

## Standard chair **GRIP STRENGTH**

### **1. Background and Rationale**

Muscle strength is an important contributor to functional performance. The contribution of strength to performance, disability and mortality is primarily related to the amount of muscle present, its functional competency, and how well it can be activated by the peripheral and central nervous systems. Grip strength is a commonly used measure of upper body skeletal muscle function and has been widely used as a general indicator of frailty and in absence of other measures of strength is generally considered a very good marker of global muscle strength. Grip strength in both hands will be measured using an adjustable, hydraulic grip strength dynamometer.

#### **Objective**

The grip strength measurement will be compared to the isokinetic strength measurements that are being collected. Grip strength has been commonly used by other epidemiological studies and allows for direct comparisons of BLSA and other studies.

#### **Recommended Instrument(s)**

Jamar Hydraulic Hand Dynamometer, which registers maximum kilograms of force during a trial, with adjustable handgrip.

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- Table with adjustable height (moveable tray table preferred)
- Mouse pad

#### **Strengths and weaknesses of selected approach**

The main strength of the assessment is ease of measurement, reliability and reproducibility of measurements. The weaknesses include the testing of multiple muscle groups from several different nerves. Several of the muscles and both nerves involved are frequently traumatized and are common contributors to mononeuropathy that invalidate the measure as a general measure of muscle function.

#### **Analogous (past) measures used in the BLSA**

Grip strength was measured from 1960 to about 1985 using a fairly similar

protocol. In addition, isometric arm strength was measured over the same period, and knee and elbow isokinetic strength were measured from approximately 1993 to 2002. At present, knee isokinetic and isometric strength is measured in addition to grip strength.

### **Reliability/Validity Studies**

The coefficient of variation between measurements during a single test session is 6%. Test-retest reliability between tests done on consecutive days was .94 (Metter et al, 1998).

### **Key Variables**

Grip strength in right and left hand in kgs.  
Questions about pain and recent surgery that might affect the testing

## **2. Equipment and Supplies**

Jamar Hydraulic Hand Dynamometer which registers maximum kilograms of force during a trial, with adjustable handgrip.

### **Maintenance**

For routine maintenance, follow the instructions in the Jamar dynamometer owner's manual.

**Service Tips:** To make sure the instrument is reading accurately, it's a good idea to make a few checks each month, as listed below.

**Posts:** Remove the adjustable handle and check that each post moves up and down freely (through a very small distance, about 1/8") within the plastic aperture (the guide) even when you exert pressure on the side of the post. About once a year, place a small amount of grease on the two guides. If excessive friction exists between the post and guide, return the dynamometer to the QC officer.

**Hydraulics:** To check the hydraulic mechanism, first remove the adjustable handle. While watching the top post, push down on the bottom post. Normally, both posts should move about 1/8", with top and bottom posts moving in opposite directions. Movement less than 1/16" indicates a probable leak in the hydraulic system, which requires service.

**Handle:** Grasp the instrument normally and look carefully at the way the forks of the adjustable handle are supported on the posts. Each fork should touch the post at approximately its mid-point.

**Peak-Hold Needle:** Check for excessive friction in the peak-hold assembly by turning the peak-hold knob counter-clockwise. If the peak-hold needle causes the gauge needle to move, return the gauge for service. If the peak hold needle is knocked off its support pin, it can readily be repositioned. Unscrew the crystal and turn it upside down. Locate the brass pin in the center of the crystal (the pin is part of the chrome knob on the outside of the crystal). Locate the slot on the brass pin and place the peak-hold needle into this slot.

### Calibration

Every week: Check the calibration of the grip strength dynamometer by hanging 5 kg and 20 kg (or 10 and 50 lb) weights across the handle using two Velcro straps, one strap on each side of the dynamometer handle, or one wide strap that covers the whole handle. Lift the weights slowly from the floor while they are strapped to the dynamometer handle and record the maximum kilograms registered. The lifting motion should be very slow and smooth, and the weight should remain evenly distributed between the two sides of the handle. Repeat the procedure three times and record each result.

Average the three calibration trials. The dynamometer should be accurate within  $\pm 2$  kgs for the average of the three calibration trials. It may be necessary to send the dynamometer to the manufacturer for repair and recalibration. DO NOT attempt to recalibrate the dynamometer yourself. Calibration problems can be caused by dropping the dynamometer or by leaks in the hydraulic system.

### 3. Safety Issues and Exclusions

This test should not be performed in the affected hand if the participant has undergone fusion, arthroplasty, tendon repair, synovectomy, or other related surgery of the upper extremity in the past 3 months. If only one side is affected, test the unaffected side. The test can be performed if the participant has a current flare-up of pain in their wrist or hand; for example arthritis or tendonitis. Be sure to record this information on the data collection form.

### 4. Participant and Exam Room Preparation

The participant should be seated at a standard height table or on a seat with a moveable tray table attached.

## 5. Detailed Measurement Procedures

Grip strength will be measured in three trials of each hand (unless there are extenuating circumstances - see above) using a hydraulic, isometric dynamometer.

### Administration

Ask the subject the following questions as indicated on the Teleform and mark the appropriate responses on the form.

Determine if the participant has had surgery on their hands or wrists in the past three months.

Script: “Have you had any surgery on your hands or wrists in the past three months?”

Record response on Teleform.

If the participant says “Yes,” ask them which hand or wrist was operated on, and do not test that hand.

Determine if the participant has an acute or recent flare of arthritis in their hands.

Script: “Has any pain or arthritis in your right hand gotten worse recently?”  
Record response on Teleform.

Script: “Will the pain keep you from squeezing as hard as you can?”  
Record response on Teleform.

Script: “Has any pain or arthritis in your left hand gotten worse recently?”  
Record response on Teleform.

Script: “Will the pain keep you from squeezing as hard as you can?”  
Record response on Teleform.

Pain or arthritis that has gotten worse recently is not an exclusion for this test. If the participant is willing to have the grip strength test, test the participant and record the results on the data collection form.

### 3) Demonstration and practice

The examination is done with the participant in the sitting position with the arm to be tested resting on the table and the elbow held at approximately a 180 degree angle (shoulder height) with the arm extended to the side. The dynamometer is held in the hand to be tested and is resting on a mouse pad.

Script: “I’d like you to take your right/left, arm, extend it to your side and rest it on the table. Grip the two bars in your hand, like this. Please slowly squeeze the bars as hard as you can.”

Demonstrate the correct grip and arm position. As you demonstrate, instruct the participant to squeeze the hand maximally.

Adjust the grip size so that the participant holds the dynamometer comfortably (this will almost always be the second setting). If the handle hits the participant’s hand distal to the second knuckle the grip size should be smaller. Allow one submaximal practice trial to determine if the procedure is understood by the participant and the grip size properly adjusted. If the participant’s finger nails are hitting their palm the dynamometer needs to be adjusted to a larger grip size.

Script: “Now try it once just to get the feel of it. For this practice, just squeeze gently. It won't feel like the bars are moving, but your strength will be recorded. Are the bars the right distance apart for a comfortable grip?”

Show dial to participant. Adjust the handgrip again, if necessary.

### 4) Test grip.

Script: “We’ll do this three times. This time it counts, so when I say squeeze, squeeze as hard as you can. Ready. Squeeze! Squeeze! Squeeze! Now, stop.”

Have the participant perform the test, starting with the right hand. Set the dynamometer to zero prior to each attempt:

Record the kilograms pulled from the dial to the nearest 2 kilograms onto the Teleform. If the reading is exactly between two readings on the scale, round up to the next higher even number. Reset the dial to “0” after each trial.

Perform three trials with at least 15 to 20 sec rest in between.

Script: “Now, one more time. Squeeze as hard as you can. Ready. Squeeze! Squeeze! Squeeze! Now, stop.”

5) Repeat the procedure on the left side, unless contra-indicated. Record the results of all trials onto the Teleform.

## **6. Procedures for Performing the Measurement at Home**

Same procedure

## **7. Alert Values/Follow-up/Reporting to Participants**

When the test is completed tell the participant how many kilograms were read on the dial and that they did just fine.

Record maximum kilograms for each side on participant's results form.

## **8. Quality Assurance**

### **8.1. Training Requirements**

The technician requires no special qualifications for performing this assessment. The training should include:

- Read and study manual
- Practice on other staff or volunteers
- Discuss problems and questions with knowledgeable staff

### **8.2. Certification Requirements**

- Complete training requirements
- Demonstrate maintenance check of dynamometer
- Demonstrate the proper adjustment of dynamometer handles
- Demonstrate the calibration check procedures
- Recite exclusions
- Conduct exam on 2 volunteers:
  - According to protocol, as demonstrated by completed QC checklist
  - $\pm 2$  kgs on repeat assessment of volunteer

### **8.3. Quality Assurance/Certification Checklist**

- Participant is asked about recent surgery on hands
- Participant is asked about pain and arthritis in hands
- Correct instructions given while demonstrating procedure
- Recording dial reset to zero after sub maximal practice
- Sub maximal practice; grip adjusted if necessary
- Forearm resting on table, elbow bent to approximate right angle
- Standard encouragement (motivation and feedback) offered to participant
- Recording dial (peak hold needle) reset to zero after first trial
- Measurement taken twice on each side (unless contra-indicated)
- Key points from script delivered clearly
- Reviews form for completeness
- Correctly completes form
- Log indicates calibration check up to date

## 9. References

1. Kallman DA, Plato CC, Tobin Jd. The role of muscle loss in the age-related decline of grip strength: cross-sectional and longitudinal perspectives. *J Gerontol* 45:M82-88, 1990.
2. Metter EJ, Conwit R, Metter B, Pacheco T, Tobin T. The relationship of peripheral motor nerve conduction velocity to age-associated loss of grip strength. *Aging Clin Exp Res* 10:471-478, 1998.
3. Metter EJ, Talbot LA, Schragger M, Conwit RA. Skeletal muscle strength as a predictor of all cause mortality in healthy men. *J Gerontol Med Sci Biol Sci* 57A:B359-B365, 2002.