CHAPTER 3

Testing the Muscles of the Neck

Testing the Muscles of the Neck

Introduction

The neck musculature contributes approximately 80% of the mechanical stability of the cervical spine.[1] Thus measurement of cervical muscle strength is important and relevant in many conditions. Trauma-related conditions such as whiplash or concussion, disease/disorder-related conditions such as rheumatoid arthritis and Guillain-Barré syndrome, and posture-ergonomic–related conditions make cervical muscle testing especially relevant.[2] A grade of 3 out of 5, the strength equivalent to moving against gravity, is sufficient for many functional activities but may not be sufficient to resist trauma such as concussion or a whiplash movement.[2] Because individuals with neck pain have reduced maximal isometric neck strength and endurance capacity, individuals with cervical pain should be manually muscle tested.[3]

Isometric measurement is the most common and reliable method of assessing cervical muscle strength and will be the only procedure discussed here. Because studies have shown the deep cervical flexors are inhibited more often in the presence of neck pain,[4] differentiation between the deep cervical flexors (longus capitus and colli), which are responsible for the chin tuck movement and which provide support of the cervical lordosis and the cervical joints,[5] and superficial cervical flexors (sternocleidomastoid and others), responsible for cervical flexion, is important.

Reliability of muscle testing of the cervical spine is affected by the lack of a fixed axis. This is particularly true with regard to the location of the thoracic support in prone extension. Significant torque differences were recorded (34 to 53 N) depending on the position of thoracic support.[6] Reliability is also affected by the lack of bilaterality for comparison purposes and the lack of reference values.

Cervical flexion muscle strength is influenced by the position of the neck and the maintenance of the normal lordosis. Cervical muscle strength is also affected by the position of the head over the thorax. In this text, we recommend resistance be placed at the mandible, below the chin.[2]

For testing the endurance of the short neck flexors, a systematic review recommended lifting the head with a slight chin tuck (page 36) as the most reliable (intercorrelation coefficient [ICC] >0.85).[3] Individuals with neck pain–related disorders have significantly less cervical strength and endurance.[3] Dvir and Prushansky found women's cervical spine strength to be approximately 40% that of men.[2]

As noted in Chapter 1, when obvious prime movers exist for a particular movement, they are bolded in the tables. However, in this chapter, there are no identifiable prime movers for capital extension, cervical extension, or capital flexion. It is the simultaneous contraction of a number of capital and cervical muscles that produces each of these three movements.

Capital Extension

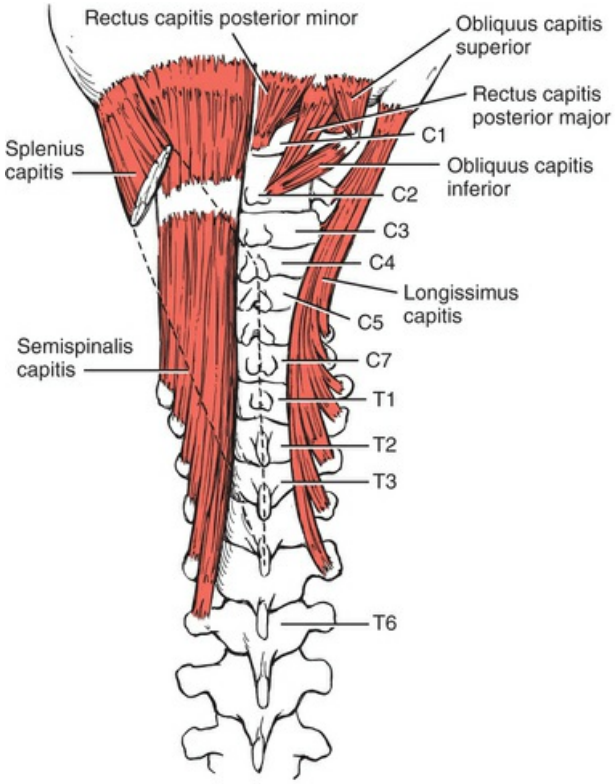


FIGURE 3.1

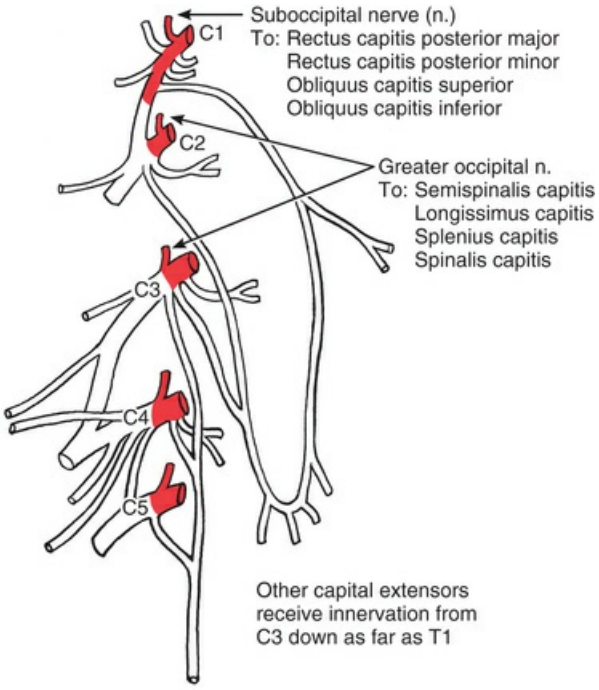


FIGURE 3.2

Range of Motion

0°–25°

Table 3.1
CAPITAL EXTENSION

I.D.	Muscle	Origin	Insertion	Function
56	Rectus capitis posterior major	Axis (spinous process)	Occiput (inferior nuchal line laterally)	Capital extension Rotation of head to same side Lateral bending of head to same side
57	Rectus capitis posterior minor	Atlas (tubercle of posterior arch)	Occiput (inferior nuchal line medially)	Capital extension
60	Longissimus capitis	T1-T5 vertebrae (transverse processes) C4-C7 vertebrae (articular processes)	Temporal bone (mastoid process, posterior surface)	Capital extension Lateral bending and rotation of head to same side
58	Obliquus capitis superior	Atlas (transverse process)	Occiput (between superior and inferior nuchal lines)	Capital extension of head on atlas (muscle on both sides) Lateral bending to same side (muscle on that side)
59	Obliquus capitis inferior	Axis (lamina and spinous process)	Atlas (transverse process, inferior-posterior surface)	Capital extension of head on atlas (muscle on both sides) Lateral bending to same side (muscle on that side)
61	Splenius capitis	Ligamentum nuchae C7-T4 vertebrae (spinous processes)	Temporal bone (mastoid process) Occiput (below superior nuchal line)	Capital extension Rotation of head to same side (debated) Lateral bending of head to same side
62	Semispinalis capitis (distinct medial part often named Spinalis capitis)	C7-T6 vertebrae (transverse processes) C4-C6 vertebrae (articular processes)	Occiput (between superior and inferior nuchal lines)	Capital extension (muscles on both sides) Rotation of head to opposite side (debated) Lateral bending of head to same side
63	Spinalis capitis	Medial part of Semispinalis capitis, usually blended inseparably	Occiput (between superior and inferior nuchal lines)	Capital extension

Grade 5 and Grade 4

Position of Patient:

Prone with head off end of table. Arms at sides.

Instructions to Therapist:

Stand at side of patient next to the head. Ask the patient to tilt the head up and look at the wall. If sufficient range is present, use one hand to provide resistance over the occiput (Fig. 3.3). Place the other hand beneath the overhanging head to support it should it give way with resistance. Resistance is applied directly opposite to the movement of the tilt of the head. Care should be made to test the head tilt, and not push the neck into flexion.

FIGURE 3.3

Test:

Patient extends head by tilting chin upward. (Cervical spine is not extended.)

Instructions to Patient:

"Look at the wall. Hold it. Don't let me push your head down."

Grading

Grade 5:

Patient completes available range of motion without substituting cervical extension. Tolerates maximum resistance. (This is a strong muscle group.)

Grade 4:

Patient completes available range of motion without substituting cervical extension. Tolerates strong to moderate resistance.

Grade 3

Position of Patient:

Prone with head off end of table, with head supported by therapist. Arms at sides.

Instructions to Therapist:

Stand at side of patient's head. One hand should remain under the head to support it should the muscles fail to hold position (Fig. 3.4).

FIGURE 3.4

Instructions to Patient:

"Look at the wall."

Test:

Patient completes available range without resistance.

Grade 2, Grade 1, and Grade 0

Position of Patient:

Supine with head on table. Arms at sides. Note: The gravity-minimized position (side-lying) is not recommended for any of the tests of the neck for Grades 2 and below because test artifacts are created by the therapist in attempting to support the head without aiding the motion.

Instructions to Therapist:

Stand at end of table, facing patient. Support the head with two hands under the occiput. Place fingers just at the base of the occiput, lateral to the vertebral column to attempt to palpate the capital extensors (Fig. 3.5). Head may be slightly lifted off table to reduce friction.

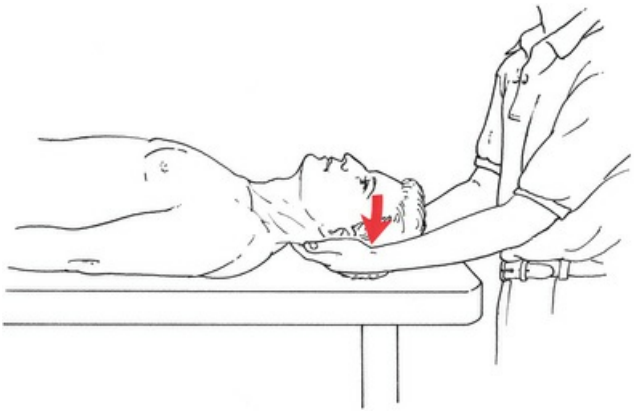


FIGURE 3.5

Test:

Patient attempts to look back toward therapist without lifting the head from the table.

Instructions to Patient:

"Tilt your chin up," OR "Look back at me. Don't lift your head."

Grading

Grade 2:

Patient completes limited range of motion.

Grade 1 and Grade 0:

Palpation of the capital extensors at the base of the occiput just lateral to the spine may be difficult; the splenius capitis lies most lateral, and the recti lie just next to the spinous process.

Helpful Hint

Clinicians are reminded that the head is a heavy object suspended on thin support (neck). Whenever testing with the patient's head off the table, care should be used for the patient's safety and comfort, especially in the presence of suspected or known neck or trunk weakness or pain. Always place a hand under the head to be ready to support it should the muscles give way.

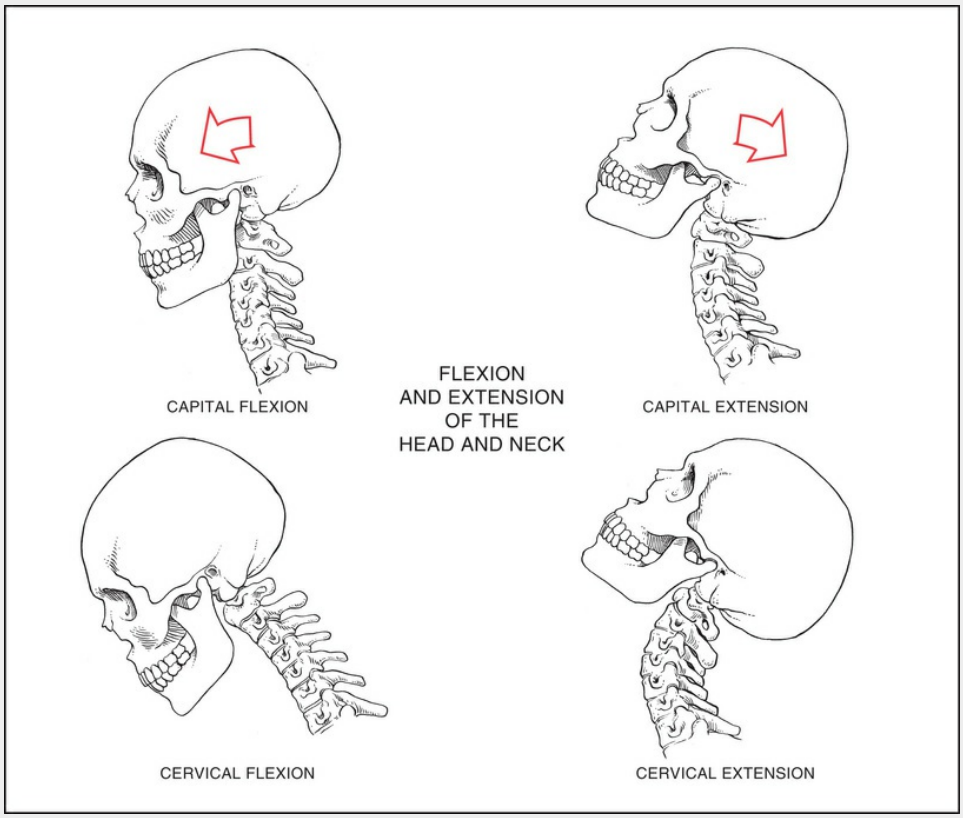

FLEXION
AND EXTENSION
OF THE
HEAD AND NECK
CAPITAL FLEXION
CAPITAL EXTENSION
CERVICAL FLEXION
CERVICAL EXTENSION

PLATE 1

Cervical Extension

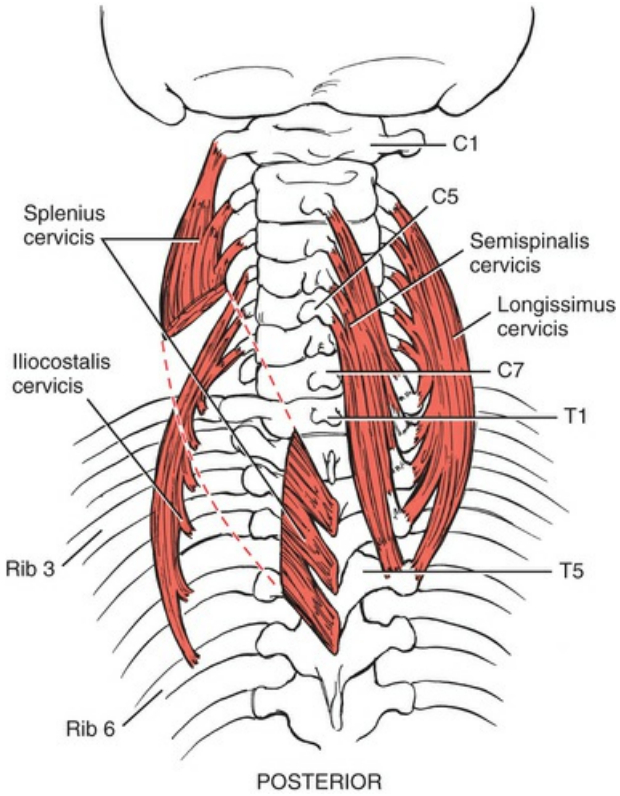


FIGURE 3.6

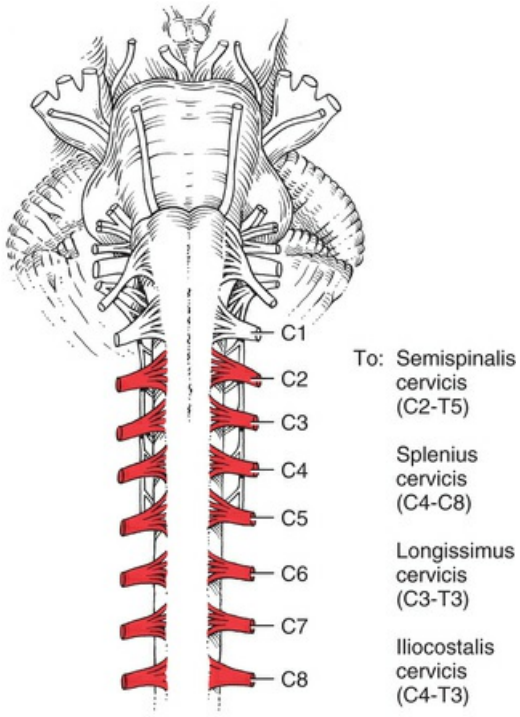


FIGURE 3.7

Range of Motion

0° to <30°

Table 3.2
CERVICAL EXTENSION

I.D.	Muscle	Origin	Insertion	Function
64	Longissimus cervicis	T1-T5 vertebrae (transverse processes) variable	C2-C6 vertebrae (transverse processes)	Extension of the cervical spine (both muscles) Lateral bending of cervical spine to same side (one muscle)
65	Semispinalis cervicis	T1-T5 vertebrae (transverse processes)	Axis (C2)-C5 vertebrae (spinous processes)	Extension of the cervical spine (both muscles) Rotation of cervical spine to opposite side (one muscle) Lateral bending to same side
66	Iliocostalis cervicis	Ribs 3-6 (angles)	C4-C6 vertebrae (transverse processes, posterior tubercles)	Extension of the cervical spine (both muscles) Lateral bending to same side (one muscle) Depression of ribs (accessory)
67	Splenius cervicis (may be absent or variable)	T3-T6 vertebrae (spinous processes)	C1-C3 vertebrae (transverse processes)	Extension of the cervical spine (both muscles) Rotation of cervical spine to same side (one muscle) Lateral bending to same side (one muscle) Synergistic with opposite sternocleidomastoid
124	Trapezius (upper)	Occiput (protuberance and superior nuchal line, middle 1/3) C7 (spinous process) Ligamentum nuchae T1-T12 vertebrae occasionally	Clavicle (posterior border of lateral 1/3)	Elevation of scapula and shoulder ("shrugging") (with levator scapulae) Rotation of head to opposite side (one) Capital extension (both) Cervical extension (both)
68	Spinalis cervicis (often absent)	C7 and often C6 vertebrae (spinous processes) Ligamentum nuchae T1-T2 vertebrae occasionally	Axis (spinous process) C2-C3 vertebrae (spinous processes)	Extension of the cervical spine
Others				
69	Interspinales cervicis			
70	Intertransversarii cervicis			
71	Rotatores cervicis			
94	Multifidi			
127	Levator scapulae			

The cervical extensor muscles are limited to those that act only on the cervical spine with motion centered in the lower cervical spine.

Grade 5 and Grade 4

Position of Patient:

Prone with head off end of table. Arms at sides.

Instructions to Therapist:

Stand next to patient's head. Ask patient to lift head while looking at the floor. If sufficient range is present, place hand applying resistance over the parieto-occipital area (Fig. 3.8). Place the other hand below the chin, ready to support the head should it suddenly give way during resistance.

FIGURE 3.8

Test:

Patient extends neck without tilting chin.

Instructions to Patient:

"Push up on my hand but keep looking at the floor. Hold it. Don't let me push it down."

Grading

Grade 5:

Patient holds test position against strong resistance. Therapist must use clinical caution because these muscles are not strong, and their maximum effort will not tolerate much resistance.

Grade 4:

Patient holds test position against moderate resistance.

Grade 3

Position of Patient:

Prone with head off end of table. Arms at sides.

Instructions to Therapist:

Stand next to patient's head with one hand supporting (or ready to support) the forehead (Fig. 3.9).

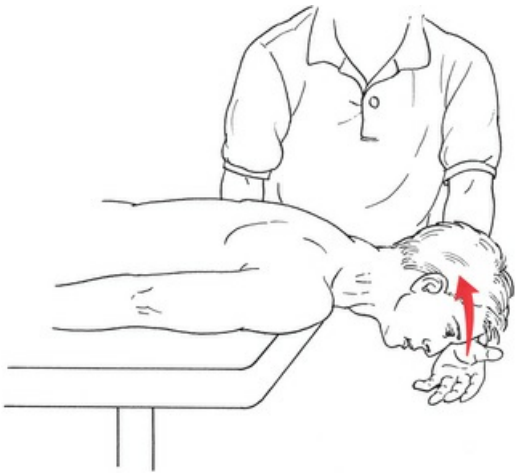


FIGURE 3.9

Test:

Patient extends neck without looking up or tilting chin.

Instructions to Patient:

"Lift your forehead from my hand, and keep looking at the floor."

Grading

Grade 3:

Patient holds test position but without resistance.

Alternate Test for Grade 3:

This test should be used if there is known or suspected trunk extensor weakness. The therapist should always have an assistant participate to provide protective guarding under the patient's forehead. This test is identical to the preceding Grade 3 test except that stabilization is provided by the therapist to the upper back by the forearm placed over the upper back with the hand cupped over the shoulder (Fig. 3.10).

FIGURE 3.10

Grade 2, Grade 1, and Grade 0

Position of Patient:

Supine with head fully supported by table. Arms at sides.

Instructions to Therapist:

Stand at the patient's head, facing the patient. Place both hands under the patient's head. Fingers should be distal to the occiput at the level of the cervical vertebrae for palpation (Fig. 3.11). Ask patient to push head into therapist's hands without any tilt.

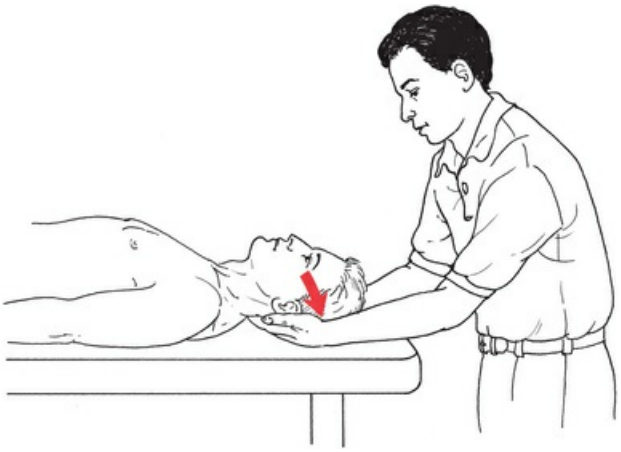


FIGURE 3.11

Test:

Patient attempts to extend neck into table without tilt.

Instructions to Patient:

"Try to push your head down into my hands."

Grading

Grade 2:

Patient moves through small range of neck extension by pushing into therapist's hands.

Grade 1:

Contractile activity palpated in cervical extensors.

Grade 0:

No discernable palpable muscle activity.

Helpful Hint

Patients with a loss of cervical lordosis may have weak cervical extensors. Weak cervical extensors may be a risk factor for cervical kyphosis and dropped head syndrome.[7]

Capital Flexion (Chin Tuck)

(Deep cervical flexors)

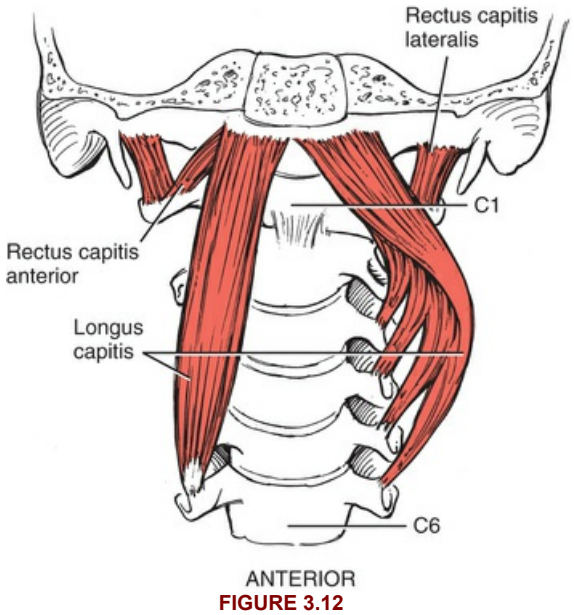


FIGURE 3.12

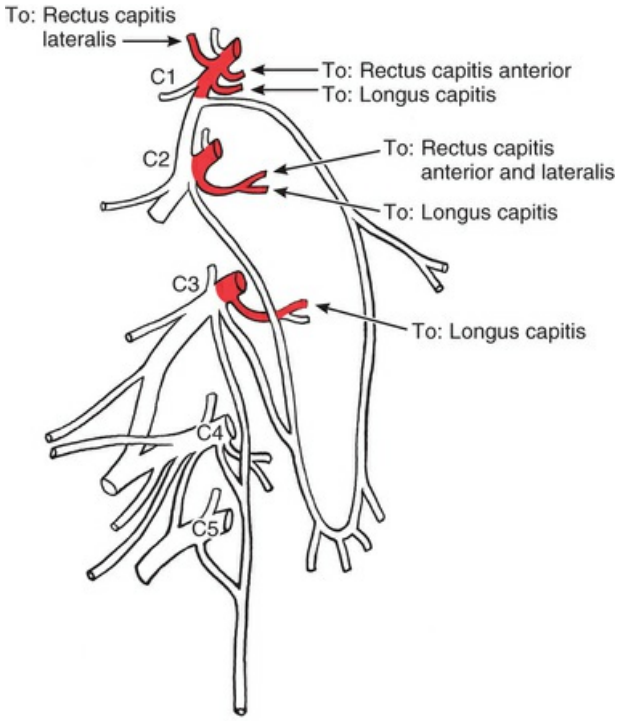


FIGURE 3.13

Range of Motion

0°–10°–15°

Table 3.3
CAPITAL FLEXION (CHIN TUCK)

I.D.	Muscle	Origin	Insertion	Function
72	Rectus capitis anterior	Atlas (C1) transverse process and lateral mass	Occiput (basilar part, inferior surface)	Capital flexion Stabilization of atlanto-occipital joint
73	Rectus capitis lateralis	Atlas (transverse process)	Occiput (jugular process)	Lateral bending of head to same side (obliquity of muscle) Assists head rotation Stabilizes atlanto-occipital joint (assists) Capital flexion
74	Longus capitis	C3-C6 vertebrae (transverse processes, anterior tubercles)	Occiput (basilar part, inferior surface)	Capital flexion Rotation of head to same side (muscle of one side)
Others				
Suprahyoids				
75	Mylohyoid			
76	Stylohyoid			
77	Geniohyoid			
78	Digastric			

The deep cervical flexors (longus capitus, rectus capitis, and colli) achieve capital flexion (nodding), called the chin tuck movement. Only the longus capitis can affect the cervical motion segments other than the atlanto-occiput joint (cranium-C1) because of its inferior attachment to the C6 vertebrae.[8] The weight of the head makes up 1/7 of the body weight. Forward head posture (FHP) is the structural forward positioning of the head away from the centerline of the body. In FHP the upper cervical vertebrae are extended and the lower cervical vertebrae are flexed, increasing the force required to support the head by up to 3.6 times more than normal aligned posture.[9] In FHP, there is increased extension in the upper cervical joints and at the atlanto-occipital joint, causing the face to be directed upward (Fig. 3.14). FHP results in lengthening of the lower cervical flexors (sternocleidomastoid, scalenes, and upper cervical [capital] extensors) and results in weakness of the lower cervical extensors and upper capital flexors. FHP is commonly accompanied by thoracic kyphosis.

FIGURE 3.14

Starting Position of Patient:

In all capital and cervical tests the patient is supine with head supported on table and arms at sides (Fig. 3.15). The therapist should be aware of and avoid the tendency of the patient to use the thoracic extensors to retract the head and cervical spine when exerting a maximal effort during the testing of capital flexion.

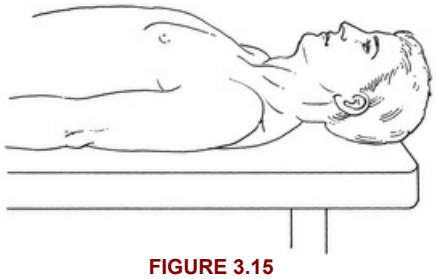


FIGURE 3.15

Grade 5 and Grade 4

Position of Patient:

Supine with head on table. Arms at sides.

Instructions to Therapist:

Stand at head of table, facing patient. Ask patient to tuck chin. If sufficient range is present, place cupped hands under the mandible to give resistance against chin tuck, in an upward direction (Fig. 3.16).

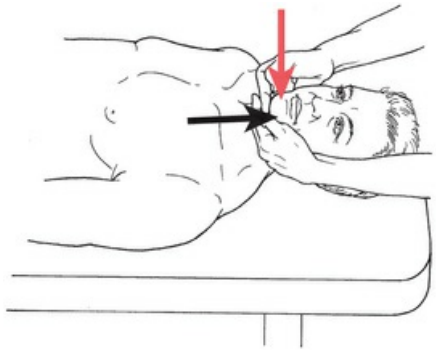


FIGURE 3.16

Test:

Patient tucks chin into neck without raising head from table. No motion should occur at the cervical spine. This is the motion of nodding.

Instructions to Patient:

"Tuck your chin and keep your eyes straight ahead. Don't lift your head from the table. Hold it. Don't let me lift up your chin."

Grading

Grade 5:

Patient holds test position against maximum resistance. These are very strong muscles.

Grade 4:

Patient holds test position against moderate resistance.

Grade 3

Position of Patient:

Supine with head supported on table. Arms at sides.

Instructions to Therapist:

Stand at head of table, facing patient.

Test:

Patient tucks chin without lifting head from table (Fig. 3.17).

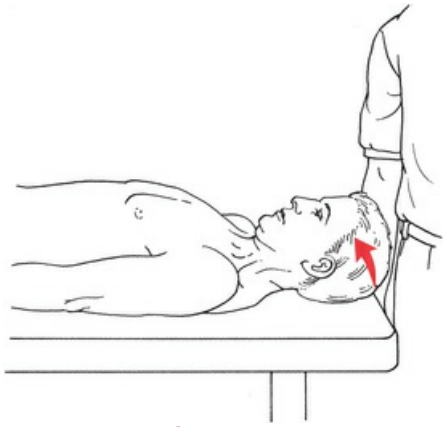


FIGURE 3.17

Instructions to Patient:

"Tuck your chin into your neck. Do not raise your head from the table."

Grading

Grade 3:

Patient completes available range of motion without resistance.

Grade 2, Grade 1, and Grade 0

Position of Patient:

Supine with head supported on table. Arms at sides.

Instructions to Therapist:

Stand at head of table, facing patient. Ask patient to tuck chin.

Test:

Patient attempts to tuck chin (Fig. 3.18).

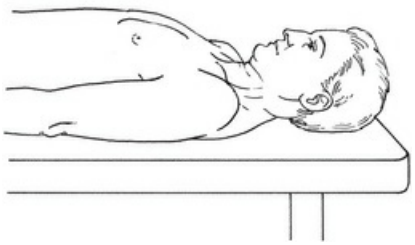


FIGURE 3.18

Instructions to Patient:

"Try to tuck your chin into your neck."

Grading

Grade 2:

Patient completes partial range of motion.

Grade 1:

Contractile activity may be palpated in capital flexor muscles, but it is difficult and only minimal pressure should be used.

Grade 0:

No discernable contractile activity.

Helpful Hints

- Palpation of the small and deep muscles of capital flexion may be a difficult task unless the patient has severe atrophy. It is NOT recommended that much pressure be put on the neck when palpating. Remember that the ascending arterial supply (carotids) to the brain runs quite superficially in this region.
- In patients with lower motor neuron lesions that do not affect the cranial nerves, capital flexion is seldom lost. This can possibly be attributed to the suprahyoid muscles, which are innervated by cranial nerves. Activity of the suprahyoid muscles can be identified by control of the floor of the mouth and the tongue, as well as by the absence of impairment of swallowing or speech.[10]
- When capital flexion is impaired or absent, there usually is serious impairment of the cranial nerves, and other central nervous system (CNS) signs are present that may require further evaluation by the physical therapist.
- Endurance as assessed by the cervical flexion test (Grade 3) decreases approximately ⅓ with neck pain (40 seconds compared with 23 seconds).[11]
- Forward head posture (FHP) is common in individuals who sit for long periods viewing a screen or who use bifocals (see Fig. 3.14).
- Capital flexors may be weak in the presence of FHP.
- For those patients with a thoracic kyphosis that is severe enough to prevent the head from lying flat or even reaching the table in a supine position, use pillows to support the cervical area so the head is in line with the trunk, before testing.

Cervical Flexion

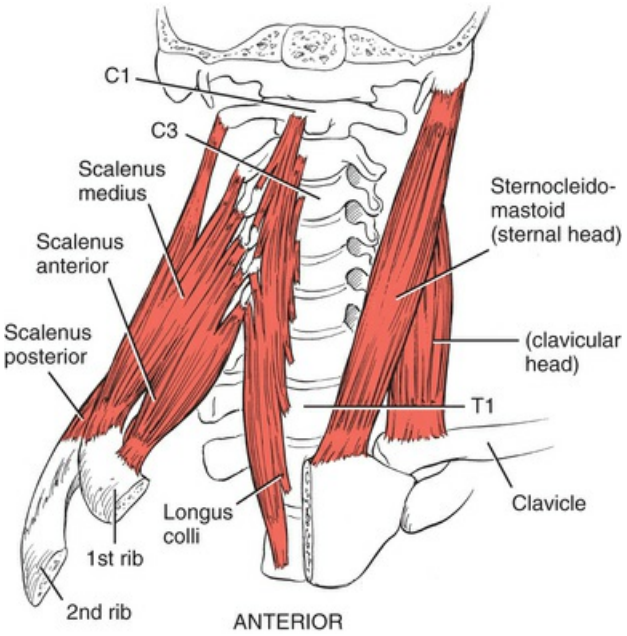
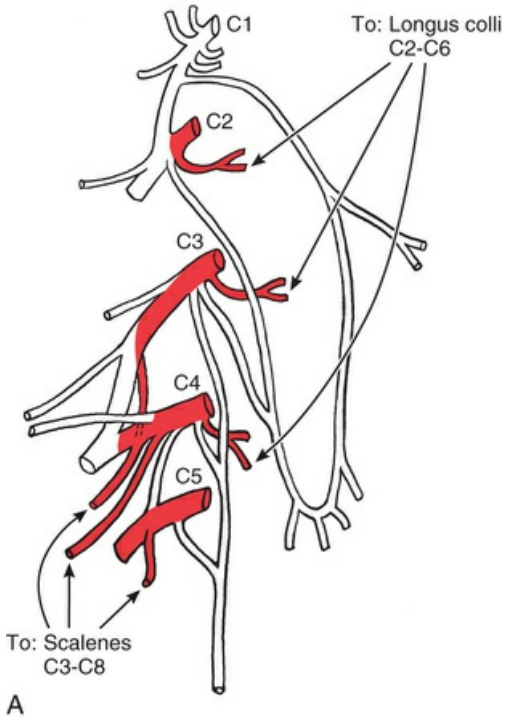


FIGURE 3.19



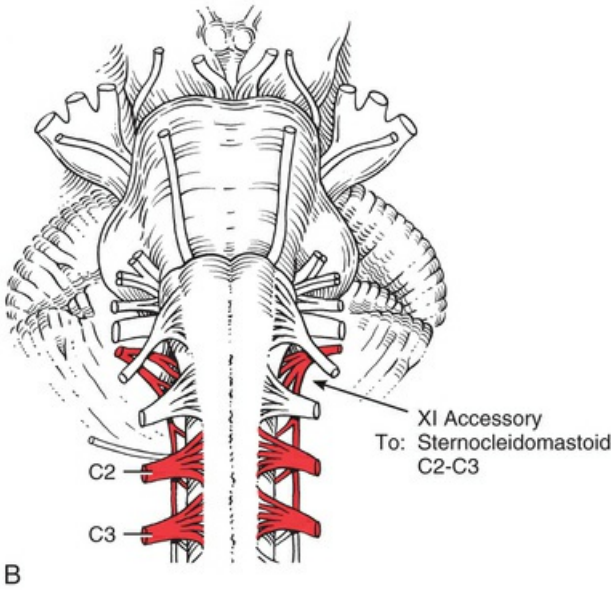


FIGURE 3.20

Range of Motion

0°–35°–45°

Table 3.4
CERVICAL FLEXION

I.D.	Muscle	Origin	Insertion	Function
83	Sternocleidomastoid			Flexion of cervical spine (both muscles) Lateral bending of cervical spine to same side Rotation of head to opposite side Capital extension (posterior fibers) Raises sternum in forced inspiration
	Sternal head	Sternum (Manubrium, upper anterior aspect)	Two heads blend in middle of neck; occiput (lateral half of superior nuchal line)	
	Clavicular head	Clavicle (medial - 1/3 superior and anterior surfaces)	Temporal bone (mastoid process)	
79	Longus colli			Cervical flexion (weak) Cervical rotation to opposite side (inferior oblique head) Lateral bending (superior and inferior oblique heads) (debatable)
	Superior oblique head	C3-C5 vertebrae (transverse processes)	Atlas (anterior arch, tubercle)	
	Vertical intermediate head	T1-T3 and C5-C7 vertebrae (anterolateral bodies)	C2-C4 vertebrae (anterior bodies)	
	Inferior oblique head	T1-T3 vertebrae (anterior bodies)	C5-C6 vertebrae (transverse processes, anterior tubercles)	
80	Scalenus anterior	C3-C6 vertebrae (transverse processes, anterior tubercles)	First rib (scalene tubercle)	Flexion of cervical spine (both muscles) Elevation of 1st rib in inspiration Rotation of cervical spine to same side Lateral bending of neck to same side
Others				
81	Scalenus medius			
82	Scalenus posterior			
Infrahyoids				
84	Sternothyroid			
85	Thyrohyoid			
86	Sternohyoid			
87	Omohyoid			

The muscles of cervical flexion act only on the cervical spine with the center of motion in the lower cervical spine.[12,13] The chin tuck position should be gently maintained when testing the cervical flexors, avoiding an extended cervical position.

Grade 5 and Grade 4

Position of Patient:

Supine, with knees bent and feet on the table (hook lying), arms at side.[3]

Instructions to Therapist:

Stand next to patient's head. Ask patient to lift head from table while keeping chin tucked in with eyes towards ceiling. If sufficient range is present, place hand for resistance on patient's chin. Use two fingers only (Fig. 3.21). Other hand may be placed on chest, but stabilization is needed only when the trunk is weak.

FIGURE 3.21

Test:

Patient lifts head straight up from the table while tucking the chin. This is a weak muscle group.

Instructions to Patient:

"Lift your head from the table; keep your chin tucked in while looking at the ceiling. Do not lift your shoulders off the table. Hold it. Don't let me push your head down."

Grading

Grade 5 and Grade 4:

Patient able to hold test position against moderate to mild two-finger resistance.

Grade 3

No resistance is used (Fig. 3.22).

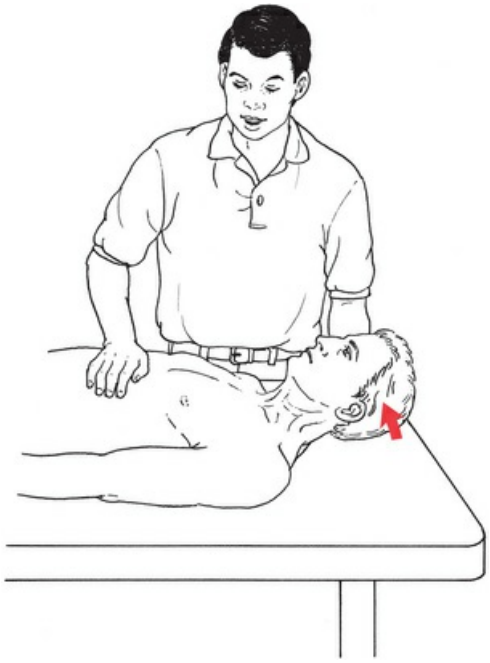


FIGURE 3.22

Grade 2, Grade 1, and Grade 0

Position of Patient:

Supine with head supported on table. Arms at sides.

Instructions to Therapist:

Stand at head of table, facing patient. Fingers of both hands (or just the index finger) are placed over the sternocleidomastoid muscles to palpate them during test (Fig. 3.23).

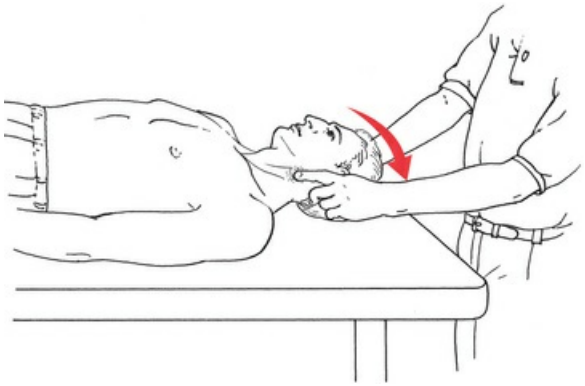


FIGURE 3.23

Test:

Patient rolls head from side to side, keeping head supported on table.

Instructions to Patient:

"Roll your head to the left and then to the right."

Grading

Grade 2:

Patient completes partial range of motion. The right sternocleidomastoid produces the roll to the left side and vice versa.

Grade 1:

No motion occurs, but contractile activity in one or both muscles can be detected.

Grade 0:

No motion and no discernable contractile activity detected.

Substitution

The platysma may attempt to substitute for weak or absent sternocleidomastoid muscles during cervical or combined flexion. When this occurs, the corners of the mouth pull down; a grimacing expression or "What do I do now?" expression is seen. Superficial muscle activity will be apparent over the anterior surface of the neck, with skin wrinkling.

Flexion to Isolate a Single Sternocleidomastoid

Range of Motion

0°–45°–55°

This test should be performed when there is suspected or known asymmetry of strength in these neck flexor muscles.

Grade 5, Grade 4, and Grade 3

Position of Patient:

Supine with head supported on table and turned to the left (to test right sternocleidomastoid).

Instructions to Therapist:

Stand at head of table, facing patient. Ask patient to raise head from table while keeping the head turned. If sufficient range is present, place hand applying resistance on the temporal area above the ear for resistance (Fig. 3.24).

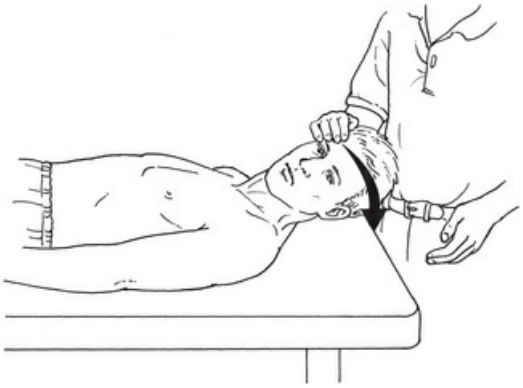


FIGURE 3.24

Test:

Patient raises head from table.

Instructions to Patient:

"Lift up your head, keeping your head turned."

Grading

Grade 5:

Patient holds test position and tolerates strong resistance. This is usually a very strong muscle group.

Grade 4:

Patient holds test position and tolerates moderate resistance.

Grade 3:

Patient completes available range of motion without resistance (Fig. 3.25).

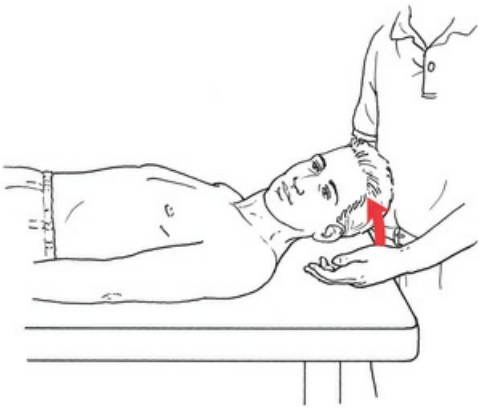


FIGURE 3.25

Grade 2, Grade 1, and Grade 0

Position of Patient:

Supine with head supported on table.

Instructions to Therapist:

Stand at head of table, facing patient. Place fingers (or just the index finger) alongside the head and neck to palpate the sternocleidomastoid (see Fig. 3.23).

Test:

Patient attempts to roll head from side to side.

Instructions to Patient:

"Roll your head to the right and then to the left."

Grading

Grade 2:

Patient completes partial range of motion.

Grade 1:

Palpable contractile activity in the sternocleidomastoid but no movement.

Grade 0:

No discernable contractile activity.

Cervical Rotation

Fifty percent of the total neck rotation occurs between C1 and C2, before any rotation is noted throughout the remainder of the cervical spine.[14]

Grade 5, Grade 4, and Grade 3

Position of Patient:

Supine with cervical spine in neutral (flexion and extension). Head supported on table with face turned as far to one side as possible. Sitting is an alternative position for all tests.

Instructions to Therapist:

Stand at head of table, facing patient. Ask patient to turn head. If sufficient range exists, place hand for resistance over the side of the patient's head above the ear (Grades 5 and 4 only).

Test:

Patient rotates head to neutral against maximum resistance. This is a strong muscle group. Repeat for rotators on the opposite side. Alternatively, have patient rotate from left side of face on table to right side of face on table.

Instructions to Patient:

"Turn your head and face the ceiling. Hold it. Do not let me turn your head back."

Grading

Grade 5:

Patient holds test position with maximum resistance.

Grade 4:

Patient holds test position with moderate resistance.

Grade 3:

Patient rotates head through full available range of motion to both right and left without resistance.

Grade 2, Grade 1, and Grade 0

Position of Patient:

Sitting. Trunk and head may be supported against a high-back chair. Head posture neutral.

Instructions to Therapist:

Stand directly in front of patient.

Test:

Patient tries to rotate head from side to side, keeping the neck in neutral (chin neither down nor up).

Instructions to Patient:

"Turn your head as far to the left as you can. Keep your chin level." Repeat for turn to right.

Grading

Grade 2:

Patient completes partial range of motion.

Grade 1:

Contractile activity in sternocleidomastoid or posterior muscles visible or evident by palpation. No movement.

Grade 0:

No discernable palpable contractile activity.

Participating Muscles in Cervical Rotation (with reference numbers)

56. Rectus capitis posterior major
59. Obliquus capitis inferior
60. Longissimus capitis
61. Splenius capitis
62. Semispinalis capitis
65. Semispinalis cervicis
67. Splenius cervicis
71. Rotatores cervicis
74. Longus capitis
79. Longus colli (Inferior oblique)
80. Scalenus anterior
81. Scalenus medius
82. Scalenus posterior
83. Sternocleidomastoid
124. Trapezius
127. Levator scapulae

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