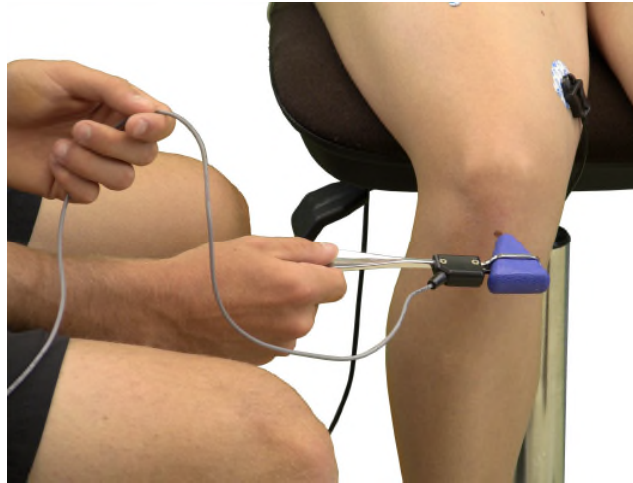


## BSL PRO Lesson H28: Reflex Response (Patellar Tendon) Using BIOPAC Reflex Hammer Transducer SS36L



This *PRO* lesson describes basic reflex exercises and details hardware and software setup of the BSL System to record the reflex reaction. All data collection and analysis is done via the BIOPAC MP36/35 data acquisition unit and the Biopac Student Lab Lessons software.

### **Abstract: Reflex Response**

Spinal cord reflexes represent the most basic of motor responses. These reflexes are carried out entirely within the spinal cord and are modified by inputs from higher brain centers to generate complex movements.

The *myotatic*, or muscle stretch reflex, is an example of a *spinal reflex*. Muscle stretch activates receptors in the muscle which send nerve impulses to the spinal cord, stimulating the muscle's motor neurons and causing reflex contraction.

The *knee-jerk reflex* is a spinal reflex activated by tapping the **patellar tendon** below the knee. This tendon then stretches the muscle spindles, generating sensory impulse to the spinal cord. Alpha motor neurons in the spinal cord cause a brief, rapid contraction of the **quadriceps femoris**, which causes the leg to extend.

Tapping the **Achilles tendon** behind the ankle and just above the heel activates *plantar flexion* of the foot. This reflex response is like walking tip-toed or standing on your toes.

These reflexes are very important when trying to diagnose damage to the nerves or spinal cord.

The **Jendrassik maneuver** will heighten (exaggerate) the patellar (knee-jerk) reflex by countering some of the normal descending inhibitory brainstem inputs to reflex arc interneurons.

- For this maneuver, the subject interlocks his/her fingers and then concentrates on pulling the fingers apart, using as much force as can be generated without breaking the interlock. The patellar tendon must be tapped as soon as the subject is distracted by attempting to pull apart the interlocked fingers.

Synaptic delay is not appreciably shortened, but a larger number of reflex arc neurons become activated due to removal of descending inhibition and the reflex response occurs a few milliseconds earlier. The amplitude of the response is increased because a larger number of motor units have been activated. Clinically, some brainstem lesions are manifested by exaggerated spinal cord reflexes. In a way, the Jendrassik maneuver mimics the effect of these lesions.

## Objective

1. To measure reflex time of different nerves in the body under different conditions using the reflex hammer.
2. To compare and correlate magnitude of hammer strike to magnitude of response (via EMG activity).
3. **Optional:** To measure response via angular movement (goniometer) under varying strike force.

## Equipment

- BIOPAC reflex hammer (SS36L)
- BIOPAC electrode lead set (SS2L)
- BIOPAC electrodes (EL500)—six per subject
- Electrode gel and abrasive pad (GEL1 and ELPAD)
- **Optional:** BIOPAC twin axis goniometer (SS20L or SS21L)
  - If using goniometer: tape (TAPE1)
- Push-pin or thumb tack
- Chair
- Desk or table
- [Lab Report](#) (Click to download PDF version)
- PC running Windows 7/Vista/XP or a Mac computer running OS X 10.5 – 10.7
- Biopac Student Lab PRO software
- BIOPAC Data Acquisition Unit (MP36/MP35/MP45)

## Setup

### Hardware

1. Plug the reflex hammer (SS36L) into CH 1 on the front of the MP unit.
2. Plug the electrode lead set (SS2L) into CH 2.
3. **Optional:** Plug the X-axis (marked with green band) of the goniometer (SS20L or SS21L) into CH 3.  
**NOTE:** Goniometer is not supported in 2-channel MP45 hardware.
4. Turn the MP unit ON.

### Software

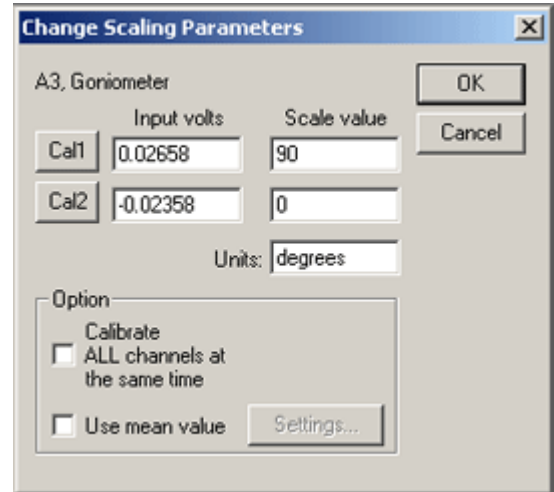
1. Turn on the computer.
2. Launch the **BSL PRO** software.
3. Open the *Reflex Hammer* template file by choosing **File menu > Open > choose Files of type: GraphTemplate (\*.GTL) > File Name: [h28.gtl](#)**.



## Calibration

- **Calibration is only necessary if using the SS20L or SS21L twin axis goniometer**

1. In BSL software click: **MP > Setup Channels**.
2. Click **View/Change Parameters** (wrench) for CH 3.
3. Click **Scaling...**
4. Place goniometer on desk at **90 degree angle** (L-shape).
5. Click **Cal 1**.
6. Under **Scale Value**, enter **90**.
7. Place goniometer on desk in a **straight line**.
8. Click **Cal 2**.
9. Under **Scale Value**, enter **0**.
10. Change Units to: **degrees**



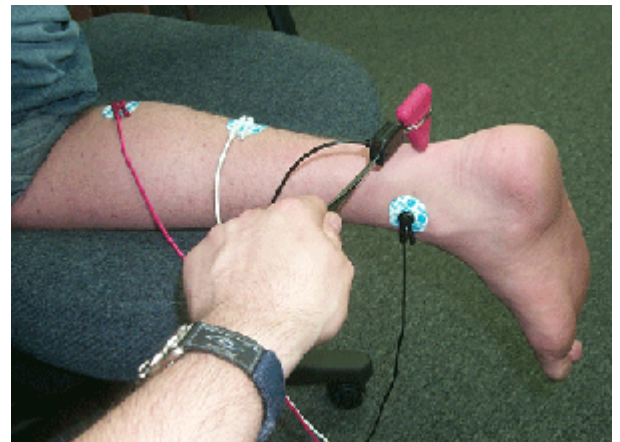
## Subject

1. Place electrodes for the ankle reflex.
  - a. Place two electrodes on the inside of the calf muscle, approximately 5 inches apart.
  - b. Place a ground electrode just inside of the ankle on the same leg.
2. Place electrodes for the knee reflex.
  - a. Place two electrodes on the quadriceps muscle on front of thigh, approximately 10 cm apart.
  - b. Place a ground electrode on the knee of the same leg.
3. **Optional:** Attach a goniometer (SS20L or SS21L) to the outside of the knee.
  - a. This will measure angular movement of the leg which is proportionate to the force of the strike from the reflex hammer.

## Reflex Exercises

1. **Ankle Jerk Reflex - tests the medial popliteal nerve**
  - a. Have the Subject stand on one leg alongside a chair, with the other leg bent at the knee and its shin resting on the seat of the chair. The foot should project over the edge of the chair.
  - b. Connect the SS2L leads to the calf (as pictured).

Lead Color	Signal	Position
Red	(+)	closest to knee
White	(-)	middle of calf
Black	(ground)	inside of ankle



- c. Click **Start** to begin recording.
- d. Strike the **Achilles tendon** behind the ankle just above the heel and observe the resulting muscle contraction.
- e. Repeat 10 times and note reaction times in lab report.
 

**Note** Reaction time is measured from onset of hammer strike to onset of EMG activity.
- f. Click **Stop** to suspend recording.

## 2. Knee Jerk Reflex - tests the quadriceps femoris tendon

- a. Move the SS2L leads to the knee reflex electrodes (as pictured).

Lead Color	Signal	Position
Red	(+)	middle electrode
White	(-)	closest to waist
Black	(ground)	on the knee

- b. Have the Subject sit with his or her legs hanging freely over the edge of the chair.
- c. **Optional:** Attach a goniometer (SS20L or SS21L) to the outside of the knee (as pictured).
  - This will measure angular movement of the leg which is proportionate to the force of the strike from the reflex hammer.
- d. Before you continue recording, find the optimal spot on the subject's knee that will cause a good reflex and mark the spot.
- e. Click **Start** to resume recording.
- f. Strike the patellar ligament and observe the resulting reflex contraction.
- g. Repeat 10 times and note reaction times and amplitudes in lab report.



**Note:** In order to get an accurate goniometer reading, it is crucial that the leg come to a resting position between strikes.

- h. Click **Stop** to suspend recording.

## 3. Knee Jerk Reflex - with Jendrassik Maneuver

The **Jendrassik maneuver** will heighten (exaggerate) the patellar (knee-jerk) reflex by countering some of the normal descending inhibitory brainstem inputs to reflex arc interneurons. Synaptic delay is not appreciably shortened, but a larger number of reflex arc neurons become activated due to removal of descending inhibition and the reflex response occurs a few milliseconds earlier. The amplitude of the response is increased because a larger number of motor units have been activated.

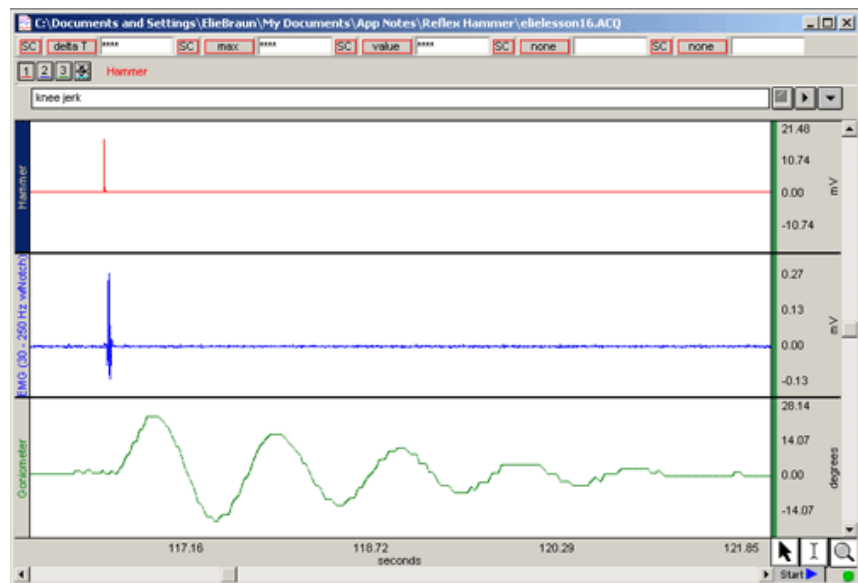
- a. Have the Subject remain seated with his or her legs hanging freely over the edge of the chair.
- b. Click **Start** to resume recording before the maneuver.
- c. **IMPORTANT:** The next two actions must be timed so that the patellar tendon is tapped as soon as the subject is distracted by attempting to pull apart his/her interlocked fingers.
  - Tell the subject to grip both hands together across his/her chest and attempt to pull them apart with maximum force.
  - Strike the patellar ligament and observe the resulting muscle contraction.
- d. Repeat 10 times and note reaction times and amplitudes in lab report.
- e. Click **Stop** to suspend recording.

## 4. Knee Jerk Reflex - with mental distraction

- a. Prepare 10 addition problems consisting of three-digit numbers (i.e., 247+498).
- b. Have the Subject remain seated with his or her legs hanging freely over the edge of the chair.
- c. Click **Start** to resume recording.

- d. Ask the Subject to solve the problems in the shortest amount of time possible without using a pen or calculator while you strike the patellar ligament and observe the resulting muscle contraction.
  - e. Repeat 10 times and note reaction times and amplitudes in lab report.
  - f. Click **Stop** to suspend recording.
5. **Flexor Withdrawal Reflex - tests delay in knee jerk when another reflex is stimulated**
- a. Have the Subject remain seated with his or her legs hanging freely over the edge of the chair.
  - b. Click **Start** to resume recording.
  - c. Apply a cutaneous stimulus (such as a pin prick to the skin) on the side of the leg, below the knee and simultaneously perform a knee jerk reflex.
  - d. Repeat 10 times and note reaction times and amplitudes in lab report.
  - e. Click **Stop** to suspend recording.
6. **Voluntary Knee Jerk Reflex**
- a. Have the Subject remain seated with his or her legs hanging freely over the edge of the chair or desk.
  - b. Click **Start** to resume recording.
  - c. Strike the table next to the subject with the hammer and ask the Subject to voluntarily jerk his/her knee upon hearing the hammer strike.
  - d. Repeat 10 times and note reaction times and amplitudes in lab report.
  - e. Click **Stop** to stop recording.

## Data Analysis



### Measurements:

Measure	Channel	Result
Delta T	EMG	Select the area from the onset of the hammer strike to the onset of EMG
Max	Goniometer	Determines maximum angular displacement of the knee
Max	Hammer	Use the result to calculate the relationship between strike force and EMG amplitude

**Report Questions:**

- Click here to download a PDF of the [Report Questions](#) and a data report table for 10 segments of each reflex test.

<b>Reflex Test</b>	<b>Report Questions</b>
<b>Ankle Jerk</b>	Which muscles contract? What causes these muscles to contract? What action occurs at the ankle joint?
<b>Knee Jerk</b>	Which muscles contract? What causes these muscles to contract? What action occurs at the knee joint?
<b>Jendrassik Maneuver</b>	Compare the size of the responses between the two conditions. What effect would a spinal-cord lesion have on the gain?
<b>Mental distraction</b>	Compare the size of the responses to the previous knee jerk test(s).
<b>Voluntary</b>	Compare to involuntary knee jerk reaction times.
<b>Flexor Withdrawal</b>	Compare reaction time with reaction time of normal knee jerk test.