

1/12/89

STUDY OF OSTEOPOROTIC FRACTURES (V2)

Muscle Strength Testing Protocol

I. LOWER EXTREMITY MUSCLE STRENGTH TESTING WITH HAND-HELD DYNAMOMETER

1. Introduction:

These tests are designed to estimate the subject's maximum isometric strength. The examiner must push on the subject's limb with the maximum force needed to overcome the resistance of the subject. The peak force attained will be automatically recorded on the dynamometer.

In order to measure the strength of the muscle, we must know the distance between the joint that is moving and the place where the dynamometer is placed. These measurements were obtained at the baseline exam.

2. Equipment:

Hand-held dynamometer (Spark Instruments, Coralville IA)

3. Measurement Procedures:

A. DETERMINE WHICH SIDE TO TEST

a) Ask the subject:

"Have you had a stroke or injury that has made one side of your body weaker than the other?"

Record the answer. If "no," test only the right side. If "yes," test both sides.

b) Do not test on side with recent hip or knee joint replacement (less than 8 weeks postoperative). **TEST ON THE NONOPERATED SIDE.**

For participants with hip or knee replacement more than eight weeks postoperative, ask about any recent problems they have had with pain or instability in the prosthesis. If pain, instability, loosening, or other complications are reported, **TEST ON THE NONOPERATED SIDE.**

B. TEST HIP ABDUCTORS

a) The participant should be in the supine position on the examining table. The leg to be tested should be flat against the examination table with the patella directed upward. Put a vinyl covered sandbag under the lowest part of the leg so that the heel is resting slightly off the table.

The opposite (left) leg should be bent with the sole of the foot flat against the bed and the side of the knee resting against the wall.

b) Measure the distance between the tip of the greater trochanter (hip bone) and the lateral malleolus (ankle bone). We will use baseline values.

c) As you give the instructions below, demonstrate what you will do by pushing the dynamometer with one hand against your opposite arm.

"I am going to use this device to measure how strong your hip muscles are (show it to patient). I will put this cushioned part against your leg. When you are ready, I will count to three. When I count three I will begin to push against your leg. I want you to hold your leg there, don't let me push it back. When I say '**PUSH, PUSH, PUSH,**' I want you to push against the bar as hard as you can. Don't be afraid to push as hard as you can. **DON'T LET ME MOVE YOUR LEG-- PUSH BACK.** I will take two measurements."

d) Tell the participant to hold on to the edges of the examination table.

The examiner should stand with legs apart facing the participant's leg. Hold the dynamometer firmly with your elbow bent at 90° and tucked firmly against your body. Support the hand that is holding the dynamometer with the other hand.

Lift the participant's leg and demonstrate how she should push her lower leg outward, away from the wall. Say:

"Keep your knee straight. Do not bend your knee."

e) Place the dynamometer along the lateral side of the lower leg 3 cm above the lateral malleolus (ankle bone). When the dynamometer is in place say:

"Ready? One, two, three, **HOLD, HOLD, PUSH, PUSH, PUSH...RELAX.**"

Push hard enough to move her leg back toward the wall.

f) Record the measurement. Record whether you were able to overcome her resistance by moving her leg backward a little.

g) Reset the dynamometer to ZERO for the next examination.

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II. TOE STANDS AND HEEL WALK

1. Equipment: Stopwatch.

2. Measurement Procedures:

A. TOE STANDS

a) Have the participant remove her shoes and stand facing a wall.

"Now I'm going to ask you to put the palm of one hand on the wall at about the same height as your shoulder. Then I want you to raise up on your toes with your heels off the floor about two inches. Do not bend your knees as you do this. I'll tell when your heels are high enough. Try to hold that position for about 10 seconds. I'll tell you when to stop."

b) Demonstrate the position and toe stand.

c) Ask the participant to stand on her toes. If the participant is reluctant or afraid to stand on toes, offer to steady her with a hand on the waist.

d) Record:

i) whether participant is able to attain the position, and if assistance is required;

ii) the number of seconds the subject is able to hold the position, with heels raised about 1-2 inches, up to 10 seconds. Time ends if either heel touches the floor.

B. HEEL WALK

a) With shoes removed, have the participant stand facing an obstacle free area about 6 feet in length.

"Now I'm going to ask you to walk on your heels without touching the ball of your foot to the floor. If you can, I'd like you to take four steps doing that. I'll hold your forearm for balance while you do this"

b) Demonstrate the heel walk for the participant.

c) Holding the participant's forearm for stability (but without supporting her weight), walk with her as she takes up to four steps. Count the steps out loud as she walks. Guard the subject closely for loss of balance.

d) Record

i) the number of steps taken without the ball of the foot touching the floor

ii) whether the participant is able to walk on heels on one or both sides.

III. 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.)

2. Subject preparation:

The subject should be seated comfortably in the leg extension chair, using the lumbar support pad as necessary. 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.

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:

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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. 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 seconds; "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 distance A on the lever arm (Figure 4). Other clinics, set the lever arm length to the nearest whole number and record.

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. When the yellow light comes on, immediately say "PUSH, 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.

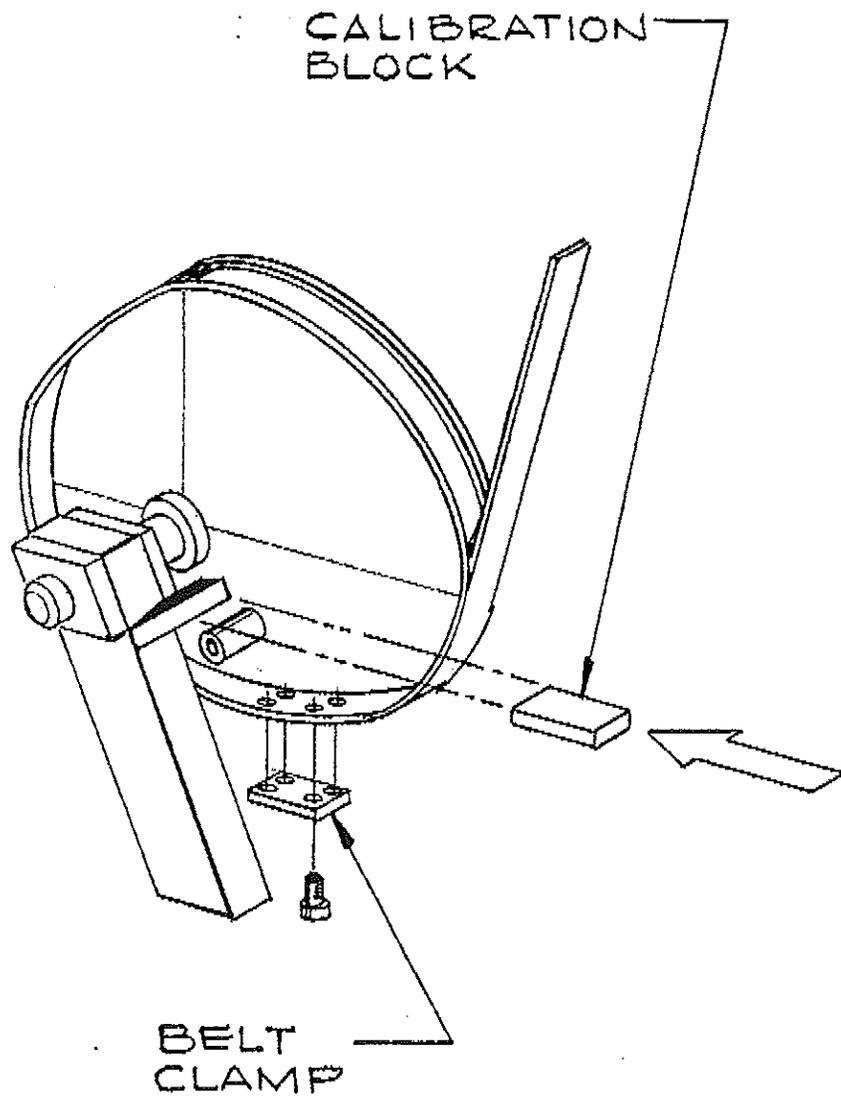
Repeat the test once for the right leg. Then, after a moderate effort practice trial on the left, test the left leg twice.

Calibration Procedure :

After installation of the load cell assembly has been completed it will be necessary to check and or recalibrate the load cell to it's testing environment. For this procedure the load selection pin will be inserted into the weight stack from the chair side.

- 1.) Plug in load cell to connector labeled XDUCER.
- 2.) Turn on system power, and allow to warm up for at least 15 minutes. (At this time you may decide to put masking tape over the black plastic protrusion on the back of the system. This is source of the obnoxious tone you experienced on power up.)
- 3.) Place the load selection pin in the 100 lb hole on the weight stack.
- 4.) Set Ready for 1 second and Test Time for 0 seconds.
- 5.) With weight machine in neutral condition, (weight stack at rest), start a test by pressing the initiate button. Peak and Average should both be 000 ± 1 . (If reading is off adjust ZERO screw and retest until correct.) NOTE : If both Peak and Average are off adjust peak first.
- 6.) Set Ready and Test times for 1 second.
- 7.) Repeat step 5. If reading is off adjust Offset screw, located next to XDUCER plug, and retest until reading is correct.
- 8.) Using load arm raise weight stack enough to insert calibration block (Fig. 3).
- 9.) Start test by pressing initiate button. Peak and Average should read 100 ± 2 . (If reading is off adjust cal screw, and repeat test until correct.) If both peak and average are off adjust peak first.
- 10.) Set Ready for 1 sec. and test for 0 sec., and test. Reading should be same as in step 5. If not use step 5 adjusting procedure.
- 11.) Repeat steps 5 thru 10. Calibration is now complete. Calibration should be checked a weekly basis. Extremes in temperature and too short of a warm up period can also affect calibration.

FIG 3



IV. GRIP STRENGTH DYNAMOMETER

1. Equipment: Preston Grip Dynamometer (Takei Kiki Kogyo). The handle should be adjusted so that the individual holds the dynamometer comfortably.

2. Measurement Procedure:

a) Grip strength will be measured in both arms.

"This device measures your arm and upper body strength. We will measure your grip strength in both arms. 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 as you squeeze as hard as you can. Once your arm is fully extended, you can loosen 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 practice trial for each arm.

d) On the second trial, record the kilograms pulled from the dial to the nearest 0.5 kg.

e) Reset the dial. Repeat the procedure for the left arm.

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