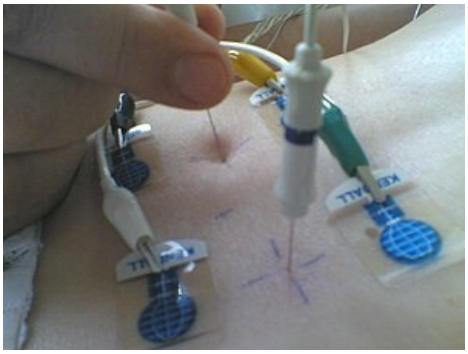
# Electromyography

Electromyography is an electro-diagnostic method that is used primarily to **diagnose** disorders of the **neuromuscular system**. The essence is the measurement of electrical potentials created as a result of skeletal muscle activity. Surface electrodes that sense the action potential of a large number of motor units and needle electrodes that sense a small number of MU (motor units) are used.

## Nerve conduction studies



Needle conventional EMG of paravertebral muscle

A conduction study (nerve conduction examination) examines the conductivity parameters of peripheral nerves. It is usually performed with surface electrodes and is therefore limited to those nerves that lie closer to the surface. Motor, sensitive and mixed nerves can be examined. We get information about maintaining nerve continuity and the speed of nerve fiber conduction. The basis of the examination is nerve stimulation and potential registration.

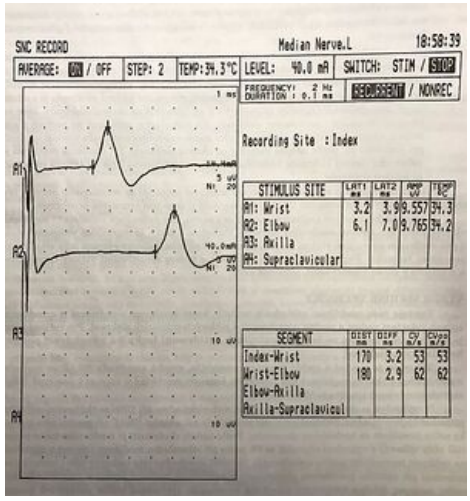
### Stimulation

A **stimulator and a stimulation electrode** are needed to stimulate the nerve.

The **stimulator** uses **direct current (https://en.wikipedia.org/wiki/Direct_current)**, while the intensity of the stimulus is regulated in mA - usually up to 80-100 mA for examination of the motor nerve and up to 30 mA for examination of the sensitive nerve. The voltage varies according to the resistance (I = U / R).

The **stimulation electrode** has two poles: a negative cathode and a positive anode. Depolarization of the nerve membrane occurs below the cathode. During bipolar stimulation, both poles are placed along the nerve - cathode closer to the sensing electrode. Usually the two poles are 2-3 cm apart.

### CMAP registration




Physiological finding of sensitive part of n. medianus

The motor electrode registration electrodes read the response from many muscle fibres. The active sensing electrode is placed above the muscle abdomen, the reference is placed above the tendon. A conductive gel is applied between the electrode and the skin. Needle registration electrodes are used only rarely. The evaluated parameters are **amplitude, summation** muscle action potential latency (CMAP) and nerve **conduction velocity**.

### Sensitive potential registration

The registration electrodes in the examination of the sensitive nerve in the **orthodromic technique** (measures the conduction of the impulse from the site of distal stimulation to the site of proximal registration) are placed above the course of the nerve. We use surface ring electrodes in the **antidromic technique** (measures the conduction of the impulse from the site of proximal stimulation to the site of distal registration). The evaluated parameters are nerve conduction **velocity** and action potential **amplitude**. For all examinations, it is necessary to use a **ground electrode**, which is placed between the stimulation and sensing electrode.

### Findings

- We can register the following phenomena on a normal EMG:
  - **M wave** - action potential of the muscle caused by direct conduction of el. impulse nerve
  - **F wave** - a wave with a longer latency than M, It is caused by retrograde conduction of the AP by a motor axon to the body of the neuron and subsequent new depolarisation leading back to the periphery.
  - **H reflex** - the wave with the highest latency, It is caused by a monosynaptic spinal reflex activated by depolarisation of sensitive fibres in the nerve.
- Pathological findings:
  - **Demyelinating** lesions - manifested by slow conduction
  - **Axonal** lesions - (ie loss of axons in the nerve) is manifested by a reduced amplitude of the M wave. The reason is the smaller number of active muscle fibers. Speed is unchanged.
  - Myasthenia gravis - with repeated stimulation there is a decrease in amplitude by 10% or more (acetylcholine depletion).

# Needle EMG

Needle EMG captures the bioelectric potentials of skeletal muscle using needle electrodes embedded in the muscle.

### Needle electrode

A concentric electrode consisting of a stainless steel sheath with a diameter of about 0.3 mm is commonly used, inside which a silver or platinum wire with a diameter of about 0.1 mm is placed. At the end of the electrode, the exposed wire forms an oval surface that senses potentials from its immediate vicinity. These are then amplified.

Again, a ground electrode must be used. The examining physician orients the needles using the nature of the sound from the speaker.

### Evaluation of needle EMG

The evaluated parameters are **advertising activity, spontaneous activity and free activity**.

The **insertion activity** is induced by mechanical irritation of the muscle fibers with the needle tip. It is caused by the discharge of tension on the membranes when the muscle fiber is broken. It is reduced by atrophy or higher fat content in the muscle. In myotonia, on the contrary, it is increased.

We do not register **spontaneous activity** physiologically in relaxed muscle. If the innervation of the muscle is damaged (peripheral lesion of the motoneuron), we register spontaneous discharges of muscle fibers - fibrillation.

In **free contraction**, we register the action potentials of motor units (MUAP - motor unit action potential, the sum of the action potentials of individual muscle fibers of a motor unit) involved in the contraction of a muscle at a given force. The strength of the contraction is determined by the number of motor units involved and the pulse frequencies of the motoneurons. We investigate with a small force of contraction, when a small number of motor units is involved. At high power, the individual registered pulses could not be distinguished from each other. We record a larger number of connected motor units than the standard during myopathies, and a smaller number during muscle deinervation.

In particular, the **amplitude** or the **number of phases** and the **duration** are evaluated. As the force of the contraction increases, the pattern gradually thickens to the image of the so-called **interference pattern**, the amplitude of which is physiologically in the range of 1-5 mV. The pathology is failure to achieve full interference or change amplitudes.

# Electromyograph

The basic components of the electromyograph are stimulation and registration electrodes, ground electrode, stimulator, amplifier, speaker and monitor.

# Links

### Související články[upravit | editovat zdroj]

- Electrocardiography
- Electroencephalography

### Source

- MUDr. Jaromír Šrámek (Formol)

### References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## Recommended literature

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