

BSL PRO Lesson H35: Range of Motion/Sit and Reach

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Introduction

A well-rounded physical activity program is an integral part of a strong, overall health, wellness, and fitness program. **Flexibility** is a major component of a well-rounded physical activity program and is defined as the ability of a joint (or group of joints) to move through its full **range of motion**. Good flexibility can prove to be beneficial for the musculoskeletal system. It may prevent injuries and soreness, improve body position and alignment/posture, and improve performance in sports and other activities.

Because of the importance of flexibility, fitness and sports medicine professionals typically assess an individuals' level of flexibility before prescribing an exercise, sports training, or physical rehabilitation program. Flexibility is joint specific, so there are no tests of overall general flexibility for an individual. Instead, **static flexibility** tests are used, which are based on linear and angular measures of the motion of a joint or group of joints. Static measures are widely accepted as a common clinical method of measuring flexibility and range of motion about a joint through the use of traditional goniometers and inclinometers. Commonly accepted field tests of static flexibility include, among others, the **sit and reach test**, which evaluates combined flexibility of the lower back and hips, and the supine straight leg flexion test, which evaluates hamstring and hip flexor flexibility. [Normative data values](#) have been established, which aid the examiner in assessing an individual's level flexibility and ROM at a specific joint.

Traditional sit and reach test scores and traditional goniometry measures of the hip are difficult to record throughout the range of motion. These traditional measures are only most effective at the beginning and end of the motion. In addition, it is difficult to quantify very small changes or improvements in flexibility with a sit and reach test alone. The BIOPAC electrogoniometer, however, provides a more effective method of overcoming these limitations – it provides a means of looking at joint angle of the hip throughout the entire range of motion, and it detects very small changes in the motion, as measured in degrees.

Measuring hip joint angle with an electrogoniometer in conjunction with the standard sit and reach test, the **straight leg flexion test**, and visual observation may allow an examiner to more effectively assess the flexibility of the individual. An examiner using these combined measures may be able to more accurately determine if improvements in flexibility of the individual have been made. In addition, continuous recording of joint range of motion through the use of these measures can provide testers with valuable insight into the kinematics of the test/activity. Kinematic information of interest could include, but is not limited to, the effect of ballistic movements on ROM or fluidity of the motion.

Read more about it...

- “Comparison Of Standard and Modified Sit-and-Reach Tests In College Students “ appeared in the spring, 1999 I.A.H.P.E.R.D. Journal.
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- “Current Issues in Flexibility Fitness” (2000) President’s Council on Physical Fitness and Sports Research Digest, 3:10
- Gajdosik, R.L, Guiliani, C.A., & Bohannon, R.W. (1990). Passive compliance and length of the

hamstring muscles of healthy men and women. *Clinical Biomechanics*, 5, 23-29.

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- Hopkins, D. R & Hoeger, W. W. K. (1992). A comparison of the sit-and-reach test and the modified sit-and-reach test in the measurement of flexibility in males. *Journal of Applied Sport Science Research*, 6:7-10.
- Norkin C.C., & White, D.J. (1995). *Measurement of joint motion: a guide to goniometry* 2nd ed. Philadelphia: F.A. Davis.
- Wilmore JH. Design issues and alternatives in assessing physical fitness among apparently healthy adults in a health examination survey of the general population. In: *Assessing physical fitness and physical activity in population-based surveys*. Washington, DC: National Center for Health Statistics, 1989. (US DHHS publication 89-1253.)

Objectives

1. To measure hamstring and back flexibility using a standard sit and reach test and determine if the measures fall within accepted normative ranges.
2. To measure hip joint range of motion and hamstring flexibility through the use of an electrogoniometer DURING the sit and reach test.
3. To measure hip joint range of motion and hamstring flexibility, performing a supine straight leg raise (passive or active), through the use of an electrogoniometer and compare to normative values.
4. Have a lab partner perform visual comparisons of the range of motion of the hip joint during each of the three activities and record the observations.

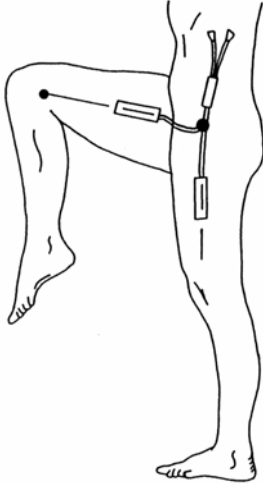
Equipment

- Twin Axis Goniometer 180 mm (SS21L)
- Double-sided adhesive tape (TAPE2)
- Standard sit and reach/flexibility box
 - To build your own: Attach two (2) pieces of 12" high wood at right angles to each other
- Ruler or yardstick to measure the extent of reach
- Computer running Windows XP or Mac OS X
- Biopac Student Lab *PRO* software
- BIOPAC Data Acquisition Unit (MP35/MP30)

Setup

Subject

- Connect the goniometer to the Subject to measure rotation of the hip joint axis (see the Hardware Guide for details as necessary).



Hardware

- Plug the goniometer into CH 1 on the MP3X unit.
- Plug the **gray** plug from the goniometer into CH 2 on the MP3X unit.
- Turn on the MP3X unit.

Software

- Use the graph template h35.gtl.
- If not using the template, confirm that Acquisition Setup is in "Append" mode.

Calibration

1. Select **MP menu > Set Up Channels**

2. Click the wrench icon to View/Change Parameters .

3. Click Scaling.

4. Under "Scale value," type:
 - a. 0
 - b. 90
 - c. degrees

5. Place the goniometer flat (180 degrees) on an even surface and then click **CAL1**.

OR

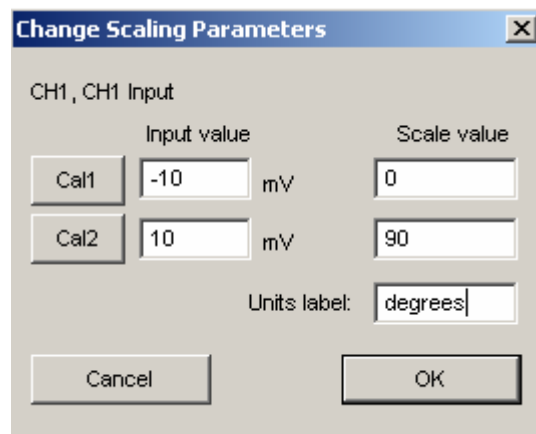
If using the "subject calibration method," secure the goniometer about the hip joint axis on the Subject, have the Subject lie flat, and then click **CAL1**.

6. Place the goniometer at 90 degrees and then click **CAL2**.

OR

If using the "subject calibration method," have the subject sit up, make sure the goniometer is at 90 degrees, and then click **CAL2**.

7. Click **OK** to save the new parameters and close the dialog.



Running the Experiment

- Advise Subject to avoid excessive extraneous movement.
- Check all transducer and hardware connections.
- Assign each test subject a partner to record measurements and make observations.

Condition 1 – Sit and Reach with Goniometry

1. Position the subject appropriately.
2. Subject sits on the floor with feet up against the sit and reach box, legs next to one another.
3. Click **Start**.
4. Subject leans forward with one hand over the other and slowly reaches forward as far as possible, three times, holding the position on the third reach for at least 2 seconds.
5. Partner records the measure reached on the sit and reach box
6. Partner makes visual observations and records them
7. Click **Stop**.

Condition 2 – Supine Straight Leg Flexion Test

8. Position the subject appropriately.
9. Click **Start**.
10. Subject completes flexion exercise:
 - a) slowly lifts one leg (side with the goniometer), keeping the other leg flat on the floor.
 - b) Keeps both legs straight.
 - c) Continues to the endpoint and then holds for several seconds.
 - d) Slowly lowers the leg to the floor.
11. This may be done passively or assisted.
12. Partner makes visual observations and records them.
13. Click **Stop**.

Data Analysis

1. Set measurement boxes as follows
 - a. Goniometer: max
 - b. Goniometer: min
2. Highlight the waveform for each activity and record values.
3. Evaluate waveform values and values recorded by the partner from sit and reach box.
4. Compare to normative data (below) to see if subject falls within accepted ranges.

FLEXIBILITY SCALE	Sit and Reach		Leg Raise	
	Male	Female	Male	Female
Performance Level				
High	16+	17+	111+	111+
Good	13-15	14-16	80-110	80-110
Marginal	10-12	11-13	60-79	60-79
Low	< 9	< 10	< 60	< 60

Adapted from Corbin, C.B., Welk, G.J, Lindsey, R., Corbin, W.A.
Concepts of Fitness and Wellness: A Comprehensive Lifestyle. 5th
 Ed., McGraw Hill, 2004.

5. Incorporate visual observations that might explain some of the values achieved.
6. Discuss what you measured, observed, and expected, and why the values you obtained were or were not in line with what was expected.

Active Learning

Encourage students to implement what they know about flexibility, apply it to an activity, identify a hypothesis, and test it out.

ACTIVE LEARNING SUGGESTIONS:

- **Statistics** — Determine if there is a statistically significant correlation between sit and reach measures obtained via a sit and reach box and range of motion values obtained through the use of an electrogoniometer. In addition, students may determine if the joint range of motion achieved during the sit and reach, as measured by the electrogoniometer varies significantly from the values found during the straight leg raise as measured by the electrogoniometer.
- **Sport-specific Training** — Prescribe a flexibility program to an athlete where hamstring and back flexibility is important. Test flexibility as well as their skill or sport performance pre and post. Look for improvements in flexibility and sport skill performance.
- **Rehabilitation/Therapeutic Concepts** — Prescribe different types of flexibility/stretching programs to groups of subjects (PNF, static, dynamic, etc.). Test improvement to determine which type of stretching was most effective.
- **Bilateral Leg on Straight Leg Flexion Comparison** — Perform the straight leg flexion test on the opposite limb to compare bilaterally.