



**Booster Prep**

INBDEBooster



INBDE Study Notes

# Head & Neck Anatomy

These notes contains high-yield information that can appear on the 2024 INBDE. For more notes like this, visit [BoosterPrep.com/INBDE](https://BoosterPrep.com/INBDE).

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# Embryology

Head and Neck Anatomy is one of the least tested topics on the INBDE. In this series, we will review high-yield head and neck anatomy topics that are commonly tested on the exam. Since this is not a heavily tested topic, we recommend focusing on the key concepts instead of memorizing every detail.



## 1 The Embryo

### Week 3

Week 3 is crucial for the embryo through because of gastrulation and the development of the pharyngeal arches

- **Gastrulation** - formation of the **ectoderm**, **mesoderm** and **endoderm**.

The three germ layers form different parts of the body.

- **Ectoderm:**

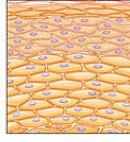
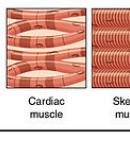
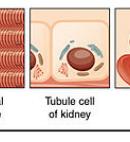
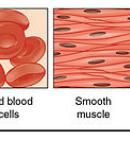
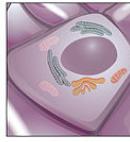
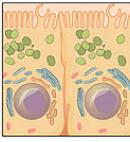
- epidermis, facial skeleton, nervous system
- teeth
- Enamel derived from surface ectoderm
- Majority of tooth derived from neural crest cells

- **Mesoderm:**

- Forms "structural components" of the body like the skeletal system, muscular system, and connective tissue

- **Endoderm:**

- lining of the foregut, midgut and hindgut

Germ Layer	Gives rise to:					
Ectoderm	Epidermis, glands on skin, some cranial bones, pituitary and adrenal medulla, the nervous system, the mouth between cheek and gums, the anus	 Skin cells	 Neurons	 Pigment cell		
Mesoderm	Connective tissues proper, bone, cartilage, blood, endothelium of blood vessels, muscle, synovial membranes, serous membranes lining body cavities, kidneys, lining of gonads	 Cardiac muscle	 Skeletal muscle	 Tubule cell of kidney	 Red blood cells	 Smooth muscle
Endoderm	Lining of airways and digestive system except the mouth and distal part of digestive system (rectum and anal canal); glands (digestive glands, endocrine glands, adrenal cortex)	 Lung cell	 Thyroid cell	 Pancreatic cell		

The three germ layers and their differentiation options

### Pharyngeal arches

**Pharyngeal arches** are visible outpouchings that are the precursors to various head and neck structures.

- Have distinct anatomical features:

- **Endodermal pouch**

- **Mesenchymal core**

- Mesoderm
- Neural crest
- Artery
- Nerve
- Muscle
- Cartilage

- **External ectodermal cleft**

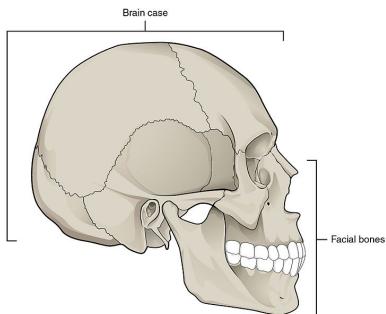
# Bones of the Skull

## 1 Overview of the Skull

There are two main components of the skull:

- **Neurocranium** - brain case
- **Viscerocranium** - facial bones

**Sutures** are fibrous joints that join the numerous skull bones.



Two major regions of the Skull

## The neurocranium

8 bones in total and Two major subdivisions:

- **Roof:** protects the brain superiorly and posteriorly
  - frontal, parietal, and occipital bones
- **Base:** protects the brain inferiorly
  - frontal, ethmoid, sphenoid, temporal, parietal, and occipital bones

## The Viscerocranium

Includes 14 bones and functions to:

- Support the soft tissues of the face
- House and protect numerous key areas
  - sinuses, nasal and oral cavities, and even the orbits
- Includes maxilla, zygomatic, lacrimal, nasal, palatine, ethmoid (superior and middle nasal conchae), inferior nasal conchae, mandible, and vomer

## 2 Features

### Fontanelles

**Fontanelles** - membranous spaces that result from the incomplete fusion of skull bones.

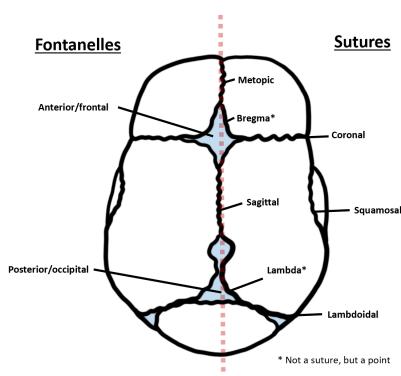
### Sutures

When the fontanelles fuse, **sutures** form.

Unlike the cartilaginous tissue of the fontanelles, the sutures are made up of fibrous tissue, and form immovable joints. Sutures usually close within 20 years after birth.

There are 5 different types

- **Frontal/metopic suture**
- **Sagittal suture**
- **Coronal suture**
- **Lambdoid suture**
- **Squamous suture**

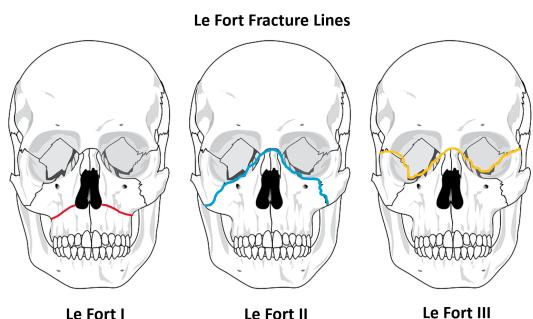


The fontanelles and sutures of the developing skull

Birth defects may arise when the fontanelles prematurely close. This is called **craniosynostosis**, where brain growth exceeds growth of the skull.

### Lines

- **Principles lines of force** are vertical lines , represent strongest regions of the skull
  - adaptions resulting from local vertical mechanical stressors such as mastication
- **Principle lines of fracture (Le Fort fracture lines)** are more horizontally oriented lines , represent the weakest regions of the skull
  - more commonly susceptible to fracture

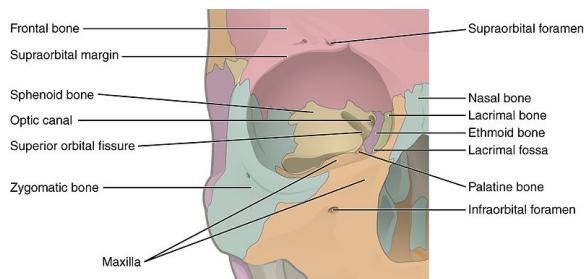


The principle lines of fracture

## 2 Bones and Regions of Interest

### Orbital bones

There 7 bones of the orbit. These include the frontal, palatine, maxillary, lacrimal, ethmoid, sphenoid, and zygomatic bones



The bones that comprise the orbit

- Note that the nasal bone is **NOT** included here.

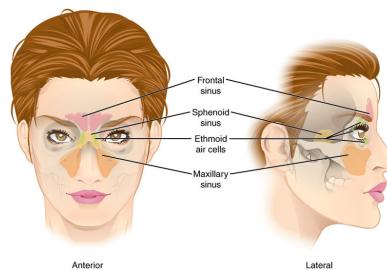
### Sinuses

The **sinuses** branch off from the lateral nasal wall and into select bones in the surrounding area. They have numerous functions:

- "Air pockets" that reduce weight of skull
- Impact voice resonance
- Dampen intranasal pressure
- Humidifying and warm air during inspiration
- Increase surface area for olfaction

The frontal, ethmoid, sphenoid and maxilla bones give rise to their respective sinuses.

- Frontal and maxillary sinuses develop after birth
- Ethmoid sinuses begin as ethmoid cells filled with air at birth

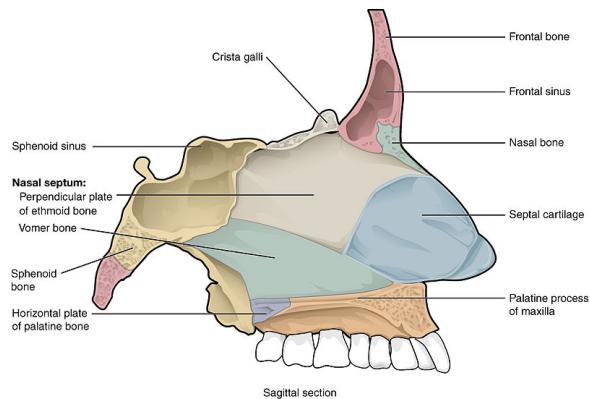


4 different sinuses and their locations

### The nasal septum

The nasal septum is a physical barrier between the left and right nasal passageways. There are three main parts, the **septal cartilage**, the **perpendicular plate of the ethmoid bone**, and the **vomer bone**.

**INBDE Pro Tip:** The components of the nasal septum are high-yield topics for your board exam

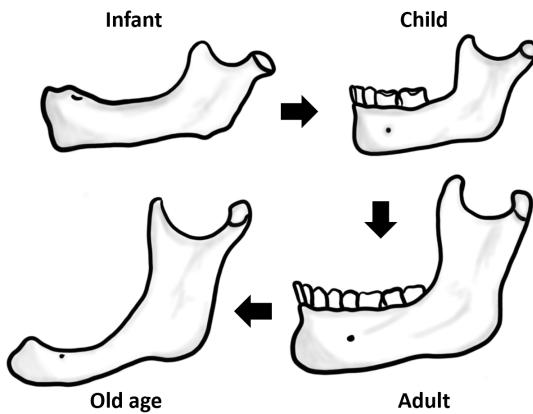


The 3 main parts of the nasal septum

### The mandible

The **angle of the mandible** experiences change as an individual becomes edentulous

- **Edentulous** individuals (ie. those lacking teeth) may occur at any age, but is more common as an individual ages
- ▶ Experience resorption of alveolar process and changes in mental foramen
- ▶ Mandible more closely resembles the mandible at birth
- Obtuse angle of mandible at about 140 to 150 degrees



The age-related changes to the mandibles

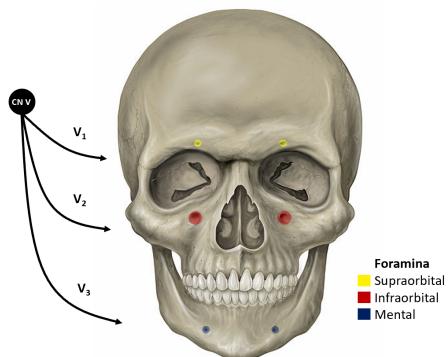
# Foramina of the Skull

## 1 Foramina of the Face

A **foramen** (plural: foramina) is an opening that allows passage of key nerves, arteries and veins.

There are three main regions of the face of importance:

- **Frontal bone:** supraorbital foramen
  - Supraorbital nerve from CN V<sub>1</sub>, artery and vein
- **Maxilla:** contains the **infraorbital foramen** located below each orbit
  - Infraorbital nerve from CN V<sub>2</sub>, artery and vein
- **Mandible:** mental foramen
  - Mental nerve from CN V<sub>3</sub>, artery and vein



Three major foramina of the face

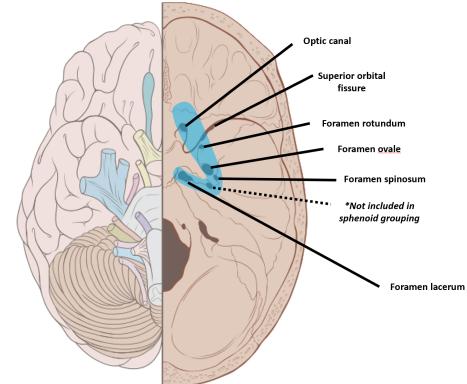
There are foramina for each branch of the trigeminal nerve (CN V).

## 2 Foramina of the Skull Base

### Sphenoid bone

Located posteriorly to the ethmoid and frontal bones. Two foramen are of special importance for the CNV

- **Foramen rotundum:** contains **CN V<sub>2</sub>**
- **Foramen ovale:** contains **CN V<sub>3</sub>, lesser petrosal nerve**



The foramina of the skull within the sphenoid bone

# Fascial Space Infections

## 1 Introduction to fascia

**Fascia** is a thin collection of fibrous tissues that surrounds and encases the body's organs, vasculature, bones, nerves, and muscles.

Three types:

- **Superficial fascia** – loose connective tissue
- **Deep fascia** – surrounds bones, nerves, muscles, and vasculature
- **Visceral fascia** – surrounds internal organs

### Cervical fascia

There are two types in the neck:

- **Superficial cervical fascia** – found between the dermis and the deep cervical fascia
  - ▶ Contains platysma muscle, cutaneous nerves and vessels, lymph nodes, and fat
- **Deep cervical fascia** – deep to the superficial cervical fascia and is comprised of four main layers:
  - ▶ **Investing layer**
  - ▶ **Pretracheal layer**: found in anterior neck
    - **Muscular part**: infrahyoid muscles
    - **Visceral part**: encases the trachea, esophagus, and thyroid gland
      - contributions from the **buccopharyngeal fascia**
  - ▶ **Prevertebral layer**:
    - Surrounds the brachial plexus and subclavian artery
  - ▶ **Carotid sheath**: contains the common and internal carotid arteries, CN X, internal jugular vein, sympathetic nerve fibres, and lymph nodes

## 2 Fascial Spaces and Infection Introduction

### Fascial spaces overview

**Fascial spaces** are possible regions for infection, that would not otherwise be present in a healthy person. There are two main types

- **Primary spaces**: can be directly infected from periapical or periodontal infection
  - ▶ **Perimandibular spaces**:
    - Submandibular
    - Submental
    - Sublingual
  - ▶ Buccal, Canine and Vestibular
- **Secondary spaces**: can be infected from another fascial region (either primary or secondary)
  - ▶ **Masticator space**:
    - Superficial and deep temporal
    - Infratemporal space
    - Submasseteric
    - Pterygomandibular
  - ▶ **Deep spaces of the neck**:
    - Parapharyngeal
    - Lateral pharyngeal
    - Retropharyngeal
    - Prevertebral
    - Danger space
  - ▶ **Periorbital**

### Cardinal signs of infection

There are **five cardinal signs of infection**

- **Rubor/redness**
- **Calor/heat**
- **Tumor/swelling**
- **Dolor/pain**
- **Functio laesa/loss of function**
  - ▶ Within the context of dentistry, may be **dyspnea** (difficulty breathing), **dysphagia** (difficulty swallowing), **trismus** (lock-jaw) etc.

### Vital signs of infection

The main vitals signs to look out for include:

- **Elevated temperature** >100 °F
- **Elevated heart rate/pulse** >100 bpm
- **Elevated blood pressure** >120/80
- **Elevated breathing/respiratory rate** >16 rpm
- Abnormal size of lymph nodes/  
lymphadenopathy

## 3 Differentiating the Fascial Spaces

### Vestibular Space

The **vestibular space** can be found between the mucoperiosteum of a tooth and the cortical bone.

- most common region for dental infections to spread from alveolar bone.

### The canine/infraorbital space

This space is found within the canine fossa

- Infection via **maxillary canines**
- Infections may present as swelling of upper lip, anterior cheek, vestibule, nasolabial folds, and in more serious cases, the lower eyelid.

### The periorbital space

Its close proximity to the eye can lead to eyelid edema and impaired vision.

- may become infected as a result of a primary infection in the canine space

### The buccal space

The buccal space is found between the buccinator muscle and skin of the face.

- Infection = swelling of the lip(s) and cheek
- May be caused by infected **premolars or molars**

### The sublingual space

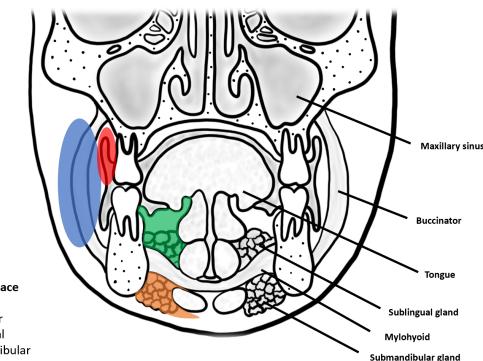
Found laterally to muscles of the tongue and lingual region of the body of the mandible.

- Infection caused by infected sublingual gland or periapical infection from mandibular teeth whose roots are located **superior** to the mylohyoid muscle attachment
- Edema → may elevate + protrude tongue; speech may also be affected

### The submandibular space

This space is located on the inferior aspect of the mandible

- Infection may be from periapical regions of molar teeth found **inferior** to the mylohyoid muscle attachment



A coronal section of the skull displaying various fascial spaces

### The submental space

Can form from infection of anterior mandibular teeth

- Infection → swelling of the chin, and potentially difficulty swallowing

### Clinical importance of perimandibular spaces

The three perimandibular spaces include the submandibular, submental, and sublingual spaces. **Ludwig's angina** is an infection and subsequent swelling of these three regions. It can be described as follows:

- The infection spreads from the sublingual region in a posteroinferior direction
  - ▶ Floor of mouth is raised
  - ▶ May spread to epiglottis and vocal cords
    - drooling, difficulty speaking, and difficulty breathing

### The superficial and deep temporal spaces

**Superficial temporal space** - between the temporal fascia and the temporalis muscle

- formed via infected upper third molars.

**Deep temporal space** - located between the temporalis muscle and the skull.

- source of infection same as the superficial region

### The infratemporal space

May also be called the **infra-temporal portion** of the deep temporal space.

- Lateral to the lateral pterygoid plate, inferior to the base of the skull, and superior to the lateral pterygoid muscle.
- Contains maxillary artery branches and pterygoid venous plexus

### The submasseteric/masseteric space

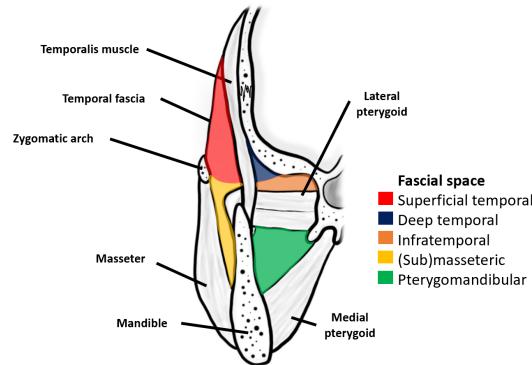
The **submasseteric** or otherwise known as the **masseteric space** is found between the mandible and the masseter muscle. May be infected due to lower third molars that are **buccally** placed.

- May cause swelling at the angle of the mandible and trismus

### The pterygomandibular space

This space is located lateral to the medial pterygoid muscle, and medial and superior to the mandible, and inferior to the lateral pterygoid.

- many key structures reside within it and is relevant for procedures like IAN block
- Contains the inferior alveolar nerve and artery, lingual nerve, sphenomandibular ligament, and the interpterygoid fascia
- May be infected due to lower third molars that are buccally placed or contaminated needle during an IAN block
- May present clinically as trismus, dysphagia, and swelling of the anterior retromolar area



Fascial spaces associated with muscles of mastication

### Clinical importance of the masticator space

Recall that the four components of this space include the submasseteric, pterygomandibular, temporal, and infratemporal spaces.

- Contains major structures, such as the muscles of mastication (see section on this for more information), ramus and body of the mandible, CN V<sub>3</sub>, inferior alveolar nerve, artery and vein, as well as the pterygoid venous plexus

### The parapharyngeal space

The **parapharyngeal space** forms a ring around the pharynx

- Contains lateral pharyngeal and retropharyngeal spaces
- pathway for the spread of infection from the facial region → neck and mediastinum

### The lateral pharyngeal space

Lateral to the pharynx and forms an inverted pyramid at the base of the skull with its apex at the hyoid bone.

- Infection may be caused by the lower third molars, pterygomandibular or submandibular spaces, in addition to the tonsils
- Difficulty opening mouth, dysphagia, or difficulty rotating the neck **contralaterally**

### The retropharyngeal space

This space is found anterior to the alar fascia and posterior to the buccopharyngeal fascia.

- superior border = base of the skull
- inferior border = superior **mediastinum**.
- Infection is dangerous, high risk of infection spread
- danger space/area is deep to this region

### The danger space/area

Infection in this region provides an easy outlet for further infection in the thorax.

- Deep to the retropharyngeal space, and superficial to the pretracheal space
- inferior border = mediastinum
  - infection spread quickly and easily from pharynx → mediastinum & its contents

### The prevertebral space

The prevertebral space is bordered by the following

- anteriorly = danger space
- inferiorly = superior **mediastinum** and as far as the coccyx.
- Contents include longus colli and longus capitis muscles, scalene muscles, vertebral artery and vein, phrenic nerve, and the brachial plexus in part

4

## Treatment

Various treatment options exist for fascial space infections. A few potential treatments could include:

- **Incision and drainage**
- **Extraction or pulpectomy** for odontogenic causes
- **Antibiotics**

# The Cranial Nerves

## 1 Nervous system structure

### Overview

The nervous system can be divided into the **central nervous system (CNS)** and **peripheral nervous system (PNS)**.

The CNS is comprised of the brain and the spinal cord. The **spinal cord** relays voluntary movements, conducts **sensory information** to the brain and motor information away from the brain.

The PNS is an extension of the brain and spinal cord in body. Its **sensory component** can be broken into:

- **Somatic**
  - **General**: pain, heat, touch, pressure, body position
  - **Special**: vision, hearing, balance
- **Visceral**:
  - **General**: pain or reflex sensations
  - **Special**: smell and taste

Its motor component can be broken into:

- **Somatic**:
  - Voluntary motor control of muscles
- **Visceral or autonomic nervous system (ANS)**:
  - Actions under involuntary control like heartbeat, pupil constriction etc.
  - **Sympathetic nervous system (SNS)**: fight or flight
  - **Parasympathetic nervous system (PSNS)**: rest and digest

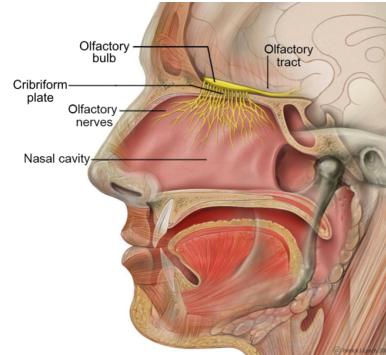
Sympathetic fibers tend to have **short preganglionic fibers** and **long postganglionic fibers**. In contrast, the parasympathetic system has **long preganglionic fibers**, and **short postganglionic fibers**, where they synapse closer to their effector organs. This is because they tend to have more localized effects.

The parasympathetic system is more relevant to some of the cranial nerves. There are 12 cranial nerves in total.

**INBDE Pro Tip:** There are different ways to remember the cranial nerves by grouping:

- CNs I, II, and VIII - all special sensory cranial nerves (smell, vision, balance, and hearing, respectively)
- CNs III, IV, and VI - muscles that move the eye
- CNs V, VII, IX, and X - numerous important branches and innervate many key structures; thus, they have both sensory and motor components
- CNs XI and XII - only move a few muscles each

#	Name	Name Mnemonic	Function	Function Mnemonic
I	Olfactory	Oh	Sensory	Some
II	Optic	Oh	Sensory	Say
III	Oculo-motor	Oh	Motor	Marry
IV	Trochlear	To	Motor	Money
V	Trigeminal	Touch	Both	But
VI	Abducens	And	Motor	My
VII	Facial	Feel	Both	Brother
VIII	Vestibulo-cochlear	Very	Sensory	Says
IX	Glossopharyngeal	Green	Both	Big
X	Vagus	Vegetables	Both	Brains
XI	(Spinal) Accessory	A	Motor	Matter
XII	Hypoglossal	H	Motor	More



## The olfactory nerve and its path

### CN II (Optic nerve)

The **optic nerve** is related to the eyes and is crucial for vision.

- **Function:** Vision
  - **Pathway:**
    - ▶ Retina --> optic nerve --> optic chiasma ("crossing" of visual information across hemispheres) --> lateral geniculate bodies --> occipital lobe

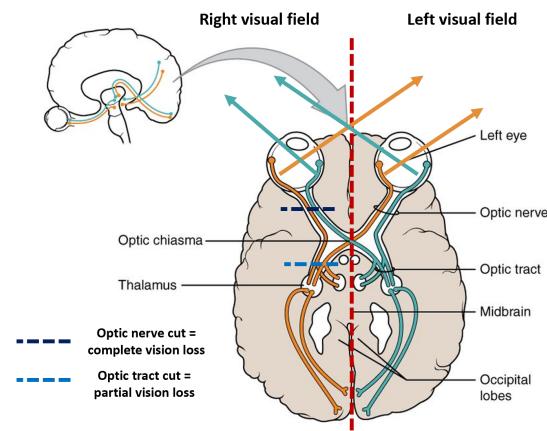
The eyes can receive visual information from the medial and lateral aspects of the eyes. The **left visual field** is sensed by the medial aspect of the left eye, and the lateral aspect of the right eye. The **right visual field** is sensed by the medial aspect of the right eye, and the lateral aspect of the left eye.

## 2 Cranial nerves I and II

## CN I (Olfactory nerve)

The **olfactory nerve** is related to the nasal cavity in terms of its course and function.

- **Function:** Smell
  - **Pathway:**
    - ▶ Olfactory nerve endings (pass through crista galli of ethmoid bone) --> olfactory bulb --> olfactory tract --> primary olfactory cortex in temporal lobe



## The pathway and clinical application of the optic nerve

Depending on where an injury, lesion, or tumor may arise on the optic nerve pathway, visual outcomes differ. For example:

- **Optic nerve cut:**

- ▶ Complete vision loss = unable to see both fields of vision in one eye
  - Ex. optic nerve cut on right side means left and right visual fields in that eye are affected

- **Optic tract cut:**

- ▶ Partial vision loss = loss of visual field on contralateral (opposite) side of lesion in both eyes
  - Ex. a cut of the right optic tract means left visual field on both eyes affected

### 3 Cranial nerves III, IV, VI

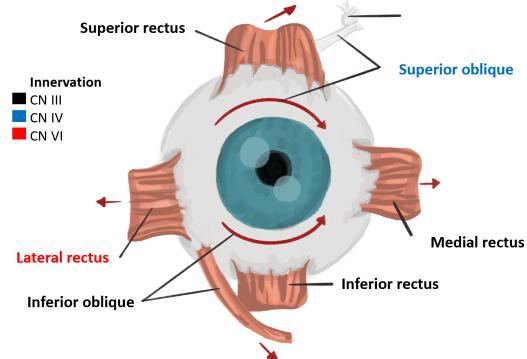
#### Overview

The extraocular eye muscles are controlled by: **the oculomotor (CN III), trochlear (CN IV), and abducens (CN VI)**. These muscles are discussed in more detail in their own section of the notes.

- **Function:** Moves the eye

- \*CN III also constricts the pupils via PSNS fibers to smooth muscles in the

Cranial nerve	Secretion
CN III: Oculomotor	Levator palpebrae superioris* Superior rectus Inferior rectus Medial rectus Inferior oblique
CN IV: Trochlear	Superior oblique
CN VI: Abducens	Lateral rectus



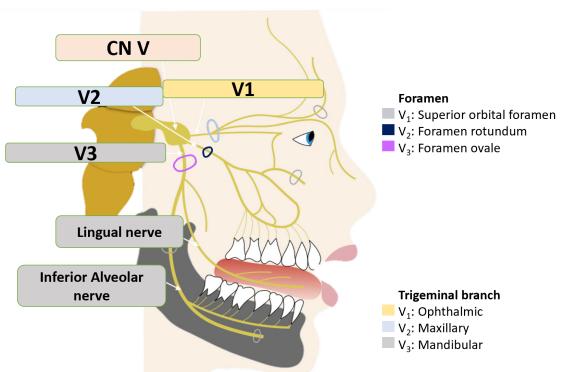
The extra ocular muscles and their innervation

### 4 Cranial nerve V

#### Overview

The trigeminal nerve has three major branches relevant to the face, glands, and muscles of mastication.

The three branches of CN V are the **ophthalmic (CN V<sub>1</sub>)**, **maxillary (CN V<sub>2</sub>)**, and **mandibular (CN V<sub>3</sub>)**. These branches course through the superior orbital fissure, the foramen rotundum, and the foramen ovale,



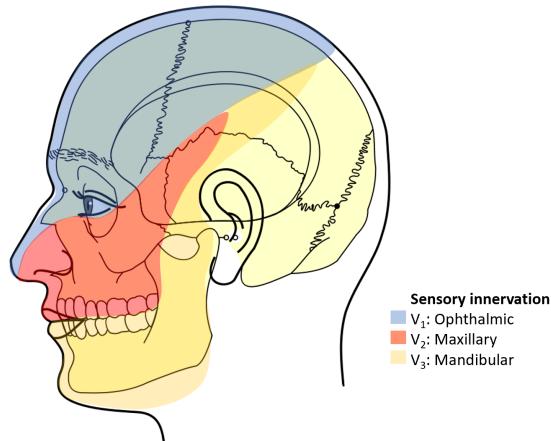
The branches of the trigeminal nerve

respectively.

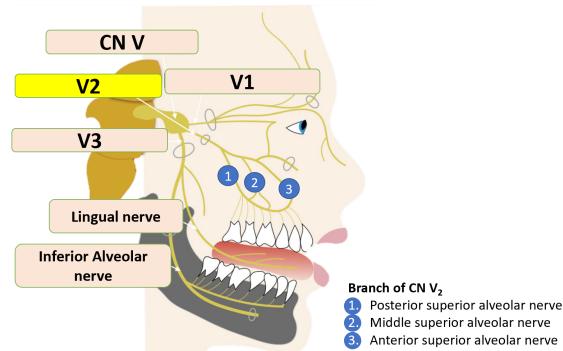
#### CN V<sub>1</sub>

The ophthalmic branch is related to the eye and upper scalp regions.

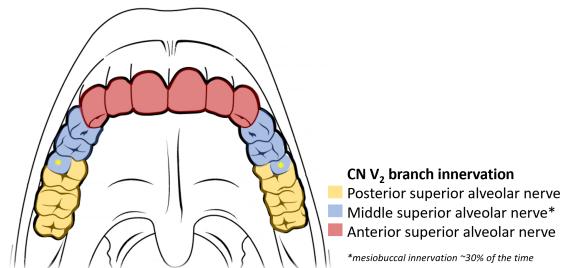
- **Regions:** Forehead, scalp, upper conjunctiva, frontal and ethmoidal sinuses,



The sensory innervation of the trigeminal branches



The superior alveolar nerve branches of CN V<sub>2</sub>



The superior alveolar nerve branch innervation of maxillary teeth

## CN V<sub>2</sub>

The maxillary branch is related to the infraorbital and maxillary regions.

- Modality:** Sensory

- Regions:**

- Inferior eyelid, anterior cheek, palate, maxillary teeth, maxillary sinus, lower eyelid, lateral nose, upper lip

The maxillary branch also has three important including the **posterior**, **middle**, and **anterior superior alveolar nerves**.

- Posterior superior alveolar nerve**

- Innervates maxillary sinus, gingiva, and cheek
- Innervates upper molar teeth (1st, 2nd, 3rd) except mesiobuccal root of 1st molar about 30% of the time

- Middle superior alveolar nerve**

- Innervates maxillary sinus, gingiva, and cheek
- Innervates upper premolar teeth (1st and 2nd) and mesiobuccal root of 1st molar about 30% of the time

- Anterior superior alveolar nerve**

- Innervates the maxillary sinus
- Innervates the upper incisors (central and lateral) and canines

## CN V<sub>3</sub>

The mandibular branch is related to many important regions of the oral cavity..

- Modality A: Sensory**

- Regions:**

- Buccal, parotid and temporal regions, anterior 2/3 of tongue, lower lip, mandibular teeth

- Modality B: Motor**

- Regions:**

- The muscles of mastication
  - Temporalis, masseter, medial and lateral pterygoids

## 5 Cranial nerve VII

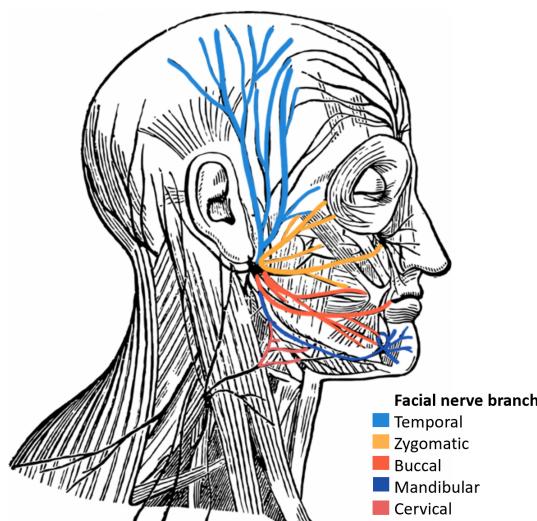
### Overview

- Modality:** sensory and motor

- Function:**

- Four main ones that provide sensory info to ear, palate, and tongue

There are five branches of the facial nerve. They include: Temporal, Zygomatic, Buccal, Mandibular, Cervical



The branches of the facial nerve

#### Somatic motor innervation:

- Muscles of facial expression\*
- Occipital belly of occipitofrontalis
- Stapedius
- Posterior auricular muscles
- Stylohyoid
- Posterior belly of digastric

\*Clinically, damage to the facial nerve may result in weakness or paralysis on one side of the face. This condition is known as **Bell's Palsy**. Symptoms include an inability to close eyes, asymmetrical facial tone, and a sagging face.



Bell's palsy demonstrating facial paralysis of the right side of the face

#### Visceral motor innervation:

Stimulates secretions of the:

- Lacrimal gland
- Sublingual gland
- Submandibular gland
- Nasal, palatine, pharyngeal mucous glands

#### Special sensory innervation:

Receives info from: Ant 2/3 of tongue (taste)

#### Somatic sensory innervation:

Receives info from: External acoustic meatus

## 6 Cranial nerves VIII and IX

#### CN VIII

The **vestibulocochlear nerve** is of lesser importance for the board exam.

- **Modality:** Sensory
- **Function:** Balance and hearing

#### CN IX

The **glossopharyngeal nerve** is involved in numerous pathways, ranging from taste to salivary gland stimulation.

Six main branches:

- Tympanic
- Carotid sinus
- Pharyngeal
- Muscular branch to stylopharyngeus
- Tonsillar
- Lingual

#### Somatic motor innervation:

Stimulates the:

- Stylopharyngeus to widen the pharynx and elevate the larynx during swallowing

#### Visceral motor innervation:

Stimulates the:

- Parotid gland for salivary secretions

**Somatic sensory innervation:**

Receives information from the:

- Middle ear
- Pharynx
- Soft palate
- Tonsils
- Posterior 1/3 of tongue

**Special sensory innervation:**

- Posterior 1/3 of the tongue for taste

## 7 Cranial nerve X

**Overview**

The vagus nerve is also a major cranial nerve in the body because it spans a great distance and is associated with a variety of key organs and organ systems.

**Special sensory:**

Receives information from the:

- Epiglottis for taste

**Somatic sensory:**

Receives information from the:

- Larynx
- Laryngopharynx
- Superficial external ear
- Epiglottis

**Visceral sensory/motor:**

Under PSNS control, the following regions receive fibers from the vagus nerve:

- Heart - Influences heart rate
- Lungs - Influences respiratory rate
- Digestive tract - May promote digestive processes via peristalsis and secretions

**Somatic motor:**

Support swallowing by stimulating the:

- Pharynx
- Larynx
- Soft palate muscles

## 8 Cranial nerves XI and XII

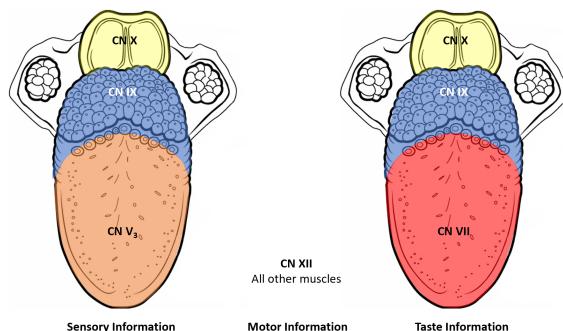
**CN XI**

The (spinal) accessory nerve is not as important as other cranial nerves for the board exam.

- **Function:** Moves the sternocleidomastoid and trapezius

**CN XII**

- **Function:** Moves muscles of the tongue



The innervation of the tongue

# Muscles of Mastication

## 1 Muscles of Mastication Overview

**Mastication** is the act of chewing, where opening and closing of the jaw and associated muscles crush food. Every muscle of mastication is innervated by the **mandibular branch** of the **trigeminal nerve (CN V<sub>3</sub>)**.

**INBDE Pro Tip:** To understand excursion of the mandible, an understanding of contralateral or ipsilateral must also be applied.

- **Contralateral excursion:** the mandible is moving medially
- **Ipsilateral excursion:** the mandible is moving laterally  
Ex. If the left masseter muscle is engaged (ie. unilaterally), ipsilateral excursion will result. This means the jaw will move to the left.

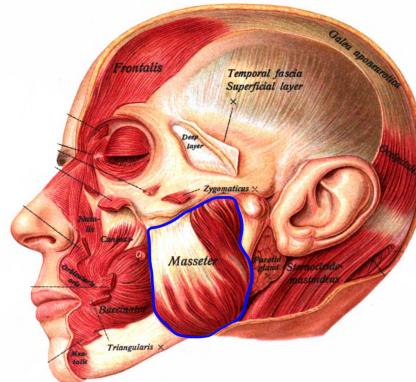
### Muscle description

The **masseter** has a superficial part and deep part. The superficial fibers run obliquely (posteroinferiorly). The deep fibers are vertically oriented, running inferiorly.

- **Innervation:**
  - Masseteric branch of CN V<sub>3</sub>
- **Superficial part:**
  - **Action:** protrudes mandible
- **Deep part:**
  - **Action:** retracts mandible

## 2 The Masseter

- **Action:** elevates mandible, unilateral contraction leads to ipsilateral excursion



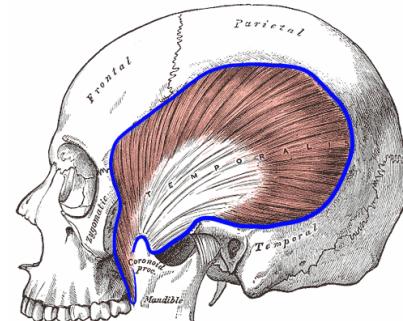
The masseter

## 3 The Temporalis

### Muscle description

The **temporalis** has anterior fibers that run vertically (superiorly), and posterior fibers run obliquely (anteroinferiorly). This muscle is deep to the masseter and zygomatic process.

- **Innervation:**
  - Deep temporal nerve branches of CN V<sub>3</sub>
- **Anterior fibers:** elevate mandible
- **Posterior fibers:** retract mandible



The temporalis muscle

## 4 The Medial Pterygoid

### Muscle description

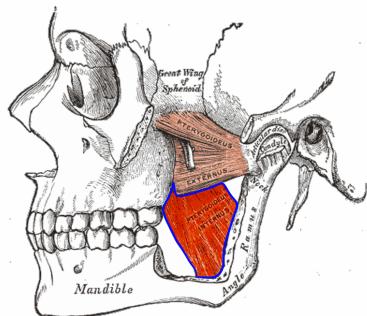
The **medial pterygoid** fibers is found within the infratemporal fossa and has fibres that descend posterolaterally.

- **Innervation:**

- ▶ Pterygoid nerve branches of CN V<sub>3</sub>

- **Action:**

- ▶ elevate and protrude mandible; unilateral contraction → contralateral excursion



The medial pterygoid

## 5 The Lateral Pterygoid

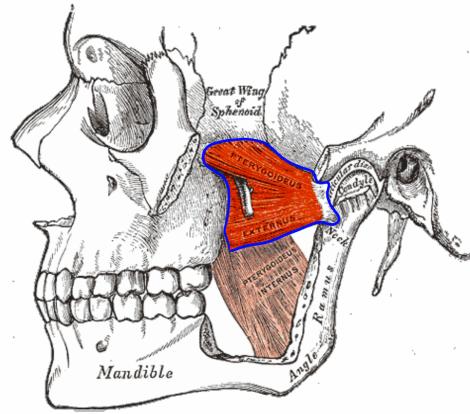
### Muscle description

The **lateral pterygoid** has muscle fibers run horizontally (laterally). Its unilateral action is the same as the medial pterygoid muscle.

- **Innervation:**

- ▶ Pterygoid nerve branches of CN V<sub>3</sub>

- **Action:** depress & protrude mandible; unilateral contraction → contralateral excursion



The lateral pterygoid

# Temporomandibular Joint

## 1 Overview of the TMJ

### Introduction

The TMJ is classified as a **synovial joint** (or **diarthrosis**). Synovial joints are the meeting of bones or cartilage in the presence of a fibrous capsule filled. **Synovial fluid** supports and protects the movement of articulating bones.

The TMJ is unique because it is composed of **hyaline cartilage**, it contains **fibrocartilage** instead. The TMJ is bilaterally located coordinates with the contralateral side to function properly. It contains a **hinging joint (ginglymus)** and a **sliding joint (arthrodia)**. As a result, the TMJ is considered a **ginglymoarthrodial joint**.

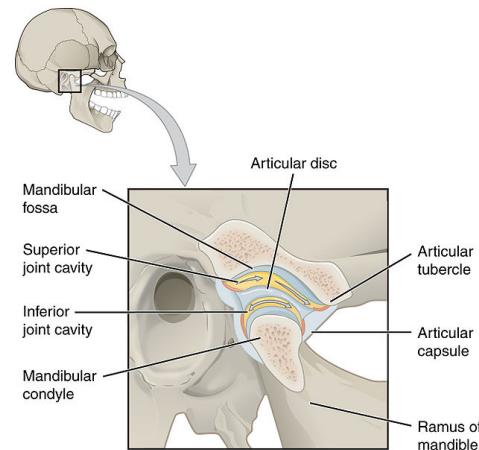
### Articular disc

The **articular disc** is a fibrocartilaginous surface that stabilizes the mandibular condyle, minimizes friction between its articulating surfaces and acts as a shock absorber during movement. It separates the TMJ into a superior compartment and an inferior compartment. It is comprised mainly of **Type I collagen** and has a biconcave shape.

- The **superior compartment** located inferior to the mandibular fossa, superior to the articular disc → **translational movement**
- The **inferior compartment** is inferior to the articular disc, superior to the mandibular condyle → **rotational movement**

### Articular cartilage

Articular surfaces of the mandibular fossa and condyle contain fibrocartilage. The rigidity of the **articular cartilage** is due to the presence of **cartilage-like proteoglycans**.



The temporomandibular joint and its components

### Retrodiscal tissue

The **retrodiscal tissue** is found posterior to the TMJ disc and has three main divisions:

- **Temporal/superior lamina:** connects superior region to temporal bone
  - ▶ Covered in synovial membrane
  - ▶ Contains elastin
- **Intermediate:** contains nerves and blood vessels
- **Condylar/inferior lamina:** connects inferior region to posterior condylar surface
  - ▶ Covered in synovial membrane
  - ▶ Contains collagen

### Synovial membrane

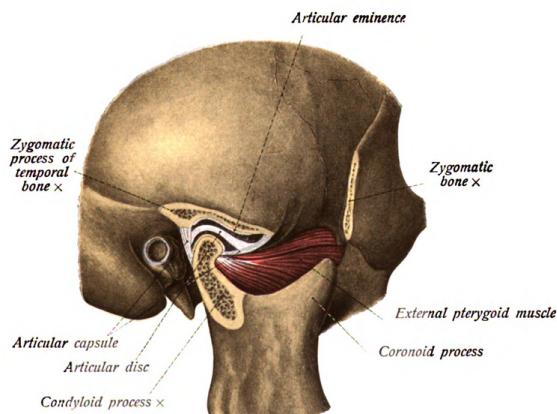
The **synovial membrane** covers the TMJ capsule

- contains **synovial fluid** and vascularized connective tissue
- creates synovial fluid, which reduces friction and provides nutrition to surrounding tissues
- houses macrophage-like cells (immune response)
- synovial fluid contains plasma filtrate, proteins, and mucins

## Bones

The TMJ is an articulation between the temporal bone and the mandibular condyle. Specifically, the mandibular or glenoid fossa and **articular tubercle or eminence** of the **temporal bone**.

Condyles should demonstrate bilateral symmetry. Condyles may be convex, flat, angled, or round. Asymmetrical condylar shapes or drastic changes to condylar shapes may cause **temporomandibular disorders (TMDs)** or signify other health concerns such as arthritis.



The relation of the TMJ to the temporal bone and mandible

## • Stylohyoid ligament

- Attachment of the styloid process to the lesser horn of the hyoid bone
- Contains a small amount of cartilage in the center; **Eagle Syndrome** occurs when this becomes ossified, or may also occur due to an elongated styloid process
  - Pain is experienced in the oropharynx and facial regions

## 3 Neuromuscular supply

### Overview

The TMJ is supplied as follows:

#### • Blood supply:

- Superficial temporal, maxillary, and masseteric arteries

#### • Drainage:

- Pterygoid plexus

#### • Innervation:

- The anterolateral articular aspect of the capsule is supplied by CN V<sub>2</sub>, the masseteric branch
- The lateral aspect of the capsule is supplied by CN V<sub>3</sub>, the auriculotemporal branch

## 2 Ligaments

### Additional ligaments

There are a few other cervical ligaments associated with TMJ region:

- **Pterygomandibular ligament (or raphe)**
  - Thickening of buccopharyngeal fascia
  - Courses from pterygoid hamulus to the posterior aspect of the myohyoid line of the mandible
  - Contacts the buccinator and pharyngeal constrictor muscle
  - Ensures jaw movements are not too excessive

# Muscles of Facial Expression

## 1 Overview

The muscles of facial expression can be grouped into 5 different sections based on their general location and function. They originate from the bone or fascia and insert directly onto the skin. Embryologically, this group of muscles is derived from the same origin, the 2nd pharyngeal arch. As such, all of the muscles are innervated by the **facial nerve (CN VII)**.

## 2 The Orbital Group

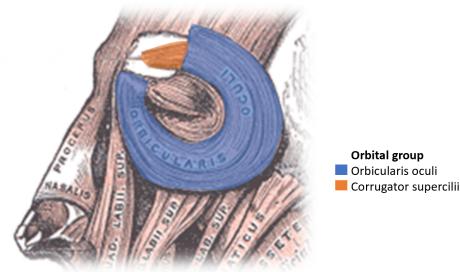
### Orbicularis oculi

This muscle surrounds the orbit of the eye and contains three parts: **orbital**, **palpebral** and **lacrimal**.

- **Action:**
  - **Orbital:** tightly closes eyelids
  - **Palpebral:** gently closes eyelids (fine control)
  - **Lacrimal:** dilates lacrimal sac + compresses lacrimal gland and ducts → tear drainage

### Corrugator supercilii

- **Origin:** frontal bone (superciliary arch)
- **Insertion:** oriented superolaterally towards skin of eyebrows
- **Action:** moves the eyebrows medially → vertically oriented wrinkles on nose bridge



The orbital muscle group

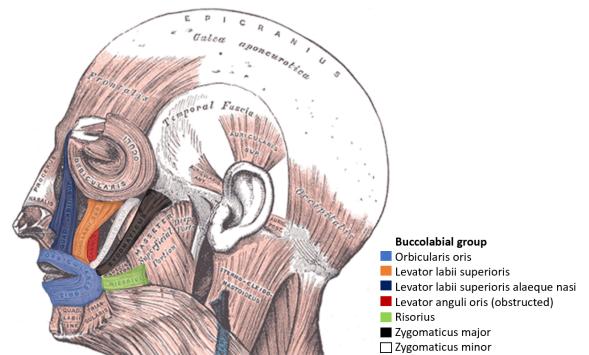
## 3 The Orbicularis Oris

### Orbicularis oris

This muscle is easily identifiable by its circular border around the mouth and lips. It has a **marginal** and **peripheral** portion.

- **Action (both parts):**

- Bilateral contraction closes mouth/lips
- Contraction of individual regions leads to various movements like pouting and puckering
- Important role in shaping the mouth for speech



The buccolabial muscle group

**Depressor labii inferioris**

- **Action:** depression of lip

**Depressor anguli oris**

- **Action:** depresses angle of the mouth, assisting in frowning

**Mentalis**

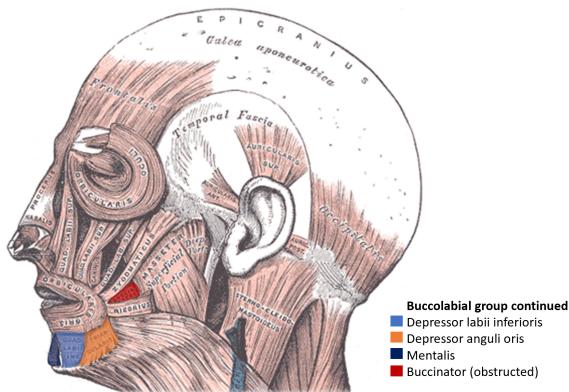
This bilateral muscle is found mirrored across the midline of the face

- **Action:** elevates and wrinkles chin, lower lip "pouts"

**Buccinator**

The buccinator is located deep to the masseter and has three parts, superior/maxillary, inferior/mandibular, and posterior/longitudinal.

- **Origin:**
  - **Superior:** alveolar process of maxilla
  - **Inferior:** buccinator ridge of mandible
  - **Posterior:** anterior margin of the pterygomandibular raphe
- **Insertion:** angle of mouth (modiolus)
- **Action:** facilitates chewing and swallowing by compressing cheeks inward against molars, activated when playing wind instruments (ex. the trumpet) or whistling



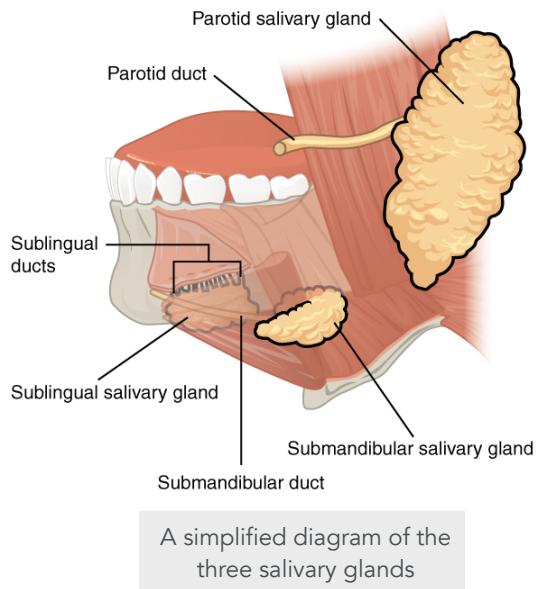
Other muscles with the buccolabial group

# Salivary Glands

## 1 Introduction

### Overview

There are three major salivary glands that will be discussed in this section: the parotid, submandibular, and sublingual glands.



## 2 The Parotid Gland

### Overview

The **parotid gland** is the largest of the three salivary glands. It is located within the retromandibular fossa.

#### • Features:

- Contains a superficial and deep lobe which is separated by the facial nerve (CN VII)
- Contains the facial nerve but does not innervate it!
- External carotid artery
- Retromandibular vein

#### • Secretion:

- predominately serous acini

#### • Innervation:

- Parasympathetic fibers from inferior salivatory nucleus --> **glossopharyngeal nerve (CN IX)** lesser petrosal nerve --> otic ganglion --> auriculotemporal nerve (of CN V<sub>3</sub>)

#### • Duct:

- **Stenson's duct**, near maxillary second molar

## 3 The Submandibular gland

### Overview

When compared with the other two salivary glands, the submandibular gland is the second largest. It is located in the submandibular fossa on the medial aspect of the mandible by the mylohyoid line.

#### • Innervation:

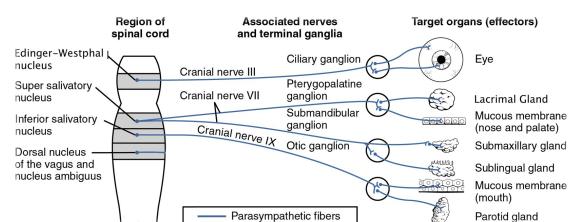
- Parasympathetic fibres from superior salivatory nucleus --> **CN VII** --> chorda tympani --> lingual nerve (of CN V<sub>3</sub>) --> submandibular ganglion

#### • Secretion:

- Mix of both serous and mucous acini
- Produces most of the saliva

#### • Duct:

- **Wharton's duct** on either side of the lingual frenulum



The parasympathetic innervation of the saliva glands and other visceral motor pathways

## 4 The Sublingual Gland

### Overview

When compared with the other salivary glands, the smallest is the **sublingual gland**. It can be found on the floor of the oral cavity between the geniohyoid, hyoglossus, and mylohyoid muscles. It is bordered laterally by the mandible.

- **Features:**

- ▶ Contributes minimally to saliva

- **Innervation:**

- ▶ Parasympathetic fibres from superior salivatory nucleus → **CN VII** → chorda tympani → lingual nerve (of CN V<sub>3</sub>) → submandibular ganglion

- **Secretion:**

- ▶ Contains some mucous and serous acini

- **Duct:**

- ▶ **Bartholin's duct** joins Wharton's duct

Salivary gland	Inner-vation	Duct	Secretion
Parotid	CN IX	Stenson's	Serous
Sub-mandibular	CN VII	Wharton's	Both
Sublingual	CN VII	Bartholin's	Mucous

# Muscles of the Tongue

## 1 Muscles of the Tongue overview

The **muscles of the tongue** are used for speech, manipulating food during mastication, and swallowing. These muscles are innervated by either the **vagus nerve (CN X)** or the **hypoglossal nerve (CN XII)**.

**INBDE Pro Tip:** All the extrinsic muscles of the tongue have a prefix that alludes to its origin, and a suffix that points to its insertion (though non-specific).

## 2 Extrinsic Muscles

### Overview

They are responsible for mass movements of the tongue, and are primarily involved in swallowing and mastication. These muscles include the **genioglossus**, **styloglossus**, **hyoglossus**, and **palatoglossus**.

### Genioglossus

- **Origin:** Mandible (superior mental spine)
- **Insertion:** lingual aponeurosis, body of hyoid bone, dorsum of tongue
- **Action:** protrusion of tongue

### Styloglossus

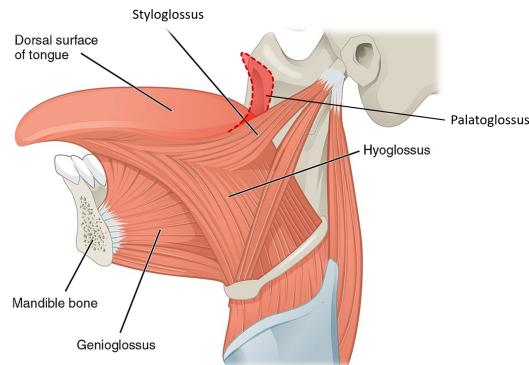
- **Origin:** styloid process, stylomandibular ligament
- **Insertion:** inferior longitudinal muscle, hyoglossus muscle
- **Action:** retraction of tongue bilaterally

### Hyoglossus

- **Origin:** body and greater horn of hyoid bone
- **Insertion:** lateral tongue (inferior aspect)
- **Action:** depression and retraction of tongue

### Palatoglossus

- **Origin:** soft palate (palatine aponeurosis)
- **Insertion:** lateral aspect of tongue
- **Action:** elevation of posterior tongue, closure of oropharyngeal isthmus, maintains palatoglossal arch
- **\*Innervation:** The only muscle of the tongue innervated by the **vagus nerve (CN X)**



The extrinsic muscles of the tongue

# Muscles of the Soft Palate

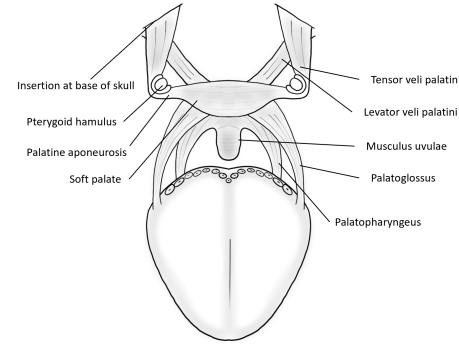
## 1 Overview

The **muscles of the soft palate** combine aponeurotic and muscular tissue to form the **soft palate**. They are important for swallowing and breathing and also contain mucous glands for lubrication of the oral cavity. These muscles are innervated by the **vagus nerve (CN X)**, though the tensor veli palatini is innervated by the **trigeminal nerve (CN V<sub>3</sub>)**.

**INBDE Pro Tip:** For the palatoglossus and palatopharyngeus, the prefix is the origin, and the suffix is the insertion  
 "Levator" means "to raise," "tensor" means "to tense," and veli means a "curtain" or a "veil", and "palatini" refers to the palate

## Palatopharyngeus

- **Action:** tenses soft palate, moves pharynx superoanteriorly and closes larynx during swallowing



The muscles of the soft palate

## 2 Muscles of the Soft Palate

### Levator veli palatini

- **Action:** elevates soft palate during swallowing (prevents food from entering nasopharynx); opens auditory tube opening during swallowing to equalize pressure between the middle ear and pharynx

### Tensor veli palatini

- **Action:** tenses soft palate during swallowing (prevents food from entering nasopharynx); opens auditory tube opening during swallowing to equalize pressure between middle ear and pharynx

### Palatoglossus

- **Action:** depresses soft palate, elevates posterior tongue to facilitate swallowing

# Muscles and Triangles of the Neck

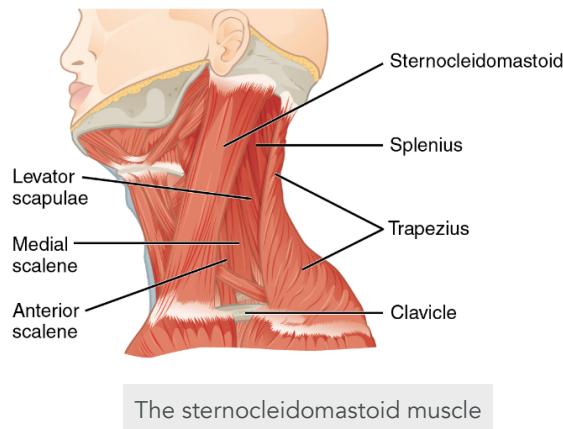
## 1 Introduction to Muscles of the Neck

In total, there are three main types of neck muscle categories: **anterior**, **lateral**, and **posterior**. More focus will be placed on the **anterior neck muscles** for the board exam.

## 2 Sternocleidomastoid Muscle

### Sternocleidomastoid

- **Action:**
  - **Bilateral contraction:** lateral neck flexion ipsilaterally, lateral head rotation contralaterally
  - **Unilateral contraction:** neck flexion
- **Innervation:** spinal accessory nerve (CN IX), spinal nerves C2 and C3



## 3 Suprathyroid Muscles

### Introduction

There are two major groups of muscles called the **suprathyroid** and **infrathyroid muscles** respectively. There are four muscles that comprise the suprathyroid group.

### Geniohyoid

- **Action:** may elevate hyoid bone or depress mandible
- **Innervation:** C1 via the hypoglossal nerve

**INBDE Pro Tip:** All muscles relating to the hyoid bone have an easy way to remember their info.

The **prefixes** of these muscles are their **origin** points, whereas their **suffixes** are their **insertion** points. Since you know the origin points are either above or below the hyoid bone, you now know its general categorization as a **suprathyroid** or **infrathyroid** muscle.

**Suprathyroid muscles** generally elevate the hyoid bone and depress the mandible, whereas **infrathyroid muscles** generally depress the hyoid bone and larynx (which opens the airway).

### Mylohyoid

The floor of the mouth is predominantly formed by this muscle.

- **Action:** elevation of hyoid bone or depression of mandible
- **Innervation:** mandibular nerve (CN V<sub>3</sub>)

### Digastric muscle

This muscle's name translates to "two stomachs" or "bellies"

- **Action:** elevation of hyoid bone and larynx to close epiglottis or depresses mandible
- **Innervation:**
  - **Anterior belly:** branch of CN V<sub>3</sub>
  - **Posterior belly:** branch of CN VII

### Stylohyoid

This muscle is as thin and tubular as its bony origin point.

- **Action:** elevates hyoid bone, retracts tongue, assists inspiration by holding pharynx open
- **Innervation:** facial nerve (CNVII)

Suprahyoid muscle	Function	Innervation
Geniohyoid	elevates hyoid bone or depresses mandible	C1 via CN XII
Mylohyoid	elevates hyoid bone or depresses mandible	CN V <sub>3</sub>
Digastric	elevates hyoid bone or depresses mandible, closes epiglottis	Anterior: CN V <sub>3</sub> Posterior: CN VII
Stylohyoid	elevates hyoid bone, retracts tongue, opens pharynx	CN VII

#### 4 Infrahyoid Muscles

##### Introduction

This muscle group, also called the "strap muscles" due to their appearance. Another four muscles comprise this group.

##### Thyrohyoid

- **Action:** depresses hyoid bone but elevates larynx
- **Innervation:** C1 and hypoglossal nerve (CN XII)

##### Omohyoid

The omohyoid muscle forms an obtuse J-like shape from its origin point to its insertion point.

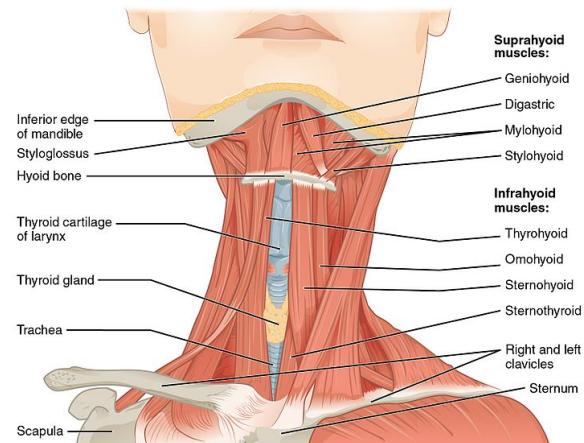
- **Action:** depresses hyoid bone and larynx
- **Innervation:** the ansa cervicalis formed via spinal nerves C1 to C3 within the cervical plexus

##### Sternothyroid

- **Action:** depresses hyoid bone and larynx
- **Innervation:** the ansa cervicalis formed via spinal nerves C1 to C3

##### Sternohyoid

- **Action:** depresses hyoid bone larynx
- **Innervation:** the ansa cervicalis formed via spinal nerves C1 to C3 within the cervical plexus



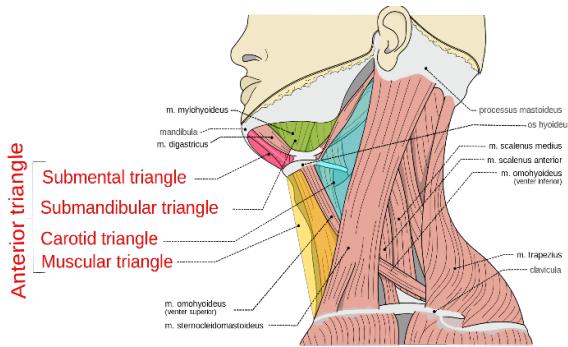
The supra hyoid and infrahyoid muscles of the neck

Infrahyoid muscle	Function	Innervation
Thyrohyoid	*depresses hyoid bone but elevates larynx	*C1 via CN XII
Omohyoid	depresses hyoid bone and larynx	ansa cervicalis via C1 to C3
Sternothyroid	depresses hyoid bone and larynx	ansa cervicalis via C1 to C3
Sternohyoid	depresses hyoid bone and larynx	ansa cervicalis via C1 to C3

## 5 Anterior Neck Triangle

The muscles of the neck can be divided into **anterior and posterior triangles of the neck** via the sternocleidomastoid muscle. The anterior triangle is bound superiorly by the mandible, laterally by the sternocleidomastoid, and medially by the median line of the neck.

There are four main triangles found within this group: the **submandibular/digastric, submental/suprahyoid, muscular/omotracheal/infrathyroid, and carotid**.



The anterior triangle of the neck and its contents

### Submandibular/digastric triangle

- Contents:**

- Lymph nodes, submandibular gland, branches of facial nerve (CN VII), artery and vein, mylohyoid, hyoglossus, middle and superior constrictor muscles, styloglossus, branches of CN V<sub>3</sub>, sublingual artery, vein and gland, and CN XII

### Submental triangle

- Contents:**

- Lymph nodes, anterior jugular vein branches, branches of facial artery and vein

### Muscular/omotracheal/infrathyroid triangle

- Contents:**

- Infrathyroid muscles, anterior jugular vein,

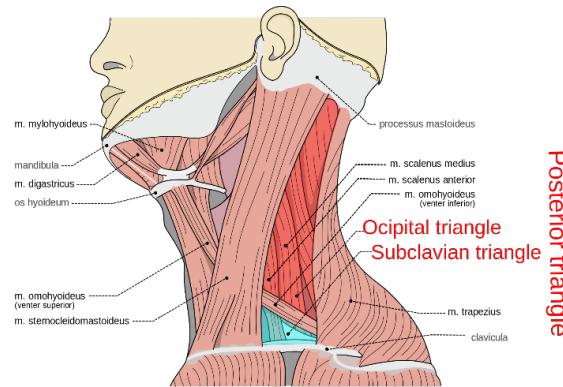
## Carotid triangle

- Contents:**

- Common, internal, and external carotid arteries, carotid sheath, internal jugular vein, CN X, CN XI, CN XII, and ansa cervicalis

## 7 Posterior Neck Triangle

The posterior triangle is bound anteriorly by the sternocleidomastoid, posteriorly by the anterior aspect of the trapezius muscle, and inferiorly by the middle third of the clavicle.



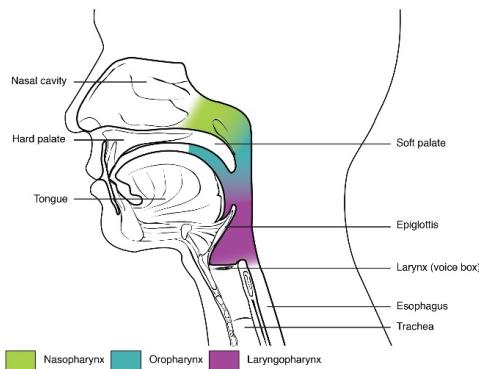
The posterior triangle and the neck and its contents

Posterior triangle

# Muscles of the Pharynx and Larynx

## 1 Introduction to the Pharynx

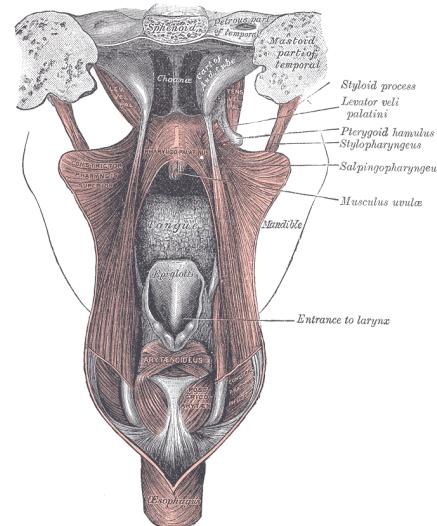
The **pharynx** is part of both the respiratory tract and digestive system. It can be divided into: the **nasopharynx**, **oropharynx**, and **laryngopharynx**.



The three main parts of the pharynx: the nano, pro, and laryngopharynx

## Palatopharyngeus

- Action:** elevates pharynx during swallowing, assists in moving bolus downwards
- Innervation:** branches of pharyngeal plexus via CN X



A posterior view of the muscles of the palate, pharynx, and larynx. The palatopharyngeus (labelled pharyngo-palatinus) can be seen posterior to the muscles uvulae

## 2 Introduction to the Larynx

### Introduction

The larynx connects the upper segment of the gastrointestinal tract (laryngopharynx) with the respiratory tract. The **epiglottis** closes off the larynx during swallowing to ensure food does not enter the trachea and impede breathing. The larynx is important for speaking since it houses the **vocal cords**.

The **inner longitudinal group** is associated with both the pharyngeal and laryngeal regions. This group includes the stylopharyngeus and palatopharyngeus

### Stylopharyngeus

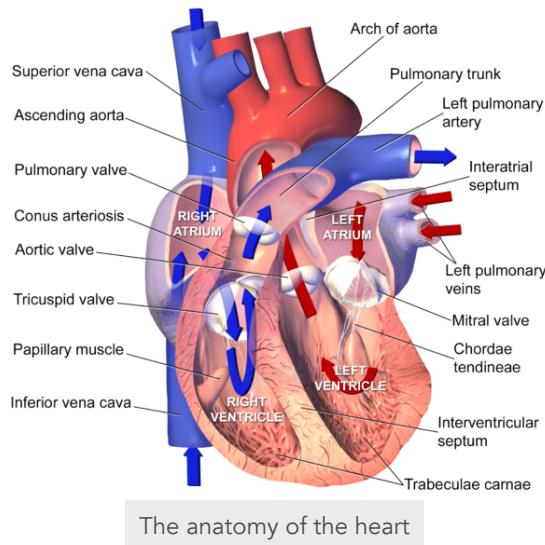
- Action:** elevates pharynx during swallowing
- Innervation:** glossopharyngeal nerve (CN IX)

# Craniofacial Arteries

## 1 Overview and background

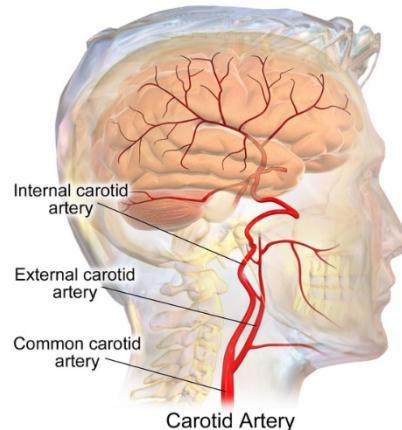
### The heart

The heart plays a key role in pumping blood throughout the body to ensure that oxygenated blood reaches organs and tissues to function, while deoxygenated blood and carbon dioxide is brought to the lungs. Blood flow between the lungs and heart is called the **pulmonary circulation** whereas blood flow from the heart to the body tissues and back is called the **systemic circulation**.



### The common carotid artery (continued)

This artery bifurcates into the **external** and **internal** carotid arteries between the level of C3 and C4. These two branches pass through the **carotid sheath** and are crucial contributors of the head's blood supply.



The internal and external carotid arteries

The **internal carotid artery** is responsible for supplying the anterior aspect of the brain and ocular region with blood. It enters the **carotid canal** of the temporal bone and possesses seven segments. These segments of the internal carotid artery are not crucial for you to know.

## 2 The aortic arch and major branches

### The common carotid artery

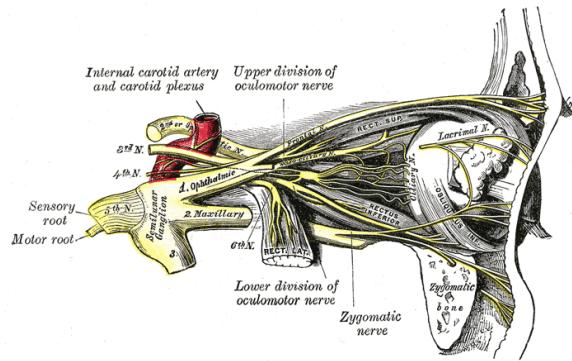
The **common carotid artery** is "common" to its two branches. This vessel is an immediate branch from the arch of the aorta on the left side, but branches indirectly off the aortic arch on the right side, since it passes through the brachiocephalic trunk first.

The **internal carotid plexus** is formed by postganglionic sympathetic fibers from the superior cervical ganglion which surround the internal carotid artery. Fibers from the plexus form the deep petrosal nerve or communicate with the trigeminal ganglion, abducens nerve, or pterygopalatine ganglion.

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## Overview

After the common carotid artery bifurcates, the **external carotid artery** differs in its anatomical course from the internal carotid artery. Rather than immediately pass into the skull, the external carotid artery branches into 8 different vessels which supply various regions of the head and neck region.



## The internal carotid plexus

### **3 The external carotid artery**

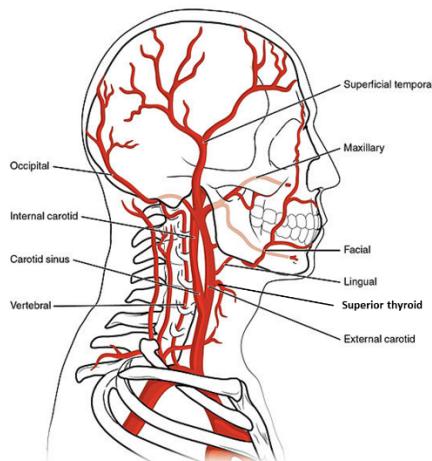
The external carotid artery contains vessels which supply various regions of the head and neck region. These branches provide a combination of deep and superficial blood supply; this will depend on the vessel and its respective region. Thankfully, the regions and the organs that are supplied by these branches can be inferred by their names.

The eight branches, from inferior to superior position, are as follows:

- **Superior thyroid artery**
    - ▶ Supplies thyroid gland, infrathyroid muscles, sternocleidomastoid
  - **Ascending pharyngeal artery**
    - ▶ Supplies pharynx
  - **Lingual artery**
    - ▶ Supplies intrinsic tongue muscles
  - **Facial artery**
    - ▶ Supplies submandibular gland, tonsils, and palate
    - **Occipital artery**
      - ▶ Supplies posterior scalp
  - **Posterior auricular artery**
    - ▶ Supplies ear and scalp near ear, parotid gland and facial nerve
  - **\*Maxillary artery**
    - ▶ Very important branch within the dental field
    - ▶ Supplies external acoustic meatus and tympanic membrane, mandible, gingivae, teeth, all muscles of mastication
  - **Superficial temporal artery**
    - ▶ Temporal aspect of scalp

The branches of the external carotid artery can be thought of being organized like a Christmas tree with ornaments. When looking at the right side of the head and neck, there are **three branches on the left** that move posterolaterally, and **four branches on the right** that move anteromedially. The external carotid artery can be thought of as the **trunk** of the tree, where the "end" at the top is the superficial temporal branch.

**INBDE Pro Tip:** There is a well-known mnemonic to remember that will make it easier to recall the branches of the external carotid artery: Some Anatomists Like Freaking Fut, Poor Medical Students.



The branches of the external carotid artery. Note that the superior thyroid and posterior auricular arteries are not shown

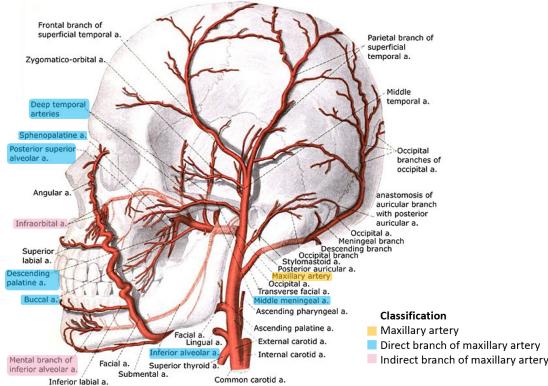
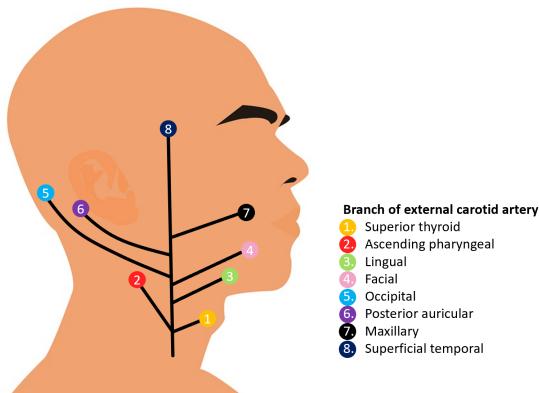


Illustration of the maxillary artery, its course, and its branches.



A "Christmas tree" diagram of the branches of the external carotid artery

### The maxillary artery

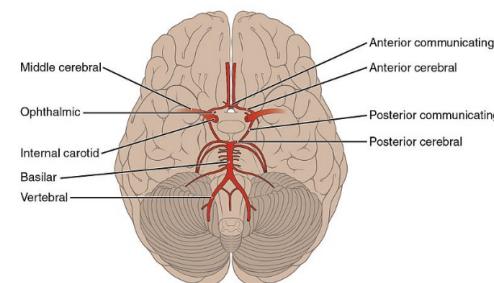
The **maxillary artery** supplies blood to many key structures of the oral cavity. It branches off from the external carotid artery at the neck of the mandible. Here it courses between the neck of the mandible and the sphenomandibular ligament. It will then pass between the heads of the lateral pterygoid muscle and towards the pterygopalatine fossa and end in a series of other small branches.

## 4 The Circle of Willis

### Overview

The blood flow to the brain is supported by the **Circle of Willis**. This circle is an anastomosis of major blood vessels at the base of the brain and brainstem, and connects with other branches that supply surrounding neural tissues. It is a form of collateral circulation for the brain. One particular vessel to take note of is the **posterior communicating artery**.

- Key point of connection between the anterior and posterior cerebral circulations via the internal carotid arteries and posterior cerebral arteries, respectively



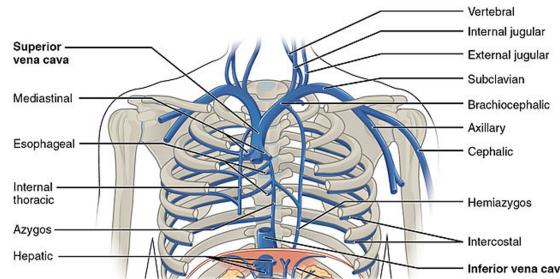
The position of the Circle of Willis relative to the brain and brainstem

# Craniofacial Veins

## 1 Branches of the superior vena cava

### The superior vena cava

Deoxygenated blood enters the heart from the body tissues through the **superior and inferior vena cava**. For the board exam and the field of dentistry, the superior vena cava is more relevant, as it drains the head, neck, upper thorax and limb regions.



The superior vena cava and its branches

### The brachiocephalic (innominate) vein

The first branch of the superior vena cava is the **brachiocephalic or innominate vein**. There are two brachiocephalic veins - one for each side of the thorax.

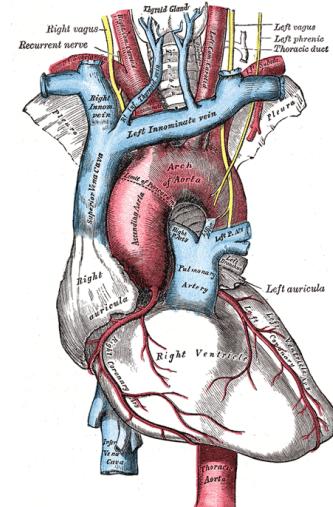
There are five main branches that drain into the brachiocephalic vein:

- **Inferior thyroid vein**
  - Drains inferior thyroid
- **Internal thoracic vein**
  - Drains the chest wall and the breasts
- **Vertebral vein**
  - Drains cervical spine, prevertebral and suboccipital muscles
- **Accessory vertebral vein**
  - Supports drainage of the vertebral vein

### • Internal jugular vein

- Important vessel since it contributes to much of the head and neck's venous drainage
- Drains the brain and venous sinuses
- Exits via jugular foramen

The subclavian vein also drains into the brachiocephalic vein from the clavicular and axillary regions.



The position of the superior vena cava and brachiocephalic veins relative to the heart and aortic arch

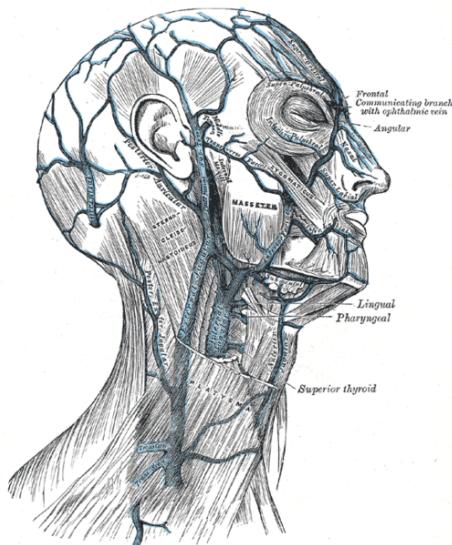
**INBDE Pro Tip:** Unlike the arterial system, there is nothing analogous to the common carotid artery for the venous system. The internal carotid artery branches off the brachiocephalic vein, and the external carotid vein branches off the subclavian vein, respectively.

## 2 Drainage of the head and face

### The facial vein

The **facial vein** branches indirectly from the internal jugular vein and drains from the angular vein. It is positioned obliquely across the face alongside the facial artery. It is an important site of drainage for numerous facial structures, as it communicates with the cavernous sinus indirectly, pterygoid plexus, deep facial vein, infraorbital vein indirectly, and ophthalmic vein indirectly.

The facial vein is responsible for draining the anterior scalp and forehead, the eyes and nose, the lips, chin, cheeks, submandibular gland, and thyroid gland.



Venous drainage of the head and face. The course of the facial vein can be seen here

### The pterygoid plexus

The **pterygoid plexus** is a web of veins within the infratemporal fossa and is affiliated with the pterygoid muscles. It drains blood from the nasal cavity, paranasal sinuses, palate, nasopharynx, and the auditory tube. The plexus anastomoses with the maxillary vein posteriorly, the facial vein anterolaterally, and the cavernous sinus superiorly.

Important for dentistry, the pterygoid plexus collects venous blood from the **inferior alveolar vein** and **superior** (both **posterior** and **anterior**) **alveolar** veins, which supply the mandibular and maxillary teeth, respectively.

### The cavernous sinus

The **cavernous sinus** is found resting on the sphenoid bone and encircling the pituitary gland. It is a bilateral pair of venous plexuses responsible for draining blood from the brain and select regions of the face (ex. the superior and inferior ophthalmic veins, superficial middle cerebral vein).

Namely, the cavernous sinus contains some key neurovascular structures that pass through it such as:

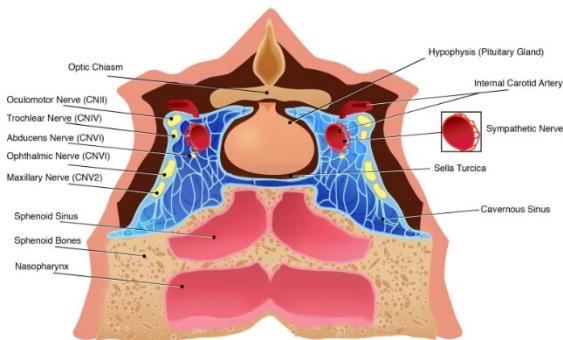
- Internal carotid artery
- CN III (Oculomotor)
- CN IV (Trochlear)
- CN V<sub>1</sub> (Ophthalmic)
- CN V<sub>2</sub> (Maxillary)
- CN VI (Abducens)

**Note:** the maxillary nerve may sometimes be found outside the sinus and may therefore not be included.

**INBDE Pro Tip:** To remember the contents of the cavernous sinus, a mnemonic can be used:  
**I**nteresting **O**nions **T**urn **O**dorous, **M**ostly.

Clinically, a condition known as **cavernous sinus thrombosis** may result from facial infections. It is generally a rare condition and may be caused by dental infections approximately 10% of the time and sinusitis about 30% of the time. The most common cause is nasal boils (or furuncles) about half the time.

Since the aforementioned neurovascular structures pass through this sinus, an infection may impede their functions, which could lead to a stroke, **mydriasis** (pupil dilation), vision loss, and **ophthalmoplegia** (extraocular muscle paralysis) to name a few.



The cavernous sinus and surrounding structures

# The Lymphatic System

## 1 The Lymphatic System

### Overview

The **lymphatic system** is responsible for moving **lymph** throughout the body and for its involvement in the body's immune response.

The lymphatic system has three main roles:

#### 1. Drains fluids

- Interstitial fluid drained from capillaries is returned to the blood

#### 2. Immunological protection

- Creates and distributes lymphocytes
- Antigen uptake via white blood cells can assist in mounting an immune response

#### 3. Lipid transport

- Lipids absorbed by the gastrointestinal tract are transferred throughout the body
  - Blood contains water (a polar substance) which does not properly carry non-polar lipids

The lymphatic system takes excess fluid, such as plasma, from circulation and transports it to nearby lymph nodes via lymphatic vessels.

**Lymph** is created by interstitial fluid that is released into surrounding tissue spaces via capillary filtration and leakage caused by blood pressure.

**INBDE Pro Tip:** There are many different ways to remember the superficial lymph nodes of the head and neck region. The first is an acronym "POMPS, So Flipping Special." A pomp is an extravagant display, which would probably be for a very special event. Perhaps it could be you when you celebrate your board exam that you passed!

Now that we have the letters in mind, we can also group the different lymph nodes together in terms of function/location to remember them better.

- Special senses:** Occipital and pre-auricular
- Glands:** Parotid, submandibular
- Bone/Muscle:** Mastoid and facial, respectively
- Other:** Superficial cervical, submental