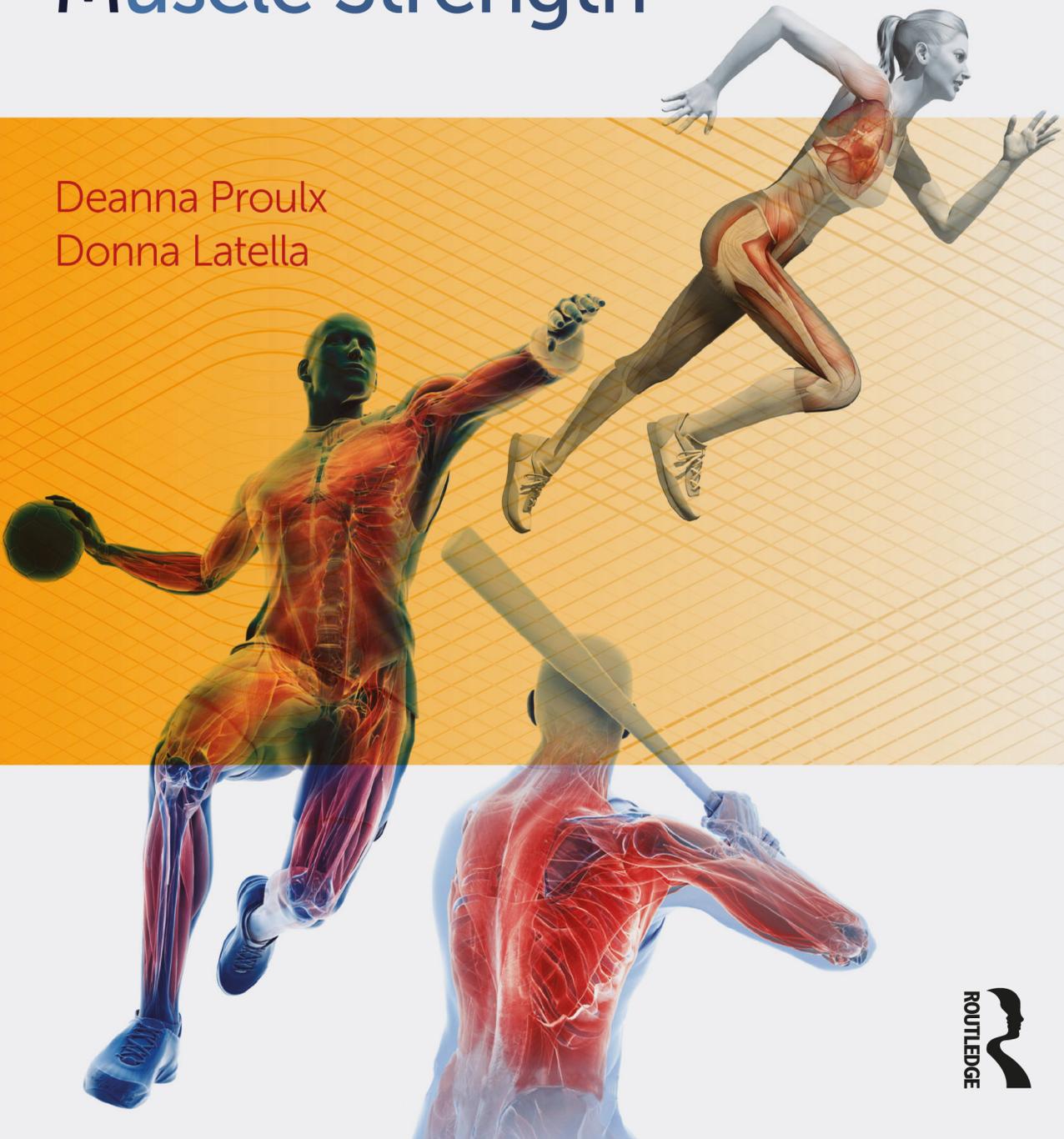


SECOND EDITION

Occupational Therapy Manual for the Evaluation of Range of Motion and Muscle Strength

Deanna Proulx
Donna Latella



Occupational Therapy
Manual for the Evaluation
of Range of Motion and
Muscle Strength,
Second Edition



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Occupational Therapy Manual for the Evaluation of Range of Motion and Muscle Strength, Second Edition

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DEDICATION

We would like to dedicate this Second edition to our children: Micaela, Jordan, Kristy, and Dylan. Their bright futures keep us working towards being positive role models, scholarly professors, and supportive parents. Also, to our full-time faculty of the OT Department of Quinnipiac University for being our inspiration, as always, to complete this project.



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PREFACE

In keeping with the tradition of the first edition of Latella and Meriano's *Occupational Therapy Manual for the Evaluation of Range of Motion and Muscle Strength*, this edition also serves as a concise teaching-learning guide for faculty and students alike. With 25+ years of expertise teaching biomechanics to occupational therapy students, here we have reorganized the original content to mirror the clinical decision-making process that a therapist undergoes in the keen development of their "diagnostic vision"; first through screening and followed by assessment as the context may require. More so, this edition emphasizes engagement in occupation as the core of why we as occupational therapists have a broad foundation in the basic sciences and, more specifically, in biomechanics.

As educators, we firmly believe that the classroom should provide instruction in formal techniques as well as prepare the student for the practical aspects of the clinic. This manual provides that road map for practical teaching in preparation for skill sets expected of clinical affiliations and beyond as practitioners. In the clinical environment today, students need the traditional skills required for joint motion and manual muscle testing procedures; however, in addition, they must also have the capabilities to appropriately adapt to the often limited evaluation time, given productivity expectations. These clinical adaptations require flexibility and a sophisticated level of clinical reasoning deeper than the simple learning of a series of individual muscle tests and movements. Rather, students must be taught how to think as a therapist and build that into the educational process. To screen through the engagement in functional activity, to diagnostically identify areas of concern, and then to execute the necessary assessment tools to substantiate Occupational Therapy intervention. The organization of this edition fosters this process and permits both a holistic view and the at-a-glance ability to focus on specific joints and dysfunction therein. We hope that you, too, see the value of a teaching manual set in this way as a pedagogy for the teaching of biomechanical screening and assessment to occupational therapy students.



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Foundations of Practice

After completing this chapter, the student will be able to accomplish the following:

- Recognize the historical roots of biomechanics in occupational therapy practice.
- Understand the foundations of occupational therapy practice that support the screening and assessment of biomechanics.
- Understand the procedural rationale/clinical reasoning behind biomechanical screening and assessment in occupational therapy practice.
- Understand the difference between screening and assessment procedures in treatment.
- Recognize kinematics of human movement: the cardinal planes and axes of motion.

As a profession born in the early 1900's, much change has influenced the scope of practice in which an Occupational Therapist can practice, and biomechanics is one that has remained steadfast (Christiansen & Haertl, 2019). While originally born from the curative nature of arts and crafts, the practice of occupational therapy evolved quickly into the hospital setting during the World War I era and in support of population needs. That trend intensified during the World War II era where the medical rehabilitation of soldiers, need for prosthetics and assistive technologies catapulted the practice into the medical model (Christiansen & Haertl, 2019). With such came the need to establish our foundational roots in biomechanics and rehabilitation as was done through fulfillment of the Centennial Vision; becoming a widely recognized and scientifically driven profession. Our roots in treating the human body at every

age and from a variety of evidence based theories, this text will focus primarily on the biomechanical and rehabilitative approaches to achieve wellness and engagement (or re-engagement) in meaningful everyday occupation.

Occupational therapy practice begins with evaluation, and the evaluation process can be broken down into two sub-components: screening and assessment. Screening is a method which allows the therapist to quickly determine areas of the human body that need further assessment. Screening is achieved through proficient observation skills by a therapist in effort to make best and most efficient use of time within the fast-paced health care environment of a hospital or medically based outpatient facility (Takala, Pehkonen, Forsman, Hansson, Mathiassen, Neumann, Sjogaard, Veiersted, Westgaard, and Winkel, 2009). In the screening, if no deficits are noted, the therapist can avoid spending additional time formally measuring the range of motion of each joint only to determine that all are within functional or normal limits. In addition, this screening can be easily combined with other assessments such as the functional observation of activities of daily living (ADL). Once a student masters the underlying anatomy and kinesiology of human motion, he/she can quickly determine which joints and muscle groups are used for different functional tasks. This foundational knowledge enables the student to observe the client completing a functional activity and to decide, based on that observation, whether a range of motion assessment or gross muscle testing is required. Examples of applicable functional tasks are provided for each joint motion by region in Chapter 3 of this manual. In addition, Appendix A: Biomechanical Task Analysis provides a format for the systematic analysis and documentation of functional activity as a matter of biomechanical screening.

This overall screening is also influenced by other factors, such as the physical and environmental contexts, the specific occupations or roles of the client, and the client's own personal goals. It is important to note however, that this manual will specifically focus on range of motion and strength screening and assessments as key components of the overall, client-centered intervention plan from a biomechanical lens alone so as to be a concise teaching tool.

The student's decision-making process of observation and screening, leading to a potential need for further client assessment, based on all the known factors, is formally referred to as **clinical reasoning** (Mattingly, 1991). Clinical reasoning, simply stated, is thinking as a therapist. In the 21st-century healthcare environment, a therapist is required to complete a client evaluation in a limited time and must use his/her clinical reasoning to determine what is the best use of that limited time. For example, if a therapist notes during an observation of a functional task that a client has limited range of motion at end ranges of the shoulder, yet the client is an older adult capable of completing all activities of daily living (ADL) independently, then the therapist would not proceed with formal goniometry or muscle strength assessment of the shoulder at that time (Figure 1-1).

The next stage of informal, biomechanical screening following analysis of functional tasks is the informal observation of a client's **active joint range of motion (AROM)** and **gross muscle strength testing (GMT)**. To begin, the client is asked to actively mirror the movements (AROM) made by the therapist in all planes of joint motions, region by region. See Figures 1-2, 1-3, 1-4, and 1-5. This can be completed either sitting or standing so as to observe motions of the upper and lower extremities with full attention to potential safety issues that may arise given specific client factors (ie: for balance in single limb support, clients are asked to hold on to the exam table). This process of the therapist's clinical reasoning requires their understanding of normal ranges of motion of all joints, and against gravity, leading us to the next step of the process.

Gross muscle testing (GMT) is a quick screening process and the first requiring hands-on by the therapist. To this point, the screening has been entirely observational and based upon the therapist's expertise in task analysis and joint range of motion. Of important note, the therapist would have clinically noted at this point of the process any underlying concerns prior to moving ahead, such as a lack of scapulohumeral rhythm typical of adhesive capsulitis or even shoulder subluxation as examples, that would have preempted the performance of gross muscle testing as a precaution or contraindication. Precautions and contraindications will be reviewed in greater detail as a matter of

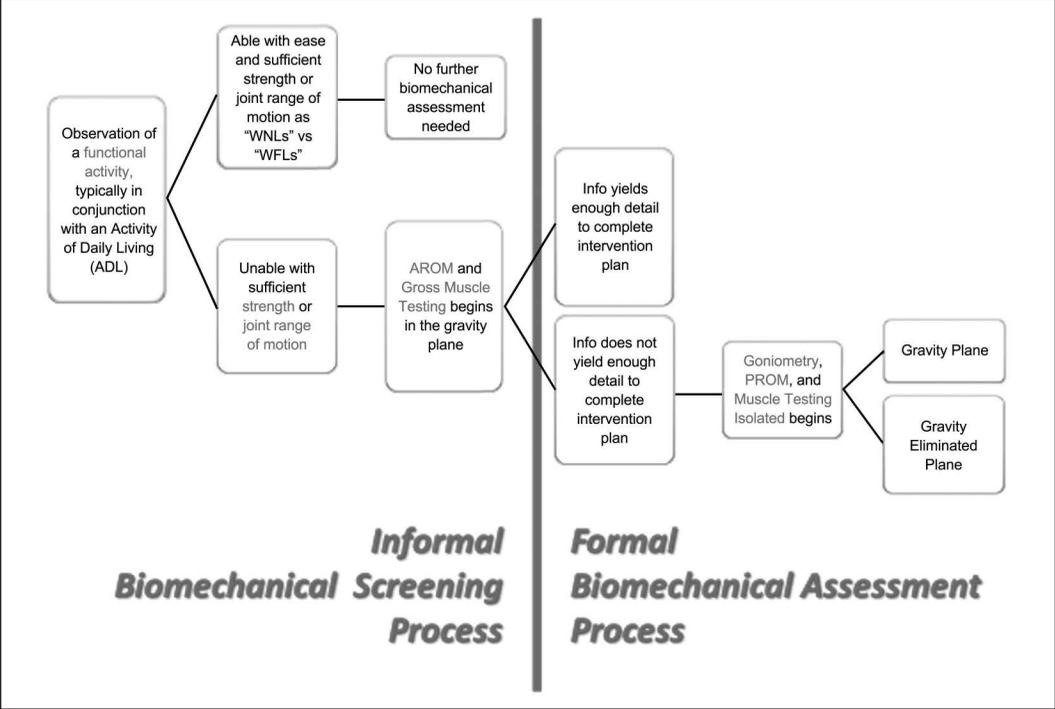


Figure 1-1. Clinical decision-making tree.

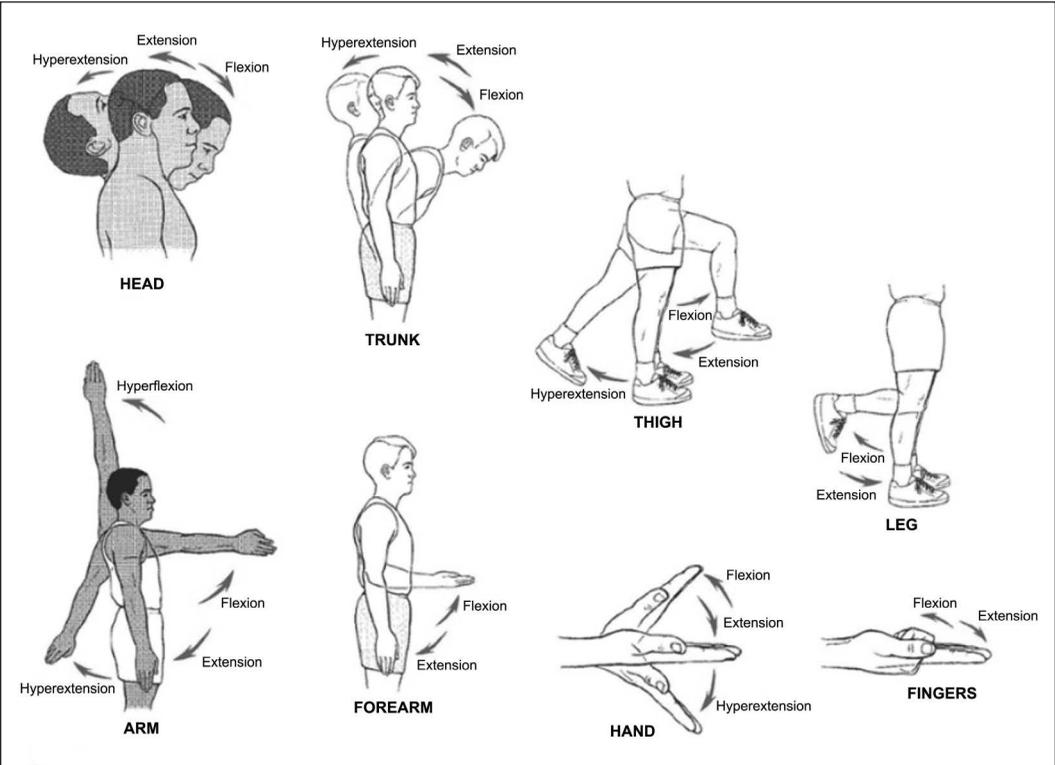


Figure 1-2. Flexion and extension. These movements occur in many joints in the body, including the vertebra, shoulder, elbow, wrist, metacarpophalanx, interphalanx, hip, knee, and metatarsophalanx. (Reproduced with permission from Hamill, J., Knutzen, K., & Derrick, T. [2015]. *Biomechanical basis of human motion* [4th edition]. Lippincott Williams and Wilkens.)

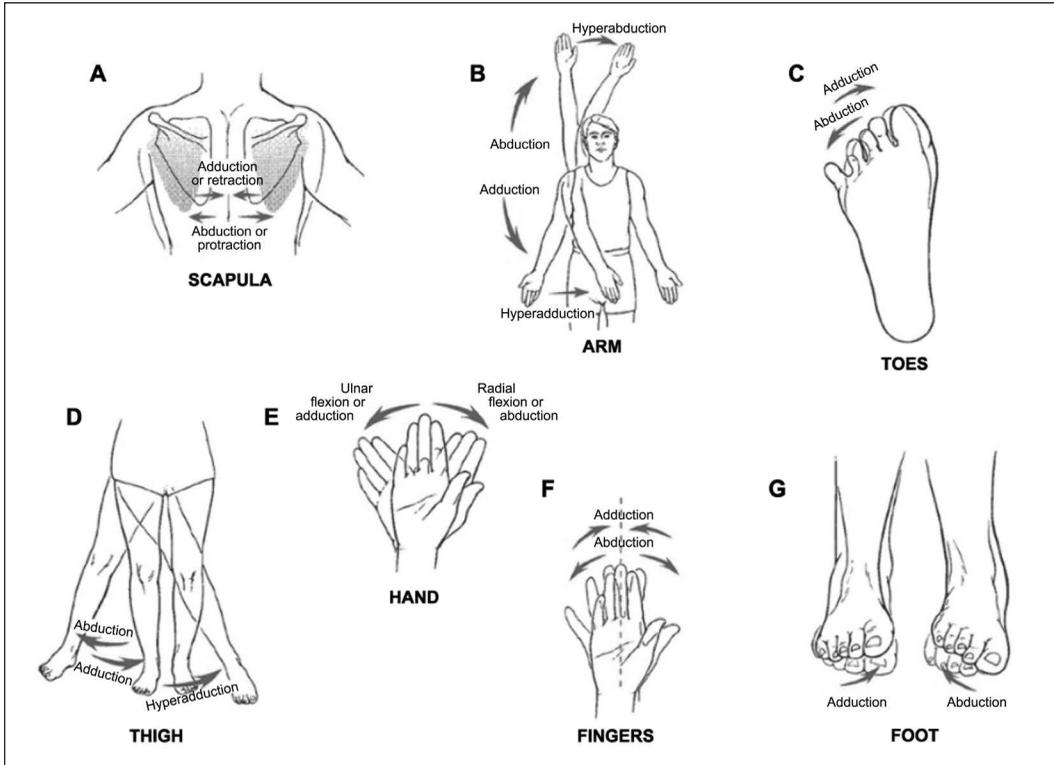


Figure 1-3. Abduction and adduction. These movements occur in the sternoclavicular, shoulder, wrist, metacarpophalangeal, hip, intertarsal, and metatarsophalangeal joints. (Reproduced with permission from Hamill, J., Knutzen, K., & Derrick, T. [2015]. *Biomechanical basis of human motion* [4th edition]. Lippincott Williams and Wilkens.)

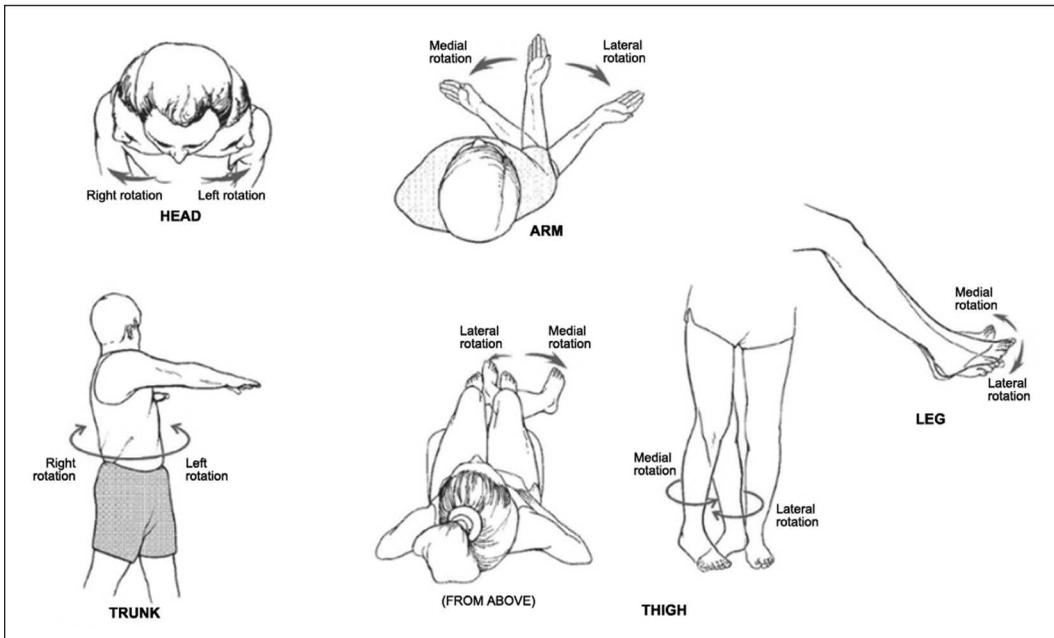


Figure 1-4. Rotation. This occurs in the vertebral, shoulder, hip, and knee joints. (Reproduced with permission from Hamill, J., Knutzen, K., & Derrick, T. [2015]. *Biomechanical basis of human motion* [4th edition]. Lippincott Williams and Wilkens.)

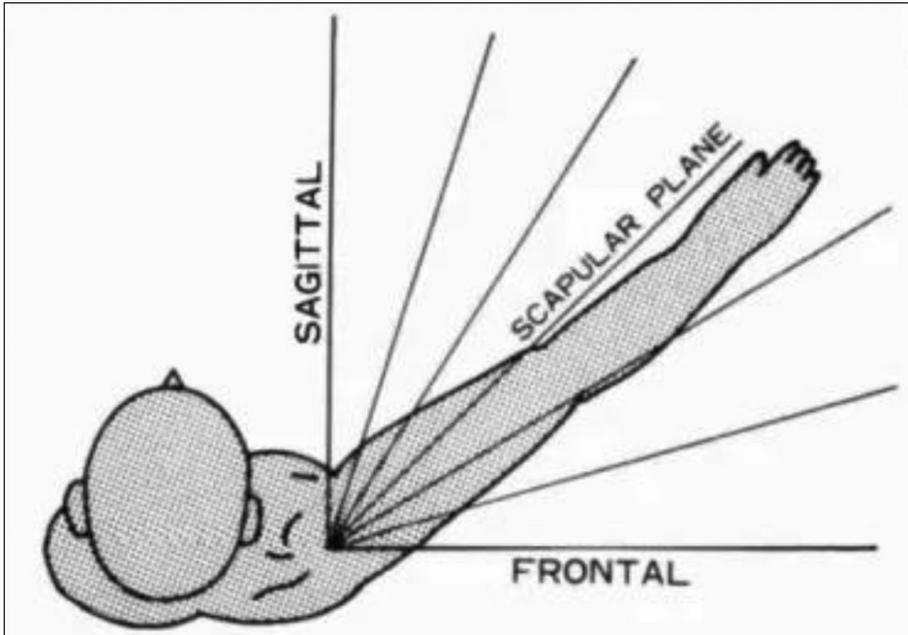


Figure 1-5.

Chapter 2. Gross muscle testing is the screening of synergistic muscle groups or sets of muscles that work together to perform the same action, or in the eyes of the occupational therapist, **functional muscle groups (FMGs)**. These sets of muscles appear as “prime movers” in anatomical literature and differ from source to source depending on the author. For example, muscle actions as they are identified in *Agur & Dalley’s Grant’s Atlas of Anatomy* (2017), differ from those grouped by Netter’s *Atlas of Human Anatomy* (2014). This is common practice in the field of biomechanics; subtle innuendos in the actions of musculature based upon physiology and a muscle’s location from the joint it influences and an obscurity students often question. For this step of the screening process, the client will again demonstrate all joint ranges of motion, though this time with resistance provided by the therapist. More specifics on gross muscle testing can be found in Chapter 3.

As a matter of effectively prioritizing time on behalf of the client and therapist alike, if there are no client complaints or observed abnormalities up until this point in the process, formal assessment is not needed to address any biomechanical factors. If however that is not the case, then the therapist will begin formal assessment with **goniometry**. This includes the use of the goniometer to measure the degrees of motion that are available at a particular joint and in a particular plane of motion. Goniometry is discussed in detail in Chapter 4 of this manual. In addition, the therapist will conduct **isolated muscle testing (IMT)** for each specific muscle in a given **functional muscle group or FMG**. This process is also described in Chapter 4 of this manual.

It is best to be proficient in all these methodologies as a matter of the efficiency demanded by clinical practice in the physical rehabilitation of today. Functional observation, AROM, and GMT as screening tools can quickly indicate or identify a biomechanical problem in need of further assessment. As applicable, the therapist will then employ goniometry and IMT to identify a clearly defined clinical picture in need of professional intervention. On an even broader scale, the experienced therapist will evaluate biomechanics in a proximal to distal manner in accordance with efficient proximal stability leading to effective distal mobility. With this principle, the therapist would first examine the core (it’s mobility and strength) prior to looking at the extremities as a foundational principle in physical rehabilitation. This manual is specific to the practice of occupational therapy

and as such, has an emphasis on the functional aspects or occupation-based aspects of biomechanics. While engaging in everyday activity, or occupations, indeed requires human kinetics and kinematics throughout the body, this manual will specifically cover screening of the neck, trunk, and lower extremity while referring further assessment thereof to our colleagues in physical therapy given their keen expertise in biomechanics.

The process for appropriate clinical reasoning is illustrated in the decision tree presented in Figure 1-1. In addition to clinical reasoning, occupational therapists also utilize frames of reference when providing evaluation and intervention to our clients. A **frame of reference** was clearly defined by Anne Mosey as “a set of interrelated internally consistent concepts, definitions, postulates, and principles that provide a systematic description of and prescription for a practitioner’s interaction with his domain of concern.” (1970, p.5). The focus of a frame of reference is to act as a guide to the therapist for the evaluation and intervention process. In this manual, a small portion of that “practitioner’s interaction” is discussed. That portion is the assessment of human movement; the product of joint range of motion and muscle strength. Because of this, the most appropriate frame of reference for use during a range of motion or strength assessment in isolation is the **Biomechanical Frame of Reference** (Trombly & Scott, 1977). This frame of reference defines function and dysfunction in terms of an individual’s range of motion, strength, and endurance. The biomechanical frame of reference is a building block on the way to other frames of reference because the components of range of motion, strength, and endurance are the building blocks to more functional activities.

The biomechanical frame of reference has four basic assumptions. The first is that purposeful activity will improve range of motion, strength, and endurance. It is important to note that this is purposeful activity, which has meaning to the client, not just activities created to provide a diversion for a client. The second assumption is that the improvement of range of motion, strength, and endurance will result in improved functional skills. This is why this frame of reference is considered a building block. Once the range of motion, strength, and endurance have improved, the functional skills will follow and the therapist can begin to utilize a frame of reference which can incorporate more functional skills and the client’s occupation. The third assumption is called the “rest/stress principle.” This principle dictates that while stress is necessary to avoid a loss of function, the body must also have time to rest and heal. This is especially important to consider in the healthcare environment of today. Many therapy referrals are occurring rapidly after the onset of a disease or injury. With shorter hospital stays, clients are pushed to progress earlier. As therapists, we must consider the needs of the body to heal while providing appropriate intervention to the client. The fourth and final assumption is that the client must have an intact central nervous system to utilize this frame of reference. This is because a client needs to demonstrate isolated and coordinated movement for the therapist to accurately measure an individual’s range of motion, strength, and endurance. If the client has abnormal muscle tone or is unable to follow directions, this will influence the accuracy of all assessment areas. Each of these tenets are essential in the therapist’s ability to effectively execute the intervention plan in every effort to restore function.

Although this manual examines the evaluative process of screening and assessment and not the intervention of deficits in the areas of range of motion and strength, the biomechanical frame of reference is appropriate because assessment is the first step in establishing a baseline on which to build an intervention plan. That intervention plan can then continue with the biomechanical frame of reference as well as other appropriate frames of reference.

Function and functional activities have been mentioned frequently in this introduction. Occupational therapists (OTs) work toward the recovery of functional skills and occupations with individual clients. *Because the focus of intervention is based on functional skills, there has been every effort throughout this manual to position the clients against gravity for both goniometry and muscle testing as this is the most appropriate context in which function occurs.* Although, there are times when this is not possible because of the client’s comfort as well as the physical context limitations. In addition, the positioning in relationship to gravity is not as applicable when assessing the hands and feet

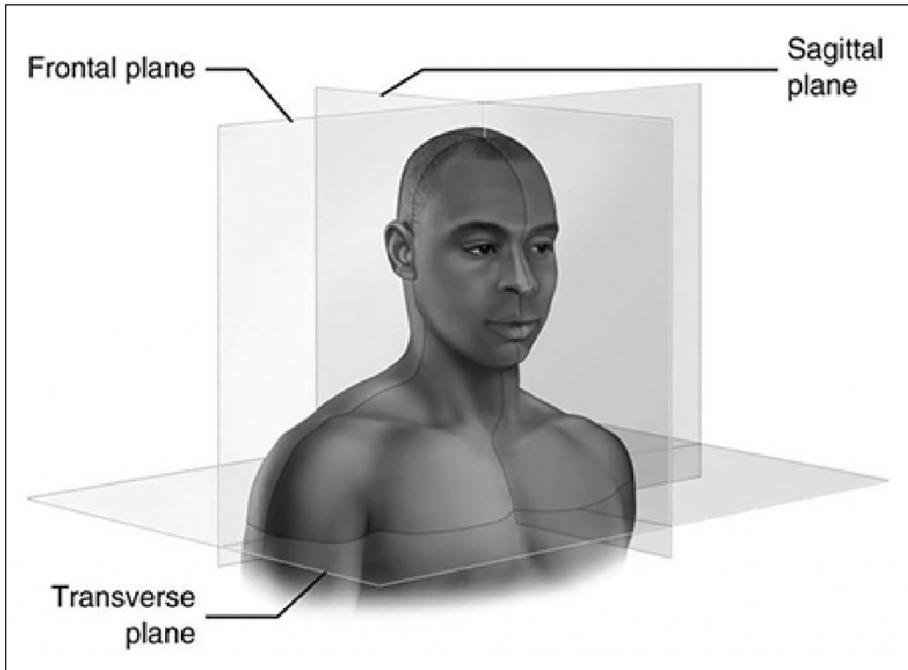


Figure 1-6. Cardinal planes upon which human motion occurs. (Reproduced with permission from Joe Muscolino [www.learnmuscles.com].)

because gravity does not have as significant an effect on these smaller muscles. As an example, the upper extremity as a unit accounts for approximately 5% of one's total body weight while the hand accounts for only 0.55% on average (Houglum & Bertoti, 2012). It is therefore prudent to recognize that a compromise in strength against gravity will have a more significant effect on reaching overhead to dress versus picking up a utensil from the table, notwithstanding other relevant client factors.

FOUNDATIONS OF HUMAN MOTION

In order to evaluate human motion most accurately, one must first be able to describe it in terms understood universally by the interprofessional, physical rehabilitation team. Therefore, the therapist must understand that all joint motion is best described as occurring on a cardinal plane and around an axis of rotation. This introduces an important foundational concept in the teaching of biomechanics and the analysis thereof; *a joint's structure dictates its function*. **Planes** are the surfaces along which human movement occurs. In other terms, they are imaginary sheets of glass that run through the body dividing it into smaller portions while in anatomical position. As a group of three cardinal or primary planes, movement at our joints becomes three dimensional or directional (Figure 1-6). The names and locations of these planes are listed in Table 1-1.

Linear movement of the body generally occurs in an arc or circular motion and around a single point, typically the designated joint. The point around which that motion occurs is called the **axis or fulcrum** represented as a straight line running through the body like an arrow. This axis also runs directly through the plane (sheet of glass). Each axis and plane are perpendicular to one another creating a partnership. The plane is the flat surface along which the movement occurs, and the axis is the location around which the movement occurs. A helpful analogy is a fidget spinner where the center remains fixed and the motion occurs on a given plane around its axis point (Figure 1-7). These partnerships in movement are summarized in Table 1-2. It is important to note that planes and axes

Table 1-1

PLANES AND AXES OF HUMAN MOTION

PLANE OF MOTION	DESCRIPTION	AXIS OF MOTION	GENERAL EXAMPLES (IN ANATOMICAL POSITION)	FIGURE REFERENCE
Sagittal Plane (also known as the medial-lateral plane)	Divides the body into even or uneven right and left portions	Sagittal plane motion occurs around a Frontal Axis point	Flexion/Extension (with exception of the CMC joint of the thumb)	Figure 1-4
Frontal Plane (also known as the anterior-posterior plane)	Divides the body into even or uneven anterior and posterior portions	Frontal plane motion occurs around a Sagittal Axis point	Lateral Rotation, Adduction/Abduction (with exception of the CMC joint of the thumb)	Figure 1-5
Transverse Plane (also known as the superior-inferior or horizontal plane)	Divides the body into even or uneven superior and inferior portions	Transverse plane motion occurs around a Vertical Axis point	All rotations including internal/medial, external/lateral rotation, supination, and pronation	Figure 1-6
Oblique Plane (also known as scaption)	Non-linear plane that divides the body into uneven portions	Not applicable	Scapular motions, ankle pronation and supination	Figure 1-7



Figure 1-7.

Table 1-2

JOINT STRUCTURE AND FUNCTION

JOINT	TYPE OF JOINT	MOTION(S) AVAILABLE	DEGREES OF FREEDOM
<i>Trunk/Neck</i>	Varies by region	Flex/Ext, Rotation, Lateral Flexion	1-3
<i>Scapula</i>	Not a true joint	Protraction/Retraction, Elevation/Depression, Upward/Downward Rotation	NA
<i>Shoulder</i>	Ball and socket	Flex/Ext/Hyperext, AB/AD, Horizontal AB/AD, IR/ER	3 (but 4, kind of!)
<i>Elbow</i>	Hinge	Flex/Ext	1
<i>Forearm</i>	Pivot (2 joints)	Supination/Pronation	1
<i>Wrist</i>	Condyloid	Flex/Ext, Ulnar/Radial Deviation	2
<i>MCPs</i>	Condyloid	Flex/Ext, AB/AD	2
<i>PIPs/DIPs</i>	Hinge	Flex/Ext	1
<i>Thumb</i>	Saddle	Flex/Ext, AB/AD	2 NOTE: Radial AB/AD = Flex/Ext; slightly different give shift/rotation in planes hence some sources state 6 directional motions
<i>Hip</i>	Ball and socket	Flex/Ext/Hyperext, AB/AD, IR/ER	3
<i>Knee</i>	Condyloid	Flex/Ext, Tibial Rotation	2
<i>Ankle</i>	Condyloid	Flex/Ext, Inversion/Eversion	2
<i>MTPs</i>	Condyloid	Flex/Ext, AB/AD	2

DPS, 2017.

refer to linear motion or motion occurring in a line. Motion that does not occur on a linear plane is said to instead occur on a tilted or oblique plane, such as the scapula laying atop the curved thorax. That said, engaging in functional activity does not occur in a straight line but instead to and through these planes and axes of motion or curvilinear motion (Houglum & Bertoti, 2012). More so, it is important to note that both circumduction and opposition are curvilinear motion or movement through the three cardinal planes and axes, hence they are not recognized as primary motions in kinesiological terms.

The physical structure of the joint dictates directly how many planes and around how many axes it is able to move; to simplify, form dictates function. Figure 1-8 and Table 1-2 provide a quick visual of the six major synovial joint structures throughout the human body. In this manual, we focus on synovial joints because by design, they are mobile, hence, the foundation of biomechanics (Neumann, 2009). Furthermore, Table 1-2 lends a quick overview of each major joint region of the human body, what its joint structure is by design, and therefore, how many **degrees of freedom (DOFs)** it is able to move in. Degrees of freedom describe how many planes that particular joint is

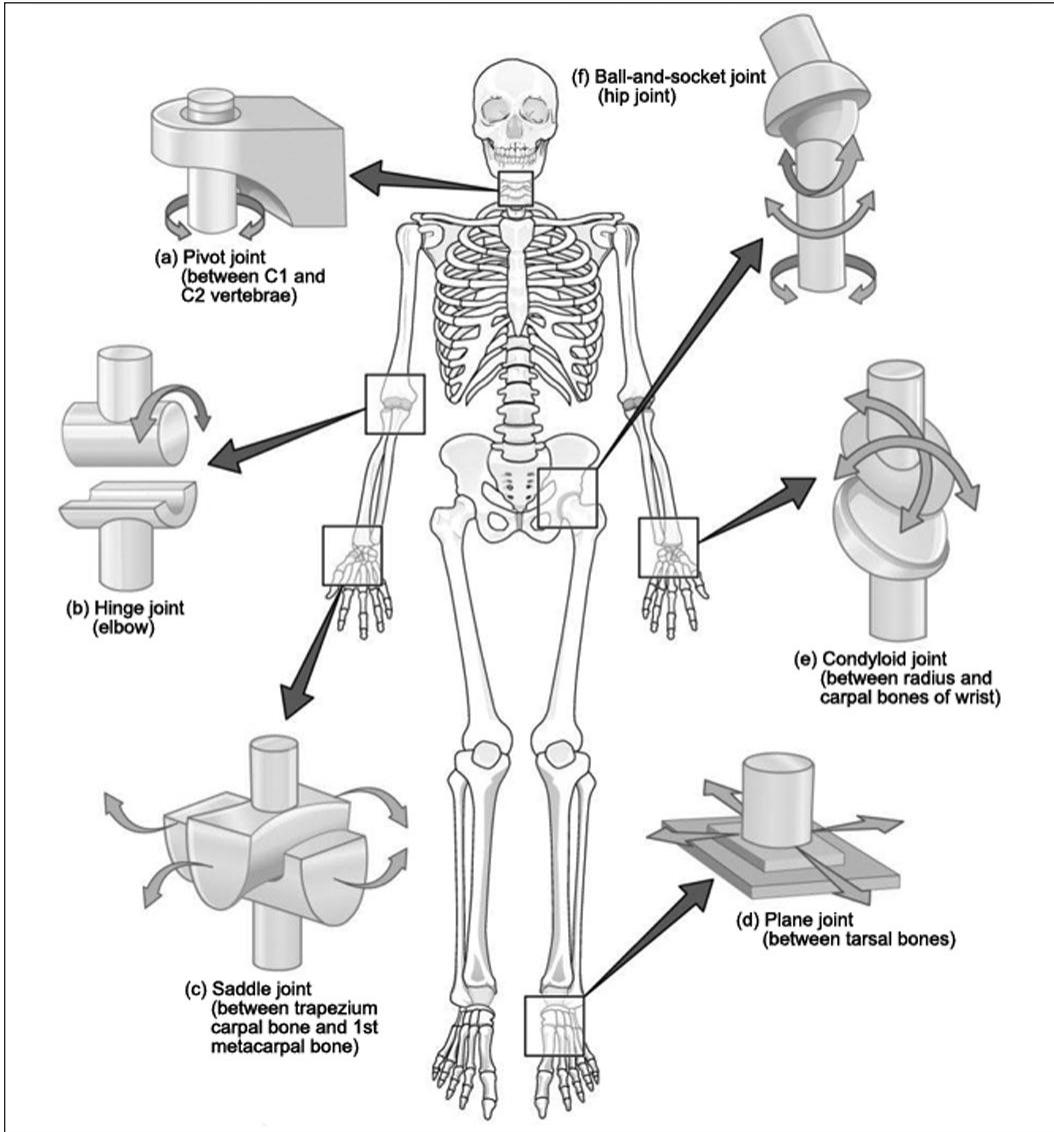


Figure 1-8. Synovial joint structures.

capable of producing by its structure alone. To provide an example, the shoulder/humeral joint is a ball and socket joint by design with three DOFs; 1. flexion and extension in the sagittal plane around the frontal axis, 2. abduction and adduction in the frontal plane around a sagittal axis, and 3. both internal/medial, external/lateral, and horizontal abduction/horizontal adduction in the transverse plane around a vertical axis.

Table 1-3

TYPES OF END FEELS

<i>Hard End Feel:</i> When bone hits bone	<i>Normal Example:</i> Elbow extension when the olecranon process enters the olecranon fossa to stop joint movement	<i>Abnormal Example:</i> Bone hitting bone because of arthritis or a bone chip in a joint which causes joint movement to stop
<i>Firm End Feel:</i> A stretching or "springy" feeling	<i>Normal Example:</i> Hip flexion when the hamstrings stretch to stop joint movement	<i>Abnormal Example:</i> Elbow extension when bicep spasticity causes joint movement to stop
<i>Soft End Feel:</i> When soft tissue hits soft tissue	<i>Normal Example:</i> Elbow or knee flexion when one muscle belly hits another to stop joint movement	<i>Abnormal Example:</i> Hand edema causes joint movement to stop

As a matter of screening, the therapist must be cognizant of the similarities and differences in **passive range of motion (PROM)** and **active range of motion (AROM)** occurring in each DOF. PROM is completed by the therapist alone. The therapist moves the extremity through each available plane or arc of motion without the assistance of the client. AROM is the opposite of PROM. The client moves the extremity through each available plane or arc of motion without the assistance of the therapist. In general, PROM is completed as an *assessment of joint integrity or a joint's end feel, muscle tone or muscle tightness* within muscle groups. The **end feel** of a joint is, as the name describes, the feeling that is elicited when the joint is brought through the entire available range of motion. The end feel can be hard, firm, or soft. Table 1-3 lists the types of end feels along with a normal and abnormal example for each. On the contrary, AROM is passively observed by the therapist and therefore, an effective means of screening when looking for potential areas of deficit. While there are differing trains of thought on which should be assessed first, general consensus as OTs is in examining engagement in functional activity foremost. As such, this manual will ascribe to observing AROM in action foremost, followed by the assessment of joint integrity as a matter of formal assessment as may be deemed necessary.



Some of the names for planes and axes are the same, which can create confusion; however, if you remember the frontal plane runs through the body dividing into front and back portions, then the frontal axis runs along the same area. Therefore, if these are parallel, they cannot be "partners."

KEY TERMS

The following is a list of Key Terms used in this manual. Key Terms are defined in the glossary at the end of the book.

Active range of motion

Against gravity

Axis of the body

Biomechanical frame of reference

Clinical reasoning

Compensation

Degrees of Freedom

End feel

Frames of reference

Fulcrum

Functional Activity

Functional observation

Functional muscle groups

Goniometry

Gravity eliminated

Gross manual muscle testing

Isolated manual muscle testing

Movable arm

Passive range of motion

Plane of the body

Resistance

Screening

Stabilization

Stationary arm

Finally, there are three icons that are used to designate features that appear intermittently throughout the text. They are: Note, Caution, and ASHT guidelines (2015).



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Introduction and Functional Activity Observation

After completing this chapter, the student will be able to accomplish the following:

- Define the simplified, 6-step process to guide completion of the biomechanical screening and assessment.
 1. The Introduction
 2. The Functional Activity Screening
 3. The Active Range of Motion (AROM) Screening
 4. The Gross Muscle Testing (GMT) Screening
 5. The Goniometry Assessment
 6. The Isolated Muscle Testing (IMT) Assessment
- Recognize the importance of establishing positive therapeutic rapport on the evaluation process.
- Recognize the importance of functional observation and task analysis to the process of screening for biomechanical ailments.
- Demonstrate the ability to engage the client in an appropriate functional activity that will support the diagnostic examination of biomechanical capacity as relevant to context and client preferences (i.e., within normal limits (WNL)/within functional limits (WFL) or in need of further examination).
- Understand the contraindications and precautions governing the therapeutic use of joint range of motion and gross muscle strength testing.

The biomechanical screening and assessment of an individual's bone, joint, and muscle integrity can be most easily simplified into a 6-step process: Introduction, the Functional Activity Screening (this chapter), the Active Range of Motion Screening, the Gross Muscle Strength Screening (Chapter 3), the Goniometric Assessment and the Isolated Muscle Strength Assessment (Chapter 4). By following these 6 steps, the therapist can ensure a thorough evaluation of a client's biomechanical abilities and disabilities as a matter of the initial evaluation. Assuming a limitation is noted at any step, the intervention plan begins to form and at the forefront of that process is the clinician to client introduction.

INTRODUCTION

Of significant importance to any therapeutic interaction is the establishment of trusting and positive rapport. Without this relationship, progress in the treatment of illness and/or injury will be hindered and as such, jeopardize your effectiveness as a treating clinician. Through trusting rapport the therapist can then ensure an accurate prior history of illnesses or injuries that may affect the integrity of a client's bones, joints, and/or muscles as key elements to the biomechanical assessment process. It is essential for the therapist to understand this history and how it may residually affect the current status of the client based upon the most recent referral. Often, students stumble with what to say in laymen's terms and to this, the following stem may be found helpful:

“Hello. My name is _____ and I am an occupational therapist here at _____. Your physician has asked that I come in this morning and take a closer look at your muscles, bones, and joints and how they are working together to support you in doing the things you both need and want to do everyday. To do that, I want to start with asking if you have ever had any injuries to your bones, muscles, or joints.....”. What we will do should not cause any discomfort but if you feel anything out of the ordinary, please let me know. Ok, let's get started.”

FUNCTIONAL ACTIVITY SCREENING

As occupational therapists, you will note that this introduction included a focus on what the client needs and wants to achieve each day. For most, this will include the completion of an Occupational Profile lending insight into who the client is and what they wish to achieve in treatment. And this occupation-based perspective uniquely permits the therapist to begin at our roots in task analysis. The occupational therapist uses their skill to determine the appropriate functional activity to ask of the client in the moment and with consideration of the context. This functional observation is considered the initial step of the screening process. Is the client status post rotator cuff repair able to hang his or her jacket on the coat rack successfully and without assistance, or not? The “diagnostic vision” and procedural thinking of the therapist has now begun. Need more tasks be observed to gain a full perspective? The biomechanical screening process has now begun.

Although a screen is not a formal assessment, it is a method which allows the therapist to determine quickly which joints need further assessment. By demonstrating proficient observation skills a therapist will be able to save time in the fast-paced health care environment (Takala, Pehkonen, Forsman, Hansson, Mathiassen, Neumann, Sjogaard, Veiersted, Westgaard, and Winkel, 2009). If no deficits are noted during observation, the therapist can avoid spending excessive time on measuring the range of motion of each joint only to determine that all joints are functional or normal. In addition, this screening can be completed during another assessment such as activities of daily living

(ADL). Once a student masters the anatomy, he/she can determine what joints and muscle groups are used for different functional tasks. Knowing this enables the student to observe the client completing a functional activity and to decide, based on that observation, whether a joint range of motion assessment, gross muscle testing (GMT), or isolated muscle testing (IMT) is required. Examples of applicable functional tasks are provided for each joint motion by region. In addition, Appendix A: Biomechanical Task Analysis provides a format for the systematic analysis and documentation of functional activity as a matter of biomechanical screening.

This overall screening is also influenced by other factors, such as the physical and environmental contexts, the specific occupations or roles of the client, and the client's own personal goals. It is important to note however, that this manual will specifically focus on range of motion and strength screening and assessments as key components of the overall, client-centered intervention plan from a biomechanical and rehabilitative lens alone so as to be a more concise teaching tool.

Contraindications and Precautions

It is the duty of the therapist to be knowledgeable regarding any potential health conditions that may otherwise contraindicate (not indicated) or require added caution (a precaution) to biomechanical screening and assessment of the musculoskeletal system.

The following are examples of contraindications:

- Acute medical conditions directly affecting the musculoskeletal system, including:
 - Joint inflammation
 - Joint dislocation or subluxation
 - Report of significant pain of muscle or joints
 - Bone fracture that is acute or unstable
- Pathological conditions directly affecting the integrity of bone such as carcinoma (myeloma, sarcoma), Osteogenesis Imperfecta, or Paget's Disease
- Pathological conditions directly affecting the integrity of skin such as chronic obstructive pulmonary disease (long-term use of corticosteroids) or hemophilia as examples
- Neurological conditions resulting in muscular hypertonicity or hypotonicity as the cause for decreased joint range and muscle strength
- History of cardiovascular disease

The following are examples of precautions (take individual precaution in light of personal context and in consultation with the medical doctor):

- Post localized or systemic infection or inflammatory conditions
- Status post acute surgical intervention
- Status post fracture with nonunion or delayed union
- Clinical history of osteoporosis
- Pathological conditions indirectly affecting the integrity of bone such as Rickets or Osteomalacia
- Significant hypermobility at joints with or without diagnosed condition such as Ehlers-Danlos syndrome (EDS)
- Report of significant pain of muscle or joints
- Presence of hematoma indicative of acute underlying injury to muscle and/or connective tissue including tendon tears, or avulsions/ruptures

SECTION 2-1: Functional Activities of the Neck and Trunk

Neck Flexion (Cervical Region) Screening

Functional Activity: Looking at the keyboard while typing (Figure 2-1-1).

Neck Extension (Cervical Region) Screening

Functional Activity: Looking up at the light fixture while changing the bulb (Figure 2-1-2).



Figure 2-1-1. Neck flexion.



Figure 2-1-2. Neck extension.

Neck Lateral Flexion (Cervical Region) Screening

Functional Activity: Putting on an earring (Figure 2-1-3).

Neck Rotation (Cervical Region) Screening

Functional Activity: Looking left and right at stop sign prior to pulling out into traffic (Figure 2-1-4).



Figure 2-1-3. Neck lateral flexion.



Figure 2-1-4. Neck rotation.

Trunk Flexion (Thoracolumbar Region) Screening

Functional Activity: Bending down to the floor to put on shoes (Figure 2-1-5).



Figure 2-1-5. Trunk flexion.

Trunk Extension (Thoracolumbar Region) Screening

Functional Activity: Removing clothes from the dryer and placing into the laundry basket (Figure 2-1-6).



Figure 2-1-6. Trunk extension.

Trunk Lateral Flexion (Thoracolumbar Region) Screening

Functional Activity: Tucking a shirt into pants (Figure 2-1-7).



Figure 2-1-7. Trunk lateral flexion.

Trunk Rotation (Thoracolumbar Region) Screening

Functional Activity: Reaching to the side and downward to place a dish in the dishwasher (Figure 2-1-8).



Figure 2-1-8. Trunk rotation.

SECTION 2-2: Functional Activities of the Scapula and Shoulder

Scapula Upward/Lateral Rotation Screening

Functional Activity: Reaching to the top shelf in the kitchen to retrieve the cereal box (Figure 2-2-1).

Scapula Downward Rotation/Medial Rotation Screening

Functional Activity: Bringing bowl down from the top shelf in the cabinet to the countertop (Figure 2-2-2).



Figure 2-2-1. Scapular upward rotation.



Figure 2-2-2. Scapular downward rotation.

Scapular Elevation Screening

Functional Activity: Carrying a backpack on one shoulder (Figure 2-2-3).

Scapular Depression Screening

Functional Activity: Reaching deep into your pants pocket to retrieve car keys (Figure 2-2-4).



Figure 2-2-3. Scapular elevation.



Figure 2-2-4. Scapular depression.

Scapular Protraction/Abduction Screening

Functional Activity: Reaching forward to turn on kitchen faucet (Figure 2-2-5).

Scapular Retraction/Adduction Screening

Functional Activity: Pulling open the dresser drawer (Figure 2-2-6).



Figure 2-2-5. Scapular protraction.



Figure 2-2-6. Scapular retraction.

Shoulder/Humeral Flexion Screening

Functional Activity: Reaching forward to turn on the kitchen faucet (Figure 2-2-7).

Shoulder/Humeral Extension Screening

Functional Activity: Reaching back for the armrests of the chair before sitting down (Figure 2-2-8).



Figure 2-2-7. Shoulder flexion.



Figure 2-2-8. Shoulder extension.

Shoulder/Humeral Abduction Screening

Functional Activity: Reaching up to head to put on baseball cap (Figure 2-2-9).

Shoulder/Humeral Adduction Screening

Functional Activity: Squeezing a clutch bag between your arm and lateral trunk (Figure 2-2-10).



Figure 2-2-9. Shoulder abduction.



Figure 2-2-10. Shoulder adduction.

Shoulder/Humeral Horizontal Abduction Screening

Functional Activity: Reaching out of the car to retrieve ordered items from the drive thru window (Figure 2-2-11).

Shoulder/Humeral Horizontal Adduction Screening

Functional Activity: Reaching over the opposite shoulder to grab the seat belt in order to put it on (Figure 2-2-12).



Figure 2-2-11. Shoulder horizontal abduction.



Figure 2-2-12. Shoulder horizontal adduction.

Shoulder/Humeral External Rotation Screening

Functional Activity: Clasp a necklace behind the neck (Figure 2-2-13).

Shoulder/Humeral Internal Rotation Screening

Functional Activity: Turning the steering wheel of the car to the left using the right arm (Figure 2-2-14).



Figure 2-2-13. Shoulder external rotation.



Figure 2-2-14. Shoulder internal rotation.

SECTION 2-3: Functional Activities of the Elbow, Forearm, and Wrist

Elbow Flexion Screening

Functional Activity: Bringing spoon from dinner plate on table to mouth (Figure 2-3-1).

Elbow Extension Screening

Functional Activity: Reaching out to turn up the volume of the radio in the car (Figure 2-3-2).



Figure 2-3-1. Elbow flexion.



Figure 2-3-2. Elbow extension.

Forearm Supination Screening

Functional Activity: Turning on the shower faucet (clockwise rotation with the right hand or counterclockwise with the left; Figure 2-3-3).

Forearm Pronation Screening

Functional Activity: Pouring a glass of orange juice (Figure 2-3-4).



Figure 2-3-3. Forearm supination.



Figure 2-3-4. Forearm pronation.

Wrist Flexion Screening

Functional Activity: Buttoning a shirt (Figure 2-3-5).

Wrist Extension Screening

Functional Activity: Grasping toothbrush while brushing teeth (Figure 2-3-6).



Figure 2-3-5. Wrist flexion.



Figure 2-3-6. Wrist extension.

Wrist Radial Deviation Screening

Functional Activity: Opening the jar of pickles (counterclockwise with right hand; clockwise with left hand; Figure 2-3-7).

Wrist Ulnar Deviation Screening

Functional Activity: Tightening the lid on the jar of tomato sauce (clockwise with right hand; counterclockwise with left hand; Figure 2-3-8).



Figure 2-3-7. Wrist radial deviation.



Figure 2-3-8. Wrist ulnar deviation.

SECTION 2-4: Functional Activities of the Hand

Metacarpal Phalangeal (MCP) Flexion (Digits II-V) Screening

Functional Activity: Gripping a knife while cutting vegetables for dinner (Figure 2-4-1).

MCP Extension/Hyperextension (Digits II-V) Screening

Functional Activity: Lifting finger off of a computer key while typing (Figure 2-4-2).



Figure 2-4-1. MCP flexion (digits II-V).



Figure 2-4-2. MCP extension (digit II as pictured).

MCP Adduction Screening

Functional Activity: Grasping a pencil while writing (Figure 2-4-3).

MCP Abduction Screening

Functional Activity: Spreading fingers apart to get them into a glove (Figure 2-4-4).



Figure 2-4-3. MCP adduction.



Figure 2-4-4. MCP abduction.

Proximal Interphalangeal (PIP) Flexion Screening

Functional Activity: Holding a grocery bag by the handles to bring them inside your house (Figure 2-4-5).

PIP Extension Screening

Functional Activity: Extending index finger to press an elevator button (Figure 2-4-6).



Figure 2-4-5. PIP flexion.



Figure 2-4-6. PIP extension.

Distal Interphalangeal (DIP) Flexion Screening

Functional Activity: Applying a contact lens onto the eye with the index finger (Figure 2-4-7).

DIP Extension Screening

Functional Activity: Releasing coffee cup on the kitchen table (Figure 2-4-8).



Figure 2-4-7. DIP flexion.



Figure 2-4-8. DIP extension.

Carpometacarpal (CMC) Flexion Screening

Functional Activity: Pressing down on phone screen while texting (one handed; Figure 2-4-9).

CMC Extension (AKA Radial Abduction) Screening

Functional Activity: Reaching out to grab the bottle of hand sanitizer (Figure 2-4-10).



Figure 2-4-9. CMC flexion.



Figure 2-4-10. CMC extension.

CMC Abduction (AKA Palmar Abduction) Screening

Functional Activity: Releasing the pitcher on the kitchen counter (Figure 2-4-11).

CMC Adduction Screening

Functional Activity: Grasping the glass of water from the counter top (Figure 2-4-12).



Figure 2-4-11. CMC abduction.



Figure 2-4-12. CMC adduction.

Metacarpalphalangeal (MP) Flexion (Digit I) Screening

Functional Activity: Pressing down on the keyboard while texting (one handed; Figure 2-4-13).

MP Extension (Digit I) Screening

Functional Activity: Releasing a coin into slot of the vending machine (Figure 2-4-14).



Figure 2-4-13. MP flexion.



Figure 2-4-14. MP extension.

Interphalangeal (IP) Flexion (Digit I) Screening

Functional Activity: Grasping a pencil while writing (Figure 2-4-15).

IP Extension (Digit I) Screening

Functional Activity: Releasing vitamin tablet on countertop (Figure 2-4-16).



Figure 2-4-15. IP flexion.



Figure 2-4-16. IP extension.

Opposition Screening

Functional Activity: Blowing your nose with a tissue (Figure 2-4-17).



Figure 2-4-17. Opposition.

SECTION 2-5: Functional Activities of the Hip and Knee

Hip Flexion Screening

Functional Activity: Raising foot up to the chair in order to tie your shoe (Figure 2-5-1).

Hip Extension Screening

Functional Activity: Pulling sock up to knee while seated (Figure 2-5-2).



Figure 2-5-1. Hip flexion.



Figure 2-5-2. Hip extension.

Hip Abduction Screening

Functional Activity: Stepping over the tub ledge to get into the shower (Figure 2-5-3).

Hip Adduction Screening

Functional Activity: Kicking a soccer ball to the left with the right, inner foot during the game (Figure 2-5-4).



Figure 2-5-3. Hip abduction.



Figure 2-5-4. Hip adduction.

Hip External Rotation Screening

Functional Activity: Putting your foot on top of your opposite knee to tie shoelace (Figure 2-5-5).

Hip Internal Rotation Screening

Functional Activity: Turning leg and foot inwards to zip a lateral zipper on a boot while getting dressed (Figure 2-5-6).



Figure 2-5-5. Hip external rotation.



Figure 2-5-6. Hip internal rotation.

Knee Flexion Screening

Functional Activity: Lowering oneself to sit down as is needed for toileting or getting into bed (Figure 2-5-7).

Knee Extension Screening

Functional Activity: Stepping up out of the car (Figure 2-5-8).



Figure 2-5-7. Knee flexion.



Figure 2-5-8. Knee extension.

SECTION 2-6: Functional Activities for Ankle and Foot

Ankle Dorsiflexion Screening

Functional Activity: Lifting foot to next step while going up the stairs (Figure 2-6-1).

Ankle Plantar Flexion Screening

Functional Activity: Pressing down the acceleration pedal in the car (Figure 2-6-2).



Figure 2-6-1. Ankle dorsiflexion.



Figure 2-6-2. Ankle plantar flexion.

Ankle Inversion Screening

Functional Activity: Shifting foot from the accelerator to the brake while driving (Figure 2-6-3).

Ankle Eversion Screening

Functional Activity: Shifting foot from the brake to the accelerator while driving (Figure 2-6-4).



Figure 2-6-3. Ankle inversion.



Figure 2-6-4. Ankle eversion.

Metatarsal Phalangeal (MTP) Flexion Screening

Functional Activity: Placing toes into opening of a sock before pulling it on (Figure 2-6-5).

MTP Extension Screening

Functional Activity: Slipping on flip flops before heading to the beach (Figure 2-6-6).



Figure 2-6-5. MTP flexion.



Figure 2-6-6. MTP extension.

MTP Abduction Screening

Functional Activity: Slipping on flip flops before heading to the beach (Figure 2-6-7).

MTP Adduction Screening

Functional Activity: Placing toes/foot into a tall boot (Figure 2-6-8).



Figure 2-6-7. MTP abduction.



Figure 2-6-8. MTP adduction.

IP (Great Toe)/PIP (Toes II-V)/DIP (Toes II-V) Flexion Screening

Functional Activity: Placing toes into opening of a sock before pulling it on (Figure 2-6-9).

IP/PIP/DIP Extension Screening

Functional Activity: Lifting foot up to next step while ascending the stairs (Figure 2-6-10).



Figure 2-6-9. IP/PIP/DIP flexion.



Figure 2-6-10. IP/PIP/DIP extension.

On a final note, there are three icons that are used to designate features that appear intermittently throughout the remainder of the text. They are: Note, Caution, and ASHT guidelines (2015).



KEY TERMS

The following is a list of Key Terms used in this manual. Key Terms are defined in the glossary at the end of the book.

Activities of Daily Living

Functional Activity

Functional observation

Gross manual muscle testing

Isolated manual muscle testing

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Biomechanical Screening

Introduction to Active Range of Motion and Gross Muscle Testing

After completing this chapter, the student should be able to accomplish the following:

- Define the terms related to joint range of motion including the cardinal plane and axis of rotation.
- Define the terms gross muscle testing (GMT) of a functional muscle group (FMG).
- Identify the average expected range of motion (AROM) of each joint in all planes.
- Recognize potential contraindications and precautions to performing joint range of motion and/or gross muscle testing.
- Demonstrate the ability to facilitate joint range of motion in all cardinal planes with a client.
- Demonstrate the ability to perform and grade gross muscle testing (GMT) in all cardinal planes with a client.
- Demonstrate appropriate clinical reasoning to determine when further biomechanical assessment is necessary based upon the outcome of the screening process.
- Demonstrate appropriate documentation of the screening results per Appendices B and C.

PROCEDURAL GUIDELINES

1. As depicted in the decision tree (Chapter 1, Figure 1-1 Clinical Decision-Making Tree), observation of functional activity (previously in Chapter 2), AROM, and GMT (this chapter) represent the first steps in the evaluative OT process in physical rehabilitation. Following that diagnostic screening, the therapist will determine if formal goniometric and isolated muscle testing assessment are necessary (Chapter 4).
2. **Active Range of Motion (AROM):** Following observation of functional activity, the therapist will ask the client to complete AROM in all planes and around all axes. This is typically completed in mirror image; therapist facing client and client repeating motions demonstrated by therapist. In addition, the therapist should observe the AROM for any compensation. **Compensation** is noted when the client uses other joint motions to achieve the AROM requested by the therapist. For example, when a client is asked to flex the shoulder/humeral joint he/she may compensate by utilizing excessive scapular motion or trunk extension in an attempt to increase shoulder flexion. It is through the therapist's keen understanding of fundamental biomechanics that compensation is easily recognized and minimized accordingly. Compensation is a result of the client's wish to succeed and not a conscious act. It is the responsibility of the therapist to recognize compensation and provide necessary cueing, verbally and physically, to prevent that from biasing the overall analysis of motion.

It should be noted that the ability to perform AROM in the full arc of motion against gravity requires strength even when added resistance externally is absent. AROM as a screening tool is commonly documented as within functional limits (WFL) or within normal limits (WNLs). WFLs consider the personal contexts under which motion is occurring. For example, for a college student, AROM of shoulder/humeral flexion is expected to reach full or ~180 degrees (WNLs), while that of an 80 year old, oxygen dependent client may be considered WFLs even at less than 180 degrees so long as they are able to tend to all the occupational tasks they need and wish to do everyday. If the AROM is not considered WFL or WNL per this screening, then further formal assessment is required via goniometry and isolated muscle testing (Chapter 3).

3. **Gross Muscle Testing (GMT):** Following the screening of AROM, the therapist will conduct a quick screening of gross functional muscle group strength or gross muscle testing (GMT). This is a form of manual muscle testing where muscle groups that work together to produce the same motion, or synergists, are tested together in a concentric fashion as a screening of functional strength. An example of a **functional muscle group (FMG)** is the elbow flexors. This screening would quickly look at the collective strength capacity of the elbow flexors including, Biceps Brachii, Brachioradialis, and Brachialis. Occupation occurs against gravity in everyday activity and as such, so does GMT screening as a means to determine if further assessment is needed. Therefore, this screening is conducted in the natural environment, against gravity or upright, whether seated or standing, and given proper safety considerations to execute.
 - a. In gross muscle testing (GMT), the therapist must consider the effect of gravity on the client because gravity itself is a form of resistance on muscles. Normally, we do not feel the effect of gravity, but when muscles are weakened the effect can be significant. **Against gravity** refers to the type of movement that occurs when a client is moving away from or perpendicular to the ground (whether seated or standing). The further the motion is away from the ground, the more resistance is generated and the more muscle strength is needed.

- b. In its simplest terms, a therapist has two hands; one which will act as the resistor and the other which will act as the stabilizer while conducting GMT. The therapist's stabilizing hand ("stabilizer") is generally placed just proximal to the designated joint (ie: elbow flexion at the anterior aspect of the humerus), while the muscle strength "resistor" is positioned just distal to the joint on which the testing muscles act (ie: elbow flexion at the anterior aspect of the radius/ulna) as a general rule. The stabilizing force from the therapist is applied in an effort to prevent any compensation a client may enact unintentionally if effort to sustain strength during resistance (ie: trunk lateral flexion during GMT of shoulder/humeral abduction). As relevant to this manual, the therapist's hand providing **resistance**, or the ("**resistor**"), describes the added external force applied manually by the therapist in the opposite direction of motion, toward the pull of gravity, during a GMT screening in order to determine which muscle strength grade is most appropriate.

During examination, the therapist will screen each FMG, applying resistance against the movement itself and toward the pull of gravity for a sustained period of time, not exceeding the count of "Hold for 1 and 2 and 3". There are a few gross muscle tests where this hand placement differs (ie: shoulder/humeral and hip internal/medial and external/lateral rotation), however, as a matter of teaching and learning, it is easier to recognize the exceptions to the overarching "rule" of hand placement. As a matter of general procedure, the resistance force is applied by the "resistor hand" and in the opposite direction of the function muscle group (FMG) action (ie: for shoulder/humeral *flexion*, resistance is toward shoulder/humeral *extension*).

Of note, if resistance is applied too distal to the designated testing joint (ie: at the forearm versus the humerus in shoulder/humeral flexion), the second joint muscle action will be activated and unintentionally yield inaccurate results as a matter of our innate instinct to succeed. Again, it is the therapist's expertise in biomechanics that will recognize and correct for these compensatory actions.

- c. The ability to move against gravity requires muscle strength. Completing AROM as per the direction of the therapist against gravity, either seated or standing, requires a muscle grade strength of fair or above (see Table 3-1 Abbreviated Muscle Strength Grading Scale). This quick screening not only clarifies that the client understood the directions given by the therapist, but also reinforces that the client can move the extremity in the against-gravity as a resistance of its own weight lending the therapist a keen sense of biomechanical integrity via this simple screening process alone.

Gross muscle testing is recorded per guidelines provided in Table 3-1: Abbreviated Muscle Strength Grading Scale.

As mentioned above, there is an intimate relationship between joint motion against gravity and muscle strength. Gravity is a resistance to motion away from the ground in a perpendicular line of pull that increases as a function of the size of the body segment it is pulling upon. For example, as a matter of gross strength, it is easier to flex your finger while typing on the keyboard resting on the desk when compared with flexing your finger while holding your entire arm out in front of you unsupported. Similarly, it requires more strength to flex your elbow in isolation against gravity than it does to flex your elbow while carrying 4 bags of groceries from the car to the kitchen as a functional example. Table 3-1: Abbreviated Muscle Strength Grading Scale gives us an illustration of this as a means of grading a GMT. As a matter of the screening, if the client is able to adequately mirror all motions requested by the therapist, in full AROM and against gravity, the GMT muscle

Table 3-1

ABBREVIATED MUSCLE STRENGTH GRADING SCALE

	WORD GRADE	NUMBER GRADE	DEFINITION
Against Gravity →	Normal	5	Full ROM against gravity with maximal added external resistance by therapist
	Good	4	Full ROM against gravity with moderate added external resistance by therapist
	Fair	3	Full ROM against gravity, unable to sustain position, without added external resistance by therapist
Gravity Eliminated →	Poor	2	1/2 to Full (Partial) ROM in gravity eliminated, no added resistance
	Trace	1	Palpation of muscle contraction only in attempt to move, no actual motion
	Zero	0	Absence of muscle contraction seen or palpated in attempt to move, no actual motion
Clinicians will alternate among words versus numbers by personal preference. For screening, + and – is not necessary.			

↑ The demand for muscle strength increases as motion occurs against gravity and in its full range of arc.

strength of 3/Fair is reasonably concluded by observation alone. If the client was furthermore able to withstand added external resistance provided by the therapist during the motion, then the GMT muscle strength of 4/Good or 5/Normal would be appropriate depending on how much force was applied. However, if the client was unable to achieve full AROM against gravity, even without any added external resistance, the screening results would instead indicate the need for further, formal biomechanical assessment by way of goniometry and isolated muscle testing outlined in Chapter 4 of this manual.

See Appendices B and C for a sample Biomechanical Screening (AROM and GMT) Documentation Forms

See Appendix D for a quick reference listing of primary/prime muscle movers by Functional Muscle Group (FMG)

See Appendix G for a comprehensive quick reference or at-a-glance guide of both screening and assessment procedures by functional muscle group (FMG) for both the upper and lower extremities.

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SECTION 3-1: The Neck and Trunk

Neck Flexion (Cervical Region) Screening

AROM

Plane: Sagittal

Axis: Frontal

Normal ROM: 0-45 degrees (Figure 3-1-1)

Gross Muscle Testing

Prime Movers: Bilateral contraction of Longus capitis, Longus colli, Sternocleidomastoid

Position: Client is seated and moves chin to chest

Stabilize: Posterior thorax

Resist: At forehead in direction of neck extension.

Neck Extension (Cervical Region) Screening

AROM

Plane: Sagittal

Axis: Frontal

Normal ROM: 0-45 degrees extension (Figure 3-1-2)

Gross Muscle Testing

Prime Movers: Bilateral contraction of Erector spinae, Splenius capitis, Splenius cervicis, Semispinalis capitis, Semispinalis cervicis

Position: Client is seated and moves into hyperextension with slight rotation toward the test side

Stabilize: Posterior thorax

Resist: Posterior-lateral aspect of head toward neck flexion and slight rotation.



Figure 3-1-1. AROM neck flexion.



Figure 3-1-2. AROM neck extension.

Neck Lateral Flexion (Cervical Region) Screening

AROM

Plane: Frontal

Axis: Sagittal

Normal ROM: 0-45 degrees (Figure 3-1-3)

Gross Muscle Testing

Prime Movers: Unilateral contraction of Sternocleidomastoid, Splenius capitis, Splenius cervicis

Position: Client is seated and moves into lateral flexion to test side

Stabilize: Superior aspect of opposite shoulder

Resist: Lateral aspect of head toward opposite motion.

Neck Rotation (Cervical Region) Screening

AROM

Plane: Transverse

Axis: Vertical

Normal ROM: 0-60 degrees (Figure 3-1-4)

Gross Muscle Testing

Prime Movers: Contralateral contraction of Sternocleidomastoid, Splenius capitis, Splenius cervicis

Position: Client is seated and moves into hyperextension with rotation to test side

Stabilize: Posterior thorax

Resist: Posterior-lateral aspect of head toward opposite motions toward neck flexion and rotation.



Figure 3-1-3. AROM neck lateral flexion.



Figure 3-1-4. AROM neck rotation.

Trunk Flexion (Thoracolumbar Region) Screening

AROM

Plane: Sagittal

Axis: Frontal

Normal ROM: 0-80 degrees (Alternative Method: 4 inches with a tape measure; Figure 3-1-5)

Gross Motor Testing

Prime Mover: Rectus abdominis, External oblique, Internal oblique

Position: Client is standing and moves into trunk flexion

Stabilize: Not formally necessary

Resist: Slight resistance toward trunk extension at manubrium.

Trunk Extension (Thoracolumbar Region) Screening

AROM

Plane: Sagittal

Axis: Frontal

Normal ROM: 0-25 degrees (Figure 3-1-6)

Gross Muscle Testing

Prime Movers: Bilateral contraction of Erector spinae (Iliocostalis, Longissimus, and Spinalis segments)

Position: Client is standing and moves into trunk extension

Stabilize: Not formally necessary

Resist: Slight resistance toward trunk flexion at mid thoracic region of vertebral column.



Figure 3-1-5. AROM trunk flexion.



Figure 3-1-6. AROM trunk extension.

Trunk Lateral Flexion (Thoracolumbar Region) Screening

AROM

Plane: Frontal

Axis: Sagittal

Normal ROM: 0-35 degrees (Figure 3-1-7)

Gross Muscle Testing

Prime Movers: Unilateral contraction of External oblique, Internal oblique, Rectus abdominis, Quadratus lumborum

Position: Client is standing and moves into trunk lateral flexion

Stabilize: Not formally necessary

Resist: Slight resistance toward upright stance at lateral aspect of ipsilateral humerus.

Trunk Rotation (Thoracolumbar Region) Screening

AROM

Plane: Transverse

Axis: Vertical

Normal ROM: 0-45 degrees (Figure 3-1-8)

Gross Muscle Testing

Prime Movers: Contralateral contraction of External oblique with Internal oblique and Rectus abdominis

Position: Client is standing and moves into trunk flexion with rotation to test side (ie: right elbow to left knee)

Stabilize: Not formally necessary

Resist: Slight resistance toward posteriorly at the anterior aspect of the shoulder moving forward during the rotation.



Figure 3-1-7. AROM trunk lateral flexion.



Figure 3-1-8. AROM trunk rotation.

Table 3-2

NECK AND TRUNK

FUNCTIONAL MUSCLE GROUP	PLANE	AXIS	FUNCTIONAL ACTIVITY ANALYSIS	NORMAL ROM	GROSS MUSCLE TESTING PROCEDURE
<i>Neck Flexion (cervical region)</i>	Sagittal	Frontal	Looking at the keyboard while typing.	0 to 45 degrees	<p>Prime Movers: Bilateral contraction of Longus capitis, Longus colli, Sternocleidomastoid</p> <p>Position: Client is seated and moves toward neck flexion</p> <p>Stabilize: Not formally necessary</p> <p>Resist: At forehead in direction of neck extension</p>
<i>Neck Extension (cervical region)</i>	Sagittal	Frontal	Looking up at the light fixture while changing the bulb.	0 to 45 degrees	<p>Prime Movers: Bilateral contraction of Erector spinae, Splenius capitis & cervicis, Semispinalis capitis & cervicis</p> <p>Position: Client is seated and moves into neck hyperextension</p> <p>Stabilize: Posterior thorax</p> <p>Resist: Posterior aspect of head toward neck flexion</p>
<i>Neck Lateral Flexion (cervical region)</i>	Frontal	Sagittal	Putting on an earring.	0 to 45 degrees	<p>Prime Movers: Unilateral contraction of Sternocleidomastoid, Splenius capitis, Splenius cervicis</p> <p>Position: Client is seated and moves into lateral flexion of test side</p> <p>Stabilize: Superior aspect of opposite shoulder</p> <p>Resist: Lateral aspect of head toward opposite motion</p>
<i>Neck Rotation (cervical region)</i>	Transverse	Vertical	Looking left and right at stop sign while driving.	0 to 60 degrees	<p>Prime Movers: Contralateral contraction of Sternocleidomastoid, Splenius capitis, Splenius cervicis</p> <p>Position: Client is seated and moves into neck hyperextension with rotation to test side</p> <p>Stabilize: Posterior thorax</p> <p>Resist: Posterior-lateral aspect of head toward opposite motions</p>

(continued)

Table 3-2 (continued)

NECK AND TRUNK

<i>Trunk Flexion (thoracolumbar region)</i>	Sagittal	Frontal	Bending down to the floor to put on shoes.	0 to 80 degrees (4 inches)	Prime Mover: Rectus abdominis, External oblique, Internal oblique Position: Client is standing (or supine) and moves into trunk flexion Stabilize: None formally necessary Resist: None formally necessary; client's arm position during motion determines muscle grade; overhead is normal (5), at chest is good (4), and toward knees is fair (3)
<i>Trunk Extension (thoracolumbar region)</i>	Sagittal	Frontal	Pulling up pants from sit to stand.	0 to 25 degrees	Prime Movers: Bilateral contraction of Erector spinae (Iliocostalis, Longissimus, and Spinalis segments) Position: Client is standing (or prone) and moves into trunk hyperextension Stabilize: None formally necessary Resist: None formally necessary; client's arm position during motion determines muscle grade; overhead is normal (5), at lower back is good (4), and at lower back with partial range is fair (3)
<i>Trunk Lateral Flexion (thoracolumbar region)</i>	Frontal	Sagittal	Tucking a shirt into pants.	0 to 35 degrees	Prime Movers: Unilateral contraction of External oblique, Internal oblique, Rectus abdominis, Quadratus lumborum Position: Client is standing (or sidelying on nontest side) and moves into trunk lateral flexion Stabilize: Hip, pelvis, and lower extremity of the test side Resist: None formally necessary; muscle grade is determined by amount of full range completed
<i>Trunk Rotation (thoracolumbar region)</i>	Transverse	Vertical	Reaching across oneself to retrieve and fasten a seatbelt.	0 to 45 degrees	Prime Movers: Contralateral contraction of External oblique, Internal oblique, Rectus abdominis Position: Client is standing (or supine) and moves into trunk flexion with rotation to test side (ie: right elbow to left knee) Stabilize: None formally necessary Resist: None formally necessary; client's arm position during motion determines muscle grade; overhead is normal (5), at chest is good (4), and toward knees is fair (3)

SECTION 3-2: The Scapula and Shoulder

Scapula Upward/Lateral Rotation Screening

AROM

Plane: Oblique Frontal or Scapular

Axis: Oblique Sagittal or Scapular

Normal ROM: Not formally measured on oblique or scapular plane (Figure 3-2-1).



Figure 3-2-1. AROM scapular upward rotation.

Gross Muscle Testing

Prime Movers: Upper trapezius, Lower trapezius, Serratus anterior

Position: Client is seated with testing extremity at side and moves toward shoulder/humeral abduction or flexion

Stabilize: Proximal to glenohumeral joint

Resist: Applied at humerus in the direction of shoulder/humeral adduction (Figure 3-2-2).



Figure 3-2-2. GMT scapular upward rotation.

Scapular Downward Rotation/Medial Rotation Screening

AROM

Plane: Oblique Frontal or Scapular

Axis: Oblique Sagittal or Scapular

Normal ROM: Not formally measured on oblique or scapular plane (Figure 3-2-3).



Figure 3-2-3. AROM scapular downward rotation.

Gross Muscle Testing

Prime Movers: Rhomboideus minor, Rhomboideus major, Levator scapula

Position: Client is seated with testing arm in 30 degrees of shoulder/humeral abduction and moves toward shoulder/humeral adduction

Stabilize: Stabilize at the shoulder to resist compensation

Resist: Resist at the humerus toward abduction (Figure 3-2-4).



Figure 3-2-4. GMT scapular downward rotation.

Scapular Elevation Screening

AROM

Plane: Oblique Frontal or Scapular

Axis: Oblique Sagittal or Scapular

Normal ROM: Not formally measured on oblique or scapular plane (Figure 3-2-5).



Figure 3-2-5. AROM scapular elevation.

Gross Motor Testing

Prime Movers: Levator scapula, Upper trapezius, Rhomboideus minor, Rhomboideus major

Position: Client is seated with arms at their sides and moves toward scapular elevation

Stabilize: Therapist will stabilize at the elbow

Resist: Apply on the superior, lateral shoulder downward in the direction of scapular depression (Figure 3-2-6).



Figure 3-2-6. GMT scapular elevation.

Scapular Depression Screening

AROM

Plane: Oblique Frontal or Scapular

Axis: Oblique Sagittal or Scapular

Normal ROM: Not formally measured on oblique or scapular plane (Figure 3-2-7).



Figure 3-2-7. AROM scapular depression.

Gross Motor Testing

Prime Movers: Pectoralis minor, Lower trapezius

Position: Client is seated with arm at side and elbow flexed to 90 degrees and moves toward scapular depression

Stabilize: At the superior shoulder

Resist: At base of elbow in upward direction toward scapular elevation (Figure 3-2-8).



Figure 3-2-8. GMT scapular depression.

Scapular Protraction/Abduction Screening

AROM

Plane: Oblique Transverse or Scapular

Axis: Oblique Vertical or Scapular

Normal ROM: Not formally measured on oblique or scapular plane (Figure 3-2-9).



Figure 3-2-9. AROM scapular protraction.

Gross Motor Testing

Prime Movers: Pectoralis minor, Serratus anterior

Position: Client is seated with extremity resting at side and moves toward scapular protraction

Stabilize: Opposite shoulder

Resist: Apply at the proximal humerus toward scapular adduction (Figure 3-2-10).



Figure 3-2-10. GMT scapular protraction.

Scapular Retraction/Adduction Screening

AROM

Plane: Oblique Transverse or Scapular

Axis: Oblique Vertical or Scapular

Normal ROM: Not formally measured on oblique or scapular plane (Figure 3-2-11).



Figure 3-2-11. AROM scapular retraction.

Gross Motor Testing

Prime Movers: Rhomboideus major, Rhomboideus minor, Middle trapezius

Position: Client is seated with extremity resting at side and moves toward scapular retraction

Stabilize: Opposite shoulder

Resist: Apply at the proximal humerus toward scapular adduction (Figure 3-2-12).



Figure 3-2-12. GMT scapular retraction.

Shoulder/Humeral Flexion Screening

AROM

Plane: Sagittal

Axis: Frontal

Normal ROM: 0-180 degrees (Figure 3-2-13).



Figure 3-2-13. AROM shoulder flexion.

Gross Motor Testing

Prime Movers: Anterior deltoid, Pectoralis major (clavicular head), Coracobrachialis

Position: Client can be seated with arm resting at side and moves toward shoulder flexion

Stabilize: At the shoulder to prevent scapular compensation

Resist: Apply at the humerus, moving arm into extension (Figure 3-2-14).



Figure 3-2-14. GMT shoulder flexion.

Shoulder/Humeral Extension Screening

AROM

Plane: Sagittal

Axis: Frontal

Normal ROM: 0-60 degrees extension (Figure 3-2-15).



Figure 3-2-15. AROM shoulder extension.

Gross Muscle Testing

Prime Movers: Posterior deltoid, Teres major, Latissimus dorsi

Position: Client is seated with arm resting at side and moves toward shoulder extension

Stabilize: At the scapula to avoid compensation of scapular elevation

Resist: Apply to proximal humerus toward shoulder/humeral flexion (Figure 3-2-16).



Figure 3-2-16. GMT shoulder extension.

Shoulder/Humeral Abduction Screening

AROM

Plane: Frontal

Axis: Sagittal

Normal ROM: 0-180 degrees (Figure 3-2-17).



Figure 3-2-17. AROM shoulder abduction.

Gross Muscle Testing

Prime Movers: Middle deltoid, Supraspinatus

Position: Client can be seated with their arm at their side and moves toward shoulder abduction

Stabilize: At the shoulder to prevent scapular elevation

Resist: Apply at the humerus toward shoulder/humeral adduction (Figure 3-2-18).



Figure 3-2-18. GMT shoulder abduction.

Shoulder/Humeral Adduction Screening

AROM

Plane: Frontal

Axis: Sagittal

Normal ROM: 180-0 degrees (Figure 3-2-19).



Figure 3-2-19. AROM shoulder adduction.

Gross Motor Testing

Prime Movers: Pectoralis major (sternal head), Latissimus dorsi, Teres major

Position: Client can be seated with the testing arm at 30 degrees of abduction and moves toward adduction

Stabilize: At the shoulder to avoid scapular depression as compensation

Resist: Apply at the humerus toward abduction (Figure 3-2-20).



Figure 3-2-20. GMT shoulder adduction.

Shoulder/Humeral Horizontal Abduction Screening

AROM

Plane: Transverse

Axis: Vertical

Normal ROM: 0-45 degrees (Figure 3-2-21).



Figure 3-2-21. AROM shoulder horizontal abduction.

Gross Muscle Testing

Prime Movers: Posterior deltoid, Teres minor, Infraspinatus

Position: Client is seated with the testing arm at 90 degrees of shoulder abduction, elbow flexed to 90 degrees and moves toward horizontal abduction

Stabilize: At posterior shoulder/scapula to prevent compensation

Resist: Apply at the humerus toward horizontal adduction (Figure 3-2-22).



Figure 3-2-22. GMT shoulder horizontal abduction.

Shoulder/Humeral Horizontal Adduction Screening

AROM

Plane: Transverse

Axis: Vertical

Normal ROM: 0-135 degrees (Figure 3-2-23).



Figure 3-2-23. AROM shoulder horizontal adduction.

Gross Muscle Testing

Prime Movers: Anterior deltoid, Pectoralis major (both heads)

Position: Client is seated with the testing arm at 90 degrees of shoulder abduction, elbow flexed to 90 degrees and moves toward shoulder horizontal adduction

Stabilize: At the anterior shoulder to prevent compensation

Resist: Apply at the humerus toward horizontal abduction (Figure 3-2-24).



Figure 3-2-24. GMT shoulder horizontal adduction.

Shoulder/Humeral External Rotation Screening

AROM

Plane: Transverse

Axis: Vertical

Normal ROM: 0-90 degrees (Figure 3-2-25).

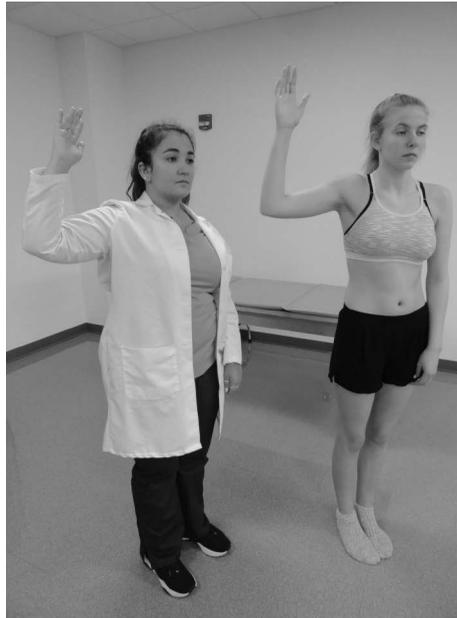


Figure 3-2-25. AROM shoulder external rotation.

Gross Muscle Testing

Prime Movers: Teres minor, Infraspinatus, Posterior deltoid

Position: Client is seated with the testing arm resting at their side, elbow flexed to 90 degrees and moves toward external rotation

Stabilize: At the humerus to prevent compensation

Resist: Apply to the forearm toward shoulder/humeral internal rotation (Figure 3-2-26).



Figure 3-2-26. GMT shoulder external rotation.

Shoulder/Humeral Internal Rotation Screening

AROM

Plane: Transverse

Axis: Vertical

Normal ROM: 0-70 degrees (Figure 3-2-27).



Figure 3-2-27. AROM shoulder internal rotation.

Gross Muscle Testing

Prime Mover: Subscapularis, Latissimus dorsi, Teres major, Pectoralis major (both heads)

Position: Client is seated with the testing arm resting at their side, elbow flexed to 90 degrees and moves toward internal rotation

Stabilize: At the humerus to avoid compensation

Resist: Apply at the forearm toward shoulder/humeral external rotation (Figure 3-2-28).



Figure 3-2-28. GMT shoulder internal rotation.

Table 3-3

SCAPULA AND SHOULDER AT A GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING

FUNCTIONAL MUSCLE GROUP	PLANE	AXIS	FUNCTIONAL ACTIVITY ANALYSIS	NORMAL ROM	GROSS MUSCLE TESTING PROCEDURE
<i>Scapula Upward/ Lateral Rotation</i>	Oblique Frontal or Scapular	Oblique Sagittal or Scapular	Reaching to the top shelf in the kitchen to retrieve the cereal box.	Not formally measured	<p>Prime Movers: Upper trapezius, Lower trapezius, Serratus anterior</p> <p>Position: Client is seated with testing extremity at side and moves in direction of humeral abduction</p> <p>Stabilize: Proximal to glenohumeral joint</p> <p>Resist: Applied at humerus in the direction of humeral adduction</p>
<i>Scapular Downward/ Medial Rotation</i>	Oblique Frontal or Scapular	Oblique Sagittal or Scapular	Bringing a bowl down from the top shelf in the cabinet to the countertop.	Not formally measured	<p>Prime Movers: Rhomboideus minor, Rhomboideus major, Levator scapula</p> <p>Position: Client is seated or standing with testing arm in 30 degrees of humeral abduction moving toward humeral adduction</p> <p>Stabilize: Stabilize at the shoulder to resist compensation</p> <p>Resist: Resist at the humerus toward abduction</p>
<i>Scapular Elevation</i>	Oblique Frontal or Scapular	Oblique Sagittal or Scapular	Carrying a backpack on one shoulder.	Not formally measured	<p>Prime Movers: Levator scapula, Upper trapezius, Rhomboideus minor, Rhomboideus major</p> <p>Position: Client is seated or standing and will have their arms at their sides and moves toward scapular elevation</p> <p>Stabilize: Therapist will stabilize at the opposite shoulder</p> <p>Resist: Apply on the superior, lateral shoulder downward in the direction of scapular depression</p>

(continued)

Table 3-3 (continued)

SCAPULA AND SHOULDER AT A GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING

<i>Scapular Depression</i>	Oblique Frontal or Scapular	Oblique Sagittal or Scapular	Reaching deep into your pants pocket to retrieve car keys.	Not formally measured	<p>Prime Movers: Pectoralis minor, Lower trapezius</p> <p>Position: Client is seated with arm at side and elbow flexed to 90 degrees and moves toward scapular depression</p> <p>Stabilize: At the posterior thorax</p> <p>Resist: At base of elbow in upward direction toward scapular elevation</p>
<i>Scapular Protraction/Abduction</i>	Oblique Transverse or Scapular	Oblique Vertical or Scapular	Reaching forward to turn on kitchen faucet.	Not formally measured	<p>Prime Movers: Pectoralis minor, Serratus anterior</p> <p>Position: Client is seated with extremity resting at side</p> <p>Stabilize: Opposite shoulder</p> <p>Resist: Apply at the proximal humerus toward scapular adduction</p>
<i>Scapular Retraction/Adduction</i>	Oblique Transverse or Scapular	Oblique Vertical or Scapular	Pulling open the dresser drawer.	Not formally measured	<p>Prime Movers: Rhomboideus major, Rhomboideus minor, Middle trapezius</p> <p>Position: Client is seated with extremity resting at side</p> <p>Stabilize: Opposite shoulder</p> <p>Resist: Apply at the proximal humerus toward scapular adduction</p>
<i>Shoulder/Humeral Flexion</i>	Sagittal	Frontal	Reaching forward to turn on the kitchen faucet.	0 to 180 degrees	<p>Prime Movers: Anterior deltoid, Pectoralis major (clavicular head), Coracobrachialis</p> <p>Position: Client can be seated or standing with arm resting at side</p> <p>Stabilize: At the shoulder to prevent scapular compensation</p> <p>Resist: Apply at the humerus, moving arm into extension</p>
<i>Shoulder/Humeral Extension</i>	Sagittal	Frontal	Reaching back for the armrests of the chair before sitting down.	0 to 60 degrees	<p>Prime Movers: Posterior deltoid, Teres major, Latissimus dorsi</p> <p>Position: Client is seated or standing with arm resting at side</p> <p>Stabilize: At the scapula to avoid compensation of scapular elevation</p> <p>Resist: Apply to proximal humerus toward humeral flexion</p>

(continued)

Table 3-3 (continued)

SCAPULA AND SHOULDER AT A GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING

<i>Shoulder/ Humeral Abduction</i>	Frontal	Sagittal	Reaching up to head to put on baseball cap.	0 to 180 degrees	Prime Movers: Middle deltoid, Supraspinatus Position: Client can be seated or standing with their arm at their side Stabilize: At the shoulder to prevent scapular elevation Resist: Apply at the humerus toward humeral adduction
<i>Shoulder/ Humeral Adduction</i>	Frontal	Sagittal	Squeezing a clutch bag between your arm and lateral trunk.	Not formally measured as opposite of abduction	Prime Movers: Pectoralis major (both heads), Latissimus dorsi, Teres major Position: Client can be seated or standing with the testing arm at 30 degrees of abduction and moves toward adduction Stabilize: At the shoulder to avoid scapular depression as compensation Resist: Apply at the humerus toward abduction
<i>Shoulder/ Humeral Horizontal Abduction</i>	Transverse	Vertical	Reaching out of the car to retrieve ordered items from the drive thru window.	0 to 45 degrees	Prime Movers: Posterior deltoid, Teres minor, Infraspinatus Position: Client is seated with the testing arm at 90 degrees of shoulder abduction, elbow flexed to 90 degrees and moves toward horizontal abduction Stabilize: At posterior shoulder/scapula to prevent compensation Resist: Apply at the humerus toward horizontal adduction
<i>Shoulder/ Humeral Horizontal Adduction</i>	Transverse	Vertical	Reaching over opposite shoulder to grab seat belt in order to put it on.	0 to 135 degrees	Prime Movers: Anterior deltoid, Pectoralis major (both heads) Position: Client is seated with the testing arm at 90 degrees of shoulder abduction, elbow flexed to 90 degrees and moves toward shoulder horizontal adduction Stabilize: At the anterior shoulder to prevent compensation Resist: Apply at the humerus toward horizontal abduction

(continued)

Table 3-3 (continued)

SCAPULA AND SHOULDER AT A GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING

<i>Shoulder/ Humeral External Rotation</i>	Transverse	Vertical	Clasping a necklace behind the neck.	0 to 90 degrees	<p>Prime Movers: Teres minor, Infraspinatus, Posterior deltoid</p> <p>Position: Client is seated with the testing arm resting at their side, elbow flexed to 90 degrees and moves toward external rotation</p> <p>Stabilize: At the humerus to prevent compensation</p> <p>Resist: Apply to the forearm toward humeral internal rotation</p>
<i>Shoulder/ Humeral Internal Rotation</i>	Transverse	Vertical	Turning the steering wheel of the car to the left using the right arm.	0 to 70 degrees	<p>Prime Movers: Subscapularis, Latissimus dorsi, Teres major, Pectoralis major (both heads)</p> <p>Position: Client is seated with the testing arm resting at their side, elbow flexed to 90 degrees and moves toward internal rotation</p> <p>Stabilize: At the humerus to avoid compensation</p> <p>Resist: Apply at the forearm toward humeral external rotation</p>

SECTION 3-3: The Elbow, Forearm, and Wrist

Elbow Flexion Screening

AROM

Plane: Sagittal

Axis: Frontal

Normal ROM: 0-135 degrees (Figure 3-3-1).

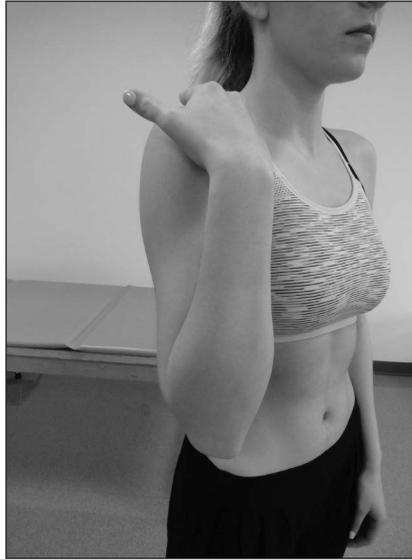


Figure 3-3-1. AROM elbow flexion.

Gross Muscle Testing

Primary Muscles: Bicep brachii, Brachialis, Brachioradialis

Position: Client is seated with arm in shoulder adduction, elbow extension and moves testing arm toward elbow flexion

Stabilize: At the humerus to avoid compensation

Resist: Applied to the distal anterior aspect of forearm toward elbow extension (Figure 3-3-2).



Figure 3-3-2. GMT elbow flexion.

Elbow Extension Screening

AROM

Plane: Sagittal

Axis: Frontal

Normal ROM: 135-0 degrees (Figure 3-3-3).



Figure 3-3-3. AROM elbow extension.

Gross Muscle Testing

Primary Muscles: Triceps, Anconeus

Position: Client is seated with arm in shoulder adduction, elbow extension and moves testing arm toward elbow extension

Stabilize: At the humerus to avoid compensation

Resist: Applied at the distal forearm toward elbow flexion (Figure 3-3-4).



Figure 3-3-4. GMT elbow extension.

Forearm Supination Screening

AROM

Plane: Transverse

Axis: Vertical

Normal ROM: 0-90 degrees (Figure 3-3-5).



Figure 3-3-5. AROM forearm supination.

Gross Muscle Testing

Primary Muscles: Supinator, Biceps brachii

Position: Client is seated with arm in shoulder adduction, elbow flexed to 90 degrees and forearm in neutral and moves the testing arm toward forearm supination

Stabilize: At the elbow to prevent shoulder compensation

Resist: Applied at the distal forearm, toward pronation (Figure 3-3-6).



Figure 3-3-6. GMT forearm supination.

Forearm Pronation Screening

AROM

Plane: Transverse

Axis: Vertical

Normal ROM: 0-90 degrees (Figure 3-3-7).



Figure 3-3-7. AROM forearm pronation.

Gross Muscle Testing

Primary Muscles: Pronator teres, Pronator quadratus

Position: Client is seated with arm in shoulder adduction, elbow flexed to 90 degrees and forearm in neutral and moves the testing arm toward forearm pronation

Stabilize: At the elbow to prevent compensation

Resist: Applied at the distal forearm, toward supination (Figure 3-3-8).



Figure 3-3-8. GMT forearm pronation.

Wrist Flexion Screening

AROM

Plane: Sagittal

Axis: Frontal

Normal ROM: 0-80 degrees (Figure 3-3-9).



Figure 3-3-9. AROM wrist flexion.

Gross Muscle Testing

Prime Movers: Flexor carpi radialis, Flexor carpi ulnaris

Position: Client is seated with arm on a table, forearm in supination and moves toward wrist flexion

Stabilize: At the distal forearm to prevent compensation

Resist: Applied to the palm of the hand toward wrist extension (Figure 3-3-10).



Figure 3-3-10. GMT wrist flexion.

Wrist Extension Screening

AROM

Plane: Sagittal

Axis: Frontal

Normal ROM: 0-70 degrees (Figure 3-3-11).



Figure 3-3-11. AROM wrist extension.

Gross Muscle Testing

Prime Movers: Extensor carpi radialis longus, Extensor carpi radialis brevis, Extensor carpi ulnaris

Position: Client is seated with arm on the table, forearm in pronation and moves toward wrist extension

Stabilize: At the distal forearm to prevent compensation

Resist: Applied on the back of the hand toward wrist flexion (Figure 3-3-12).



Figure 3-3-12. GMT wrist extension.

Wrist Radial Deviation Screening

AROM

Plane: Frontal

Axis: Sagittal

Normal ROM: 0-20 degrees (Figure 3-3-13).



Figure 3-3-13. AROM wrist radial deviation.

Gross Muscle Testing

Prime Movers: Extensor carpi radialis longus, Extensor carpi radialis brevis, Flexor carpi radialis

Position: Client is seated with arm at rest, elbow flexed to 90 degrees, forearm pronation and moves toward wrist radial deviation

Stabilize: At the distal forearm to prevent compensation

Resist: Applied at the second metacarpal toward wrist ulnar deviation (Figure 3-3-14).



Figure 3-3-14. GMT wrist radial deviation.

Wrist Ulnar Deviation Screening

AROM

Plane: Frontal

Axis: Sagittal

Normal ROM: 0-30 degrees (Figure 3-3-15).



Figure 3-3-15. AROM wrist ulnar deviation.

Wrist Ulnar Deviation: Gross Muscle Testing

Prime Movers: Extensor carpi ulnaris, Flexor carpi ulnaris

Position: Client is seated with arm at rest, elbow flexed to 90 degrees, forearm pronation and moves toward wrist ulnar deviation

Stabilize: At the distal forearm to prevent compensation

Resist: Applied at the fifth metacarpal toward wrist radial deviation when testing normal and good strengths (Figure 3-3-16).



Figure 3-3-16. GMT wrist ulnar deviation.

Table 3-4

ELBOW, FOREARM, AND WRIST SCREENING AT A GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING

FUNCTIONAL MUSCLE GROUP	PLANE	AXIS	FUNCTIONAL ACTIVITY ANALYSIS	NORMAL ROM	GROSS MUSCLE TESTING PROCEDURE
<i>Elbow Flexion</i>	Sagittal	Frontal	Bringing spoon from dinner plate on table to mouth.	0 to 135 degrees	<p>Primary Muscles: Bicep brachii, Brachialis, Brachioradialis</p> <p>Position: Client is seated with arm in shoulder adduction, elbow extension and moves testing arm toward elbow flexion</p> <p>Stabilize: At the humerus to avoid compensation</p> <p>Resist: Applied to the distal anterior aspect of forearm toward elbow extension</p>
<i>Elbow Extension</i>	Sagittal	Frontal	Reaching out to turn up the volume of the radio in the car.	135 to 0 degrees	<p>Primary Muscles: Triceps & Anconeus</p> <p>Position: Client is seated with arm in shoulder adduction, elbow extension and moves testing arm toward elbow extension</p> <p>Stabilize: At the humerus to avoid compensation</p> <p>Resist: Applied at the distal forearm toward elbow flexion</p>
<i>Forearm Supination</i>	Transverse	Vertical	Turning on the shower faucet (clockwise rotation with the right hand or counterclockwise with the left).	0 to 90 degrees	<p>Primary Muscles: Supinator & Biceps brachii</p> <p>Position: Client is seated with arm in shoulder adduction, elbow flexed to 90 degrees and forearm in neutral and moves the testing arm toward forearm supination</p> <p>Stabilize: At the elbow to prevent shoulder compensation</p> <p>Resist: Applied at the distal forearm, toward pronation</p>

(continued)

Table 3-4 (continued)

ELBOW, FOREARM, AND WRIST SCREENING AT A GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING

<i>Forearm Pronation</i>	Transverse	Vertical	Pouring a glass of orange juice.	0 to 90 degrees	<p>Primary Muscles: Pronator teres, Pronator quadratus</p> <p>Position: Client is seated with arm in shoulder adduction, elbow flexed to 90 degrees and forearm in neutral and moves the testing arm toward forearm pronation</p> <p>Stabilize: At the elbow to prevent compensation</p> <p>Resist: Applied at the distal forearm, toward supination</p>
<i>Wrist Flexion</i>	Sagittal	Frontal	Buttoning a shirt	0 to 80 degrees	<p>Prime Movers: Flexor carpi radialis, Flexor carpi ulnaris</p> <p>Position: Client is seated with arm on a table, forearm in supination and moves toward wrist flexion</p> <p>Stabilize: At the distal forearm to prevent compensation</p> <p>Resist: Applied to the palm of the hand toward wrist extension</p>
<i>Wrist Extension</i>	Sagittal	Frontal	Grasping toothbrush while brushing teeth.	0 to 70 degrees	<p>Prime Movers: Extensor carpi radialis longus, Extensor carpi radialis brevis, Extensor carpi ulnaris</p> <p>Position: Client is seated with arm on the table, forearm in pronation and moves toward wrist extension</p> <p>Stabilize: At the distal forearm to prevent compensation</p> <p>Resist: Applied on the back of the hand toward wrist flexion</p>

(continued)

Table 3-4 (continued)

ELBOW, FOREARM, AND WRIST SCREENING AT A GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING

<i>Wrist Radial Deviation</i>	Frontal	Sagittal	Opening the jar of pickles (counterclockwise with right hand; clockwise with left hand).	0 to 20 degrees	<p>Prime Movers: Extensor carpi radialis longus, Extensor carpi radialis brevis, Flexor carpi radialis</p> <p>Position: Client is seated with arm at rest, elbow flexed to 90 degrees, forearm pronation and moves toward wrist radial deviation</p> <p>Stabilize: At the distal forearm to prevent compensation</p> <p>Resist: Applied at the second metacarpal toward wrist ulnar deviation.</p>
<i>Wrist Ulnar Deviation</i>	Frontal	Sagittal	Tightening the lid on the jar of tomato sauce (clockwise with right hand; counterclockwise with left hand)	0 to 30 degrees	<p>Prime Movers: Extensor carpi ulnaris, Flexor carpi ulnaris</p> <p>Position: Client is seated with arm at rest, elbow flexed to 90 degrees, forearm pronation and moves toward wrist ulnar deviation</p> <p>Stabilize: At the distal forearm to prevent compensation</p> <p>Resist: Applied at the fifth metacarpal toward wrist radial deviation when testing normal and good strengths</p>

SECTION 3-4: The Hand

Metacarpal Phalangeal (MCP) Flexion (Digits II-V) Screening

AROM

Plane: Sagittal

Axis: Frontal

Normal ROM: 0-90 degrees (Figure 3-4-1).



Figure 3-4-1. AROM MCP flexion (digits II-V).

MCP Flexion (Digits II-V): Gross Muscle Testing

Prime Movers: Flexor digitorum superficialis, Flexor digitorum profundus, Lumbricals, Flexor digiti minimi (digit V)

Position: Client is seated with the testing arm supinated, in MCP extension and moves toward MCP flexion (simultaneous PIP/DIP flexion is acceptable)

Stabilize: Proximal to the MCP joints at the metacarpals to prevent compensation

Resist: Apply with one or two fingers at the proximal phalanges toward MCP extension (Figure 3-4-2).



Figure 3-4-2. GMT MCP flexion (digits II-V).

MCP Extension/Hyperextension (Digits II-V) Screening

AROM

Plane: Sagittal

Axis: Frontal

Normal ROM: 90-0 ext, 0-30 hyper (Figure 3-4-3).



Figure 3-4-3. AROM MCP extension (digits II-V).

Gross Muscle Testing

Prime Mover: Extensor digitorum, Extensor indicis (digit II), Extensor digiti minimi (digit V)

Position: Client is seated with the testing arm in forearm pronation, digit flexion and moves toward MCP/PIP/DIP extension

Stabilize: Proximal to the MCP joints at the metacarpals to prevent compensation

Resist: Applied at the proximal, middle, and distal phalanges toward MCP/PIP/DIP flexion (Figure 3-4-4).



Figure 3-4-4. GMT MCP extension (digits II-V).

MCP Adduction Screening

AROM

Plane: Frontal

Axis: Sagittal

Normal ROM: Compare with opposite side (Figure 3-4-5).



Figure 3-4-5. AROM MCP adduction.

Gross Muscle Testing

Prime Mover: Palmar interossei

Position: Client is seated with the testing arm in forearm pronation, digit extension and moves toward MCP adduction

Stabilize: At the metacarpals

Resist: Applied to digits 2, 4, and 5 toward abduction (3rd digit does not adduct; Figure 3-4-6).



Figure 3-4-6. GMT MCP adduction.

MCP Abduction Screening

AROM

Plane: Frontal

Axis: Sagittal

Normal ROM: Compare with opposite side (Figure 3-4-7).



Figure 3-4-7. AROM MCP abduction.

Gross Muscle Testing

Prime Mover: Dorsal interossei

Position: Client is seated with the testing arm in forearm pronation, digit extension and moves toward MCP abduction

Stabilize: At the metacarpals

Resist: Applied to digits 2, 4, and 5 toward adduction as well as both sides of digit 3 (3rd digit abducts to both sides; Figure 3-4-8).



Figure 3-4-8. GMT MCP abduction.

Proximal Interphalangeal (PIP) Flexion Screening

AROM

Plane: Sagittal

Axis: Frontal

Normal ROM: 0-100 (Figure 3-4-9).



Figure 3-4-9. AROM PIP flexion.

Gross Muscle Testing

Prime Mover: Flexor digitorum superficialis

Position: Client is seated with the testing arm in forearm supination, digit extension and moves toward PIP/DIP flexion while keeping MCP's in extension

Stabilize: At the MCP joints to prevent compensation

Resist: Apply at both the middle and distal phalanges into PIP/DIP extension (Figure 3-4-10).



Figure 3-4-10. GMT PIP flexion.

PIP Extension Screening

AROM

Plane: Sagittal

Axis: Frontal

Normal ROM: 100-0 (Figure 3-4-11).



Figure 3-4-11. AROM PIP extension.

Gross Muscle Testing

Prime Movers: Extensor digitorum, Lumbricals

Position: Client is seated with the testing hand in forearm pronation, digit flexion and moves toward MCP/PIP/DIP extension

Stabilize: Proximal to the MCP joints at the metacarpals to prevent compensation

Resist: Applied to the proximal, middle and distal phalanges toward MCP/PIP/DIP flexion when testing normal and good strengths (Figure 3-4-12).



Figure 3-4-12. GMT PIP extension.

Distal Interphalangeal (DIP) Flexion Screening

AROM

Plane: Sagittal

Axis: Frontal

Normal ROM: 0-90 (Figure 3-4-13).



Figure 3-4-13. AROM DIP flexion.

Gross Muscle Testing

Prime Mover: Flexor digitorum profundus

Position: Client is seated with the testing hand in forearm supination and digit extension, and moves toward PIP/DIP flexion while keeping MCP's in extension

Stabilize: At the MCP joints to prevent compensation of hyperextension

Resist: Applied with one or two fingers at both the middle and distal phalanges toward PIP/DIP extension when testing normal and good strengths (Figure 3-4-14).



Figure 3-4-14. GMT DIP flexion.

DIP Extension Screening

AROM

Plane: Sagittal

Axis: Frontal

Normal ROM: 90-0 (Figure 3-4-15).



Figure 3-4-15. AROM DIP extension.

Gross Muscle Testing

Prime Movers: Extensor digitorum, Lumbricals

Position: Client is seated with the testing hand in forearm pronation, digit flexion and moves toward MCP/PIP/DIP extension

Stabilize: Proximal to the MCP joints at the metacarpals to prevent compensation

Resist: Apply to the proximal, middle and distal phalanges toward MCP/PIP/DIP flexion when testing normal and good strengths (Figure 3-4-16).



Figure 3-4-16. GMT DIP extension.

Carpometacarpal (CMC) Flexion Screening

AROM

Plane: Frontal

Axis: Sagittal

Normal ROM: 0-20 (Figure 3-4-17).



Figure 3-4-17. AROM CMC flexion.

Gross Muscle Testing

Prime Movers: Flexor pollicis brevis, Flexor pollicis longus

Position: Client is seated with the forearm in supination, all digits in extension and moves CMC toward flexion

Stabilize: At the wrist

Resist: Apply at the metacarpal toward extension (Figure 3-4-18).



Figure 3-4-18. GMT CMC flexion.

CMC Extension (aka Radial Abduction) Screening

AROM

Plane: Frontal

Axis: Sagittal

Normal ROM: 0-45 (Figure 3-4-19).



Figure 3-4-19. AROM CMC extension.

Gross Muscle Testing

Prime Movers: Extensor pollicis longus, Extensor pollicis brevis

Position: Client is seated with the forearm in supination, digits II-V in extension, thumb at CMC joint is flexed and moves toward extension

Stabilize: At the wrist

Resist: Toward CMC flexion when testing normal and good strengths (Figure 3-4-20).



Figure 3-4-20. GMT CMC extension.

CMC Abduction (aka Palmar Abduction) Screening

AROM

Plane: Sagittal

Axis: Frontal

Normal ROM: 0-70 (Figure 3-4-21).



Figure 3-4-21. AROM CMC abduction.

Gross Muscle Testing

Prime Movers: Abductor pollicis brevis, Abductor pollicis longus

Position: Client is seated with the forearm in supination, digits II-V in extension, thumb is adducted and moves toward abduction

Stabilize: At the wrist

Resist: Applied at the first metacarpal toward adduction (Figure 3-4-22).



Figure 3-4-22. GMT CMC abduction.

CMC Adduction Screening

AROM

Plane: Sagittal

Axis: Frontal

Normal ROM: Compare with opposite side (Figure 3-4-23).



Figure 3-4-23. AROM CMC adduction.

Gross Muscle Testing

Prime Movers: Adductor pollicis, Palmar interossei

Position: Client is seated with the forearm in supination, digits II-V in extension, thumb is abducted and moves toward adduction

Stabilize: At the wrist

Resist: Applied at the first metacarpal toward abduction (Figure 3-4-24).



Figure 3-4-24. GMT CMC adduction.

Metacarpalphalangeal (MP) Flexion (Digit I) Screening

AROM

Plane: Frontal

Axis: Sagittal

Normal ROM: 0-50 (Figure 3-4-25).



Figure 3-4-25. AROM MP flexion.

Gross Muscle Testing

Prime Mover: Flexor pollicis brevis

Position: Client is seated with forearm in supination, all digits are extended and MP moves toward flexion

Stabilize: At the metacarpal of the thumb

Resist: Applied toward extension when testing normal and good strengths (Figure 3-4-26).



Figure 3-4-26. GMT MP flexion.

MP Extension (Digit I) Screening

AROM

Plane: Frontal

Axis: Sagittal

Normal ROM: 50-0 (Figure 3-4-27).



Figure 3-4-27. AROM MP extension.

Gross Muscle Testing

Prime Mover: Extensor pollicis brevis

Position: Client is seated with forearm in supination digits 2-4 are extended, thumb MP is flexed and moves toward extension

Stabilize: At the metacarpal of the thumb

Resist: Applied toward flexion in normal and good strengths (Figure 3-4-28).



Figure 3-4-28. GMT MP extension.

Interphalangeal (IP) Flexion (Digit I) Screening

AROM

Plane: Frontal

Axis: Sagittal

Normal ROM: 0-90 (Figure 3-4-29).



Figure 3-4-29. AROM IP flexion.

Gross Muscle Testing

Prime Mover: Flexor pollicis longus

Position: Client is seated with forearm in supination, all digits are extended and IP moves toward flexion

Stabilize: At the thumb proximal phalanx

Resist: Applied toward extension when testing normal and good strengths (Figure 3-4-30).



Figure 3-4-30. GMT IP flexion.

IP Extension (Digit I) Screening

AROM

Plane: Frontal

Axis: Sagittal

Normal ROM: 90-0 (Figure 3-4-31).



Figure 3-4-31. AROM IP extension.

Gross Muscle Testing

Prime Mover: Extensor pollicis longus

Position: Client is seated with forearm in supination digits 2-4 are extended, thumb IP is flexed and moves toward extension

Stabilize: At the thumb proximal phalanx

Resist: Applied toward flexion in normal and good strengths (Figure 3-4-32).



Figure 3-4-32. GMT IP extension.

Opposition Screening

AROM

Plane: This is a curvilinear motion that crosses cardinal planes; not applicable

Axis: This is a curvilinear motion that shifts among cardinal axes; not applicable

Normal ROM: 0 centimeters (Figure 3-4-33).

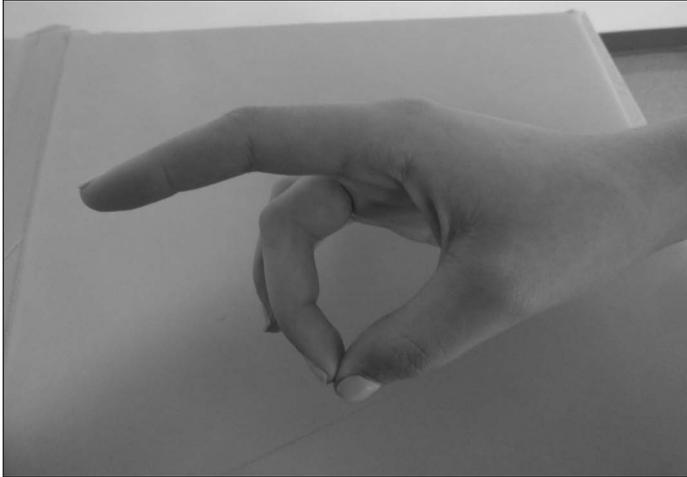


Figure 3-4-33. AROM opposition.

Gross Muscle Testing

Prime Movers: Opponens pollicis (digit I), Opponens digiti minimi (digit V)

Position: Client is seated with forearm in pronation and moves into gross grasp pattern while squeezing therapist's fingers

Stabilize: At the wrist

Resist: At both the thenar and hypothenar eminences away from opposition (Figure 3-4-34).



Figure 3-4-34. GMT opposition.

Table 3-5

HAND AT A GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING

FUNCTIONAL MUSCLE GROUP	PLANE	AXIS	FUNCTIONAL ACTIVITY ANALYSIS	NORMAL ROM	GROSS MUSCLE TESTING PROCEDURE
<i>MCP Flexion (Digits II-V)</i>	Sagittal	Frontal	Gripping a knife while cutting vegetables for dinner.	0 to 90 degrees	<p>Prime Movers: Flexor digitorum superficialis, Flexor digitorum profundus, Lumbricals, Flexor digiti minimi (digit V)</p> <p>Position: Client is seated with the testing arm supinated, in MCP extension and moves toward MCP flexion (simultaneous PIP/DIP flexion is acceptable)</p> <p>Stabilize: Proximal to the MCP joints at the metacarpals to prevent compensation</p> <p>Resist: Apply with one or two fingers at the proximal phalanges toward MCP extension</p>
<i>MCP Extension/Hyperextension (Digits II-V)</i>	Sagittal	Frontal	Lifting finger off of a computer key while typing.	90 to 0 extension 0 to 30 hyper-extension	<p>Prime Mover: Extensor digitorum, Extensor indicis (digit II), Extensor digiti minimi (digit V)</p> <p>Position: Client is seated with the testing arm in forearm pronation, digit flexion and moves toward MCP/PIP/DIP extension</p> <p>Stabilize: Proximal to the MCP joints at the metacarpals to prevent compensation</p> <p>Resist: Applied at the proximal, middle, and distal phalanges toward MCP/PIP/DIP flexion</p>
<i>MCP Adduction</i>	Frontal	Sagittal	Grasping a pencil while writing.	Compare with opposite side	<p>Prime Mover: Palmar interossei</p> <p>Position: Client is seated with the testing arm in forearm pronation, digit extension and moves toward MCP adduction</p> <p>Stabilize: At the metacarpals</p> <p>Resist: Applied to digits 2, 4 & 5 toward abduction (3rd digit does not adduct)</p>

(continued)

Table 3-5 (continued)

HAND AT A GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING

<i>MCP Abduction</i>	Frontal	Sagittal	Spreading fingers apart to get them into a glove.	Compare with opposite side	<p>Prime Mover: Dorsal interossei, Abductor digiti minimi</p> <p>Position: Client is seated with the testing arm in forearm pronation, digit extension and moves toward MCP abduction</p> <p>Stabilize: At the metacarpals</p> <p>Resist: Applied to digits 2, 4 & 5 toward adduction as well as both sides of digit 3 (3rd digit abducts to both sides)</p>
<i>PIP Flexion</i>	Sagittal	Frontal	Holding a grocery bag by the handles to bring them inside your house.	0 to 100	<p>Prime Mover: Flexor digitorum superficialis</p> <p>Position: Client is seated with the testing arm in forearm supination, digit extension and moves toward PIP/DIP flexion while keeping MCP's in extension</p> <p>Stabilize: At the MCP joints to prevent compensation</p> <p>Resist: Apply at both the middle and distal phalanges into PIP/DIP extension</p>
<i>PIP Extension</i>	Sagittal	Frontal	Extending index finger to press an elevator button.	100 to 0	<p>Prime Movers: Extensor digitorum, Lumbricals, Extensor indicis (digit II), Extensor digiti minimi (digit V)</p> <p>Position: Client is seated with the testing hand in forearm pronation, digit flexion and moves toward MCP/PIP/DIP extension</p> <p>Stabilize: Proximal to the MCP joints at the metacarpals to prevent compensation</p> <p>Resist: Applied to the proximal, middle and distal phalanges toward MCP/ PIP/DIP flexion when testing normal and good strengths</p>

(continued)

Table 3-5 (continued)

HAND AT A GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING

<i>DIP Flexion</i>	Sagittal	Frontal	Applying a contact lens onto the eye with the index finger.	0 to 90	<p>Prime Mover: Flexor digitorum profundus</p> <p>Position: Client is seated with the testing hand in forearm supination and digit extension, and moves toward PIP/DIP flexion while keeping MCP's in extension</p> <p>Stabilize: At the MCP joints to prevent compensation of hyperextension</p> <p>Resist: Applied with one or two fingers at both the middle and distal phalanges toward PIP/DIP extension when testing normal and good strengths</p>
<i>DIP Extension</i>	Sagittal	Frontal	Releasing coffee cup on the kitchen table	90 to 0	<p>Prime Movers: Extensor digitorum, Lumbricals, Extensor Indicis, Extensor Digiti Minimi</p> <p>Position: Client is seated with the testing hand in forearm pronation, digit flexion and moves toward MCP/PIP/DIP extension.</p> <p>Stabilize: Proximal to the MCP joints at the metacarpals to prevent compensation.</p> <p>Resist: Apply to the proximal, middle and distal phalanges toward MCP/ PIP/DIP flexion when testing normal and good strengths.</p>
<i>CMC Flexion</i>	Frontal	Sagittal	Pressing down on phone screen while texting (one handed).	0 to 20	<p>Prime Movers: Flexor pollicis brevis, Flexor pollicis longus</p> <p>Position: Client is seated with the forearm in supination, all digits in extension and moves CMC toward flexion</p> <p>Stabilize: At the wrist</p> <p>Resist: Apply at the metacarpal toward extension</p>
<i>CMC Extension (also known as radial abduction)</i>	Frontal	Sagittal	Reaching out to grab the bottle of hand sanitizer.	0 to 45	<p>Prime Movers: Extensor pollicis longus, Extensor pollicis brevis</p> <p>Position: Client is seated with the forearm in supination, digits II-V in extension, thumb at CMC joint is flexed and moves toward extension</p> <p>Stabilize: At the wrist</p> <p>Resist: Toward CMC flexion when testing normal and good strengths</p>

(continued)

Table 3-5 (continued)

HAND AT A GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING

<i>CMC Abduction (also known as palmar abduction)</i>	Sagittal	Frontal	Releasing the pitcher on the kitchen counter.	0 to 70	<p>Prime Movers: Abductor pollicis brevis, Abductor pollicis longus</p> <p>Position: Client is seated with the forearm in supination, digits II-V in extension, thumb is adducted and moves toward abduction</p> <p>Stabilize: At the wrist</p> <p>Resist: Applied at the first metacarpal toward adduction</p>
<i>CMC Adduction</i>	Sagittal	Frontal	Gripping a book to retrieve it from the shelf.	Compare with opposite side	<p>Prime Movers: Adductor pollicis, Palmar interossei</p> <p>Position: Client is seated with the forearm in supination, digits II-V in extension, thumb is abducted and moves toward adduction</p> <p>Stabilize: At the wrist</p> <p>Resist: Applied at the first metacarpal toward abduction</p>
<i>MP Flexion (Digit I)</i>	Frontal	Sagittal	Pressing down on the keyboard while texting (one handed).	0 to 50 degrees	<p>Prime Mover: Flexor pollicis brevis</p> <p>Position: Client sits with forearm in supination and digits II-V extended; thumb is extended. Moves thumb MP into flexion</p> <p>Stabilize: At metacarpal</p> <p>Resist: At proximal phalange toward extension</p>
<i>MP Extension (Digit I)</i>	Frontal	Sagittal	Releasing a coin into slot of the vending machine.	50 to 0	<p>Prime Mover: Extensor pollicis brevis</p> <p>Position: Client sits with forearm in supination and digits II-V extended; thumb is extended. Moves thumb MP into extension</p> <p>Stabilize: At metacarpal</p> <p>Resist: At proximal phalange toward flexion</p>

(continued)

Table 3-5 (continued)

HAND AT A GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING

<i>IP Flexion (Digit I)</i>	Frontal	Sagittal	Grasping a pencil while writing.	0 to 90	<p>Prime Mover: Flexor pollicis longus</p> <p>Position: Client is seated with forearm in supination, all digits are extended and IP moves toward flexion</p> <p>Stabilize: At the thumb proximal phalanx</p> <p>Resist: Applied toward extension when testing normal and good strengths</p>
<i>IP Extension (Digit I)</i>	Frontal	Sagittal	Releasing vitamin tablet on countertop.	90 to 0	<p>Prime Mover: Extensor pollicis longus</p> <p>Position: Client is seated with forearm in supination digits 2-4 are extended, thumb IP is flexed and moves toward extension</p> <p>Stabilize: At the thumb proximal phalanx</p> <p>Resist: Applied toward flexion in normal and good strengths</p>
<i>Opposition (Note: This is a curvilinear motion that crosses cardinal planes.)</i>			Blowing your nose with a tissue to relieve congestion.	0 centimeters	<p>Prime Movers: Opponens pollicis (digit I), Opponens digiti minimi (digit V)</p> <p>Position: Client is seated with forearm in pronation and moves into gross grasp pattern while squeezing therapist's fingers</p> <p>Stabilize: At the wrist</p> <p>Resist: At both the thenar and hypothenar eminences away from opposition</p>

SECTION 3-5: The Hip and Knee

Hip Flexion Screening

AROM

Plane: Sagittal

Axis: Frontal

Normal ROM: 0-120 degrees (Figure 3-5-1).



Figure 3-5-1. AROM hip flexion.

Gross Motor Testing

Prime Movers: Psoas major, Iliacus

Position: Client is seated with testing hip and knee are flexed so that foot is resting on the floor and moves toward hip flexion

Stabilize: At the ipsilateral iliac crest of the pelvis

Resist: Applied over the anterior aspect of the femur toward hip extension (Figure 3-5-2).



Figure 3-5-2. GMT hip flexion.

Hip Extension Screening

AROM

Plane: Sagittal

Axis: Frontal

Normal ROM: 0-30 degrees extension (Figure 3-5-3).



Figure 3-5-3. AROM hip extension.

Gross Muscle Testing

Prime Movers: Gluteus maximus, Biceps femoris, Semitendinosus, Semimembranosus

Position: Client is seated with testing hip and knee are flexed so that foot is up off the floor and moves toward hip extension

Stabilize: At the ipsilateral iliac crest of the pelvis

Resist: Applied over the posterior aspect of the femur toward hip flexion (Figure 3-5-4).



Figure 3-5-4. GMT hip extension.

Hip Abduction Screening

AROM

Plane: Frontal

Axis: Sagittal

Normal ROM: 0-45 degrees (Figure 3-5-5).

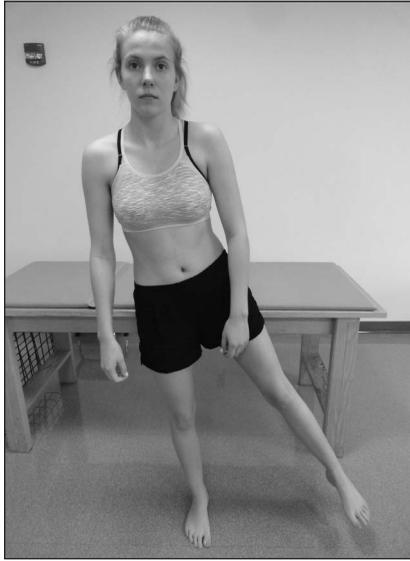


Figure 3-5-5. AROM hip abduction.

Gross Muscle Testing

Prime Movers: Gluteus medius, Gluteus minimus, Tensor fascia latae

Position: Client is seated with testing hip and knee are flexed so that foot is resting on the floor and moves toward hip abduction

Stabilize: At the ipsilateral iliac crest of the pelvis

Resist: Applied over the lateral aspect of the femur toward hip adduction (Figure 3-5-6).



Figure 3-5-6. GMT hip abduction.

Hip Adduction Screening

AROM

Plane: Frontal

Axis: Sagittal

Normal ROM: 0-30 degrees (Figure 3-5-7).

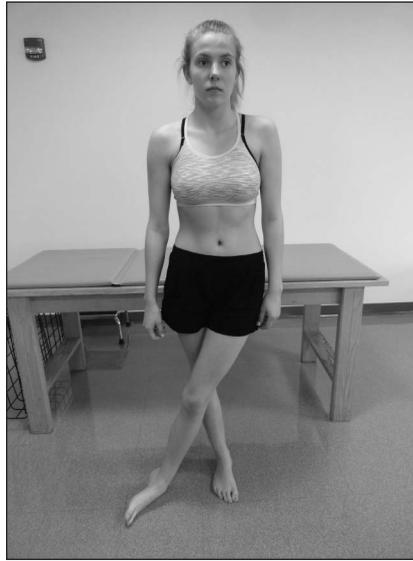


Figure 3-5-7. AROM hip adduction.

Gross Motor Testing

Prime Movers: Adductor brevis, Adductor longus, Gracilis, Adductor magnus

Position: Client is seated with testing hip and knee are flexed so that foot is resting on the floor and moves toward hip adduction

Stabilize: At the ipsilateral iliac crest of the pelvis

Resist: Applied over the medial aspect of the femur toward hip abduction (Figure 3-5-8).



Figure 3-5-8. GMT hip adduction.

Hip External Rotation Screening

AROM

Plane: Transverse

Axis: Vertical

Normal ROM: 0-45 degrees (Figure 3-5-9).



Figure 3-5-9. AROM hip external rotation.

Gross Motor Testing

Prime Movers: Gluteus maximus, Piriformis, Gemellus superior, Quadratus femoris, Gemellus inferior

Position: Client is seated with testing hip and knee are flexed so that foot is up off the floor and moves toward hip external rotation (rotate foot medially)

Stabilize: At the anterolateral aspect of the femur

Resist: Applied over the medial aspect of the distal lower leg, proximal to the ankle and toward internal rotation (Figure 3-5-10).



Figure 3-5-10. GMT hip external rotation.

Hip Internal Rotation Screening

AROM

Plane: Transverse

Axis: Vertical

Normal ROM: 0-45 degrees (Figure 3-5-11).



Figure 3-5-11. AROM hip internal rotation.

Gross Motor Testing

Prime Movers: Gluteus medius, Gluteus minimus, Tensor fascia latae

Position: Client is seated with testing hip and knee are flexed so that foot is up off the floor and moves toward hip internal rotation (rotate foot laterally)

Stabilize: At the anterolateral aspect of the femur

Resist: Applied over the lateral aspect of the distal lower leg, proximal to the ankle and toward external rotation (Figure 3-5-12).



Figure 3-5-12. GMT hip internal rotation.

Knee Flexion Screening

AROM

Plane: Sagittal

Axis: Frontal

Normal ROM: 0-135 degrees (Figure 3-5-13).



Figure 3-5-13. AROM knee flexion.

Gross Muscle Testing

Prime Movers: Semitendinosus, Semimembranosus, Biceps femoris

Position: Client is seated with knee extended out in front so that foot is up off the floor and moves toward knee flexion

Stabilize: At the anterior aspect of the femur

Resist: Applied over the anterior aspect of the distal lower leg, proximal to the ankle and toward knee extension (Figure 3-5-14).



Figure 3-5-14. GMT knee flexion.

Knee Extension Screening

AROM

Plane: Sagittal

Axis: Frontal

Normal ROM: 135-0 degrees (Figure 3-5-15).



Figure 3-5-15. AROM knee extension.

Gross Muscle Testing

Prime Movers: Vastus intermedius, Vastus medialis, Vastus lateralis, Rectus femoris

Position: Client is seated with knee flexed, foot resting on the floor and moves toward knee extension

Stabilize: At the anterior aspect of the femur

Resist: Applied over the posterior aspect of the distal lower leg, proximal to the ankle and toward knee flexion (Figure 3-5-16).



Figure 3-5-16. GMT knee extension.

Note: The knee is a condyloid joint permitting 2 degrees of freedom (flexion/extension on the sagittal plane and rotation on the transverse plane). Knee rotation occurs simultaneously along with flexion and extension in a 2:1 ratio and is not isolated out as a means of a functional screening.

Table 3-6

HIP AND KNEE AT A GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING

FUNCTIONAL MUSCLE GROUP	PLANE	AXIS	FUNCTIONAL ACTIVITY ANALYSIS	NORMAL ROM	GROSS MUSCLE TESTING PROCEDURE
<i>Hip Flexion</i>	Sagittal	Frontal	Raising leg up into pants while getting dressed.	0 to 120 degrees	<p>Prime Movers: Psoas major, Iliacus</p> <p>Position: Client is seated with testing hip and knee are flexed so that foot is resting on the floor and moves toward hip flexion</p> <p>Stabilize: At the ipsilateral iliac crest of the pelvis</p> <p>Resist: Applied over the anterior aspect of the femur toward hip extension</p>
<i>Hip Extension</i>	Sagittal	Frontal	Pulling sock up to knee while seated.	0 to 30 degrees	<p>Prime Movers: Gluteus maximus, Biceps femoris, Semitendinosus, Semimembranosus</p> <p>Position: Client is seated with testing hip and knee are flexed so that foot is up off the floor and moves toward hip extension</p> <p>Stabilize: At the ipsilateral iliac crest of the pelvis</p> <p>Resist: Applied over the posterior aspect of the femur toward hip flexion</p>
<i>Hip Abduction</i>	Frontal	Sagittal	Stepping over tub ledge to get into the shower.	0 to 45 degrees	<p>Prime Movers: Gluteus medius, Gluteus minimus, Tensor fascia latae</p> <p>Position: Client is seated with testing hip and knee are flexed so that foot is resting on the floor and moves toward hip abduction</p> <p>Stabilize: At the ipsilateral iliac crest of the pelvis</p> <p>Resist: Applied over the lateral aspect of the femur toward hip adduction</p>

(continued)

Table 3-6 (continued)

HIP AND KNEE AT A GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING

Hip Adduction <i>(Note: Unlike shoulder adduction, this is not the opposite of hip abduction.)</i>	Frontal	Sagittal	Kicking a soccer ball to the left with the right, inner foot during game.	0 to 30 degrees	<p>Prime Movers: Adductor brevis, Adductor longus, Gracilis, Adductor magnus, Pectineus</p> <p>Position: Client is seated with testing hip and knee are flexed so that foot is resting on the floor and moves toward hip adduction</p> <p>Stabilize: At the ipsilateral iliac crest of the pelvis</p> <p>Resist: Applied over the medial aspect of the femur toward hip abduction</p>
Hip External Rotation	Transverse	Vertical	Putting your foot on top of your opposite knee to tie shoelace.	0 to 45 degrees	<p>Prime Movers: Gluteus maximus, Piriformis, Gemellus superior, Quadratus femoris, Gemellus inferior, Obturator internus, Obturator externus</p> <p>Position: Client is seated with testing hip and knee are flexed so that foot is up off the floor and moves toward hip external rotation (rotate foot medially)</p> <p>Stabilize: At the anterolateral aspect of the femur</p> <p>Resist: Applied over the medial aspect of the distal lower leg, proximal to the ankle and toward internal rotation</p>
Hip Internal Rotation	Transverse	Vertical	Turning leg and foot inwards to zip a lateral zipper on a boot while getting dressed.	0 to 45 degrees	<p>Prime Movers: Gluteus medius, Gluteus minimus, Tensor fascia latae</p> <p>Position: Client is seated with testing hip and knee are flexed so that foot is up off the floor and moves toward hip internal rotation (rotate foot laterally)</p> <p>Stabilize: At the anterolateral aspect of the femur</p> <p>Resist: Applied over the lateral aspect of the distal lower leg, proximal to the ankle and toward external rotation</p>

(continued)

Table 3-6 (continued)

HIP AND KNEE AT A GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING

<i>Knee Flexion</i>	Sagittal	Frontal	Lowering oneself down to sit as needed for toileting.	0 to 135 degrees	<p>Prime Movers: Semitendinosus, Semimembranosus, Biceps femoris</p> <p>Position: Client is seated with knee extended out in front so that foot is up off the floor and moves toward knee flexion</p> <p>Stabilize: At the anterior aspect of the femur</p> <p>Resist: Applied over the anterior aspect of the distal lower leg, proximal to the ankle and toward knee extension</p>
<i>Knee Extension</i>	Sagittal	Frontal	Stepping out of the car.	135 to 0 degrees	<p>Prime Movers: Vastus intermedius, Vastus medialis, Vastus lateralis, Rectus femoris</p> <p>Position: Client is seated with knee flexed, foot resting on the floor and moves toward knee extension</p> <p>Stabilize: At the anterior aspect of the femur</p> <p>Resist: Applied over the posterior aspect of the distal lower leg, proximal to the ankle and toward knee flexion</p>

SECTION 3-6: The Ankle and Foot

Ankle Dorsiflexion Screening

AROM

Plane: Oblique Sagittal

Axis: Oblique Frontal

Normal ROM: 0-20 degrees (Figure 3-6-1).



Figure 3-6-1. AROM ankle dorsiflexion.

Gross Muscle Testing

Prime Movers: Tibialis anterior

Position: Client is seated with knee flexed, foot resting on the floor and moves toward ankle dorsiflexion

Stabilize: At the anterior aspect of the tibia

Resist: Applied over the anterior aspect of the foot and toward ankle plantar flexion (Figure 3-6-2).



Figure 3-6-2. GMT ankle dorsiflexion.

Ankle Plantar Flexion Screening

AROM

Plane: Oblique Sagittal

Axis: Oblique Frontal

Normal ROM: 0-50 degrees (Figure 3-6-3).



Figure 3-6-3. AROM ankle plantar flexion.

Gross Muscle Testing

Prime Movers: Gastrocnemius, Soleus

Position: Client is seated with knee flexed, foot in dorsiflexion and moves toward ankle plantarflexion

Stabilize: At the anterior aspect of the tibia

Resist: Applied over the anterior aspect of the foot and toward ankle dorsiflexion (Figure 3-6-4).



Figure 3-6-4. GMT ankle plantar flexion.

Ankle Inversion Screening

AROM

Plane: Oblique Frontal

Axis: Oblique Sagittal

Normal ROM: 0-35 degrees Forefoot; 0-5 degrees Hindfoot (Figure 3-6-5).



Figure 3-6-5. AROM ankle inversion.

Gross Muscle Testing

Prime Movers: Tibialis posterior

Position: Client is seated with knee extended in order to hold foot just off the floor and moves ankle medially toward inversion

Stabilize: At the anterior aspect of the tibia

Resist: Applied on the medial border of the foot toward eversion (Figure 3-6-6).



Figure 3-6-6. GMT ankle inversion.

Ankle Eversion Screening

AROM

Plane: Oblique Frontal

Axis: Oblique Sagittal

Normal ROM: 0-15 degrees Forefoot; 0-5 degrees Hindfoot (Figure 3-6-7).



Figure 3-6-7. AROM ankle eversion.

Gross Muscle Testing

Prime Movers: Peroneus longus (also known as Fibularis longus), Peroneus brevis (also known as Fibularis brevis)

Position: Client is seated with knee extended in order to hold foot just off the floor and moves ankle laterally toward eversion

Stabilize: At the anterior aspect of the tibia

Resist: Applied on the lateral border of the foot toward inversion (Figure 3-6-8).



Figure 3-6-8. GMT ankle eversion.

Metatarsal Phalangeal (MTP) Flexion Screening

AROM

Plane: Sagittal

Axis: Frontal

Normal ROM: 0-45 at great toe and 0-40 at toes II-V (Figure 3-6-9).



Figure 3-6-9. AROM MTP flexion.

Gross Muscle Testing

Prime Movers: Flexor hallucis brevis, Lumbricals

Position: Client is seated with knee extended in order to hold foot just off the floor and moves into MTP flexion

Stabilize: Anterior aspect of metatarsals

Resist: Posterior aspect of proximal phalanx toward MTP extension (Figure 3-6-10).



Figure 3-6-10. GMT MTP flexion.

MTP Extension Screening

AROM

Plane: Sagittal

Axis: Frontal

Normal ROM: 45-0 at great toe; 40-0 at toes II-V (Figure 3-6-11).



Figure 3-6-11. AROM MTP extension.

Gross Muscle Testing

Prime Movers: Extensor hallucis brevis, Extensor digitorum brevis

Position: Client is seated with knee extended in order to hold foot just off the floor and moves into MTP extension

Stabilize: Anterior aspect of metatarsals

Resist: Anterior aspect of proximal phalanx toward MTP flexion (Figure 3-6-12).



Figure 3-6-12. GMT MTP extension.

MTP Abduction Screening

AROM

Plane: Transverse

Axis: Vertical

Normal ROM: Compare with opposite side (Figure 3-6-13).



Figure 3-6-13. AROM MTP abduction.

Gross Muscle Testing

Prime Movers: Abductor hallucis, Abductor digiti minimi, Dorsal interossei

Position: Client is seated with knee extended in order to hold foot just off the floor and moves into MTP abduction

Stabilize: At the first metacarpal

Resist: On the medial aspect of the proximal phalanx of the great toe toward MTP adduction (Figure 3-6-14).



Figure 3-6-14. GMT MTP abduction.

MTP Adduction Screening

AROM

Plane: Transverse

Axis: Vertical

Normal ROM: Compare with opposite side (Figure 3-6-15).



Figure 3-6-15. AROM MTP adduction.

Gross Muscle Testing

Prime Movers: Adductor hallucis, Plantar interossei

Position: Client is seated with knee extended in order to hold foot just off the floor and moves into MTP adduction

Stabilize: At the first metacarpal

Resist: On the lateral aspect of the proximal phalanx of the great toe toward MTP abduction (Figure 3-6-16).



Figure 3-6-16. GMT MTP adduction.

Interphalangeal (IP; Great Toe)/Proximal Interphalangeal (PIP; Toes II-V)/Distal Interphalangeal (DIP; Toes II-V) Flexion Screening

AROM

Plane: Sagittal

Axis: Frontal

Normal ROM: 0-90 at great toe, IP; 0-35 at toes II-V, PIP; 0-60 at toes II-V, DIP (Figure 3-6-17).



Figure 3-6-17. AROM IP/PIP/DIP flexion.

Gross Muscle Testing

Prime Movers: Flexor hallucis longus, Flexor digitorum brevis, Flexor digitorum longus

Position: Client is seated with knee extended in order to hold foot just off the floor and moves into IP/PIP/DIP flexion

Stabilize: Proximal/middle phalanx

Resist: Middle/distal phalanx toward IP/PIP/DIP extension (Figure 3-6-18).



Figure 3-6-18. GMT IP/PIP/DIP flexion.

IP/PIP/DIP Extension Screening

AROM

Plane: Sagittal

Axis: Frontal

Normal ROM: 90-0 at great toe, IP; 35-0 at toes II-V, PIP; 60-0 at toes II-V, DIP (Figure 3-6-19).



Figure 3-6-19. AROM IP/PIP/DIP extension.

Gross Motor Testing

Prime Movers: Extensor hallucis longus, Extensor digitorum brevis, Extensor digitorum longus

Position: Client is seated with knee extended in order to hold foot just off the floor and moves toes into extension

Stabilize: Proximal/middle phalanx

Resist: Middle/distal phalanx toward IP/PIP/DIP flexion (Figure 3-6-20).



Figure 3-6-20. GMT IP/PIP/DIP extension.

Table 3-7

ANKLE AND FOOT AT A GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING

FUNCTIONAL MUSCLE GROUP	PLANE	AXIS	FUNCTIONAL ACTIVITY ANALYSIS	NORMAL ROM	GROSS MUSCLE TESTING PROCEDURE
<i>Ankle Dorsiflexion</i>	Oblique Sagittal	Oblique Frontal	Lifting foot to next step while going up the stairs.	0 to 20 degrees	<p>Prime Movers: Tibialis anterior</p> <p>Position: Client is seated with knee flexed, foot resting on the floor and moves toward ankle dorsiflexion</p> <p>Stabilize: At the anterior aspect of the tibia</p> <p>Resist: Applied over the anterior aspect of the foot and toward ankle plantar flexion</p>
<i>Ankle Plantar Flexion</i>	Oblique Sagittal	Oblique Frontal	Pressing down the acceleration pedal in the car.	0 to 50 degrees	<p>Prime Movers: Gastrocnemius, Soleus</p> <p>Position: Client is seated with knee flexed, foot in dorsiflexion and moves toward ankle plantarflexion</p> <p>Stabilize: At the anterior aspect of the tibia</p> <p>Resist: Applied over the anterior aspect of the foot and toward ankle dorsiflexio</p>
<i>Ankle Inversion (With Dorsiflexion)</i>	Oblique Frontal	Oblique Sagittal	Shifting foot from the accelerator to the brake while driving.	0 to 35 degrees forefoot 0 to 5 degrees hindfoot	<p>Prime Movers: Tibialis posterior</p> <p>Position: Client is seated with knee extended in order to hold foot just off the floor and moves ankle medially toward inversion</p> <p>Stabilize: At the anterior aspect of the tibia</p> <p>Resist: Applied on the medial border of the foot toward eversion</p>

(continued)

Table 3-7 (continued)

ANKLE AND FOOT AT A GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING

<i>Ankle Eversion (With Plantar Flexion)</i>	Oblique Frontal	Oblique Sagittal	Shifting foot from the brake to the accelerator while driving.	0 to 15 degrees forefoot 0 to 5 degrees hindfoot	<p>Prime Movers: Peroneus longus (also known as Fibularis longus), Peroneus brevis (also known as Fibularis brevis)</p> <p>Position: Client is seated with knee extended in order to hold foot just off the floor and moves ankle laterally toward eversion</p> <p>Stabilize: At the anterior aspect of the tibia</p> <p>Resist: Applied on the lateral border of the foot toward inversion</p>
<i>MTP/MP Flexion</i>	Sagittal	Frontal	Placing toes into opening of a sock before pulling it on.	0 to 45 degrees great toe 0 to 40 degrees toes II-V	<p>Prime Movers: Flexor hallucis brevis, Lumbricals</p> <p>Position: Client is seated with knee extended in order to hold foot just off the floor and moves into MTP flexion</p> <p>Stabilize: Anterior aspect of metatarsals</p> <p>Resist: Posterior aspect of proximal phalanx toward MTP extension</p>
<i>MTP/MP Extension</i>	Sagittal	Frontal	Slipping on flip flops before heading to the beach.	45 to 0 degrees great toe 40 to 0 degrees toes II-V	<p>Prime Movers: Extensor hallucis longus, Extensor digitorum brevis, Extensor digitorum longus</p> <p>Position: Client is seated with knee extended in order to hold foot just off the floor and moves into MTP extension</p> <p>Stabilize: Anterior aspect of metatarsals</p> <p>Resist: Anterior aspect of proximal phalanx toward MTP flexion</p>
<i>MTP Abduction</i>	Transverse	Vertical	Slipping on flip flops before heading to the beach.	Compare with opposite side	<p>Prime Movers: Abductor hallucis, Abductor digiti minimi, Dorsal interossei</p> <p>Position: Client is seated with knee extended in order to hold foot just off the floor and moves into MTP abduction</p> <p>Stabilize: At the first metacarpal</p> <p>Resist: On the medial aspect of the proximal phalanx of the great toe toward MTP adduction</p>

(continued)

Table 3-7 (continued)

ANKLE AND FOOT AT A GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING

<i>MTP Adduction</i>	Transverse	Vertical	Placing toes/foot into a tall boot.	Compare with opposite side	<p>Prime Movers: Adductor hallucis, Plantar interossei</p> <p>Position: Client is seated with knee extended in order to hold foot just off the floor and moves into MTP adduction</p> <p>Stabilize: At the first metacarpal</p> <p>Resist: On the lateral aspect of the proximal phalanx toward MTP abduction</p>
<i>IP/PIP/DIP Flexion</i>	Sagittal	Frontal	Placing toes into opening of a sock before pulling it on.	<p>0 to 90 degrees IP/PIP great toe</p> <p>0 to 35 degrees PIP toes II-V</p> <p>0 to 60 degrees DIP</p>	<p>Prime Movers: Flexor hallucis longus, Flexor digitorum longus, Flexor digitorum brevis</p> <p>Position: Client is seated with knee extended in order to hold foot just off the floor and moves into IP/PIP flexion</p> <p>Stabilize: Proximal phalanx</p> <p>Resist: Middle phalanx toward IP/PIP extension</p>
<i>IP/PIP/DIP Extension</i>	Sagittal	Frontal	Applying toe nail polish.	<p>90 to 0 degrees IP/PIP great toe</p> <p>35 to 0 degrees PIP toes II-V</p> <p>60 to 0 degrees DIP</p>	<p>Prime Movers: Extensor hallucis longus, Extensor digitorum longus, Extensor digitorum brevis</p> <p>Position: Client is seated with knee extended in order to hold foot just off the floor and moves toes into extension</p> <p>Stabilize: Proximal phalanx</p> <p>Resist: Middle phalanx toward IP/PIP flexion</p>



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Biomechanical Assessment

Introduction to Goniometry and Isolated Muscle Testing

After completing this chapter, the student should be able to accomplish the following:

- Define the terms related to biomechanical assessment via goniometry and isolated muscle testing (IMT).
- Define the terms associated with biomechanical assessment via isolated muscle testing (IMT) of a functional muscle group (FMG).
- Identify the average expected range of motion of each joint in all planes.
- Recognize potential contraindications and precautions to performing goniometry and/or isolated muscle testing.
- Demonstrate the ability to perform all steps of the goniometry process.
- Demonstrate the ability to perform and grade isolated muscle testing (IMT).
- Demonstrate the clinical reasoning necessary to identify biomechanical abnormalities that interfere with engagement in everyday tasks and therefore warrant Occupational Therapy intervention.
- Demonstrate appropriate documentation of the assessment results per Appendix E.

PROCEDURAL GUIDELINES

1. As depicted in the decision tree (Chapter 2, Figure 1-1 Clinical Decision-Making Tree), observation of functional activity, AROM, and GMT represent the first step in the evaluative OT process (Chapter 3). Following that screening, the therapist will diagnostically determine if formal goniometric and isolated muscle testing assessment are necessary.
2. **Goniometry:** The purpose of **goniometry** is to formally assess and measure the arc of motion available within a given joint. To do so, the therapist utilizes specifically defined bony landmarks in the human body as reference points. The **goniometer** is the most commonly used instrument to measure joint motion and are available in several different shapes and sizes (see Figure 4-1 and Figure 4-2). Goniometers have three essential components: a fulcrum, a stationary arm, and a movable arm. The **fulcrum** is the point around which the expected joint motion will occur; either a sagittal, frontal, or vertical **axis of rotation**. The **stationary arm** represents the designated reference point from which the motion begins and the **movable arm** represents the designated reference plane upon which the motion occurs or is followed. For example, if shoulder/humeral flexion is measured, the axis is on the lateral aspect of the shoulder, the stable arm stays positioned in alignment with the trunk of the body, and the movable arm follows the humerus along the plane of motion. The transparent nature of the goniometer itself fosters the therapist's use of diagnostic vision; permitting observation of biomechanical movement at a particular joint representing the axis or rotation and upon the cardinal plane of motion. For a review of these key terms/points related to anatomical planes and axes, please refer to Chapter 1.
 - a. As a matter of procedure in goniometry, measurements are obtained of both the right and left sides so as to draw joint specific comparisons within a personal context. The format for recording goniometry differs by site-specific preference, but is universally measured in degrees of motion. The universal method of documenting goniometry measurements is the 0-180 degrees method (Rondinelli, 2009). This method emphasizes a beginning degree and end degree to illustrate the total arc of motion measured. With this method, the majority of joint motions begin at zero degrees; a plus symbol (+) would imply hypermobility beyond expected range of normal, and a minus symbol (-) would imply limited motion less than expected range of normal (Rondinelli, 2009). Norkin and White (2016), also define the documentation of goniometry by way of visual estimation (AROM as described in Chapter 2 of this manual), or the Sagittal-Frontal-Transverse-Rotation (SFTR) method. This method is noted as not universally used in the United States though depicts the range of motion available upon each plane at each joint (ie.: Hip 45-0-35). While still others will document a single range by a single number of degrees represented as either positive or negative, this method is not used universally and may lead to confusion among the profession (Norkin & White, 2016). Different measurements require different placement of the goniometer arms. The goniometer arms may be closed with both arms together, open with both arms opposite each other, perpendicular to each other, or somewhere in-between. Where a given measurement may begin away from a zero point, the therapist should document the exact beginning point in degrees with careful attention to the difference between the negative sign (-) and the "through to" sign (-) where in the following example yields motion from -5 degrees (hyperextension) through to 180 degrees for a total of 185 degrees of motion (ie.: -5-180 degrees). As such, it is recommended that motion be documented as -5/180° in this example.

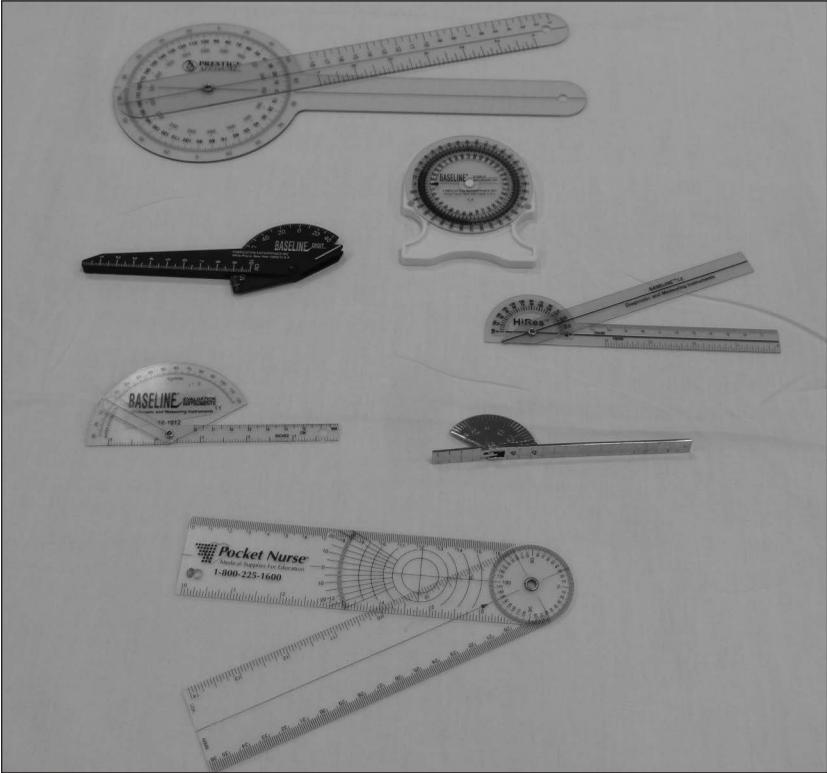


Figure 4-1.

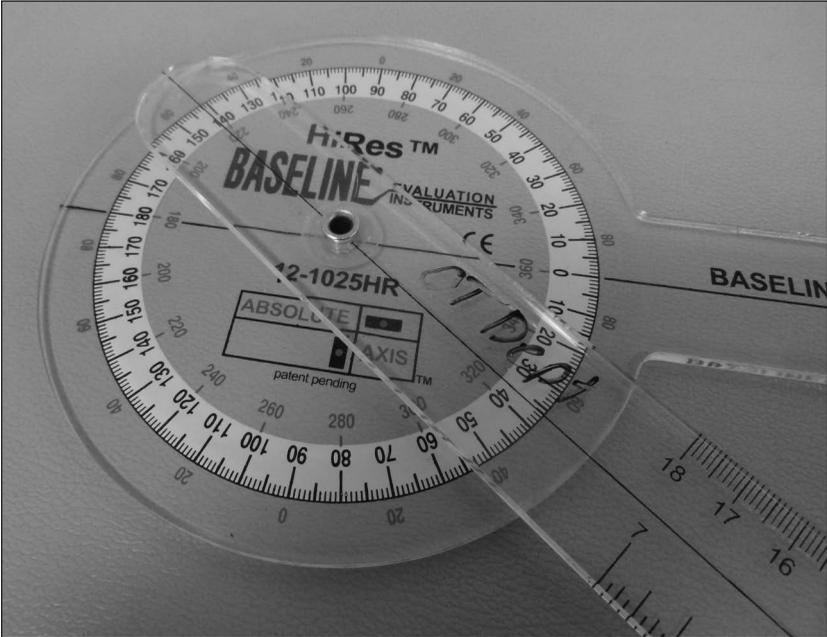


Figure 4-2.

- b. The process of goniometry can be simplified as follows. Looking through the transparent goniometer, the fulcrum is placed atop the joint or axis of rotation you wish to measure and on the plane of motion in which it occurs. Then, the stable arm is aligned to a stable, proximal body segment or parallel/perpendicular to the ground while the movable arm is placed in alignment with the proximal body segment that will be moving around that axis of rotation. The client is asked to perform the motion to its fullest extent (“Is that as far as you can go?”). The measurement is determined, and the body segment then returned to its resting position. Measurements are then compared to established norms to determine if occupational therapy intervention is needed.
 - c. The standardized process for goniometric measurement of each joint in the upper extremity follows. Detailed assessment of the lower extremity when identified by the Occupational Therapist during the screening process (Chapter 2) should be referred to our colleagues in Physical Therapy as a matter of best and most evidence-based practice.
3. **Isolated Muscle Testing (IMT):** As stated in earlier chapters, isolated muscle testing is completed as part of the formal assessment process as may be required following the diagnostic screening of functional activity, AROM, and GMT. Recall that GMT tests the concentric strength of groups of muscles, such as the hip flexors, while isolated muscle testing assess specific, individual muscles as they concentrically contract to assess the actual limitation noted during the screening process. However, that does not mean that every muscle of the body can be fully tested in isolation. There are certain sets of muscles that are tested together because it is not possible to further isolate these groups given how intimately they work together to produce a given motion. For example, Levator scapulae cannot be isolated from upper fibers of Trapezius in their shared action of scapular elevation. In this chapter, such muscles are specifically noted and only one procedure is listed accordingly.

Of importance as a manual focused on the teaching of biomechanical screening and assessment from an Occupational Therapy perspective, the assessment of neck, trunk, and the lower extremity are provided from a functional perspective (ie.: functional mobility and postural control). This accurately reflects how our profession understands the foundation of anatomy and biomechanics as they relate to our physical ability to engage in everyday meaningful occupations. A sample format for conducting a postural assessment is provided in Appendix F: Occupational Therapy: Posture Assessment. More formal biomechanical assessment of the neck, trunk, and lower extremity, beyond engagement in meaningful occupation, would be referred to our colleagues in Physical Therapy as a matter of comprehensive, interdisciplinary, and evidence-based intervention.

Chapter 3 of this manual describes terminology and procedures related to GMT that also apply to IMT. In review, the client must be positioned in either a gravity-eliminated (movement parallel to or supported by the ground) or an against-gravity (movement perpendicular to or against the ground) position. Again, as was introduced in Chapter 2, in the simplest of terms and as a matter of executing IMT as well, a therapist has two hands; one which will act to stabilize the motion and the other which will act to resist the motion in order to assess a given muscle's strength.

As introduced in Chapter 3 with gross muscle testing, in order to begin the isolated muscle testing, the therapist places one hand proximal to the joint being tested as a stabilizing hand or the “**stabilizer**”. This effort is to maintain proper alignment and prevent innate compensation by the client. **Compensation** is noted when the client uses alternative motions to achieve the actual movement requested by the therapist. The therapist’s other hand is therefore generally placed immediately distal to that same joint and applies pressure in the direction opposite of the motion being assessed. This is the **resistance** or “**resistor**” hand. During examination, the therapist will assess each individual muscle of a functional muscle group in isolation, or as close to isolation as possible, applying resistance against the movement itself and toward the pull of gravity for a sustained period of time, not exceeding the count of “Hold for 1 and 2 and 3”. There are a few isolated muscle tests where this generalized hand placement differs (ie: shoulder/humeral internal and external rotation), however, as a matter of teaching and learning, it is recommended that focus be placed on exceptions to the overarching “rule” of hand placement. Once the isolated muscle test is complete, the therapist grades the muscle strength and tests/compares with the contralateral side.

4. As a matter of grading and documenting isolated muscle strength, the following table is provided highlighting a detailed continuum the therapist must closely consider as a matter of formal assessment and clinical judgment. The grading of isolated muscle testing is, therefore, more detailed and specific than that of the abbreviated, gross muscle testing version. Refer to Table 4-1 for the Abbreviated Muscle Strength Grading Scale. While other resources may have slight variation in this level of detail, this scale is the widely accepted model for practice in quantifying muscle strength as most clearly illustrating that intimate relationship between biomechanical movement and strength. The use of plus (+) and minus (-) again appears as a matter of common practice and indicative of the amount of the entire arc of motion achieved. However, it should be noted that as a matter of current publication, *Daniels and Worthingham’s Muscle Testing: Techniques of Manual Examination and Performance Testing* (2019) discourages the use of plus and minus given the adverse effect on the inter-rater reliability of the manual muscle testing process itself. Again, pluses and minuses are included in this publication as a teaching manual and in effort to best prepare students for what they may see in practice while also providing evidence in support or lack thereof.

Because we live in a gravity environment, the movement of our body requires strength, whether with added manual resistance by the therapist, or not. As such it typically requires 3/fair muscle grade strength to move even in part against gravity. Therefore, to assess muscles unable to concentrically contract in full in upright against gravity the therapist must artificially provide a gravity-eliminated environment; one where the limb or limb segment is supported in full by either a surface perpendicular to the ground, such as on a plinth, or by the support provided from the therapist in full as motion is attempted. This type of support provided by the therapist is called **active assisted range of motion (AAROM)** where the client is providing partial movement/muscle contraction through the arc of motion, or **passive range of motion (PROM)**, where the client is not or can not participate at all through the arc of motion despite verbal cueing. When this scenario applies, the therapist resisting hand or “resistor” becomes a “palpator”, serving to feel for the slightest of muscle twitch or weak contraction. In this position, the therapist is assessing for muscle strength that is 0/zero, 1/trace, or 2/poor.

Table 4-1

MUSCLE STRENGTH GRADING SCALE

WORD/ LETTER	NUMBER GRADE	DESCRIPTION
Normal	5	Full ROM against gravity with maximal added external resistance by therapist
Good	4	Full ROM against gravity with moderate added external resistance by therapist
Good minus	4-	Full ROM against gravity with minimal added external resistance by therapist
Fair plus	3+	Full ROM against gravity, and sustain position without added external resistance by therapist
Fair	3	Full ROM against gravity, unable to sustain position, without added external resistance by therapist
Fair minus	3-	Less than full ROM against gravity, without added external resistance by therapist
Poor plus	2+	Full ROM in gravity eliminated, without added external resistance by therapist
Poor	2	1/2 to Full (Partial) ROM in gravity eliminated, no added resistance
Poor minus	2-	Less than 1/2 range in gravity eliminated, no added resistance
Trace	1	Palpation of muscle contraction only in attempt to move, no actual motion
Zero	0	Absence of muscle contraction seen or palpated in attempt to move, no actual motion

See Appendix F for a sample Biomechanical Assessment (Goniometry and IMT) Documentation Form

See Appendix D for a quick reference listing of primary/prime muscle movers by Functional Muscle Group (FMG)

See Appendix G for a comprehensive quick reference or at-a-glance guide of both screening and assessment procedures by functional muscle group (FMG) for both the upper and lower extremities.

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SECTION 4-1: The Neck and Trunk

KEY BONY LANDMARKS	
Landmark	Approximate Vertebral Level
Hyoid	C3
Thyroid Cartilage	C4-5
Cricoid Cartilage	C6
First Palpable Spinous Process	C7
Superior Angle of Scapula	T2
Manubrium	T4
Inferior Angle of Scapula	T7
Xiphoid Process	T10
Iliac Crest	L4
Posterior Superior Iliac Crest (PSIS)	S2

Neck Flexion (Cervical Region): Goniometry

Normal ROM: 0-45 degrees

End feel: Firm



Figure 4-1-1.



Figure 4-1-2.

Client Position: Client is sitting with upper extremity resting at side. Lumbar and thoracic spines are supported by the chair.

Starting—client is in resting position with neck straightened (Figure 4-1-1).

Ending—client bend their neck into maximum flexion (Figure 4-1-2).

Therapist Position: Observe the lumbar and thoracic regions to prevent compensatory movements.

Goniometer Position:

FULCRUM: over external auditory meatus of the skull

STABLE ARM: perpendicular or parallel to the floor

MOVABLE ARM: along the base of the nares

Alternate Test

A tape measure may be used to assess the distance between the tip of the chin and the sternal notch. Observe to ensure the client's mouth is closed.

Neck Flexion (Cervical Region): Isolated Muscle Testing

The neck and trunk are linked as a series of interconnected joints and muscles working together to produce movement. This is an example of “coupled motion” that cannot functionally be isolated as a matter of muscle strength testing. It is recommended that an “Occupational Therapy Posture Assessment” is conducted to assess core strength as a necessary precursor for distal mobility in the appendicular skeleton (Figures 4-1-3 and 4-1-4). (See Appendix F.)

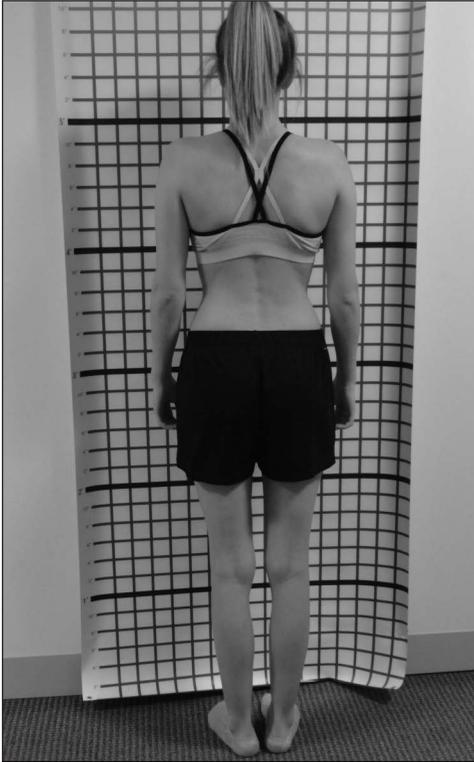


Figure 4-1-3.



Figure 4-1-4.

Neck Extension (Cervical Region): Goniometry

Plane: Sagittal

Axis: Frontal

Normal ROM: 0-45

End feel: Firm



Figure 4-1-5.

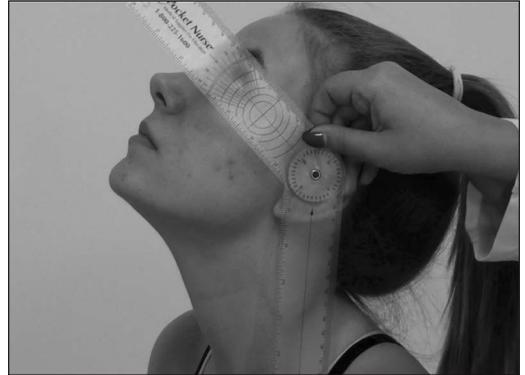


Figure 4-1-6.

Client Position: Client is sitting with upper extremity resting at side. Lumbar and thoracic spines are supported by the chair.

Starting—cervical spine is in neutral (Figure 4-1-5).

Ending—client moves into maximum cervical extension (Figure 4-1-6).

Therapist Position: Observe the lumbar and thoracic regions to prevent compensatory movements.

Goniometer Position:

FULCRUM: over external auditory meatus

STABLE ARM: perpendicular or parallel to the floor

MOVABLE ARM: along the base of the nares

Alternate Test

A tape measure may be used to assess the distance between the tip of the chin and the sternal notch. Observe to ensure the client's mouth is closed.

Neck Extension (Cervical Region): Isolated Muscle Testing

The neck and trunk are linked as a series of interconnected joints and muscles working together to produce movement. This is an example of “coupled motion” that cannot functionally be isolated as a matter of muscle strength testing. It is recommended that an “Occupational Therapy Posture Assessment” is conducted to assess core strength as a necessary precursor for distal mobility in the appendicular skeleton (Figures 4-1-3 and 4-1-4). (See Appendix F.)

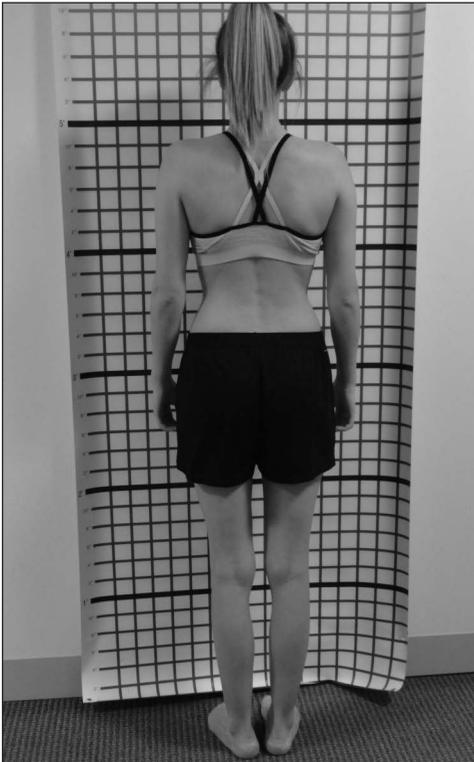


Figure 4-1-3.



Figure 4-1-4.

Neck Lateral Flexion (Cervical Region): Goniometry

Plane: Frontal

Axis: Sagittal

Normal ROM: 0-45 degrees

End feel: Firm



Figure 4-1-7.



Figure 4-1-8.

Client Position: Client is sitting with upper extremities resting at sides. Lumbar and thoracic spines are supported by the chair.

Starting—cervical spine is in neutral (Figure 4-1-7).

Ending—client moves into maximum cervical lateral flexion (Figure 4-1-8).

Therapist Position: Observe the lumbar and thoracic regions to prevent compensatory movements.

Goniometer Position:

FULCRUM: over spinous process of C7 vertebrae
STABLE ARM: over spinous processes of the thoracic vertebrae with arm perpendicular to the floor

MOVABLE ARM: over dorsal midline of the head with the occipital protuberance as a guide

Alternate Test

A tape measure may be used to assess the distance between the mastoid process and the acromial process. Observe to ensure client's mouth is closed.

Neck Lateral Flexion (Cervical Region): Isolated Muscle Testing

The neck and trunk are linked as series of interconnected joints and muscles working together to produce movement. This is an example of “coupled motion” that cannot functionally be isolated as a matter of muscle strength testing. It is recommended that an “Occupational Therapy Posture Assessment” is conducted to assess core strength as a necessary precursor for distal mobility in the appendicular skeleton (Figures 4-1-3 and 4-1-4). (See Appendix F.)



Figure 4-1-3.



Figure 4-1-4.

Neck Rotation (Cervical Region): Goniometry

Plane: Transverse

Axis: Vertical

Normal ROM: 0-60 degrees

End feel: Firm



Figure 4-1-9.



Figure 4-1-10.

Client Position: Client is sitting with upper extremity resting at side. Lumbar and thoracic spines are supported by the chair.

Starting—cervical spine is in neutral (Figure 4-1-9).

Ending—client moves into maximum cervical rotation (Figure 4-1-10).

Therapist Position: Observe the lumbar and thoracic regions to prevent compensatory movements.

Goniometer Position:

FULCRUM: centered over the middle of the cranial aspect of the head

STABLE ARM: parallel to an imaginary line between the acromial processes

MOVABLE ARM: in line with the tip of the nose

Alternate Test

A tape measure may be used to assess the distance between the tip of the chin and the acromion process. Observe to ensure the client's mouth is closed.

Neck Rotation (Cervical Region): Isolated Muscle Testing

The neck and trunk are linked as a series of interconnected joints and muscles working together to produce movement. This is an example of “coupled motion” that cannot functionally be isolated as a matter of muscle strength testing. It is recommended that an “Occupational Therapy Posture Assessment” is conducted to assess core strength as a necessary precursor for distal mobility in the appendicular skeleton (Figures 4-1-3 and 4-1-4). (See Appendix F.)



Figure 4-1-3.



Figure 4-1-4.

Trunk Flexion (Thoracolumbar Region): Goniometry

Plane: Sagittal

Axis: Frontal

Normal ROM: 0-80 degrees/4 inches

End feel: Firm



Figure 4-1-11.



Figure 4-1-12.

Client Position: Client is standing with upper extremity resting at side. Cervical spine is in neutral. Feet are shoulder width apart.

Starting—spine is in neutral (Figure 4-1-11).

Ending—client moves into maximum spinal flexion (Figure 4-1-12).

Therapist Position: Observe to prevent anterior tilt.

Measurement: A tape measure is placed between the spinous processes of C7 and S1. First the measurement is taken with the client in the upright position and a second one taken at maximal flexion. The difference between the two measurements is the amount of flexion present.

Trunk Flexion (Thoracolumbar Region): Isolated Muscle Testing

The neck and trunk are linked as a series of interconnected joints and muscles working together to produce movement. This is an example of “coupled motion” that cannot functionally be isolated as a matter of muscle strength testing. It is recommended that an “Occupational Therapy Posture Assessment” is conducted to assess core strength as a necessary precursor for distal mobility in the appendicular skeleton (Figures 4-1-3 and 4-1-4). (See Appendix F.)



Figure 4-1-3.

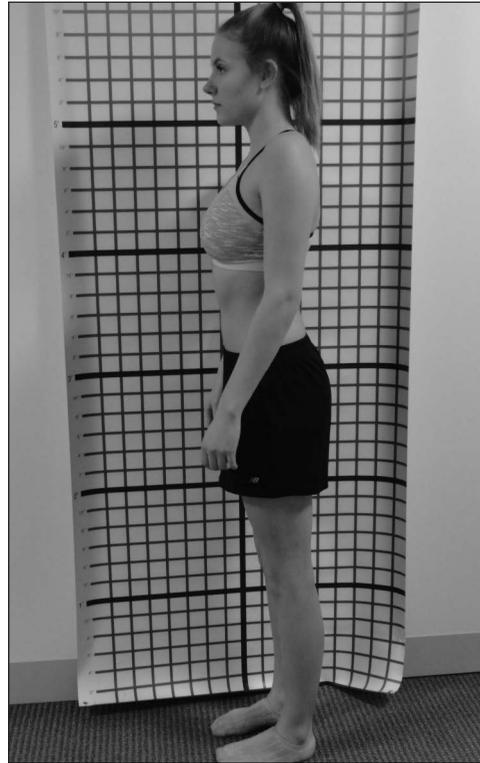


Figure 4-1-4.

Trunk Extension (Thoracolumbar Region): Goniometry

Plane: Sagittal

Axis: Frontal

Normal ROM: 0-25 degrees

End feel: Firm



Figure 4-1-13.



Figure 4-1-14.

Client Position: Client is standing with upper extremity resting at side. Cervical spine is in neutral. Feet are shoulder width apart.

Starting—spine is in neutral (Figure 4-1-13 START).

Ending—client moves into maximum spinal extension (Figure 4-1-14 END).

Therapist Position: Observe to prevent anterior tilt.

Measurement: A tape measure is placed between the spinous processes of C7 and S1. First the measurement is taken with the client in the upright position and a second one taken at maximal extension. The difference between the two measurements is the amount of extension present.

Trunk Extension (Thoracolumbar Region): Isolated Muscle Testing

The neck and trunk are linked as a series of interconnected joints and muscles working together to produce movement. This is an example of “coupled motion” that cannot functionally be isolated as a matter of muscle strength testing. It is recommended that an “Occupational Therapy Posture Assessment” is conducted to assess core strength as a necessary precursor for distal mobility in the appendicular skeleton (Figures 4-1-3 and 4-1-4). (See Appendix F.)

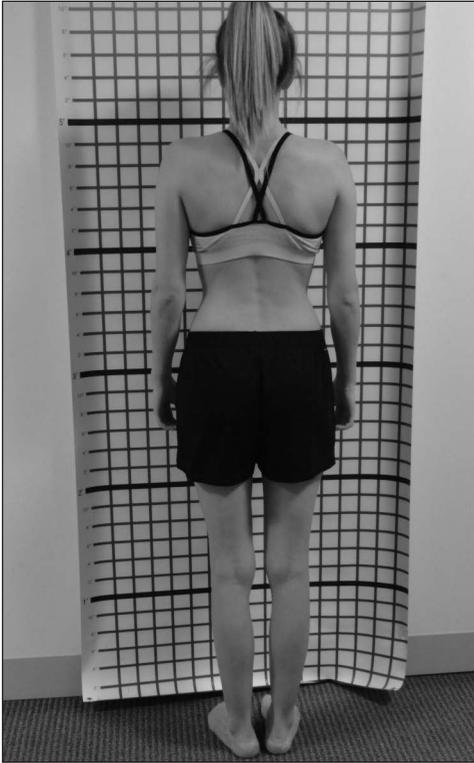


Figure 4-1-3.



Figure 4-1-4.

Trunk Lateral Flexion: Goniometry

Plane: Frontal

Axis: Sagittal

Normal ROM: 0-35 degrees

End feel: Firm



Figure 4-1-15.



Figure 4-1-16.

Client Position: Client is standing with upper extremity resting at side. Cervical spine is in neutral. Feet are shoulder width apart.

Starting—spine is in neutral (Figure 4-1-15 START).

Ending—client moves into maximum lateral flexion (Figure 4-1-16 END).

Therapist Position: Observe the pelvic region to prevent compensatory movements.

Goniometer Position:

FULCRUM: over the posterior aspect of the spinous process of S1

STABLE ARM: perpendicular to the floor

MOVABLE ARM: over the posterior aspect of the spinous process of C7

Alternate Test

A tape measure may be used to determine the distance from the tip of the middle finger and the floor as the client maintains maximum lateral flexion. The client's feet are flat on the ground and knees fully extended.

Trunk Lateral Flexion (Thoracolumbar Region): Isolated Muscle Testing

The neck and trunk are linked as series of interconnected joints and muscles working together to produce movement. This is an example of “coupled motion” that cannot functionally be isolated as a matter of muscle strength testing. It is recommended that an “Occupational Therapy Posture Assessment” is conducted to assess core strength as a necessary precursor for distal mobility in the appendicular skeleton (Figures 4-1-3 and 4-1-4). (See Appendix F.)

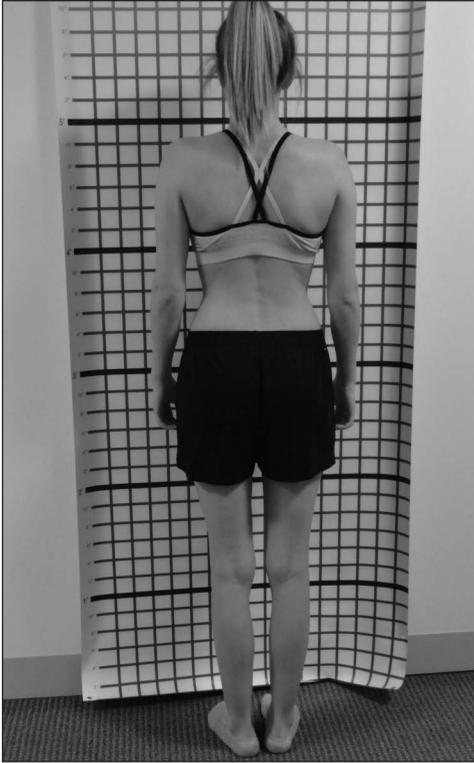


Figure 4-1-3.



Figure 4-1-4.

Trunk Rotation (Thoracolumbar Region): Goniometry

Plane: Transverse

Axis: Vertical

Normal ROM: 0-45 degrees

End feel: Firm



Figure 4-1-17.



Figure 4-1-18.

Client Position: Client is sitting or standing with upper extremity resting at side. Cervical spine is in neutral. Feet are shoulder width apart. Starting—Spine is in neutral (Figure 4-1-17). Ending—client moves into maximum rotation (Figure 4-1-18).

Therapist Position: Observe the pelvic region to prevent compensatory movements.

Goniometer Position:

FULCRUM: over the center of the cranial aspect of the head

STABLE ARM: parallel to an imaginary line between the prominences of the iliac crests

MOVABLE ARM: along an imaginary line between the acromial processes

Trunk Rotation (Thoracolumbar Region): Isolated Muscle Testing

The neck and trunk are linked as a series of interconnected joints and muscles working together to produce movement. This is an example of “coupled motion” that cannot functionally be isolated as a matter of muscle strength testing. It is recommended that an “Occupational Therapy Posture Assessment” is conducted to assess core strength as a necessary precursor for distal mobility in the appendicular skeleton (Figures 4-1-3 and 4-1-4). (See Appendix F.)



Figure 4-1-3.

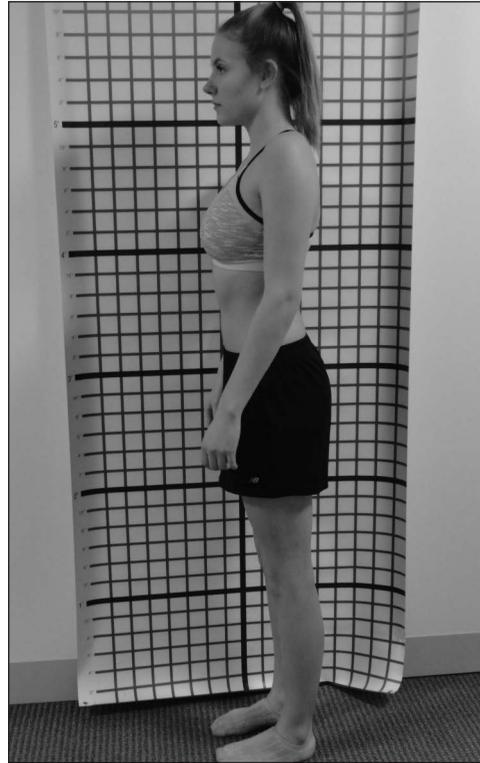


Figure 4-1-4.

Table 4-2

NECK AND TRUNK ASSESSMENT AT A GLANCE

FUNCTIONAL MUSCLE GROUP	PLANE	AXIS	NORMAL ROM	GONIOMETRY/ROM TESTING PROCEDURE	END FEEL	ISOLATED MUSCLE TESTING PROCEDURE (OF PRIMARY MOVERS)
<i>Neck Flexion (Cervical Region)</i>	Sagittal	Frontal	0 to 45 degrees	Fulcrum: Over external auditory meatus Stable arm: Perpendicular or parallel to the floor Movable arm: Along the base of the nares	Firm	Functional Posture Assessment as alternate to formal isolated muscle testing
<i>Neck Extension (Cervical Region)</i>	Sagittal	Frontal	0 to 45 degrees	Fulcrum: Over external auditory meatus Stable arm: Perpendicular or parallel to the floor Movable arm: Along the base of the nares	Firm	Functional Posture Assessment as alternate to formal isolated muscle testing
<i>Neck Lateral Flexion (Cervical Region)</i>	Frontal	Sagittal	0 to 45 degrees	Fulcrum: Over spinous process of C7 vertebrae Stable arm: Over spinous processes of the thoracic vertebrae with arm perpendicular to the floor Movable arm: Over dorsal midline of the head with the occipital protuberance as a guide	Firm	Functional Posture Assessment as alternate to formal isolated muscle testing
<i>Neck Rotation (Cervical Region)</i>	Transverse	Vertical	0 to 60 degrees	Fulcrum: Centered over the middle of the cranial aspect of the head Stable arm: Parallel to an imaginary line between the acromial processes Movable arm: In line with the tip of the nose	Firm	Functional Posture Assessment as alternate to formal isolated muscle testing
<i>Trunk Flexion (Thoracolumbar Region)</i>	Sagittal	Frontal	0 to 80 degrees (4 inches)	Measurement: A tape measure is placed between the spinous processes of C7 and S1. First the measurement is taken with the client in the upright position and a second one taken at maximal flexion. The difference between the two measurements is the amount of flexion present	Firm	Functional Posture Assessment as alternate to formal isolated muscle testing

(continued)

Table 4-2 (continued)

NECK AND TRUNK ASSESSMENT AT A GLANCE

<i>Trunk Extension (Thoracolumbar Region)</i>	Sagittal	Frontal	0 to 25 degrees	Measurement: A tape measure is placed between the spinous processes of C7 and S1. First the measurement is taken with the client in the upright position and a second one taken at maximal extension. The difference between the two measurements is the amount of extension present	Firm	Functional Posture Assessment as alternate to formal isolated muscle testing
<i>Trunk Lateral Flexion (Thoracolumbar Region)</i>	Frontal	Sagittal	0 to 35 degrees	Fulcrum: Over the posterior aspect of the spinous process of S1 Stable Arm: Perpendicular to the floor Movable Arm: Over the posterior aspect of the spinous process of C7	Firm	Functional Posture Assessment as alternate to formal isolated muscle testing
<i>Trunk Rotation (Thoracolumbar Region)</i>	Transverse	Vertical	0 to 45 degrees	Fulcrum: Over the center of the superior aspect of the head Stable Arm: Parallel to an imaginary line between the prominences of the iliac crests looking inferiorly Movable Arm: Along an imaginary line between the acromial processes looking inferiorly	Firm	Functional Posture Assessment as alternate to formal isolated muscle testing

SECTION 4-2: The Scapula and Shoulder

KEY BONY LANDMARKS	
<i>Bone</i>	<i>Landmark</i>
Clavicle	Sternal end
	Acromial end
	Conoid tubercle
Scapula	Spine
	Body
	Acromion
	Glenoid cavity
	Medial (vertebral) border
	Lateral (axillary) border
	Inferior angle
	Superior angle
	Superior border
	Scapular notch
	Coracoid process
	Supraspinous fossa
	Infraspinous fossa
Subscapular fossa	
Humerus	Head
	Anatomical neck/surgical neck
	Greater tubercle
	Lesser tubercle
	Body (shaft)
	Deltoid tuberosity

Scapular Upward Rotation: Assessment: Goniometry

Plane: Oblique Frontal or Scapular

Axis: Oblique Sagittal or Scapular

Normal ROM: Because the scapulothoracic joint is not an anatomically classified joint, but rather a functionally classified joint, its degree of motion are not formally measured. Rather, being intimately co-joined with both the glenohumeral and acromioclavicular joints, scapulothoracic motion is more commonly observed as component motion of the shoulder complex.

End feel: Not applicable

Isolated Muscle Testing

Prime Movers: Upper trapezius, Lower trapezius, Serratus anterior

Upper trapezius and Levator scapulae (tested together)

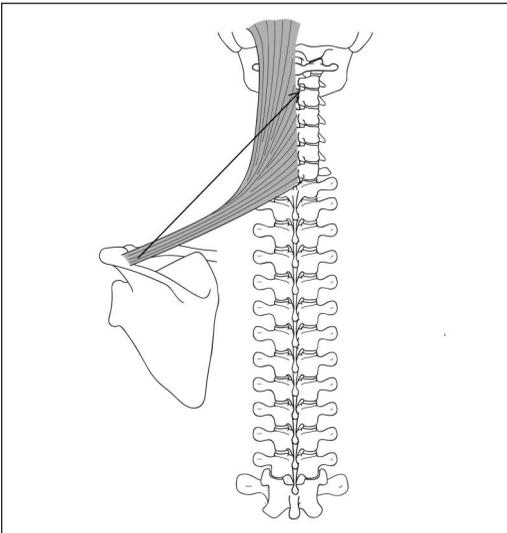


Figure 4-2-1A.

Upper trapezius

Origin: Occipital protuberance, medial 1/3 of nuchal line of occipital bone, ligamentum nuchae, and spinous process of C1–C7

Insertion: Lateral 1/3 of clavicle and acromion process

Innervation: Spinal accessory nerve

Action: Scapular elevation, scapular upward rotation

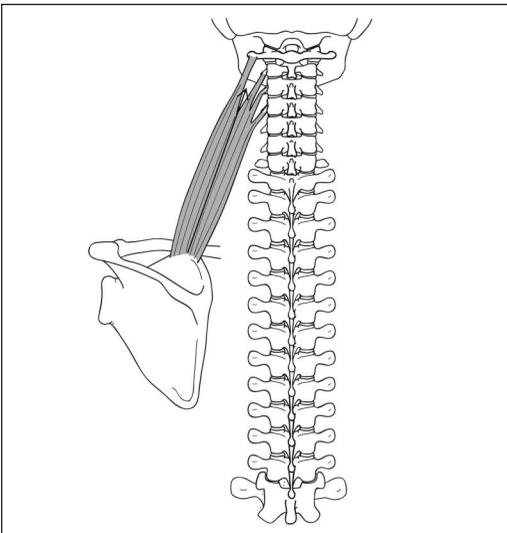


Figure 4-2-1B.

Levator scapulae

Origin: Transverse process of C1–C4

Insertion: Superior angle of the scapula

Innervation: Dorsal scapular nerve

Action: Scapular elevation



Figure 4-2-2.



Figure 4-2-3.



Figure 4-2-4.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity at the side. The head is tilted toward the testing side and rotated away from the testing side (Figure 4-2-2).

Motion—client moves the scapula being tested in the direction of scapular elevation (Figure 4-2-3).

Therapist Position: Stabilize at the lateral head. Resistance is applied at the shoulder/scapula in the direction of scapular depression when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

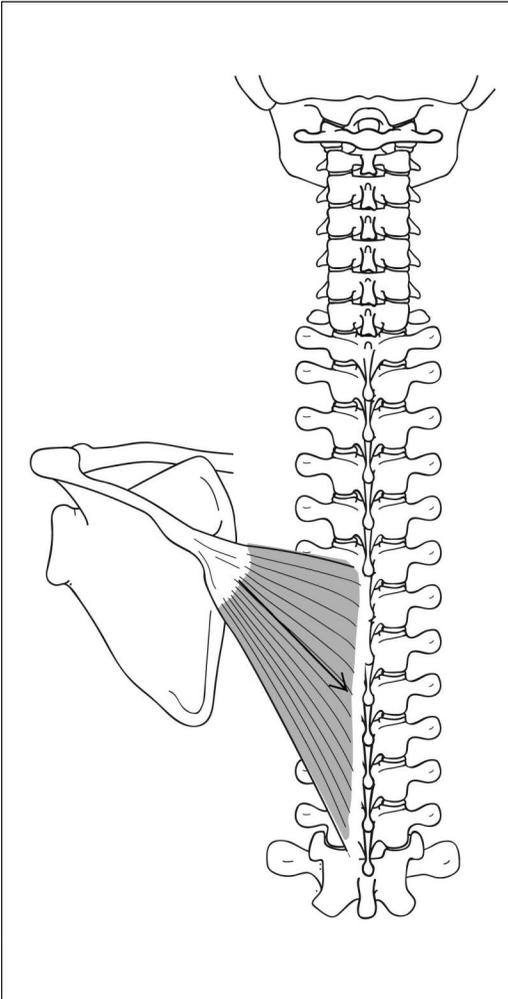
Client Position: Starting—client is supine or prone with the testing extremity at the side. The head is tilted toward the testing side and rotated away from the testing side (Figure 4-2-4).

Motion—client moves the scapula being tested in the direction of scapular elevation.

Therapist Position: Stabilize at the lateral head. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The upper trapezius can be palpated next to C7, and above the lateral 1/3 of the clavicle.

Lower trapezius



Origin: T6–T12

Insertion: Medial spine of the scapula and tubercle at the apex of the spine of the scapula

Innervation: Spinal accessory nerve

Action: Scapular depression, scapular upward rotation

Figure 4-2-5.



Figure 4-2-6.



Figure 4-2-7.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is prone with the testing extremity at approximately 140 degrees of shoulder/humeral adduction (Figure 4-2-6).

Motion—client raises the testing extremity toward the ceiling and depresses the scapula (Figure 4-2-7).

Therapist Position: Stabilize at the thorax. Resistance is applied at the distal humerus in a downward motion when testing Normal or Good strengths. No resistance is applied when testing Fair strength.



Figure 4-2-8.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

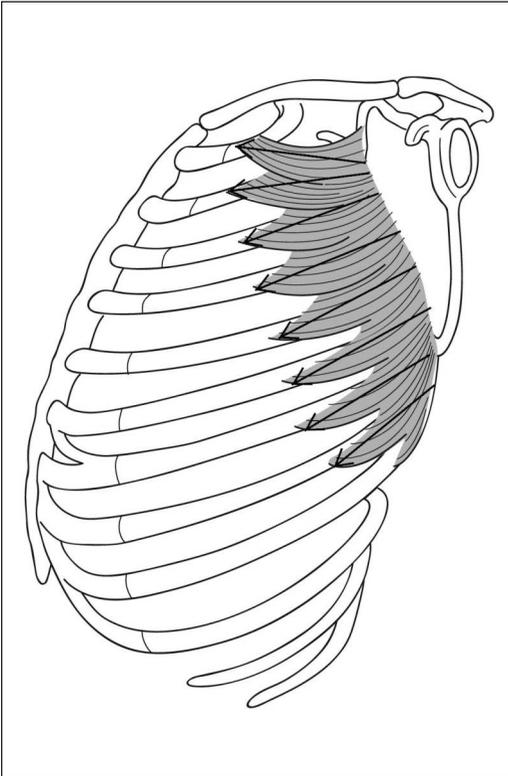
Client Position: Client is prone with the testing extremity at approximately 140 degrees of shoulder/humeral abduction (Figure 4-2-8).

Motion—client raises the testing extremity toward the ceiling and depresses the scapula.

Therapist Position: Stabilize at the thorax and stabilize the extremity against gravity without assisting the motion. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The lower trapezius is palpated along T6–T12 and at the medial spine of the scapula.

Serratus anterior



Origin: Ribs 1 through 9

Insertion: Anterior, medial border of the scapula

Innervation: Long thoracic nerve

Action: Scapular abduction

Figure 4-2-9.



Figure 4-2-10.



Figure 4-2-11.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is supine with testing extremity in 90 degrees of humeral/shoulder flexion and elbow extension (Figure 4-2-10).

Motion:client moves the testing extremity in the direction of scapular abduction (reaches toward the ceiling) (Figure 4-2-11).

Therapist Position: Stabilize at the trunk to avoid trunk rotation. Resistance is applied at the proximal humerus in the direction of scapular adduction when testing Normal or Good strengths. No resistance is applied when testing Fair strength.



Figure 4-2-12.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

Client Position: Starting—client is sitting with the testing extremity in 90 degrees of shoulder/humeral flexion and elbow extension, supported on a table or by the therapist (Figure 4-2-12).

Motion:client moves the testing extremity in the direction of scapular abduction.

Therapist Position: Stabilize at the trunk to avoid trunk rotation. Support the testing extremity to eliminate gravity; however, do not assist the motion. No resistance is applied in the gravity-eliminated position.

Palpation: The serratus anterior can be palpated at the anterior-lateral border of the scapula when the testing extremity is positioned as stated above.

Scapular Downward Rotation Assessment: Goniometry

Plane: Oblique Frontal or Scapular

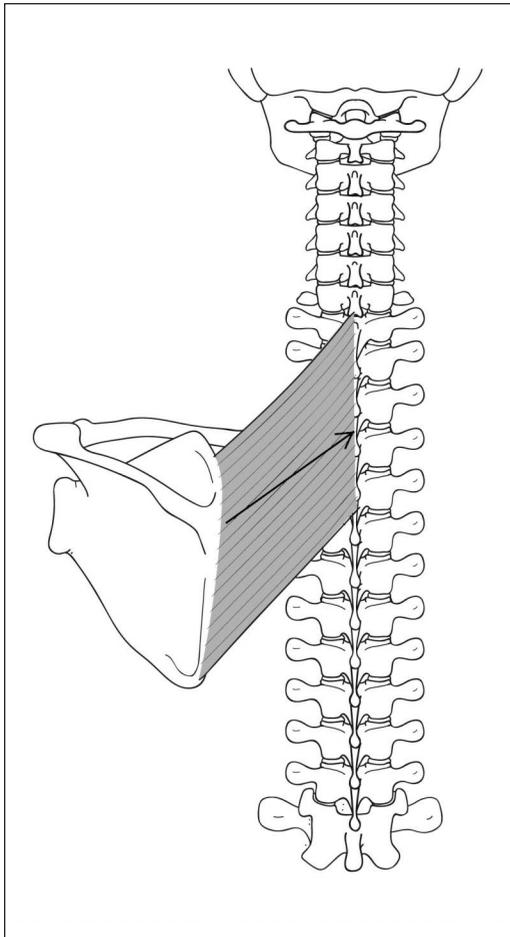
Axis: Oblique Sagittal or Scapular

Normal ROM: Because the scapulothoracic joint is not an anatomically classified joint, but rather a functionally classified joint, its degree of motion are not formally measured. Rather, being intimately co-joined with both the glenohumeral and acromioclavicular joints, scapulothoracic motion is more commonly observed as component motion in movement of the shoulder complex. End feel: Not applicable

Isolated Muscle Testing

Prime Movers: Rhomboideus major, Rhomboideus minor, Levator scapulae

Rhomboids (major and minor are tested together)



Origin: Spinous process C7–T5, Ligamentum nuchae

Insertion: Entire medial border of the scapula

Innervation: Dorsal scapular nerve

Action: Scapular adduction and scapular downward rotation

Figure 4-2-13.



Figure 4-2-14.



Figure 4-2-15.



Figure 4-2-16.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is prone with the testing extremity hand placed behind the back (internal rotation, adduction of humerus) (Figure 4-2-14).

Motion—client moves the testing extremity away from the back (toward the ceiling) (Figure 4-2-15).

Therapist Position: Stabilization is usually not required. Resistance is applied at the distal humerus in the direction of shoulder/humeral abduction and shoulder/humeral external rotation when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

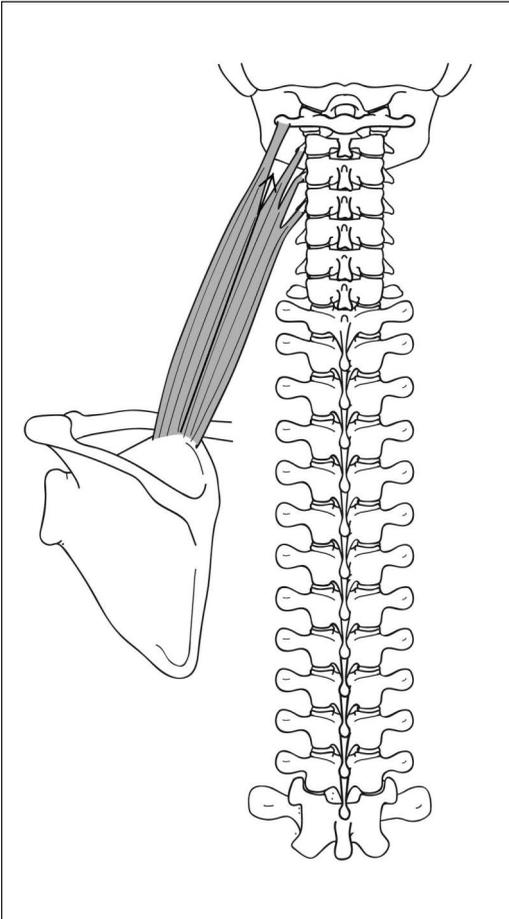
Client Position: Starting—client is sitting with the testing extremity hand placed behind the back (internal rotation, adduction of humerus; Figure 4-2-16).

Motion—client moves the testing extremity away from the back.

Therapist Position: Stabilization is usually not required. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The rhomboids can be palpated medial to the vertebral border of the scapula.

Levator scapulae (tested with Upper trapezius)



Origin: Transverse process of C1–C4
Insertion: Superior angle of the scapula
Innervation: Dorsal scapular nerve
Action: Scapular elevation

Figure 4-2-1B.



Figure 4-2-2.



Figure 4-2-3.

Against Gravity: Fair (3), Good (4), Normal (5)

Client Position: Starting—client is sitting with the testing extremity at the side. The head is tilted toward the testing side and rotated away from the testing side (Figure 4-2-2).

Motion:client moves the scapula being tested in the direction of scapular elevation (Figure 4-2-3).

Therapist Position: Stabilize at the lateral head. Resistance is applied at the shoulder/scapula in the direction of scapular depression when testing Normal or Good strengths. No resistance is applied when testing Fair strength.



Figure 4-2-4.

Gravity Eliminated: Zero (0), Trace (1), Poor (2)

Client Position: Starting—client is supine or prone with the testing extremity at the side. The head is tilted toward the testing side and rotated away from the testing side (Figure 4-2-4).

Motion:client moves the scapula being tested in the direction of scapular elevation.

Therapist Position: Stabilize at the lateral head. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The levator is too deep to palpate because it lies under the Upper trapezius.

Scapular Elevation Assessment: Goniometry

Plane: Oblique Frontal or Scapular

Axis: Oblique Sagittal or Scapular

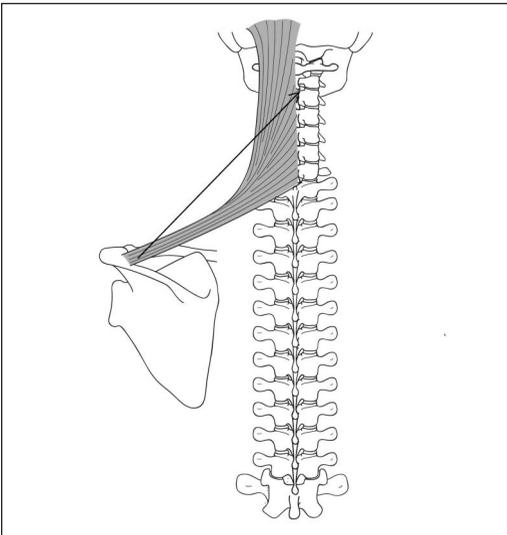
Normal ROM: Because the scapulothoracic joint is not an anatomically classified joint, but rather a functionally classified joint, its degree of motion are not formally measured. Rather, being intimately co-joined with both the glenohumeral and acromioclavicular joints, scapulothoracic motion is more commonly observed as component motion in movement of the shoulder complex.

End feel: Not applicable

Isolated Muscle Testing

Prime Movers: Levator scapulae, Upper trapezius, Rhomboideus minor, Rhomboideus major

Upper trapezius and Levator scapulae (tested together)



Upper trapezius

Origin: Occipital protuberance, medial 1/3 of nuchal line of occipital bone, ligamentum nuchae, and spinous process of C1–C7

Insertion: Lateral 1/3 of clavicle and acromion process

Innervation: Spinal accessory nerve

Action: Scapular elevation, scapular upward rotation

Figure 4-2-1A.

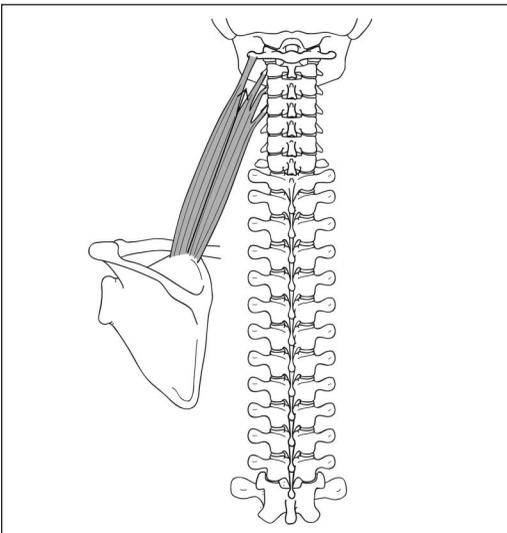


Figure 4-2-1B.

Levator scapulae

Origin: Transverse process of C1–C4

Insertion: Superior angle of the scapula

Innervation: Dorsal scapular nerve

Action: Scapular elevation



Figure 4-2-2.



Figure 4-2-3.



Figure 4-2-4.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity at the side. The head is tilted toward the testing side and rotated away from the testing side (Figure 4-2-2).

Motion—client moves the scapula being tested in the direction of scapular elevation (Figure 4-2-3).

Therapist Position: Stabilize at the lateral head. Resistance is applied at the shoulder/scapula in the direction of scapular depression when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

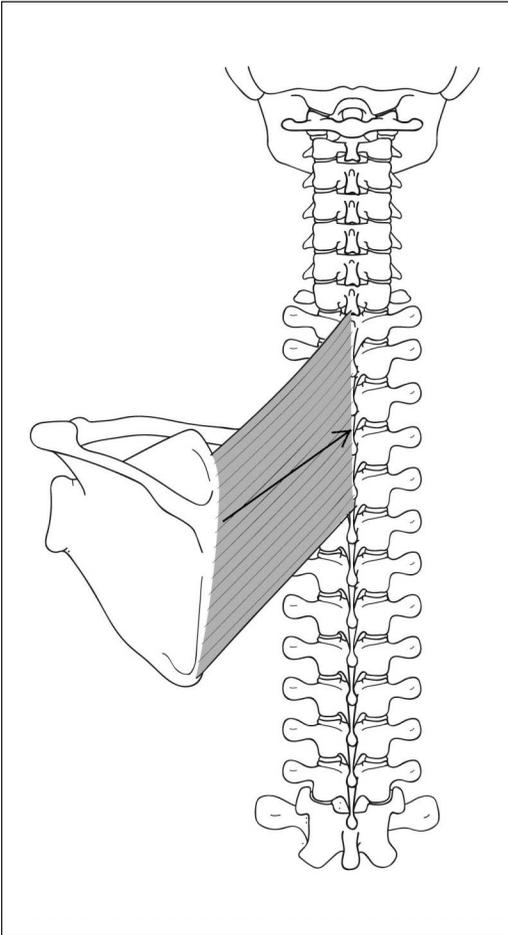
Client Position: Starting—client is supine or prone with the testing extremity at the side. The head is tilted toward the testing side and rotated away from the testing side (Figure 4-2-4).

Motion—client moves the scapula being tested in the direction of scapular elevation.

Therapist Position: Stabilize at the lateral head. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The Upper trapezius can be palpated next to C7, and above the lateral 1/3 of the clavicle.

Rhomboids (major and minor are tested together)



Origin: Spinous process C7–T5, ligamentum nuchae

Insertion: Entire medial border of the scapula

Innervation: Dorsal scapular nerve

Action: Scapular adduction and scapular downward rotation

Figure 4-2-13.



Figure 4-2-14.



Figure 4-2-15.



Figure 4-2-16.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is prone with the testing extremity hand placed behind the back (internal rotation, adduction of humerus) (Figure 4-2-14).

Motion—client moves the testing extremity away from the back (toward the ceiling) (Figure 4-2-15).

Therapist Position: Stabilization is usually not required. Resistance is applied at the distal humerus in the direction of shoulder/humeral abduction and shoulder/humeral external rotation when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

Client Position: Starting—client is sitting with the testing extremity hand placed behind the back (internal rotation, adduction of humerus; Figure 4-2-16).

Motion—client moves the testing extremity away from the back.

Therapist Position: Stabilization is usually not required. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The rhomboids can be palpated medial to the vertebral border of the scapula.

Scapular Depression Assessment: Goniometry

Plane: Oblique Frontal or Scapular

Axis: Oblique Sagittal or Scapular

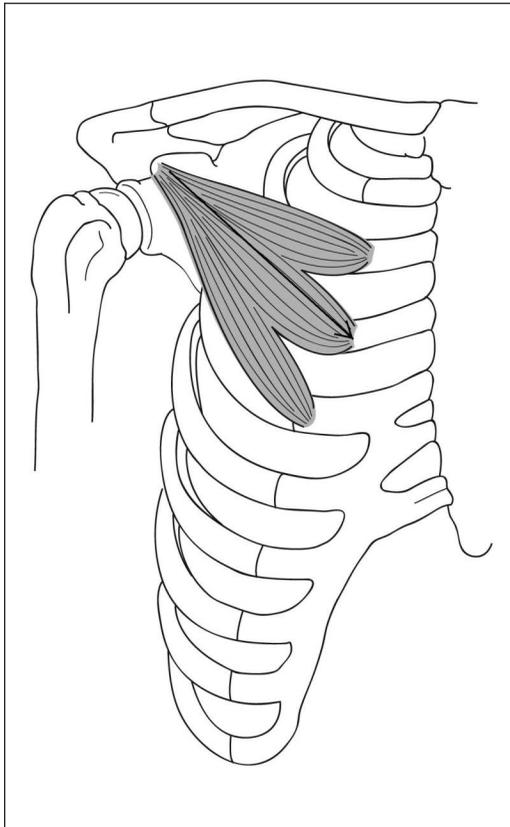
Normal ROM: Because the scapulothoracic joint is not an anatomically classified joint, but rather a functionally classified joint, its degree of motion are not formally measured. Rather, being intimately co-joined with both the glenohumeral and acromioclavicular joints, scapulothoracic motion is more commonly observed as component motion in movement of the shoulder complex.

End feel: Not applicable

Isolated Muscle Testing

Prime Movers: Pectoralis minor, Lower trapezius

Pectoralis minor



Origin: Ribs 3, 4, and 5

Insertion: Coracoid process of the scapula, superior surface

Innervation: Medial and lateral pectoral nerves

Action: Scapular abduction, scapular downward rotation

Figure 4-2-17.



Figure 4-2-18.



Figure 4-2-19.



Figure 4-2-20.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is supine with testing extremity at side and raised slightly off the table (Figure 4-2-18).

Motion—client moves the testing extremity in the direction of scapular abduction (brings shoulder toward the ceiling) (Figure 4-2-19).

Therapist Position: Stabilize at the trunk to avoid trunk rotation. Resistance is applied at the anterior aspect of the shoulder in the direction of scapular adduction when testing Normal and Good strengths. No resistance is applied when testing Fair strength.

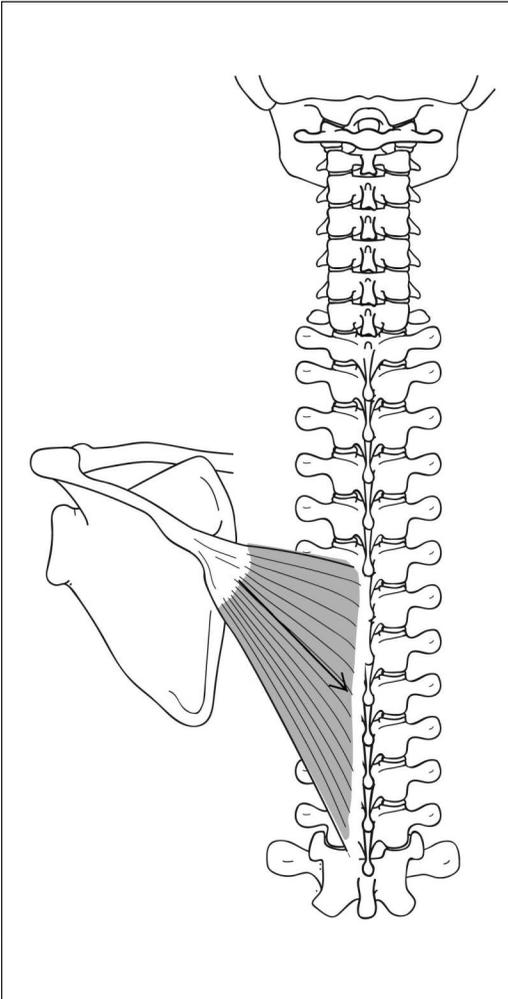
**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

Client Position: Starting—client is sitting with testing extremity at the side (Figure 4-2-20). **Motion—**client moves the testing extremity in the direction of scapular abduction.

Therapist Position: Stabilize at the trunk to avoid trunk rotation. No resistance is applied in the gravity-eliminated position.

Palpation: The pectoralis minor is too difficult to palpate because it lies under the pectoralis major.

Lower trapezius



Origin: T6–T12

Insertion: Medial spine of the scapula and tubercle at the apex of the spine of the scapula

Innervation: Spinal accessory nerve

Action: Scapular depression, scapular upward rotation

Figure 4-2-5.



Figure 4-2-6.



Figure 4-2-7.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is prone with the testing extremity at approximately 140 degrees of shoulder/humeral abduction (Figure 4-2-6).

Motion—client raises the testing extremity toward the ceiling and depresses the scapula (Figure 4-2-7).

Therapist Position: Stabilize at the thorax. Resistance is applied at the distal humerus in a downward motion when testing Normal or Good strengths. No resistance is applied when testing Fair strength.



Figure 4-2-8.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

Client Position: Client is prone with the testing extremity at approximately 140 degrees of shoulder/humeral abduction (Figure 4-2-8).

Motion—client raises the testing extremity toward the ceiling and depresses the scapula.

Therapist Position: Stabilize at the thorax and stabilize the extremity against gravity without assisting the motion. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The lower trapezius is palpated along T6–T12 and at the medial spine of the scapula.

Scapular Protraction/Abduction Assessment: Goniometry

Plane: Oblique Transverse or Scapular

Axis: Oblique Vertical or Scapular

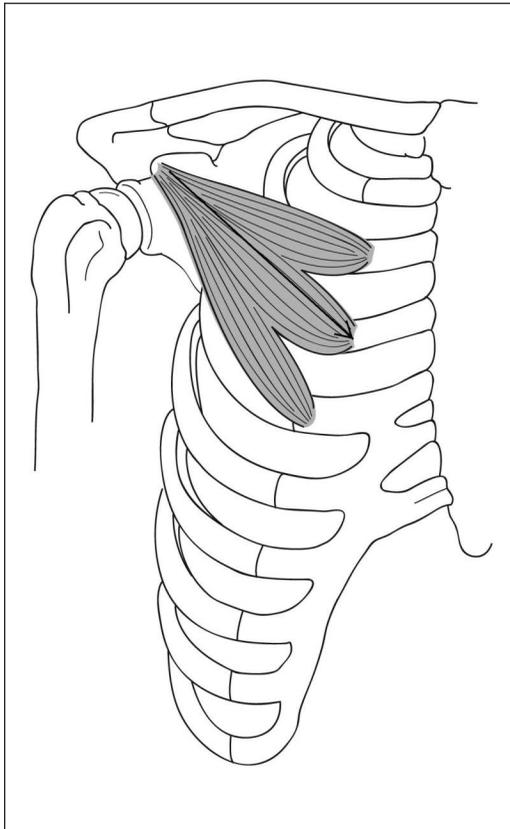
Normal ROM: Because the scapulothoracic joint is not an anatomically classified joint, but rather a functionally classified joint, its degree of motion are not formally measured. Rather, being intimately co-joined with both the glenohumeral and acromioclavicular joints, scapulothoracic motion is more commonly observed as component motion in movement of the shoulder complex.

End feel: Not applicable

Isolated Muscle Testing

Prime Movers: Pectoralis minor, Serratus anterior

Pectoralis minor



Origin: Ribs 3, 4, and 5

Insertion: Coracoid process of the scapula, superior surface

Innervation: Medial and lateral pectoral nerves

Action: Scapular abduction, scapular downward rotation

Figure 4-2-17.



Figure 4-2-18.



Figure 4-2-19.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is supine with testing extremity at side and raised slightly off the table (Figure 4-2-18).

Motion:client moves the testing extremity in the direction of scapular abduction (brings shoulder toward the ceiling) (Figure 4-2-19).

Therapist Position: Stabilize at the trunk to avoid trunk rotation. Resistance is applied at the anterior aspect of the shoulder in the direction of scapular adduction when testing Normal and Good strengths. No resistance is applied when testing Fair strength.



Figure 4-2-20.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

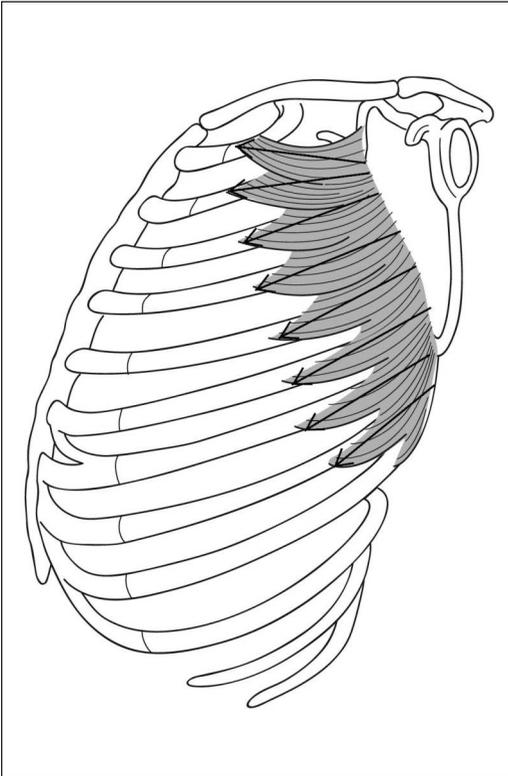
Client Position: Starting—client is sitting with testing extremity at the side (Figure 4-2-20).

Motion:client moves the testing extremity in the direction of scapular abduction.

Therapist Position: Stabilize at the trunk to avoid trunk rotation. No resistance is applied in the gravity-eliminated position.

Palpation: The pectoralis minor is too difficult to palpate because it lies under the pectoralis major.

Serratus anterior



Origin: Ribs 1 through 9

Insertion: Anterior, medial border of the scapula

Innervation: Long thoracic nerve

Action: Scapular abduction

Figure 4-2-9.



Figure 4-2-10.



Figure 4-2-11.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is supine with testing extremity in 90 degrees of shoulder/humeral flexion and elbow extension (Figure 4-2-10).

Motion:client moves the testing extremity in the direction of scapular abduction (reaches toward the ceiling; Figure 4-2-11).

Therapist Position: Stabilize at the trunk to avoid trunk rotation. Resistance is applied at the proximal humerus in the direction of scapular adduction when testing Normal or Good strengths. No resistance is applied when testing Fair strength.



Figure 4-2-12.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

Client Position: Starting—client is sitting with the testing extremity at 90 degrees of shoulder/humeral flexion and elbow extension, supported on a table or by the therapist (Figure 4-2-12).

Motion:client moves the testing extremity in the direction of scapular abduction.

Therapist Position: Stabilize at the trunk to avoid trunk rotation. Support the testing extremity to eliminate gravity; however, do not assist the motion. No resistance is applied in the gravity-eliminated position.

Palpation: The serratus anterior can be palpated at the anterior-lateral border of the scapula when the testing extremity is positioned as stated above.

Scapular Retraction/Adduction Assessment: Goniometry

Plane: Oblique Transverse or Scapular

Axis: Oblique Vertical or Scapular

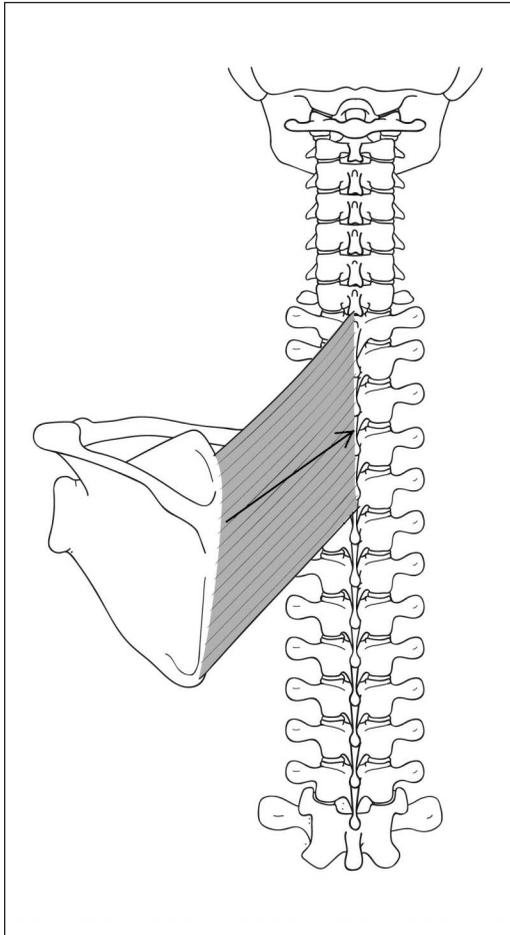
Normal ROM: Because the scapulothoracic joint is not an anatomically classified joint, but rather a functionally classified joint, its degree of motion are not formally measured. Rather, being intimately co-joined with both the glenohumeral and acromioclavicular joints, scapulothoracic motion is more commonly observed as component motion in movement of the shoulder complex.

End feel: Not applicable

Isolated Muscle Testing

Prime Movers: Rhomboideus major, Rhomboideus minor, Middle trapezius

Rhomboids (major and minor are tested together)



Origin: Spinous process C7–T5, ligamentum nuchae

Insertion: Entire medial border of the scapula

Innervation: Dorsal scapular nerve

Action: Scapular adduction and scapular downward rotation

Figure 4-2-13.



Figure 4-2-14.



Figure 4-2-15.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is prone with the testing extremity hand placed behind the back (internal rotation, adduction of humerus; Figure 4-2-14).

Motion:client moves the testing extremity away from the back (toward the ceiling) (Figure 4-2-15).

Therapist Position: Stabilization is usually not required. Resistance is applied at the distal humerus in the direction of shoulder/humeral abduction and shoulder/humeral external rotation when testing Normal or Good strengths. No resistance is applied when testing Fair strength.



Figure 4-2-16.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

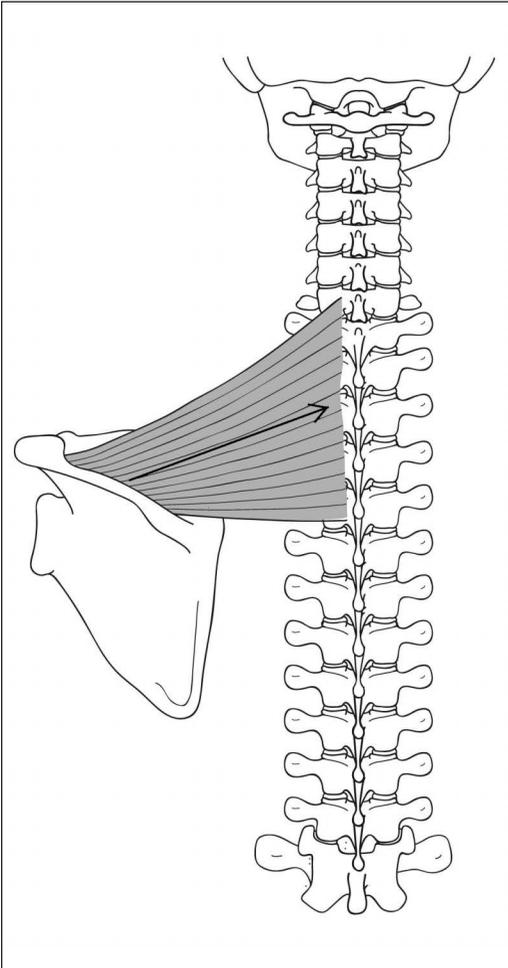
Client Position: Starting—client is sitting with the testing extremity hand placed behind the back (internal rotation, adduction of humerus; Figure 4-2-16).

Motion:client moves the testing extremity away from the back.

Therapist Position: Stabilization is usually not required. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The rhomboids can be palpated medial to the vertebral border of the scapula.

Middle trapezius



Origin: Inferior aspect of the ligamentum nuchae and C7–T5

Insertion: Medial margin of the acromion process, superior spine of the scapula

Innervation: Spinal accessory nerve

Action: Scapular adduction

Figure 4-2-21.



Figure 4-2-22.



Figure 4-2-23.



Figure 4-2-24.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is prone with the testing extremity at 90 degrees of shoulder/humeral abduction and 90 degrees of elbow flexion (fingers point toward floor) (Figure 4-2-22).

Motion—client moves the scapula being tested in the direction of scapular adduction. Humerus will follow in the direction of horizontal abduction; however, testing should isolate this motion from scapular adduction (Figure 4-2-23).

Therapist Position: Stabilize at the thorax to avoid compensation. Resistance is applied along the medial border of the scapula in the direction of scapular adduction when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

Client Position: Starting—client is sitting with the testing extremity in 90 degrees of shoulder/humeral abduction and 90 degrees of elbow flexion, supported on a table or by the therapist (Figure 4-2-24).

Motion—client moves the scapula being tested in the direction of scapular adduction.

Therapist Position: Stabilize at the thorax to avoid compensation. Support the testing extremity to eliminate gravity; however, do not assist the motion. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The middle trapezius is palpated above the spine of the scapula.

Shoulder/Humeral Flexion Assessment: Goniometry

Plane: Sagittal

Axis: Frontal

Normal ROM: 0-180 degrees

End feel: Firm



Figure 4-2-25.

Client Position: Client is supine with knees flexed or sitting.

Starting—testing extremity is at client's side, elbow extended and forearm in neutral (Figure 4-2-25).

Ending—client moves the testing extremity into maximum shoulder/humeral flexion (Figure 4-2-26).



Figure 4-2-26.

Therapist Position: Observe the scapula to prevent compensatory elevation, posterior tilt, and upward rotation.

Goniometer Position:

FULCRUM: lateral surface of the acromion process

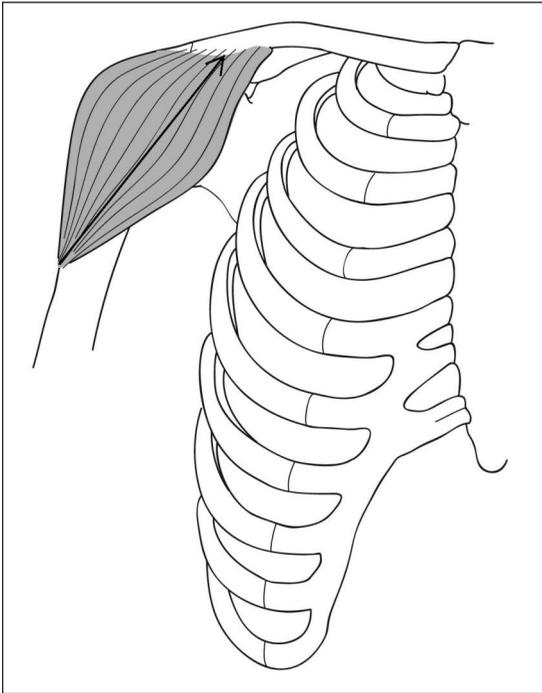
STABLE ARM: mid axilla/thorax

MOVABLE ARM: lateral midline of the humerus

Isolated Muscle Testing

Prime Movers: Anterior deltoid, Pectoralis major (clavicular head), Coracobrachialis

Anterior deltoid



Origin: Lateral 1/3 of clavicle

Insertion: Deltoid tuberosity of the humerus

Innervation: Axillary nerve

Action: Shoulder/humeral flexion, shoulder/humeral horizontal adduction, and shoulder/humeral internal rotation

Figure 4-2-27.



Figure 4-2-28.



Figure 4-2-29.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting or standing with the testing extremity at the side with slight elbow flexion and forearm pronation (Figure 4-2-28).

Motion—client moves the testing extremity in the direction of shoulder/humeral flexion (Figure 4-2-29).

Therapist Position: Stabilize at the shoulder to avoid compensation of shoulder/humeral rotation or horizontal movement. Resistance is applied at the proximal humerus in the direction of shoulder/humeral extension when testing Normal or Good strengths. No resistance is applied when testing Fair strength.



Figure 4-2-30.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

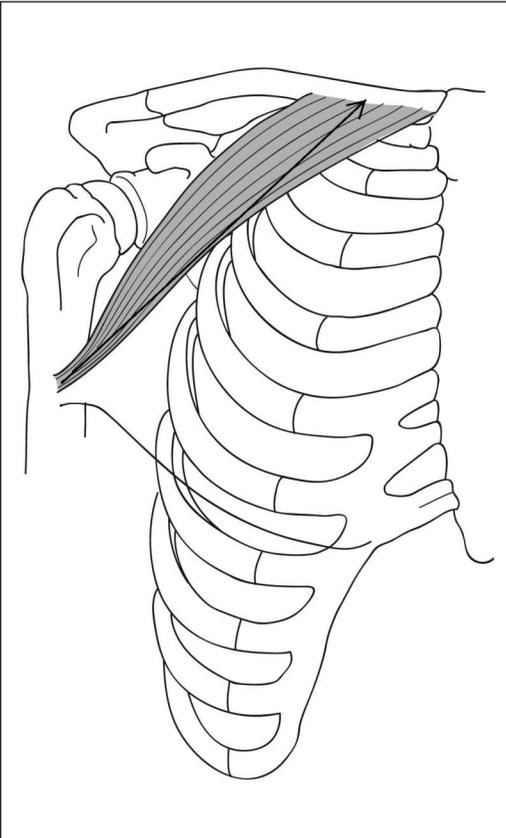
Client Position: Starting—client is seated with the testing extremity in slight elbow flexion, and forearm pronation, supported by the therapist (Figure 4-2-30).

Motion—client moves the testing extremity in the direction of shoulder/humeral flexion.

Therapist Position: Stabilize at the shoulder to avoid compensation of shoulder/humeral rotation or horizontal movement. Support the testing extremity to eliminate gravity; however, do not assist the motion. No resistance is applied when testing in the gravity-eliminated position.

Palpation: Anterior deltoid is palpated by locating the acromion process and bringing the therapist's fingers 2 to 3 inches anteriorly along the client's shoulder.

Pectoralis major (clavicular head)



Origin: Medial 2/3 of the clavicle

Insertion: Crest of greater tubercle of humerus

Innervation: Medial pectoral nerve

Action: Shoulder/humeral flexion, shoulder/humeral horizontal adduction, shoulder/humeral adduction

Figure 4-2-31.



Figure 4-2-32.



Figure 4-2-33.



Figure 4-2-34.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is supine with the testing extremity positioned in 90 degrees of shoulder/humeral flexion, slight shoulder/humeral internal rotation, and complete elbow extension (Figure 4-2-32).

Motion—client moves the testing extremity in the direction of the horizontal adduction (Figure 4-2-33).

Therapist Position: Stabilize at the contralateral shoulder to avoid compensation. Resistance is applied at the proximal humerus in the direction of horizontal abduction when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

Client Position: Starting—client is sitting with the testing extremity positioned in 90 degrees of shoulder/humeral flexion, slight shoulder/humeral internal rotation, and complete elbow extension, supported by the therapist (Figure 4-2-34).

Motion—client moves the testing extremity in the direction of shoulder/humeral horizontal adduction.

Therapist Position: Stabilize at the contralateral shoulder to avoid compensation. Support the testing extremity to eliminate gravity; however, do not assist the motion. No resistance is applied when testing in the gravity-eliminated position.

Palpation: Pectoralis major (clavicular) can be palpated below the middle of the clavicle.

Coracobrachialis



Origin: Coracoid process of scapula

Insertion: Opposite deltoid tuberosity on the medial aspect of the mid-humerus

Innervation: Musculocutaneous nerve

Action: Shoulder/humeral flexion

Figure 4-2-35.

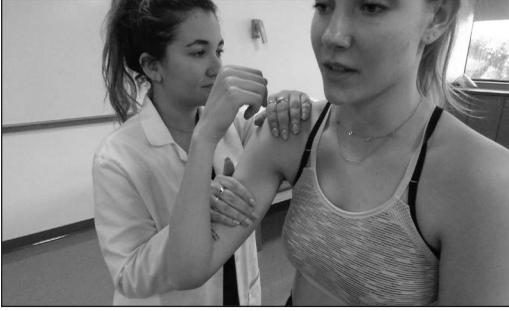


Figure 4-2-36.



Figure 4-2-38A.



Figure 4-2-37.



Figure 4-2-38B.

Against Gravity:
Fair (3), Good (4), Normal (5)

Client Position: Starting—client is sitting or standing with the testing extremity at the side with slight shoulder/humeral external rotation, full elbow flexion, and forearm supination (Figure 4-2-36).

Motion—client moves the testing extremity in the direction of shoulder/humeral flexion while keeping the elbow flexed (Figure 4-2-37).

Therapist Position: Stabilize at the shoulder to avoid compensation. Resistance is applied at the proximal humerus in the direction of shoulder/humeral extension and slight shoulder/humeral internal rotation when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

Gravity Eliminated:
Zero (0), Trace (1), Poor (2)

Client Position: Starting—client is lying on nontest side with the testing extremity at the side with slight shoulder/humeral external rotation, full elbow flexion, and forearm supination (Figures 4-2-38A and 4-2-38B).

Motion—client moves the testing extremity in the direction of shoulder/humeral flexion while keeping the elbow flexed.

Therapist Position: Stabilize at the shoulder to avoid compensation. No resistance is applied when testing in the gravity-eliminated position.

Palpation: Muscle is too deep to be palpated.

Shoulder/Humeral Extension Assessment: Goniometry

Plane: Sagittal

Axis: Frontal

Normal ROM: 0-60 degrees

End feel: Firm

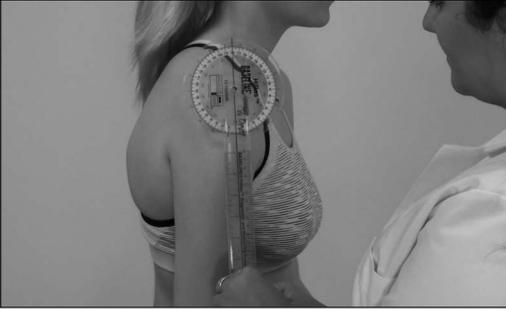


Figure 4-2-39.

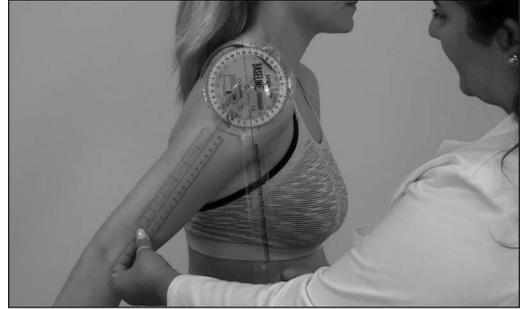


Figure 4-2-40.

Client Position: Client is prone and head is turned away from testing side or sitting.

Starting—testing extremity is at client's side, elbow in slight flexion and forearm in neutral (Figure 4-2-39).

Ending—client moves the testing extremity into maximum shoulder/humeral extension (Figure 4-2-40).

Therapist Position: Observe the scapula to prevent compensatory elevation and anterior tilt.

Goniometer Position:

FULCRUM: lateral surface of the acromion process

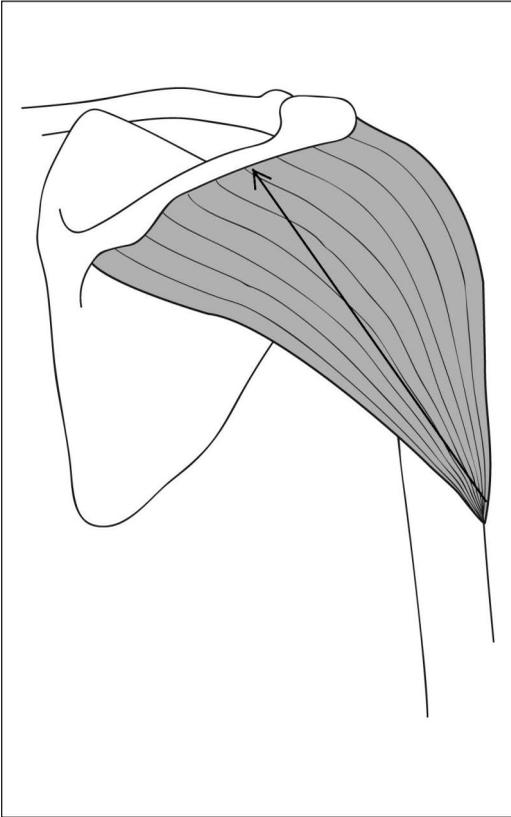
STABLE ARM: midline of axilla/thorax

MOVABLE ARM: lateral midline of the humerus

Isolated Muscle Testing

Prime Movers: Posterior deltoid, Teres major, Latissimus dorsi

Posterior deltoid



Origin: Inferior lip, spine of scapula
Insertion: Deltoid tuberosity of the humerus
Innervation: Axillary nerve
Action: Shoulder/humeral extension, shoulder/humeral horizontal abduction, and shoulder/humeral external rotation

Figure 4-2-41.



Figure 4-2-42.



Figure 4-2-43.



Figure 4-2-44.

Against Gravity: Fair (3), Good (4), Normal (5)

Client Position: Starting—client is prone with the testing extremity in abduction and slight external rotation. Elbow is flexed at 90 degrees (over the edge of the table; Figure 4-2-42). Motion—client moves the testing extremity in the direction of shoulder/humeral horizontal abduction (Figure 4-2-43).

Therapist Position: Stabilize at the scapula to avoid scapular retraction/adduction. Observe elbow for compensation of the triceps (elbow extension). Resistance is applied at the posterior-lateral aspect of the distal humerus in the direction of horizontal adduction when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

Gravity Eliminated: Zero (0), Trace (1), Poor (2)

Client Position: Starting—client is sitting with the testing extremity in 90 degrees of shoulder/humeral flexion and 90 degrees of elbow flexion, supported on a table or by the therapist (Figure 4-2-44).

Motion—client moves the testing extremity in the direction of horizontal abduction.

Therapist Position: Stabilize at the scapula to avoid scapular retraction/adduction. Observe elbow for compensation of the triceps (elbow extension). Support the testing extremity to eliminate gravity; however, do not assist the motion. No resistance is applied in the gravity-eliminated position.

Palpation: The posterior deltoid can be palpated on the dorsal/proximal 1/3 of the humerus.

Latissimus dorsi and *Teres major* (tested together)

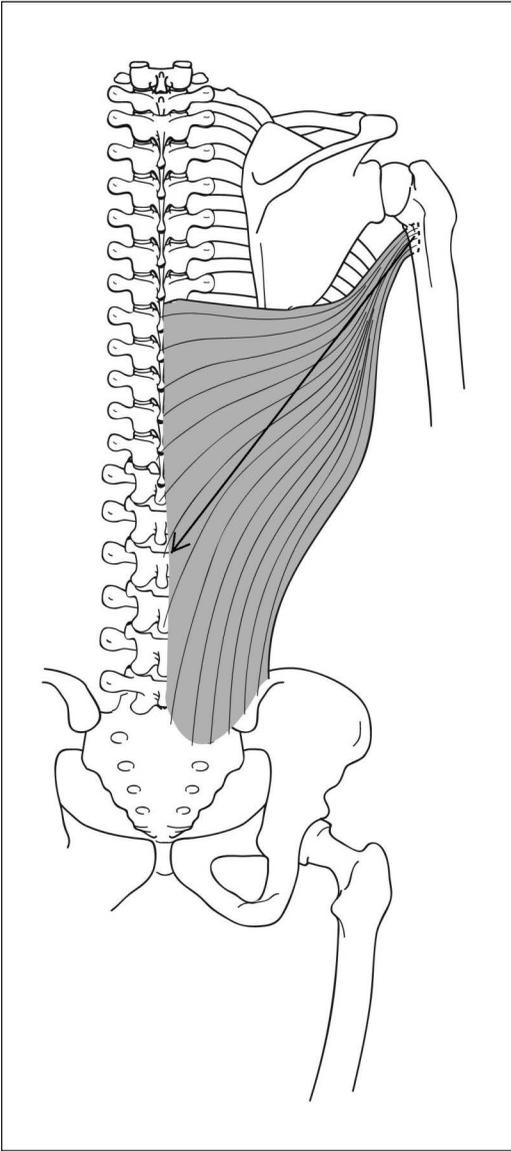


Figure 4-2-45A.

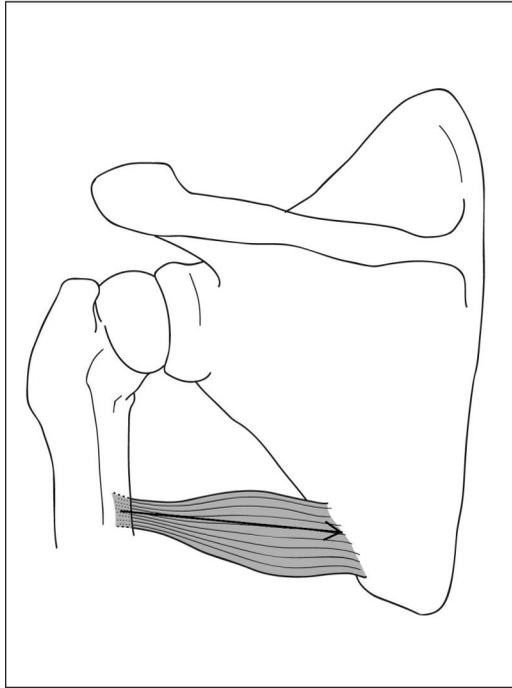


Figure 4-2-45B.

Latissimus dorsi

Origin: Spinous process of last 6 thoracic vertebrae, all lumbar and all sacral vertebrae, posterior iliac crest, posterior last 3 ribs, inferior angle of the scapula

Insertion: Bottom of intertubercular groove of humerus

Innervation: Thoracodorsal nerves

Action: shoulder/humeral extension, shoulder/humeral adduction, and shoulder/humeral internal rotation

Teres major

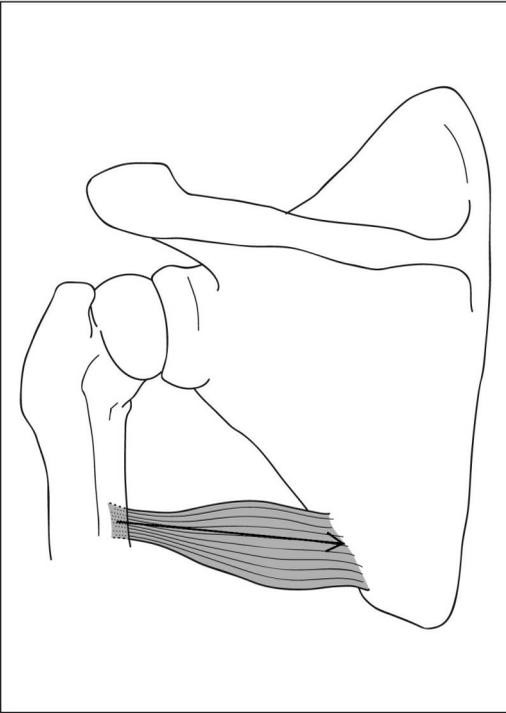


Figure 4-2-46.

Origin: Dorsal surface of the inferior angle of the scapula

Insertion: Below the lesser tuberosity of the humerus, posterior to the latissimus dorsi insertion

Innervation: Inferior subscapular nerve

Action: Shoulder/humeral extension, shoulder/humeral internal rotation, and shoulder/humeral adduction



Figure 4-2-47.



Figure 4-2-48.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is prone with the testing extremity at side in shoulder/humeral internal rotation (Figure 4-2-47).

Motion—client moves the testing extremity in the direction of shoulder/humeral extension and shoulder/humeral adduction while also depressing the scapula. (Reach toward feet while maintaining extension; Figure 4-2-48.)

Therapist Position: Stabilize at the lateral pelvis to avoid the compensation of trunk rotation. Resistance is applied on the distal humerus in the direction of shoulder/humeral flexion and shoulder/humeral abduction when testing Normal or Good strengths. No resistance is applied when testing Fair strength.



Figure 4-2-49.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

Client Position: Starting—client is prone with the testing extremity in shoulder/humeral extension, shoulder/humeral internal rotation, and shoulder/humeral adduction (Figure 4-2-49).

Motion—client moves the testing extremity in the direction of shoulder/humeral extension and shoulder/humeral adduction while also depressing the scapula. (Reach toward feet while maintaining extension.) A grade of poor is given when the client moves through partial range only.

Therapist Position: Stabilize at the lateral trunk to avoid the compensation of rotation. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The latissimus dorsi is palpated on the lower border of the scapula below the teres major fibers. The teres major is palpated along the lower border of the scapula.

Shoulder/Humeral Abduction Assessment: Goniometry

Plane: Frontal

Axis: Sagittal

Normal ROM: 0-180 degrees

End feel: Firm



Figure 4-2-50.



Figure 4-2-51.

Client Position: Client is sitting or standing.

Starting—testing extremity is at client's side, humerus is in full external rotation, elbow extension, and forearm in supination.

This position is important in order to prevent impingement of the greater tuberosity of the humerus at the acromion process (Figure 4-2-50).

Ending—client moves the testing extremity into maximum shoulder/humeral abduction (Figure 4-2-51).

Therapist Position: Observe the scapula to prevent excessive compensatory upward rotation and elevation.

Goniometer Position:

FULCRUM: at anterior or posterior surface of the acromion process depending on the client's starting position

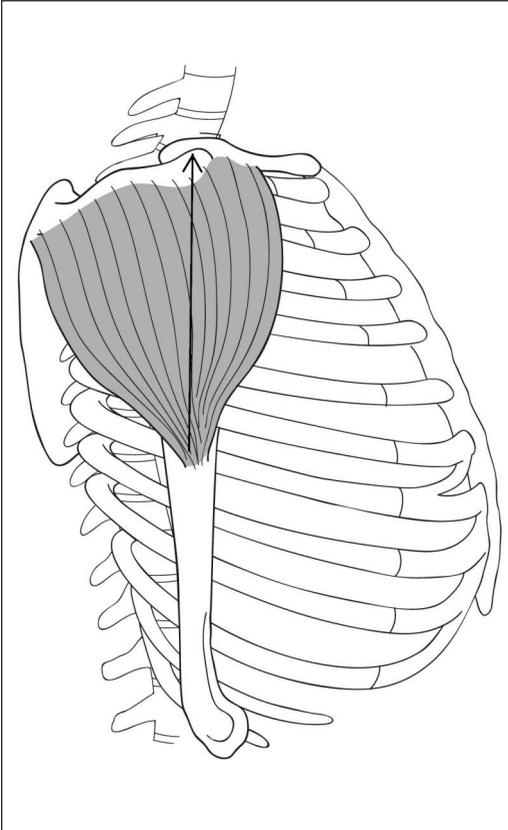
STABLE ARM: parallel to the sternum (anterior) or spine (posterior)

MOVABLE ARM: medial aspect of the humerus

Isolated Muscle Testing

Prime Movers: Middle deltoid, Supraspinatus

Middle deltoid



Origin: Acromion process

Insertion: Deltoid tuberosity of the humerus

Innervation: Axillary nerve

Action: Shoulder/humeral abduction

Figure 4-2-52.



Figure 4-2-53.



Figure 4-2-54.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting or standing with the testing extremity between zero and 45 degrees of shoulder/humeral abduction and the elbow is flexed to 90 degrees (Figure 4-2-53).

Motion:client moves the testing extremity in the direction of shoulder/humeral abduction (Figure 4-2-54).

Therapist Position: Stabilize at the shoulder to avoid compensation of scapular elevation. Resistance is applied at the distal humerus in the direction of adduction when testing Normal or Good strengths. No resistance is applied when testing Fair strength.



Figure 4-2-55.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

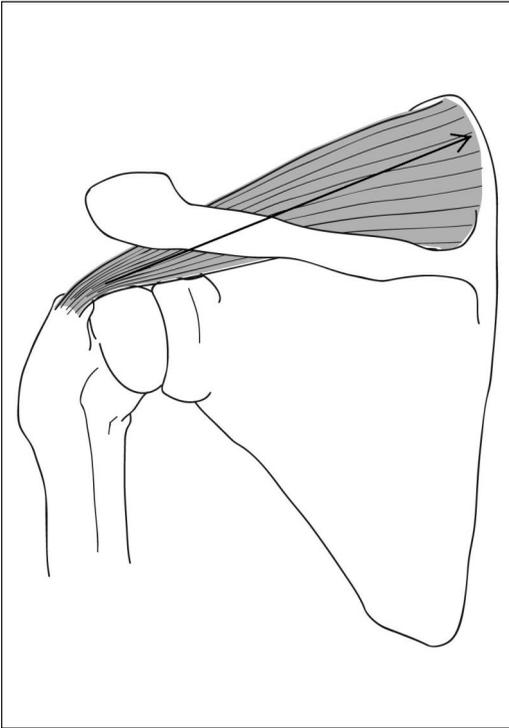
Client Position: Starting—client is supine with the testing extremity in shoulder/humeral adduction (Figure 4-2-55).

Motion:client moves the testing extremity in the direction of shoulder/humeral abduction.

Therapist Position: Stabilize at the shoulder to avoid compensation of scapular elevation. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The middle deltoid can be palpated below the acromion process on the lateral/proximal 1/3 of the humerus.

Supraspinatus



- Origin:** Medial 2/3 of the supraspinous fossa
Insertion: Greater tubercle of the humerus and shoulder joint capsule
Innervation: Suprascapular nerve
Action: Shoulder/humeral abduction; one of the muscles of the rotator cuff

Figure 4-2-56.



Figure 4-2-57.



Figure 4-2-58.



Figure 4-2-59.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting or standing with the testing extremity at the side of shoulder/humeral abduction and the head rotated to the contralateral side (Figure 4-2-57).

Motion:client moves the testing extremity in the direction of shoulder/humeral abduction (Figure 4-2-58).

Therapist Position: Stabilize at the shoulder to avoid compensation. Resistance is applied at the humerus in the direction of shoulder/humeral adduction when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

Client Position: Client is prone or supine with the testing extremity in shoulder/humeral adduction and the head rotated to the contralateral side (Figure 4-2-59).

Motion:client moves the testing extremity in the direction of shoulder/humeral abduction.

Therapist Position: Stabilize at the shoulder to avoid compensation. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The supraspinatus is too deep to palpate.

Shoulder/Humeral Adduction Assessment: Goniometry

Plane: Frontal

Axis: Sagittal

Normal ROM: 180-0 degrees

End feel: Soft



Figure 4-2-60.

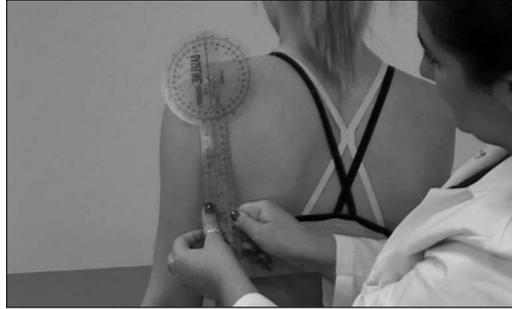


Figure 4-2-61.

Client Position: Client is sitting or standing.

Starting—testing extremity is in maximal shoulder/humeral abduction and external rotation, elbow extension and forearm in supination (Figure 4-2-60).

Ending—client moves the testing extremity into maximum shoulder/humeral adduction (Figure 4-2-61).

Therapist Position: Observe the scapula to prevent excessive compensatory downward rotation and depression.

Goniometer Position:

FULCRUM: at the anterior or posterior surface of the acromion process depending on the client's starting position

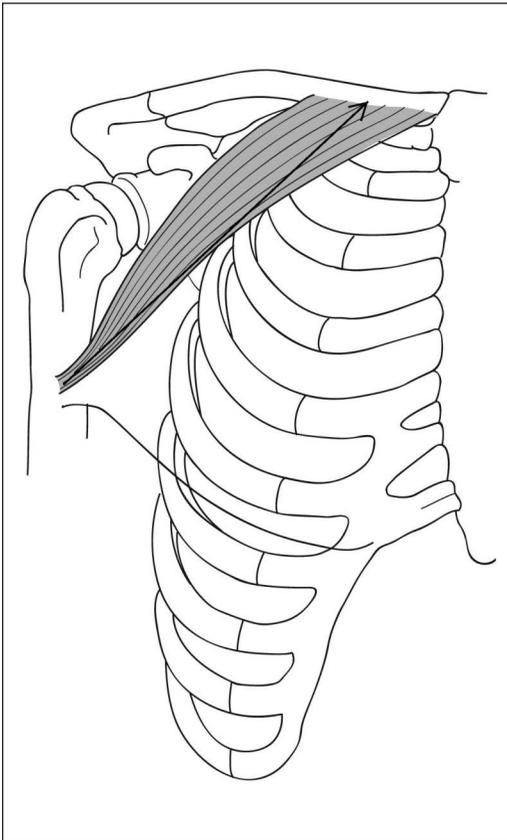
STABLE ARM: parallel to the sternum (anterior) or spine (posterior)

MOVABLE ARM: medial aspect of the humerus

Isolated Muscle Testing

Prime Movers: Pectoralis major (clavicular and sternal heads), Latissimus dorsi, Teres major

Pectoralis major (clavicular head)



Origin: Medial 2/3 of the clavicle

Insertion: Crest of greater tubercle of humerus

Innervation: Medial pectoral nerve

Action: Shoulder/humeral flexion, shoulder/humeral horizontal adduction, shoulder/humeral adduction

Figure 4-2-31.



Figure 4-2-32.



Figure 4-2-33.



Figure 4-2-34.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is supine with the testing extremity positioned in 90 degrees of shoulder/humeral flexion, slight shoulder/humeral internal rotation, and complete elbow extension (Figure 4-2-32).

Motion—client moves the testing extremity in the direction of the horizontal adduction (Figure 4-2-33).

Therapist Position: Stabilize at the contralateral shoulder to avoid compensation. Resistance is applied at the proximal humerus in the direction of horizontal abduction when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

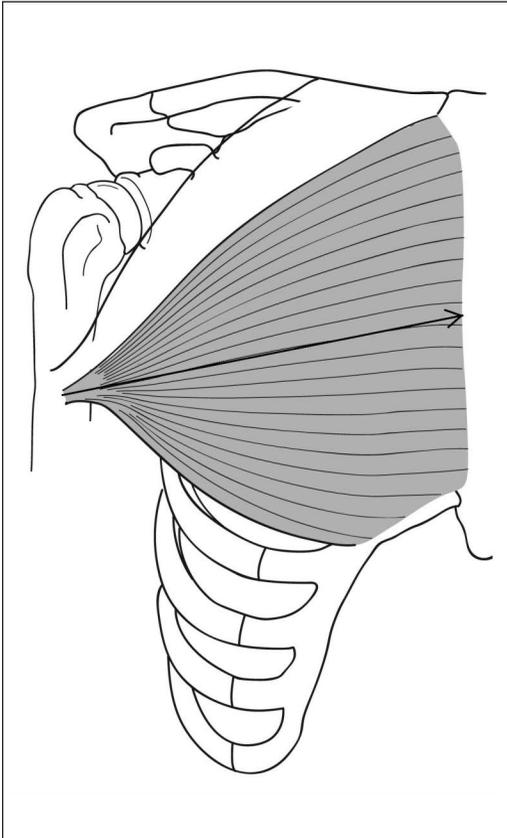
Client Position: Starting—client is sitting with the testing extremity positioned in 90 degrees of shoulder/humeral flexion, slight shoulder/humeral internal rotation, and complete elbow extension, supported by the therapist (Figure 4-2-34).

Motion—client moves the testing extremity in the direction of shoulder/humeral horizontal adduction.

Therapist Position: Stabilize at the contralateral shoulder to avoid compensation. Support the testing extremity to eliminate gravity; however, do not assist the motion. No resistance is applied when testing in the gravity-eliminated position.

Palpation: Pectoralis major (clavicular) can be palpated below the middle of the clavicle.

Pectoralis major (sternal head)



Origin: Sternum, costal cartilage ribs 1–6

Insertion: Crest of greater tubercle of the humerus

Innervation: Lateral pectoral nerve

Action: Shoulder/humeral horizontal adduction, shoulder/humeral extension

Figure 4-2-62.



Figure 4-2-63.



Figure 4-2-64.



Figure 4-2-65.

Against Gravity: Fair (3), Good (4), Normal (5)

Client Position: Starting—client is supine with the testing extremity in 90 degrees of shoulder/humeral flexion, slight shoulder/humeral internal rotation, and complete elbow extension (Figure 4-2-63).

Motion:client moves the testing extremity in the direction of shoulder/humeral horizontal adduction, but in a diagonal pattern toward the opposite iliac crest (Figure 4-2-64).

Therapist Position: Stabilize at the opposite iliac crest to avoid trunk rotation. Resistance is applied at the proximal humerus in a diagonal pattern of shoulder/humeral horizontal abduction when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

Gravity Eliminated: Zero (0), Trace (1), Poor (2)

Client Position: Starting—client is sitting with the testing extremity in 90 degrees shoulder/humeral flexion, slight shoulder/humeral internal rotation, and complete elbow flexion, supported by the therapist (Figure 4-2-65).

Motion:client moves the testing extremity in the direction of shoulder/humeral horizontal adduction, but in a diagonal pattern toward the opposite iliac crest.

Therapist Position: Stabilize at the opposite iliac crest to avoid compensation of trunk rotation. Support the testing extremity to eliminate gravity; however, do not assist the motion. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The pectoralis major (sternal end) is palpated on the anterior aspect of the axilla.

Latissimus dorsi and Teres major (tested together)

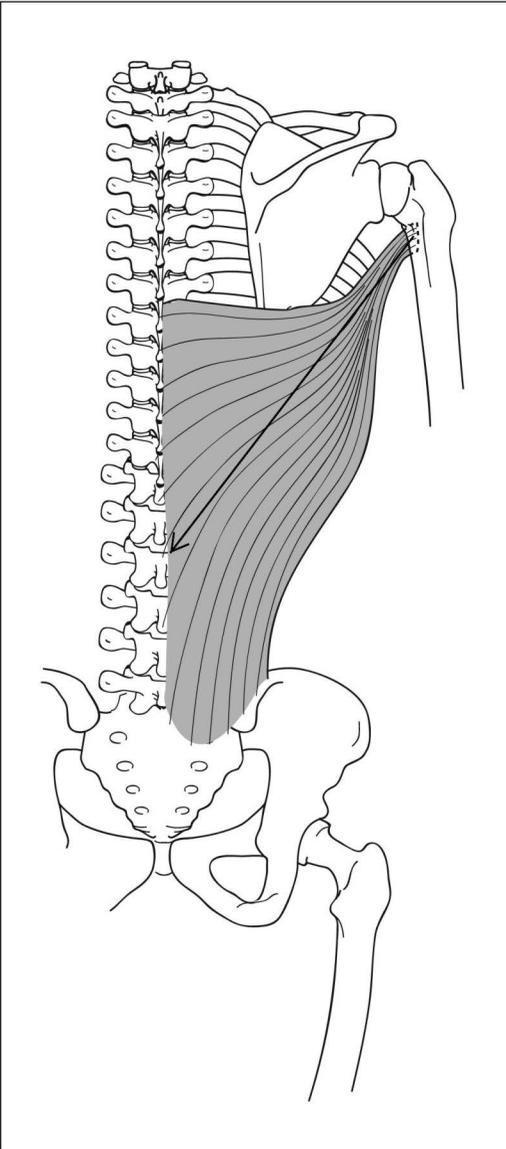


Figure 4-2-45A.

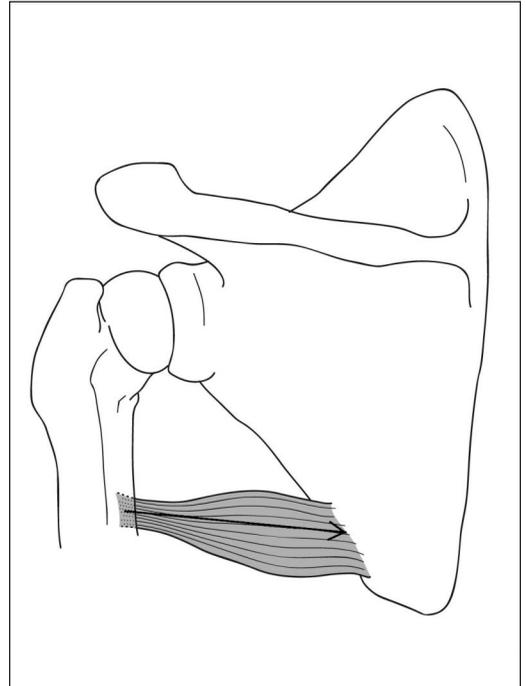


Figure 4-2-45B.

Latissimus dorsi

Origin: Spinous process of last 6 thoracic vertebrae, all lumbar and all sacral vertebrae, posterior iliac crest, posterior last 3 ribs, inferior angle of the scapula

Insertion: Bottom of intertubercular groove of humerus

Innervation: Thoracodorsal nerves

Action: shoulder/humeral extension, shoulder/humeral adduction, and shoulder/humeral internal rotation

Teres major

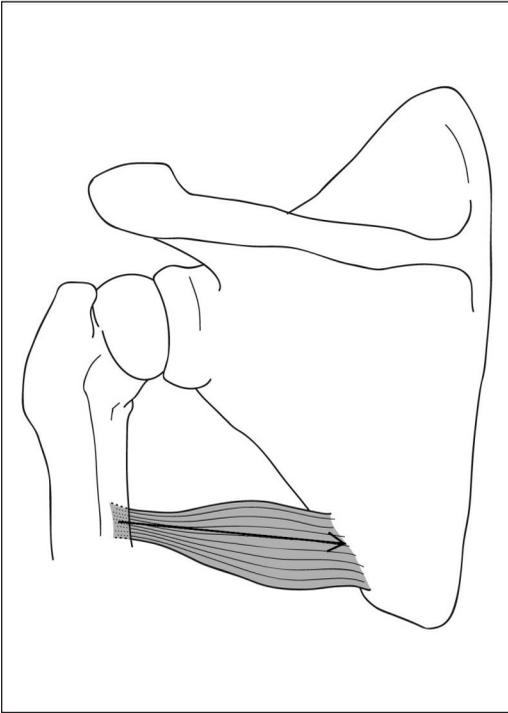


Figure 4-2-46.

Origin: Dorsal surface of the inferior angle of the scapula

Insertion: Below the lesser tuberosity of the humerus, posterior to the latissimus dorsi insertion

Innervation: Inferior subscapular nerve

Action: Shoulder/humeral extension, shoulder/humeral internal rotation, and shoulder/humeral adduction



Figure 4-2-47.



Figure 4-2-48.



Figure 4-2-49.

Against Gravity: Fair (3), Good (4), Normal (5)

Client Position: Starting—client is prone with the testing extremity at side in shoulder/humeral internal rotation (Figure 4-2-47).

Motion:—client moves the testing extremity in the direction of shoulder/humeral extension and shoulder/humeral adduction while also depressing the scapula. (Reach toward feet while maintaining extension.) (Figure 4-2-48).

Therapist Position: Stabilize at the lateral pelvis to avoid the compensation of trunk rotation. Resistance is applied on the distal humerus in the direction of shoulder/humeral flexion and shoulder/humeral abduction when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

Gravity Eliminated: Zero (0), Trace (1), Poor (2)

Client Position: Starting—client is prone with the testing extremity in shoulder/humeral extension, shoulder/humeral internal rotation, and shoulder/humeral adduction (Figure 4-2-49).

Motion:—client moves the testing extremity in the direction of shoulder/humeral extension and shoulder/humeral adduction while also depressing the scapula. (Reach toward feet while maintaining extension.) A grade of poor is given when the client moves through partial range only.

Therapist Position: Stabilize at the lateral trunk to avoid the compensation of rotation. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The latissimus dorsi is palpated on the lower border of the scapula below the teres major fibers. The teres major is palpated along the lower border of the scapula.

Shoulder/Humeral Horizontal Abduction Assessment: Goniometry

Plane: Transverse

Axis: Vertical

Normal ROM: 0-45 degrees

End feel: Firm



Figure 4-2-66.



Figure 4-2-67.

Client Position: Client is sitting.

Starting—testing extremity is in 90 degrees of shoulder/humeral abduction and neutral rotation, elbow flexed to 90 degrees, forearm pronated (Figure 4-2-66).

Ending—client moves the testing extremity into maximum shoulder/humeral horizontal abduction (Figure 4-2-67).

Therapist Position: Support the testing extremity in 90 degrees of abduction to prevent compensation.

Goniometer Position:

FULCRUM: superior aspect of the acromion process

STABLE ARM: parallel to humerus

MOVABLE ARM: parallel to the humerus (goniometer arms start parallel to the humerus, once the extremity moves, the stable arm remains in the initial position)

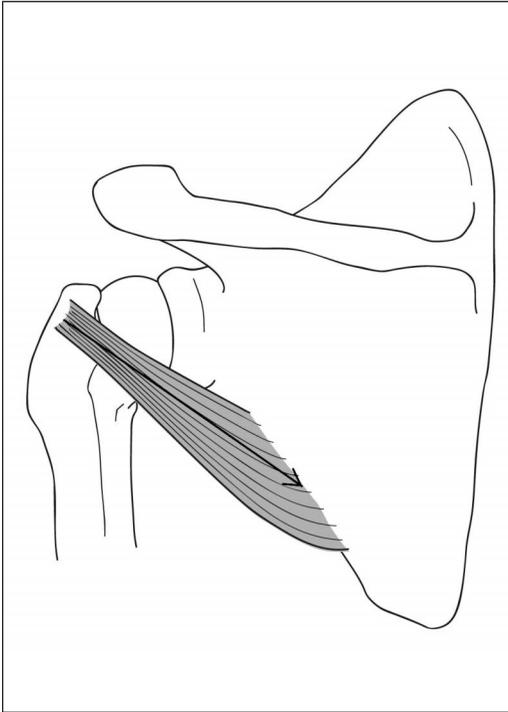


The American Society of Hand Therapy (ASHT) guidelines recommend starting horizontal abduction in full horizontal adduction (Figure 4-2-74). This starting position will modify the norm as listed above (The American Society of Hand Therapists, 1992).

Isolated Muscle Testing

Prime Movers: Posterior deltoid, Teres minor, Infraspinatus

Teres minor (tested with infraspinatus)



Teres minor

Origin: Upper 2/3 of the lateral, dorsal border of the scapula

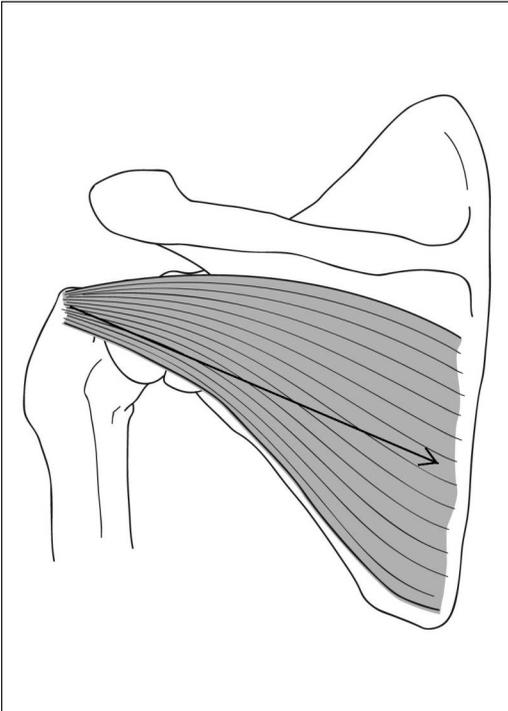
Insertion: Greater tubercle of humerus and capsule of the shoulder joint

Innervation: Axillary nerve

Action: Shoulder/humeral external rotation and shoulder/humeral horizontal abduction, one of the muscles of the rotator cuff

Figure 4-2-68.

Infraspinatus



Origin: Medial 2/3 of infraspinatus fossa of the scapula

Insertion: Greater tubercle of humerus, capsule of the shoulder joint

Innervation: Suprascapular nerve

Action: Shoulder/humeral external rotation and shoulder/humeral horizontal abduction, one of the muscles of the rotator cuff

Figure 4-2-69.



Figure 4-2-70.



Figure 4-2-71.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is prone with the testing extremity in 90 degrees of shoulder/humeral abduction and 90 degrees of elbow flexion (fingers point toward the floor) (Figure 4-2-70).

Motion—client moves the testing extremity in the direction of shoulder/humeral external rotation (Figure 4-2-71).

Therapist Position: Stabilize under the humerus to avoid compensation. Resistance is applied at the forearm in the direction of shoulder/humeral internal rotation when testing Normal or Good strengths. No resistance is applied when testing Fair strength.



Figure 4-2-72.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

Client Position: Starting—client is prone with the entire extremity off the table (fingers point toward the floor; Figure 4-2-72).

Motion—client moves the testing extremity in the direction of shoulder/humeral external rotation (LUE = counter-clockwise, RUE = clockwise).

	<p>You must observe shoulder/humeral rotation, not forearm rotation.</p>
--	--

Therapist Position: Stabilize at the scapula to avoid compensation. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The teres minor is not palpable. The infraspinatus is palpated below the spine of the scapula.

Alternate Position

Client Position: Starting—client is sitting with the testing extremity in shoulder/humeral abduction, and elbow flexion to 90 degrees.

Motion—client moves the testing extremity in the direction of shoulder/humeral external rotation (hand moves away from the body).

Shoulder Horizontal Adduction Assessment: Goniometry

Plane: Transverse

Axis: Vertical

Normal ROM: 0-135 degrees

End feel: Firm/soft



Figure 4-2-73.

Client Position: Client is sitting.

Starting—testing extremity is in 90 degrees of shoulder/humeral abduction and neutral rotation, the elbow flexed, forearm pronated (Figure 4-2-73).

Ending—client moves the testing extremity into maximum shoulder/humeral horizontal adduction (Figure 4-2-74).



Figure 4-2-74.

Therapist Position: Support the testing extremity in 90 degrees of abduction to prevent compensation.



The ASHT guidelines recommend starting horizontal adduction in full horizontal abduction. This starting position will modify the norm as listed above. (The American Society of Hand Therapists, 1992).

Goniometer Position:

FULCRUM: superior aspect of the acromion process

STABLE ARM: parallel to humerus

MOVABLE ARM: parallel to the humerus (goniometer arms start parallel to the humerus, once the extremity moves, the stable arm remains in the initial position)

Isolated Muscle Testing

Prime Movers: Anterior deltoid, Pectoralis major (clavicular and sternal heads)

Anterior deltoid

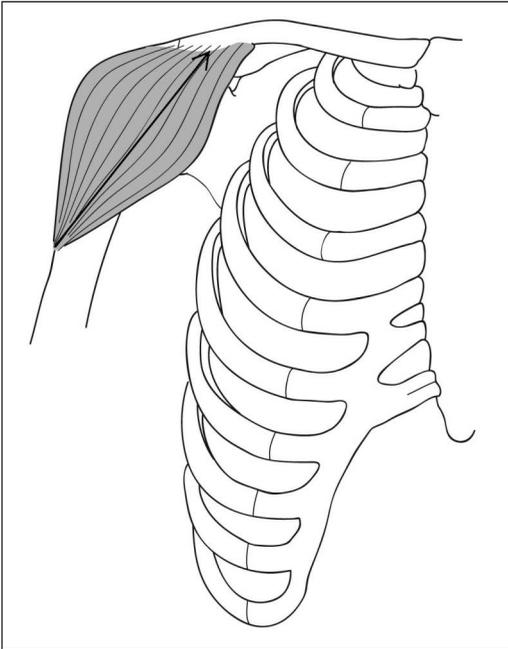


Figure 4-2-27A.

Origin: Lateral 1/3 of clavicle

Insertion: Deltoid tuberosity of the humerus

Innervation: Axillary nerve

Action: Shoulder/humeral flexion, shoulder/humeral horizontal adduction, and shoulder/humeral internal rotation



Figure 4-2-28.



Figure 4-2-29.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting or standing with the testing extremity at the side with slight elbow flexion and forearm pronation (Figure 4-2-28).

Motion—client moves the testing extremity in the direction of shoulder/humeral flexion (Figure 4-2-29).

Therapist Position: Stabilize at the shoulder to avoid compensation of shoulder/humeral rotation or horizontal movement. Resistance is applied at the proximal humerus in the direction of shoulder/humeral extension when testing Normal or Good strengths. No resistance is applied when testing Fair strength.



Figure 4-2-30.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

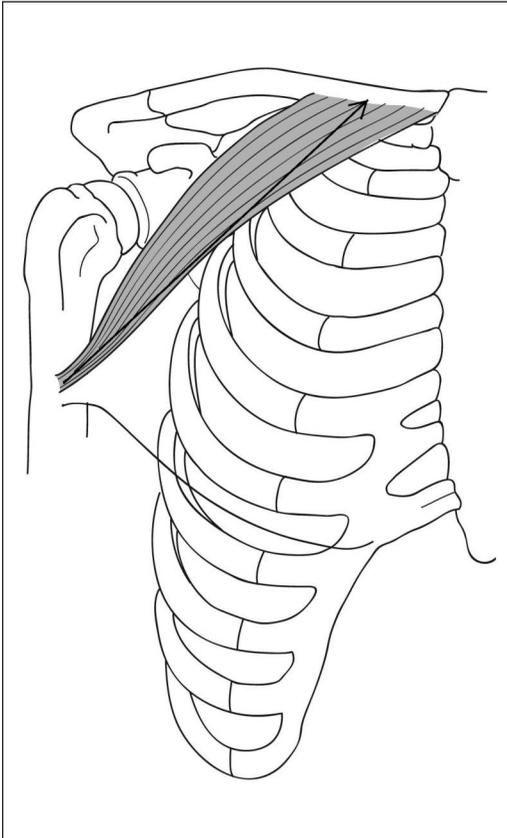
Client Position: Starting—client is lying on the uninvolved side and the testing extremity is at the side with slight elbow flexion, and forearm pronation, supported on a table or by the therapist (Figure 4-2-30).

Motion—client moves the testing extremity in the direction of shoulder/humeral flexion.

Therapist Position: Stabilize at the shoulder to avoid compensation of shoulder/humeral rotation or horizontal movement. Support the testing extremity to eliminate gravity; however, do not assist the motion. No resistance is applied when testing in the gravity-eliminated position.

Palpation: Anterior deltoid is palpated by locating the acromion process and bringing the therapist's fingers 2 to 3 inches anteriorly along the client's shoulder.

Pectoralis major (clavicular head)



Origin: Medial 2/3 of the clavicle

Insertion: Crest of greater tubercle of humerus

Innervation: Medial pectoral nerve

Action: Shoulder/humeral flexion, shoulder/humeral horizontal adduction, shoulder/humeral adduction

Figure 4-2-31.



Figure 4-2-32.



Figure 4-2-33.



Figure 4-2-34.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is supine with the testing extremity positioned in 90 degrees of shoulder/humeral flexion, slight shoulder/humeral internal rotation, and complete elbow extension (Figure 4-2-32).

Motion—client moves the testing extremity in the direction of the horizontal adduction (Figure 4-2-33).

Therapist Position: Stabilize at the contralateral shoulder to avoid compensation. Resistance is applied at the proximal humerus in the direction of horizontal abduction when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

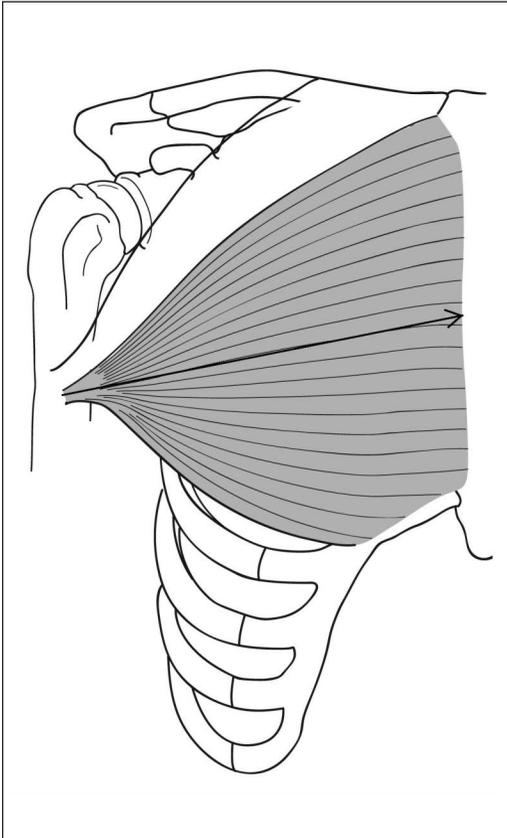
Client Position: Starting—client is sitting with the testing extremity positioned in 90 degrees of shoulder/humeral flexion, slight shoulder/humeral internal rotation, and complete elbow extension, supported by the therapist (Figure 4-2-34).

Motion—client moves the testing extremity in the direction of shoulder/humeral horizontal adduction.

Therapist Position: Stabilize at the contralateral shoulder to avoid compensation. Support the testing extremity to eliminate gravity; however, do not assist the motion. No resistance is applied when testing in the gravity-eliminated position.

Palpation: Pectoralis major (clavicular) can be palpated below the middle of the clavicle.

Pectoralis major (sternal head)



Origin: Sternum, costal cartilage ribs 1–6

Insertion: Crest of greater tubercle of the humerus

Innervation: Lateral pectoral nerve

Action: Shoulder/humeral horizontal adduction, shoulder/humeral extension

Figure 4-2-62.



Figure 4-2-63.



Figure 4-2-64.



Figure 4-2-65.

Against Gravity: Fair (3), Good (4), Normal (5)

Client Position: Starting—client is supine with the testing extremity in 90 degrees of shoulder/humeral flexion, slight shoulder/humeral internal rotation, and complete elbow extension (Figure 4-2-63).

Motion:client moves the testing extremity in the direction of shoulder/humeral horizontal adduction, but in a diagonal pattern toward the opposite iliac crest (Figure 4-2-64).

Therapist Position: Stabilize at the opposite iliac crest to avoid trunk rotation. Resistance is applied at the proximal humerus in a diagonal pattern of shoulder/humeral horizontal abduction when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

Gravity Eliminated: Zero (0), Trace (1), Poor (2)

Client Position: Starting—client is sitting with the testing extremity in 90 degrees shoulder/humeral flexion, slight shoulder/humeral internal rotation, and complete elbow flexion, supported by the therapist (Figure 4-2-65).

Motion:client moves the testing extremity in the direction of shoulder/humeral horizontal adduction, but in a diagonal pattern toward the opposite iliac crest.

Therapist Position: Stabilize at the opposite iliac crest to avoid compensation of trunk rotation. Support the testing extremity to eliminate gravity; however, do not assist the motion. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The pectoralis major (sternal end) is palpated on the anterior aspect of the axilla.

Shoulder External Rotation Assessment: Goniometry

Plane: Transverse

Axis: Vertical

Normal: 0–90 degrees

End feel: Firm



Figure 4-2-75.



Figure 4-2-76.

Client Position: Client is prone.

Starting—testing extremity is in 90 degrees of shoulder/humeral abduction, elbow flexed to 90 degrees, forearm perpendicular to the plinth. A pad is placed under the humerus (Figure 4-2-75).

Ending—client moves the testing extremity into maximum shoulder/humeral external rotation (Figure 4-2-76).

Therapist Position: Observe the distal end of humerus to maintain 90 degrees of abduction and to prevent compensation of excessive scapular depression.

Goniometer Position:

FULCRUM: midline of the olecranon process

STABLE ARM: perpendicular to the floor

MOVABLE ARM: midline of the lateral ulna

Alternate Position

Some references start the procedure in sitting or standing position and the forearm is parallel to the floor.

FULCRUM: midline of the olecranon process

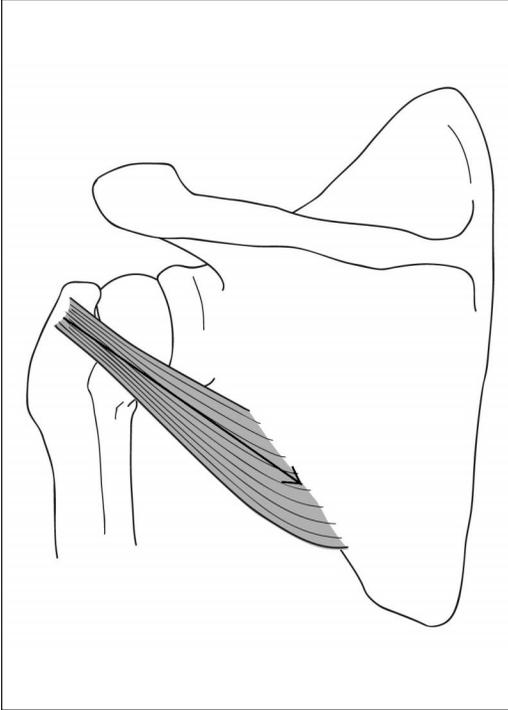
STABLE ARM: parallel to the floor

MOVABLE ARM: midline of the lateral ulna

Isolated Muscle Testing

Prime Movers: Teres Minor, Infraspinatus, Posterior Deltoid

Teres minor (tested with infraspinatus)



Teres minor

Origin: Upper 2/3 of the lateral, dorsal border of the scapula

Insertion: Greater tubercle of humerus and capsule of the shoulder joint

Innervation: Axillary nerve

Action: Shoulder/humeral external rotation and shoulder/humeral horizontal abduction, one of the muscles of the rotator cuff

Figure 4-2-68.

Infraspinatus

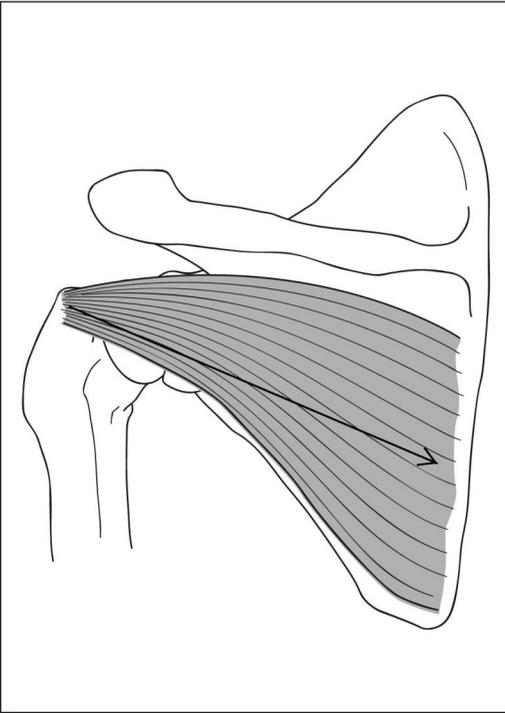


Figure 4-2-69.

Origin: Medial 2/3 of infraspinatus fossa of the scapula

Insertion: Greater tubercle of humerus, capsule of the shoulder joint

Innervation: Suprascapular nerve

Action: Shoulder/humeral external rotation and shoulder/humeral horizontal abduction, one of the muscles of the rotator cuff



Figure 4-2-70.



Figure 4-2-72.



Figure 4-2-71.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is prone with the testing extremity in 90 degrees of shoulder/humeral abduction and 90 degrees of elbow flexion (fingers point toward the floor) (Figure 4-2-70).

Motion—client moves the testing extremity in the direction of shoulder/humeral external rotation (Figure 4-2-71).

Therapist Position: Stabilize under the humerus to avoid compensation. Resistance is applied at the forearm in the direction of shoulder/humeral internal rotation when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

Client Position: Starting—client is prone with the entire extremity off the table (fingers point toward the floor).

Motion—client moves the testing extremity in the direction of shoulder/humeral external rotation (LUE = counter-clockwise, RUE = clockwise).

	<p>You must observe shoulder/humeral rotation, not forearm rotation.</p>
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Therapist Position: Stabilize at the scapula to avoid compensation. No resistance is applied when testing in the gravity-eliminated position.

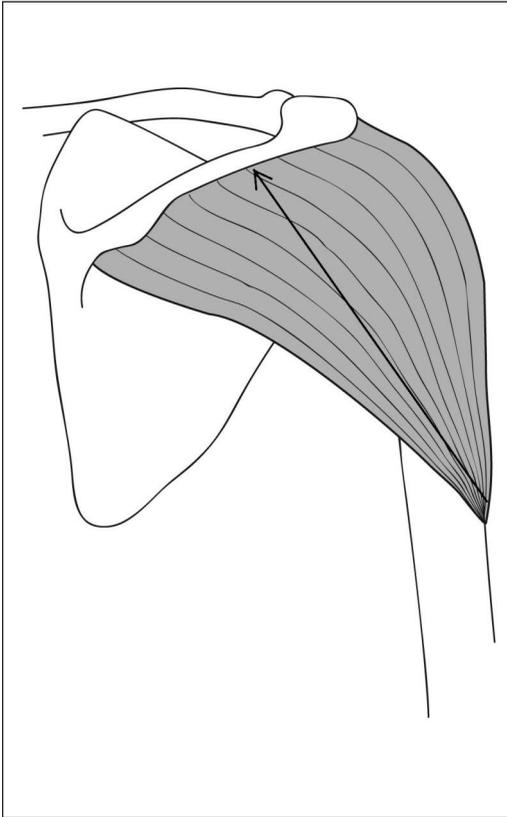
Palpation: The teres minor is not palpable. The infraspinatus is palpated below the spine of the scapula.

Alternate Position

Client Position: Starting—client is sitting with the testing extremity in shoulder/humeral abduction, and elbow flexion to 90 degrees.

Motion—client moves the testing extremity in the direction of shoulder/humeral external rotation (hand moves away from the body).

Posterior deltoid



Origin: Inferior lip, spine of scapula

Insertion: Deltoid tuberosity of the humerus

Innervation: Axillary nerve

Action: Shoulder/humeral extension, shoulder/humeral horizontal abduction, and shoulder/humeral external rotation.

Figure 4-2-41.



Figure 4-2-42.



Figure 4-2-43.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is prone with the testing extremity in abduction and slight external rotation. Elbow is flexed at 90 degrees (over the edge of the table) (Figure 4-2-42). Motion—client moves the testing extremity in the direction of shoulder/humeral horizontal abduction (Figure 4-2-43).

Therapist Position: Stabilize at the scapula to avoid scapular retraction/adduction. Observe elbow for compensation of the triceps (elbow extension). Resistance is applied at the posterior-lateral aspect of the distal humerus in the direction of horizontal adduction when testing Normal or Good strengths. No resistance is applied when testing Fair strength.



Figure 4-2-44.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

Client Position: Starting—client is sitting with the testing extremity in 90 degrees of shoulder/humeral flexion and 90 degrees of elbow flexion, supported on a table or by the therapist (Figure 4-2-44).

Motion—client moves the testing extremity in the direction of horizontal abduction.

Therapist Position: Stabilize at the scapula to avoid scapular retraction/adduction. Observe elbow for compensation of the triceps (elbow extension). Support the testing extremity to eliminate gravity; however, do not assist the motion. No resistance is applied in the gravity-eliminated position.

Palpation: The posterior deltoid can be palpated on the dorsal/proximal 1/3 of the humerus.

Shoulder Internal Rotation Assessment: Goniometry

Plane: Transverse

Axis: Vertical

Normal ROM: 0-70 degrees

End feel: Firm



Figure 4-2-77.

Client Position: Client is prone.

Starting—testing extremity is in 90 degrees of shoulder/humeral abduction, elbow flexed to 90 degrees, forearm is perpendicular to the plinth (Figure 4-2-77).

Ending—client moves the testing extremity into maximum shoulder/humeral internal rotation (Figure 4-2-78).



Figure 4-2-78.

Therapist Position: Observe the distal end of the humerus to maintain 90 degrees of shoulder abduction and to prevent scapular compensation.

Goniometer Position:

FULCRUM: midline of the olecranon process

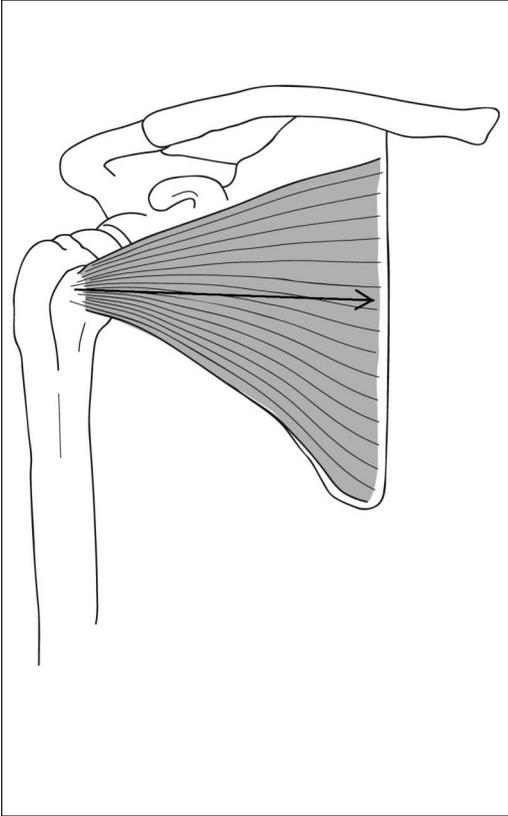
STABLE ARM: perpendicular to the floor

MOVABLE ARM: midline of the lateral ulna

Isolated Muscle Testing

Prime Movers: Subscapularis, Latissimus dorsi, Teres major, Pectoralis minor (clavicular and sternal heads)

Subscapularis



Origin: Subscapular fossa of scapula

Insertion: Lesser tubercle of humerus, capsule of shoulder joint

Innervation: Superior upper and inferior lower subscapular nerves

Action: Shoulder/humeral internal rotation, one of the muscles of the rotator cuff

Figure 4-2-79.



Figure 4-2-80.



Figure 4-2-82.



Figure 4-2-81.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is prone with the testing extremity in 90 degrees of shoulder/humeral abduction and 90 degrees of elbow flexion (fingers pointed toward the floor) (Figure 4-2-80).

Motion—client moves the testing extremity in the direction of shoulder/humeral internal rotation (Figure 4-2-81).

Therapist Position: Stabilize under the humerus to avoid compensation. Resistance is applied at the forearm in the direction of shoulder/humeral external rotation when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

Client Position: Starting—client is prone with the entire humerus off the table (fingers point toward the floor; Figure 4-2-82).

Motion—client moves the testing extremity in the direction of shoulder/humeral internal rotation (LUE = clockwise, RUE = counter-clockwise).



CAUTION

You must observe shoulder/humeral rotation, not forearm rotation.

Therapist Position: Stabilize at the scapula to avoid compensation. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The subscapularis is palpated deep in the axilla, near the insertion.

Alternate Position

Client Position: Starting—client is sitting with the testing extremity in shoulder/humeral abduction, and elbow flexion to 90 degrees.

Motion—client moves the testing extremity in the direction of shoulder/humeral internal rotation (hand moves toward the body).

Latissimus dorsi and *Teres major* (tested together)

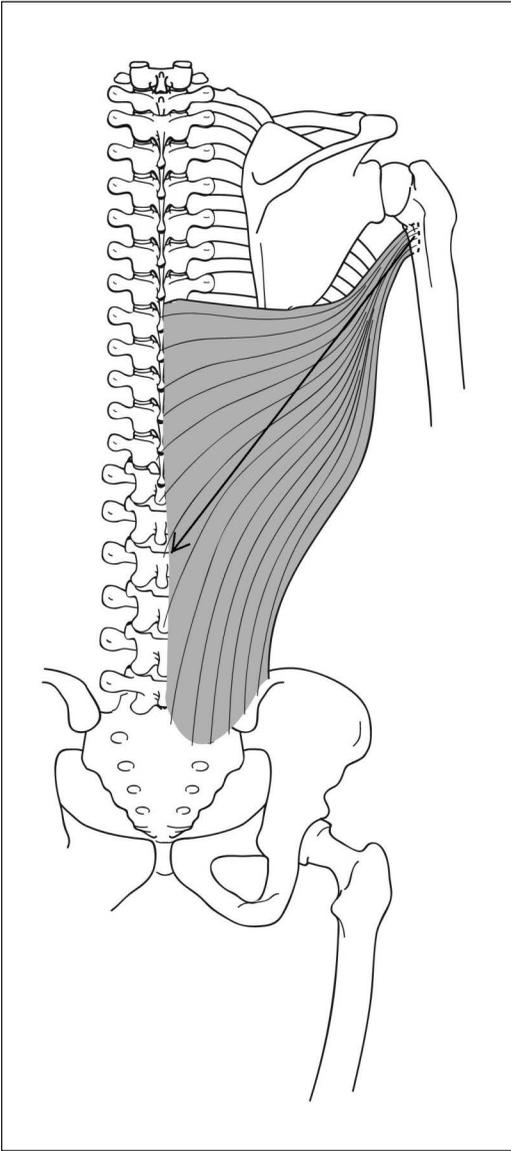


Figure 4-2-45A.

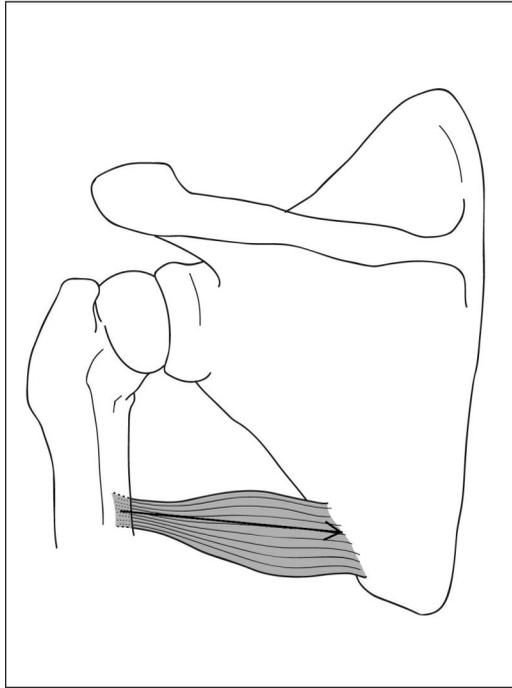


Figure 4-2-45B.

Latissimus dorsi

Origin: Spinous process of last 6 thoracic vertebrae, all lumbar and all sacral vertebrae, posterior iliac crest, posterior last 3 ribs, inferior angle of the scapula

Insertion: Bottom of intertubercular groove of humerus

Innervation: Thoracodorsal nerves

Action: shoulder/humeral extension, shoulder/humeral adduction, and shoulder/humeral internal rotation

Teres major

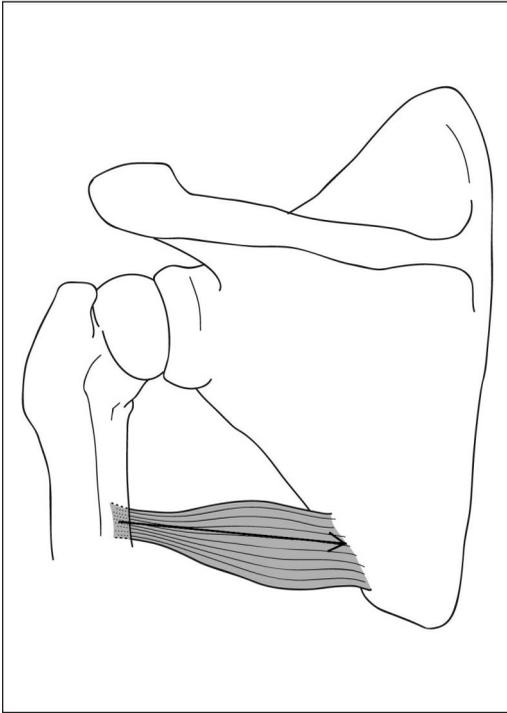


Figure 4-2-46.

Origin: Dorsal surface of the inferior angle of the scapula

Insertion: Below the lesser tuberosity of the humerus, posterior to the latissimus dorsi insertion

Innervation: Inferior subscapular nerve

Action: Shoulder/humeral extension, shoulder/humeral internal rotation, and shoulder/humeral adduction



Figure 4-2-47.



Figure 4-2-48.



Figure 4-2-49.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is prone with the testing extremity at side in shoulder/humeral internal rotation (Figure 4-2-47).

Motion:—client moves the testing extremity in the direction of shoulder/humeral extension and shoulder/humeral adduction while also depressing the scapula. (Reach toward feet while maintaining extension.) (Figure 4-2-48).

Therapist Position: Stabilize at the lateral pelvis to avoid the compensation of trunk rotation. Resistance is applied on the distal humerus in the direction of shoulder/humeral flexion and shoulder/humeral abduction when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

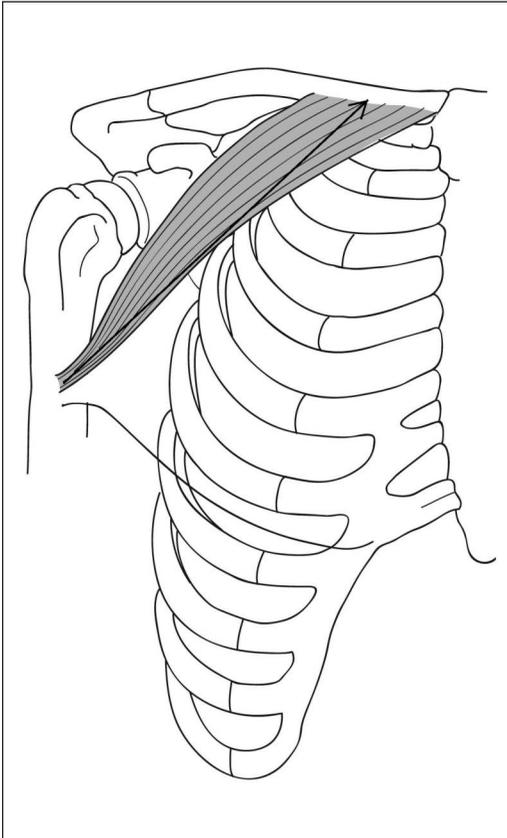
Client Position: Starting—client is prone with the testing extremity in shoulder/humeral extension, shoulder/humeral internal rotation, and shoulder/humeral adduction (Figure 4-2-49).

Motion:—client moves the testing extremity in the direction of shoulder/humeral extension and shoulder/humeral adduction while also depressing the scapula. (Reach toward feet while maintaining extension.) A grade of poor is given when the client moves through partial range only.

Therapist Position: Stabilize at the lateral trunk to avoid the compensation of rotation. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The latissimus dorsi is palpated on the lower border of the scapula below the teres major fibers. The teres major is palpated along the lower border of the scapula.

Pectoralis major (clavicular head)



Origin: Medial 2/3 of the clavicle

Insertion: Crest of greater tubercle of humerus

Innervation: Medial pectoral nerve

Action: Shoulder/humeral flexion, shoulder/humeral horizontal adduction, shoulder/humeral adduction

Figure 4-2-31.



Figure 4-2-32.



Figure 4-2-33.



Figure 4-2-34.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is supine with the testing extremity positioned in 90 degrees of shoulder/humeral flexion, slight shoulder/humeral internal rotation, and complete elbow extension (Figure 4-2-32).

Motion—client moves the testing extremity in the direction of the horizontal adduction (Figure 4-2-33).

Therapist Position: Stabilize at the contralateral shoulder to avoid compensation. Resistance is applied at the proximal humerus in the direction of horizontal abduction when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

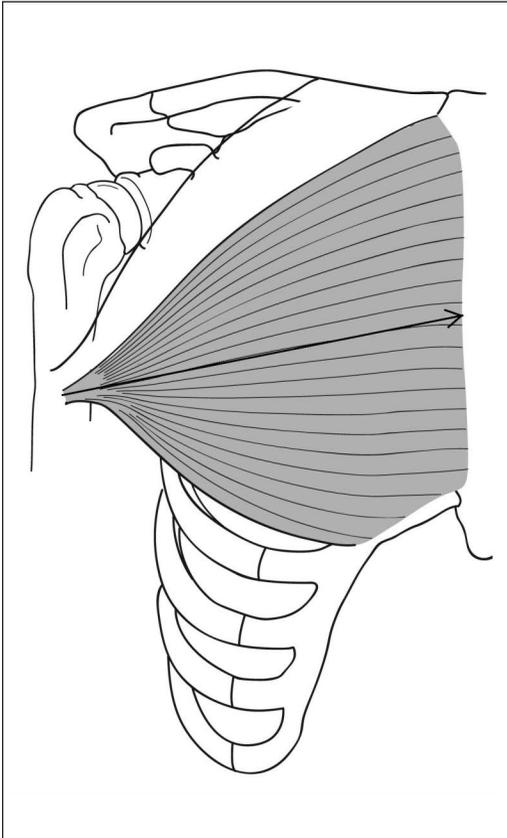
Client Position: Starting—client is sitting with the testing extremity positioned in 90 degrees of shoulder/humeral flexion, slight shoulder/humeral internal rotation, and complete elbow extension, supported by the therapist (Figure 4-2-34).

Motion—client moves the testing extremity in the direction of shoulder/humeral horizontal adduction.

Therapist Position: Stabilize at the contralateral shoulder to avoid compensation. Support the testing extremity to eliminate gravity; however, do not assist the motion. No resistance is applied when testing in the gravity-eliminated position.

Palpation: Pectoralis major (clavicular) can be palpated below the middle of the clavicle.

Pectoralis major (sternal head)



Origin: Sternum, costal cartilage ribs 1–6

Insertion: Crest of greater tubercle of the humerus

Innervation: Lateral pectoral nerve

Action: Shoulder/humeral horizontal adduction, shoulder/humeral extension

Figure 4-2-62.



Figure 4-2-63.



Figure 4-2-64.



Figure 4-2-65.

Against Gravity: Fair (3), Good (4), Normal (5)

Client Position: Starting—client is supine with the testing extremity in 90 degrees of shoulder/humeral flexion, slight shoulder/humeral internal rotation, and complete elbow extension (Figure 4-2-63).

Motion:client moves the testing extremity in the direction of shoulder/humeral horizontal adduction, but in a diagonal pattern toward the opposite iliac crest (Figure 4-2-64).

Therapist Position: Stabilize at the opposite iliac crest to avoid trunk rotation. Resistance is applied at the proximal humerus in a diagonal pattern of shoulder/humeral horizontal abduction when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

Gravity Eliminated: Zero (0), Trace (1), Poor (2)

Client Position: Starting—client is sitting with the testing extremity in 90 degrees shoulder/humeral flexion, slight shoulder/humeral internal rotation, and complete elbow flexion, supported by the therapist.

Motion:client moves the testing extremity in the direction of shoulder/humeral horizontal adduction, but in a diagonal pattern toward the opposite iliac crest.

Therapist Position: Stabilize at the opposite iliac crest to avoid compensation of trunk rotation. Support the testing extremity to eliminate gravity; however, do not assist the motion. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The pectoralis major (sternal end) is palpated on the anterior aspect of the axilla.

Table 4-3

SCAPULA AND SHOULDER ASSESSMENT AT A GLANCE

FUNCTIONAL MUSCLE GROUP	PLANE	AXIS	NORMAL ROM	GONIOMETRY/ROM TESTING PROCEDURE	END FEEL	ISOLATED MUSCLE TESTING PROCEDURE (OF PRIMARY MOVERS)
<i>Shoulder Flexion</i>	Sagittal	Frontal	0 to 180 degrees	<p>Fulcrum: Lateral surface of the acromion process.</p> <p>Stable arm: Mid axilla/thorax.</p> <p>Movable arm: Lateral midline of the humerus.</p>	Firm	<p>ANTERIOR DELTOID</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated or is standing with testing arm at side, with slight elbow flexion and forearm pronation.</p> <p>Motion: Client moves testing extremity into shoulder/humeral flexion.</p> <p>Stabilize: At the shoulder to avoid shoulder/humeral rotation or horizontal movement.</p> <p>Resist: Apply at proximal humerus in direction of shoulder/humeral extension.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client lays on uninvolved side. Testing arm is at the side with slight elbow flexion and forearm pronation, being supported on a table or by therapist.</p> <p>Motion: Client moves the testing extremity into shoulder/humeral flexion.</p> <p>Stabilize: At shoulder to avoid shoulder/humeral rotation or horizontal movement. Support testing extremity to eliminate gravity but do not assist the motion.</p> <p>Palpate: Anterior shoulder 2–3 inches from acromion process.</p>

(continued)

Table 4-3 (continued)

SCAPULA AND SHOULDER ASSESSMENT AT A GLANCE

					<p>PECTORALIS MAJOR (CLAVICULAR HEAD)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client lays supine with testing arm in 90 degrees of shoulder/humeral flexion, slight shoulder/humeral internal rotation, and complete elbow extension.</p> <p>Motion: Client moves testing arm into horizontal adduction.</p> <p>Stabilize: Stabilize at the contralateral shoulder.</p> <p>Resist: Apply at the proximal humerus toward horizontal abduction.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is seated with testing arm in 90 degrees shoulder/humeral flexion, slight internal rotation, and complete elbow extension, supported by therapist.</p> <p>Motion: Client moves testing arm into shoulder/humeral horizontal adduction.</p> <p>Stabilize: At the contralateral shoulder. Support the testing extremity to eliminate gravity but do not assist in the motion.</p> <p>Palpate: Palpate below the middle of the clavicle.</p>
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(continued)

Table 4-3 (continued)

SCAPULA AND SHOULDER ASSESSMENT AT A GLANCE

						<p>CORACOBRAHIALIS</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated or is standing with testing arm at side, with slight shoulder/humeral external rotation, full elbow flexion, and forearm supination.</p> <p>Motion: Client moves the testing arm in the direction of shoulder/humeral flexion (keeping the elbow flexed).</p> <p>Stabilize: At shoulder to avoid compensation.</p> <p>Resist: Applied at proximal humerus in direction of shoulder/humeral extension and slight internal rotation.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client lies on the unaffected side with testing extremity at side with slight shoulder/humeral external rotation, full elbow flexion, and forearm supination.</p> <p>Motion: Client moves testing arm in the direction of shoulder/humeral flexion while keeping elbow flexed.</p> <p>Stabilize: At shoulder to avoid compensation.</p> <p>Palpate: Too deep to palpate.</p>
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(continued)

Table 4-3 (continued)

SCAPULA AND SHOULDER ASSESSMENT AT A GLANCE

<i>Shoulder Extension</i>	Sagittal	Frontal	0 to 60 degrees	<p>Fulcrum: Lateral surface of acromion process</p> <p>Stable arm: Midline of thorax</p> <p>Movable arm: Lateral midline of humerus</p>	Firm	<p>POSTERIOR DELTOID</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is prone with testing arm in abduction and slight external rotation, with elbow flexed at 90 degrees (over the edge of the table).</p> <p>Motion: Client moves the testing arm in the direction of shoulder/humeral horizontal abduction.</p> <p>Stabilize: At scapula to avoid retraction/adduction. Observe elbow for extension (compensation of triceps).</p> <p>Resist: Apply at the posterior-lateral aspect of the distal humerus in the direction of horizontal adduction.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is seated with the testing arm in 90 degrees of shoulder/humeral flexion and 90 degrees of elbow flexion, supported on a table or by therapist.</p> <p>Motion: Client moves the testing arm in the direction of horizontal abduction.</p> <p>Stabilize: At the scapula to avoid scapular retraction/adduction. Observe elbow for extension (compensation of triceps).</p> <p>Palpate: On the dorsal/proximal 1/3 of the humerus.</p>
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(continued)

Table 4-3 (continued)

SCAPULA AND SHOULDER ASSESSMENT AT A GLANCE

						<p>LATISSIMUS DORSI (TESTED WITH TERES MAJOR)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is prone with testing arm at side in shoulder/humeral internal rotation.</p> <p>Motion: Client moves testing arm in the direction of shoulder/humeral extension and adduction while depressing the scapula (reach towards feet).</p> <p>Stabilize: At lateral pelvis (same side) to avoid trunk rotation.</p> <p>Resist: At the distal humerus in the direction of shoulder/humeral flexion and abduction.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is prone with testing arm in shoulder/humeral extension, internal rotation, and adduction.</p> <p>Motion: Client moves testing arm in direction of shoulder/humeral extension and adduction while depressing the scapula (reach towards feet).</p> <p>Stabilize: At lateral trunk to avoid rotation.</p> <p>Palpate: On the lower border of the scapula below Teres major fibers.</p> <p>TERES MAJOR: TESTED WITH LATISSIMUS DORSI</p> <p>Palpated: Along lower border of scapula.</p>
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(continued)

Table 4-3 (continued)

SCAPULA AND SHOULDER ASSESSMENT AT A GLANCE

Shoulder Abduction	Frontal	Sagittal	0 to 180 degrees	<p>Fulcrum: Anterior or posterior surface of acromion process.</p> <p>Stable arm: Parallel to the sternum or the spine</p> <p>Movable arm: Medial aspect of humerus</p>	Firm	<p>MIDDLE DELTOID</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated or standing with the testing extremity between 0 and 45 degrees of shoulder/humeral abduction and the elbow is flexed to 90 degrees.</p> <p>Motion: Client moves the testing extremity in the direction of shoulder/humeral abduction.</p> <p>Stabilize: at the shoulder to avoid compensation of scapular elevation.</p> <p>Resist: Is applied at the distal humerus in the direction of adduction when testing normal or good strengths.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is supine with the testing extremity in shoulder/humeral adduction.</p> <p>Motion: Client moves the testing extremity in the direction of shoulder/humeral abduction.</p> <p>Stabilize: At the shoulder to avoid compensation of scapular elevation.</p> <p>Palpate: The middle deltoid can be palpated below the acromion process on the lateral/proximal one-third of the humerus.</p>
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(continued)

Table 4-3 (continued)

SCAPULA AND SHOULDER ASSESSMENT AT A GLANCE

					<p>SUPRASPINATUS</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated or is standing with testing arm at side in shoulder/humeral abduction and the head rotated to the contralateral side.</p> <p>Motion: Client moves testing arm in the direction of shoulder/humeral abduction.</p> <p>Stabilize: At shoulder to avoid compensation.</p> <p>Resist: Apply at humerus in the motion of shoulder/humeral adduction.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is prone or supine with testing arm in shoulder/humeral adduction and head rotated to contralateral side.</p> <p>Motion: Client moves testing arm into shoulder/humeral abduction.</p> <p>Stabilize: At shoulder to avoid compensation.</p> <p>Palpate: Too deep to palpate.</p>
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(continued)

Table 4-3 (continued)

SCAPULA AND SHOULDER ASSESSMENT AT A GLANCE

Shoulder Adduction	Frontal	Sagittal	Not formally measured as opposite motion to abduction		Soft	<p>PECTORALIS MAJOR (STERNAL HEAD)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is supine with the testing arm in 90 degrees of shoulder/humeral flexion, full elbow extension, and slight shoulder/humeral internal rotation.</p> <p>Motion: Client moves testing arm in a diagonal motion down toward opposite iliac crest, in the direction of shoulder/humeral horizontal adduction.</p> <p>Stabilize: At opposite iliac crest, resisting trunk rotation.</p> <p>Resist: At proximal humerus in a diagonal pattern of shoulder/humeral horizontal abduction.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is seated with testing arm at 90 degrees of shoulder/humeral flexion, full elbow flexion, and slight shoulder/humeral internal rotation, supported by therapist.</p> <p>Motion: Client moves testing extremity in the direction of shoulder/humeral horizontal adduction in the diagonal motion towards the opposite iliac crest.</p> <p>Stabilize: At opposite iliac crest, resisting trunk rotation. Support testing extremity to eliminate gravity but do not assist the motion.</p> <p>Palpate: Sternal end is palpated on the anterior aspect of the axilla.</p>
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(continued)

Table 4-3 (continued)

SCAPULA AND SHOULDER ASSESSMENT AT A GLANCE

						<p>PECTORALIS MAJOR (CLAVICULAR HEAD): STATED ABOVE IN SHOULDER FLEXION</p> <p>LATISSIMUS DORSI: STATED ABOVE IN SHOULDER EXTENSION/HYPEREXTENSION</p> <p>TERES MAJOR: STATED ABOVE IN SHOULDER EXTENSION/HYPEREXTENSION</p>
<i>Shoulder Horizontal Abduction</i>	Transverse	Vertical	0 to 45 degrees	<p>Fulcrum: Place on the superior aspect of the acromion process.</p> <p>Stable arm: Parallel to the humerus, remaining in beginning position.</p> <p>Movable arm: Parallel to the humerus.</p>	Firm	<p>POSTERIOR DELTOID: STATED ABOVE IN SHOULDER EXTENSION/HYPEREXTENSION</p> <p>TERES MINOR (TESTED WITH INFRASPINATUS) Palpate: Too deep to palpate.</p>

(continued)

Table 4-3 (continued)

SCAPULA AND SHOULDER ASSESSMENT AT A GLANCE

					<p>INFRASPINATUS (TESTED WITH TERES MINOR)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is prone with testing arm in 90 degrees of shoulder/humeral abduction and 90 degrees elbow flexion with fingers pointed toward floor.</p> <p>Motion: Client moves testing arm in direction of shoulder/humeral external rotation.</p> <p>Stabilize: Under the humerus to avoid compensation.</p> <p>Resist: At forearm toward shoulder/humeral internal rotation.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is prone with entire arm off table and fingers pointed toward floor.</p> <p>Motion: Client moves testing extremity toward shoulder/humeral external rotation.</p> <p>Stabilize: At scapula to avoid compensation.</p> <p>Palpate: Below spine of scapula.</p>
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(continued)

Table 4-3 (continued)

SCAPULA AND SHOULDER ASSESSMENT AT A GLANCE

<p><i>Shoulder Horizontal Adduction</i></p>	<p>Transverse</p>	<p>Vertical</p>	<p>0 to 135 degrees</p>	<p>Fulcrum: Superior acromion process. Stable arm: Parallel to humerus, remaining in beginning position. Movable arm: Parallel to humerus.</p>	<p>Firm/soft</p>	<p>ANTERIOR DELTOID: STATED ABOVE IN SHOULDER FLEXION</p> <p>PECTORALIS MAJOR (CLAVICULAR HEAD): STATED ABOVE IN SHOULDER FLEXION</p> <p>PECTORALIS MAJOR (STERNAL HEAD): STATED ABOVE IN SHOULDER ADDUCTION</p>
<p><i>Shoulder External Rotation</i></p>	<p>Transverse</p>	<p>Vertical</p>	<p>0 to 90 degrees</p>	<p>Fulcrum: Midline of the olecranon process of the ulna. Stable arm: Perpendicular to the floor. Movable arm: Midline of lateral ulna.</p>	<p>Firm</p>	<p>TERES MINOR (TESTED WITH INFRASPINATUS): Palpate: Too deep to palpate.</p> <p>INFRASPINATUS: STATED ABOVE IN SHOULDER HORIZONTAL ABDUCTION.</p> <p>POSTERIOR DELTOID: STATED ABOVE IN SHOULDER EXTENSION/HYPEREXTENSION</p>

(continued)

Table 4-3 (continued)

SCAPULA AND SHOULDER ASSESSMENT AT A GLANCE

<i>Shoulder Horizontal Adduction</i>	Transverse	Vertical	0 to 135 degrees	<p>Fulcrum: Superior acromion process.</p> <p>Stable arm: Parallel to humerus, remaining in beginning position.</p> <p>Movable arm: Parallel to humerus.</p>	Firm/soft	<p>SUBSCAPULARIS</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is prone with testing arm in 90 degrees shoulder/humeral abduction and 90 degrees elbow flexion with fingers toward floor.</p> <p>Motion: Move testing arm into shoulder/humeral internal rotation.</p> <p>Stabilize: Under the humerus to avoid compensation.</p> <p>Resist: Apply at forearm in the direction of shoulder/humeral external rotation.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is prone with entire humerus off table and fingers toward floor.</p> <p>Motion: Client moves testing arm into shoulder/humeral internal rotation.</p> <p>Stabilize: At scapula to avoid compensation.</p> <p>Palpate: Deep in the axilla near insertion of muscle.</p>
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(continued)

Table 4-3 (continued)

SCAPULA AND SHOULDER ASSESSMENT AT A GLANCE

						<p>LATISSIMUS DORSI: STATED ABOVE IN SHOULDER EXTENSION/HYPEREXTENSION</p> <p>TERES MAJOR: STATED ABOVE IN SHOULDER EXTENSION/HYPEREXTENSION</p> <p>TESTED WITH LATISSIMUS DORSI</p> <p>PECTORALIS MAJOR: STATED ABOVE IN SHOULDER FLEXION</p>
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SECTION 4-3: The Elbow, Forearm, and Wrist

KEY BONY LANDMARKS	
Bone	Landmark
Scapula	Acromion
	Coracoid process
Humerus	Body (shaft)
	Medial epicondyle
	Lateral epicondyle
Ulna	Ulnar tuberosity
	Styloid process
Radius	Radial tuberosity
	Styloid process
Carpals	Pisiform

Elbow Flexion Assessment: Goniometry

Plane: Sagittal

Axis: Frontal

Normal ROM: 0-135 degrees

End feel: Soft



Figure 4-3-1.



Figure 4-3-2.

Client Position: Client is supine with knees flexed or sitting.

Starting—testing extremity is fully extended at client's side and forearm is in neutral (Figure 4-3-1).

Ending—client moves the testing extremity into maximum elbow flexion (Figure 4-3-2).

Therapist Position: Observe at the humerus and shoulder to prevent compensation.

Goniometer Position:

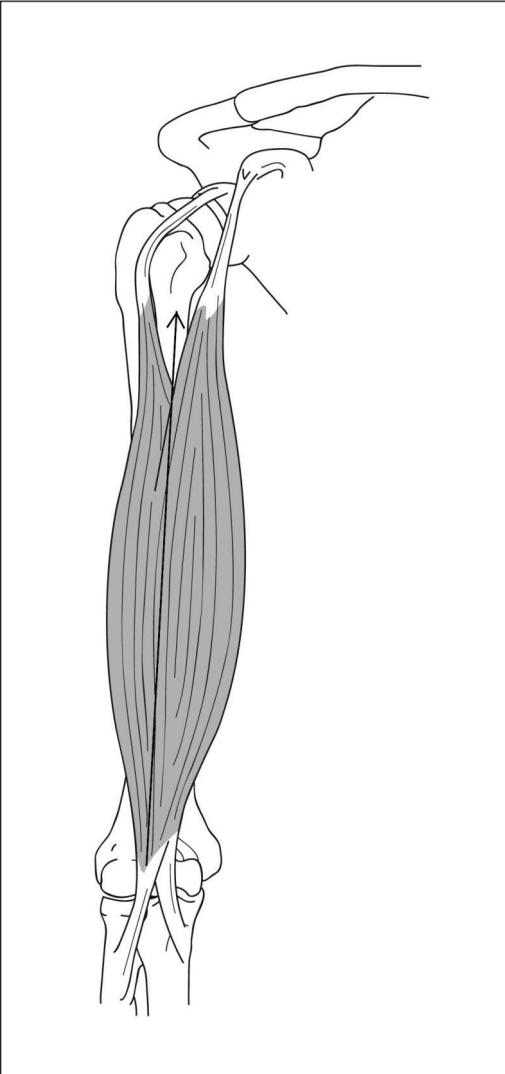
FULCRUM: lateral epicondyle of the humerus
STABLE ARM: midline of lateral surface of the humerus

MOVABLE ARM: midline of lateral surface of the radius

Isolated Muscle Testing

Prime Movers: Biceps brachii, Brachialis, Brachioradialis

Biceps brachii



Origin: Short head—scapular coracoid process; long head—scapular supraglenoid process

Insertion: Short head—posterior aspect of radial tuberosity; long head—bicipital aponeurosis

Innervation: Musculocutaneous nerve

Action: Elbow flexion, forearm supination

Figure 4-3-3.



Figure 4-3-4.



Figure 4-3-5.



Figure 4-3-6.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Client is sitting with the testing extremity in humeral adduction, elbow extension, and forearm supination (Figure 4-3-4).

Motion—client moves the testing extremity in the direction of elbow flexion (Figure 4-3-5).

Therapist Position: Stabilize at the humerus to avoid compensation. Resistance is applied at the forearm in the direction of elbow extension when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

Client Position: Starting—client is sitting with the testing extremity in 90 degrees of humeral flexion or abduction, elbow extension, and forearm in supination, supported on a table or by the therapist (Figure 4-3-6).

Motion—client moves the testing extremity in the direction of elbow flexion.

Therapist Position: Stabilize at the humerus to avoid compensation. Support the testing extremity to eliminate gravity; however, do not assist the motion. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The biceps brachii is palpated on the volar aspect of the distal/medial humerus when the forearm is in supination.

Brachialis

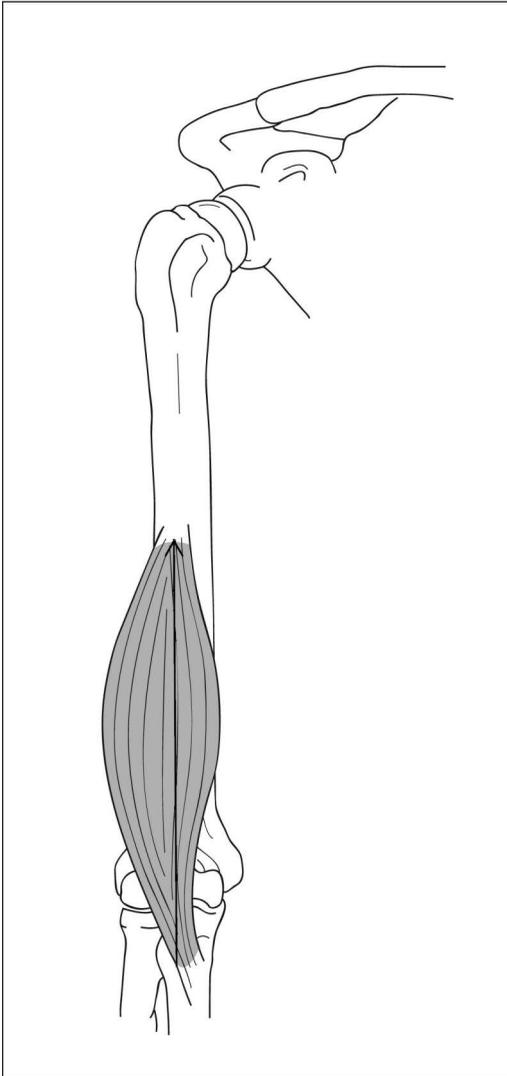


Figure 4-3-7.

Origin: Distal 1/2 of the anterior aspect of the humerus and medial/lateral intermuscular septa

Insertion: Tuberosity and coronoid process of the ulna

Innervation: Musculocutaneous and radial nerves

Action: Elbow flexion



Figure 4-3-8.



Figure 4-3-9.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity in humeral adduction, elbow extension, and forearm pronation (Figure 4-3-8).

Motion—client moves the testing extremity in the direction of elbow flexion, while remaining in forearm pronation (Figure 4-3-9).

Therapist Position: Stabilize at the humerus to avoid compensation. Resistance is applied at the mid-forearm, in the direction of elbow extension when testing Normal or Good strengths. No resistance is applied when testing Fair strength.



Figure 4-3-10.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

Client Position: Starting—client is sitting with the testing extremity in 90 degrees of humeral flexion or abduction, elbow extension, and forearm pronation, supported on a table or by the therapist (Figure 4-3-10).

Motion—client moves the testing extremity in the direction of elbow flexion while remaining in forearm pronation.

Therapist Position: Stabilize at the humerus to avoid compensation. Support the testing extremity to eliminate gravity; however, do not assist the motion. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The brachialis is palpated medial to the biceps brachii tendon when the forearm is in pronation.

Brachioradialis



Origin: Proximal, lateral supracondylar ridge of humerus

Insertion: Lateral side of radial styloid process

Innervation: Radial nerve

Action: Elbow flexion

Figure 4-3-11.



Figure 4-3-12.



Figure 4-3-13.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity in humeral adduction, elbow extension, and the forearm in neutral (Figure 4-3-12).

Motion—client moves the testing extremity in the direction of elbow flexion, while the forearm remains in neutral (Figure 4-3-13).

Therapist Position: Stabilize at the humerus to avoid compensation. Resistance is applied at the mid-forearm in the direction of elbow extension when testing Normal or Good strengths. No resistance is applied when testing Fair strength.



Figure 4-3-14.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

Client Position: Starting—client is sitting with the testing extremity in 90 degrees of humeral flexion or abduction, elbow extension, and forearm in neutral, supported on a table or by the therapist (Figure 4-3-14).

Motion—client moves the testing extremity in the direction of elbow flexion while the forearm remains in neutral.

Therapist Position: Stabilize the humerus to avoid compensation. Support the testing extremity to eliminate gravity; however, do not assist the motion. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The brachioradialis is palpated at the distal/lateral humerus when the forearm is in neutral.

Elbow Extension Assessment: Goniometry

Plane: Sagittal

Axis: Frontal

Normal ROM: 135-0 degrees

End feel: Firm



Figure 4-3-15.

Client Position: Client is seated.

Starting—testing extremity is resting at side, elbow fully flexed, forearm supinated (Figure 4-3-15).

Ending—client moves the testing extremity into maximum elbow extension (Figure 4-3-16).



Figure 4-3-16.

Therapist Position: Observe at the humerus and shoulder to prevent compensation.

Goniometer Position:

FULCRUM: lateral epicondyle of the humerus

STABLE ARM: midline of lateral surface of the humerus

MOVABLE ARM: midline of lateral surface of the radius

Isolated Muscle Testing

Prime Movers: Triceps brachii and Anconeus

Triceps brachii and Anconeus (tested together)

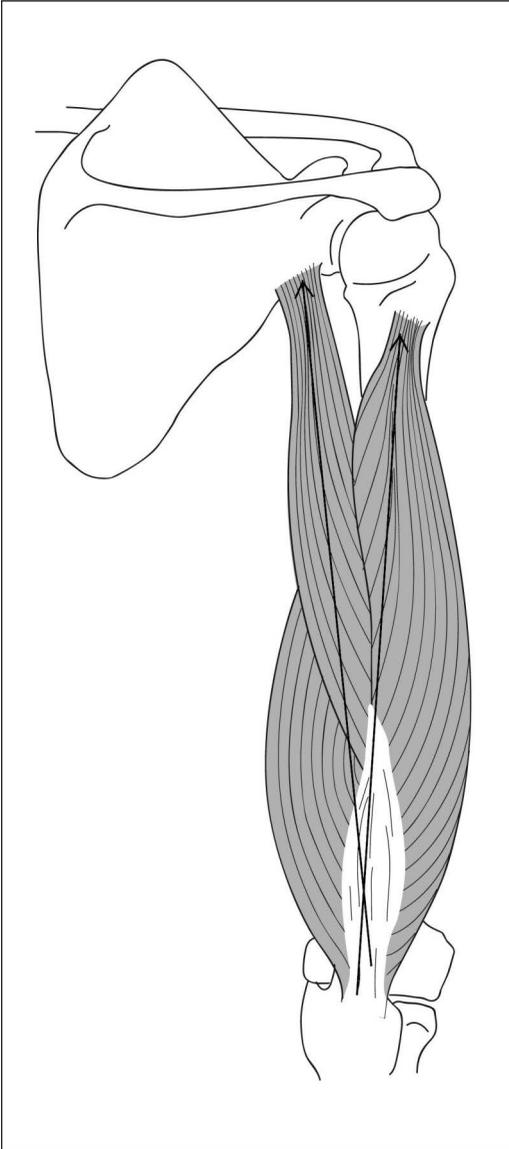


Figure 4-3-17A.

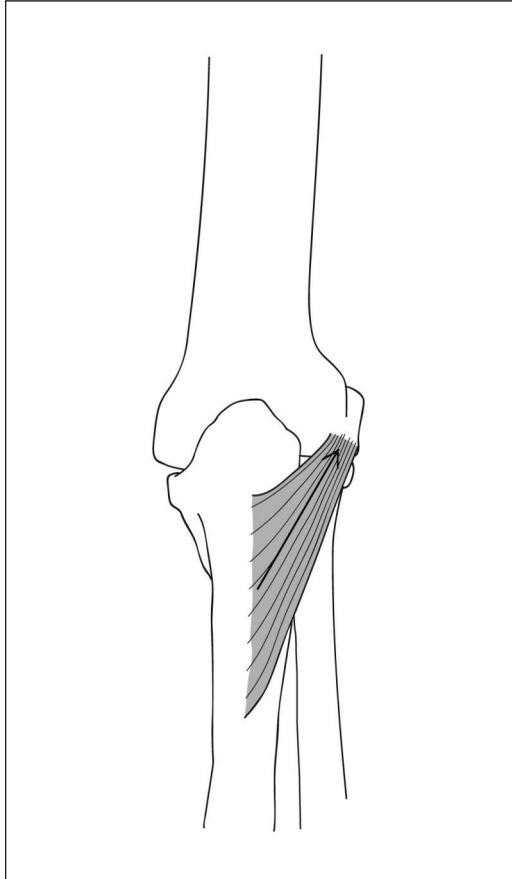


Figure 4-3-17B.

Triceps

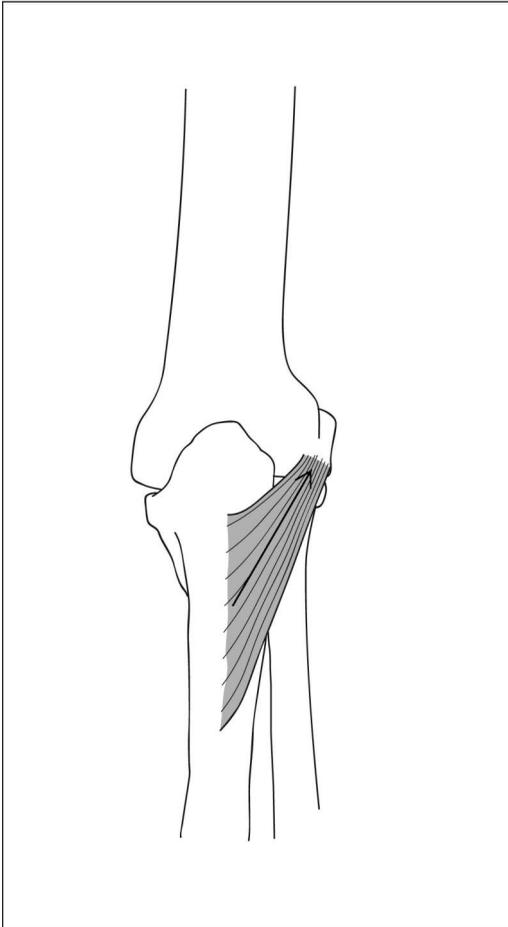
Origin: Long head—infraglenoid tubercle of the scapula. Lateral head—posterolateral surface of the humerus between the radial groove and the insertion of teres minor. Medial head—posterior surface of the humerus below the radial groove

Insertion: Posterior surface of olecranon process

Innervation: Radial nerve

Action: Elbow extension

Anconeus



Origin: Lateral epicondyle of the humerus
Insertion: Lateral side of olecranon process and upper 1/4 of ulna
Innervation: Radial nerve
Action: Elbow extension

Figure 4-3-18.



Figure 4-3-19.



Figure 4-3-20.



Figure 4-3-21.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is supine with the testing extremity in humeral flexion, elbow flexion, and forearm supination (Figure 4-3-19).

Motion—client moves the testing extremity in the direction of elbow extension (Figure 4-3-20).

Therapist Position: Stabilize at the humerus to avoid compensation. Resistance is applied at the posterior aspect of the forearm in the direction of elbow flexion when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

Client Position: Starting—client is sitting with the testing extremity in humeral flexion or abduction, elbow flexion, and forearm is neutral, supported on a table or by the therapist (Figure 4-3-21).

Motion—client moves the testing extremity in the direction of elbow extension.

Therapist Position: Stabilize at the humerus to avoid compensation. Support the testing extremity to eliminate gravity; however, do not assist the motion. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The triceps are palpated at the posterior, mid-humerus. The anconeus is too deep to be palpated.

Alternate Position

Standing or sitting with the testing extremity in 180 degrees of humeral flexion, elbow flexion, and forearm supination.

Forearm Supination Assessment: Goniometry

Plane: Transverse

Axis: Vertical

Normal ROM: 0-90 degrees

End feel: Firm



Figure 4-3-22.

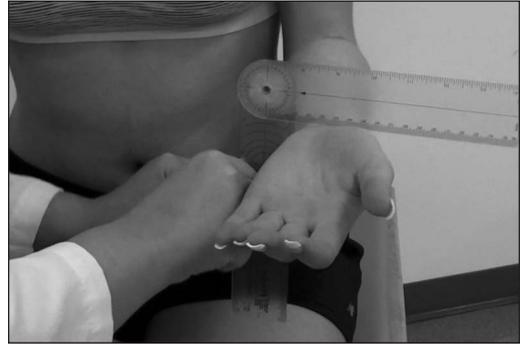


Figure 4-3-23.

Client Position: Client is sitting with feet on the floor.

Starting—testing extremity is at client's side, humerus adducted, elbow flexed to 90 degrees, forearm in neutral (Figure 4-3-22).

Ending—client moves the testing extremity into maximum forearm supination (Figure 4-3-23).

Therapist Position: Observe at the humerus and elbow to prevent compensation of humerus moving away from the trunk.

Goniometer Position:

FULCRUM: volar surface of distal forearm one centimeter proximal to the pisiform

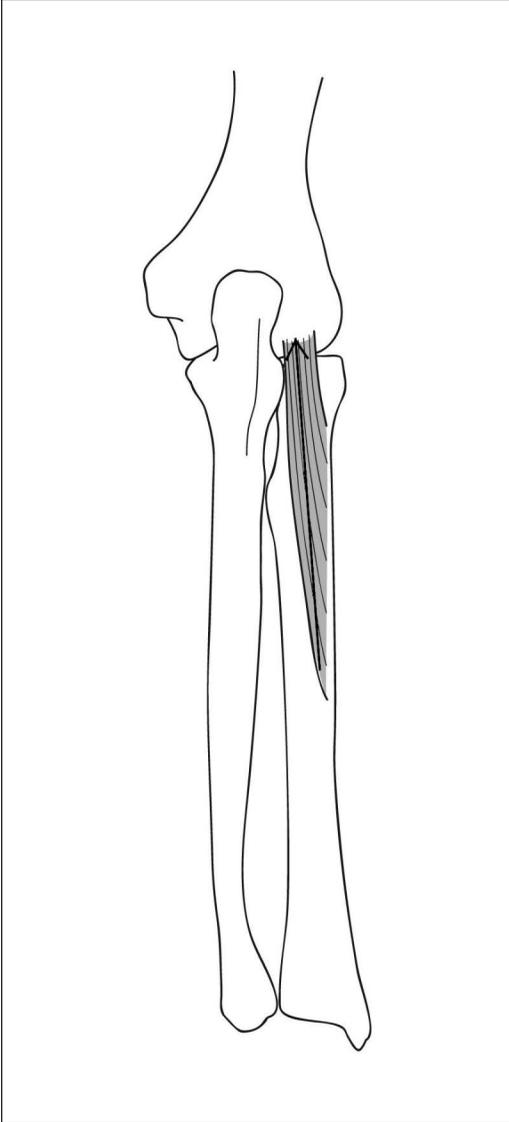
STABLE ARM: perpendicular to the floor

MOVABLE ARM: across the volar aspect of the distal forearm

Isolated Muscle Testing

Prime Movers: Supinator, Biceps brachii

Supinator



Origin: Lateral epicondyle of the humerus
Insertion: Proximal 1/3 of the radius
Innervation: Posterior interosseus branch of the radial nerve
Action: Forearm supination

Figure 4-3-24.



Figure 4-3-25.



Figure 4-3-26.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity in adduction, 90 degrees of elbow flexion, and forearm pronation. (Figure 4-3-25).

Motion:client moves the testing extremity in the direction of forearm supination (Figure 4-3-26).

Therapist Position: Stabilize at the distal humerus to avoid compensation. Resistance is applied at the posterior aspect of the distal end of the forearm in the direction of forearm pronation when testing Normal or Good strengths. No resistance is applied when testing Fair strength.



Figure 4-3-27.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

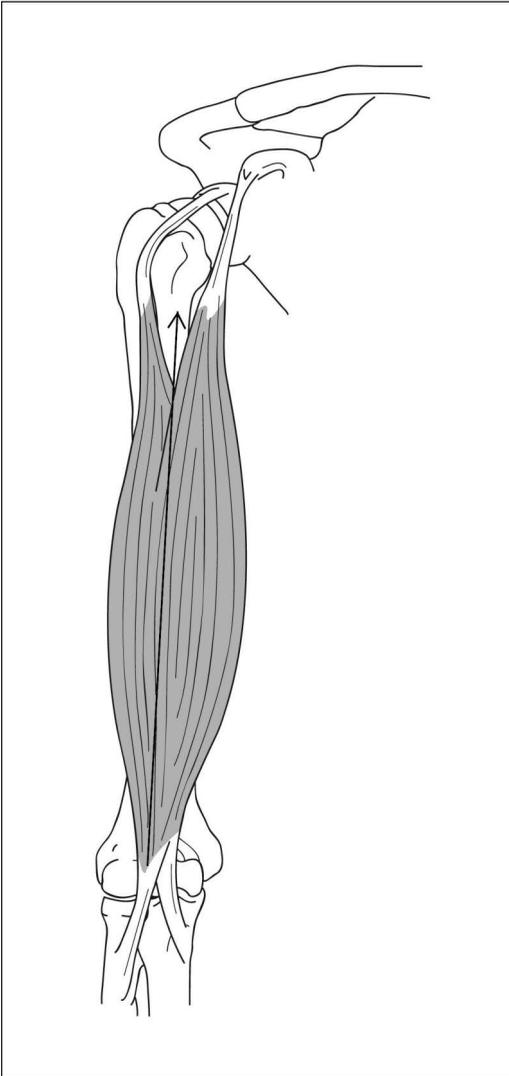
Client Position: Starting—client is sitting with the testing extremity in humeral flexion, elbow flexion, and forearm pronation with the elbow supported on the table (Figure 4-3-27).

Motion:client moves the testing extremity in the direction of forearm supination.

Therapist Position: Stabilize at the humerus to avoid compensation. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The supinator is palpated at the posterior, proximal forearm over the radius.

Biceps brachii



Origin: Short head—scapular coracoid process; long head—scapular supraglenoid process

Insertion: Short head—posterior aspect of radial tuberosity; long head—bicipital aponeurosis

Innervation: Musculocutaneous nerve

Action: Elbow flexion, forearm supination

Figure 4-3-3.



Figure 4-3-4.



Figure 4-3-5.



Figure 4-3-6.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Client is sitting with the testing extremity in humeral adduction, elbow extension, and forearm supination (Figure 4-3-4).

Motion—client moves the testing extremity in the direction of elbow flexion (Figure 4-3-5).

Therapist Position: Stabilize at the humerus to avoid compensation. Resistance is applied at the forearm in the direction of elbow extension when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

Client Position: Starting—client is sitting with the testing extremity in 90 degrees of humeral flexion or abduction, elbow extension, and forearm in supination, supported on a table or by the therapist (Figure 4-3-6).

Motion—client moves the testing extremity in the direction of elbow flexion.

Therapist Position: Stabilize at the humerus to avoid compensation. Support the testing extremity to eliminate gravity; however, do not assist the motion. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The biceps brachii is palpated on the volar aspect of the distal/medial humerus when the forearm is in supination.

Forearm Pronation Assessment: Goniometry

Plane: Transverse

Axis: Vertical

Normal ROM: 0-90 degrees

End feel: Hard



Figure 4-3-28.



Figure 4-3-29.

Client Position: Client is sitting with feet on the floor.

Starting—testing extremity is at client's side, humerus adducted, elbow flexed to 90 degrees, forearm in neutral (Figure 4-3-28).

Ending—client moves the testing extremity into maximum forearm pronation (Figure 4-3-29).

Therapist Position: Observe at the humerus and elbow to prevent compensation of humerus moving away from the trunk.

Goniometer Position:

FULCRUM: ulnar styloid process

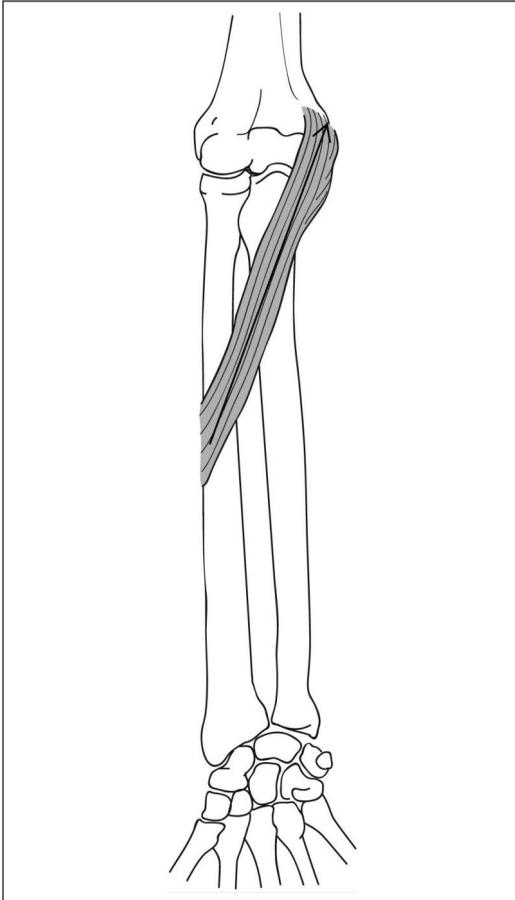
STABLE ARM: perpendicular to the floor

MOVABLE ARM: across dorsal surface of the distal forearm

Isolated Muscle Testing

Prime Movers: Pronator teres, Pronator quadratus

Pronator teres



Origin: Humeral head—proximal to the medial epicondyle and common flexor tendon. Ulnar head—medial side of coronoid process of ulna

Insertion: Lateral surface of radial shaft

Innervation: Median nerve

Action: Forearm pronation

Figure 4-3-30.



Figure 4-3-31.



Figure 4-3-32.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity in humeral adduction, partial elbow flexion, and forearm supination (Figure 4-3-31).

Motion—client moves the testing extremity in the direction of forearm pronation (Figure 4-3-32).

Therapist Position: Stabilize at the humerus. Resistance is applied at the posterior aspect of the distal end of the forearm in the direction of forearm supination when testing Normal or Good strengths. No resistance is applied when testing Fair strength.



Figure 4-3-33.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

Client Position: Starting—client is sitting with the testing extremity in 90 degrees of humeral flexion, elbow partially flexed, and forearm in supination with elbow supported on a table (Figure 4-3-33).

Motion—client moves the testing extremity in the direction of forearm pronation.

Therapist Position: Stabilize at the humerus. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The pronator teres is palpated at the anterior, proximal forearm between the radius and the ulna.

Pronator quadratus

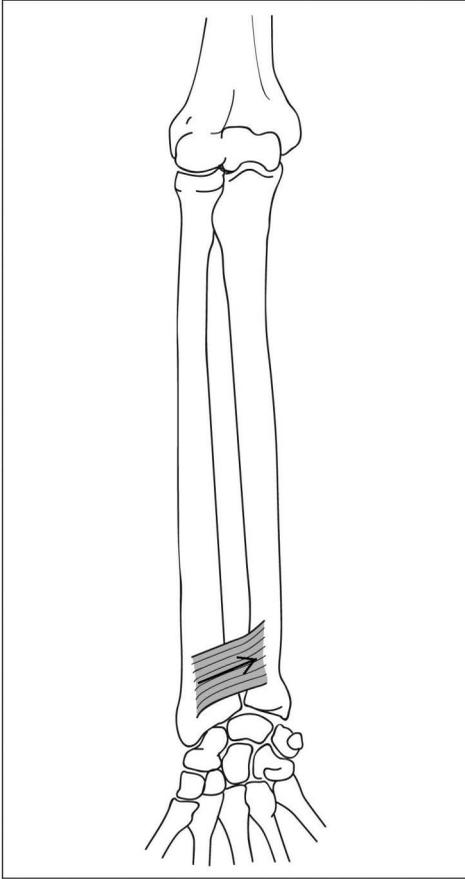


Figure 4-3-34.

Origin: Distal 1/4 of the anterior surface of the ulnar shaft

Insertion: Distal 1/4 of the anterior surface of the radial shaft

Innervation: Anterior interosseous branch of the median nerve

Action: Forearm pronation



Figure 4-3-35.



Figure 4-3-36.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity in humeral adduction, elbow fully flexed, and forearm supinated (Figure 4-3-35).

Motion—client moves the testing extremity in the direction of forearm pronation (Figure 4-3-36).

Therapist Position: Stabilize at the humerus to avoid compensation. Resistance is applied at the posterior aspect of the distal end of the forearm in the direction of forearm supination when testing Normal or Good strengths. No resistance is applied when testing Fair strength.



Figure 4-3-37.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

Client Position: Starting—client is sitting with the testing extremity in 90 degrees of humeral flexion, elbow fully flexed, and forearm in supination with the elbow supported on the table (Figure 4-3-37).

Motion—client moves the testing extremity in the direction of forearm pronation.

Therapist Position: Stabilize at the humerus to avoid compensation. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The pronator quadratus is too deep to palpate.

Wrist Flexion Assessment: Goniometry

Plane: Sagittal

Axis: Frontal

Normal ROM: 0-80 degrees

End feel: Firm



Figure 4-3-38.



Figure 4-3-39.

Client Position: Client is sitting with feet on the floor.

Starting—testing extremity is resting on table with the humerus abducted, elbow flexed, forearm supinated for wrist flexion (Figure 4-3-38). The distal forearm is placed on the end of a table so that the wrist is free to move through the full range.

Ending—client moves the testing extremity through maximum wrist flexion (Figure 4-3-39).

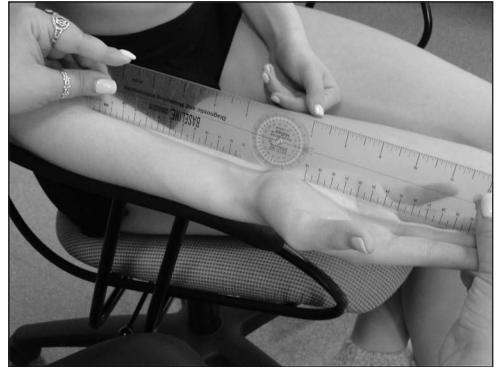


Figure 4-3-38A.



Figure 4-3-39A.

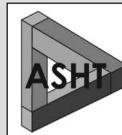
Therapist Position: Observe at the forearm to prevent compensation.

Goniometer Position:

FULCRUM: medial aspect of ulnar styloid process

STABLE ARM: midline of ulna

MOVABLE ARM: midline of fifth metacarpal

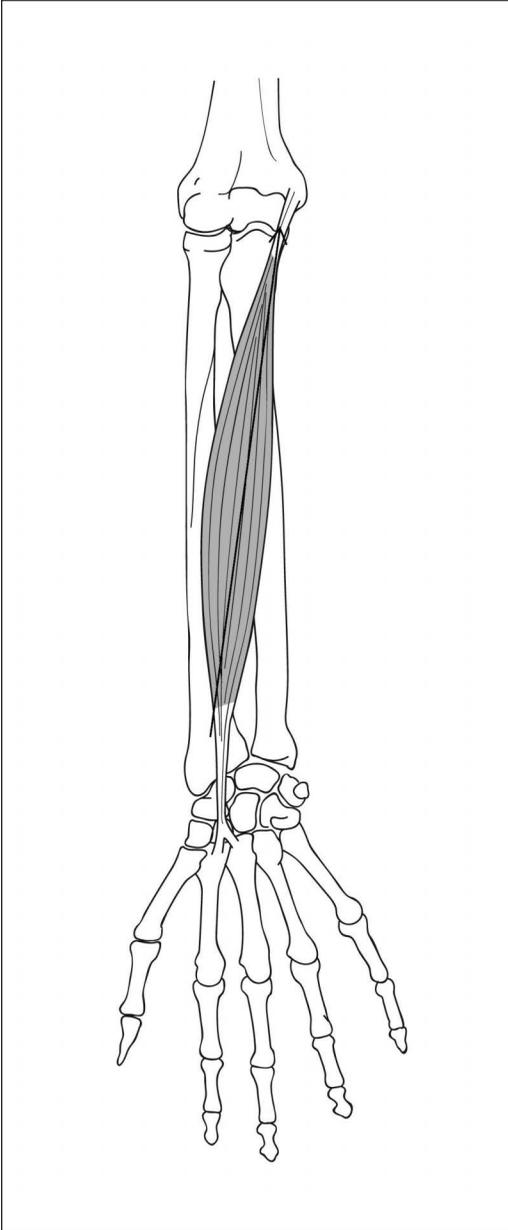


ASHT guideline recommendations for the measurement of wrist flexion places the goniometer on the dorsal surface of the wrist with the stable arm parallel to the radius and the movable arm parallel to the third metacarpal (Figures 4-3-39 and 4-3-39a; The American Society of Hand Therapists, 2015).

Isolated Muscle Testing

Prime Movers: Flexor carpi radialis, Flexor carpi ulnaris

Flexor carpi radialis



Origin: Medial epicondyle, common extensor tendon

Insertion: Base of the second metacarpal

Innervation: Median nerve

Action: Wrist flexion, wrist radial deviation

Figure 4-3-40.



Figure 4-3-41.



Figure 4-3-42.



Figure 4-3-43.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity on a table with the forearm in supination, and the wrist over the edge of the table in slight extension (Figure 4-3-41).

Motion:client moves the testing extremity in the directions of both wrist flexion and wrist radial deviation (Figure 4-3-42).

Therapist Position: Stabilize at the distal forearm to avoid compensation. Resistance is applied at the second metacarpal in the directions of both extension and ulnar deviation when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

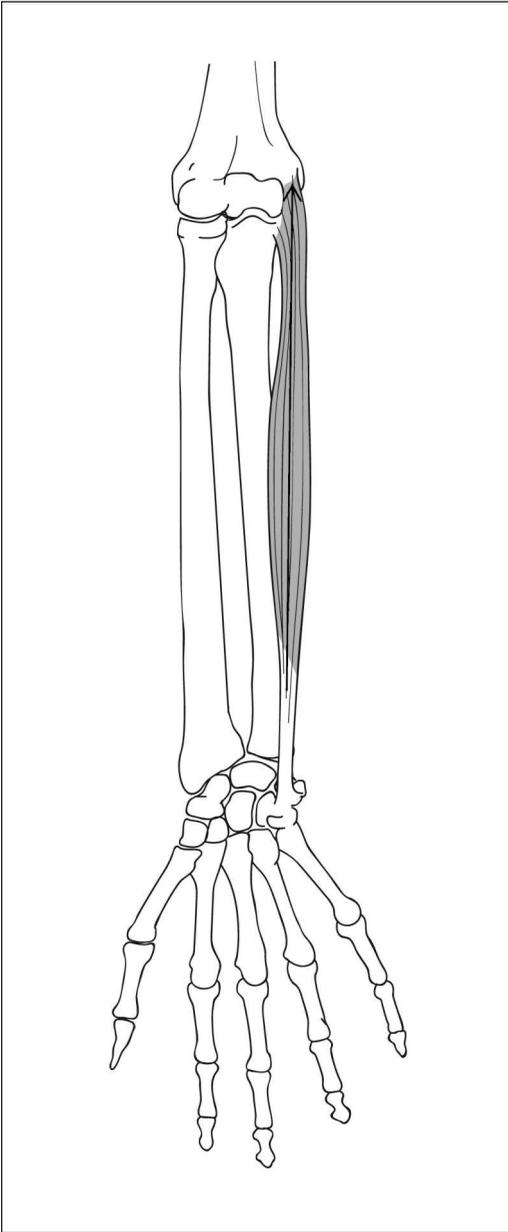
Client Position: Starting—client is sitting with the testing extremity on a table with the wrist in neutral and the forearm in supination (Figure 4-3-43).

Motion:client moves the testing extremity in the directions of both wrist flexion and wrist radial deviation.

Therapist Position: Stabilize at the distal forearm to avoid compensation. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The flexor carpi radialis is palpated on the anterior surface of the forearm in line with the second metacarpal, just lateral to the palmaris longus.

Flexor carpi ulnaris



Origin: Medial epicondyle, common flexor tendon, proximal ulna

Insertion: Pisiform bone

Innervation: Ulnar nerve

Action: Wrist flexion, wrist ulnar deviation

Figure 4-3-44.



Figure 4-3-45.



Figure 4-3-46.



Figure 4-3-47.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity on a table with the forearm in supination, and the wrist over the edge of the table in slight extension (Figure 4-3-45).

Motion—client moves the testing extremity in the directions of both wrist flexion and wrist ulnar deviation (Figure 4-3-46).

Therapist Position: Stabilize at the distal forearm to avoid compensation. Resistance is applied at the fifth metacarpal in the directions of both extension and radial deviation when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

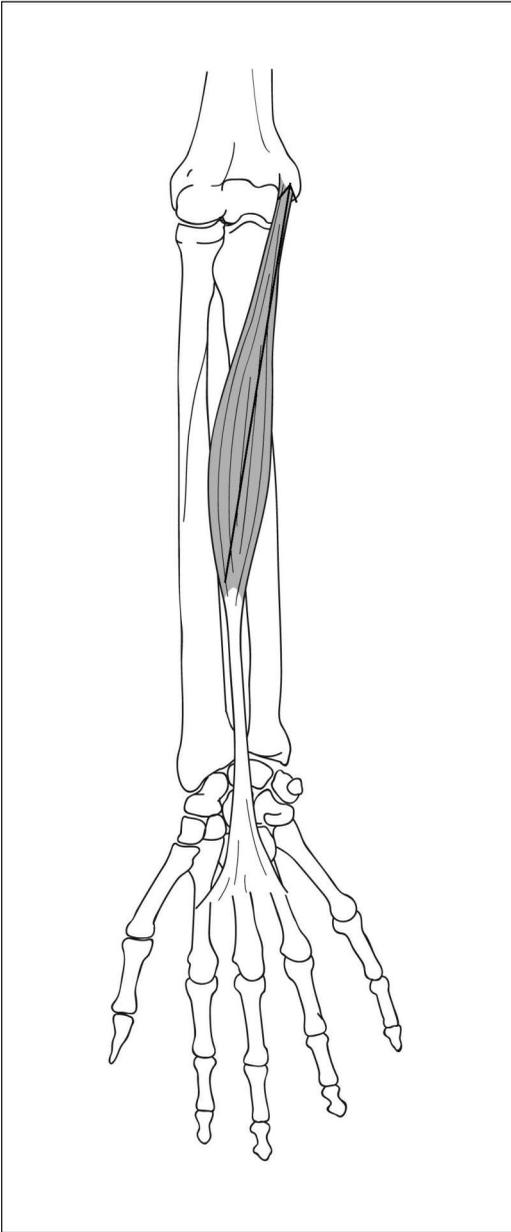
Client Position: Starting—client is sitting with the testing extremity on a table with the wrist in neutral and the forearm in supination (Figure 4-3-47).

Motion—client moves the testing extremity in the directions of both wrist flexion and wrist ulnar deviation.

Therapist Position: Stabilize at the distal forearm to avoid compensation. No resistance is applied when testing in the gravity-eliminated position.

Palpation: Flexor carpi ulnaris is palpated proximal to the pisiform bone on the anterior/distal forearm.

Palmaris longus



Origin: Medial epicondyle, common flexor tendon
Insertion: Palmar aponeurosis
Innervation: Median nerve
Action: Wrist flexion

Figure 4-3-48.

Palmaris longus is not tested in isolation because it is a weak flexor, and only 80% of the population actually have this muscle. To determine if an individual has this muscle, ask the client to strongly flex the wrist while cupping all fingers together. Both the palmaris longus and the flexor carpi radialis should be prominent at the distal forearm.

Wrist Extension Assessment: Goniometry

Plane: Sagittal

Axis: Frontal

Normal ROM: 0-70

End feel: Firm



Figure 4-3-49.

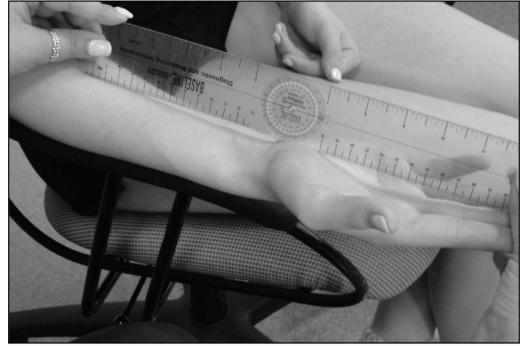


Figure 4-3-49A.



Figure 4-3-50.

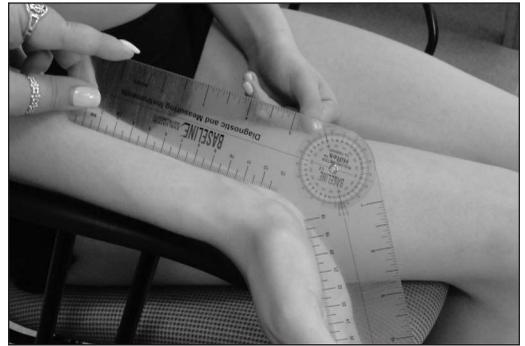


Figure 4-3-50A.

Client Position: Client is sitting with feet on the floor.

Starting—testing extremity is resting on table with the humerus abducted, elbow flexed, forearm pronated for wrist extension (Figure 4-3-49). The distal forearm is placed on the end of a table so that the wrist is free to move through the full range.

Ending—client moves the testing extremity through maximum wrist extension (Figure 4-3-50).

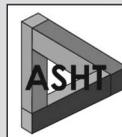
Therapist Position: Observe at the forearm to prevent compensation.

Goniometer Position:

FULCRUM: medial aspect of ulnar styloid process

STABLE ARM: midline of ulna

MOVABLE ARM: midline of fifth metacarpal



ASHT guideline recommendations for the measurement of wrist extension places the goniometer on the volar surface of the wrist with the stable arm parallel to the radius and the movable arm parallel to the third metacarpal (Figures 4-3-49a and 4-3-50a; American Society of Hand Therapists, 2015).

Isolated Muscle Testing

Prime Movers: Extensor carpi radialis Longus, Extensor carpi radialis brevis, Extensor carpi ulnaris

Extensor carpi radialis longus (ECRL) and Extensor carpi radialis brevis (ECRB)

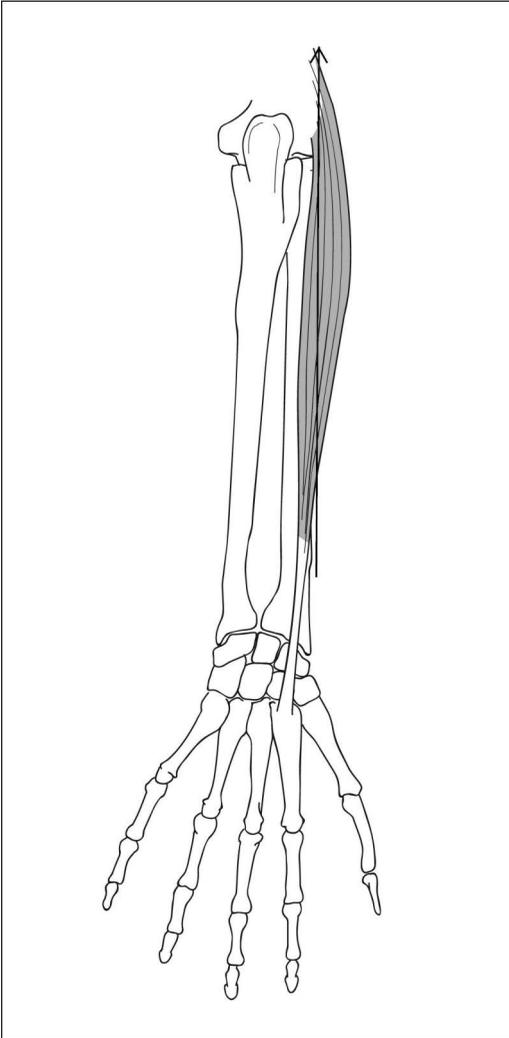


Figure 4-3-51.

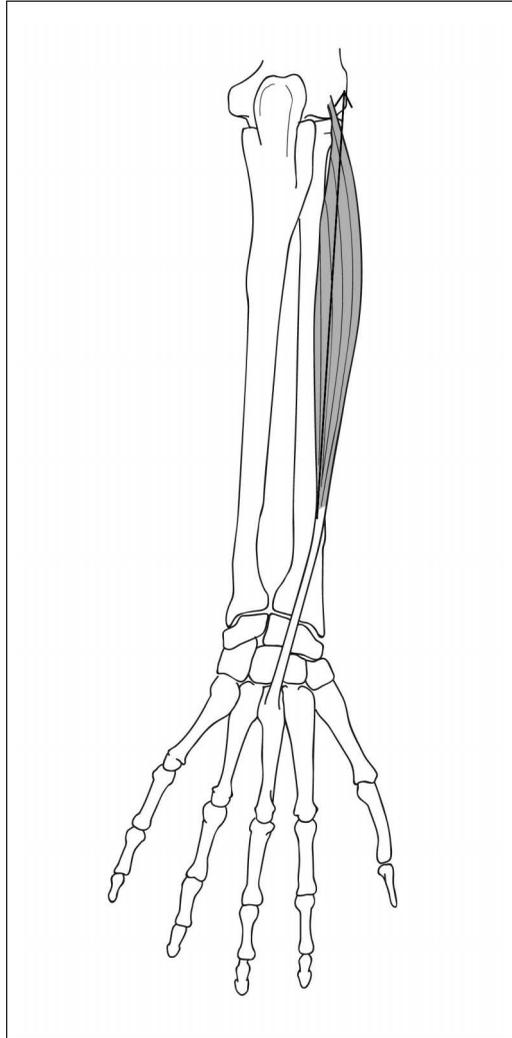


Figure 4-3-52.

Origin: Lateral supracondylar ridge, lateral epicondyle, common extensor tendon

Insertion: Base of the second metacarpal

Innervation: Radial nerve

Action: Wrist extension and wrist radial deviation



Figure 4-3-53.



Figure 4-3-54.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity on a table with the forearm in slightly less than full pronation, and the wrist over the edge of the table in slight flexion. To isolate ECRL, elbow is flexed to 30 degrees (Figure 4-3-53).

Motion:client moves the testing extremity in the directions of both wrist extension and wrist radial deviation (Figure 4-3-54).

Therapist Position: Stabilize at the distal forearm to avoid compensation. Resistance is applied at the second metacarpal in the directions of both wrist flexion and wrist ulnar deviation when testing Normal or Good strengths. No resistance is applied when testing Fair strength.



Figure 4-3-55.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

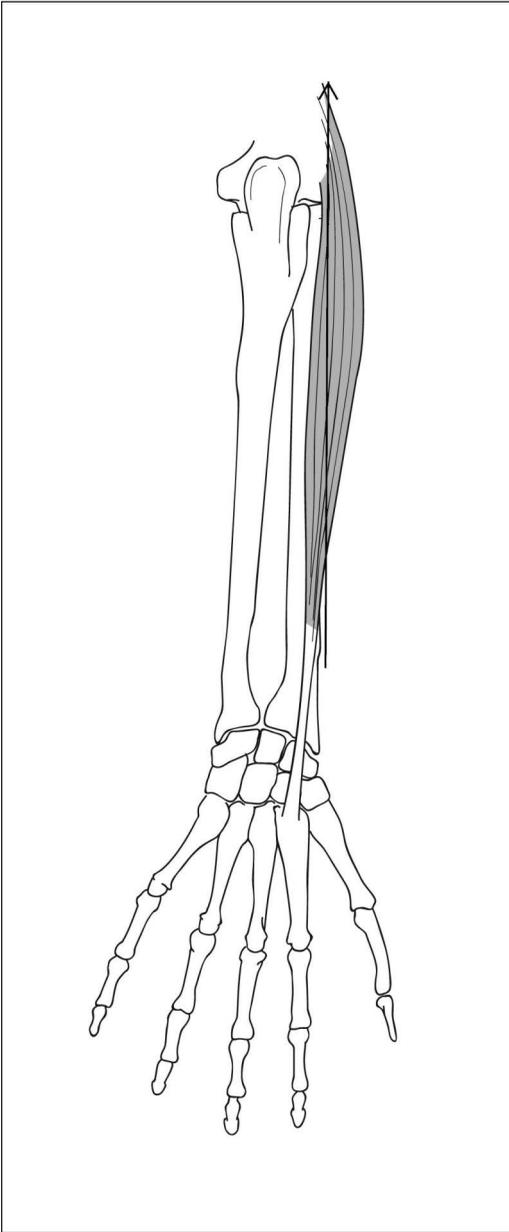
Client Position: Starting—client is sitting with the testing extremity on a table with the wrist in neutral and the forearm in pronation. To isolate ECRL, elbow is flexed to 30 degrees (Figure 4-3-55).

Motion:client moves the testing extremity in the directions of both wrist extension and wrist radial deviation.

Therapist Position: Stabilize at the distal forearm to avoid compensation. No resistance is applied when testing in the gravity-eliminated position.

Palpation: Extensor carpi radialis longus can be palpated at the distal/dorsal forearm, at the base of the second metacarpal.

Extensor carpi radialis brevis (ECRB)



Origin: Lateral epicondyle, common extensor tendon

Insertion: Base of the third metacarpal

Innervation: Radial nerve

Action: Wrist extension and wrist radial deviation

Figure 4-3-56.



Figure 4-3-57.



Figure 4-3-58.



Figure 4-3-59.

Against Gravity: Fair (3), Good (4), Normal (5)

Client Position: Starting—client is sitting with the testing extremity on a table with the forearm in slightly less than full pronation, and the wrist over the edge of the table in slight flexion. To isolate ECRB, elbow is in full flexion (Figure 4-3-57).

Motion—client moves the testing extremity in the directions of both wrist extension and wrist radial deviation (Figure 4-3-58).

Therapist Position: Stabilize at the distal forearm to avoid compensation. Resistance is applied at the second metacarpal in the directions of both wrist flexion and wrist ulnar deviation when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

Gravity Eliminated: Zero (0), Trace (1), Poor (2)

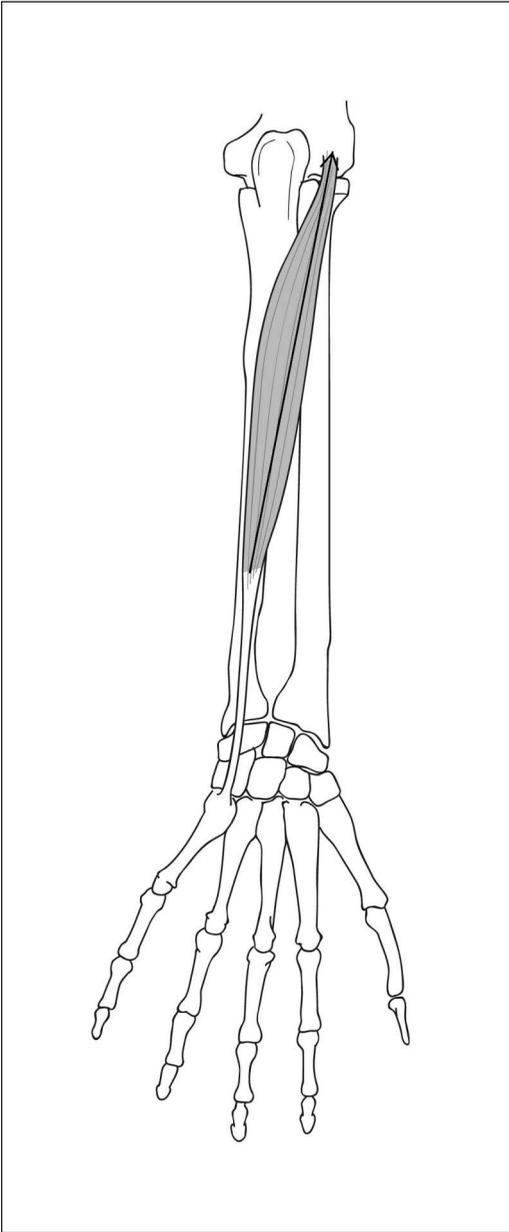
Client Position: Starting—client is sitting with the testing extremity on a table with the wrist in neutral and the forearm in pronation. To isolate ECRB, elbow is in full flexion (Figure 4-3-59).

Motion—client moves the testing extremity in the directions of both wrist extension and wrist radial deviation.

Therapist Position: Stabilize at the distal forearm to avoid compensation. No resistance is applied when testing in the gravity-eliminated position.

Palpation: Extensor carpi radialis brevis can be palpated at the distal/dorsal forearm, at the base of the third metacarpal.

Extensor carpi ulnaris



Origin: Lateral epicondyle, common extensor tendon, proximal ulna

Insertion: Base of the fifth metacarpal

Innervation: Radial nerve

Action: Wrist extension, wrist ulnar deviation

Figure 4-3-60.



Figure 4-3-61.



Figure 4-3-62.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity on a table with the forearm in pronation, and the wrist over the edge of the table in slight flexion (Figure 4-3-61). Motion—client moves the testing extremity in the directions of both wrist extension and wrist ulnar deviation (Figure 4-3-62).

Therapist Position: Stabilize at the distal forearm to avoid compensation. Resistance is applied at the fifth metacarpal in the directions of both wrist flexion and wrist radial deviation when testing Normal or Good strengths. No resistance is applied when testing Fair strength.



Figure 4-3-63.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

Client Position: Starting—client is sitting with the testing extremity on a table with the wrist in neutral and the forearm in pronation (Figure 4-3-63).

Motion—client moves the testing extremity in the directions of both wrist extension and wrist ulnar deviation.

Therapist Position: Stabilize at the distal forearm to avoid compensation. No resistance is applied when testing in the gravity-eliminated position.

Palpation: Extensor carpi ulnaris can be palpated on the dorsal wrist between the base of the fifth metacarpal and the ulnar styloid process.

Wrist Radial Deviation Assessment: Goniometry

Plane: Frontal

Axis: Sagittal

Normal ROM: 0-20

End feel: Hard



Figure 4-3-64.

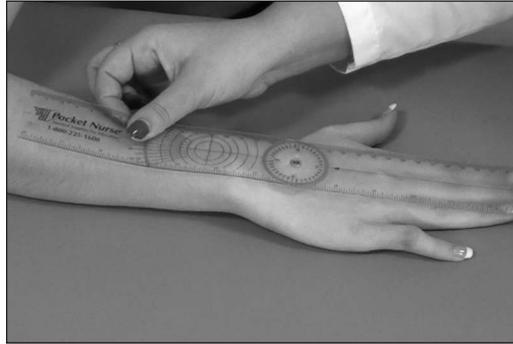


Figure 4-3-65.

Client Position: Client is sitting with feet on the floor.

Starting—testing extremity is resting on the table with the humerus abducted, elbow flexed, forearm pronated. Forearm is placed on the table with the palm flat. Wrist is in neutral (Figure 4-3-64).

Ending—client moves the testing extremity through maximum wrist radial deviation (Figure 4-3-65).

Therapist Position: Observe at the distal forearm to prevent compensation.

Goniometer Position:

FULCRUM: base of the third metacarpal, over the capitate bone

STABLE ARM: midline of the forearm

MOVABLE ARM: midline of the third metacarpal

Isolated Muscle Testing

Prime Movers: Extensor carpi radialis longus, Extensor carpi radialis brevis, Flexor carpi radialis

Extensor carpi radialis longus (ECRL) and Extensor carpi radialis brevis (ECRB)

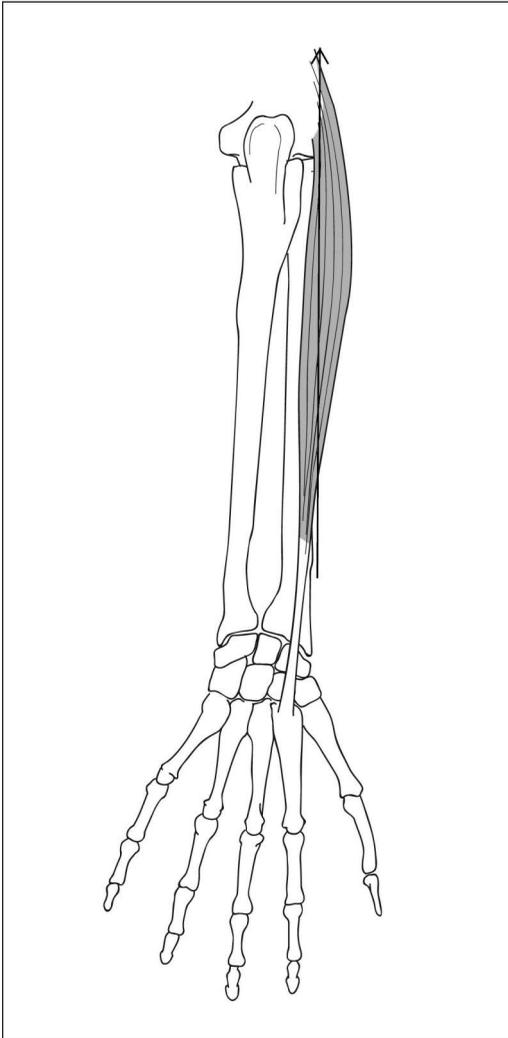


Figure 4-3-51.

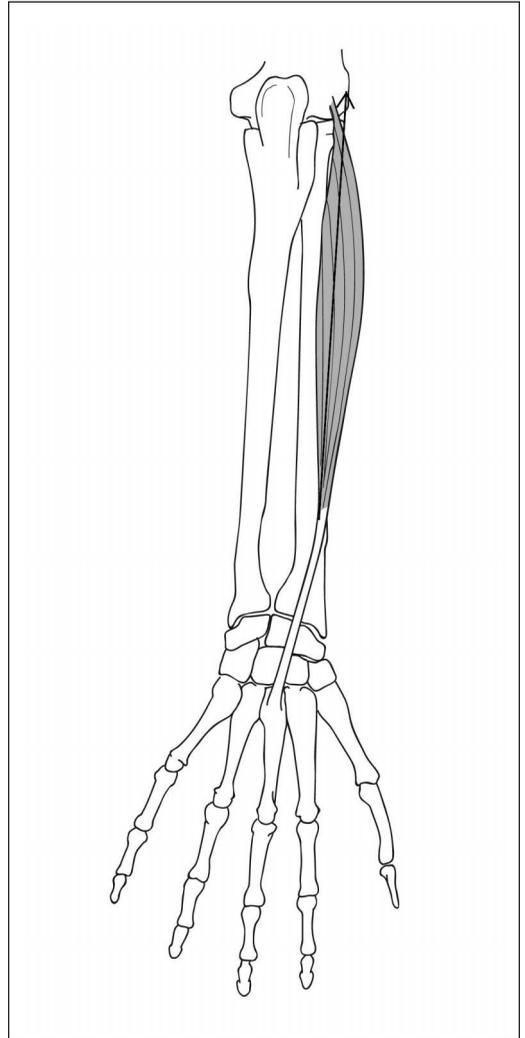


Figure 4-3-52.

Origin: Lateral supracondylar ridge, lateral epicondyle, common extensor tendon

Insertion: Base of the second metacarpal

Innervation: Radial nerve

Action: Wrist extension and wrist radial deviation



Figure 4-3-53.



Figure 4-3-54.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity on a table with the forearm in slightly less than full pronation, and the wrist over the edge of the table in slight flexion. To isolate ECRL, elbow is flexed to 30 degrees (Figure 4-3-53).

Motion—client moves the testing extremity in the directions of both wrist extension and wrist radial deviation (Figure 4-3-54).

Therapist Position: Stabilize at the distal forearm to avoid compensation. Resistance is applied at the second metacarpal in the directions of both wrist flexion and wrist ulnar deviation when testing Normal or Good strengths. No resistance is applied when testing Fair strength.



Figure 4-3-55.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

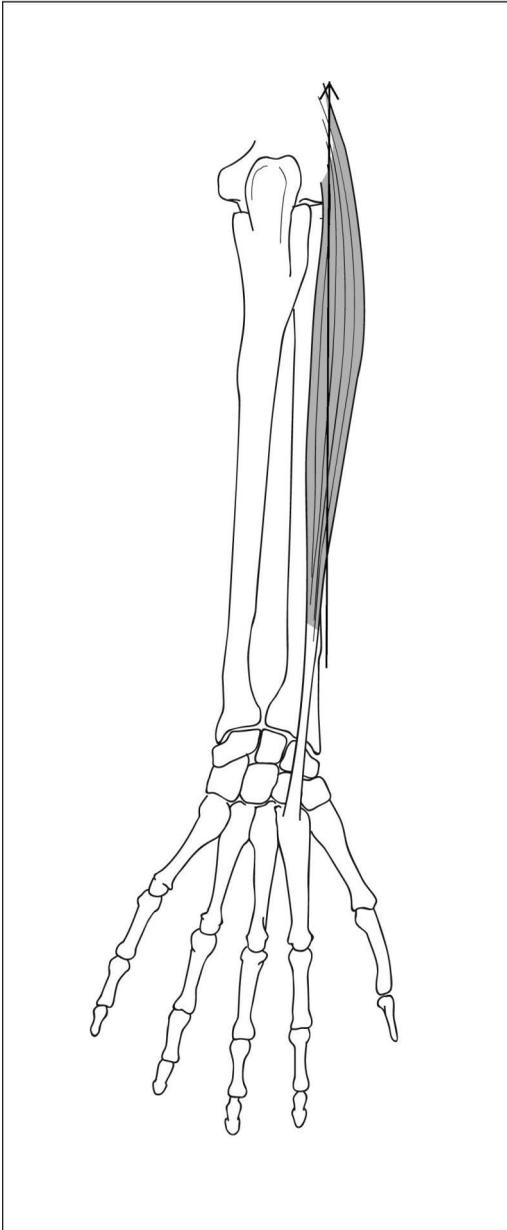
Client Position: Starting—client is sitting with the testing extremity on a table with the wrist in neutral and the forearm in pronation. To isolate ECRL, elbow is flexed to 30 degrees (Figure 4-3-55).

Motion—client moves the testing extremity in the directions of both wrist extension and wrist radial deviation.

Therapist Position: Stabilize at the distal forearm to avoid compensation. No resistance is applied when testing in the gravity-eliminated position.

Palpation: Extensor carpi radialis longus can be palpated at the distal/dorsal forearm, at the base of the second metacarpal.

Extensor carpi radialis brevis (ECRB)



Origin: Lateral epicondyle, common extensor tendon

Insertion: Base of the third metacarpal

Innervation: Radial nerve

Action: Wrist extension and wrist radial deviation

Figure 4-3-56.



Figure 4-3-57.



Figure 4-3-58.



Figure 4-3-59.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity on a table with the forearm in slightly less than full pronation, and the wrist over the edge of the table in slight flexion. To isolate ECRB, elbow is in full flexion (Figure 4-3-57).

Motion—client moves the testing extremity in the directions of both wrist extension and wrist radial deviation (Figure 4-3-58).

Therapist Position: Stabilize at the distal forearm to avoid compensation. Resistance is applied at the second metacarpal in the directions of both wrist flexion and wrist ulnar deviation when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

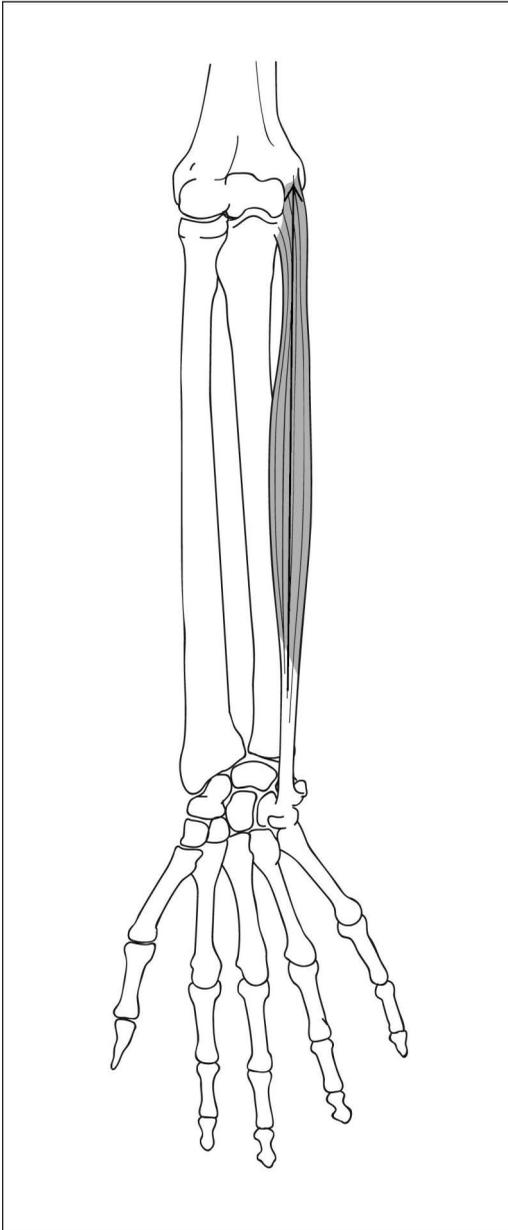
Client Position: Starting—client is sitting with the testing extremity on a table with the wrist in neutral and the forearm in pronation. To isolate ECRB, elbow is in full flexion (Figure 4-3-59).

Motion—client moves the testing extremity in the directions of both wrist extension and wrist radial deviation.

Therapist Position: Stabilize at the distal forearm to avoid compensation. No resistance is applied when testing in the gravity-eliminated position.

Palpation: Extensor carpi radialis brevis can be palpated at the distal/dorsal forearm, at the base of the third metacarpal.

Flexor carpi ulnaris



Origin: Medial epicondyle, common flexor tendon, proximal ulna

Insertion: Pisiform bone

Innervation: Ulnar nerve

Action: Wrist flexion, wrist ulnar deviation

Figure 4-3-44.



Figure 4-3-45.



Figure 4-3-46.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity on a table with the forearm in supination, and the wrist over the edge of the table in slight extension (Figure 4-3-45).

Motion—client moves the testing extremity in the directions of both wrist flexion and wrist ulnar deviation (Figure 4-3-46).

Therapist Position: Stabilize at the distal forearm to avoid compensation. Resistance is applied at the fifth metacarpal in the directions of both extension and radial deviation when testing Normal or Good strengths. No resistance is applied when testing Fair strength.



Figure 4-3-47.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

Client Position: Starting—client is sitting with the testing extremity on a table with the wrist in neutral and the forearm in supination (Figure 4-3-47).

Motion—client moves the testing extremity in the directions of both wrist flexion and wrist ulnar deviation.

Therapist Position: Stabilize at the distal forearm to avoid compensation. No resistance is applied when testing in the gravity-eliminated position.

Palpation: Flexor carpi ulnaris is palpated proximal to the pisiform bone on the anterior/distal forearm.

Wrist Ulnar Deviation Assessment: Goniometry

Plane: Frontal

Axis: Sagittal

Normal ROM: 0-30

End feel: Firm



Figure 4-3-66.

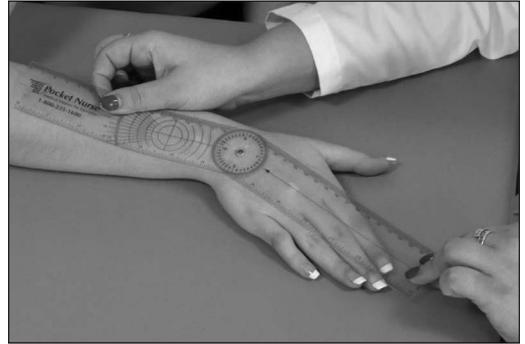


Figure 4-3-67.

Client Position: Client is sitting with feet on the floor.

Starting—testing extremity is resting on the table with the humerus abducted, elbow flexed, forearm pronated. Forearm is placed on the table with the palm flat. Wrist is in neutral (Figure 4-3-66).

Ending—client moves the testing extremity through maximum wrist ulnar deviation (Figure 4-3-67).

Therapist Position: Observe at the distal forearm to prevent compensation.

Goniometer Position:

FULCRUM: base of the third metacarpal, over the capitate bone

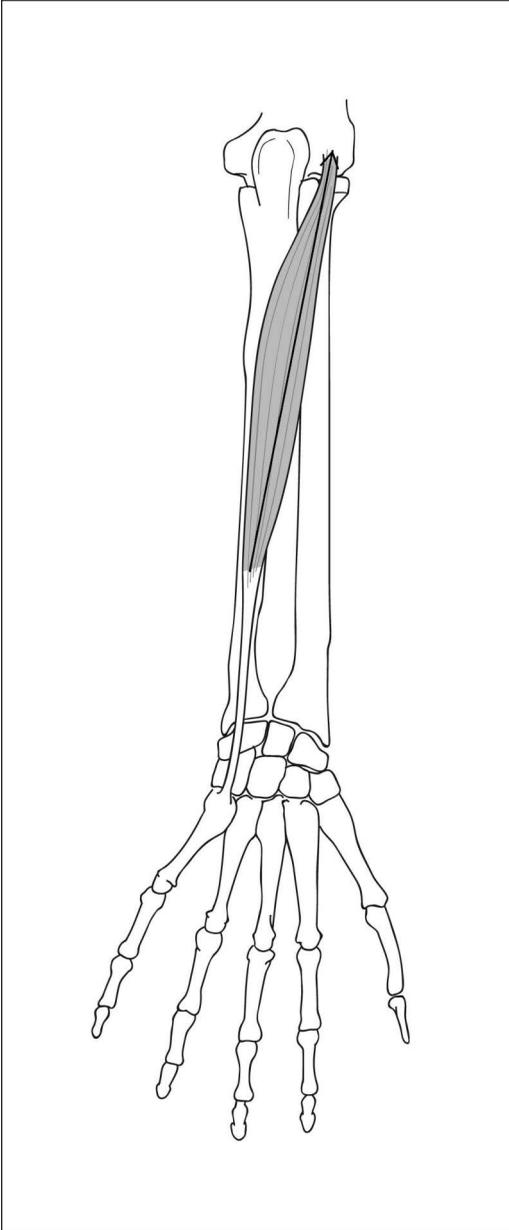
STABLE ARM: midline of the forearm

MOVABLE ARM: midline of the third metacarpal

Isolated Muscle Testing

Prime Movers: Extensor carpi ulnaris, Flexor carpi ulnaris

Extensor carpi ulnaris



Origin: Lateral epicondyle, common extensor tendon, proximal ulna

Insertion: Base of the fifth metacarpal

Innervation: Radial nerve

Action: Wrist extension, wrist ulnar deviation

Figure 4-3-60.



Figure 4-3-61.



Figure 4-3-62.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity on a table with the forearm in pronation, and the wrist over the edge of the table in slight flexion (Figure 4-3-61). Motion—client moves the testing extremity in the directions of both wrist extension and wrist ulnar deviation (Figure 4-3-62).

Therapist Position: Stabilize at the distal forearm to avoid compensation. Resistance is applied at the fifth metacarpal in the directions of both wrist flexion and wrist radial deviation when testing Normal or Good strengths. No resistance is applied when testing Fair strength.



Figure 4-3-63.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

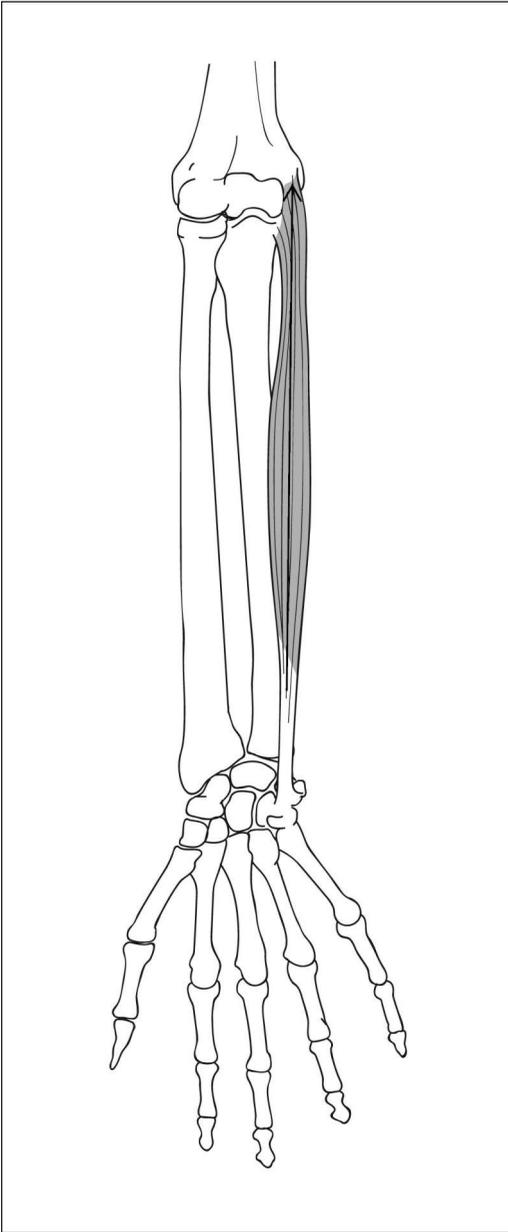
Client Position: Starting—client is sitting with the testing extremity on a table with the wrist in neutral and the forearm in pronation (Figure 4-3-63).

Motion—client moves the testing extremity in the directions of both wrist extension and wrist ulnar deviation.

Therapist Position: Stabilize at the distal forearm to avoid compensation. No resistance is applied when testing in the gravity-eliminated position.

Palpation: Extensor carpi ulnaris can be palpated on the dorsal wrist between the base of the fifth metacarpal and the ulnar styloid process.

Flexor carpi ulnaris



Origin: Medial epicondyle, common flexor tendon, proximal ulna

Insertion: Pisiform bone

Innervation: Ulnar nerve

Action: Wrist flexion, wrist ulnar deviation

Figure 4-3-44.



Figure 4-3-45.



Figure 4-3-46.



Figure 4-3-47.

Against Gravity - Fair (3), Good (4), Normal (5)

Client Position: Starting—client is sitting with the testing extremity on a table with the forearm in supination, and the wrist over the edge of the table in slight extension (Figure 4-3-45).

Motion:—client moves the testing extremity in the directions of both wrist flexion and wrist ulnar deviation (Figure 4-3-46).

Therapist Position: Stabilize at the distal forearm to avoid compensation. Resistance is applied at the fifth metacarpal in the directions of both extension and radial deviation when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

Gravity Eliminated - Zero (0), Trace (1), Poor (2)

Client Position: Starting—client is sitting with the testing extremity on a table with the wrist in neutral and the forearm in supination (Figure 4-3-47).

Motion:—client moves the testing extremity in the directions of both wrist flexion and wrist ulnar deviation.

Therapist Position: Stabilize at the distal forearm to avoid compensation. No resistance is applied when testing in the gravity-eliminated position.

Palpation: Flexor carpi ulnaris is palpated proximal to the pisiform bone on the anterior/distal forearm.

Table 4-4

ELBOW, FOREARM, AND WRIST ASSESSMENT AT A GLANCE

FUNCTIONAL MUSCLE GROUP	PLANE	AXIS	FUNCTIONAL ACTIVITY ANALYSIS	NORMAL ROM	GROSS MUSCLE TESTING PROCEDURE
<i>Elbow Flexion</i>	Sagittal	Frontal	Bringing spoon from dinner plate on table to mouth.	0 to 135 degrees	<p>Primary Muscles: Bicep brachii, Brachialis, Brachioradialis</p> <p>Position: Client is seated with arm in shoulder adduction, elbow extension and moves testing arm toward elbow flexion</p> <p>Stabilize: At the humerus to avoid compensation</p> <p>Resist: Applied at the distal anterior aspect of forearm towards elbow extension</p>
<i>Elbow Extension</i>	Sagittal	Frontal	Reaching out to turn up the volume of the radio in the car.	135 to 0 degrees	<p>Primary Muscles: Triceps, Anconeus</p> <p>Position: Client is seated with arm in shoulder adduction, elbow extension and moves testing arm toward elbow extension</p> <p>Stabilize: At the humerus to avoid compensation</p> <p>Resist: Applied at the distal forearm toward elbow flexion</p>
<i>Forearm Supination</i>	Transverse	Vertical	Pouring a glass of orange juice.	0 to 90 degrees	<p>Primary Muscles: Pronator teres, Pronator quadratus</p> <p>Position: Client is seated with arm in shoulder adduction, elbow flexed to 90 degrees and forearm in neutral and moves the testing arm toward forearm pronation</p> <p>Stabilize: At the elbow to prevent compensation</p> <p>Resist: Applied at the distal forearm, toward supination</p>
<i>Wrist Flexion</i>	Sagittal	Frontal	Buttoning a shirt.	0 to 80 degrees	<p>Prime Movers: Flexor carpi radialis, Flexor carpi ulnaris</p> <p>Position: Client is seated with arm on a table, forearm in supination and moves toward wrist flexion</p> <p>Stabilize: At the distal forearm to prevent compensation</p> <p>Resist: Applied to the palm of the hand toward wrist extension</p>

(continued)

Table 4-4 (continued)

ELBOW, FOREARM, AND WRIST ASSESSMENT AT A GLANCE

<i>Wrist Extension</i>	Sagittal	Frontal	Grasping toothbrush while brushing teeth.	0 to 70 degrees	<p>Prime Movers: Extensor carpi radialis longus, Extensor carpi radialis brevis, Extensor carpi ulnaris</p> <p>Position: Client is seated with arm on the table, forearm in pronation and moves toward wrist extension</p> <p>Stabilize: At the distal forearm to prevent compensation</p> <p>Resist: Applied on the back of the hand toward wrist flexion</p>
<i>Wrist Radial Deviation</i>	Frontal	Sagittal	Opening the jar of pickles (counterclockwise with right hand; clockwise with left hand).	0 to 20 degrees	<p>Prime Movers: Extensor carpi radialis longus, Extensor carpi radialis brevis, Flexor carpi radialis</p> <p>Position: Client is seated with arm at rest, elbow flexed to 90 degrees, forearm pronation and moves toward wrist radial deviation</p> <p>Stabilize: At the distal forearm to prevent compensation</p> <p>Resist: Applied at the second metacarpal toward wrist ulnar deviation</p>
<i>Wrist Ulnar Deviation</i>	Frontal	Sagittal	Tightening the lid on the jar of tomato sauce (clockwise with right hand; counterclockwise with left hand).	0 to 30 degrees	<p>Prime Movers: Extensor carpi ulnaris, Flexor carpi ulnaris</p> <p>Position: Client is seated with arm at rest, elbow flexed to 90 degrees, forearm pronation and moves toward wrist ulnar deviation</p> <p>Stabilize: At the distal forearm to prevent compensation</p> <p>Resist: Applied at the fifth metacarpal toward wrist radial deviation when testing normal and good strengths</p>

SECTION 4-4: The Hand

KEY BONY LANDMARKS	
<i>Bone</i>	<i>Landmark</i>
Ulna	Olecranon and olecranon process
	Styloid process
Radius	Styloid process
Carpals	Lunate
	Scaphoid
	Triquetrum
	Pisiform
	Trapezium
	Trapezoid
	Capitate
Hamate	
Metacarpals	Digits I-V
Phalanges	Distal phalanx (I-V)
	Middle phalanx (II-V)
	Proximal phalanx (I-V)

Metacarpal Phalangeal (MCP/MP) Flexion Assessment: Goniometry

Plane: Sagittal

Axis: Frontal

Normal ROM: 0-90

End feel: Hard



Figure 4-4-1.



Figure 4-4-2.

Client Position: Client is sitting with feet on the floor.

Starting—elbow of testing extremity is resting on table with the humerus slightly flexed and forearm in neutral. MCPs are in neutral when measuring MCP flexion (Figure 4-4-1).

Ending—client moves the testing extremity through maximal MCP flexion (Figure 4-4-2).

Therapist Position: Observe at the metacarpals and the wrist to prevent compensation.

Goniometer Position:

FULCRUM: dorsal surface of the MCP joint that is being measured

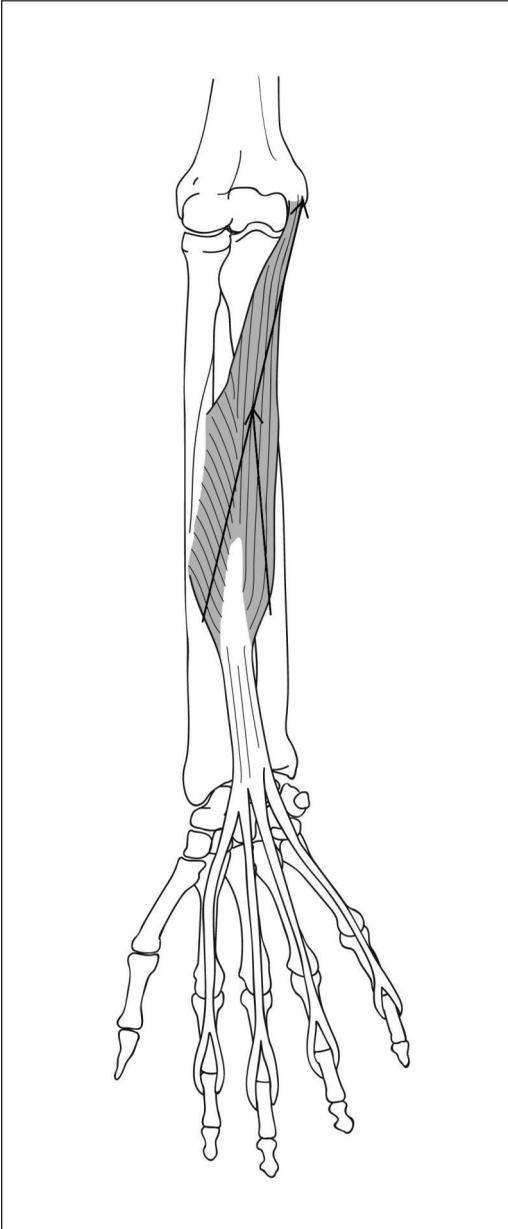
STABLE ARM: midline and dorsal surface of the metacarpal of the digit being measured

MOVABLE ARM: midline and dorsal surface of the proximal phalanx of the digit being measured

Isolated Muscle Testing

Prime Movers: Flexor digitorum superficialis, Flexor digitorum profundus, Lumbricals (digits II-V); Flexor pollicis brevis (digit I); Flexor digiti minimi (digit V)

Flexor digitorum superficialis



Origin: Medial epicondyle, coronoid process, ulna, proximal radius

Insertion: Lateral and medial surface of the middle phalanx of digits II-V

Innervation: Median nerve

Action: Flexion of the digit PIP joint

Figure 4-4-3.



Figure 4-4-4.



Figure 4-4-5.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity placed on the table in forearm supination and digit extension (Figure 4-4-4).

Motion:—client moves the testing extremity in the direction of PIP flexion with MCPs remaining in extension (Figure 4-4-5).

Therapist Position: Stabilize at the proximal phalanx to avoid compensation. Resistance is applied at the middle phalanx in the direction of PIP extension when testing Normal or Good strengths. No resistance is applied when testing Fair strength.



Figure 4-4-6.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

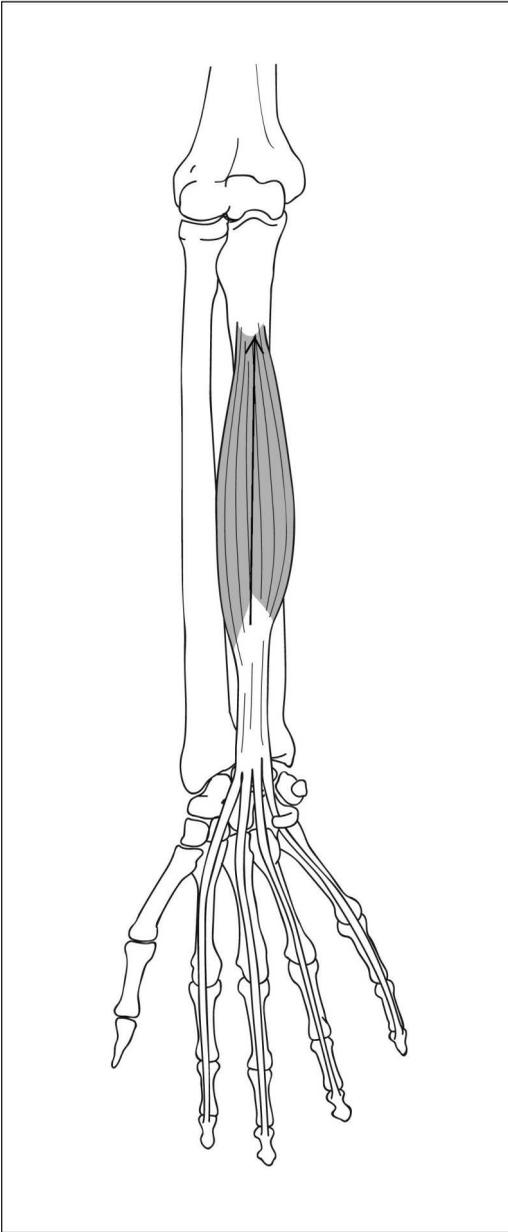
Client Position: Starting—client is sitting with the testing extremity placed on a table in forearm neutral rotation and digit extension (Figure 4-4-6).

Motion:—client moves the testing extremity in the direction of PIP flexion.

Therapist Position: Stabilize at the proximal phalanx to avoid compensation. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The flexor digitorum superficialis is palpated either on the proximal phalanx or on the volar surface of the wrist between the palmaris longus and the flexor carpi ulnaris tendons.

Flexor digitorum profundus



Origin: Body of the ulna

Insertion: Through the insertions of the flexor digitorum superficialis onto the distal phalanx of digits II-V

Innervation: Ulnar nerve (digits IV and V), Median nerve (digits II and III)

Action: Flexion of the digit DIP joint

Figure 4-4-7.



Figure 4-4-8.



Figure 4-4-9.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity placed on a table in forearm supination and digit extension (Figure 4-4-8).

Motion:—client moves the testing extremity in the direction of DIP flexion with MCPs and PIPs remaining in extension (Figure 4-4-9).

Therapist Position: Stabilize at the middle phalanx to avoid compensation. Resistance is applied at the distal phalanx when testing Normal or Good strengths. No resistance is applied when testing Fair strength.



Figure 4-4-10.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

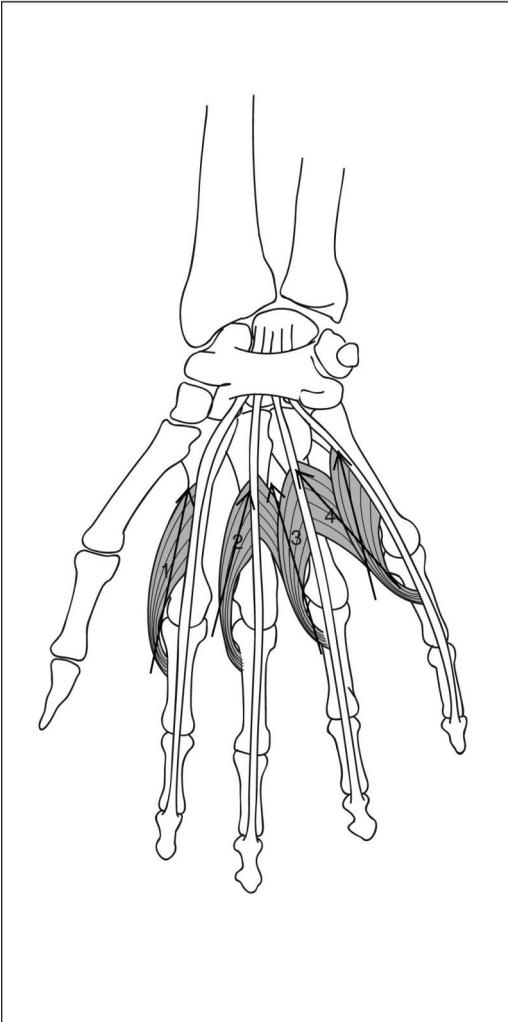
Client Position: Starting—client is sitting with the testing extremity placed on a table in forearm neutral rotation and digit extension (Figure 4-4-10).

Motion:—client moves the testing extremity in the direction of DIP flexion.

Therapist Position: Stabilize at the middle phalanx to avoid compensation. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The flexor digitorum profundus tendon can be palpated over the middle phalanges of the digits, palmar surface.

Lumbricals



Origin: First—FDP digit II tendon
Second—FDP digit III tendon
Third—FDP digit III and IV tendons
Fourth—FDP digit IV and V tendons

Insertion: Radial side dorsal aponeurosis

Innervation: First and second—median nerve,
third and fourth—ulnar nerve

Action: MCP flexion and PIP/DIP extension

Figure 4-4-11.



Figure 4-4-12.



Figure 4-4-13.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity placed on a table in forearm supination and MCP extension/PIP and DIP flexion (Figure 4-4-12).

Motion:—client moves the testing extremity in the direction of MCP flexion while PIP and DIP enter extension (Figure 4-4-13).

Therapist Position: Stabilize at the metacarpals to avoid compensation. Resistance is applied at the proximal phalanx in the direction of MCP extension when testing Normal or Good strengths. No resistance is applied when testing Fair strength.



Figure 4-4-14.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

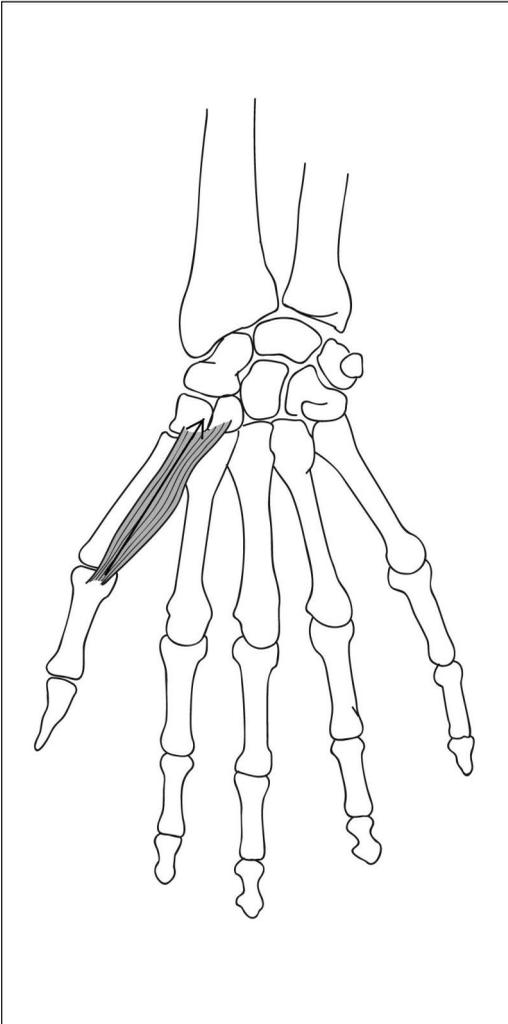
Client Position: Starting—client is sitting with the testing extremity placed on a table in forearm neutral rotation, and MCP extension/PIP and DIP flexion (Figure 4-4-14).

Motion:—client moves the testing extremity in the direction of MCP flexion while PIP and DIP enter extension.

Therapist Position: Stabilize at the metacarpals to avoid compensation. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The lumbricals are too deep for palpation.

Flexor pollicis brevis



Origin: Trapezium, trapezoid

Insertion: Base of the first digit proximal phalanx

Innervation: Median and ulnar nerves

Action: Thumb MCP flexion, and assist with CMC flexion

Figure 4-4-15.



Figure 4-4-16.



Figure 4-4-17.



Figure 4-4-18.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity placed on the table in forearm supination (Figure 4-4-16).

Motion:—client moves the testing extremity in the direction of thumb MCP flexion (Figure 4-4-17).

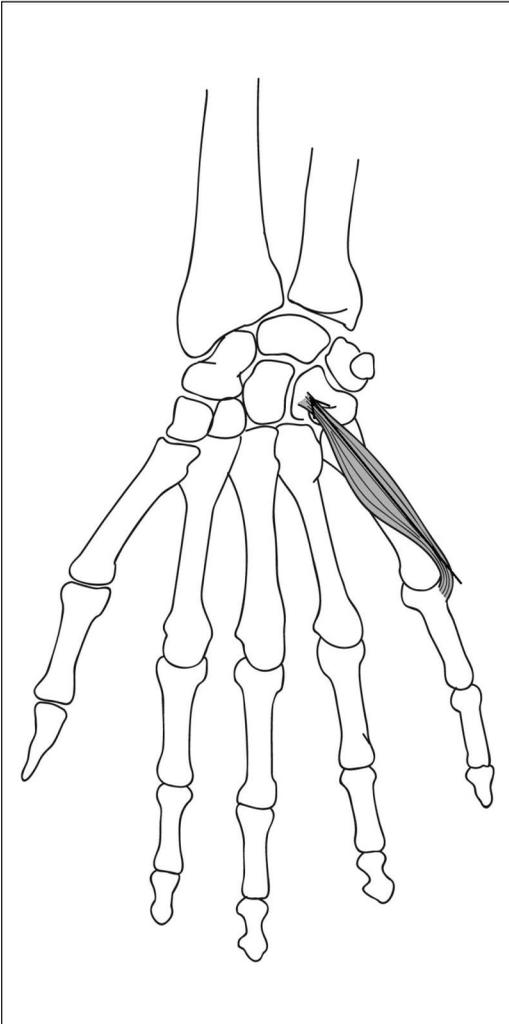
Therapist Position: Stabilize at the metacarpal to eliminate any compensation. Resistance is applied at the proximal phalanx of the thumb in the direction of MCP extension when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

The testing positions are the same as above. A grade of poor is given when the client can move the testing extremity through only a small portion of the range in this position (Figure 4-4-18).

Palpation: Flexor pollicis brevis is palpated over the first metacarpal, palmar surface.

Flexor digiti minimi



Origin: Hook of hamate

Insertion: Base of the fifth digit proximal phalanx, ulnar side

Innervation: Ulnar nerve

Action: Fifth digit MCP flexion

Figure 4-4-19.



Figure 4-4-20.



Figure 4-4-21.



Figure 4-4-22.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity placed on the table with the forearm in supination (Figure 4-4-20).
Motion—client moves the fifth digit in the direction of MCP flexion (Figure 4-4-21).

Therapist Position: Stabilize at the fifth metacarpal. Resistance is applied at the fifth proximal phalanx in the direction of MCP extension when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

Client Position: Starting—client is sitting with the testing extremity placed on the table with the forearm in neutral.
Motion—client moves the fifth digit in the direction of MCP flexion.

Therapist Position: Stabilize at the fifth metacarpal. No resistance is applied when testing in the gravity-eliminated position.
Palpation: The flexor digiti minimi tendon is palpated over the proximal phalanx of the fifth digit, palmar surface.

MCP/MP Extension/Hyperextension Assessment: Goniometry

Plane: Sagittal

Axis: Frontal

Normal ROM: 90-0 extension; 0-30 hyperextension (digits II-V)

End feel: Firm



Figure 4-4-23.



Figure 4-4-25.



Figure 4-4-24.



Figure 4-4-26.

Client Position: Client is sitting with feet on the floor.

Starting—elbow of testing extremity is resting on table with the humerus slightly flexed and forearm in neutral. MCPs are in neutral when measuring MCP extension/hyperextension (Figures 4-4-23 and 4-4-25).

Ending—client moves the testing extremity through maximal MCP extension/hyperextension (Figures 4-4-24 and 4-4-26).

Therapist Position: Observe at the metacarpals and the wrist to prevent compensation.

Goniometer Position:

FULCRUM: dorsal surface of the MCP joint that is being measured

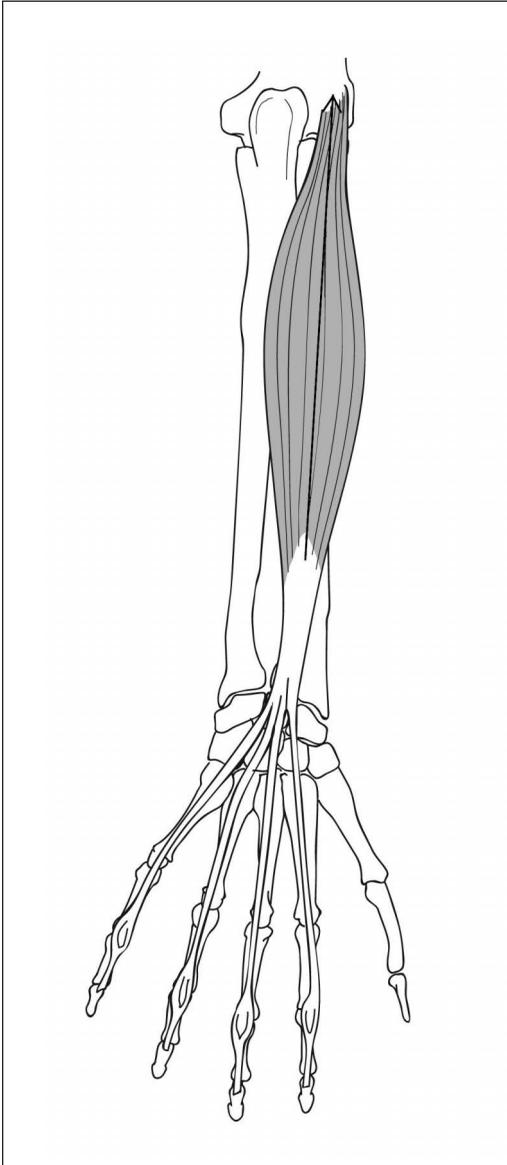
STABLE ARM: midline and dorsal surface of the metacarpal of the digit being measured

MOVABLE ARM: midline and dorsal surface of the proximal phalanx of the digit being measured

Isolated Muscle Testing

Prime Movers: Extensor digitorum (digits II-V); Extensor indicis (digit II), Extensor digiti minimi (digit V), Extensor pollicis brevis (digit I)

Extensor digitorum (tested with Extensor indicis [digit II] and Extensor digiti minimi [digit V])



Origin: Lateral epicondyle

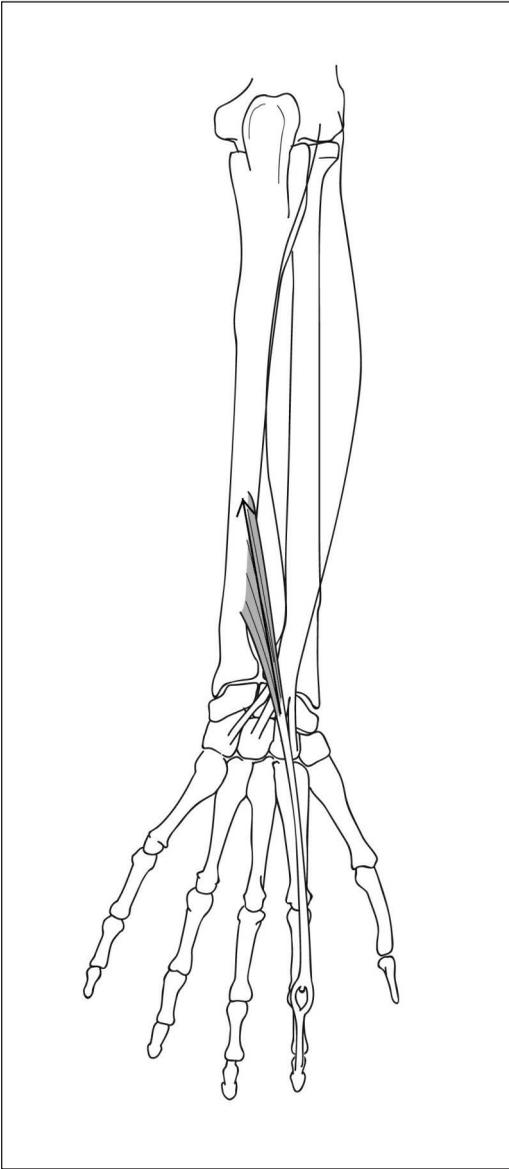
Insertion: Base of the middle and distal phalanges digits II-V

Innervation: Radial nerve

Action: Extension of the MCP of digits II-V

Figure 4-4-27.

Extensor indicis (tested with Extensor digitorum and Extensor digiti minimi [digit V])



Origin: Posterior ulna

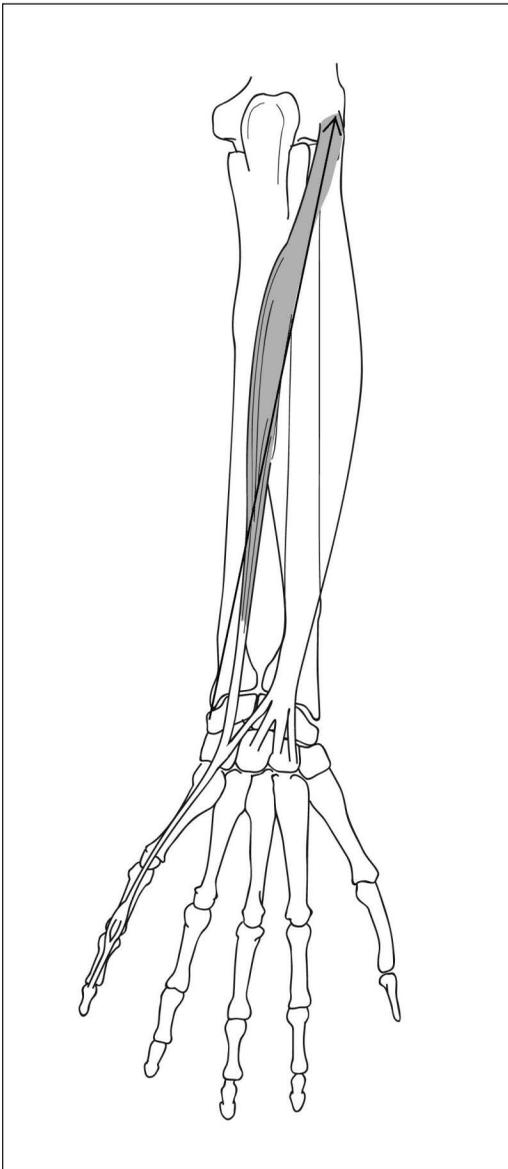
Insertion: Tendon of extensor digitorum, dorsal aponeurosis

Innervation: Radial nerve

Action: Extension of the MCP, PIP, DIP of the second digit

Figure 4-4-28.

Extensor digiti minimi (tested with Extensor indicis [digit II] and Extensor digitorum)



Origin: Lateral epicondyle

Insertion: Tendon of extensor digitorum fifth digit

Innervation: Radial nerve

Action: Extension of the MCP, PIP, DIP of the fifth digit

Figure 4-4-29.



Figure 4-4-30.



Figure 4-4-31.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity placed on a table edge (digits off the table) in forearm pronation and digit flexion (Figure 4-4-30).

Motion—client moves the testing extremity in the direction of digit MCP extension with PIP and DIP flexed (Figure 4-4-31).

Therapist Position: Stabilize at the metacarpals to avoid compensation. Resistance is applied at the proximal phalanges in the direction of digit MCP flexion when testing Normal or Good strengths. No resistance is applied when testing Fair strength.



Figure 4-4-32.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

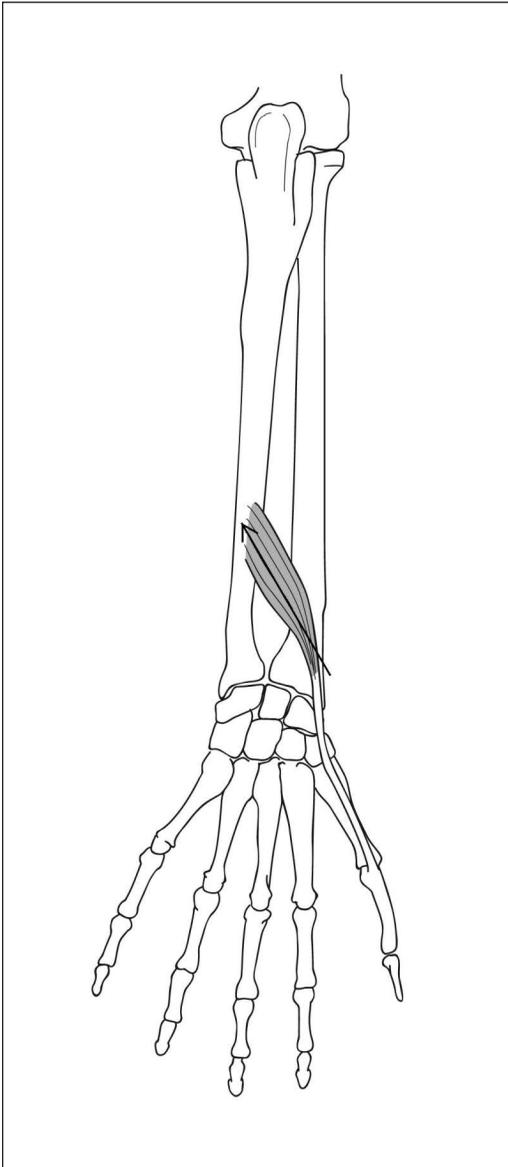
Client Position: Starting—client is sitting with the testing extremity placed on a table in forearm neutral rotation and digit flexion (Figure 4-4-32).

Motion—client moves the testing extremity in the direction of digit extension.

Therapist Position: Stabilize at the metacarpals to avoid compensation. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The extensor digitorum tendon is palpated over the metacarpal heads, dorsal surface. The extensor indicis tendon is palpated over the second digit metacarpal head, dorsal surface. The extensor digiti minimi tendon is palpated over the fifth digit metacarpal head, dorsal surface.

Extensor pollicis brevis



Origin: Posterior radius and ulna

Insertion: Base of the first digit proximal phalanx, dorsal surface

Innervation: Radial nerve

Action: MCP and assists CMC extension

Figure 4-4-33.



Figure 4-4-34.



Figure 4-4-35.



Figure 4-4-36.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity placed on the table with the forearm in neutral and thumb in slight MCP flexion (Figure 4-4-34).

Motion:client moves the testing extremity in the direction of thumb MCP extension (Figure 4-4-35).

Therapist Position: Stabilize at the thumb metacarpal to eliminate any compensation. Resistance is applied at the proximal phalanx of the thumb in the direction of thumb MCP flexion when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

The testing positions are the same as above. A grade of poor is given when the client can move the testing extremity through only a small portion of the range in this position (Figure 4-4-36).

Palpation: Extensor pollicis brevis tendon is palpated at the base of the first metacarpal, dorsal surface.

MCP Adduction Assessment: Goniometry

Plane: Frontal

Axis: Sagittal

Normal ROM: Compare with opposite side

End feel: Firm



Figure 4-4-37.

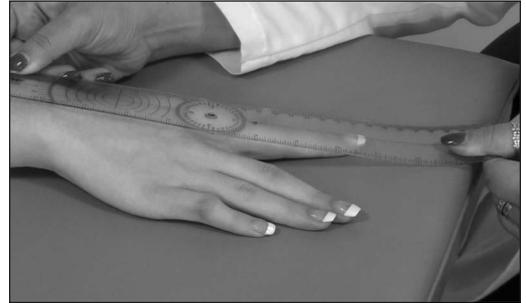


Figure 4-4-38.

Client Position: Client is sitting with feet on the floor.

Starting—testing extremity is resting on the table with the humerus abducted, elbow flexed, and forearm pronated. Digits are in abduction (Figure 4-4-37).

Ending—client moves the testing extremity digits into maximum MCP adduction (Figure 4-4-38). Note: The third digit does not adduct.

Therapist Position: Observe at the metacarpal to avoid compensation.

Goniometer Position:

FULCRUM: dorsal to the MCP joint

STABLE ARM: dorsal and parallel to the metacarpal

MOVABLE ARM: dorsal and parallel to the proximal phalanx

Isolated Muscle Testing

Prime Mover: Palmar interossei

Palmar interossei

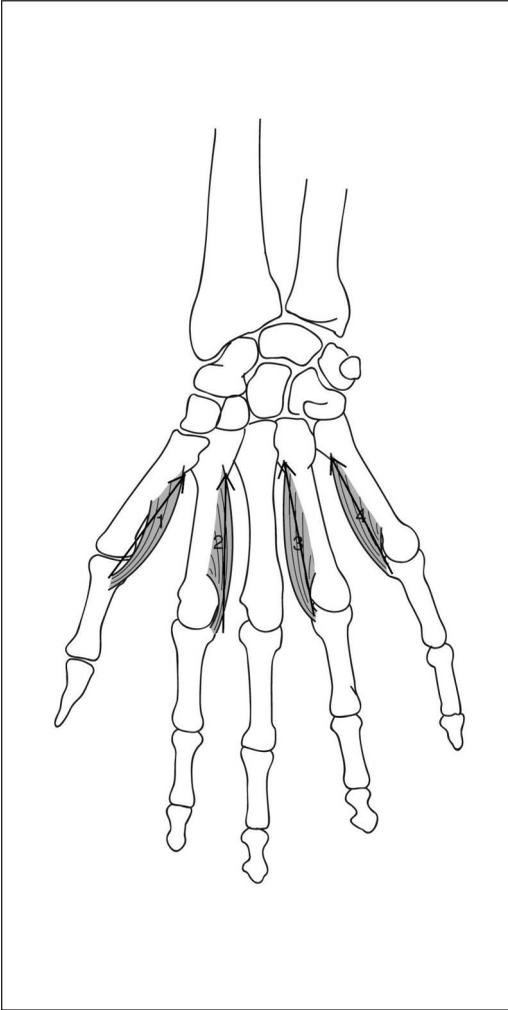


Figure 4-4-39.

Origin: First interosseous—ulnar surface of second metacarpal

Second interosseous—ulnar surface of second metacarpal

Third interosseous—radial surface of fourth metacarpal

Fourth interosseous—radial surface of fifth metacarpal

Insertion: First interosseous—base of the first digit proximal phalanx, ulnar side

Second interosseous—base of the second digit proximal phalanx, ulnar side

Third interosseous—base of the fourth digit proximal phalanx, radial side

Fourth interosseous—base of the fifth digit proximal phalanx, radial side

Innervation: Ulnar nerve

Action: Digit MCP adduction



Figure 4-4-40.



Figure 4-4-41.



Figure 4-4-42.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity on a table in forearm supination and MCP abduction (Figure 4-4-40). Motion—client moves the testing extremity in the direction of MCP adduction (Figure 4-4-41).

Therapist Position: Stabilize at the metacarpals to avoid compensation. Resistance is applied at the proximal phalanx on the ulnar side of the second digit, and the radial side of the fourth and fifth digits when testing Normal or Good strengths. No resistance is applied when testing Fair strength. Note: The third digit does not adduct.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

The client and therapist positions are the same and no resistance is applied (Figure 4-4-42).

Palpation: The interossei are too deep for palpation.

MCP Abduction Assessment: Goniometry

Plane: Frontal

Axis: Sagittal

Normal ROM: Compare with opposite side

End feel: Soft

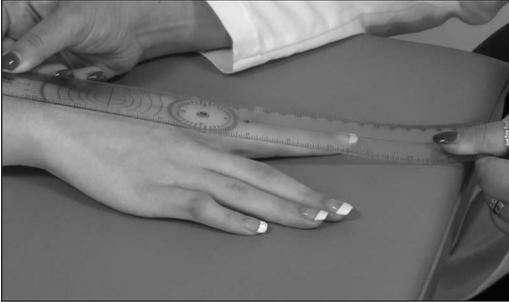


Figure 4-4-43.

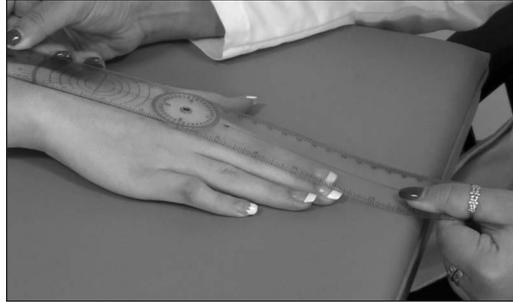


Figure 4-4-44.

Client Position: Client is sitting with feet on the floor.

Starting—testing extremity is resting on the table with the humerus abducted, elbow flexed, and forearm pronated. Digits are in MCP adduction (Figure 4-4-43).

Ending—client moves the testing extremity digits into maximum MCP abduction (Figure 4-4-44). Note: The third digit adducts in both the radial and ulnar directions.

Therapist Position: Observe at the metacarpal to avoid compensation.

Goniometer Position:

FULCRUM: dorsal to the MCP joint

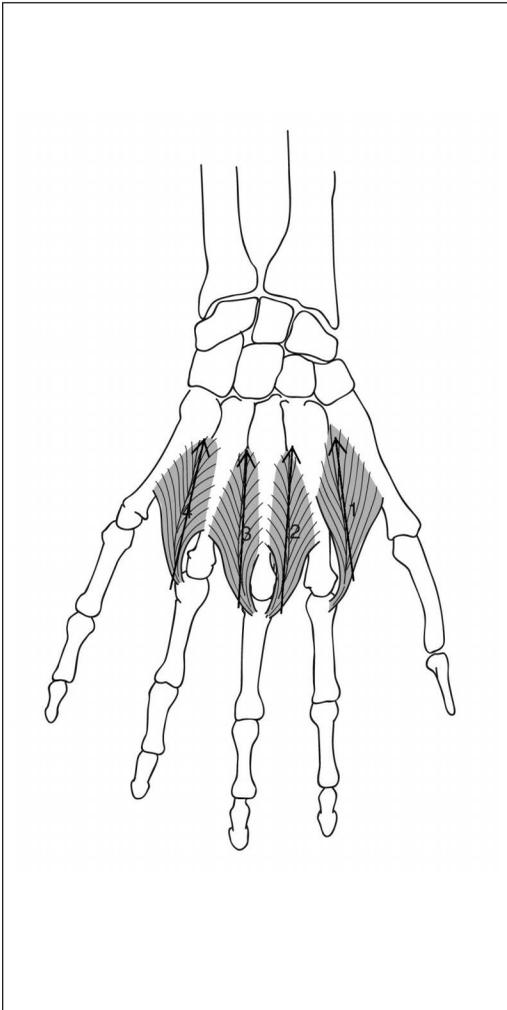
STABLE ARM: dorsal and parallel to the metacarpal

MOVABLE ARM: dorsal and parallel to the proximal phalanx

Isolated Muscle Testing

Prime Mover: Dorsal interossei, Abductor digiti minimi

Dorsal interossei (tested with Abductor digiti minimi)



Origin: Each interosseous has its origin on both of the adjacent metacarpals

Insertion: First interosseous—base of the second digit proximal phalanx, radial side

Second interosseous—base of the third digit proximal phalanx, radial side

Third interosseous—base of the third digit proximal phalanx, ulnar side

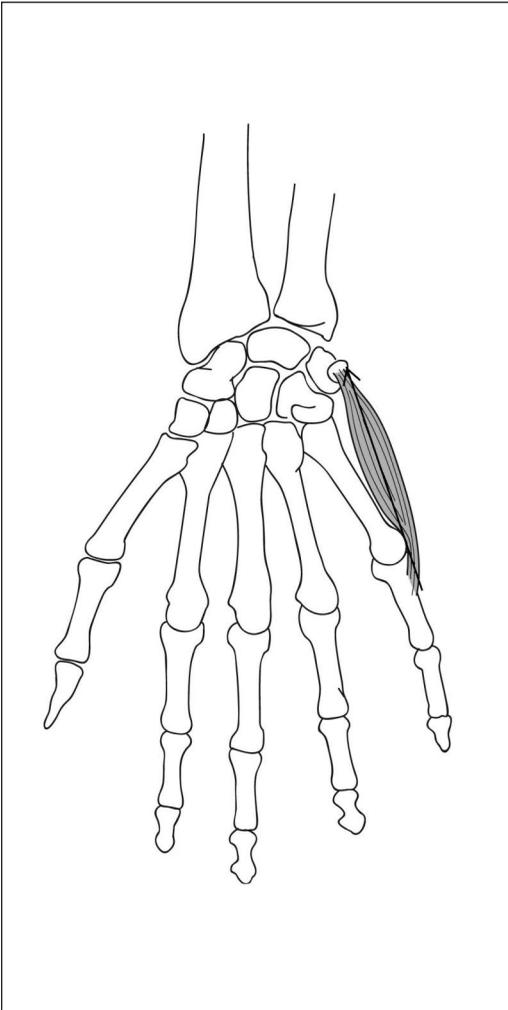
Fourth interosseous—base of the fourth digit proximal phalanx, ulnar side

Innervation: Ulnar nerve

Action: Digit MCP abduction

Figure 4-4-45.

Abductor digiti minimi (tested with Dorsal interossei)



Origin: Pisiform

Insertion: Base of the fifth digit proximal phalanx, ulnar side

Innervation: Ulnar nerve

Action: MCP abduction of the fifth digit

Figure 4-4-46.



Figure 4-4-47.



Figure 4-4-48A.



Figure 4-4-48B.



Figure 4-4-48C.



Figure 4-4-48D.



Figure 4-4-48E.

Against Gravity:
Fair (3), Good (4), Normal (5)

Client Position: Starting—client is sitting with the testing extremity on a table in forearm pronation and MCP adduction (Figure 4-4-47).

Motion—client moves the testing extremity in the direction of MCP abduction (Figure 4-4-48).

Therapist Position: Stabilize at the metacarpals to avoid compensation. Resistance is applied at the proximal phalanx on the radial side of the second digit, both the radial and ulnar side

of the third digit as it abducts in two directions, the ulnar side of the fourth and fifth digits when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

Gravity Eliminated:
Zero (0), Trace (1), Poor (2)

The client and therapist positions are the same and no resistance is applied.

Palpation: The interossei are too deep for palpation. The abductor digiti minimi is palpated on the lateral aspect of the fifth digit metacarpal.

Proximal Interphalangeal (PIP) Flexion Assessment: Goniometry

Plane: Sagittal

Axis: Frontal

Normal ROM: 0-90

End feel: Hard



Figure 4-4-49.



Figure 4-4-50.

Client Position: Client is sitting with feet on the floor.

Starting—elbow of the testing extremity is resting on the table with the humerus slightly flexed and forearm in neutral. The PIPs are in neutral or extension (Figure 4-4-49).

Ending—client moves the testing extremity through maximum PIP flexion (Figure 4-4-50).

Therapist Position: Observe and possibly stabilize at the MCPs to prevent compensation.

Goniometer Position:

FULCRUM: dorsal surface of the PIP joint that is being measured

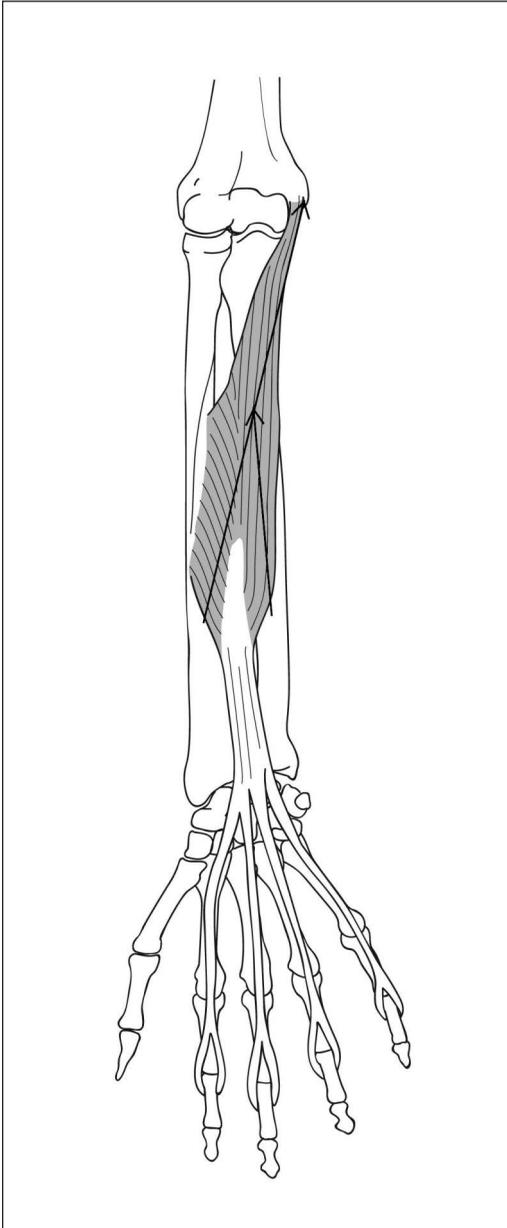
STABLE ARM: dorsal and the midline of the proximal phalanx of the digit being measured

MOVABLE ARM: dorsal and the midline of the middle phalanx of the digit being measured

PIP Flexion: Isolated Muscle Testing

Prime Movers: Flexor digitorum superficialis

Flexor digitorum superficialis



Origin: Medial epicondyle, coronoid process, ulna, proximal radius

Insertion: Lateral and medial surface of the middle phalanx of digits II-V

Innervation: Median nerve

Action: Flexion of the digit PIP joint

Figure 4-4-3.



Figure 4-4-4.



Figure 4-4-5.



Figure 4-4-6.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity placed on the table in forearm supination and digit extension (Figure 4-4-4).

Motion:client moves the testing extremity in the direction of PIP flexion with MCPs remaining in extension (Figure 4-4-5).

Therapist Position: Stabilize at the proximal phalanx to avoid compensation. Resistance is applied at the middle phalanx in the direction of PIP extension when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

Client Position: Starting—client is sitting with the testing extremity placed on a table in forearm neutral rotation and digit extension (Figure 4-4-6).

Motion:client moves the testing extremity in the direction of PIP flexion.

Therapist Position: Stabilize at the proximal phalanx to avoid compensation. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The flexor digitorum superficialis is palpated either on the proximal phalanx or on the volar surface of the wrist between the palmaris longus and the flexor carpi ulnaris tendons.

PIP Extension Assessment: Goniometry

Plane: Sagittal

Axis: Frontal

Normal ROM: 90-0

End feel: Firm



Figure 4-4-51.



Figure 4-4-52.

Client Position: Client is sitting with feet on the floor.

Starting—elbow of the testing extremity is resting on the table with the humerus slightly flexed and forearm in neutral. The PIPs are in flexion (Figure 4-4-51).

Ending—client moves the testing extremity through maximum PIP extension, but not into PIP hyperextension (Figure 4-4-52).

Therapist Position: Observe and possibly stabilize the MCPs in extension to prevent compensation.

Goniometer Position:

FULCRUM: dorsal surface of the PIP joint that is being measured

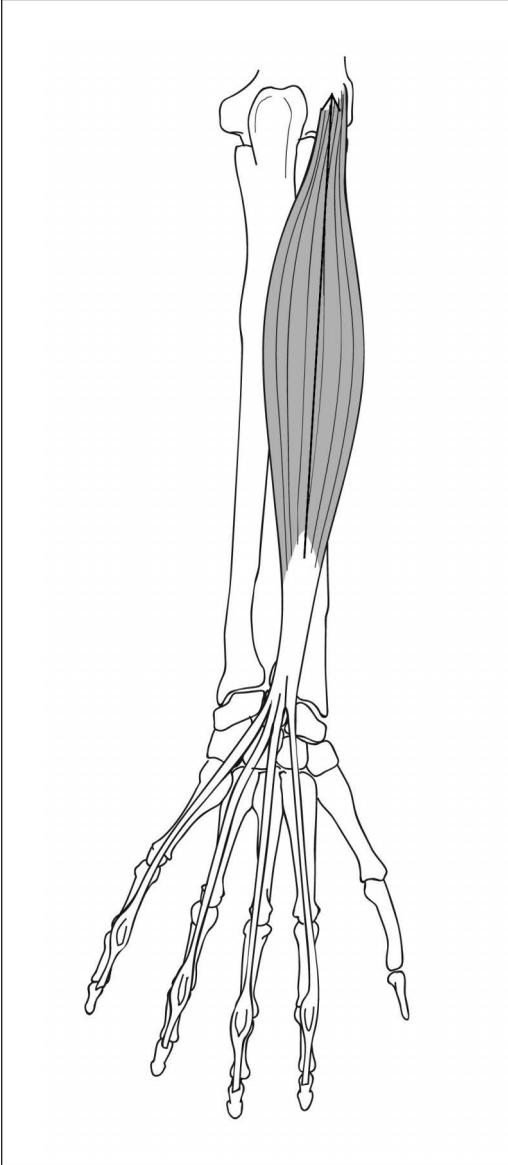
STABLE ARM: dorsal and the midline of the proximal phalanx of the digit being measured

MOVABLE ARM: dorsal and the midline of the middle phalanx of the digit being measured

Isolated Muscle Testing

Prime Movers: Extensor digitorum, Lumbricals

Extensor digitorum



Origin: Lateral epicondyle

Insertion: Base of the middle and distal phalanges digits II-V

Innervation: Radial nerve

Action: Extension of the MCP of digits II-V; and PIP, DIP extension.

Figure 4-4-27.



Figure 4-4-30A.



Figure 4-4-31A.



Figure 4-4-32A.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity placed on a table edge (digits off the table) in forearm pronation and digit flexion (Figure 4-4-30a).

Motion—client moves the testing extremity in the direction of digit MCP extension with PIP and DIP flexed (Figure 4-4-31a).

Therapist Position: Stabilize at the metacarpals to avoid compensation. Resistance is applied at the proximal phalanges in the direction of digit MCP flexion when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

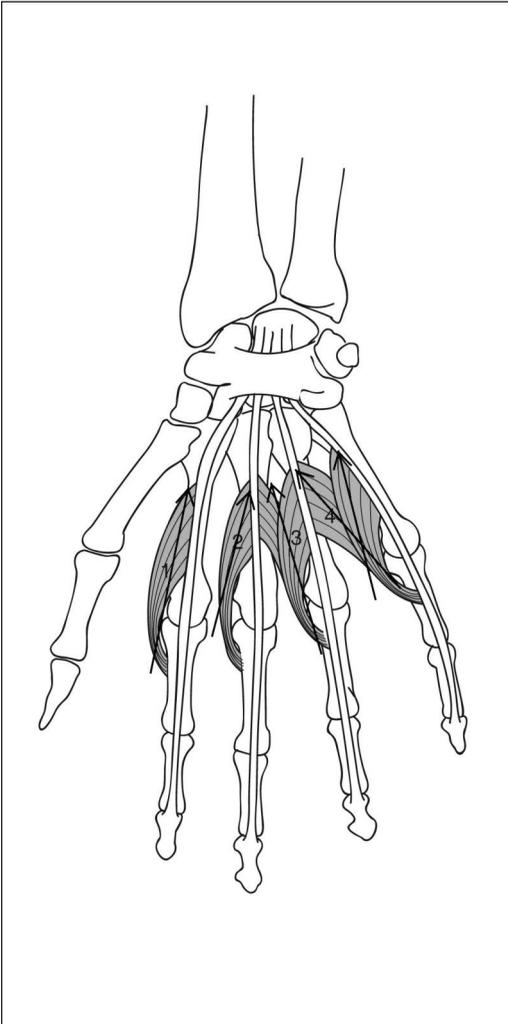
Client Position: Starting—client is sitting with the testing extremity placed on a table in forearm neutral rotation and digit flexion (Figure 4-4-32a).

Motion—client moves the testing extremity in the direction of digit extension.

Therapist Position: Stabilize at the metacarpals to avoid compensation. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The extensor digitorum tendon is palpated over the metacarpal heads, dorsal surface.

Lumbricals



Origin: First—FDP digit II tendon
Second—FDP digit III tendon
Third—FDP digit III and IV tendons
Fourth—FDP digit IV and V tendons

Insertion: Radial side dorsal aponeurosis

Innervation: First and second—median nerve,
third and fourth—ulnar nerve

Action: MCP flexion and PIP/DIP extension

Figure 4-4-11.



Figure 4-4-12.



Figure 4-4-13.



Figure 4-4-14.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity placed on a table in forearm supination and MCP extension/PIP and DIP flexion (Figure 4-4-12).

Motion—client moves the testing extremity in the direction of MCP flexion while PIP and DIP enter extension (Figure 4-4-13).

Therapist Position: Stabilize at the metacarpals to avoid compensation. Resistance is applied at the proximal phalanx in the direction of MCP extension when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

Client Position: Starting—client is sitting with the testing extremity placed on a table in forearm neutral rotation, and MCP extension/PIP and DIP flexion (Figure 4-4-14).

Motion—client moves the testing extremity in the direction of MCP flexion while PIP and DIP enter extension.

Therapist Position: Stabilize at the metacarpals to avoid compensation. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The lumbricals are too deep for palpation.

Distal Interphalangeal (DIP) Flexion Assessment: Goniometry

Plane: Sagittal

Axis: Frontal

Normal ROM: 0-90

End feel: Firm



Figure 4-4-53.



Figure 4-4-54.

Client Position: Client is sitting with feet on the floor.

Starting—elbow of the testing extremity is resting on the table with the humerus slightly flexed and forearm in neutral. The DIPs are in neutral or extension (Figure 4-4-53).

Ending—client moves the testing extremity through maximum DIP flexion (Figure 4-4-54).

Therapist Position: Stabilize at the PIP joint as necessary.

Goniometer Position:

FULCRUM: dorsal DIP joint that is being measured

STABLE ARM: dorsal and the midline of middle phalanx of joint being measured

MOVABLE ARM: dorsal and the midline of distal phalanx of joint being measured

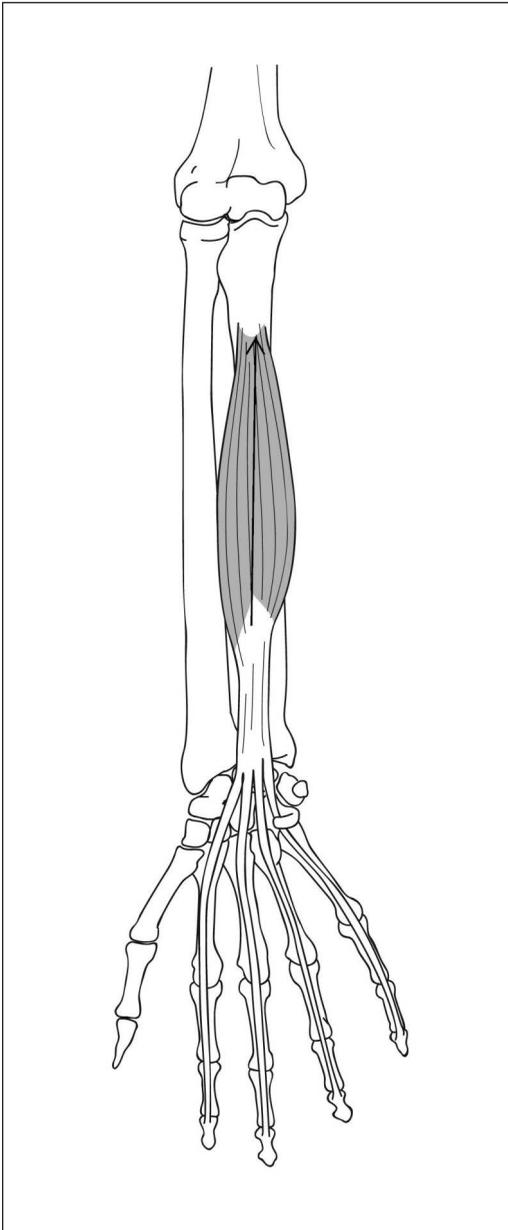


Some clients may not achieve full DIP motion unless the PIP joint is stabilized in extension or the client is allowed to flex both the PIP joint and DIP joint while MCP joint is in extension.

Isolated Muscle Testing

Prime Mover: Flexor digitorum profundus

Flexor digitorum profundus



Origin: Body of the ulna

Insertion: Through the insertions of the flexor digitorum superficialis onto the distal phalanx of digits II-V

Innervation: Ulnar nerve (digits IV and V), Median nerve (digits II and III)

Action: Flexion of the digit DIP joint

Figure 4-4-7.



Figure 4-4-8.



Figure 4-4-9.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity placed on a table in forearm supination and digit extension (Figure 4-4-8).

Motion—client moves the testing extremity in the direction of DIP flexion with MCPs and PIPs remaining in extension (Figure 4-4-9).

Therapist Position: Stabilize at the middle phalanx to avoid compensation. Resistance is applied at the distal phalanx when testing Normal or Good strengths. No resistance is applied when testing Fair strength.



Figure 4-4-10.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

Client Position: Starting—client is sitting with the testing extremity placed on a table in forearm neutral rotation and digit extension (Figure 4-4-10).

Motion—client moves the testing extremity in the direction of DIP flexion.

Therapist Position: Stabilize at the middle phalanx to avoid compensation. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The flexor digitorum profundus tendon can be palpated over the middle phalanges of the digits, palmar surface.

DIP Extension Assessment: Goniometry

Plane: Sagittal

Axis: Frontal

Normal ROM: 90-0

End feel: Firm



Figure 4-4-55.



Figure 4-4-56.

Client Position: Client is sitting with feet on the floor.

Starting—elbow of the testing extremity is resting on the table with the humerus slightly flexed and forearm in neutral. The DIPs are in flexion (Figure 4-4-55).

Ending—client moves the testing extremity through maximum DIP extension, but not into DIP hyperextension (Figure 4-4-56).

Therapist Position: Observe at the PIPs to prevent compensation.

Goniometer Position:

FULCRUM: dorsal DIP joint that is being measured

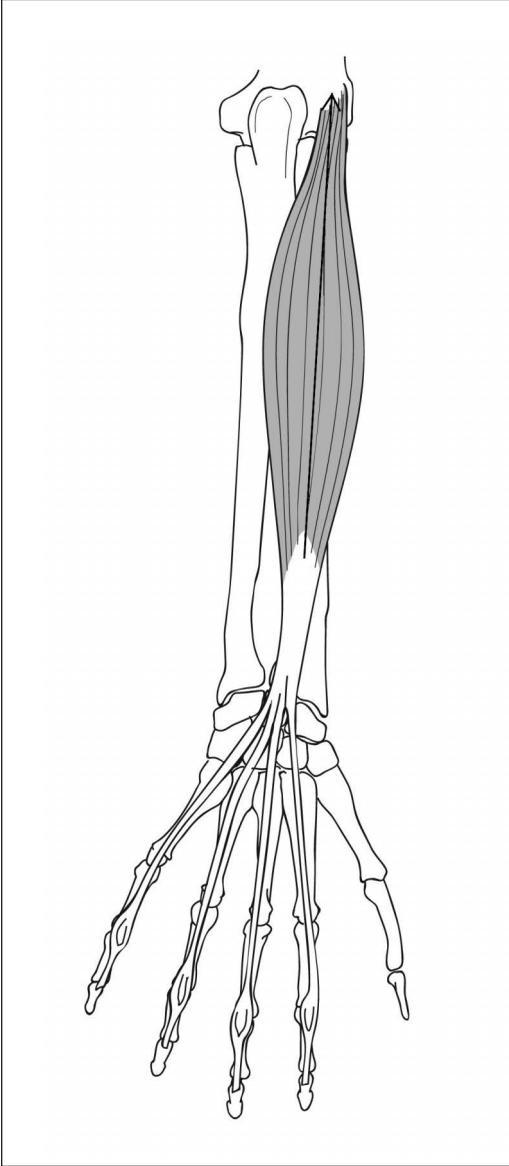
STABLE ARM: dorsal and the midline of middle phalanx of joint being measured

MOVABLE ARM: dorsal and the midline of distal phalanx of joint being measured

DIP Extension: Isolated Muscle Testing

Prime Movers: Extensor digitorum, Lumbricals

Extensor digitorum



Origin: Lateral epicondyle
Insertion: Base of the middle and distal phalanges digits II-V
Innervation: Radial nerve
Action: Extension of the MCP of digits II-V

Figure 4-4-27.



Figure 4-4-30B.



Figure 4-4-31B.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity placed on a table edge (digits off the table) in forearm pronation and digit flexion (Figure 4-4-30b).

Motion:—client moves the testing extremity in the direction of digit MCP extension with PIP and DIP flexed (Figure 4-4-31b).

Therapist Position: Stabilize at the proximal phalanx to avoid compensation. Resistance is applied at the proximal phalanges in the direction of digit PIP flexion when testing Normal or Good strengths. No resistance is applied when testing Fair strength.



Figure 4-4-32B.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

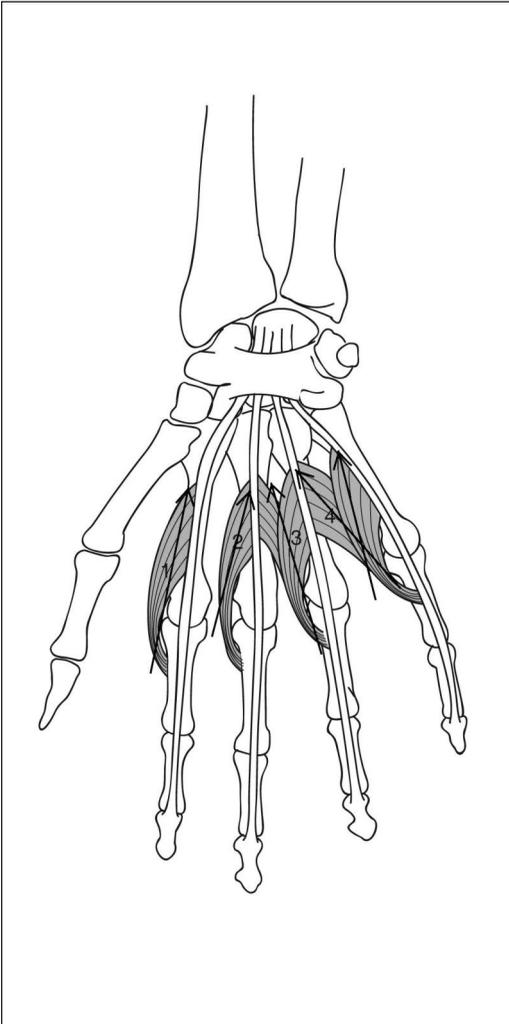
Client Position: Starting—client is sitting with the testing extremity placed on a table in forearm neutral rotation and digit flexion (Figure 4-4-32b).

Motion:—client moves the testing extremity in the direction of digit extension.

Therapist Position: Stabilize at the proximal phalanx to avoid compensation. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The extensor digitorum tendon is palpated over the proximal phalanx heads, dorsal surface.

Lumbricals



Origin: First—FDP digit II tendon
Second—FDP digit III tendon
Third—FDP digit III and IV tendons
Fourth—FDP digit IV and V tendons

Insertion: Radial side dorsal aponeurosis

Innervation: First and second—median nerve,
third and fourth—ulnar nerve

Action: MCP flexion and PIP/DIP extension

Figure 4-4-11.



Figure 4-4-12.



Figure 4-4-13.



Figure 4-4-14.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity placed on a table in forearm supination and MCP extension/ PIP and DIP flexion (Figure 4-4-12).

Motion:—client moves the testing extremity in the direction of MCP flexion while PIP and DIP enter extension (Figure 4-4-13).

Therapist Position: Stabilize at the metacarpals to avoid compensation. Resistance is applied at the proximal phalanx in the direction of MCP extension when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

Client Position: Starting—client is sitting with the testing extremity placed on a table in forearm neutral rotation, and MCP extension/ PIP and DIP flexion (Figure 4-4-14).

Motion:—client moves the testing extremity in the direction of MCP flexion while PIP and DIP enter extension.

Therapist Position: Stabilize at the metacarpals to avoid compensation. No resistance is applied when testing in the gravity-eliminated position.

Palpation: The lumbricals are too deep for palpation.

Carpometacarpal (CMC) Flexion Assessment: Goniometry

Plane: Frontal

Axis: Sagittal

Normal ROM: 0-20 degrees

End feel: Soft

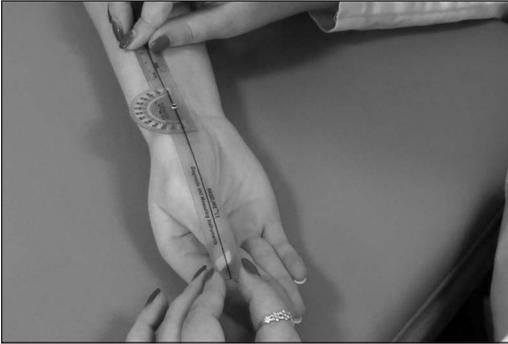


Figure 4-4-57.



Figure 4-4-58.

Client Position: Client is sitting with feet on the floor.

Starting—testing extremity is resting on the table with the humerus abducted, elbow flexed, and forearm supinated. Client's hand is placed "palm up" with the thumb placed in line with the second digit (Figure 4-4-57).

Ending—client moves the testing extremity thumb across the palm into maximum CMC flexion (Figure 4-4-58).

Therapist Position: Observe at the forearm/wrist to prevent compensation.

Goniometer Position:

FULCRUM: base of the CMC joint

STABLE ARM: midline of radius

MOVABLE ARM: midline of first metacarpal

Goniometry Measurement: This measurement is unusual because it does not start at zero, but starts in a negative position. The measurement starts to the right of the zero (negative), crosses the zero mark, and ends left of the zero (positive). The negative beginning point and the positive ending point should both be recorded.

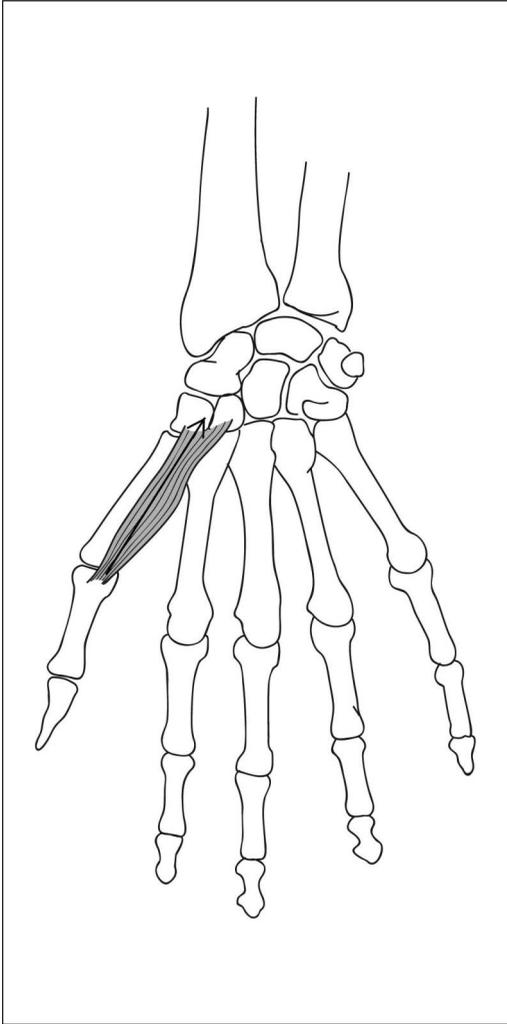


It is important to stay in line with the metacarpal and *not* the thumb phalanges.

Isolated Muscle Testing

Prime Movers: Flexor pollicis brevis, Flexor pollicis longus

Flexor pollicis brevis



Origin: Trapezium, trapezoid

Insertion: Base of the first digit proximal phalanx

Innervation: Median and ulnar nerves

Action: Thumb MCP flexion, and assist with CMC flexion

Figure 4-4-15.



Figure 4-4-16.



Figure 4-4-17.



Figure 4-4-18.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity placed on the table in forearm supination (Figure 4-4-16).

Motion—client moves the testing extremity in the direction of thumb MCP flexion (Figure 4-4-17).

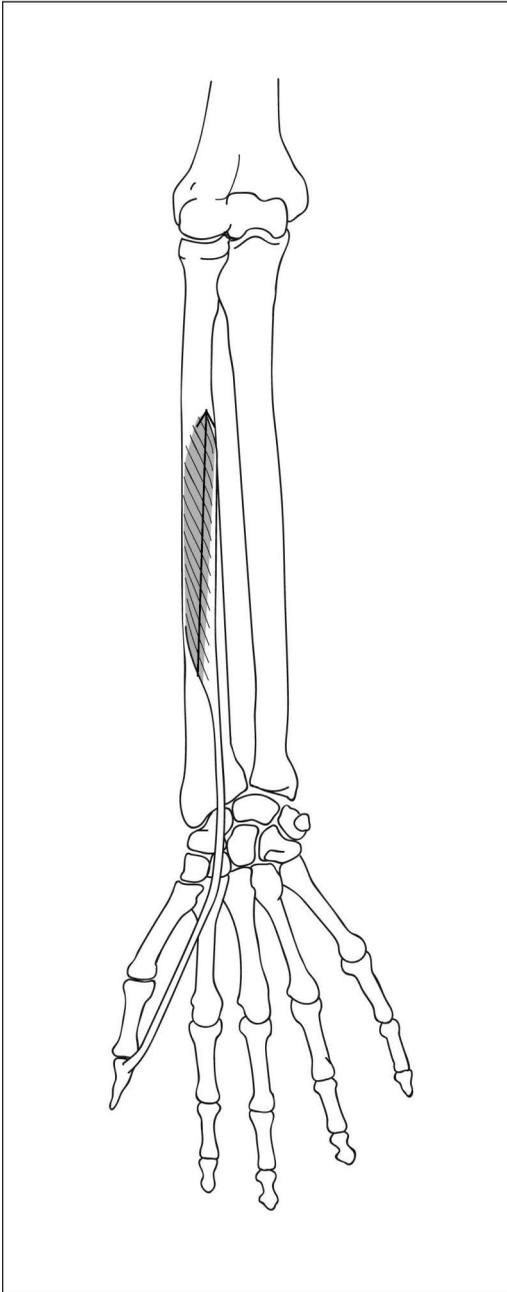
Therapist Position: Stabilize at the metacarpal to eliminate any compensation. Resistance is applied at the proximal phalanx of the thumb in the direction of MCP extension when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

The testing positions are the same as above. A grade of poor is given when the client can move the testing extremity through only a small portion of the range in this position (Figure 4-4-18).

Palpation: Flexor pollicis brevis is palpated over the first metacarpal, palmar surface.

Flexor pollicis longus



Origin: Anterior radius

Insertion: Base of the first digit distal phalanx

Innervation: Median nerve

Action: Thumb IP flexion

Figure 4-4-59.



Figure 4-4-60.



Figure 4-4-61.



Figure 4-4-62.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity placed on the table in forearm supination (Figure 4-4-60).

Motion—client moves the testing extremity in the direction of thumb IP flexion while maintaining thumb MCP extension (Figure 4-4-61).

Therapist Position: Stabilize at the proximal phalanx to eliminate any compensation. Resistance is applied at the distal phalanx of the thumb in the direction of IP extension when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

The testing positions are the same as above. A grade of poor is given when the client can move the testing extremity through only a small portion of the range in this position (Figure 4-4-62).

Palpation: Flexor pollicis brevis tendon is palpated over the first proximal phalanx, palmar surface.

CMC Extension Assessment: Goniometry

Plane: Frontal

Axis: Sagittal

Normal ROM: 0-45 degrees

End feel: Firm



Figure 4-4-63.

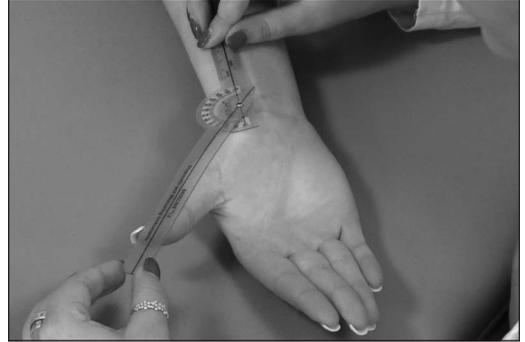


Figure 4-4-64.

Client Position: Client is sitting with feet on the floor.

Starting—testing extremity is resting on the table with the humerus abducted, elbow flexed, and forearm supinated. Client's hand is placed "palm up" with the thumb placed in line with the second digit (Figure 4-4-63).

Ending—client moves the testing extremity thumb into maximum CMC extension (Figure 4-4-64).

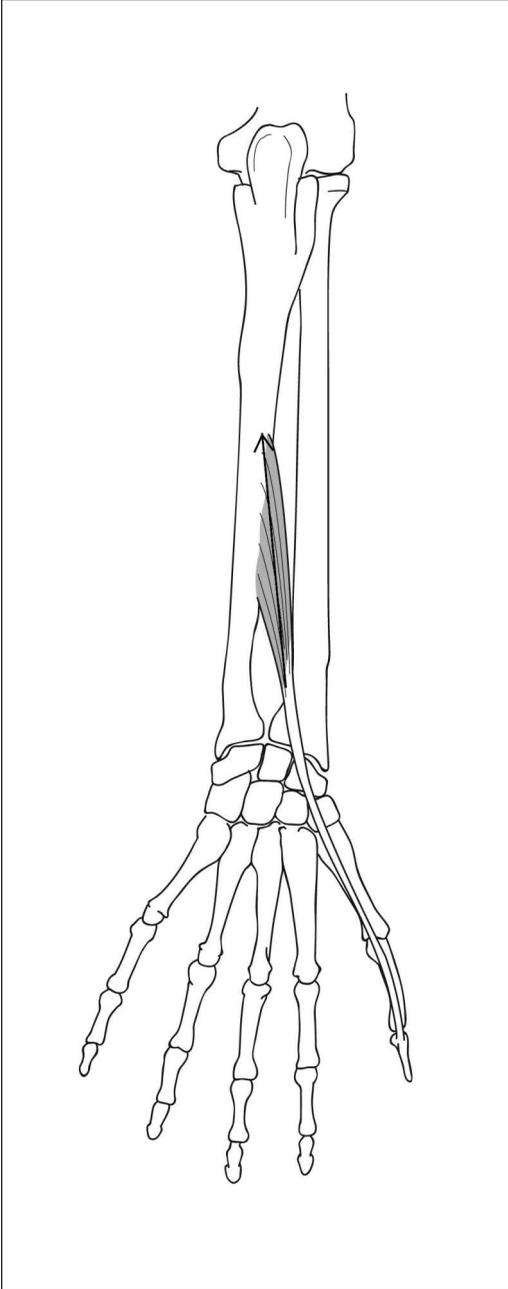
Therapist Position: Observe at the forearm/wrist to prevent compensation.

Goniometer Position: Same position as thumb CMC flexion above. The goniometer readings for thumb CMC extension should be positive, but do not necessarily start at zero.

CMC Extension:
Isolated Muscle Testing

Prime Movers: Extensor pollicis longus, Extensor pollicis brevis

Extensor pollicis longus



Origin: Middle, posterior ulna
Insertion: Base of the first digit distal phalanx, dorsal surface
Innervation: Radial nerve
Action: Thumb IP extension

Figure 4-4-65.



Figure 4-4-66.



Figure 4-4-67.



Figure 4-4-68.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity placed on the table with the forearm in neutral and thumb IP flexed (Figure 4-4-66).

Motion:client moves the testing extremity in the direction of thumb IP extension (Figure 4-4-67).

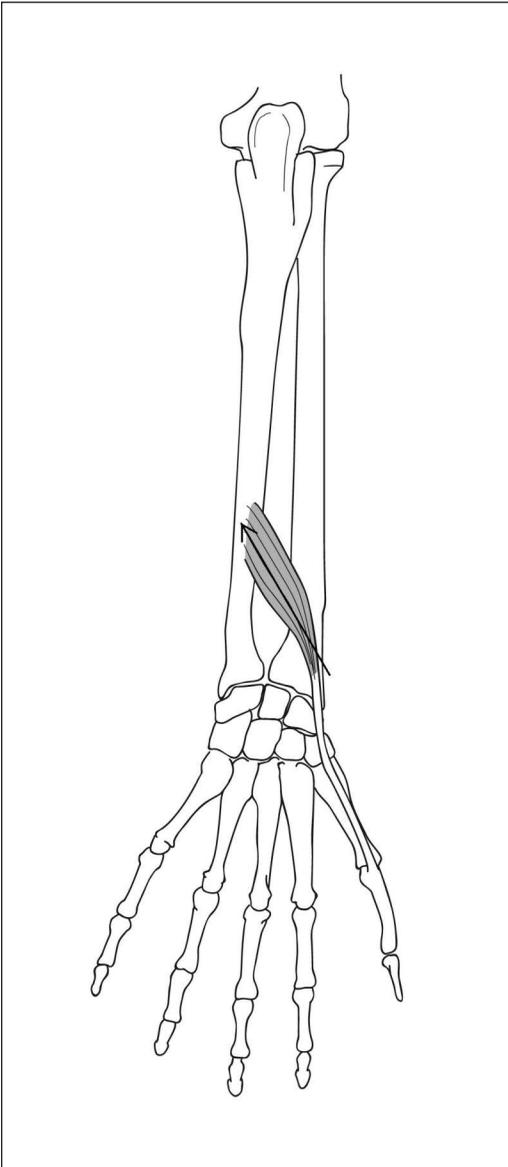
Therapist Position: Stabilize at the thumb proximal phalanx to eliminate any compensation. Resistance is applied at the distal phalanx of the thumb in the direction of thumb IP flexion when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

The testing positions are the same as above. A grade of poor is given when the client can move the testing extremity through only a small portion of the range in this position (Figure 4-4-68).

Palpation: Extensor pollicis longus tendon is palpated over the first proximal phalanx, dorsal surface.

Extensor pollicis brevis



Origin: Posterior radius and ulna

Insertion: Base of the first digit proximal phalanx, dorsal surface

Innervation: Radial nerve

Action: MCP and assists CMC extension

Figure 4-4-33.



Figure 4-4-34.



Figure 4-4-35.



Figure 4-4-36.

Against Gravity: Fair (3), Good (4), Normal (5)

Client Position: Starting—client is sitting with the testing extremity placed on the table with the forearm in neutral and thumb in slight MCP flexion (Figure 4-4-34).

Motion: client moves the testing extremity in the direction of thumb MCP extension (Figure 4-4-35).

Therapist Position: Stabilize at the thumb metacarpal to eliminate any compensation. Resistance is applied at the proximal phalanx of the thumb in the direction of thumb MCP flexion when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

Gravity Eliminated: Zero (0), Trace (1), Poor (2)

The testing positions are the same as above. A grade of poor is given when the client can move the testing extremity through only a small portion of the range in this position (Figure 4-4-36).

Palpation: Extensor pollicis brevis tendon is palpated at the base of the first metacarpal, dorsal surface.

CMC Abduction Assessment: Goniometry

Plane: Sagittal

Axis: Frontal

Normal ROM: 0-70 degrees

End feel: Firm



Figure 4-4-69.



Figure 4-4-70.

Client Position: Client is sitting with feet on the floor.

Starting—testing extremity is resting on the table with the humerus abducted, elbow flexed, and forearm supinated. Client's hand is placed with the ulnar aspect on the table. The thumb is placed in line with the second digit (Figure 4-4-69).

Ending—client moves the testing extremity thumb into maximum CMC abduction (Figure 4-4-70).

Therapist Position: Observe at the wrist/forearm to prevent compensation.

Goniometer Position:

FULCRUM: base of the first and second metacarpals

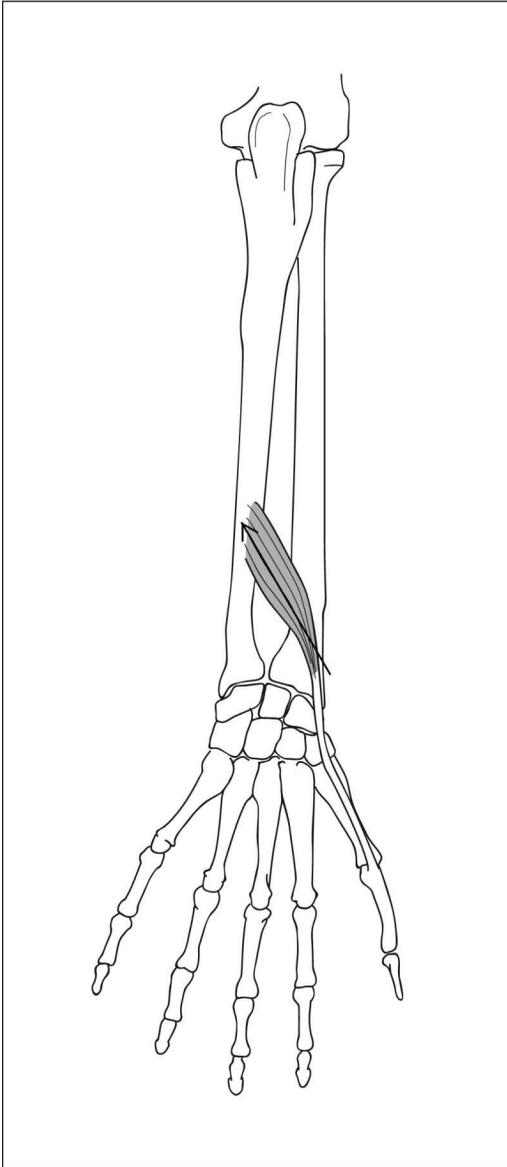
STABLE ARM: midline of the second metacarpal, along the radial border

MOVABLE ARM: midline of the first metacarpal, along the radial border

Isolated Muscle Testing

Prime Movers: Abductor pollicis brevis, Abductor pollicis longus

Abductor pollicis brevis



Origin: Scaphoid, trapezium

Insertion: Base of the first digit proximal phalanx, radial side

Innervation: Median nerve

Action: Thumb CMC abduction

Figure 4-4-71.



Figure 4-4-72.



Figure 4-4-73.



Figure 4-4-74.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity placed on the table in forearm supination (Figure 4-4-72).

Motion—client moves the testing extremity in the direction of thumb CMC abduction (Figure 4-4-73).

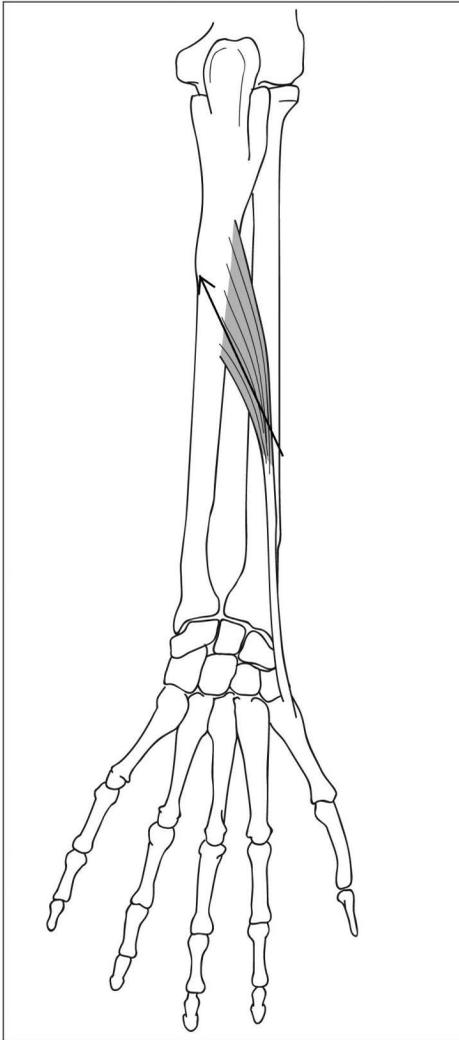
Therapist Position: Stabilize the hand to eliminate any compensation. Resistance is applied at the proximal phalanx of the thumb in the direction of CMC adduction when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

The testing positions are the same as above. A grade of poor is given when the client can move the testing extremity through only a small portion of the range in this position (Figure 4-4-74).

Palpation: Abductor pollicis brevis is palpated over the first digit metacarpal, lateral surface.

Abductor pollicis longus



Origin: Posterior, middle radius and ulna
Insertion: Base of the first digit metacarpal
Innervation: Radial nerve
Action: Thumb CMC abduction

Figure 4-4-75.



Figure 4-4-77.



Figure 4-4-78.



Figure 4-4-79.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity placed on the table with the forearm in neutral (Figure 4-4-76).

Motion—client moves the testing extremity in the direction of thumb CMC abduction (Figure 4-4-77).

Therapist Position: Stabilize at the wrist to eliminate any compensation. Resistance is applied at the thumb metacarpal in the direction of CMC adduction when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

The testing positions are the same as above. A grade of poor is given when the client can move the testing extremity through only a small portion of the range in this position (Figure 4-4-78).

Palpation: Abductor pollicis longus tendon is palpated at the base of the first digit metacarpal, lateral surface.

CMC Adduction Assessment: Goniometry

Plane: Sagittal

Axis: Frontal

Normal ROM: As compared to the opposite side. This ROM is often not tested and assumed as the opposite of abduction.

End feel: Soft



Figure 4-4-79.



Figure 4-4-80.

Client Position: Client is sitting with feet on the floor.

Starting—testing extremity is resting on the table with the humerus abducted to 90 degrees, elbow flexed, and forearm supinated. Client's hand is placed with the medial aspect on the table. The thumb is placed in full abduction (Figure 4-4-79).

Ending—client moves the testing extremity thumb into maximum CMC adduction (ending with thumb parallel with the second metacarpal) (Figure 4-4-80).

Therapist Position: Observe at the wrist/forearm to prevent compensation.

Goniometer Position:

FULCRUM: base of the first and second metacarpals

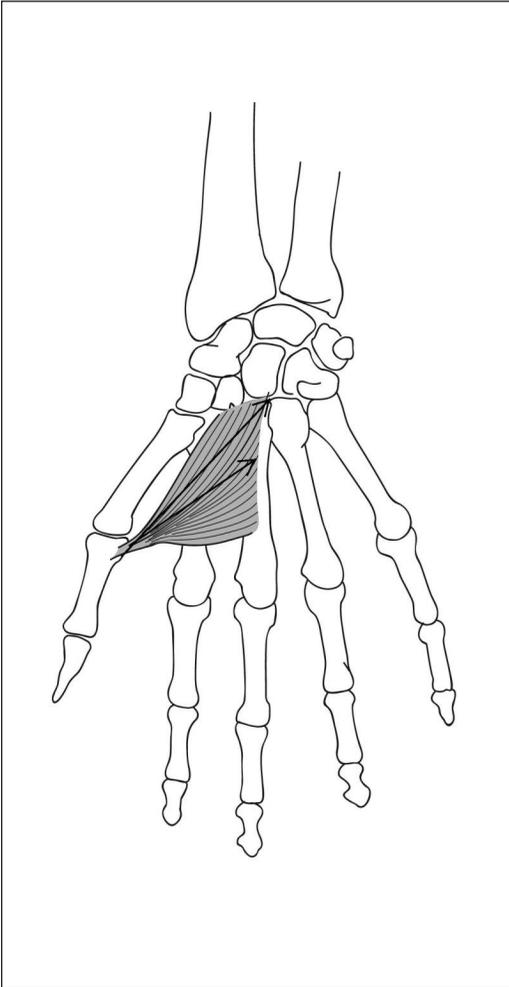
STABLE ARM: midline of the second metacarpal, along the radial border

MOVABLE ARM: midline of the first metacarpal, along the radial border

CMC Adduction: Isolated Muscle Testing

Prime Mover: Adductor pollicis, Palmar interossei

Adductor pollicis



Origin: Third digit metacarpal, capitate, trapezoid

Insertion: Base of the first digit proximal phalanx, ulnar side

Innervation: Ulnar nerve

Action: Thumb CMC adduction

Figure 4-4-81.



Figure 4-4-82.



Figure 4-4-83.



Figure 4-4-84.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity placed on the table in forearm supination. Thumb is placed in CMC abduction (Figure 4-4-82).

Motion: client moves the testing extremity in the direction of thumb CMC adduction (Figure 4-4-83).

Therapist Position: Stabilize at the wrist to eliminate any compensation. Resistance is applied at the proximal phalanx of the thumb in the direction of CMC abduction when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

The testing positions are the same as above. A grade of poor is given when the client can move the testing extremity through only a small portion of the range in this position (Figure 4-4-84).

Palpation: Adductor pollicis is palpated between the first and second metacarpals, palmar surface.

Palmar interossei

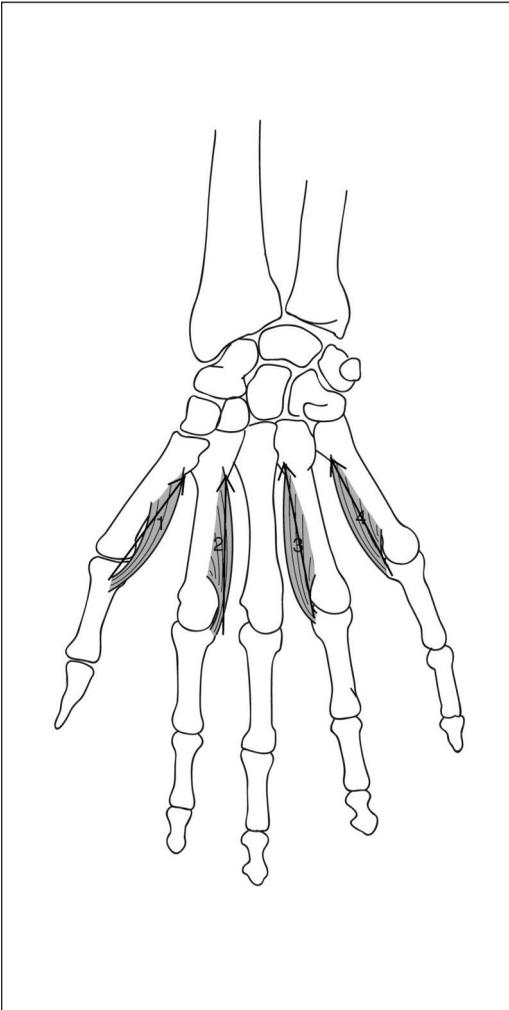


Figure 4-4-39.

Origin: First interosseous—ulnar surface of second metacarpal

Second interosseous—ulnar surface of second metacarpal

Third interosseous—radial surface of fourth metacarpal

Fourth interosseous—radial surface of fifth metacarpal

Insertion: First interosseous—base of the first digit proximal phalanx, ulnar side

Second interosseous—base of the second digit proximal phalanx, ulnar side

Third interosseous—base of the fourth digit proximal phalanx, radial side

Fourth interosseous—base of the fifth digit proximal phalanx, radial side

Innervation: Ulnar nerve

Action: Digit MCP adduction



Figure 4-4-40.



Figure 4-4-41.



Figure 4-4-42.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity on a table in forearm supination and MCP abduction (Figure 4-4-40). Motion—client moves the testing extremity in the direction of MCP adduction (Figure 4-4-41).

Therapist Position: Stabilize at the metacarpals to avoid compensation. Resistance is applied at the proximal phalanx on the ulnar side of the second digit, and the radial side of the fourth and fifth digits when testing Normal or Good strengths. No resistance is applied when testing Fair strength. Note: The third digit does not adduct.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

The client and therapist positions are the same and no resistance is applied (Figure 4-4-42).

Palpation: The interossei are too deep for palpation.

Metacarpalphalangeal (MP) Flexion (Digit I) Assessment: Goniometry

Plane: Frontal

Axis: Sagittal

Normal Range: 0-60 degrees

End feel: Hard or Firm



Figure 4-4-85.



Figure 4-4-86.

Client Position: Client is sitting with feet on the floor.

Starting—elbow of the testing extremity is resting on the table with the humerus slightly flexed and forearm in neutral. The MP is in neutral or extension (Figure 4-4-85).

Ending—client moves the testing extremity through maximum MP flexion (Figure 4-4-86).

Therapist Position: Stabilize at the metacarpal joint as necessary.

Goniometer Position:

FULCRUM: dorsal surface of the MP joint of the thumb

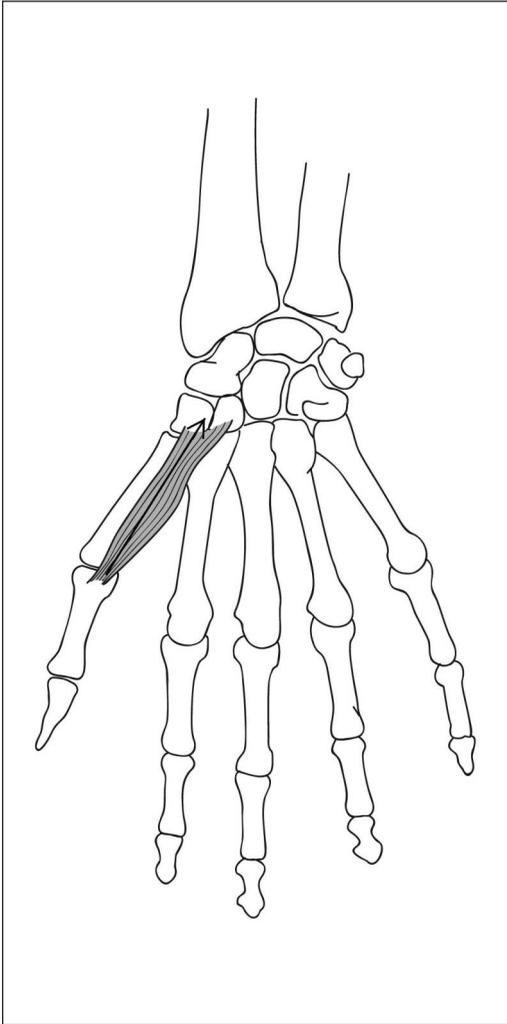
STABLE ARM: midline and dorsal surface of the metacarpal of the thumb

MOVABLE ARM: midline and dorsal surface of the proximal phalanx of the thumb

Isolated Muscle Testing

Prime Mover: Flexor pollicis brevis

Flexor pollicis brevis



Origin: Trapezium, trapezoid

Insertion: Base of the first digit proximal phalanx

Innervation: Median and ulnar nerves

Action: Thumb MCP flexion, and assist with CMC flexion

Figure 4-4-15.



Figure 4-4-16.



Figure 4-4-17.



Figure 4-4-18.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity placed on the table in forearm supination (Figure 4-4-16).

Motion—client moves the testing extremity in the direction of thumb MCP flexion (Figure 4-4-17).

Therapist Position: Stabilize at the metacarpal to eliminate any compensation. Resistance is applied at the proximal phalanx of the thumb in the direction of MCP extension when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

The testing positions are the same as above. A grade of poor is given when the client can move the testing extremity through only a small portion of the range in this position (Figure 4-4-18).

Palpation: Flexor pollicis brevis is palpated over the first metacarpal, palmar surface.

MP Extension (Digit I) Assessment: Goniometry

Plane: Frontal

Axis: Sagittal

Normal Range: 60-0 degrees

End feel: Firm



Figure 4-4-87.



Figure 4-4-88.

Client Position: Client is sitting with feet on the floor.

Starting—elbow of the testing extremity is resting on the table with the humerus slightly flexed and forearm in neutral. The MP is in neutral or flexion (Figure 4-4-87).

Ending—client moves the testing extremity through maximum MP extension (Figure 4-4-88).

Therapist Position: Stabilize at the metacarpal joint as necessary.

Goniometer Position:

FULCRUM: dorsal surface of the MP joint of the thumb

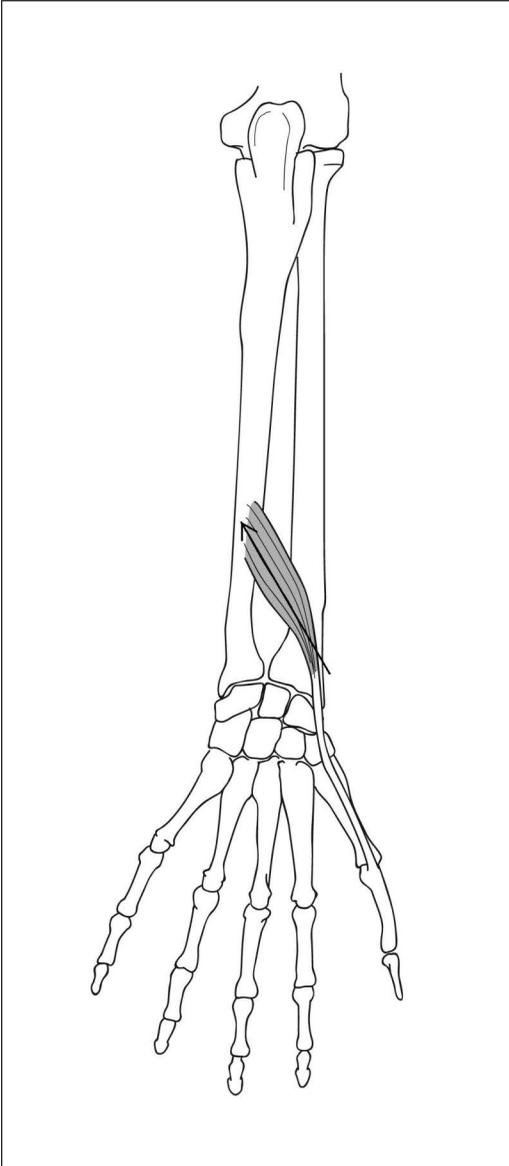
STABLE ARM: midline and dorsal surface of the metacarpal of the thumb

MOVABLE ARM: midline and dorsal surface of the proximal phalanx of the thumb

Isolated Muscle Testing

Prime Mover: Extensor pollicis brevis

Extensor pollicis brevis



Origin: Posterior radius and ulna

Insertion: Base of the first digit proximal phalanx, dorsal surface

Innervation: Radial nerve

Action: MCP and assists CMC extension

Figure 4-4-33.



Figure 4-4-34.



Figure 4-4-35.



Figure 4-4-36.

Against Gravity: Fair (3), Good (4), Normal (5)

Client Position: Starting—client is sitting with the testing extremity placed on the table with the forearm in neutral and thumb in slight MCP flexion (Figure 4-4-34).

Motion:—client moves the testing extremity in the direction of thumb MCP extension (Figure 4-4-35).

Therapist Position: Stabilize at the thumb metacarpal to eliminate any compensation. Resistance is applied at the proximal phalanx of the thumb in the direction of thumb MCP flexion when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

Gravity Eliminated: Zero (0), Trace (1), Poor (2)

The testing positions are the same as above. A grade of poor is given when the client can move the testing extremity through only a small portion of the range in this position (Figure 4-4-36).

Palpation: Extensor pollicis brevis tendon is palpated at the base of the first metacarpal, dorsal surface.

Interphalangeal (IP) Flexion (Digit I) Assessment: Goniometry

Plane: Frontal

Axis: Sagittal

Normal ROM: 0-90

End feel: Firm



Figure 4-4-89.



Figure 4-4-90.

Client Position: Client is sitting with feet on the floor.

Starting—elbow of the testing extremity is resting on the table with the humerus slightly flexed and forearm in neutral. The IP is in neutral or extension (Figure 4-4-89).

Ending—client moves the testing extremity through maximum IP flexion (Figure 4-4-90).

Therapist Position: Stabilize at the proximal phalanx as necessary.

Goniometer Position:

FULCRUM: dorsal IP joint of the thumb

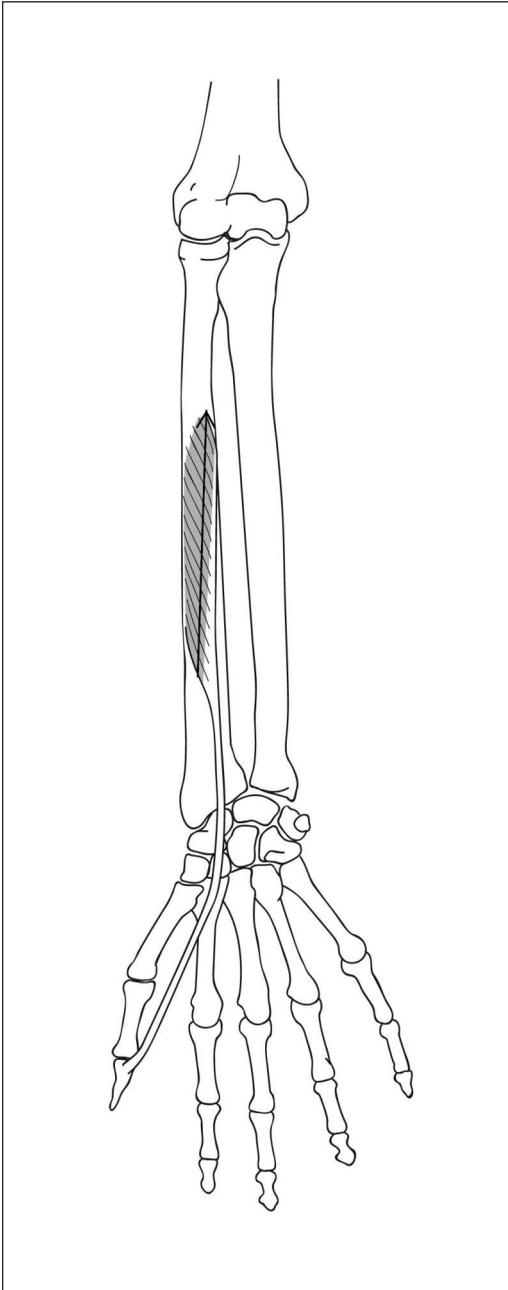
STABLE ARM: dorsal midline of proximal phalanx of thumb

MOVABLE ARM: Dorsal midline of distal phalanx of thumb

Interphalangeal (MP) Flexion (Digit I): Isolated Muscle Testing

Prime Mover: Flexor pollicis longus

Flexor pollicis longus



Origin: Anterior radius

Insertion: Base of the first digit distal phalanx

Innervation: Median nerve

Action: Thumb IP flexion

Figure 4-4-59.



Figure 4-4-60.



Figure 4-4-61.



Figure 4-4-62.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity placed on the table in forearm supination (Figure 4-4-60).

Motion—client moves the testing extremity in the direction of thumb IP flexion while maintaining thumb MCP extension (Figure 4-4-61).

Therapist Position: Stabilize at the proximal phalanx to eliminate any compensation. Resistance is applied at the distal phalanx of the thumb in the direction of IP extension when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

The testing positions are the same as above. A grade of poor is given when the client can move the testing extremity through only a small portion of the range in this position (Figure 4-4-62).

Palpation: Flexor pollicis brevis tendon is palpated over the first proximal phalanx, palmar surface.

Interphalangeal (IP) Extension (Digit I) Assessment: Goniometry

Plane: Frontal

Axis: Sagittal

Normal ROM: 0-90

End feel: Firm



Figure 4-4-91.



Figure 4-4-92.

Client Position: Client is sitting with feet on the floor.

Starting—elbow of the testing extremity is resting on the table with the humerus slightly flexed and forearm in neutral. The IP is in neutral or flexion (Figure 4-4-91).

Ending—client moves the testing extremity through maximum IP extension (Figure 4-4-92).

Therapist Position: Stabilize at the proximal phalanx as necessary.

Goniometer Position:

FULCRUM: dorsal IP joint of the thumb

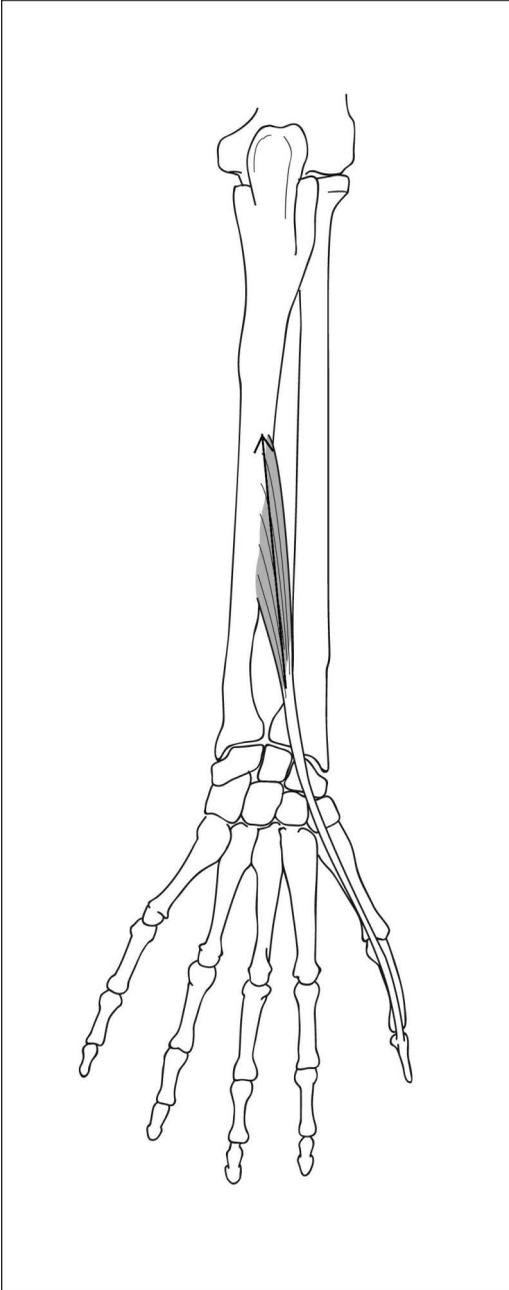
STABLE ARM: dorsal midline of proximal phalanx of thumb

MOVABLE ARM: Dorsal midline of distal phalanx of thumb

Isolated Muscle Testing

Prime Mover: Extensor pollicis longus

Extensor pollicis longus



Origin: Middle, posterior ulna

Insertion: Base of the first digit distal phalanx, dorsal surface

Innervation: Radial nerve

Action: Thumb IP extension

Figure 4-4-65.



Figure 4-4-66.



Figure 4-4-67.



Figure 4-4-68.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity placed on the table with the forearm in neutral and thumb IP flexed (Figure 4-4-66).

Motion:—client moves the testing extremity in the direction of thumb IP extension (Figure 4-4-67).

Therapist Position: Stabilize at the thumb proximal phalanx to eliminate any compensation. Resistance is applied at the distal phalanx of the thumb in the direction of thumb IP flexion when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

The testing positions are the same as above. A grade of poor is given when the client can move the testing extremity through only a small portion of the range in this position (Figure 4-4-68).

Palpation: Extensor pollicis longus tendon is palpated over the first proximal phalanx, dorsal surface.

Opposition Assessment: Goniometry

Opposition is a curvilinear motion as a result of combined CMC and MCP flexion and adduction of the first and fifth digits. As such, it is motion that occurs through and across the traditional cardinal planes and axes.

Normal ROM: 0 centimeters; digits I and V are free to touch distally

End feel: Soft



Figure 4-4-93.



Figure 4-4-94.

Client Position: Client is sitting with feet on the floor.

Starting—testing extremity is resting on the table with the humerus abducted to 90 degrees, elbow flexed, and forearm in supination (Figure 4-4-93).

Ending—client moves the testing extremity into opposition (Figure 4-4-94).

Therapist Position: Observe at the wrist to avoid compensation.

Goniometer Position:

The ruler measurements, which are located on one of the arms of the goniometer, are used for opposition. The measurement is taken from the tip of the fifth digit to the tip of the first digit. The measurement is recorded in the number of centimeters of opposition that is lacking. This same method can be used for opposition of the first digit to any of the digits.

Isolated Muscle Testing

Prime Movers: Opponens pollicis (digit I), Opponens digiti minimi (digit V)

Opponens pollicis



Figure 4-4-95.

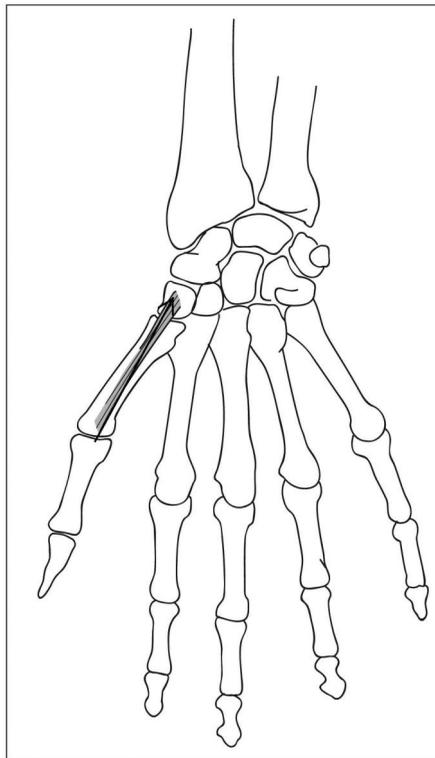


Figure 4-4-95A.

Origin: Trapezium

Insertion: First digit metacarpal, radial side

Innervation: Median nerve

Action: First digit opposition



Figure 4-4-96.



Figure 4-4-97.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity placed on the table in forearm supination (Figure 4-4-96).

Motion—client moves the testing extremity in the direction of thumb opposition (CMC flexion and abduction) (Figure 4-4-97).

Therapist Position: Stabilize at the fifth metacarpal to avoid compensation. Resistance is applied at the first metacarpal in the opposite direction from opposition (CMC extension and adduction) when testing Normal or Good strengths. No resistance is applied when testing Fair strength.



Figure 4-4-98.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

The testing positions are the same as above. A grade of poor is given when the client can move through only a small portion of the range in this position (Figure 4-4-98).

Palpation: Opponens pollicis is palpated in the thenar eminence, lateral to the abductor pollicis.

Opponens digiti minimi



Figure 4-4-99.

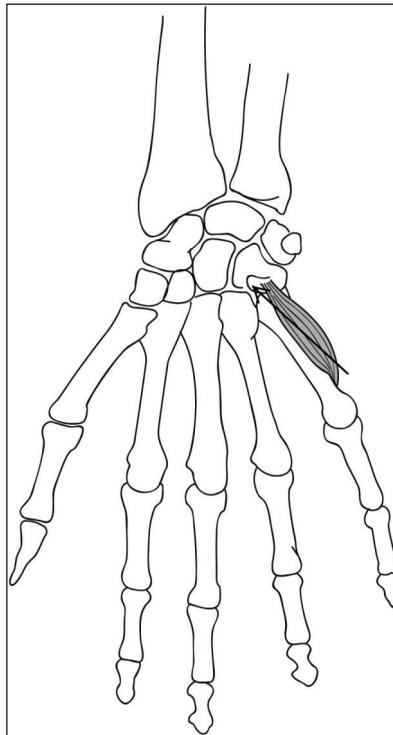


Figure 4-4-99.

Origin: Hamate

Insertion: Fifth digit metacarpal, ulnar side

Innervation: Ulnar nerve

Action: Fifth digit opposition



Figure 4-4-100.



Figure 4-4-101.



Figure 4-4-102.

**Against Gravity:
Fair (3), Good (4), Normal (5)**

Client Position: Starting—client is sitting with the testing extremity on a table in forearm supination (Figure 4-4-100).

Motion—client moves the testing extremity in the direction of opposition (flexion and adduction) (Figure 4-4-101).

Therapist Position: Stabilize at the first metacarpal. Resistance is applied at the fifth metacarpal in the opposite direction of opposition (extension and abduction) when testing Normal or Good strengths. No resistance is applied when testing Fair strength.

**Gravity Eliminated:
Zero (0), Trace (1), Poor (2)**

The client and therapist positions are the same and no resistance is applied. A grade of poor is given when the client is unable to move through the complete ROM (Figure 4-4-102).

Palpation: Opponens digiti minimi is palpated on the hypothenar eminence.

Table 4-5

HAND ASSESSMENT AT A GLANCE

FUNCTIONAL MUSCLE GROUP	PLANE	AXIS	NORMAL ROM	GONIOMETRY/ROM TESTING PROCEDURE	END FEEL	ISOLATED MUSCLE TESTING PROCEDURE (OF PRIMARY MOVERS)
<i>MCP Flexion (Digits II-V)</i>	Sagittal	Frontal	0 to 90 degrees	<p>Fulcrum: Dorsal surface of MCP joint being measured.</p> <p>Stable arm: Midline and dorsal surface of the metacarpal of digit being measured.</p> <p>Movable arm: Midline and dorsal surface of the proximal phalanx of the digit being measured.</p>	Hard	<p>FLEXOR DIGITORUM SUPERFICIALIS</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing arm placed on table in forearm supination and digit extension.</p> <p>Motion: Client moves testing fingers into PIP flexion, keeping the MCPs extended.</p> <p>Stabilize: At the proximal phalanx to resist compensation.</p> <p>Resist: At the middle phalanx toward PIP extension.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2):</p> <p>Position: Client is seated with testing arm on table with forearm neutral rotation and digit extension.</p> <p>Motion: Client moves testing fingers into PIP flexion.</p> <p>Stabilize: At the proximal phalanx to resist compensation.</p> <p>Palpate: On the proximal phalanx or palmar surface of wrist between tendons of palmaris longus and flexor carpi ulnaris.</p>

(continued)

Table 4-5 (continued)

HAND ASSESSMENT AT A GLANCE

						<p>FLEXOR DIGITORUM PROFUNDUS:</p> <p>Against Gravity: Fair (3), Good (4), Normal (5):</p> <p>Position: Client is seated with testing arm placed on table in forearm supination and digit extension.</p> <p>Motion: Client moves testing fingers into DIP flexion while keeping the PIP and MCP joints extended.</p> <p>Stabilize: At the middle phalanx to resist compensation.</p> <p>Resist: At the distal phalanx.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2):</p> <p>Position: Client is seated with testing arm on table, with neutral forearm rotation and digit extension.</p> <p>Motion: Client moves testing fingers into DIP flexion.</p> <p>Stabilize: At the middle phalanx to resist compensation.</p> <p>Palpate: Over the middle phalanges on the palmar surface of the digits.</p>
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(continued)

Table 4-5 (continued)

HAND ASSESSMENT AT A GLANCE

					<p>LUMBRICALS</p> <p>Against Gravity: Fair (3), Good (4), Normal (5): Position: Client is seated with testing arm on table with forearm supination, MCP extension, and PIP and DIP flexion. Motion: Client moves testing fingers into MCP flexion and PIP and DIP extension. Stabilize: At the metacarpals to resist compensation. Resist: Apply at the proximal phalanx into MCP extension.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2) Position: Client is seated with testing arm on table with the forearm in neutral rotation, MCP extension, and the PIP and DIP joints flexed. Motion: Client moves testing fingers into MCP flexion while extending the PIP and DIP joints. Stabilize: At the metacarpals to resist compensation. Palpate: Too deep to palpate.</p>
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(continued)

Table 4-5 (continued)

HAND ASSESSMENT AT A GLANCE

						<p>FLEXOR DIGITI MINIMI: Against Gravity: Fair (3), Good (4), Normal (5): Position: Client is seated with testing arm on table with forearm supination, MCP/PIP/DIP extension. Motion: Client moves fifth digit into MCP flexion. Stabilize: At the metacarpal to resist compensation. Resist: Apply at the proximal phalanx into MCP extension of the fifth digit. Gravity Eliminated: Zero (0), Trace (1), Poor (2): Position: Client is seated with testing arm on table with the forearm in neutral rotation, MCP/PIP/DIP extension. Motion: Client moves fifth digit into MCP flexion. Stabilize: At the metacarpal to resist compensation. Palpate: Over proximal phalanx, palmar surface.</p>
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(continued)

Table 4-5 (continued)

HAND ASSESSMENT AT A GLANCE

<p><i>MCP Extension/ Hyperextension</i></p>	<p>Sagittal</p>	<p>Frontal</p>	<p>90 to 0 degrees extension 0 to 30 degrees hyper-extension</p>	<p>Fulcrum: Dorsal surface of MCP joint being measured. Stable arm: Midline and dorsal surface of the metacarpal of digit being measured. Movable arm: Midline and dorsal surface of the proximal phalanx of the digit being measured.</p>	<p>Firm</p>	<p>EXTENSOR POLLICIS BREVIS Against Gravity: Fair (3), Good (4), Normal (5): Position: Client is seated with testing arm on table with a neutral forearm and thumb in slight MCP flexion. Motion: Client moves testing thumb into MCP extension. Stabilize: At the metacarpal of the thumb to resist compensation. Resist: Apply at the proximal phalanx of the thumb towards thumb MCP flexion. Gravity Eliminated: Zero (0), Trace (1), Poor (2) Positioning is the same as above. Palpate: At the base of the first metacarpal.</p>
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(continued)

Table 4-5 (continued)

HAND ASSESSMENT AT A GLANCE

<i>MCP Adduction</i>	Frontal	Sagittal	Compare with opposite side	<p>Fulcrum: Dorsal to the MCP joint.</p> <p>Stable arm: Parallel along the dorsal metacarpal</p> <p>Movable arm: Along the dorsal proximal phalanx.</p>	Firm	<p>PALMAR INTEROSSEI</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing arm on table in forearm supination and the MCP joints abducted.</p> <p>Motion: Client moves testing hand into MCP adduction.</p> <p>Stabilize: At the metacarpals to resist compensation.</p> <p>Resist: At the proximal phalanx on the ulnar side of the second digit, and the radial side of digit four and five.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Same as testing against gravity.</p> <p>Palpate: Too deep to palpate.</p>
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(continued)

Table 4-5 (continued)

HAND ASSESSMENT AT A GLANCE

<p><i>MCP Abduction</i></p>	<p>Frontal</p>	<p>Sagittal</p>	<p>Compare with opposite side</p>	<p>Fulcrum: Dorsal to the MCP joint. Stable arm: Parallel along the dorsal metacarpal. Movable arm: Parallel along the dorsal proximal phalanx.</p>	<p>Soft</p>	<p>DORSAL INTEROSSEI Against Gravity: Fair (3), Good (4), Normal (5) Position: Client is seated with testing arm on table in forearm pronation and MCP adduction. Motion: Client moves testing hand into MCP abduction. Stabilize: At the metacarpals to resist compensation. Resist: At the proximal phalanx on the radial side of digit two, the radial and ulnar side of digit three, and the ulnar side of digits four and five. Gravity Eliminated: Zero (0), Trace (1), Poor (2) Same as testing against gravity. Palpate: Too deep to palpate. ABDUCTOR DIGITI MINIMI The testing positions are the same for the Dorsal interossei above. Palpate: Over the lateral aspect of the fifth metacarpal.</p>
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(continued)

Table 4-5 (continued)

HAND ASSESSMENT AT A GLANCE

<i>PIP Flexion</i>	Sagittal	Frontal	0 to 90 degrees	<p>Fulcrum: Dorsal surface of the PIP joint being tested.</p> <p>Stable arm: Dorsal midline of the proximal phalanx of digit being measured.</p> <p>Movable arm: Dorsal midline of the middle phalanx of digit being tested.</p>	Hard	<p>FLEXOR DIGITORUM SUPERFICIALIS</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing arm placed on table in forearm supination and digit extension.</p> <p>Motion: Client moves testing hand into PIP flexion while keeping MCPs extended.</p> <p>Stabilize: At the proximal phalanx to resist compensation.</p> <p>Resist: At the middle phalanx towards PIP extension.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is seated with testing arm on table with the forearm neutral and the digits extended.</p> <p>Motion: Client moves testing hand into PIP flexion.</p> <p>Stabilize: At the proximal phalanx to resist compensation.</p> <p>Palpate: Either on the proximal phalanx, or the palmar surface of the wrist between the tendons of the palmaris longus and flexor carpi ulnaris.</p>
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(continued)

Table 4-5 (continued)

HAND ASSESSMENT AT A GLANCE

<p><i>PIP Extension</i></p>	<p>Sagittal</p>	<p>Frontal</p>	<p>90 to 0 degrees</p>	<p>Same positioning as PIP flexion.</p>	<p>Firm</p>	<p>EXTENSOR DIGITORUM Against Gravity: Fair (3), Good (4), Normal (5) Position: Client is seated with testing arm on a table edge in forearm pronation and the digits flexed off the table. Motion: Client moves testing hand into MCP extension, keeping the PIP and DIP joints flexed. Stabilize: Over proximal phalanx of digits 2-4 to resist compensation. Resist: At the middle phalanx towards PIP flexion. Gravity Eliminated: Zero (0), Trace (1), Poor (2) (gravity eliminated) Position: Client is seated with testing arm on table with the forearm neutral and the digits flexed. Motion: Client moves testing hand into digit extension. Stabilize: Over proximal phalanx toward PIP flexion. Palpate: On the dorsal surface of the proximal phalanx.</p>
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(continued)

Table 4-5 (continued)

HAND ASSESSMENT AT A GLANCE

					<p>LUMBRICALS</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing arm on table with forearm supination, MCP extension, and PIP and DIP flexion.</p> <p>Motion: Client moves testing fingers into MCP flexion and PIP and DIP extension.</p> <p>Stabilize: At the metacarpals to resist compensation.</p> <p>Resist: Apply at the proximal phalanx into MCP extension.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is seated with testing arm on table with the forearm in neutral rotation, MCP extension, and the PIP and DIP joints flexed.</p> <p>Motion: Client moves testing fingers into MCP flexion while extending the PIP and DIP joints.</p> <p>Stabilize: At the metacarpals to resist compensation.</p> <p>Palpate: Too deep to palpate.</p>
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(continued)

Table 4-5 (continued)

HAND ASSESSMENT AT A GLANCE

						<p>EXTENSOR INDICIS The testing positions are the same for the extensor digitorum above. Palpate: Over the second metacarpal head, dorsal surface.</p> <p>EXTENSOR DIGITI MINIMI The testing positions are the same for the extensor digitorum above. Palpate: Over the fifth metacarpal head, dorsal surface</p>
<i>DIP Flexion</i>	Sagittal	Frontal	0 to 90 degrees	<p>Fulcrum: Dorsal DIP joint of finger being measured. Stable arm: Dorsal midline of middle phalanx being measured. Movable arm: Dorsal midline of distal phalanx being measured.</p>	Firm	<p>FLEXOR DIGITORUM PROFUNDUS Against Gravity: Fair (3), Good (4), Normal (5) Position: Client is seated with testing arm placed on table in forearm supination and digit extension. Motion: Client moves testing fingers into DIP flexion while keeping the PIP and MCP joints extended. Stabilize: At the middle phalanx to resist compensation. Resist: At the distal phalanx. Gravity Eliminated: Zero (0), Trace (1), Poor (2) Position: Client is seated with testing arm on table, with neutral forearm rotation and digit extension. Motion: Client moves testing fingers into DIP flexion. Stabilize: At the middle phalanx to resist compensation. Palpate: Over the middle phalanges on the palmar surface of the digits.</p>

(continued)

Table 4-5 (continued)

HAND ASSESSMENT AT A GLANCE

<i>DIP Extension</i>	Sagittal	Frontal	90 to 0 degrees	Same placement as DIP flexion.	Firm	<p>EXTENSOR DIGITORUM</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing arm on a table edge in forearm pronation and the digits flexed off the table.</p> <p>Motion: Client moves testing hand into MCP extension, keeping the PIP and DIP joints flexed.</p> <p>Stabilize: At the middle phalanx to resist compensation.</p> <p>Resist: At the distal phalanges towards DIP flexion.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2):</p> <p>Position: Client is seated with testing arm on table with the forearm neutral and the digits flexed.</p> <p>Motion: Client moves testing hand into digit extension.</p> <p>Stabilize: At the middle phalanx to resist compensation.</p> <p>Palpate: On the dorsal surface of the middle phalanx.</p>
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(continued)

Table 4-5 (continued)

HAND ASSESSMENT AT A GLANCE

					<p>LUMBRICALS</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing arm on table with forearm supination, MCP extension, and PIP and DIP flexion.</p> <p>Motion: Client moves testing fingers into MCP flexion and PIP and DIP extension.</p> <p>Stabilize: At the metacarpals to resist compensation.</p> <p>Resist: Apply at the proximal phalanx into MCP extension.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2):</p> <p>Position: Client is seated with testing arm on table with the forearm in neutral rotation, MCP extension, and the PIP and DIP joints flexed.</p> <p>Motion: Client moves testing fingers into MCP flexion while extending the PIP and DIP joints.</p> <p>Stabilize: At the metacarpals to resist compensation.</p> <p>Palpate: Too deep to palpate.</p> <p>EXTENSOR INDICIS</p> <p>The testing positions are the same for the extensor digitorum above.</p> <p>Palpate: Over the second metacarpal head, dorsal surface.</p>
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(continued)

Table 4-5 (continued)

HAND ASSESSMENT AT A GLANCE

						<p>EXTENSOR DIGITI MINIMI</p> <p>The testing positions are the same for the extensor digitorum above.</p> <p>Palpate: Over the fifth metacarpal head, dorsal surface</p>
<i>CMC Flexion</i>	Frontal	Sagittal	0 to 20 degrees	<p>Fulcrum: Base of CMC joint.</p> <p>Stable arm: Midline of radius.</p> <p>Movable arm: Midline of first metacarpal.</p>	Soft	<p>FLEXOR POLLICIS BREVIS AS ABOVE IN MCP/MP FLEXION</p> <p>FLEXOR POLLICIS LONGUS</p> <p>Against Gravity: Fair (3), Good (4), Normal (5):</p> <p>Position: Client is seated with testing arm on table in forearm supination.</p> <p>Motion: Client moves testing thumb into IP flexion while keeping the MCP joint extended.</p> <p>Stabilize: At the proximal phalanx to resist compensation.</p> <p>Resist: Apply at the distal phalanx of the thumb into IP extension.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Same as “fair, good, normal” for positioning, motion, and stabilizing. A Client is “poor” if they can only move testing thumb through a small range of motion in the position.</p> <p>Palpate: On the palmar surface of the first proximal phalanx.</p>

(continued)

Table 4-5 (continued)

HAND ASSESSMENT AT A GLANCE

<p><i>CMC Extension (also known as Radial Abduction)</i></p>	<p>Frontal</p>	<p>Sagittal</p>	<p>0 to 45 degrees</p>	<p>Same position as thumb CMC flexion. Readings should be positive, but do not necessarily start at 0.</p>	<p>Firm</p>	<p>EXTENSOR POLLICIS BREVIS AS ABOVE IN MCP/MP EXTENSION</p> <p>EXTENSOR POLLICIS LONGUS</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing arm on table with a neutral forearm and thumb in IP flexion.</p> <p>Motion: Client moves testing thumb towards IP extension.</p> <p>Stabilize: At the proximal phalanx of the thumb to resist compensation.</p> <p>Resist: At the distal phalanx of the thumb towards thumb IP flexion.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2): Positions are the same as against gravity.</p> <p>Palpate: Over the first proximal phalanx on the dorsal surface.</p>
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(continued)

Table 4-5 (continued)

HAND ASSESSMENT AT A GLANCE

<p>CMC Abduction (also known as Palmar Abduction)</p>	Sagittal	Frontal	0 to 70 degrees	<p>Fulcrum: Base of the first and second metacarpals.</p> <p>Stable arm: Midline of the second metacarpal, along the radial edge.</p> <p>Movable arm: Midline of the first metacarpal, along the radial edge.</p>	Firm	<p>ABDUCTOR POLLICIS BREVIS Against Gravity: Fair (3), Good (4), Normal (5) Position: Client is seated with testing arm on table in forearm supination. Motion: Client moves testing thumb into CMC abduction. Stabilize: At the hand to resist compensation. Resist: At the proximal phalanx of the thumb towards CMC adduction. Gravity Eliminated: Zero (0), Trace (1), Poor (2) Testing positions are the same. Palpate: At the lateral surface of the first digit metacarpal.</p> <p>ABDUCTOR POLLICIS LONGUS Against Gravity: Fair (3), Good (4), Normal (5) Position: Client is seated with testing arm on table with a neutral forearm. Motion: Client moves testing thumb into CMC abduction. Stabilize: At the wrist to avoid compensation. Resist: At the thumb metacarpal towards CMC adduction. Gravity Eliminated: Zero (0), Trace (1), Poor (2) Positions are the same as above. Palpate: At the lateral surface of the base of the first digit metacarpal.</p>
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(continued)

Table 4-5 (continued)

HAND ASSESSMENT AT A GLANCE

<p><i>CMC Adduction</i></p>	<p>Sagittal</p>	<p>Frontal</p>	<p>Compare with opposite side</p>	<p>Same position as thumb CMC abduction.</p>	<p>Soft</p>	<p>ADDUCTOR POLLICIS Against Gravity: Fair (3), Good (4), Normal (5) Position: Client is seated with testing arm on table in forearm supination, and thumb in CMC abduction. Motion: Client moves testing thumb into CMC adduction. Stabilize: At the wrist to avoid compensation. Resist: At the proximal phalanx of the thumb towards CMC abduction. Gravity Eliminated: Zero (0), Trace (1), Poor (2) Testing positions are the same as against gravity. Palpate: At web space between first and second metacarpals.</p>
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(continued)

Table 4-5 (continued)

HAND ASSESSMENT AT A GLANCE

						<p>PALMAR INTEROSSEI</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing arm on table in forearm supination and MCP abduction.</p> <p>Motion: Client moves testing hand into MCP adduction.</p> <p>Stabilize: At the metacarpals to resist compensation.</p> <p>Resist: At the proximal phalanx on the ulnar side of the second digit, and the radial side of the fourth and fifth digits.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Positions are the same.</p> <p>Palpate: Too deep to palpate.</p>
<i>MP Flexion (Digit I)</i>	Frontal	Sagittal	0 to 60 degrees	<p>Fulcrum: Dorsal surface of the MP joint that is being measured</p> <p>Stable arm: Midline and dorsal surface of the metacarpal of the digit being measured</p> <p>Movable arm: Midline and dorsal surface of the proximal phalanx of the digit being measured</p>	Hard or Firm	<p>FLEXOR POLLICIS BREVIS AS ABOVE IN CMC FLEXION</p>

(continued)

Table 4-5 (continued)

HAND ASSESSMENT AT A GLANCE

MP Extension (Digit I)	Frontal	Sagittal	60 to 0 degrees	Same position as MP flexion.	Firm	EXTENSOR POLLICIS BREVIS AS ABOVE IN CMC EXTENSION
IP Flexion (Digit I)	Frontal	Sagittal	0 to 90 degrees	Fulcrum: Dorsal IP joint being measured. Stable arm: Dorsal midline of proximal phalanx of thumb being measured. Movable arm: Dorsal midline of distal phalanx of thumb being measured.	Firm	FLEXOR POLLICIS LONGUS: STATED ABOVE IN CMC FLEXION
IP Extension (Digit I)	Frontal	Sagittal	90 to 0 degrees	Same placement as IP flexion.	Firm	EXTENSOR POLLICIS LONGUS: STATED ABOVE IN CMC EXTENSION
Opposition (Note: This is a curvilinear motion that crosses cardinal planes.)			0 centimeters	Using ruler on the arm of the goniometer, measure distance between digits I & V when attempting to oppose in full.	Soft	OPPONENS POLLICIS Against Gravity: Fair (3), Good (4), Normal (5) Position: Client is seated with testing arm on table in forearm supination and MCP abduction. Motion: Client moves testing hand into opposition. Stabilize: At the metacarpal of digit V to resist compensation. Resist: At the first metacarpal in the opposite direction from opposition. Gravity Eliminated: Zero (0), Trace (1), Poor (2) Positions are the same, however no resistance is applied. Palpate: On the thenar eminence lateral to abductor pollicis.

(continued)

Table 4-5 (continued)

HAND ASSESSMENT AT A GLANCE

						<p>OPPONENS DIGITI MINIMI Against Gravity: Fair (3), Good (4), Normal (5) Position: Client is seated with testing arm on table in forearm supination and MCP abduction. Motion: Client moves testing hand into opposition. Stabilize: At the metacarpal of digit I to resist compensation. Resist: At the first metacarpal in the opposite direction from opposition. Gravity Eliminated: Zero (0), Trace (1), Poor (2) Positions are the same, however no resistance is applied. Palpate: On the hypothenar eminence.</p>
<i>Elbow Flexion</i>	Sagittal	Frontal	0 to 135 degrees	<p>Fulcrum: Lateral epicondyle of humerus. Stable arm: Midline of lateral surface of humerus. Movable arm: Midline of lateral surface of radius.</p>	Soft	<p>BICEPS BRACHII Against Gravity: Fair (3), Good (4), Normal (5) Position: Client is seated with testing arm in humeral adduction, elbow extension, and forearm supination. Motion: Client moves testing arm into elbow flexion. Stabilize: At the humerus to resist compensation. Resist: At forearm, pushing toward elbow extension.</p>

(continued)

Table 4-5 (continued)

HAND ASSESSMENT AT A GLANCE

					<p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is seated with testing arm at 90 degrees of shoulder flexion or abduction, elbow extension, and forearm supination. Arm should be on a table or supported by therapist.</p> <p>Motion: Client moves testing arm into elbow flexion.</p> <p>Stabilize: Stabilize at the humerus to resist compensation, also support the testing arm so that gravity is eliminated but do not perform the motion for the client.</p> <p>Palpate: At the palmar aspect of the distal and medial humerus with the forearm in supination.</p> <p>BRACHIALIS</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing arm in shoulder adduction, elbow extension, and forearm pronation.</p> <p>Motion: Client moves testing arm into elbow flexion, while keeping the forearm pronated.</p> <p>Stabilize: Stabilize at humerus to resist compensation.</p> <p>Resist: Apply at the mid-forearm toward elbow extension.</p>
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(continued)

Table 4-5 (continued)

HAND ASSESSMENT AT A GLANCE

						<p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is seated with testing arm in 90 degrees of shoulder flexion or abduction, elbow extension, and a neutral forearm. Arm is supported by therapist or a table.</p> <p>Motion: Client moves testing arm into elbow flexion while keeping the forearm neutral.</p> <p>Stabilize: At the humerus to resist compensation. Support the arm to eliminate gravity but do not help Client perform motion.</p> <p>Palpate: At the distal and lateral humerus with a neutral forearm.</p>
<i>Elbow Extension</i>	Sagittal	Frontal	135 to 0 degrees	<p>Fulcrum: Lateral epicondyle of humerus.</p> <p>Stable arm: Midline of lateral humerus.</p> <p>Movable arm: Middle of lateral radius.</p>	Firm	<p>TRICEPS BRACHII (TESTED WITH ANCONEUS)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client lays supine with testing arm in shoulder flexion, elbow flexion, and forearm supination.</p> <p>Motion: Client moves testing arm into elbow extension.</p> <p>Stabilize: At the humerus to resist compensation.</p> <p>Resist: Apply at the posterior forearm toward elbow flexion.</p>

(continued)

Table 4-5 (continued)

HAND ASSESSMENT AT A GLANCE

						<p>Gravity Eliminated: Zero (0), Trace (1), Poor (2) Position: Client is seated with testing arm in shoulder flexion or abduction, elbow flexion, and a neutral forearm that is supported by the therapist or a table. Motion: Client moves testing arm into elbow extension. Stabilize: At the humerus to resist compensation. Also, support the arm against gravity but do not help Client complete the motion. Palpate: At the posterior mid-humerus. Anconeus (tested with triceps): Too deep to palpate.</p>
Forearm Supination	Transverse	Vertical	0 to 90 degrees	<p>Fulcrum: Palmar surface of distal forearm slightly proximal to the pisiform. Stable arm: Perpendicular to the floor. Movable arm: Across the palmar aspect of the distal forearm.</p>	Firm	<p>BICEPS BRACHII: STATED ABOVE IN ELBOW FLEXION SUPINATOR Against Gravity: Fair (3), Good (4), Normal (5) Position: Client is seated with testing arm in shoulder adduction, 90 degrees of elbow flexion, and a pronated forearm. Motion: Client moves testing arm into forearm supination. Stabilize: At the distal humerus to resist compensation. Resist: Apply at the posterior, distal forearm toward forearm pronation.</p>

(continued)

Table 4-5 (continued)

HAND ASSESSMENT AT A GLANCE

						<p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is seated with testing arm in shoulder flexion, elbow flexion, and a pronated forearm. Elbow is supported on a table.</p> <p>Motion: Client moves testing arm into forearm supination.</p> <p>Stabilize: At the humerus to resist compensation.</p> <p>Palpate: Palpate at the posterior, proximal forearm above the radius.</p>
<i>Forearm Pronation</i>	Transverse	Vertical	0 to 90 degrees	<p>Fulcrum: Ulnar styloid process.</p> <p>Stable arm: Perpendicular to the floor.</p> <p>Movable arm: Across the posterior surface of distal forearm.</p>	Hard	<p>PRONATOR TERES</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing arm in shoulder adduction, semi elbow flexion, and forearm supination.</p> <p>Motion: Client moves testing arm into forearm pronation.</p> <p>Stabilize: At the humerus.</p> <p>Resist: Apply at the posterior distal forearm in the direction of forearm supination.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is seated with testing arm in 90 degrees of shoulder flexion, partial elbow flexion, and with forearm in supination. Elbow is supported on a table.</p> <p>Motion: Client moves testing arm into forearm pronation.</p> <p>Stabilize: At the humerus.</p> <p>Palpate: At the anterior proximal forearm between ulna and radius.</p>

(continued)

Table 4-5 (continued)

HAND ASSESSMENT AT A GLANCE

						<p>PRONATOR QUADRATUS</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing arm in shoulder adduction, full elbow flexion, and forearm supination.</p> <p>Motion: Client moves testing arm into forearm pronation.</p> <p>Stabilize: At the humerus to resist compensation.</p> <p>Resist: Apply at the posterior distal forearm into forearm supination.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is seated with testing arm in 90 degrees of shoulder flexion, full elbow flexion, and forearm supination. The elbow is supported on the table.</p> <p>Motion: Client moves testing arm into forearm pronation.</p> <p>Stabilize: At the humerus to resist compensation.</p> <p>Palpate: Too deep to palpate.</p>
--	--	--	--	--	--	--



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GLOSSARY

Active range of motion—movement of the extremity by the client through the available arc of motion without the therapist's assistance

Against gravity—a position in which the client moves the extremity or body part perpendicular to the floor because the force of gravity is exerted down toward the floor

Axis of the body—the location around which movement of the body occurs

Biomechanical frame of reference—the frame of reference that defines function and dysfunction in terms of an individual's range of motion, strength, and endurance

Clinical reasoning—the decision-making process used to determine the need for further assessment, taking into account all known factors and observations

Compensation—use of alternative motions by the client to achieve the active range of motion that has been requested by the therapist

Degrees of Freedom—refers to the number of planes of motion allowed at a joint. A joint can have 1, 2, or 3 degrees of angular freedom which correspond to the three planes discussed.

End feel—the feeling that is elicited when the joint is brought through the entire available range of motion

Frames of reference—a guide to the therapist for the evaluation and intervention process

Functional Muscle Group—sets of muscle that synergistically work together to produce the cardinal motions of the human body

Fulcrum—part of the goniometer that is placed over the axis of motion when measuring range of motion

Functional observation—observation of a client completing a functional activity

Goniometer—the most commonly used instrument for measuring joint motion

Goniometry—the measurement of arc of motion of a joint

Gravity-eliminated—a position in which the client moves the extremity or body part parallel to the floor

Gross manual muscle testing—a test of entire muscle groups rather than individual muscles

Isolated manual muscle testing—a test of each specific muscle within a muscle group

Movable arm—part of the goniometer that is aligned with the plane of motion but is distal to the joint being measured and follows the arc of motion

Passive range of motion—movement of the extremity by the therapist through the available arc of motion without the client's assistance

Plane of the body—the flat surface along which movement of the body occurs

Resistance—application of pressure by the therapist in order to determine which muscle strength grade a client demonstrates

Screening—an informal functional assessment to determine quickly which joints need further assessment

Stabilization—applied manually by the therapist in order to avoid compensation by the client

Stationary arm—part of the goniometer that stays fixed and aligned with the plane of motion proximal to the joint being measured

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APPENDIX A

Occupational Therapy Screening: Biomechanical Task Analysis

Occupational Therapy Screening: Biomechanical Task Analysis

NAME: _____

Description of Functional Activity: _____

Task Analysis <small>(steps leading from start to completion of the functional activity)</small>	Active Range of Motion and Gross Muscle Strength Demands																		
	SHOULDER			ELBOW			FOREARM			WRIST			DIGITS 2-5			THUMB			
	AROM	GMT		AROM	GMT		AROM	GMT		AROM	GMT		AROM	GMT		AROM	GMT		
Sample: Reaching forward toward the bathroom sink faucet with the right upper extremity.	Flexion/ Extension	0-45 <i>Flex</i>	3 5	Flexion/ Extension	90-0 <i>Ext</i>	4 5	Supination/ Pronation	0-90 <i>Sup</i>	3 5	Flexion/ Extension	0-20 <i>Ext</i>	3 5	Flexion/ Extension	0-20 <i>Flex</i>	3 5	Flexion/ Extension	0 <i>Ext</i>	NA	
	Abduction/ Adduction	0	NA							Radial/ Ulnar Deviation	0-15 <i>Radial</i>	3 5	Abduction/ Adduction	0	NA	Abduction/ Adduction	0	NA	
	Horizontal Abduction/ Adduction	0	NA																
	Internal/ External Rotation	0-35 <i>IR</i>	4 5																
		AROM	GMT		AROM	GMT		AROM	GMT		AROM	GMT		AROM	GMT		AROM	GMT	
Step 1:	Flexion/ Extension			Flexion/ Extension			Supination/ Pronation			Flexion/ Extension			Flexion/ Extension			Flexion/ Extension			
	Abduction/ Adduction									Radial/ Ulnar Deviation			Abduction/ Adduction			Abduction/ Adduction			
	Horizontal Abduction/ Adduction																		
	Internal/ External Rotation																		
		AROM	GMT		AROM	GMT		AROM	GMT		AROM	GMT		AROM	GMT		AROM	GMT	
Step 2:	Flexion/ Extension			Flexion/ Extension			Supination/ Pronation			Flexion/ Extension			Flexion/ Extension			Flexion/ Extension			
	Abduction/ Adduction									Radial/ Ulnar Deviation			Abduction/ Adduction			Abduction/ Adduction			
	Horizontal Abduction/ Adduction																		
	Internal/ External Rotation																		
		AROM	GMT		AROM	GMT		AROM	GMT		AROM	GMT		AROM	GMT		AROM	GMT	

Step 3:		AROM	GMT		AROM	GMT		AROM	GMT		AROM	GMT		AROM	GMT
	Flexion/ Extension				Flexion/ Extension			Supination/ Pronation			Flexion/ Extension			Flexion/ Extension	
Abduction/ Adduction										Radial/ Ulnar Deviation			Abduction/ Adduction		
Horizontal Abduction/ Adduction															
Internal/ External Rotation															
Step 4:		AROM	GMT		AROM	GMT		AROM	GMT		AROM	GMT		AROM	GMT
	Flexion/ Extension			Flexion/ Extension			Supination/ Pronation			Flexion/ Extension			Flexion/ Extension		
Abduction/ Adduction										Radial/ Ulnar Deviation			Abduction/ Adduction		
Horizontal Abduction/ Adduction															
Internal/ External Rotation															
Step 5:		AROM	GMT		AROM	GMT		AROM	GMT		AROM	GMT		AROM	GMT
	Flexion/ Extension			Flexion/ Extension			Supination/ Pronation			Flexion/ Extension			Flexion/ Extension		
Abduction/ Adduction										Radial/ Ulnar Deviation			Abduction/ Adduction		
Horizontal Abduction/ Adduction															
Internal/ External Rotation															

*Add steps as may be necessary



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APPENDIX B

Occupational Therapy Screening: Biomechanical Screening Form: AROM

Patient's FIRST Name (only): _____

Evaluator FULL Name: _____

RANGE OF MOTION SCREENING						
Left			Scapula:	Right		
WNLs	WFLs	Further Assessment Needed		WNLs	WFLs	Further Assessment Needed
X			Sample	X		
			Elevation:			
			Depression:			
			Protraction:			
			Retraction:			
			Up Rotation:			
			Down Rotation:			
WNLs	WFLs	Further Assessment Needed	Shoulder:	WNLs	WFLs	Further Assessment Needed
			Flexion:			
			Extension:			
			Abduction:			
			Adduction:			
			Internal Rotation:			
			External Rotation:			
			Horiz Abduction:			
			Horiz Adduction:			

(continued)

WNLs	WFLs	Further Assessment Needed	Elbow:	WNLs	WFLs	Further Assessment Needed
			Flexion:			
			Extension:			
WNLs	WFLs	Further Assessment Needed	Forearm:	WNLs	WFLs	Further Assessment Needed
			Supination:			
			Pronation:			
WNLs	WFLs	Further Assessment Needed	Wrist:	WNLs	WFLs	Further Assessment Needed
			Flexion:			
			Extension:			
			Ulnar Deviation:			
			Radial Deviation:			
WNLs	WFLs	Further Assessment Needed	Hand:	WNLs	WFLs	Further Assessment Needed
			Gross Flexion and Adduction			
			Gross Extension and Abduction			
			Opposition			
WNLs	WFLs	Further Assessment Needed	Hip:	WNLs	WFLs	Further Assessment Needed
			Flexion:			
			Extension:			
			Abduction:			
			Adduction:			
			Internal Rotation:			
			External Rotation:			

(continued)

WNLs	WFLs	Further Assessment Needed	Knee:	WNLs	WFLs	Further Assessment Needed
			Flexion:			
			Extension:			
WNLs	WFLs	Further Assessment Needed	Ankle:	WNLs	WFLs	Further Assessment Needed
			Plantar Flexion:			
			Dorsiflexion:			
			Inversion:			
			Eversion:			
WNLs	WFLs	Further Assessment Needed	Foot:	WNLs	WFLs	Further Assessment Needed
			MTP Flexion and Adduction:			
			MTP Extension and Abduction:			
			IP/PIP/DIP Flexion:			
			IP/PIP/DIP Extension:			



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APPENDIX C

Occupational Therapy Screening: Biomechanical Screening Form: GMT

Patient's *FIRST* Name (only): _____

Evaluator *FULL* Name: _____

GROSS MUSCLE STRENGTH TEST SCREENING				
<i>Left</i>		Scapula:	<i>Right</i>	
Muscle Grade (3/F, 4/G, 5/N)	Further Assessment Needed		Muscle Grade (3/F, 4/G, 5/N)	Further Assessment Needed
5		SAMPLE		X
		Elevation:		
		Depression:		
		Protraction:		
		Retraction:		
		Up Rotation:		
		Down Rotation:		
Muscle Grade (3/F, 4/G, 5/N)	Further Assessment Needed	Shoulder:	Muscle Grade (3/F, 4/G, 5/N)	Further Assessment Needed
		Flexion:		
		Extension:		
		Abduction:		
		Adduction:		
		Internal Rotation:		
		External Rotation:		
		Horiz Abduction:		
		Horiz Adduction:		

(continued)

Muscle Grade (3/F, 4/G, 5/N)	Further Assessment Needed	Elbow:	Muscle Grade (3/F, 4/G, 5/N)	Further Assessment Needed
		Flexion:		
		Extension:		
Muscle Grade (3/F, 4/G, 5/N)	Further Assessment Needed	Forearm:	Muscle Grade (3/F, 4/G, 5/N)	Further Assessment Needed
		Supination:		
		Pronation:		
Muscle Grade (3/F, 4/G, 5/N)	Further Assessment Needed	Wrist:	Muscle Grade (3/F, 4/G, 5/N)	Further Assessment Needed
		Flexion:		
		Extension:		
		Ulnar Deviation:		
		Radial Deviation:		
Muscle Grade (3/F, 4/G, 5/N)	Further Assessment Needed	Digits and Thumb:	Muscle Grade (3/F, 4/G, 5/N)	Further Assessment Needed
		Gross Flexion and Adduction		
		Gross Extension and Abduction		
Muscle Grade (3/F, 4/G, 5/N)	Further Assessment Needed	Hip:	Muscle Grade (3/F, 4/G, 5/N)	Further Assessment Needed
		Flexion:		
		Extension:		
		Abduction:		
		Adduction:		
		Internal Rotation:		
		External Rotation:		

(continued)

Muscle Grade (3/F, 4/G, 5/N)	Further Assessment Needed	Knee:	Muscle Grade (3/F, 4/G, 5/N)	Further Assessment Needed
		Flexion:		
		Extension:		
Muscle Grade (3/F, 4/G, 5/N)	Further Assessment Needed	Ankle:	Muscle Grade (3/F, 4/G, 5/N)	Further Assessment Needed
		Plantar Flexion:		
		Dorsiflexion:		
		Inversion:		
		Eversion:		
Muscle Grade (3/F, 4/G, 5/N)	Further Assessment Needed	Rays and Great Toe:	Muscle Grade (3/F, 4/G, 5/N)	Further Assessment Needed
		Gross Flexion and Adduction		
		Gross Extension and Abduction		



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APPENDIX D

Functional Muscle Groups: Prime Movers

FUNCTIONAL MUSCLE GROUP	<i>PRIMARY</i> MUSCLE MOVERS (VARIES FROM SOURCE TO SOURCE)
Neck flexion (cervical region)	BILATERAL CONTRACTION: Longus capitis: Longus colli: Sternocleidomastoid:
Neck extension (cervical region)	BILATERAL CONTRACTION: Erector spinae: Splenius capitis & cervicis: Semispinalis capitis & cervicis:
Neck lateral flexion (cervical region)	UNILATERAL CONTRACTION: Sternocleidomastoid: Splenius capitis: Splenius cervicis:
Neck rotation (cervical region)	CONTRALATERAL CONTRACTION: Sternocleidomastoid: Splenius capitis: Splenius cervicis:
Trunk flexion (thoracolumbar region)	Rectus abdominis: External oblique: Internal oblique:
Trunk extension (thoracolumbar region)	BILATERAL CONTRACTION: Erector spinae (Iliocostalis, Longissimus, and Spinalis segments):
Trunk lateral flexion (thoracolumbar region)	UNILATERAL CONTRACTION: External oblique: Internal oblique: Rectus abdominis: Quadratus lumborum:

(continued)

Trunk rotation (thoracolumbar region)	CONTRALATERAL CONTRACTION: External oblique: Internal oblique: Rectus abdominis:
Scapula upward rotation	Upper trapezius: Lower trapezius: Serratus anterior:
Scapular downward rotation	Rhomboideus minor: Rhomboideus major: Levator scapula:
Scapular elevation	Levator scapula: Upper trapezius: Rhomboideus minor: Rhomboideus major:
Scapular depression	Pectoralis minor: Lower trapezius:
Scapular protraction (AB)	Pectoralis minor: Serratus anterior:
Scapular retraction (AD)	Rhomboideus major: Rhomboideus minor: Middle trapezius:
Shoulder flexion	Anterior deltoid: Pectoralis major (clavicular head): Coracobrachialis:
Shoulder extension	Posterior deltoid: Teres major: Latissimus dorsi:
Shoulder abduction	Middle deltoid: Supraspinatus:
Shoulder adduction	Pectoralis major (sternal head): Latissimus dorsi: Teres major:
Shoulder horizontal (AB)	Posterior deltoid: Teres minor: Infraspinatus:
Shoulder horizontal (AD)	Anterior deltoid: Pectoralis major (both heads):
Shoulder external rotation	Teres minor: Infraspinatus: Posterior deltoid:

(continued)

Shoulder internal rotation	Subscapularis: Latissimus dorsi: Teres major: Pectoralis major (both heads):
Elbow flexion	Biceps brachii: Brachialis: Brachioradialis:
Elbow extension	Triceps brachii: Anconeus:
Forearm supination	Biceps brachii: Supinator:
Forearm pronation	Pronator teres: Pronator quadratus:
Wrist flexion	Flexor carpi radialis: Flexor carpi ulnaris:
Wrist extension	Extensor carpi radialis longus: Extensor carpi radialis brevis: Extensor carpi ulnaris:
Wrist radial deviation	Extensor carpi radialis longus: Extensor carpi radialis brevis: Flexor carpi radialis:
Wrist ulnar deviation	Extensor carpi ulnaris: Flexor carpi ulnaris:
MCP flexion	Flexor digitorum superficialis: Flexor digitorum profundus: Lumbricals: Flexor digiti minimi (digit V):
MCP extension/hyperextension	Extensor digitorum: Extensor indicis (digit II): Extensor digiti minimi (digit V):
MCP adduction	Palmar interossei:
MCP abduction	Dorsal interossei: Abductor digiti minimi (digit V):
PIP flexion	Flexor digitorum superficialis:
PIP extension	Extensor digitorum: Lumbricals: Extensor indicis (digit II): Extensor digiti minimi (digit V):
DIP flexion	Flexor digitorum profundus:

(continued)

DIP extension	Extensor digitorum: Lumbricals: Extensor indicis (digit II): Extensor digiti minimi (digit V):
CMC flexion	Flexor pollicis brevis: Flexor pollicis longus:
CMC extension	Extensor pollicis brevis: Extensor pollicis longus:
CMC abduction	Abductor pollicis brevis: Abductor pollicis longus:
CMC adduction	Adductor pollicis: Palmar interossei:
MP flexion (digit I)	Flexor pollicis brevis:
MP extension (digit I)	Extensor pollicis brevis:
IP flexion (digit I)	Flexor pollicis longus:
IP extension (digit I)	Extensor pollicis longus:
Opposition (digits I & V) Note: A curvilinear motion that crosses cardinal planes.	Opponens pollicis (digit I): Opponens digiti minimi (digit V):
Hip flexion	Psoas major, Iliacus
Hip abduction	Gluteus maximus, Biceps femoris, Semitendinosus, Semimembranosus
Hip adduction Note: Unlike shoulder adduction, this is not the opposite of hip abduction.	Adductor brevis, Adductor longus, Gracilis, Adductor magnus, Pectineus
Hip external rotation	Gluteus maximus, Piriformis, Gemellus superior, Quadratus femoris, Gemellus inferior, Obturator internus, Obturator externus
Hip internal rotation	Gluteus medius, Gluteus minimus, Tensor fascia latae
Knee flexion	Semitendinosus, Semimembranosus, Biceps femoris
Knee extension	Vastus intermedius, Vastus medialis, Vastus lateralis, Rectus femoris

(continued)

Ankle dorsiflexion	Tibialis anterior
Ankle plantar flexion	Gastrocnemius, Soleus
Ankle inversion (with dorsiflexion)	Tibialis posterior
Ankle eversion (with plantar flexion)	Fibularis (Peroneus) longus, Fibularis (Peroneus) brevis
MTP flexion	Flexor hallucis brevis, Lumbricals
MTP extension	Extensor hallucis longus, Extensor digitorum longus, Extensor digitorum brevis
MTP abduction	Abductor hallucis, Abductor digiti minimi, Dorsal interossei
MTP adduction	Adductor hallucis, Plantar interossei
IP/PIP/DIP flexion	Flexor hallucis longus, Flexor digitorum longus, Flexor digitorum brevis
IP/PIP/DIP extension	Extensor hallucis longus, Extensor digitorum longus, Extensor digitorum brevis



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APPENDIX E

Occupational Therapy: Biomechanical Assessment of the Upper Extremity

Patient's *FIRST* Name (only): _____

Evaluator *FULL* Name: _____

<i>Left</i>		Scapula:	<i>Right</i>	
IMT	Degrees		IMT	Degrees
		Elevation:		
		Depression:		
		Protraction:		
		Retraction:		
		Up Rotation:		
		Down Rotation:		
IMT	Degrees	Shoulder:	IMT	Degrees
5/5	0 to 180	SAMPLE	0 to 180	5/5
		Flexion:		
		Extension:		
		Hyperextension:		
		Abduction:		
		Adduction:		
		Internal Rotation:		
		External Rotation:		
		Horiz Abduction:		
		Horiz Adduction:		
IMT	Degrees	Shoulder:	IMT	Degrees
		Flexion:		
		Extension:		

(continued)

IMT	Degrees	Shoulder:	IMT	Degrees
		Supination:		
		Pronation:		
IMT	Degrees	Shoulder:	IMT	Degrees
		Flexion:		
		Extension:		
		Ulnar Deviation:		
		Radial Deviation:		
IMT	Degrees	Shoulder:	IMT	Degrees
		MCP Flexion:		
		MCP Extension:		
		MCP Hyperextension:		
		MCP Abduction:		
		MCP Adduction:		
		PIP Flexion:		
		PIP Extension:		
		DIP Flexion:		
		DIP Extension:		
IMT	Degrees	Shoulder:	IMT	Degrees
		CMC Flexion:		
		CMC Extension:		
		CMC Abduction:		
		CMC Adduction:		
		IP Flexion:		
		IP Extension:		
		MP Flexion:		
		MP Extension:		

APPENDIX F

Occupational Therapy: Posture Assessment

Within Normal Limits (✓)	Within Functional Limits (✓)	Ideal Posture Plumb Line
		Head: near mastoid process
		Shoulder: through glenohumeral joint
		Sacrum: anterior to sacral level 2 (average center of gravity)
		Hip: just posterior to hip joint (through greater trochanter)
		Knee: just anterior to the tibiofemoral joint
		Ankle: anterior to the subtalar joint

PATIENT INFORMATION	
Name:	_____
DOB:	_____
MR:	_____

<p>Insert Posture Grid Photo:</p> <p>Sagittal View Left</p>
--

<p>Insert Posture Grid Photo:</p> <p>Sagittal View Right</p>

<p>Insert Posture Grid Photo:</p> <p>Anterior View</p>

<p>Insert Posture Grid Photo:</p> <p>Posterior View</p>
--

Sagittal View Left			Sagittal View Right			Anterior View			Posterior View		
Ankle Joints	R	L	Ankle Joints	R	L	Feet	R	L	Feet	R	L
Neutral			Neutral			Neutral			Neutral		
Plantar Flexed			Plantar Flexed			Inverted/ Supinated			Inverted/ Supinated		
Dorsiflexed			Dorsiflexed			Everted/ Pronated			Everted/ Pronated		
Knees			Knees			Knees			Femur		
Neutral			Neutral			Neutral			Neutral		
Hyperextended			Hyperextended			Knock-kneed (genu valgum)			Medial Rotation		
Flexed			Flexed			Bow-legged (genu varum)			Lateral Rotation		
Pelvis			Pelvis			Rib Cage			Scapula		
Neutral			Neutral			Neutral			Neutral		
Anterior Pelvic Tilt			Anterior Pelvic Tilt			Elevated			Protracted		
Posterior Pelvic Tilt			Posterior Pelvic Tilt			Shifted			Retracted		
									Elevated		
									Depressed		
									Winging		
Lumbar Spine			Lumbar Spine			Shoulders			Humerus		
Neutral			Neutral			Level			Neutral		
Flat decreased convex curve anteriorly			Flat decreased convex curve anteriorly			Elevated			Medially Rotated		
Excessive extension increased convex curve anteriorly			Excessive extension increased convex curve anteriorly			Depressed					

(continued)

Sagittal View Left			Sagittal View Right			Anterior View			Posterior View		
Lower Thoracic Spine	R	L	Lower Thoracic Spine	R	L	Head	R	L	Spine (all views)	R	L
Neutral			Neutral			Rotated clockwise			Imbalances		
Flat decreased convex curve posteriorly			Flat decreased convex curve posteriorly			Rotated counter-clockwise			Abnormal curvatures		
Excessive flexion increased convex curve posteriorly			Excessive flexion increased convex curve posteriorly			Neutral			Flat areas		
						Tilted					
Upper Thoracic Spine			Upper Thoracic Spine			ADDITIONAL OBSERVATIONS/ REPORT OF PAIN:					
Neutral			Neutral								
Flat decreased convex curve posteriorly			Flat decreased convex curve posteriorly								
Excessive flexion increased convex curve posteriorly			Excessive flexion increased convex curve posteriorly								
Shoulder/ Scapula			Shoulder/ Scapula								
Neutral			Neutral								
Excessive Protraction			Excessive Protraction								
Excessive Retraction			Excessive Retraction								
Cervical Spine			Cervical Spine								
Neutral			Neutral								
Flat decreased convex curve anteriorly			Flat decreased convex curve anteriorly								
Excessive extension increased convex curve anteriorly			Excessive extension increased convex curve anteriorly								

(continued)

Sagittal View Left			Sagittal View Right			Anterior View	Posterior View
Head	R	L	Head	R	L	ADDITIONAL OBSERVATIONS/ REPORT OF PAIN:	
Neutral			Neutral				
Forward			Forward				
Retracted			Retracted				

Additional Treatment

Referral Recommended (Circle one): NO YES: _____
 Provide Contact Information

Therapist Signature

Date Completed

Client Signature

Date Reviewed

APPENDIX G

At-A-Glance: Biomechanical Occupational Therapy Screening and Assessment

AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

FUNCTIONAL MUSCLE GROUP	PLANE	AXIS	FUNCTIONAL ACTIVITY ANALYSIS	NORMAL ROM	GROSS MUSCLE TESTING PROCEDURE	GONIOMETRY/ROM TESTING PROCEDURE	END FEEL	ISOLATED MUSCLE TESTING PROCEDURE (OF PRIMARY MOVERS)
<i>Neck Flexion (Cervical Region)</i>	Sagittal	Frontal	Looking at the keyboard while typing.	0 to 45 degrees	<p>Prime Movers: Bilateral contraction of Longus capitis, Longus colli, Sterno-cleidomastoid</p> <p>Position: Client is seated and moves toward neck flexion</p> <p>Stabilize: Not formally necessary</p> <p>Resist: At forehead in direction of neck extension</p>	<p>Fulcrum: over external auditory meatus</p> <p>Stable arm: perpendicular or parallel to the floor</p> <p>Movable arm: along the base of the nares</p>	Firm	Functional Posture Assessment as alternate to formal isolated muscle testing.

(continued)

AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>Neck Extension (Cervical Region)</i>	Sagittal	Frontal	Looking up at the light fixture while changing the bulb.	0 to 45 degrees	<p>Prime Movers: Bilateral contraction of Erector spinae, Splenius capitis & cervicis, Semispinalis capitis & cervicis</p> <p>Position: Client is seated and moves into neck hyperextension</p> <p>Stabilize: Posterior thorax</p> <p>Resist: Posterior aspect of head toward neck flexion</p>	<p>Fulcrum: over external auditory meatus</p> <p>Stable arm: perpendicular or parallel to the floor</p> <p>Movable arm: along the base of the nares</p>	Firm	Functional Posture Assessment as alternate to formal isolated muscle testing.
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>Neck Lateral Flexion (Cervical Region)</i>	Frontal	Sagittal	Putting on an earring.	0 to 45 degrees	<p>Prime Movers: Unilateral contraction of Sternocleidomastoid, Splenius capitis, Splenius cervicis</p> <p>Position: Client is seated and moves into lateral flexion of test side</p> <p>Stabilize: Superior aspect of opposite shoulder</p> <p>Resist: Lateral aspect of head toward opposite motion</p>	<p>Fulcrum: over spinous process of C7 vertebrae</p> <p>Stable arm: over spinous processes of the thoracic vertebrae with arm perpendicular to the floor</p> <p>Movable arm: over dorsal midline of the head with the occipital protuberance as a guide</p>	Firm	Functional Posture Assessment as alternate to formal isolated muscle testing.
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>Neck Rotation (Cervical Region)</i>	Trans-verse	Vertical	Looking left and right at stop sign while driving.	0 to 60 degrees	<p>Prime Movers: Contralateral contraction of Sterno-cleidomastoid, Splenius capitis, Splenius cervicis</p> <p>Position: Client is seated and moves into neck hyperextension with rotation to test side</p> <p>Stabilize: Posterior thorax</p> <p>Resist: Posterior-lateral aspect of head toward opposite motions</p>	<p>Fulcrum: centered over the middle of the cranial aspect of the head</p> <p>Stable arm: parallel to an imaginary line between the acromial processes</p> <p>Movable arm: in line with the tip of the nose</p>	Firm	Functional Posture Assessment as alternate to formal isolated muscle testing.
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>Trunk Flexion (Thoraco-lumbar Region)</i>	Sagittal	Frontal	Bending down to the floor to put on shoes.	0 to 80 degrees (4 in)	<p>Prime Mover: Rectus abdominis, External oblique, Internal oblique</p> <p>Position: Client is standing and moves into trunk flexion</p> <p>Stabilize: None formally necessary</p> <p>Resist: Slight resistance toward trunk extension at manubrium</p>	<p>Measurement: A tape measure is placed between the spinous processes of C7 and S1. First the measurement is taken with the client in the upright position and a second one taken at maximal flexion. The difference between the two measurements is the amount of flexion present.</p>	Firm	Functional Posture Assessment as alternate to formal isolated muscle testing.
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>Trunk Extension (Thoraco-lumbar Region)</i>	Sagittal	Frontal	Removing clothes from the dryer and placing into the laundry basket.	0 to 25 degrees	<p>Prime Movers: Bilateral contraction of Erector spinae (Iliocostalis, Longissimus, and Spinalis segments)</p> <p>Position: Client is standing and moves into trunk hyperextension</p> <p>Stabilize: None formally necessary</p> <p>Resist: Slight resistance toward trunk flexion at mid thoracic region of vertebral column</p>	<p>Measurement: A tape measure is placed between the spinous processes of C7 and S1. First the measurement is taken with the client in the upright position and a second one taken at maximal extension. The difference between the two measurements is the amount of extension present.</p>	Firm	Functional Posture Assessment as alternate to formal isolated muscle testing.
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>Trunk Lateral Flexion (Thoraco-lumbar Region)</i>	Frontal	Sagittal	Tucking a shirt into pants.	0 to 35 degrees	Prime Movers: Unilateral contraction of External oblique, Internal oblique, Rectus abdominis, Quadratus lumborum Position: Client is standing and moves into trunk lateral flexion Stabilize: Hip, pelvis, and lower extremity of the test side Resist: Slight resistance toward upright stance at lateral aspect of Ipsilateral humerus	Fulcrum: over the posterior aspect of the spinous process of S1 Stable arm: perpendicular to the floor Movable arm: over the posterior aspect of the spinous process of C7	Firm	Functional Posture Assessment as alternate to formal isolated muscle testing.
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>Trunk Rotation (Thoraco-lumbar Region)</i>	Transverse	Vertical	Reaching to the side and downward to place a dish in the dishwasher.	0 to 45 degrees	<p>Prime Movers: Contralateral contraction of External oblique with Internal oblique, and Rectus abdominis</p> <p>Position: Client is standing and moves into trunk flexion with rotation to test side (ie: right elbow to left knee)</p> <p>Stabilize: None formally necessary</p> <p>Resist: Slight resistance toward posteriorly at the anterior aspect of the shoulder moving forward during the rotation</p>	<p>Fulcrum: over the center of the superior aspect of the head</p> <p>Stable arm: parallel to an imaginary line between the prominences of the iliac crests looking inferiorly</p> <p>Movable arm: along an imaginary line between the acromial processes looking inferiorly</p>	Firm	Functional Posture Assessment as alternate to formal isolated muscle testing.
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<p><i>Scapula Upward/Lateral Rotation</i></p>	<p>Oblique Frontal or Scapular</p>	<p>Oblique Sagittal or Scapular</p>	<p>Reaching to the upper shelf in the kitchen to retrieve the cereal box.</p>	<p>Not formally measured</p>	<p>Prime Movers: Upper trapezius, Lower trapezius, Serratus anterior Position: Client is seated with testing extremity at side and moves in direction of humeral abduction Stabilize: Proximal to glenohumeral joint Resist: Applied at humerus in the direction of humeral adduction</p>	<p>Not formally assessed</p>	<p>Not formally assessed</p>	<p>UPPER TRAPEZIUS (TESTED WITH LEVATOR SCAPULAE; ALSO SCAPULAR ELEVATOR) Against Gravity: Fair (3), Good (4), Normal (5) Position: Client is seated with testing extremity at side, head is tilted toward the testing side and rotated away from the testing side. Motion: Client moves the scapula in the direction of scapular elevation. Stabilize: at the lateral head. Resist: at shoulder in scapular depression. Gravity Eliminated: Zero (0), Trace (1), Poor (2) Position: Client is supine or prone with testing extremity at side, head is tilted toward the testing side and rotated away from testing side. Motion: Client moves the scapula in elevation. Stabilize: At the lateral head. Palpate: Next to C7, and above the lateral 1/3 of the clavicle.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<p><i>Scapular Downward/ Medial Rotation</i></p>	<p>Oblique Frontal or Scapular</p>	<p>Oblique Sagittal or Scapular</p>	<p>Retrieving a bowl down from the top shelf in the cabinet to the countertop.</p>	<p>Not formally measured</p>	<p>Prime Movers: Rhomboideus minor, Rhomboideus major, Levator scapula Position: Client is seated or standing with testing arm in 30 degrees of humeral abduction moving toward humeral adduction Stabilize: Stabilize at the shoulder to resist compensation Resist: Resist at the humerus toward abduction</p>	<p>Not formally assessed</p>	<p>Not formally assessed</p>	<p>RHOMBOID (MAJOR AND MINOR ARE TESTED TOGETHER) Against Gravity: Fair (3), Good (4), Normal (5) Position: Client is prone with hand of the testing extremity placed behind the lower back, humerus is adducted and internally rotated. Motion: Client moves the testing extremity toward the ceiling. Stabilize: Typically not necessary. Resist: Applied at the distal humerus in the direction of humeral abduction and external rotation. Gravity Eliminated: Zero (0), Trace (1), Poor (2) Position: Client is seated with testing extremity hand behind back in humeral adduction and internal rotation. Motion: Client moves testing extremity away from back. Stabilize: Typically not necessary. Palpate: Medially to the vertebral border of the scapula on testing extremity.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

								<p>LEVATOR SCAPULAE (TESTED WITH UPPER TRAPEZIUS; ALSO SCAPULAR ELEVATION)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing extremity at their side, head tilted toward and rotated away, from the testing side.</p> <p>Motion: Client moves testing scapula in the direction of scapular elevation.</p> <p>Stabilize: Lateral head.</p> <p>Resist: At the shoulder/scapula in the direction of scapular depression.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client starts in supine or prone with testing extremity at side, head tilted toward, and rotated away, from the testing side.</p> <p>Motion: Client moves testing scapula in the direction of scapula elevation.</p> <p>Stabilize: Lateral head.</p> <p>Palpate: Too deep to be palpated.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>Scapular Elevation</i>	Oblique Frontal or Scapular	Oblique Sagittal or Scapular	Carrying a backpack on one shoulder.	Not formally measured	<p>Prime Movers: Levator scapula, Upper trapezius, Rhomboideus minor, Rhomboideus major</p> <p>Position: Client is seated or standing and will have their arms at their sides and moves toward scapular elevation</p> <p>Stabilize: Therapist will stabilize at the opposite shoulder</p> <p>Resist: Apply on the superior, lateral shoulder downward in the direction of scapular depression</p>	Not formally assessed	Not formally assessed	<p>UPPER TRAPEZIUS (TESTED WITH LEVATOR SCAPULAE; ALSO SCAPULAR UPWARD ROTATION)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing extremity at side, head is tilted toward the testing side and rotated away from the testing side.</p> <p>Motion: Client moves the scapula in the direction of scapular elevation.</p> <p>Stabilize: At the lateral head.</p> <p>Resist: At shoulder in scapular depression.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is supine or prone with testing extremity at side, head is tilted toward the testing side and rotated away from testing side.</p> <p>Motion: Client moves the scapula in elevation.</p> <p>Stabilize: At the lateral head.</p> <p>Palpate: Next to C7, and above the lateral 1/3 of the clavicle.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>Scapular Depression</i>	Oblique Frontal or Scapular	Oblique Sagittal or Scapular	Reaching deep into your pants pocket to retrieve car keys.	Not formally measured	<p>Prime Movers: Pectoralis minor, Lower trapezius</p> <p>Position: Client is seated with arm at side and elbow flexed to 90 degrees and moves toward scapular depression</p> <p>Stabilize: At the posterior thorax.</p> <p>Resist: At base of elbow in upward direction toward scapular elevation.</p>	Not formally assessed	Not formally assessed	<p>PECTORALIS MINOR</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is supine and has testing extremity at side and slightly raised off table.</p> <p>Motion: Client brings testing shoulder toward ceiling in movement of scapular abduction.</p> <p>Stabilize: Trunk to avoid rotation.</p> <p>Resist: Applied to anterior shoulder in direction of scapular adduction.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is seated with testing arm at side.</p> <p>Motion: Moves extremity into scapular abduction.</p> <p>Stabilize: Trunk to resist rotation.</p> <p>Palpate: Too deep to palpate.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>Scapular Protraction/Abduction</i>	Oblique Transverse or Scapular	Oblique Vertical or Scapular	Reaching forward to turn on kitchen faucet.	Not formally measured	<p>Prime Movers: Pectoralis minor, Serratus anterior</p> <p>Position: Client is seated with extremity resting at side</p> <p>Stabilize: Opposite shoulder</p> <p>Resist: Apply at the proximal humerus toward scapular adduction</p>	Not formally assessed	Not formally assessed	<p>PECTORALIS MINOR (ALSO SCAPULAR DEPRESSION)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is supine and has testing extremity at side and slightly raised off table.</p> <p>Motion: Client brings testing shoulder toward ceiling in movement of scapular abduction.</p> <p>Stabilize: Trunk to avoid rotation.</p> <p>Resist: Applied to anterior shoulder in direction of scapular adduction.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is seated with testing arm at side.</p> <p>Motion: Moves extremity into scapular abduction.</p> <p>Stabilize: Trunk to resist rotation.</p> <p>Palpate: Too deep to palpate.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

								<p>SERRATUS ANTERIOR (ALSO SCAPULAR UPWARD ROTATION)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is supine with testing extremity in 90 degrees of humeral flexion and elbow extension.</p> <p>Motion: Client moves the testing extremity in the direction of scapular abduction (reaching to the ceiling).</p> <p>Stabilize: The trunk.</p> <p>Resist: At the proximal humerus in the direction of scapular adduction.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is seated with the testing extremity in 90 degrees humeral flexion and elbow extension, supported on a table or by therapist.</p> <p>Motion: Client moves testing extremity in the direction of scapular abduction.</p> <p>Stabilize: The trunk and support the extremity to eliminate gravity.</p> <p>Palpate: At anterior-lateral border of the scapula.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<p><i>Scapular Retraction/Adduction</i></p>	<p>Oblique Transverse or Scapular</p>	<p>Oblique Vertical or Scapular</p>	<p>Pulling open the dresser drawer.</p>	<p>Not formally measured</p>	<p>Prime Movers: Rhomboideus major, Rhomboideus minor, Middle trapezius Position: Client is seated with extremity resting at side Stabilize: Opposite shoulder Resist: Apply at the proximal humerus toward scapular adduction</p>	<p>Not formally assessed</p>	<p>Not formally assessed</p>	<p>RHOMBOID (MAJOR AND MINOR ARE TESTED TOGETHER; ALSO SCAPULAR DOWNWARD ROTATION) Against Gravity: Fair (3), Good (4), Normal (5) Position: Client is prone with hand of the testing extremity placed behind the lower back, humerus is adducted and internally rotated. Motion: Client moves the testing extremity toward the ceiling. Stabilize: Typically not necessary. Resist: Applied at the distal humerus in the direction of humeral abduction and external rotation. Gravity Eliminated: Zero (0), Trace (1), Poor (2) Position: Client is seated with testing extremity hand behind back in humeral adduction and internal rotation. Motion: Client moves testing extremity away from back. Stabilize: Typically not necessary. Palpate: Medially to the vertebral border of the scapula on testing extremity.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>Shoulder/ Humeral Flexion</i>	Sagittal	Frontal	Reaching forward to turn on the kitchen faucet.	0 to 180 degrees	<p>Prime Movers: Anterior deltoid, Pectoralis major (clavicular head), Coracobrachialis</p> <p>Position: Client can be seated or standing with arm resting at side</p> <p>Stabilize: At the shoulder to prevent scapular compensation</p> <p>Resist: Apply at the humerus, moving arm into extension</p>	<p>Fulcrum: Lateral surface of the acromion process</p> <p>Stable arm: Mid axilla/ thorax</p> <p>Movable arm: Lateral midline of the humerus</p>	Firm	<p>ANTERIOR DELTOID</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated or is standing with testing arm at side, with slight elbow flexion and forearm pronation.</p> <p>Motion: Client moves testing extremity into humeral flexion.</p> <p>Stabilize: At the shoulder to avoid humeral rotation or horizontal movement.</p> <p>Resist: Apply at proximal humerus in direction of humeral extension.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client lays on nontest side. Testing arm is at the side with slight elbow flexion and forearm pronation, being supported on a table or by therapist.</p> <p>Motion: Client moves the testing extremity into humeral flexion.</p> <p>Stabilize: At shoulder to avoid humeral rotation or horizontal movement. Support testing extremity to eliminate gravity but do not assist the motion.</p> <p>Palpate: Anterior shoulder 2-3 inches from acromion process.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

Shoulder / Humeral Extension	Sagittal	Frontal	Reaching back for the armrests of the chair before sitting down.	0 to 60 degrees	<p>Prime Movers: Posterior deltoid, Teres major, Latissimus dorsi</p> <p>Position: Client is seated or standing with arm resting at side</p> <p>Stabilize: At the scapula to avoid compensation of scapular elevation</p> <p>Resist: Apply to proximal humerus toward humeral flexion</p>	<p>Fulcrum: Lateral surface of acromion process</p> <p>Stable arm: Midline of thorax</p> <p>Movable arm: Lateral midline of humerus</p>	Firm	<p>POSTERIOR DELTOID:</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is prone with testing arm in abduction and slight external rotation, with elbow flexed at 90 degrees (over the edge of the table).</p> <p>Motion: Client moves the testing arm in the direction of humeral horizontal abduction.</p> <p>Stabilize: At scapula to avoid retraction/adduction. Observe elbow for extension (compensation of triceps).</p> <p>Resist: Apply at the posterior-lateral aspect of the distal humerus in the direction of horizontal adduction.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is seated with the testing arm in 90 degrees of humeral flexion and 90 degrees of elbow flexion, supported on a table or by therapist.</p> <p>Motion: Client moves the testing arm in the direction of horizontal abduction.</p> <p>Stabilize: At the scapula to avoid scapular retraction/adduction. Observe elbow for extension (compensation of triceps).</p> <p>Palpate: On the dorsal/proximal one-third of humerus.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>Shoulder / Humeral Abduction</i>	Frontal	Sagittal	Reaching up to head to put on baseball cap.	0 to 180 degrees	<p>Prime Movers: Middle Deltoid, Supraspinatus</p> <p>Position: Client can be seated or standing with their arm at their side.</p> <p>Stabilize: At the shoulder to prevent scapular elevation.</p> <p>Resist: Apply at the humerus toward humeral adduction.</p>	<p>Fulcrum: Anterior or posterior surface of acromion process.</p> <p>Stable arm: Parallel to the sternum or the spine</p> <p>Movable arm: Medial aspect of humerus</p>	Firm	<p>MIDDLE DELTOID</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated or standing with the testing extremity between 0 and 45 degrees of humeral abduction and the elbow is flexed to 90 degrees.</p> <p>Motion: Client moves the testing extremity in the direction of humeral abduction.</p> <p>Stabilize: at the shoulder to avoid compensation of scapular elevation.</p> <p>Resist: is applied at the distal humerus in the direction of adduction when testing normal or good strengths.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2):</p> <p>Position: Client is supine with the testing extremity in humeral adduction.</p> <p>Motion: Client moves the testing extremity in the direction of humeral abduction.</p> <p>Stabilize: At the shoulder to avoid compensation of scapular elevation.</p> <p>Palpate: The middle deltoid can be palpated below the acromion process on the lateral/proximal 1/3 of the humerus.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<p><i>Shoulder/ Humeral Adduction</i></p>	<p>Frontal</p>	<p>Sagittal</p>	<p>Squeezing a clutch bag between your arm and lateral trunk.</p>	<p>Not formally measured as opposite of abduction</p>	<p>Prime Movers: Pectoralis major (both heads), Latissimus dorsi, Teres major Position: Client can be seated or standing with the testing arm at 30 degrees of abduction and moves toward adduction Stabilize: At the shoulder to avoid scapular depression as compensation Resist: Apply at the humerus toward abduction</p>	<p>Not formally tested as opposite of abduction</p>	<p>Soft</p>	<p>PECTORALIS MAJOR (STERNAL HEAD) Against Gravity: Fair (3), Good (4), Normal (5) Position: Client is supine with the testing arm in 90 degrees of humeral flexion, full elbow extension, and slight humeral internal rotation. Motion: Client moves testing arm in a diagonal motion down toward opposite iliac crest, in the direction of humeral horizontal adduction. Stabilize: At opposite iliac crest, resisting trunk rotation. Resist: At proximal humerus in a diagonal pattern of humeral horizontal abduction. Gravity Eliminated: Zero (0), Trace (1), Poor (2): Position: Client is seated with testing arm at 90 degrees of humeral flexion, full elbow flexion, and slight humeral internal rotation, supported by therapist. Motion: Client moves testing extremity in the direction of humeral horizontal adduction in the diagonal motion toward the opposite iliac crest. Stabilize: At opposite iliac crest, resisting trunk rotation. Support testing extremity to eliminate gravity but do not assist the motion. Palpate: Sternal end is palpated on the anterior aspect of the axilla.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<p><i>Shoulder/ Humeral Horizontal Abduction</i></p>	<p>Transverse</p>	<p>Vertical</p>	<p>Reaching out of the car to retrieve ordered items from the drive thru window.</p>	<p>0 to 45 degrees</p>	<p>Prime Movers: Posterior deltoid, Teres minor, Infraspinatus Position: Client is seated with the testing arm at 90 degrees of shoulder abduction, elbow flexed to 90 degrees and moves toward horizontal abduction Stabilize: At posterior shoulder/scapula to prevent compensation Resist: Apply at the humerus toward horizontal adduction</p>	<p>Fulcrum: Place on the superior aspect of the acromion process Stable arm: Parallel to the humerus, remaining in beginning position Movable arm: Parallel to the humerus</p>	<p>Firm</p>	<p>TERES MAJOR TESTED WITH LATISSIMUS DORSI Palpated: Along lower border of scapula.</p> <p>POSTERIOR DELTOID (ALSO SHOULDER EXTENSION) Against Gravity: Fair (3), Good (4), Normal (5) Position: Client is prone with testing arm in abduction and slight external rotation, with elbow flexed at 90 degrees (over the edge of the table). Motion: Client moves the testing arm in the direction of humeral horizontal abduction. Stabilize: At scapula to avoid retraction/adduction. Observe elbow for extension (compensation of triceps). Resist: Apply at the posterior-lateral aspect of the distal humerus in the direction of horizontal adduction. Gravity Eliminated: Zero (0), Trace (1), Poor (2): Position: Client is seated with the testing arm in 90 degrees of humeral flexion and 90 degrees of elbow flexion, supported on a table or by therapist. Motion: Client moves the testing arm in the direction of horizontal abduction. Stabilize: At the scapula to avoid scapular retraction/adduction. Observe elbow for extension (compensation of triceps). Palpate: On the dorsal/proximal 1/3 of the humerus.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

								<p>INFRASPINATUS (TESTED WITH TERES MINOR)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is prone with testing arm in 90 degrees of humeral abduction and 90 degrees elbow flexion with fingers pointed toward floor.</p> <p>Motion: Client moves testing arm in direction of humeral external rotation.</p> <p>Stabilize: Under the humerus to avoid compensation.</p> <p>Resist: At forearm toward humeral internal rotation.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is prone with entire arm off table and fingers pointed toward floor.</p> <p>Motion: Client moves testing extremity toward humeral external rotation.</p> <p>Stabilize: At scapula to avoid compensation.</p> <p>Palpate: Below spine of scapula.</p> <p>TERES MINOR (TESTED WITH INFRASPINATUS)</p> <p>Palpate: Too deep to palpate.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<p><i>Shoulder/ Humeral Horizontal Adduction</i></p>	<p>Transverse</p>	<p>Vertical</p>	<p>Reaching over opposite shoulder to grab seat belt in order to put it on.</p>	<p>0 to 135 degrees</p>	<p>Prime Movers: Anterior deltoid, Pectoralis major (both heads) Position: Client is seated with the testing arm at 90 degrees of shoulder abduction, elbow flexed to 90 degrees and moves toward shoulder horizontal adduction Stabilize: At the anterior shoulder to prevent compensation Resist: Apply at the humerus toward horizontal abduction</p>	<p>Fulcrum: Superior acromion process Stable arm: Parallel to humerus, remaining in beginning position Movable arm: Parallel to humerus</p>	<p>Firm/soft</p>	<p>ANTERIOR DELTOID (ALSO SHOULDER FLEXION) Against Gravity: Fair (3), Good (4), Normal (5) Position: Client is seated or is standing with testing arm at side, with slight elbow flexion and forearm pronation. Motion: Client moves testing extremity into humeral flexion. Stabilize: At the shoulder to avoid humeral rotation or horizontal movement. Resist: Apply at proximal humerus in direction of humeral extension. Gravity Eliminated: Zero (0), Trace (1), Poor (2) Position: Client lays on nontest side. Testing arm is at the side with slight elbow flexion and forearm pronation, being supported on a table or by therapist. Motion: Client moves the testing extremity into humeral flexion. Stabilize: At shoulder to avoid humeral rotation or horizontal movement. Support testing extremity to eliminate gravity but do not assist the motion. Palpate: Anterior shoulder 2-3 inches from acromion process.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>Shoulder/ Humeral External Rotation</i>	Transverse	Vertical	Clasping a necklace behind the neck.	0 to 90 degrees	<p>Prime Movers: Teres minor, Infraspinatus, Posterior deltoid</p> <p>Position: Client is seated with the testing arm resting at their side, elbow flexed to 90 degrees and moves toward external rotation</p> <p>Stabilize: At the humerus to prevent compensation</p> <p>Resist: Apply to the forearm toward humeral internal rotation</p>	<p>Fulcrum: Midline of the olecranon process of the ulna</p> <p>Stable arm: Perpendicular to the floor</p> <p>Movable arm: midline of lateral ulna</p>	Firm	<p>INFRASPINATUS (TESTED WITH TERES MINOR; ALSO SHOULDER HORIZONTAL ABDUCTION)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is prone with testing arm in 90 degrees of humeral abduction and 90 degrees elbow flexion with fingers pointed toward floor.</p> <p>Motion: Client moves testing arm in direction of humeral external rotation.</p> <p>Stabilize: Under the humerus to avoid compensation.</p> <p>Resist: At forearm toward humeral internal rotation.</p> <p>Gravity Eliminated; Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is prone with entire arm off table and fingers pointed toward floor.</p> <p>Motion: Client moves testing extremity toward humeral external rotation.</p> <p>Stabilize: At scapula to avoid compensation.</p> <p>Palpate: Below spine of scapula.</p> <p>TERES MINOR (TESTED WITH INFRASPINATUS)</p> <p>Palpate: Too deep to palpate.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>Shoulder/ Humeral Internal Rotation</i>	Transverse	Vertical	Turning the steering wheel of the car to the left using the right arm.	0 to 70 degrees	<p>Prime Movers: Subscapularis, Latissimus dorsi, Teres major, Pectoralis major (both heads)</p> <p>Position: Client is seated with the testing arm resting at their side, elbow flexed to 90 degrees and moves toward internal rotation</p> <p>Stabilize: At the humerus to avoid compensation</p> <p>Resist: Apply at the forearm toward humeral external rotation</p>	<p>Fulcrum: Midline of the olecranon process of the ulna</p> <p>Stable arm: Perpendicular to the floor</p> <p>Movable arm: Midline of the lateral ulna</p>	Firm	<p>SUBSCAPULARIS</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is prone with testing arm in 90 degrees humeral abduction and 90 degrees elbow flexion with fingers toward floor.</p> <p>Motion: Move testing arm into humeral internal rotation.</p> <p>Stabilize: Under the humerus to avoid compensation.</p> <p>Resist: Apply at forearm in the direction of humeral external rotation.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is prone with entire humerus off table and fingers toward floor.</p> <p>Motion: Client moves testing arm into humeral internal rotation.</p> <p>Stabilize: At scapula to avoid compensation.</p> <p>Palpate: Deep in the axilla near insertion of muscle.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>Elbow Flexion</i>	Sagittal	Frontal	Bringing spoon from dinner plate on table to mouth.	0 to 135 degrees	<p>Primary Muscles: Bicep brachii, Brachialis, Brachioradialis</p> <p>Position: Client is seated with arm in shoulder adduction, elbow extension and moves testing arm toward elbow flexion</p> <p>Stabilize: At the humerus to avoid compensation</p> <p>Resist: Applied to the distal anterior aspect of forearm toward elbow extension</p>	<p>Fulcrum: Lateral epicondyle of humerus</p> <p>Stable arm: Midline of lateral surface of humerus</p> <p>Movable arm: Midline of lateral surface of radius</p>	Soft	<p>BICEPS BRACHII</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing arm in humeral adduction, elbow extension, and forearm supination.</p> <p>Motion: Client moves testing arm into elbow flexion.</p> <p>Stabilize: At the humerus to resist compensation.</p> <p>Resist: At forearm, pushing toward elbow extension.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is seated with testing arm at 90 degrees of shoulder flexion or abduction, elbow extension, and forearm supination. Arm should be on a table or supported by therapist.</p> <p>Motion: Client moves testing arm into elbow flexion.</p> <p>Stabilize: Stabilize at the humerus to resist compensation, also support the testing arm so that gravity is eliminated but do not perform the motion for the client.</p> <p>Palpate: At the palmar aspect of the distal and medial humerus with the forearm in supination.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>Elbow Extension</i>	Sagittal	Frontal	Reaching out to turn up the volume of the radio in the car.	135 to 0 degrees	<p>Primary Muscles: Triceps & Anconeus</p> <p>Position: Client is seated with arm in shoulder adduction, elbow extension and moves testing arm toward elbow extension</p> <p>Stabilize: At the humerus to avoid compensation</p> <p>Resist: Applied at the distal forearm toward elbow flexion</p>	<p>Fulcrum: Lateral epicondyle of humerus</p> <p>Stable arm: Midline of lateral humerus</p> <p>Movable arm: Middle of lateral radius</p>	Firm	<p>TRICEPS BRACHII (TESTED WITH ANCONEUS)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client lays supine with testing arm in shoulder flexion, elbow flexion, and forearm supination.</p> <p>Motion: Client moves testing arm into elbow extension.</p> <p>Stabilize: At the humerus to resist compensation.</p> <p>Resist: Apply at the posterior forearm toward elbow flexion.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is seated with testing arm in shoulder flexion or abduction, elbow flexion, and a neutral forearm that is supported by the therapist or a table.</p> <p>Motion: Client moves testing arm into elbow extension.</p> <p>Stabilize: At the humerus to resist compensation. Also, support the arm against gravity but do not help Client complete the motion.</p> <p>Palpate: At the posterior mid-humerus.</p> <p>ANCONEUS (TESTED WITH TRICEPS BRACHII): Too deep to palpate.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>Forearm Supination</i>	Transverse	Vertical	Turning on the shower faucet (clockwise rotation with the right hand or counterclockwise with the left).	0 to 90 degrees	<p>Primary Muscles: Supinator & Biceps brachii</p> <p>Position: Client is seated with arm in shoulder adduction, elbow flexed to 90 degrees and forearm in neutral and moves the testing arm toward forearm supination</p> <p>Stabilize: At the elbow to prevent shoulder compensation</p> <p>Resist: Applied at the distal forearm, toward pronation</p>	<p>Fulcrum: Palmar surface of distal forearm slightly proximal to the pisiform</p> <p>Stable arm: Perpendicular to the floor</p> <p>Movable arm: Across the palmar aspect of the distal forearm</p>	Firm	<p>BICEPS BRACHII (ALSO ELBOW FLEXION)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing arm in humeral adduction, elbow extension, and forearm supination.</p> <p>Motion: Client moves testing arm into elbow flexion.</p> <p>Stabilize: At the humerus to resist compensation.</p> <p>Resist: At forearm, pushing toward elbow extension.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is seated with testing arm at 90 degrees of shoulder flexion or abduction, elbow extension, and forearm supination. Arm should be on a table or supported by therapist.</p> <p>Motion: Client moves testing arm into elbow flexion.</p> <p>Stabilize: At the humerus to resist compensation, also support the testing arm so that gravity is eliminated but do not perform the motion for the client.</p> <p>Palpate: At the palmar aspect of the distal and medial humerus with the forearm in supination.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>Forearm Pronation</i>	Transverse	Vertical	Pouring a glass of orange juice.	0 to 90 degrees	<p>Primary Muscles: Pronator teres & Pronator quadratus</p> <p>Position: Client is seated with arm in shoulder adduction, elbow flexed to 90 degrees and forearm in neutral and moves the testing arm toward forearm pronation</p> <p>Stabilize: At the elbow to prevent compensation</p> <p>Resist: Applied at the distal forearm, toward supination</p>	<p>Fulcrum: Ulnar styloid process</p> <p>Stable arm: Perpendicular to the floor</p> <p>Movable arm: Across the posterior surface of distal forearm</p>	Hard	<p>PRONATOR TERES</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing arm in shoulder adduction, semi elbow flexion, and forearm supination.</p> <p>Motion: Client moves testing arm into forearm pronation.</p> <p>Stabilize: At the humerus.</p> <p>Resist: Apply at the posterior distal forearm in the direction of forearm supination.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is seated with testing arm in 90 degrees of shoulder flexion, partial elbow flexion, and with forearm in supination. Elbow is supported on a table.</p> <p>Motion: Client moves testing arm into forearm pronation.</p> <p>Stabilize: At the humerus.</p> <p>Palpate: At the anterior proximal forearm between ulna and radius.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>Wrist Flexion</i>	Sagittal	Frontal	Buttoning a shirt.	0 to 80 degrees	<p>Prime Movers: Flexor carpi radialis Flexor carpi ulnaris</p> <p>Position: Client is seated with arm on a table, forearm in supination and moves toward wrist flexion</p> <p>Stabilize: at the distal forearm to prevent compensation</p> <p>Resist: Applied to the palm of the hand toward wrist extension</p>	<p>Fulcrum: Middle aspect of ulnar styloid process</p> <p>Stable arm: Midline of ulna</p> <p>Movable arm: Midline of 5th metacarpal</p>	Firm	<p>FLEXOR CARPI RADIALIS (ALSO WRIST RADIAL DEVIATION)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing arm on table with a supinated forearm, and the wrist in slight extension over the edge of the table.</p> <p>Motion: Client moves testing wrist into wrist flexion and radial deviation.</p> <p>Stabilize: At the distal forearm to counteract compensation.</p> <p>Resist: Apply at the second metacarpal into extension and ulnar deviation of the wrist.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is seated with testing arm on table. Wrist is neutral and the forearm is supinated.</p> <p>Motion: Client moves testing wrist into wrist flexion and radial deviation.</p> <p>Stabilize: At distal forearm to resist compensation.</p> <p>Palpate: Anterior surface of the forearm in line with second metacarpal, lateral to the palmaris longus.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>Wrist Extension</i>	Sagittal	Frontal	Grasping toothbrush while brushing teeth.	0 to 70 degrees	<p>Prime Movers: Extensor carpi radialis longus, Extensor carpi radialis brevis, Extensor carpi ulnaris</p> <p>Position: Client is seated with arm on the table, forearm in pronation and moves toward wrist extension</p> <p>Stabilize: At the distal forearm to prevent compensation</p> <p>Resist: Applied on the back of the hand toward wrist flexion</p>	<p>Fulcrum: Middle aspect of ulnar styloid process</p> <p>Stable arm: Midline of ulna</p> <p>Movable arm: Midline of 5th metacarpal</p>	Firm	<p>EXTENSOR CARPI RADIALIS LONGUS (ALSO WRIST RADIAL DEVIATION)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing arm on table. Forearm is slightly less than fully pronated, and the wrist is slightly flexed over the edge of the table. Elbow is flexed to 30 degrees.</p> <p>Motion: Client moves testing wrist into wrist extension and radial deviation.</p> <p>Stabilize: At the distal forearm to resist compensation.</p> <p>Resist: Apply at the second metacarpal into wrist flexion and wrist ulnar deviation.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is seated with testing arm on table with the wrist neutral and the forearm pronated. Elbow is flexed to 30 degrees.</p> <p>Motion: Client moves testing wrist into wrist extension and wrist radial deviation.</p> <p>Stabilize: At the distal forearm to resist compensation.</p> <p>Palpate: At the dorsal distal forearm, at the base of the second metacarpal.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>Wrist Radial Deviation</i>	Frontal	Sagittal	Opening the jar of pickles (counter-clockwise with right hand; clockwise with left hand).	0 to 20 degrees	<p>Prime Movers: Extensor carpi radialis longus, Extensor carpi radialis brevis, Flexor carpi radialis</p> <p>Position: Client is seated with arm at rest, elbow flexed to 90 degrees, forearm pronated and moves toward wrist radial deviation</p> <p>Stabilize: At the distal forearm to prevent compensation</p> <p>Resist: Applied at the second metacarpal toward wrist ulnar deviation</p>	<p>Fulcrum: Base of 3rd metacarpal, placed over the capitate bone</p> <p>Stable arm: Midline of forearm</p> <p>Movable arm: Midline of the 3rd metacarpal</p>	Hard	<p>EXTENSOR CARPI RADIALIS LONGUS (ALSO WRIST EXTENSION)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing arm on table. Forearm is slightly less than fully pronated, and the wrist is slightly flexed over the edge of the table. Elbow is flexed to 30 degrees.</p> <p>Motion: Client moves testing wrist into wrist extension and radial deviation.</p> <p>Stabilize: At the distal forearm to resist compensation.</p> <p>Resist: Apply at the second metacarpal into wrist flexion and wrist ulnar deviation.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is seated with testing arm on table with the wrist neutral and the forearm pronated. Elbow is flexed to 30 degrees.</p> <p>Motion: Client moves testing wrist into wrist extension and wrist radial deviation.</p> <p>Stabilize: At the distal forearm to resist compensation.</p> <p>Palpate: At the dorsal distal forearm, at the base of the second metacarpal.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>Wrist Ulnar Deviation</i>	Frontal	Sagittal	Tightening the lid on the jar of tomato sauce (clockwise with right hand; counter-clockwise with left hand).	0 to 30 degrees	<p>Prime Movers: Extensor carpi ulnaris, Flexor carpi ulnaris</p> <p>Position: Client is seated with arm at rest, elbow flexed to 90 degrees, forearm pronation and moves toward wrist ulnar deviation</p> <p>Stabilize: At the distal forearm to prevent compensation</p> <p>Resist: Applied at the fifth metacarpal toward wrist radial deviation when testing normal and good strengths</p>	<p>Fulcrum: Base of 3rd metacarpal, placed over the capitate bone</p> <p>Stable arm: Midline of forearm</p> <p>Movable arm: Midline of the 3rd metacarpal</p>	Firm	<p>EXTENSOR CARPI ULNARIS (ALSO WRIST EXTENSION)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing arm on table with forearm pronated, and the wrist slightly flexed over the edge of the table.</p> <p>Motion: Client moves testing wrist into wrist extension and wrist ulnar deviation.</p> <p>Stabilize: At the distal forearm to resist compensation.</p> <p>Resist: Apply at the fifth metacarpal into wrist flexion and wrist radial deviation.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is seated with testing arm on table and wrist neutral. Forearm is pronated.</p> <p>Motion: Client moves testing wrist into wrist extension and wrist ulnar deviation.</p> <p>Stabilize: At the distal forearm to resist compensation.</p> <p>Palpate: At the dorsal wrist between the base of the fifth metacarpal and the styloid process of the ulna.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>MCP Flexion (Digits II-V)</i>	Sagittal	Frontal	Gripping a knife while cutting vegetables for dinner.	0 to 90 degrees	<p>Prime Movers: Flexor digitorum superficialis, Flexor digitorum profundus, Lumbricals, Flexor digiti minimi (digit V)</p> <p>Position: Client is seated with the testing arm supinated, in MCP extension and moves toward MCP flexion (simultaneous PIP/DIP flexion is acceptable)</p> <p>Stabilize: Proximal to the MCP joints at the metacarpals to prevent compensation</p> <p>Resist: Apply with one or two fingers at the proximal phalanges toward MCP extension</p>	<p>Fulcrum: Dorsal surface of MCP joint being measured</p> <p>Stable arm: Midline and dorsal surface of the metacarpal of digit being measured</p> <p>Movable arm: Midline and dorsal surface of the proximal phalanx of the digit being measured</p>	Hard	<p>FLEXOR DIGITORUM SUPERFICIALIS (ALSO PIP FLEXION)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing arm placed on table in forearm supination and digit extension.</p> <p>Motion: Client moves testing fingers into PIP flexion, keeping the MCPs extended.</p> <p>Stabilize: At the proximal phalanx to resist compensation.</p> <p>Resist: At the middle phalanx toward PIP extension.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is seated with testing arm on table with forearm neutral rotation and digit extension.</p> <p>Motion: Client moves testing fingers into PIP flexion.</p> <p>Stabilize: At the proximal phalanx to resist compensation.</p> <p>Palpate: On the proximal phalanx or palmar surface of wrist between tendons of palmaris longus and flexor carpi ulnaris.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

								<p>LUMBRICALS (ALSO PIP EXTENSION)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing arm on table with forearm supination, MCP extension, and PIP and DIP flexion.</p> <p>Motion: Client moves testing fingers into MCP flexion and PIP and DIP extension.</p> <p>Stabilize: At the metacarpals to resist compensation.</p> <p>Resist: Apply at the proximal phalanx into MCP extension.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is seated with testing arm on table with the forearm in neutral rotation, MCP extension, and the PIP and DIP joints flexed.</p> <p>Motion: Client moves testing fingers into MCP flexion while extending the PIP and DIP joints.</p> <p>Stabilize: At the metacarpals to resist compensation.</p> <p>Palpate: Too deep to palpate.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<p><i>MCP Extension/ Hyperextension (Digits II-V)</i></p>	<p>Sagittal</p>	<p>Frontal</p>	<p>Lifting finger off of a computer key while typing.</p>	<p>90 to 0 extension 0 to 30 hyper-extension</p>	<p>Prime Mover: Extensor digitorum, Extensor indicis (digit II), Extensor digiti minimi (digit V) Position: Client is seated with the testing arm in forearm pronation, digit flexion and moves toward MCP/PIP/DIP extension Stabilize: Proximal to the MCP joints at the metacarpals to prevent compensation Resist: Applied at the proximal, middle, and distal phalanges toward MCP/PIP/DIP flexion</p>	<p>Fulcrum: Dorsal surface of MCP joint being measured Stable arm: Midline and dorsal surface of the metacarpal of digit being measured Movable arm: Midline and dorsal surface of the proximal phalanx of the digit being measured</p>	<p>Firm</p>	<p>EXTENSOR DIGITORUM (ALSO PIP/DIP EXTENSION OF DIGITS II-V) Against Gravity: Fair (3), Good (4), Normal (5): Position: Client is seated with testing arm on a table edge in forearm pronation and the digits flexed off the table. Motion: Client moves testing hand into MCP extension, keeping the PIP and DIP joints flexed. Stabilize: Over proximal phalanx of digits II-IV to resist compensation. Resist: At the middle phalanx toward PIP flexion. Gravity Eliminated: Zero (0), Trace (1), Poor (2) Position: Client is seated with testing arm on table with the forearm neutral and the digits flexed. Motion: Client moves testing hand into digit extension. Stabilize: Over proximal phalanx toward PIP flexion. Palpate: On the dorsal surface of the proximal phalanx.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

								<p>EXTENSOR INDICIS (ALSO PIP/DIP EXTENSION OF 2nd DIGIT)</p> <p>The testing positions are the same for the extensor digitorum above.</p> <p>Palpate: Over the second metacarpal head, dorsal surface.</p> <p>EXTENSOR DIGITI MINIMI (ALSO PIP/DIP EXTENSION OF 5th DIGIT)</p> <p>The testing positions are the same for the extensor digitorum above.</p> <p>Palpate: Over the fifth metacarpal head, dorsal surface.</p>
MCP Adduction	Sagittal	Frontal	Grasping a pencil while writing.	Compare with opposite side	<p>Prime Mover: Palmar interossei</p> <p>Position: Client is seated with the testing arm in forearm pronation, digit extension and moves toward MCP adduction</p> <p>Stabilize: At the metacarpals</p> <p>Resist: Applied to digits II, IV, and V toward abduction (3rd digit does not adduct).</p>	<p>Fulcrum: Dorsal to the MCP joint</p> <p>Stable arm: Parallel along the dorsal metacarpal</p> <p>Movable arm: Along the dorsal proximal phalanx</p>	Firm	<p>PALMAR INTEROSSEI (ALSO CMC ADDUCTION)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing arm on table in forearm supination and the MCP joints abducted.</p> <p>Motion: Client moves testing hand into MCP adduction.</p> <p>Stabilize: At the metacarpals to resist compensation.</p> <p>Resist: At the proximal phalanx on the ulnar side of the second digit, and the radial side of digit IV and V.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Same as testing against gravity.</p> <p>Palpate: Too deep to palpate.</p>

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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>MCP Abduction</i>	Frontal	Sagittal	Spreading fingers apart to get them into a glove.	Compare with opposite side	<p>Prime Mover: Dorsal interossei, Abductor digiti minimi</p> <p>Position: Client is seated with the testing arm in forearm pronation, digit extension and moves toward MCP abduction</p> <p>Stabilize: At the metacarpals</p> <p>Resist: Applied to digits II, IV, and V toward adduction as well as both sides of digit III (3rd digit abducts to both sides)</p>	<p>Fulcrum: Dorsal to the MCP joint</p> <p>Stable arm: Parallel along the dorsal metacarpal</p> <p>Movable arm: Parallel along the dorsal proximal phalanx</p>	Soft	<p>DORSAL INTEROSSEI</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing arm on table in forearm pronation and MCP adduction.</p> <p>Motion: Client moves testing hand into MCP abduction.</p> <p>Stabilize: At the metacarpals to resist compensation.</p> <p>Resist: At the proximal phalanx on the radial side of digit II, the radial and ulnar side of digit III, and the ulnar side of digits IV and V.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Same as testing against gravity.</p> <p>Palpate: Too deep to palpate.</p> <p>ABDUCTOR DIGITI MINIMI (5th DIGIT)</p> <p>The testing positions are the same for the Dorsal interossei above.</p> <p>Palpate: Over the lateral aspect of the fifth metacarpal.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>PIP Flexion</i>	Sagittal	Frontal	Holding a grocery bag by the handles to bring them inside your house.	0 to 90 degrees	<p>Prime Mover: Flexor digitorum superficialis</p> <p>Position: Client is seated with the testing arm in forearm supination, digit extension and moves toward PIP/DIP flexion while keeping MCP's in extension</p> <p>Stabilize: At the MCP joints to prevent compensation</p> <p>Resist: Apply at both the middle and distal phalanges into PIP/DIP extension</p>	<p>Fulcrum: Dorsal surface of the PIP joint being tested</p> <p>Stable arm: Dorsal midline of the proximal phalanx of digit being measured</p> <p>Movable arm: Dorsal midline of the middle phalanx of digit being tested</p>	Hard	<p>FLEXOR DIGITORUM SUPERFICIALIS (ALSO MCP FLEXION)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing arm placed on table in forearm supination and digit extension.</p> <p>Motion: Client moves testing hand into PIP flexion while keeping MCPs extended.</p> <p>Stabilize: At the proximal phalanx to resist compensation.</p> <p>Resist: At the middle phalanx toward PIP extension.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is seated with testing arm on table with the forearm neutral and the digits extended.</p> <p>Motion: Client moves testing hand into PIP flexion.</p> <p>Stabilize: At the proximal phalanx to resist compensation.</p> <p>Palpate: Either on the proximal phalanx, or the palmar surface of the wrist between the tendons of the palmaris longus and flexor carpi ulnaris.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>PIP Extension</i>	Sagittal	Frontal	Extending index finger to press an elevator button.	90 to 0 degrees	<p>Prime Movers: Extensor digitorum, Lumbricals, Extensor indicis (digit II), Extensor digiti minimi (digit V)</p> <p>Position: Client is seated with the testing hand in forearm pronation, digit flexion and moves toward MCP/PIP/DIP extension</p> <p>Stabilize: Proximal to the MCP joints at the metacarpals to prevent compensation</p> <p>Resist: Applied to the proximal, middle and distal phalanges toward MCP/PIP/DIP flexion when testing normal and good strengths</p>	Same positioning as PIP flexion.	Firm	<p>EXTENSOR DIGITORUM (ALSO MCP/DIP EXTENSION OF DIGITS II-V)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing arm on a table edge in forearm pronation and the digits flexed off the table.</p> <p>Motion: Client moves testing hand into MCP extension, keeping the PIP and DIP joints flexed.</p> <p>Stabilize: Over proximal phalanx of digits II-IV to resist compensation.</p> <p>Resist: At the middle phalanx toward PIP flexion.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is seated with testing arm on table with the forearm neutral and the digits flexed.</p> <p>Motion: Client moves testing hand into digit extension.</p> <p>Stabilize: Over proximal phalanx toward PIP flexion.</p> <p>Palpate: On the dorsal surface of the proximal phalanx.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

								<p>EXTENSOR INDICIS (ALSO MCP/DIP EXTENSION OF 2nd DIGIT)</p> <p>The testing positions are the same for the extensor digitorum above.</p> <p>Palpate: Over the second metacarpal head, dorsal surface.</p> <p>EXTENSOR DIGITI MINIMI (ALSO MCP/DIP EXTENSION of 5th DIGIT)</p> <p>The testing positions are the same for the extensor digitorum above.</p> <p>Palpate: Over the fifth metacarpal head, dorsal surface.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>DIP Flexion</i>	Sagittal	Frontal	Applying a contact lens onto the eye with the index finger.	0 to 90 degrees	<p>Prime Mover: Flexor digitorum profundus</p> <p>Position: Client is seated with the testing hand in forearm supination and digit extension, and moves toward PIP/DIP flexion while keeping MCP's in extension</p> <p>Stabilize: At the MCP joints to prevent compensation of hyperextension</p> <p>Resist: Applied with one or two fingers at both the middle and distal phalanges toward PIP/DIP extension when testing normal and good strengths</p>	<p>Fulcrum: Dorsal DIP joint of finger being measured</p> <p>Stable arm: Dorsal midline of middle phalanx being measured</p> <p>Movable arm: Dorsal midline of distal phalanx being measured</p>	Firm	<p>FLEXOR DIGITORUM PROFUNDUS (ALSO MCP FLEXION)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing arm placed on table in forearm supination and digit extension.</p> <p>Motion: Client moves testing fingers into DIP flexion while keeping the PIP and MCP joints extended.</p> <p>Stabilize: At the middle phalanx to resist compensation.</p> <p>Resist: At the distal phalanx.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is seated with testing arm on table, with neutral forearm rotation and digit extension.</p> <p>Motion: Client moves testing fingers into DIP flexion.</p> <p>Stabilize: At the middle phalanx to resist compensation.</p> <p>Palpate: Over the middle phalanges on the palmar surface of the digits.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>DIP Extension</i>	Sagittal	Frontal	Releasing coffee cup on the kitchen table.	90 to 0 degrees	<p>Prime Movers: Extensor digitorum, Lumbricals, Extensor indicis, Extensor digiti minimi</p> <p>Position: Client is seated with the testing hand in forearm pronation, digit flexion and moves toward MCP/PIP/DIP extension</p> <p>Stabilize: Proximal to the MCP joints at the metacarpals to prevent compensation</p> <p>Resist: Apply to the proximal, middle, and distal phalanges toward MCP/PIP/DIP flexion when testing normal and good strengths</p>	Same placement as DIP flexion	Firm	<p>EXTENSOR DIGITORUM (ALSO MCP/PIP EXTENSION OF DIGITS II-V)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing arm on a table edge in forearm pronation and the digits flexed off the table.</p> <p>Motion: Client moves testing hand into MCP extension, keeping the PIP and DIP joints flexed.</p> <p>Stabilize: Over proximal phalanx of digits II-V to resist compensation.</p> <p>Resist: At the middle phalanx toward PIP flexion.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is seated with testing arm on table with the forearm neutral and the digits flexed.</p> <p>Motion: Client moves testing hand into digit extension.</p> <p>Stabilize: Over proximal phalanx toward PIP flexion.</p> <p>Palpate: On the dorsal surface of the proximal phalanx.</p> <p>EXTENSOR INDICIS (ALSO MCP/PIP EXTENSION OF 2nd DIGIT)</p> <p>The testing positions are the same for the extensor digitorum above.</p> <p>Palpate: Over the second metacarpal head, dorsal surface.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>CMC Flexion</i>	Frontal	Sagittal	Pressing down on phone screen while texting (one handed).	0 to 20 degrees	<p>Prime Movers: Flexor pollicis brevis, Flexor pollicis longus</p> <p>Position: Client is seated with the forearm in supination, all digits in extension and moves CMC toward flexion</p> <p>Stabilize: At the wrist</p> <p>Resist: Apply at the metacarpal toward extension</p>	<p>Fulcrum: Base of CMC joint</p> <p>Stable arm: Midline of radius</p> <p>Movable arm: Midline of first metacarpal</p>	Soft	<p>FLEXOR POLLICIS BREVIS (ALSO MP FLEXION)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing arm on table with the forearm supinated.</p> <p>Motion: Client moves testing hand into thumb MCP flexion.</p> <p>Stabilize: At the metacarpal to resist compensation.</p> <p>Resist: Apply at the proximal phalanx of the thumb into MCP extension.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Same as “fair, good, normal” positioning, motion, and stabilizing. A Client is “poor” if Client can only move testing thumb through a small portion of the range of motion in this position.</p> <p>Palpate: On the palmar surface of the first metacarpal.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<p><i>CMC Extension (also known as Radial Abduction)</i></p>	<p>Frontal</p>	<p>Sagittal</p>	<p>Reaching out to grab the bottle of hand sanitizer.</p>	<p>0 to 45 degrees</p>	<p>Prime Movers: Extensor pollicis longus, Extensor pollicis brevis Position: Client is seated with the forearm in supination, digits II-V in extension, thumb at CMC joint is flexed and moves toward extension Stabilize: At the wrist Resist: Toward CMC flexion when testing normal and good strengths</p>	<p>Same position as thumb CMC flexion. Readings should be positive, but do not necessarily start at 0</p>	<p>Firm</p>	<p>EXTENSOR POLLICIS BREVIS (ALSO MP EXTENSION) Against Gravity: Fair (3), Good (4), Normal (5) Position: Client sits with testing extremity on table with a neutral forearm and slight thumb MCP flexion. Motion: Client moves testing extremity into thumb MCP extension. Stabilize: At the thumb metacarpal. Resist: At the proximal phalanx of thumb when in a position toward thumb MCP flexion (when testing normal or good strengths). No resistance applied when testing fair strength. Gravity Eliminated: Zero (0), Trace (1), Poor (2) Position: Same as against gravity. Palpate: Over the dorsal surface at the base of first metacarpal.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<p>CMC <i>Abduction (also known as Palmar Abduction)</i></p>	<p>Sagittal</p>	<p>Frontal</p>	<p>Releasing the pitcher on the kitchen counter.</p>	<p>0 to 70 degrees</p>	<p>Prime Movers: Abductor pollicis brevis, Abductor pollicis longus Position: Client is seated with the forearm in supination, digits II-V in extension, thumb is adducted and moves toward abduction Stabilize: At the wrist Resist: Applied at the first metacarpal toward adduction</p>	<p>Fulcrum: Base of the first and second metacarpals Stable arm: Midline of the second metacarpal, along the radial edge Movable arm: Midline of the first metacarpal, along the radial edge</p>	<p>Firm</p>	<p>ABDUCTOR POLLICIS BREVIS: Against Gravity: Fair (3), Good (4), Normal (5) Position: Client is seated with testing arm on table in forearm supination. Motion: Client moves testing thumb into CMC abduction. Stabilize: At the hand to resist compensation. Resist: At the proximal phalanx of the thumb toward CMC adduction. Gravity Eliminated: Zero (0), Trace (1), Poor (2) Testing positions are the same. Palpate: At the lateral surface of the first digit metacarpal.</p> <p>ABDUCTOR POLLICIS LONGUS Against Gravity: Fair (3), Good (4), Normal (5) Position: Client is seated with testing arm on table with a neutral forearm. Motion: Client moves testing thumb into CMC abduction. Stabilize: At the wrist to avoid compensation. Resist: At the thumb metacarpal toward CMC adduction. Gravity Eliminated: Zero (0), Trace (1), Poor (2) Positions are the same as above. Palpate: At the lateral surface of the base of the first digit metacarpal.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<p>CMC Adduction</p>	<p>Sagittal</p>	<p>Frontal</p>	<p>Grasping the glass of water from the counter top.</p>	<p>Compare with opposite side</p>	<p>Prime Movers: Adductor pollicis, Palmar interossei</p> <p>Position: Client is seated with the forearm in supination, digits II-V in extension, thumb is abducted and moves toward adduction</p> <p>Stabilize: At the wrist</p> <p>Resist: Applied at the first metacarpal toward abduction</p>	<p>Same position as thumb CMC abduction</p>	<p>Soft</p>	<p>ADDUCTOR POLLICIS</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing arm on table in forearm supination, and thumb in CMC abduction.</p> <p>Motion: Client moves testing thumb into CMC adduction.</p> <p>Stabilize: At the wrist to avoid compensation.</p> <p>Resist: At the proximal phalanx of the thumb toward CMC abduction.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Testing positions are the same as against gravity.</p> <p>Palpate: At web space between first and second metacarpals.</p> <p>PALMAR INTEROSSEI (ALSO MCP ADDUCTION)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing arm on table in forearm supination and MCP abduction.</p> <p>Motion: Client moves testing hand into MCP adduction.</p> <p>Stabilize: At the metacarpals to resist compensation.</p> <p>Resist: At the proximal phalanx on the ulnar side of the second digit, and the radial side of the fourth and fifth digits.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Positions are the same.</p> <p>Palpate: Too deep to palpate.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<p><i>MP Flexion (Digit I)</i></p>	<p>Frontal</p>	<p>Sagittal</p>	<p>Pressing down on the keyboard while texting (one handed).</p>	<p>0 to 60 degrees</p>	<p>Prime Mover: Flexor pollicis brevis Position: Client sits with forearm in supination and digits II-V extended; thumb is extended. Moves thumb MP into flexion Stabilize: At metacarpal Resist: At proximal phalange toward extension</p>	<p>Fulcrum: Dorsal surface of the MP joint that is being measured Stable arm: Midline and dorsal surface of the metacarpal of the digit being measured Movable arm: Midline and dorsal surface of the proximal phalanx of the digit being measured</p>	<p>Hard or firm</p>	<p>FLEXOR POLLICIS BREVIS (ALSO CMC FLEXION) Against Gravity: Fair (3), Good (4), Normal (5) Position: Client is seated with testing arm on table with the forearm supinated. Motion: Client moves testing hand into thumb MCP flexion. Stabilize: At the metacarpal to resist compensation. Resist: Apply at the proximal phalanx of the thumb into MCP extension. Gravity Eliminated: Zero (0), Trace (1), Poor (2) Same as “fair, good, normal” positioning, motion, and stabilizing. A Client is “poor” if Client can only move testing thumb through a small portion of the range of motion in this position. Palpate: On the palmar surface of the first metacarpal.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>MP Extension (Digit I)</i>	Frontal	Sagittal	Releasing a coin into slot of the vending machine.	60 to 0 degrees	<p>Prime Mover: Extensor pollicis brevis</p> <p>Position: Client sits with forearm in supination and digits II-V extended; thumb is extended. Moves thumb MP into extension</p> <p>Stabilize: At metacarpal</p> <p>Resist: At proximal phalange toward flexion</p>	Same position as MP flexion	Firm	<p>EXTENSOR POLLICIS BREVIS (ALSO CMC EXTENSION)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client sits with testing extremity on table with a neutral forearm and slight thumb MCP flexion.</p> <p>Motion: Client moves testing extremity into thumb MCP extension.</p> <p>Stabilize: At the thumb metacarpal.</p> <p>Resist: At the proximal phalanx of thumb when in a position toward thumb MCP flexion (when testing normal or good strengths). No resistance applied when testing fair strength.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Same as against gravity.</p> <p>Palpate: Over the dorsal surface at the base of first metacarpal.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<p><i>IP Flexion (Digit I)</i></p>	<p>Frontal</p>	<p>Sagittal</p>	<p>Grasping a pencil while writing.</p>	<p>0 to 90 degrees</p>	<p>Prime Mover: Flexor pollicis longus Position: Client is seated with forearm in supination, all digits are extended and IP moves toward flexion Stabilize: At the thumb proximal phalanx Resist: Applied toward extension when testing normal and good strengths</p>	<p>Fulcrum: Dorsal IP joint being measured Stable arm: Dorsal midline of proximal phalanx of thumb being measured Movable arm: Dorsal midline of distal phalanx of thumb being measured</p>	<p>Firm</p>	<p>FLEXOR POLLICIS LONGUS (ALSO CMC FLEXION) Against Gravity: Fair (3), Good (4), Normal (5) Position: Client is seated with testing arm on table in forearm supination. Motion: Client moves testing thumb into IP flexion while keeping the MCP joint extended. Stabilize: At the proximal phalanx to resist compensation. Resist: Apply at the distal phalanx of the thumb into IP extension. Gravity Eliminated: Zero (0), Trace (1), Poor (2) Same as "fair, good, normal" for positioning, motion, and stabilizing. A Client is "poor" if they can only move testing thumb through a small range of motion in the position. Palpate: On the palmar surface of the first proximal phalanx.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>IP Extension (Digit I)</i>	Frontal	Sagittal	Releasing vitamin tablet on countertop.	90 to 0 degrees	<p>Prime Mover: Extensor pollicis longus</p> <p>Position: Client is seated with forearm in supination digits II-IV are extended, thumb IP is flexed and moves toward extension</p> <p>Stabilize: At the thumb proximal phalanx</p> <p>Resist: Applied toward flexion in normal and good strengths</p>	Same position as IP flexion	Firm	<p>EXTENSOR POLLICIS LONGUS (ALSO CMC EXTENSION):</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing arm on table with a neutral forearm and thumb in IP flexion.</p> <p>Motion: Client moves testing thumb toward IP extension.</p> <p>Stabilize: At the proximal phalanx of the thumb to resist compensation.</p> <p>Resist: At the distal phalanx of the thumb toward thumb IP flexion.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Positions are the same as against gravity.</p> <p>Palpate: Over the first proximal phalanx on the dorsal surface.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<p><i>Opposition</i> (Note: This is a curvilinear motion that crosses cardinal planes.)</p>		<p>Blowing your nose with a tissue.</p>	<p>0 centimeters</p>	<p>Prime Movers: Opponens pollicis (digit I), Opponens digiti minimi (digit V)</p> <p>Position: Client is seated with forearm in pronation and moves into gross grasp pattern while squeezing therapist fingers</p> <p>Stabilize: at the wrist</p> <p>Resist: at both the thenar and hypothenar eminences away from opposition</p>	<p>Using ruler on the arm of the goniometer, measure distance between digits I & V when attempting to oppose in full</p>	<p>Soft</p>	<p>OPPONENS POLLICIS</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is seated with testing arm on table in forearm supination and MCP abduction.</p> <p>Motion: Client moves testing hand into opposition.</p> <p>Stabilize: At the metacarpal of digit V to resist compensation.</p> <p>Resist: At the first metacarpal in the opposite direction from opposition.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Positions are the same, however no resistance is applied.</p> <p>Palpate: On the thenar eminence lateral to abductor pollicis.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

							<p>OPPONENS DIGITI MINIMI Against Gravity: Fair (3), Good (4), Normal (5) Position: Client is seated with testing arm on table in forearm supination and MCP abduction. Motion: Client moves testing hand into opposition. Stabilize: At the metacarpal of digit I to resist compensation. Resist: At the first metacarpal in the opposite direction from opposition. Gravity Eliminated: Zero (0), Trace (1), Poor (2) Positions are the same, however no resistance is applied. Palpate: On the hypothenar eminence.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>Hip Flexion</i>	Sagittal	Frontal	Raising foot up to the chair in order to tie your shoe.	0 to 120 degrees	<p>Prime Movers: Psoas major, Iliacus</p> <p>Position: Client is seated with testing hip and knee are flexed so that foot is resting on the floor and moves toward hip flexion</p> <p>Stabilize: At the ipsilateral iliac crest of the pelvis</p> <p>Resist: Applied over the anterior aspect of the femur toward hip extension</p>	<p>Fulcrum: Laterally on the greater trochanter</p> <p>Stable arm: Parallel to mid-axillary line on the trunk</p> <p>Movable arm: Parallel to the lateral femur</p>	Soft	<p>ILIACUS AND PSOAS MAJOR (TESTED TOGETHER)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: client is sitting in 90 degrees of hip flexion, knee is flexed and the foot is unsupported up off the floor.</p> <p>Motion: moves in the direction of hip flexion.</p> <p>Stabilize: at the contralateral iliac crest of the pelvis.</p> <p>Resist: over the thigh in the direction of hip extension.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is lying on nontest side with hip and knee flexed. The testing extremity is in hip extension and knee flexion while supported by the therapist.</p> <p>Motion: Moves the testing extremity into maximal hip flexion.</p> <p>Stabilize: At the pelvis.</p> <p>Palpate: Too deep to be palpated.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>Hip Extension</i>	Sagittal	Frontal	Pulling sock up to knee while seated.	0 to 30 degrees	<p>Prime Movers: Gluteus maximus, Biceps femoris, Semitendinosus, Semimembranosus</p> <p>Position: Client is seated with testing hip and knee are flexed so that foot is up off the floor and moves toward hip extension</p> <p>Stabilize: At the ipsilateral iliac crest of the pelvis</p> <p>Resist: Applied over the posterior aspect of the femur toward hip flexion</p>	<p>Fulcrum: Laterally on the greater trochanter</p> <p>Stable arm: Parallel to the mid-axillary line on the trunk</p> <p>Movable arm: Parallel to the lateral femur</p>	Firm	<p>GLUTEUS MAXIMUS (ALSO HIP EXTERNAL ROTATION)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is prone with both legs extended and resting on testing surface holding onto edge of testing surface for stability.</p> <p>Motion: Moves the testing extremity in the direction of hip extension while knee remains flexed.</p> <p>Stabilize: At the pelvis.</p> <p>Resist: Over the posterior thigh in the direction of flexion.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is lying on nontest side in maximal hip and knee flexion. Testing hip is in neutral and knee is flexed.</p> <p>Motion: Moves into maximal hip extension. Therapist supports the testing extremity to eliminate gravity without assisting the motion.</p> <p>Stabilize: At the pelvis.</p> <p>Palpate: Medial to the insertion on the gluteal tuberosity.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>Hip Abduction</i>	Frontal	Sagittal	Stepping over tub ledge to get into the shower.	0 to 45 degrees	<p>Prime Movers: Gluteus medius, Gluteus minimus, Tensor fascia latae</p> <p>Position: Client is seated with testing hip and knee flexed so that foot is resting on the floor and moves toward hip abduction</p> <p>Stabilize: At the ipsilateral iliac crest of the pelvis</p> <p>Resist: Applied over the lateral aspect of the femur toward hip adduction</p>	<p>Fulcrum: Anterior superior iliac spine</p> <p>Stable arm: Horizontally between ASIS on both sides</p> <p>Movable arm: Parallel to the midline on anterior femur</p>	Firm	<p>GLUTEUS MEDIUS AND GLUTEUS MINIMUS (TESTED TOGETHER; ALSO INTERNAL ROTATION)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is lying on nontest side in hip and knee flexion. Testing extremity is in slight hip extension, neutral rotation, and knee extension. The pelvis is rotated slightly forward.</p> <p>Motion: Moves the testing extremity in the direction of hip abduction.</p> <p>Stabilize: At the pelvis.</p> <p>Resist: Applied over the lateral aspect of the thigh proximal to the knee in the direction of adduction.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is supine with hip and knees extended resting on testing surface.</p> <p>Motion: Moves the testing extremity into maximal hip abduction. Therapist supports the testing extremity to eliminate gravity without assisting the motion.</p> <p>Stabilize: At pelvis on the contralateral side.</p> <p>Palpation: The gluteus medius is palpated distal to the lateral lip of the iliac crest or proximal to the greater trochanter of the femur. The gluteus minimus is too deep to be palpated.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>Hip Adduction (Note: Unlike shoulder adduction, this is not the opposite of hip abduction.)</i>	Frontal	Sagittal	Kicking a soccer ball to the left with the right, inner foot during game.	0 to 30 degrees	<p>Prime Movers: Adductor brevis, Adductor longus, Gracilis, Adductor magnus, Pectineus</p> <p>Position: Client is seated with testing hip and knee are flexed so that foot is resting on the floor and moves toward hip adduction</p> <p>Stabilize: At the ipsilateral iliac crest of the pelvis</p> <p>Resist: Applied over the medial aspect of the femur toward hip abduction</p>	<p>Fulcrum: On the anterior superior iliac spine</p> <p>Stable arm: Horizontally between the ASIS on either side</p> <p>Movable arm: Parallel to the midline of the anterior femur</p>	Firm	<p>PECTINEUS, ADDUCTOR MAGNUS, GRACILIS, ADDUCTOR LONGUS, AND ADDUCTOR BREVIS (TESTED TOGETHER):</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is lying on side on testing extremity with hip in neutral and knee extended.</p> <p>Motion: Moves in the direction of hip adduction toward the nontest extremity.</p> <p>Stabilize: Support the nontest extremity in hip abduction.</p> <p>Resist: Applied over the medial aspect of the thigh proximal to the knee in the direction of abduction.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is supine with hip in abduction and knee extended on testing surface.</p> <p>Motion: Moves the testing extremity into maximal hip adduction. Therapist supports the testing extremity to eliminate gravity without assisting the motion.</p> <p>Stabilize: At the pelvis. No resistance is applied in the gravity-eliminated position.</p> <p>Palpation: Palpated as a group on the medial and proximal aspect of the thigh.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>Hip External Rotation</i>	Transverse	Vertical	Putting your foot on top of your opposite knee to tie shoelace.	0 to 45 degrees	<p>Prime Movers: Gluteus maximus, Piriformis, Gemellus superior, Quadratus femoris, Gemellus inferior, Obturator internis, Obturator externus</p> <p>Position: Client is seated with testing hip and knee are flexed so that foot is up off the floor and moves toward hip external rotation (rotate foot medially)</p> <p>Stabilize: At the anterolateral aspect of the femur</p> <p>Resist: Applied over the medial aspect of the distal lower leg, proximal to the ankle and toward internal rotation</p>	<p>Fulcrum: Over midpoint of patella</p> <p>Stable arm: Perpendicular to the ground</p> <p>Movable arm: Parallel to the anterior midline of the tibia halfway between the two malleoli</p>	Firm	<p>PIRIFORMIS, QUADRATUS FEMORIS, OBTURATOR INTERNIS, OBTURATOR EXTERNUS, GEMELLUS SUPERIOR, GEMELLUS INFERIOR (TESTED TOGETHER)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is sitting with testing hip in 90 degrees of flexion, knee flexed at edge of testing surface.</p> <p>Motion: Moves the testing extremity in the direction of hip external rotation.</p> <p>Stabilize: At the anterolateral aspect of the distal thigh.</p> <p>Resist: Applied over the medial aspect of the lower leg proximal to the ankle in the direction of internal rotation.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is supine with testing hip in internal rotation and knee extension.</p> <p>Motion: Moves the testing extremity into maximal hip external rotation.</p> <p>Stabilize: At medial aspect of the thigh.</p> <p>Palpation: The external rotators are too deep to palpate.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<p><i>Hip Internal Rotation</i></p>	<p>Transverse</p>	<p>Vertical</p>	<p>Turning leg and foot inwards to zip a lateral zipper on a boot while getting dressed.</p>	<p>0 to 45 degrees</p>	<p>Prime Movers: Gluteus medius, Gluteus minimus, Tensor fascia latae</p> <p>Position: Client is seated with testing hip and knee are flexed so that foot is up off the floor and moves toward hip internal rotation (rotate foot laterally)</p> <p>Stabilize: At the anterolateral aspect of the femur</p> <p>Resist: Applied over the lateral aspect of the distal lower leg, proximal to the ankle and toward external rotation</p>	<p>Fulcrum: Over midpoint of patella</p> <p>Stable arm: Perpendicular to the floor</p> <p>Movable arm: Parallel to the anterior midline of the tibia halfway between the two malleoli</p>	<p>Firm</p>	<p>GLUTEUS MEDIUS AND GLUTEUS MINIMUS (TESTED TOGETHER; ALSO ABDUCTION)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is lying on nontest side in hip and knee flexion. Testing extremity is in slight hip extension, neutral rotation, and knee extension. The pelvis is rotated slightly forward.</p> <p>Motion: Moves the testing extremity in the direction of hip abduction.</p> <p>Stabilize: At the pelvis.</p> <p>Resist: Applied over the lateral aspect of the thigh proximal to the knee in the direction of adduction.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is supine with hip and knees extended resting on testing surface.</p> <p>Motion: Moves the testing extremity into maximal hip abduction. Therapist supports the testing extremity to eliminate gravity without assisting the motion.</p> <p>Stabilize: At pelvis on the contralateral side.</p> <p>Palpation: The gluteus medius is palpated distal to the lateral lip of the iliac crest or proximal to the greater trochanter of the femur. The gluteus minimus is too deep to be palpated.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

								<p>TENSOR FASCIA LATAE (ALSO HIP FLEXION AND ABDUCTION)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is lying on nontest side with hip and knee flexed. The testing extremity is in 45 degrees of hip flexion, internal rotation and knee extension. The pelvis is rolled posteriorly.</p> <p>Motion: Moves the testing extremity in the direction of hip abduction while maintaining hip flexion.</p> <p>Stabilize: At the pelvis.</p> <p>Resist: On the thigh in the direction of hip adduction and extension.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is supine with hip and knees extended resting on testing surface.</p> <p>Motion: Moves the testing extremity into maximal hip abduction and slight hip flexion. Therapist supports the testing extremity to eliminate gravity without assisting the motion.</p> <p>Stabilize: At the pelvis.</p> <p>Palpation: Lateral to the upper portion of the sartorius or distal to the greater trochanter on the iliotibial band.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>Knee Flexion</i>	Sagittal	Frontal	Lowering oneself to sit down as is needed for toileting or getting into bed.	0 to 135 degrees	<p>Prime Movers: Semitendinosus, Semimembranosus, Biceps femoris</p> <p>Position: Client is seated with knee extended out in front so that foot is up off the floor and moves toward knee flexion</p> <p>Stabilize: At the anterior aspect of the femur</p> <p>Resist: Applied over the anterior aspect of the distal lower leg, proximal to the ankle and toward knee extension</p>	<p>Fulcrum: Over lateral epicondyle of femur</p> <p>Stable arm: Parallel to the lateral midline of femur</p> <p>Movable arm: Parallel to midline of fibula</p>	Soft	<p>SEMITENDINOSUS AND SEMIMEMBRANOSUS (TESTED TOGETHER; ALSO HIP EXTENSION)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is prone with testing knee in slight flexion and internal rotation (toes pointed toward nontest side).</p> <p>Motion: While maintaining internal rotation, the client flexes the knee in a diagonal motion toward the lateral aspect of the testing extremity buttocks.</p> <p>Stabilize: At the testing thigh.</p> <p>Resist: Proximal to the ankle in the direction of knee extension and external rotation.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is lying on nontest side with testing hip and knee extended.</p> <p>Motion: Moves into maximal knee flexion. Therapist supports the testing extremity to eliminate gravity without assisting the motion.</p> <p>Stabilize: At the thigh.</p> <p>Palpation: The semitendinosus is palpated proximal to the knee joint on the medial aspect of the popliteal fossa. The semimembranosus is palpated on either side of that tendon.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

								<p>BICEPS FEMORIS (ALSO HIP EXTENSION)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is prone with testing knee slightly flexed and externally rotated (toes are pointed away from nontest side).</p> <p>Motion: While maintaining external rotation, flex the knee in a diagonal motion toward the contralateral buttocks.</p> <p>Stabilize: At the testing thigh.</p> <p>Resist: Applied proximal to the ankle on the posterior aspect of the leg in the direction of knee extension and internal rotation.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is lying on nontest side with hip and knee extended.</p> <p>Motion: Moves the testing extremity into maximal knee flexion. Therapist supports the testing extremity to eliminate gravity without assisting the motion.</p> <p>Stabilize: At the thigh.</p> <p>Palpation: Proximal to the knee joint on the lateral margin of the popliteal fossa.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>Knee Extension</i>	Sagittal	Frontal	Stepping out of the car.	135 to 0 degrees	<p>Prime Movers: Vastus intermedius, Vastus medialis, Vastus lateralis, Rectus femoris</p> <p>Position: Client is seated with knee flexed, foot resting on the floor and moves toward knee extension</p> <p>Stabilize: At the anterior aspect of the femur</p> <p>Resist: Applied over the posterior aspect of the distal lower leg, proximal to the ankle and toward knee flexion</p>	<p>Fulcrum: Over lateral epicondyle of femur</p> <p>Stable arm: Parallel to the midline of the femur</p> <p>Movable arm: Parallel to the lateral midline of the fibula</p>	Firm	<p>RECTUS FEMORIS, VASTUS INTERMEDIUS, VASTUS LATERALIS, AND VASTUS MEDIALIS (TESTED TOGETHER)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is sitting with testing knee flexed and lower leg and feet are over edge of testing surface.</p> <p>Motion: Toward knee extension.</p> <p>Stabilize: At the testing thigh.</p> <p>Resist Applied on the anterior surface of the distal lower extremity in the direction of knee flexion.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is lying on nontest side with testing hip extended and knee flexed.</p> <p>Motion: Moves the testing extremity into maximal knee extension. Therapist supports the testing extremity to eliminate gravity without assisting the motion.</p> <p>Stabilize: At the thigh. No resistance is applied in the gravity-eliminated position.</p> <p>Palpation: The rectus femoris is palpated on the anterior midthigh. The vastus intermedius is too deep to be palpated. The vastus lateralis is palpated on the lateral aspect of the midthigh. The vastus medialis is palpated on the medial aspect of the thigh.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

Ankle <i>Dorsiflexion</i>	Oblique Sagittal	Oblique Frontal	Lifting foot to next step while going up the stairs.	0 to 20 degrees	<p>Prime Movers: Tibialis anterior</p> <p>Position: Client is seated with knee flexed, foot resting on the floor and moves toward ankle dorsiflexion</p> <p>Stabilize: At the anterior aspect of the tibia</p> <p>Resist: Applied over the anterior aspect of the foot and toward ankle plantar flexion</p>	<p>Fulcrum: Lateral aspect of lateral malleolus</p> <p>Stable arm: Parallel to lateral midline of fibula</p> <p>Movable arm: Parallel to the lateral midline of the 5th metatarsal</p>	Firm	<p>TIBIALIS ANTERIOR</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is sitting with lower leg and foot over edge of testing surface. Ankle is in plantar flexion and foot in slight eversion.</p> <p>Motion: Moves the testing extremity into dorsiflexion and foot inversion with toes relaxed.</p> <p>Stabilize: At lower leg proximal to the ankle.</p> <p>Resist: Applied on the medial side and dorsal aspect of the forefoot in the direction of plantar flexion and foot eversion.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is lying on side on test side with hip extended, knee flexed, the ankle in plantar flexion, the foot in slight eversion.</p> <p>Motion: Moves the testing extremity into maximal ankle dorsiflexion and foot inversion. Therapist supports the testing extremity to eliminate gravity without assisting the motion.</p> <p>Stabilize: At lower leg proximal to the ankle. No resistance is applied in the gravity-eliminated position.</p> <p>Palpation: At the anterior lateral portion of the lower leg.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>Ankle Plantar Flexion</i>	Oblique Sagittal	Oblique Frontal	Pressing down the acceleration pedal in the car.	0 to 50 degrees	<p>Prime Movers: Gastrocnemius, Soleus</p> <p>Position: Client is seated with knee flexed, foot in dorsiflexion and moves toward ankle plantarflexion</p> <p>Stabilize: At the anterior aspect of the tibia</p> <p>Resist: Applied over the anterior aspect of the foot and toward ankle dorsiflexion</p>	<p>Fulcrum: Lateral aspect of lateral malleolus</p> <p>Stable arm: Parallel to midline of fibula</p> <p>Movable arm: Parallel to the lateral midline of the 5th metatarsal</p>	Firm	<p>GASTROCNEMIUS</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is prone with knee extended and feet are over edge of testing surface. The ankle is in dorsiflexion.</p> <p>Motion: Moves the testing extremity into plantar flexion with toes relaxed.</p> <p>Stabilize: At the lower leg proximal to the ankle.</p> <p>Resist: Applied on the posterior aspect of the calcaneus in the direction of dorsiflexion.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Position: Client is lying on side on test side with nontest knee flexed. The testing knee is extended and the ankle is in dorsiflexion.</p> <p>Motion: Moves the testing extremity into maximal ankle plantar flexion.</p> <p>Stabilize: The lower leg proximal to the ankle.</p> <p>Palpation: The gastrocnemius is palpated at the medial and lateral margin of the popliteal fossa, distal to the knee joint.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<p><i>Ankle Inversion (With Dorsiflexion)</i></p>	<p>Oblique Sagittal</p>	<p>Oblique Frontal</p>	<p>Shifting foot from the accelerator to the brake while driving.</p>	<p>0 to 35 degrees forefoot: 0 to 5 degrees hindfoot</p>	<p>Prime Movers: Tibialis posterior Position: Client is seated with knee extended in order to hold foot just off the floor and moves ankle medially toward inversion Stabilize: At the anterior aspect of the tibia Resist: Applied on the medial border of the foot toward eversion</p>	<p>Forefoot Fulcrum: Over anterior aspect of ankle halfway between malleoli Stable arm: Parallel to the anterior midline of lower leg Movable arm: Parallel to the anterior midline of the 2nd metatarsal</p>	<p>Firm</p>	<p>TIBIALIS POSTERIOR Against Gravity: Fair (3), Good (4), Normal (5) Position: Client is sitting with lower leg and foot over edge of testing surface. The ankle is in slight plantar flexion and foot in neutral. Motion: Moves the testing extremity into inversion with toes relaxed. Stabilize: At the lower leg proximal to the ankle. Resist: On the medial border of the forefoot in the direction of foot eversion. Gravity Eliminated: Zero (0), Trace (1), Poor (2) Position: Client is supine with testing knee extended and the foot and ankle in neutral. Motion: Moves the testing extremity into maximal foot inversion. Stabilize: At the lower leg proximal to the ankle. Palpation: The tibialis posterior is palpated between the medial malleolus and the navicular.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<p><i>Ankle Eversion (With Plantar Flexion)</i></p>	<p>Oblique Frontal</p>	<p>Oblique Sagittal</p>	<p>Shifting foot from the brake to the accelerator while driving.</p>	<p>0 to 15 degrees forefoot: 0 to 5 degrees hindfoot</p>	<p>Prime Movers: Peroneus longus (also known as Fibularis longus), Peroneus brevis (also known as Fibularis brevis) Position: Client is seated with knee extended in order to hold foot just off the floor and moves ankle laterally toward eversion Stabilize: At the anterior aspect of the tibia Resist: Applied on the lateral border of the foot toward inversion</p>	<p>Forefoot Fulcrum: Over anterior aspect of ankle halfway between malleoli Stable arm: Parallel to the anterior midline of lower leg Movable arm: Parallel to the anterior midline of the 2nd metatarsal</p>	<p>Firm</p>	<p>FIBULARIS LONGUS (ALSO KNOWN AS PERONEUS LONGUS) AND FIBULARIS BREVIS (ALSO KNOWN AS PERONEUS BREVIS; TESTED TOGETHER) Against Gravity: Fair (3), Good (4), Normal (5) Position: Client is sitting with lower leg and foot over edge of testing surface. The ankle and foot are in neutral (Figure 3-7-15). Motion: Moves the testing extremity into foot eversion. Stabilize: At the lower leg proximal to the ankle. Resist: Applied on the lateral border of the foot and on the plantar surface of the head of the first metatarsal in the direction of foot inversion. Gravity Eliminated: Zero (0), Trace (1), Poor (2) Position: Client is supine with the testing knee extended and heel resting over the edge of testing surface. The foot and ankle are in neutral. Motion: Moves the testing extremity into maximal foot eversion. Stabilize: At the lower leg proximal to the ankle. Palpation: The peroneus longus is palpated posterior to the lateral malleolus or distal to the head of the fibula. The peroneus brevis is palpated proximal to the base of the fifth metatarsal on the lateral border of the foot.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

MTP/MP Flexion	Sagittal	Frontal	Placing toes into opening of a sock before pulling it on.	0 to 45 degrees great toe 0 to 40 degrees toes II-V	<p>Prime Movers: Flexor hallucis brevis, Lumbricals</p> <p>Position: Client is seated with knee extended in order to hold foot just off the floor and moves into MTP flexion</p> <p>Stabilize: Anterior aspect of metatarsals</p> <p>Resist: Posterior aspect of proximal phalanx toward MTP extension</p>	<p>Fulcrum: Over dorsum of MTP</p> <p>Stable arm: Parallel to dorsal midline of metatarsal</p> <p>Movable arm: Parallel to dorsal midline of proximal phalanx</p>	Firm	<p>FLEXOR HALLUCIS BREVIS AND LUMBRICALS (TESTED TOGETHER)</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is supine with testing knee extended, lower leg and foot resting in neutral on surface.</p> <p>Motion: Moves into MTP flexion of each toe.</p> <p>Stabilize: At the metatarsals with IP joint extension.</p> <p>Resist: Applied on the plantar surface of the proximal phalanges of each toe individually in the direction of MTP extension.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Same as testing against gravity.</p> <p>Palpation: Medial border of the sole of the foot. The lumbricals are too deep to palpate.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<p>MTP/MP Extension</p>	<p>Sagittal</p>	<p>Frontal</p>	<p>Slipping on flip flops before heading to the beach.</p>	<p>45 to 0 degrees great toe 40 to 0 degrees toes II-V</p>	<p>Prime Movers: Extensor hallucis longus, Extensor digitorum brevis, Extensor digitorum longus Position: Client is seated with knee extended in order to hold foot just off the floor and moves into MTP extension Stabilize: Anterior aspect of metatarsals Resist: Anterior aspect of proximal phalanx toward MTP flexion</p>	<p>Fulcrum: Over dorsum of MTP Stable arm: Parallel to dorsal midline of metatarsal Movable arm: Parallel to dorsal midline of proximal phalanx</p>	<p>Firm</p>	<p>EXTENSOR HALLUCIS LONGUS, EXTENSOR DIGITORUM LONGUS, AND EXTENSOR DIGITORUM BREVIS (TESTED TOGETHER) Against Gravity: Fair (3), Good (4), Normal (5) Position: Client is supine, testing knee is extended, lower leg and foot resting in neutral on the testing surface. The toes are flexed. Motion: Moves the great toe into MTP extension and toes #2–4 into IP extension (group or individually). Stabilize: At the metatarsals of each toe tested. Resist: Applied on the dorsal surface of the distal phalanx of the great toe and the distal surface of toes #2–5 individually (or together) in the direction of IP flexion. Gravity Eliminated: Zero (0), Trace (1), Poor (2) Same as testing against gravity. Palpation: The extensor hallucis longus is palpated on the dorsal aspect of the first MTP joint or on the anterior aspect of the ankle joint lateral to the tendon of the tibialis anterior. The extensor digitorum brevis is palpated on the dorsal aspect of the foot anterior to the lateral malleolus. The extensor digitorum longus is palpated on the dorsal aspect of the metatarsal bones of toes #2–5 or on the anterior aspect of the ankle joint lateral to the tendon of the extensor hallucis longus.</p>
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AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>MTP Abduction</i>	Transverse	Vertical	Slipping on flip flops before heading to the beach.	Compare with opposite side	<p>Prime Movers: Abductor hallucis, Abductor digiti minimi, Dorsal interossei</p> <p>Position: Client is seated with knee extended in order to hold foot just off the floor and moves into MTP abduction</p> <p>Stabilize: At the first metacarpal</p> <p>Resist: On the medial aspect of the proximal phalanx of the great toe toward MTP adduction</p>	<p>Fulcrum: Over dorsum of MTP</p> <p>Stable arm: Parallel to dorsal midline of metatarsal</p> <p>Movable arm: Parallel to dorsal midline of proximal phalanx</p>	Firm	<p>ABDUCTOR HALLUCIS</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is supine, testing knee is extended, lower leg and foot resting neutral on the testing surface. The toes are in adduction.</p> <p>Motion: Moves the great toe into abduction.</p> <p>Stabilize: At the first metatarsal.</p> <p>Resist: On the medial aspect of the proximal phalanx of the great toe in the direction of adduction.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Same as testing against gravity.</p> <p>Palpation: On the medial border of distal first metatarsal.</p> <p>ABDUCTOR DIGITI MINIMI AND DORSAL INTEROSSEI (TESTED TOGETHER)</p> <p>IMT is not formally performed on these muscles but rather observation of toes #2–5 provides a functional level while stabilizing at the great toe.</p>
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(continued)

AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<i>MTP Adduction</i>	Transverse	Vertical	Placing toes/foot into a tall boot.	Compare with opposite side	<p>Prime Movers: Adductor hallucis, Plantar interossei</p> <p>Position: Client is seated with knee extended in order to hold foot just off the floor and moves into MTP adduction</p> <p>Stabilize: At the first metacarpal</p> <p>Resist: On the lateral aspect of the proximal phalanx toward MTP abduction</p>	<p>Fulcrum: Over dorsum of MTP</p> <p>Stable arm: Parallel to dorsal midline of metatarsal</p> <p>Movable arm: Parallel to dorsal midline of proximal phalanx</p>	Firm	<p>ADDUCTOR HALLUCIS</p> <p>Against Gravity: Fair (3), Good (4), Normal (5)</p> <p>Position: Client is supine, testing knee is extended, lower leg and foot resting neutral on the testing surface. The toes are in adduction.</p> <p>Motion: Moves the great toe into adduction.</p> <p>Stabilize: At the first metatarsal.</p> <p>Resist: On the lateral aspect of the proximal phalanx of the great toe in the direction of abduction.</p> <p>Gravity Eliminated: Zero (0), Trace (1), Poor (2)</p> <p>Same as testing against gravity.</p> <p>Palpation: Lateral aspect of 1st proximal phalanx in webspace.</p> <p>PLANTAR INTEROSSEI</p> <p>IMT is not formally performed on these muscles but rather observation of toes #2–5 provides a functional level while stabilizing at the great toe.</p>
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(continued)

AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<p>IP/PIP/DIP Flexion</p>	<p>Sagittal</p>	<p>Frontal</p>	<p>Placing toes into opening of a sock before pulling it on.</p>	<p>0 to 35 degrees PIP toes II-V 0 to 60 degrees DIP</p>	<p>Prime Movers: Flexor hallucis longus, Flexor digitorum longus, Flexor digitorum brevis Position: Client is seated with knee extended in order to hold foot just off the floor and moves into IP/PIP flexion Stabilize: Proximal phalanx Resist: Middle phalanx toward IP/PIP extension</p>	<p>Fulcrum: Over dorsum of IP/PIP/DIP Stable arm: Parallel to dorsal midline of proximal/middle phalanx Movable arm: Parallel to dorsal midline of middle/distal phalanx</p>	<p>Soft/firm</p>	<p>FLEXOR HALLUCIS LONGUS, FLEXOR DIGITORUM LONGUS, AND FLEXOR DIGITORUM BREVIS (TESTED TOGETHER) Against Gravity: Fair (3), Good (4), Normal (5) Position: Client is supine with testing knee extended, lower leg and foot resting in neutral on testing surface. Motion: Moves into IP flexion of each toe. Stabilize: At the MTP joint of each toe tested. Resist: Applied on the plantar surface of the distal phalanx of the great toe and the distal and middle phalanges of toes #2-5 individually in the direction of IP extension. Gravity Eliminated: Zero (0), Trace (1), Poor (2) Same as testing against gravity. Palpation: The flexor hallucis longus may be palpated on the plantar surface of the proximal phalanx of the great toe or inferior to the medial malleolus. The flexor digitorum brevis is too deep to palpate. The flexor digitorum longus may be palpated on the plantar aspect of the proximal phalanges.</p>
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(continued)

AT-A-GLANCE: BIOMECHANICAL OCCUPATIONAL THERAPY SCREENING AND ASSESSMENT

<p><i>IP/PIP/DIP Extension</i></p>	<p>Sagittal</p>	<p>Frontal</p>	<p>Applying toe nail polish</p>	<p>90 to 0 degrees IP/PIP great toe 35 to 0 degrees PIP toes II-V 60 to 0 DIP</p>	<p>Prime Movers: Extensor hallucis longus, Extensor digitorum longus, Extensor digitorum brevis Position: Client is seated with knee extended in order to hold foot just off the floor and moves toes into extension Stabilize: Proximal phalanx Resist: Middle phalanx toward IP/PIP flexion</p>	<p>Fulcrum: Over dorsum of IP/PIP/DIP Stable arm: Parallel to dorsal midline of proximal/ middle phalanx Movable arm: Parallel to dorsal midline of middle/distal phalanx</p>	<p>Firm</p> <p>EXTENSOR HALLUCIS LONGUS, EXTENSOR DIGITORUM LONGUS, AND EXTENSOR DIGITORUM BREVIS (TESTED TOGETHER) Against Gravity: Fair (3), Good (4), Normal (5) Position: Client is supine, testing knee is extended, lower leg and foot resting in neutral on the testing surface. The toes are flexed. Motion: Moves the great toe into MTP extension and toes #2–4 into IP extension (group or individually). Stabilize: At the metatarsals of each toe tested. Resist: Applied on the dorsal surface of the distal phalanx of the great toe and the distal surface of toes #2–5 individually (or together) in the direction of IP flexion. Gravity Eliminated: Zero (0), Trace (1), Poor (2) Same as testing against gravity. Palpation: The extensor hallucis longus is palpated on the dorsal aspect of the first MTP joint or on the anterior aspect of the ankle joint lateral to the tendon of the tibialis anterior. The extensor digitorum brevis is palpated on the dorsal aspect of the foot anterior to the lateral malleolus. The extensor digitorum longus is palpated on the dorsal aspect of the metatarsal bones of toes #2–5 or on the anterior aspect of the ankle joint lateral to the tendon of the extensor hallucis longus.</p>
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