Al-Mustaqbal University university
Department of Biomedical Engineering

جامعة المستقبل
AL MUSTAQBAL UNIVERSITY

ELECTROMYOGRAPHY (EMG)

Medical Measurements Lab 1

Fourth Stage

Supervised by

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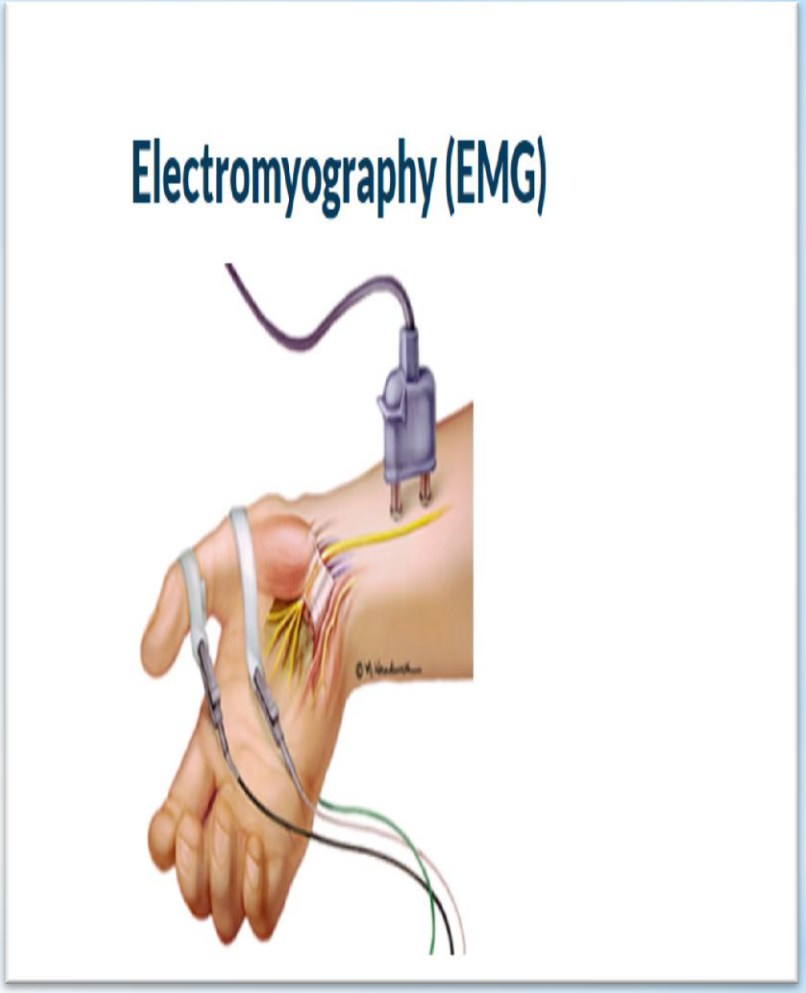
Electromyogram(EMG) Features

- Electromyogram (EMG) is recorded by an electromyography device, which measures the muscle's electrical potential.
- The central nervous system consisting of the brain, spinal cord and peripheral
- nerves controls the action of the muscle fibers that typically results in movements.
- Muscle is composed of specialized cells that are capable of contraction and relaxation and is controlled by simulations from innervated motor units (neurons).



Why we are study Electromyogram(EMG)

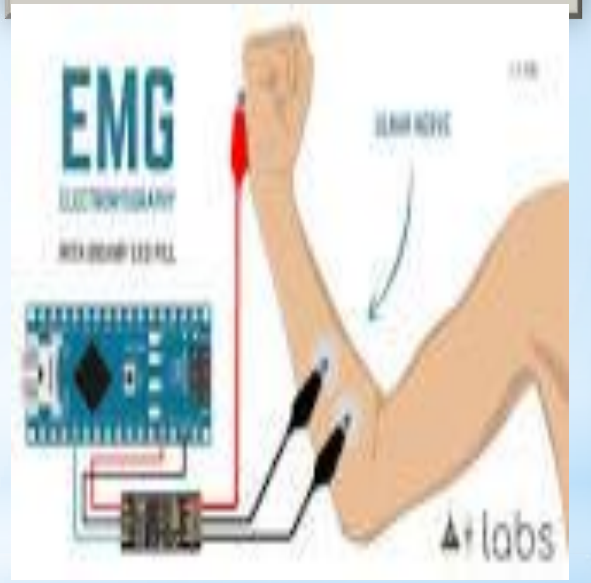
- **Electromyography (EMG) is a valuable medical and scientific tool used for several important purposes:**

- Diagnosis of Neuromuscular Disorders
- Assessment of Muscle Function
- Biofeedback and Rehabilitation
- Prosthetics and Assistive Devices
- Sports Science and Ergonomics
- Neurological Research
- Monitoring during Surgery

Mechanism of EMG

- Electromyography (EMG) is a diagnostic procedure that evaluates the health condition of muscles and the nerve cells that control them.
- These nerve cells are known as motor neurons
- They transmit electrical signals that cause muscles to contract and relax.
- An EMG translates these signals into graphs or numbers.
- An EMG uses tiny devices called electrodes to transmit or detect electrical signals.

- EMG results can reveal nerve dysfunction, muscle dysfunction or problems with nerve to muscle signal transmission



Muscle Types

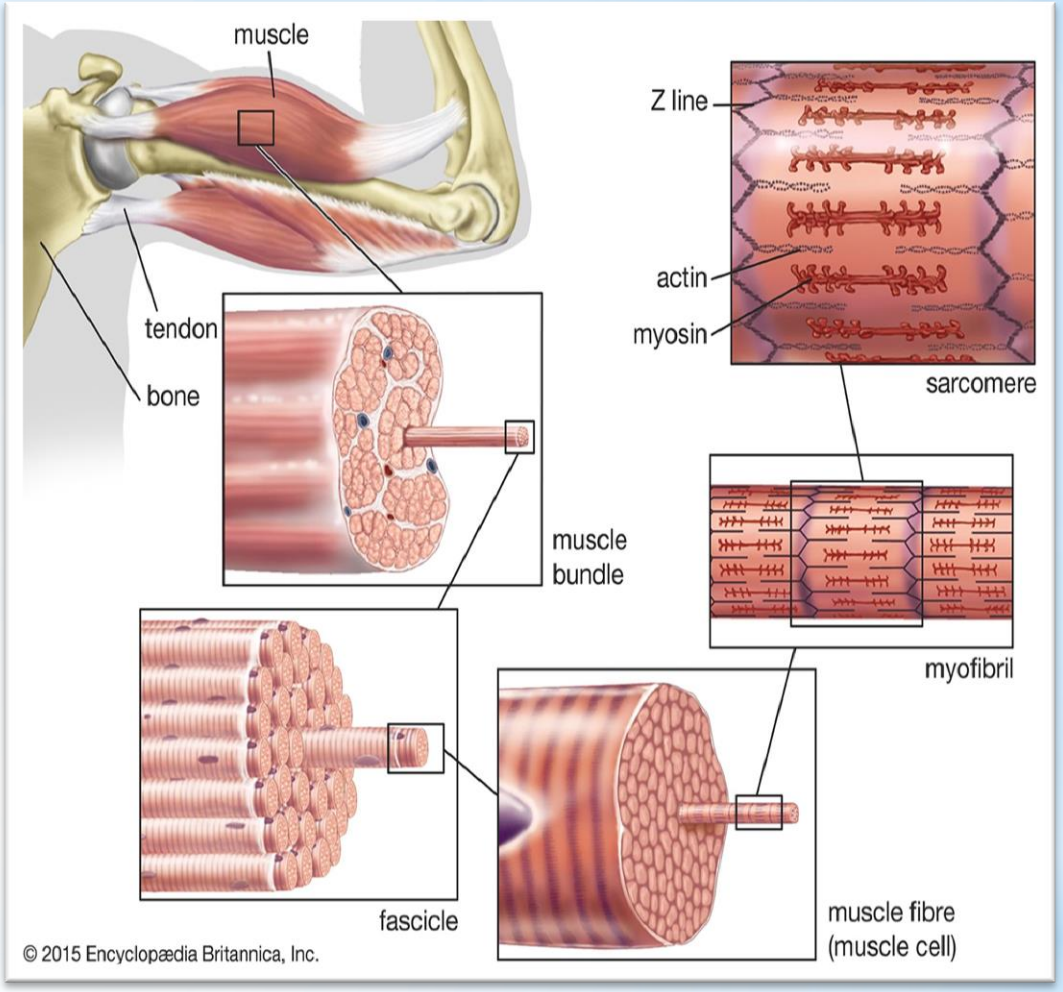
- Skeletal muscle, attached to bones, is responsible for skeletal movements. The peripheral portion of the central nervous system (CNS) controls the skeletal muscles

- Smooth muscle, found in the walls of the hollow internal organs such as blood vessels, the gastrointestinal tract, bladder, and uterus, is under control of the autonomic nervous system.

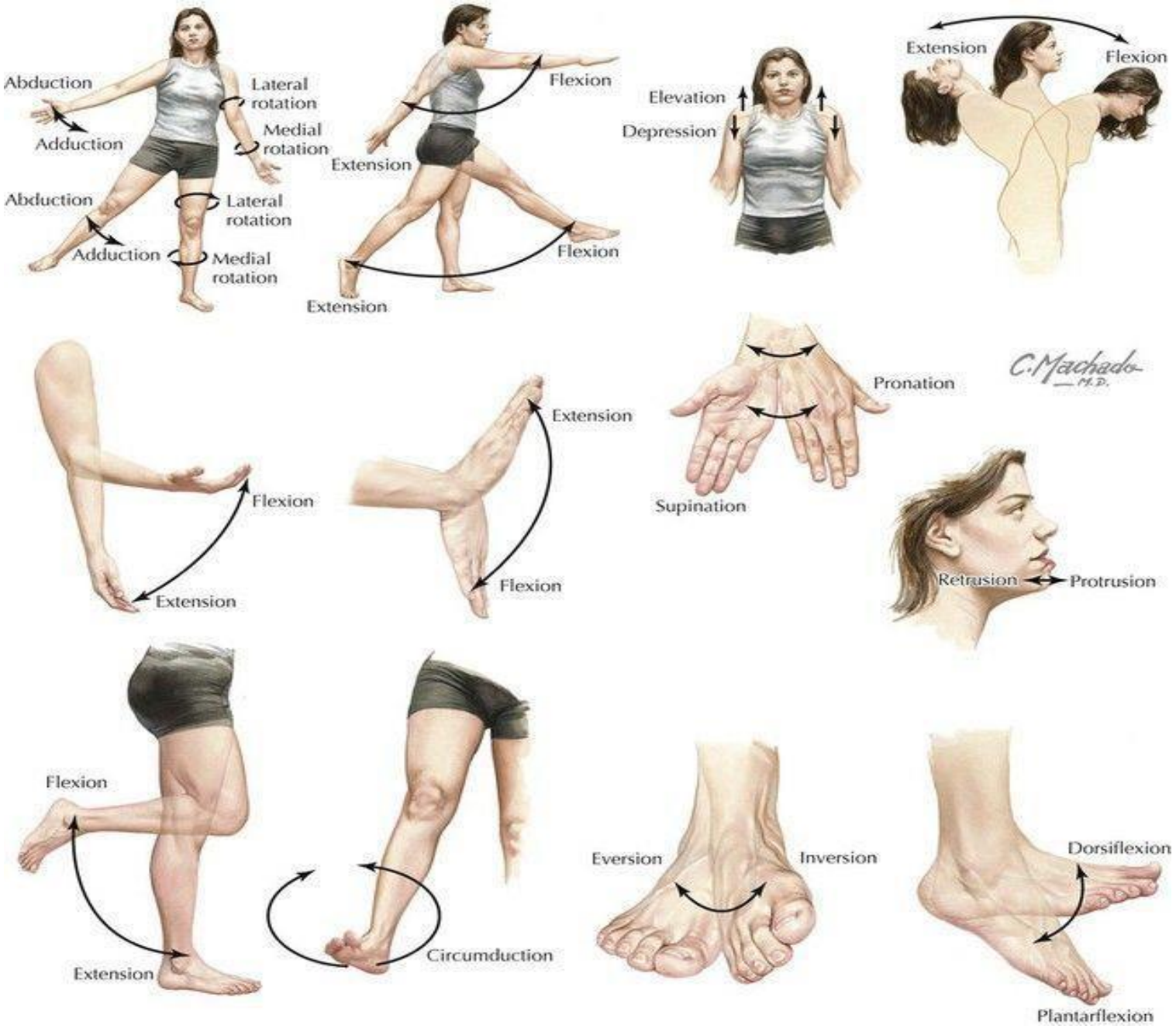
- Cardiac muscle, found in the walls of the heart, is also under control of the autonomic nervous system. The cardiac muscle cell has one central nucleus, like smooth muscle, but it also is striated, like skeletal muscle

Properties of Skeletal Muscle

- The best known feature of skeletal muscle is its ability to contract and cause movement of Skeletal
- Muscles act not only to produce movement but also to stop movement, such as resisting gravity to maintain posture.
- Muscles also prevent excess movement of the bones and joints, maintaining skeletal stability and preventing skeletal structure damage or deformation.
- Skeletal muscles also protect internal organs (particularly abdominal and pelvic organs) by acting as an external barrier or shield to external trauma

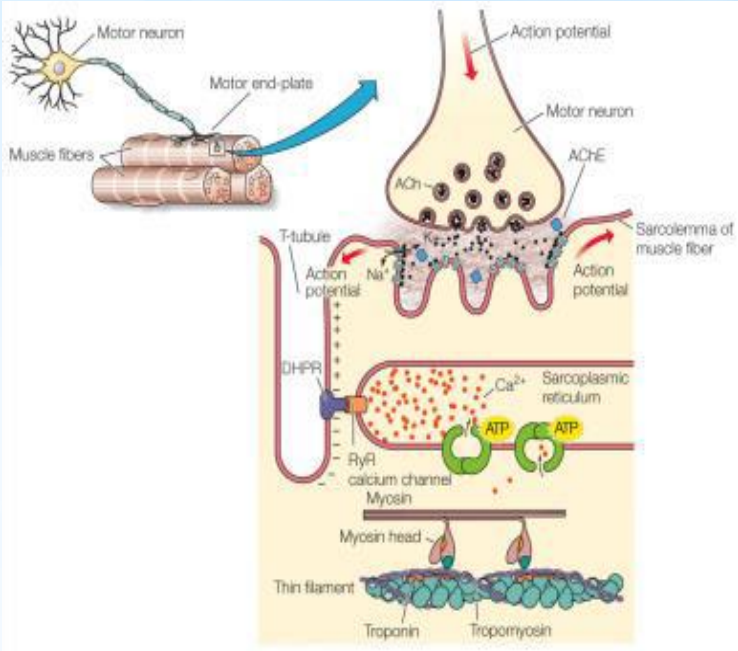


TYPES OF MUSCLE BY ACTION



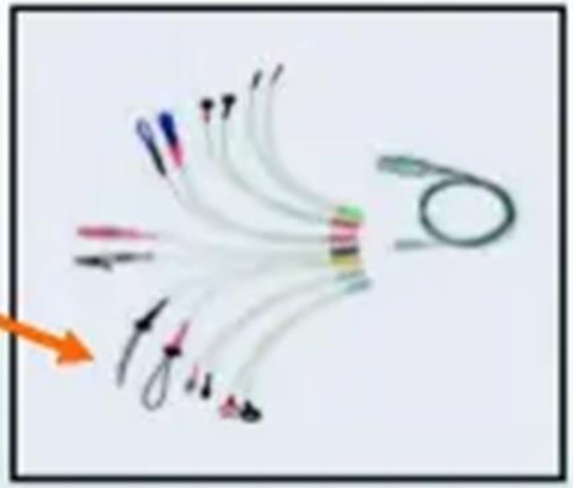
ORIGIN OF THE EMG SIGNAL

To create voluntary muscle movement, an action potential must travel from initiation in the brain to the target muscle. It travels from the brain, into the spinal cord, and then to an efferent nerve which synapses on the target muscle fiber. Each muscle fiber is innervated by a single neuron. However, one neuron innervates several hundred muscle fibers. The number of muscle fibers innervated by a single neuron is called the innervation ratio. A lower innervation ratio corresponds to finer control of muscle forces. The connection between a nerve and a muscle is called the neuromuscular junction. The action potential propagates down the motor neuron and causes the release of acetylcholine (Ach), a neurotransmitter, at the neuromuscular junction. As Ach is released, it travels across the neuromuscular junction and causes Ach gated receptors on the muscle fiber to open. When these gates open, sodium ions flow into the cell depolarizing it. This potential change activates voltage dependent sodium channels resulting in an action potential that propagates throughout the muscle fiber. The action currents create potentials in the extracellular space that are recorded as EMG.

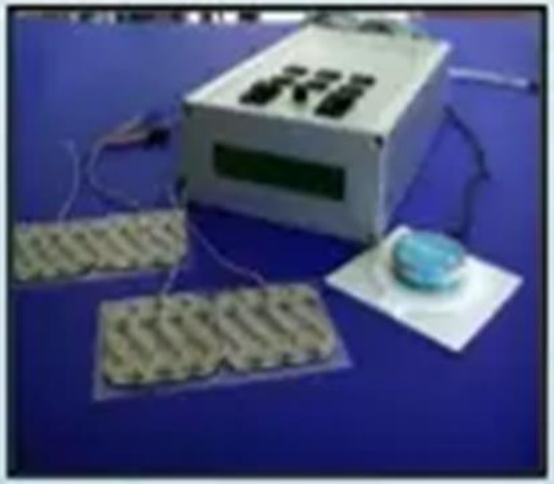


TYPE OF EMG ELECTRODES

Intramuscular
- Needle Electrodes

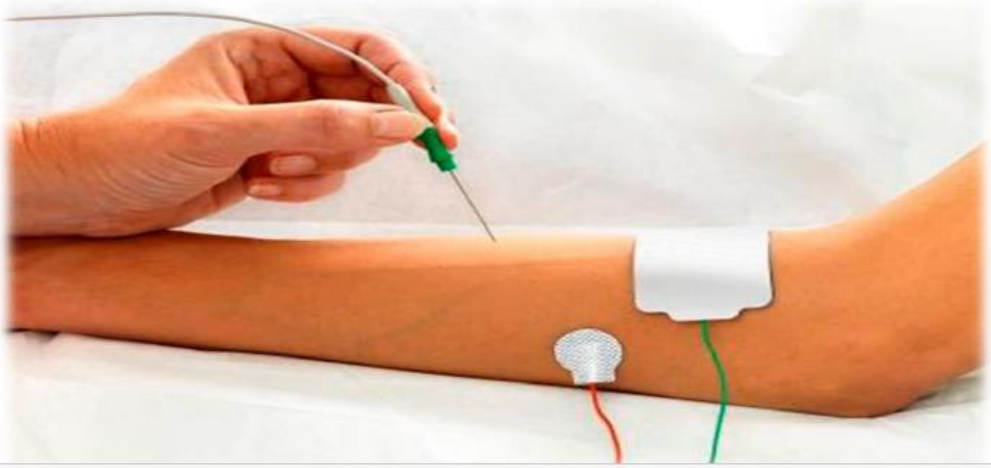


Extramuscular
- Surface Electrodes



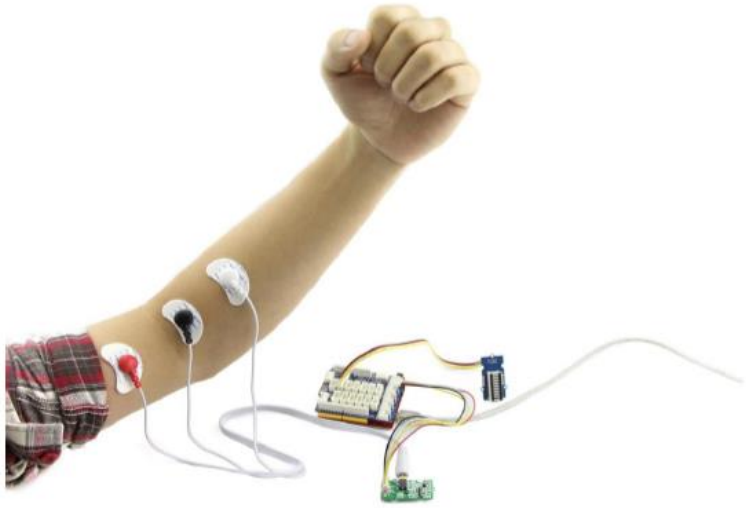
INTRAMUSCULAR ELECTRODES

- Needle electromyography (EMG) is the technique of recording and analyzing the electrical signals derived from individual muscle fibers of motor units, at rest and during voluntary contraction, using a needle recording electrode inserted into the muscle.
- Needle EMG entails inserting a needle electrode into a muscle, recording and amplifying the electrical signals generated from resting or contracting muscle fibers, and interpreting the signals to determine the function of the muscle fibers and motor units.



EXTRAMACULAR ELECTRODES

- **Surface electrode** measures the potential available from the surface of the skin. It senses the signal from heart, brain and nerves. Larger surface electrodes sense the ECG signals. Smaller surface electrodes sense the EMG and EEG signals.

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