CHAPTER 1

Principles of Manual Muscle Testing

Muscle Test

Grading System

Grades for a manual muscle test are recorded as numeric ordinal scores ranging from zero (0), which represents no discernable muscle activity, to five (5), which represents a maximal or best-possible response or as great a response as can be evaluated by a manual muscle test. Because this text is based on actions (e.g., elbow flexion) rather than tests of individual muscles (e.g., biceps brachii), the grade represents the performance of all muscles contributing to that action.

The numeric 0 to 5 system of grading is the most commonly used muscle strength scoring convention across health care professions. Each numeric grade (e.g., 4) can be paired with a word grade (e.g., good) that describes the test performance in qualitative, but not quantitative, terms. (See table.) Use of these qualitative terms is an outdated convention and is not encouraged because these terms tend to misrepresent the strength of the tested action. For knee extension, forces that are less than 50% of average and therefore not "normal" are often graded 5.[1] Knee extension actions graded as 4 may generate forces as low as 10% of maximal expected force, a level clearly not described appropriately as "good." For this reason, the qualitative terms have largely been removed from this book. The numeric grades are based on several factors that will be addressed later in this chapter.

Numeric Score	Qualitative Score
5	Normal (N)
4	Good (G)
3	Fair (F)
2	Poor (P)
1	Trace activity (T)
0	Zero (no activity) (0)

Overview of Test Procedures

Break Test

Manual resistance is applied to a limb or other body part after it has actively completed its test range of motion against gravity. The term *resistance* is always used to denote a concentric force provided by the tester that acts in opposition to contracting muscles. Manual resistance should always be applied opposite to the muscle action of the participating muscle or muscles. The patient is asked to hold the body segment at or near the end of the available range, or at the point in the range where the muscle is most strongly challenged. At this point, the patient is instructed to not allow the therapist to "break" the hold while the therapist applies manual resistance. For example, a seated patient is asked to flex the elbow to its end range (Grade 3); when that position is reached, the therapist applies resistance just proximal to the wrist, trying to "break" the muscle's hold and thus allow the forearm to move downward into extension. This is called a break test, and it is the procedure most commonly used in manual muscle testing nowadays. However, there are alternatives to the break test for grading specific muscle actions.

As a recommended alternative procedure, the therapist may choose to place the muscle or muscle group to be tested in the end or test position, after ensuring that the patient can complete the available range (Grade 3), before applying additional resistance. In this procedure the therapist ensures correct positioning and stabilization for the test.

Make Test

An alternative to the break test is the application of manual resistance against an actively contracting muscle or muscle group (i.e., opposite the direction of the movement) that matches the patient's resistance but does not overcome it. During the maximum contraction, the therapist gradually, over approximately 3 seconds, increases the amount of manual resistance until it matches the patient's maximal level. The make test is not as reliable as the break test, therefore making the break test the preferred test.

Active Resistance Test

Resistance is applied opposite the actively contracting movement throughout the range, starting at the fully lengthened position. The amount of resistance matches the patient's resistance but allows the joint to move through the full range. This kind of manual muscle test requires considerable skill and experience to perform and is not reliable; thus its use is not recommended as a testing procedure but may be effective as a therapeutic exercise technique.

Application of Resistance

The principles of manual muscle testing presented here and in all published sources since 1921 follow the basic tenets of muscle length–tension relationships, as well as those of joint mechanics.[2,3] In the case of the elbow flexion, for example, when the elbow is straight, the biceps are long but the lever is short; leverage increases as the elbow flexes and becomes maximal at 90°, where it is most efficient. However, as flexion continues beyond that point, the biceps are short and their lever arm again decreases in length and efficiency.

In manual muscle testing, external force in the form of resistance is applied at the end of the range or after backing off slightly from the end of range in the direction opposite the actively contracting muscle. For some muscle actions (e.g., knee flexion), this backing off is considerable—to the point that the primary muscles tested are at what may be considered mid-range. Two-joint muscles are typically tested in mid-range where length-tension is more favorable. Ideally, all muscles and muscle groups should be tested at optimal length-tension, but there are many occasions in manual muscle testing where the therapist is not able to distinguish between Grades 5 and 4 without putting the patient at a mechanical disadvantage. Thus the one-joint brachialis, gluteus medius, and quadriceps muscles are tested at end range and the two-joint hamstrings and gastrocnemius muscles are tested in mid-range.

Critical to the accuracy of a manual muscle test are the location of the applied resistance and the consistency of application across all patients. The placement of resistance is typically near the distal end of the body segment to which the tested muscle attaches. There are exceptions to this rule. One exception is when resistance cannot be provided effectively without moving to a more distal body segment. In the case of shoulder and hip internal and external rotators, this involves applying resistance through the hand placed on the distal forearm or lower leg. Another exception involves patients with a shortened limb segment as in an amputation. Take for example a patient with a transfemoral amputation. Even if the patient could hold against maximum resistance while abducting the hip, the weight of the lower limb is so reduced and the therapist's lever arm for resistance application is so short, that a grade of 5 cannot be assumed regardless of the resistance applied. A patient holding against maximum resistance may still struggle with the force demands of walking with a prosthesis. If a variation is used, the therapist should make a note of the placement of resistance to ensure consistency in testing.

The application of manual resistance should never be sudden or uneven (jerky). The therapist should apply resistance with full patient awareness and in a somewhat slow and gradual manner, slightly exceeding the muscle's force as it builds over 2 to 3 seconds to achieve the maximum tolerable intensity. Applying resistance that slightly exceeds the muscle's force generation will more likely encourage a maximum effort and an accurate break test.

The therapist also should understand that the weight of the limb plus the influence of gravity is part of the test response. Heavier limbs and longer limb segments put a higher demand on the muscles that move them. Therefore lifting the lower limb against gravity can demand more than 20% of the “normal strength” of the hip muscles.[4] In contrast, lifting the hand against gravity requires less than 3% of the normal strength of the wrist muscles.[4] When the muscle contracts in a parallel direction to the line of gravity, it is noted as “gravity minimal.” It is suggested that the commonly used term “gravity eliminated” be avoided because, of course, that can never occur except in a zero-gravity environment.

Weakened muscles are tested in a plane horizontal to the direction of gravity with the body part supported on a smooth, flat surface in such a way that friction force is minimal (Grades 2, 1, and 0). A powder board may be used to minimize friction. For stronger muscles that can complete a full range of motion in a direction against the pull of gravity (Grade 3), resistance is applied perpendicular to the line of gravity (Grades 4 and 5). Acceptable variations to antigravity and gravity-minimal positions are discussed in individual test sections.

Stabilization

Stabilization of the body or segment is crucial to assigning accurate muscle test grades. Patients for whom stabilization is particularly important include those with weakness in stabilizing muscles (e.g., scapular stabilizers) when testing the shoulder muscles and those who are particularly strong in the tested muscle action.

Numerous muscles, some seemingly remote, can contribute as stabilizers to the performance of tested muscle actions. However, muscle test performance is not meant to be dependent on muscles other than the prime movers. To give an extreme example, shoulder abduction on the left side should not be dependent on the trunk muscles on the right side. Therefore a patient with weak trunk muscles and limited sitting balance should be supported and stabilized either through patient positioning or by a stabilizing hand on the right shoulder.

A muscle or muscle group that is particularly strong may also require patient stabilization if the full capacity of a muscle group is to be accurately tested.[5] For example, a tester may not be able to break the knee extension action of a patient who is allowed to rise off of a support surface during the performance of a break test. However, the same patient, properly stabilized by the tester, an assistant, or a belt during testing, may not be able to hold against maximum tester resistance and thus break the muscle contraction, indicating that the patient has a muscle test grade of 4 rather than 5.

Criteria for Assigning a Muscle Test Grade

The grade given on a manual muscle test comprises both subjective and objective factors. Subjective factors include the therapist's impression of the amount of resistance given during the actual test and then the amount of resistance the patient actually holds against during the test. Objective factors include the ability of the patient to complete a full range of motion or to hold the test position once placed there, the ability to move the part against gravity, or an inability to move the part at all. All these factors require clinical judgment, which makes manual muscle testing a skill that requires considerable practice and experience to master. An accurate test grade is important not only to establish the presence of an impairment but also to assess the patient's longitudinal status over time. Clinical reasoning is necessary for the therapist to determine the causes for the lack of ability to complete the full range or hold the position, ascertain which is most applicable, and decide whether manual muscle testing is appropriate.

Consistent with a typical orthopedic exam, the patient is first asked to perform the active movement of the muscle to be tested. Active movement is performed by the patient without therapist or mechanical assistance. This active movement informs the therapist of the patient's willingness and ability to move the body part, of the available range in the related joint(s), and whether there are limitations to full range, such as pain, excess tone, or weakness. Active movement without resistance is the equivalent of a Grade 3. Active movement is also called active range of motion and begins every muscle test to help determine the appropriate test position and amount of resistance to apply.

Grade 5 Muscle

A grade of 5 is assigned when a patient can complete full active range of motion (active movement) against gravity and hold the test position against maximum resistance. If the therapist can break a patient's hold, a grade of 5 should *not* be assigned. Overgrading will prevent the differentiation of a weak from a strong muscle and the identification of muscles that do, versus do not, get stronger over time.

The wide range of “normal” muscle performance typically leads to a considerable underestimation of a muscle's capability.[6] If the therapist has no experience in examining people who are free of disease or injury, it is unlikely that there will be any realistic or accurate assessment of what is Grade 5 and how much normality can vary. In general, a student learns manual muscle testing by practicing on classmates, but this provides only minimal experience compared with what is needed to master the skill. It should be recognized, for example, that the average therapist cannot “break” knee extension in a reasonably fit young man, even by doing a handstand on his leg! A therapist may not be aware of underestimation of a muscle contraction unless quantitative measures of strength are also used, such as in a sit-to-stand test. In addition, contributing to an underestimation of weakness is the inability of some therapists, particularly those who are women, to apply adequate resistance.[7]

Grade 4 Muscle

Grade 4 is assigned when the patient can complete the full active range of motion (active movement) against gravity but is not able to hold the test position against maximum resistance. The Grade 4 muscle "gives" or "yields" to some extent at the end of its test range with maximal or submaximal resistance. When maximal resistance results in a break or give, irrespective of age or disability, the muscle is assigned a grade of 4. However, if pain limits the ability to maximally resist the force applied by the therapist, evaluation of actual strength may not be realistic and should be documented as such. An example might be, "Elbow flexion appeared strong but painful."

The grade of 4 represents the true weakness in manual muscle testing procedures (pun intended). Sharrard counted remaining alpha motor neurons in the spinal cords of individuals with poliomyelitis at the time of autopsy.[8] He correlated the manual muscle test grades in the patient's chart with the number of motor neurons remaining in the anterior horns. His data revealed that more than 50% of motor neurons of a muscle group were absent when the muscle test grade was 4. Thus, when the muscle could withstand considerable but less than "normal" resistance, it had already been deprived of at least half of its innervation. Appropriate stabilization is critical to determine the true difference between a Grade 5 and Grade 4 muscle.

Grade 3 Muscle

The Grade 3 muscle test is based on an objective measure. The muscle or muscle group can complete a full range of motion against the resistance of gravity. This is also called "active range." Even if a tested muscle can move through the full range against gravity and tolerate a small or "mild" amount of resistance, the muscle is assigned a grade of 3.

Direct force measurements have demonstrated that the force level of the Grade 3 muscle is quite low (less than 5% of normal for knee extension), so that a much greater span of functional loss exists between Grades 3 and 5 than between Grades 3 and 1.[9] Beasley, in a study of children ages 10 to 12 years, reported the Grade 3 in 36 muscle tests as no greater than 40% of Grade 5 (one motion), the rest being 30% or below normal "strength," with the majority falling between 5% and 20% of a Grade 5.[10] A grade of 3 may represent a *functional threshold* for some muscle actions tested (e.g., elbow flexion during feeding); however, a grade 3 may fall far short of the functional requirements of many lower extremity muscles during weight-bearing activities, particularly for such muscle groups as the hip abductors and the ankle plantar flexors. The therapist must be sure that muscles given a grade of 3 are not in the joint "locked" position during the test (e.g., locked elbow when testing elbow extension).

Grade 2 Muscle

The Grade 2 is assigned to a muscle group that can move the body segment when gravity is minimized. This position is typically described as the horizontal plane of motion. Movement in this plane may be eased by use of a powder board or other such friction-eliminating surface.

Grade 1 Muscle

The Grade 1 is assigned when the therapist can detect visually or by palpation some contractile activity in one or more of the muscles that participate in the action being tested (provided that the muscle is superficial enough to be palpated). The therapist also may be able to see or feel a tendon pop up or tense as the patient tries to perform the movement. However, there is no movement of the part as a result of this contractile muscle activity.

Patient positioning is less important in Grade 1 testing because a Grade 1 muscle can be detected in almost any position. When a Grade 1 muscle is suspected, the therapist should passively move the part into the test position and ask the patient to hold the position and then relax; this will enable the therapist to palpate the muscle or tendon, or both, during the patient's attempts to contract the muscle and also during relaxation. Care should be taken to avoid substitution of other muscles.

Grade 0 Muscle

The Grade 0 muscle is assigned when palpation or visual inspection fail to provide evidence of contraction. This does not mean there is no muscle activation. In fact, electromyography may demonstrate that some activation is present. Thus the phrase "no discernable contraction" defines a Grade 0 in this text.

Plus (+) and Minus (−) Grades

Use of a plus (+) or minus (−) addition to a manual muscle test grade is discouraged. Avoiding the use of plus or minus signs restricts manual muscle test grades to those that are meaningful, defendable, and reliable. The use of pluses and minuses adds a level of subjectivity that lacks reliability, especially for grades of 3 or greater. However, in the case of Grade 2, described above, there is a considerable difference between the muscle that can complete full range in a gravity-minimized position (horizontal position) and the one that cannot complete full range but can achieve some joint movement. Therefore the grade of 2- is acceptable when the muscle can complete partial range of motion in the horizontal plane, gravity minimized. The difference between Grade 2 and Grade 1 muscles represents such a broad functional difference that a minus sign may be important in assessing even minor improvements in function. The therapist is encouraged to supplement the grade with descriptive documentation of the quality of movement.

Grade 4 Muscle Revisited

Historically, manual muscle testing has used two grading systems, one using numbers (5-0) and the other using descriptors (normal to zero). Although both systems convey the same information, the authors favor the numeric system because it avoids use of the vague and subjective term "good." As noted previously, there is no other term in muscle testing that is more problematic. Too often clinical practitioners, including therapists and physicians, construe the term in the literal sense, interpreting "good" to mean totally adequate. The assumption is that if strength is adequate, then the patient is not in need of rehabilitation.

However, an abundance of evidence demonstrates unequivocally that once the therapist discerns that strength is no longer normal, but "good" instead, the muscle being tested has already lost approximately half its strength. Evidence of this has already been presented.[11] More recently, Bohannon found that force values for muscles that were graded as "normal" ranged from 80 to 625 Newtons,[6] an astronomic difference, further demonstrating how difficult it is to distinguish a "good" muscle from a "normal" muscle.

It is unclear how a grade of "good" became synonymous with achievement of a satisfactory end point of treatment. Certainly, the pressure from third-party payers to discharge patients as soon as possible does not help the therapist to fulfill the minimum goal of reaching "prior level of function." Nonetheless, the opportunity for patients to recover muscle forces to the fullest extent possible is a primary goal of an intervention. If this goal is not met, patients (especially aging individuals) may lose their independence or find themselves incapable of returning to a desired sport or activity because their weak muscles fatigue too quickly. Athletes who have not fully recovered their strength before returning to a sport are far more likely to suffer a reinjury, potentially harming themselves further.

There are numerous instances in which a Grade 4 muscle cannot meet its functional demands. When the gluteus medius is Grade 4, a patient will display a positive Trendelenburg sign. When the soleus is Grade 4, the heel rise fails to occur during the latter portion of the stance phase of gait, which reduces gait speed.[12] When the abdominals are Grade 4, there is difficulty stabilizing the pelvis while arising from bed or when sitting up, and this often results in back pain. Calling a muscle "good," rather than Grade 4 is simply is not "good" enough.

Repeatedly there is a disconnect between what patients can functionally accomplish and the manual muscle strength grade the therapist assigns, particularly in older adults. By the time a person reaches the age of 80 years, approximately 50% of their muscle mass and strength may be lost due to natural decline,[13] and yet therapists often assign a manual muscle test grade of "normal" or "within normal limits" to an 80-year-old, even though the individual's strength is half of what it used to be. Functionally, these same older adults with "normal strength" cannot get out of a chair without pushing on the arms or ascend stairs without pulling on the railing. Therefore assigning "within functional limits" is discouraged. Muscle grades that are inaccurate based on the patient's age, gender, and presumed strength or because the therapist cannot apply adequate resistance must be avoided.

In summary, a "good" muscle is not always "good." Everything must be done to ensure accuracy in manual muscle test grading and to provide the intervention necessary to fully restore strength and function to "normal." Substituting the numerical system of 5-0 for the subjective terms "good" or "normal" in manual muscle testing assessment is a start in the right direction.

Available Range of Motion

When muscle shortness ("tightness"), a contracture, or fixed joint limitation (e.g., total knee replacement) limits joint range of motion, the patient performs only within the range available. In this circumstance, the *available range* is the full passive range of motion for that patient at that time, even though it is not "normal." This is the range used to assign a muscle testing grade. For example, the normal knee extension range is 135° to 0°. A patient with a 20° knee flexion contracture is tested for knee extension strength at the end of available range or 20°. If this range (in sitting) can be completed with maximal resistance, the grade assigned would be a 5. If the patient cannot actively complete that range, the grade assigned MUST be less than 3. The patient then should be repositioned in the side-lying position to ascertain the correct grade.

Screening Tests

In the interests of time and cost-efficient care, it is often unnecessary to perform a muscle test on each muscle of the body. As the strength of various muscle actions tend to be correlated and internally consistent,[6] a systematic testing of a limited number of muscle actions often will suffice. Three screening indexes warrant mentioning. Each was developed with a specific diagnostic group in mind and allows for the calculation of a total score. The first, the Motricity Index, was developed for patients with stroke and includes three muscle actions of the upper limb (shoulder elevation, elbow flexion, and hand grasp) and three muscle actions of the lower limb (hip flexion, knee extension, and ankle dorsiflexion).[9] The second, the Motor Index Score, was developed for patients with spinal cord injury and includes muscle actions representative of key nerve root levels in the upper and lower limbs (elbow flexion [C5], wrist extension [C6], elbow extension [C7], finger flexion [C8], small finger abduction [T1], hip flexion [L2], knee extension [L3], ankle dorsiflexion [L4], great toe extension [L5], ankle plantarflexion [S1]).[14] The final test, the Medical Research Council Sum Score, was produced to capture weakness in patients with Guillain-Barré but has since been used with other patients with dispersed weakness. It includes most of the actions included in the Motricity Index (shoulder abduction, elbow flexion, wrist extension, hip flexion, knee extension, ankle dorsiflexion).[15]

Never should the therapist use phrases such as "within normal limits" or "within functional limits" for a screening exam. If a nonspecific strength exam is performed (e.g., through observation of tasks), documentation is better served with terms like "patient demonstrated no difficulty performing task," rather than making a judgment about the degree of strength present.

To screen for muscles that need definitive testing, the therapist can use a number of maneuvers to identify movements that do and do not need testing. Observation of the patient before the examination will provide valuable clues to muscular weakness and performance deficits. For example, the therapist can do the following:

- Observe the patient as he or she enters the treatment area to detect gross abnormalities of gait or other aspects of mobility.
- Observe the patient doing other everyday activities such as rising from a chair, completing admission or history forms, or removing street clothing.
- Ask the patient to walk on the toes and then on the heels.
- Ask the patient to grip the therapist's hand.
- Perform gross checks of bilateral muscle groups: reaching toward the floor, overhead, and behind the back.

If evidence from the previous "quick checks" suggests a deficit in movement, manual muscle testing can quickly be focused to the region observed to be weak, in the interest of time and to optimize the patient's clinic visit.

Preparing for the Muscle Test

The therapist and the patient must work in harmony if the test session is to be successful. This means that some basic principles and inviolable procedures should be second nature to the therapist.

1. The patient should be as free as possible from discomfort or pain for the duration of each test. It may be necessary to allow some patients to move or be positioned differently between tests.
2. The environment for testing should be quiet and nondistracting. The ambient temperature should be comfortable for the partially disrobed patient.
3. The testing surface must be firm to help stabilize the part being tested. The ideal is a firm surface, minimally padded or not padded at all. The firm surface will not allow the trunk or limbs to “sink in.” Friction of the surface material should be kept to a minimum. When the patient is reasonably mobile, a plinth is fine, but its width should not be so narrow that the patient is afraid of falling or sliding off. Sometimes a low mat table is the more practical choice. The height of the table should be adjustable to allow the therapist to use proper leverage and body mechanics.
4. Patient position should be carefully organized so that position changes in a test sequence are minimized. The patient's position must permit adequate stabilization of the part or parts being tested by virtue of body weight or with help provided by the therapist.
5. All materials needed for the test must be at hand. This is particularly important when the patient is anxious for any reason or is too weak to be safely left unattended.

Materials needed include the following:

- Manual muscle test documentation forms (Fig. 1.1)

DOCUMENTATION OF MANUAL MUSCLE TESTS

			Date of Examination / Examiner's Initials			
LEFT				RIGHT		
3	2	1		1	2	3
			CERVICAL			
			Capital extension			
			Cervical extension			
			Capital flexion (chin tuck)			
			Cervical flexion			
			Cervical rotation			
			TRUNK			
			Trunk extension combined			
			Lumbar			
			Thoracic			
			Elevation of the pelvis			
			Trunk flexion			
			Trunk rotation			
			Core tests			
			Prone plank			
			Side bridge endurance test			
			Timed partial curl up test			
			Isometric trunk flexor endurance test			
			Front abdominal power test			
			Unilateral supine bridge test			
			Maximal inspiratory pressure			
			Maximal expiratory pressure			
			Cough			
			Pelvic floor			
			UPPER EXTREMITY			
			Scapular abduction and upward rotation (serratus)			
			Scapular elevation			
			Scapular adduction (retraction)			
			Scapular depression and adduction			
			Scapular adduction (retraction) and downward rotation (rhomboids)			
			Latissimus dorsi			
			Shoulder flexion			
			Shoulder extension			
			Shoulder abduction			
			Shoulder horizontal abduction (posterior deltoid)			
			Shoulder horizontal adduction (pectoralis major)			
			Shoulder external rotation			
			Shoulder internal rotation (subscapularis)			
			Elbow flexion (combined)			
			Elbow extension			
			Forearm supination			
			Forearm pronation			
			Wrist flexion combined			
			Flexor carpi radialis			
			Flexor carpi ulnaris			

MANUAL MUSCLE TESTS - Page 2

			Date of Examination / Examiner's Initials			
LEFT				RIGHT		
3	2	1		1	2	3
			Wrist extension combined			
			Extensor carpi radialis longus and brevis			
			Extensor carpi radialis ulnaris			
			Hand			
			Finger proximal phalanges (PIP) and distal phalanges (DIP) flexion			
			Combined			
			Flexor digitorum superficialis (PIP)			
			Flexor digitorum profundus (DIP)			
			Finger MCP extension			
			Extensor digitorum			
			Extensor indicis			
			Extensor digiti minimi			
			Finger MCP flexion			
			Finger abduction			
			Dorsal interossei			
			Abductor digiti minimi			
			Finger adduction (palmar interossei)			
			Thumb MCP and IP flexion			
			Flexor pollicis brevis			
			Flexor pollicis longus			
			Thumb MCP and IP extension (extensor pollicis brevis and longus)			
			Thumb abduction			
			Abductor pollicis longus			
			Abductor pollicis brevis			
			Thumb adduction (adductor pollicis)			
			Opposition			
			Opponens pollicis			
			Opponens digiti minimi			
			Grip strength			
			LOWER EXTREMITY			
			Hip flexion			
			Hip flexion, abduction, and external rotation with knee flexion (sartorius)			
			Hip extension combined			
			Gluteus maximus			
			Supine hip extensor test			
			Hip abduction			
			Hip adduction			
			Hip external rotation			
			Hip internal rotation			
			Knee flexion combined			
			Medial hamstring test (semitendinosus and semimembranosus)			
			Lateral hamstring test (biceps femoris)			

MANUAL MUSCLE TESTS - Page 3

			Date of Examination	Examiner's Initials		
LEFT				RIGHT		
3	2	1		1	2	3
			Knee extension			
			Ankle plantar flexion combined			
			Soleus			
			Foot dorsiflexion and inversion			
			Foot inversion			
			Foot eversion with plantar flexion			
			Hallux and toe MP flexion			
			Hallus MP flexion			
			Toe MP flexion			
			Hallux and toe DIP and PIP flexion			
			Hallux and toe MP and IP extension			

Comments:

Diagnosis ______ Onset ______ Age ______ Birth date ______

Patient Name ______

last first middle ID number

FIGURE 1.1 Documentation of manual muscle examination.

- Pen, pencil, or computer terminal
- Pillows, towels, pads, and wedges for positioning
- Sheets or other draping linen
- Goniometer
- Stopwatch
- Specific equipment for specific functional tests
- Test forms for functional tests
- Interpreter (if needed)
- Assistance for turning, moving, or stabilizing the patient
- Emergency call system (if no assistant is available)
- Reference material

Exercises

Specific exercises have been included in the text where there is electromyographic evidence of isometric maximal voluntary contraction (MVC). Clinically, motions that evoke higher electromyographic activities (%MVC) have been interpreted to be more challenging to a muscle.[16] The following scale is used when interpreting %MVC:

Low	0%–20%
Moderate	21%–40%
High	41%–60%
Very high	>60%

An MVC of greater than 40% is considered necessary for strengthening.[17,18]

We have included higher-tier exercises as suggested exercises. These exercises should be considered challenging and used later in the rehabilitation process. The therapist should also be aware of the different types of contractions applied in muscle testing and exercise. See Box 1.1.

Box 1.1

Types of Contractions

Concentric contraction refers to the shortening of a muscle as it contracts, as in the bending flexion portion of a biceps curl or extension of the elbow when lifting an object overhead. Concentric activity is generally the primary motion of the muscle.

Eccentric contraction refers to the lowering phase of an exercise, when the muscle lengthens, as in lowering the weight to the chest during the bench press or lowering oneself into a chair. Eccentric muscle activity is seen in many mobility-related functional tasks such as stepping down a curb or in gait.

Isometric contraction refers to the creation of muscle tension without joint movement. Isometric contractions are often used when the limb is immobilized, such as post surgery. Isometric contractions are used with handheld dynamometry, discussed in Chapter 9.

Prime Movers

Within each chapter are tables indicating the muscles involved in the action that is tested (e.g., shoulder flexion). When prime movers have been identified for a particular action, they are in **boldface** type. For example, the prime mover of shoulder flexion is the anterior deltoid muscle and therefore this muscle is bolded. In other instances, there is no distinct prime mover and thus no bolding. The movement of back extension, for example, involves a dozen muscles, none of which is a prime mover, and therefore there are no muscle names bolded. Our intent in highlighting the prime movers is to help the student more readily understand which muscles are critical for many important movements and to have a better understanding of which muscles to strengthen when weakness is present.

Summary

From the foregoing discussion, it should be clear that manual muscle testing is an exacting clinical skill. Practice, practice, and more practice on a variety of patient types create the experience essential to building the skill to an acceptable level of clinical proficiency, to say nothing of clinical mastery.

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