QUESTION:

1. Write an essay on cavernous sinus
2. Discuss the walls of the nose
3. The [human brain](https://www.kenhub.com/en/library/anatomy/cerebral-cortex) is a highly vascular organ responsible for coordinating a myriad of processes throughout the body. Therefore, it is important that a pathway exists to return blood that enters [the cranium](https://www.kenhub.com/en/library/anatomy/the-skull) to systemic circulation. The **cavernous sinuses** are one of several drainage pathways for the brain that sits in the middle. In addition to receiving venous drainage from the brain, it also receives tributaries from parts of the [face](https://www.kenhub.com/en/library/anatomy/the-human-face).

The left and right cavernous sinuses communicate by through the anterior and posterior intercavernous sinuses. The cavernous sinus drains to the superior and inferior petrosal sinuses, which then join the sigmoid sinus.

The cavernous sinuses are 1 cm wide cavities that extend a distance of 2 cm from the most posterior aspect of the [orbit](https://www.kenhub.com/en/library/anatomy/bones-of-the-orbit) to the **petrous part of the**[temporal bone](https://www.kenhub.com/en/library/anatomy/the-temporal-bone). They are bilaterally paired collections of venous plexuses that sit on either side of the [sphenoid bone](https://www.kenhub.com/en/library/anatomy/the-sphenoid-bone). Although they are not truly trabeculated cavities like the corpora cavernosa of the penis, the numerous plexuses, however, give the cavities their characteristic sponge-like appearance.

The cavernous sinus is **roofed** by an inner layer of [**dura mater**](https://www.kenhub.com/en/library/anatomy/meninges-of-the-brain-and-spinal-cord) that continues with the diaphragma sellae that covers the superior part of the [pituitary gland](https://www.kenhub.com/en/library/anatomy/pituitary-gland). The roof of the sinus also has several other attachments. Anteriorly, it attaches to the anterior and middle **clinoid processes**, posteriorly it attaches to the **tentorium** (at its attachment to the posterior clinoid process). Part of the periosteum of the greater wing of the sphenoid bone forms the floor of the sinus. The body of the sphenoid acts as the medial wall of the sinus while the lateral wall is formed from the visceral part of the dura mater.

The cavernous sinus contains the internal carotid artery and several cranial nerves. Abducens nerve (CN VI) traverses the sinus lateral to the internal carotid artery. The remainder of the cranial nerves pass through the lateral wall of the carotid sinus, and from superior to inferior they are:

* Oculomotor nerve (CN III)
* Trochlear nerve (CN IV)
* Trigeminal nerve (CN V) - ophthalmic and maxillary divisions.

The contents of the cavernous sinus can be easily remembered with the mnemonic **O**h, **COAT**, that stands for the **O**culmotor nerve (III), Internal **C**arotid artery, **O**phthalmic nerve (V1), **A**bducens nerve (VI), **T**rochlear nerve (IV).

### **Internal carotid artery**

In addition to the thin walled veins that traverse the cavernous sinus, a lone arterial vessel also uses the area as a conduit. The [**internal carotid artery**](https://www.kenhub.com/en/library/anatomy/internal-carotid-artery) (a branch of the common carotid artery) – along with its postganglionic **sympathetic plexus** from the superior cervical ganglion – gains access to the cavernous sinus posteriorly.

As the petrous part of the internal carotid artery leaves the **carotid canal**, it curves vertically and superiorly above foramen lacerum to enter the cavernous sinus. Here the artery is also referred to as the **cavernous part**.

Within the sinus, the internal carotid artery travels anteriorly, in a horizontal manner until it reaches the anterior limit of the sinus. Here it curves vertically and superiorly to exit the sinus through its roof and become the **cerebral part**of the internal carotid artery. It is noteworthy that the cavernous part of the internal carotid artery is the only arterial vessel that is completely surrounded by venous networks. This fact is of great clinical significance, which will be discussed later.

### **Abducent nerve**

There are also other non-vascular structures that utilize the cavernous sinus as a pathway to their points of supply. Five cranial nerves (CN) use this pathway to gain access to their points of innervation. The first to be discussed is the abducent nerve (CN VI). This motor nerve leave the pons and gains access through the posterior part of the sinus after passing of the apical potion of the petrous temporal bone. It has also been known to access the cavernous sinus by way of the petrosal sinus, adjacent to the clivus.

Within the cavernous sinus, it takes an inferolateral course, relative to the internal carotid artery. It exits the sinus by way of the **superior orbital fissure** to gain access to the orbit, where it innervates the [lateral rectus muscle](https://www.kenhub.com/en/library/anatomy/lateral-rectus-muscle) of the eyeball.

### **Oculomotor nerve**

The other nerves travelling through the cavernous sinus do so between the endothelial lining and the dura mater of its lateral wall. The most superior of the four nerves in the lateral wall is the [**oculomotor nerve (CN III)**](https://www.kenhub.com/en/library/anatomy/the-oculomotor-nerve). At the posterior aspect of the roof of the cavernous sinus, the free and attached edges of tentorium cerebelli forms a space through which CN III enters the lateral wall of the sinus. It takes an anterior, inferomedial course (relative to the other nerves in the lateral wall) towards the anterior extremity of the sinus.

Here it bifurcates into its **superior and inferior rami** that pass through the superior orbital fissure. Along with **sympathetic fibers** from the internal carotid plexus, CN III provides motor supply to [inferior oblique](https://www.kenhub.com/en/library/anatomy/inferior-oblique-muscle), [levator palpebrae superioris](https://www.kenhub.com/en/library/anatomy/levator-palpebrae-superioris-muscle), and the inferior, medial and superior recti muscles.

### **Trochlear nerve**

The smallest of the cranial nerves, the [**trochlear nerve (CN IV)**](https://www.kenhub.com/en/library/anatomy/the-trochlear-nerve-and-the-abducent-nerve), enters the posterior aspect of the cavernous sinus after leaving the posterior part of the [brainstem](https://www.kenhub.com/en/library/anatomy/the-brainstem) and decussating with the same nerve from the opposite side. It continues anteriorly in the lateral wall of the cavernous sinus, inferior to CN III and passes through the superior orbital fissure at the anterior aspect of the sinus. Once in the orbit, CN IV has the responsibility of innervating the [muscles of the eyeball](https://www.kenhub.com/en/library/anatomy/muscles-of-the-orbit) that are responsible for inferolateral motions.

### **Trigeminal nerve**

Finally, two of the three branches of the [**trigeminal nerve (CN V)**](https://www.kenhub.com/en/library/anatomy/the-trigeminal-nerve) pass through the cavernous sinus. Prior to entering the cavernous sinus, the proximal portion of the nerve lies in Meckel’s cave, where it forms the trigeminal ganglion. After leaving the cave, the [**mandibular division (CN V3)**](https://www.kenhub.com/en/library/anatomy/the-mandibular-branch-of-the-trigeminal-nerve) courses inferiorly to pass through foramen ovale (without entering the cavernous sinus).

The other two branches, the [ophthalmic](https://www.kenhub.com/en/library/anatomy/the-ophthalmic-branch-of-the-trigeminal-nerve)and the[maxillary](https://www.kenhub.com/en/library/anatomy/the-maxillary-branch-of-the-trigeminal-nerve)**(CN V1 and CN V2**, respectively), travel through the lateral wall of the sinus. Both take courses inferior to CN III and CN IV, however, CN V2 is the most inferior of them all. Both CN V branches in the sinus travels horizontally. CN V2 leaves the sinus via foramen rotundum, while the three branches of CN V1 exit the cranial fossa via the superior orbital fissure. CN V1 and CN V2 are purely sensory and supply specific regions of the face.

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**Communications**

The cavernous sinus is an unconventional venous system in the sense that it does not have a unidirectional flow of blood. Owing to the fact that there are no valves in the sinus and its connected veins, the direction of blood flow is dependent on venous pressure. The veins that communicate with the cavernous sinus are:

* Superior ophthalmic vein
* Inferior ophthalmic vein
* Superficial middle cerebral vein
* Middle meningeal vein
* Hypophyseal veins

### **Superior ophthalmic vein**

The cavernous sinus generally has five venous tributaries. The **superior ophthalmic vein** receives blood from the ethmoidal, nasofrontal, vorticose (drains the ocular choroid), and central retinal veins. It drains into the anterior part of the sinus via the superior orbital fissure.

### **Inferior ophthalmic vein**

The **inferior ophthalmic vein** collects blood from the eyelids, lacrimal sac, and some vorticose contributions, as well as the anterior floor and medial wall of the orbit. In addition to draining to the cavernous sinus, it also drains to the pterygoid plexus.

### **Superficial middle cerebral vein**

At the point where the internal carotid artery emerges, the **superficial middle cerebral vein**pierces the roof of the sinus. Here, it drains blood from the cortices that are adjacent to it as it courses through the lateral sulcus.

### **Middle meningeal vein**

Finally, branches of the **middle meningeal vein** may join the **sphenoparietal sinus** on its way to the cavernous sinus. Before piercing the roof of the sinus, it travels along the edge of the lesser wing of the sphenoid between the layers of dura mater.

### **Hypophyseal veins**

Additionally, **efferent hypophyseal veins** of both the adenohypophysis and neurohypophysis drain to the cavernous sinus.

The left and right cavernous sinuses communicate by way of the **anterior and posterior intercavernous sinuses**. These vessels travel anteriorly and posteriorly (respectively) around the infundibulum of the pituitary gland, deep to the diaphragma sellae, between the layers of dura mater.

The cavernous sinus in turn drains to the **superior and inferior petrosal sinuses**. Both sinuses join the sigmoid sinus, which then becomes the internal jugular vein. The internal jugular vein meets with the subclavian vein to become the left (or right) [**brachiocephalic vein**](https://www.kenhub.com/en/library/anatomy/brachiocephalic-veins).

1. **Medial wall of the nasal cavity**

The **medial wall of the**[nasal cavity](https://www.kenhub.com/en/library/anatomy/nasal-cavity) comprises the nasal septum, the septal catilage and various [bones](https://www.kenhub.com/en/library/anatomy/bones) of [the skull](https://www.kenhub.com/en/library/anatomy/the-skull).

# **Lateral wall of the nasal cavity**

The lateral wall of the [nasal cavity](https://www.kenhub.com/en/library/anatomy/nasal-cavity) is a region of the [nasopharynx](https://www.kenhub.com/en/library/anatomy/the-pharynx) essential for humidifying and filtering the air we breathe in nasally.

Here we can find a structure called **agger nasi**. The agger nasi is also referred to as the ‘nasoturbinal concha’ or ‘nasal ridge.’ It can be described as a small mound or ridge found in the lateral side of the [nasal cavity](https://www.kenhub.com/en/library/anatomy/nasal-cavity). The structure is located midway along the anterior aspect of the middle nasal concha. An abnormally enlarged form may restrict the drainage of the frontal sinus by obstructing the frontal recess area.

**Parts:**

**Nasal septum**

- Cartilages: lesser alar cartilages, greater alar cartilages, lateral nasal cartilages

- Bones: anterior nasal aperture (piriform aperture) formed by maxilla and nasal bones

**Nasal conchae**

- Superior nasal concha

- Middle nasal concha

- Inferior nasal concha

**Nasal septum**

### **Bones and cartilages**

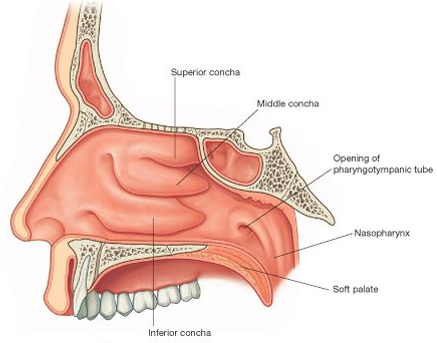
The **anterior nasal aperture** is simply the area where the anterior bony aspects of both the [maxilla](https://www.kenhub.com/en/library/anatomy/the-maxilla) and the [nasal bone](https://www.kenhub.com/en/library/anatomy/the-nasal-bone) terminate and form an opening into the cartilaginous nasal vestibule. The structure is also referred to as the piriform aperture.

Three cartilages contribute to the nasal septum:

* **lesser alar cartilages** are paired cartilages suspended in the fibro-fatty tissue that forms the lateral aspect of the nostril. The structures lie free from the other cartilages and provide the nostril with stability and form.
* **greater alar cartilages** are paired cartilages that form part of the antero-superior nostril as well as the nasal tip. The structures give the tip of the nose stability and flexibility and are a crucial element of the cartilaginous apparatus of the nose.
* **lateral nasal cartilages** are structures that articulate inferiorly with the greater alar cartilages and superiorly with the anterior nasal aperture formed by both the nasal bone superiorly and for a short part of its border with the perpendicular plate of the [ethmoid bone](https://www.kenhub.com/en/library/anatomy/the-ethmoid-bone). These structures form the cartilaginous part of the bridge of the nose and form in conjunction with the greater alar cartilages, the major structural appearance of the nose.

**Nasal conchae**

We can find 3 types of nasal conchae in the nasal cavity. Those are:



* **inferior nasal concha.** It is the longest and broadest of the conchae and is formed by an independent bone (of the same name, inferior concha). The concha is covered by a mucous membrane that contains large vascular spaces and is one of the three that work to both humidify and clear the air that passes into the nasopharynx.
* **superior and middle nasal conchae** arise from the perpendicular plate of the ethmoid bone. The middle nasal concha is found in between the superior and [inferior nasal concha](https://www.kenhub.com/en/library/anatomy/inferior-nasal-concha) and plays a role in humidifying and clearing inspired air of micro-particles such as dirt. The superior nasal concha is a bony shelf located above the middle nasal concha and below the sphenoethmoidal recess. Similar to the middle nasal concha the superior concha is itself part of the ethmoid bone.