

Lab 9: Muscle Physiology

Purpose: Procedures will be used to investigate the different contraction characteristics of skeletal, cardiac, and smooth muscle. The effects of the neurotransmitters, acetylcholine and norepinephrine, on the rates of contraction of cardiac and smooth muscle will be examined. A procedure for recording an electromyogram (EMG) and the effect of oxygen availability to skeletal muscles will also be demonstrated.

Procedure:

9-D: Demonstration of the electromyograph (EMG)

This exercise will demonstrate the concepts of agonist, antagonist and synergist muscles. An agonist, or prime mover, is the muscle primarily responsible for a given movement. An antagonist muscle will work in opposition to the agonist. A synergist will aid the agonist and help refine a given movement.

NOTE: You will need to arrange yourselves in groups to be able to obtain a copy of EMG recordings from the laptop computer running the Iworx program.

Procedure

1. To get things started:
 - **Before you turn anything on**, be sure the **IWX/214 unit** is plugged in, and that the IWX/214 unit is connected to the laptop by USB cable.
 - Be sure that the **C-AAMI-504 EEG cable** is inserted into the isolated inputs of Channels 1 and 2 of the IWX/214. Be sure that the **color-coded lead wires** are correctly inserted in the lead pedestal of the C-AAMI-504 EEG cable. Insert the connectors on the electrode lead wires into the color-coded matching sockets on the lead pedestal of the ECG cable.
 - Once everything is connected, **FIRST turn on the laptop** and allow it to **fully boot up before** you turn on the IWX/214 unit. Once the Iworx unit is on, the red indicator light on the Iworx unit should light up and you may hear the USB chime from the laptop if the laptop does not default to mute (many are set to default to mute).
2. Open the Labscribe3 program by **clicking on the Labscribe3 icon** on the desktop. As soon as the program opens, you should see a window pop-up that says "**Hardware found IWX214:2008-1-24,**" click "OK."

3. In the second from the top row (the row that says "File Edit View Tools Settings Advanced External Devices Help"), click on the "**Settings**" tab. About halfway down the drop-down window should be a tab called "**Human Muscle**." Click on that tab and that should lead you to another drop-down list with the second tab from the top called "**AntagonisticMuscle**," click on that tab and then close the pdf file that appears, you don't need it.
4. Instruct the subject to **remove all jewelry** from his/her arm and wrist. Use an alcohol swab to **clean** the regions of skin on the forearm you are going to use (Fig. 9-1). Let the area **dry**. Remove a disposable electrode from its plastic shield, and **apply the electrode** to the six locations.
5. Place the **electrodes** from proximal to distal on the **forearm** in the following order: +2, -2 on the posterior and +1, -1 and ground on the anterior. (Fig. 9-1.) **Snap the lead wires** onto the electrodes as follows:
 - the **red "+1"** lead is attached to the proximal electrode on the anterior surface.
 - the **black "-1"** lead is attached to the distal electrode on the anterior forearm.
 - the **green "C"** lead (the ground) is attached to the remaining electrode on the anterior surface.
 - the **white "+2"** lead is attached to the proximal electrode on the posterior forearm.
 - the **brown "-2"** lead is attached to the distal electrode on the posterior surface.

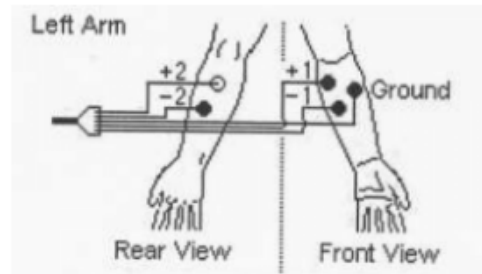


Fig. 9-1: Electrode placement

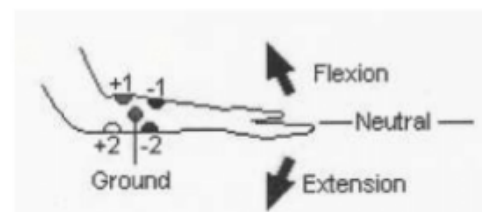


Fig. 9-2: Experimental set-up

The experimental set-up should look like the illustration in Fig. 9-2.

6. Record an EMG of the muscles of the forearm illustrating agonistic and antagonistic muscle activity for each of the exercises described below. Type the student's name and the appropriate letter for the activity (A, B, C, D – see below) in the **Mark box** to the right of the **Mark button**. Click the red **Rec** button to begin the recording; then, press the **Enter** key on the keyboard to mark the beginning of each the activity. The recording for exercise "A" should look like Fig. 9-3. If you do not see anything, try clicking on the AutoScale tab and/or checking the electrode contacts. Repeat these procedures for each of the remaining activities.

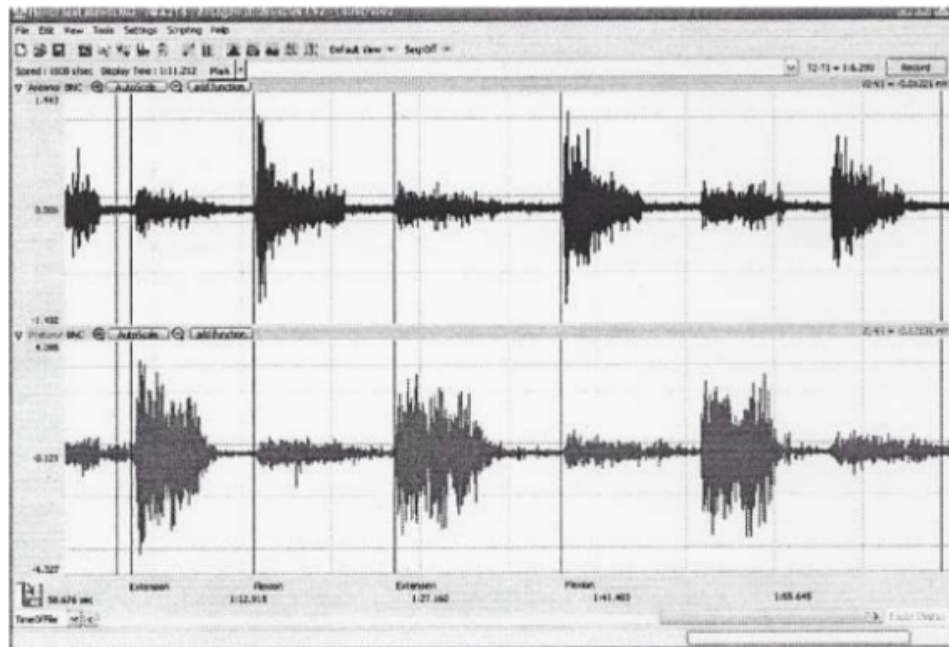
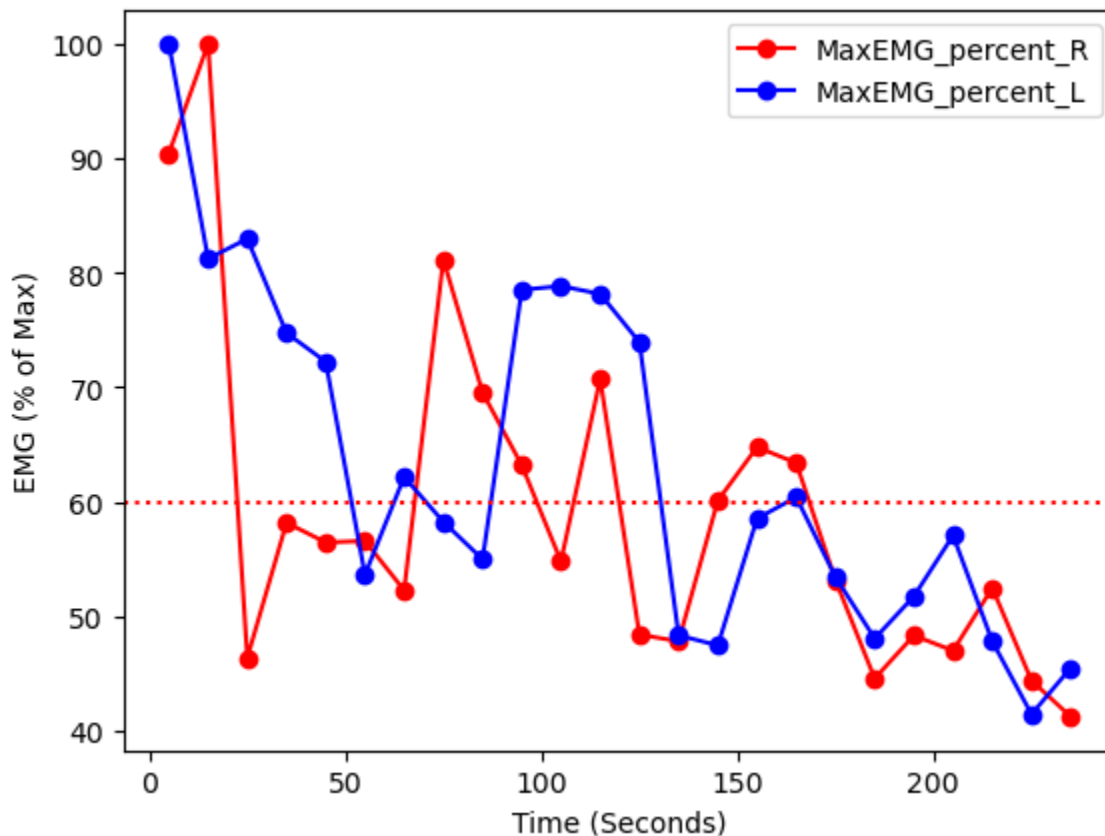


Fig. 9-3: Illustration of data for flexion and extension of wrist (Exercise A).

- A. Gently flex the wrist with the palm open and hold for four seconds. Return the wrist to a neutral position. Extend the wrist, again with the palm open, and hold for four seconds. Repeat several times.
- B. Forcefully flex the wrist with the hand closed into a fist, hold for four seconds. Return to a neutral position. Extend the wrist maintaining the fist and hold for four seconds. Repeat several times.
- C. Attempt to flex the wrist against resistance applied by another student for 10 seconds.
- D. Place the hand in mid-supination and make a fist. Attempt to move the hand upwards against resistance applied by another student. Hold for 10 seconds.

7. Evaluate the amplitude and frequency of the EMG recordings. Identify the agonists, antagonists and synergists, if applicable, for each activity. For example, what muscles were the agonists during wrist flexion - anterior or posterior forearm muscles? How did the EMG change for the antagonists when the wrist was more forcefully moved? During which exercise(s) did synergistic muscle activity become apparent?
8. Print a sample of each activity. Before you print, find your highest amplitude waves (probably in activity C or D) and AutoScale. Click on the **AutoScale** tab at the upper margin of each of the EMG channels. Look for the row that says on the left "▽A1:EMG Anterior (or Posterior) 3-10KHz," the **AutoScale** tab is the second icon after "Hz," it looks like a magnifying glass with a ↑ symbol on it. After you click this for the biggest waves, **this is the scale you will print all four activities.** To print a section of the recording, click on "File," select "Print View." Select "Landscape" for the page set-up. Be sure to select M-106 as the printer destination.

Results:



Discussion: The quick drop off of the right hand could have been from error. Since this data was from my own test I can remember slightly letting go to re-grip the tennis ball. This

slight mistake may not have been significant to skew my data but something to keep in mind.

Conclusion: The EMG is a clear and concise method to measure any type of muscle activity. This lab helped me understand and see the difference in fatigability between my left and right hand.