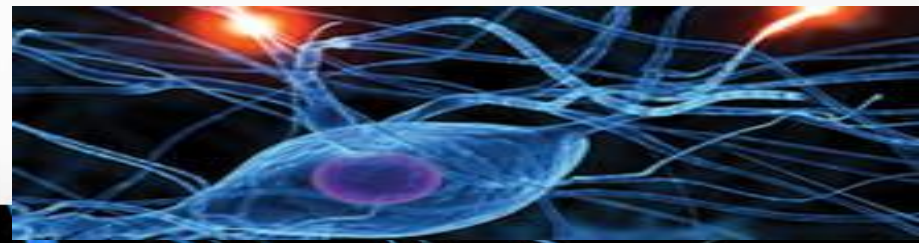


Electromyography (EMG) & Motor Nerve Conduction Velocity

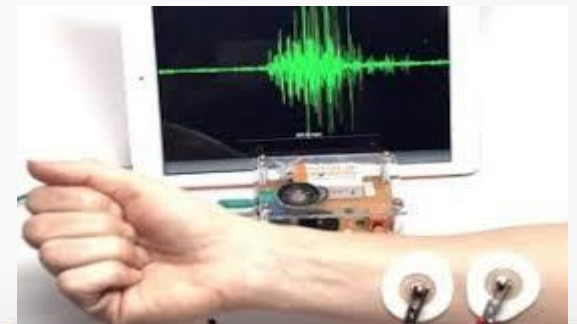
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- **Motor Unit:** Consists of a motor neuron and all the muscle fibers it innervates.
- When an action potential occurs in a motor neuron, all the muscle fibers in its **Motor Unit (MU)** are stimulated to contract.



Electromyography(EMG)

- **EMG**: is the recording of electrical activity (Action Potential) of a muscle at rest & during contraction to evaluate the electrophysiology of a **Motor Unit**.
- Activity is amplified and displayed on an Oscilloscope.

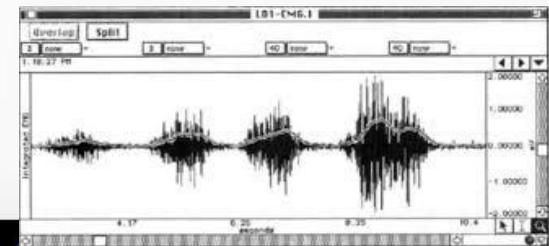


Needle EMG

- **Needle EMG** does not introduce any electrical stimulation instead it records the intrinsic electrical activity of skeletal muscle fibers.
- A concentric needle electrode is inserted into the belly of the muscle.

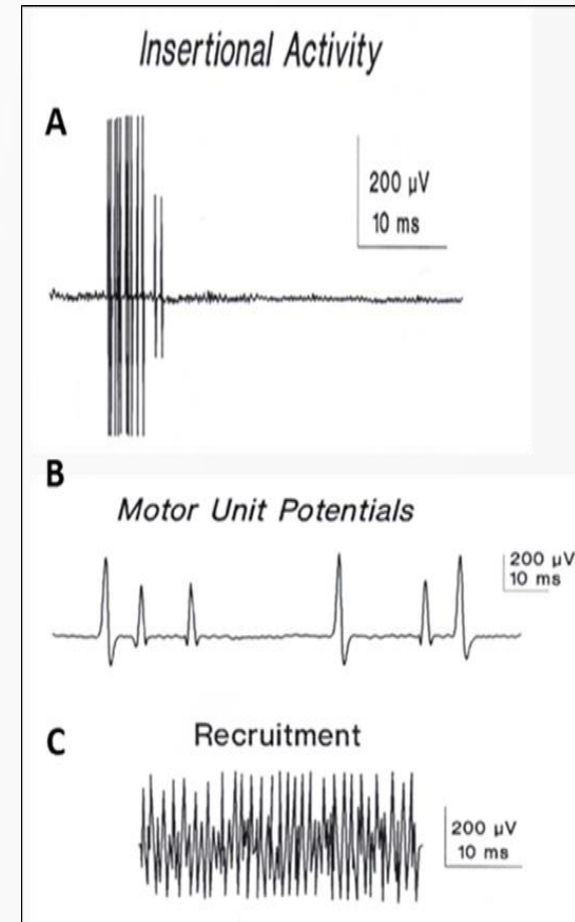


- Electrical activity is then recorded at **rest**, **mild-moderate muscle activity**, and at **maximum muscle contraction** → **MUs** are activated and motor unit action potential (**MUAPs**) appear on the screen.
- **MUAPs**: represent the summation of the potentials generated by muscle fibers belonging to the **MU**.



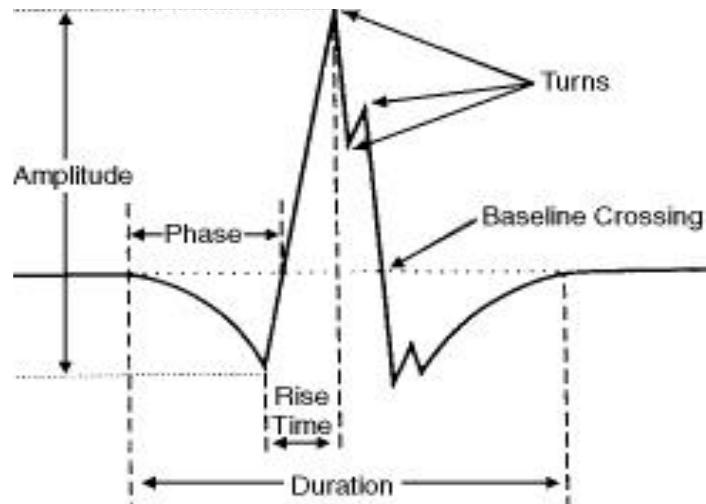
Normal MUPs

- Normally a muscle is silent at rest, electrical activity may be seen during needle insertion (**insertional activity**).
- With increase in the strength of contraction → recruitment of **MUs** → increase in number and size of **MUAPs**.

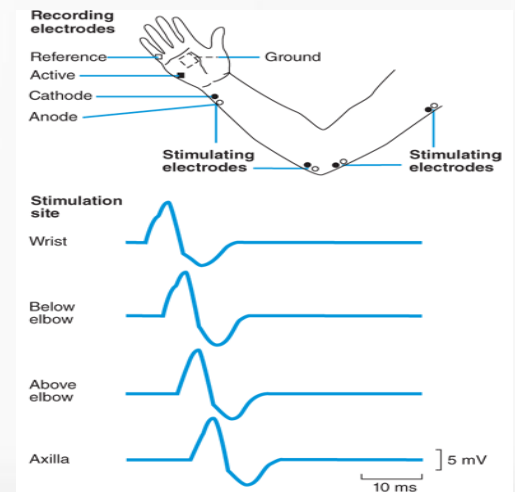
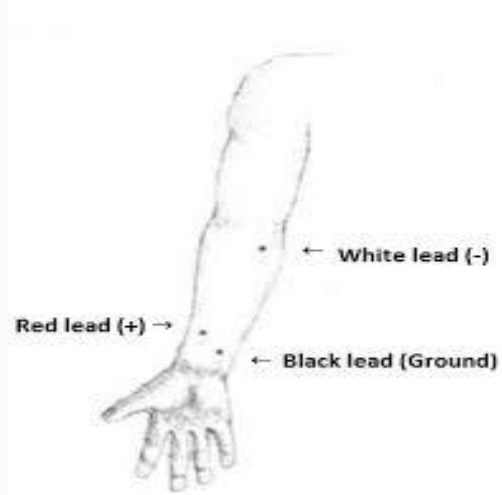


Normal MUPs

- Bi or triphasic
- Duration 3-15 ms.
- Amplitude 300-5000 μV .



- In our lab, surface electrodes are used instead of needle electrodes.
- Instead of **MUPs** surface electrodes record the sum of all **MUPs (compound motor AP)**.



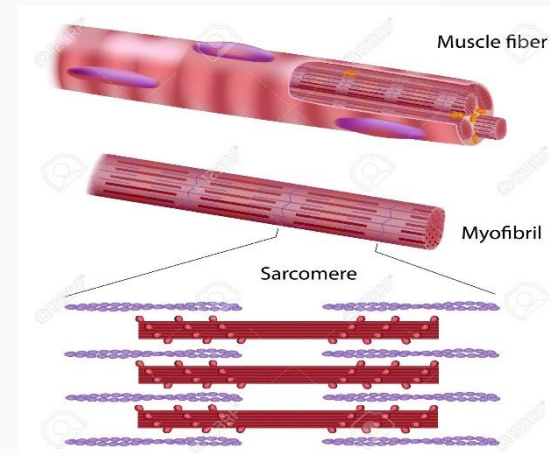
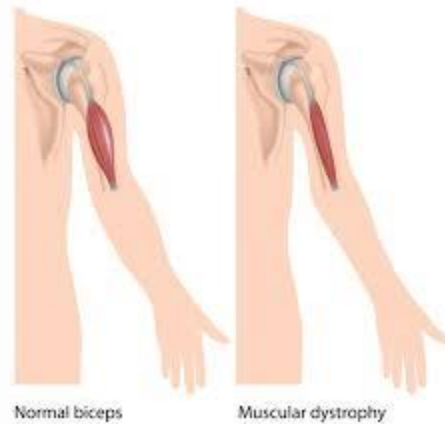
EMG Indications

- EMG is used to investigate both **myopathic** and **neuropathic** disorders.
- The size, duration & frequency of the electrical signals generated by muscle cells help determine if there is damage to the muscle or to the nerve leading to that muscle.

- **Myopathic disorders:**

Progressive degeneration of muscle fibers.

Duchenne Muscular dystrophy



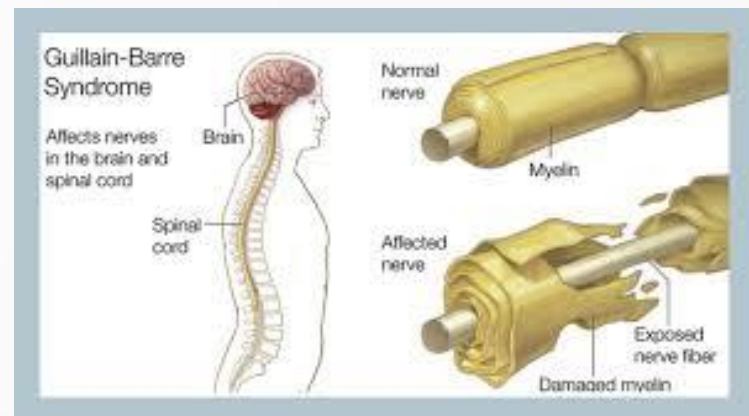
- **Neuropathic disorders:**

Damage to the distal part of the nerve.

Guillain Barré syndrome

Diabetes mellitus

Alcohol abuse



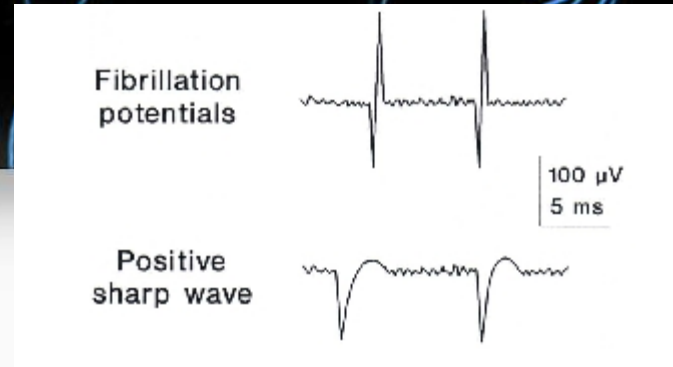
ECG Abnormalities at Rest

- At **rest**, any activity present is considered to be abnormal.
- Abnormal activities that may occur at **rest**:
 - Fibrillation potentials**
 - Positive sharp waves**
 - Fasciculation potentials**

- **Fibrillation potentials:**

Low amplitude, short duration, biphasic potentials.

Occur due to nerve fiber degeneration which will lead to hypersensitivity to acetylcholine due to stimulation of the whole muscle fiber membrane rather than neuromuscular junction alone (spontaneous discharge).



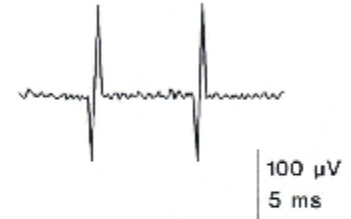
- **Positive sharp waves**

Small fibrillations, positive and sharp potentials.

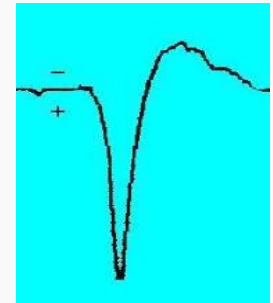
Fast down stroke and slow return to baseline.

Same origin as fibrillations due to nerve fiber damage (spontaneous action potentials).

Fibrillation potentials



Positive sharp wave





- **Fasciculation potentials:**

Randomly discharge at rest, can be seen and felt by the patient.

(brief spontaneous contraction affecting a small number of muscle fibers)

Larger and more complex than fibrillation potentials, are isolated discharges at regular intervals, brief (sec.).

ECG Abnormalities on Muscle Contraction

- In neuromuscular diseases, muscle contraction will lead to changes occurring in **MUPs** as well as in **recruitment**.
- **MUPs**: changes in duration and amplitude.
- **Recruitment**: rapid or reduced MUPs.

How Myopathic lesions show on EMG?

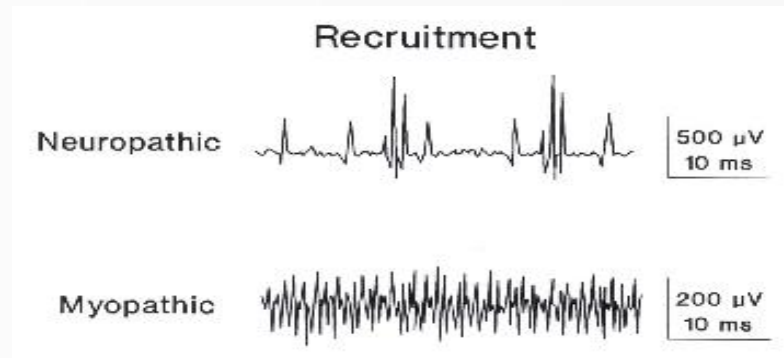
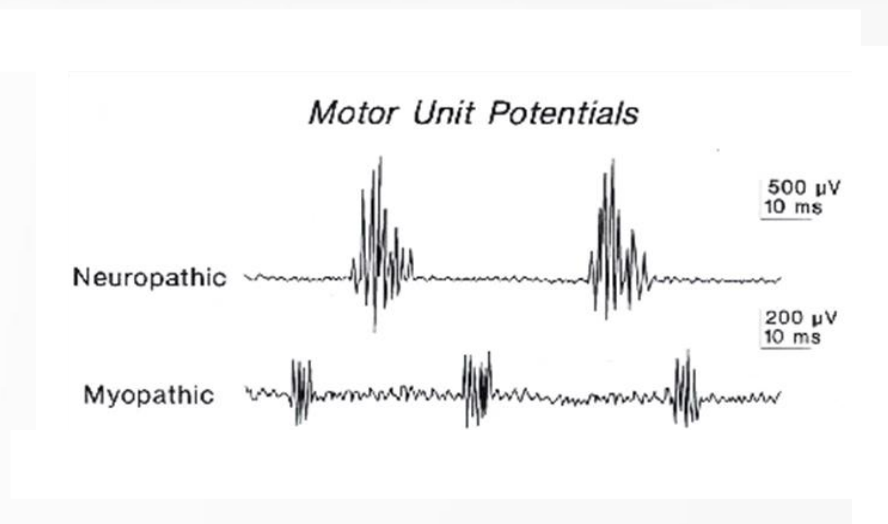
Myopathy:

MUPs:

Polyphasic, short duration, reduced voltage of MUPs.

Recruitment:

Rapid recruitment, low amplitude.



How Neuropathic lesions show on EMG?

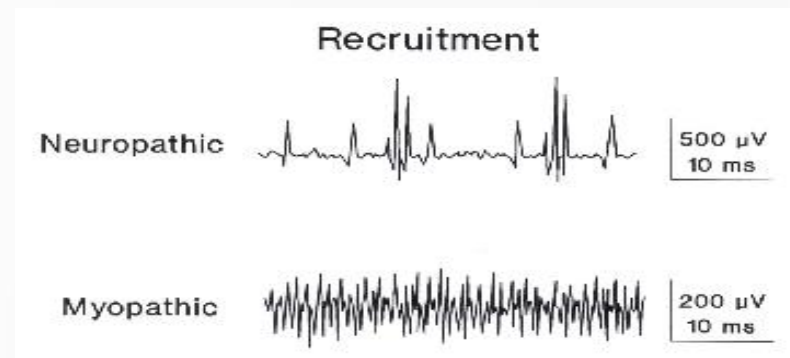
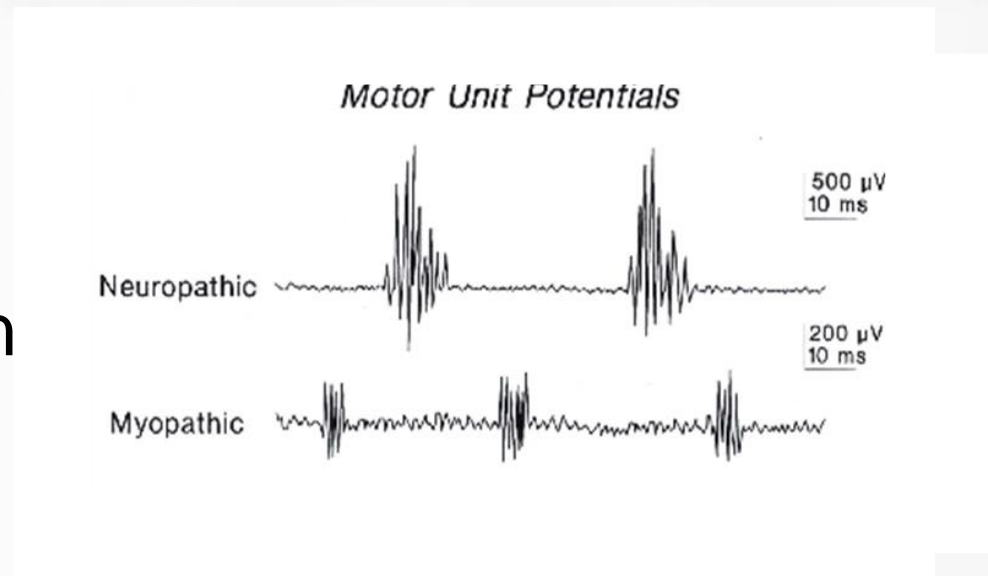
Neuropathy:

MUPs:

Polyphasic, long duration high voltage (Gaint MUAPs).

Recruitment:

Reduced recriutment.



Analysis of MUP

MUP	Normal	Neuropathy	Myopathy
Duration (msec)	3-15	↑	↓
Amplitude (μV)	300-5000	↑	↓
Phases	Bi/Triphasic	Polyphasic	Polyphasic
Resting Activity	Silent	+++	+++
Interference Pattern	Full	Partial	Full

Motor Nerve Conduction Velocity (MNCV) Study

- **MNCV**: is a test to evaluate the function of peripheral nerves.
- Especially electrical **conduction velocity** as well as **response latency** of peripheral nerves.
- Upper limb: median, ulnar, and radial nerves.

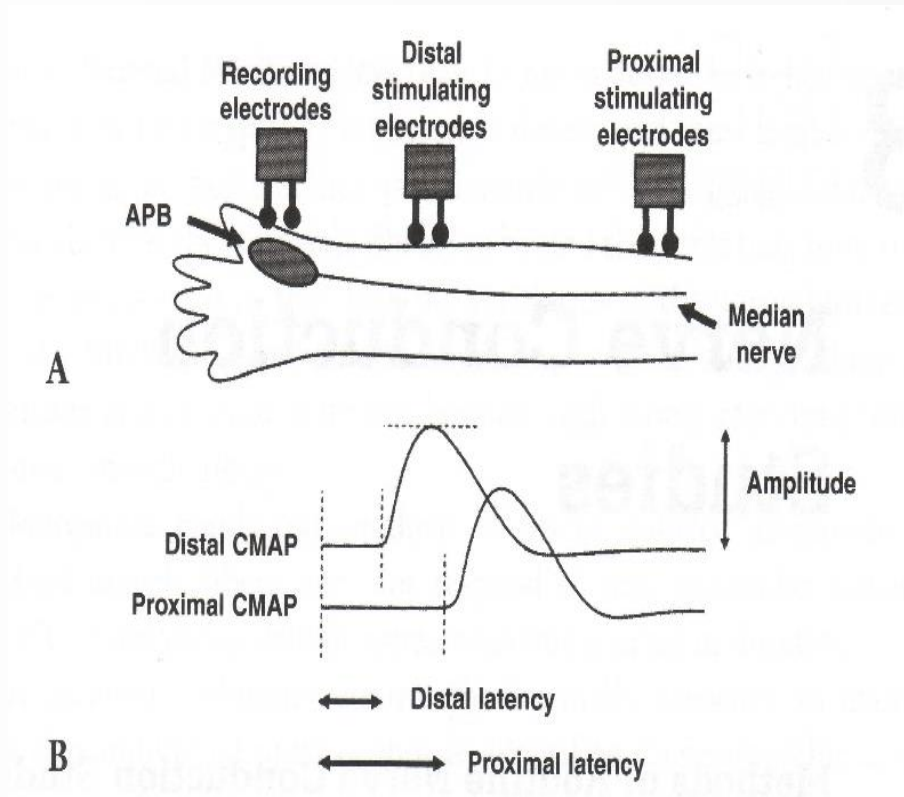
Principle MNCV

- Stimulation of median nerve at two different sites to generate action potential.
- Distance between those two sites are measured (mm).
- Latency is also measured which is the time for the impulse to travel from stimulus to the recording site (ms).



- Stimulation of median nerve at two points until visible muscle contraction is seen and are produce Compound Muscle Action Potentials (**CMAP**) which are recorded.
- Recording electrode over the thenar eminence.
- **CMAP**: summated potentials from all Motor Units in a muscle.

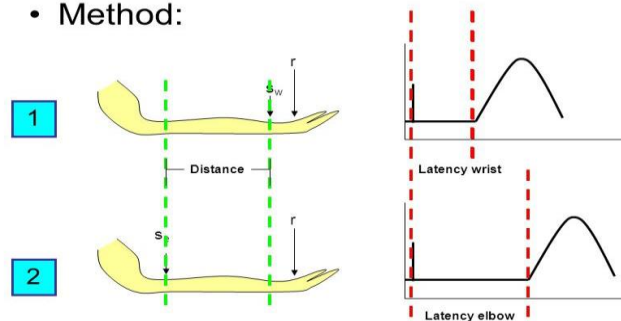
Median Nerve conduction Study



- The latency is the interval between the onset of the stimulus and the onset of the initial deflection from baseline of the resultant CMAP in (ms).

Conduction Velocity

- Calculations: $Velocity = \frac{Distance}{Time} = \frac{Distance}{L_{elbow} - L_{wrist}}$
- Method:



Normal values for conduction velocity

- In Arm:
50 – 70 m/s
- In Leg:
40 – 60 m/s

if < 40 m/s ???

Thank You !!!

