TESTS AND MEASUREMENTS

Lecture 3:

Goniometric Measurements and Manual Muscle Testing for the Shoulder Complex

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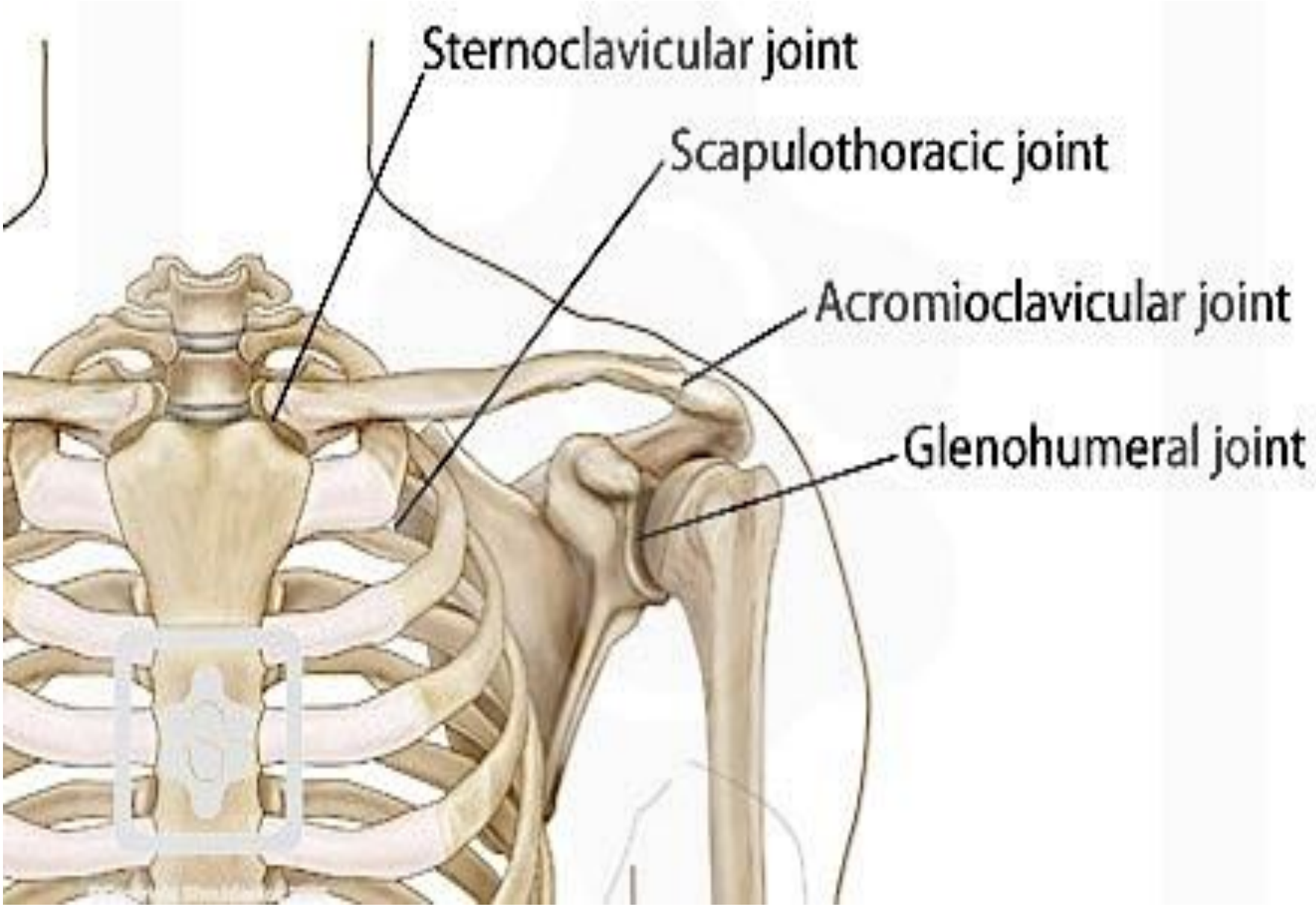
The Shoulder Girdle

- In all, there are four major articulations associated with the Shoulder Complex involving the sternum, clavicle, ribs, scapula, and humerus, which work together to provide large ranges of motion to the upper extremity in all three planes of motion. Movement at the Shoulder Complex occurs as a result of movement at each of these four joints, listed below.

1. Glenohumeral Joint,
2. Acromioclavicular Joint
3. Sternoclavicular Joint
4. Scapulothoracic Joint

- Acromioclavicular joint: Between the acromion of the scapula and the acromial (distal) end of the clavicle.
- Sternoclavicular joint: Between the manubrium of the sternum and the first costal cartilage with the sternal (proximal) end of the clavicle.
- Glenohumeral joint: Between the head of the humerus and the glenoid fossa of the scapula
- Scapulothoracic joint: Between the anterior surface of the scapula and the posterior thoracic cage.


Sternoclavicular joint
Scapulothoracic joint
Acromioclavicular joint
Glenohumeral joint

Scapular Movements

- Normal ROM at the sternoclavicular and acromioclavicular joints (i.e., clavicular motion) is required for normal scapular motion.
- In the clinical setting, motion at the sternoclavicular joint and scapula is not easily measured, and it is not possible to measure motion at the acromioclavicular joint.
- Scapular movement is assessed by visual observation of the AROM and the evaluation of passive movement.
- The ROM is estimated as either “full” or “restricted.”

	Elevation	Depression	Abduction (Protraction)	Adduction (Retraction)
Articulation	Scapulothoracic Acromioclavicular Sternoclavicular	Scapulothoracic Acromioclavicular Sternoclavicular	Scapulothoracic Acromioclavicular Sternoclavicular	Scapulothoracic Acromioclavicular Sternoclavicular
Plane	Frontal	Frontal	Horizontal	Horizontal
Axis	Sagittal	Sagittal	Vertical	Vertical
Normal limiting factors	Tension in the costoclavicular ligament, inferior sternoclavicular joint capsule, lower fibers of trapezius, pectoralis minor, and subclavius	Tension in the interclavicular ligament, sternoclavicular ligament, articular disk, upper fibers of trapezius, and levator scapulae; bony contact between the clavicle and the superior aspect of the first rib	Tension in the trapezoid ligament, posterior sternoclavicular ligament, posterior lamina of the costoclavicular ligament, trapezius, and rhomboids	Tension in the conoid ligament, anterior lamina of the costoclavicular ligament, anterior sternoclavicular ligament, pectoralis minor, and serratus anterior
Normal end feel	Firm	Firm/hard	Firm	Firm
Normal AROM	10–12 cm (total range for elevation—depression)	10–12 cm (total range for elevation—depression)	10–12 cm (total range for abduction—adduction)	10–12 cm (total range for abduction—adduction)

	Medial Rotation (Downward Rotation)	Lateral Rotation (Upward Rotation)
Articulation	Scapulothoracic Acromioclavicular Sternoclavicular	Scapulothoracic Acromioclavicular Sternoclavicular
Plane	Frontal	Frontal
Axis	Sagittal	Sagittal
Normal limiting factors	Tension in the conoid ligament and serratus anterior	Tension in the trapezoid ligament, the rhomboid muscles and the levator scapulae
Normal end feel	Firm	Firm/hard
Normal AROM	45–60° (total range for medial-lateral rotation)	45–60° (total range for medial-lateral rotation)

AROM Assessment

- **Start Position.** The patient is sitting and assumes a relaxed, anatomical posture. In this posture, the scapula normally lies between the second and seventh ribs and the vertebral border lays approximately 5 to 6 cm lateral to the spine. The therapist stands behind the patient to observe the scapular movements.
- ***Scapular Elevation***

  Movement. The patient moves the shoulders toward the ears in an upward or cranial direction.
- ***Scapular Depression***

  Movement. The patient moves the shoulders toward the waist in a downward or caudal direction.

Figure 3-18 Start position for all active scapular movements.

Figure 3-19 Active movement: scapular elevation.

Figure 3-20 Active movement: scapular depression.

- ***Scapular Abduction***

  Movement. From the start position, the patient flexes the arms to 90°, and scapular abduction is observed as the patient reaches forward. The vertebral borders of the scapulae move away from the vertebral column.

- ***Scapular Adduction***

  Movement. The patient moves the scapulae horizontally toward the vertebral column.

- ***Scapular Medial (Downward) Rotation***

  Movement . The patient extends and adducts the arm to place the hand across the small of the back and the inferior angle of the scapula moves in a medial.

- ***Scapular Lateral (Upward) Rotation***

  Movement. The patient elevates the arm through flexion or abduction. During elevation, the inferior angle of the scapula moves in a lateral direction.

Figure 3-21 Active movement: scapular abduction.

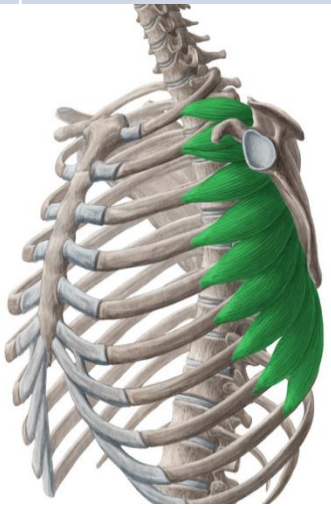
Figure 3-22 Active movement: scapular adduction.

Figure 3-23 Active movement: scapular medial (downward) rotation.

Figure 3-24 Active movement: scapular lateral (upward) rotation.

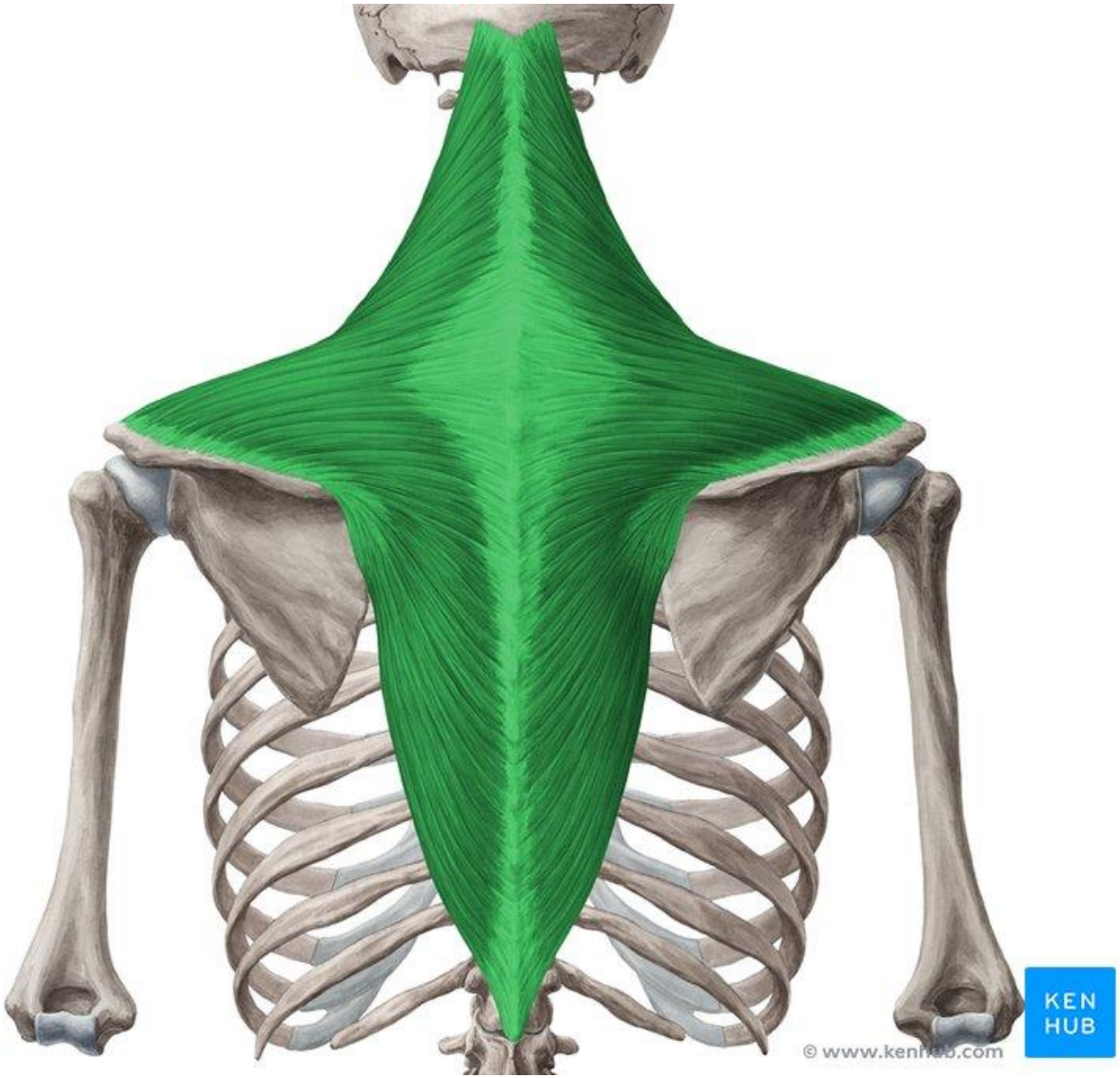
Muscle Actions, Attachments, and Nerve Supply

Muscle	Primary Muscle Action	Muscle Origin	Muscle Insertion	Peripheral Nerve	Nerve Root
Serratus anterior	Scapular abduction Scapular lateral rotation	Outer surfaces and superior borders of the upper 8, 9, or 10 ribs; fascia covering corresponding intercostal muscles	Costal surface of the medial border of the scapula including the superior angle and the inferior angle	Long thoracic	C567



Muscle	Primary Muscle Action	Muscle Origin	Muscle Insertion	Peripheral Nerve	Nerve Root
Levator scapulae	Scapular elevation Scapular medial rotation	Transverse processes of the upper 4 cervical vertebrae	Medial border of the scapula between the superior angle and the root of the spine	Third and fourth cervical; dorsal scapular	C3 4 5

Muscle	Primary Muscle Action	Muscle Origin	Muscle Insertion	Peripheral Nerve	Nerve Root
Trapezius a. Upper fibers	Scapular elevation	Medial one-third of the superior nuchal line of the occipital bone; external occipital protuberance; ligamentum nuchae	Posterior border of the lateral one-third of the clavicle	Spinal accessory	C34
b. Middle fibers	Scapular adduction	Spinous processes of T1 to T5 and the corresponding supraspinous ligament	Medial border of the acromion process and the superior border of the rest of the spine of the scapula	Spinal accessory	C34
c. Lower fibers	Scapular depression Scapular adduction	Spinous processes of T6 to T12 and the corresponding supraspinous ligament	Tubercle at the apex of the triangular surface at the medial end of the spine of the scapula	Spinal accessory	C34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Muscle	Primary Muscle Action	Muscle Origin	Muscle Insertion	Peripheral Nerve	Nerve Root
Rhomboid minor	Scapular adduction Scapular medial rotation	Inferior portion of the ligamentum nuchae; spinous processes of C7 and T1 and the corresponding supraspinous ligament	Base of the smooth triangular region at the root of the spine of the scapula	Dorsal scapular	C45
Rhomboid major	Scapular adduction Scapular medial rotation	Spinous processes of T2 to T5 and the corresponding supraspinous ligament	Medial border of the scapula between the root of the spine and inferior angle	Dorsal scapular	C45

Rhomboid minor

Rhomboid major

MANUAL MUSCLE TESTING

1. Scapular Abduction and Lateral Rotation

- **Against Gravity: Serratus Anterior**
- **Accessory muscles**: trapezius (lateral rotation) and pectoralis minor (abduction).
- **Start Position.** The patient is supine. The shoulder is flexed to 90° with slight horizontal adduction (i.e., 15° medial to the sagittal plane), and the elbow is extended. This position is an optimal test position for serratus anterior while decreasing the participation of pectoralis major.[19]
- **Stabilization.** The weight of the trunk.
- **Movement.** The patient abducts (protracts) the scapula through full ROM.
- **Palpation.** Midaxillary line over the thorax.
- **Substitute Movement.** Pectoralis major, pectoralis minor.
- **Resistance Location.** Applied on the distal end of the humerus.
- **Resistance Direction.** Scapular adduction

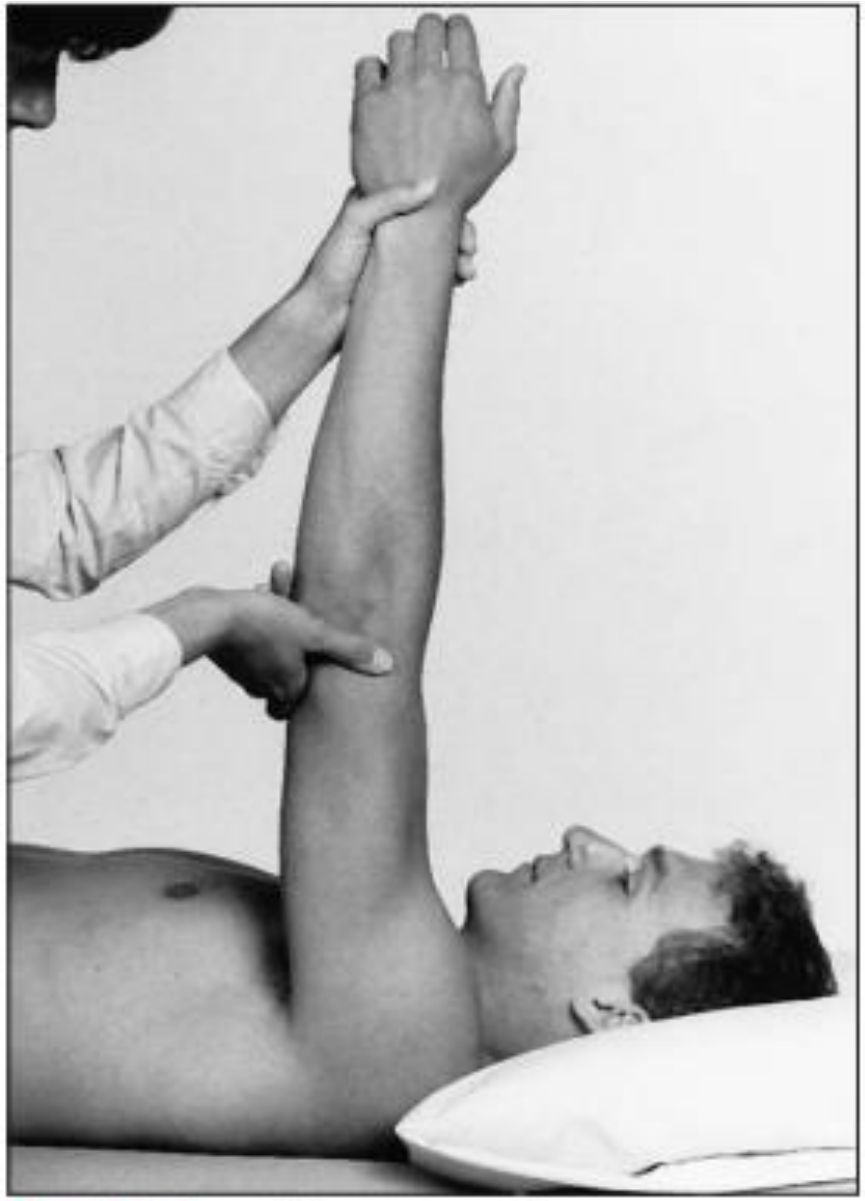


Figure 3-77 Start position: serratus anterior.

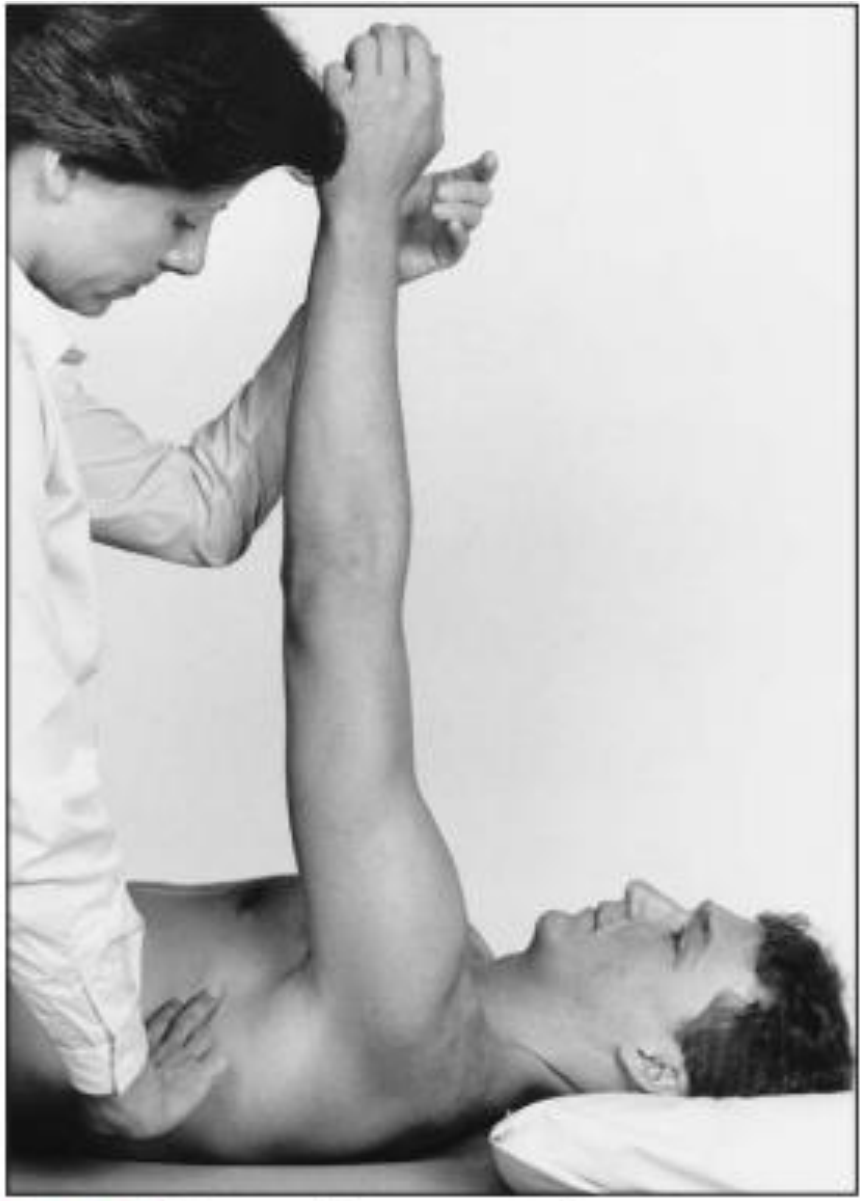


Figure 3-78 Screen position: serratus anterior.

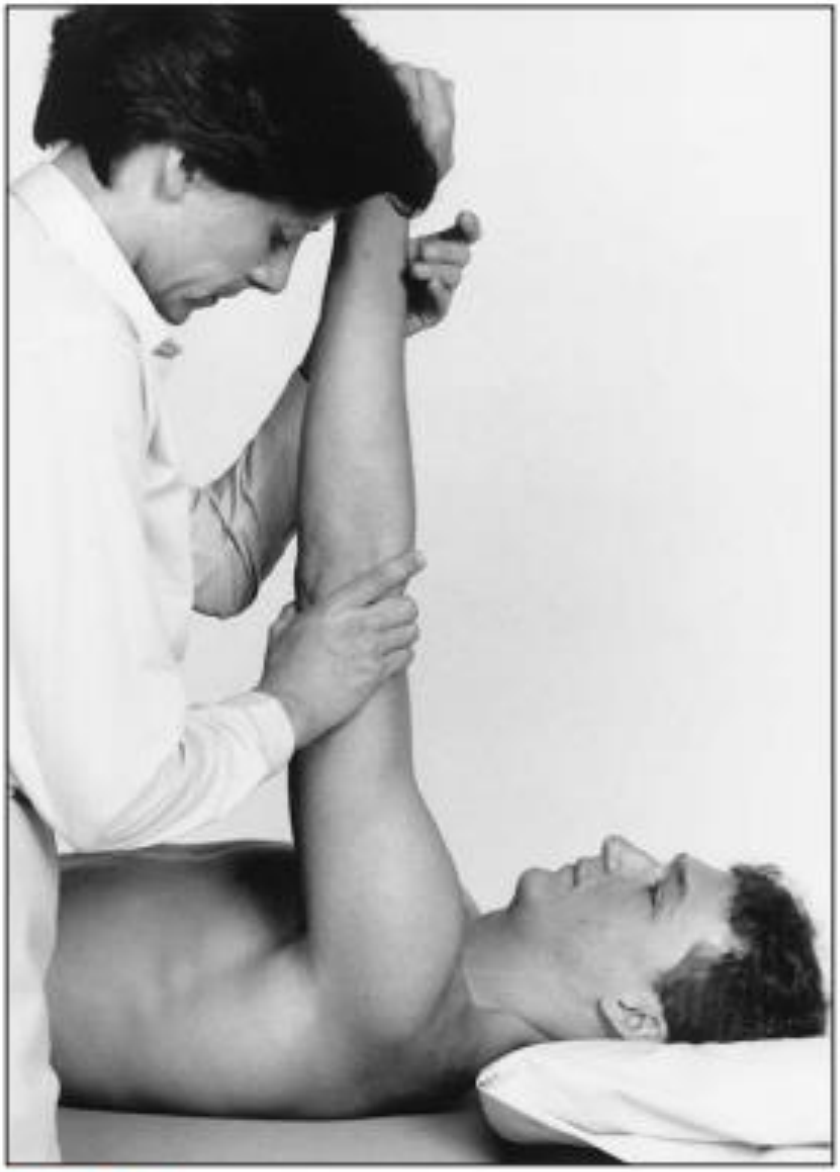


Figure 3-79 Resistance: serratus anterior.

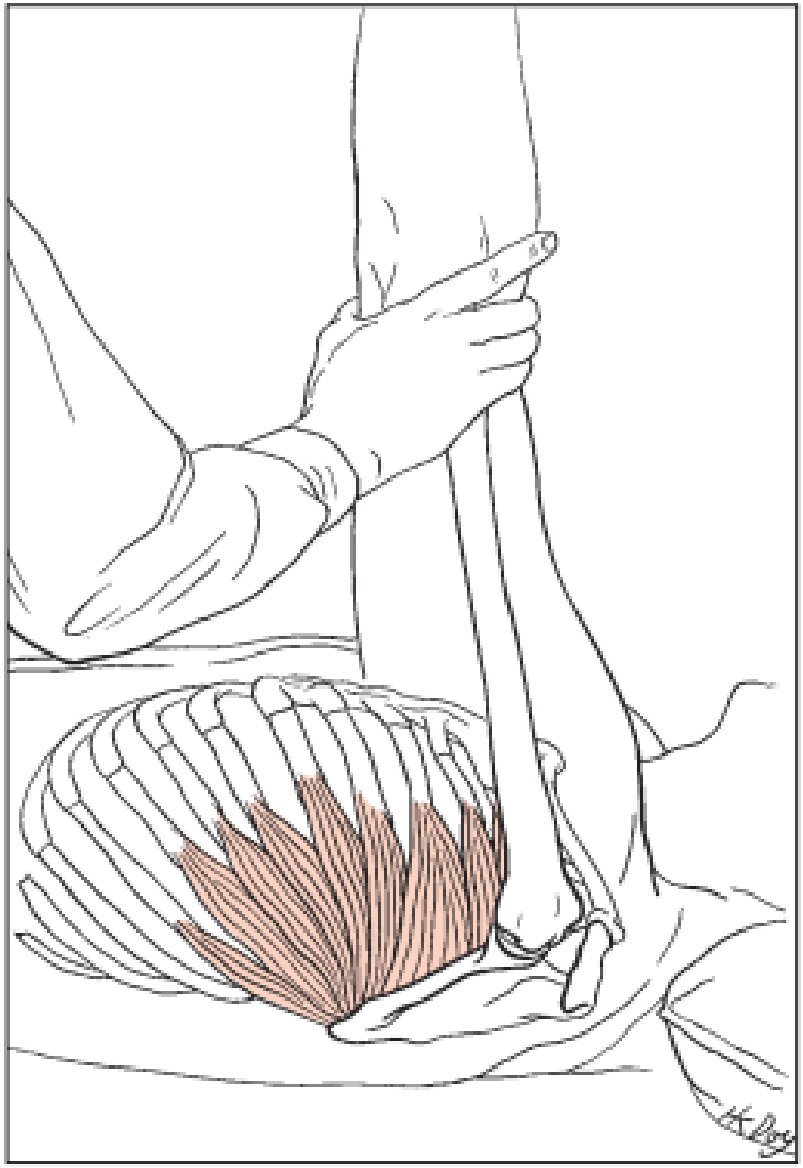


Figure 3-80 Serratus anterior.

- **Gravity Eliminated: Serratus Anterior**

  Start Position. The patient is sitting. The shoulder is flexed to 90° with slight horizontal adduction, and the elbow is extended. The therapist supports the weight of the upper extremity.

- **Stabilization.** The patient is instructed to avoid trunk rotation.

  End Position. The patient abducts the scapula through full ROM.

  Substitute Movement. Pectoralis major and minor, upper and lower fibers of trapezius, and contralateral trunk rotation.

Figure 3-81 Start position: serratus anterior.

Figure 3-82 End position: serratus anterior.

Alternate Test : Against Gravity: Serratus Anterior

- The patient must have adequate shoulder flexor muscle strength to perform this test.
- **Weakness of serratus anterior** is demonstrated by **"winging" of the scapula**. When "winging" is present, the medial border and inferior angle of the scapula become more prominent, and the scapula remains in an adducted and medially rotated position.
- **Grading Method.** This alternate test for Serratus Anterior is only performed against gravity using Isometric/Palpation Grading.
- **Start Position.** The patient is sitting. The shoulder is flexed to 120° with slight horizontal adduction (i.e., 15° medial to the sagittal plane), and the elbow in extension.
- **Stabilization.** The patient may hold onto the plinth with the non test hand.

- **Movement.** The patient holds the test position.
- **Palpation.** Midaxillary line over the thorax anterior to the lateral border of the scapula.
- **Substitute Movement.** Pectoralis major, pectoralis minor, contralateral trunk rotation.
- **Resistance Location.** Applied on the distal end of the humerus and the lateral border of the scapula.
- **Resistance Direction.** Shoulder extension and scapular medial rotation

Figure 3-83 Alternate test: isometric grading of serratus anterior.

Figure 3-84 Alternate test: palpation grading of serratus anterior.

Clinical Test: Serratus Anterior

- This is a quick clinical test used to assess whether the serratus anterior muscle is strong or weak. A specific grade cannot be assigned.
- **Start Position.** The patient is standing and facing a wall. The hands are placed on the wall at shoulder level, the shoulders are in slight horizontal abduction, and the elbows are extended. The thorax is allowed to sag toward the wall so that the scapulae are adducted.
- **Movement.** The patient pushes the thorax away from the wall so that the scapulae abduct.
- **Observation.** Weakness is demonstrated by "winging"[21] of the scapula. The medial border and inferior angle of the scapula become more prominent, and the scapula remains in an adducted and medially rotated position.

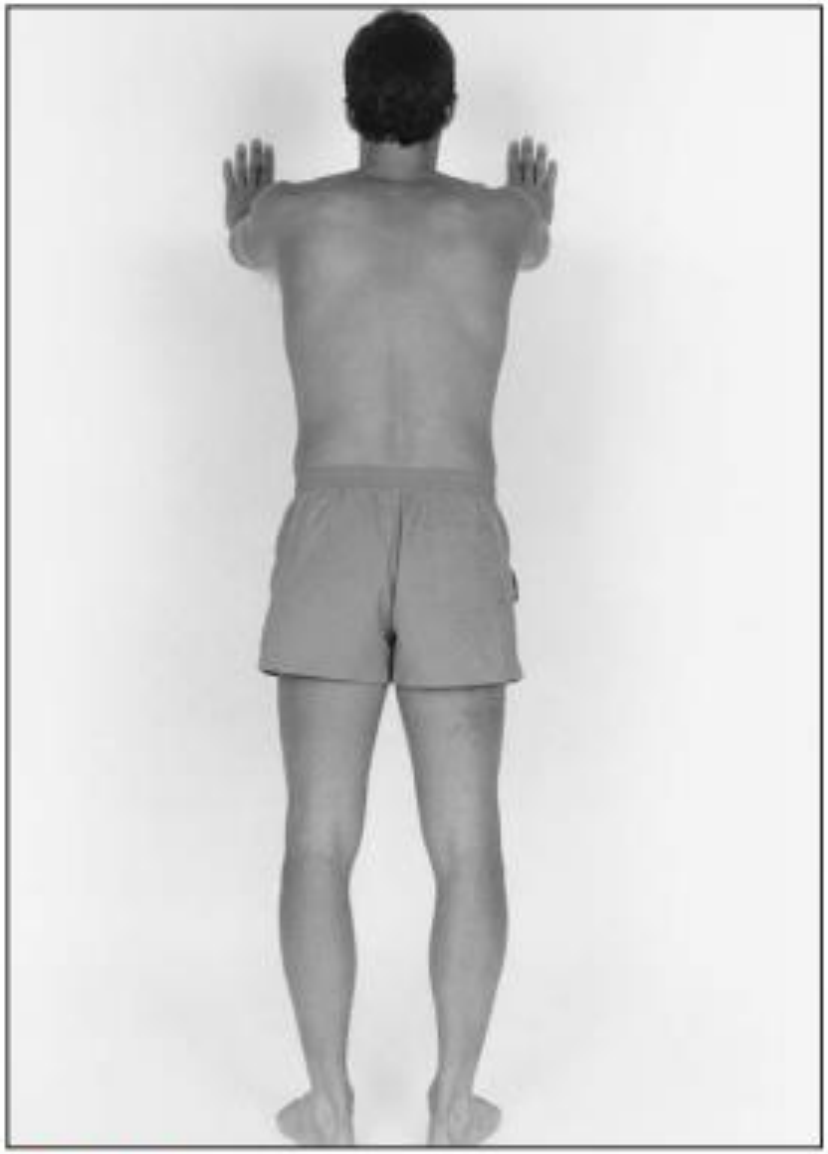


Figure 3-85 Start position: serratus anterior clinical test.

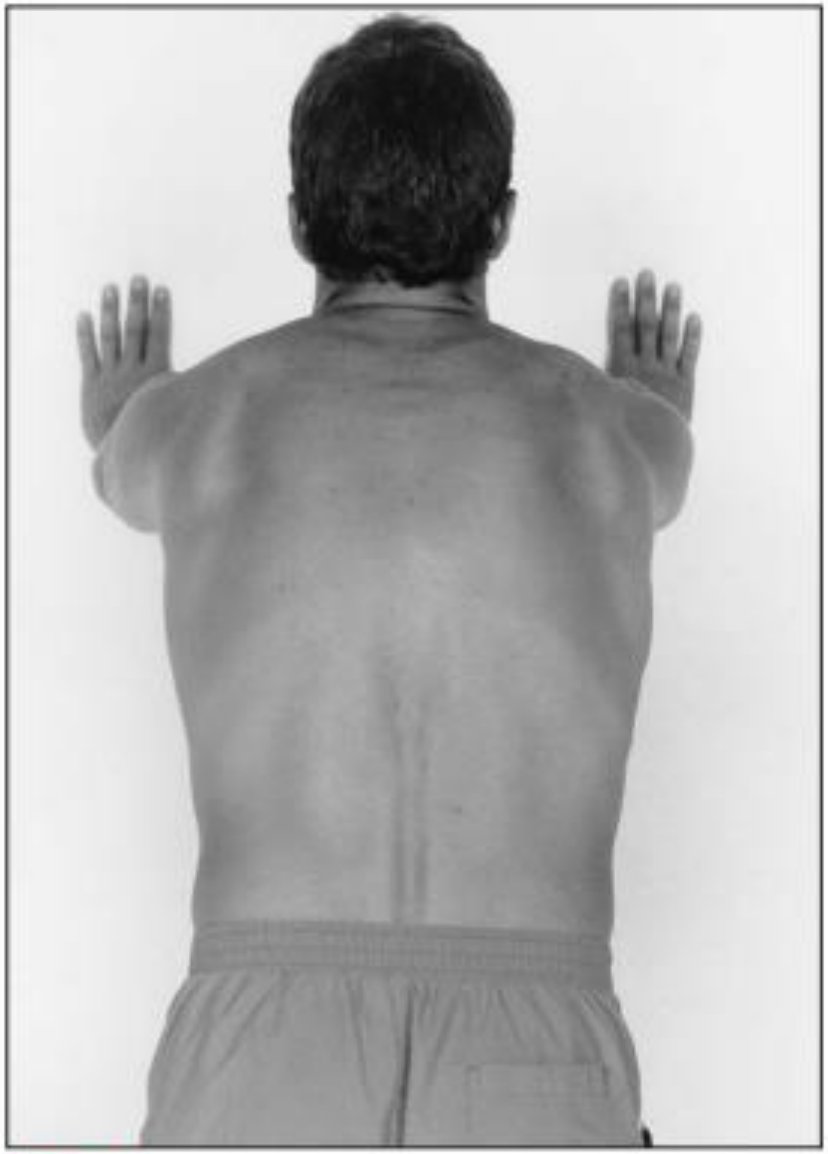


Figure 3-86 End position: serratus anterior clinical test.

2. Scapular Elevation: Against Gravity: Upper Fibers of Trapezius and Levator Scapulae

- **Start Position.** The patient is sitting. The shoulders are slightly abducted, and the elbows are flexed to 90 °.
- **Movement.** The patient elevates the shoulder girdle(s) to bring the acromion process closer to the ear.
- For the unilateral test, the therapist places the hand against the lateral aspect of the patient's head on the test side, maintaining the head in a neutral position to stabilize the origins of the muscles.
- **Palpation.** *Upper fibers of trapezius:* on a point of a line midway between the inion and the acromion process.
  Levator scapulae: too deep to palpate.
- **Substitute Movement.** Unilateral test: lowering ear to shoulder and contralateral trunk side flexion.
- **Resistance Location.** Applied over the top of the shoulder(s).
- **Resistance Direction.** Scapular depression.

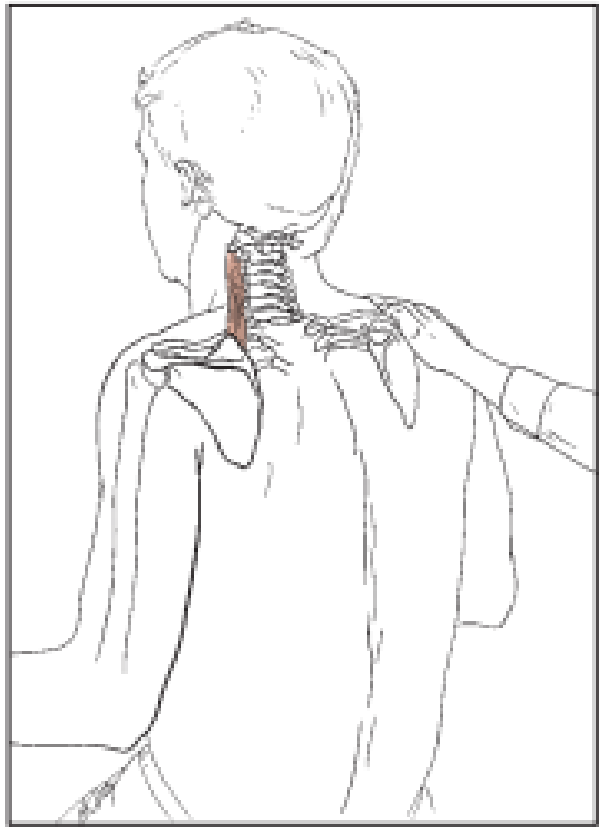


Figure 3-91 Levator scapulae.

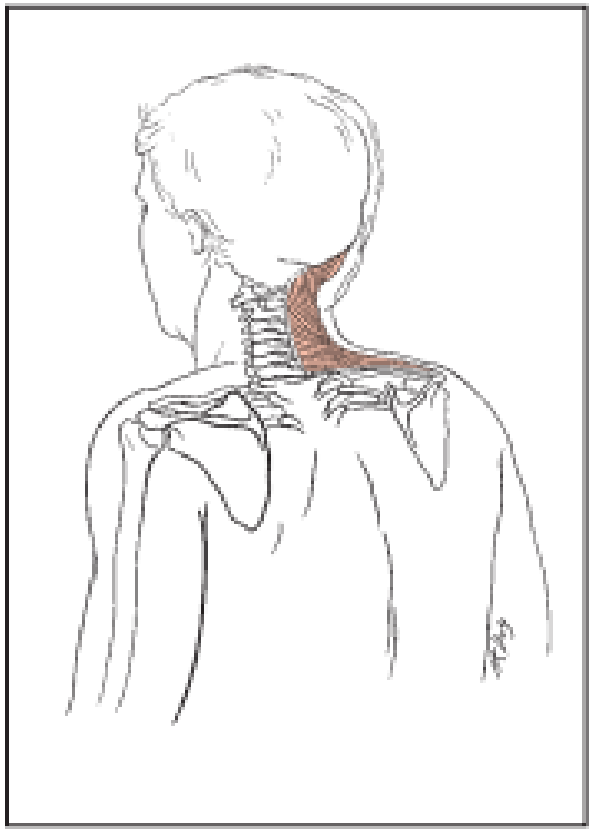


Figure 3-92 Upper fibers of trapezius.

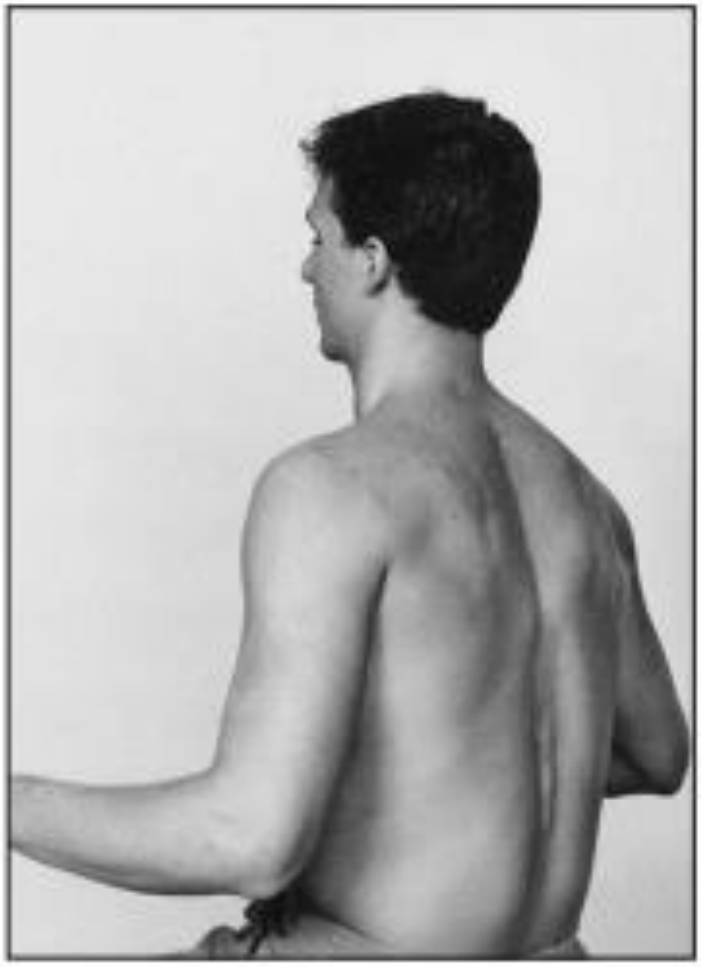


Figure 3-87 Start position: upper fibers of trapezius and levator scapulae.

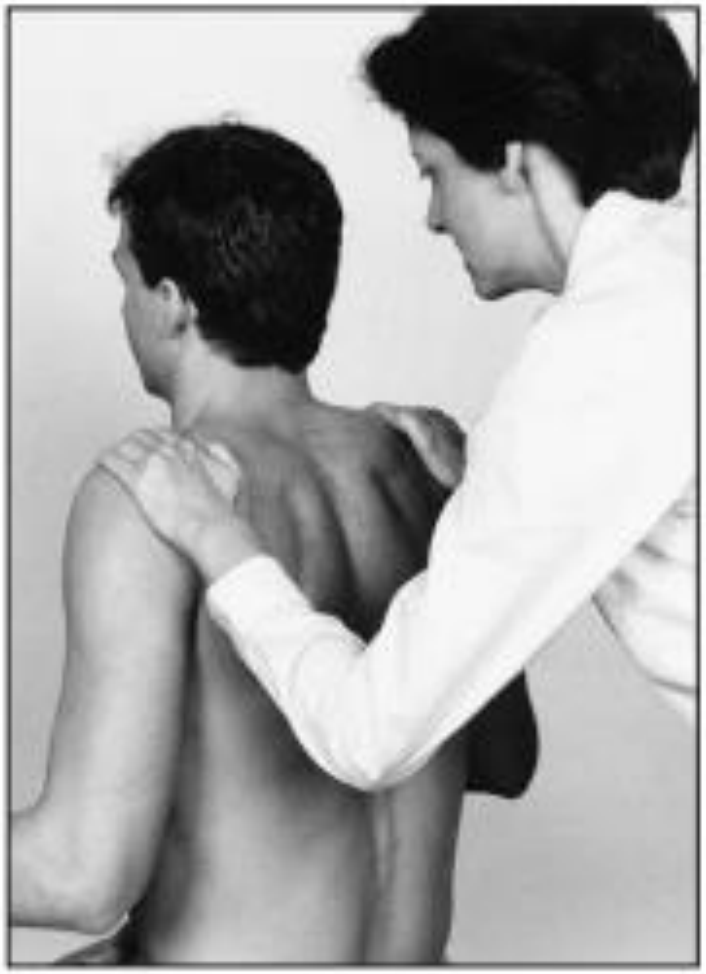


Figure 3-90 Resistance: upper fibers of trapezius and levator scapulae.

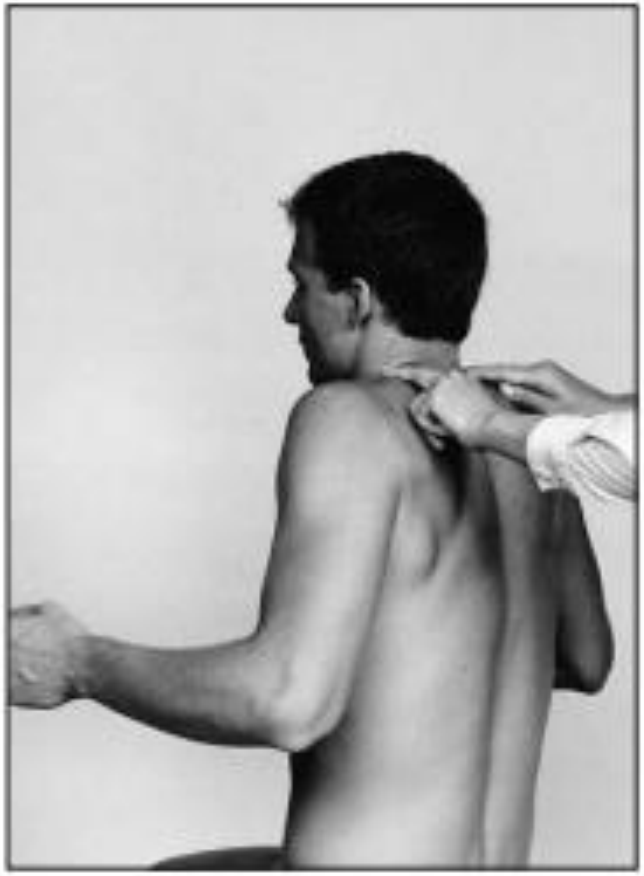


Figure 3-88 Screen position: bilateral test for upper fibers of trapezius and levator scapulae.

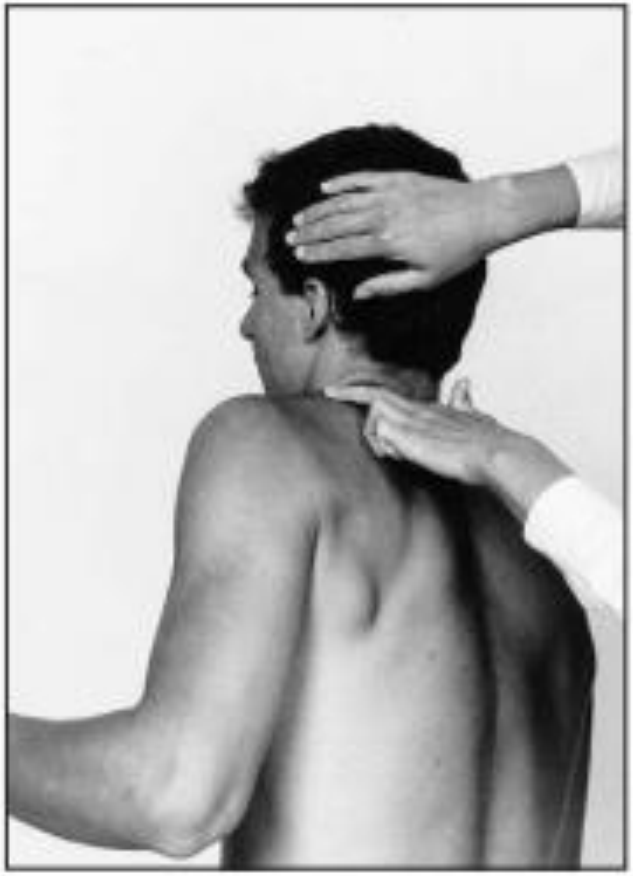


Figure 3-89 Screen position: unilateral test for upper fibers of trapezius and levator scapulae.

Gravity Eliminated: Upper Fibers of Trapezius and Levator Scapulae

- **Start Position.** The patient is prone. The arm is at the side, and the shoulder is in neutral rotation. The therapist supports the weight of the upper extremity to reduce the resistance of friction between the plinth and the upper extremity.
- **Stabilization.** The weight of the head.
- **End Position.** The patient elevates the scapula through full ROM.
- **Substitute Movement.** Contralateral trunk side flexion.
- **Alternate Test.**

If the patient is unable to assume a prone position, these muscles can be tested in the against gravity position of sitting using Isometric/Palpation Grading to assess the muscle strength for grades 2 or less. The therapist positions the shoulder girdle in elevation and palpates for the quality of muscle contraction while the patient attempts to hold the position.

Figure 3-93 Start position: upper fibers of trapezius and levator scapulae.

Figure 3-94 End position: upper fibers of trapezius and levator scapulae.

3. Scapular Adduction
Against Gravity: Middle Fibers of Trapezius

- **Accessory muscles:** trapezius (upper and lower fibers).
  The patient must have adequate shoulder horizontal abduction muscle strength to perform this test.
- **Start Position.** The patient is prone. The shoulder is abducted to 90° and laterally rotated so the thumb points toward the ceiling. The elbow is extended.
- **Stabilization.** The weight of the trunk. The therapist stabilizes the contralateral thorax as required, to prevent lifting of the trunk.
  Movement. The patient raises the arm toward the ceiling and adducts the scapula toward the midline
- **Palpation.** Between the medial (vertebral) border of the scapula and the vertebrae, above the spine of the scapula.
- **Substitute Movement.** Rhomboid major, rhomboid minor, ipsilateral trunk rotation, and shoulder horizontal abduction.

- **Resistance Location.** Applied at the distal forearm. In the presence of posterior deltoid muscle weakness, the arm hangs vertically over the edge of the plinth in 90° shoulder flexion and resistance is applied over the scapula.
- **Resistance Direction.** Scapular abduction.

Figure 3-95 Start position: middle fibers of trapezius.

Figure 3-96 Screen position: middle fibers of trapezius.

Figure 3-97 Resistance applied at distal forearm: middle fibers of trapezius.

Figure 3-98 Resistance applied over scapula: middle fibers of trapezius.

Gravity Eliminated: Middle Fibers of Trapezius

- **Start Position.** The patient is sitting. The shoulder is abducted to 90° and laterally rotated. The elbow is extended. The arm is supported by the therapist or on a powder board.
- **Stabilization.** The therapist instructs the patient to avoid trunk rotation.
- **End Position.** The patient adducts the scapula through full ROM.
- **Substitute Movement.** Shoulder horizontal abduction, and ipsilateral trunk rotation.
- **Alternate Test.** If the patient cannot assume a sitting posture, this muscle can be tested in the against gravity position of prone-lying using Isometric/Palpation Grading to assess the muscle strength for grades 2 or less. The therapist supports the upper extremity, positions the scapula in adduction, and palpates for the quality of muscle contraction while the patient attempts to hold the position.

Figure 3-99 Start position: middle fibers of trapezius.

Figure 3-100 End position: middle fibers of trapezius.

4. Scapular Adduction and Medial Rotation

Against Gravity: Rhomboid Major and Rhomboid Minor

- **Accessory muscles:** levator scapulae, middle fibers of trapezius.
- **Start Position.** The patient is prone. The dorsum of the hand is placed over the buttock of the non test side, and the shoulders remain relaxed.
- **Stabilization.** The weight of the trunk.
- **Movement.** The patient raises the arm away from the back. The weight of the raised upper extremity provides resistance to the scapular test motion.
- **Palpation.** On a point of an oblique line between the vertebral border of the scapula and C7 to T5. Rhomboid major can be palpated medial to the vertebral border of the scapula lateral to the lower fibers of trapezius, near the inferior angle of the scapula.
- **Substitute Movement.** Tipping the scapula forward through pectoralis minor.
- **Resistance Location.** Applied over the scapula. Ensure that resistance is not applied over the humerus. Isometric grading is preferred.
- **Resistance Direction.** Scapular abduction and lateral rotation.

Figure 3-101 Start position: rhomboids.

Figure 3-102 Screen position: rhomboids.

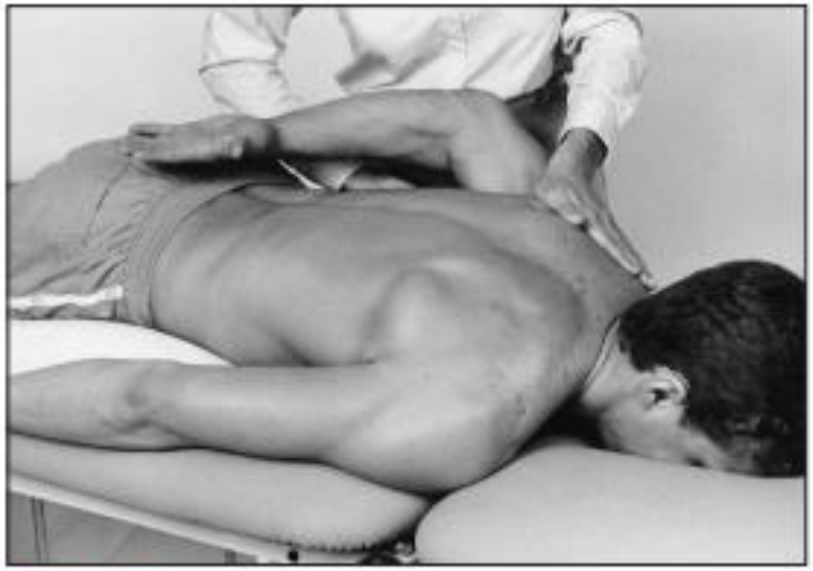
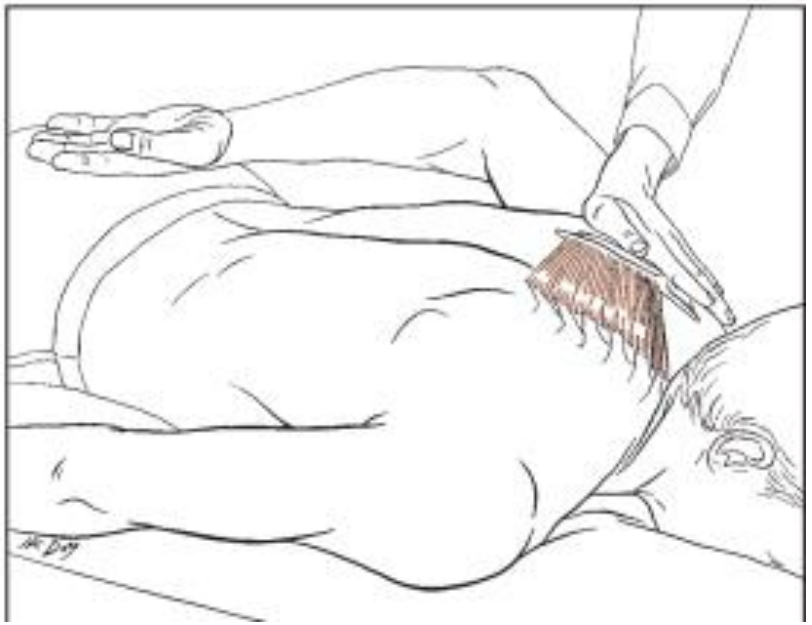


Figure 3-103 Resistance: rhomboids.



Gravity Eliminated: Rhomboid Major and Rhomboid Minor

- **Start Position.** The patient is sitting. The dorsum of the hand is placed over the non-test side buttock, and the shoulders remain relaxed.
- **Stabilization.** The therapist instructs the patient to avoid trunk forward flexion and/or ipsilateral trunk rotation.
- **End Position.** The patient adducts and medially rotates the scapula by moving the arm away from the back while maintaining the hand over the buttock.
- **Substitute Movement.** Ipsilateral trunk rotation and/or trunk forward flexion, and tipping the scapula forward.

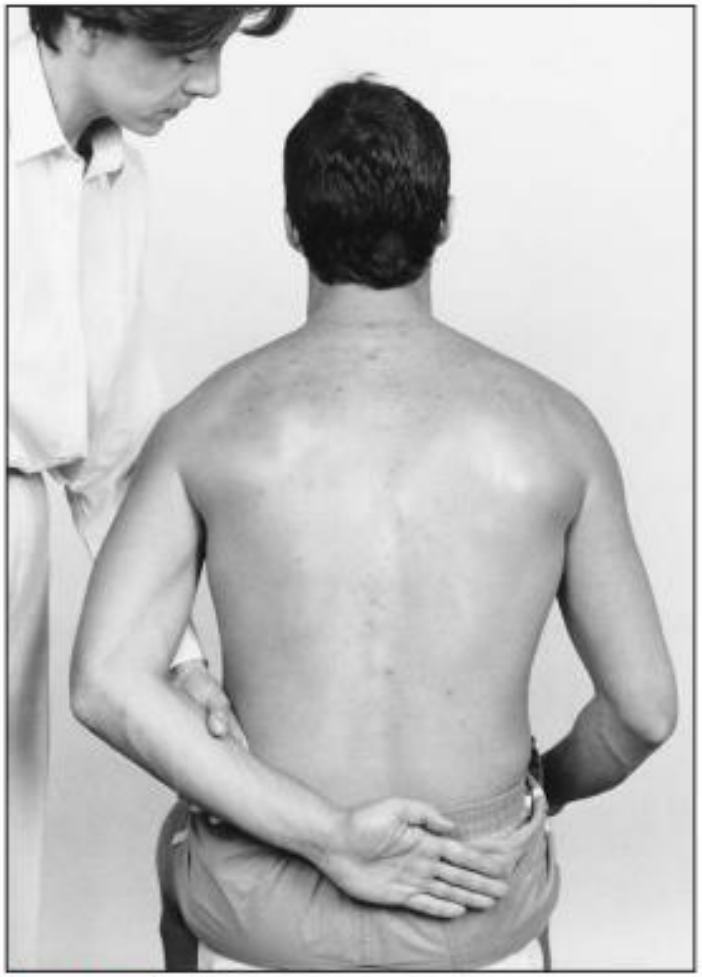


Figure 3-105 Start position: rhomboids.

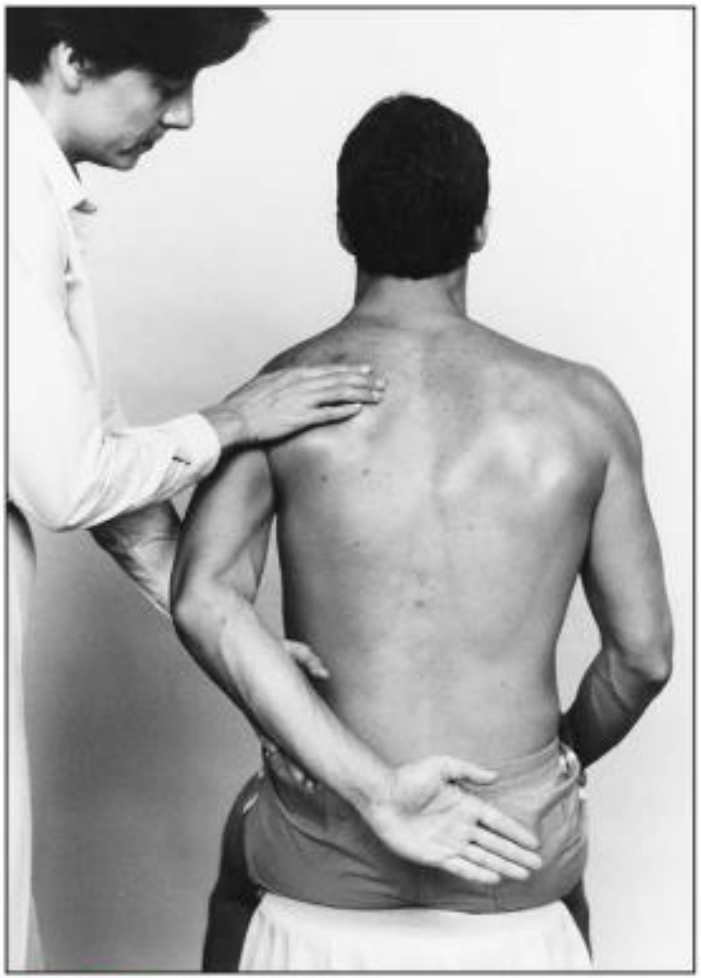


Figure 3-106 End position: rhomboids.

Alternate Test Against Gravity: Rhomboid Major and Rhomboid Minor

- **Accessory muscles:** levator scapulae, middle fibers of trapezius.
- **Start Position.** The patient is prone. The shoulder is adducted 0°, the elbow is flexed and the forearm pronated.
- **Stabilization.** The weight of the trunk.
- **Movement.** The patient raises the elbow upward and inward toward the opposite shoulder to extend and adduct the shoulder.
- **Palpation.** On a point of an oblique line between the vertebral border of the scapula and C7 to T5. Rhomboid major can be palpated medial to the vertebral border of the scapula lateral to the lower fibers of trapezius, near the inferior angle of the scapula.

- **Substitute Movement.** Tipping the scapula forward using pectoralis minor.
- **Resistance Location.** Applied proximal to the elbow joint on the posteromedial aspect of the humerus.
- **Resistance Direction.** Shoulder abduction and flexion.
- **For grades 2 or less.** Isometric/Palpation Grading is used to assess the muscle strength. The therapist supports the humerus in extension and adduction and palpates rhomboid major for the quality of muscle contraction while the patient attempts to hold the position

Figure 3-107 Start position: rhomboids.

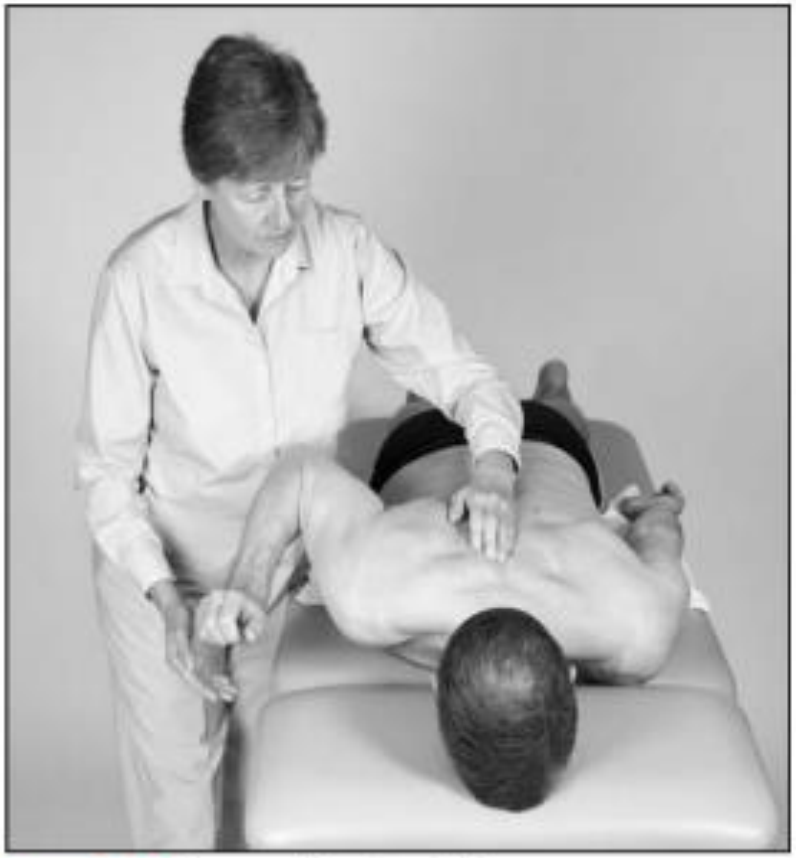


Figure 3-108 Screen position: rhomboids.

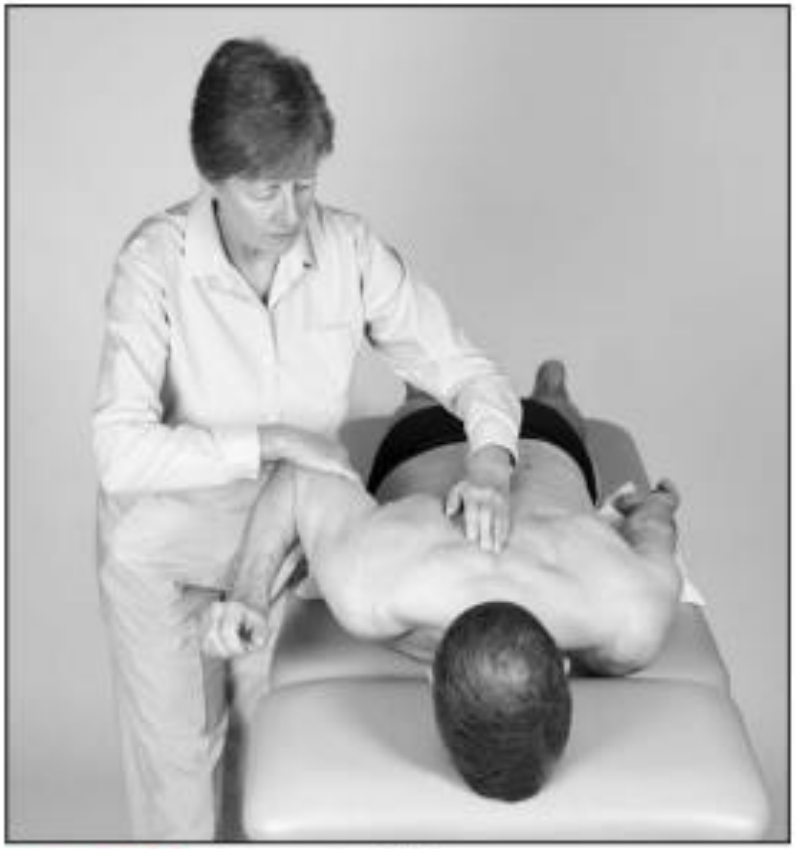


Figure 3-109 Resistance: rhomboids.

5. Scapular Depression and Adduction

Against Gravity: Lower Fibers of Trapezius

- **Accessory muscle:** middle fibers of trapezius.
- **Start Position.** The patient is prone. The head is rotated to the opposite side, and the shoulder is abducted to about 130°. Although the prone position is a gravity eliminated position for the movement of scapular depression, the lower fibers of trapezius, through the position of the arm, work against resistance of the weight of the arm.
- **Stabilization.** The weight of the trunk.
- **Movement.** The patient raises the arm to produce depression and adduction of the scapula.
- **Palpation.** Medial to the inferior angle of the scapula along a line between the root of the spine of the scapula and the T12 spinous process.
- **Substitute Movement.** Trunk extension, middle fibers of trapezius.

- **Resistance Location.** Isometric grading is preferred, and the resistance is applied over the scapula.
- **Resistance Direction.** Scapular elevation and abduction.

Figure 3-110 Start position: lower fibers of trapezius.

Figure 3-111 Screen position: lower fibers of trapezius.

Figure 3-112 Resistance: lower fibers of trapezius.

Figure 3-113 Lower fibers of trapezius.

Gravity Eliminated: Lower Fibers of Trapezius

- **Start Position.** The patient is prone with the arms by the sides. The therapist supports the arm through range, to reduce the resistance of friction between the plinth and the upper extremity.
- **Stabilization.** The weight of the trunk
- **End Position.** The patient depresses and adducts the scapula through full ROM.
- **Substitute Movement.** Ipsilateral trunk side flexion and middle fibers of trapezius.
- **Alternate Test.** If the patient cannot assume a sitting posture, this muscle can be tested in the against gravity position of prone-lying using Isometric/Palpation Grading to assess the muscle strength for grades 2 or less.

Figure 3-114 Start position: lower fibers of trapezius.

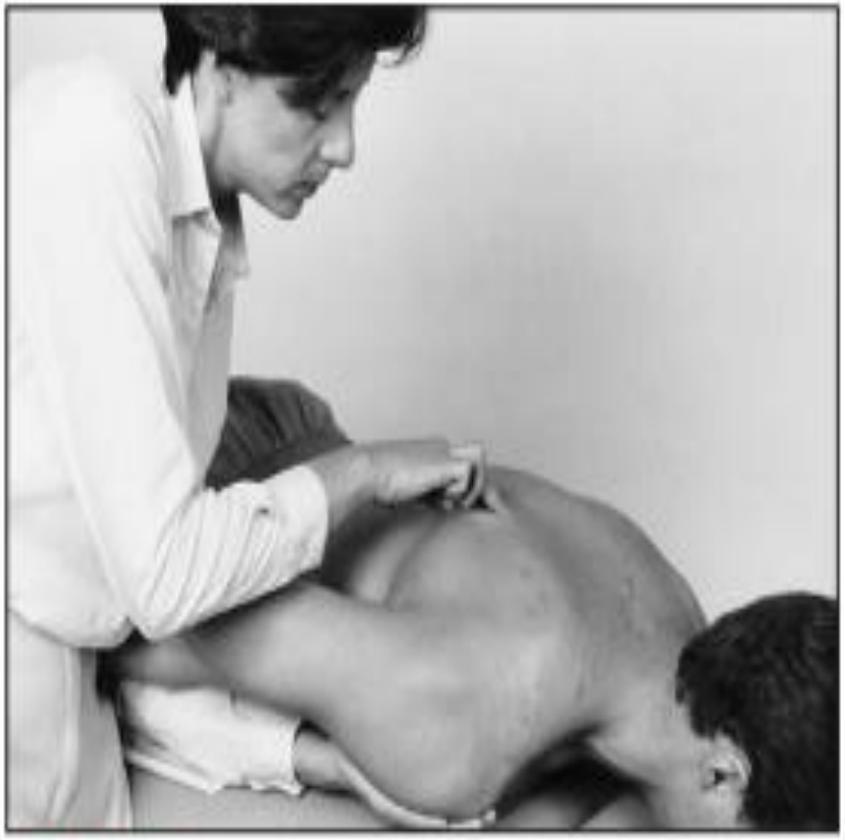


Figure 3-115 End position: lower fibers of trapezius.

سبحانك اللهم وبحمدك

أشهد أن لا إله إلا أنت أستغفرك وأتوب إليك

Thank you