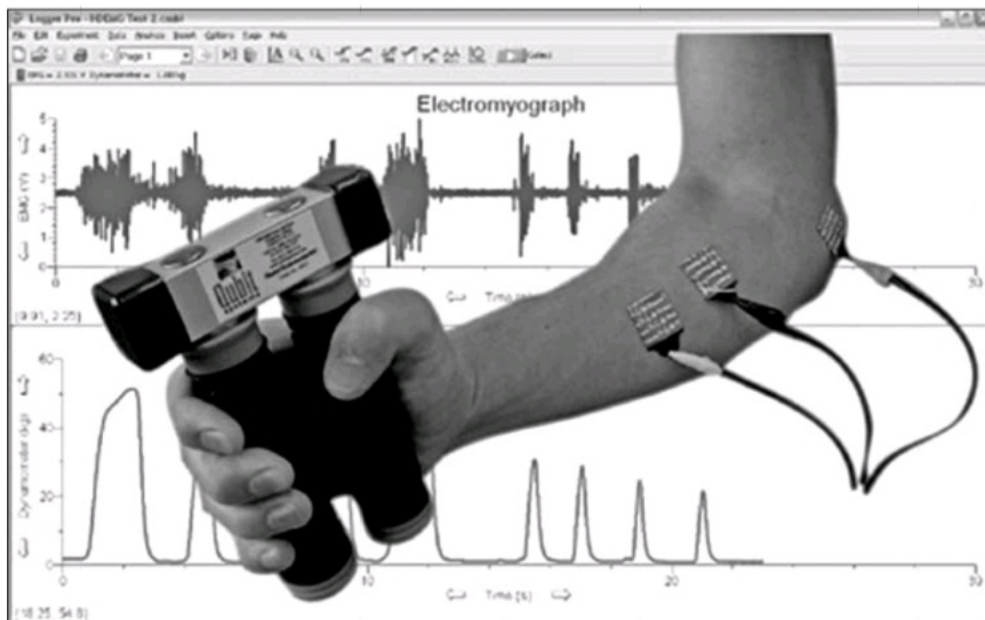


## Chapter 1

# Electromyography (EMG)



**Electromyography (EMG) is a technique for evaluating and recording the activation signal of muscles**

*Section I: Before you read*

**A. Key words:**

Attempt understanding the meaning of the new words in the following sentences.

widespread (adj.)	The plan received <b>widespread</b> support throughout the country.
insert (v.)	They <b>inserted</b> a tube in his mouth to help him breath.
evaluate (v.)	We need to <b>evaluate</b> the effectiveness of the method.
oppose (n.)	They would <b>oppose</b> changing the law
elicit (v.)	I could <b>elicit</b> no response from her
impulse (n.)	He had a sudden <b>impulse</b> to stand up and sing
accurate (adj.)	He gave us an <b>accurate</b> information about the accident
contract (v.)	The heart muscles <b>contract</b> to expel the blood.
judge (v.)	We can't <b>judge</b> people by their appearances
retract (v.)	The undercarriage was fully <b>retracted</b> .

**B. Word Building:** Using prefixes; intra, a(b)(bs), un, bio, in you can change the meaning of many adjectives/nouns by adding a prefix.

prefix	meaning	Examples
Intra-	Within, inside	Intramuscular, intranet
ab-, a-, abs-	Apart, away from	Abnormal, abscission, abduct
Un-	Not, the opposite of	Unable, untrue, unconscious Un-Iranian activities
Bio-	Life, living things	Biomedical, biology, biophysics
In-	Into-within	Innervate, innervating, introvert

**C. Think about the following questions and then attempt answering them.**

1. What is an EMG?
2. What are the different types of EMG?
3. What is the use of EMG?
4. What is a motor unit and how does it work?

Section II: Reading

# Electromyography

- 1 **Electromyography (EMG)** is a technique for evaluating and recording the activation signal of muscles. EMG is performed using an instrument called an electromyogram, to produce a record called an electromyogram. An electromyogram detects the electrical potential generated by muscle cells when these cells contract, and also when the cells are at rest.
- 2 There are two kinds of EMG in widespread use: needle (intramuscular) EMG and surface EMG. To perform intramuscular EMG, a needle electrode (Figure 1-1) is inserted through the skin into the muscle tissue. A trained professional (most often a physiatrist, neurologist, physical therapist, or chiropractor) observes the electrical activity while inserting the electrode in to the muscle. (Figure 1-2)
- 3 The insertion activity provides valuable information about the state of the muscle and its innervating nerve. Normal muscles, at rest, make certain normal electrical sounds when the needle is inserted into them. Abnormal spontaneous activity might indicate some nerve and/or muscle damage. Then the patient is asked to contract the muscle smoothly. The shape, size and frequency of the resulting motor unit potentials is then judged. Then the electrode is retracted a few millimeters, and again the activity is analyzed until at least 10-20 motor units have



Figure 1-1. Needle electrode

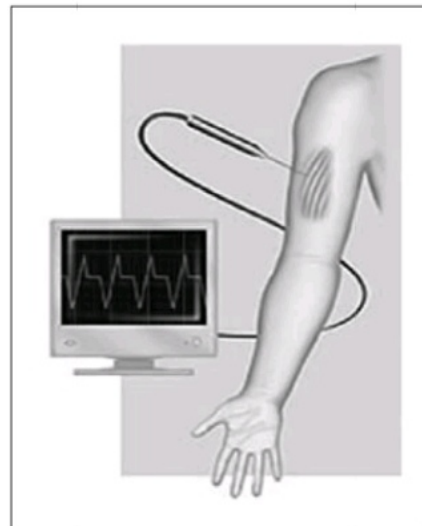


Figure 1-2. needle electrode is inserted in to the muscle tissue and the resulting signal is processed and demonstrated by the computer.

been collected. Each Needle electrode can record only a very local activity of the whole muscle. Because skeletal muscles differ in the inner structure, therefore, the electrode has to be placed at various locations to obtain an accurate study.

- 4 Intramuscular EMG may be considered too invasive or unnecessary in some cases. Instead, a surface electrode may be used to monitor the general picture of muscle activation, as opposed to the activity of only a few fibers as observed using a needle (Figure 1-3). This technique is used in a number of settings; for example, in the physiotherapy clinics, muscle activation is monitored using surface EMG and patients have an auditory or visual stimulus to help them know when they are activating the muscle. (Figure1-4)



Figure1-3. Surface electrode

- 5 One of the most usual applications of EMG signal is to analyze the motor unit action potential (MUAP). A motor unit is defined as a motor neuron and all of the muscle fibers it innervates. When a motor unit fires, the impulse (called an action potential) is carried down the motor neuron to the muscle. The area where the nerve contacts the muscle is called the neuromuscular junction, an action potential is elicited in all of the innervated muscle fibers of that particular motor unit. The sum of all this electrical activity is known as a motor unit action potential. This electrophysiological activity of multiple motor units is the signal typically evaluated during an EMG. The composition of the motor unit, the number of muscle fibers per motor unit, the metabolic type of muscle fibers, and many other factors affect the shape of the motor unit potentials in the electromyogram.

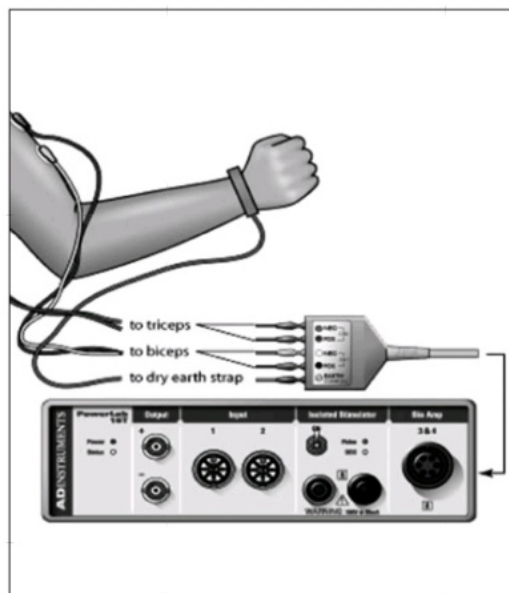


Figure1-4. Surface electrodes are placed on the skin of the limb and the activity of the muscle is recorded.

*Robertson, D.G.E & Hamill, J (2004), Kaj-ge Henneberg (2006)*

Section III: After you read**A. Comprehension activities**

**a. Read the statements below and write T for true and F for false statements. Then justify your option by writing the number of paragraph in the passage that helped you.**

1. ----/---- Electromyography is a technique for evaluating and recording of the activation signal of heart muscles.
2. ----/---- An electromyography discovers the electrical potential produced by muscle cells in contraction.
3. ----/---- To perform surface EMG, a needle electrode is put through the skin into the muscle tissue.
4. ----/---- To obtain an exact study, the electrode has to be placed at different spots.
5. ----/---- A neuromuscular junction is the area where the nerve contracts the muscle.
6. ----/---- A great number of factors influence the form of the motor unit potentials in the electromyogram

**b. Analyze the following statements and mark the best choice that completes each statement.**

1. EMG is performed using an instrument called .....
- a. electromyography      b. electromyograph      c. electromyogram      d. MUAP
2. The electrical potential generated by muscle cells when they are in/at .....
- a. rest      b. contraction      c. a &b      d. neutral
3. What provides valuable information about the state of the muscles and their innervating nerves is .....
- a. insertion activity      b. electrical activity  
c. muscle activity      d. muscle activation
4. While using EMG, the electrode has to be placed at different locations because.....
- a. the skeleton muscles differ in the inner structures.      b. 10-20 units have been collected.  
c. of obtaining an accurate study      d. the electrode is retracted a few  
- millimeters
5. To monitor the general picture of muscle activation a(n) ..... may be used.
- a. surface electrode      b. intramuscular EMG  
c. needle EMG      d. action potential



2. The teacher didn't expect the students' .....response.
3. An example of an ..... disease is Influenza type A.
4. They discussed a ..... range of issues at the meeting last month.
5. You need a..... to promote your interest in studying seriously.
6. Prior to any decision making, one should ..... the needed information.
7. When a spring is released, it .....to its original shapes immediately.
8. New findings in biomedical engineering researches provide.....results for relieving elderly people's problems.
9. By applying new measures in big cities, traffic is now flowing .....
10. After marriage, there is a.....source of conflict between young people.

**d. Match the words/phrases in the column A with their synonyms / antonyms in the column B**

**Column A**

1. instrument .....
2. to generate .....
3. whole .....
4. tissue .....
5. abnormal .....
6. application .....
7. observe .....
8. contract .....
9. spontaneous .....
10. invasive .....

**Column B**

- a. expand
- b. practical use
- c. induced
- d. conductive
- e. watch carefully
- f. mass of cells
- g. unusual
- h. complete
- i. produce
- j. tool, device
- k. noninvasive

**C. Cloze exercise**

Fill out the following blanks with the best word from the box below.

1.surgeries	4.lower	7.actuators	10.controls
2.enhancement	5.freedom	8.movement	11.joints
3.improvements	6.support	9.controlling	

Exoskeleton robots are mechanical constructions attached to human body parts, containing ..... for influencing human motion. One important application area for exoskeletons is human motion ..... for example, for disabled people, including rehabilitation training, and for force ..... in healthy subjects.

There are two exoskeleton systems developed in laboratory. The first system is a .....extremity exoskeleton with one actuated degree of ..... in the knee joint. This system was designed for motion .....in disabled people. The second system is an exoskeleton for a human hand with 16 actuated ....., four for each finger. This hand exoskeleton will be used in rehabilitation training after hand .....