

# Centre for Exercise and Rehabilitation Science (CERS)

## **Standard Operating Procedure – Quadriceps Maximal Voluntary Contraction (QMVC)**

### **Scope and Purpose**

The quadriceps muscle is of significant functional importance and may be affected by disuse, local disorders, or systematic problems. The force generated by a contracting muscle depends upon a number of factors, including the number of fibres stimulated and the muscle length.

It is important that the same procedure is always followed to obtain a Quadriceps Maximal Voluntary Contraction (QMVC) to ensure consistent, reproducible and standardised measurements.

### **Equipment**

Quads chair with seatbelt, ankle strap and strain gauge.  
Data acquisition system.

### **Precautions**

Patients will not have the MVC recorded on the right if they report any known confounding musculoskeletal or neuromuscular pathology affecting the right leg. This will include:

- 1) Severe osteoarthritis of either the right hip or knee joint which causes pain when positioned or performing the manoeuvre as described above
- 2) Compressive spinal pathology affecting the lumbar nerve roots
- 3) Polyneuropathy or mononeuropathy affecting the femoral nerve. Patients with diabetes will general NOT be considered to fall into this category.
- 4) Co-existent or progressive motor neuron, neuromuscular junction or primary muscle disease.
- 5) Previous stroke (thrombo-embolic or haemorrhagic) affecting the right side
- 6) Critical peripheral vascular disease affecting proximal leg blood flow (aorto-iliac disease)

If you are unable to assess the right leg, you can determine whether the left leg falls into any of the above these categories. If not, the left leg may be used for testing on that patient, however this must be clearly recorded and *all* other quadriceps/thigh tests on that patient must be performed on the left leg.

### **Procedure**

QMVC is measured using the technique described by Edwards et al (1977)(1). The subjects are studied seated in the quads chair, with hip and knee flexion of 90 degrees. An inextensible strap is placed around the ankle, immediately proximal to the malleoli, adjusted to ensure the knee remains at 90 degrees flexion. The ankle strap is connected to a strain gauge mounted on the back of the chair, and runs perpendicular to both the ankle and the strain gauge. A seatbelt is secured across the subject's hips to stabilise the pelvis.

Where possible the participant's dominant leg should be measured. The non-dominant leg should be measured instead should there be a contraindication to testing the dominant leg.

- 1) The procedure should be explained to the subject.
- 2) The subject should rest their hands/arms across their chest to avoid the use of their upper limbs to increase force. Supervision should be provided to ensure the patient does not use other muscle groups to increase contraction force, such as holding on with hands, arching the back, lifting the buttocks off chair, or pushing the pelvis upwards against the hip strap.
- 3) The subject is asked to perform a warm-up consisting of four contractions at approximately 50% effort, followed by four contractions at approximately 75% effort, before commencing QMVC measures.
- 4) The QMVC measurements can then be commenced. Strong encouragement should be provided to obtain a maximal effort. The display should be visible to subject and investigator to provide visual feedback
- 5) For the purpose of measurement, the maximal contraction needs to be maintained for several seconds.
- 6) At least a 20 second interval between maximal contractions should be observed to allow time for recovery.
- 7) Six QMVC contractions should be performed, with the best effort recorded. If force is increasing additional manoeuvres are permitted.
- 8) The QMVC is recorded as the maximal force able to be maintained for one full second. Also record the peak force created (excluding any initial spike created by poor technique) and the mean force.

### **Analysis**

Retrospective analysis is completed through LabChart systems using the COPD/MAP WP4 Macro application (Appendix 1).

### **Reference**

(1) Edwards RH, Young A, Hosking GP, Jones DA. Human skeletal muscle function: description of tests and normal values. Clin Sci Mol Med 1977 Mar;52(3):283-290.

*This has been modified for CERS from the COPD/MAP WP4 SOP V1 (C Smith, N Hopkinson and M Polkey, 2011)*

## **Appendix 1: LabChart Macro for Analysing QMVC**

- 1) Load the LabChart file you want to analyse
- 2) You will have six measures in the file with at least 20 seconds rest in-between.
- 3) Starting at the first measurement, use curser to click an area just before a QMVC wave begins.
- 4) Then click the 'new' macro tab at the top of the page.
- 5) Scroll through the table and find the highest value in the minimum column.
- 6) Repeat for each of the six QMVC and record accordingly on your CRF/clinic file.
- 7) The best of the six measurements should be chosen.