Experiment HN-6: Hoffman Reflex using the Soleus Muscle

The Hoffman reflex using the iWorx equipment was developed as part of the STEM program at Bridgewater College, Bridgewater, VA; it was funded in part by National Science Foundation Grant DUE-0756838 award "Bridging the Valley: A Step Ahead for STEM Majors."

Participants included: Robert Hammill, Associate Professor in Health & Human Sciences
Abigail Martin, Senior Health & Exercise Science Major
Sara Church, First Year Biology Major
Hannah Scaletta, First Year Biology Major

iWorx Sample Lab

Equipment Required

PC or Mac Computer

IXTA, USB cable, Power supply for IXTA

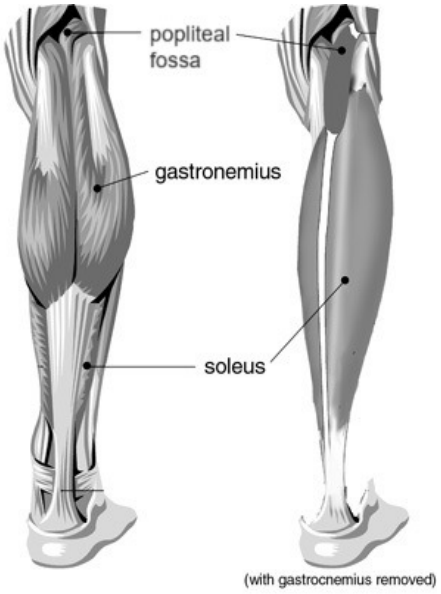
ROAM EMG

Disposable snap electrodes

HV stimulator lead wires and stimulating electrodes

Preparation of the Subject

1. Locate:
    - the soleus muscle just inferior to the belly of the gastrocnemius muscle
    - the popliteal fossa behind the knee joint
    - the anterior thigh just superior to the patella
    - any bony landmark (mid tibia and either malleolus will work)
2. Apply disposable electrodes:
    - 2 in line with the soleus muscle fibers approximately so the centers of the electrodes are approximately 2 cm apart
    - 2 in the popliteal fossa
    - 1 between the 2 on the soleus and the 2 in the popliteal fossa



3. Connect leads accordingly:
    - Red and black ROAM EMG leads will attach to the two electrodes over the soleus
    - The ground on the center of the ROAM will be between the 2 recording EMG leads and the two stimulating electrodes.
    - Black stimulator lead will go on the electrode in the popliteal fossa (behind the knee)

- Red stimulator lead will go on the electrode next to the black stimulator lead

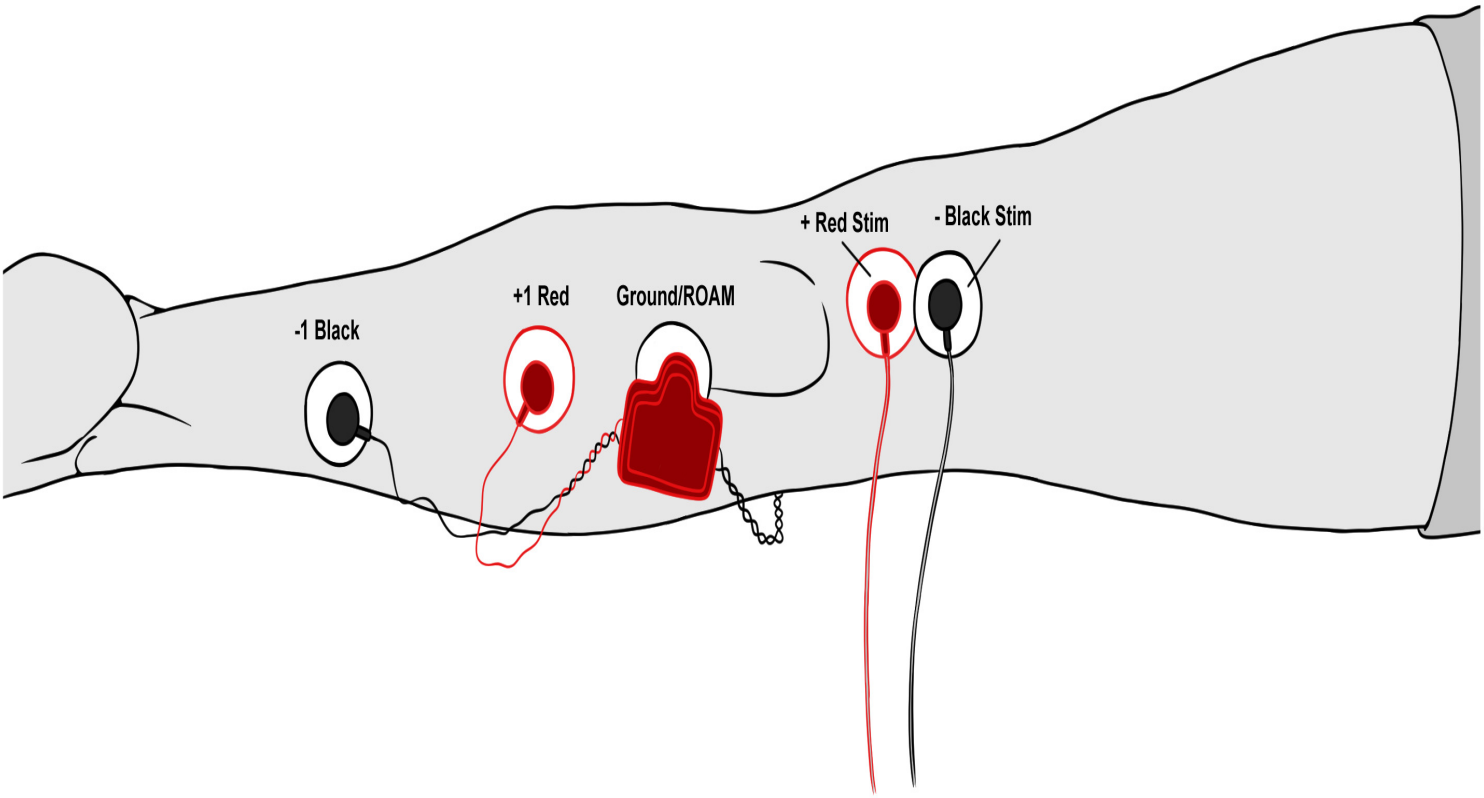


Figure HN-6-S1: Electrode placement for recording the Hoffman Reflex from the soleus muscle.

The Equipment Setup

1. Disconnect the ROAM from the dock and place the electrodes as shown in the image above.
2. Check the stimulator control panel and confirm values as shown. Adjust the Amp to "0".

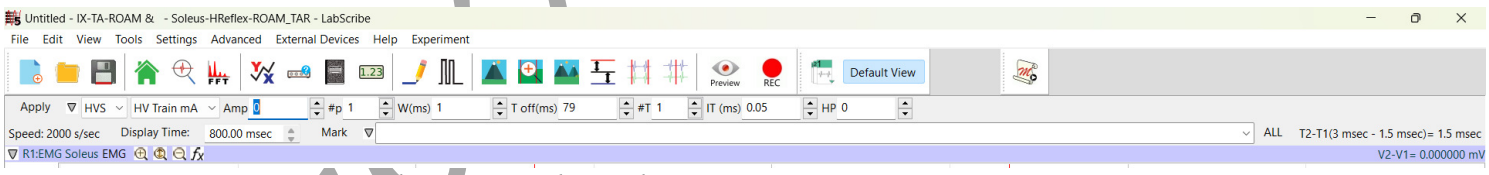


Figure HN-6-S2 – Stimulator Control Panel.

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IXTA Stimulator Setup

1. Place the IXTA on the bench near the subject.

Warning: Before connecting the IXTA stimulating electrodes to the subject, check the Stimulator Control Panel to make sure the amplitude value is set to zero (0).

Note: Disconnect the subject from the IXTA prior to powering off the device.

2. Instruct the subject to remove all jewelry from leg if necessary before beginning the experiment.

Warning: Make sure the Amplitude is set to zero.

3. Connect the color-coded stimulator lead wires to the High Voltage Current Stimulator. Make sure you push the safety connector of each lead wire into the appropriate socket as far as possible.
4. Connect the 2 stimulating electrodes as stated above.

Figure HN-6-S3: The IXTA stimulating electrodes.

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Figure HN-6-S4: The front panel of the IXTA with the stimulating electrodes connected correctly.

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Note: Disconnect the subject from the IXTA prior to powering off the device.

If the subject feels a painful stimuli, then the electrodes are in the wrong place.

Exercise 1: To investigate the H and M reflex responses.

Aim: To investigate the H-reflex response and the M-wave response during muscle stimulation.

Approximate Time: 60 minutes

Procedure:

1. Have the subject lay on their stomach and relax their leg and foot fully.
2. Increase the current to 2 mA using the IXTA Stimulator Control Panel.
    - Check the Setup file to determine the initial stimulator preferences.
    - Click the "Apply" button to make any changes.
3. Click Record.
    - A 120 msec tracing will be displayed on your computer screen.
    - There should be 20 msec of inactivity followed by the 1 msec stimulus.
    - You will notice the artifact from the stimulus in your EMG channel. Approximately 30 msec later you will see the H-reflex appear if the stimulus was large enough and threshold was reached.
4. If nothing appears, confirm with the participant a stimulus was delivered and if the subject felt any tingling sensation.
5. If so, increase the current on the stimulator by 1 mA, then deliver the stimulus again. Click Apply each time. Repeat steps 2-5 until an H-reflex is recorded so its peak to peak maximum is at its highest. To do this you will need to use the double cursor function as show in the figure below.
6. Click Stop.
7. Repeat the procedure with a slightly increasing stimulus, no more than 1mA at a time. Stop at any time the subject does not wish to continue.

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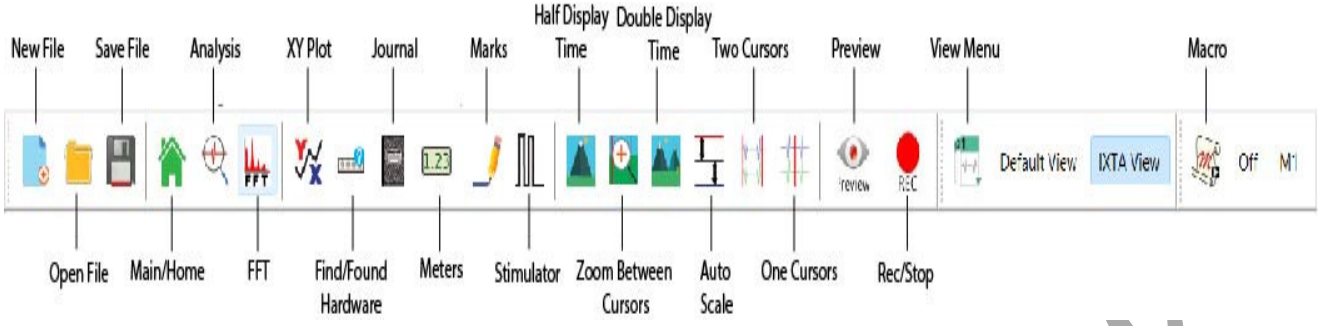

Figure HN-6-S1: LabScribe Toolbar

Figure HN-6-L2: Hoffman Reflex shown in the main window with cursors in position to measure the amplitude (V2-V1) of the full H-reflex.

Note: If the trace is upside-down, click the Invert button using the down arrow to the left of the Soleus channel.

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Data Analysis

Background Information

The maximal peak to peak EMG amplitude is considered the maximal H-reflex. Note that the tracing is very similar to that seen in a reflex hammer test of the Achilles tendon – *see the Achilles Reflex Lab*.

The value of the H-reflex is that the location of the stimulus and the intensity of the stimulus are easily controlled via bypassing the muscle spindle completely. Afferent neurons receive direct stimulation from the electric current provided by the stimulator.

The H-reflex is highly variable if the supraspinal input is not controlled. That is to say, any activity that causes the brain to function differently could lead to altered descending nerve tract information that could affect reflex activity. Interneurons synapsing with the descending tracts could facilitate or inhibit reflex output.

An example of this is the Jendrassik maneuver where you try to pull your hands apart during the reflex measurement. Changes in temperature, limb position, auditory input, visual input, stress, etc. can all affect maximal H-reflex amplitude.

Procedure:

1. In the main window, double the display time so that the recording resembles the trace shown in Figure HN-6-L2.
2. Click and drag the cursors so that the left hand cursor is on the stimulus and the right hand cursor is on the first peak of the response. Measure **T2-T1** for the time it took for the H-reflex to occur from the delivery of the stimulus.
3. With the right hand cursor still on the peak of the response, move the left hand cursor so that it is on the maximal downward spike of the H-reflex. Measure **V2-V1** for the amplitude of the complete Hoffman Reflex of the soleus muscle.
4. Once the cursors are placed in the correct positions for determining the reflex conduction time and the amplitude of the reflex response, record the value for T2-T1, and V2-V1 in the Journal. The value can be recorded in the on-line notebook of LabScribe by typing its name and value directly into the Journal. Values can also be recorded in separate data table.

Additional Exercises

- Try using the Jendrassik maneuver and determine the result on the Hoffman Reflex.
- Add a small weight to the foot.
- Alter the temperature, using either an ice pack or moist heat pack, and determine the H-reflex in both situations.
- Try collecting a maximal M-wave. Calculate the Hmax:Mmax ratio which is the standard for reporting in sports medicine.

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