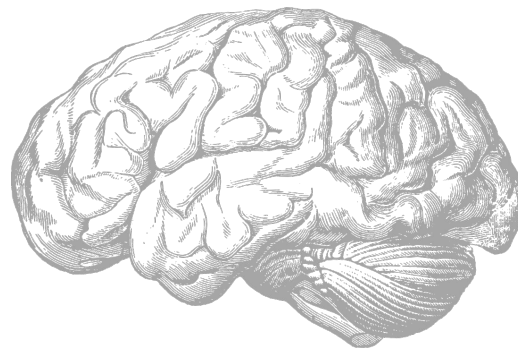




Anatomy of the Nose and Olfactory Nerve

CNS Block



Color Index


- ◆ Main Text
- ◆ Female Slides
- ◆ Male Slides
- ◆ Drs' Notes
- ◆ Important
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[The Editing File](#)




Objectives

 Describe the structures forming the walls of the nasal cavity.

 List the main structures draining into the lateral wall of the nasal cavity.

 Differentiate between the respiratory and olfactory regions of the nasal cavity.

 List the main sensory and blood supply of the nose.

 Describe the olfactory pathway.

 [Clinical Anatomy](#)



You can find Atlas by [Clicking HERE!](#)

Introduction

A

The external (anterior) nares or nostrils, lead to the nasal cavity.

B

Formed above by bony skeleton and below by plates of hyaline cartilage.

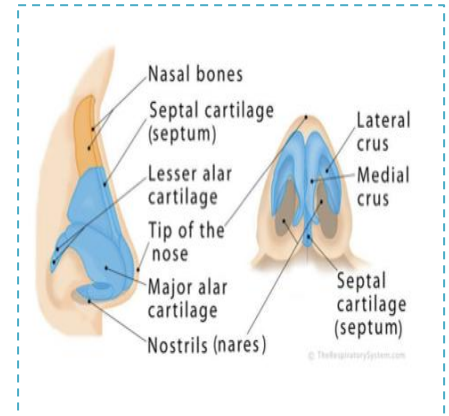
C

Both smell and taste complement each other and respond to many of the same stimuli.

D

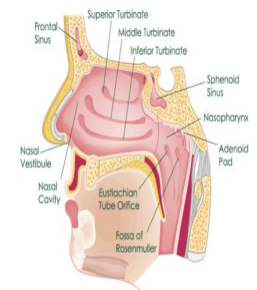
Smell is considered chemical senses (Chemoreceptors)

- Stimulated by chemicals in solution.
- Smell can differentiate a wider range of chemicals.
- Taste has five types of receptors.



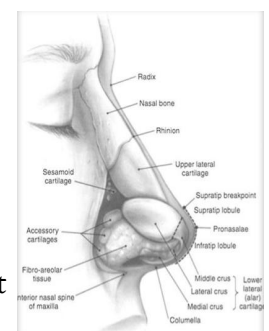
NASAL CAVITY:

- It is a large air-filled space above and behind the nose in the middle of the face.
- Each cavity is the continuation of one of the two nostrils.
- It communicates with the nasopharynx posteriorly.
- It consists of Vestibule, Respiratory and Olfactory regions.
- Each contains, roof, floor, lateral and medial walls.



Function:

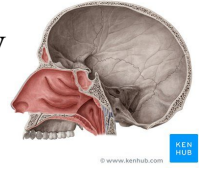
- Olfaction: smell
- Respiration : breathing
- Warming the inspired air : submucous venous plexus
- Filtration of dust
- Humidification of the inspired air: Mucous
- Reception of secretions from the paranasal sinuses and nasolacrimal duct



Nasal Cavity

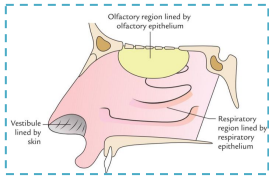
Definition of nasal cavity

It extends from **nostrils** anteriorly to the (**Turbinate**) **choanae** posteriorly
 Divided into right and left parts by the **nasal septum**.
 Each part has :



<p>Floor</p>	<p>Formed By: Nasal (upper) surface of the hard (bony) palate: A. Palatine process of maxilla, anteriorly. B. Horizontal plate of the palatine bone, posteriorly.</p>	
<p>Roof</p>	<p>Formed By: 1. Body of sphenoid, posteriorly. 2. Cribriform plate of ethmoid, in the middle. 3. Frontal, and nasal bones, Anteriorly.</p>	
<p>Lateral Wall</p>	<ul style="list-style-type: none"> ▶ Marked By Three projections (Nasal Conchae): Superior, middle, and inferior. ▶ The space below each concha is called Meatus: Superior, middle, and inferior meatus. ▶ The space (fossa) above the superior concha is the Sphenoethmoidal recess 	
<p>Medial Wall (Nasal Septum)</p>	<p>The Nasal Septum: A. Vertical plate of ethmoid. B. Septal cartilage. C. Vomer.</p>	

Nasal Cavity



Regions

Vestibule Region:

The area surrounding the external opening to the nasal cavity

Lined by modified skin, provided with hairs, and sebaceous glands, to filter the incoming air.

Respiratory Region:

The largest and lined with mucous that is continuous with that of
Nasal Sinuses,
Lacrimal sac,
Conjunctiva, and
Nasopharynx.

Olfactory Region:

Located at the apex of the nasal cavity

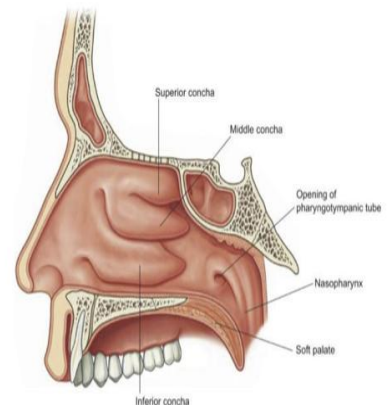
It is lined by olfactory cells with olfactory receptors.

Nasal Conchae

Projecting out of the lateral walls of the nasal cavity are curved shelves of bone.

They project into the nasal cavity, creating four pathways for the air to flow. These pathways are called meatuses:

- o Inferior meatus: Lies between the inferior concha and floor of the nasal cavity.
- o Middle meatus: Lies between the inferior and middle concha.
- o Superior meatus: Lies between the middle and superior concha.
- o Spheno-ethmoidal recess: Lies superiorly and posteriorly to the superior concha.



Concha Function:

- o increase the surface area of the nasal cavity to increase the amount of inspired air that can come into contact with the cavity walls.
- o They also disrupt the fast, laminar flow of the air, making it slow, turbulent.
- o The air spends longer in the nasal cavity, so that it can be humidified.

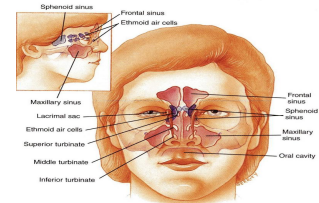
Paranasal Sinuses

They are a group of four paired air-filled spaces that surround the nasal cavity.

- **Maxillary Sinuses:** the largest of the paranasal sinuses, located under the eyes in the maxillary bones/ Maxilla.
- **Frontal Sinuses:** superior to the eyes in the frontal bone, which forms the hard part of the forehead.
- **Ethmoidal Sinuses:** formed from several discrete air cells within the Ethmoid bone between the nose and the eyes.
- **Sphenoidal Sinuses:** in the sphenoid bone.

They are cavities inside the:

- Maxilla
- Frontal bone
- Sphenoid bone
- Ethmoid bone



Characteristics:

- **Lined** with mucoperiosteum.
- **Filled** with air.
- **Communicate** with the nasal cavity.
- **Open** in the lateral wall of the nasal cavity

Functions:

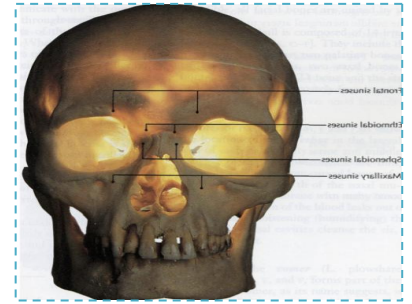
- **Lighten the skull weight.**
- **Amplify the sound as we speak.**
- **Decreasing** the relative weight of the front of the skull, and especially the bones of the face.
- **Increasing** resonance of the voice.
- **Providing** a buffer against facial trauma.
- **Insulating** sensitive structures like dental roots and eyes from rapid temperature fluctuations in the nasal cavity.
- **Humidifying** and heating of inhaled air because of slow air turnover in this region.

Sinuses Opening In Lateral Wall

Sphenoethmoidal recess	receives the opening of sphenoidal air sinus.
Superior meatus	receives the opening of posterior ethmoidal sinus.
Middle meatus (contains bulla ethmoidalis and hiatus semilunaris)	Receives the openings of maxillary, frontal, & anterior, middle ethmoidal sinuses.
Inferior meatus	receives the opening of nasolacrimal duct.

Sinuses Opening In Lateral Wall

The mucosal lining of these sinuses is continuous with that in the nose and the throat. So, infection in this area tends to migrate into the sinuses causing sinusitis.

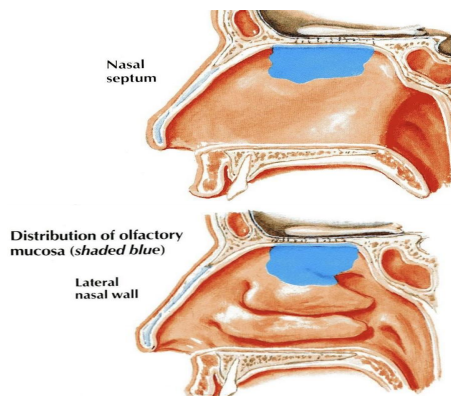


Note:

all sinuses open into the middle meatus **EXCEPT:**
 Sphenoidal sinus: in **sphenoethmoidal recess.**
 Posterior ethmoidal sinus: in **superior meatus.**

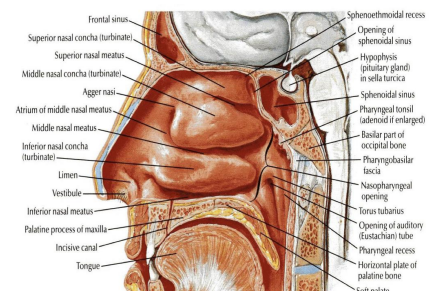
Nasal Mucosa

- ❖ **Olfactory:** It is **delicate** and contains olfactory nerve cells. (receptors for smell).
- ❖ It is present in the upper part of nasal cavity (superior surface of the cribriform plate):
 1. **Roof**
 2. **Lateral wall:** It lines the upper surface of the superior concha and the sphenoethmoidal recess.
 3. **Medial wall:** It lines the superior (upper) part of the nasal septum.



Respiratory Mucosa

- ❖ It is **thick** ciliated highly vascular and contains mucous glands & goblet cells.
- ❖ It lines the **lower part of the nasal cavity** (from **skin of vestibule** to superior concha)
- ❖ It functions to **moisten, clean and warm** the inspired air.
- ❖ The air is **moistened** by the **secretion** of numerous serous glands.
- ❖ The air **cleaned** by the **removal** of the dust particles by the ciliary action of the columnar ciliated epithelium that covers the mucosa.
- ❖ The air is **warmed** by a **submucous venous plexus.**



Supply of Nasal Cavity

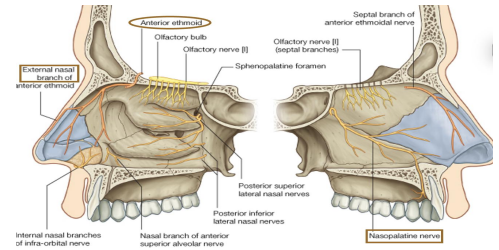
Nerve Supply

Nerves of smell:

Olfactory Nerves (Cr 1).

The nerves of General Sensation are derived from the **Ophthalmic** and **Maxillary** divisions of Trigeminal nerve.

- The Anterior part is supplied by **anterior ethmoidal nerve**.
- The Posterior part is supplied by branches of the **pterygopalatine ganglion**:
 - 1-Nasopalatine
 - 2-Nasal
 - 3-Palatine



Arterial Supply

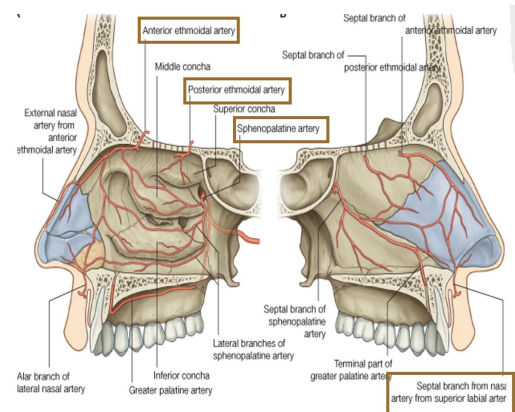
Internal carotid branches:

- 1) Anterior and Posterior ethmoidal artery (**ophthalmic**)
- 2) The **ethmoidal** arteries are branches of the **ophthalmic** artery
- 3) The **ophthalmic** artery is a branch of internal carotid artery.

External carotid branches:

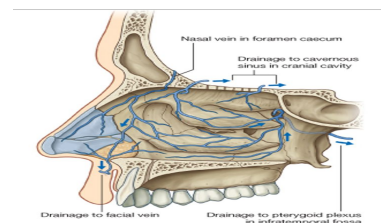
- 1) Sphenopalatine artery (**branch of maxillary**)
- 2) Superior labial artery (**branch of Facial**)
- 3) Greater palatine artery
- 4) Lateral nasal arteries

Applied anatomy : The most common site for epistaxis is at the anterior & inferior part of nasal septum (Little's Area) because of the rich arterial anastomosis.



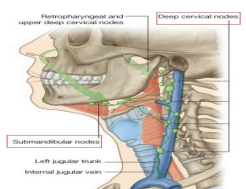
Venous Drainage

Plexus in submucosa by veins accompany the arteries. They drain into cavernous sinus & pterygoid venous plexus.



Lymphatic Drainage

Submandibular and upper deep cervical nodes.



Clinical Notes

NOSEBLEED:

- It is common case due to rich blood supply of the nose.
- Most likely occur in anterior third of nasal cavity.
- Cause could be local due to trauma or systemic due to hypertension.

DISEASES OF THE NASAL CAVITY INCLUDE:

- Viral.
- Bacterial
- Fungal infections
- Nasal cavity tumors
- Inflammations of the nasal mucosa

SADDLE NOSE DEFORMITY

▶ The saddle nose deformity occurs primarily as a result of nasal trauma; whereby septal support to the nose is lost, and subsequently the middle part of the nose appears sunken.

▶ This is either a result of direct damage to the septal bone or cartilage, or a consequence of nasal septal haematoma.

▶ As cartilage has no blood supply of its own, it relies on oxygen and nutrients diffusing from blood vessels in the surrounding perichondrium.

▶ A haematoma between these two structures can result in destruction of the septum, and therefore deformity of the nose.



DANGER TRIANGLE OF THE FACE

▶ The venous drainage of the nose and surrounding area is unique as a result of communication between the facial vein and cavernous sinus, via the ophthalmic vein.

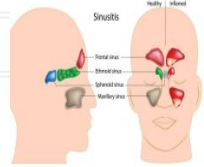
▶ As the cavernous sinus lies within the cranial cavity, this enables infections from the nasal area to spread to the brain.

▶ This retrograde spread of infection can therefore cause cavernous sinus thrombosis, meningitis or brain abscess.



SINUSITIS

- ▶ As the paranasal sinuses are continuous with the nasal cavity, an upper respiratory tract infection can spread to the sinuses.
- ▶ Infection of the sinuses causes inflammation (particularly pain and swelling) of the mucosa and is known as sinusitis.
- ▶ If more than one sinus is affected, it is called pansinusitis.
- ▶ The maxillary nerve supplies both the maxillary sinus and maxillary teeth, and so inflammation of that sinus can present with toothache.



SPREAD OF INFECTION

- ▶ As the auditory tube connects the middle ear and upper respiratory tract, it is a path by which infection can spread from the upper respiratory tract to the ear.
- ▶ Infection of the auditory tube causes swelling of the mucous linings, and the tube becomes blocked. This results in diminished hearing.



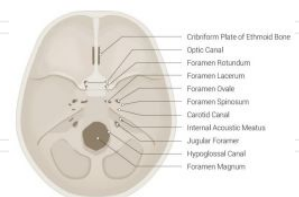
EPISTAXIS

- ▶ Epistaxis is the medical term for a nosebleed.
- ▶ It is a common case due to the rich blood supply of the nose.
- ▶ It is most likely to occur in the anterior third of the nasal cavity.
- ▶ The cause can be local (such as trauma), or systemic (such as hypertension).



CRIBRIFORM PLATE FRACTURE

- ▶ A fracture of the cribriform plate can occur as a result of nose trauma.
- ▶ It is either fractured directly by the trauma, or by fragments of the ethmoid bone.
- ▶ A fractured cribriform plate can penetrate the meningeal linings of the brain, causing leakage of cerebrospinal fluid.
- ▶ Exposing the brain to the outside environment like this increases the risks of meningitis, encephalitis and cerebral abscesses.
- ▶ The olfactory bulb lies on the cribriform plate and can be damaged irreversibly by the fracture.
- ▶ In this case, the patient may present with anosmia (loss of smell).



▶ There are 12 pairs of cranial nerves in our body (I-XII), called cranial nerve because they originated directly from the brain.

▶ communicate and relay information between the brain and parts of the body, primarily to and from regions of the head and neck.

▶ They are generally named from anterior to posterior based on structure or function.

▶ For example, the olfactory nerve (I) provides smell, and the facial nerve (VII) provides motor innervation to the face.

Olfactory Nerve

Definition

- The first and shortest cranial nerve.
- It is the nerve to transmits special sensory information to have a sense of smell.
- It is one of two nerves that DO NOT emerge from brainstem,
- Elderly people usually have less sensation of smell probably because of progressive reduction in number of olfactory cells

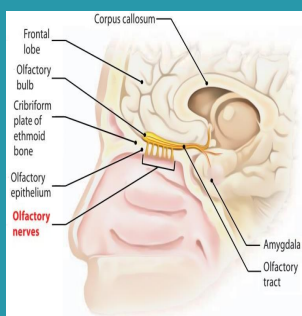
IMPORTANCE

- We will ever appreciate the smell of morning cup of coffee or the odor an authentic brand perfume if we perform great function of olfactory nerve.
- The secretion of the saliva in the mouth will be increased if the smell of a great meal of chicken touches the cilia in olfactory region located in the top of nasal cavity to transmit that smell to the brain.
- Moreover, great memories are connected to the sense of smell.

FUNCTIONS

- It is only sensory.
- carry afferent impulses for the sense of smell.

NERVE COURSE



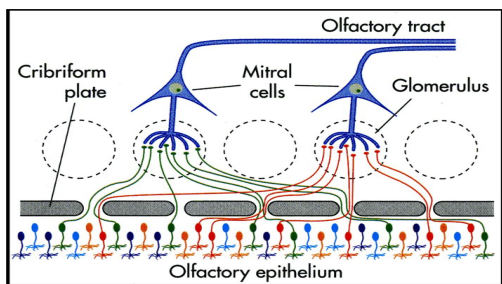
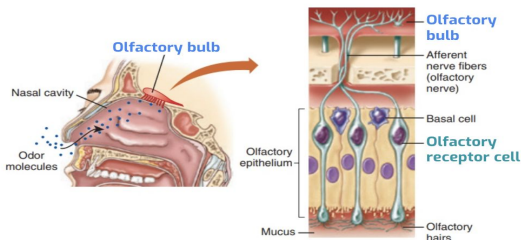
- At the top of nasal cavity, the olfactory receptors are embedded into the olfactory epithelium to detect chemicals that activate the sense of smell.
- The axons of those cells form fila olfactoria where they are collected into small bundles of true olfactory nerves.
- Through the puncture of small foramina in cribriform plate of the ethmoid bone, the axons pass into the cranial cavity.
- Immediately after reaching the cranial cavity, those fibres access the olfactory bulb found in the olfactory groove within the anterior cranial fossa.
- The nerve fibers run within the olfactory bulb as olfactory tracts to reach the olfactory cortex in the temporal lobe.
- The olfactory tract, on the posterior and anterior sides of the optic chiasm, is divided into lateral and medial olfactory striae.
- The lateral stria continues on to structures associated with the olfactory cortex.
- The medial stria protrudes to the anterior commissure to contralateral olfactory structures

Olfactory pathway

(Special sensation olfactory nerve)

First Order Neurons

- **Olfactory receptors** are specialized, ciliated nerve cells that lie in the olfactory epithelium.
- The axons of these bipolar cells 12-20 fibers form the true olfactory nerve fibers. Which passes through the **cribriform plate of ethmoid**.
- They join the **olfactory bulb**.
- Preliminary processing of olfactory information is within the olfactory bulb, which contains interneurons and large **Mitral cells**; axons from the latter leave the bulb to form the **olfactory tract**.



Second Order Neurons

- It is formed by the **Mitral cells** of olfactory bulb.
- The axons of these cells form the olfactory tract.
- Each tract divides into 2 roots at the **Anterior Perforated Substance**.

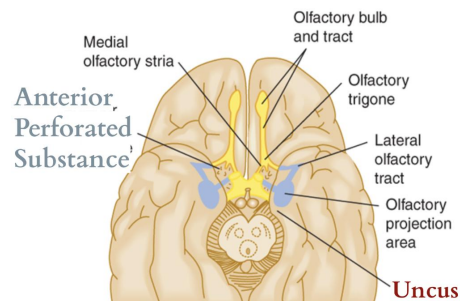
1-Medial Root:

Crosses midline through **anterior commissure** and joins the uncrossed lateral root of opposite side. It connects olfactory centers of 2 cerebral hemispheres.

2-Lateral Root

Carries olfactory fibers to end in cortex of the **Uncus** & adjacent part of **Hippocampal** gyrus (center of smell).

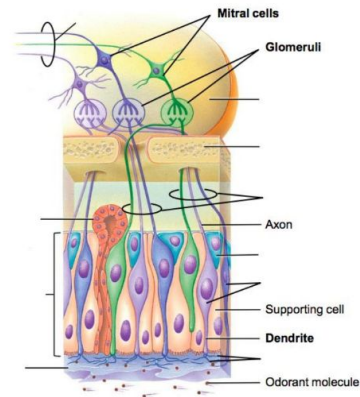
- So, each olfactory centre receives smell sensation from **both halves of nasal cavity**.
- NB. Olfactory pathway is the **only sensory pathway** which reaches the cerebral cortex without passing through the **Thalamus**.



Olfactory Nerve Cont.

OLFACTORY BULB

- In the cranial cavity, the fibers enter the olfactory bulb, which lies in the olfactory groove, within the anterior cranial fossa.
- The olfactory bulb is an ovoid structure which contains specialized neurons, called mitral cells.
- The olfactory nerve fibers synapse with the mitral cells, forming collections known as synaptic glomeruli.
- From the glomeruli, **second order nerves** then pass posteriorly into the olfactory tract.



OLFACTORY TRACT

- The olfactory tract runs inferiorly to the frontal lobe to reaches the anterior perforated substance to divides into medial and lateral stria:
 - The lateral stria carry the axons to the olfactory area of the cerebral cortex (also known as the primary olfactory cortex).
 - The medial stria carry the axons across the medial plane of the anterior commissure where they meet the olfactory bulb of the opposite side.
- The primary olfactory cortex sends nerve fibers to many other areas of the brain, like piriform cortex, amygdala, olfactory tubercle and the secondary olfactory cortex.
- These areas are involved in the memory and appreciation of olfactory sensations.

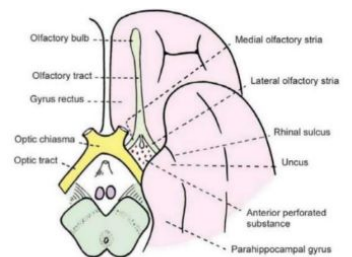
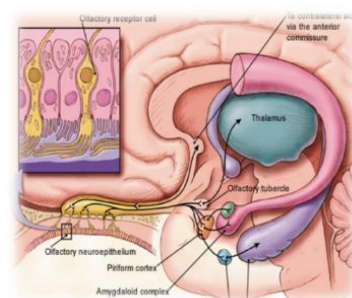
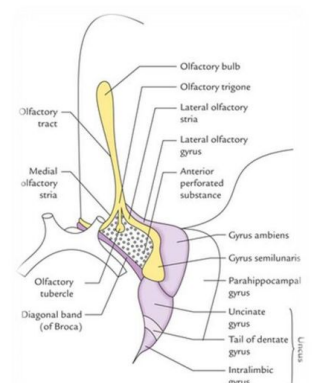


Fig. 16.1. Some structures related to the anterior part of the base of the brain.



OLFACTORY STRIAE

- Posterior and anterior to the optic chiasm, the olfactory tract on both sides divides into medial and lateral olfactory striae.
- The medial stria projects to the anterior commissure, and then to contralateral olfactory structures.
- The lateral stria continues to structures associated with the olfactory cortex.

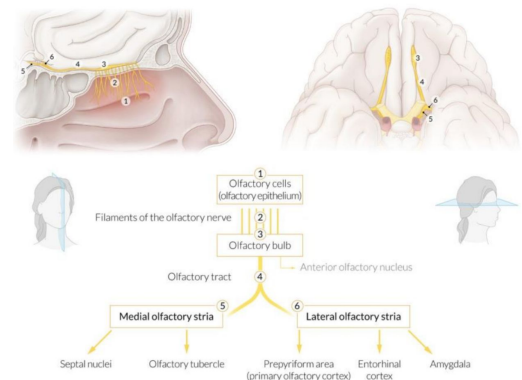


NERVE PATHWAY

■ It is important to note that the olfactory nerve is made up of multiple nerve fibers/rootlets coming from the receptor's cells.

■ The pathway can be summarized as follows:

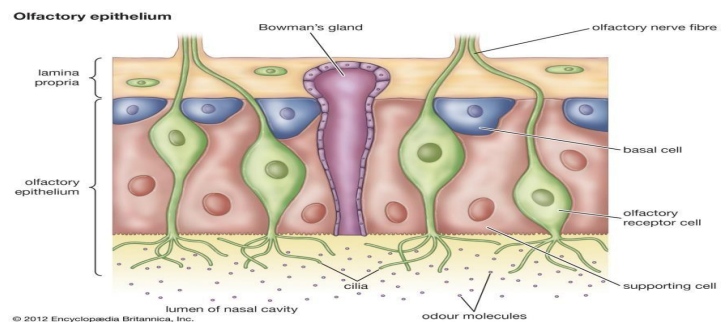
- olfactory receptor cells
- olfactory nerves
- olfactory bulb
- olfactory tract
- olfactory striae
- olfactory cortex



OLFACTORY MUCOSA

■ The olfactory mucosa is a very important structure as it not only senses smell, but also the more advanced aspects of taste.

■ It is located in the roof of the nasal cavity and is composed of pseudostratified columnar epithelium which contains a number of cells.

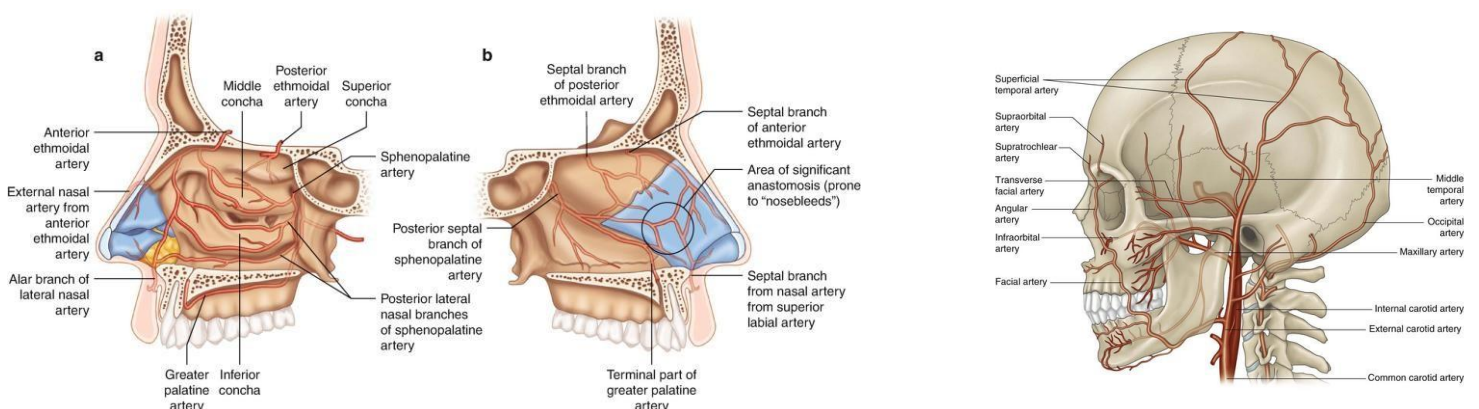


MUCOSA CELLS

- Basal cells: form the new stem cells from which the new olfactory cells can develop.
- Sustentacular cells: tall cells for structural support. These are similar to the glial cells located in the CNS.
- Olfactory receptor cells: bipolar neurons which have two processes, a dendritic process and a central process. The dendritic process projects to the surface of the epithelium, where they project a number of short cilia, the olfactory hairs, into the mucous membrane. These cilia react to odors in the air and stimulate the olfactory cells. The central process (also known as the axon) projects in the opposite direction through the basement membrane.
- There are also Bowman's glands present in the mucosa, which secrete mucus.

BLOOD SUPPLY

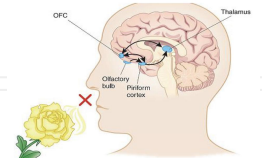
- The nasal cavity, including the olfactory epithelium receives blood supply from several branches including the carotid (external and internal) arteries, the sphenopalatine artery and the ethmoidal (anterior and posterior) arteries.
- The external carotid artery gives off the maxillary artery which it then gives off the sphenopalatine artery.
- The sphenopalatine artery within pterygopalatine fossa reaches the upper nasal cavity posterosuperior to the middle nasal conchae to form extensive network of major branches include the posterior lateral nasal and nasal septal arteries.
- The ophthalmic artery, which is a branch of the internal carotid artery gives off two branches, the anterior and posterior ethmoidal arteries.



Clinical Notes

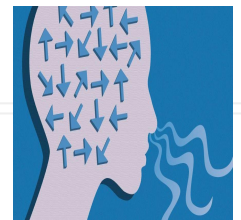
ANOSMIA

- ▶ The complete absence of the sense of smell.
- ▶ It can be temporary or permanent.
- ▶ Temporary anosmia: can be caused by infection or by local disorders of the nose.
- ▶ Permanent anosmia: can be caused by head injury, or tumours which occur in the olfactory groove (e.g. meningioma).
- ▶ Anosmia can also occur as a result of neurodegenerative conditions, such as Parkinson's or Alzheimer's disease.



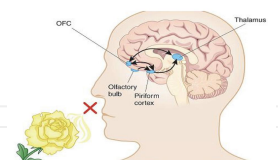
DYSOSMIA

- ▶ A distortion in the quality of the perception of an odor.
- ▶ Sometimes, the perception of an odor when no odor is present.
- ▶ Damage to olfactory nerve fibers can occur as a complication of upper respiratory tract infections.
- ▶ A decrease in the number of nerve fibers from these infections mean that there are not enough different fibers to accurately differentiate odors resulting in parosmia.



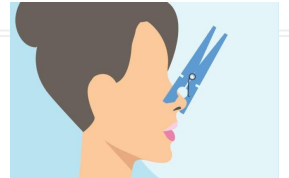
HYPOSMIA

- ▶ It is the reduction of the ability to smell and to detect odors.
- ▶ The causes include allergies, nasal polyps, viral infections and head trauma.
- ▶ Older people are subjected to have hyposmia.
- ▶ Hyposmia might be a very early sign of Parkinson's disease.
- ▶ Lifelong hyposmia could be syndrome or Autistic Spectrum Disorder. caused by Kallmann



HYPEROSMIA

- ▶ Hyperosmia is an increased olfactory sharpness with increased sense of smell.
- ▶ This perceptual disorder arises when there is an abnormally increased signal at any point between the olfactory receptors and the olfactory cortex.
- ▶ The causes may include genetic, hormonal or environmental.
- ▶ When odorants enter the nasal cavity, they bind to odorant receptors at the base of the olfactory epithelium.
- ▶ These receptors are bipolar neurons that connect to the glomerular layer of the olfactory bulb, traveling through the cribriform plate.
- ▶ The hyperosmic person may need to be removed from strong odorants for a period of time if the sensation becomes unbearable.



NERVE ASSESSMENT

- ▶ Testing the sense of smell can easily be conducted through using well and strong odors, such as menthol, coffee or peppermint.
- ▶ This test can be done in the alterations of odor perception or if there is damage to any sinus or nasal cavity issues



MCQs

Q1. The largest paranasal sinus is _____

A. Maxillary

B. Ethmoidal

C. Sphenoidal

D. Frontal

Q2. Which of the following is NOT a component of the medial wall of nasal cavity?

A. Vomer

B. Cribriform plate of ethmoid

C. Septal cartilage

D. Nasal septum

Q3. The _____ sinus doesn't open in the middle meatus

A. Frontal ethmoidal

B. Anterior ethmoidal

C. Posterior ethmoidal

D. Middle ethmoidal

Q4. The olfactory receptors are _____ neurons

A. Unipolar

B. Bipolar

C. Multipolar

D. Stellate

Q5. The olfactory pathway is the only sensory pathway that does NOT pass through _____

A. Basal ganglia

B. Spinal cord

C. Brainstem

D. Thalamus

Q6. Preliminary processing of olfactory information is done in _____

A. Olfactory receptors

B. Primary olfactory cortex

C. Secondary olfactory cortex

D. Olfactory bulb

A1. **A** A2. **B** A3. **C** A4. **B** A5. **D** A6. **D**

FOR ANKI FLASHCARDS



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Team Leaders

Remaz Almahmoud

Moath Alhudaif

Areej Alquraini

Faris Alzahrani

Sarah Alshahrani

Team Members

Aleen Alkulyah

Ghaida Aldossary

Omar Almogren

Khawla Alfaqih

Retal Alshohail

Nazmi M Alqutub

Haya Alajmi

Norah Almania

Abdulaziz Alqarni

Sarah Alajaji

Sara Alsharani

Mansour Alotaibi

Almas Almutairi

Deena Almahawas

Khalid Alsobei

Bayan Alenazi

Khalid Alanezi

Sadeem Alyahya

Almuthana Alageel

Zahra Alhazmi

Aban Basfar

Salma Alsaadoun

Zeyad Alotaibi

Norah Almohaimeed

Mohammed Alqutub



Waad Alanazi

Abdalmalik Alshammakhi

Aseel Alshehri



Hamad Alyahya

Lama Alsuliman

Mohammed Alsalamah

Aljoharah Alkhalifah

Mohammed Alarfaj

Aishah Boureggah

Ziyad Alsalamah

Maryam Alghannam

Faisal Alshowier

Lama Alotaibi

Faisal Alhejji

Wafa Alakeel

Abdullah Aldhuwaihy



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Anatomy.med443@gmail.com