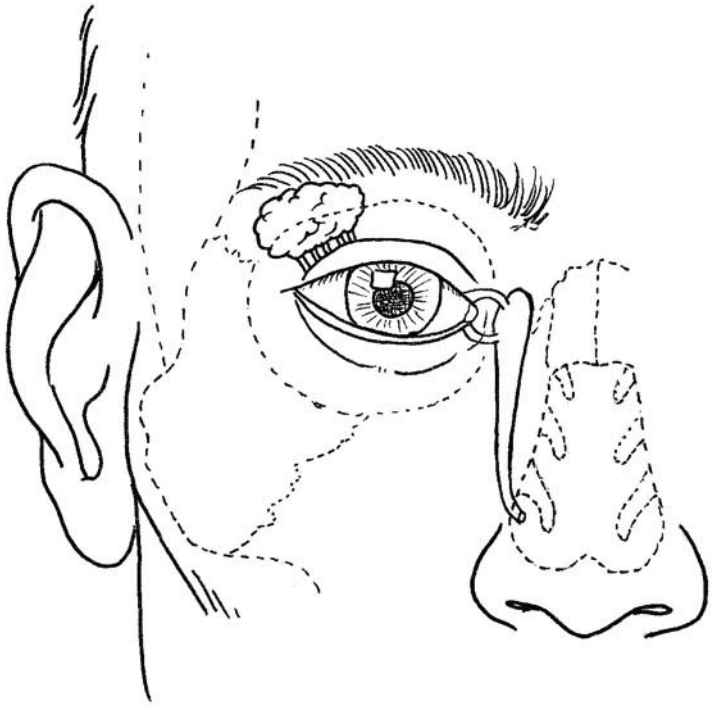
GROSS ANATOMY

Lecture Syllabus 2008

Unit #3: Head and Neck



ANAT 6010 - Gross Anatomy
Department of Neurobiology and Anatomy
University of Utah School of Medicine

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Unit #3- Neck and Head

G15- Neck Overview

G16-17A: Triangles of the Neck

Posterior Triangle

Anterior Triangle

Visceral Triangle

G17B- Brain and Base of the Skull

G18- Cranial Nerves and Autonomics- A Systemic Overview

G19- Orbit

G20A- Superficial Face and Infratemporal Fossa

G20B- Pterygopalatine Fossa, Nasal Cavity, and Paranasal Sinuses

G21A- Oral Cavity, Tongue and Teeth

G21B- Pharynx

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G23- Ear

G15: Neck Overview

At the end of this lecture, students should be able to master the following:

1)Fascia

a) Describe the location and anatomical structures associated with the following fascial layers

(1) Superficial cervical fascia- same as subcutaneous layer of skin; contains the platysma m.
Platysma m.: innervated by the cervical branch of CN VII

(2) Deep cervical fascia

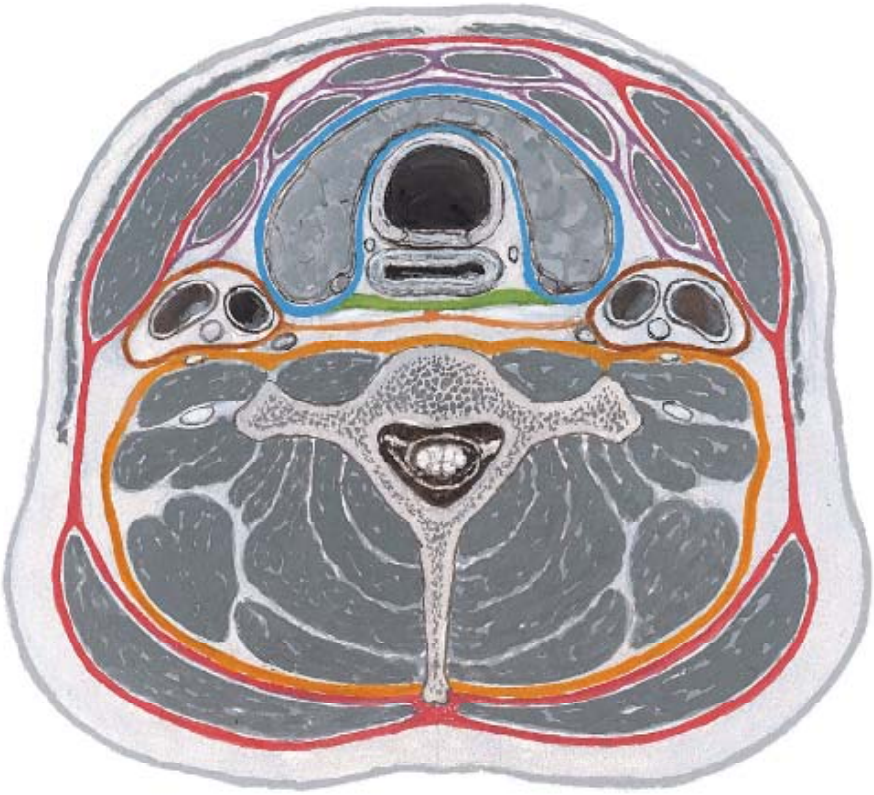
Investing fascia- envelopes sternocleidomastoid and trapezius muscles; occipital bone, mastoid process, zygomatic arch inferiorly to the scapular spine, acromion, clavicle and manubrium

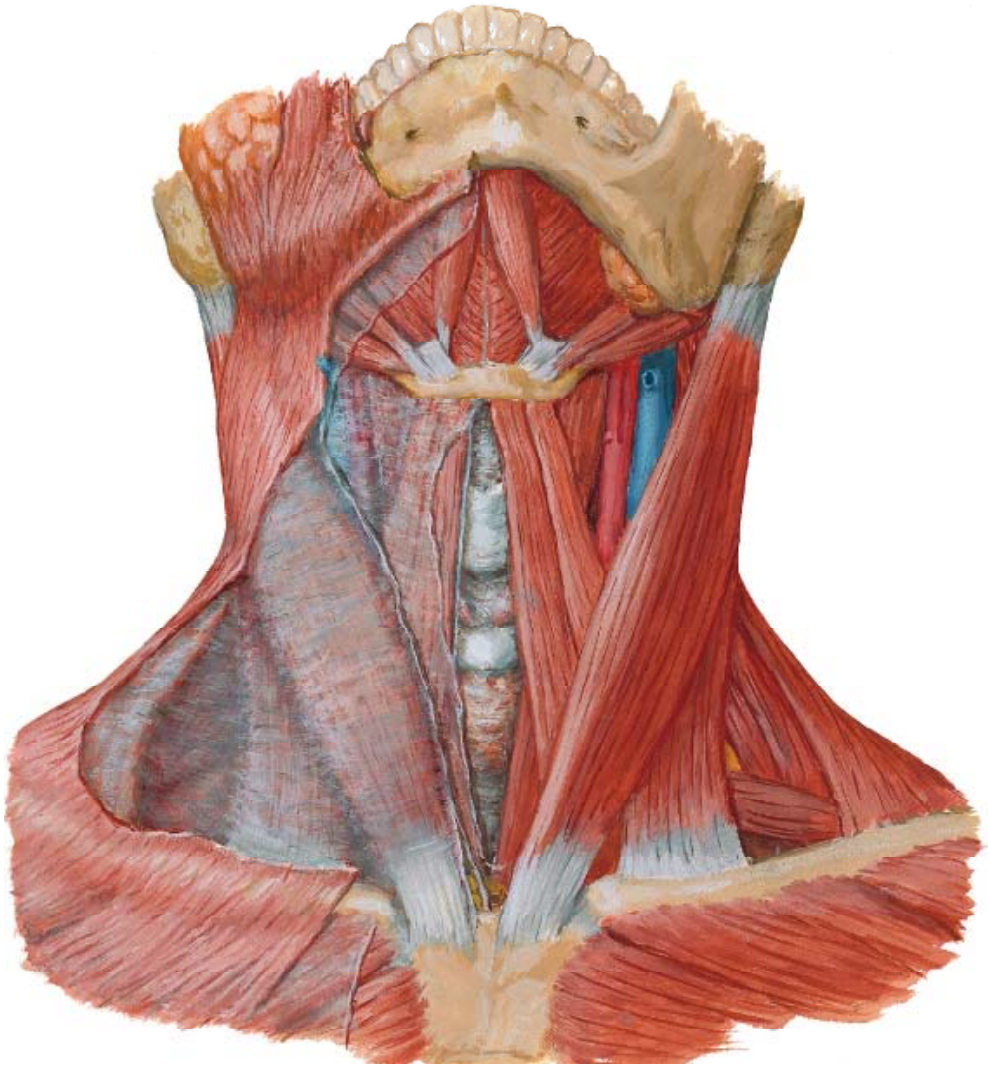
Pretracheal fascia-the muscular portion encloses the infrahyoid muscles, while the visceral portion surrounds the thyroid gland, larynx, trachea, pharynx and esophagus

Prevertebral fascia- surrounds the cervical vertebral column, and envelopes deep neck muscles including prevertebral, scalenes, and deep back muscles

Carotid sheath- formed by the investing, pretracheal and prevertebral fascial layers; surrounds internal jugular vein, common carotid artery, and vagus nerve

b) Describe the location of the retropharyngeal space and its relation to the deep cervical fascial layers





2) Cervical Plexus

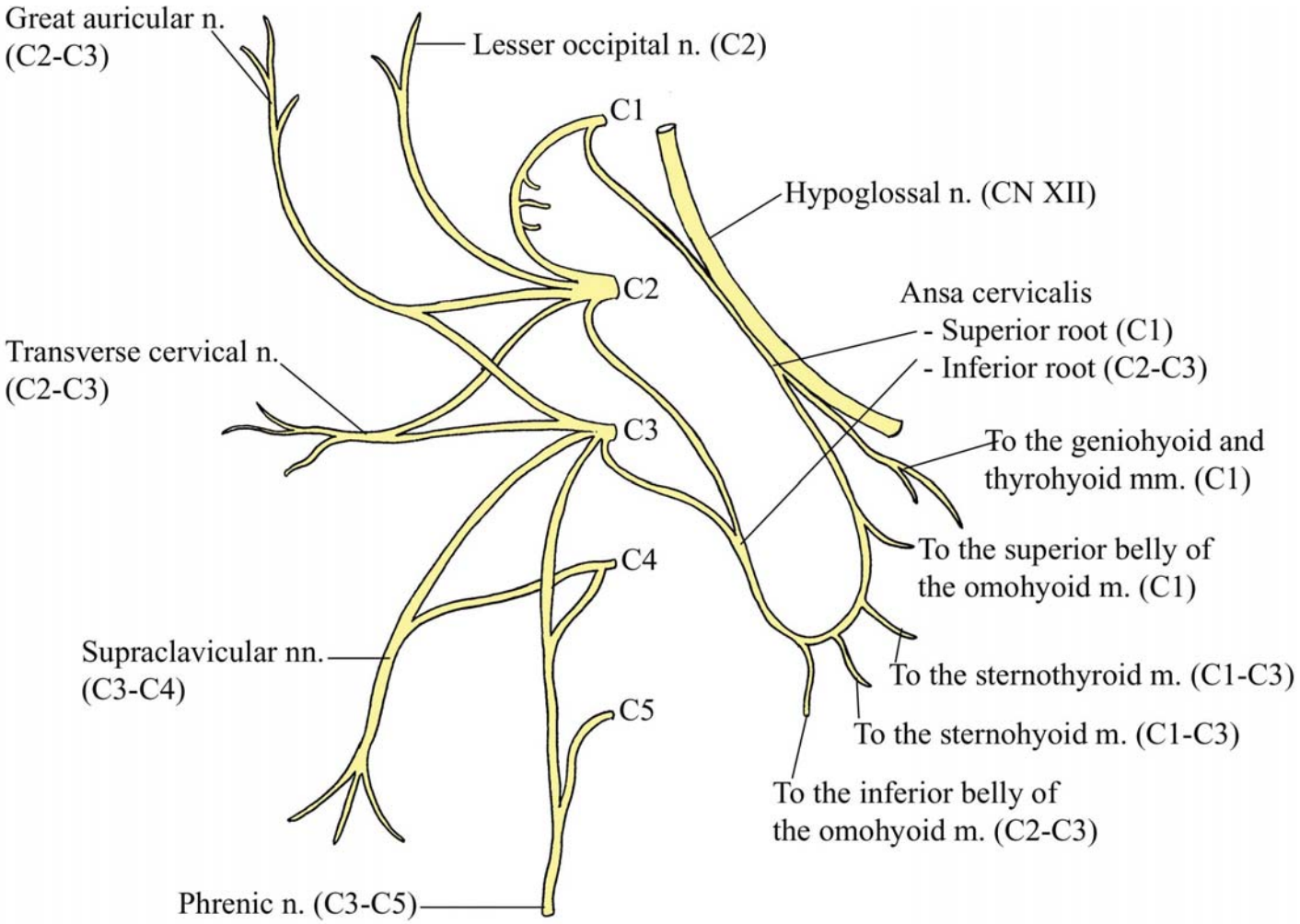
Draw and label the cervical plexus including all spinal levels (C1-4):

Sensory nerve branches

- Lesser occipital (C2)
- Great auricular (C2-C3)
- Transverse cervical (C2-C3)
- Supraclavicular (C3-C4)

Motor nerve branches

- Ansa cervicalis (C1 superior root) (C2-C3 inferior root)
  - Nerve to geniohyoid and thyrohyoid mm. (C1)
  - Nerve to superior belly of omohyoid m. (C1)
  - Nerve to sternothyroid and sternohyoid mm. (C1-C3)
  - Nerve to inferior belly of omohyoid m. (C2-C3)
- Phrenic (C3-C5)


Great auricular n.
(C2-C3)
Lesser occipital n. (C2)
C1
Hypoglossal n. (CN XII)
C2
Ansa cervicalis
- Superior root (C1)
- Inferior root (C2-C3)
Transverse cervical n.
(C2-C3)
C3
To the geniohyoid and
thyrohyoid mm. (C1)
To the superior belly of
the omohyoid m. (C1)
C4
Supraclavicular nn.
(C3-C4)
To the sternothyroid m. (C1-C3)
C5
To the sternohyoid m. (C1-C3)
To the inferior belly of
the omohyoid m. (C2-C3)
Phrenic n. (C3-C5)

3) Vessels of the Head and Neck

a) Common Carotid Artery

i) Internal carotid artery- courses through neck in carotid sheath without any branching, then travels through the carotid canal to enter to skull

Carotid sinus - baroreceptor; CN IX visceral sensory

Carotid body - chemoreceptor; CN IX and X visceral sensory; located at bifurcation

ii) External carotid artery

Describe the origin, course, and destination of the following branches of the external carotid artery:

Superior thyroid

Ascending pharyngeal

Lingual

Facial

Occipital

Posterior auricular

Maxillary

Superficial temporal

b) The IJV and EJV are the primary venous channels for the head and neck

i) Internal jugular vein- located in carotid sheath

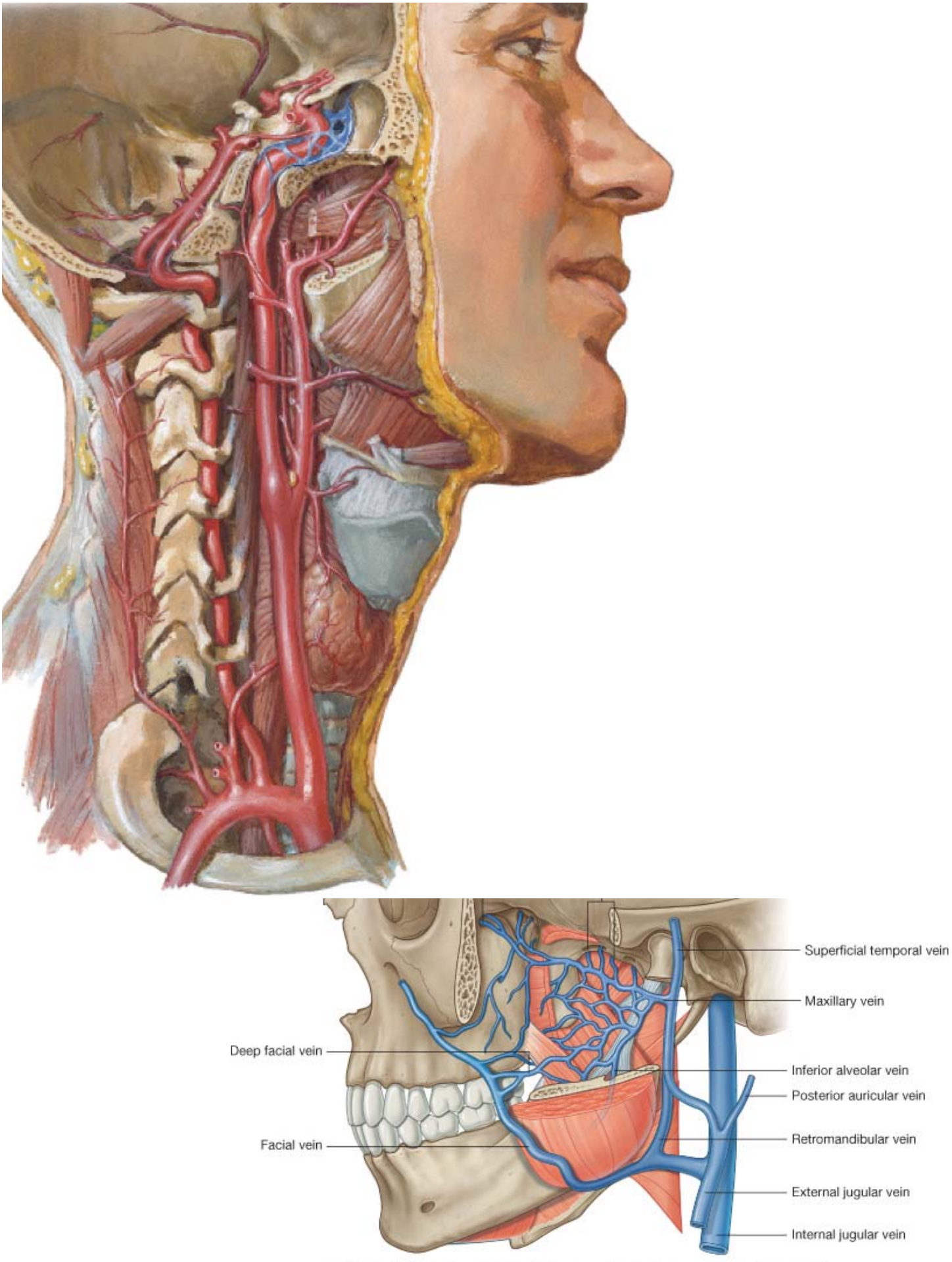
Anterior jugular vein

ii) External jugular vein - formed posterior to the angle of the mandible as the posterior auricular vein and retromandibular vein

Retromandibular vein is formed by the superficial temporal and maxillary veins

Anterior division - joins the facial vein to form the common facial vein, which joins the IJV

Posterior division - joins the posterior auricular vein to form the external jugular vein


Superficial temporal vein
Maxillary vein
Deep facial vein
Inferior alveolar vein
Posterior auricular vein
Facial vein
Retromandibular vein
External jugular vein
Internal jugular vein

4) Muscles of the Neck

Superficial Neck Muscles

- Platysma m.

- Trapezius m.

- Sternocleidomastoic m.
  Unilateral: Tilts the head to the same side; rotates the head to the opposite side
  Bilateral: Extends the head; assists in respiration when the head is fixed
  Innervated by CN XI

Ventral Strap Muscles

Suprahyoid muscles

- Digastric, geniohyoid, mylohyoid, stylohyoid

Infrahyoid muscles

- Sternohyoid, sternothyroid, thyrohyoid, omohyoid

Prevertebral Muscles: stretch between the cervical spine and skull acting on both

Longus captis m.

Longus colli m.

Lateral, Deep Neck Muscles

Scalenes: lateral, deep neck muscles; attach between the cervical spine and upper two ribs and assist in respiration. the anterior and middle scalene are separated by the interscalene space; a topgraphicallly important interval traversed by the brachial plexus and subclavian artery

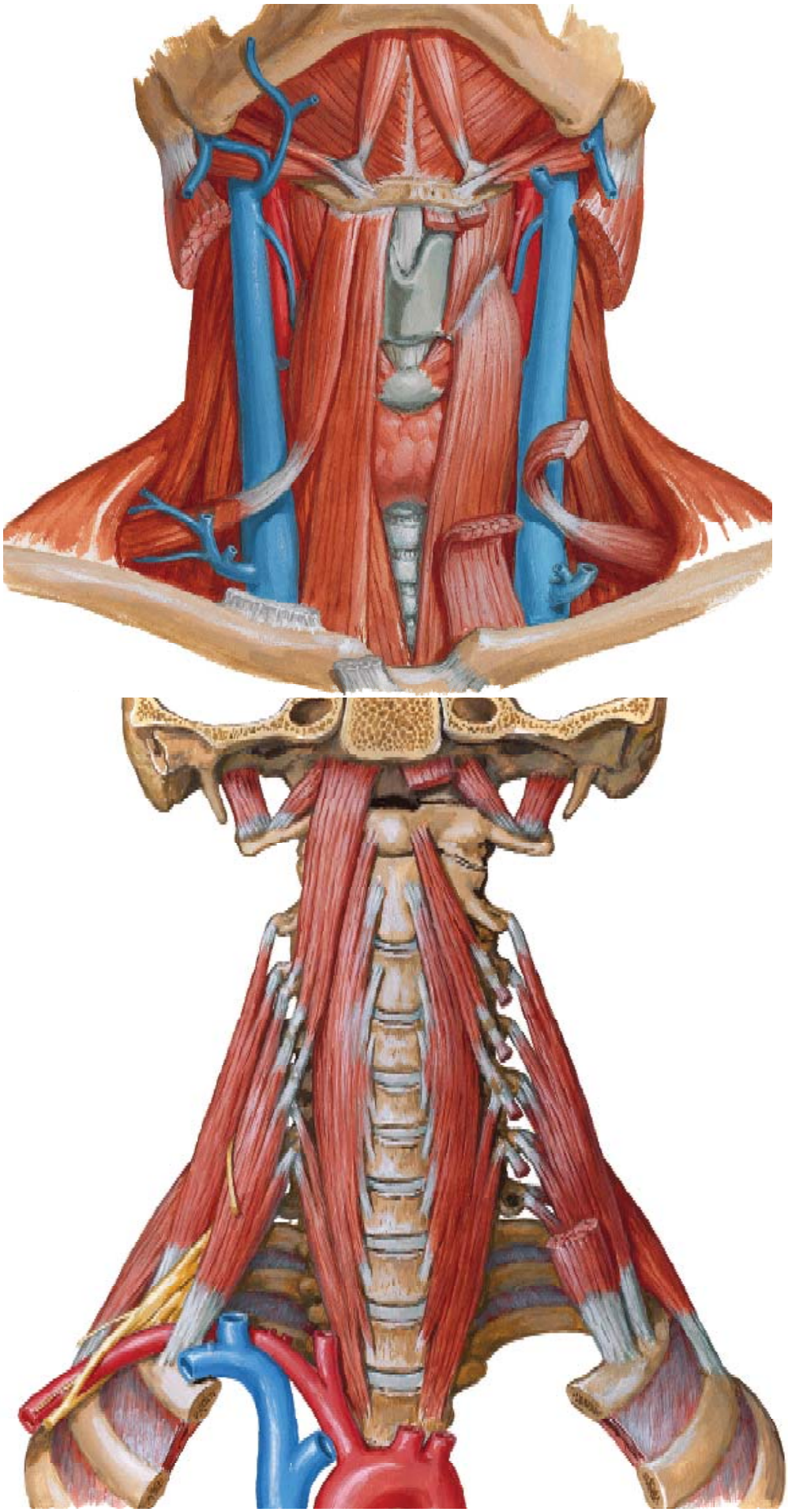
Posterior scalene

Middle scalene

Axillary sheath
Brachial plexus
Subclavian artery - courses posterior to the anterior scalene m.

Anterior scalene

Subclavian vein - courses across the anterior scalene m.



G16-17A: Triangles of the Neck

1) Posterior Triangle of the Neck

Describe the anatomical structures that create the following boundaries of the posterior triangle of the neck:

Borders: sternocleidomastoid m., trapezius m., clavicle, occipital bone

Roof: Investing layer of deep cervical fascia that surrounds the SCM and trapezius mm.

Floor: Prevertebral fascia (splenius capitis, levator scapulae, posterior, middle and anterior sclane mm.)

2) Anterior Triangle of the Neck

Describe the boundaries and major anatomical contents of the following subdivisions of the anterior triangle of the neck

a) Submental Triangle: body of hyoid, anterior belly of digastricus, mandibular symphysis
- Contains submental lymph nodes and mylohyoid muscle

b) Submandibular (digastric) Triangle: inferior mandible, anterior and posterior bellies of digastricus
- Contains the submandibular gland and portions of the hypoglossal nerve, facial artery, facial vein

c) Carotid Triangle: superior belly of the omohyoid, anterior SCM, posterior belly of digastricus
- Contains portions of the common carotid artery, internal jugular vein, and vagus nerve

d) Muscular (omotracheal) Triangle: midline of neck, superior belly of omohyoid, anterior SCM
- Contains: longus colli, longus capitis, rectus capitis anterior, rectus capitis lateralis, sternocleidomastoid, digastric, mylohyoid, geniohyoid, thyrohyoid, omohyoid, sternothyroid, sternohyoid

3 Visceral Triangle of the Neck

Describe the boundaries and major anatomical contents of the visceral triangle of the neck

a) Anterior: contains thyroid and parathyroid glands, pharynx/esophagus

1) Posterior Triangle of the Neck

a) Describe the following topographical relations:

i) The relation of the cervical plexus to the sternocleidomastoid muscle

ii) The cutaneous distribution of the superficial branches of the cervical plexus (lesser occipital, great auricular, transverse cervical, supraclavicular)

iii) External jugular vein formed by posterior auricular and retromandibular vein. Courses down the neck in superficial fascia external to the SCM and pierces the investing deep cervical fascia entering the subclavian vein.

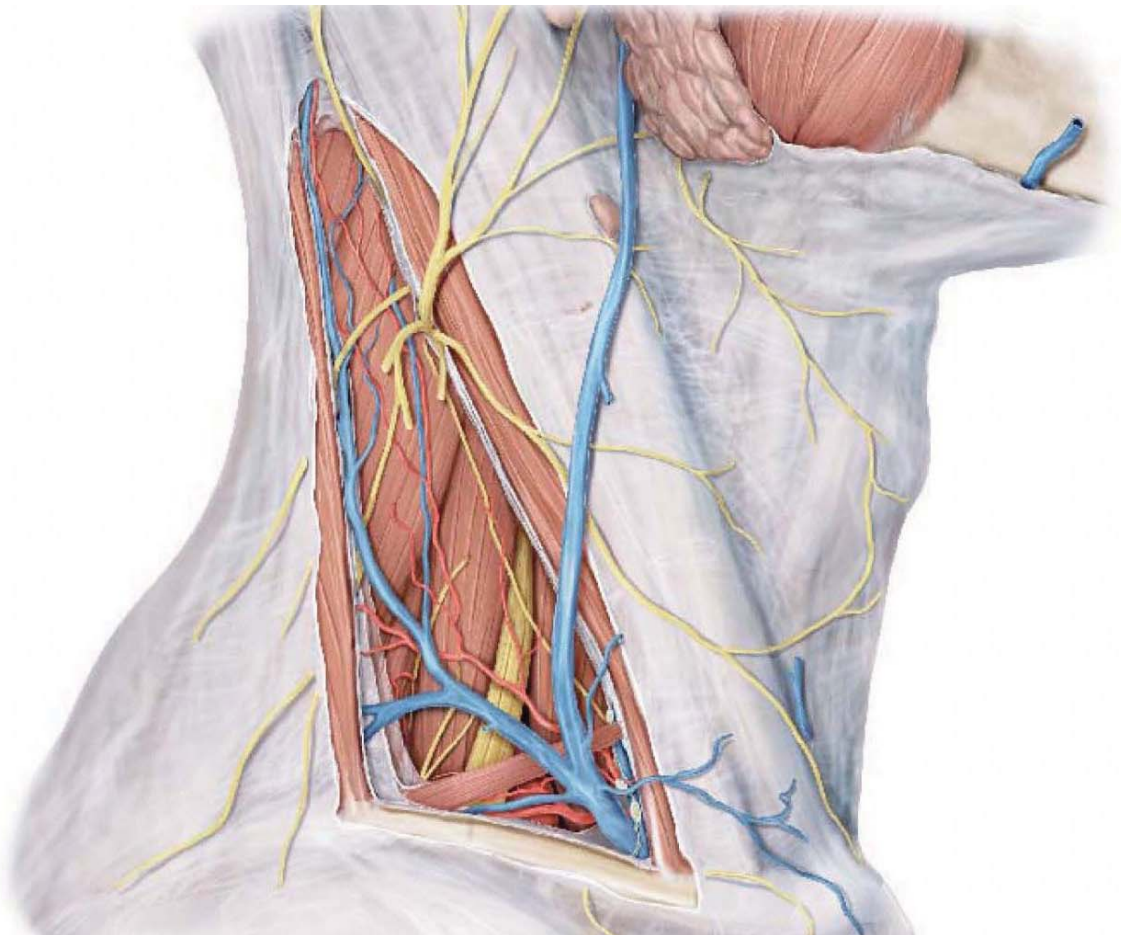
Clinical correlations with EJV - jugular venous pulse

iv) The relation between the anterior scalene and the phrenic nerve

v) The location of the brachial plexus nerves (C5-T1 ventral rami) in the posterior triangle of the neck

vi) The pathway of the following vessels through the posterior triangle of the neck: suprascapular artery, transverse cervical artery, occipital artery, external jugular vein, and subclavian vein

vii) The relation of the prevertebral fascia to the spinal accessory nerve (CN XI)



2) Anterior Triangle of the Neck

a) Submandibular triangle
  i) Superior to the digastric bellies
  ii) Contents: submandibular gland, submandibular nodes, facial a. and v., hypglossal n.

b) Carotid triangle
  i) Posterior digastric, inferior omohyoid and SCM
  ii) Contents: carotid sheath and related structures (carotids, CN X, IJV, carotid body and sinus)

c) Muscular triangle
  i) Formed by the infrahyoid mm.
  ii) Contents: infrahyoid mm.

d) Submental triangle
  i) Anterior digastric bellies and hyoid bone
  ii) Contents: submental lymph nodes

2) Continued ... Nerves Associated with the Anterior Triangle of the Neck

a) Cervical plexus

i) Know the branches to geniohyoid and thyrohyoid mm., to superior belly of omohyoid m., to sternothyroid m., to sternohyoid m., to inferior belly of the omohyoid m.

ii) Describe the relation of the ansa cervicalis to the carotid sheath, common carotid artery, internal jugular vein, and sympathetic trunk

iii) Describe the relationship of the ansa cervicalis (superior root) to CN XII

b) Glossopharyngeal nerve (CN IX)

i) Describe the course/function of the glossopharyngeal nerve (CN XI) to the carotid sinus and carotid body
Carotid branch- descends to the carotid sinus and carotid body to monitor arterial blood pressure and oxygen content (VS)

c) Vagus nerve (CN X)

i) Describe the relation of the vagus nerve to the common carotid artery and internal jugular vein

ii) Describe the course, destination, and nerve fiber contents of the following branches of the vagus nerve: superior laryngeal, internal laryngeal, external laryngeal, recurrent laryngeal

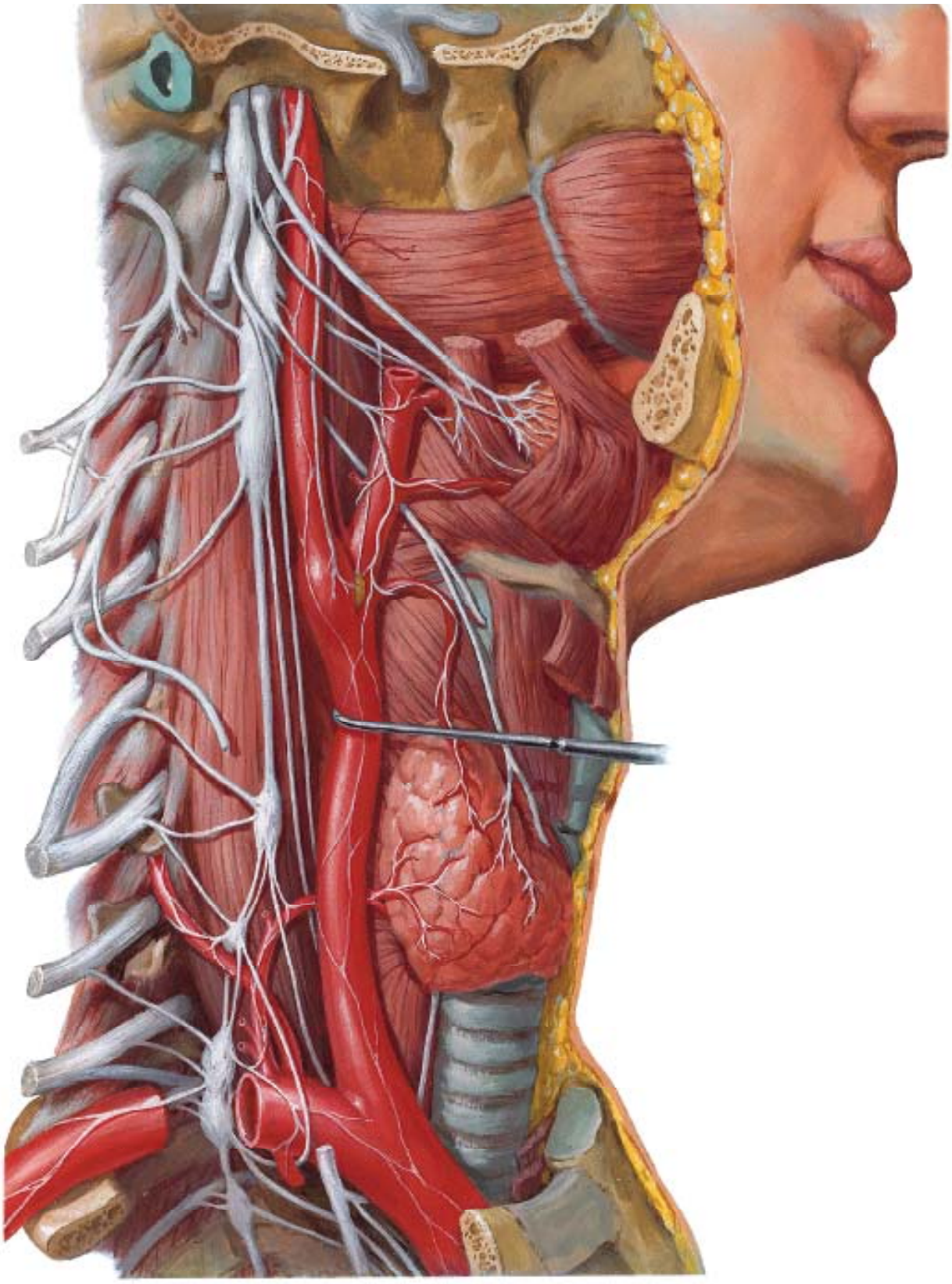
iii) Describe the course and function of the vagus nerve (CN X) supply to the carotid body
Carotid body branch- branches from the inferior vagal ganglion and descends to the carotid body to monitor arterial oxygen content (VS)

d) Sympathetics

i) Describe the relation of the sympathetic trunk (chain) to the prevertebral fascia, longus colli muscle, longus capitis muscle and cervical vertebrae

ii) Describe the location and nerve fiber contents of the following sympathetic trunk ganglia: inferior cervical, middle cervical, and superior cervical ganglia

iii) Describe the function of the cervical sympathetic trunk in innervation of the head and neck



3) Visceral Triangle and Root of the Neck

a) Thyroid gland
i) Identify the parts (lobes and isthmus) and general function

ii) Describe the arteries and veins of the thyroid gland

iii) Describe the relationship between the superior thyroid artery and superior laryngeal nerve, and the inferior thyroid artery and recurrent laryngeal nerve

b) Parathyroid glands
i) Describe the location and general function of the parathyroid glands

c) Trachea
i) Describe the general function of the trachea and topography

d) Esophagus
i) Describe the general function of the esophagus and topography

4) Root of the Neck

a) Describe the anatomical structures that create the following boundaries of the root of the neck:

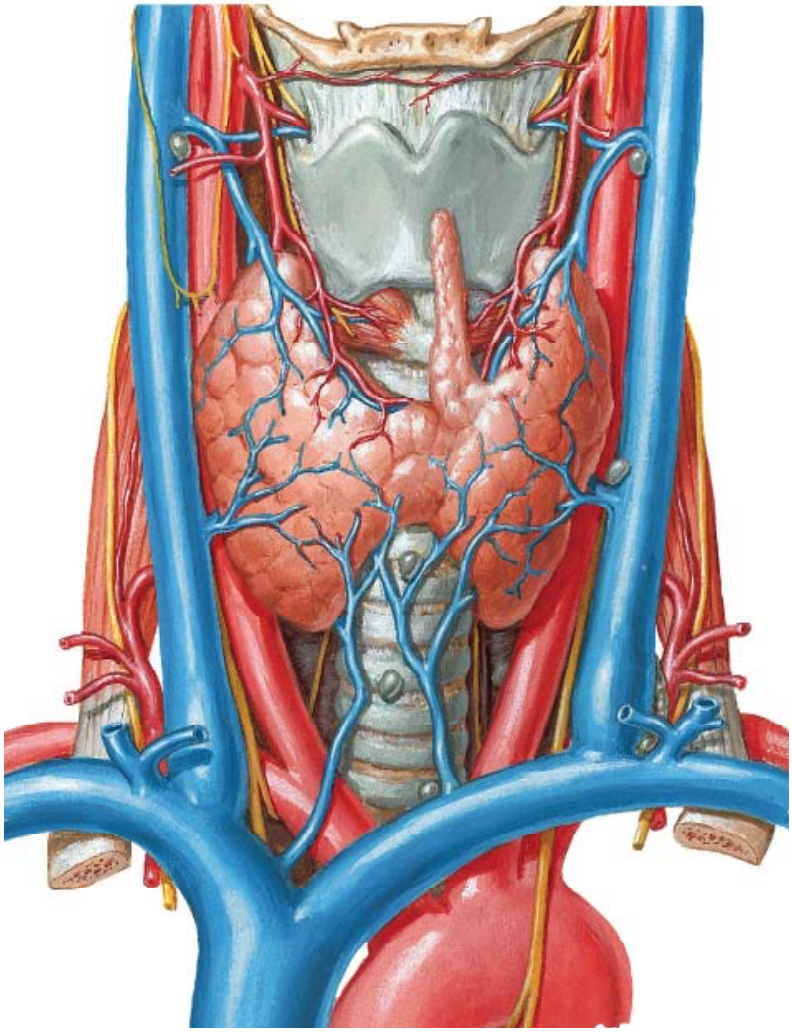
- Manubrium, rib 1 and T1 vertebra

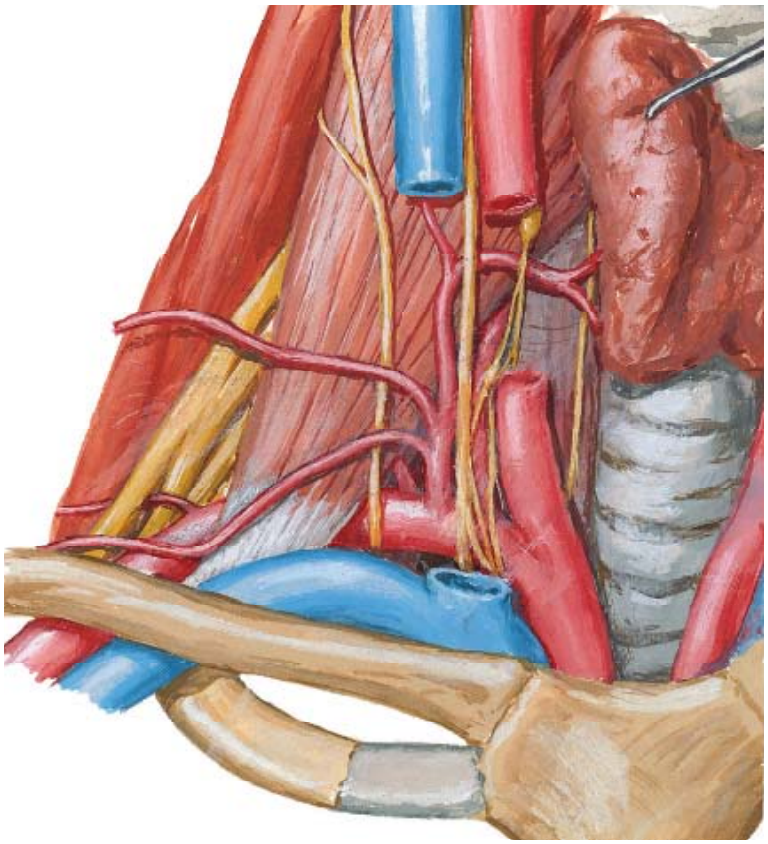
b) Describe the arterial asymmetry of the aortic arch branches in the root of the neck

c) Describe the origin, course, and destination of the following branches of the subclavian arteries: vertebral, thyrocervical, dorsal scapular arteries

d) Describe the origin, course, and destination of the following veins of the root of the neck: external jugular, anterior jugular, jugular venous arch, subclavian, internal jugular, brachiocephalic veins

e) Describe the relation of the thoracic lymphatic and right lymphatic ducts to the cervical veins





G17B: Brain and Base of Skull

At the end of this lecture, students should be able to master the following:

1) Scalp

a) Describe the layers of the scalp. The first three layers are held tightly together.

Skin

Connective tissue- dense connective tissue; distributes neurovascular supply to the scalp

Aponeurosis - consists of the occipitalis muscle, galea aponeurotica and frontalis muscle

Loose connective tissue - separates the aponeurotic layer from the pericraneum

Pericranium - periosteum

b) Describe the arterial vascularization of the scalp

Internal carotid artery - ophthalmic artery - supratrochlear and supraorbital branches

External carotid artery - superficial temporal, posterior auricular, and occipital arteries

c) Map the cutaneous innervation of the scalp

Trigeminal nerve branches- supraorbital (CN V-1), supratrochlear (CN V-1), zygomaticotemporal (CN V-2), auriculotemporal (CN V-3)

Lesser occipital nerve (C2 ventral ramus)

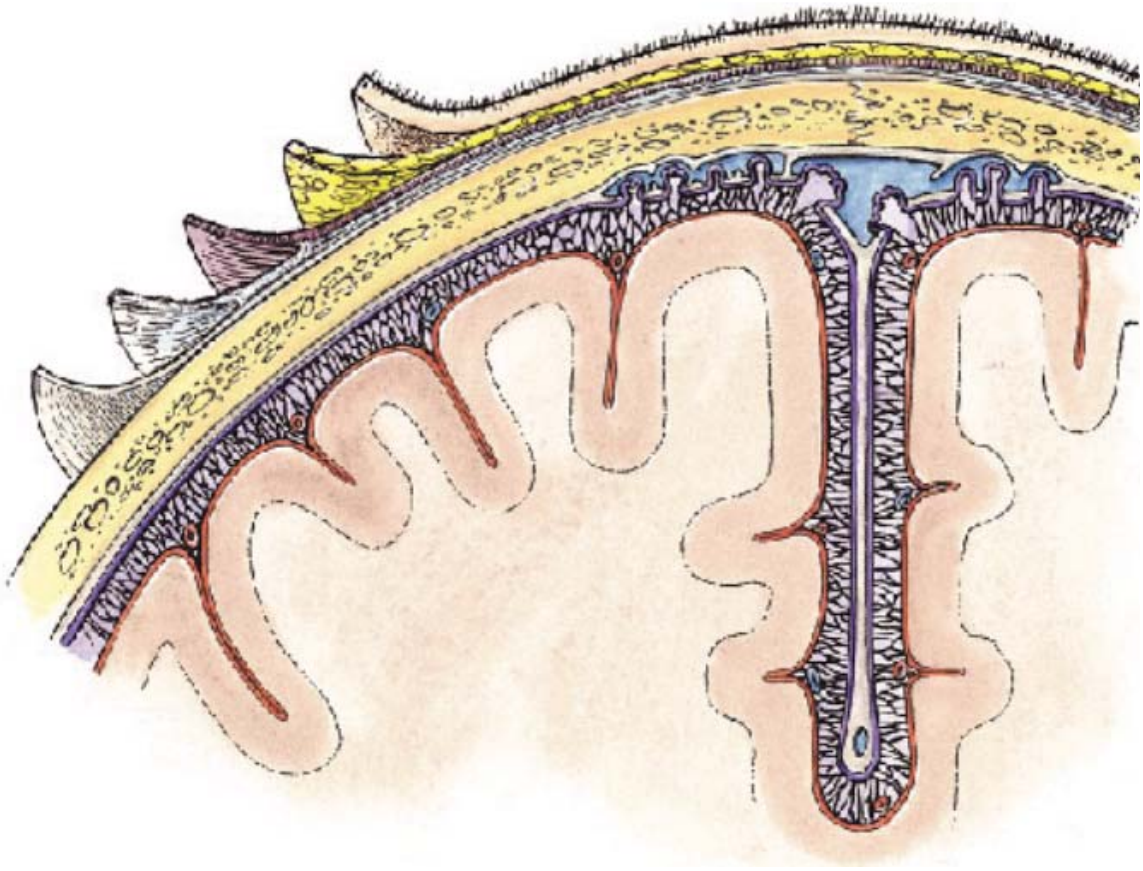
Greater occipital nerve (C2 dorsal ramus)

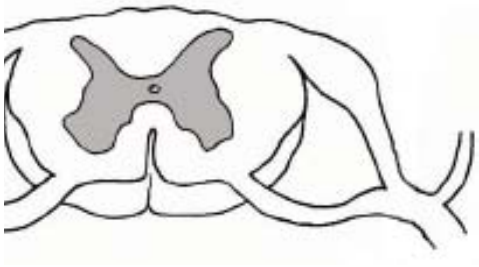
Third (least) occipital nerve (C3 anterior ramus)

2) Skull

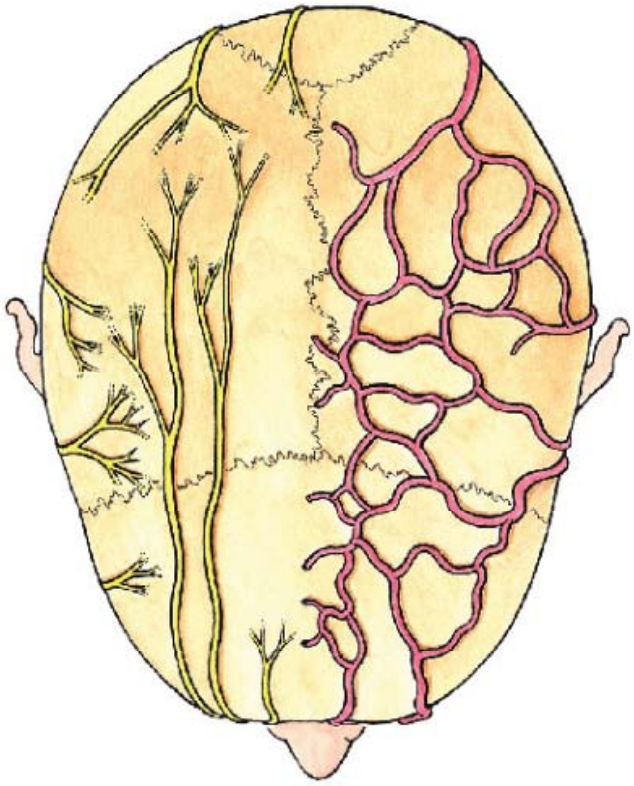
a) Identify the bones of the neurocranium (frontal, parietal, temporal, occipital, sphenoid, and ethmoid bones)

b) Identify the following sutures and related landmark on the skull: sagittal suture, lamboid suture, coronal suture, and pterion





C2 Spinal cord level



3) Cranial Meninges

The brain is surrounded and protected by meninges, coupled with real and potential spaces within the cranial cavity.

a) Dura Mater

Describe the 2 layers of dura mater

The periosteal layer is attached to the internal skull and sutures

The meningeal layer is in close contact with the arachnoid mater and is continuous with the spinal dura

The 2 layers of dura separate at numerous locations to form partitions which project inward and separate parts of the brain (falx cerebri, falx cerebelli, tentorium cerebelli, sellar diaphragm)

Describe the composition and function of the dural venous sinuses and contrast them to the typical veins of the body

Formed between two layers of dura

Lined with endothelium, no tunica media or externa, no valves

Eventually lead to the IJV

Diploic veins coursing in the spongy bone of the skull and emissary veins coursing outside of the skull may drain into the dural venous sinuses

Understand the potential spaces associated with the dura (epidural and subdural spaces)

Describe the vascularization of the dura mater (primarily the middle meningeal artery with small meningeal branches from the ophthalmic, occipital, and vertebral arteries)

Describe the general sensory innervation of the dura mater (by small meningeal branches from all three divisions of CN V and C1-C2 cervical nerves; detect pain from stretching dura mater

b) Arachnoid Mater

Describe the location and components of the arachnoid mater

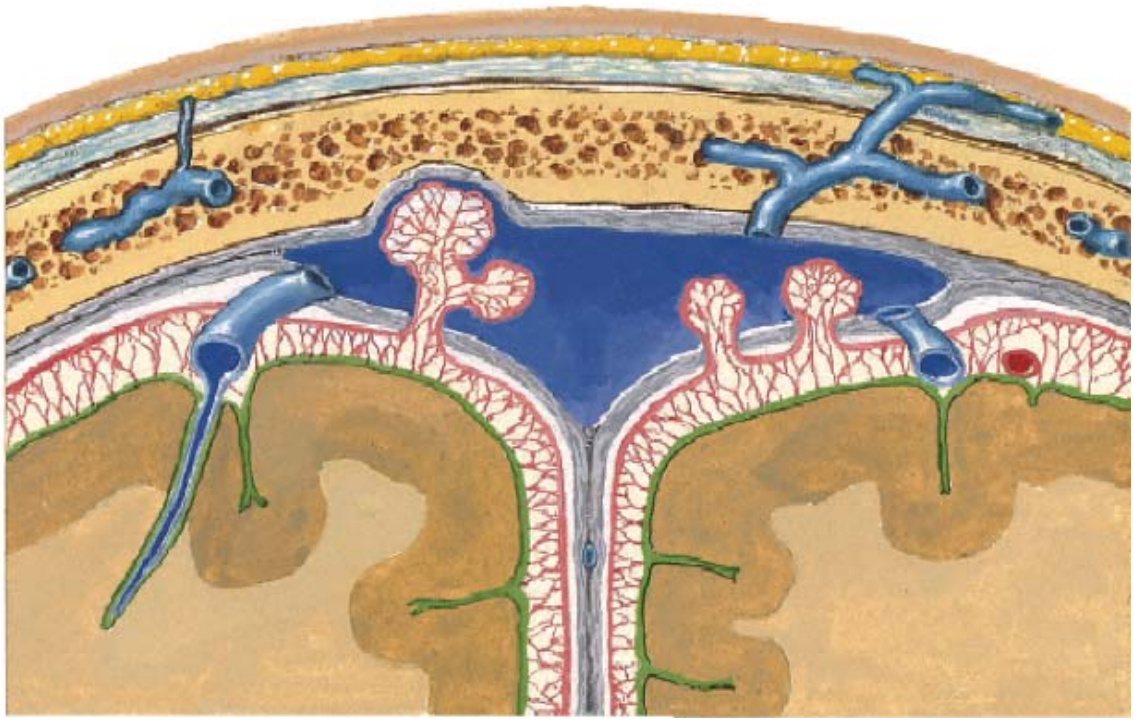
Arachnoid mater, arachnoid trabeculae, subarachnoid space, and archnoid villi/granulations

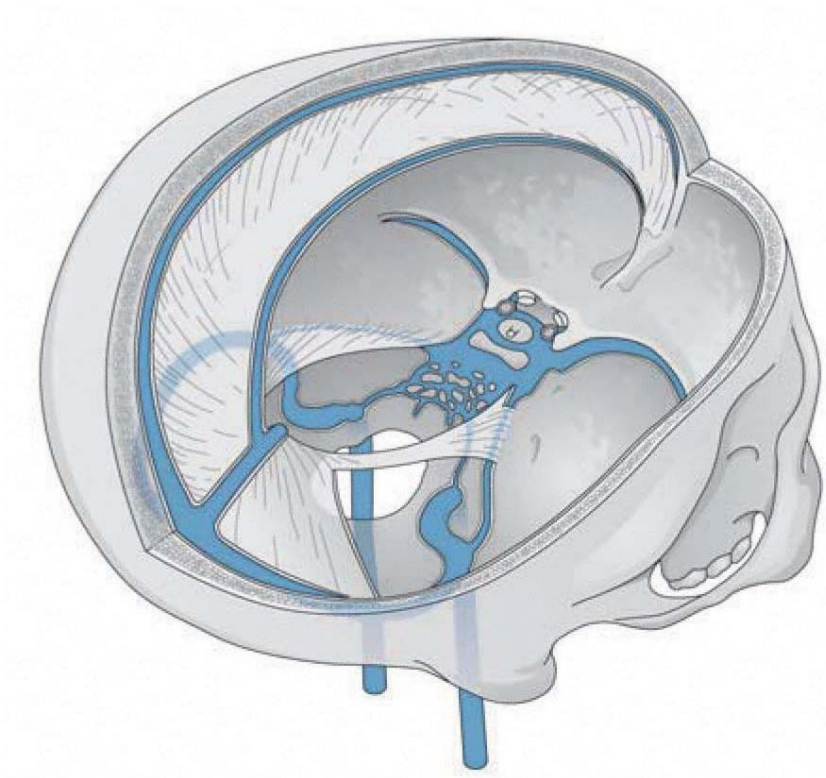
The subarachnoid space contains CSF and blood vessels and surrounds the brain and spinal cord and in certain locations enlarges into cisterns)

c) Pia Mater

Describe the location of the pia mater and its relation to the arachnoid mater, the cerebrospinal fluid, and the gray matter of the central nervous system

Pia mater follows the surface and contour of the brain into the grooves and fissures





d) Venous Drainage

Describe venous drainage of the brain

Small veins, lead to larger cerebral and cerebellar veins, which eventually empty into dural venous sinuses

Identify the major dural venous sinues (as outlined in the figure)

Describe the importance of the cavernous sinus

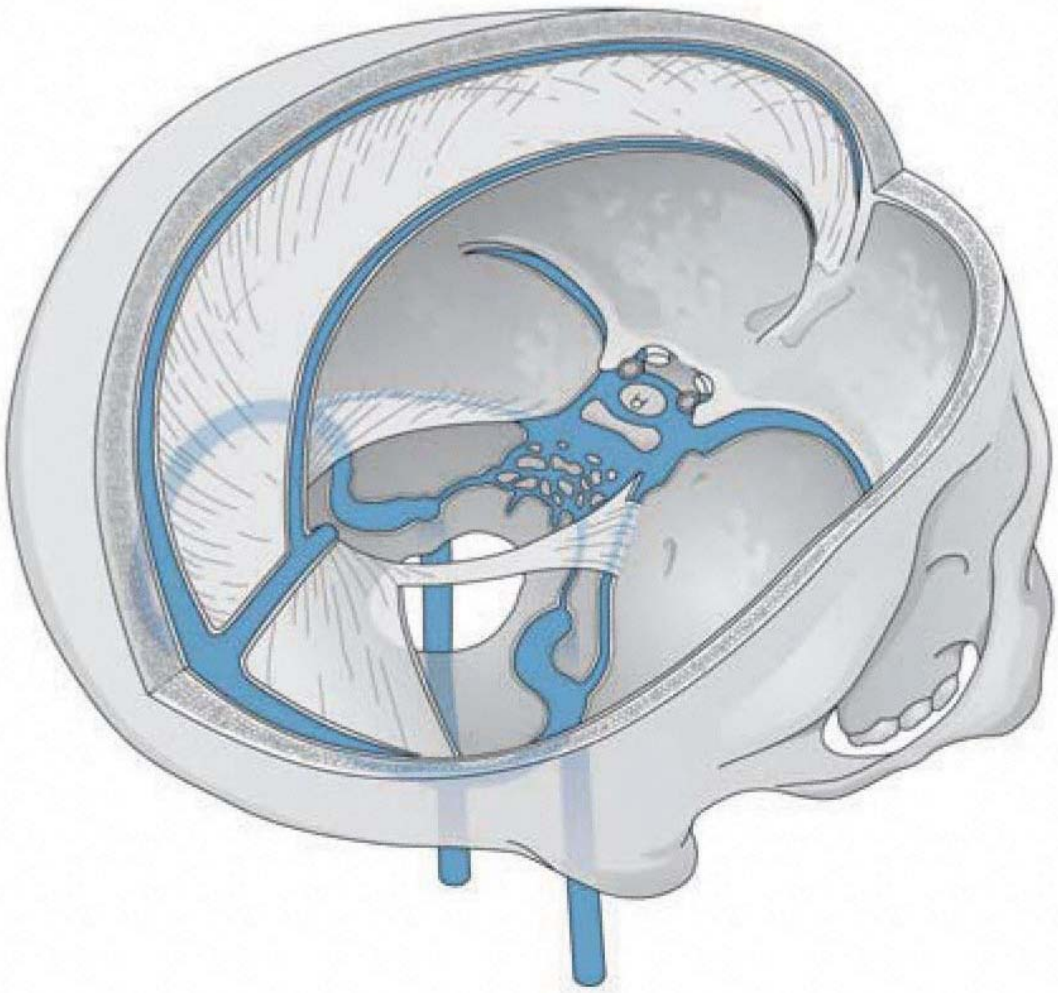
The cavernous sinuses receive blood from cerebral veins, ophthalmic veins and emissary veins from the pterygoid plexus

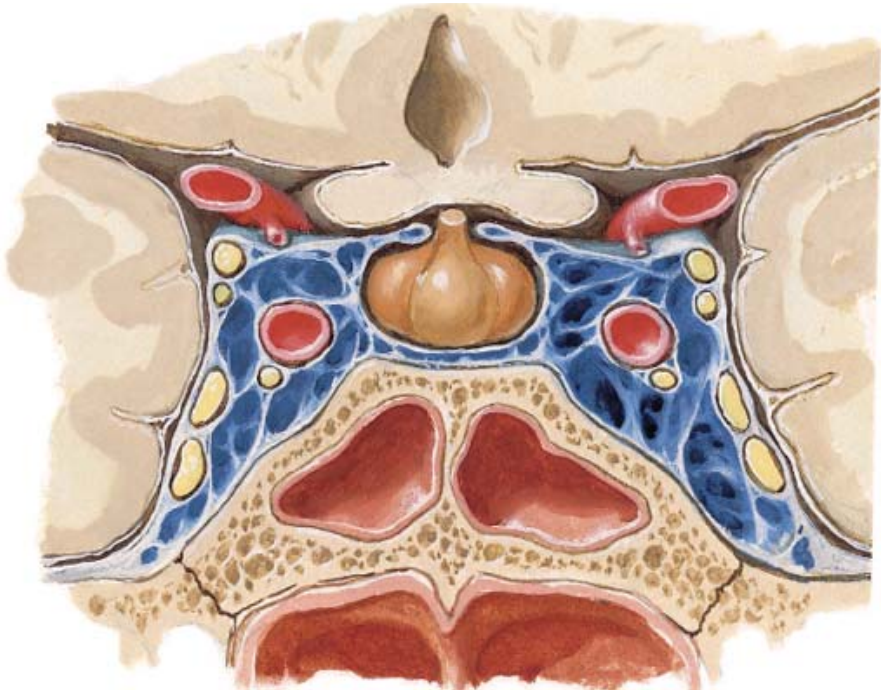
These connections provide pathways for infections to spread from extracranial to intracranial

Describe the relation of the cavernous sinus to the following structures:

- Structures passing through the cavernous sinus: internal carotid artery and CN VI

- Structures in the lateral wall of the cavernous sinus from superior to inferior: CN III, IV, V-1 and V-2





4) Brain

a) Parts of the Brain

Describe the general location and function of the following parts of the brain including associated ventricles and cranial nerves

Cerebrum- cerebral hemispheres with lateral ventricles

Brainstem

Diencephalon and third ventricle

Midbrain- nuclei of CN III, IV

Cerebral aqueduct

Pons- nuclei of CN V, VI, VII, VIII

Medulla oblongata- nuclei of CN IX, X, XI, XII

Cerebellum- fourth ventricle

Corpus callosum - commisure

b) Ventricles of the Brain and Cerebrospinal Fluid

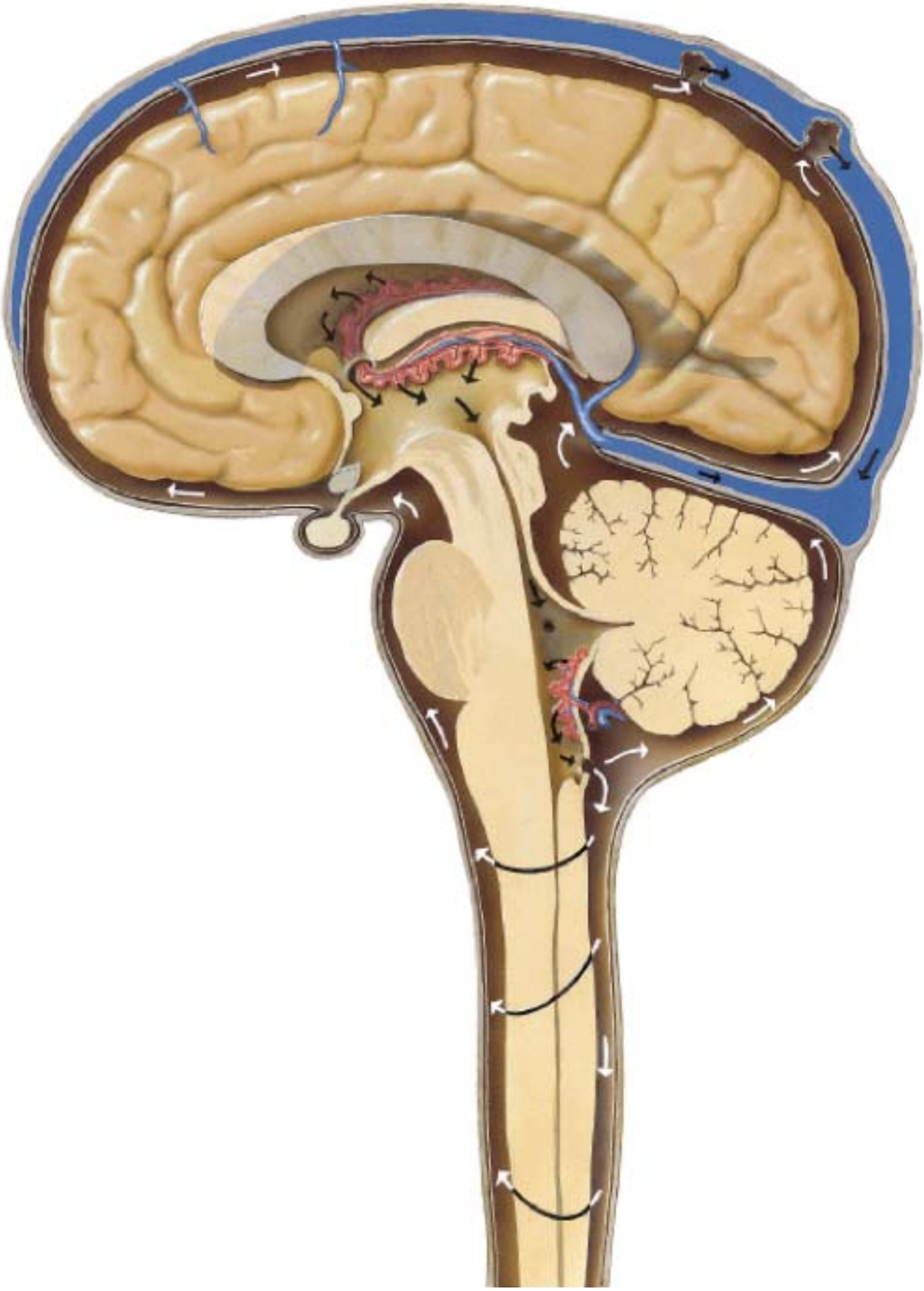
Describe the location and function of the choroid plexuses and cerebrospinal fluid

Trace the flow of cerebrospinal fluid through the ventricular system

- CSF is produced by choroid plexus in the ventricles

- CSF is clear, colorless, cell-free fluid that circulates through the subarachnoid space surrounding the brain and spinal cord

- CSF returns to the venous system through arachnoid villi into the superior sagittal sinus



5) Blood Supply to the Brain

a) Internal Carotid Artery

Trace the pathway of the internal carotid artery into the skull (cervical portion passes through carotid sheath, petrous portion travels through the carotid canal, cavernous portion then bends through the cavernous sinus to give rise to the cerebral portion of the internal carotid)

Describe the pathway and distribution of the major intracranial branches of the internal carotid artery

Ophthalmic artery- courses towards orbit, supplies eye and other orbital structures

Anterior cerebral artery- courses anteriorly, supplies medial surface of brain (leg-foot area of motor and sensory cortices)

Middle cerebral artery- courses laterally, supplies lateral surface of brain (trunk-arm-face are of motor and sensory cortices, Broca's and Wernicke's speech areas)

Anterior communicating artery- connects the two anterior cerebral arteries in the circle of Willis

b) Vertebral Arteries

Trace the pathway of the vertebral artery from branching off the subclavian artery into the skull, to the anastamosis to form the basilar artery (transverse foramina of cervical vertebrae, floor of sub-occipital triangle, foramen magnum, anastamosis)

Describe the pathway and distribution of the major branches of the basilar artery

Posterior and anterior inferior cerebellar arteries- (posterior branching off of the vertebral arteries) Supply the cerebellum and brain stem

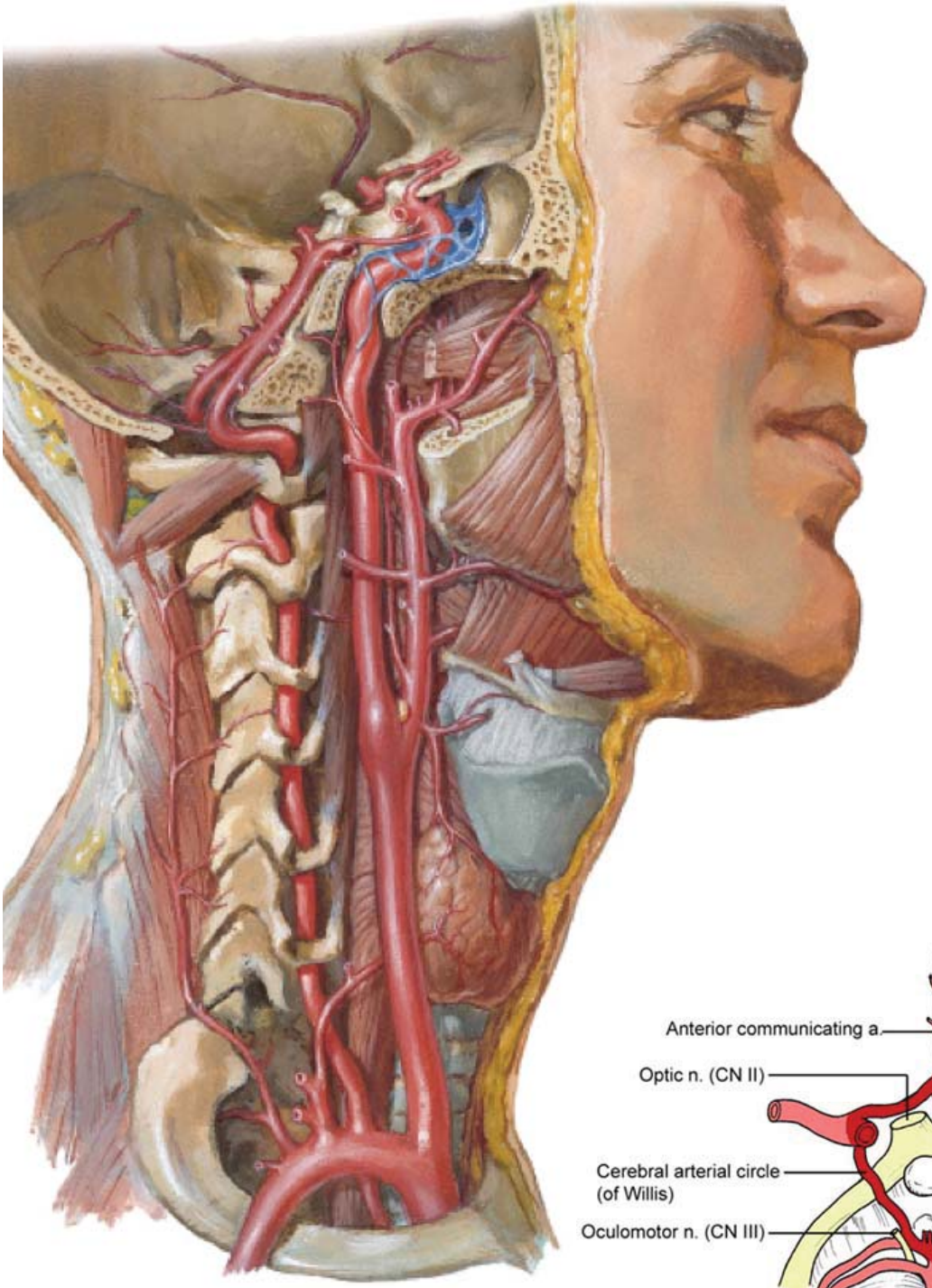
Posterior cerebral arteries- terminal branches of the basilar artery, supply the occipital lobes of the cerebrum

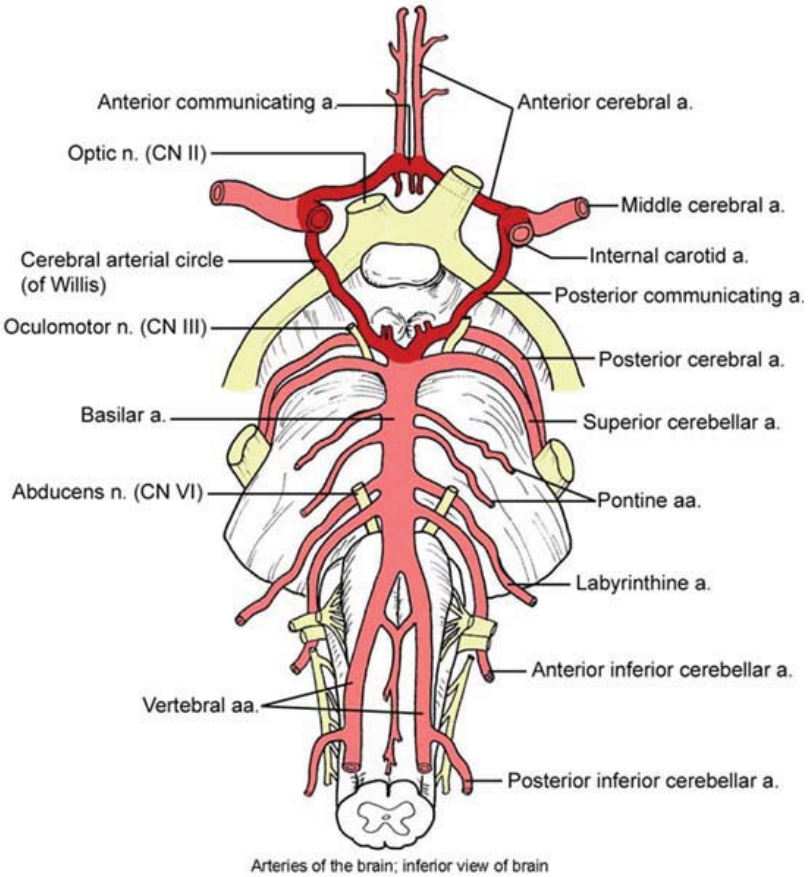
Posterior communication artery- connects the middle cerebral artery with the posterior cerebral arteries

c) Circle of Willis

Explain the function of having redundancies in cerebral circulation

If one part of the circle or artery supplying the circle become blocked or narrowed, blood flow from the other blood vessels can often preserve the cerebral perfusion well enough to avoid ischemia.





Arteries of the brain; inferior view of brain

G18: Cranial Nerves and Autonomics- A Systemic Overview

At the end of this lecture students should be able to master the following:
1) Introduction to Cranial Nerve Modalities

a) Describe the difference between a nerve and a neuron (a nerve is a bundle of neurons
- A neuron can be sensory, or motor
- A nerve can contain only sensory neurons, only motor neurons or a mixture of both

b) Describe the difference between a nucleus and a ganglion
- Nucleus: A collection of nerve cell bodies in the CNS
- Ganglion: A collection of nerve cell bodies in the PNS (sensory or autonomic)

c) Compare and contrast the following sensory (afferent) neuron modalities:

General Somatic Afferent (GSA) = General Sensory (GS)
- pain, temperature, touch, proprioception (CN V, VII, X)

Special Afferent (SA) = Special Sensory (SS)
- smell, sight, hearing, taste and balance (CN I, II, VII, VIII, IX, X)

General Visceral Afferent (GVA) = Visceral Sensory (VS)
- sensory input from viscera (CN IX, X)

d) Compare and contrast the following motor (efferent) neuron modalities:

General Somatic Efferent (GSE) = Somatic Motor (SM)
- innervate voluntary muscles derived from somites (CN III, IV, VI, XII

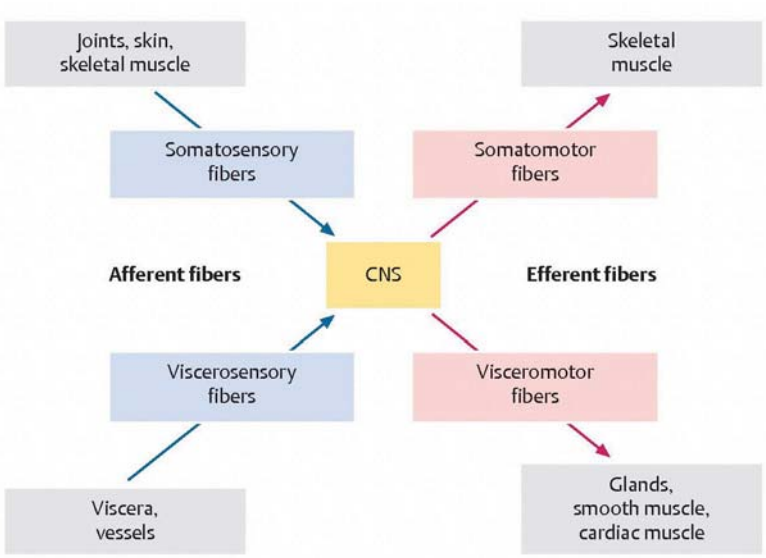
Branchial efferent (BE) = Branchial Motor (BM)
- innervate voluntary muscles derived from branchial (pharyngeal) arches (CN V, VII, IX, X, XI)

General Visceral Efferent (GVE) = Visceral Motor (VM)
- motor innervation to smooth muscle, heart muscle and glands (CN III, VII, IX, X)

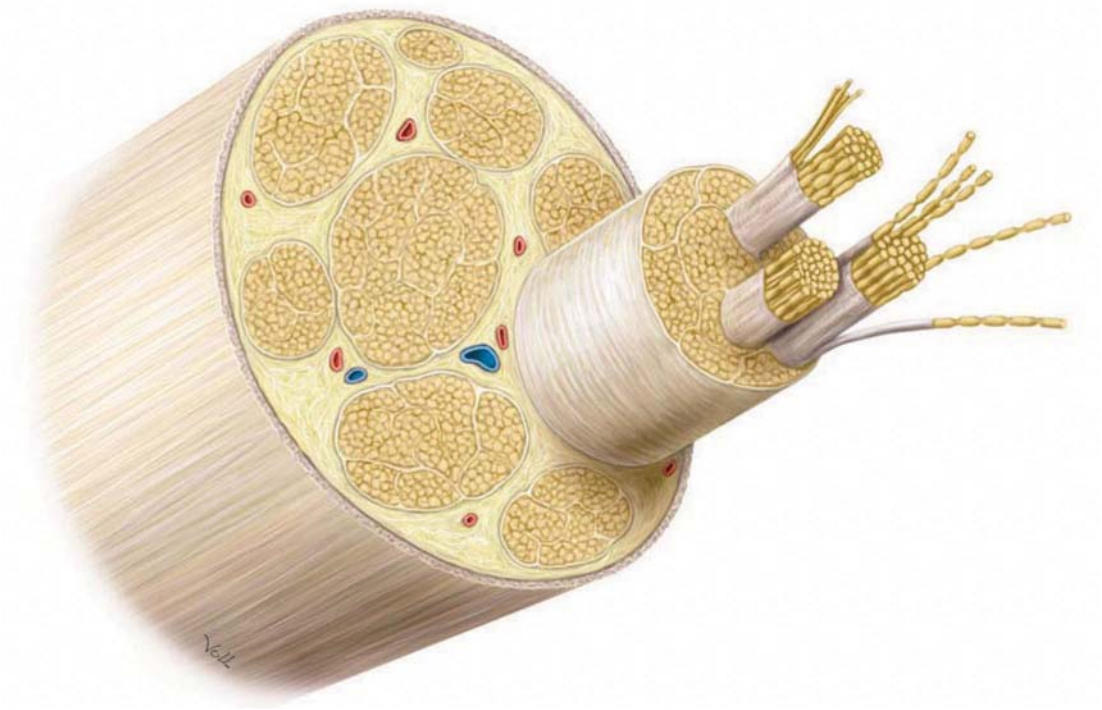
* only parasympathetics arise from the brainstem via CN III, VII, IX and X; sympathetics to the head arise from the T1 level of the spinal cord*

Memorise the cranial nerves by Roman numeral as well as name

The Tables on pgs 800-801, 805, 807 in GAFS are very helpful



Schematic diagram of information flow in the nervous system



2) The Cranial Nerves

Describe the course, distribution, function, and common manifestations of lesions for each of the CN's

i) Olfactory nerve (CN I)- olfactory epithelium in upper nasal cavity for smell (SS)

Lesions- anosmia

ii) Optic nerve (CN II)- optic chiasm, optic canal, orbit, retina of eye for sight (SS)

Lesions- visual field defects (anopsia), loss of light reflex with CN III, blindness, only CN affected by MS

iii) Oculomotor nerve (CN III)

SM- superior orbital fissure, orbit to 4 of the 6 extraoccular muscles (superior, medial and inferior rectus, inferior oblique plus the levator palpebrae superioris)

VM- constricts pupil (parasympathetic fibers to cilliary ganglion) via the sphincter pupillae muscle; lens accommodation (ciliary muscles)

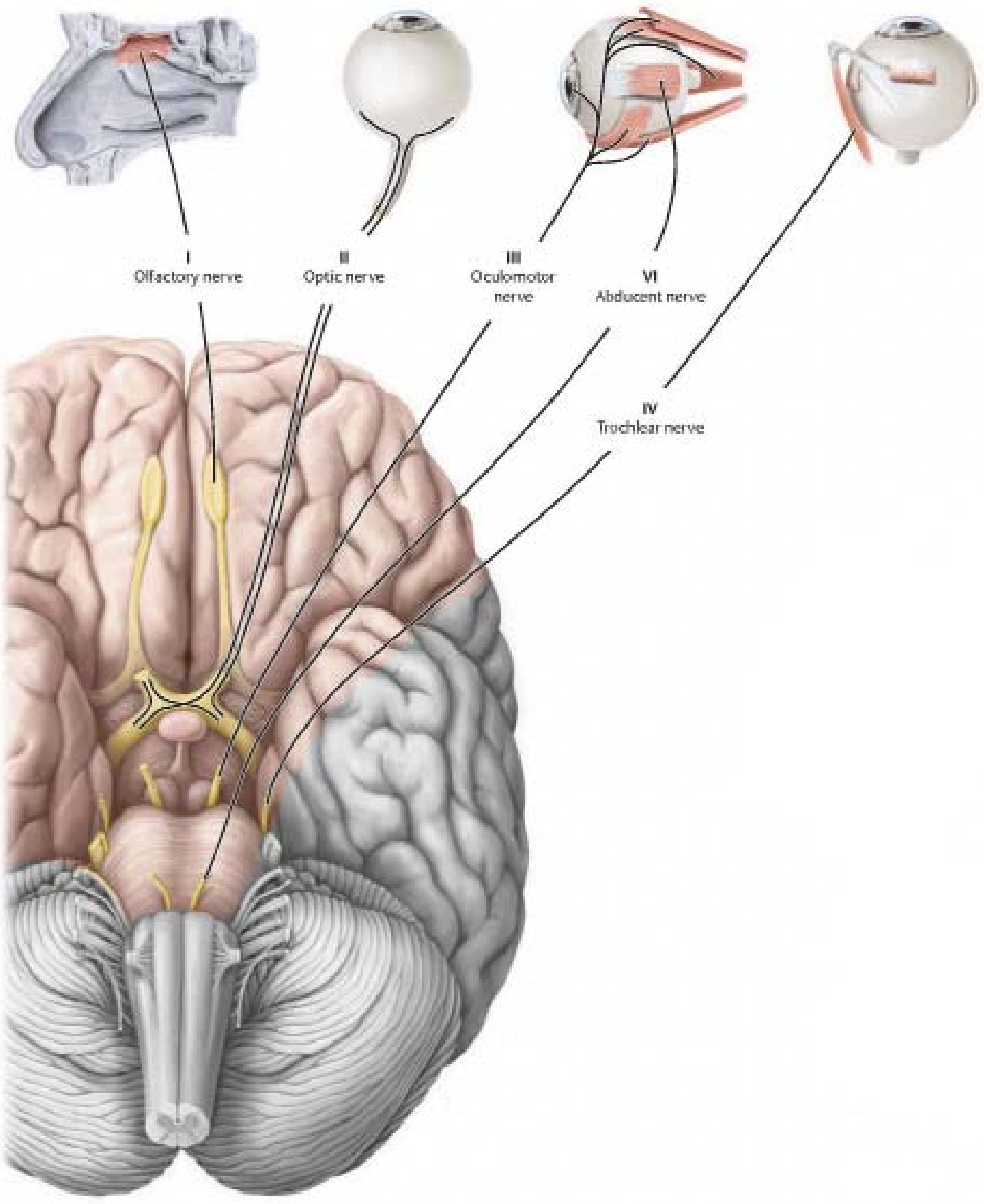
Lesions- diplopia (external strabismus), injured eye positioned down and out, loss of parallel gaze, dilated pupil, loss of light reflex with CN II, loss of near response, ptosis

iv) Trochlear nerve (CN IV)- superior oblique muscle (SM) to move the eye down and out

Lesions- inability to look inferiorly when eye is adducted, head tilts away from lesioned side; difficulty walking down stairs

vi) Abducens nerve (CN VI)- lateral rectus muscle (SM) to abduct eye

Lesions- inability of lateral eye movement, diplopia (internal strabismus), loss of parallel gaze


I
Olfactory nerve
II
Optic nerve
III
Oculomotor nerve
VI
Abducent nerve
IV
Trochlear nerve

v) Trigeminal nerve (CN V)- trigeminal ganglion with sensory cell bodies; possesses three branches named for cranial location, supplies eyes, maxilla, and mandible

(1) Ophthalmic nerve (CN V-1)- orbit, surface of the cornea and skin of the forehead and scalp (GS)

Lesions- loss of sensation in the skin of the forehead and scalp, loss of blink reflex with VII

(2) Maxillary nerve (CN V-2)- palate, nasal cavity, skin over maxillary face and maxillary teeth (GS)

Lesions- loss of sensation in skin over maxilla and maxillary teeth, trigeminal neuralgia (pain)

(3) Mandibular nerve (CN V-3)

GS- sensory to the anterior tongue, mandibular teeth, and skin over mandibular face

BM- motor to muscles of mastication (masseter, temporalis, pterygoids), anterior digastricus, mylohyoid, and 2 tensors (tensor tympani, tensor veli palatini)

Lesions- Loss of sensation in the mandibular skin, teeth, and tongue, weakness in chewing, jaw deviates to one side, trigeminal neuralgia (pain)

vii) Facial nerve (CN VII)

BM- muscles of facial expression, posterior digastricus, stylohyoid, stapedius

SS- chorda tympani to the anterior tongue for taste

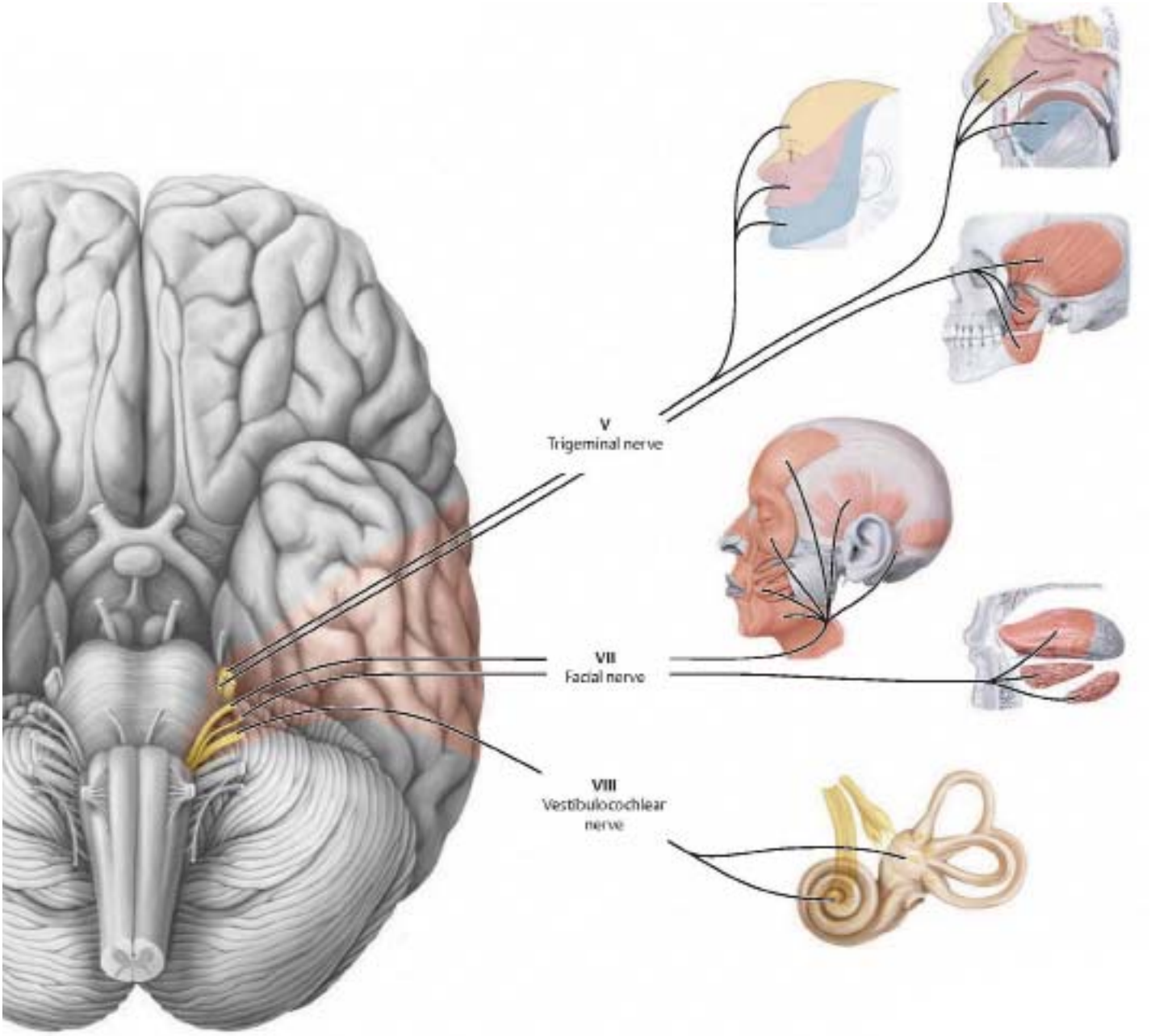
VM- submandibular and sublingual salivary glands (chorda tympani) via V-3, lacrimal, nasal and palatine glands (greater petrosal) via V-2

Lesions- paralysis of facial muscles (Bell's palsy) on ipsilateral side (peripheral CN VII injury), paralysis of contralateral facial muscles below the eye (brainstem injury), loss of blink reflex, hyperacusis, alteration or loss of taste (ageusia), red and dry eye

viii) Vestibulocochlear (CN VIII)

SS- hearing (cochlea) and balance (vestibular apparatus)

Lesions- hearing loss, loss of balance, tinnitus (ringing in the ear)


V
Trigeminal nerve
VII
Facial nerve
VIII
Vestibulocochlear
nerve

ix) Glossopharyngeal nerve (CN IX)

GS- mucous of the oropharynx, tympanic cavity and auditory tube

SS- taste for posterior tongue

VM- parotid gland (lesser petrosal nerve to the otic ganglion) to the auriculotemporal n. (CN V-3)

BM- stylopharyngeus

VS- carotid body/sinus

Lesions- loss of gag reflex with CN X, alteration or loss of taste to posterior tongue; altered vaso-vagal reflex

x) Vagus nerve (CN X)

BM- palatoglossus, soft palate muscles (except tensor veli pal), pharynx (except stylopharyngeus) and laryngeal muscles

GS- skin posterior to ear and external acoustic meatus and posterior dura

VS- aortic body, chemo- and baroreceptors in aortic arch, mucous membranes of pharynx, larynx, esophagus, bronchi, lungs, heart, and abdominal viscera of foregut and midgut

VM- smooth muscle and glands in the pharynx, larynx, thoracic and abdominal viscera (fore-/midgut)

Lesions- loss of gag reflex with CN IX, loss of cough reflex, uvula pointing away from affected side,

xi) Accessory nerve (CN XI)

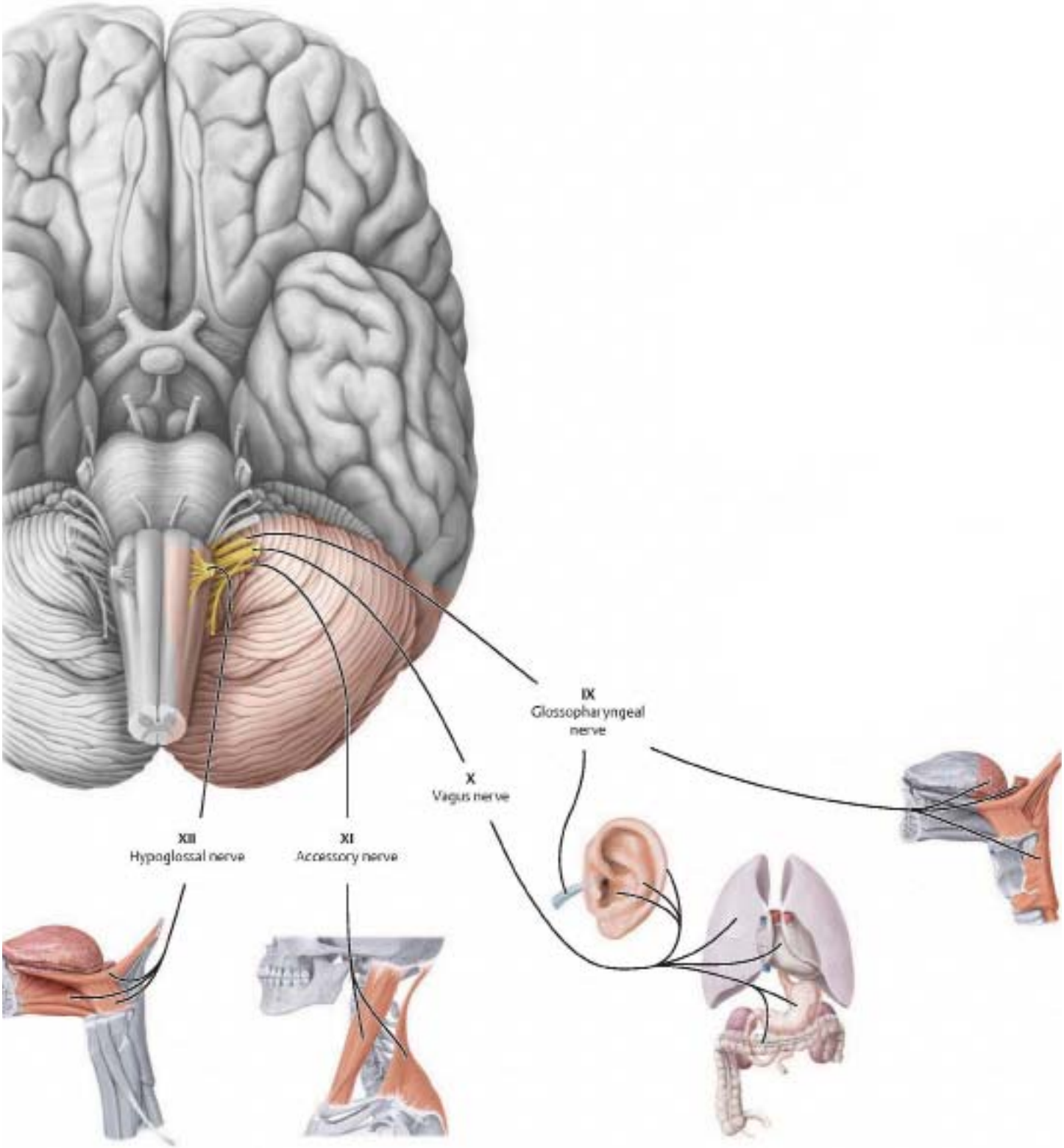
BM- trapezius and sternocleidomastoid

Lesions- weakness turning head to opposite side, shoulder drop

xii) Hypoglossal nerve (CN XII)

(BM)- innervates all extrinsic and intrinsic tongue muscles (except palatoglossus)

Lesions- tongue pointing towards affected side on protrusion


IX
Glossopharyngeal nerve
X
Vagus nerve
XII
Hypoglossal nerve
XI
Accessory nerve

3) Autonomics

a) Sympathetic innervation to the head

Describe the origin, course, distribution, function, and common manifestations of lesions of sympathetic innervation in the head

- Preganglionic sympathetic fibers- originate from T1 of the spinal cord, ascend in the sympathetic trunk, synapse with postganglionic fibers in the superior cervical ganglion

- Postganglionic sympathetic fibers- follow internal and external carotid artery branches throughout the head to serve primarily blood vessels and sweat glands, but also the superior tarsal muscle to raise the upper eye lid and dilatator pupillae muscle to dilate the pupil

Lesions- Horner syndrome, eyelid droop (ptosis), constricted pupil (miosis), loss of sweating (anhydrosis), flushed face

b) Parasympathetic innervation to the head

Describe the origin and distribution of parasympathetic innervation in the head, include location of synapse

CN III - Oculomotor nerve
- Preganglionic parasympathetic neurons originate in Edinger-Westphal nucleus and synapse in the **ciliary ganglion**
- Postganglionic parasympathetic neurons serve the ciliary muscles and sphincter pupillae for light accommodation and constriction of the pupil

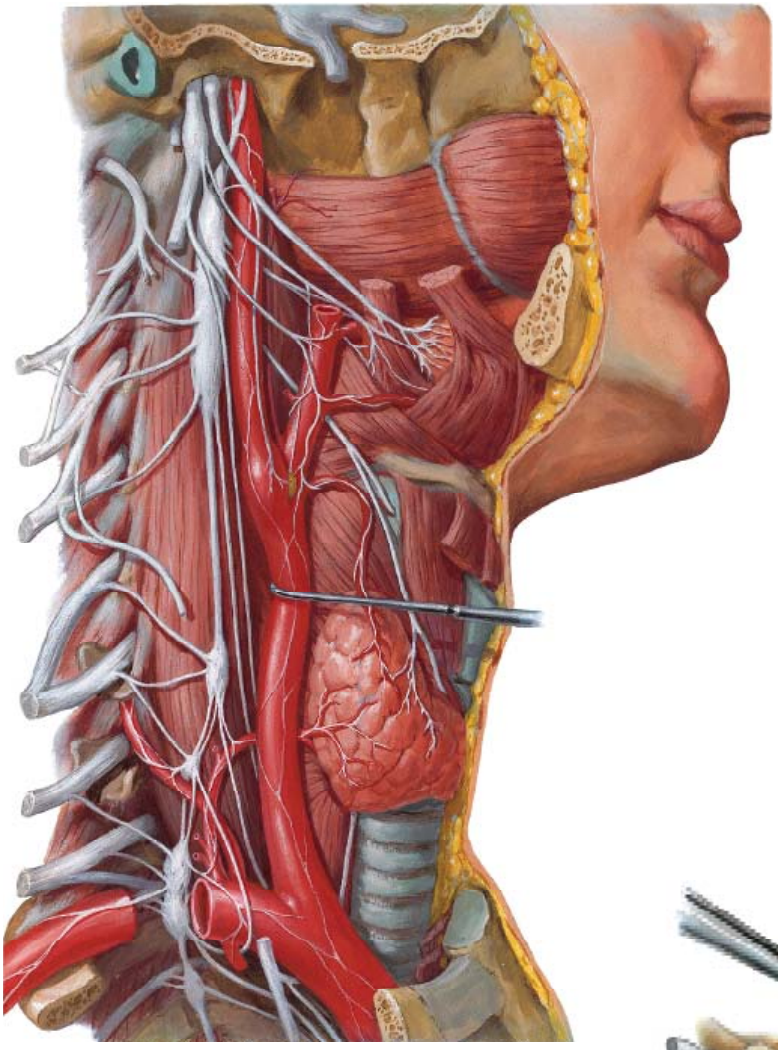
CN VII - Facial nerve

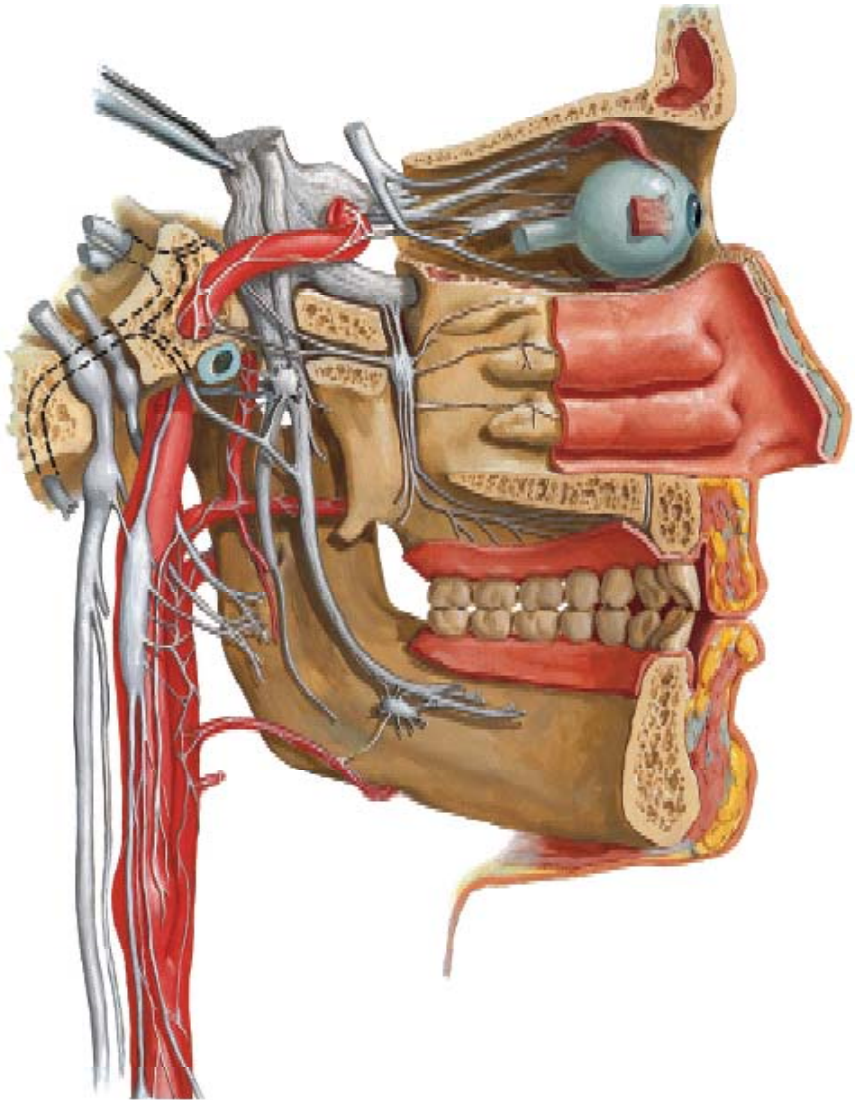
Greater petrosal nerve branch
- Preganglionic parasympathetic neurons originate in the superior salvatory nucleus and synapse in the **pterygopalatine ganglion**
- Postganglionic parasympathetic neurons serve the lacrimal gland, nasal glands, and nasal mucosa;

Chorda tympani nerve branch
- Preganglionic parasympathetic neurons originate in the superior salvatory nucleus and synapse in the **submandibular ganglion**
- Postganglionic parasympathetic neurons serve the submandibular and sublingual salivary glands

CN IX - Glossopharyngeal nerve
- Preganglionic parasympathetic neurons originate in the inferior salvatory nucleus and synapse in the **otic ganglion**
- Postganglionic parasympathetic neurons serve the parotid gland via the auriculotemporal n. (CN V-3)

CN X - Vagus nerve
- Preganglionic parasympathetic neurons originate in the dorsal vagal nucleus and synapse with **intramural ganglia** at or near target organ
- Postganglionic parasympathetic neurons serve smooth muscle and glands of the pharynx and larynx, heart, lungs and GI tract to the transverse colon





G19: Obit

At the end of this lecture students should be able to master the following:
1) Eyelid and Conjunctiva

a) Describe the action and innervation of the following eyelid muscles:

Orbiularis oculi- closes eyelid, CN VII

Levator palpebrae superioris- opens upper eyelid, CN III

Superior tarsal (Muller's) muscle- smooth muscle portion under sympathetic control; elevates eyelid

b) Describe the function and differences in location and innervation of the palpebral and bulbar conjunctiva

2) Lacrimal Apparatus

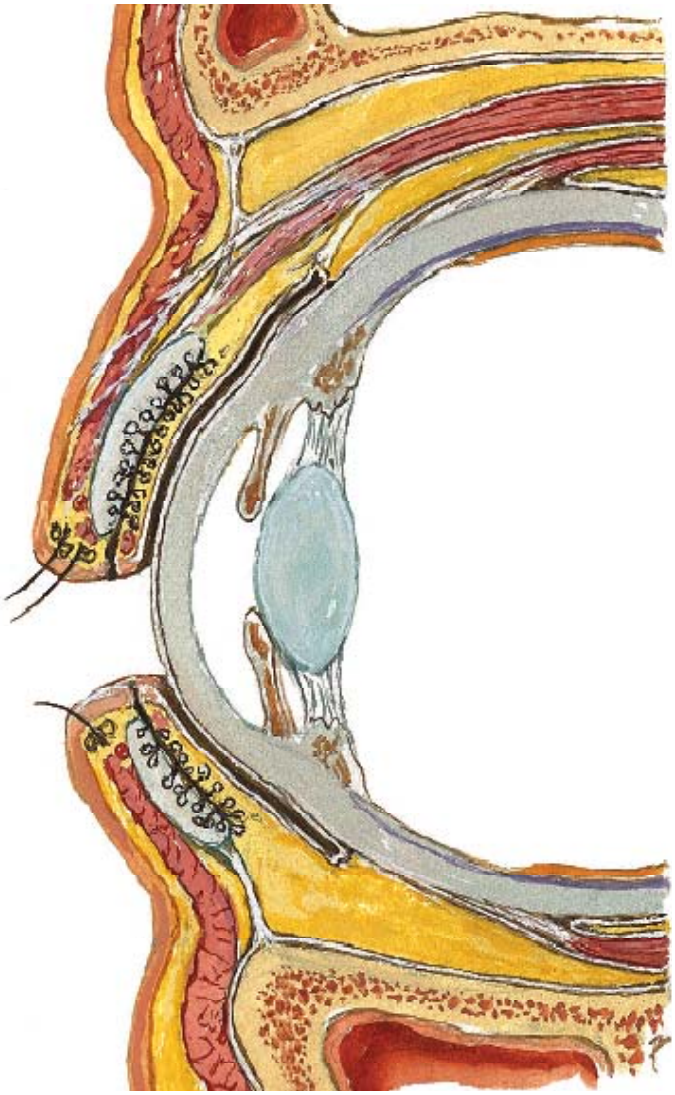
a) Describe the location of the lacrimal gland

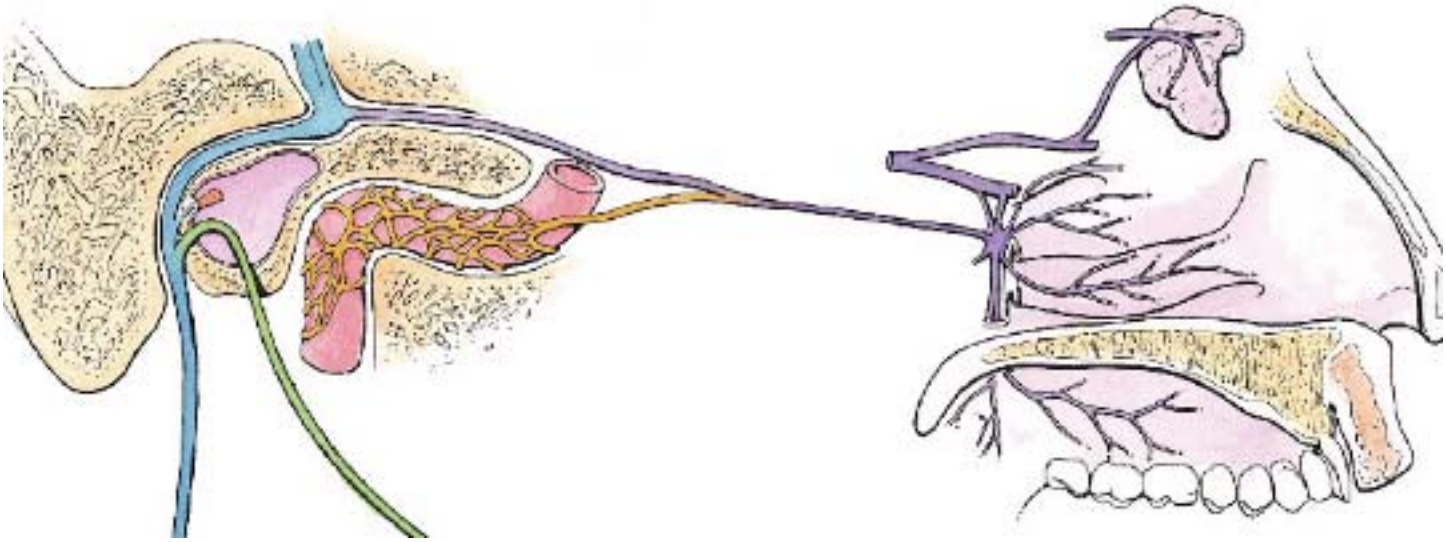
b) Trace tears flowing from the orbit to the nasal cavity

c) Describe the innervation of the lacrimal gland (VM from CN VII via the greater petrosal n.)

- Preganglionic parasympathetic cell bodies in brain, internal acoustic meatus, facial, canal, greater petrosal nerve, nerve of the pterygoid canal, pterygopalatine fossa, synapse in pterygopalatine ganglion

- Postganglionic fibers jump hitch-hike on the zygomatic nerve (CN V-2), on lacrimal nerve, lacrimal gland





3) Eyeball

a) Fibrous Layer

Describe the location and function of the components of the fibrous layer of the eye

Cornea- anterior surface, bends light, encases most of anterior chamber (sensory innervation by CN V-1)

Sclera- surrounds posterior surface, gives strength and structure to eye along with vitreous body, allows for muscle attachment

b) Choroid Layer

i) Describe the function of the ciliary apparatus (lens accommodation)

Ciliary muscle control through parasympathetic innervation (CN III) lens accommodation (see below)

ii) Describe the function and innervation of the following muscles of the iris:

Sphincter pupillae- constricts the pupil (para CN III)

- Preganglionic cell bodies in Edinger Westphal nucleus, cavernous sinus, superior orbital fissure, synapse in ciliary ganglion

- Postganglionic fibers in short ciliary nerves to ciliary muscle and sphincter pupillae

Dilator pupillae- dilates the pupil (sympathetic control from T1)

- Preganglionic fibers from T1, sympathetic trunk, synapse in superior cervical ganglion

- Postganglionic fibers run along internal carotid artery, ophthalmic artery, short or long ciliary nerves or muscular branches of CN III to dilator pupillae and/or superior tarsal muscles (elevate eyelid)

c) Retina

Describe the structure and function of the retina- pigmented region with photoreceptors sensitive to light

Optic disc- where optic nerve enters, blind spot

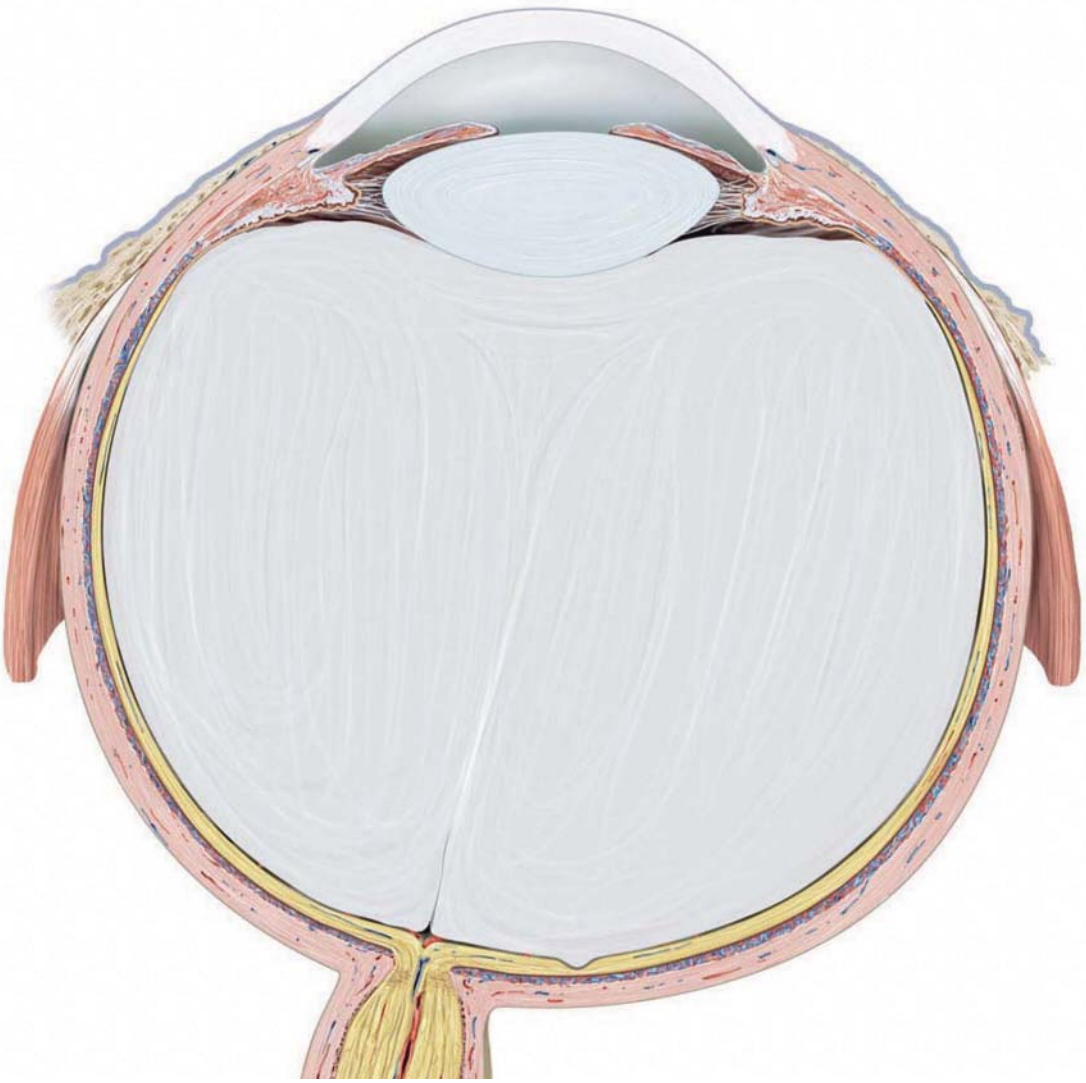
Macula lutea and fovea centralis- most acute vision

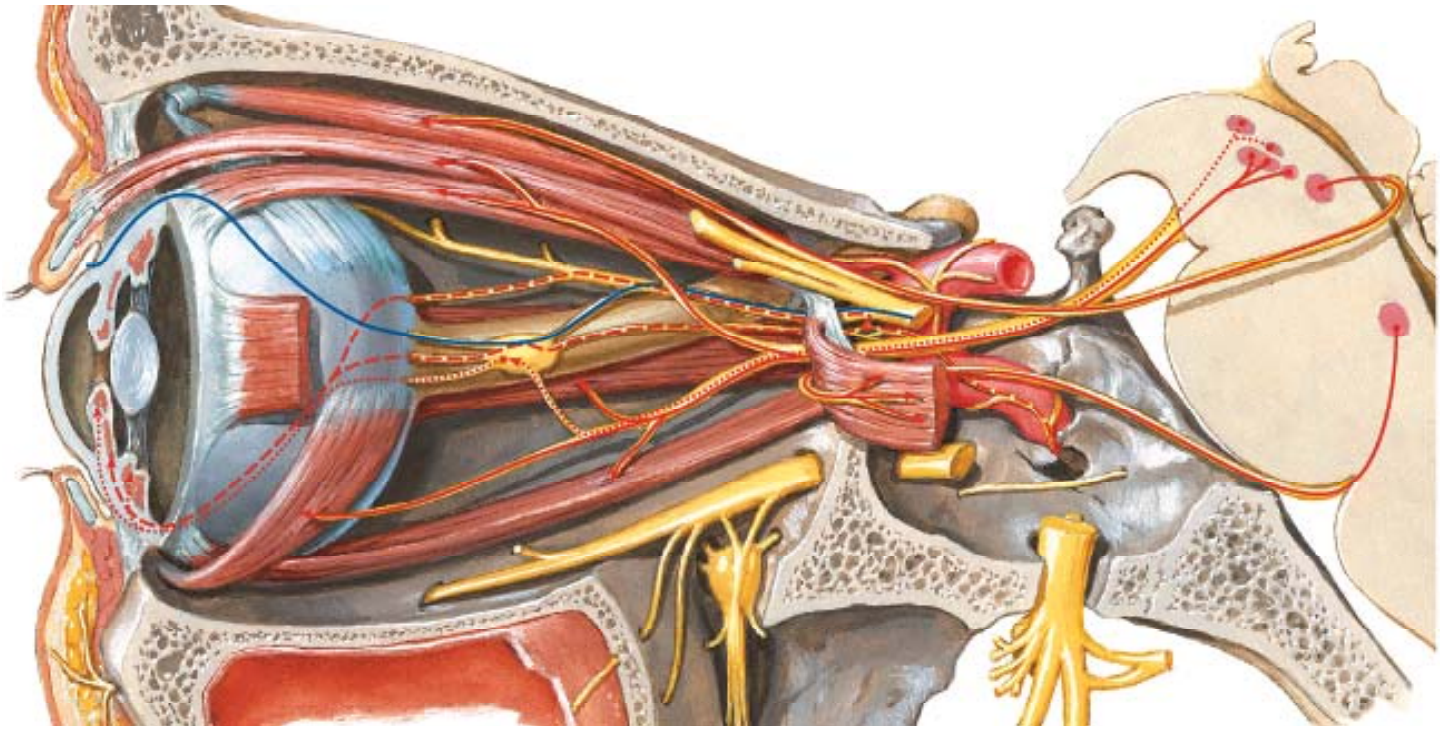
d) Chambers of the eye

Identify the chambers of the eye and their associated humors

Anterior and posterior chambers-aqueous humor

Vitreous chamber- vitreous humour





4) Extraoccular Eye Muscles

a) Distinguish between optical axis and orbital axis

- Orbital axis: directed laterally from back to front by an angle of 23 degrees

- Optical axis: Each eyeball is directed anteriorly

As a result, the pull of some extraoccular eye muscles has multiple effects on the movement of the eyeball, while that of others has only a single effect

b) Describe the action, innervation, and topography for each of the extraoccular eye muscles

i) CN III

- Medial rectus m. (adduct)

- Superior rectus m. (up and in)

- Inferior rectus m. (down and in)

- Inferior oblique m. (up and out)

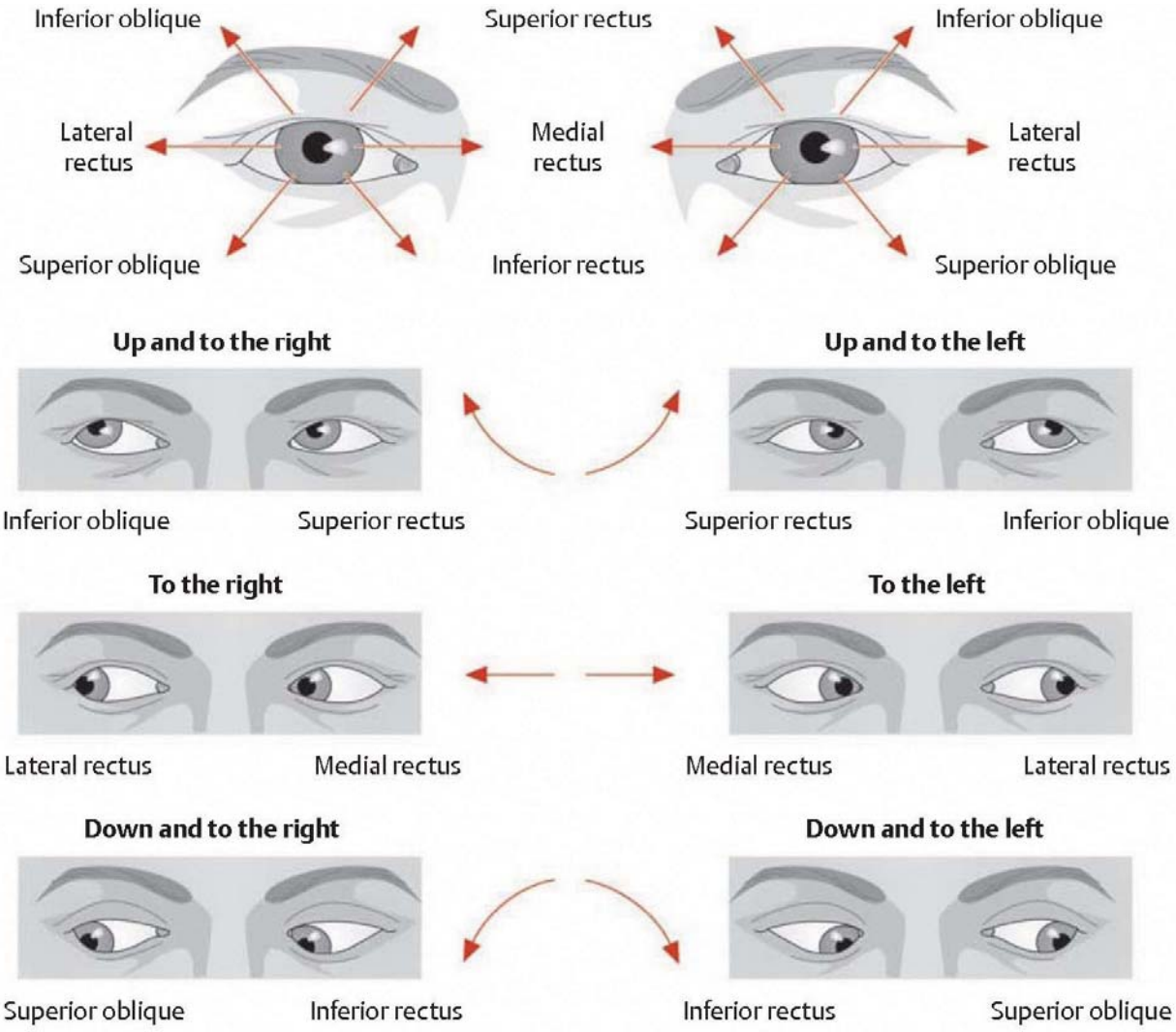
- Levator palpebrae superioris (eye lid up)

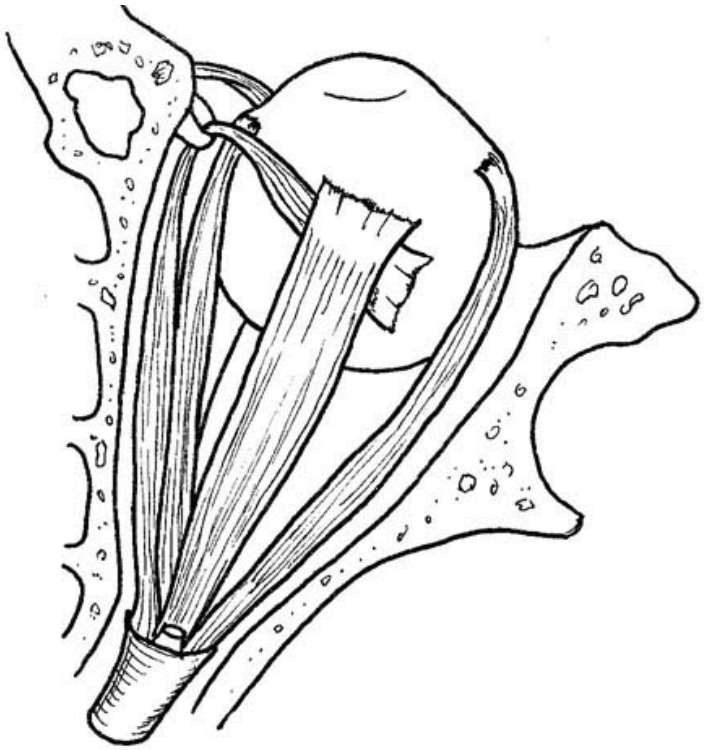
ii) CN IV

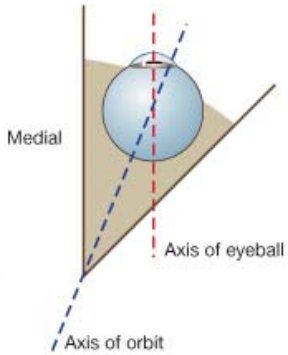
- Superior oblique m. (down and out); tendon courses through a tendinous pulley called the trochlea to double back and insert into the sclera on the top of the globe

iii) CN VI

- Lateral rectus m. (abduct)


Inferior oblique
Lateral rectus
Superior oblique
Superior rectus
Medial rectus
Inferior rectus
Inferior oblique
Lateral rectus
Superior oblique
Up and to the right
Inferior oblique
Superior rectus
Up and to the left
Superior rectus
Inferior oblique
To the right
Lateral rectus
Medial rectus
To the left
Medial rectus
Lateral rectus
Down and to the right
Superior oblique
Inferior rectus
Down and to the left
Inferior rectus
Superior oblique




Medial
Axis of eyeball
Axis of orbit

c) Contrast the difference between anatomical actions of the extraoccular eye muscles and how to clinically test them

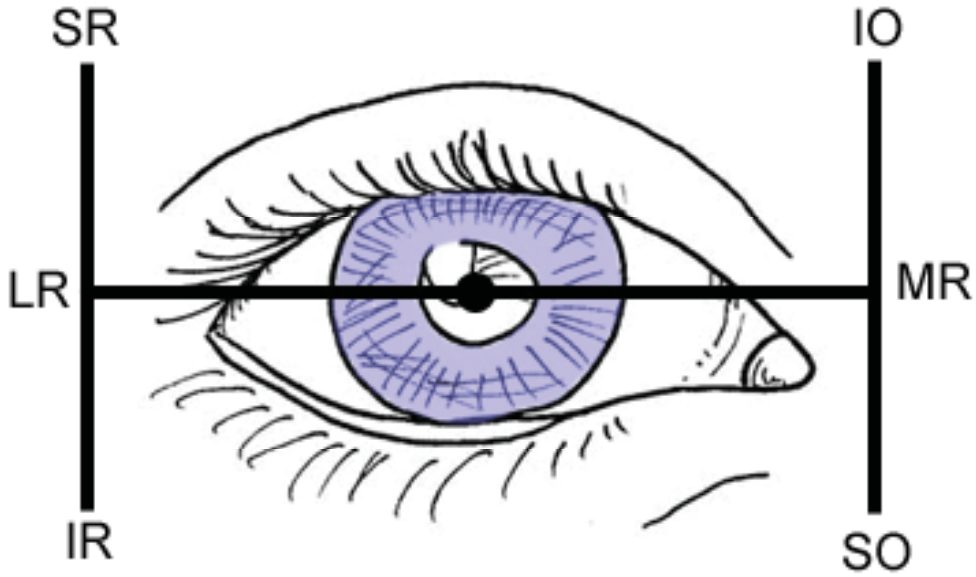
Clinical testing
Ask the patient to follow your finger drawing a large “H” pattern in the air in front of their face.

- The two vertical lines of the “H” isolate and test the superior and inferior rectus muscles and superior and inferior oblique muscles.
- The horizontal lines of the “H” will test the medial and lateral rectus muscles.

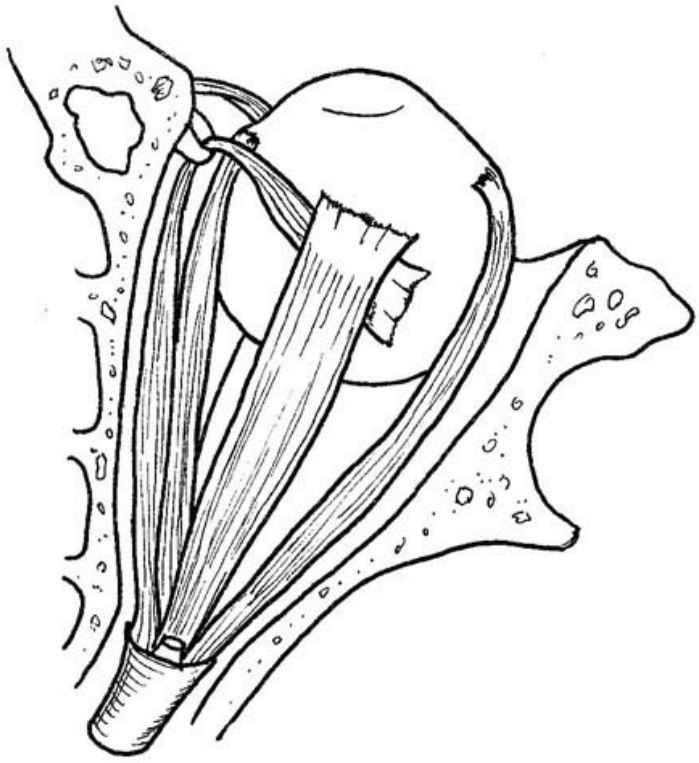
Explanation
The lateral rectus muscle abducts the eye (away from the nose) and the medial rectus muscle adducts the eye (towards the nose). The lateral and medial muscles move the eye only in the horizontal or axial plane. Therefore, the action of these muscles and clinically testing these two muscles is the same.

However, the vertical motion is a little more complex. Four muscles (superior rectus, inferior rectus, superior oblique and inferior oblique) control the vertical motion.

To clinically test the superior and inferior rectus muscles you first need to isolate them from the superior and inferior oblique muscles. When the right eye is fully abducted (away from the nose), only the superior and inferior rectus muscles can elevate and depress the eye. This is purely a mechanical property due to the axis of the eye lining up parallel to the superior and inferior rectus muscles.
When the right eye is fully adducted (towards the nose), only the superior and inferior oblique muscles can elevate and depress the eye. This is again due to the axis of the muscles paralleling the axis of the eye. Using the picture at the bottom of the page observe how it is possible for the superior oblique muscle to depress the eye when the eye is adducted.



Anterior view of right eye - Clinical testing of eye muscles



5) Vasculature of the Orbit

a) Trace the pathway and distribution of the major branches of the ophthalmic artery

b) Describe the pathway of the central artery of the retina

c) Describe the venous anastamosis between the superior ophthalmic, inferior ophthalmic and facial veins near the orbit. Describe the three possible drainage pathways.

6) Innervation of the Orbit

a) CN II
Exits/Enters Cranium: optic canal with ophthalmic artery
Function: sight (SS)

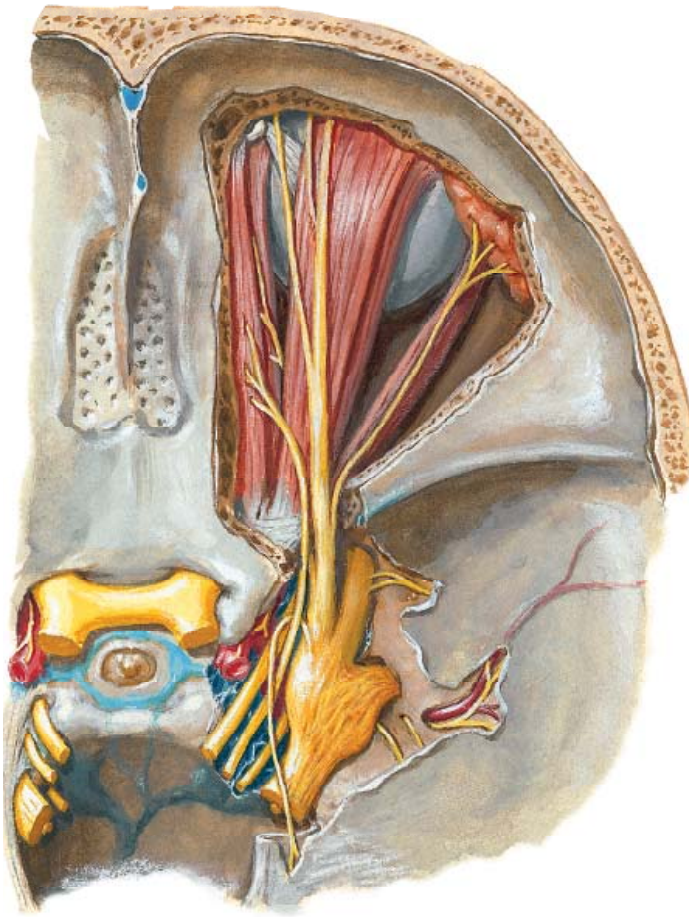
b) CN III
Exits/Enters Cranium: Superior orbital fissure along with IV, V-1, VI and sup. ophthalmic v.
Function: innervates 4 of the 6 extraoccular eye mm. and lev. palp. sup. m. (SM); constricts the pupil and accomodates the lens via the ciliary ganglion (VM)

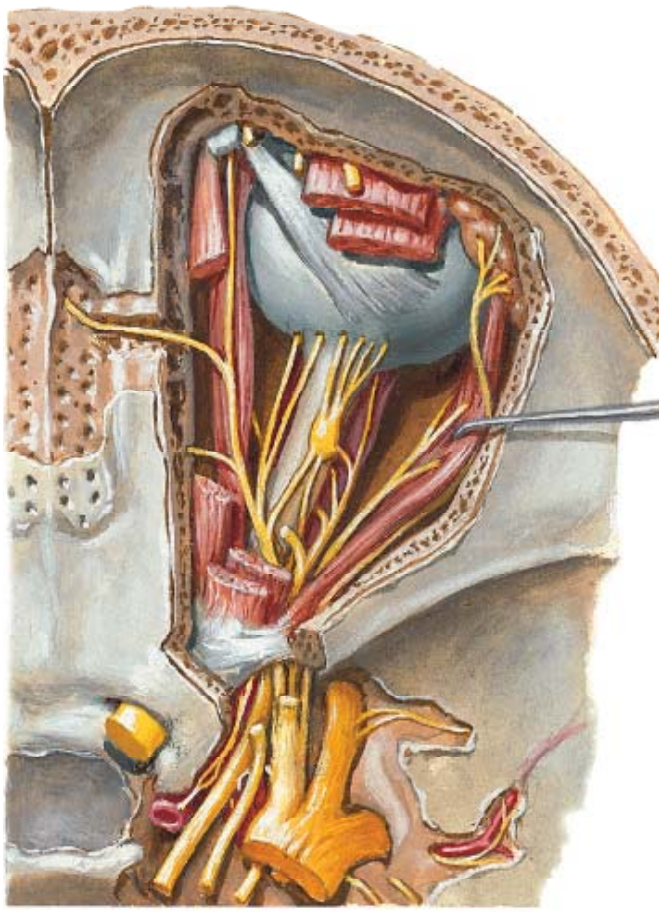
c) CN IV
Exits/Enters Cranium: Superior orbital fissure
Function: innervates superior oblique m.

d) CN V
Exits/Enters Cranium: V-1 Superior orbital fissure
Function: general sensory to the forehead, scalp, cornea and bridge of the nose (GS)

e) CN VI
Exits/Enters Cranium: Superior orbital fissure
Function: Innervates lateral rectus m. (SM)

f) CN VII
Exits/Enters Cranium: Internal acoustic meatus, greater petrosal hiatus, greater petrosal nerve, pterygopalatine ganglion, V-2, V-1 to lacrimal gland
Function: Innervates the lacrimal gland (VM)





G20A: Superficial Face and Infratemporal Fossa

At the end of this lecture, students should be able to master the following:

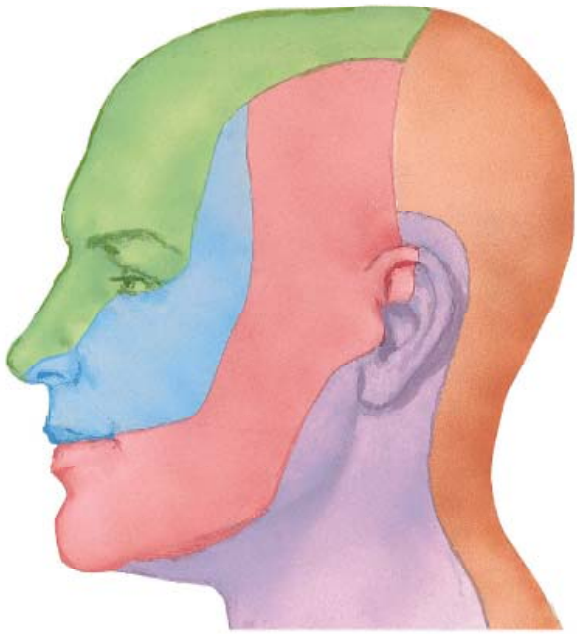
1) Cutaneous Innervation

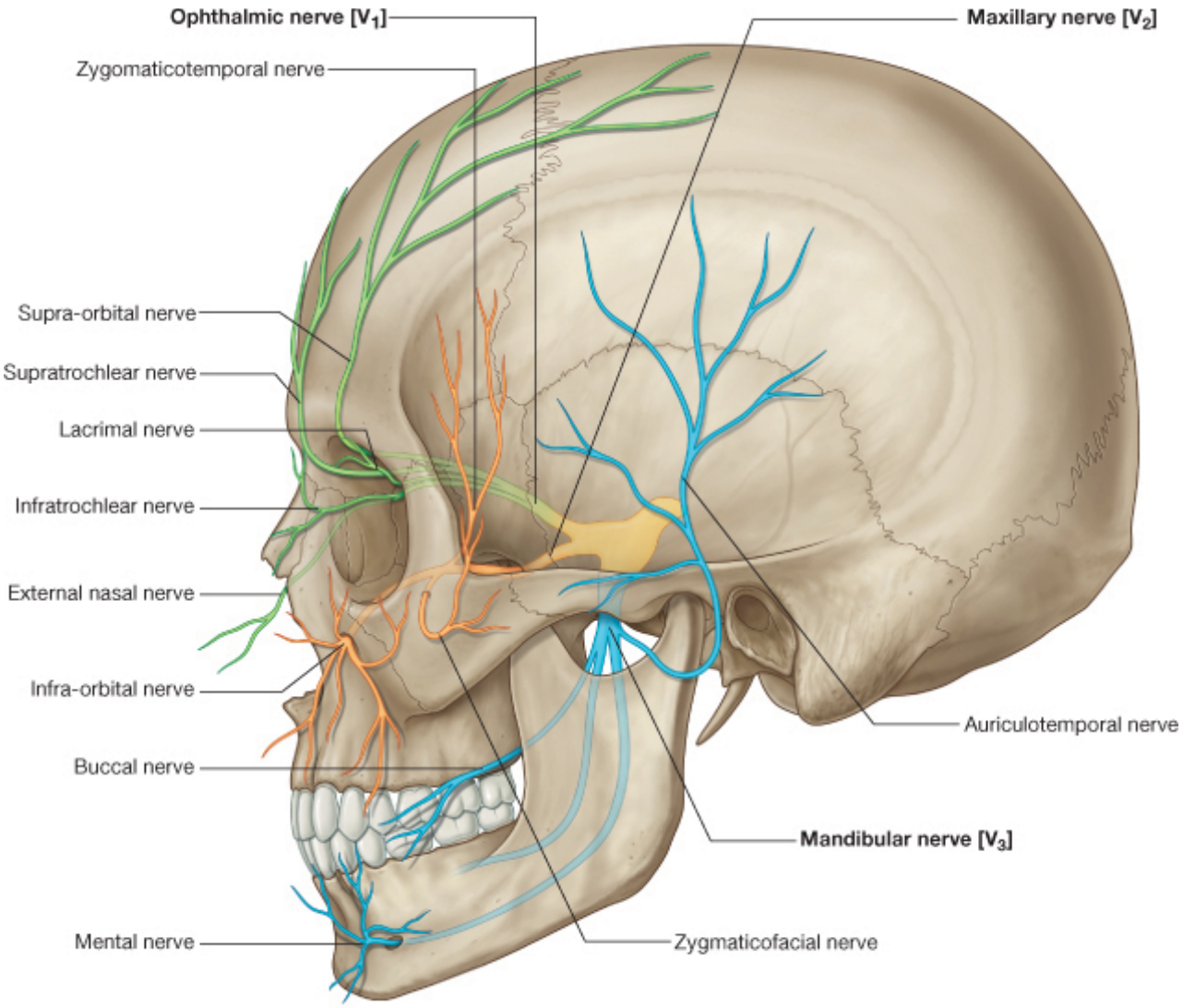
Map out the distribution of the major cutaneous branches of the trigeminal nerve (CN V)

Ophthalmic division (CN V-1) - Superior orbital fissure to orbit
- Frontal nerve- supraorbital and supratrochlear nerves
- Nasociliary nerve- infratrochlear and anterior ethmoidal (external nasal) nerve

Maxillary division (CN V-2) - Foramen rotundum - pterygopalatine fossa - infraorbital canal and foreman
- Zygomatic nerve- zygomaticotemporal and zygomaticofacial nerves
- Infraorbital nerve- inferior palpebral, lateral nasal, and superior labial nerves

Mandibular division (CN V-3) - Foramen ovale - infratemporal fossa - mandibular canal - mental foramen
- Buccal nerve
- Auriculotemporal nerve
- Inferior alveolar nerve- mental nerve

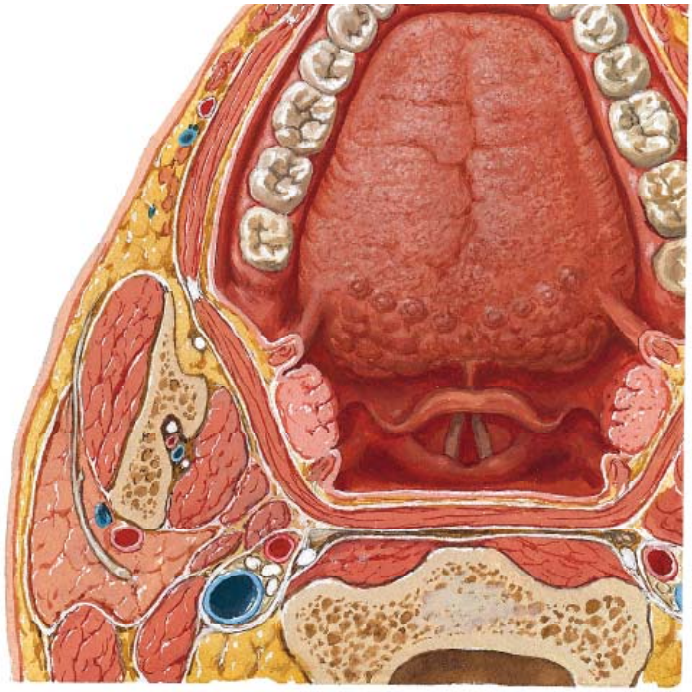



Ophthalmic nerve [V1]
Maxillary nerve [V2]
Zygomaticotemporal nerve
Supra-orbital nerve
Supratrochlear nerve
Lacrimal nerve
Infratrochlear nerve
External nasal nerve
Infra-orbital nerve
Buccal nerve
Mental nerve
Auriculotemporal nerve
Mandibular nerve [V3]
Zygmaticofacial nerve

2) Parotid Gland

a) Describe the function and location of the parotid gland including relations to the external carotid artery, retromandibular vein, facial nerve, masseter, bucal fat pad, and buccinator muscle

b) Trace the parasympathetic innervation to the parotid gland along the glossopharyngeal nerve (CN IX) naming all nerves and anatomical spaces traveled (preganglionic cell bodies in brain, CN IX, jugular foramen, tympanic canal into temporal bone, middle ear, tympanic plexus, lesser petrosal nerve, foramen ovale, motor-motor synapse in otic ganglion, postganglionic fibers to parotid gland)



3) Facial Expression

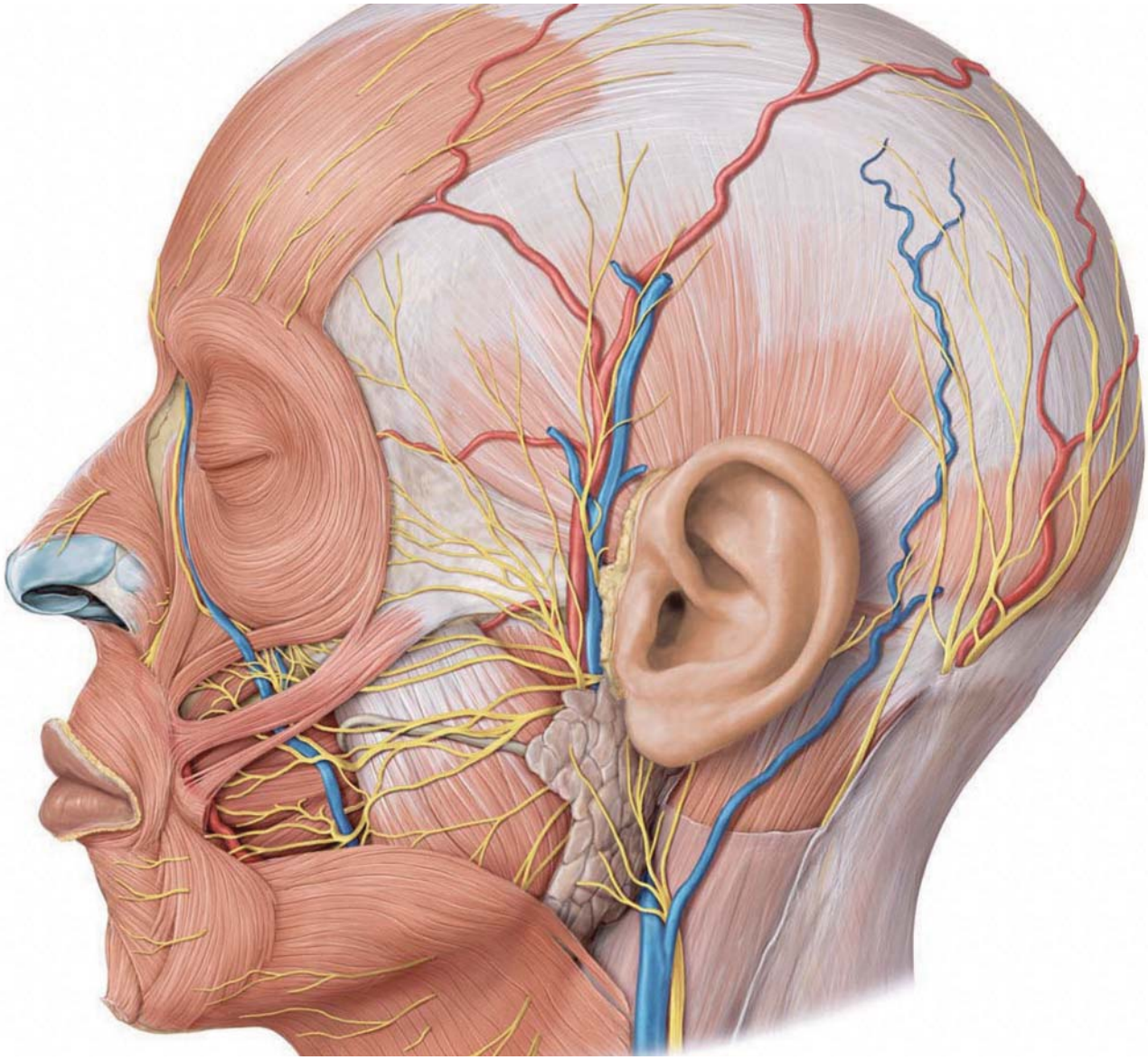
Describe the location, and basic attachments and actions of the following muscles of facial expression:

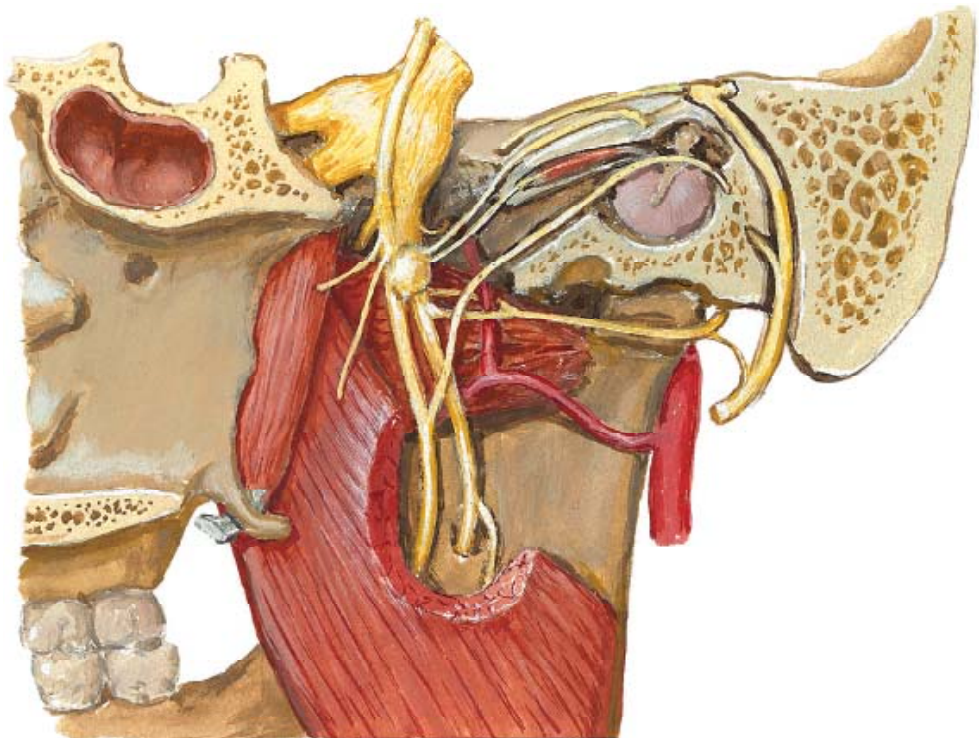
- Zygomaticus major and minor
- Levator anguli oris
- Levator labii superioris
- Levator labii superioris alaeque nasi
- Buccinator
- Risorius
- Orbicularis oris
- Depressor anguli oris
- Depressor labii inferioris
- Mentalis
- Platysma
- Occipitofrontalis
- Corrugator supercilii
- Procerus
- Nasalis

Innervation of the muscles of facial expression (BM)

CN VII- internal acoustic meatus, facial canal, stylomastoid foramen, through parotid gland

- Muscular branches: Temporal, Zygomatic, Buccal, Mandibular, Cervical nerves





4) Blood Supply to the Face

Arteries

Describe the origin, course, and destination of the following external carotid arterial branches to the face

Facial artery- curls around mandible, banches into superior and inferior labial, lateral nasal, and angular areries

Superficial temporal- branches out on lateral surface of cranium anterior to ear

Transverse facial- extends anteriorly along zygomatic arch

Maxillary artery- deep to mandibular ramus gives rives to many branches (inferior alveolar, superior alveolar, infraorbital, deep temporal)

Veins

Describe the origin, course, and destination of the following veins of the face

External jugular tributaries

Posterior auricular vein- drains skin posterior to the ear

Retromandibular vein- drain skin anterior to the ear, through the parotid

Internal jugular tributaries

Facial vein- drains most of facial skin

Anterior vein- drains anterior cervical skin

5) Infratemporal Fossa

Topography

a) Describe the boundaries of the infratemporal fossa

Medial- lateral pterygoid plate of the sphenoid

Lateral- ramus of the mandible

Anterior- posterior aspect of the maxilla

Posterior- condyle of the mandible, mastoid process and styloid process of the temporal bone

b) Describe the openings that communicate with the infratemporal fossa

Foramen ovale- mandibular nerve (CN V-3)

Foramen spinosum- middle meningeal artery

Pterygomaxillary fissure- maxillary artery

Inferior orbital fissure- infraorbital nerve

c) Temporomandibular joint (TMJ)

Describe the structure and movements of the temporomandibular joint, including bony components, fibrous capsule, synovial membrane, and the articular disc

d) Describe the actions and muscles that produce the actions of the TMJ

- Elevation: temporalis, masseter, medial pterygoid
- Depression: gravity, digastric, geniohyoid and mylohyoid
- Protrusion: lateral pterygoid m. (assisted by medial pterygoid)
- Retraction: posterior termporalis, deep masseter geniohyoid, digastric,

e) Muscles of Mastication

Describe the location, function, basic attachments, and innervation for each of the following muscles of mastication:

- Masseter
- Temporalis
- Medial pterygoid
- Lateral pterygoid

f) Arteries of the Infratemorpal Fossa

Maxillary artery

Describe how the maxillary artery is broken into three regions relative to the lateral pterygoid muscle

Describe the course and distribution of the principle branches of the three regions of the maxillary artery

First region- middle meningeal, inf alveolar (deep auricular, anterior tympanic, accessory meningeal)

Second region- deep temporal (buccal, pterygoid arteries, masseteric)

Third region- descending palatine, sphenopalatine, infraorbital (artery of the pterygoid canal)

g) Pterygoid plexus of veins

Describe the origin, course destination, and relations of the pterygoid plexus of veins and drainage to the maxillary, deep facial and ophthalmic vv.; include its potential drainage into the cavernous sinus

h) Nerves of the Infratemporal Fossa

Mandibular division of the trigeminal nerve (CN V-3) (anterior 2/3 of tongue, mandibular face, and teeth)

Main trunk of V-3- through foramen ovale to infratemporal fossa then spilts into anterior and posterior divisions (nerve to tensor tympani, nerve to tensor veli palatini, nerve to medial pterygoid)

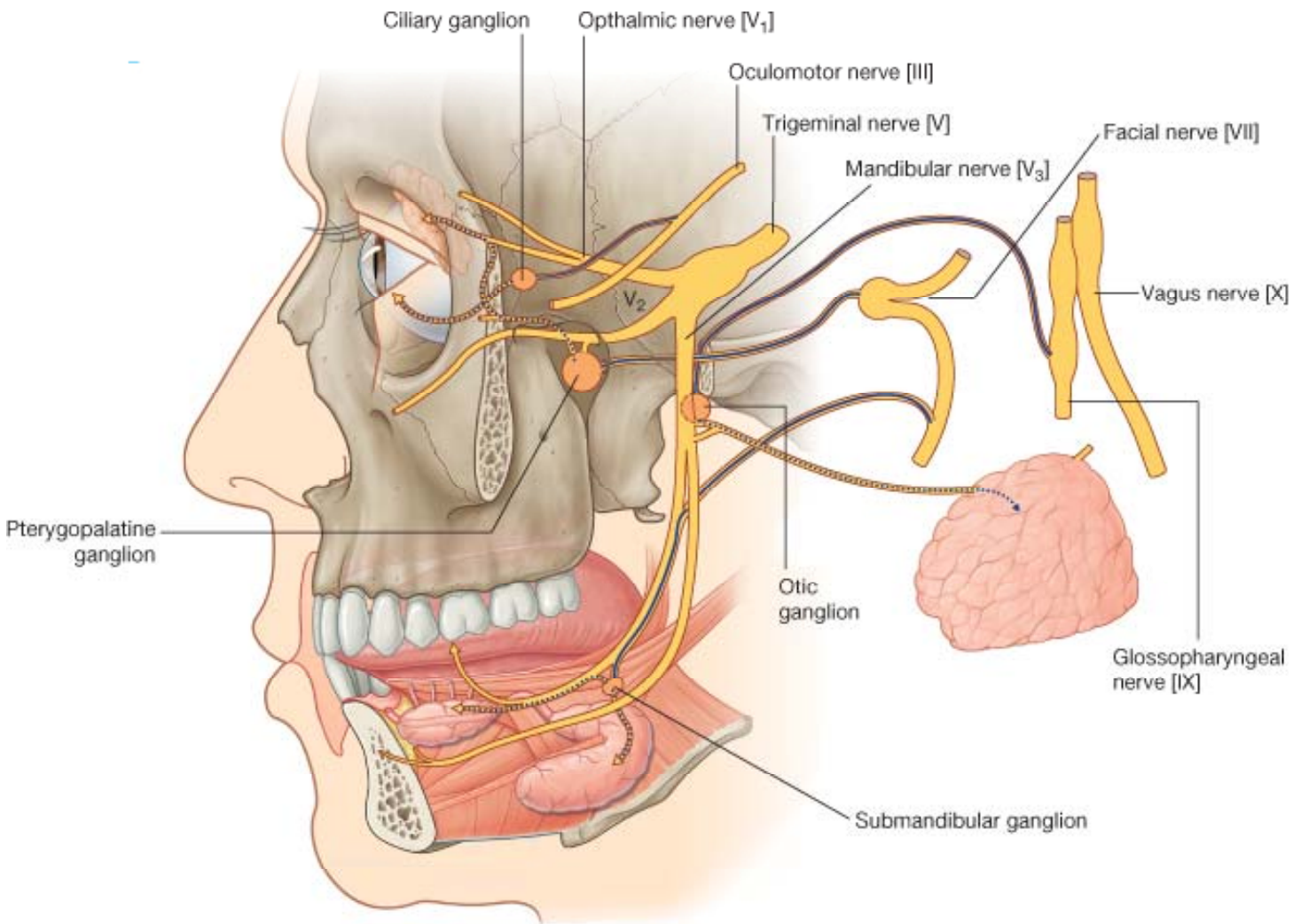
Anterior division
Sensory: buccal
Motor: nerve to lateral pterygoid, masseter, deep temporal nerves

Posterior division
Sensory: Auriculotemporal, inferior alveolar and mental, lingual
Motor: Nerve to mylohyoid

Chorda tympani - CN VII SS hitches to lingual n. for taste on anterior 2/3 of tongue

Submandibular ganglion - CN VII VM hitches to lingual to submandibular and sublingual salivary glands

Otic Ganglion - CN IX VM hitches to CN V-3 to the parotid gland; synapses in otic ganglion



G21B: Pterygopalatine Fossa, Nasal Cavity, and Paransal Sinuses

At the end of this lecture, students should be able to master the following:

1) Boundaries, Osteology and Contents of the Pterygopalatine Fossa

Describe the bony boundaries of the pterygopalatine fossa

- Medial to the infratemporal fossa through the pterygomaxillary fissure

Describe the principle contents of the pterygopalatine fossa

- Maxillary artery
- Maxillary nerve (CN V-2)
- Pterygopalatine ganglion)

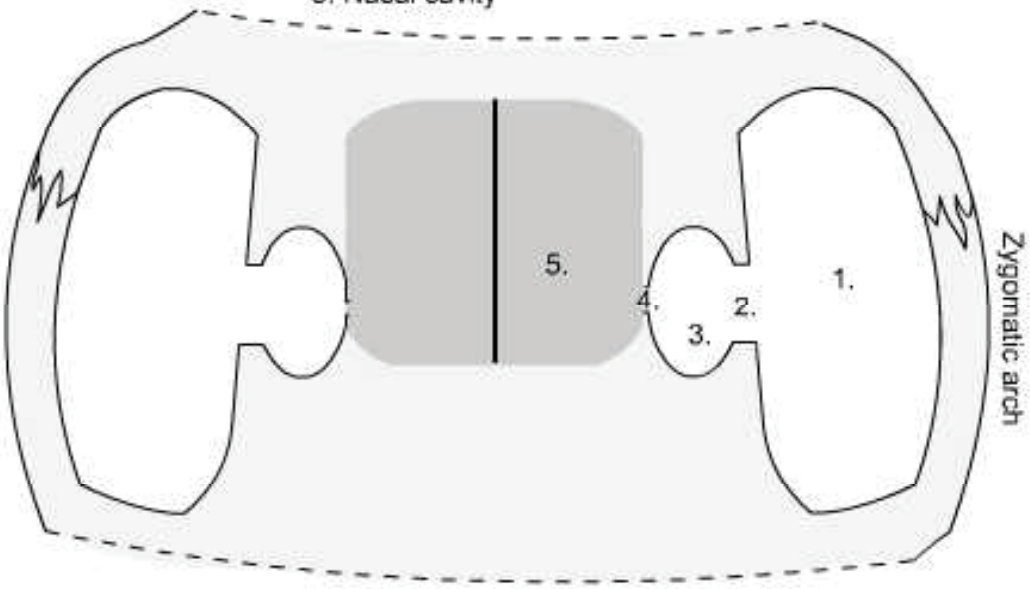
2) Pterygopalatine Fossa

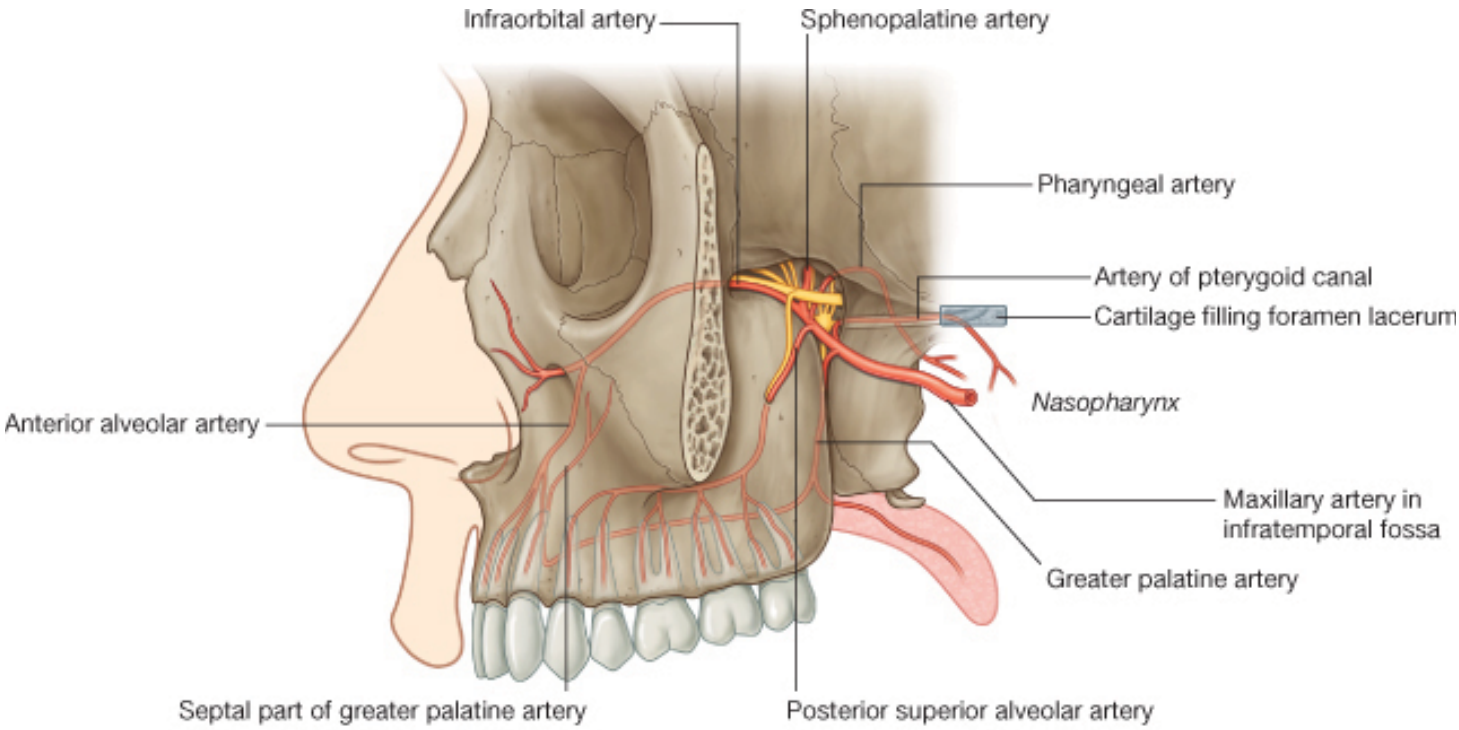
a) Know the main branches of the third part of the maxillary artery

- Posterior superior alveolar artery
- Descending palatine artery
- Infraorbital artery: in the infraorbital canal, the infraorbital nerve gives rise to the:
  - Anterior superior alveolar
  - Middle superior alveolar
- Sphenopalatine artery- passes through the sphenopalatine foramen to supply the nasal mucosa

Cross section through the skull

1. Infratemporal fossa
2. Pterygomaxillary fissure
3. Pterygopalatine fossa
4. Sphenopalatine foramen
5. Nasal cavity





b) Nerves of the pterygopalatine fossa

Describe the course and distribution of the branches of CN V-2

- Posterior superior alveolar nerve (PSA)

- Zygomatic nerve: passes through the inferior orbital fissure towards the lateral orbital wall, gives rise to a communicating branch that carries parasympathetic autonomic fibers from CN VII to the lacrimal nerve; sends off zygomaticofacial and zygomaticotemporal branches to skin in temporal region

- Greater and lesser palatine nerves

- Nasoplalatine nerve- courses through the sphenopalatine foramen, to the medial and lateral wall of the nasal cavity, then travels anteriorly along the nasal septum supplying general sense and parasympathetic postganglionic visceral motor (CN VII) to the mucosa, traversing the incisive canal to the hard palate

- Infraorbital nerve- While in the infraorbital groove/canal, the nerve gives rives to the:
  - Middle superior alveolar nerve- GS to the upper premolars and maxillary sinus
  - Anterior superior alveolar nerve- GS to the upper incisors and canine

- Pharyngeal nerve- courses through the palatovaginal canal to supply GS and VM (postganglionic parasympathetic via CN VII) to the mucosa and glands of the nasopharynx

- Nerve of the pterygoid canal (Vidian nerve)- courses into the pterygopalatine fossa as a union of greater petrosal nerve (parasympathetic preganglionic fibers from CN VII) and the deep petrosal nerve (sympathetic postganglionic fibers from the carotid plexus) through the pterygoid canal and synapses with postganglionic parasympathetic fibers in the pterygopalatine ganglion; which are then distributed to the mucosal glands of the nasal cavity, palate and VM fibers hitch-hike on CN V-2 (zygomatic n.) and then CN V-1 (lacrimal gland)

Pterygopalatine ganglion

Trace the following autonomic pathways to the following areas:

Parasympathetics

- Preganglionic fibers- cell bodies in brain, CN VII, internal acoustic meatus, facial canal, greater petrosal nerve, joined by deep petrosal nerve to form the nerve of the pterygoid canal (Vidian nerve) passing through the pterygoid canal, pterygopalatine fossa, synapse in pterygopalatine ganglion

- Postganglionic fibers to:

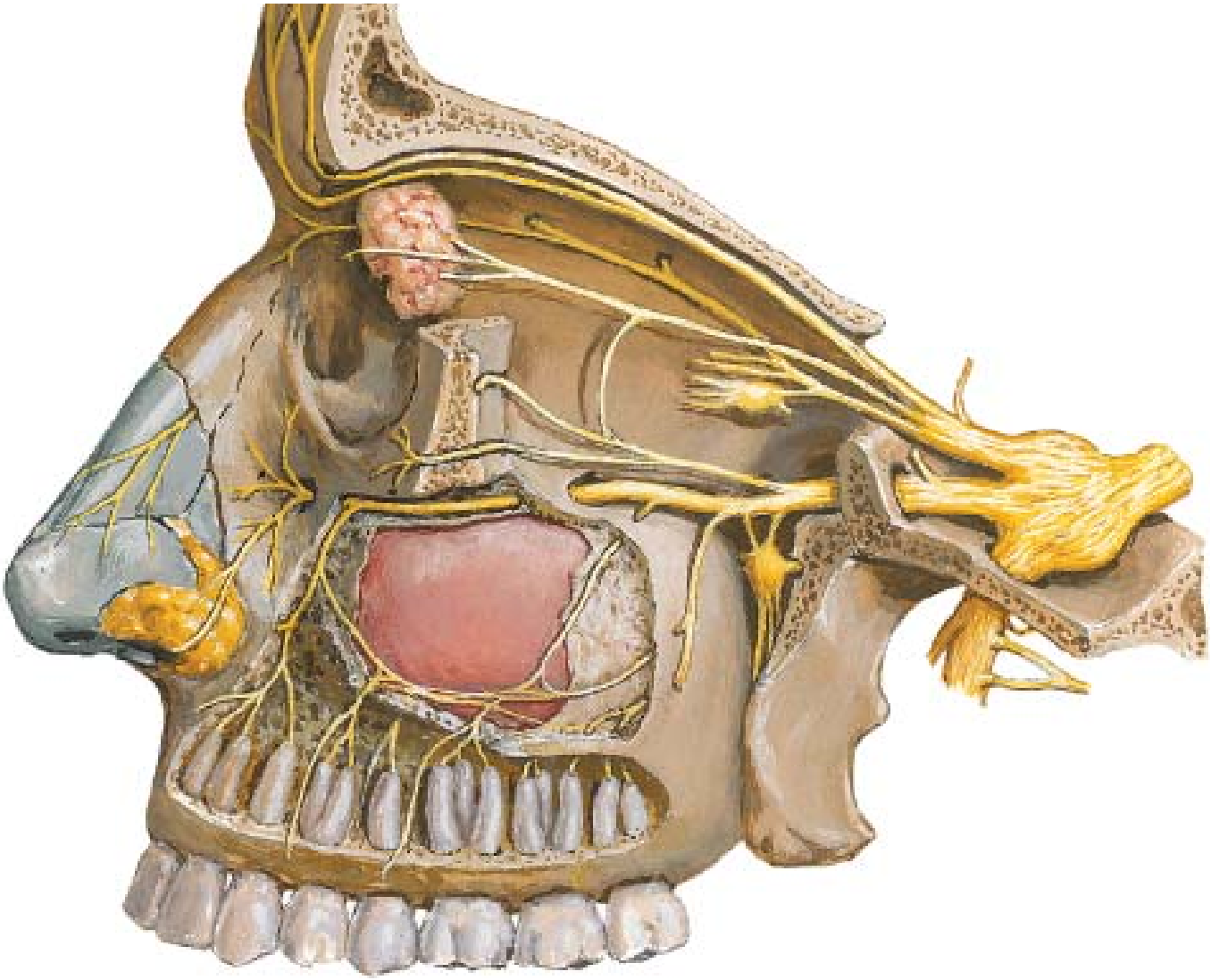
  Lacrimal gland- zygomatic nerve through the inferior orbital fissure, communicating branch to lacrimal nerve, lacrimal gland

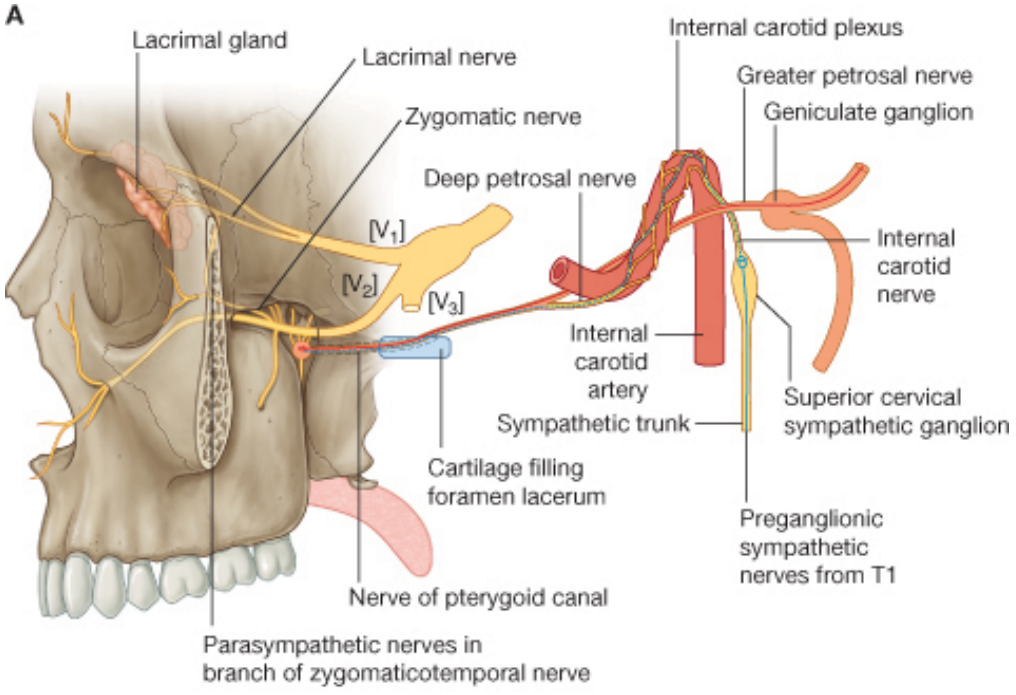
  Smooth muscle and glands of the nasal cavity- nasopalatine nerve through the sphenopalatine foramen to the nasal mucosa

  Smooth muscle and glands of the palate- greater and lesser palatine nerves through the greater and lesser palatine canals, respectively

Sympathetic fibers

- Preganglionic fibers- originate from spinal levels T1-L2, ascend to synapse in sup cervical ganglion
- Postganglionic fibers- carotid nerve runs with internal carotid artery, deep petrosal nerve, nerve of pterygoid canal through pterygoid canal, pterygopalatine fossa, pterygopalatine ganglion, travels with parasympathetic postganglionic fibers to same target organs (lacrimal gland, nasal. and palatal mucosa)



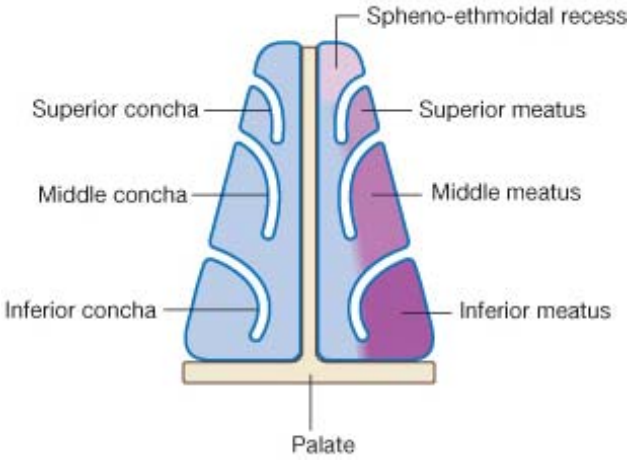

A
Lacrimal gland
Lacrimal nerve
Zygomatic nerve
Deep petrosal nerve
[V1]
[V2]
[V3]
Internal carotid plexus
Greater petrosal nerve
Geniculate ganglion
Internal carotid nerve
Internal carotid artery
Sympathetic trunk
Superior cervical sympathetic ganglion
Cartilage filling foramen lacerum
Preganglionic sympathetic nerves from T1
Nerve of pterygoid canal
Parasympathetic nerves in branch of zygomaticotemporal nerve

3) Nasal Cavity

a) Boundaries and osteology of the nasal cavity

Describe the bony boundaries of the nasal cavity

- Medial boundary (septum)- perpendicular plate of the ethmoid, vomer and septal nasal cartilage
- Floor- palatine process of the maxilla and palatine bone
- Roof- nasal bones, cribriform plate of the ethmoid, and sphenoid bone
- Lateral boundary- inferior nasal concha, middle and superior nasal concha, frontal process of maxilla, perpendicular plate of the palatine bone, medial pterygoid plate of the sphenoid, lacrimal bone

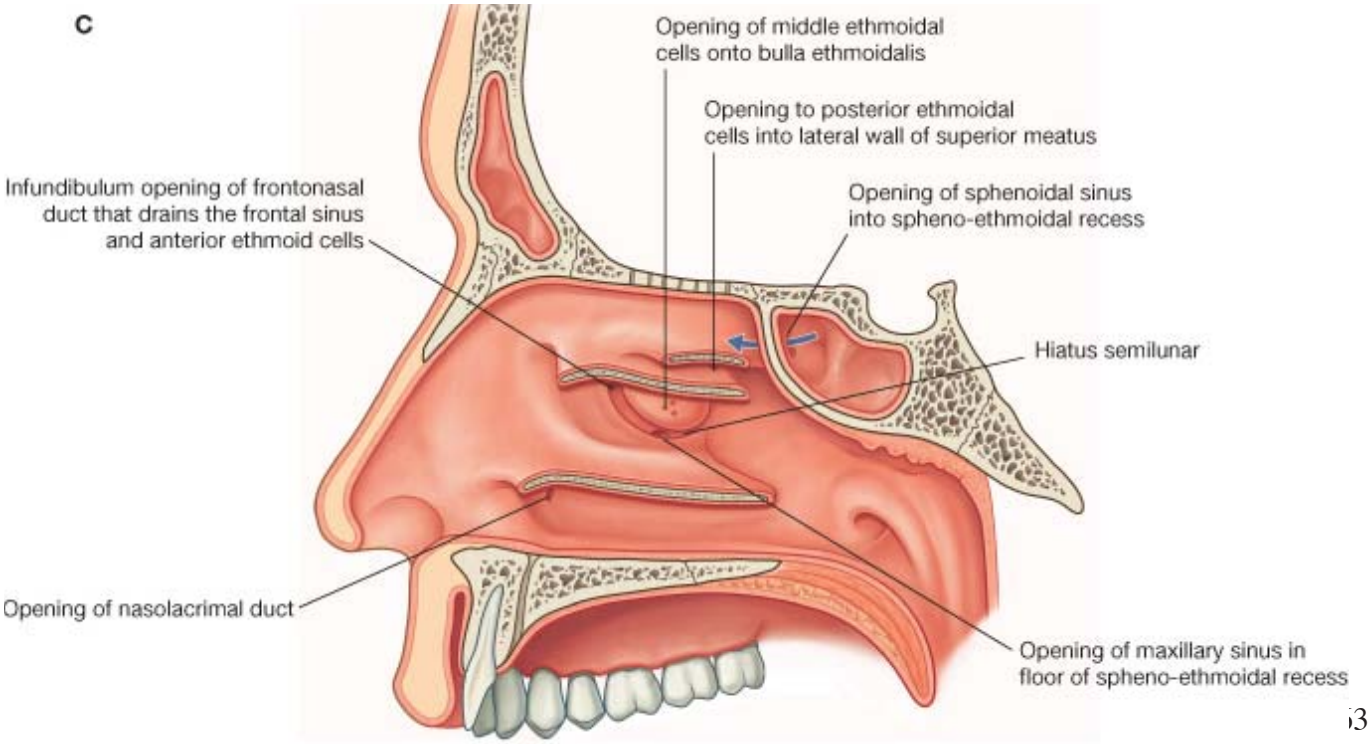


b) Describe the topography of the lateral wall of the nasal cavity

- Superior nasal concha- superior meatus, sphenoethmoidal recess, sphenoid sinus, post. ethmoid air cells

- Middle nasal concha- middle meatus, hiatus semilunaris, ethmoidal bulla, uncinate process, middle and anterior ethmoidal air cells, maxillary sinus, frontal sinus

- Inferior nasal concha- inferior meatus, nasolacrimal duct



c) Arteries of the nasal cavity

Describe the pathway and distribution of the carotid branches that serve the nasal cavity

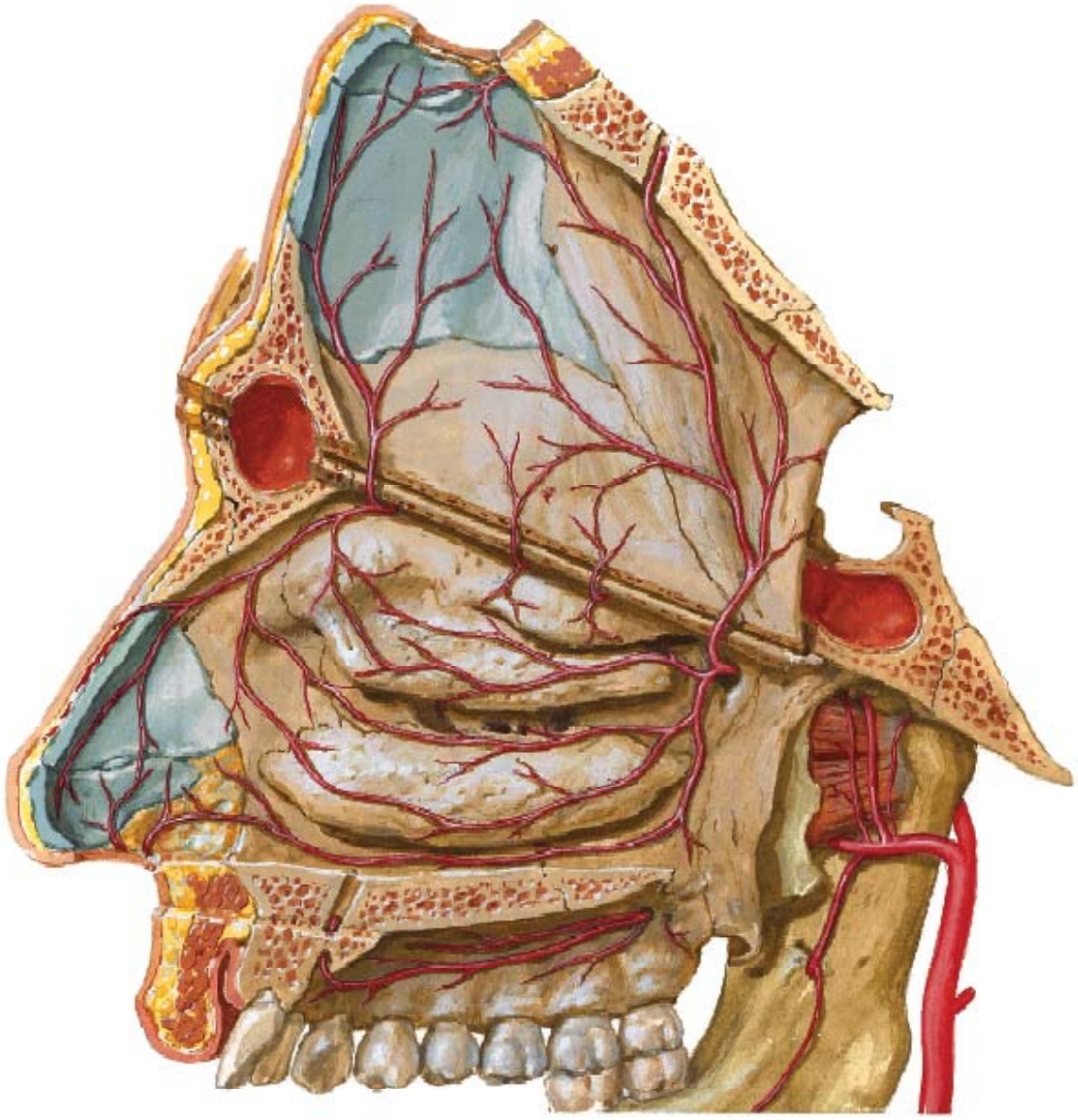
Maxillary artery- branches from the external carotid artery, passes through the infratemporal fossa, then through the pterygomaxillary fissure to the pterygopalatine fossa to give rise to:

- Sphenopalatine artery
- Greater palatine artery

Ophthalmic artery- internal carotid artery, travels through the superior orbital fissure to the orbit, gives rise to anterior and posterior ethmoidal arteries

Facial artery branches to nasal cavity

- Kiesselbach's plexus: region in the antero-inferior portion of nasal septum where all arteries to the nasal cavity anastomose (common site for epistaxis)



d) Nerves of the nasal cavity

Olfactory nerve (CN I)- olfactory bulb lies superior to the cribriform plate and houses sensory cell bodies, sends olfactory nerves through the cribriform foramina to the olfactory epithelium in the roof of the nasal cavity to detect smell (SS)

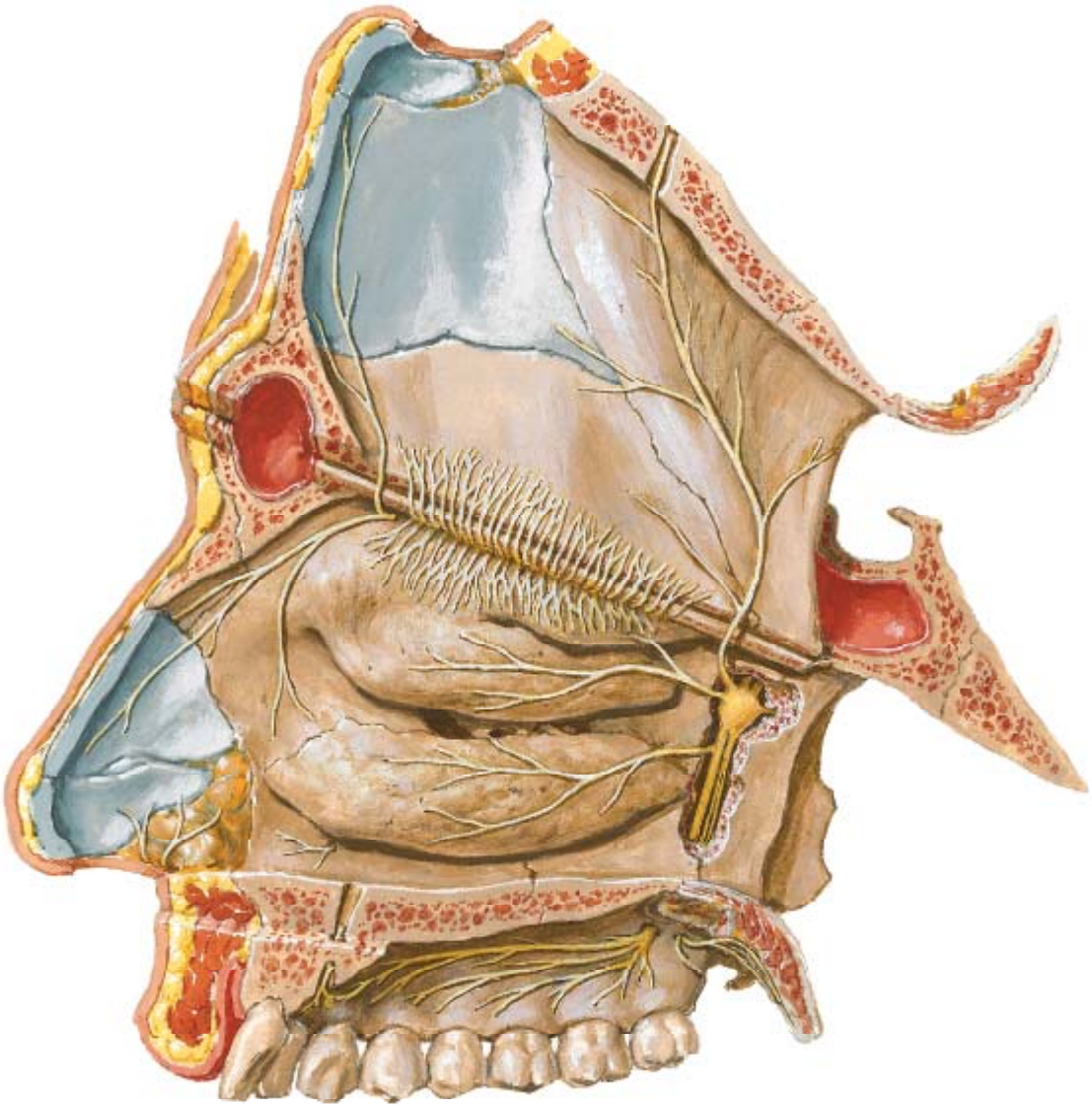
Opthalmic division of the trigeminal nerve (CN V-1)

Nasocilliary nerve- courses to the superior, medial aspect of the orbit, gives rise to the anterior ethmoidal nerve

Anterior ethmoidal nerve- -passes through the anterior ethmoidal canal, supplies the ethmoidal air cell and frontal sinus before it splits to supply both medial and lateral aspects of the anterior nasal cavity. It will continue anterior and terminate as the external nasal nerve on the skin around the nares.

Maxillary division of the trigeminal nerve (CN V-2)- passes through the foramen rotundum to the pterygo-palatine fossa and gives rise to several nasal branches that travel through the sphenophalatine foramen, the largest being the nasopalatine

- Nasopaltine nerve- sends branches to inferior and posterior septum and lateral walls



4) Paranasal Sinuses

Describe the location, drainage pathway, relation to nasal structures, and innervation for each of the following paranasal sinuses

Frontal sinus- frontal bone, drains via frontonasal duct to the hiatus semilunaris, supraorbital nerve (CN V-1)

Ethmoidal sinus- ethmoidal labrynth (anterior middle and posterior), anterior drain into ethmoidal infundibulum or frontonasal duct, middle drain into ethmoidal bulla, posterior drain onto superior nasal meatus, innervated by anterior and posterior ethmoidal nerves (CN V-1) and orbital branches of the pterygopalatine ganglion (CN V-2)

Sphenoidal sinus- with the body of the sphenoid, drains into the spheno-ethmoidal recess, innervated by posterior ethmoidal nerve (CN V-1) and orbital branches of the pterygopalatine ganglion (CN V-2)

Maxillary sinus- maxilla, drains in to the hiatus semilunaris, innervated by the infra-orbital and superior alveolar branches of the maxillary nerve (CN V-2)

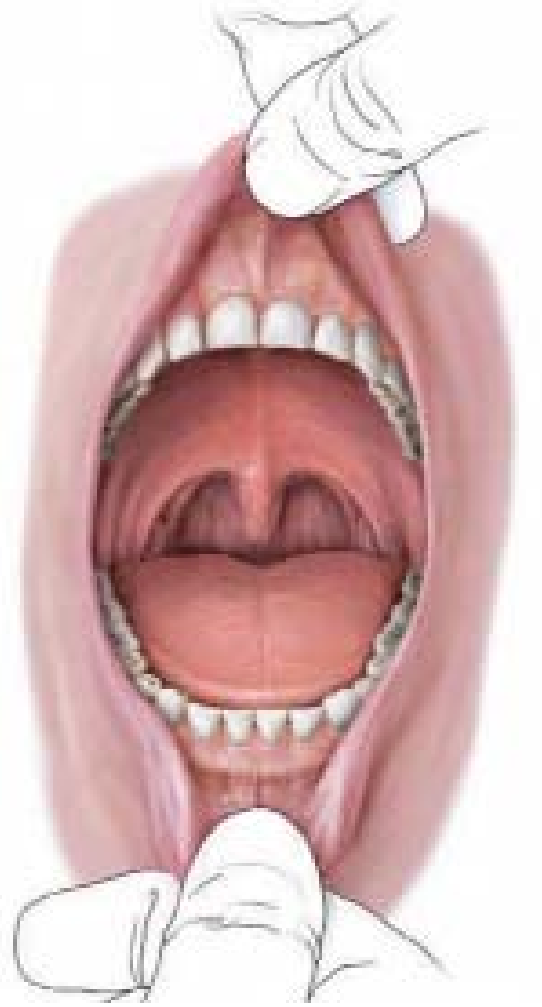
G21A: Oral Cavity

At the end of this lecture, students should be able to master the following:

1) Oral Cavity Overview

Contents

Locate the contents of the oral cavity: tongue, hard palate, soft palate (palatoglossal arch, palatopharyngeal arch, palatine tonsil, uvula), frenula (upper and lower lips), oral vestibule



2) Tongue

a) Surface anatomy- describe the location and significance of the following surface lingual structures

- Sulcus terminalis- V-shaped groove, boundary between oral and pharyngeal regions of the tongue

- Foramen caecum- fossa at center of sulcus terminalis, embryonic remnant of thyroid gland invagination

- Vallate papillae- anterior to sulcus ternimalis, contain taste buds

- Lingual tonsil- lymphoid tissue in submucosa of the pharyngeal surface of the tongue

- Pharyngeal part of the tongue- posterior 1/3 of the tongue

- Oral of the tongue- anterior 2/3 of the tongue

- Root of the tongue- attaches to the mandible and hyoid

b) Tongue muscles

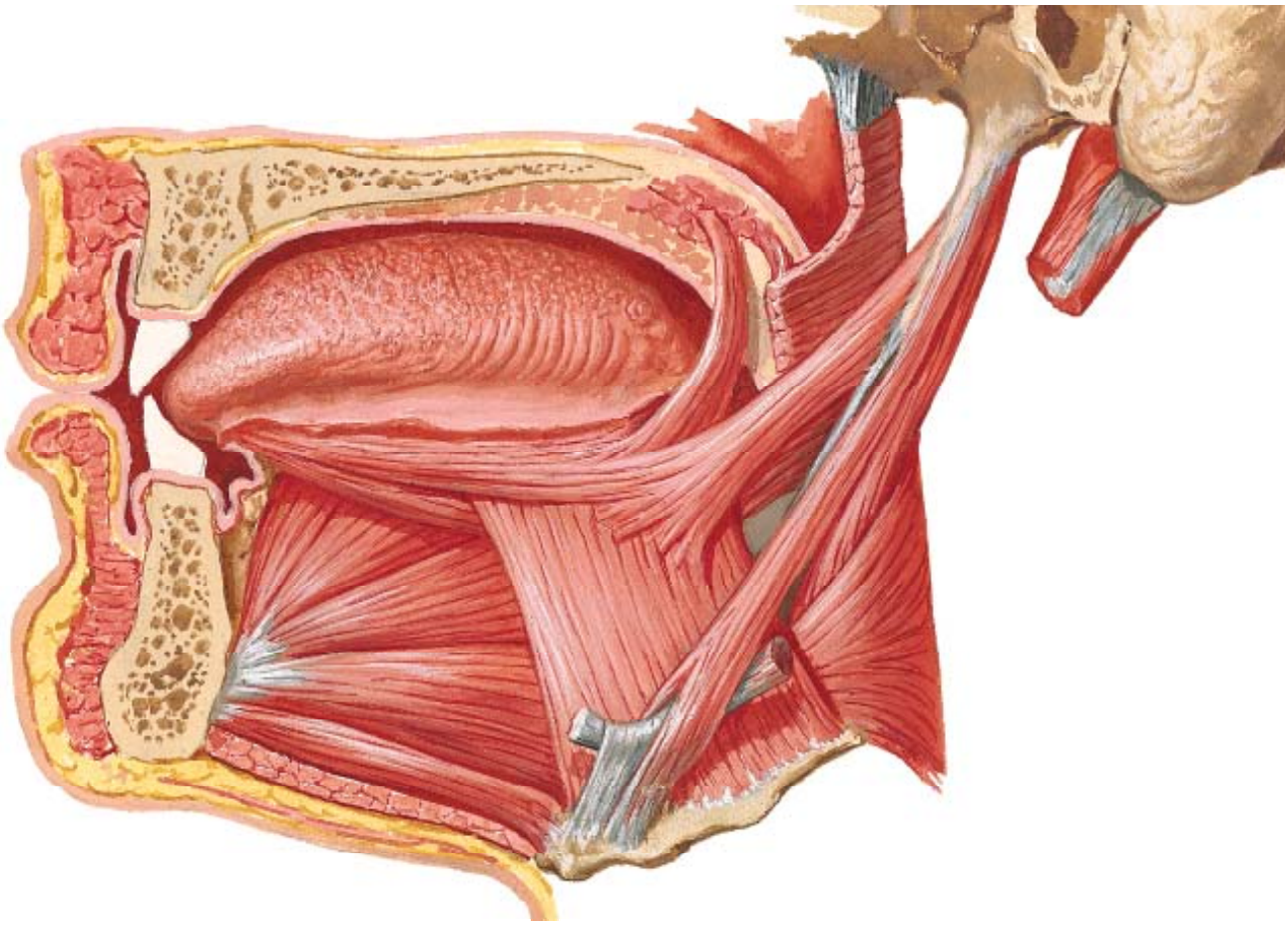
Describe the location and function of each of the following extrinsic tongue muscles

Genioglossus- runs from superior mental tubercles to tongue and hyoid, superior to geniohyoid, protrudes tongue, depresses center of tongue (CN XII)

Hyoglossus- runs from hyoid to lateral surface of tongue, depresses tongue (CN XII)

Styloglossus- runs from the styloid process to the lateral surface of tongue, elevates and retracts tongue (CN XII)

Palatoglossus- runs from palatine aponeurosis to lateral margin of tongue, medial to styloglossus, depresses palate, elevates posterior tongue (CN X)



c) Arteries of the tongue

Lingual artery- branches from the external carotid artery just superior to the hyoid bone, runs anterior between the superior and middle pharyngeal constrictors, then travels anterior to the oral cavity between the hyoglossus and the genioglossus, then branches

Dorsal lingual arteries- stay in floor of oral cavity

Deep lingual artery- branches superiorly toward tongue

Facial artery

Sublingual branch- branches near body of mandible, forms anastamosis with dorsal lingual arteries

d) Innervation of the tongue

Motor

Describe the pathway and distribution of the following motor nerves

Hypoglossal nerve (CN XII)- hypoglossal canal, descends through the submandibular triangle of the neck, joins ansa cervicalis, deep to mylohyoid innervating all tongue muscles (except palatoglossus)

Vagus nerve (CN X) (somatic motor)- jugular foramen, pharyngeal nerve branches off of inferior vagal ganglion, fibers join pharyngeal plexus, supplies palatoglossus m.

Sensory

General sensory- Describe the pathway and distribution of the following GS nerves

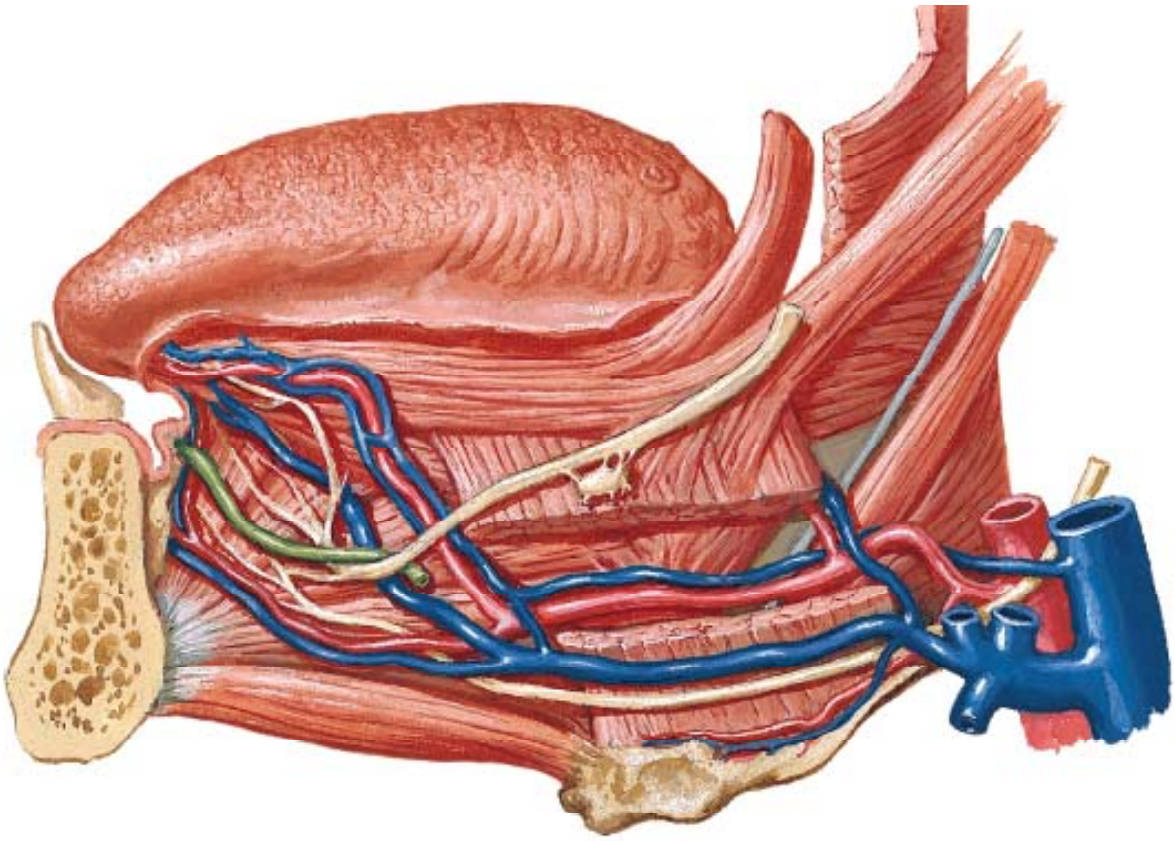
Mandibular nerve (CN V-3)- cell bodies in trigeminal ganglion in cranial cavity, foramen ovale, intratemporal fossa, lingual nerve between mandible and medial pterygoid, supplies general sense to anterior 2/3 of tongue

Glossopharyngeal nerve (CN IX)- brain, jugular foramen, cell bodies in superior glossopharyngeal ganglion, along posterior aspect of pharynx, between superior and middle pharyngeal constrictors to enter oral cavity, supplies general sense to posterior 1/3 of tongue

Special sensory (taste)- Describe the pathway and distribution of the following SS nerves

Facial nerve (CN VII)- brain, internal acoustic meatus, cell bodies in geniculate ganglion, facial canal, chorda tympani branches in middle ar, petrotympanic fissure, infratemporal fossa, lingual nerve, taste to anterior 2/3 of tongue

Glossopharyngeal nerve (CN IX)- brain, jugular foramen, cell bodies in superior and inferior glossopharyngeal ganglia, taste to posterior 1/3 of tongue



3) Palate

a) Muscles of the Soft palate

Muscles of the soft palate- describe the location and function of the following palatal muscles

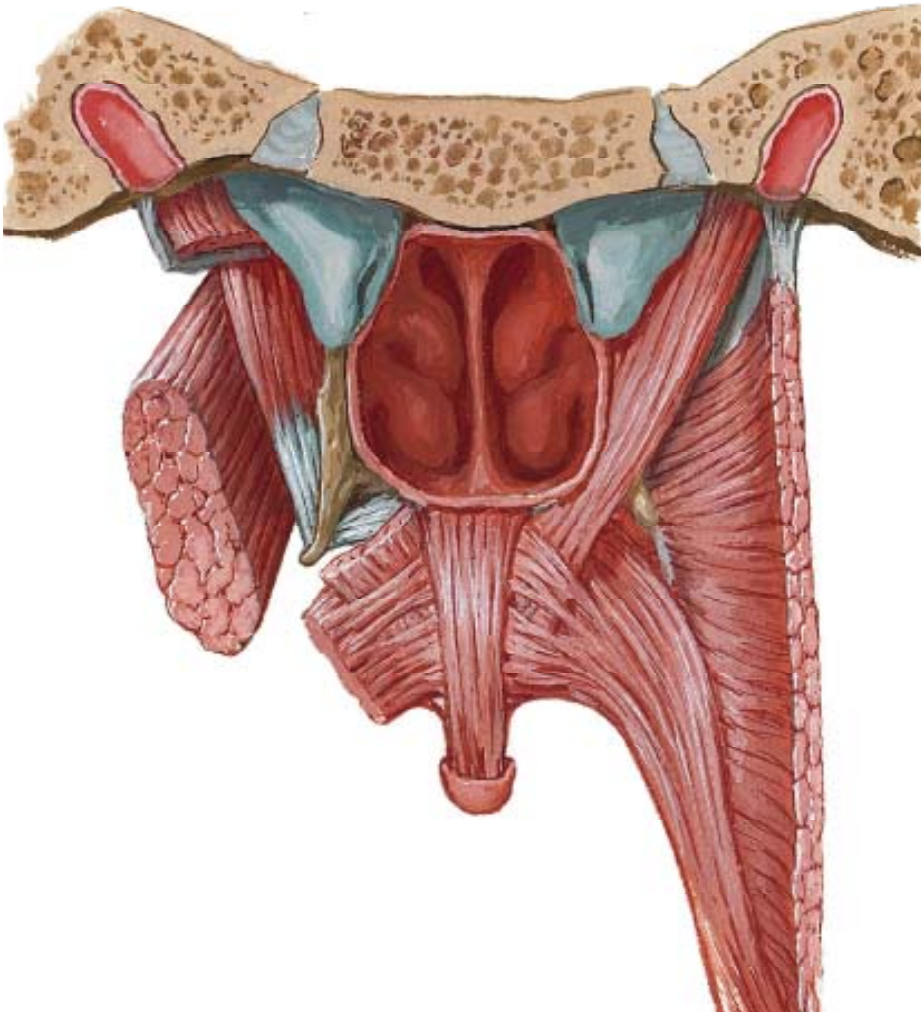
Tensor veli palatini- runs from the sphenoid bone to the palatal aponeurosis, lateral to the levator veli palatini, tenses the soft palate, opens the pharyngotympanic tube (CN V-3)

Levator veli palatini- runs from the temporal bone to the palatal aponeurosis, medial to the tensor veli palatini, elevates the soft palate (CN X)

Palatopharyngeus- runs from palatine aponeurosis to pharyngeal wall, posterior to the palatine tonsil, depresses soft palate, elevates pharynx (CN X)

Palatoglossus- runs from palatine aponeurosis to lateral margin of tongue, medial to styloglossus, anterior to the palatine tonsil, depresses palate, elevates posterior tongue (CN X)

Musculus uvulae- runs from hard palate to connective tissue of uvula, elevates uvula (CN X)



b) Palatine tonsils

Describe the location and function of the palatine tonsils (between the palatoglossal and palatopharyngeal arches for body defense)

c) Arteries of the palate

Describe the pathway and distribution of the arteries that serve the palate

Maxillary artery

Descending palatine artery

Greater palatine artery

Lesser palatine artery

Facial artery

Ascending palatine artery- ascends along the pharynx, passes superior to the superior pharyngeal constrictor, perforates the pharyngeal fascia to enter the soft palate

Ascending pharyngeal artery- branches directly off of external carotid artery, runs with ascending palatine artery

d) Innervation of the palate

Motor

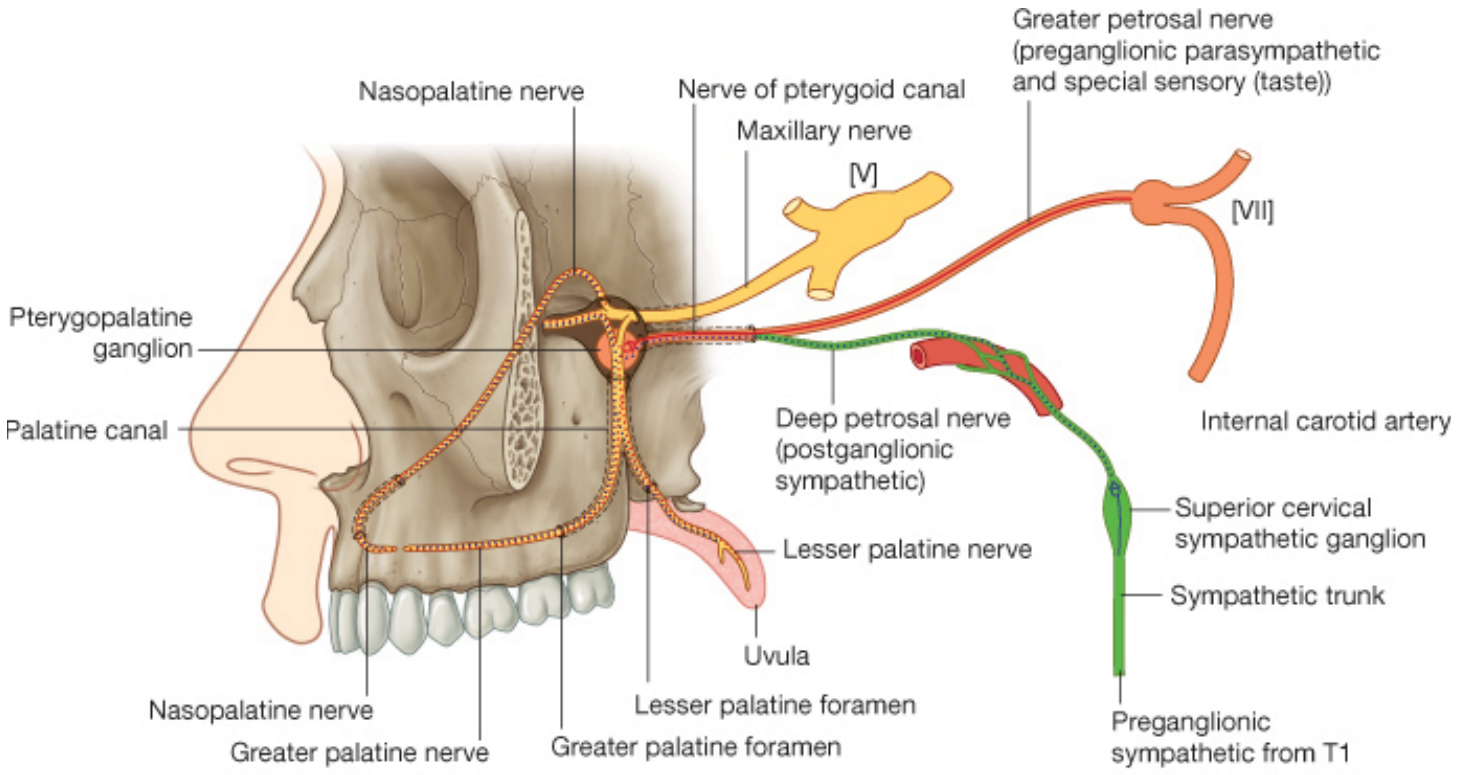
- Vagus nerve (CN X)- brain, jugular foramen, pharyngeal nerve branches off of inferior vagal ganglion, pharyngeal nerve plexus to all soft palate muscles except tensor veli palatini
- Mandibular nerve (CN V-3)- brain, foramen ovale, infratemporal fossa to the tensor veli palatini

Sensory

Maxillary nerve (CN V-2)- brain, sensory cell bodies in trigeminal ganglion, foramen rotundum, pterygopalatine fossa, pterygopalatine ganglion

Greater and lesser palatine nerves

Nasoplalatine nerve

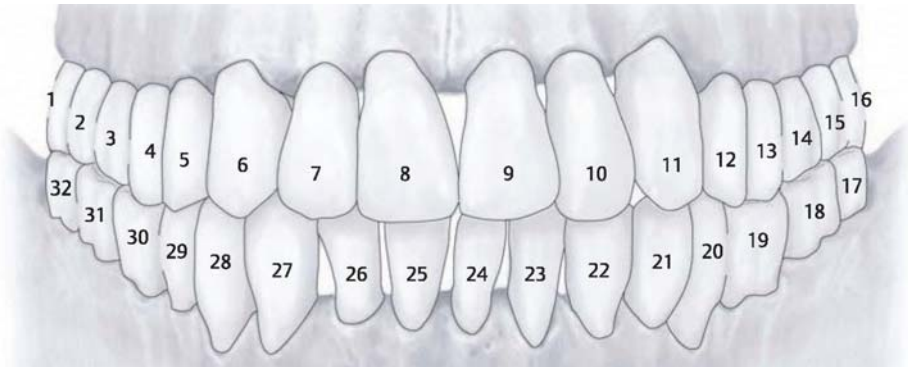


4) Teeth

Describe the number and position of incisors, canines, premolars, and molars found in an adult's and a child's mouth

Understand directional terminology specific to teeth

Describe the innervation of the upper and lower teeth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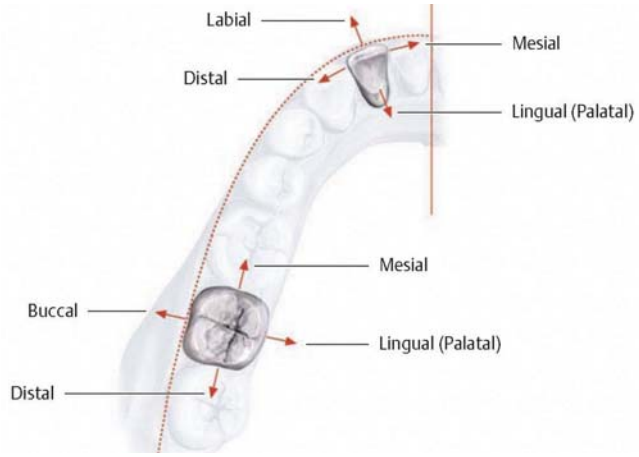
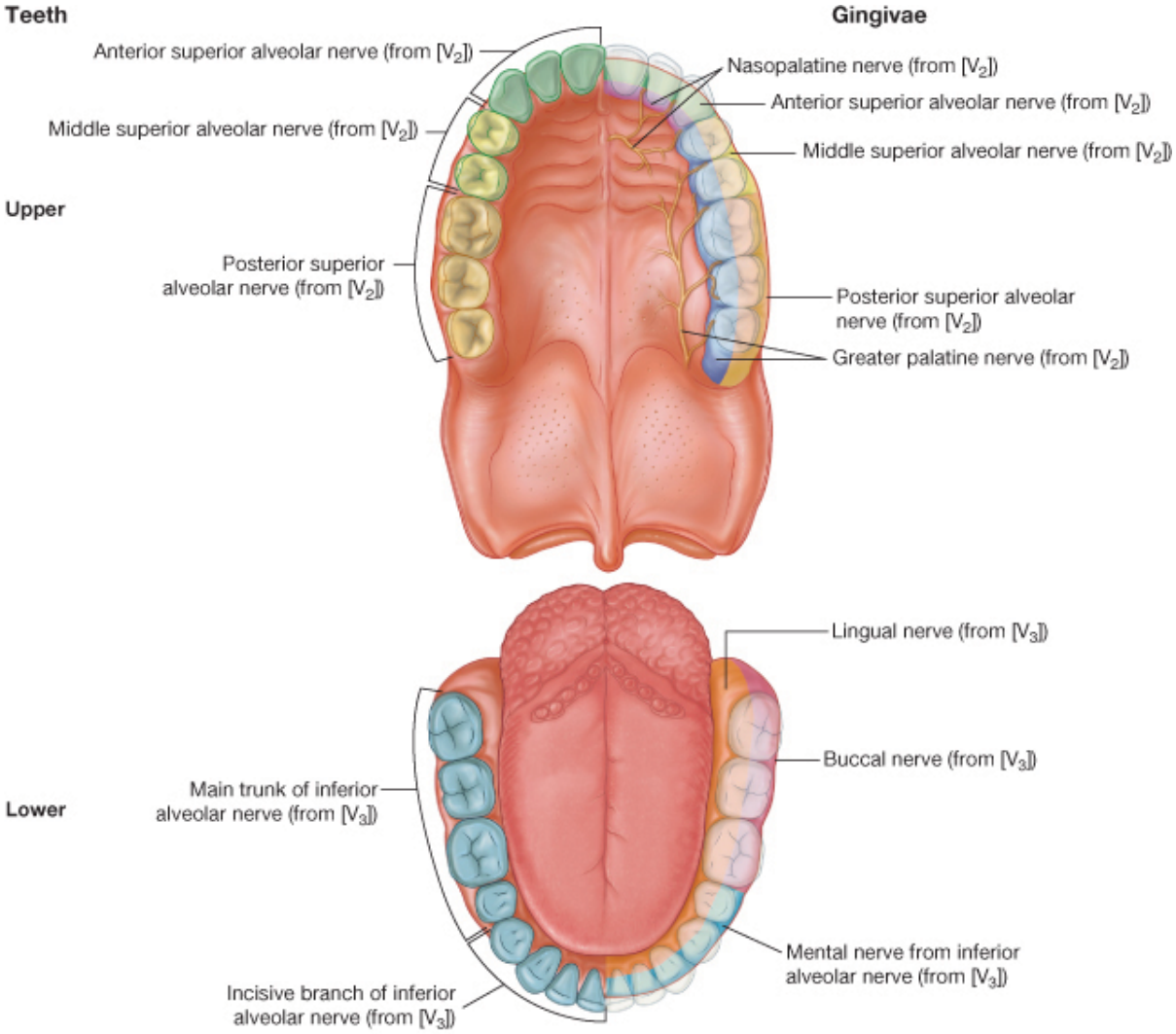

Labial
Mesial
Distal
Lingual (Palatal)
Mesial
Buccal
Lingual (Palatal)
Distal


Teeth
Gingivae
Anterior superior alveolar nerve (from [V2])
Middle superior alveolar nerve (from [V2])
Upper
Posterior superior alveolar nerve (from [V2])
Nasopalatine nerve (from [V2])
Anterior superior alveolar nerve (from [V2])
Middle superior alveolar nerve (from [V2])
Posterior superior alveolar nerve (from [V2])
Greater palatine nerve (from [V2])
Lingual nerve (from [V3])
Buccal nerve (from [V3])
Lower
Main trunk of inferior alveolar nerve (from [V3])
Mental nerve from inferior alveolar nerve (from [V3])
Incisive branch of inferior alveolar nerve (from [V3])

G21B: Pharynx

At the end of this lecture, students should be able to master the following:

1) Pharynx

a) Regions of the pharynx

Describe the topographical relations of the three regions of the pharynx: nasopharynx, oropharynx, laryngophaynx

b) Describe the attachments and functions of each of the the following pharyngeal muscles:

- Superior pharyngeal constrictor- pterygoid hamulus to pterygomandibular raphe to mandible, constricts the pharynx during swallowing (CN X)

- Middle pharyngeal constrictor- hyoid bone to central raphe, constricts the pharynx during swallowing (CN X)

- Inferior pharyngeal constrictor- thyroid and cricoid cartilages to central raphe, constricts the pharynx during swallowing (CN X)

- Stylopharyngeus- styloid process of the temporal bone to the pharyngeal wall in between the superior and middle pharyngeal constrictors, elevates the pharynx during swallowing (CN IX)

- Salpingopharyngeus- pharyngotympanic tube to pharyngeal wall, elevates pharynx during swallowing (CN X)

- Palatopharyngeus- palatine aponeurosis to paryngeal wall, elevates pharynx during swallowing (CN X)

c) Vascularization of the Pharynx

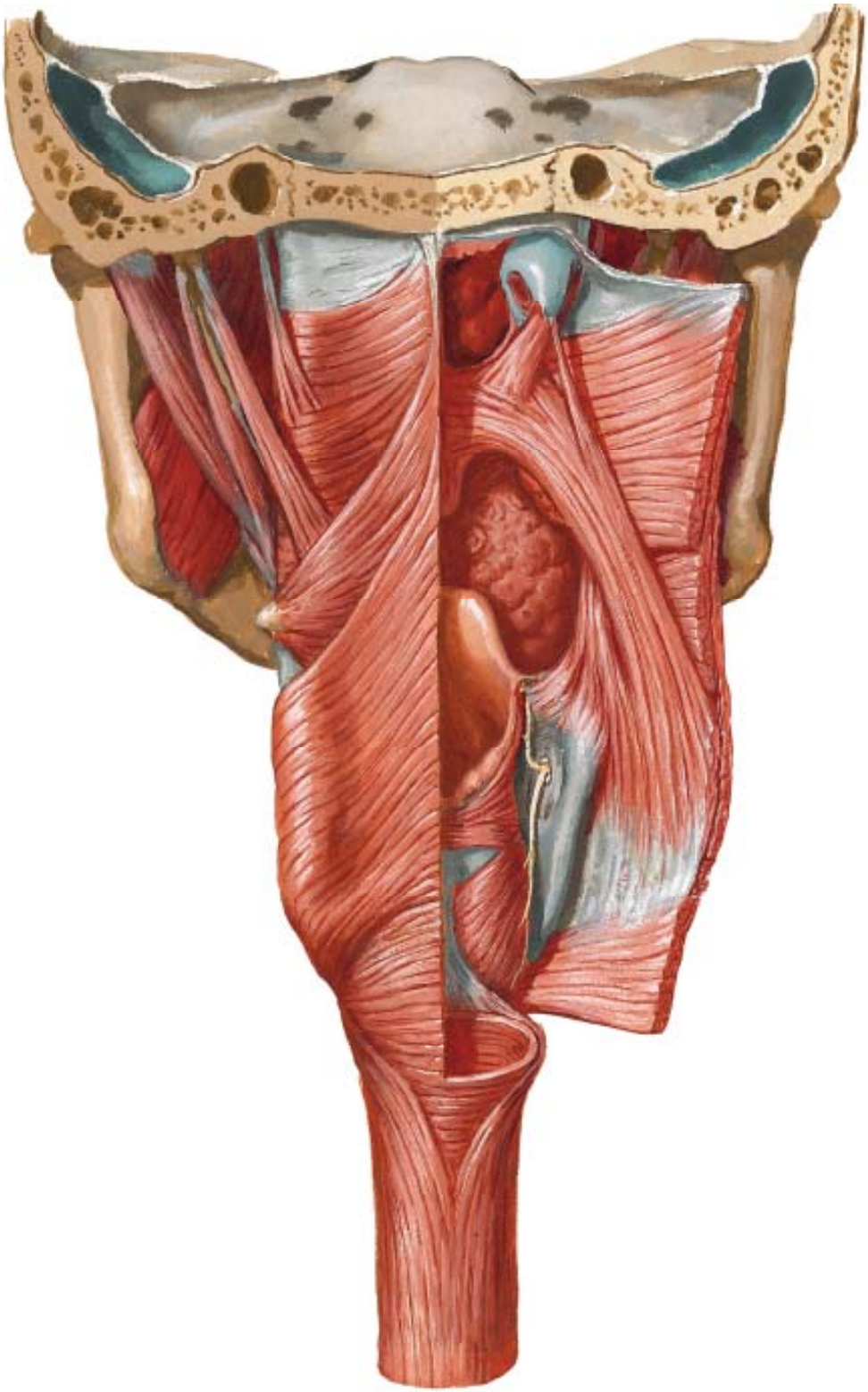
-Pharyngeal artery: branch of the maxillary artery through the palatovaginal canal

- Facial artery:
  - Ascending palatine artery: ascends along the pharynx, passes superior to the sup. pharyng constr.
  - Tonsillar artery: branches from the ascending palatine artery, penetrates the sup. pharyng constr. and supplies the palatine tonsil

- Ascending pharyngeal artery: branches directly off of the external carotid artery, runs with ascending palatine artery

d) Pharyngeal tonsil (adenoids)

Describe the location and function of the pharyngeal tonsils



e) Innervation of the Pharynx

Somatic Motor (SM)

- CN IX: stylopharyngeus m.

- CN X: all pharyngeal muscles (except stylopharyngeus m.)

General Sensory (GS) (Note: some texts may call CN IX and X's sensory input from the pharynx VS)

- CN V-2: Nasopharynx; maxillary division of CN V via the pharyngeal branch from pterygopalatine fossa

- CN IX: Orogpharynx; pharyngeal plexus

- CN X: Laryngopharynx; pharyngeal plexus

f) Structures passing through the gaps

Between the floor of the sphenoid bone and superior pharyngeal constrictor (pharyngeal fascia)

- Levator veli palatini
- Auditory tube
- Ascending palatine artery

Between superior and middle pharyngeal constrictors

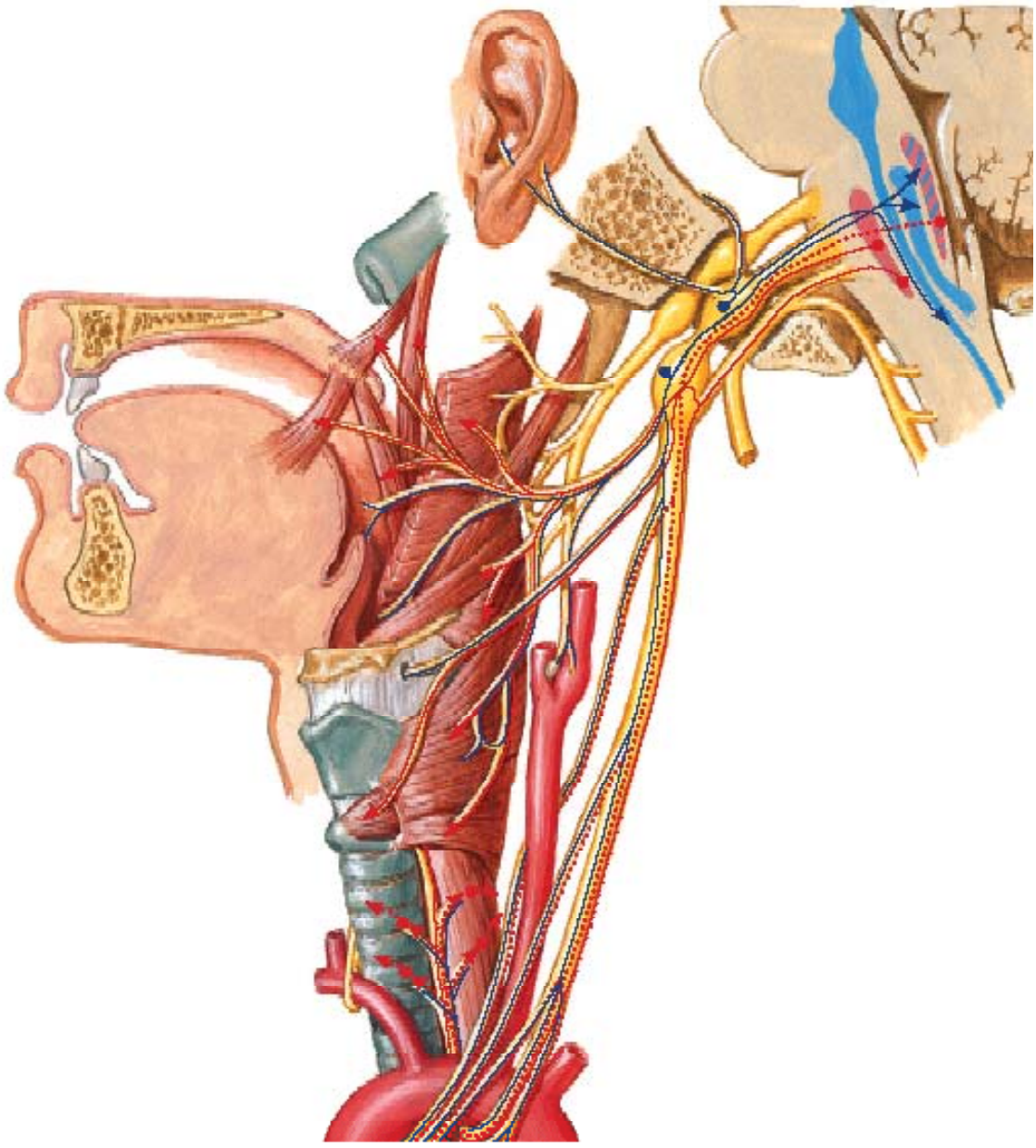
- Stylopharyngeus
- CN IX
- Stylohyoid ligament

Between middle and inferior pharyngeal constrictors

- Internal laryngeal nerve on route to larynx
- Superior laryngeal artery and vein on route to larynx

Below inferior pharyngeal constrictor

- Recurrent laryngeal nerve
- Inferior laryngeal artery



G22: Larynx

At the end of this lecture, students should be able to master the following:

1) Cartilages

Describe the location and relation between the cartilages of the larynx

Thyroid

Cricoid

Arytenoid - identify the vocal process and muscular process

Corniculate

Epiglottis

Movements of the laryngeal cartilages

Arrows on the illustration indicate the directions of movement in each joint.

The thyroid cartilage can tilt relative to the cricoid cartilage in the cricothyroid joint

The base of the arytenoid cartilage on each side can transfer or rotate relative to the upper edge of the cricoid cartilage at the cricoarytenoid joint

The arytenoid cartilages move during talking

2) Folds of the Larynx

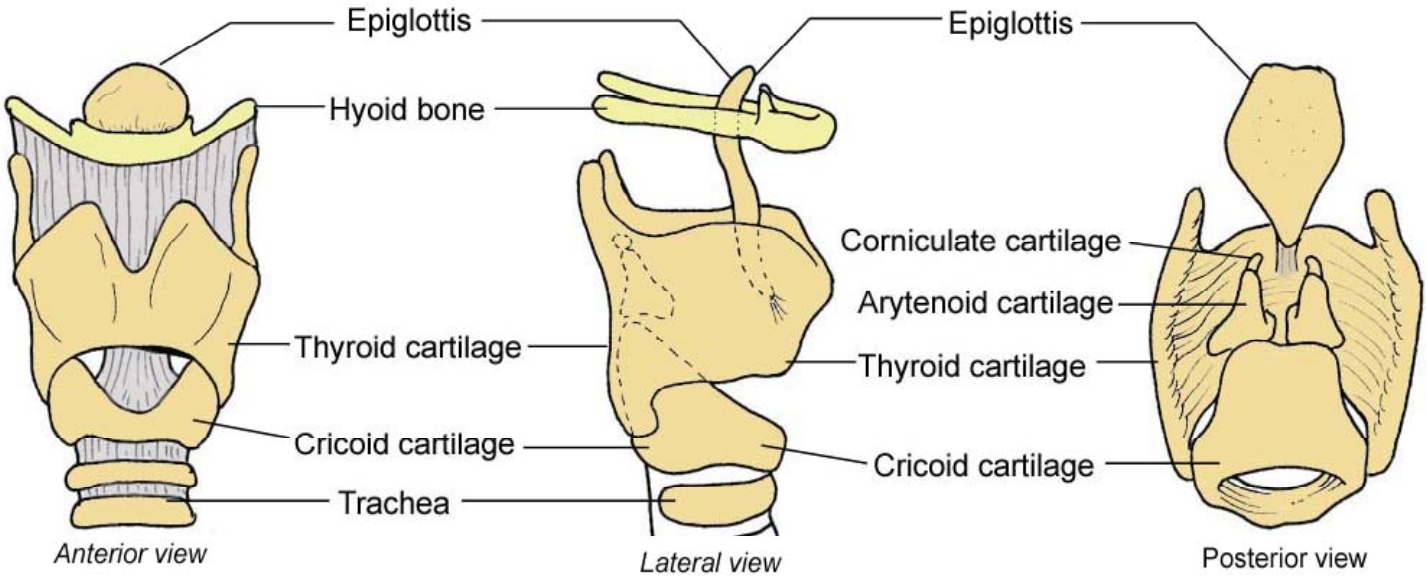
Describe the location, anatomical contents and relations of the following folds of the larynx

Aryepiglottic fold - formed by the aryepiglotticus muscles and overlying mucosa; create the lateral borders of the laryngeal inlet

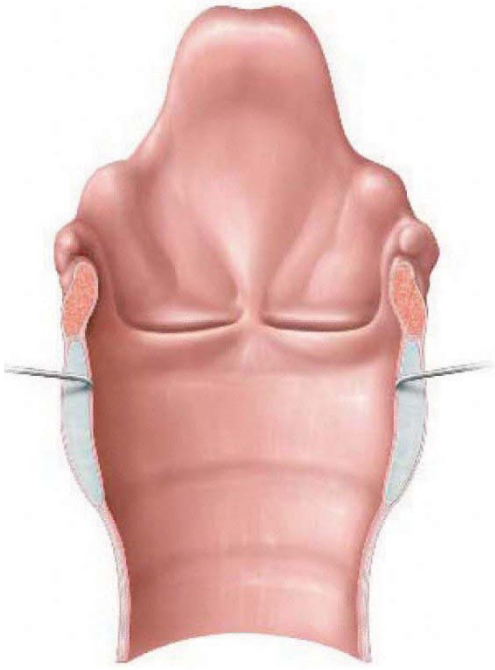
Vestibular folds - formed by the vestibular ligament and overlying mucosa; creates the boundary between the vestibule and the ventricle, also the rima vestibuli between the two vestibular folds

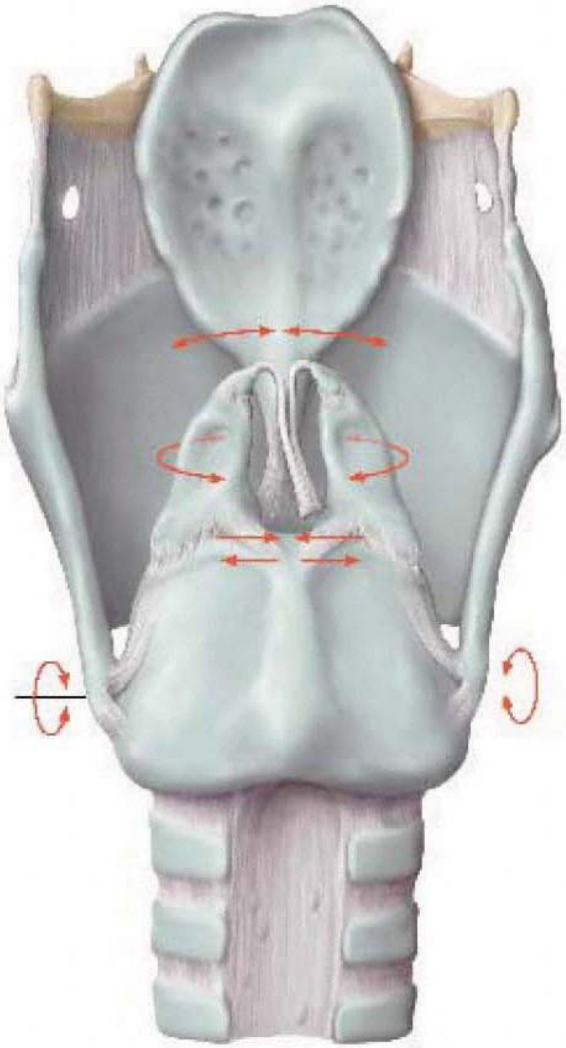
Laryngeal ventricle - expanded region of mucosa between the vestibular and vocal folds

Vocal folds - formed by the vocal ligament and overlying mucosa, creates the boundary between the vestibule and the infraglottic space, also rima glottidis between the two volds



Cartilage skeleton of the larynx





3) Muscles of the Larynx

Extrinsic muscles

Sternothyroid m. - depresses larynx; C2 and C3 spinal nerves via ansa cervicalis

Thyrohyoid m. - elevates larynx; C1 spinal nerve

Intrinsic muscles

Posterior cricoarytenoid m. - aBDucts vocal cords; recurrent laryngeal n. (CN X)

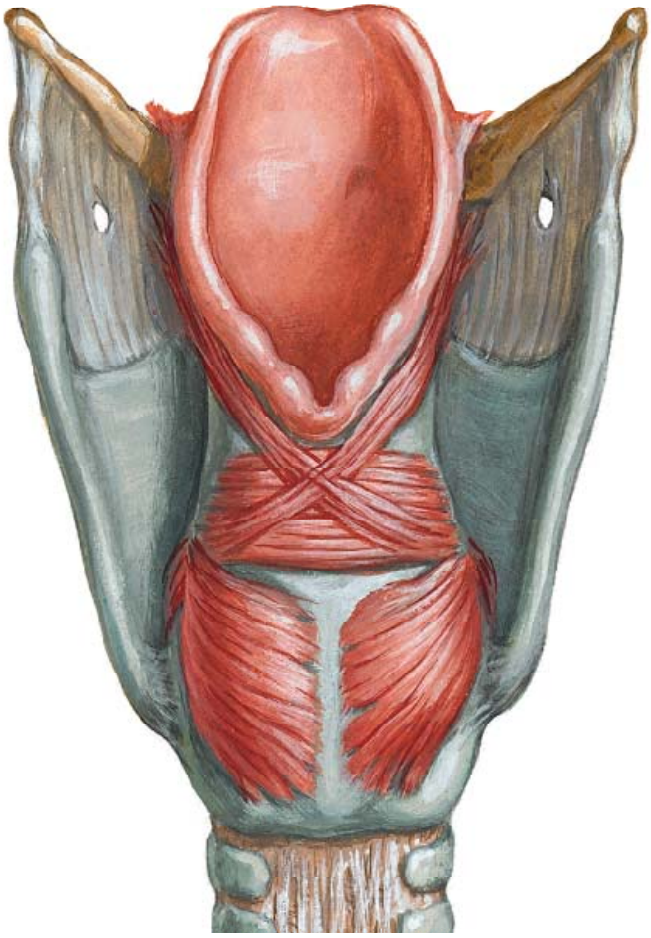
Lateral cricoarytenoid m. - aDDucts vocal cords; recurrent laryngeal n. (CN X)

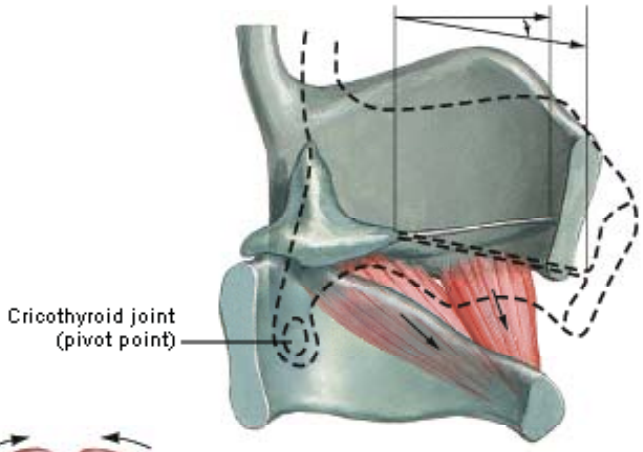
Cricothyroid m. - tighten vocal cords; external laryngeal n. (CN X)

Thyroarytenoid m. - shortening/relaxing vocal cords; recurrent laryngeal n. (CN X)

Transverse/oblique arytenoid mm. - aDDuct vocal cords to close the glottis; recurrent laryngeal n. (CN X)

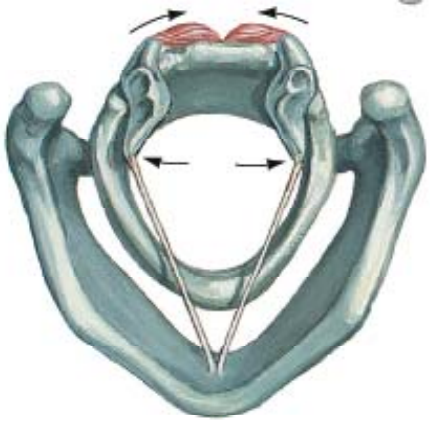
Vocalis m. - tensing and relaxing vocal cords; recurrent larngeal n. (CN X)



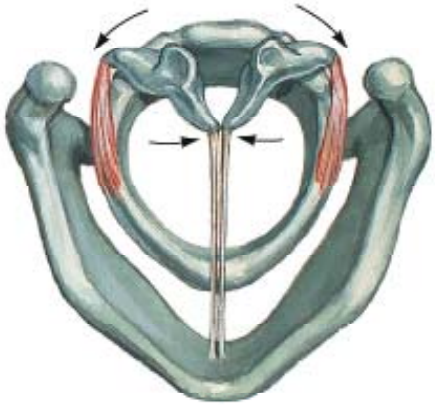


Cricothyroid joint
(pivot point)

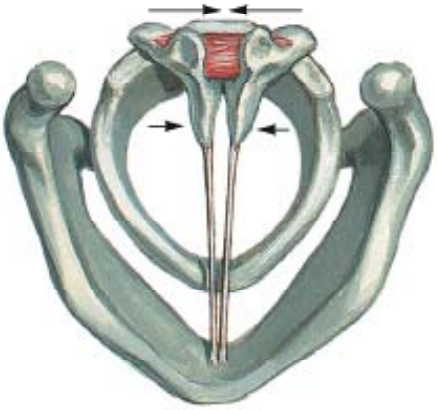
Action of cricothyroid muscles
Lengthening (increasing tension)
of vocal ligaments



Action of posterior cricoarytenoid muscles
Abduction of vocal ligaments



Action of lateral cricoarytenoid muscles
Adduction of vocal ligaments



Action of transverse arytenoid muscle
Adduction of vocal ligaments

Action of vocalis and thyroarytenoid muscles
Shortening (relaxation) of vocal ligaments

3) Vascularization of the Larynx

External carotid artery - superior thyroid a. - superior laryngeal a. - perforates thyrohyoid membrane to enter the larynx

Subclavian artery - thyrocervical trunk - inferior thyroid a. - enters larynx below inferior pharyng. constr.

4) Innervation of the Larynx

Vagus n. (CN X)

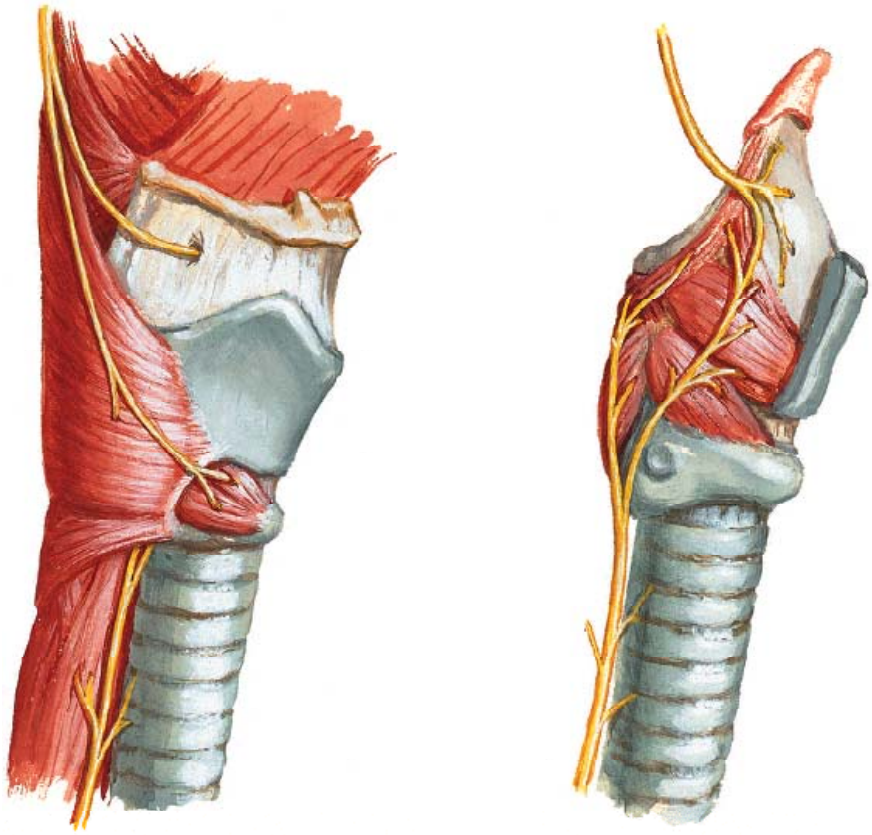
Superior laryngeal n. (branches off of the inferior vagal ganglion)

- External laryngeal n.: BM to cricothyroid m.
- Internal laryngeal n.: perforates thyrohyoid membrane and provides GS to laryngeal mucosa above vocal folds

Recurrent laryngeal n.

- Right: loops under the right subclavian artery
- Left: loops under the aortic arch

Both recurrent laryngeal nerves ascend between the esophagus and trachea, and enter the larynx below the inf phar const.; supply BM to all laryngeal muscles (except the cricothyroid m.); provide VS and VM below the vocal folds



G23: Ear

At the end of this lecture, students should be able to master the following:

1) External Ear

Auricle

Concha, tragus, antitragus, lobule, concha, antihelix, scaphoid fossa, helix, triangular fossa

External acoustic meatus

Tympanic membrane

Innervation of external ear (GS)

Great auricular n. (cervical plexus)

Auriculotemoral n. (CN V-3)

Facial n. (CN VII)

Vagus n. (CN X)

2) Middle Ear

Contents

Internal surface of tympanic membrane (GS via CN IX)

Ossicles (malleus, incus, stapes)

Muscles - stapedius m. (CN VII) and tensor tympani muscle (CN V-3)

Trace the chorda tympani and tympanic plexus through middle ear

Auditory tube - innervated by CN IX GS

3) Inner Ear

Cochlea - sound division (SS CN VIII) and Vestibule - equilibrium (SS CN VIII)