

PhysMate Lab 6: Patellar and Achilles Stretch Reflexes

Start the Software

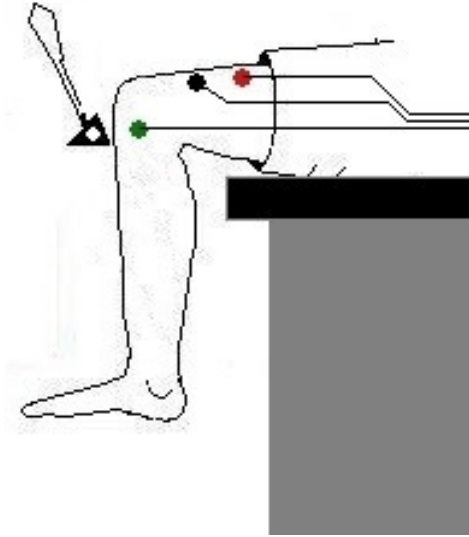
1. Click on LabScribeLite
2. Click Settings → StretchReflexes

EMG Cable Setup

1. Plug the PTP-100 Pulse sensor into the Sensor port on the PhysMate.
2. Plug the red, black and green electrodes (C-ISO-SL5) into the PhysMate.



3. Use an alcohol swab to clean and scrub the areas where the electrodes will be placed and let the areas dry before attaching the electrodes.
4. Snap the recording lead wires onto the electrodes before placing the them on the subject:
 - the black lead is attached to an electrode which is about 12cm from the knee.
 - the red lead is attached to an electrode which is about 10cm above the black electrode.
 - the green lead (ground) is attached to the electrode on the knee.



5. Attach the pulse sensor to the side of the head of the patellar hammer with its velcro strap. When the reflex hammer strikes the tendon, the sensor will mark the recording when the tendon was struck.

NOTE: Do NOT strike the hammer on the pulse sensor. The pulse sensor is just strapped to the side of the reflex hammer to pick up the vibration of the strike on the tendon.

Exercise 1: Patellar Tendon (Knee Jerk) Reflex

Aim: To determine conduction time from tendon tap to response of the quadriceps muscle in the patellar tendon reflex arc.

Procedure

1. Instruct the subject to sit on a lab bench so that the subject's thighs are supported by the top of the bench and his or her calves hang freely.
2. Feel the position of the patellar tendon just below the kneecap. Place one hand on the patella (kneecap), and use the other hand to tap the patellar tendon with the reflex hammer. Find the point on the patellar tendon that causes the greatest response from the quadriceps muscle.
3. Click Record and then instruct the subject to raise and lower his or her lower leg to demonstrate the type of EMG that occurs during quadriceps contraction and relaxation. Click AutoScale All. Click Stop.
4. Type "Patellar" in the Mark box.
5. Click Record. Press the mark button.
6. Instruct the subject to relax his or her leg.

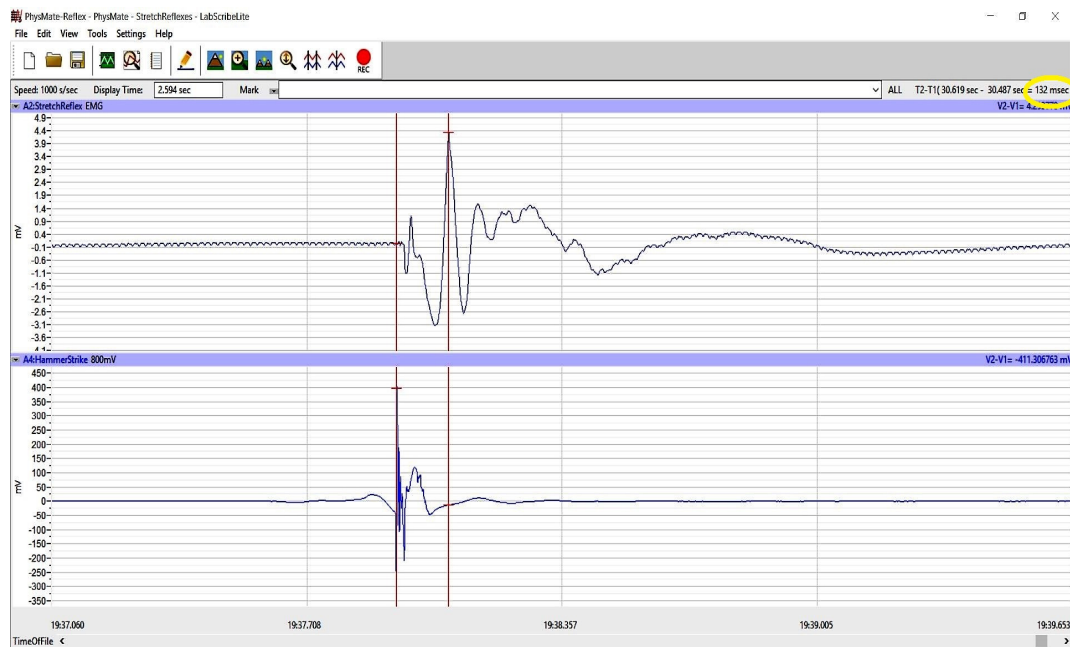
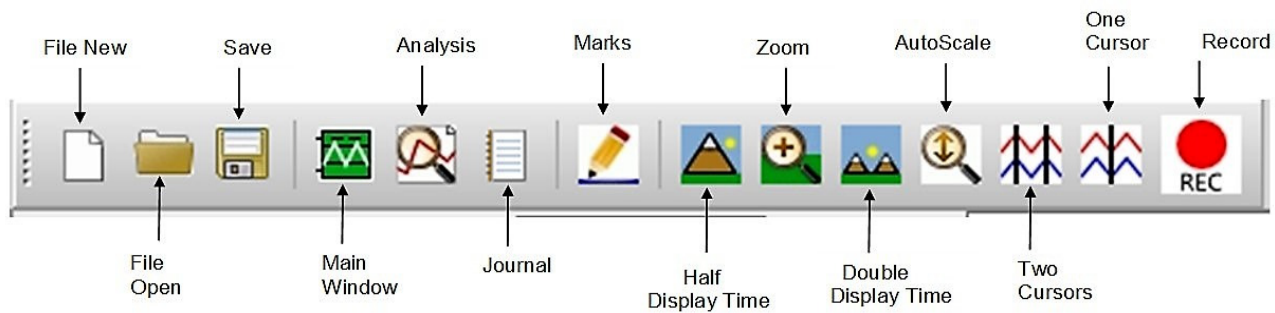
7. Firmly tap the subject's patellar tendon to elicit the stretch reflex. Record a total of five trials using the same firm tapping force. Wait at least 5 seconds between taps.
8. After the fifth trial, click Stop.
9. Select Save in the File menu.
10. Repeat this exercise on the same subject while the subject is voluntarily contracting his or her quadriceps.
11. Repeat this exercise on the same subject while the subject is performing the Jendrassik Maneuver. To perform this muscle activity:



Jendrassik Maneuver

Data Analysis

1. Scroll to the beginning of the data recorded for Exercise 1 to display the five trials on the Main window.
2. Click double display time (two mountain peaks icon) to show all the responses for the tendon tap and the EMG.
3. Use the mouse to click on and drag a cursor to the beginning of the signal recorded from the pulse sensor. Drag the other cursor to the beginning of the EMG wave.
4. The value for T2-T1 is shown in the upper right of the window. This is the length of time it took for the knee to react to the hammer tap.
5. Repeat Steps 3 and 4 on the data from the other 4 trials.
6. Calculate the mean reflex conduction (reaction) time of the subject. Record the mean reflex conduction time for the Patellar reflex at this relative strength of tap on the table below.



6. Measure the distance between the belly of the subject's quadriceps muscles and the site of the sensory-motor synapse in the spinal cord. For the purpose of this exercise, assume that the sensory-motor synapse is at spinal segments L5 and S1, which are just above the top of the hip bone. Multiply this measurement by 2 to determine the total length, up and down, of the nerve path.
7. Even though this stretch reflex is known as a monosynaptic reflex, the pathway includes the neuromuscular synapse (NMJ) as well. Assume that synaptic transmission takes about 0.5 msec, calculate the conduction velocity in the nerves composing this reflex pathway by the equation:

$$\text{Conduction Velocity (m/sec)} = \frac{\text{Total path length (mm)}}{(\text{Mean reflex time (msec)} - 0.5\text{msec})}$$

8. Record the conduction velocities for the Patellar reflex recorded from:

- Relaxed Quadriceps
- Tensed Quadriceps
- Jendrassik Maneuver

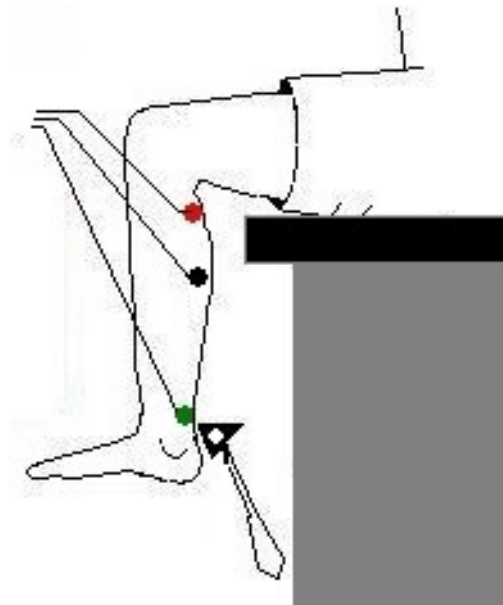
Questions

1. Is the patellar reflex inhibited or enhanced by voluntary muscle activity in the quadriceps? Speculate on the mechanism of inhibition or enhancement.
2. Is the patellar reflex retarded or facilitated during the Jendrassik's Maneuver (voluntary muscle activity in another part of the body)? Speculate on the mechanism of retardation or facilitation.

Exercise 2: Achilles Tendon Reflex

Aim: To determine conduction time from tendon tap to response of the gastrocnemius muscle in the Achilles tendon reflex arc.

Place the Electrodes



- the red lead is attached to the electrode near the back of the knee.
- the black lead is attached to the electrode in the middle of the calf muscle.
- the green lead (ground) is attached to the electrode on the ankle.

Procedure

1. Instruct the subject to sit on a lab bench so that the subject's thighs are supported by the top of the bench and his or her calves hang freely. The subject could also kneel on a padded chair with the subject's ankles and feet hanging over the edge of the seat.
2. The Achilles tendon is located above the heel and connects the gastrocnemius muscle to the tarsal bone of the foot. Tap the tendon with the wide end of the reflex hammer a few times to locate a point on the tendon which produces a consistent contraction of the gastrocnemius muscle and a downward movement of the foot (plantar flexion). The opposite, upward movement is known as dorsiflexion.
3. Click Record and then instruct the subject to move his or her foot up and down to demonstrate the type of EMG that occurs during plantar flexion and dorsiflexion. Click AutoScale All.
4. Type "Achilles" in the Mark box. Press the mark button. Continue recording.
5. Lightly tap the subject's Achilles tendon to elicit the stretch reflex. Record a total of five trials using the same light tapping force. Tap the tendon approximately once every 5 seconds.
6. After the fifth trial, click Stop.
7. Select Save As in the File menu and click on the Save button to save the data file.
8. Repeat this exercise on the same subject using two other amounts of force: medium and hard.

Data Analysis

1. Use the same technique explained in Exercise 1 to measure and record the conduction times of the subject's Achilles reflex: light force, medium force and hard force.
2. Measure the distance between the belly of the subject's calf muscle and the site of the sensory-motor synapse in the spinal cord. For the purpose of this exercise, assume that the sensory-motor synapse is at spinal segments L5 and S1, which are just above the top of the hip bone. Multiply this measurement by 2 to determine the total length of the nerve path.
3. Use the same formula as above to calculate conduction velocity.
4. Enter the mean reflex conduction times and velocities for this exercise in the table below.

Questions

1. Compare the average reflex times of the Achilles and patellar tendon reflexes. What factors contribute to the difference between the two reflex times?
2. Which muscle groups are involved in plantar flexion and in dorsiflexion of the ankle?
3. Does the subject's reflex time change with different stimulus strengths? Why does it or doesn't it change?
4. Besides excitatory inputs from stretch receptors, what synaptic inputs might influence the activity of spinal motoneurons?

Reflex Conduction Times and Velocities for Patellar and Achilles Tendon Reflexes.

Reflex	Mean Reflex Conduction Time (ms)	Reflex Conduction Velocity (m/s)
Patellar Tendon - Quadriceps Relaxed		
Patellar Tendon - Quadriceps Tensed		
Patellar Tendon - Jendrassik's Maneuver		
Achilles Tendon - Light Tap		
Achilles Tendon - Medium Tap		
Achilles Tendon - Heavy Tap		