
MUSCLE STRENGTH PROTOCOLS

I. GRIP STRENGTH (WITH DYNAMOMETER)

1. Description:

Grip strength is a measure of hand muscle strength that also is a good representation of upper body muscle strength. It is one of the most widely used measures of strength because of its simplicity and ease of measurement.

2. Equipment:

Preston Grip Dynamometer, Jackson MI (Takei Kiki Kogyo; "Smedley" Lightweight Hand Dynamometer) or the dynamometer from baseline (TEC). The handle should be adjusted so that the individual holds the dynamometer comfortably.

The grip dynamometer should be calibrated weekly by hanging at least 2 different weights (5 lb, 10 lb, 15 lb, etc) from the handle and recording the measure. The weights can be attached using velcro or any other means that works. Record the weight used and the result in a log book. Deviations of more than ± 2 kg should be reported to the Coordinating Center and the company should be called for repair.

3. Measurement Procedure:

a) Grip strength will be measured in both arms unless the participant has had a recent flare-up of extreme arthritis or recent surgery - in this case the unaffected side is not tested (see below). If the participant has a history of stroke or injury causing weakness (this injury occurred in the past and is not the cause of acute pain presently), still measure BOTH sides. Even though one side may be weaker, it does not have acute pain and thus can be tested.

Scoring: The scoring categories are mutually exclusive, so either each hand is tested and has a value or it is suffering from an acute flareup of pain and is thus "weakened" or the participant refused or is unable. There should not be a score and a box checked - this will result in logic errors.

- For each hand, determine if the subject has an acute flare-up of arthritis in the hand, or surgery in the hand or wrist in the past 3 months (12 weeks). If the subject has had an acute flare-up of arthritis or is less than 13 weeks post fusion, arthroplasty, tendon repair, synovectomy, etc. then do not test grip on the affected side (mark "weakened" on the form).

"Have you had a recent worsening of pain or arthritis in your hands, or have you had surgery on your hands in the past 3 months (12 weeks)?"

If yes, test grip strength in unaffected side only. Mark "weakened" on the form for the affected side only.

"This device measures your arm and upper body strength. I will demonstrate how it is done. Bend your elbow at a 90°

angle, with your forearm parallel to the floor. Don't let your arm touch the side of your body. Lower the device slowly, taking about 3 seconds, squeezing as hard as you can. Once your arm is fully extended, release your grip."

b) Place the dynamometer in the right hand with the dial facing the palm. The arm should be flexed 90° at the elbow and the forearm parallel to the floor. As you demonstrate, instruct the individual to squeeze the hand maximally while simultaneously lowering the arm on a three second count. The grip should be released when the arm is completely extended, hanging straight at the side.

c) Allow one submaximal practice trial using the right arm.

"Does that feel like a comfortable grip?"

Adjust the handgrip, if necessary.

"Now try it once just to get the feel of it. For this practice, just squeeze gently. Don't let your arm touch the side of your body. One, two, three."

d) Perform two trials on the right side.

"Good. Now this time it counts. We'll repeat this twice on the right side and then twice on the left side. Be sure to squeeze as hard as you can.

Ready? Ok. Squeeze as hard as you can! One, two, three (count out loud for the participant as she lowers her arm) "

Record the kilograms from the dial to the nearest 1 kg. Reset the dial. Perform the second trial.

e) Repeat the procedure for the left arm. No practice trial is needed for the left, but ask the subject if the grip is comfortable.

Precautions: The arm should not contact the body. The gripping action should be a slow sustained squeeze rather than an explosive jerk.

f) On the scoring form, there should either be a value for strength attained OR one of the three boxes - refused, unable, or weakened, should be checked (this will automatically put the correct special values for this participant in the field). The weakened box should only be checked if the participant has had recent arthritis or surgery on that side (and that side is not tested). (Weakened = 6's. Refused = 7's. Unable (unable to test) = 8's.)

g) **If the participant has trouble standing, this exam can be performed sitting or lying down. Make a note of these instances in the comments section of the exam form.**

4. QC Checklist - Grip strength

- Weakness and arthritis checked
- If stroke, test both sides
- Elbow kept near 90° ($\pm 15^\circ$)
- One practice given on right side
- Comfortable grip checked
- Instructed to "Squeeze as hard as you can"
- Slow sustained (3 second) extension
- Arm does not touch side of body
- Both right and left sided completed twice
- Only one response entered on data form
- Calibration logs up to date (weekly or biweekly)

II. QUADRICEPS ISOMETRIC TESTING (WITH WEIGHT MACHINE)

1. Equipment:

- a) Bodymasters MD110 leg extension chair with range of motion limits.
- b) Strain gauge load cell with a 0-1000 lb capacity; monitor (Lafayette Instruments). The monitor displays peak torque in pounds and average torque generated at the load cell during a specified data collection interval.
- c) Parts and accessories for adapting the MD110 for isometric testing with a strain gauge load cell. The load cell is inserted into the Kelvar belt system just above the weight stack. A steel indexed side plate is attached to the outside of the weight stack to immobilize it.
- d) Check the calibration of the load cell at the beginning of each week. (See instructions provided by Magnum Electronics, Fremont CA.) Calibration procedures may not catch all potential problems with the machine. Be alert to abnormal values or unusual functioning of your machine.

2. Subject preparation:

Contraindications: Traditionally, it is thought that the type of muscle straining produced by this test should be avoided after a recent MI. In addition, the test might pose a slight risk to persons with a cerebral aneurism. Although the risk associated with the test in these two situations is very small, we will consider a known cerebral aneurism and hospitalization for an MI in the past four weeks as contraindications for this test. Ask the participant, "Do you have an aneurism in your brain? In the past four weeks, have you been hospitalized for a heart attack or myocardial infarction?" If the answer to either question is "Yes", do not do this test. A "Don't know" answer is considered a "No" for purposes of this screen.

For those women who, in the past eight weeks, have had a knee replacement, surgery, fracture, or other contraindicating circumstance, only test quad strength on the unaffected side. Note the contraindicating circumstance on the form.

Hip replacement is not a contraindication for testing quadriceps strength.

Positioning: The subject should be seated comfortably in the leg extension chair, using the lumbar support pad as necessary for comfort. The back of the knee should be snug against the front edge of the seat. To provide stability during testing, the subject should be strapped snugly into the chair with the safety belts. Arms are held across the chest, with palms facing open toward the body. Allow the subject one practice trial on each side. To reduce muscle fatigue, effort during the practice should be moderate, not maximal.

"We've adapted this exercise chair to help us measure your strength as you push against the padded bar with your leg. When I tell you to, I want you to push your right leg as hard as you can against the padded arm. The arm will not move when you push, but the strength of your pushing will be measured electronically and displayed here on the monitor."

"When I say "READY", bring your leg up to the pad. A few seconds later I will start saying "PUSH, PUSH, PUSH, PUSH". When I say PUSH, push and keep pushing as hard as you can until I tell you to "RELAX". That will be about 5 seconds. You may feel a little discomfort in your leg as you push hard - that's normal. However, don't push so hard that you injure yourself."

"Please place your arms across your chest during the test. The safety belt will help to stabilize you as you push."

"Let's practice with your right leg. During the practice, don't push your hardest. I just want you to see how it feels."

3. Measurement procedures:

Isometric testing of quadriceps strength will be performed bilaterally, with one practice and two test trials on each side. A trial consists of 4 seconds of pushing. Force data are collected during the last 3 seconds of the trial.

Testing will be performed with the knee extended to 125° (or 35° of extension past the resting position with the knee at 90° with the subject sitting).

Set the testing angle to 125° by setting the range of motion limit to position G. Insert the pin through the top hole in the indexed side plate and into the weight stack. You can also insert the weight pin into the bottom weight of the stack to immobilize it (no one will be able to lift the whole stack). Use a goniometer to check the angle of the load arm relative to the plane of the seat.

The monitor should be turned on 15 minutes prior to testing. Set the testing intervals on the monitor: "Ready" interval to 1 second; "Test" interval to 3 seconds. The auditory signal on the monitor should be muffled by placing several pieces of masking tape over it.

a) Test the right leg first. When the subject is properly seated, adjust the padded arm so that the center line of the pad hits the subject's shin just above the ankle bone.

b) Portland clinic: Measure the length of the lever arm. Record this distance (in cm) in the specified section on the exam form.

Other clinics, set the lever arm length to the nearest whole number (0-9) and record the whole number in the "lever arm setting" section of the exam form (not in the "length of the lever arm section").

c) Ask the subject to get "READY" by pushing lightly on the pad with her leg until tension is placed on the load cell. (There is an inch or so of play in the belt system.) Press the INITIATE switch and at the same instant begin saying "PUSH, PUSH, PUSH, PUSH." Data collection begins when the tone sounds and the green light comes on. When the tone sounds a second time and the green light goes off, tell the subject to "RELAX".

Keep saying "PUSH" throughout the 5 second trial, about once per second. Use an even and encouraging tone. Use the same tone and encouragement for all subjects.

d) Record peak and average torque in pounds.

Repeat the test once for the right leg. Then, after a moderate effort practice trial on the left, test the left leg twice.

4. Scoring

Any value under 10, although possible, should be considered suspect. Consider the physical abilities of the participant, her comprehension, etc to determine whether a retrial should be conducted. The goal here is accurate strength data. If the participant didn't understand the instructions or had a momentary lapse in concentration that may have resulted in a lower than expected score, test her again.

5. OC Checklist - Quadriceps strength (Body master)

- Calibration records kept
- Monitor turned on 15 minutes before testing
- Intervals set at 1 (ready) and 3 (test) seconds
- Auditory signal muffled
- Length of lever arm measured
- Subject seated with back of knee against edge of seat
- Subject keeps arms across chest, palms open toward body
- Correct (125°) testing angle ($\pm 10^\circ$)
- Examiner says "push, push..." throughout trial
- Completed twice on both sides
- Peak and average torques recorded on form