



Al-Mustaqbal University
College of Engineering
Biomedical Engineering Department



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Lecture No.: - 2 -

Lecture Title: [Limb Position and Grip Strength]

Limb Position and Grip Strength

The importance of hand strength and function is evident in all aspects of our daily living, from eating and maintaining personal hygiene to typing at the computer, performing brain surgery, or playing tennis or the piano. People suffering from arthritis or hand injury quickly appreciate the difficulty of performing even simple tasks with reduced grip strength.

Testing of hand grip strength is used by orthopedic surgeons and physical therapists to evaluate the extent of an injury and the progress of recovery. Grip strength can also be used to diagnose neuromuscular problems such as stroke, herniated disks in the neck, carpal tunnel syndrome, and elbow tendonitis. Athletes are interested in grip strength because it relates to performance in many sports, such as tennis, golf, baseball, football, gymnastics, and rock climbing.

Pinch strength is a way for occupational therapists to measure loss of fine-motor strength in the thumb, fingers, and forearm. It is useful for analyzing the extent of an injury and the outcome from surgery or therapy.

In Part I of this experiment, you will measure and compare grip strength in your right and left hands. You will also correlate grip strength with arm position and handedness. In Part II you will analyze the pinch strength of each of your four fingers on your dominant hand.

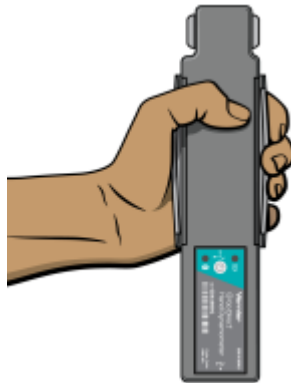


Figure 1

OBJECTIVES

- Measure and compare grip strength of your right and left hands in three different lower arm positions.
- Compare grip strength of dominant hand and nondominant hand.
- Compare the pinch strengths of the individual fingers of the dominant hand.

MATERIALS

Chromebook, computer, **or** mobile device
Graphical Analysis 4 app
Go Direct Hand Dynamometer

PROCEDURE

Part I Hand grip strength

Each person in the group will have a chance to be the subject. **Important:** Do not attempt this exercise if you have arthritis, carpal tunnel syndrome, or any ailment that might be exacerbated by using the muscles of your arm and hand.


1. Launch Graphical Analysis. Connect Go Direct Hand Dynamometer to your Chromebook, computer, or mobile device.
2. Set up the data-collection mode.
 - a. Click or tap Mode to open Data Collection Settings.
 - b. Change Rate to 100 samples/s and End Collection to 10 s.
 - c. Click or tap Done.
3. Zero the readings for the Hand Dynamometer.
 - a. Hold the Hand Dynamometer at the base, in an upright position. Do not put any force on the pads of the Hand Dynamometer.
 - b. When the readings stabilize, click or tap the Force meter and choose Zero. The readings for the sensor should be close to zero.
4. Have the subject sit with his or her back straight and feet flat on the floor. The Hand Dynamometer should be held in the left hand. The elbow should be at a 90° angle, with the arm unsupported and the hand in a neutral position (see Figure 1).
5. Have the subject close his or her eyes or avert them from the screen.
6. Click or tap Collect to start data collection. After collecting 2 seconds of baseline data, instruct the subject to grip the sensor with full strength for the next 8 seconds. Data will be collected for 10 seconds.
7. Determine the maximum and mean force exerted by your hand during a portion of the data-collection period.
 - a. Select the data from 4 s to 8 s.
 - b. Click or tap Graph Tools, , and choose View Statistics.
 - c. Record the maximum and mean force in Table 1.
 - d. Dismiss the Statistics box.
8. Repeat Steps 3–7 with the right hand. **Note:** The previous data set is automatically saved.



Figure 2

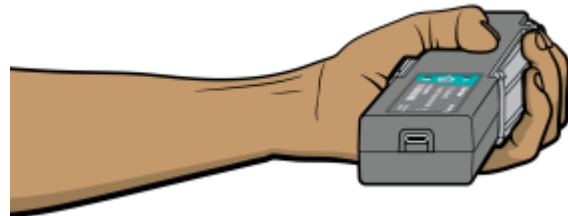


Figure 3

9. Repeat Steps 3–8 with the hand in a prone position (palm down) (see Figure 2).
10. Repeat Steps 3–8 with the hand in a supine position (palm up) (see Figure 3).
11. Repeat Steps 3–10 for each group member.
12. Work with your classmates to complete Table 2.

Part II Pinch strength

13. Change the data-collection duration.
 - a. Click or tap Mode to open Data Collection Settings.
 - b. Change End Collection to 30 s.
 - c. Click or tap Done.
14. Have the subject sit with his or her back straight and feet flat on the floor, holding the base of the Hand Dynamometer with the nondominant hand (see Figure 4). **Note:** No additional force should be placed on the sensor by this hand.

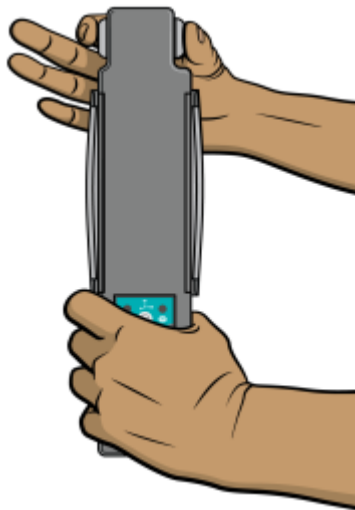




Figure 4

15. Have the subject close his or her eyes or avert them from the screen.
16. Zero the readings for the Hand Dynamometer.
 - a. Hold the Hand Dynamometer at the base, in an upright position. Do not put any force on the pads of the Hand Dynamometer.

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- b. When the readings stabilize, click or tap the Force meter and choose Zero. The readings for the sensor should be close to zero.
17. Click or tap Collect to start data collection. Instruct the subject to immediately pinch the end of the sensor between the pads of the thumb and forefinger of his or her dominant hand, and hold for 5 seconds.
18. Instruct the subject to switch to successive fingers every 5 seconds. Data collection will stop after 30 seconds.
19. Determine the mean force applied during each pinch.
 - a. Select the data in the first plateau on the graph to select the data representing the pinch strength of the thumb and index finger.
 - b. Click or tap Graph Tools, , and choose View Statistics. Record the mean pinch strength to the nearest 0.1 N in Table 3.
 - c. Select the data in the second plateau, representing the pinch strength of the thumb and middle finger.
 - d. Click or tap Graph Tools, , and choose View Statistics. Record the mean pinch strength to the nearest 0.1 N in Table 3.
 - e. Repeat this process to obtain statistics for the pinch strengths of the remaining two fingers.
20. Repeat Steps 16–19 for each person in the group.

DATA

Table 1: Individual Grip Strength Data		
	Maximum force (N)	Mean force (N)
Right hand grip strength: neutral		
Left hand grip strength: neutral		
Right hand grip strength: prone		
Left hand grip strength: prone		
Right hand grip strength: supine		
Left hand grip strength: supine		

Table 2: Class Grip Strength Data		
	Average mean force: neutral (N)	
	Right hand	Left hand
Right-handed individuals		
Left-handed individuals		

Table 3: Individual Pinch Strength Data	
	Mean force (N)
Dominant hand index finger	
Dominant hand middle finger	
Dominant hand ring finger	
Dominant hand little finger	

DATA ANALYSIS

1. Is there a difference in grip strength in your dominant and nondominant hands? Are you surprised by the result?
2. Does there appear to be a correlation between grip strength and arm position? If so, in which position was grip the strongest? Weakest?
3. Examining the data in Table 2, does there appear to be a correlation between “handedness” and grip strength? Are the results similar for right-handed and left-handed people?
4. Using the pinch strength data in Table 3, describe the difference in strength between fingers. Where is the difference the largest?
5. List at least two possible reasons for the differences you see between the pinch strength of the first two fingers and the second two fingers. In your answer consider actions of the hand and musculature. **Note:** You can use an anatomy book or atlas to view the muscles of the forearm and hand.

EXTENSIONS

1. Perform daily hand-strengthening exercises to increase your grip and/or pinch strength (such as squeezing a rubber ball). Measure your grip and/or pinch strength after two weeks and after four weeks. Compare the results with your original data.
2. Design an experiment to explore whether there is a correlation between grip strength and other physical characteristics such as height or arm circumference.