

## II. EXPERIMENTAL OBJECTIVES

- 1) To observe and record skeletal muscle tonus as reflected by a basal level of electrical activity associated with the muscle in a resting state.
- 2) To record maximum clench strength for right and left hands.
- 3) To observe, record, and correlate motor unit recruitment with increased power of skeletal muscle contraction.
- 4) To listen to EMG sounds and correlate sound intensity with motor unit recruitment.

## III. MATERIALS

- BIOPAC Electrode Lead Set (SS2L)
- BIOPAC Disposable Electrodes (EL503,) 6 electrodes per Subject
- BIOPAC Electrode Gel (GEL1) and Abrasive Pad (ELPAD)
- *Optional:* BIOPAC Skin Prep Gel (ELPREP) or alcohol prep
- *Optional:* BIOPAC Headphones (OUT1/OUT1A for MP3X or 40HP for MP45)
- Biopac Student Lab System: BSL 4 software, MP36, MP35 or MP45 hardware
- Computer system (Windows or Mac)

## IV. EXPERIMENTAL METHODS

### A. SETUP

#### FAST TRACK Setup

1. Turn the computer **ON**.
  - If using an MP36/35 unit, turn it **OFF**.
  - If using an MP45, make sure USB cable is connected and Ready light is **ON**.
2. **Plug the equipment in** as follows:  
Electrode Lead Set (SS2L) → CH 1  
Headphones (OUT1 or OUT1A\*) → back of unit  
*\*OUT1A is compatible with MP36 only.*
3. Turn **ON** the MP36/35 unit.

Setup continues...

#### Detailed Explanation of Setup Steps



**Fig. 1.4 MP3X (top) and MP45 (bottom) equipment connections**

- Windows: If using MP45, the Sound Playback device must be set to MP45 via Start > Control Panel.

4. Clean and abrade skin.
5. Attach three electrodes to each forearm (Fig. 1.5).
6. Clip the Electrode Lead Set (SS2L) to **Subject's** dominant arm, following the color code (Fig. 1.5).

Clean electrode sites with ELPREP Skin Prep Gel or alcohol before abrading.

Always apply a drop of gel (GEL1) to the sponge portion of electrodes before attaching.



**Fig. 1.5 Electrode placement and lead attachment**

- If **Subject** is right-handed, the right forearm is generally dominant; if **Subject** is left-handed, the left forearm is generally dominant.
- For optimal electrode adhesion, place electrodes on the skin at least 5 minutes before the start of Calibration.
- The pinch connectors work like a small clothespin and will only latch onto the nipple of the electrode from one side of the connector.



**Fig. 1.6 Proper Seating Position**

- The dominant arm should rest on thigh to relax the muscles in the shoulder and upper arm.
- Optional: Subject may hold a small object, such as a rubber ball, while performing this procedure



**Fig. 1.7 Positioning**

Setup continues...

8. **Start** the Biopac Student Lab Program.
9. Choose lesson **L01 – Electromyography (EMG) I** and click **OK**.
10. Type in a unique **filename** and click **OK**.

Start Biopac Student Lab by double-clicking the Desktop shortcut.



No two people can share the same filename, so use a unique identifier, such as **Subject's** nickname or student ID#.

A folder will be created using the filename. This same filename can be used in other lessons to place the **Subject's** data in a common folder.

To change the preference, see next step.

11. **Optional:** Set Preferences.
  - Choose File > **Lesson Preferences**.
  - Select an option.
  - Select the desired setting and click **OK**.

This lesson has optional Preferences for data and display while recording. Per your Lab Instructor's guidelines, you may set:

**Grids:** Show or hide gridlines

**Lesson Recordings:** Specific recordings may be omitted based on instructor preferences.

**END OF SETUP**

## B. CALIBRATION

Calibration establishes the hardware's internal parameters (such as gain, offset, and scaling) and is critical for optimal performance. **Pay close attention to Calibration.** *For a video example of proper Calibration procedure,* click the **Calibration** tab in the Lesson Set Up Journal.

### FAST TRACK Calibration

1. Click **Calibrate**.
2. Two seconds after Calibration begins, **clench** fist as hard as possible for two to three seconds, then **release**.
3. **Wait** for Calibration to stop.
4. Verify recording resembles the example data
  - If similar, click **Continue** and proceed to Data Recording.
  - If necessary, click **Redo Calibration**.

**END OF CALIBRATION**

### Detailed Explanation of Calibration Steps

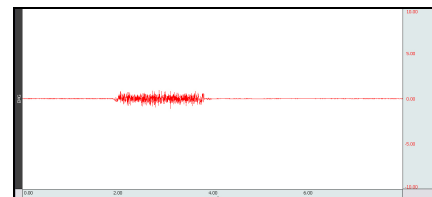


**Fig. 1.8 Clench Fist for Calibration**

The program needs a reading of the maximum clench to perform an auto-calibration.

Calibration lasts eight seconds.

Data should show a zero baseline and a clear burst when **Subject** clenched.



**Fig. 1.9 Example Calibration data**

If recording does not resemble the Example Data

- If the data is noisy or flatline, check all connections to the MP unit.
- Verify electrodes are making good contact and that leads are clipped to the correct color position with minimal cable strain.

## C. DATA RECORDING

### FAST TRACK Recording

1. Prepare for the **Dominant arm** recording.
  - Electrodes must be attached to **Subject's** dominant arm.
  - **Subject's** hand must be relaxed.
  - **Review** recording steps.

#### *Dominant arm*

2. Click **Record**.
3. Perform a series of four Clench -Release-Wait cycles.
  - Hold clench for two seconds, release for two seconds.
  - Begin with a weak clench, then increase grip so the fourth clench is at maximum.
4. Click **Suspend**.
5. Verify recording resembles the example data.
  - If similar, click **Continue** and proceed to next recording.
  - If necessary, click **Redo**.
  - If all required recordings have been completed, click **Stop** and proceed to Step 11.

#### *Nondominant arm*

6. Prepare for the **Nondominant arm** recording.
  - Clip electrode leads to **Subject's** nondominant arm.
  - **Subject's** hand must be relaxed.
  - **Review** recording steps.
7. Click **Record**.

**Recording continues...**

### Detailed Explanation of Recording Steps

Two data recordings\* will be acquired in this lesson:

- a. Recording 1 records **Dominant arm**.
- b. Recording 2 records **Nondominant arm**.

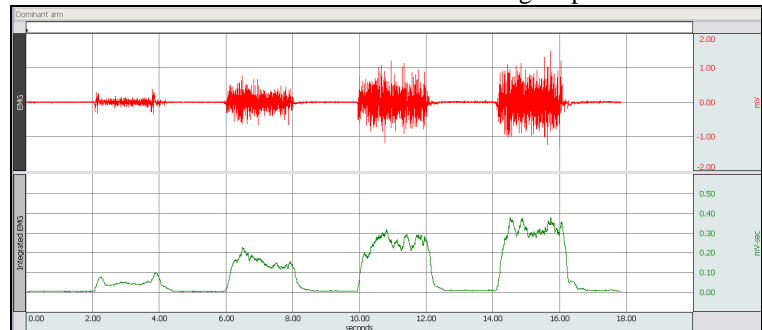
To work efficiently, read this entire section before recording, or review onscreen **Tasks** to preview recording steps in advance.

#### **\*IMPORTANT**

This procedure assumes that all lesson recordings are enabled in Lesson Preferences, which may not be the case for your lab. Always match the recording title to the recording reference in the journal and disregard any references to excluded recordings.

- Completely relax the grip between clenches.
- Allow at least two seconds between clenches.
- Two channels will be presented during the recording, CH 1 = Raw EMG, and CH 2 = Integrated EMG (a moving average of the raw signal).

Data should show four EMG bursts of increasing amplitude.



**Fig. 1.10 Example data – Dominant arm**

#### If recording does not resemble the Example Data

- If there is not enough variation between the clenches, repeat recording and start with a weaker clench.
- If the data is noisy or flatline, check all connections to the MP unit.
- Verify electrodes are making good contact and that leads are clipped to the correct color position with minimal cable strain.

Click **Redo** and repeat Steps 2 ó 5 if necessary. Note that once **Redo** is clicked, the most recent recording will be erased.

Disconnect the lead set (SS2L) from the electrodes on the ðdominantö forearm and connect to electrodes on ðnondominantö forearm. Refer to Fig. 1.5 for proper electrode lead attachment.

8. Perform a series of four Clench-Release-Wait cycles.
  - Hold clench for two seconds, release for two seconds.
  - Begin with a weak clench, and then increase grip so the fourth clench is at maximum.
9. Click **Suspend**.
10. Verify recording resembles the example data.
  - If similar, click **Continue** to proceed to the optional recording section, or click **Stop** to end the recording.
  - If necessary, click **Redo**.

Perform four cycles of Clench-Release-Wait, holding for two seconds and waiting for two seconds after releasing before beginning the next cycle. Try to increase the strength in equal increments so that the fourth clench is at maximum force.

- Completely relax the grip between clenches.
- Allow at least two seconds between clenches.

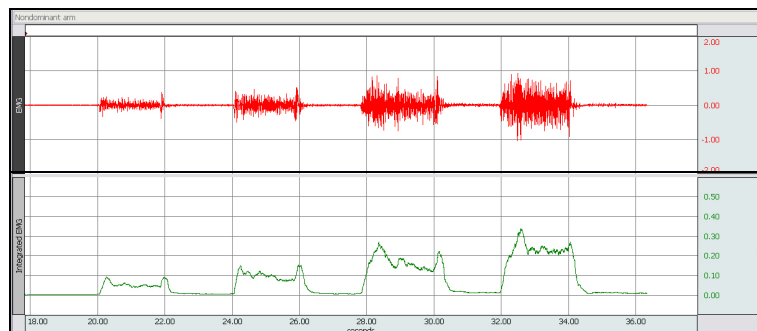


Fig. 1.11 Example data– Nondominant arm

The data description is the same as outlined in Step 4.

Click **Redo** and repeat Steps 7 to 10 if necessary. Note that once **Redo** is clicked, the most recent recording will be erased.

## OPTIONAL ACTIVE LEARNING PORTION

With this lesson you may record additional data by clicking **Continue** following the last recording. Design an experiment to test or verify a scientific principle(s) related to topics covered in this lesson. Although you are limited to this lesson's channel assignments, the electrodes may be moved to different locations on the **Subject**.

### Design Your Experiment

Use a separate sheet to detail your experiment design, and be sure to address these main points:

#### A. Hypothesis

Describe the scientific principle to be tested or verified.

#### B. Materials

List the materials you will use to complete your investigation.

#### C. Method

Describe the experimental procedure—be sure to number each step to make it easy to follow during recording.

### Run Your Experiment

#### D. Set Up

Set up the equipment and prepare the subject for your experiment.

#### E. Record

Use the **Continue**, **Record**, and **Suspend** buttons to record as much data as necessary for your experiment.

Click **Stop** when you have completed all of the recordings required for your experiment.

### Analyze Your Experiment

- F. Set measurements relevant to your experiment and record the results in a Data Report.

Recording continues...

- To listen to the EMG signal, proceed to Step 11.
- To skip listening to the EMG signal and end the recording, proceed to Step 14.

11. Click **Listen** to record EMG data and hear it through the headphones.
12. Increase grip force and notice how the volume increases.
13. Click **Stop** when finished.
  - Click **Redo** to hear EMG again.
14. Click **Done** to end the lesson.
15. Choose an option and click **OK**.
16. Remove the electrodes.

**END OF RECORDING**

*Listening to the EMG is optional.*

Listening to the EMG is optional and can be a valuable tool in detecting muscle abnormalities, and is performed here for general interest. Data on screen is not saved.

The EMG signal will be audible through the headphones as it is being displayed on the screen. The screen will display two channels:

CH 1 EMG and CH 40 Integrated EMG

The signal will run until **Stop** is clicked. If others in lab group would like to listen to the EMG signal, pass the headphones around before clicking **Stop** or click **Redo** and then **Stop** when done.

This will end listening to the EMG.

If choosing the **Record from another Subject** option:

- Repeat Setup Steps 4 6 7 and then proceed to Calibration.

Remove the electrode cable pinch connectors, and peel off all electrodes. Discard the electrodes (BIOPAC electrodes are not reusable). Wash the electrode gel residue from the skin, using soap and water. The electrodes may leave a slight ring on the skin for a few hours, which is quite normal.