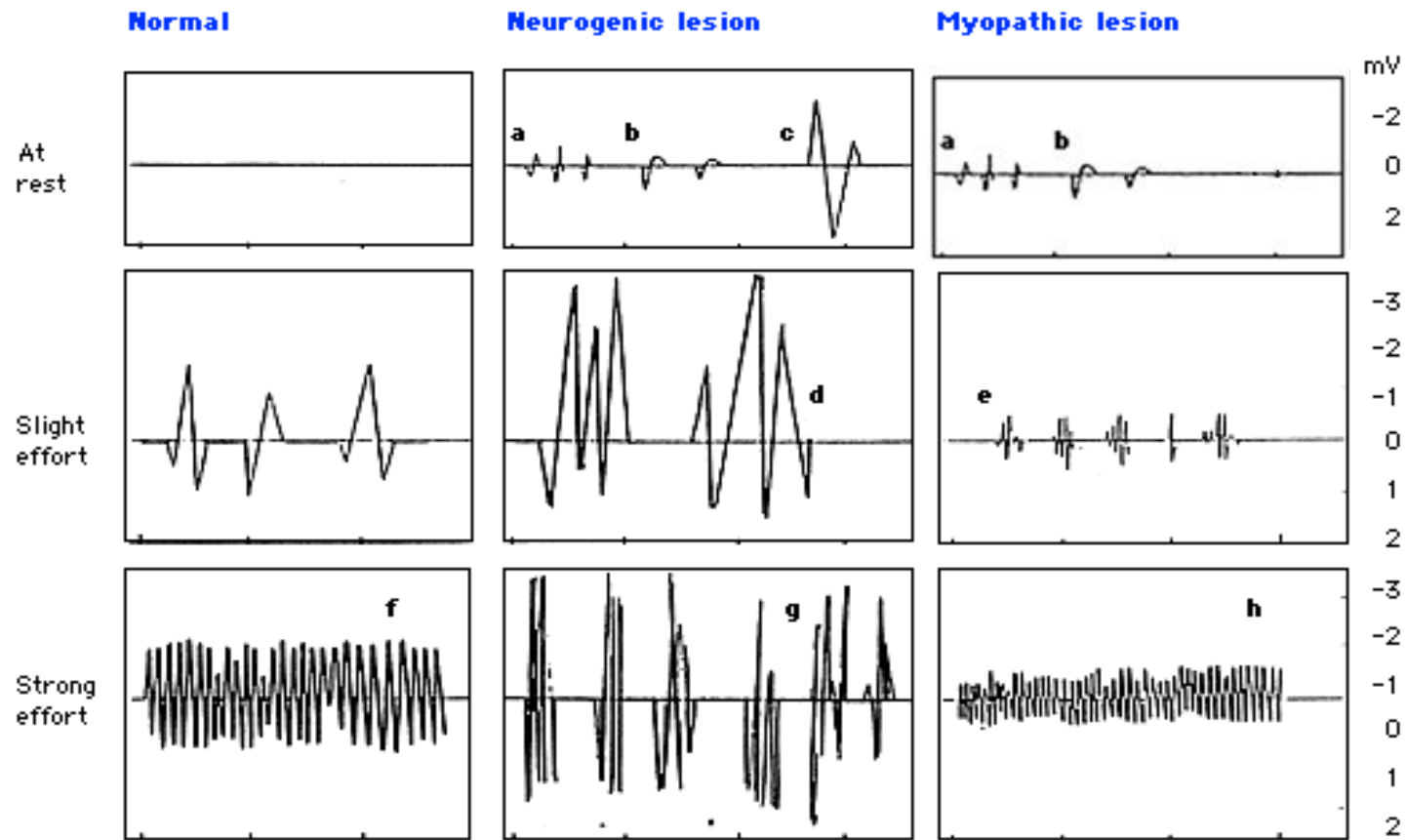
- ◆ Polyphasia , long duration , high voltage of MUPs



Analysis of MUP

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

Electromyography*



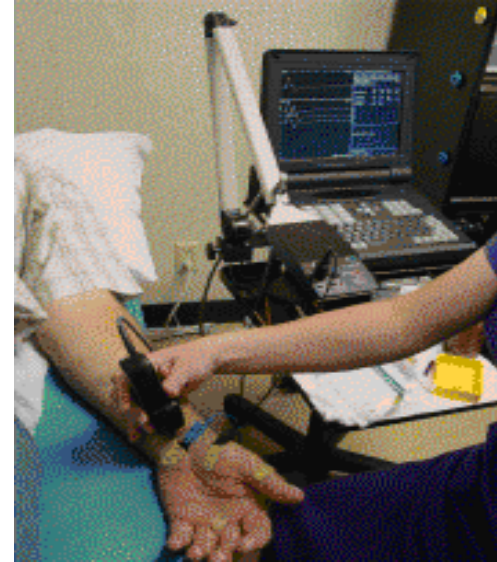
1. At rest (spontaneous activity): a. fibrillations, b. positive sharp waves, c. fasciculation.
 2. Slight effort (motor unit potentials): d. giant polyphasic, e. BSAPS (brief-small-abundant polyphasic).
 3. Strong effort (interference pattern); f. full, g. reduced units, h. reduced amplitude.
- * (helpful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

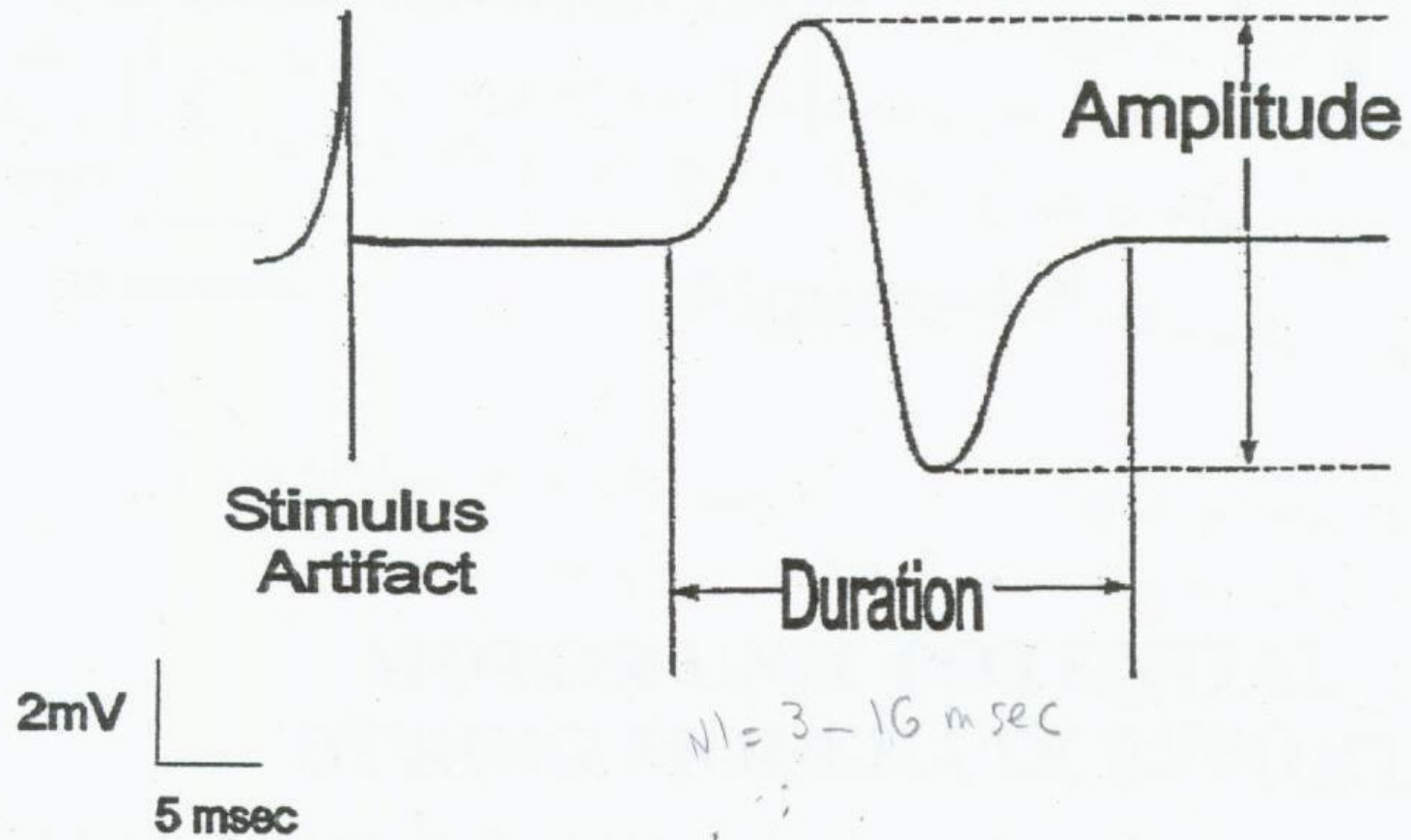
Motor Nerve Conduction Study

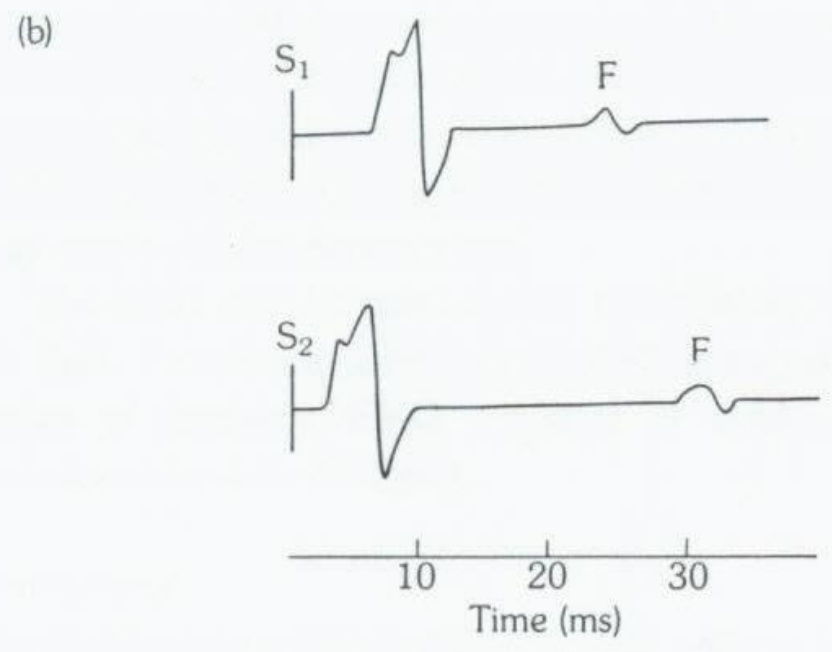
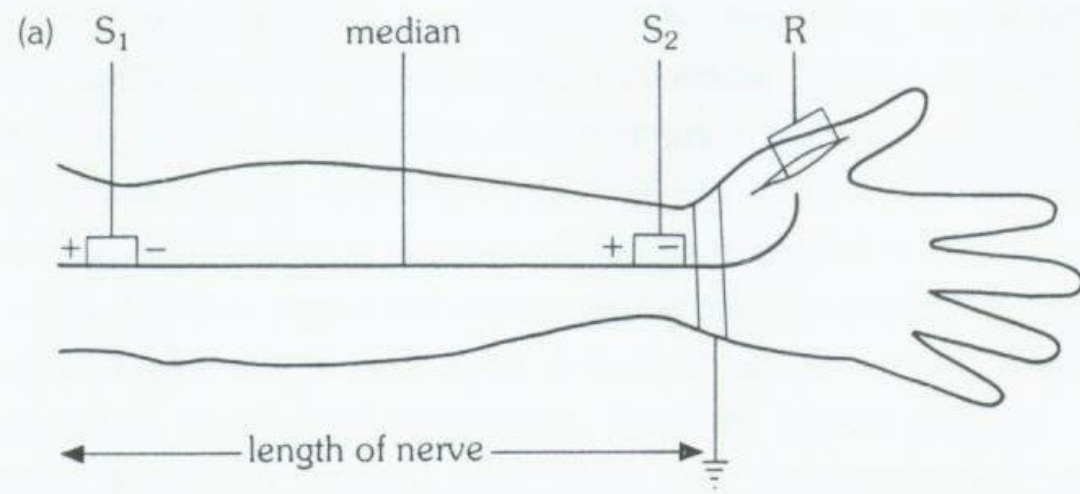
- Stimulat^o of median nerve at two points until visible muscle contract^o is seen and a reproducible Compound Muscle A P is recorded



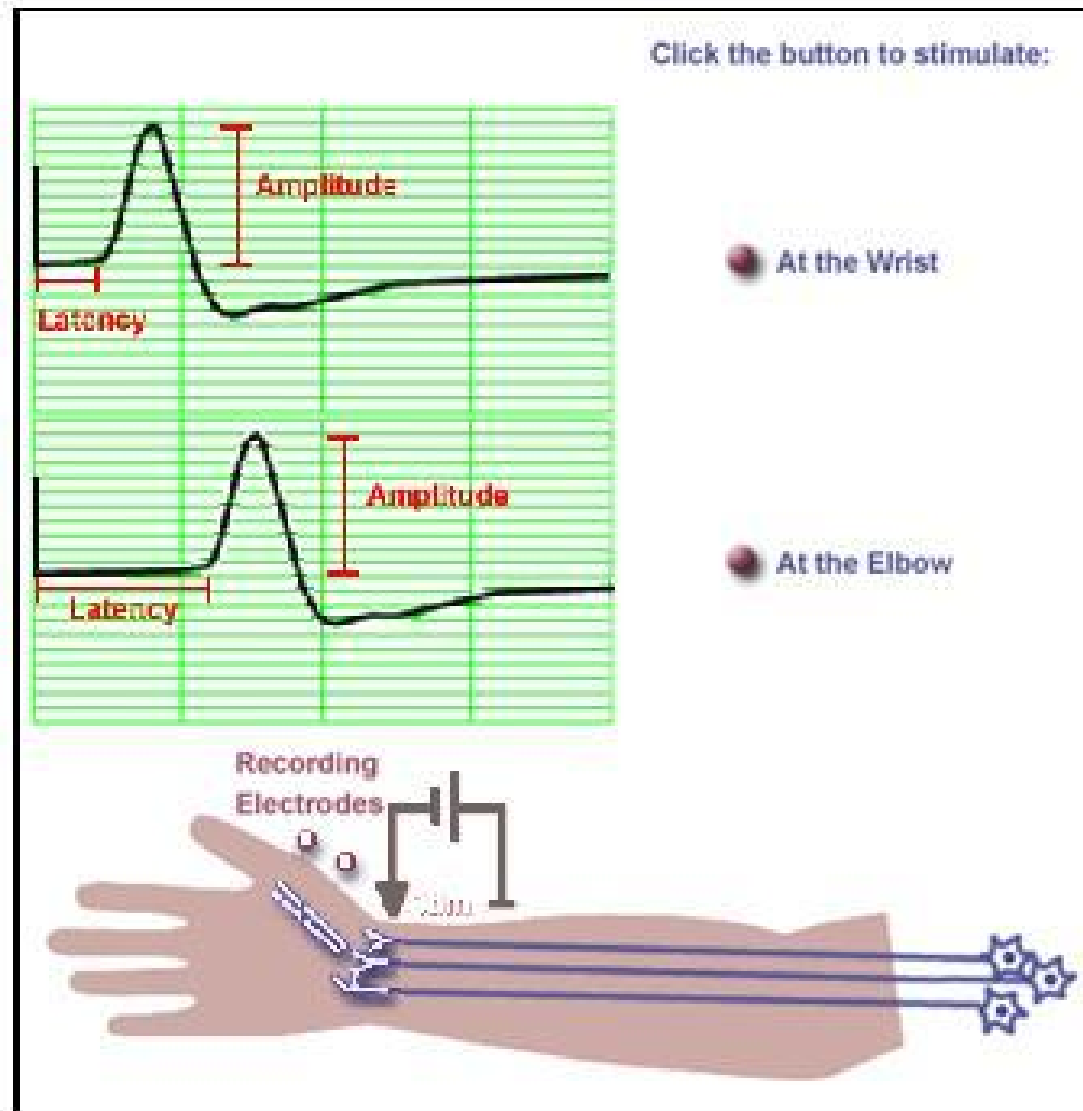
CMAP: summated potentials from all Motor Units in a muscle

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



Normal values for conduction velocity

- In arm

- 50 to 70 m / sec.

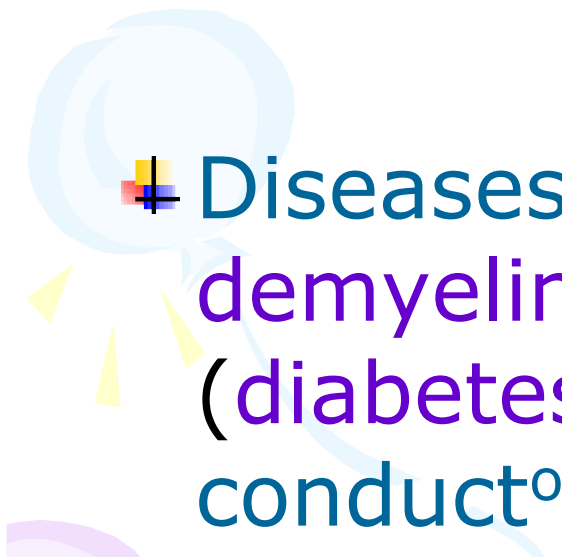


- In leg

- 40 to 60 m / sec.

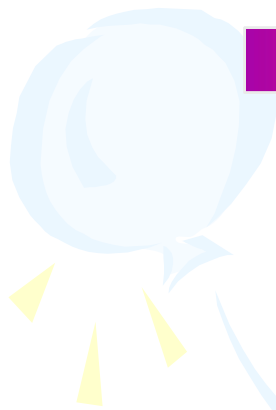


+ Conduction is **faster** in **myelinated** fibres.



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





THANK YOU...