NORTHERN ILLINOIS UNIVERSITY

Instructional Guidebook for Manual Muscle Testing

A Thesis Submitted to the

University Honors Program

In Partial Fulfillment of the

Requirements of the Baccalaureate Degree

With University Honors

Department of

Kinesiology and Physical Education

By

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DeKalb, Illinois

13 May 2005

University Honors Program

Capstone Approval Page

Capstone Title: (print or type):

Instructional Guidebook for Manual Muscle Testing

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Faculty Approval Signature:

Department of (print or type): Kinesiology and Physical Education

Date of Approval (print or type): 20 September 2005

HONORS THESIS ABSTRACT
THESIS SUBMISSION FORM

AUTHOR: Anna DiDonna

THESIS TITTLE: Instructional Guidebook to Manual Muscle Testing

ADVISOR: William A. Pitney, ATC, MSEd

ADVISOR'S DEPT: KNPE

DICIPLINE: Athletic Training

YEAR: Senior

PAGE LENGTH: 95

BIBLIOGRAPHY: No

ILLUSTRATED: No

PUBLISHED: No

LIST PUBLICATION: *N/A*

COPIES AVAILABLE: Hard copy and CD-rom

ABSTRACT:

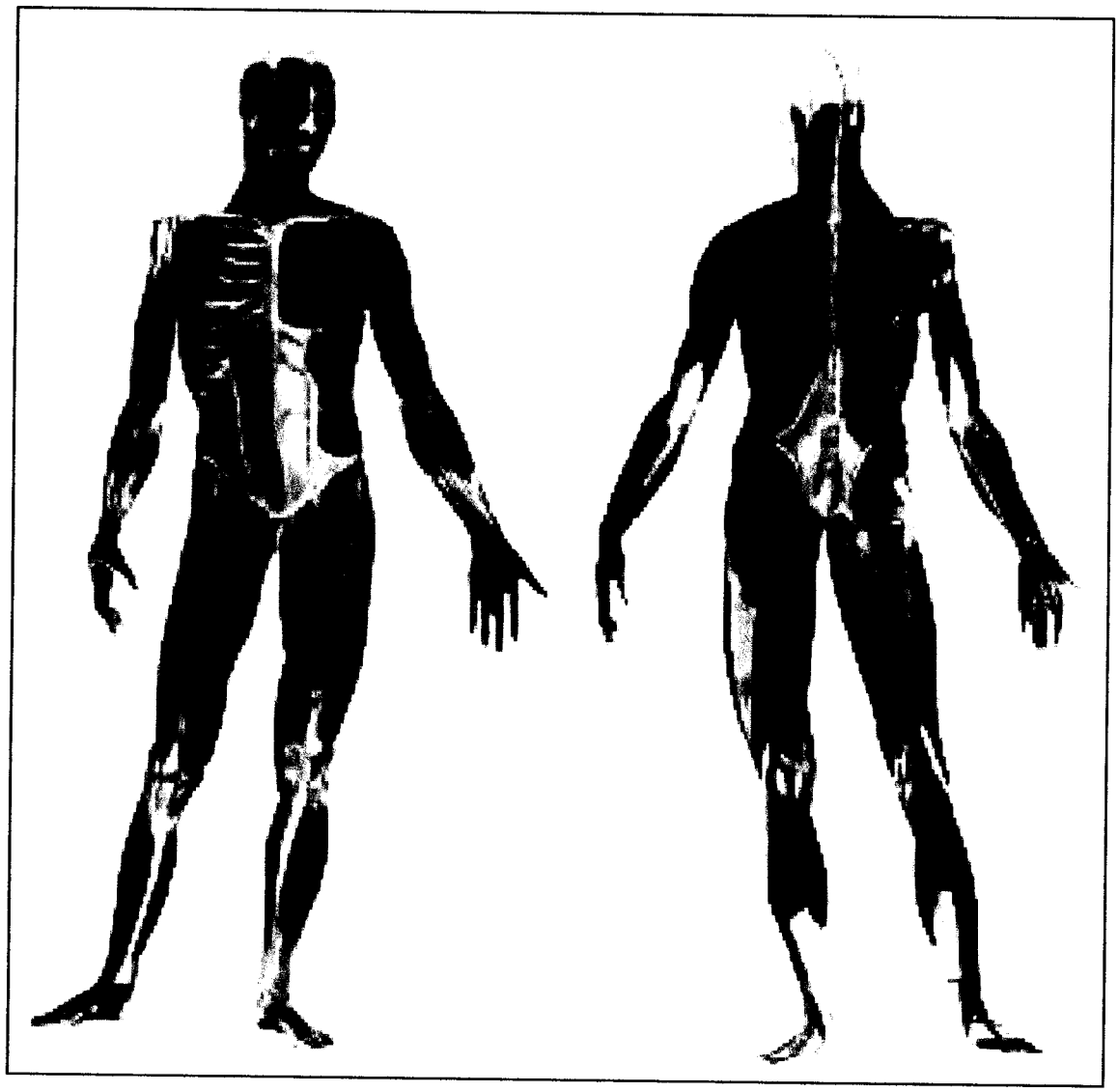
There was a need for more instruction on manual muscle testing in the KNPE department for athletic training majors. This is a manual designed to fulfill that need and aid the athletic training students in learning and performing manual muscle testing.

Manual muscle testing is an integral part of a complete physical assessment. It can be utilized in conditions of muscle weakness, muscle imbalance, determining muscle length and strength, and neuromuscular involvement. When the testing is done, a grade is given to each muscle that is tested in order to describe its function.

In order to assign the grade, one must perform the test. In this manual you fill find instructions on testing 44 different muscles found in the human body. The anatomy of the muscle can be found including the origin, insertion, action, and innervation. The testing technique will be listed, clinical pearls will follow, and a digital image is provided to help visualize the test.

Instructional Guidebook for Manual Muscle Testing

By Anna DiDonna



Contents

Manual Muscle Testing

Manual muscle testing is an integral part of a complete physical assessment. It can provide information not obtained through other procedures which can be helpful in "differential diagnosis, prognosis, and treatment of neuromuscular and musculoskeletal disorders" (Kendall, 2005, pA).

Manual muscle testing can be utilized in conditions with muscle weakness. Muscle weakness as a result of neuromuscular conditions can show definite patterns of muscle involvement or just spotty weakness with out any discernible pattern (Kendall, 2005, pA). Weakness in the muscles may be symmetrical or asymmetrical. By utilizing manual muscle testing, the examiner can define the muscle weakness thoroughly.

Muscle imbalances are another reason to include manual muscle testing in an assessment. Patterns of muscle imbalances often lead to musculoskeletal conditions. These patterns can range from handedness to habitually poor posture (Kendall, 2005, pA). This may be a result of recreational activities or occupational activities involving persistent use of certain muscles without use of opposing muscles. Muscular imbalances in postural muscles are an important factor in most painful postural conditions (Kendall, 2005, pA). Manual muscle testing is an excellent tool to determine the extent of imbalances.

When a practitioner is prescribing activities and exercises for clients it is necessary to determine muscle length and strength because most exercises are prescribed with the intentions of either stretching shortened muscles or strengthening weakened muscles (Kendall, 2005, pA). Muscle length testing determines if a muscle is too long and allows an excessive range of motion or if a muscle is too short and restricts normal range of motion. When stretching muscles, it is imperative for the examiner to check and be sure stability will not be compromised in attempts to achieve increased range of motion.

The capability of muscles or muscle groups to function in movement and to provide stability and support is determined by muscle strength (Kendall, 2005, p.5). Many factors can contribute to muscle weakness such as "nerve involvement, disuse atrophy, stretch weakness, pain, [and] fatigue" (Kendall, 2005, p.5). Each muscle in the body is a prime mover in some actions and a secondary in other actions. No muscle has the exact same action as another. Muscle tests are designed to isolate specific muscles by performing the actions only that muscle primarily performs in attempts to assess strength and other components as discusses earlier. It is because of the fact that muscle overlap in their functions, strict adherence to muscle testing techniques is required (Kendall, 2005, p.5).

The examiner should strictly adhere to muscle testing techniques and should also be proficient in the procedures. In order to be proficient, the examiner must possess the knowledge and skill of anatomy, muscle function, joint motion, palpation, and recognition of abnormalities (Kendall, 2005, p.5). Once the examiner is

proficient in these aspects they may go on to study and learn the techniques of manual muscle testing.

Kendall offers a basic step by step guide for strength testing as follows:

1. Place the subject in a position that offers the best fixation of the body as a whole (usually supine, prone, or side-lying)
2. Stabilize the part proximal to the tested part or, as in the case of the hand, adjacent to the tested part. Stabilization is necessary for specificity in testing
3. Place the part to be tested in precise antigravity test position, whenever appropriate, to help elicit the desired muscle action and aid in grading
4. Use test movements in the horizontal plane when testing muscles that are too weak to function against gravity. Use test movements in antigravity positions for most trunk muscle tests in which body weight offers sufficient resistance
5. Apply pressure directly opposite the line of pull of the muscle or the muscle segment being tested. Like the antigravity position, the direction of pressure helps to elicit the desired muscle action
6. Apply pressure gradually but not too slowly, allowing the subject to get set and hold. Apply uniform pressure; avoid localized pressure than can cause discomfort
7. Use a long lever whenever possible, unless contraindicated. The length of the lever is determined by the location of the pressure along the lever arm. Better discrimination of strength for purposes of grading is obtained through use of a long lever.
8. Use a short lever if the intervening muscles do not provide sufficient fixation for use of a long lever.

When manually testing muscle, the examiner assigns a grade to each muscle being tested. Each grade represents the examiners assessment of the muscle. There are different scales used by each practitioner but they are all essentially the same. Most scales range from 0 - 5 and each number is related to a word such as trace, fair, or normal. Cutter provides a table of a grading system in her manual and it follows as such:

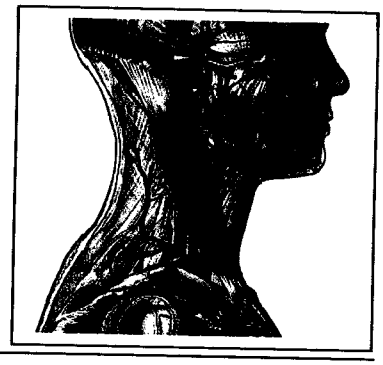
Grades	Terms	Description
5	Normal	Achieves full available range against gravity and able to maintain maximal resistance
4	Good	Achieves full available range against gravity and able to maintain moderate resistance
3	Fair	Achieves full available range against gravity only. Cannot maintain against resistance
2	Trace	A visible or palpable contraction with no significant muscle movement
1	Zero	No contraction seen or felt

When performing muscle testing any muscle graded above fair, the "pressure is applied in addition to the resistance offered by gravity" (Kendall, 2005, p.19). A test called a break test can be utilized in situations where grades of fair+ through good+ are warranted. A break test is "a muscle strength test to determine the maximal effort exerted by a subject who is performing an isometric contraction as the examiner applies a gradual buildup of pressure to the point that the effort by the

subject is overcome" (Kendall, 2005, p.19). It is not necessary to break the subjects hold if the examiner has determined the grade of 5 is appropriate, or in other words, the strength is normal.

In order to help maintain reliability between examiners, a description of each grade is given. A grade of normal means the subjects muscle can hold the test position against strong pressure. It can also be described as "strength that is adequate for ordinary functional activities" (Kendall, 2005, p.20). Good means the muscle can hold the position against moderate pressure generated by the examiner. Fair indicates the subjects muscle can hold the test position when only gravity is generating pressure. If the examiner were to apply any force, slight as it may be, the subjects muscle would fail to maintain the position. The grade poor can be more thorough by making it a poor - or a poor +. Poor - can be defined as "the ability to move through a partial arc of motion in the horizontal plane" (Kendall, 2005, p. 20). Poor + "denotes the ability to move in the horizontal plane to completion of the range of motion against resistance or to hold the completed position against pressure" (Kendall, 2005, p.20). Also it can mean the muscle is able to move through a partial arc of motion in the antigravity position. Poor would mean the muscle is simply capable of completing the range of motion in the horizontal plane. Trace would mean the examiner noticed a feeble contraction or the tendon slightly becomes prominent; however, the examiner does not notice any movement. . A grade of zero is simply put as "no evidence of any muscle contraction [was] visible or palpable" (Kendall, 2005, p.21).

Sternocleidomastoid



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ANATOMY

Origin

- Anterior and upper surfaces of the sternum
- Anterior and upper surfaces of the medial third of the clavicle

Insertion

- The mastoid process of the temporal bone

Action

- Flexion of the neck
- Lateral Flexion of the neck to the same side
- Rotation of the head to the opposite side on the trunk

Innervation

- Spinal Accessory Nerve (CN XI, communicates with Spinal N. C2-C4)

TESTING TECHNIQUE

Technique 1

- Subject stands with head and neck in neutral and relaxed
- Examiner places one hand on the side of the subjects head
- Subject rotates head
- Examiner provides resistance while subject rotates head back to neutral

Technique 2

- Subject lies supine with shoulders externally rotated and abducted to 90° and elbows flexed 90°
- Examiner places one hand on the subject's forehead
- Subject lifts the head off of the table
- Examiner attempts to push the subject's head back down while the subject holds the position

Special Considerations

N/A

CLINICAL PEARLS

- .:. Contracture of this muscle may cause a condition known as torticollis
- .:. It is possible, during contraction of the sternocleidomastoid, to increase cervical lordosis causing head extension relative to the cervical spine and cervical flexion relative to the thoracic spine

Anterior teltoid


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ANATOMY

Origin

- .:. Anterior border of the lateral third of the clavicle

Insertion

- .:. Deltoid Tuberosity (lateral side of the humerus near the midpoint)

Action

- .:. Flexion of the humerus
- .:. Horizontal flexion of the humerus from an abducted position
- .:. Internal rotation of the humerus
- .:. Shoulder scaption

Innervation

- .:. Axillary Nerve

TESTING TECHNIQUE

Technique 1

- .:. Subject sits with shoulder abducted to 90°, slightly flexed, and slight external rotation. The elbow is slightly flexed
- .:. Examiner places one hand on the subjects arm and the other stabilizes the scapula
- .:. Examiner applies pressure in the direction of adduction and slight extension
- .:. Subject resists the examiners pressure

Technique 2

- .:. Subject lies supine with shoulder abducted, slightly flexed, and internally rotated. The elbow is flexed
- .:. Examiner places one hand on the anterior aspect of the wrist and the other hand on the elbow
- .:. Examiner applies pressure in direction of adduction toward the side of the body
- .:. Subject resists the examiners application of pressure

Special Considerations

N/A

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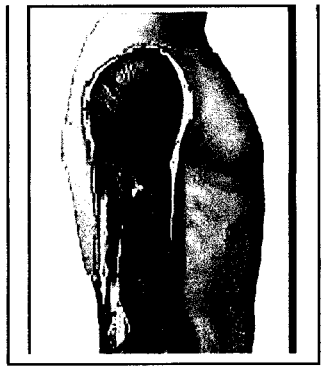

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ANATOMY

Origin
- .:. Lateral end of the clavicle
- .:. Acromion Process of the Scapula

Insertion
- .:. Deltoid Tuberosity (lateral side of the humerus near the midpoint)

Action
- .:. Abduction of the humerus

Innervation
- .:. Axillary Nerve

TESTING TECHNIQUE

Technique
- .:. Subject sits with arms abducted to 90° and elbows flexed to 90°
- .:. Tester places hands just proximal to the subject's elbow and applies a downward force
- .:. Subject holds the position resisting the examiners attempts to break them of it

Special Considerations
- .:. Do not allow external rotation of the humerus as it will bring in the biceps brachii leading to false results due to lack of middle deltoid isolation

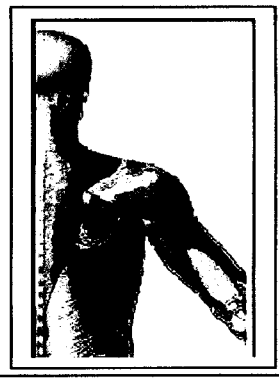
CLINICAL PEARLS

.:. Ipsilateral shoulder elevation or lateral flexion of the trunk to the opposite side may give the illusion of abduction

CLINICAL PEARLS

.:. Shoulder scaption is the position more frequently used for function than either forward flexion or abduction

Posterior ~toid



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ANATOMY

Origin
- .:. Inferior lip of the posterior border of the spine of the scapula

Insertion
- .:. Deltoid Tuberosity (lateral side of the humerus near the midpoint)

Action
- .:. Extension of the humerus
- .:. Adduction of the humerus from flexion
- .:. Horizontal extension of the humerus from flexion
- .:. External rotation of the humerus

Innervation
- .:. Axillary Nerve

TESTING TECHNIQUE

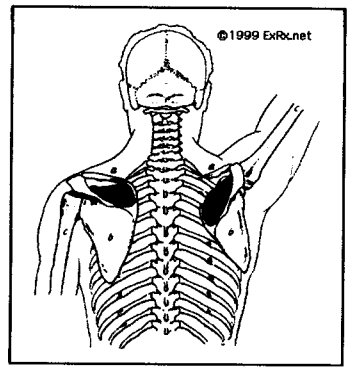
Technique
- .:. Subject sits with shoulder abducted to 90°, slightly extended, and internally rotated and the elbow flexed to 60°
- .:. Examiner places one hand on the subject's scapula and the other hand proximal to the elbow .
- •:. The subject is instructed to extend the shoulder against the examiners resistance

Special Considerations
- .:. The elbow needs to remain in flexion in order to isolate the posterior deltoid. If it is extended, the triceps brachii will substitute for the posterior deltoid and produce a false result

CLINICAL PEARLS

.:. If the subject has weak scapular musculature, it is necessary for the tester to stabilize the scapula to avoid scapular protraction

Supraspinatus



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ANATOMY

Origin

- Medial two thirds of the supraspinatus fossa of the scapula

Insertion

- Summit of the greater tubercle of the humerus

Action

- Abduction of the humerus

Innervation

- Suprascapular Nerve

TESTING TECHNIQUE

Technique 1

- Subject may sit or stand with arms resting comfortably by sides, head rotated ipsilaterally and extended, and shoulder abducted to 90°
- The examiner places one hand just proximal to the elbow
- The subject holds this position while the examiner tries to break him of it

Technique 2

- Subject stands or sits with arms resting comfortable by his sides
- Examiner palpates the Supraspinatus with one hand and places the other hand proximal to the elbow
- Subject is instructed to abduct the shoulder while the examiner palpates and provides resistance

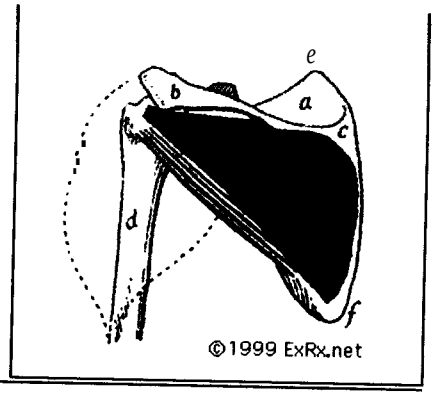
Special Considerations

- It is important for the tester to palpate the supraspinatus during testing to *see* if it is active as it shares its action with the middle deltoid
- Examiner must be sure external rotation is not allowed to occur as the biceps brachii may be substituting for the supraspinatus .
- Shoulder elevation, external rotation, or lateral flexion of the trunk need to be avoided as well to prevent false results as those movements mimic abduction

CLINICAL PEARLS

- .:. Stability of the shoulder joint will be decreased if a rupture of the supraspinatus tendon occurs
- .:. Shoulder impingement syndrome most often involves supraspinatus
- .:. Supraspinatus is one of four muscles that comprises the rotator cuff
- .:. The suprascapular nerve comes off of the upper trunk before any cords of the brachial plexus are formed

Infraspirntus



EXRx.net

ANATOMY

Origin

- Medial two thirds of the infraspinatus fossa

Insertion

- Posterior aspect of the middle of the greater tubercle of the humerus

Action

- External rotation of the humerus
- Horizontal extension of the humerus from flexion
- Depression and stabilization of the head of the humerus in the glenoid fossa during abduction by the deltoids

Innervation

- Suprascapular Nerve

TESTING TECHNIQUE

Technique

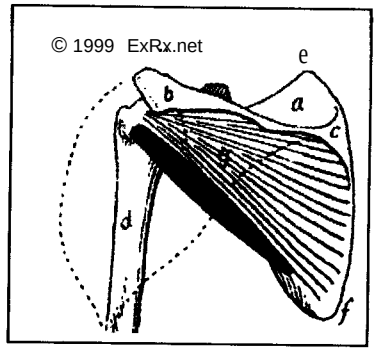
- Subject lies prone with shoulder abducted to 90° and elbow flexed to 900
- Examiner places one hand midway between the elbow and the wrist and the other hand supporting the scapula
- Subject is instructed to hold this position while the examiner provides resistance in attempts to break him out of it

Special Considerations

- If the infraspinatus is weak, supination may be mistaken for external rotation
- Examiner needs to apply the resistance gradually to avoid any injury should there be any instability of in the joint

CLINICAL PEARLS

- ∴ Infraspinatus is one of four muscles that make up the rotator cuff
- ∴ Infraspinatus and teres major are inseparable in muscle testing
- ∴ The suprascapular nerve comes off of the upper trunk before any cords of the brachial plexus are formed



TeresMror

ANATOMY

Origin

- .:. Posterior surface of the lateral border of the scapula

Insertion

- .:. Posterior surface of the lower part of the greater tubercle
- .:. Adjacent posterior surface of the upper part of the shaft of the humerus

Action

- .:. External rotation of the humerus
- .:. Adduction of the humerus
- .:. Stabilization of the humerus in the glenoid fossa

Innervation

- .:. Axillary Nerve

TESTING TECHNIQUE

Technique

- .:. Subject lies prone with shoulder abducted to 90° and elbow flexed to 90°
- .:. Examiner places one hand midway between the elbow and the wrist and the other hand supporting the scapula
- .:. Subject is instructed to hold this position while the examiner provides resistance in attempts to break him out of it

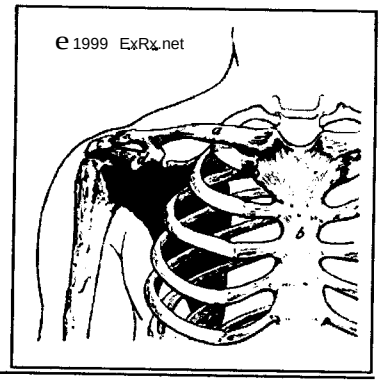
Special Considerations

- .:. If the teres minor is weak, the subject may supinate instead of externally rotate
- .:. If there is instability in the shoulder, resistance should be given gradually and slowly to avoid any secondary injury

CLINICAL PEARLS

- .:. Teres minor is one of four rotator cuff muscles
- .:. Teres minor forms the superior border of the quadrilateral space
- .:. Teres minor and Infraspinatus are virtually inseparable in muscle testing

5bscapularis



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ANATOMY

Origin

- Subscapular fossa (anterior surface of the scapula)

Insertion

- Lesser tubercle of the humerus

Action

- Internal rotation of the humerus
- Horizontal adduction of the humerus from an abducted position
- Stabilization and depression of the head of the humerus in the glenoid fossa

Innervation

- Subscapular Nerve

TESTING TECHNIQUE

Technique

- Subject lies supine with the shoulder abducted to 90° and elbow flexed to 90°
- Examiner places on hand on the scapula to stabilize and the other hand on the forearm .
- The subject internally rotates the humerus against the testers resistance

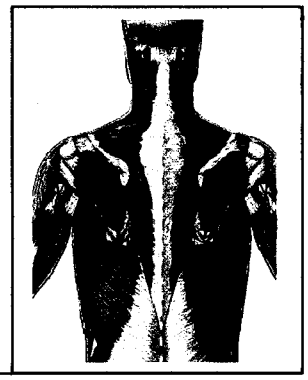
Special Considerations

- The subject may attempt to substitute by pronating the forearm, this movement can be mistaken for internal rotation

CLINICAL PEARLS

- .:. Internal rotation of the shoulder is a stronger movement than external rotation due to greater muscle mass
- .:. By depressing the humerus, the Subscapularis keeps the humeral head in the glenoid fossa
- .:. Subscapularis is one of four rotator cuff muscles
- .:. In combination with the scapula, the Subscapularis forms the posterior wall of the axilla
- .:. This muscle is very difficult to isolate from the other very strong internal rotators

Lpper Trapezils



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ANATOMY

Origin
- External occipital protuberance
- Medial third of superior nuchal line of occipital bone
- Upper part of ligamentum nuchae
- C7 vertebrae spinous process

Insertion
- Distal one third of the posterior border of the clavicle
- Acromion process

Action
- Elevation of the scapula
- Retraction of the scapula
- Rotation of the head to the opposite side
- lateral flexion of the head to the same side

Innervation
- Spinal Accessory Nerve (CN XI)

TESTING TECHNIQUE

Technique
- Subject sits with arms relaxed at sides
- Examiner places one hand on the subject's occiput and the other hand on the subjects shoulder
- Subject is instructed to raise shoulders as high as possible, extend the neck and rotate the occiput towards the shoulder being tested in attempts to bring the shoulder up to the occiput
- The Examiner provides resistance as the subject is performing this action

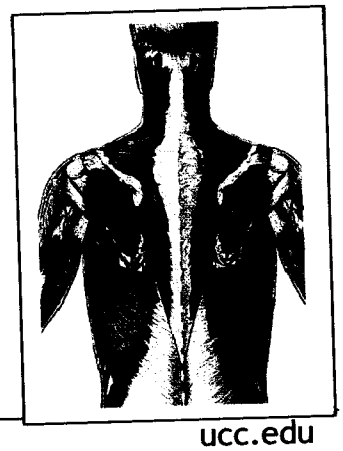
Special Considerations

N/A

CLINICAL PEARLS

- .:. Weakness of the trapezius secondary to spinal accessory nerve compromise often results in a winged scapula
- .:. Scapular elevation may be limited if there is tension in the costoclavicular ligament
- .:. If torticollis is present, unilateral contracture is often observed
- .:. Weakness interferes with the ability to abduct and flex the humerus above shoulder level
- .:. Trigger potnts are commonly found in this muscle

Mddle Trapezius



ANATOMY

Origin
- .:. Inferior ligamentum nuchae
- .:. Spinous process of C7 and superior thoracic vertebrae

Insertion
- .:. Medial margin of the Acromion process
- .:. Superior lip of the posterior border of the spine of the scapula

Action
- .:. Retraction of the scapula

Innervation
- .:. Spinal Accessory Nerve (CN XI)

TESTING TECHNIQUE

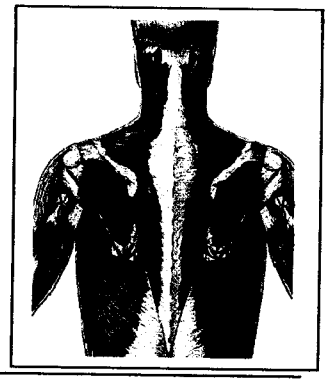
Technique
- .:. Subject lies prone with elbow extended, shoulder abducted'to 90° and externally rotated
- .:. The subjects palm will be facing superiorly and the shoulder girdle should be in neutral, not elevated
- .:. Examiner places one hand on the subjects forearm and uses the other to stabilize the scapula
- .:. Subject is instructed to push against the examiners hand while the examiner provides resistance

Special Considerations
- .:. If the subject does not externally rotate his shoulder, the middle trapezius is not being isolated

CLINICAL PEARLS

.:. *See* clinical pearls of the upper trapezius

lcMer' Trapezius



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ANATOMY

Origin

- .:. Spinous processes of T7 through T12 and their corresponding supraspinal ligament

Insertion

- .:. Medial aspect of the spine of the scapula

Action

- .:. Depression of the scapula
- .:. Retraction of the scapula
- .:. Upward rotation of the scapula

Innervation

- .:. Spinal Accessory Nerve (CN IX)

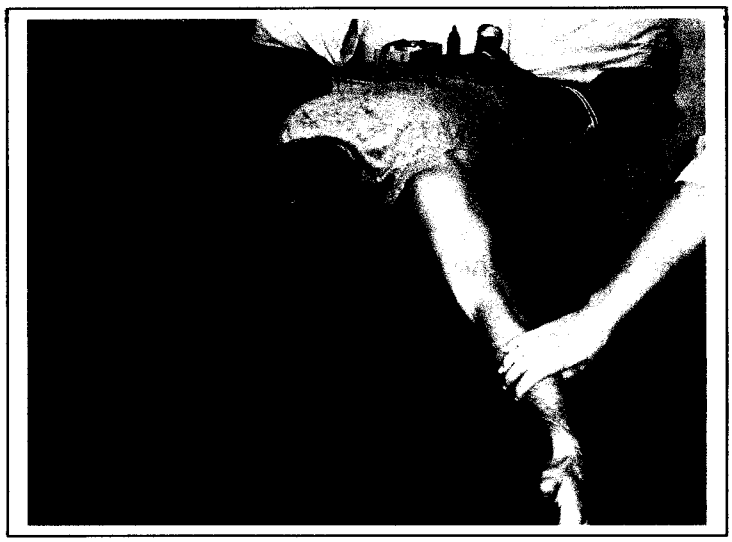
TESTING TECHNIQUE

Technique

- .:. Subject lies prone with shoulder held diagonally overhead and externally rotated
- .:. Examiner places one had on the subjects forearm and the other stabilizing the scapula
- .:. The subject is instructed to push up against the examiners resistance

Special Considerations

N/A



CLINICAL PEARLS

.:. See clinical pearls for upper trapezius

latissims lJJrsi

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ANATOMY

Origin

- .:. Lower three ribs
- .:. Spinous process of lower six thoracic vertebrae
- .:. All five lumbar vertebrae
- .:. Posterior surface of sacrum
- .:. Crest of the ilium

Insertion

- .:. Intertubercular sulcus of the humerus

Action

- .:. Extension of the humerus
- .:. Internal rotation of the humerus
- .:. Adduction of the humerus from an abducted position

Innervation

- .:. Thoracodorsal Nerve

TESTING TECHNIQUE

Technique

- .:. Patient lies prone with shoulders internally rotated and adducted with the palm facing posteriorly
- .:. The tester stabilizes the thorax with one hand and places the other hand on the upper arm
- .:. The subject extends his arm against the testers resistance

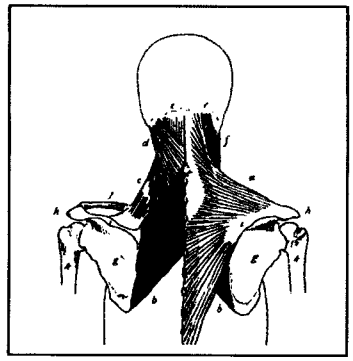
Special Consideration

- .:. Do not allow the subject to flex the thoracic spine or abduct the shoulder

CLINICAL PEARLS

- Latissimus dorsi is very important in crutch walking or any activity that pulls the body toward the arm such as rock climbing, pulling up on parallel bars, etc
- Latissimus dorsi is also a major source of power for swimming, rowing, and chopping movements
- A shortened latissimus dorsi may result in limitation of elevation if flexion or abduction. This is apparent in scoliosis, kyphosis, or long time crutch users.
- The latissimus dorsi is also active in strong expiration (coughing and sneezing) and deep inspiration

Rhomboid Major and Minor



ANATOMY

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Origin

Major

- Spinous process of T2 through T5

Minor

- Ligamentum nuchae
- Spinous processes of C7 through T1

Insertion

Major

- Medial border of the scapula between the spine of the scapula and the inferior border

Minor

- Medial border at the root of the scapula

Action

- Retraction of the scapula
- Elevation of the scapula
- Downward rotation of the scapula

Innervation

- Dorsal Scapular Nerve

TESTING TECHNIQUE

Patient Position

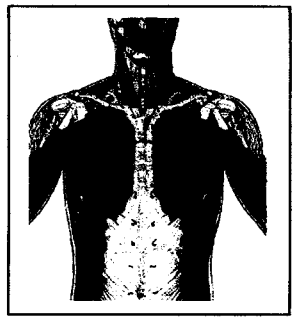
- Subject lies prone with shoulders adducted, slightly extended and externally rotated, elbows flexed to 90°, and head turned towards the side being tested
- Examiner places one hand on the subjects medial elbow and the other hand on the superior aspect of the subjects shoulder
- Examiner attempts to abduct the subjects scapula and laterally rotate the inferior angle of the scapula
- Examiner also presses inferiorly on the subjects shoulder
- Subject contracts the muscle in attempts to keep the arm in the starting position

Special Consideration

- The patient should not be allowed to force the head of the humerus downward against the table in attempt to lift the arms. The arm and scapula should move together

CLINICAL PEARLS

- .:. Strength of adduction and extension of the humerus is diminished by loss of rhomboid fixation of the scapula. Ordinary function of the arm is affected less by loss of rhomboids than by loss of either trapezius or serratus anterior
- .:. Medial winging may result in weakness of this muscle
- .:. The dorsal scapular nerve comes directly off the cervical nerve roots and not the brachial plexus



Pectoralis Major

ANATOMY

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Origin

Clavicular

- Anterior surface of the medial two thirds of the clavicle

Sternal

- Anterior surface of the whole length of the sternum
- Costal cartilage of the upper six ribs

Insertion

Clavicular

- Crest of the greater tubercle of the humerus

Sternal

- Crest of the greater tubercle of the humerus

Action

Clavicular

- Flexion of the humerus
- Internal rotation of the humerus

Sternal

- Depresses the shoulder girdle
- Adducts the humerus toward the opposite iliac crest

Innervation

Clavicular

- Lateral Pectoral Nerve

Sternal

- Medial Pectoral Nerve

TESTING TECHNIQUE

Technique *Clavicular*

- Subject lies supine with shoulders in 60° to 90° of abduction with elbow flexion
- Examiner places one hand on each of the subjects arms
- Subject is instructed to horizontally adduct the shoulders against the examiners resistance

Technique *Sternal*

- Subject lies supine with shoulder in 120° abduction and elbow flexion
- Examiner places one hand just proximal to the subjects elbow
- Subject is instructed to bring arm down and across their body against the examiners resistance

Special Considerations

- If the elbow flexors are weak, provide resistance proximal to the elbow

Clavicular

Sternal

CLINICAL PEARLS

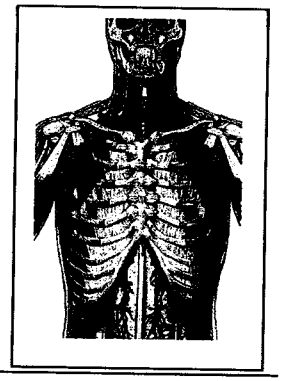
Clavicular

- .:. This muscle is important in crutch walking and ambulation in parallel bars
- .:. This muscle can be ruptured in arm wresting by a sudden forceful medial rotation and adduction of the shoulder
- .:. If this muscle is weakened, the subject may not be able to touch the opposite shoulder

Sternal

- .:. This muscle is important in crutch walking and ambulation in parallel bars
- .:. If this muscle is weakened, chopping or striking movements will be difficult
- .:. If this muscle is weakened, it will be difficult to hold any large or heavy objects in both hands at or near waist level
- .:. This muscle forms the anterior wall of the axilla
- .:. Absence of this portion of the pectoralis major results in no significant disability but the anterior axillary fold is absent and the nipple is lower

Pectoralis Mror



ucc.edu

ANATOMY

Origin

- .:. Superior margins of ribs three through five along the outer surface lateral to the costal cartilage

Insertion

- .:. Coracoid Process of the scapula

Action

- .:. Protraction of the scapula
- .:. Depression of the scapula
- .:. Downward rotation of the scapula

Innervation

- .:. Medial Pectoral Nerve

TESTING TECHNIQUE

Technique

- .:. Subject lies supine with arms resting at their side
- .:. Tester places hands on the subject's shoulder anteriorly, applying force
- .:. Subject protracts the scapulas, lifting their shoulders off of the table

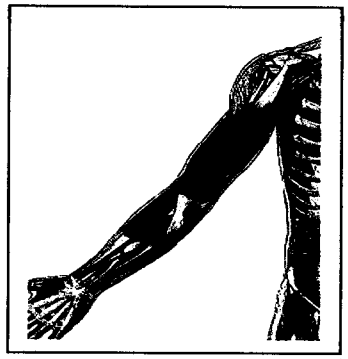
Special Consideration

- .:. Do not allow the patient to exert downward pressure on the hand to force the shoulder forward. It is essential to keep the elbow and hand off the table while testing

CLINICAL PEARLS

- .:. If pectoralis minor is weak arm extension may be weak due to decreased stability
- .:. If pectoralis minor is tight, arm pain may result secondary to impingement on the cords of the brachial plexus or axillary vessels (thoracic outlet syndrome)
- .:. A contracture may result in decreased shoulder flexion
- .:. The pectoralis minor forms the anterior wall of the axilla
- .:. The pectoralis minor can act as a shoulder protractor
- .:. The lateral pectoral nerve may innervate this muscle but it is rare

Biceps Brachii



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ANATOMY

Origin

Long Head

- Supraglenoid tubercle of the scapula

Short Head

- Coracoid process of the scapula

Insertion

- Radial tuberosity

Action

- Flexion of the forearm
- Supination of forearm

Innervation

- Musculocutaneous Nerve

TESTING TECHNIQUE

Technique

- Subject sits with arm resting at the side
- Examiner stabilizes the subjects shoulder with one hand and places the other hand on the anterior aspect of the subjects forearm
- Subject is instructed to flex the forearm while examiner applies resistance

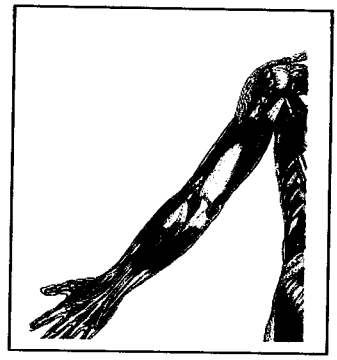
Special Considerations

- The tester should instruct the subject to keep the wrist flexors relaxed as they may assist in flexion of the forearm

CLINICAL PEARLS

- If the subject has a musculocutaneous nerve lesion, the forearm will pronate as it flexes because of the relatively unopposed activity of the brachioradialis muscle
- If the subject has a rupture of the long head of the biceps brachii which can be associated with increased age and lifting, a deformity known as "Popeye" muscle may be observed •
- Chin-ups with the forearms pronated are usually more difficult due to a mechanical disadvantage of the biceps brachii

Triceps Brachii



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ANATOMY

Origin

Long Head

.:. Infraglenoid tubercle of the scapula

Lateral Head

.:. Posterior surface of the upper one half of the humerus

Medial Head

.:. Posterior surface of the lower two thirds of the humerus

Insertion

.:. Olecranon Process of the ulna

Action

.:. Extension of the forearm

Innervation

.:. Radial Nerve

TESTING TECHNIQUE

Technique 1

.:. Subject lies prone with shoulder abducted to 90^{o} and elbow extended but not locked out

.:. Examiner places one hand on the subjects forearm and one hand stabilizing the scapula

.:. Subject is instructed to hold the position while the examiner applies a force

Technique 2

.:. Subject lies supine with should abducted to 180^{o} and elbow extended but not locked out

.:. Examiner places one hand on the subjects forearm and one hand stabilizing the scapula

.:. Subject is instructed to hold the position while the examiner applies a force

Technique 3

.:. Subject sits with shoulder abducted to 180^{o} and elbow extended but not locked out

.:. Examiner places one hand on the subjects forearm and one hand stabilizing the scapula

.:. Subject is instructed to hold the position while the examiner applies a force

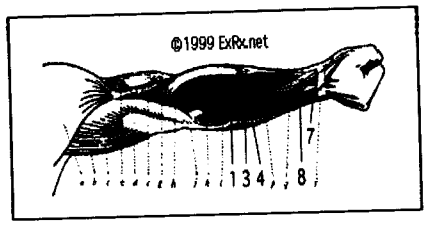
Special Considerations

.:. *Nt* A

CLINICAL PEARLS

- Shoulder external rotation or horizontal adduction may act a substitute for a weakened triceps brachii
- The radial nerve is often injured when a fracture of the proximal humerus occurs. However, the supply to the triceps brachii is often unharmed because it is located proximal. In these cases, the distal muscles that are innervated by the radial nerve are the only affected muscles.
- During transfers, substitution of elbow extension can come by putting the arm in a closed chain position and flexing the shoulder to lock out the elbow. This way, patients with absent triceps brachii function may still be able to transfer

Extemr Cgrpi Pmalis Laq.!S & Brevis



ANATOMY

ExRx.net

Origin

Longus

- Lower one third of the lateral supracondylar ridge of the humerus
- Lateral epicondyle of the humerus

Brevis

- Lateral epicondyle of the humerus

Insertion

Longus

- Posterior surface of the base of the 2nd metacarpal

Brevis

- Posterior surface of the base of the 3rd metacarpal

Action

- Extension of the hand
- Radial deviation of the hand

Innervation

- Radial Nerve

TESTING TECHNIQUE

Technique

- Subject sits or lies supine with forearm just short of full pronation
- Examiner uses one hand to stabilize the arm and places the other arm on the posterior aspect of the hand
- Examiner palpates at the base of the 2nd metacarpal to test longus and the base of the 3rd metacarpal to test Brevis
- Subject extends and radially deviates hand against examiners resistance

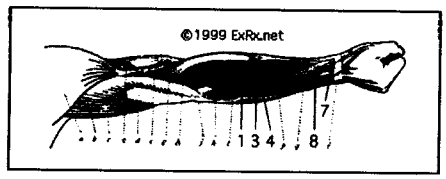
Special Consideration

- Nt A

CLINICAL PEARLS

- .:. It is easy to palpate the insertion of the extensor carpi radialis longus at the 2nd metacarpal bone
- .:. It is easy to palpate the insertion of the extensor carpi radialis brevis at the 3rd metacarpal bone
- .:. The fingers will naturally, passively flex during wrist extension however, if extension of the fingers is noted it may be in substitution for weak wrist extensors
- .:. The natural, passive finger flexion will occur during wrist extension via tenodesis action

Extensor Carpi Umris



ANATOMY

ExRx.net

Origin

- Lateral epicondyle of the humerus
- Middle one third of the narrow ridge of the posterior border of the ulna

Insertion

- Posterior surface of the base of the 5th metacarpal

Action

- Extension of the hand
- Ulnar deviation

Innervation

- Radial Nerve

TESTING TECHNIQUE

Technique

- Subject may sit or lay supine with forearm completely pronated
- Examiner stabilizes the arm with one hand places the other hand on the posterior aspect of the subject's hand
- Subject extends and ulnarly deviates the wrist against the testers resistance

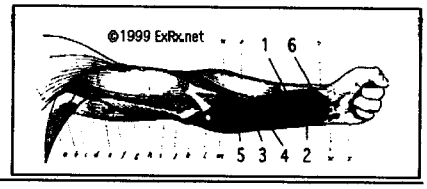
Special Consideration

- *Nt* A

CLINICAL PEARLS

- .:. The fingers will naturally, passively flex during wrist extension however, if extension of the fingers is noted it may be in substitution for weak wrist extensors
- .:. The natural, passive finger flexion will occur during wrist extension via tenodesis action

Aexor Carpi Radialis



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ANATOMY

Origin

- Medial epicondyle of the humerus

Insertion

- Anterior surface of the base of the 2nd and 3rd metacarpals

Action

- Flexion of the hand
- Radial deviation of the hand

Innervation

- Median Nerve

TESTING TECHNIQUE

Technique

- Subject may sit or lie supine with forearm completely supinated
- Tester stands in front or to the side of the subject and places one hand on the anterior aspect of the subjects hand and uses the other hand to support the patients forearm
- Subject is instructed to flex and radial deviate the hand against the examiners resistance

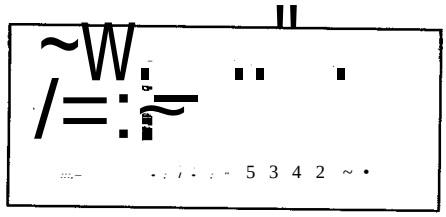
Special Considerations

- Nt A

CLINICAL PEARLS

- The median nerve may be found in the wrist between the tendon of this muscle and that of the palmaris longus

Aexor Carpi Umris



ANATOMY

Origin

- Medial epicondyle of the humerus
- Medial margin of the Olecranon process

Insertion

- Anterior surface of the pisiform bone
- Base of the 5th metacarpal
- Hamate bone

Action

- Flexion of the hand
- Ulnar deviation of the hand

Innervation

- Ulnar Nerve

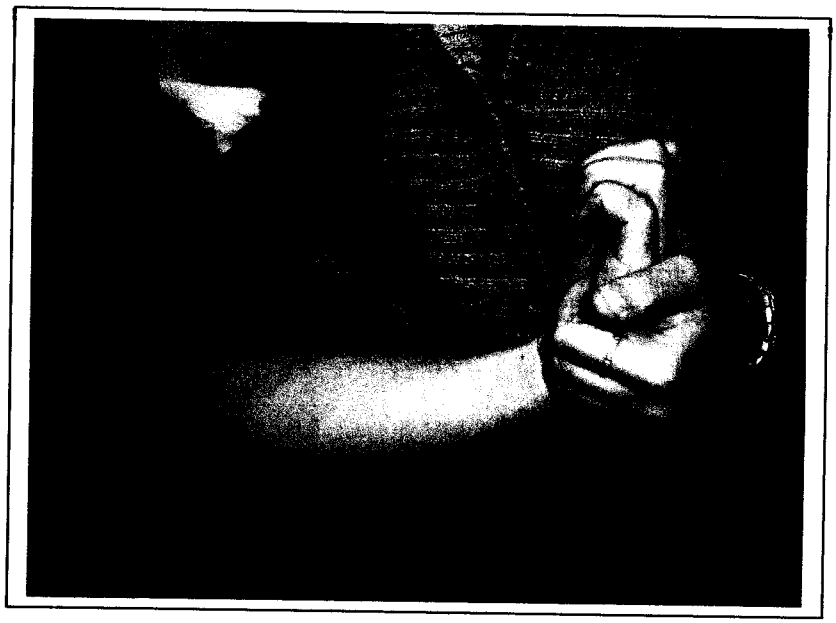
TESTING TECHNIQUE

Technique

- Subject sits or lies supine with forearm supported
- Examiner stabilizes the wrist and puts the other hand on the palm of the subject's hand
- Subject flexes and ulnarly deviates the wrist against the testers resistance

Special Considerations

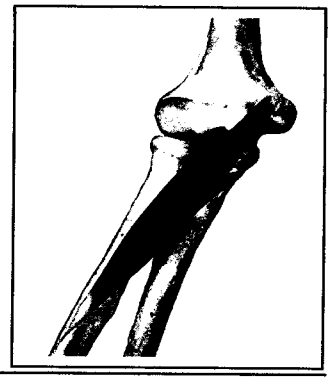
- N/A



CLINICAL PEARLS

.:. Several branches of the ulnar nerve supply this muscle at or distal to the medial epicondyle of the elbow. If cubital tunnel syndrome is observed, this muscle is usually spared.

Pronator Teres



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ANATOMY

Origin

- Medial epicondyle of the humerus
- Medial side of the coronoid process of the ulna

Insertion

- Lateral surface of the radius near its middle

Action

- Pronation of the forearm
- Flexion of the forearm at the elbow

Innervation

- Median Nerve

TESTING TECHNIQUE

Technique

- Subject may sit or lie supine with the elbow flexed to approximately 60° and the forearm supinated
- The examiner stabilizes the subjects elbow against the thorax
- Examiner instructs the subject to pronate their forearm against the examiners resistance

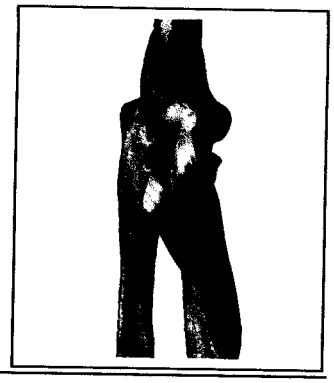
Special Considerations

- If the elbow is not flexed to 60° the pronator teres is put at a mechanical disadvantage and will not be isolated properly

CLINICAL PEARLS

- The pressure needs to be placed proximal to the wrist and the elbow needs to be flexed to 60° in order to properly differentiate the functions of pronator teres from pronator quadratus

5f>irntor



red. washington.edu

ANATOMY

Origin

- .:. Supinator Crest of the ulna
- .:. Lateral epicondyle of the humerus
- .:. Radial collateral and Annular ligaments

Insertion

- .:. Lateral surface of the upper one third of the radius

Action

- .:. Supination of the forearm

Innervation

- .:. Radial Nerve

TESTING TECHNIQUE

Technique 1

- .:. Subject sits or stands with elbow and shoulder in extension
- .:. Examiner places one hand at the elbow and one hand at the wrist
- .:. Examiner attempts to pronate the subjects forearm
- .:. Subject resists this attempt

Special Considerations

- .:. Subject may attempt to substitute by externally rotating the humerus so it appears that wrist holds supination

Technique 2

- .:. Subject lies supine with shoulder flexed and elbow completely flexed
- .:. Examiner places one hand on the forearm and the other hand on the elbow
- .:. Examiner attempts to pronate the subjects forearm while the subject resists

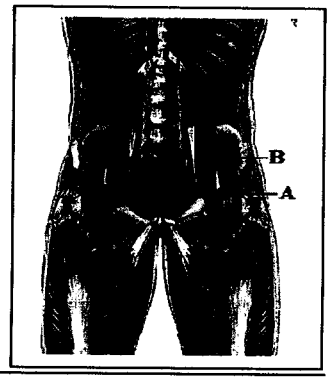
Special Considerations

- .:. Examiner should take care to avoid applying maximum pressure to avoid a muscle cramp in the biceps from coming on

CLINICAL PEARLS

- ∴ If the supinator is weak, the test position cannot be held
- ∴ In "supinator syndrome," it is technically possible that the supinator muscle will be normal in electrodiagnosis and manual muscle testing, as the radial nerve often sends branches to this muscle prior to diving into the arcade of Frohse

Iliopsoas



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ANATOMY

Origin

Iliacus

- Inner surface of the ilium
- Internal lip of the iliac crest
- Iliolumbar ligaments
- Ventral sacroiliac ligaments
- Ala of sacrum

Psoas

- Anterolateral aspect of T12-L5 vertebral bodies
- Transverse processes of T12-L5

Insertion

- Common insertion on and just distal to the lesser trochanter of the femur

Action

- Hip flexion
- Hip external rotation
- Hip adduction

Innervation

Iliacus

- Femoral Nerve

Psoas

- Ventral rami of L2-L4

TESTING TECHNIQUE

Technique 1

- Subject lies supine with knee extended and hip slightly abducted
- Examiner stabilizes the hip with one hand and places the other hand proximal to the subjects knee
- Subject is instructed to flex the hip against the examiners resistance

Technique 2

- Subject sits with knee flexed
- Examiner stabilizes the hip with one hand and places the other hand proximal to the subjects knee
- Subject is instructed to flex the hip against the examiners resistance

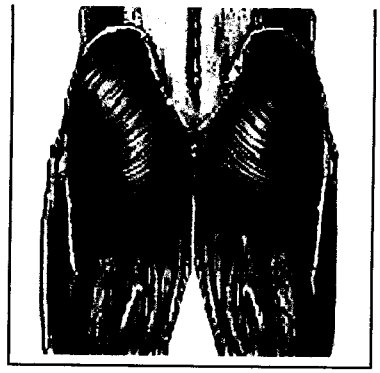
Special Considerations

- The examiner need to make sure the subject is not allowed to externally rotate the femur which would cause the adductors to fire

CLINICAL PEARLS

- Lesions in the retroperitoneal space may contribute to clinical weakness in this muscle
- Iliopsoas is the most powerful hip flexor

Gluteus Maximus



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ANATOMY

Origin

- Posterior one fourth of the crest of the ilium
- Posterior surface of the sacrum near the ilium
- Lateral side of coccyx bones

Insertion

- Gluteal line of the femur between the greater trochanter and linea aspera
- Iliotibial band of the fascia latae

Action

- Extension
- Abduction
- Outward rotation

Innervation

- Gluteal Nerve

TESTING TECHNIQUE

Technique

- Subject lies prone with knee flexed to at least 90°
- Examiner places one hand on the distal thigh and another hand stabilizing the subjects hip
- Examiner instructs the subject to extend the thigh against the examiners resistance

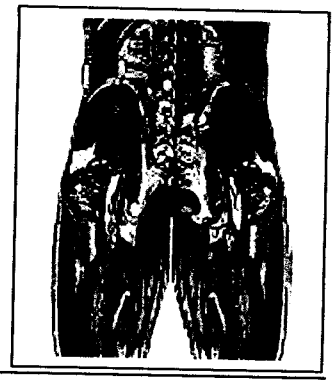
Special Considerations

- In order to eliminate hamstring involvement and completely isolate the gluteus maximus the knee must be flexed to at least 90°

CLINICAL PEARLS

- This muscle is the power extensor of the hip and it is activated during such activities as stair climbing or standing from a squatted position, but not as much during normal gait .
- The characteristic lurching "gluteus maximus gait" may develop if this muscle is severely weakened

Gluteus Medius



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ANATOMY

Origin

- Outer surface of the ilium below the crest

Insertion

- Oblique ridge on the lateral surface of the greater trochanter of the femur

Action

- Abduction
- Inward rotation

Innervation

- Gluteal Nerve

TESTING TECHNIQUE

Technique

- Subject lies on the unaffected side with hip in slight extension and external rotation
- Examiner places one hand on the proximal lower leg and the other stabilizing the hip
- Examiner instructs the subject to abduct the leg against the examiners resistance

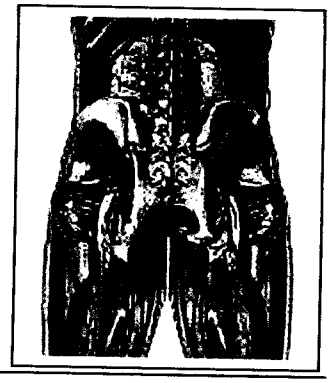
Special Consideration

- The leg should not be allowed to flex because it will cause the hip flexors to fire which is an inappropriate substitution

CLINICAL PEARLS

- In the posterolateral surgical approach for a total hip arthroplasty, this muscle is cut and reflected back in the posterolateral surgical approach
- Trendelenburg gait pattern can be caused by weakness in this muscle and gluteus minimus
- In an open chain action, other muscles can abduct the femur, but only the gluteus medius and minimus can stabilize the pelvis in a closed chain action
- Although this muscle has the potential to be active in flexion and internal rotation, electromyographic data has shown it is only active in extension and external rotation

Gluteus Mnirrus



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ANATOMY

Origin

- .:. Outer surface of the lower part of the ilium below he origin of the gluteus medius

Insertion

- .:. Uppermost part of the anterior surface of the greater trochanter of the femur

Action

- .:. Internal rotation of the femur
- .:. Abduction of the femur

Innervation

- .:. Gluteal Nerve

TESTINGTECHNIQUE

Technique

- .:. Subject lies on the contralateral side
- .:. Examiner places one hand on the lower leg and the other hand on the hips
- .:. Subject abducts the leg avoiding rotation, flexion, and extension
- .:. Examiner resists the subjects action

Special Considerations

- .:. The hips should be in a neutral position to test this muscle

CLINICAL PEARLS

- This muscle is cut and reflected back in the posterolateral surgical approach for total hip arthroplasty
- A Trendelenburg gait pattern is caused from a weak gluteus minimus
- Sartorius, obterator internus, upper portion of gluteus maximus all can abduct the leg in an open chain action but only gluteus medius and minimus can stabilize the pelvis in a closed chain action
- Gluteus minimus has been shown to be active in flexion and internal rotation but not in extension and external rotation by electromyographic data although it potentially has those actions
- If the tester applies pressure in slight extension it helps to differentiate this muscle from the gluteus medius

Tensor Fascia Lata

ExRx.net

ANATOMY

Origin

- Lateral surface of the anterior-superior iliac spine
- Anterior one fourth of the lateral lip of the iliac crest

Insertion

- Iliotibial band of the fascia latae one fourth of the way down on the anterior-lateral side of the thigh

Action

- Flexion of the femur
- Abduction of the femur
- Internal rotation of the femur

Innervation

- Gluteal Nerve

TESTING TECHNIQUE

Technique

- Subject lays supine with knee extended
- Examiner places a hand on the lower leg
- Subject flexes, internally rotates, and abducts the leg while the examiner generates force in the opposite direction

Special Consideration

- *N/A*

CLINICAL PEARLS

- .:. Anterior pelvic tilt as well as possibLegenu valgum can be a result of bilaterally tight tensor fascia lata muscles
- .:. Unilateral tightness of the tensor fascia lata can cause a laterally tilted pelvis and ipsilateral genu valgum
- .:. The tensor fascial lata is a two joint muscle

Gracilis

ExRx.net

ANATOMY

Origin

- Outer surface of inferior ramus of pubis and the ramus of the ischium

Insertion

- Medial surface of the tibia below the medial condyle

Action

- Adduction of the femur
- Internal rotation of the femur
- Flexion of the femur

Innervation

- Obturator Nerve

TESTING TECHNIQUE

Technique

- Subject lies on the ipsilateral side
- Examiner supports the top leg with one hand and place the other hand on the bottom leg at the knee
- Subject adducts the bottom leg while the examiner provides resistance

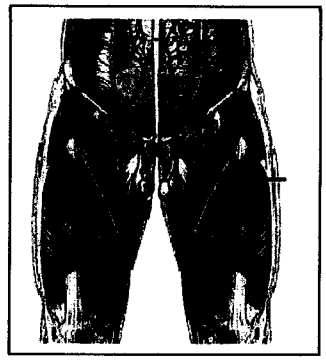
Special Considerations

- The examiner needs to be sure the subjects pelvis does not roll forward allowing the patient to substitute with the gluteus maximus .
- Flexion at the hip or anterior tilt of the pelvis allows substitution by the hip flexors

CLINICAL PEARLS

- .:. In testing the adductor group, when the muscle grade is 0 to 2, the patient should be supine and attempt to adduct the hip with no assistance or resistance by the examiner. Naturally, rotation must be avoided
- .:. The hip adductors are tested as a group. Individual muscles cannot be isolated

Sartorius



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ANATOMY

Origin
- Anterior superior iliac spine
- Upper one half of the notch below the anterior superior iliac spine

Insertion
- Iliotibial band of the fascia latae one fourth of the way down on the anterior lateral side of the thigh

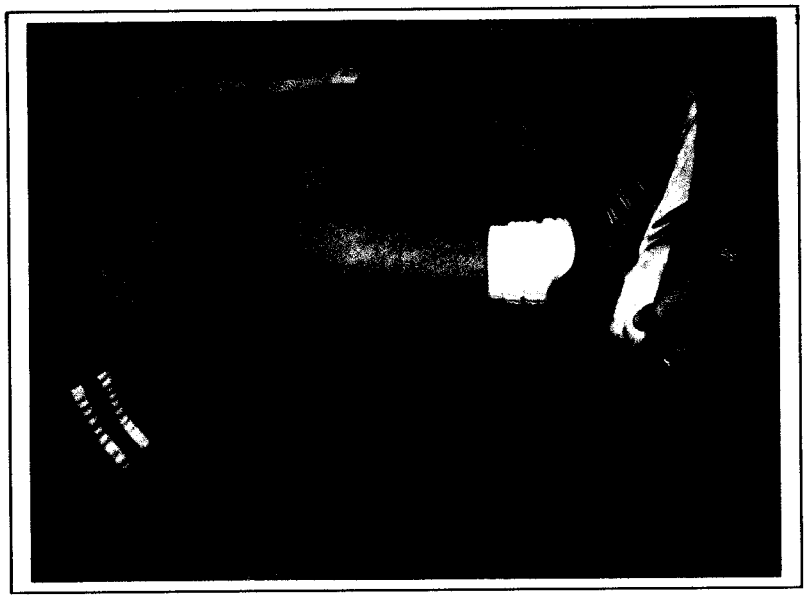
Action
- Flexion of the femur
- Abduction of the femur
- Internal rotation of the femur

Innervation
- Gluteal Nerve

TESTING TECHNIQUE

Technique
- Subject lies supine
- Examiner places one hand on the lateral, distal femur and the other hand on the posterior aspect of the calcaneus
- Subject puts the leg into a faber position which means flexion of the hip and knee, abduction of the hip, and external rotation so the legs makes a "4"
- Examiner provides resistance to this motion

Special Considerations
- The examiner must be sure to provide combined resistance moment to test the multiple actions of the Sartorius. It is a weak muscle with a large range of actions that other lower leg muscles can duplicate. Isolated Sartorius testing can be technically difficult



CLINICAL PEARLS

- ∴ The Sartorius is nicknamed the tailors muscle because it helps initiate the action of crossing the legs
- ∴ Sartorius is a two joint muscle

Adductor Muscles

ucc.edu

ANATOMY

Origin
- Inferior ramus of the pubis
- Ramus of the ischium
- Ischial tuberosity

Insertion
- Whole length of the linea aspera
- Medial supracondylar line
- Adductor tubercle of the medial condyle of the femur

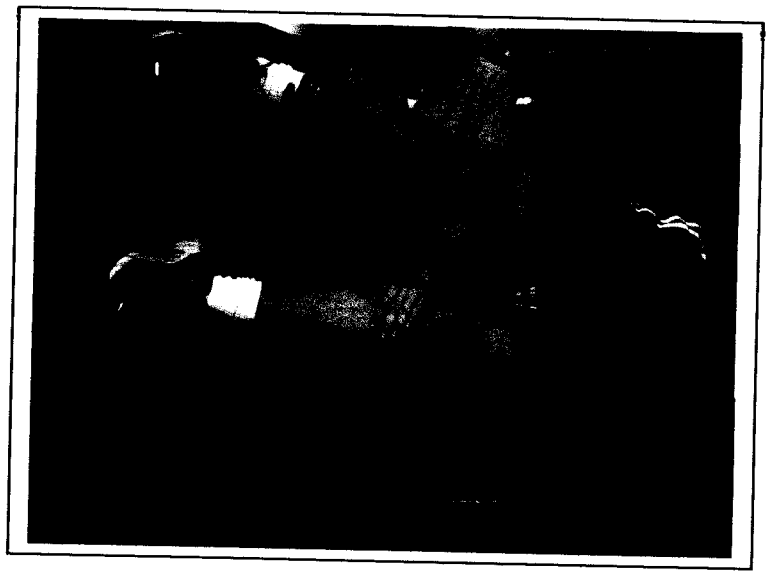
Action
- Adduction of the femur
- Flexion of the femur
- Internal rotation of the femur
- Extension of the femur

Innervation
- Obturator Nerve

TESTING TECHNIQUE

Technique
- Subject lies on the ipsilateral side
- Examiner supports the top leg with one hand and place the other hand on the bottom leg at the knee
- Subject adducts the bottom leg while the examiner provides resistance

Special Considerations
- The examiner needs to be sure the subjects pelvis does not roll forward allowing the patient to substitute with the gluteus maximus .
- Flexion at the hip or anterior tilt of the pelvis allows substitution by the hip flexors



CLINICAL PEARLS

- .:. The adductor magnus has a dual nerve supply
- .:. Individual adductor muscles cannot be isolated and must be tested as a group
- .:. In testing the adductor group, when the muscle grade is 0 to 2, the patient should be supine and attempt to adduct the hip with no assistance or resistance by the examiner. Naturally, rotation must be avoided

Quadriceps Group

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ANATOMY

Origin

Rectus Femoris

- Straight head: anterior inferior iliac spine
- Reflected head: grove above rim of acetabulum

Vastus Lateralis

- Linea aspera of femur
- Greater trochanter of the femur
- Intertrochanteric line of the femur

Vastus Medialis

- Linea aspera of femur
- Intertrochanteric line of the femur
- Tendon of adductor magnus and longus

Vastus Intermedius

- Upper two thirds of the femur

Insertion

- Proximal border of patella
- Tibial tuberosity via patellar ligament

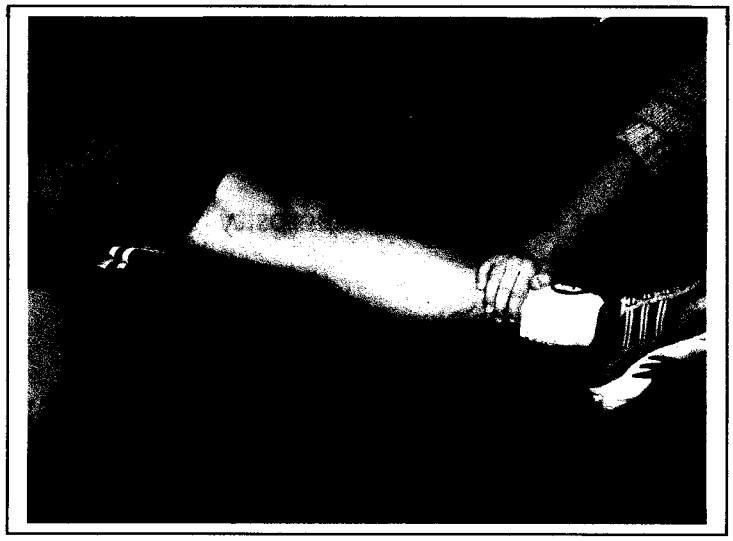
TESTING TECHNIQUE

Technique

- Subject sits at the edge of the table with knees flexed
- Examiner places a hand on the lower leg
- Subject sits back into a supine position to relax the hamstrings then straightens the leg against the examiners resistance

Special Consideration

- Examiner should be sure the subject does not lock out the knee. Locking out the knee would lead to an untrue assessment of strength



CLINICAL PEARLS

- If this muscle group is weakened, the ability to climb stairs, walk up an incline or and stand from seated position will be impaired
- Genu recurvatum or knee hyperextension during stance may be a result of prolonged weakness of the quadriceps .
- The superficial muscle fibers are bipennate but the deep muscle fibers are parallel
- If the Rectus Femoris is short, there can be restriction of knee flexion when the hip is extended or restriction of hip extension when the knee is flexed
- A small muscle lying deep in the quadriceps called genu articularis pulls the articular capsule proximally. This muscle cannot be clinically isolated

Semitendionosus & Semimembranosus

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ANATOMY

Origin

Semitendinosus

.:. Lower and medial facet of the ischial tuberosity

Semimembranosus

.:. Lower and upper facet of the ischial tuberosity

Insertion

Semitendinosus

.:. Medial surface of the upper part of the shaft of the tibia

Semimembranosus

.:. Posterior- medial aspect of the medial condyle of the tibia

Action

.:. Extension of the hip

.:. Internal rotation of the femur

Innervation

.:. Sciatic Nerve

TESTING TECHNIQUE

Technique

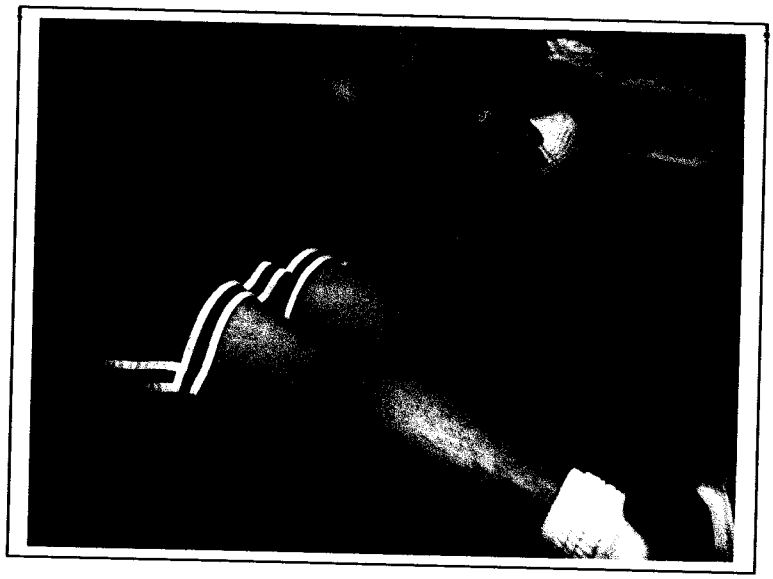
.:. Subject lies prone with the knee bent 30°-45° and slightly internally rotated

.:. Examiner places on hand on the subjects lower leg and the other hand stabilizing the subjects hips

.:. Subject lifts the leg, or extends the hip, against the testers resistance

Special Consideration

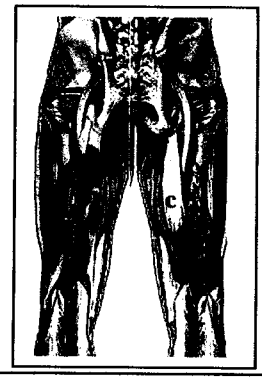
.:. If this muscle is tested in full flexion it may be uncomfortable for the subject



CLINICAL PEARLS

- Semimembranosus and semitendinosus are two joint muscles
- A tight rectus femoris can be suspected if the ipsilateral hip flexes when the knee has completed flexion

Biceps Ferroris



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ANATOMY

Origin

Long head

.:. Lower and medial facet of the ischial tuberosity

Short head

.:. Linea aspera of femur

.:. Proximal part of the lateral supracondylar line

Insertion

.:. Lateral condyle of the fibular head

.:. Lateral side of head of the fibula

Action

.:. Extension of the hip

.:. External rotation of the femur

Innervation

Long head

.:. Sciatic Nerve tibial division

Short head

.:. Sciatic Nerve peroneal division

TESTING TECHNIQUE

Technique

.:. Subject lies prone with knee bent to 30°.45° of flexion

Action

.:. Tester holds the hip in slight external rotation and places pressure against the lower leg to resist knee flexion

.:. Subject lifts the leg, or extends the hip, against the examiners resistance

Special Considerations

.:. If this muscle is tested in full flexion it may be uncomfortable for the subject

CLINICAL PEARLS

- .:. The short head of the biceps femoris is sometimes absent
- .:. A tight rectus femoris can be suspected if the ipsilateral hip flexes when the knee has completed flexion
- .:. Numerous muscles can substitute for the hamstrings such as the hip flexors, gracilis, sartorius, and gastrocnemius
- .:. If a peroneal neuropathy at the fibular head is suspected, the short head of the biceps femoris should always be tested electrodiagnostically
- .:. The biceps femoris is dually innervated

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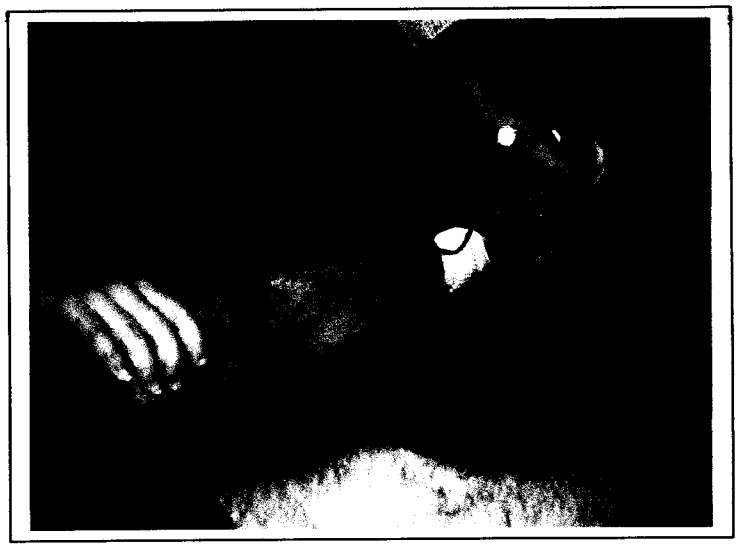
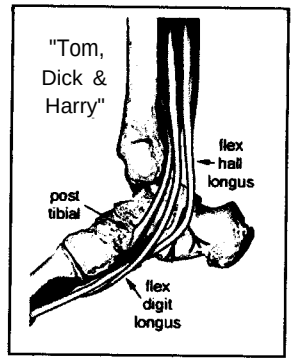


CLINICAL PEARLS

- .:. To quickly assessthe functional strength is to have the subject walk on the lateral edge of their feet or on their heels while looking for symmetry of foot inversion
- .:. The first largest tendon palpated anterior to the medial malleolus is the tibialis anterior



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libialis Posterior

ANATOMY

Origin

- .:. Upper two thirds of the posterior surface of the tibia
- .:. Upper two thirds of the medial surface of the fibula
- .:. Interosseous membrane

Insertion

- .:. Plantar surface of the navicular tuberosity
- .:. Three cuneiforms
- .:. Cuboid
- .:. Base of the three middle metatarsal bones

Action

- .:. Extension (plantarflexion) of the foot
- .:. Inversion of the foot

Innervation

- .:. Tibial Nerve

TESTING TECHNIQUE

Technique

- .:. Subject lies supine or sits
- .:. Examiner places one hand on the subjects posterior lower leg and the other hand on the plantar surface of the subjects foot
- .:. Subject plantarflexes and inverts the foot and ankle against the examiners resistance

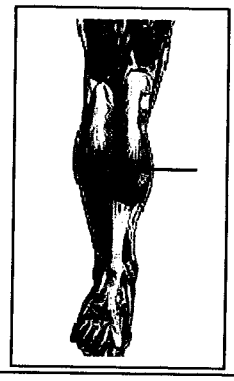
Special Consideration

- .:. Watch for strong flexion by flexor hallucis longus and flexor digitorum longus as they can substitute for the tibialis posterior

CLINICAL PEARLS

- .:. A tear or a rupture of the tibialis posterior may cause a significant foot pronation. It is major muscle for the longitudinal foot arch
- .:. Along with the gastrocnemius, the tibialis posterior is another culprit in equinovarus contracture of the ankle
- .:. The tibialis posterior has been found to be purely innervated by L5 based on electrodiagnostic studies

Gastrocnemius



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ANATOMY

Origin

.:. Posterior surface of the two condyles of the femur

Insertion

.:. Posterior surface of the calcaneus by calcaneal tendon

Action

.:. Extension (plantarflexion) of the foot

Innervation

.:. Tibial Nerve

TESTING TECHNIQUE

Technique

.:. Subject is standing and holding on to a stable object for balance

.:. Examiner stands behind the subject o ensure safety

.:. Subject plantarflexes so they are standing on the balls of their feet

.:. Subject attempts to do ten unipedal heel raises while the examiner counts and looks for fatigue

Special Consideration

.:. The gastrocnemius is a very strong muscle therefore it is hard to recognize a subtle weakness. This muscle needs to be tested with the subject standing to fully assess the strength at grades 3 or higher. The examiner cannot give a grade of normal if they are unable to "break" the muscle when the subject is supine

CLINICAL PEARLS

- .:. The gastrocnemius is a two joint muscle crossing at both the knee and the ankle. Therefore it is able to act in the flexion of the knee and the plantarflexion of the ankle. This anatomic fact puts the muscle at a higher risk for shortening and a development of contracture
- .:. To best assess a contracture of the gastrocnemius, the examiner should assess the degree of passive ankle dorsiflexion attained with the knee fully flexed and compare it to the knee fully extended. The gastrocnemius is stretch the most when the knee is fully extended and the ankle is fully dorsiflexed
- .:. In order to stretch the gastrocnemius, it is best to have the knee fully extended. In order to stretch the soleus, it is best to have the knee flexed to provide slack to the gastrocnemius

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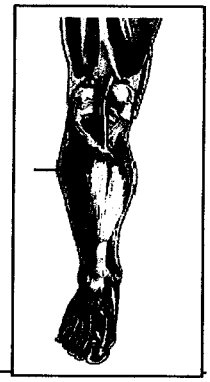

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ANATOMY

Origin
- .:. Medial border of the middle one third of the tibia
- .:. Upper two thirds of the posterior surface of the fibula

Insertion
- .:. Posterior surface of the calcaneus by calcaneal tendon

Action
- .:. Extension (plantarflexion) of the foot

Innervation
- .:. Tibial Nerve

TESTINGTECHNIQUE

Technique
- .:. Subject lies prone with the knee flexed to 90°
- .:. Examiner places one hand on the calcaneus and the other hand on the anterior portion on the lower leg distally
- .:. The subject plantarflexes the foot against the examiners resistance without inverting or everting their ankle

Special Consideration
- .:. It is difficult to detect slight weaknessesin the soleus because it is a strong muscle like the gastrocnemius. This muscle needs to be tested with the subject standing to fully assessthe strength at grades 3 or higher. The examiner cannot give a grade of normal if they are unable to "break" the muscle when the subject is supine

CLINICAL PEARLS

- If inversion occurs during testing, substitution by the tibialis posterior can be assumed. If eversion occurs, substitution by peroneii can be assumed.
- In order to isolate the soleus and take out the pull of the gastrocnemius, the knee must be flexed to 90°
- The soleus crosses only at the ankle making it a single joint muscle. A plantarflexion contracture of the ankle is mostly due to the gastrocnemius shortening

Peroneus Longus and Brevis

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ANATOMY

Origin

Longus

- Upper two thirds of the lateral surface of the fibula
- lateral condyle of the tibia

Brevis

- Lower two thirds of the lateral surface of the fibula

Insertion

Longus

- Lateral surface of the firs cuneiform
- Base of the first metatarsal bone

Brevis

- Tuberosity of the base of the 5th metatarsal bone

Action

- Extension (plantarflexion) of the foot
- Eversion of the foot

Innervation

- Superficial Peroneal Nerve

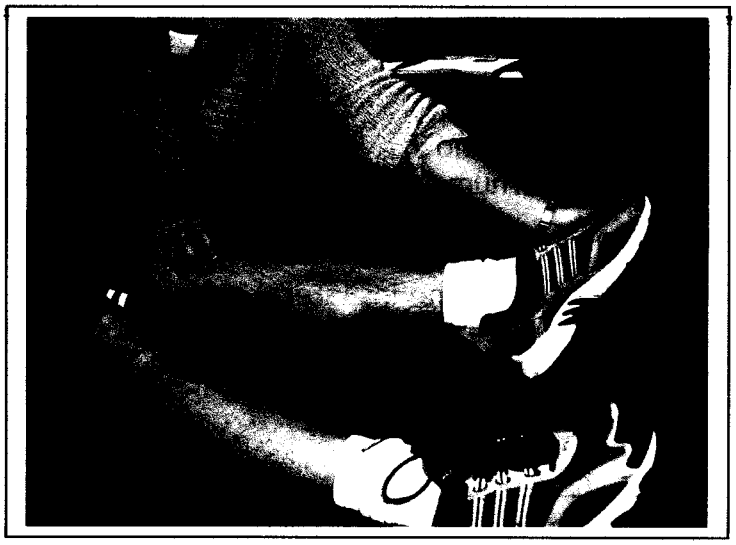
TESTING TECHNIQUE

Technique

- Subject sits or lies supine
- The examiner stabilizes the distal leg and places one hand on the plantar aspect of the subjects foot
- Subject is instructed to plantarflex and invert the foot against the examiners resistance

Special Considerations

- It is very difficult to separate the peroneus longus and brevis during muscle testing

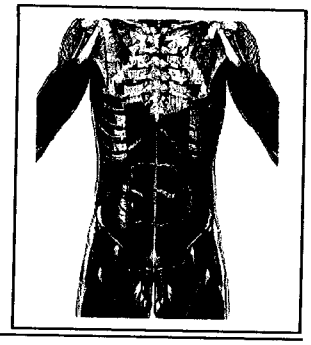


CLINICAL PEARLS

- The peroneus longus wraps around the lateral foot and crosses under the metatarsals to insert into the first metatarsal. The examiner should look for first ray depression in order to assess activity and strength. They could also look at their own foot to understand the direction of the pull
- Peroneus longus is located in the proximal two thirds of the lower leg. The peroneus brevis is located in the distal two thirds of the lower leg. Therefore, the middle tow thirds of the lower leg has two overlapping muscles. This fact needs to be remember when palpating for muscle contraction
- These muscles are the only muscles innervated by the superficial peroneal nerve

CORE

Rectus Abdominis



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ANATOMY

Origin

- .:. Crest of the pubis

Insertion

- .:. Costal cartilage of ribs 5, 6, and 7
- .:. Xyphoid process of the sternum

Action

- .:. Flexion of the trunk
- .:. Lateral flexion of the trunk to the ipsilateral side

Innervation

- .:. Thoracic Spinal Nerve

TESTING TECHNIQUE

Technique *Lower abdominal strength*

- .:. Subject lies supine with forearms folded across the chest. The legs are positioned at 90° of hip flexion with knees straight
- .:. The subject slowly lowers the legs down, flattening their back against the table, while the examiner watches for when the pelvis starts the tilt anteriorly and the lumbar spine arches off the table and notes the degree of flexion at the hips
- .:. The examiner also watches to make sure the subject does not use the elbows to assist in this test
- .:. Based on this angle, a muscle strength is given according to the following chart:

Angle (Degrees)	Muscle Grade (verbal)	Muscle Grade (numerical)
90	Poor	2
75	Fair	3
60	Fair (+)	3+
45	Good (-)	4-
30	Good	4
15	Good (+)	4+
0	Normal	5

**This chart was taken from Cutter, 1999, p.194

Special Considerations

- .:. If the hamstrings are tight, the subject may not be able to flex hips to 90° for the starting position
- .:. The examiner should not provide assistance in stabilizing the trunk; it would defeat the purpose of this test
- .:. If the elbows are allowed to lay on the table they could potentially provide support or assistance

CLINICAL PEARLS

.:. The following combinations of strength and weaknesses listed in order of decreasing frequency are generally found of the abdominal muscles:

- o Upper abdominal muscles strong; lower abdominal muscles weak
- o Upper abdominal muscles; lower abdominal muscles both weak
- o Upper abdominal muscles; lower abdominal muscles both strong
- o Upper abdominal muscles weak; lower abdominal muscles strong

Technique *Upper abdominal strength*

- Subject lies supine with hands clasped behind the head
- Subject slowly raises head and shoulders off the table while curling up the trunk
- Subject then moves into curling up at the hips without hesitating and ends in a long sitting position
- If subject is unable to complete the motion in this position, the next position is with hands folded across chest
- If subject is unable to complete the motion in the modified position, the next position is with arms straight in front
- Examiner may hold the feet only once the subject has started flexing at the hips
- Examiner watches the subjects movement to give a grade based on following:
  - Fair: with arms extended forward the subject can flex the vertebral column but cannot maintain flexion when attempting to enter hip flexion phase
  - Fair +: with arms extended forward, the subject can flex the vertebral column and can maintain flexion when entering the hip flexion phase and coming to a seated position
  - Good: with arms folded across chest, subject is able to flex the vertebral column and can maintain flexion when entering the hip flexion phase and coming to seated position
  - Normal: with hands clasped behind head, subject is able to flex the vertebral column and can maintain flexion when entering the hip flexion phase and coming to a seated position

*Grading scale comes from Cutter, 1999, p.194

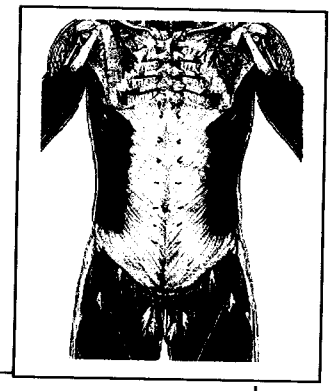
Special Considerations

- Examiner should not hold legs during the trunk curling phase because it allows the hip flexors to initiate trunk flexion
- This test cannot be stopped before the hip flexion phase because this phase provides strong resistance against the abdominal muscles. If the test is stopped the muscle will not be properly tested
- During the hip flexion phase, the subject's pelvis needs to remain posteriorly tilted, low back flat, otherwise the hip flexors will substitute for the abdominals

CLINICAL PEARLS

- ∴ A lack in lumbosacral spine ROM may lead to a misinterpretation as weakness so the examiner needs to check the ROM prior to the test
- ∴ The Thomas test also needs to be done prior to the testing of the rectus abdominis in order to rule out hip flexor tightness since it can prevent a posterior pelvic tilt that is required to flatten the lumbar spine
- ∴ Only one properly performed trial is required to assign a grade for the muscle test
- ∴ Three muscles, rectus abdominis, internal abdominal obliques, and external abdominal obliques, contribute to these movements:
  - o Rectus abdominis depresses the chest and pulls the thorax toward pelvis
  - o Internal abdominal obliques flare out the rib cage
  - o External abdominal obliques become active when the patient enters hip flexion phase of the movement and acts to pull the rib cage inward again

External Abdominal Oblique



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ANATOMY

Origin

- Costal cartilage of the lower eight ribs

Insertion

- Linea alba
- Crest of the pubis
- Anterior one half of the iliac crest

Action

- Flexion of the trunk
- Lateral flexion of the trunk to the ipsilateral side
- Rotation of the trunk to the contralateral side

Innervation

- Thoracic Spinal Nerve

TESTING TECHNIQUE

Technique

- Subject lies prone with their hands behind their neck
- Examiner should stabilize the lower extremities
- Subject flexes and rotates the trunk to the contralateral side
  - A muscle grade of good can be assigned if there is full elevation of the contralateral shoulder and only a partial elevation of the ipsilateral shoulder
  - A muscle grade of fair can be assigned if only the contralateral shoulder is elevated

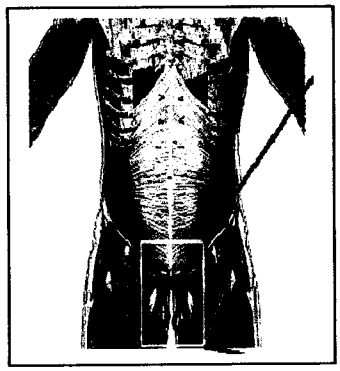
~(:ial Consideration

- The pelvis must be stabilized if the hip flexors are weak

CLINICAL PEARLS

- Trunk rotation occurs when the ipsilateral external abdominal oblique and the contralateral internal oblique muscles fire
- A lateral shift of the pelvis occurs when there is unilateral weakness of lateral fibers of the internal obliques and external obliques. It is known as a C-curve and it is convex to the side of weakness
- A decrease in respiratory efficiency can be seen when moderate weakness of the external abdominal obliques is noted. Also, a decrease in the support of abdominal viscera may be noted .
- A decreased ability to flex the vertebral column and to tilt the pelvis posteriorly results from bilateral weakness of the external abdominal obliques

Internal Abdominal Obliques



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ANATOMY

Origin
- .:. Inguinal ligament
- .:. Anterior two thirds of the iliac crest

Insertion
- .:. Costal cartilage of the ribs 8, 9, and 10
- .:. Linea alba
- .:. Crest of the pubis

Action
- .:. Flexion of the trunk
- .:. Lateral flexion of the trunk to the ipsilateral side
- .:. Rotation of the trunk to the contralateral side

Innervation
- .:. Thoracic Spinal Nerve

TESTING TECHNIQUE

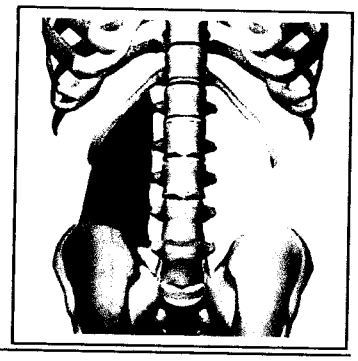
Technique
- .:. Subject lies supine with hands together behind the head
- .:. Examiner should stabilize the lower extremities
- .:. Subject flexes and rotates the trunk to the contralateral side
  - o A muscle grade of good can be assigned if there is full elevation of the contralateral shoulder and only a partial elevation of the ipsilateral shoulder
  - o A muscle grade of fair can be assigned if only the contralateral shoulder is elevated

Special Consideration
- .:. The pelvis must be stabilized if the hip flexors are weak

CLINICAL PEARLS

- ∴ A decrease in respiratory efficiency can be seen when moderate weakness of the external abdominal obliques is noted. Also, a decrease in the support of abdominal viscera may be noted.
- ∴ If there is a weakness in the internal abdominal oblique combined with a weakness of the external abdominal oblique, it can play a role in scoliosis as follows:
  - Weak internal abdominal oblique on the left with weak external abdominal oblique on the right causes the right costal margin to separate from the left iliac crest therefore causing the thorax to deviate to and rotate posteriorly on the right. If it is reversed, the same effect would be seen the opposite way
  - Weak internal abdominal oblique and external abdominal oblique ipsilaterally causes the thorax and iliac crest to separate laterally resulting in a C-curve with the convex portion facing the weak side
- ∴ Kyphosis and a depressed chest will result from bilateral shortness of the internal and external obliques due to anterior compression of the thorax and flexion of the vertebral column
- ∴ The rotation involved in this test is accomplished by activation of the ipsilateral external abdominal oblique and the contralateral internal abdominal oblique. It is not possible to isolate the actions of the internal oblique from the other abdominal muscles. The technique used for this muscle test is for direct evaluation of function of the obliques. In order to get an indirect measure of function, the examiner could have the subject perform a curled trunk sit-up

Quadratus Lumborum



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ANATOMY

Origin

- .:. Crest of the ilium
- .:. Transverse process of L2-L5

Insertion

- .:. Lower border of the 12th rib
- .:. Transverse process of L1-L2

Action

- .:. Ipsilateral lateral flexion of lumbar vertebrae

Innervation

- .:. Lower Thoracic Spinal Nerve
- .:. Upper Lumbar Spinal Nerve

TESTING TECHNIQUE

Technique1

- .:. Subject stands with the feet spread pelvis width apart
- .:. Examiner stand behind subject to support the upper trunk
- .:. Subject laterally flexes bringing the ribs and hips together

Technique 2

- .:. Subject lies supine with maintaining lumbar lordosis
- .:. Examiner gives resistance above the ankle [oint
- .:. Subject laterally flexes bringing the ribs and hips together

Special Considerations

- .:. The examiner needs to be sure the subject is elevating the pelvis not laterally flexing the trunk

CLINICAL PEARLS

- The examiner should be sure to complete this test bilaterally
- Any patient who have subacute and chronic low back pain should do this test as the quadratus lumborum is may be a key muscle in controlling lumbar facet motion
- Another technique to perform this test is to have the subject sidelying with knee and hip flexed to 90°, examiner stabilizing trunk, and subject abducting the lower extremity
- Muscles involved in trunk flexion, which is a combination of lateral tilting of the pelvis and hip abduction, are the lateral fibers of the internal and external obliques, quadratus lumborum, latissimus dorsi, and ipsilateral rectus abdominis.

Spinal Rotators

ANATOMY

Origin

- .:. Transverse processes of vertebrae from the axis to the sacrum

Insertion

- .:. Base of the spinous process of the first and second vertebrae above its origin
- .:. Lamia of vertebra above

Action

- .:. Extension of the trunk
- .:. Ipsilateral lateral flexion of the spine
- .:. Contralateral rotation of the spine

Innervation

- .:. Thoracic Spinal Nerve

TESTING TECHNIQUE

Technique

- .:. Subject sits with their hands behind the head
- .:. The examiner stands behind the subject and puts their arm under the subjects shoulder, across the subjects chest, and resting on top of the shoulder
- .:. The examiner should be palpating the clavicle with the thumb and the subject's Acromion with their finger tips
- .:. The subject rotates to the side on which the examiners hand is resting while the examiner provides resistance

Special Considerations

- .:. In order for this test to be properly performed, the examiners fingertips on the Acromion process, should provide adequate resistance to posterior movements

CLINICAL PEARLS

- .:. The spinal rotators will show basically continuous activity when in the relaxed extended position
- .:. Both the left and right sided rotators will be activated in thoracic region while only the right sided rotators in the lumbar region will be activated during left sided rotation
- .:. The rotators cannot be differentiated from the deep fibers of multifidus. The rotators lie deep to multifidus

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