Nasal Cavity and Paranasal Sinuses

The nasal cavities and sinuses are located in the middle third of the facial skeleton. These hollowed-out areas provide a protective barrier against bacteria. They also warm the inspired air before it reaches the pulmonary tree. Many authorities believe another purpose of these cavities is to reduce the weight of the head.

Bony Architecture

The right and left nasal cavities are separated by the median septum. This bony septum is comprised of the vomer and the ethmoid bone. Laterally, each nasal cavity is bounded by the maxillary sinus. The posterior boundary is the paired openings into the nasopharynx, known as the choanae. The floor of the nasal cavity is the palatine process of the maxillae and the horizontal process of the palatine bone. Thus, the palate separates the nasal and oral cavities. Projecting backward from the center of the posterior border of the hard palate is a small point of bone, the posterior nasal spine. The anterior nasal spine is the pointed process seen at the anterior midline of the anterior nasal aperture. It is formed by a junction of the right and left maxillae. The roof of the nasal cavity is formed by the nasal bones, the cribriform plate of the ethmoid bone and the sphenoid bone. Anteriorly, the boundary is the anterior nasal aperture. This is also known as the piriform aperture and is heart-shaped. The rim of this opening is formed by the nasal bones and the maxillae.

Several anatomic landmarks can be identified within the nasal cavity. It should be noted that the roof is perforated by multiple small foramina, which transmit the olfactory nerves. Posteriorly on the roof, the opening into the sphenoid sinus can be seen. The large triangular notch noted on the anterior border of the septum is the area that receives the cartilaginous portion of the nasal septum. Also, the septum displays severe furrows that mark the locations of vessels and nerves.

The lateral wall of the nasal cavity is most interesting. The lacrimal bone, maxillae, ethmoid bone, sphenoid bone, and even the palatine bone contribute to this area. The inferior nasal concha is a separate bone, not a process of the ethmoid bone. The superior and middle conchae are processes of the ethmoid bone. The three conchae are bulbous, banana-shaped structures attached lengthwise to the lateral wall. Below each concha is a depression. These depressions are the superior, middle, and inferior meatus. The posterior ethmoid cells open into the superior meatus. Also, the sphenopalatine foramen opens here. The maxillary sinus opens into the middle meatus as do the middle and anterior ethmoid air cells. Moreover, the frontal sinus drains into the middle meatus. The nasolacrimal canal opens into the inferior meatus. The nasolacrimal canal drains tears from the eyes into the nose. Hence, excessive tearing, as in crying, produces a "runny nose".

Soft Tissues

The external nose is primarily cartilage, skin, and mucosa. The two openings into the nose, the nares, are guarded by a number of stiff hairs, vibrissae. These hairs remove foreign
material carried in the current of inspired air. The cartilage of the external nose consists of the cartilage of the septum and the lateral and alar cartilages. The outside of the nose is covered with skin and the inside of the nose and nasal cavity is lined with mucous membrane. The skin surrounds the nares and even passes into the nose for 2 to 3 millimeteres to line the vestibule.

Further back into the nose on the lateral wall, just after entering the nasopharynx, the opening of the auditory tube can be seen guarded by the cartilaginous torus tubarius. This opening leads into the middle ear via the eustachian tube. Behind the torus tubarius is a depression, the pharyngeal recess where the adenoids (pharyngeal tonsil) are found. Removal of the three nasal conchae exposes numerous openings through the mucosa in the lateral wall of the nasal cavity. These openings correspond to the bony openings previously discussed. The hiatus semilunaris is merely a curved cleft at the depths of which lies the opening into the maxillary sinus. The bulla ethmoidalis is a prominence on the lateral wall just above the hiatus. It represents a bulging of the middle ethmoid air cells which open here.

**Blood Supply**

Details of arterial and venous anatomy are described in Chapter 3. In brief, the ophthalmic artery supplies blood to the nasal cavity via its ethmoidal branches. The sphenopalatine branch of the internal maxillary artery supplies the septum, meatus, and conchae. Venous drainage is via the ethmoid, sphenopalatine, and anterior facial veins.

**Nerves**

The nerves of ordinary sense - pain, touch, temperature - are carried via the nasociliary branch of the ophthalmic nerve, anterior superior alveolar branch of the maxillary nerve, nasopalatine nerve, and nasal branches of the sphenopalatine ganglion. Parasympathetic fibers for the glands of the nasal mucosa are also carried in branches of the sphenopalatine ganglion.

The olfactory nerve distributes special sensory fibers for smell via a plexus of nerves passing through the cribriform plate of the ethmoid bone.

**Paranasal Sinuses**

The skull and facial skeleton are hollowed out into various compartments. The cranial cavity, oral cavity, nasal cavity, and orbits are the largest. However, in the region of the orbits and nasal cavity, even more voids are located in the bony skeleton. Within the substance of the maxillae, frontal bone, zygomas, ethmoid bone, and sphenoid bone are the paranasal sinuses. These sinuses are air-containing spaces, lined by mucous membrane, that communicate with the nasal cavity via the openings described earlier. They develop by the invagination of mucous membrane of the nose into the peripheral bone. In the young, these sinuses are much smaller than in adults. They slowly increase in size with age. This process is known as pneumatization.
**Frontal Sinuses**

The frontal sinuses are located in the frontal bone just above the nasal cavity. The right and left frontal sinuses are divided by a septum which is somewhat perpendicular but rarely divides the two into a symmetrical pair. They drain into the ipsilateral middle meatus through a short canal, the *frontonasal duct*. Each at full size is about 2 to 3 centimeters in height, width, and depth.

**Sphenoid Sinuses**

Within the body of sphenoid bone, the air chambers known as the sphenoid sinuses are rarely symmetrical because of the lateral position of the intervening sinus septum. They communicate with the nasal cavity through an aperture above the superior concha. The size of each sinus is approximately 1.5 to 2.5 centimeters in diameter.

**Ethmoid Air Cells**

Numerous thin-walled cavities lie between the upper parts of the nasal cavities and orbits. They are formed between the *lamina orbitalis* (lamina papyracea) and the *superior* and *middle conchae* in skull. These ethmoid air cells open into the superior and middle meatus of the nasal cavity.

**Maxillary Sinuses**

The maxillary sinuses are the largest of the paranasal sinuses and occupy the body of the maxilla. Their shape is roughly pyramidal, with the base of the pyramid at the lateral wall of the nose and the apex pointing into the zygomatic process. The roof of the sinus is the orbital floor, and the alveolar process of the maxilla forms the floor of the sinus. The size varies from patient to patient, but on the average, the adult capacity is about 15 mL. The vertical height is 4 cm; the anteroposterior depth, 3 cm; and transverse breadth, 2 cm.

The maxillary sinus opens into the nasal cavity through an opening in the depth of the *hiatus semilunaris*. This is found under the middle concha.

The maxillary sinus is divided into various communicating compartments by bony walls and spicules; *septae*. As the sinus pneumatizes with age, it surrounds the roots of the teeth and even progresses into the body of the zygoma.

**Vessels and Nerves**

The ethmoid branches of the ophthalmic artery supply the ethmoid air cells and frontal sinuses. The sphenoid sinus is supplied by the sphenopalatine branch of the maxillary artery, and the maxillary sinuses are supplied by the infraorbital and the alveolar branches of the maxillary artery. The venous drainage is via ophthalmic veins and pterygoid plexuses. The nerve supply is via various branches of the first two divisions of the trigeminal nerve. Of note is that the alveolar branches of the maxillary nerve ramify in the maxillary sinus before entering the roots of the maxillary teeth. For this reason, patients with maxillary sinus disease often have the complaint of pain in all the maxillary teeth.
Lymphatic drainage of the nose and paranasal sinuses ends in the submandibular nodes, retropharyngeal nodes, and superior deep cervical nodes.

**Clinical Notes**

To the dental professional, the maxillary sinus is the most clinically significant. Inflammation of this sinus often causes pain in the maxillary teeth. Also, removal of the root tips of maxillary teeth can be hazardous in that these roots may be accidentally pushed into the sinus during the procedure. When these sinuses become inflamed, their mucous membranes produce large amounts of mucus via the various intramucosal glands. The maxillary sinus drains poorly, since its ostium is higher than its floor. Collection of material in the sinus sometimes produces considerable discomfort. Infection of a maxillary molar or a bicuspid commonly perforates and extends into the sinus to produce a secondary sinusitis.

Once an opening has been established through the floor of the sinus into the oral cavity, this opening must be closed to prevent influx of oral material into the sinus with resultant chronic sinusitis. Such an opening is termed an oral-antral fistula.

Trauma to the facial skeleton, particularly the orbital region, may cause disruption of the sinus roof and herniation of the orbital contents down into the sinus. This may produce double vision, diplopia, or other difficulties in function of the eye.