Surgical and Perioperative Management of Patients with Anatomic Anomalies

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After completion of the work on this book but prior to its publication, our dear friend and Co-editor Dr. Deepak Narayan sadly passed away. His diligence, mentorship, encouragement, and attention to detail were exemplary and something that those of us who partnered with him will never forget. This book therefore, in all humility, is dedicated to his memory.

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Preface

Since ancient times, it has been well recognized that variations of the normal human anatomy exist. Most anatomical variants were identified after the discovery of X-rays. The understanding of normal human anatomy over the centuries was slow since the deliberate opening of a human body to study its contents was strictly forbidden until the twelfth century when human dissections were first performed. Advances in imaging and technology in recent times including magnetic resonance imaging, computerized tomography, and ultrasonography have revolutionized the understanding of anatomical anomalies immensely.

Surgical and perioperative management of patients with anatomic anomalies is truly a challenge. Versatility and excellence in the understanding of anatomical anomalies is essential. Creative and innovative management of these anatomical anomalies is vital. Sadly, there is sparse reference to the perioperative management of anatomical anomalies in the literature.

An important strategy in the creation of this book has been the challenge posed to clinicians involved in the perioperative management of patients with anatomical anomalies in light of the ever-evolving technology in the present era. How does one make it practical for clinicians managing such patients? To achieve that goal we have recruited anatomists, surgeons, and anesthesiologists caring for patients with an array of anatomical anomalies as well as anatomists and other basic scientists.

This book is the first of its kind to outline the perioperative management of patients with anatomical anomalies. Every attempt has been made to present information with conciseness and clarity. The book will also provide optimism and hope to future generations of patients afflicted with anatomical anomalies.

We thank each one of our contributors for their lucent discussion of cutting-edge research and providing the reader with modern-day treatment options. Finally, we thank all our colleagues, teachers, and trainees for their inspiration and our families for their support and patience.

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Part I

Head and Neck

Anatomy of the Head and Neck

1

Walter Guillory II, Caroline Miller, Gopal Kodumudi, and Rajuno Ettarh

Skull

The skull is comprised of numerous flat bones that encase the brain and provide structural support for the face. The skull consists of two parts:

The **neurocranium** is the bone case surrounding the brain (Fig. 1.1). The bones of the neurocranium are as follows:

- Frontal
- Parietal (2)
- Temporal (2)
- Occipital
- Sphenoid
- Ethmoid

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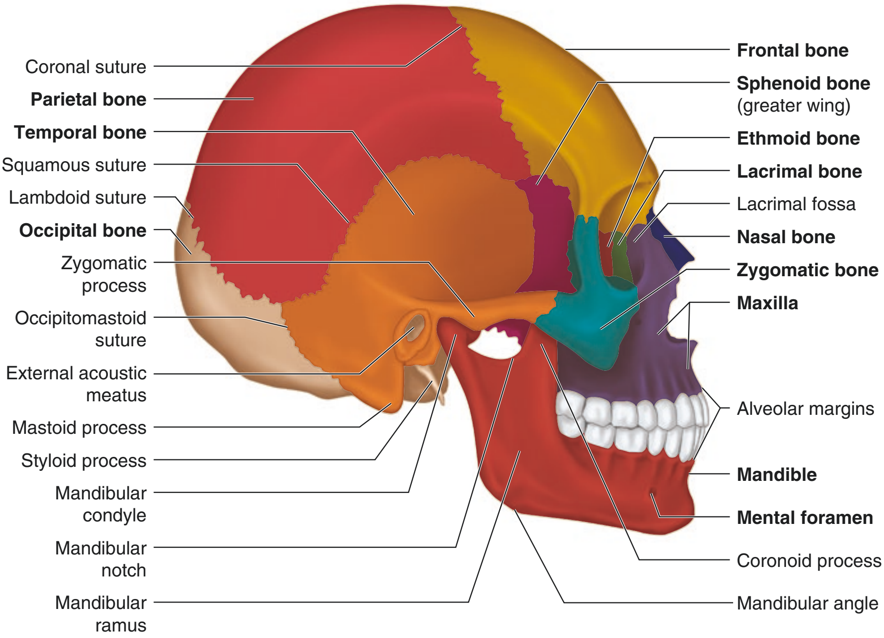

Fig. 1.1 The neurocranium is the bone case surrounding the brain

The bones of the neurocranium join together to form sutures. The major sutures are as follows:

- Coronal: suture between frontal and parietal bones
- Sagittal: suture between parietal bones
- Squamous: suture between parietal and temporal bones
- Lambdoid: suture between the parietal bones and occipital bone

The viscerocranium is the facial component of the cranium and is derived from pharyngeal arches. The bones are as follows.

- Mandible
- Vomer
- Maxilla (2)
- Nasal (2)
- Palatine (2)
- Inferior nasal concha (2)
- Lacrimal (2)
- Zygomatic (2)

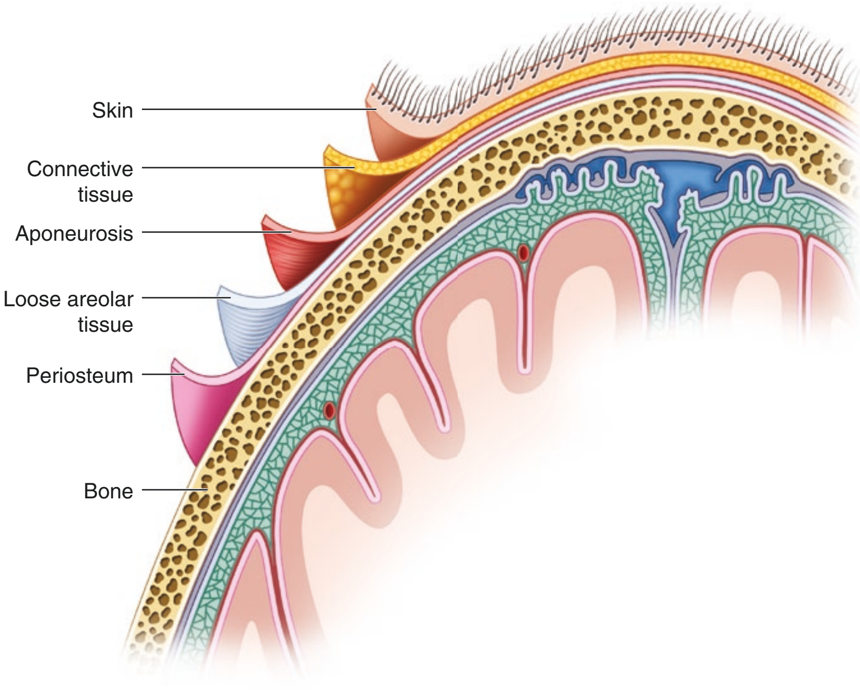

Fig. 1.2 The scalp is made up of five layers: skin, connective tissue, aponeurosis, loose connective tissue, and pericranium

Scalp

The scalp (Fig. 1.2) is made up of five layers:

Skin: contains numerous sebaceous glands, sweat glands, and hair follicles
Connective tissue: contains the vascular and nervous supply of the scalp
Aponeurosis: contains the occipitofrontalis muscle
Loose connective tissue: contains loose areolar tissue and the emissary veins
Pericranium: periosteum covering the external surface of the skull

Meninges

The meninges consist of three connective tissue layers that surround and protect the brain. The meningeal layers include the dura mater, arachnoid mater, and pia mater.

Dura Mater

The dura mater can be divided into two layers:

1. Periosteal: outer layer of dura which lines the internal surface of the skull
2. Meningeal: inner layer of dura which is continuous with the dura of the spinal meninges

The two layers separate to form the dural venous sinuses.

Arachnoid Mater

The arachnoid mater is a thin layer which connects to the pia mater with filaments. The space between the arachnoid mater and pia mater is called the subarachnoid space. The subarachnoid space is where cerebrospinal fluid (CSF) circulates.

Pia Mater

The pia mater is the deepest meningeal layer. Pia mater is adherent to the brain and is the only meningeal layer to dip into the gyri and sulci of the cerebrum (Fig. 1.3).

The middle meningeal artery, which is a branch of the maxillary artery, is the main blood supply of the dura. Middle meningeal artery enters the skull through

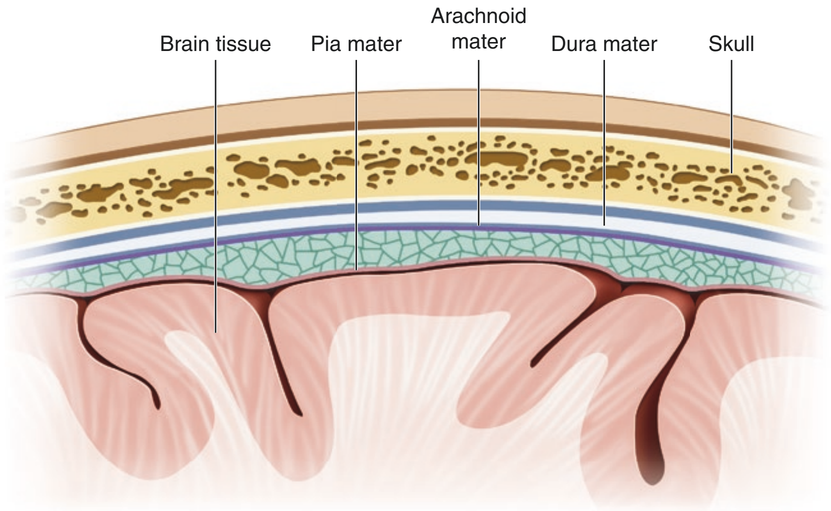

Fig. 1.3 The pia mater is the deepest meningeal layer. Pia mater is adherent to the brain and is the only meningeal layer to dip into the gyri and sulci of the cerebrum

foramen spinosum and courses along the inner surface of the skull superficial to the dura mater.

Brain

The brain can be subdivided into the cerebrum, diencephalon, brainstem, and cerebellum.

Cerebrum

The cerebrum is the control site for the nervous system. There are two hemispheres which are divided by the longitudinal cerebral fissure. Each cerebral hemisphere consists of gyri (ridges) and sulci (depressions) and can be divided into lobes (Fig. 1.4).

- **Frontal lobe**: located in the anterior of the brain and contains the precentral gyrus, which is the primary motor area of the brain

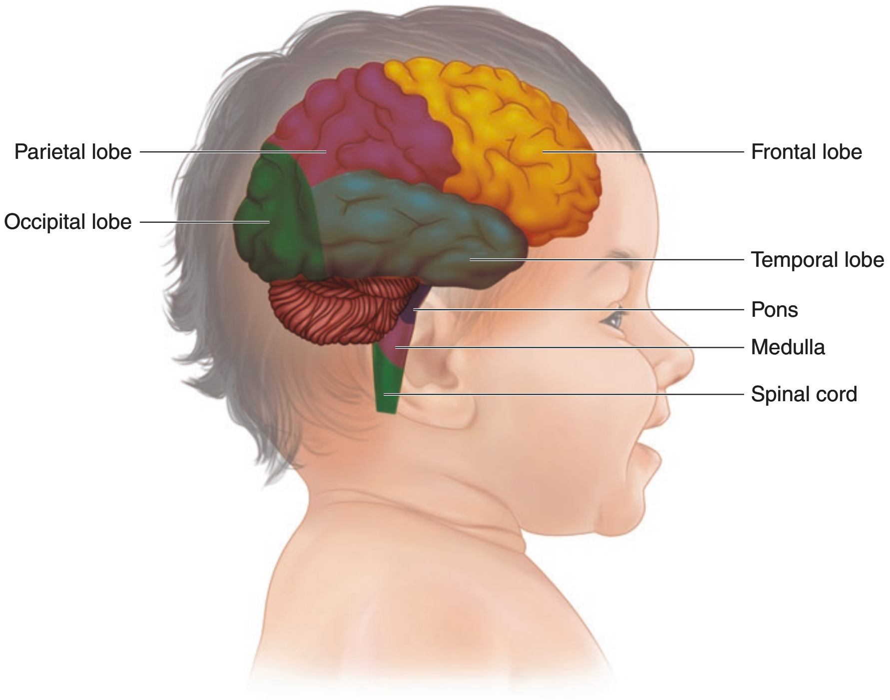

Fig. 1.4 The cerebrum is the control site for the nervous system. There are two hemispheres which are divided by the longitudinal cerebral fissure. Each cerebral hemisphere consists of gyri (ridges) and sulci (depressions) and can be divided into lobes

- **Parietal lobe**: located in the superior middle portions of the cerebrum and contains the postcentral gyrus which is the primary sensory area of the brain
- **Occipital lobe**: located in the posterior portion of the cerebrum and is superior to the cerebellum and is the visual area of the brain
- **Temporal lobe**: located in the inferior middle portions of the cerebrum and is involved with memory and hearing

Diencephalon

The diencephalon is made up of the thalamus, subthalamus, hypothalamus, and epithalamus.

- Thalamus: serves as a relay station of sensory and motor information to and from the cerebral cortex
- Hypothalamus: regulates the autonomic nervous system as well as regulating many metabolic and homeostatic mechanisms

Brainstem

The brainstem is divided into the midbrain, pons, and medulla oblongata. The brainstem plays an important role in the regulation of cardiac and respiratory functions. The brainstem is the location of the cranial nuclei of CN III-XII.

Cerebellum

The cerebellum is located in the posterior cranial fossa. The cerebellum is involved with coordination of skeletal muscles.

Blood Supply

The blood supply of the brain is from the internal carotid artery and the vertebral artery. After these paired arteries enter the skull, they anastomose to form the Circle of Willis.

Ventricular System

The ventricular system within the brain is divided into four chambers and is responsible for the creation and flow of cerebral spinal fluid (CSF). The two lateral ventricles are C-shaped chambers located within each cerebral hemisphere and connect to the third ventricle via the interventricular foramens. The third ventricle is a midline chamber between the diencephalon and communicates with the fourth ventricle through the cerebral aqueduct. CSF is made by the choroid plexus located on the walls of the ventricles and flows from the ventricles to the subarachnoid space surrounding the brain and spinal cord (Table 1.1, Fig. 1.5).

Table 1.1 Cranial nerves

CN #	Name	Components	Function/innervations	Exit from skull
I	Olfactory	SSA	Smell	Cribriform plate
II	Optic	SSA	Sight	Optic canal
III	Occulomotor	GSE	Superior rectus m., inferior rectus, medial rectus m., levator palpebrae superioris m., and inferior oblique m.	Superior orbital fissure
		GVE	Pupillary constriction and lens accommodation	
IV	Trochlear	GSE	Superior oblique m.	Superior orbital fissure
V	Trigeminal Divisions: V-1 ophthalmic V-2 maxillary V-3 mandibular	GSA	V-1: Orbit, cornea & forehead, anterior nasal mucosa V-2: Maxillary region, posterior nasal mucosa, hard palate via greater palatine nerve and anterior part of hard palate by nasopalatine nerve via the incisive fossa. It also supplies the soft palate. V-3: Mandibular region & anterior two-thirds of tongue	V-1: Superior orbital fissure V-2: Foramen rotundum V-3: Foramen ovale
		SVE	V-3: Muscles of mastication, mylohyoid m., anterior digastric m., tensor tympani m., tensor veli palatine m.	
VI	Abducens	GSE	Lateral rectus m.	Superior orbital fissure
VII	Facial	GSA	Concha of the auricle and small area behind the ear	Internal acoustic meatus
		SVE	Muscles of facial expression, posterior digastric m., stylohyoid m., stapedius m.	
		GVE	Parasympathetic innervation to lacrimal, submandibular, sublingual glands, and mucous membranes of nasopharynx, hard and soft palate.	
		SVA	Taste anterior 2/3 of tongue	
VIII	Vestibulocochlear	SSA	Hearing, balance, and equilibrium	Internal acoustic meatus
IX	Glossopharyngeal	GSA	Posterior 1/3 of tongue, oropharynx, tympanic membrane, middle ear and auditory tube	Jugular foramen
		SVE	Stylopharyngeus m.	
		GVE	Parasympathetics to parotid gland	
		SVA	Taste posterior 1/3 of tongue	
		GVA	Carotid sinus (baroreceptor) and carotid body (chemoreceptor)	

(continued)

Table 1.1 (continued)

CN #	Name	Components	Function/innervations	Exit from skull
X	Vagus	GSA	Skin of posterior ear and external acoustic meatus	Jugular foramen
		SVE	Palatal muscles (except tensor tympani), pharyngeal muscles (except stylopharyngeus), and all laryngeal muscles	
		GVE	Parasympathetics to heart, lungs, foregut, and midgut.	
		GVA	Aortic and carotid bodies (chemoreceptors) and aortic arch (baroreceptor), pharynx, larynx, esophagus, thoracic, and abdominal viscera. SVA: From taste receptors in the epiglottis	
XI	Spinal accessory	GSE	Trapezius m. and sternocleidomastoid m.	Jugular foramen
XII	Hypoglossal	GSE	Tongue muscles (except palatoglossus)	Hypoglossal canal

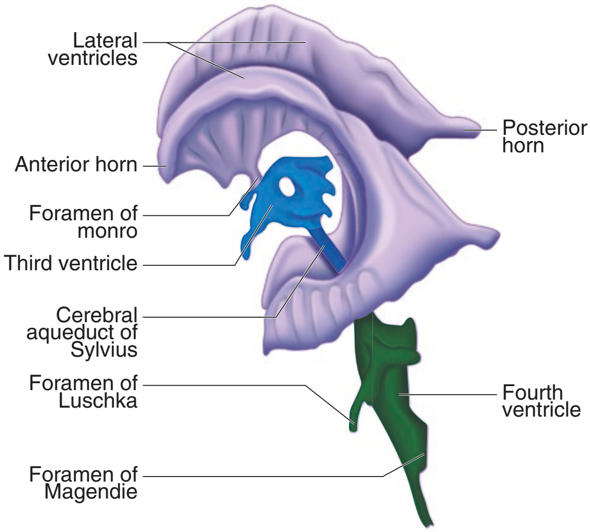

Fig. 1.5 Cerebrospinal fluid (CSF) is made by the choroid plexus located on the walls of the ventricles and flows from the ventricles to the subarachnoid space surrounding the brain and spinal cord

Face

Cutaneous Sensation

The three divisions of the Trigeminal nerve (CN V) provide the cutaneous innervation of the face. V-1 provides general sensation to the forehead, upper eyelid, and the bridge of the nose. V-2 provides sensation to the maxillary region of the face including the lower eyelid and upper lip. V-3 provides sensation to the mandibular region including the lateral face, lower lip, and chin.

Blood Supply

Branches of the external carotid artery: facial artery and superficial temporal artery supply the face. Terminal branches of the ophthalmic artery also provide blood supply to areas around the orbit.

Muscles

The muscles of the face include the muscles of facial expression and muscles of mastication. The muscles of facial expression are innervated by branches of the Facial nerve (CN VII). These muscles originate on the viscerocranium and insert into the skin allowing them to create facial expressions. The mandibular division of the trigeminal nerve (V-3) innervates the muscles of mastication. These muscles are responsible for chewing (mastication) and all insert onto the mandible. The muscles of mastication include the temporalis, masseter, lateral pterygoid and medial pterygoid muscles (Fig. 1.6).

Parotid Gland

The paired parotid gland is located superficially on the lateral portion of the face. The parotid gland produces and secretes saliva into the oral cavity through a large parotid duct. The parotid duct passes superficially over the masseter muscles to open into the oral cavity. Within the parotid gland reside important structures such as the motor branches of CN VII that supply the muscles of facial expression, the retromandibular vein, and the external carotid artery. The parotid gland receives parasympathetic innervation (GVE) from the lesser petrosal nerve, which is a branch of CN IX. The presynaptic parasympathetic neurons of the lesser petrosal nerve synapse in the otic ganglion. Postsynaptic parasympathetic neurons from the otic ganglion then join with the auriculotemporal nerve to reach the parotid gland.

Oral Cavity

Palate

The palate forms the roof of the oral cavity and is divided into the hard and soft palate. The hard palate is formed by the maxillary bone as well as the palatine bone. The incisive foramen/canal is located anterior midline and transmits branches from CN V-2 as well as arterial branches from the maxillary artery. The soft palate is located posterior to the hard palate. The soft palate acts to move food inferiorly to the esophagus and prevent the food from entering the nasal cavity (Fig. 1.7).

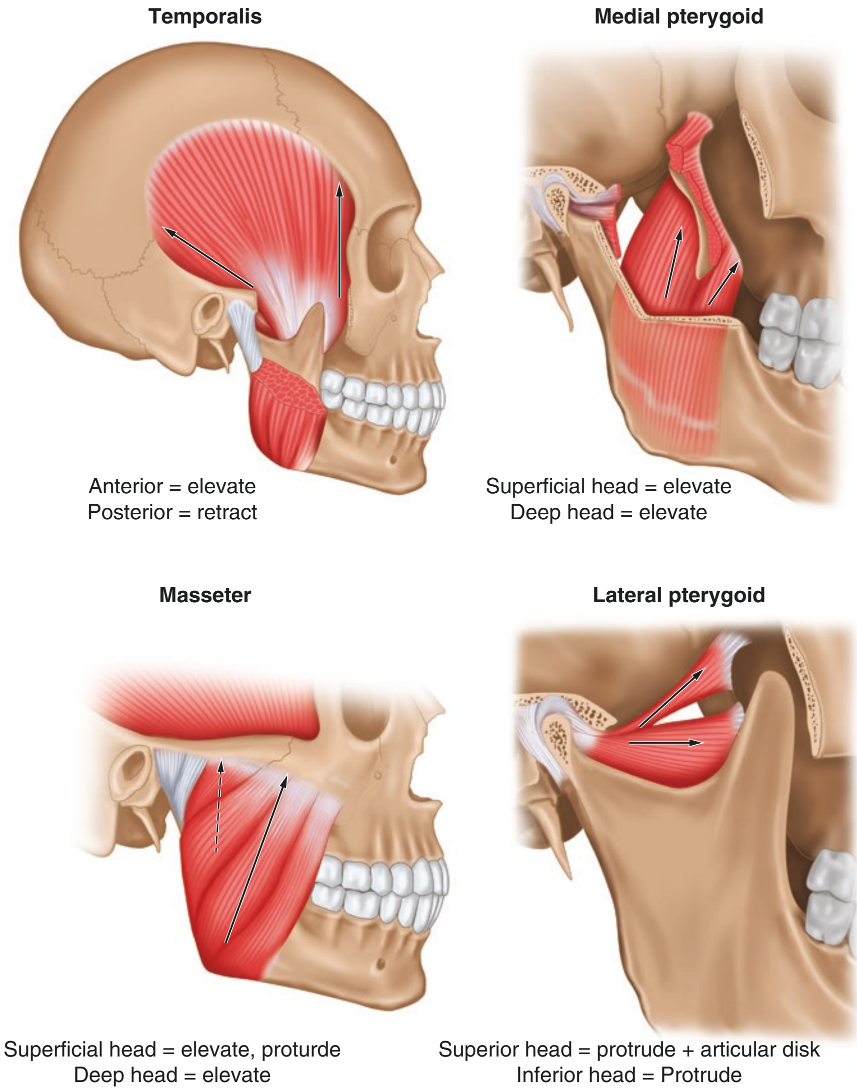

Fig. 1.6 The muscles of mastication include the temporalis, masseter, lateral pterygoid, and medial pterygoid muscles

Tongue

The tongue is made of powerful skeletal muscle with taste buds and general sensory nerve endings within the covering. The muscular component of the tongue is supported through connections to the mandible, hyoid bone, styloid process, the palate, and pharynx. The tongue can be anatomically and embryologically divided into an anterior 2/3 and posterior 1/3. Table 1.2 outlines the innervation of the tongue:

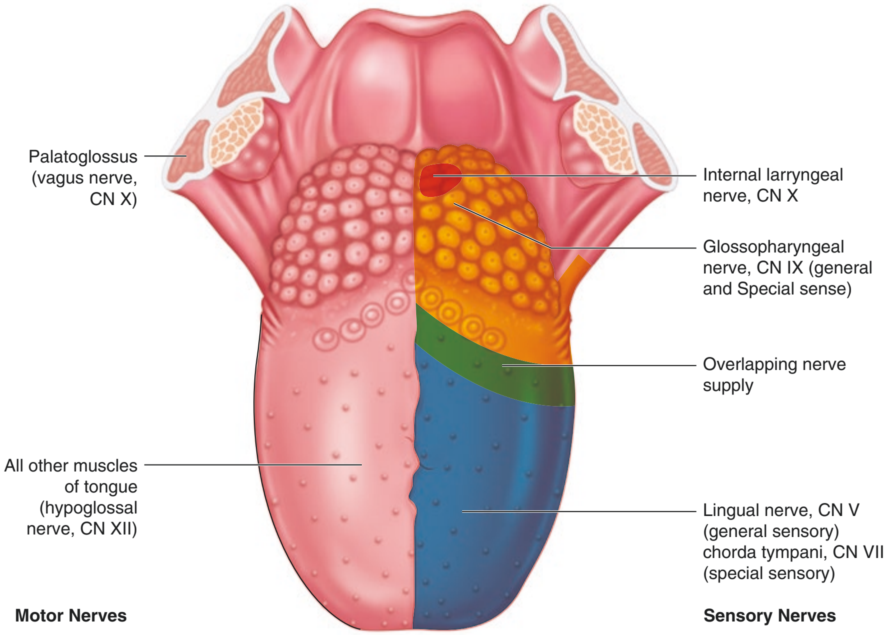

Fig. 1.7 The soft palate acts to move food inferiorly to the esophagus and prevent the food from entering the nasal cavity

Table 1.2 Divisions of the tongue

Divisions of the tongue	Anterior 2/3	Posterior 1/3
Taste – SVA	CN VII – chorda tympani n.	CN IX
General sensation – GSA	CN V-3 – lingual n.	CN IX
Skeletal motor – GSE	CN XII	CN XII *except palatoglossus m. which is innervated by CN X

The blood supply of the tongue is from the lingual artery, which is a branch of the external carotid artery.

Submandibular and Sublingual Glands

The paired submandibular and sublingual glands, as well as the parotid glands, produce and secrete saliva. The submandibular glands are situated superficially inferior to the mandible. The sublingual glands are located just inferior to the tongue. Both the submandibular and sublingual glands receive parasympathetic innervation from the chorda tympani nerve, which is a branch of CN VII. Presynaptic

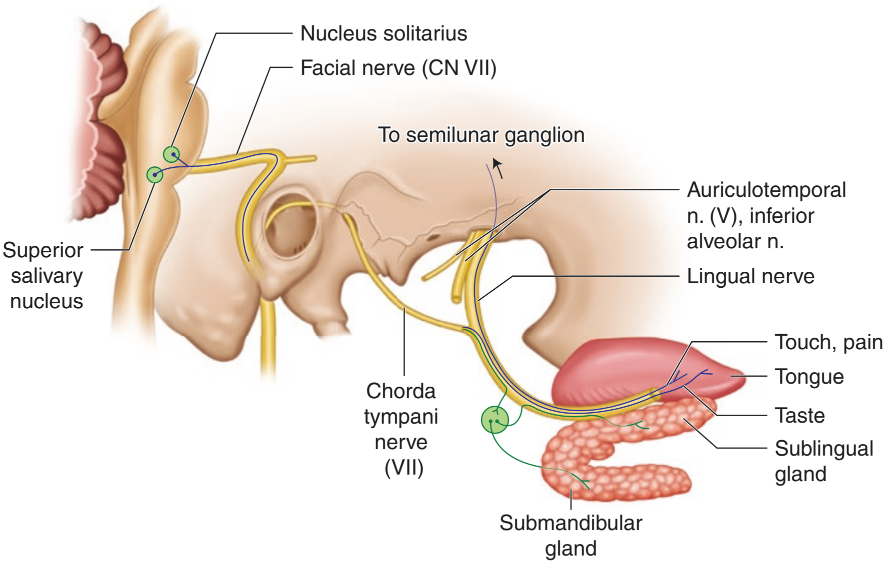

Fig. 1.8 Postsynaptic parasympathetic neurons then travel on lingual nerve to reach the submandibular and sublingual glands

parasympathetic neurons travel on the chorda tympani nerve and then join with the lingual nerve to synapse on the submandibular ganglion. Postsynaptic parasympathetic neurons then travel on lingual nerve to reach the submandibular and sublingual glands (Fig. 1.8).

Neck Anatomy

The neck is comprised of a myriad of structures nutritionally supported by a labyrinth of neurovasculature and lymphatics. It serves as the structural and neural link between the head and remainder of the body, housing a portion of the spinal cord and several major vessels that deliver blood directly to the brain. Due to its relatively narrow width and abundance of anatomical features, the neck is a common site of severe injuries and pathologies. This section will focus on the anatomy of the neck, beginning superficially with the skin and delving deep to the level of the spinal cord, from the body of the mandible anterosuperiorly and the occipital triangle posterosuperiorly to the level of the clavicle anteroinferiorly and to the level of vertebra T4 inferiorly.

Platysma

The following visual perspective is of the cadaver in anatomical position lying supine. The alveolar crest/mental protuberance of the mandible is pushed upward as perpendicularly as possible to the coronal plane, such that the skin covering the floor of the oral cavity is fully visible and stretched as tightly as possible, exposing the anterior neck fully as well. The platysma muscle and fascial layers will be defined in the following section, down to the level of the trachea and esophagus, both located in the center of the neck. The layers defined are spatially located at the level of vertebrae C7 (vertebra prominens) and T1, to account for the presence of the thyroid gland. The terms “posterior” and “deep” will be used interchangeably, respective to the coronal plane.

Immediately deep to the subcutaneous tissue is a very thin superficial muscle called the platysma which, except for a small gap aligned with the midline of the mental protuberance, follows the contour of the neck, originating on the superficial fascia inferior to the clavicle, traveling superiorly over the clavicle, and inserting near the oblique line/ramus of the mandible and oral muscles. Directly deep to the platysma muscle is the superficial (investing) layer of deep cervical fascia. This layer’s anterior aspect extends from the geniohyoid fascia superiorly to the manubrium of the sternum inferiorly, splitting just before reaching the manubrium to form the suprasternal space of Burns. The layer’s posterior aspect extends from the external occipital protuberance superiorly, down far inferiorly to the termination of the neck and into the back region. Moving toward the posterior of the neck, the investing fascia forms the first structure deep to the subcutaneous layer after passing the lateral boundary of the platysma. This layer is described as “investing” due to its total envelopment of several superficial muscles: the sternocleidomastoid muscles anteriorly, and the trapezius muscles posteriorly. Upon reaching these muscles, the investing fascia splits into two layers (anterior and posterior respective to the invested muscle) in order to fit around the muscle on all sides, converging again into a single fascial layer after completing the investment and continuing its path around the superficial neck. There is a layer of fat in the posterior cervical triangle located between the investing fascia and the prevertebral fascia.

Fascial Layers

Fascial layers become more complex deep to the superficial (investing) fascia. Keep in mind that the neck layers are highly symmetrical on both sides of the midsagittal plane. If we divide the neck along the coronal plane and look upon it from a superior perspective, one intuitive demarcation is between the esophagus anteriorly and the vertebral bodies posteriorly. This results in an unequal “amount of neck” on either side of the demarcation, with the lesser “share of neck space” being on the esophageal side and continuing anteriorly, and the greater “share of neck space” being on the vertebral side and continuing posteriorly. The next paragraph is concerned with the esophageal (anterior) side, and we will begin the description directly deep to the superficial (investing) fascial layer.

The esophageal side of the neck contains the infrahyoid fascia surrounding several muscles; the pretracheal fascia (also known as the visceral fascia and the thyroid capsule), which invests the thyroid gland, the trachea, the esophagus, the left and right recurrent laryngeal nerves; and the carotid sheath, which invests three structures: the common carotid artery, internal jugular vein, and vagus nerve. The infrahyoid fascia extends from the level of the superior boundary of the investing fascia to the manubrium of the sternum inferiorly. This fascial layer lies directly deep to the superficial (investing) fascia and invests the following muscles individually in a manner similar to the investing action of the superficial fascia: sternohyoid, sternothyroid, and omohyoid muscles. The infrahyoid fascia fuses with the superficial fascia laterally and the carotid sheath more medially. Located directly deep to the infrahyoid fascia is the pretracheal fascia (thyroid capsule) investing the thyroid gland. The pretracheal fascia extends from the level of C6 superiorly to the arch of the aorta and pericardium inferiorly. The thyroid gland itself wraps loosely into a cupping around the trachea and esophagus. In the depression formed by this cup-shaped gland is, of course, the trachea anteriorly, the esophagus directly bordering the trachea posteriorly, and the left and right recurrent laryngeal nerves located on each of the tracheal–esophageal boundary. Directly deep to the esophagus and terminating on the medial thyroid capsule on each side is the buccopharyngeal (visceral) fascia. The carotid sheaths are located laterally to the posterior thyroid capsule bilaterally. The sheath contains the internal jugular vein laterally, the common carotid artery medially, and the vagus nerve between the two blood vessels.

Remembering our neck demarcation described earlier, there is a small space deep to the buccopharyngeal fascia, termed the retropharyngeal space. In this space lie the left and right sympathetic trunks, each bordering the medial aspect of the carotid sheath bilaterally.

Regarding the vertebral side of our neck demarcation, matters become simpler. We are now moving from the coronal midline toward the posterior surface of the neck, so do not allow the term “deep” to confuse you: it still means “posterior” in this context. The entire side is enclosed within the prevertebral layer of deep cervical fascia. Located in the retropharyngeal space, deep to the buccopharyngeal fascia, the prevertebral fascia splits to form an out-pocketing. The fascia overlying this out-pocketing on the anterior side is called alar fascia. The alar fascia projects a very short isthmus that connects to the buccopharyngeal fascia along the midsagittal plane, and extends the length of the neck from the level of C1 to T2. At C7 (vertebra prominens), the alar fascia is briefly interrupted by the long spinous process of this particular vertebra.

The width of the vertebral body borders the prevertebral fascia. Directly lateral to the vertebral body and resting in the anterior pocket formed by the transverse processes are the longus colli muscles on either side. Lateral to the longus colli are the anterior scalene muscles. Directly posterior to the anterior scalene muscles are the left and right spinal nerves. Directly posterior to the spinal nerves are the middle and posterior scalene muscles, so named by their position in the coronal plane relative to each member of the scalene group. Directly posterior to the transverse processes and medial to the posterior scalene muscles are several deep cervical muscles, which will be elaborated later. The levator scapulae muscles are located directly posterior to the middle and posterior scalene muscles. Remember that the muscles discussed in this paragraph are all located within the prevertebral layer of deep cervical fascia (Fig. 1.9).

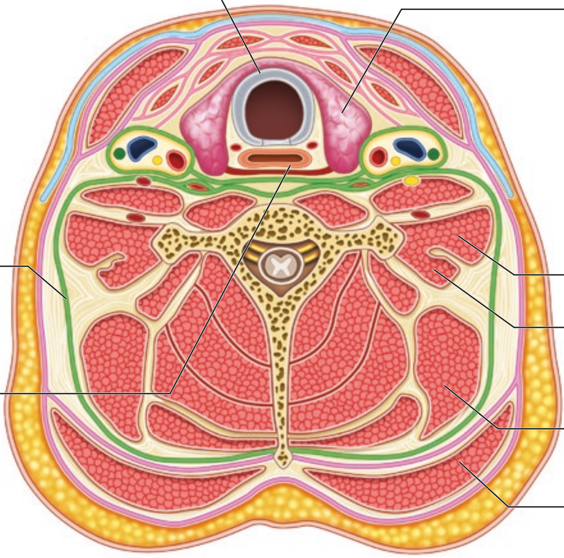

Fig. 1.9 The levator scapulae muscles are located directly posterior to the middle and posterior scalene muscles within the prevertebral layer of deep cervical fascia

Neck Bones and Cartilages

To set reference points for muscular attachments and neurovasculature pathways through the neck, the locations of the intrinsic bones, cartilages, and membranes of the neck will be described in this section, extending from the level of C1 down to the manubrium of the sternum. The most superior bony landmark useful in an examination of the neck is the mandible, a movable bone anchored to the skull by its condylar and coronoid processes. The following visual perspective is of the anterior aspect of the larynx. Inferior and posterior to the angle of the mandible is the hyoid bone, the site of many muscular attachments in the area. It is located spatially at the level of the C3–C4 intervertebral disc. The bone is roughly C-shaped and characterized by the following descriptive terms: the hyoid body is the wide face of the bone located on its anterior aspect; the lesser horn is a small bony projection a small distance posterior to the front of the hyoid body; the greater horn is the long bony projection of the hyoid, traveling posteriorly and overlapping with C3 in the coronal plane. The hyoid bone itself is anchored to the styloid process at the lesser horn by the stylohyoid ligament, to the directly posterior epiglottis by the hyoepiglottic ligament, and to the inferior thyroid cartilage by the thyrohyoid membrane. The triticeal cartilage joins the greater horn of the hyoid bone to the superior horn of the thyroid cartilage. The thyroid cartilage extends from the C4 to C6 level, and is comprised of the following structural peculiarities: the thyroid cartilage lamina is the main medial aspect of the cartilage located predominately at the C5 level and anchored to the cricoid cartilage inferiorly by the median and lateral cricothyroid ligaments; two superior horns project superiorly from the lateral thyroid cartilage bilaterally to the C4 level and are anchored to the thyrohyoid membrane; one superior thyroid notch is present as a superior–inferior oriented indentation in the thyroid cartilage (termed the laryngeal prominence at its apex) along the cartilage midline and filled in by the thyrohyoid membrane; two inferior horns project inferiorly from the lateral thyroid cartilage bilaterally to the C6 level and are anchored to the cricoid cartilage inferiorly at the thyroid articular surface of the cricothyroid joint. Located on the posterolateral thyroid cartilage lamina is a prominent oblique line that serves as a point of origin for the thyrohyoid muscle. The cricoid cartilage is located at the C6 level and is anchored to the thyroid cartilage above and the trachea directly inferiorly. Unlike the thyroid cartilage, which terminates in its wrap-around of the larynx at points directly aligned with the superiorly located hyoid greater horn, the cricoid cartilage wraps completely around the larynx. The posterior aspect of the cricoid cartilage is termed the arch of the cricoid cartilage.

Viewing the thyroid cartilage from a posterior perspective, the epiglottis is anchored to the posterior aspect of the thyroid cartilage lamina by the thyroepiglottic ligament. Two arytenoid cartilages rest directly posterior to the thyroid cartilage lamina, each anchored to the lamina by a vocal ligament and resting atop the cricoid cartilage lamina on the arytenoid articular surface. The posterior-most extension of the arytenoid cartilages is termed the muscular process. Sitting at the superior apex of each arytenoid cartilage is a small corniculate cartilage.

Neck Musculature

The following initial visual perspective is of the cadaver in anatomical position lying supine. The alveolar crest/mental protuberance of the mandible is pushed upward as perpendicularly as possible to the coronal plane, such that the skin covering the floor of the oral cavity is fully visible and stretched as tightly as possible, exposing the anterior neck fully as well. It will be useful to rotate your mental image around the midsagittal plane when we consider the muscles obscured by superficial structures and located laterally. We will now begin to define the muscle groups of the neck. When a muscle is introduced, its characteristics will be described in the following order: name of muscle, origin, insertion, nerve supply, blood supply, and action.

Sternocleidomastoid

The sternocleidomastoid muscle is located on the superficial lateral neck, just deep to the platysma and investing fascia. It is comprised of two heads that have different origins. The sternal head originates on the anterior surface of the manubrium of the sternum, while the clavicular head originates on the upper surface of the medial 1/3 of the clavicle. Both heads insert on the lateral surface of the mastoid process and lateral half of the superior nuchal line of the occipital bone. The sternocleidomastoid is innervated by the accessory nerve (CN XI) and receives blood from several sources: sternocleidomastoid branch of the superior thyroid and occipital arteries, the muscular branch of the suprascapular artery, and the occipital branch of the posterior auricular artery. The muscle functions bilaterally to flex the head and raise the thorax. Unilaterally, each sternocleidomastoid functions to turn the face toward the contralateral side (Fig. 1.10).

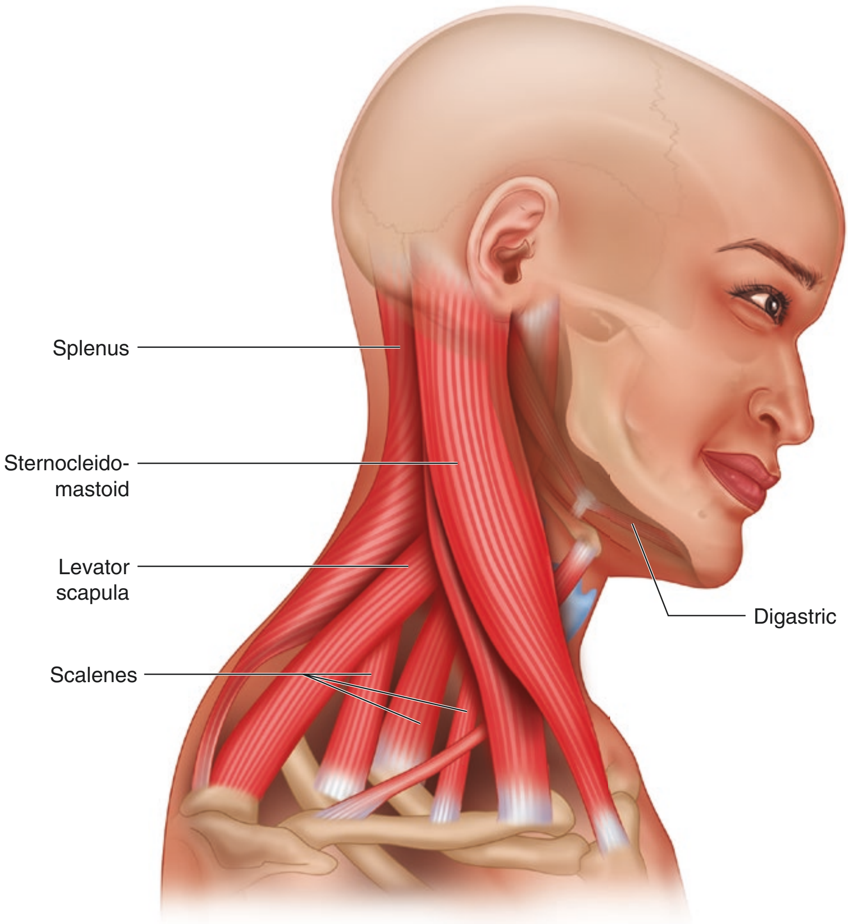

Fig. 1.10 The sternocleidomastoid is innervated by the accessory nerve (CN XI) and receives blood from several sources: sternocleidomastoid branch of the superior thyroid and occipital arteries, the muscular branch of the suprascapular artery, and the occipital branch of the posterior auricular artery. The muscle functions bilaterally to flex the head and raise the thorax. Unilaterally, each sternocleidomastoid function to turn the face toward the contralateral side

Subclavius

The subclavius muscle originates on the upper border of the first rib and its cartilage. It inserts on the inferior surface of the middle third of the clavicle. It is innervated by the nerve to subclavius, and it receives blood from the clavicular branch of the thoraco-acromial artery. It functions to anchor and depress the clavicle.

Beneath the Mandible/Floor of the Oral Cavity/Suprahyoid Muscles (Fig. 1.11)

Geniohyoid

Forming the floor of the oral cavity is a group of muscles involved in moving the mandible. The following muscles are known as suprahyoid muscles due to their

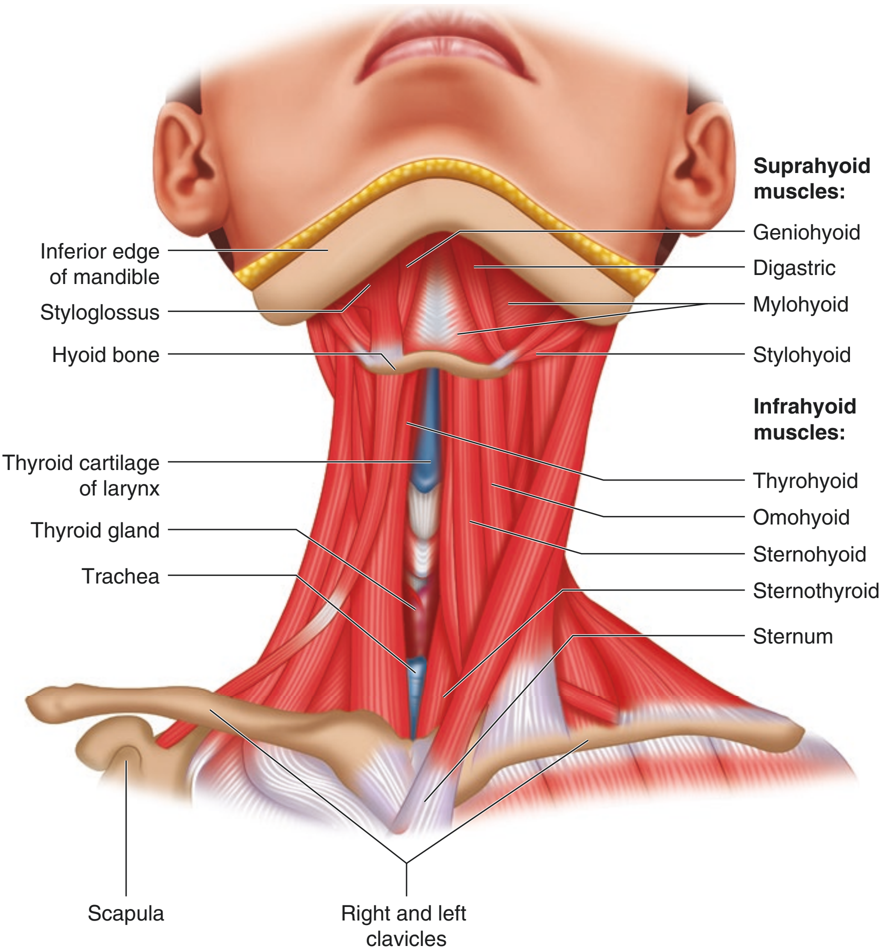

Fig. 1.11 A view of the oral cavity floor, beneath the mandible. Also shown are the suprahyoid and infrahyoid muscles