

Marcello Cherchi's notes for Gross Anatomy

HEAD and NECK

Last updated: 3/3/2000

(Please let me know of any errors! mchercl@uic.edu)

References:

- BU BURT, Alvin M., *Textbook of Neuroanatomy*. Philadelphia: W.B. Saunders Company, 1993.
- CH CHUNG, Kyung Won, *Gross Anatomy*, 3rd ed. Baltimore: Williams & Wilkins, 1995.
- CL CLEMENTE, Carmine, *Anatomy: A Regional Atlas of the Human Body*, 4th ed. Baltimore: Williams & Wilkins, 1997.
- GR WILLIAMS, Peter L. and Roger WARWICK (eds.), *Gray's Anatomy*, 36th British ed. Philadelphia: W.B. Saunders Co., 1980.
- HA HAINES, Duane E., *Neuroanatomy: An Atlas of Structures, Sections, and Systems*, 5th ed. Philadelphia: Lippincott Williams & Wilkins, 2000.
- MA MOORE, Keith L. and Anne M. R. AGUR, *Essential Clinical Anatomy*. Baltimore: Williams & Wilkins, 1995.
- NE NETTER, Frank H., *Atlas of Human Anatomy*, 2nd ed. East Hanover, New Jersey: Novartis, 1998.
- RY ROHEN, Johannes W. and Chihiro YOKOCHI, *Color Atlas of Anatomy: A Photographic Study of the Human Body*, 2nd ed. New York and Tokyo: Igaku-Shoin, 1988.
- SA SADLER, Thomas W., *Langman's Medical Embryology*, 7th ed. Baltimore: Williams & Wilkins, 1995.
- SH JACOBS, John J., *Shearer's Manual of Human Dissection*, 7th ed. New York: McGraw-Hill, Inc., 1989.

Also see:

The M1 home page for anatomy: http://www2.uic.edu/stud_orgs/prof/M1/

SPINAL COLUMN, SPINAL CORD and DEEP BACK (from most superficial to deepest)

| Muscle | Innervations | Blood supplies | Origins | Insertions | Actions |
|---------------|---------------------|-----------------------|----------------|-------------------|----------------|
|---------------|---------------------|-----------------------|----------------|-------------------|----------------|

| | | | | | |
|---|------------------------------|--|--|--|---|
| Splenius (capitis, cervicis) | Dorsal rami of spinal nn. | | Arises from ligamentum nucae and spinous processes of C7-T3 or T4 vertebrae | <i>Splenius capitus</i> : fibers run superolaterally to mastoid process of temporal bone and lateral third of superior nuchal line of occipital bone. <i>Splenius cervicis</i> : posterior tubercles of transverse processes of C1-C3 or C4 vertebrae. | Acting alone (unilaterally) these mm. laterally bend and rotate head to side of active muscles. Acting together (bilaterally) they extend the head and neck. |
| ERECTOR SPINAE consist of three sets of muscles: | | | | | Acting unilaterally, they laterally bend the vertebral column. Acting bilaterally, they extend the vertebral column and head; as the back is flexed they control movement by gradually lengthening their fibers. |
| (1) Iliocostalis (cervicis, thoracis, lumborum) | Ditto | | Arises by a broad tendon from the posterior part of the iliac crest, posterior surface of the sacrum, sacral and inferior lumbar spinous processes, and supraspinous ligament. | Fibers run superiorly to angles of lower ribs and cervical transverse processes. | |
| (2) Longissimus (capitis, cervicis, thoracis) | Ditto | | Ditto | Fibers run superiorly to ribs between tubercles and angles, to transverse processes in thoracic and cervical regions, and to mastoid process of temporal bone. | |

| | | | | | |
|--|-------|--|--|--|--|
| (3) Spinalis (capitis, cervicis, thoracis) | Ditto | | Ditto | Fibers run superiorly to spinous processes in the upper thoracic region and to the skull | |
| TRANSVERSO-SPINALIS consist of three sets of muscles: | | | | | |
| (1) Semispinalis (capitis, cervicis, thoracis) | Ditto | | Arises from thoracic and cervical transverse processes. | Fibers run superomedially and attach to occipital bone and spinous processes in thoracic and cervical regions, spanning 4 to 6 segments. | Extend head and thoracic and cervical regions of vertebral column and rotate them contralaterally. |
| (2) Multifidus | Ditto | | Arises from sacrum and ilium, transverse processes of T1-T3, and articular processes of C4-C7. | Fibers pass superomedially to spinous processes spanning 2 to 4 segments. | Stabilizes vertebrae during local movements of vertebral column. |
| (3) Rotatores | Ditto | | Arise from transverse processes of vertebrae; best developed in the thoracic region. | Pass superomedially and attach to junction of lamina and transverse process of vertebra of origin or into spinous process above their origin, spanning 1 to 2 segments. | Stabilize vertebrae and assist with local extension and rotary movements of vertebral column. |
| Minor deep layer consists of three sets of muscles: | | | | | |
| (1) Interspinales | Ditto | | Superior surfaces of spinous processes of cervical and lumbar vertebrae. | Inferior surfaces of spinous processes of vertebrae superior to vertebrae of origin. | Aid in extension and rotation of vertebral column. |

| | | | | | |
|------------------------|--|--|--|--|--|
| (2) Intertransversarii | Dorsal and ventral rami of spinal nn. | | Transverse processes of cervical and lumbar vertebrae. | Transverse processes of adjacent vertebrae. | Aid in lateral bending of vertebral column; acting bilaterally, they stabilize vertebral column. |
| (3) Levatores costorum | Dorsal rami of C8-T11 spinal nn. | | Tips of transverse processes of C7 and T1-T11 vertebrae. | Pass inferolaterally and insert on rib between its tubercle and angle. | Elevate ribs, assisting inspiration; assist with lateral bending of vertebral column. |

See MA 205 fig. 5.3c for a transverse section displaying the relative disposition of these muscles.

Notes

From superficial to deep the following structures and spaces are encountered in the central nervous system (NE 149, 155; MA 211-4, 361-2; CH 244; CL 433):

- (1) The **epidural space**, containing the internal vertebral venous plexus and epidural fat. An epidural hematoma can be caused by arterial bleeding, frequently from the middle meningeal artery (see NE 96).
- (2) The **DURA MATER** (a meningeal layer). The dura mater descends inferiorly with the cauda equina and then narrows and forms the dural part of the filum terminale. The dura mater consists of two layers (MA 358):
 - (a) The **external endosteal (periosteal) layer** formed by the periosteum covering the internal surface of the calvaria.
 - (b) The **internal meningeal layer**.
- (3) The **subdural space**. Subdural hematoma or hemorrhage is usually the result of venous bleeding, especially from the superior cerebral veins (see NE 96).
- (4) The **ARACHNOID MATER** (a meningeal layer), which extends delicate trabeculae through the subarachnoid space to the pia mater. The subarachnoid space is filled with cerebrospinal fluid.
- (5) The **subarachnoid space**, containing cerebrospinal fluid. Subarachnoid hemorrhage usually is the result of bleeding from cerebral arteries; this blood will appear in the cerebrospinal fluid.
- (6) The **PIA MATER** (a meningeal layer). This layer is applied directly to the spinal cord. It has lateral extensions, called dentate (or “denticulate”) ligaments, which help to anchor the spinal cord in place. The pia mater extends below the most inferior part of the spinal cord, with the cauda equina, as the pial part of the filum terminale. Pial hemorrhages involve rupture of the small vessels of the pia and brain tissue (CH 293).

An older system of nomenclature used the term “pachymeninges” to refer to the dura mater, and the term “leptomeninges” to refer to both the arachnoid and pia mater.

Note that the **filum terminale** is a prolongation of the pia mater from the tip (conus medullaris) of the spinal cord at the level of approximately Lv2. It lies in the midst of the cauda equina and ends at the level of Sv2 by attaching to the apex of the dural sac. At this point it blends with the dura, and then the dura continues inferiorly as the filum of the dura mater (**coccygeal ligament**), which is attached to the dorsum of the coccyx (CH 246).

Clinical correlations

When the lamina of the vertebral arches do not meet and join in the midline, a cleft remains through which the meninges and often the spinal cord may protrude. This condition is known as **spina bifida** (MA 192).

Rachischisis refers to any cleft in the dorsal spine of the vertebra (BU 25).

The integrity of the lumbosacral junction is required for upright posture. **Spondylolysis** is a congenital abnormality in which the inferior articular process of Lv5 is separated from the rest of the vertebra. With the loss of the required anchoring effect, the articular process of Lv5 may slide forward on the sacrum, thus throwing the entire column out of line; the resulting condition is called **spondylolisthesis**.

Lordosis is excessive lumbar curvature. **Kyphosis** is excessive cervical curvature. **Scoliosis** is any lateral curvature of the vertebral column (MA 191).

Lumbar punctures (for withdrawing cerebrospinal fluid) can safely be done in the adult between Lv3 and Lv4 (MA 213; CH 247). The **supracristal plane** is defined by a line joining the highest parts of the two iliac crests (MA 194), and this line passes through the spinous process of the 4th lumbar vertebra (GR 1320).

Embryology

The vertebral column of the fetus and newborn has a single posteriorly convex primary curvature. The **cervical curvature** (posteriorly concave) secondarily formed when the infant begins to hold its head erect. The **lumbar curvature** (posteriorly concave) is secondarily formed when the infant begins to walk (MA 191-2).

Embryonically the spinal cord is as long as the vertebral canal. At birth the conus medullaris (viz. the most inferior part of the spinal cord) extends to the level of Lv3 or Lv4 (CL 429). In the adult, the conus medullaris is located at approximately the level of the Lv1-Lv2 intervertebral disc (MA 210; NE 149).

Fascia

The **thoracolumbar fascia** invests the deep mm. of the back. Its anterior layer lies anterior to the erector spinae and attaches to the vertebral transverse processes. Its posterior layer lies posterior to the erector spinae and attaches to the spinous processes (CH 240).

Nerves

Most of the deep mm. of the back are innervated by dorsal primary rami of spinal nn. The only exception is the intertransversarii mm., which are innervated by both dorsal and ventral primary rami.

In the adult, although the spinal cord only extends inferiorly as far as the Lv1-Lv2 intervertebral disc, the spinal nerves continue to descend, thereby forming the **cauda equina** (MA 211; NE 149).

Arteries (CH 240)

The **vertebral a.** (← subclavian a.) ascends through the transverse foramina of the upper six cervical vertebrae (CL 431, 458-9), winds behind the lateral mass of the atlas, runs in a groove on the superior surface of the posterior arch of the atlas, pierces the dura mater to enter the vertebral canal, and ascends into the cranial cavity through the foramen magnum.

The **occipital a.** (← external carotid a.) runs deep to the sternocleidomastoid m., and lies on the obliquus capitis superior and semispinalis capitis. It pierces the trapezius m., and is accompanied by the greater occipital n. (C2) and supplies the scalp.

The **transverse cervical a.** (← thyrocervical trunk of the subclavian a.).

The **great anterior radicular artery (of Adamkiewicz)** arises in the lower thoracic or upper lumbar region and helps supply the spinal cord (CL 431; NE 157; MA 214). It is usually located at spinal levels T12-L1 and more frequently arises on the left side (HA 84). According to Dr. Nayvelt, it gives rise to aa. supplying T5-L6.

Veins

There are anastomosing **longitudinal** and **transverse veins** in the front of the vertebral column. These veins communicate with the **intervertebral veins** and **basivertebral veins** (see CL 433; NE 159). This venous system is thought to be responsible for metastasis of testicular cancer to the CNS (CH 238).

Osteology

The vertebrae at the various levels have different characteristics (MA 195-7):

| | Cervical | Thoracic | Lumbar |
|-----------------------------|--|--|---|
| Body | Small and longer from side to side than anteroposteriorly. Superior surface is concave and inferior surface is convex. | Heart-shaped ; has one or two facets for articulation with head of a rib. | Massive; kidney-shaped when viewed superiorly. |
| Vertebral foramen | Large and triangular . | Circular and smaller than in cervical and lumbar regions. | Triangular ; larger than in thoracic region and smaller than in cervical region. |
| Transverse processes | Transverse foramina (foramina transversaria); small or absent in C7; vertebral arteries and accompanying venous and sympathetic plexuses pass through foramina except at C7, which transmits only small accessory vertebral veins; anterior and posterior tubercles. | Long and strong and extends posterolaterally. Length diminishes from T1-T12. (T1-T10 have facets for articulation with tubercle of a rib.) | Long and slender; accessory process on posterior surface of base of each process. |
| Articular processes | Superior facets directed superoposteriorly; inferior facets directed inferoanteriorly. | Superior facets directed posteriorly; inferior facets directed anteriorly. | Superior facets directed posteromedially (or medially); inferior facets directed anterolaterally (or laterally); mamillary process on posterior surface of each superior articular process. |
| Spinous process | Short (C3-C5) and bifid (C3-C5); process of C6 is long but that of C7 is longer (because of this, C7 is called vertebra prominens). | Long and slopes posteroinferiorly. Tip extends to level of vertebral body below. | Short and sturdy. |

The **atlas** (=C1) permits us to nod “yes.” This motion is made possible by the **atlantooccipital joint** (an ellipsoidal synovial joint, CH 243) which is formed by the superior articular facets of the atlas (CL 418) articulating with the occipital condyles at the base of the skull.

The **axis** (=C2) permits us to shake our head “no.” This motion is made possible by the **atlantoaxial joint** (CL 420 fig. 652). This in turn consists of two plane joints (between the superior articular facets of the axis and the inferior articular facets of the atlas)

and one pivot joint (formed by the median joint between the **dens** [or “odontoid process”] of the axis extending superiorly up into the anterior arch of the atlas), thereby permitting rotation in a horizontal plane (CH 243).

Ligaments

The **anterior longitudinal ligament** runs along the anterior aspect of the vertebral body (CL 425).

The **posterior longitudinal ligament** runs along the posterior aspect of the vertebral body, which is along the anterior of the vertebral canal (CL 427; NE 146).

The **ligamentum flavum** runs along the posterior of the vertebral canal, connecting the laminae of two adjacent vertebrae (CL 427; NE 146).

The **ligamentum nuchae** is a triangular-shaped median fibrous septum between the mm. on the two sides of the posterior aspect of the neck. It is formed by the thickened supraspinous ligaments that extend from vertebra C7 to the external occipital protuberance and crest. It is attached to the posterior tubercle of the atlas and to the spinous processes of the other cervical vertebrae (CH 238).

Landmarks

The **supracristal plane** is defined by a line joining the highest parts of the two iliac crests (MA 194), and this line passes through the spinous process of the 4th lumbar vertebra (GR 1320).

SUBOCCIPITAL TRIANGLE (CH 243)

| Muscle | Innervations | Blood supplies | Origins | Insertions | Actions |
|--------------------------------|-------------------------------------|-----------------------|-----------------------------|---|--|
| Rectus capitis posterior major | Suboccipital n. (dorsal rami of C1) | | Spine of axis | Lateral portion of inferior nuchal line | Extend, rotate and flex head laterally |
| Rectus capitis posterior minor | Ditto | | Posterior tubercle of atlas | Occipital bone below inferior nuchal line | Extend and flex head laterally |
| Obliquus capitis superior | Ditto | | Transverse process of atlas | Occipital bone above inferior nuchal line | Extend, rotate and flex head laterally |
| Obliquus capitis inferior | Ditto | | Spine of axis | Transverse process of atlas | Extend head and rotate it laterally |

Nerves

The **suboccipital n.** is formed by dorsal rami of C1. It supplies motor innervation exclusively.

The **greater occipital n.** is formed by the dorsal rami of C2. It supplies cutaneous innervation exclusively.

SKULL

Notes

For a good illustration for where muscles insert onto the skull see CL 499.

Embryology

In the neonate the coronal and sagittal sutures are not completely closed, leaving a soft part at the apex of the skull called the **anterior fontanelle** (NE 8; CL 484-5). In the adult the juncture between the coronal and sagittal sutures is called the **bregma** (NE 4; CL 482).

Fascia

Dural septa (partitions) divide the cranial cavity into compartments and support parts of the brain (MA 358; NE 97-8; CL 488):

- (1) **Falx cerebri** is a vertical septum between the cerebral hemispheres.
- (2) **Tentorium cerebelli** separates the occipital lobes of the cerebral hemispheres from the cerebellum.
- (3) **Falx cerebelli** is a vertical fold in the posterior part of the posterior cranial fossa separating the cerebellar hemispheres.
- (4) **Diaphragma sellae** is a small circular sheet of dura forming the roof of the hypophyseal fossa.

Veins

Diploic veins course within the plane of the skull in the cancellous layer of bone which lies between the inner table and outer table of bone (NE 94; MA 357).

The **emissary veins** communicate between the exterior and interior of the skull.

There are seven paired and five unpaired dural **venous sinuses** (enumerated on CL 488; see also MA 358-60; NE 97-8, 103, 137; CL 489):

Paired sinuses:

- (1) **Transverse sinuses** pass laterally from the confluence of sinuses. They leave the tentorium cerebelli and become the sigmoid sinuses.
- (2) **Sigmoid sinuses** follow S-shaped courses in the posterior cranial fossa, forming deep grooves in the temporal and occipital bones. They continue inferiorly (below the jugular foramen) (as the internal jugular veins).
- (3) **Occipital sinuses** lie in the attached border of the falx cerebelli and ends superiorly in the confluence of sinuses.
- (4) **Superior petrosal sinuses** run along the margin of the tentorium cerebell from the posterior ends of the cavernous sinuses to the transverse sinuses.
- (5) **Inferior petrosal sinuses** drain the cavernous sinuses into the internal jugular veins.
- (6) **Cavernous sinuses** are located on each side of the sella turcica.
- (7) **Sphenoparietal sinuses** drains into the cavernous sinus.

Unpaired sinuses:

- (1) **Superior sagittal sinus** lies in the convex border of the falx cerebri. It begins as the crista galli (specifically, from the foramen cecum, where it communicates with an emissary vein from the nasal cavity) and ends near the internal occipital protuberance.
- (2) **Inferior sagittal sinus** runs in the inferior concave border of the falx cerebri and ends in the straight sinus.
- (3) **Straight sinus** is formed by the union of the inferior sagittal sinus with the great cerebral vein.
- (4) **Intercavernous sinus** communicates between the cavernous sinuses.
- (5) **Basilar sinus** connects the inferior petrosal sinuses and communicates inferiorly with the internal vertebral venous plexus.

Osteology

Note the foramina through which various structures course (NE 7; CL 496-7).

Note the various sutures: coronal, sagittal, lambda (NE 4).

The **inion** is the most salient point on the external occipital protuberance in the median plane (GR 301).

The **nasion** is the point where the internasal and frontonasal sutures meet (GR 298).

Landmarks

The **pterion** (NE 2) is the location where the parietal bone articulates with the sphenoid bone. Internal to the pterion there courses the anterior branch of the middle meningeal a. (NE 3; MA 344) which has passed through the foramen spinosum at the base of the skull.

NECK, cross sections

Notes

For good cross-sectional illustrations see NE 30; CL 453, 457.

Clinical correlations

The **retropharyngeal space** is a conduit for pathological processes to travel from the cervical region down the spinal cord to the superior mediastinum (MA 414). It is bounded anteriorly by the buccopharyngeal fascia and posteriorly by the prevertebral fascia. (The alar fascia actually lies in between, but it is very thin and does not extend very far inferiorly.)

Fascia

The fascial layers of the neck are as follows (NE 30):

1. **Investing layer of cervical fascia** envelops the sternocleidomastoid and trapezius mm.
2. **Pretracheal fascia** envelops the sternohyoid, sternothyroid and omohyoid mm.
3. **Visceral portion of pretracheal fascia** envelops the thyroid gland. Its posterior portion constitutes the buccopharyngeal fascia.
4. **Buccopharyngeal fascia** lies posterior to the esophagus and forms the anterior boundary of the retropharyngeal space.
5. **Alar fascia** lies within the retropharyngeal space.
6. **Prevertebral layer of cervical fascia** goes around the cervical spinal vertebrae, the deep cervical mm, the levator scapulae m., all the scalene mm. and the longus colli m. Its anterior part forms the posterior border of the retropharyngeal space.
7. **Carotid sheath** encloses the common carotid a., the internal jugular v. and the vagus n. (CN X).

Note that the platysma m. lies external to all the above-listed fascial layers.

Nerves

The **recurrent laryngeal n.** runs in the groove between the trachea and esophagus. While ascending, it changes its name to the **inferior laryngeal n.** at the lower border of the cricoid cartilage (CH 300).

The **vagus n. (CN X)** runs in the carotid sheath, in the posterior groove between the common carotid a. and internal jugular v.

The **sympathetic trunk** runs just lateral to the transverse processes of the cervical vertebrae, between the anterior scalene m. and middle scalene mm.

TRIANGLES OF THE NECK

The sternocleidomastoid m. (SCM) divides the neck into anterior and posterior triangles. These in turn are subdivided as follows (MA 415):

| Triangle | Borders | Contents and notes |
|----------------------------------|---|---|
| POSTERIOR | <i>Anterior:</i> SCM. <i>Posterior:</i> Trapezius m. <i>Inferior:</i> Middle third of clavicle. <i>Apex:</i> Intersection of SCM and trapezius. <i>Roof:</i> Investing layer of cervical fascia. <i>Floor:</i> Muscles covered by the prevertebral layer of cervical fascia. | Accessory n. (CN XI) Cervical lymph nodes. Brachial plexus (supraclavicular part). Third part of subclavian a. |
| 1. Posterior cervical | <i>Anterior:</i> SCM. <i>Posterior:</i> Trapezius m. <i>Inferior:</i> Inferior belly of omohyoid m. | |
| 2. Omoclavicular (or subclavian) | <i>Superior:</i> Inferior belly of omohyoid m. <i>Inferior:</i> Middle third of clavicle. <i>Anterior:</i> SCM. | |
| ANTERIOR | <i>Anterior:</i> Median line of neck. <i>Posterior:</i> SCM. <i>Superior:</i> Inferior border of mandible. <i>Apex:</i> Jugular notch in the mediastinum. <i>Floor:</i> Pharynx, larynx, thyroid gland. | |
| 1. Digastric | | Submandibular gland. Facial a. and v. Portions of parotid gland and external carotid a. Internal carotid a., internal jugular v., glossopharyngeal (CN IX) and vagus (CN X) n. are situated deep. |

| | | |
|------------------|---|---|
| 2. Submental | | Submental lymph nodes. Small vv. that unite to form the anterior jugular v. |
| 3. Carotid | <i>Superior:</i> Inferior belly of digastric m. <i>Anterior:</i> Superior belly of omohyoid m. <i>Posterior:</i> SCM. | External carotid a. and some of its branches. Larynx, pharynx, external laryngeal nn. are situated deep. This triangle is the surgical approach to the carotid a. |
| 4. Muscular | <i>Anterior:</i> Median line of neck. <i>Posterior:</i> Superior belly of omohyoid m. <i>Inferior:</i> SCM. | Sternothyroid and sternohyoid mm. Thyroid gland, trachea, esophagus. |
| 5. Submandibular | <i>Superior:</i> Inferior border of mandible. <i>Medial:</i> Digastric m. <i>Posterior:</i> Stylohyoid m. | Submandibular gland. Submandibular lymph nodes. Hypoglossal n. (CN XII). Mylohyoid n. Parts of facial a. and v. |

NECK, POSTERIOR CERVICAL TRIANGLES (MA 413)

| Muscle | Innervations | Blood supplies | Origins | Insertions | Actions |
|---------------------|---|-----------------------|--|--|---|
| Platysma | Cervical b. of facial n. (CN VII) | | Inferior border of mandible, skin and subcutaneous tissues of lower face | Fascia covering superior parts of pectoralis major and deltoid mm. | Draw corners inferiorly and widens mouth; draw the skin of neck superiorly |
| Sternocleidomastoid | Spinal root of accessory n. (CN XI), and C2, C3 | | Lateral surface of mastoid process of temporal bone and lateral half of superior nuchal line | <i>Sternal head:</i> anterior surface of manubrium of sternum. <i>Clavicular head:</i> superior surface of medial third of clavicle | Tilt head to one side (laterally); flex neck and rotate it. Acting together, the two muscles flex the neck. |

| | | | | | |
|--------------------|---|--|--|---|--|
| Trapezius | Spinal root of accessory n. (CN XI), and C3, C4 | | Medial third of superior nuchal line, external occipital protuberance, ligamentum nuchae, spinous processes of C7-T12 vertebrae, and lumbar and sacral spinous processes | Lateral third of clavicle, acromion, and spine of scapula | Elevate, retract and rotate scapula |
| Splenius capitus | Dorsal rami of middle cervical spinal nn. | | Inferior half of ligamentum nuchae and spinous processes of superior six thoracic vertebrae | Lateral aspect of mastoid process and lateral third of superior nuchal line | Laterally flex and rotate head and neck to same side. Acting bilaterally, they extend head and neck. |
| Levator scapulae | Dorsal scapular n. (C5) and cervical spinal nn (C3, C4) | | Posterior tubercles of transverse processes of C1-C4 vertebrae | Superior part of medial border of scapula | Elevate scapula and tilt its glenoid cavity inferiorly by rotating scapula |
| Scalenus posterior | Ventral rami of cervical spinal nn. (C7, C8) | | Posterior tubercles of transverse processes of C4-C6 vertebrae | External border of 2nd rib | Flex neck laterally; elevate 2nd rib during forced inspiration. |
| Scalenus medius | Ventral rami of cervical spinal nn. | | Posterior tubercles of transverse processes of C2-C7 vertebrae | Superior surface of 1st rib, posterior to groove for subclavian a. | Flex neck laterally; elevate 1st rib during forced inspiration. |

Nerves

The **spinal accessory n. (CN XI)** pierces (and supplies) the sternocleidomastoid m. and descends in the posterior triangle to reach and innervate the trapezius m. (CL 440).

NECK, ANTERIOR CERVICAL TRIANGLE; HYOID and THYROID MUSCLES (MA 418-19)

| Muscle | Innervations | Blood supplies | Origins | Insertions | Actions |
|---------------|--------------------------------------|-----------------------|---|-----------------------------------|-------------------------------|
| Sternothyroid | C2 and C3 by a b. of ansa cervicalis | | Posterior surface of manubrium of sternum | Oblique line of thyroid cartilage | Depress hyoid bone and larynx |

| Suprahyoid mm. | | | | | |
|---|--|--|--|---|---|
| Mylohyoid | Mylohyoid n., (a b. of inferior alveolar n.) | | Mylohyoid line of mandible | Raphe and body of hyoid bone | Elevate hyoid bone, floor of mouth, and tongue during swallowing and speaking. |
| Geniohyoid | C1 via hypoglossal n. (CN XII) | | Inferior mental spine of mandible | Body of hyoid bone | Pull hyoid bone antero-superiorly, shorten floor of mouth, widen pharynx |
| Stylohyoid | Cervical b. of facial n. (CN VII) | | Styloid process of temporal bone | Body of hyoid bone | Elevate and retract hyoid bone, thereby elongating floor of mouth. |
| Digastric | <i>Anterior belly:</i> mylohyoid n. (a b. of inferior alveolar n.) <i>Posterior belly:</i> facial n. (CN VII) | | <i>Anterior belly:</i> digastric fossa of mandible <i>Posterior belly:</i> mastoid notch of temporal bone | Body of hyoid bone | Depress mandible; raise hyoid bone and steady it during swallowing and speaking |
| Infrahyoid mm. (“strap muscles”) | | | | | |
| Sternohyoid | C1-C3 from ansa cervicalis | | Manubrium of sternum and medial end of clavicle | Body of hyoid bone | Depress hyoid bone after it has been elevated during swallowing. |
| Omohyoid | C1-C3 by a b. of the ansa cervicalis | | Superior border of scapula near suprascapular notch | Inferior border of hyoid bone | Depress, retract and steady hyoid bone |
| Thyrohyoid | C1 via hypoglossal n. (CN XII) | | Oblique line of thyroid cartilage | Inferior border of body and superior (greater) horn of hyoid bone | Depress hyoid bone and elevate larynx |

Notes

“Hyoid” is Greek for “H-shaped.” “Omo” is Greek for “shoulder.” “Thyroid” means “shield-like,” which allegedly describes the shape of the thyroid cartilage and thyroid gland.

For a diagram illustrating the actions of the muscles connected to the hyoid see NE 24.

The **isthmus of the thyroid gland** overlays tracheal rings 2, 3 and 4 (according to Dr. Lieska). For good illustrations see NE 68-9; CL 447-453.

Clinical correlations

The **carotid sinus** is a slight dilation of the proximal part of the internal carotid a. and contains stretch receptors that are sensitive to changes in blood pressure (MA 422). Applying pressure to the proper point on the neck can stimulate these receptors.

The **carotid body** is a small mass of tissue located at the bifurcation of the common carotid artery. It contains chemoreceptors that are sensitive to blood levels of oxygen and carbon dioxide (MA 422).

Embryology

The **pyramidal lobe** of the thyroid gland is frequently absent; it is a remnant of the embryonic connection between the thyroid gland and the thyroglossal duct (SA 329 fig. 16.16). In the adult, the **foramen cecum** at the base of the tongue (at the apex of the sulcus terminalis, MA 391) is the remnant of the ectodermal outpocketing whose continuation constituted the thyroglossal canal (NE 57).

Nerves

The **brachial plexus** passes between the anterior and middle scalene muscles (CL 452).

The **ansa cervicalis** (part of the cervical plexus, NE 27, 123) is a “loop” which consists of an superior branch (formed by fibers from C1) and inferior branch (formed by fibers from C2 and C3) (CL 443). The ansa cervicalis supplies a number of the strap muscles.

The **vagus n.** courses with the internal and common carotid aa. (CL 444).

The **phrenic n.** descends along the surface of the anterior scalene m. (CL 444).

Arteries

The **common carotid a.** branches at the level of Cv4 (CL 459 fig. 722) into the internal and external carotid aa.

Although MA 422-3 only lists six major branches of the **external carotid a.**, Dr. Lieska prefers to describe it as having three anterior and five posterior branches. There is some variation in the order at which these branches leave the external carotid artery.

Ascending along the external carotid, the branches are: (see illustrations in MA 422; NE 63; CL 474)

Anterior branches:

1. Superior thyroid a.
2. Lingual a.

3. Facial a.

Posterior branches:

1. Ascending pharyngeal a.
2. Occipital a.
3. Posterior auricular a.
4. Maxillary a.
5. Superficial temporal a. (=terminal branch of the external carotid a.)

The **thyroid artery** passes external to the carotid sheath (according to Dr. Lieska).

Veins

See MA 423.

The **thyroid ima** (CL 454) is a union of thyroid veins (according to Dr. Lieska).

Lymphatics

Important lymphatics are the **jugulodigastric lymphatic nodes** and the **jugulo-omohyoid lymphatic nodes** (NE 66-7; CL 455).

Landmarks

The hyoid bone is at the level of the intervertebral disc between Cv3 and Cv4 (NE 57; MA 440).

The **carotid line** is an imaginary line between the anterior of the mastoid process and the sternoclavicular joint. This line represents the approximate course of the external carotid artery (according to Dr. Lieska).

ROOT OF NECK

Notes

Between the anterior and middle scalene mm. there pass:

1. Roots of the cervical plexus
2. Roots of the brachial plexus
3. Subclavian a. (on 1st rib)

On the anterior face of the anterior scalene m. there runs the phrenic n. (superolaterally to inferomedially).
Anterior to the anterior scalene m. there passes the subclavian v.

The deep cervical a. ascends between the semispinalis capitis and semispinalis cervicis mm.

Nerves

The eight cervical spinal nerves condense into three cervical ganglia (which are paravertebral ganglia) which are in continuity with the sympathetic chain. The superior cervical ganglion is located at the level of Cv2; the middle at Cv6; the inferior at Cv7 or Tv1 (CH 265). See CL 452; NE 124 for illustrations.

Arteries

The **subclavian a.** is divided into three parts. The branches from the subclavian a. are (MA 426):

First part (medial to the anterior scalene m.)

1. Vertebral a.
2. Internal thoracic a.
3. Thyrocervical trunk
 - a. Inferior thyroid a.
 - b. Suprascapular a.
 - c. Transverse cervical a.

Second part (posterior to the anterior scalene m.)

4. Costocervical trunk
 - a. Superior intercostal a.
 - b. Deep cervical a.

Third part (lateral to the anterior scalene m.)

5. Dorsal scapular a.

After the lateral border of the 1st rib, the subclavian a. becomes the axillary a.

See NE 28 for a good illustration (though note that Netter has apparently reversed the order of the vertebral a. and the thyrocervical trunk!).

FACE and JAW

Notes

See illustrations of the mm. of facial expression in NE 20-1; CL 462-3.

See illustrations of the mm. of mastication in NE 48-9; CL 466-7.

The **parotid duct (of Stenson)** pierces the buccinator m. and enters the oral cavity at the site of the second upper molar (NE 45).

Note the five layers of the scalp (MA 355-7):

1. Skin
2. Connective tissue (dense). This is where blood vessels course.
3. Aponeurosis
4. Loose connective tissue
5. Periosteum

Dr. Lieska describes the actions of the jaw as follows:

Opening of the jaw is achieved primarily due to the action of the lateral pterygoid m.

Closing of the jaw is achieved by the actions of the medial pterygoid m., the masseter m. and the temporalis m.

Protrusion of the jaw is achieved by the action of the lateral pterygoid mm.

Retrusion (or retraction) is achieved by the action of the posterior fibers of the temporalis m. **Lateral** (side to side) motion is due to the lateral pterygoid mm. (See MA 382 table 8.7.)

During mastication, the **buccinator m.** keeps food pressed against the buccal surface of the teeth (so that food won't collect in the cheeks) (MA 385-6).

Clinical correlations

Bell's palsy, characterized by weakness or paralysis of the muscles of facial expression (usually unilaterally), is due to a lesion (typically an inflammatory process) of the facial n. (CN VII). Typical signs are drooping of the face, inability to close the eye completely, drooling from the corner of the mouth (MA 353).

Embryology

All the **mm. of facial expression** are derived from the **second branchiomic arch** (SA 315 table 16.1), and hence all of their innervations (through the facial n., CN VII) are via SVE (special visceral efferent) fibers.

All the **mm. of mastication** are derived from the **first branchiomic arch**, and receive SVE innervation from the trigeminal n. (CN V).

Nerves

All the muscles of facial expression are innervated by the facial n. (CN VII). The facial n. courses through the parotid gland (NE 19; MA 351) and distributes along the following terminal branches:

1. Temporal branch
2. Zygomatic branch
3. Buccal branch (which is not the same thing as the buccal nerve!)
4. Marginal mandibular branch
5. Cervical branch

Arteries

Dr. Lieska describes the **maxillary a.** as having three parts (NE 35; MA 380-3). Particularly important arteries are boldfaced.

- I. Mandibular part (running next to the mandible)
 1. Deep auricular a.
 2. Anterior tympanic a.
 3. **Inferior alveolar a.**
 4. **Middle meningeal a.**
 5. Accessory meningeal a.
- II. Pterygoid part (overlying the pterygoid mm.), which supplies muscles
 6. Pterygoid a.
 7. Masseter a.

8. Anterior deep temporal a.
9. Posterior deep temporal a.

III. Pterygopalatine part (running in the pterygopalatine fossa through the pterygomaxillary fissure)

10. **Descending palatine a.**

11. Artery of the pterygoid canal

12. Pharyngeal a.

13. **Infraorbital a.**, which branches into:

- a. Middle superior alveolar a.
- b. Anterior superior alveolar a.

14. Posterior superior alveolar a.

15. **Sphenopalatine a.** (this is the terminal branch of the maxillary a.)

Osteology

The supraorbital foramen, infraorbital foramen and mental foramen all lie in the same vertical plane (NE 1).

Mnemonics

Concerning the terminal branches of the facial n.: “Ten zebras bit my cookies”: “Temporal, zygomatic, buccal, mandibular, cervical.”

BRANCHIAL ARCHES

The trigeminal, facial, glossopharyngeal and vagus nn. (CN V, VII, IX and X) send special visceral efferent fibers to striated skeletal muscles derived from embryonic branchiomic (pharyngeal) arches. The following table presents information from SA 315 (table 16.1) and Dr. Ashiru. The fifth branchiomic arch is vestigial or degenerates completely in humans.

| Arch | Innervation | Muscles | Blood supply | Skeletal structures | Ligamentous structures | Cartilagenous structures |
|-----------------------|---|--|-----------------------------------|--|---|---|
| 1 (mandibular) | Maxillary and mandibular branches of the trigeminal (CN V ₃) | <ul style="list-style-type: none"> • Mm. of mastication • Mylohyoid • Anterior belly of digastric • Tensor tympani • Tensor veli palatini | Terminal branches of maxillary a. | <ul style="list-style-type: none"> • Malleus • Incus | <ul style="list-style-type: none"> • Anterior ligament of malleus • Sphenomandibular ligament | Meckel's cartilage |
| 2 (hyoid) | Facial n. (CN VII) | <ul style="list-style-type: none"> • Mm. of facial expression • Stapedius • Stylohyoid • Posterior belly of digastric | Stapedius a. | <ul style="list-style-type: none"> • Stapes • Styloid process • Lesser cornu of hyoid • Upper part of body of the hyoid bone | Stylohyoid ligament | Reichert's cartilage |
| 3 | Glossopharyngeal n. (CN IX) | Stylopharyngeus | Common carotid a. | <ul style="list-style-type: none"> • Greater cornu of hyoid • Lower part of body of the hyoid bone | [none] | [none] |
| 4 and 6 | <ul style="list-style-type: none"> • Superior laryngeal branch of vagus (CN X) • Recurrent laryngeal branch of vagus (CN X) | <ul style="list-style-type: none"> • Cricothyroid • Levator veli palatini • Constrictors of pharynx • Intrinsic mm. of larynx • Striated mm. of esophagus | Arch of aorta | [none] | [none] | <ul style="list-style-type: none"> • Thyroid cartilage • Cricoid cartilage • Arytenoid cartilage • Corniculate cartilage • Cuneiform cartilage |

LIESKA'S "RULES OF TWO"

The following is Dr. Lieska's method for organizing muscles (mostly) into "pairs."

Derived from branchiomic **arch 1**, motor innervation by the **mandibular branch of trigeminal (CN V₃)**:

Medial pterygoid m.

Lateral pterygoid m.

Temporalis m.

Masseter m.

Anterior belly of digastric m.

Mylohyoid m.

Tensor veli palatini m.

Tensor tympani m.

Derived from branchiomic **arch 2**, motor innervation by the **facial nerve (CN VII)**:

Muscles of facial expression

Stapedius m.

Posterior belly of digastric m.

Stylohyoid

Derived from branchiomic **arch 3**, motor innervation by the **glossopharyngeal n. (CN IX)**:

Stylopharyngeus m.

Derived from branchiomic **arches 4 and 6**, motor innervation by the **vagus nerve (CN X)** through the pharyngeal plexus, superior laryngeal nerve and inferior laryngeal nerve:

All of the external (constrictor) muscles of the pharynx (see list on CL 550).

Most of the internal muscles of the pharynx (except the stylopharyngeus, which is innervated by CN IX).

All the muscles of the larynx. (Most are supplied by the inferior laryngeal n.; the cricothyroid is supplied by the superior laryngeal n.)

Motor innervation by the **spinal accessory nerve (CN XI)**:

Sternocleidomastoid m. (with supplemental innervation by ventral primary rami of C2, C3)

Trapezius m. (with supplemental innervation by ventral primary rami of C3, C4)

The **ansa cervicalis** (NE 27, 123) is a confluence of C1, C2, C3. It provides motor innervation to:

Superior belly of omohyoid m.

Inferior belly of omohyoid m.

Sternohyoid m.

Sternothyroid m.

Part of **C1** (through the **cervical plexus** [NE 27, 123], not through the ansa cervicalis) provides motor innervation to:

Geniohyoid m.

Thyrohyoid m.

Part of **C4** (through the **cervical plexus**), along with supplementary innervation from C3 and C5, gives rise to:

Phrenic n.

Accessory phrenic n.

Dorsal ramus of C1 provides motor innervation via the **suboccipital n.** to mm. of the suboccipital triangle:

Obliquus capitis inferioris m.

Obliquus capitis superioris m.

Rectus capitis major m.

Rectus capitis minor m.

TONGUE

See illustrations (NE 56, 129; CL 532, 539) and discussion in MA 391-2. The skeletal muscles of the tongue are of occipital **somatic origin** (GR 152 fig. 2.58B), though its mucosa is of branchiomic origin (BU 285).

The **genioglossus m.** constitutes the bulk of the tongue.

All muscles of the tongue (except the palatoglossus, which is innervated by the pharyngeal branch of the vagus) are supplied with somatic efferent innervation by the hypoglossal n. (CN XII) (MA 391).

| Part of tongue | General sensory innervation (tactile) | Special sensory innervation (taste) | Derivation of epithelium | Motor innervation |
|--------------------------------|---|--|------------------------------|--|
| Anterior 2/3 of tongue | GSA fibers via the lingual nerve (→ mandibular division of trigeminal CN V ₃). | SVA fibers via: <ul style="list-style-type: none"> • chorda tympani nerve (→ facial n. CN VII) • lingual branch (→ glossopharyngeal n. CN IX). | Branchiomic arch 1 (BU 285). | <ul style="list-style-type: none"> • Motor innervation (SE) to nearly all parts of the tongue is by the hypoglossal nerve (CN XII). • The exception is the palatoglossus m. (which is innervated by the pharyngeal branch of the vagus [CN X] (MA 392). |
| Posterior 1/3 of tongue | GSA fibers via the lingual branch of the glossopharyngeal n. (CN IX). | SVA fibers via the lingual branch (→ glossopharyngeal n. CN IX). | Branchiomic arch 3 (BU 285). | |
| Epiglottis and palate | GSA fibers via the internal laryngeal n. (→ superior laryngeal n. → vagus n. CN X) (MA 392). | SVA fibers via the internal laryngeal n. (→ superior laryngeal n. → vagus n. CN X). | Branchiomic arch 4. | |

INFRATEMPORAL FOSSA

Nerves

The mandibular branch of the trigeminal nerve (CN V₃) carries both GSA (sensory) and SVE (parasympathetic) innervation to a number of structures.

The **anterior division** of V₃ is primarily motor (with the single exception of the buccal n. which is sensory).

The **posterior division** of V₃ is primarily sensory (with the single exception of the motor innervation to the mylohyoid m.).

The **buccal nerve** is from the mandibular branch of the trigeminal (CN V₃); see NE 116. It is **sensory** to the cheek.

In contrast, the **buccal branches** are from the facial n. (CN VII); see NE 117. It is **motor** to the buccinator m.

Arteries

The **middle meningeal a.** is usually “embraced” by the two nerve twigs which form the auriculotemporal n. (according to Dr. Lieska).

Landmarks

The **buccal n.** passes between the two heads of the lateral pterygoid m. and then courses on the surface of the buccinator m. (NE 41).

PTERYGOPALATINE FOSSA

Osteology

The **mylohyoid line** is the attachment of the mylohyoid m. (CL 542).

The **mylohyoid groove** or sulcus is the groove along which the mylohyoid n. courses (CL 542).

PHARYNX

Notes

The pharynx can be thought of as a “crossing” of the air passage (which starts superiorly in the nose and ends anteriorly in the trachea) and the food passage (which starts inferiorly in the mouth and ends posteriorly in the esophagus). It is divided into nasopharynx, oropharynx and laryngopharynx. See NE 59-61; CL 550-554.

Note the following folds:

Palatopharyngeal

Salpingopharyngeal (CL 531, 549, 552, 554; MA 441)

Sphingopalatine (CL 552)

Nerves

The **glossopharyngeal n. (CN IX)** courses along the posterior aspect of the stylopharyngeus m. (see CL 551).

The **spinal accessory n. (CN XI)** courses inferolaterally across the posterior aspect of the posterior belly of the digastric m. (see CL 551).

Lymphatics

This entrance to the body is protected by the lymphatic system known as **Waldeyer’s ring**, which consists of lingual, palatal and pharyngeal tonsils (CH 325).

LARYNX

Notes

For the actions of the various muscles of the larynx see NE 72-75; CL 560-1.

The posterior cricoarytenoid is the only muscle which abducts the vocal folds (see NE 73).

Most of the muscles of the larynx are innervated by the inferior laryngeal nerve (← recurrent laryngeal n. ← CN X). The exception is the cricothyroid m., which is innervated by the superior laryngeal nerve (← CN X).

BRANCHES OF THE VAGUS

The following are some innervations in the head and neck region supplied by the vagus nerve (CN X).

| Branch of vagus (CN X) | PHARYNX | | LARYNX | | OTHER | |
|--|---|------------------------|---|-----------------------------------|--|---|
| | Motor (SVE) | Sensory (GVA) | Motor (SVE) | Sensory (GVA) | Motor (SVE) | Sensory (GVA) |
| Pharyngeal branch | Most mm. of pharynx via pharyngeal plexus (except stylopharyngeus, by CN IX) (CH 300) | Lower pharynx (NE 120) | | | Most mm. of palate (except tensor veli palatini, by CN V ₃) (CH 300) | Nerve to carotid body, which supplies carotid body and carotid sinus (CH 300) |
| (Superior laryngeal n. →) External branch | Inferior pharyngeal constrictor mm. (CH 300) | | Cricothyroid m. (CH 300) | | | |
| (Superior laryngeal n. →) Internal branch | | | | Larynx above vocal folds (CH 300) | | |
| (Recurrent laryngeal n. →) Inferior laryngeal n. | | | Most mm. of larynx (except cricothyroid) (CH 301) | Larynx below vocal folds (CH 301) | | Upper esophagus and trachea (NE 120) |