ELECTRO MYOGRAPH (EMG)

Electromyograph is an instrument used for recording the electrical activity of the muscles. Also useful for the study of several aspects such as neuromuscular function, neuromuscular condition, extent of nerve lesion, reflex response and diagnosing the muscular diseases.

Electrodes Used:

- EMG is usually recorded by using surface electrodes or needle electrodes, which are inserted directly into the muscle.
- Surface electrodes or needle electrodes pickup the potentials produced by the contracting muscle fibers.
- Surface electrodes are from Ag-Ag CI and are in disc shape.
- The surface of the skin is cleaned, and electrode paste is applied.
- The electrodes are kept in place by means of elastic bands. In this way the contact impedence is reduced below 10kΩ.

EMG Recording Techniques:

The following block diagram shows the typical set-up for EMG recording.

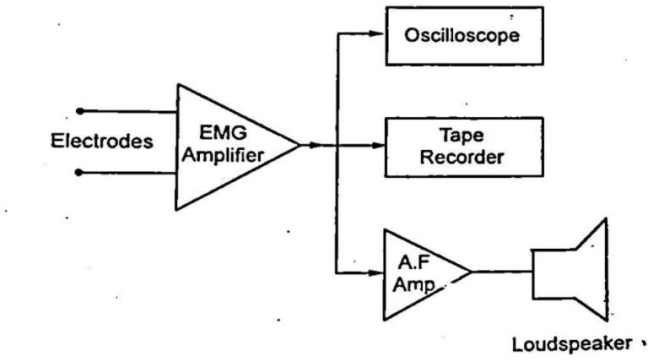

Fig: Block diagram of a typical set up for EMG recording

EMG recording instruments includes on audio amplifier and loudspeaker to permit the operator to hear the crackling sounds of the EMG. This audio presentation is helpful in the placement of needle or wire electrodes into a muscle. The oscilloscope displays EMG waveforms.

The tape recorder is used to facilitate playback and study of EMG sound waveforms at a later convenient time. The waveform can also photographed from the CRT screen by

using a synchronized camera. The amplitude of the EMG signals depends upon type and placement of electrodes used, degree of muscular exertions.

The surface electrodes pick up many overlapping spikes and produce an average voltage from various muscles. The needle electrode picks up voltage from a single muscle fiber. EMG signals have range from 0.1 to 0.5 mv with frequency from 20HZ to 100KHZ, in audio range. Such high frequency signals cannot be recorded on the conventional pen records. Therefore, they displayed on CRT screen, using photographic recording.

A little sensitive paper moves over the recording cathode ray tube and the image is produced on that paper for continuous recording the paper speed is about 5 to 25 cm/sec. Amplifier should have the uniform frequency response with range from 10Hz to 1KHz with high. CMRR and input impedance greater than 10MΩ.

Measurement of Conduction Velocity:

- The measurement of conduction velocity in motor nerve is used to indicate the location and type of nerve lesion.
- Nerve function is examined directly at various segment by means of stimulating it with brief electric shock having pulse duration of 0.2 – 0.5ms.
- Latency is defined as the elapsed time between the stimulating impulse and the muscles action potential.

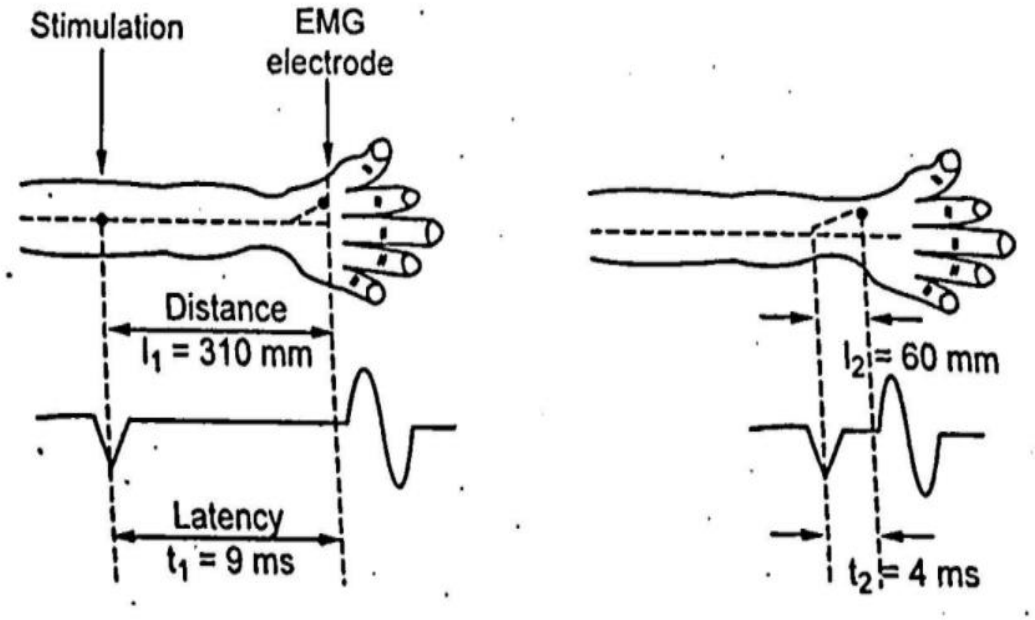

Fig: Determination of conduction velocity in a motor nerve

Procedure:

- EMG electrode and stimulating electrode are placed at two points on the skin separated by a known distance l_1.
- A brief electric pulse is applied through the stimulating electrode.
- When excitation reaches the muscle, all nerve fibers are stimulated at the same time and the conduction velocity is same in all nerve fibers, there is synchronous activation of muscle fiber.
- The action potential of muscle is picked up by the EMG electrode and displayed on the oscilloscope along with the stimulating impulse. Therefore, latency t_1 is measured.
- By placing electrodes in another position with separation distance as l_2 ($<l_1$) meters, latency t_2 is measured.

$$\text{The Conduction Velocity, } V=\frac{l1-l2}{t1-t2}$$

- The conduction velocity in peripheral nerve is normally 50m/s. In case of disorder in nerve conduction, conduction velocity is reduced less than 40m/s.

Application of EMG:

- Used in Electrophysiological testing
- Used in Neurology