EMG AND MOTOR NERVE CONDUCTION VELOCITY STUDY (MNCV) 1

INTRODUCTION

Electromyography is the recording of electrical activity of the muscle by inserting needle electrode over the belly of the muscles. The potentials recorded on volitional efforts are derived from motor units of the muscle (Figure – 1,), hence known as motor unit potentials (MUPs). At rest the skeletal muscle is silent. The presence or absence of resting activitgy, the morphology and duration of MUPs and pattern of recruitments are the basis of utility of EMG in health and diseases. In other words, the study tests the integrity of the entire motor system which consists of upper and low motor neurons, neuro-muscular junction and muscles.

Similarly, motor nerve conduction velocity of the peripheral nerves may be closely correlated to their functional integrity or to their structural abnormalities. Based on the nature of conduction abnormalities, two principal type of peripheral nerve lesions can be identified: Axonal degeneration and segmental demyelination.

In the patients with muscular weakness, muscle atropohy, traumatic or metabolic neuropathy, these tests are considered as an extension of the physical examination rather than a simple laboratory procedure.

OBJECTIVES:

At the end of the session, the students should be able to:

1. acquire a skill to perform the test by themselves.
2. analyze the motor unit potentials and states their uses in health and diseases.
3. determine and calculate motor conduction velocities of the peripheral nerves.

REQUIREMENTS:

Oscilloscope
Concentric needle electrode
Plate electrode (recording)
Electrode jelly
Stimulating electrode
Ground electrode
Saline and anti-septic (70% alcohol)
Adhesive tape.

INSTRUMENT SET UP:

EMG:

- Sweep time : 10 msec/cm
- Amplitude : 1 µV/cm
- Audio-amplifier: On

NERVE CONDUCTION:

- Sweep time : 2 msec/cm
- Amplitude : 1 µV

STIMULATOR SET UP:

- Frequency : 1 / sec.
- Duration : 0.2 msec
- Intensity : Gradually increasing (MAM)

A SINGLE MOTOR UNIT

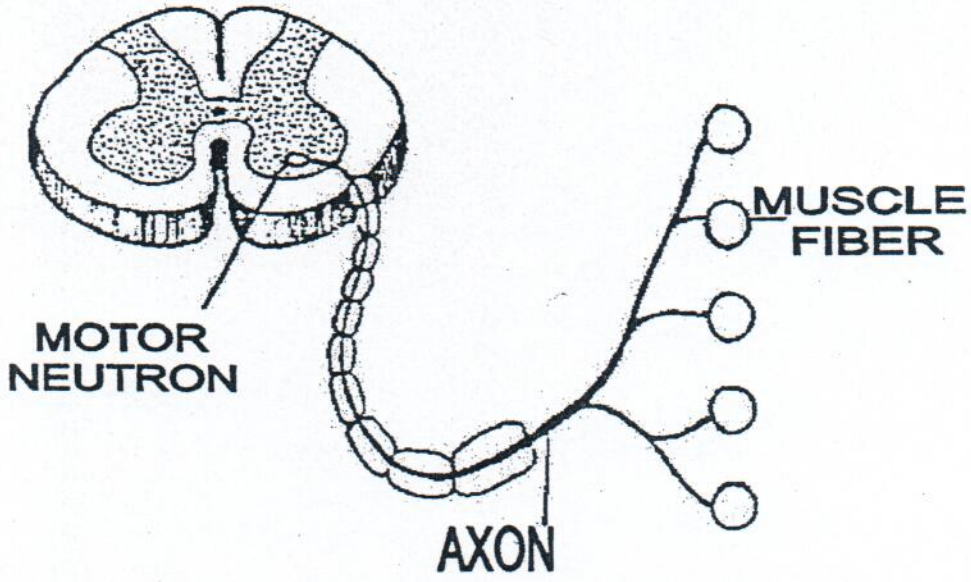

Figure - 1

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PROCEDURE:

1. Select a volunteer and make him/her understand about the procedure.
2. Put the ground electrode over the forearm after soaking with saline.
3. Clean the skin over the selected muscle.
4. Insert the sterile bipolar needle electrode into the muscle.
5. For surface electrode: Put the recording electrode over the belly of the muscle to be tested after lubricating with electrode jelly and reference electrode over a bony point at least 3 cm aplart.
6. Put the sweep run (continuous).
7. Ask the subject to relax to evaluate any resting activity.
8. Ask the subject to exert mild voluntary effort, then moderate effort while continue recording.
9. Change the sweep speed to 100 msec/cm and then ask the subject to exert maximum effort to determine interference patterns.

MOTOR CONDUCTION STUDY (MNCV):

1. Give assurance to the subject about a harmless short electric stimulation.
2. Adjust the sweep speed to 2 msec/cm.
3. Adjust stimulus duration to 0.2 msec and stimulus frequency to 1/sec.
4. Put some electrode jelly on the plate electrodes.
5. Then put the recording electrode over the thenar eminence for median nerve and over the abductor digiti minimi for the ulnar nerve and fix it with adhesive tape.
6. Fix the reference electrode 3 cm away and over a bony point.
7. Soak the stimulating electrode with saline and put it over the nerve to be stimulated.
8. Increase the stimulus intensity in steps. In each step, give stimulation manually by pressing the stimulation switch downward once or twice until a visible muscular contraction is seen and a reproducible compound muscle action potential (CMAP) is recorded in the storage oscilloscope (Figure – 2).
9. Store the CMAP in the first channel.
10. Change the stimulating site i.e. from elbow to wrist.
11. Record CMAP in the first channel.
12. Measure distance from elbow to wrist with the measuring tape.
13. Calculate the latencies of CMAPs by moving cursors.
14. Press L1 knob and then move the cursosr in trace 1 up to the origin of CMAP.
15. Press L2 knob and then move the cursosr in trace 2 up to the origin of CMAP.
16. Press Δ L and then press knob to obtain the conduction velocity in meter/sec. or calculate the MNCV by the following formula:

CALCULATIONS:

$$MNCV = \frac{\text{Distance}}{t_1 - t_2} = \text{m/sec.}$$

t_1 = latency at elbow

t_2 = latency at wrist

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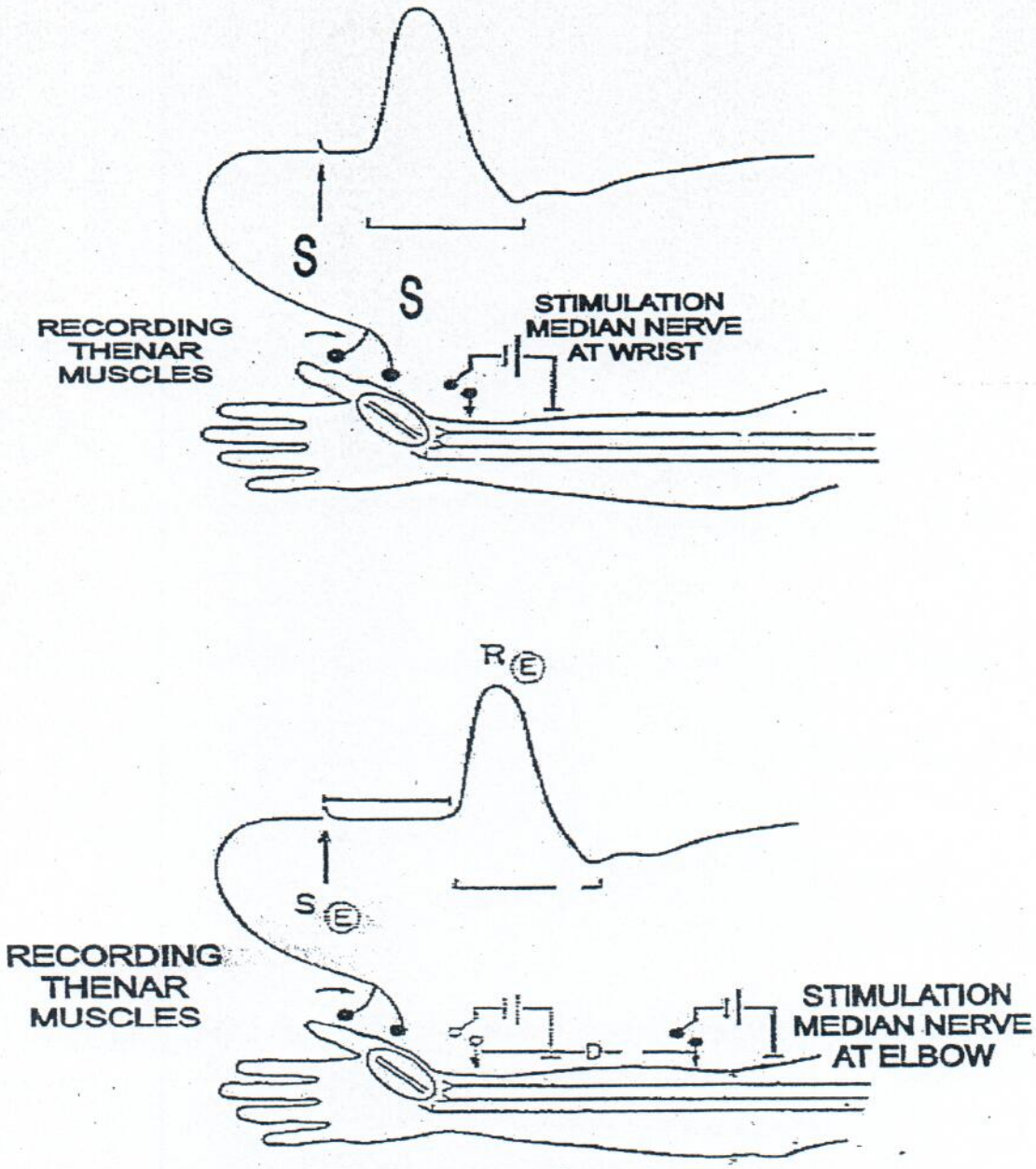
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RECORDING
THENAR
MUSCLES
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MEDIAN NERVE
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AT ELBOW

Figure - 2

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ANALYSIS:

EMG:

A. Spontaneous activity:

The skeletal muscle is silent at rest. Hence, spontaneous activity is absent.

In Neurogenic lesion or in active myositis, the following spontaneous activity is noted (Figure – 3)

1. Positive sharp wave: A small potentials of 50 to 100 μV, 5 to 10 msec duration with abrupt onset and slow outset.
2. Fibrillation potential: These are randomly occurring small amplitude potentials or may appear in runs. The audio-amplifier gives sounds, as if somebody listens sounds of rains in a tin shade house. These potentials are generated from the single muscle fiber of a denervated muscle, possibly due to denervation hypersensitivity to acetylcholine.
3. Fasciculation potentials: These are high voltage, polyphasic, long duration potentials, appear spontaneously associated with visible contraction of the muscle(Figure – 4). They originate from a large motor unit which is formed due to reinnervation of another motor unit from the neighboring motor unit (Figure – 5)

B. Analysis of a Motor Unit Potentials (MUP) (Figure – 6):

MUP	NORMAL	NEUROGENIC	MYOPATHIC
Duration msec	10 to 12	Longer	Shorter
Amplitude μV	300 to 500	Larger	Smaller
Phases	Biphasic/Triphasic	Polyphasic	May be Polyphasic
Interference* Pattern	Full	Partial	Full

- Interference pattern: In maximal voluntary effort, the number of MUPs are So many that the oscilloscope is completely filled up with them (Figure – 7).

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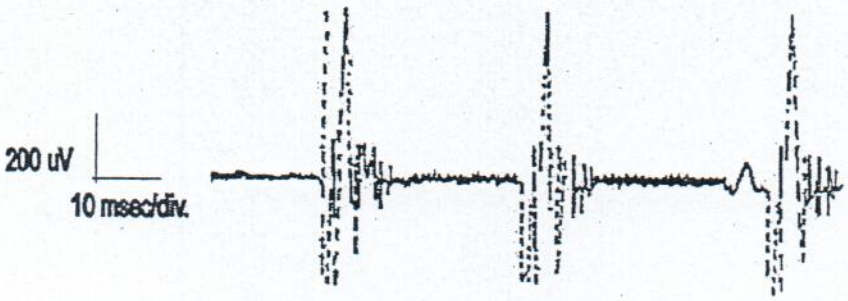
REINNERVATION BY COLLATERAL SROUTING



LONG DURATION POLYPHASIC
MOTOR UNIT POTENTIAL

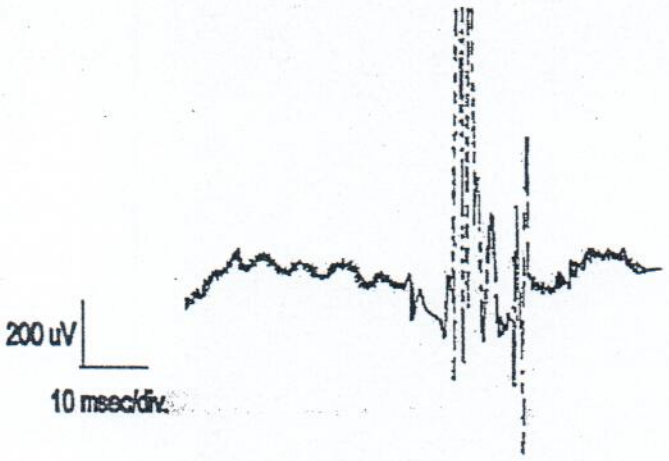


Figure - 4

REINNERVATION

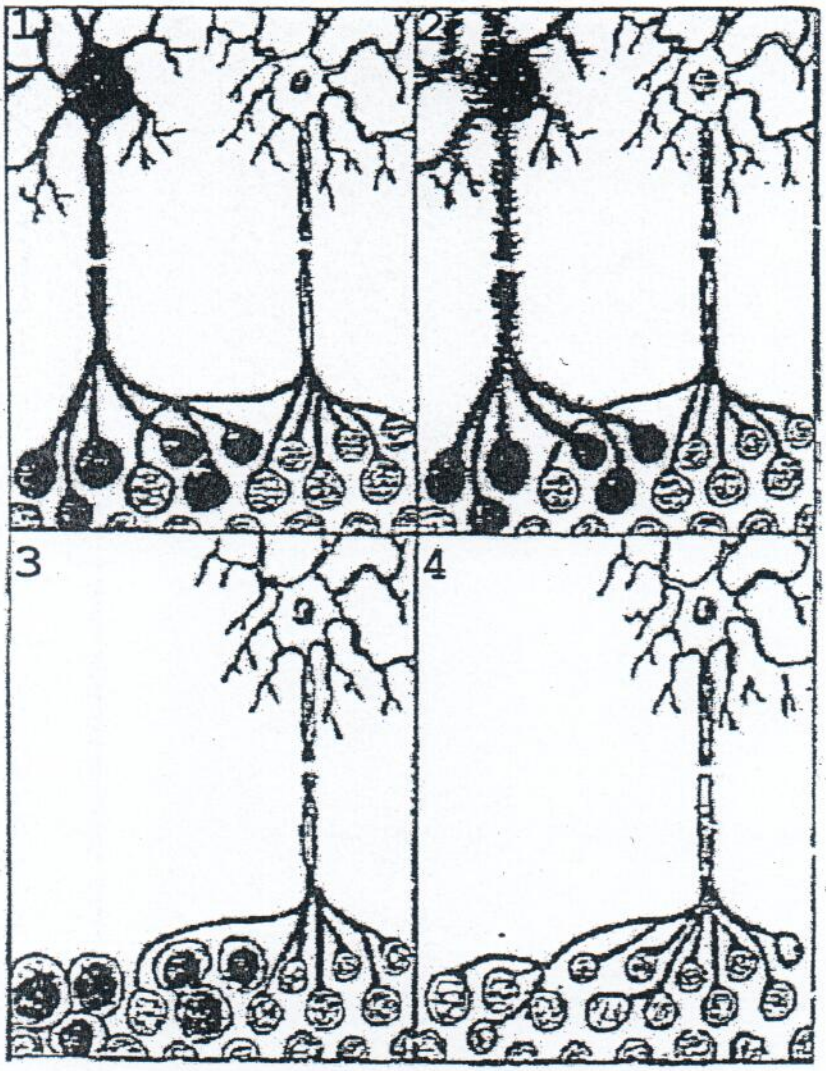


Figure - 5

COMPONENTS OF THE CMAP

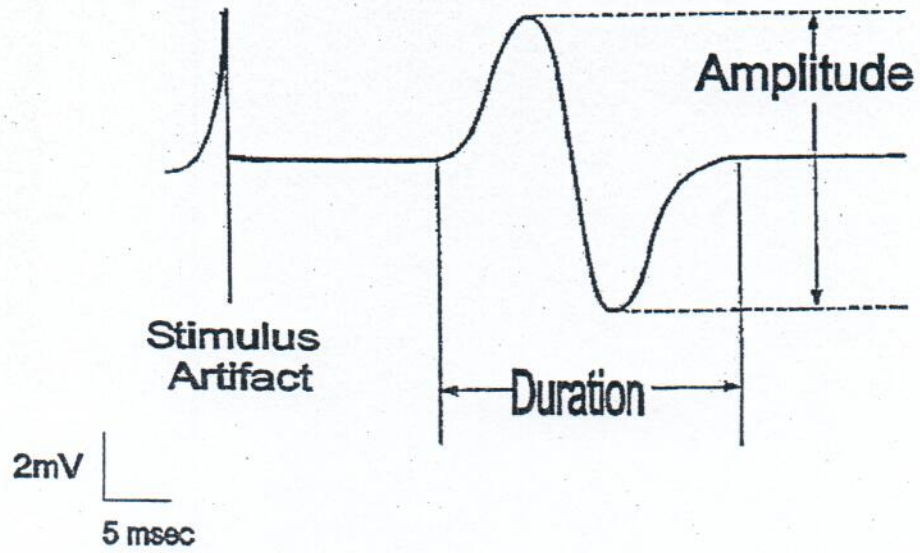


Figure -6

MOTOR UNIT POTENTIAL DURING MILD EFFORT

Figure -7

MOTOR UNIT POTENTIAL DURING MODERATE EFFORT

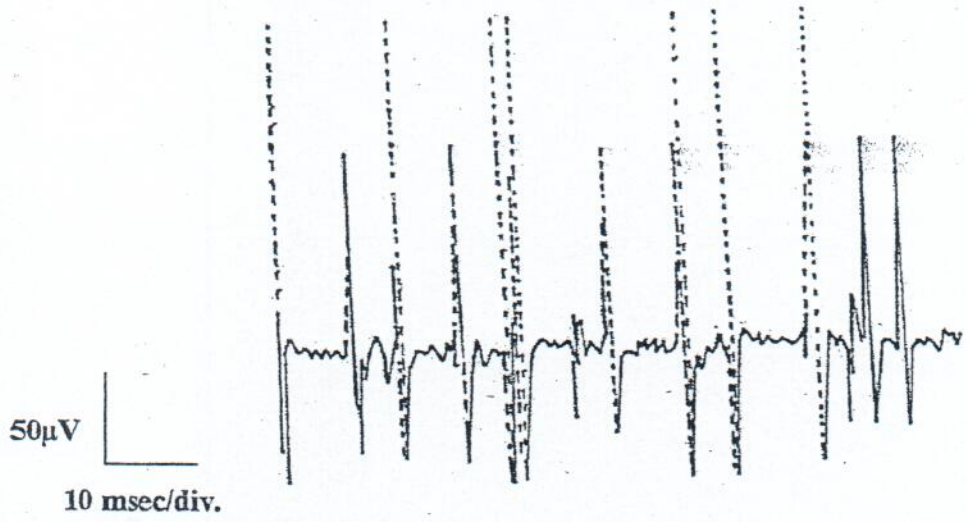


Figure -8

MOTOR UNIT POTENTIAL
AT FULL VOLUNTARY EFFORT

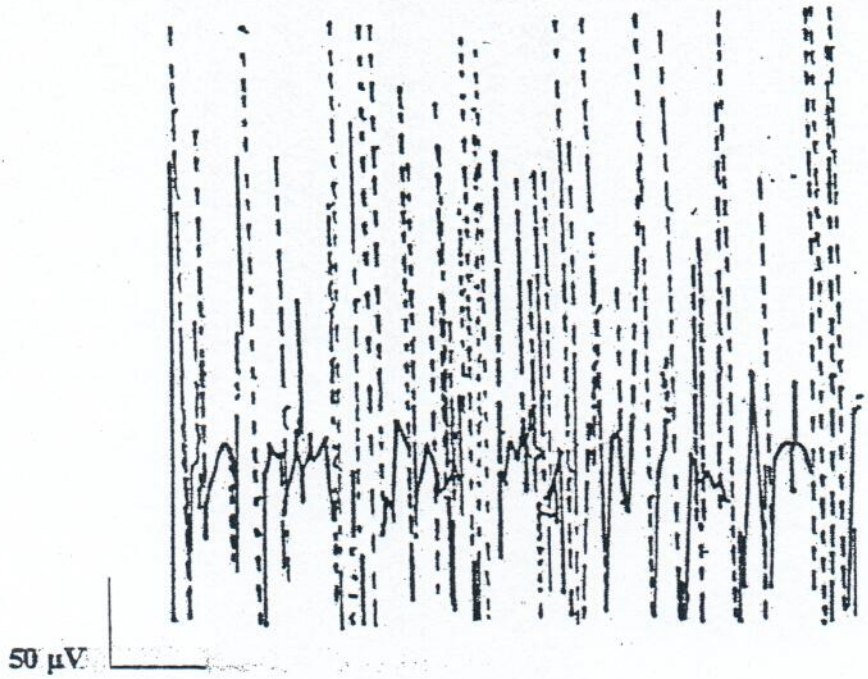
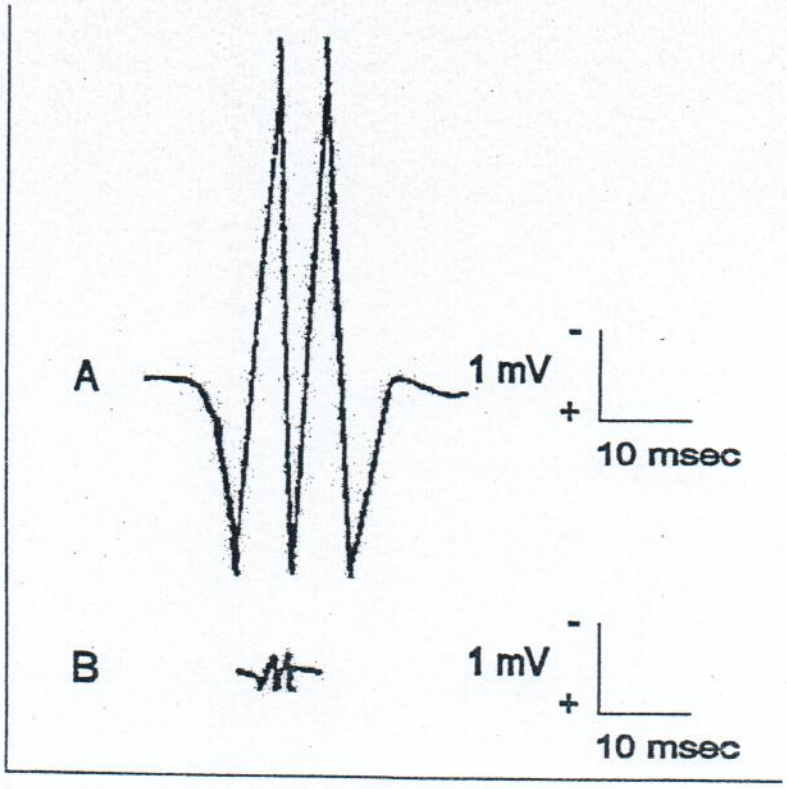


Figure - 9



Typical MUAP Characteristics in Myopathic, Neuropathic and Normal Muscle

	MYOPATHY	NORMAL	NEUROPATHY
Duration	< 3 msec	3 - 16 msec	> 16 msec
Amplitude	< 300μV	300 μV	> 5 mV
Configuration	Polyphasic	Triphasic	Polyphasic

H - reflex

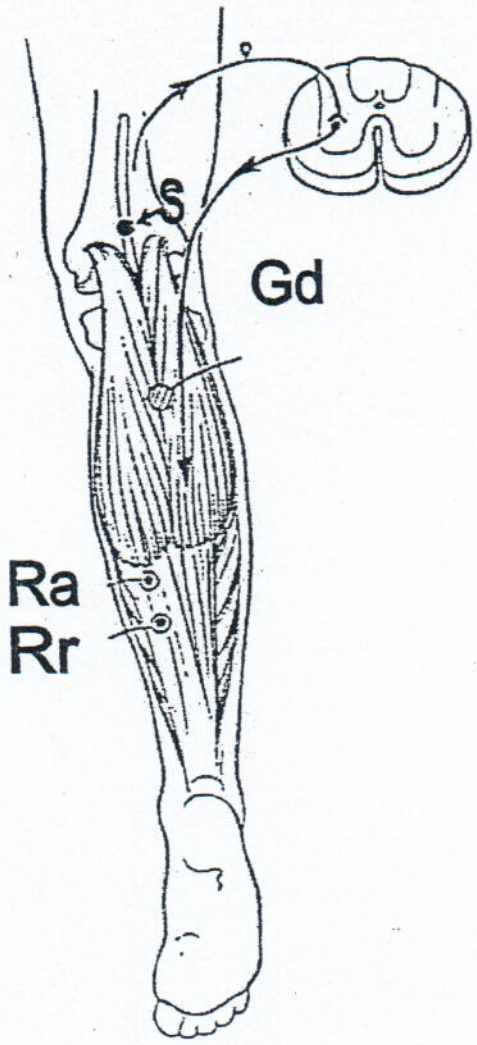


Figure -10

H – REFLEX AND F - WAVE

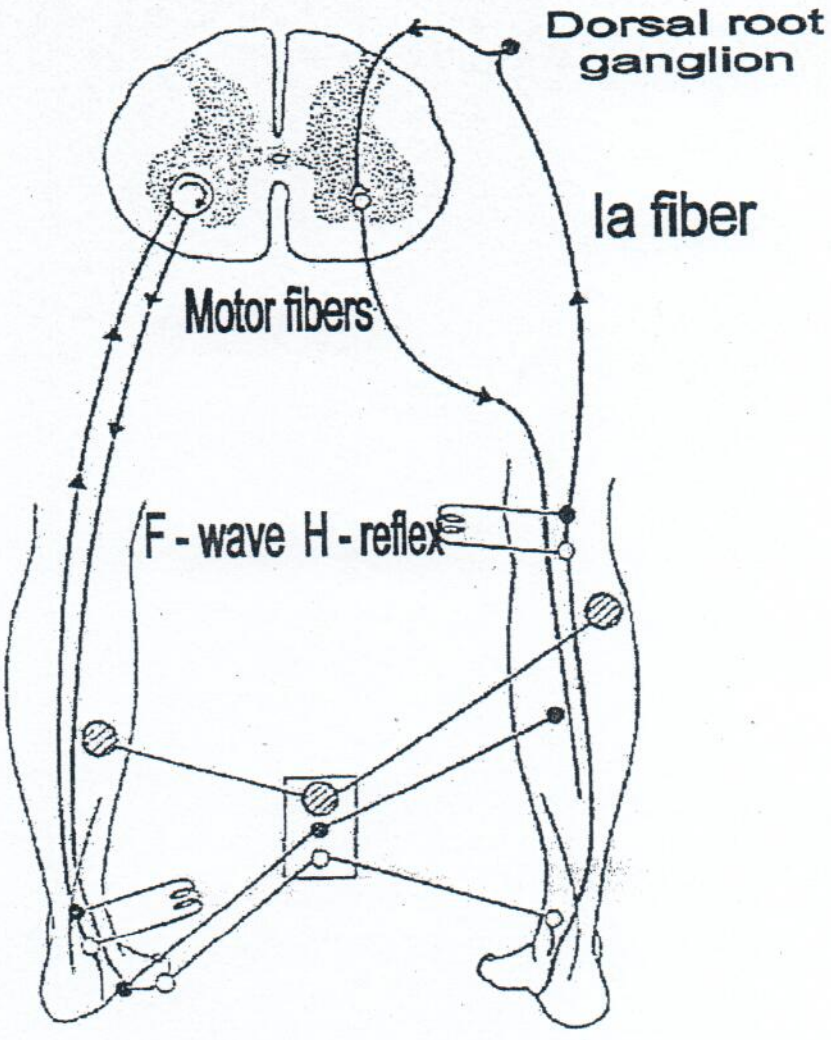


Figure -11

QUESTIONS

1. What is Electromyography?

2. Discuss EMG changes in lower motor neuron lesion.

3. What is motor unit and motor unit potentials (MUPs)?

4. Discuss MUPs changes in myopathy?

5. What are the physiological and clinical implortance of measuring nerve conduction in human beings?

Practical 132

Names:

Define the following:

1. EMG

2. Single Motor Unit

3. Positive Sharp Wave

4. Fibrillation Potential

5. Fasciculation Potential

CHARACTERISTIC ELECTROMYOGRAPHIC WAVEFORMS

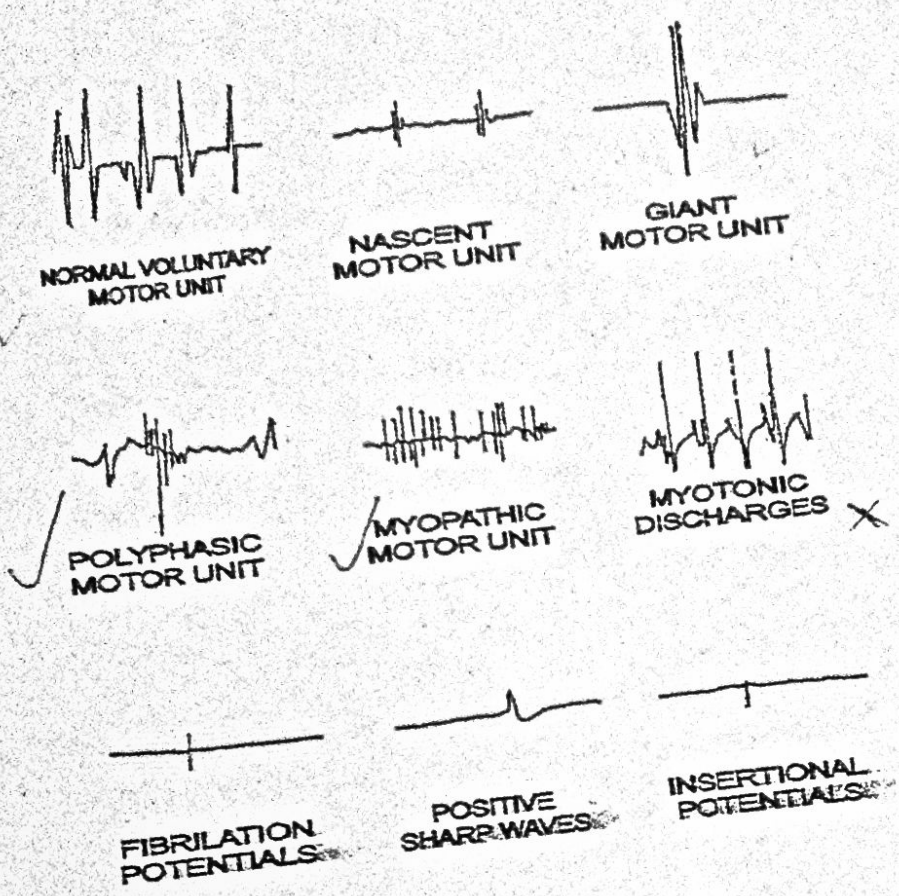


Figure - 3