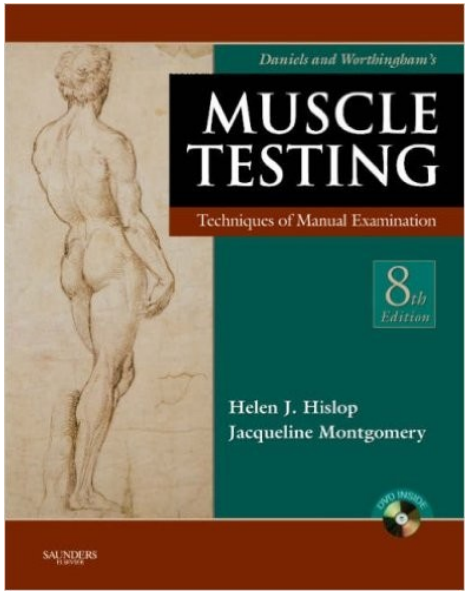
Examination Methods in Rehabilitation, 5.10.2020

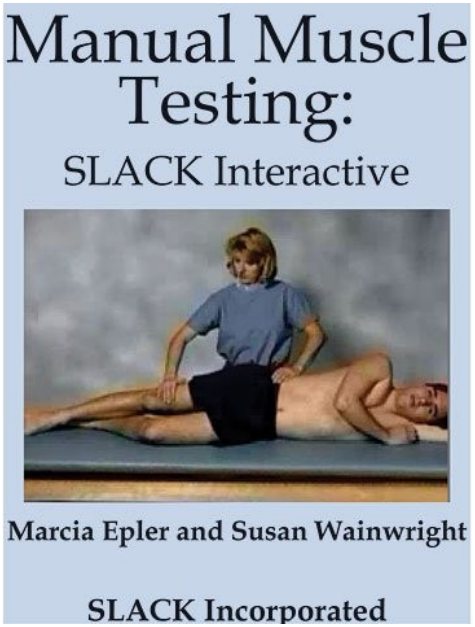
Manual muscle testing Introduction (1)



Mgr. Veronika Mrkvicová (physiotherapist)

Content

- Muscle strength
- Assessing muscle strength
- Manual muscle test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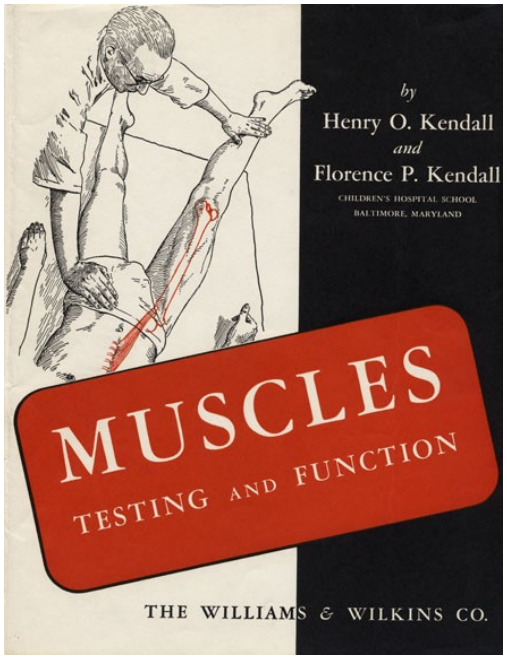
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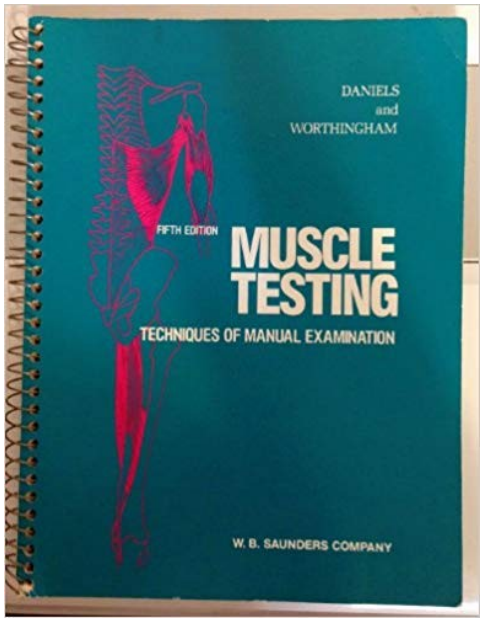
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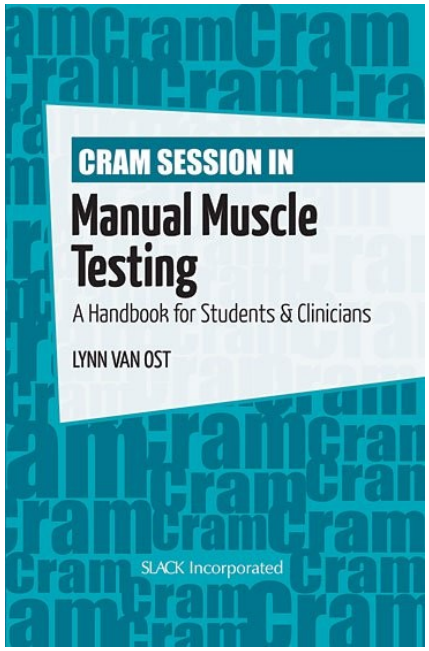
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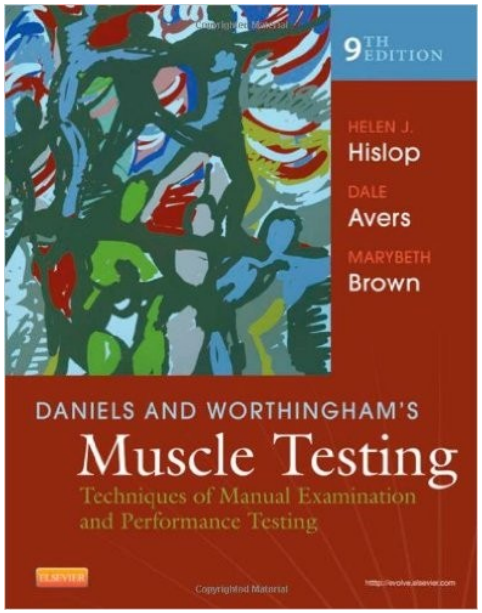
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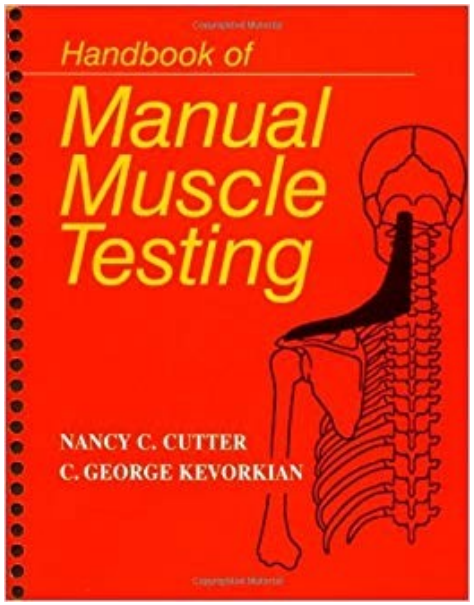

Handbook of
Manual Muscle Testing
NANCY C. CUTTER
C. GEORGE KEVORKIAN

Introduction

- **The measurement of muscle function** is an essential component of many neurological and physical exams

Muscle strength correlates to :

- function
- work productivity
- general quality of life

Muscle function becomes compromised:

- as we age
- when associated with a skeletal impairment
- as a secondary consequence of many disease processes

Assessing muscle function

It is **an important clinical skill** that is routinely used by:

- Neurologists
- Orthopedists
- General practitioners
- Occupational and physical therapists

Assessing muscle function

Evaluation of muscle strength is used for:

- Diagnostic, differential diagnosis
- Examine the improvement or deterioration of a patient's status over time
- Predictive or prognostic tool
- Determine the extent of strength loss
- Outcome measures in clinical research
- Determine the need for compensatory measures or assistive devices
- Helps in the formulation of the treatment plan
- Evaluates the effectiveness of treatment

Assessing muscle function

There are several components of muscle performance:

Muscle performance

Muscle strength

Instantaneous muscle power

Muscle endurance

Of these performance indicators, muscle strength is the one most commonly measured when assessing the muscle function

Components of muscle performance

1. Muscle performance

- the capacity of a muscle to do work

Components of muscle performance

2. Muscle strength

- the force exerted by a muscle or group of muscles to overcome a resistance in one maximal effort

Components of muscle performance

3. Instantaneous muscle power

- the mechanical power produced by the muscle (muscle force times muscle velocity)

Components of muscle performance

4. Muscle endurance

- the ability to contract a muscle repeatedly over time

Assessing muscle strength

- In assessing muscle strength, **the conditions** under which the muscle contracts must be specified so that the muscle test data can be interpreted properly

The following conditions are relevant:

- Isometric contraction
- Isotonic contraction
- Isokinetic contraction

Assessing muscle strength

1. Isometric contraction

- the muscle contracts while at a fixed length

2. Isotonic contraction

- the muscle contracts while working against a fixed load (eg. a hanging weight)

3. Isokinetic contraction

- the muscle contracts while moving at a constant velocity (generally, isokinetic contractions are only possible with the limb strapped into a special machine that imposes the constant velocity condition)

Assessing muscle strength

Eccentric contraction

- the muscle contracts against a load that is greater than the force produced by the muscle so that the muscle lengthens while contracting

Concentric contraction

- the muscle contracts against a load that is less than the force produced by the muscle so that the muscle shortens while contracting

Muscle weakness

- It means any reduction of the normal ability of the muscle to generate force

Causes:

- Muscle strain
- Pain, reflex inhibition
- Nerve root lesion
- Tendon pathology, avulsion, rupture
- Prolonged disuse/immobilization
- Psychological overlay

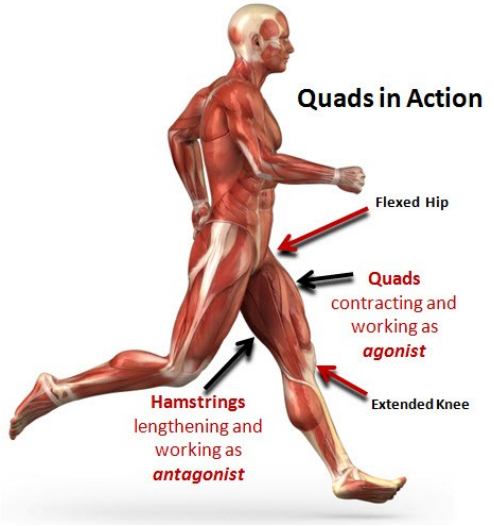
Muscles work in pairs

- Muscles usually work in pairs or groups (e.g. the biceps flexes the elbow and the triceps extends it) – it is called **antagonistic muscle action**

- The working muscle is called the prime mover or **agonist**. The relaxing muscle is the **antagonist** (e.g. quadriceps and hamstrings)

- The prime mover is helped by other muscles called **synergists.** These contract at the same time as the prime mover. They hold the body in position so that the prime mover can work smoothly

Muscles

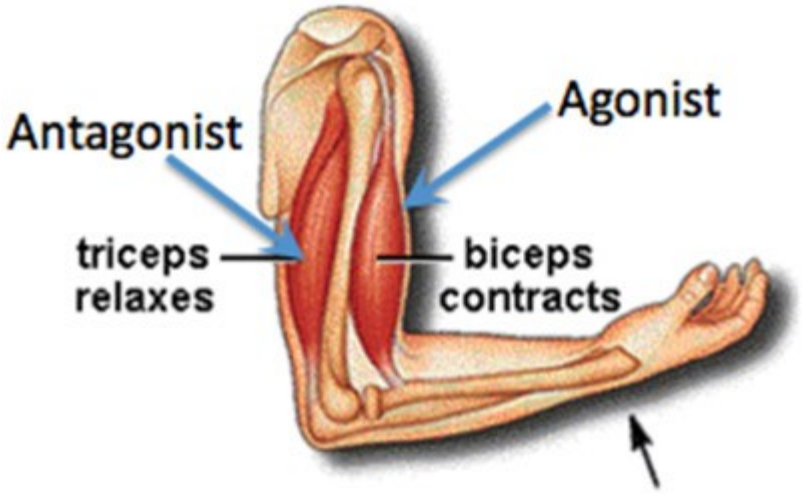


- *Agonist* muscles cause a movement to occur through their own contraction
- *Antagonist* muscles oppose a specific movement. This controls a motion, slows it down, and returns a limb to its initial position
- *Synergist* muscles performs, or helps perform, the same set of joint motion as the agonists. Synergists muscles act on movable joints. Synergists are sometimes referred to as "neutralizers" because they help cancel out, or neutralize, extra motion from the agonists to make sure that the force generated works within the desired plane of motion

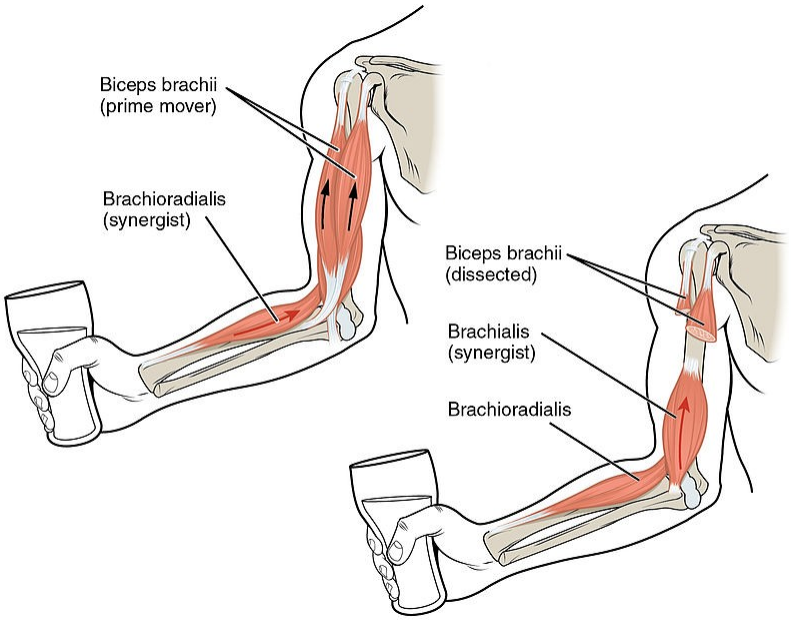
Muscles

Neutralizer Action

- A muscle that fixes or holds a bone so that the agonist can carry out the intended movement is said to have a neutralising action



Muscle function



- The biceps brachii flex the lower arm. The brachoradialis, in the forearm, and brachialis, located deep to the biceps in the upper arm, are both synergists that aid in this motion

Manual muscle test (MMT)

Definition

- **Manual muscle testing (MMT)** is an attempt to determine a patient's ability to voluntarily contract a specific muscle

- (Keep in mind that this does not provide information on the patient's ability to use the muscle in daily activities, or if the muscle interacts with other muscle around it in a synergistic pattern)

MMT

- it is **the simplest and most common method** of assessing muscle strength

- a procedure for **evaluating strength and function** of an individual muscle or a muscle group in which the patient voluntarily contracts the muscle against gravity load or manual resistance

- **quick, efficient, and easy to learn,** however, it requires total cooperation from the patient and learned response levels by the assessor

MMT

- The procedures for conducting the MMT have been **standardized** to assure, as much as possible, that results from the test will be **reliable**

- The specific muscle or muscle group must be determined and the examiner must be aware of, and control for, common **substitution patterns** where the patient voluntarily or involuntarily uses a different muscle to compensate for a weak muscle being tested

MMT

- To conduct a MMT, **the patient is positioned** in a posture appropriate for the muscle being tested, which generally entails isolating the muscle and positioning so that the muscle works against gravity
- The body part proximal to the joint acted on by the muscle is **stabilized**
- **A screening test** is performed by asking the patient to move the body part through the full available range of motion (ROM)
- **The main test** is then performed either unloaded, against a gravity load, or against manual resistance, and **a grade is assigned** to indicate muscle strength

Purpose of MMT

MMT is indicated in any patient with suspected or actual **impaired muscle performance**, including strength, power, or endurance

Identification of specific impaired muscles or muscle groups provides information for proper treatment

Precautions

- It is important to determine the patient's ability to resist the force to be applied
- Proper positioning is important, as is instruction in breathing techniques (avoid the Val Salva)
- Remember to assess surrounding area for ability to sustain muscle test
- In the case of a recent fracture, post-surgical, or other tissue healing, consider post-poning muscle test

Note:

- Always tell your client about **what procedure you are going to perform** and **what you are going to obtain** from that procedure

- Remember **to check the uninvolved side first** and be consistent on **where you apply the resistance**

- Also, instruct your client **not to hold his or her breath** as you apply force or resistance

Note:

- Muscle origin, insertion and action
- Function of participating muscles
- Patterns of substitution
- Ability to detect contractile activity
- Ability to palpate muscle or tendon
- Ability to detect atrophy
- Recognize abnormal position or movement

MMT - grading

Manual **grading** of muscle strength is based on:

- palpation or observation of muscle contraction
- ability to move the limb through its available ROM against or without gravity
- ability to move the limb through its ROM against manual resistance by the examiner

- **Manual resistance** is applied by the examiner using one hand with the other hand **stabilizing the joint**

- **Exact locations** for applying resistive force are specified and must be followed exactly to obtain accurate MMT results

MMT - grading

- A slow, repeatable velocity is used to take the limb through its ROM, applying a resistive force just under the force that stops motion

- The instructions to the patient are to use all of their strength to move the limb as far as possible against the resistance

- For weaker muscles that can move the limb, but not against gravity, the patient is repositioned so that the motion is done in the horizontal plane with no gravity

MMT - grading

- The assignment of scores is based on clinical judgment and the experience of the examiner

- The amount of resistance (moderate, maximal) applied by the examiner is also based on clinical experience and is adjusted to match the muscle being tested as well as the patient's age, gender and/or body type

MMT - grading

- While the MMT is the most widely used method to assess muscle function, its **reliability and accuracy** are questionable
- The MMT scores are least accurate for higher force levels
- **Interrater reliability** for MMT is not high, suggesting that the same examiner should perform multiple tests on one subject or across subjects
- All tests based on voluntary activation of a muscle are prone to artifact because of patient motivation and examiner encouragement

Grade 5 (Normal; 100%)

The patient or subject can complete the whole range of motion (movement) against gravity with maximum resistance applied by the therapist at end-of-range

Grade 4 (Good;75%)

The subject can complete the whole range of motion against gravity with moderate resistance applied by the physical therapist (PT) at end-range.

Testing the uninvolved limb should always be considered to know whether you are applying too much force on the involved limb or not

Grade 3+ (Fair+)

The patient can complete the motion against gravity with minimal resistance applied by the examiner at end-range

Grade 3 (Fair;50%)

The patient can only complete
the range of motion against gravity.
When external force is applied by the PT,
the patient gives way

Grade 2+ (Poor +)

Patient can move his or her joint at a certain range but cannot complete the motion against gravity. When gravity is eliminated, such as performing the motion in side-lying, your client can perform the movement at full range of motion with ease. However, muscles being tested give way immediately when you apply some resistance

Grade 2 (Poor;25%)

Patient cannot perform
the movement against gravity.
But patient can do complete
range of motion when pull of
gravity is eliminated.
No resistance is applied.

Grade 2 - (Poor -)

Initiation of movement can be done
only as gravity is eliminated.
That is, only a partial movement is observed.
Here, full range cannot be completed.

Grade 1 (Trace)

Patient is not able to move the joint
even with gravity eliminated.
However, closer examination by the therapist
would reveal slight muscle contraction
through palpation.

Grade 0 (Zero; No trace)

No contraction is noticed, even
with physical therapist's palpation (touch).

Grading

• 5	Normal	subject completes ROM against gravity with maximal resistance
• 4+	Good Plus	completes ROM against gravity with moderate-maximal resistance
• 4	Good	completes ROM against gravity with moderate resistance
• 4-	Good Minus	completes ROM against gravity with minimal-moderate resistance
• 3+	Fair Plus	completes ROM against gravity with only minimal resistance
• 3	Fair	completes ROM against gravity without manual resistance
• 3-	Fair Minus	does not complete the range of motion against gravity, but does complete more than half of the range
• 2+	Poor Plus	is able to initiate movement against gravity
• 2	Poor	completes range of motion with gravity eliminated
• 2-	Poor Minus	does not complete ROM in a gravity eliminated position
• 1	Trace	muscle contraction can be palpated, but no joint movement
• 0	Zero	patient demonstrates no palpable muscle contraction

General procedure

Basic consideration:

- Observation
- Palpation
- Positioning
- Stabilization
- Resistance
- Validity and reliability

1. Observation and palpation

- Observe the size and contour of muscles
- Palpate contractile tissues

2. Position Patient

- The patient and the part to be tested should be **positioned** comfortably on a firm surface in the correct testing position

- **The correct testing position** ensures that the muscle fibers to be tested are correctly aligned

- The patient is properly draped so that the involved body part is exposed as necessary

3. Stabilization

- Stabilization, which helps to

  prevent substitute movements

  and adds validity to the muscle test, can be provided manually (or through the use of an external support such as a belt)

- The stabilization is applied to the proximal segment using counter pressure to the resistance

4. Active Range of Motion

- The patient moves through the test the body segment actively against gravity
- The clinician palpates the muscle for activity and also notes any **adaptive shortening** (slight to moderate loss of motion), **substitutions** or **trick movements** (weakness or instability), or **contractures** (marked loss of motion)
- The joint is then returned to the start position
- If the patient is unable to perform the muscle action against gravity, the patient is positioned in the gravity-minimized position
- Generally speaking, testing the muscle in the transverse plane can minimize the effects of gravity

Validity and Reliability

- **Patient Factors**
  - Age
  - Gender
  - Pain
  - Fatigue
  - Lower motor neuron disease
  - Spasticity
- **Therapist factors**
  - Experience
  - Manner and content of instructions
  - Interaction
- **Environmental factors**
  - Temperature
  - Distractions
- **Other factors**
  - Muscle factors
  - Psychological factors
  - Methodological factors

Test

- The test should be completed on the uninvolved side first **to find out normal strength** before being repeated on the involved side

- Then the patient is instructed to complete the test movement on the involved side

- The clinician alerts the patient that resistance will be applied and then applies resistance in **the appropriate direction** and in a smooth and gradual fashion

Test

- **The proper location** for the application of resistance is as far distal as possible from the axis of movement on the moving segment without crossing another joint

- Resistance should never cross an intervening joint unless **the integrity of the joint** has been assessed as normal

- The resistance is applied in a direction opposite the muscle's rotary component and at right angles to the long axis of the segment (opposite the line of the pull of the muscle fibers)

Test

- The appeal of the MMT is that it can be performed simply with the patient, an examiner, and a bench or table

- This makes it ideal for the routine clinical environment where specialized equipment is unavailable and time is short

- It is also suited for situations in which testing must be performed away from the clinic (eg. nursing homes, rural areas, or remote emergency settings)

Conclusion

- The assessment of a patient's muscle strength is one of the most important vital functions that is typically monitored
- Specifically, strength assessment is necessary for determining distribution of weakness, disease progression, and/or treatment efficacy
- The particular assessment approach will be, in part, dictated by the clinical circumstance or severity of illness
- Several assessment techniques and tools are currently available to the healthcare provider and/or researcher, yet each has its unique attributes

Conclusion

- MMT is a relatively **quick and inexpensive method** of evaluating strength however, it is somewhat **subjective**
- By using consistent test positions, accurate joint placement and avoiding use of compensatory muscle use, results allow for **increased reliability** in using MMT as an evaluation tool
- Keep in mind that MMT often does not correlate with a patient's **ability to perform functional activities**
- In addition, a normal muscle grade does not necessarily indicate a patient's **ability to return to his or her normal level of activity**
- It is important to include **functional tests** in any patient evaluation

Thank you for your attention ☺