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The Region of the Nose and Nasal Cavities

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quality or color. The next succeeding four layers are alternating *nuclear* and *molecular* layers, called *outer* and *inner*, from their relative positions. They consist of strata of clear nucleated corpuscles or granules, modified in each layer so as to offer some peculiarities, and embedded in the retinal connective tissue. They are severally connected by upward and downward prolongations, the outer nuclear layer with the rods and cones as above stated, whereas the inner molecular layer joins the seventh or ganglionic layer. The last is a very clear stratum of spheroidal nerve-cells connected by oblique processes with the eighth retinal layer, which consists of the ultimate fibres of the optic nerve. The ganglionic cells are inserted into several strata in the vicinity of the yellow spot, and within it into six or seven. The layer of nerve-fibres is composed of the axis cylinders only, and is continued as far forward as the ora serrata, arranged for the most part in bundles which interchange so as to form plexuses. At the yellow spot this layer is interrupted by the accumulation of nerve-cells.

THE REGION OF THE NOSE AND THE NASAL CAVITIES.

The special organ of the sense of smell consists of an external portion, the *nose*, and internal portions, the *nasal fossæ*, or *nasal cavities*.

The nose is the prominent feature which projects anteriorly between the orbits from the upper part of the face, being connected by its summit with the forehead and by its base with the upper lip. It serves as the chief avenue of respiration when the mouth is closed. The skeleton of the nose consists of the two nasal bones and the nasal processes of the superior maxillary bones, to which is attached a cartilaginous framework composed of five peculiarly-shaped movable cartilages.

The *nasal bones* are severally of an elongated quadrilateral shape, being narrow and thick above, where they are firmly attached by suture with the nasal spine of the frontal bone, constituting the *nasion*, and wide and thin below, where they form the upper margin of the *anterior nasal fossæ* of the skull (Plate 28) and in the recent state give attachment to the upper

lateral nasal cartilages. They are strongly united in the middle line, forming "the bridge" of the nose, this juncture being strengthened by their inner borders projecting as a longitudinal *crest*, which connects them with the ethmoidal portion of the septum of the nose. Their outer borders are bevelled, and supported by the contiguous borders of the superior maxillary bones. The width and length of the nasal bones vary greatly in different skulls, and, as they are almost immediately beneath the skin (Plate 1), they give shape and character to the organ. The under surfaces of the nasal bones are grooved for the nasal nerves, and perforated by a few small foramina for the transmission of vessels.

The *nasal processes of the superior maxillary bones* are triangular, thick, bony plates which extend upward on each side of the nose to be joined by suture with the frontal bone. Their anterior borders are serrated for articulation with the nasal bones,—the form and dimensions of the nose being mainly dependent upon the development of these processes and the manner in which the nasal bones are set upon them. The outer surfaces of the nasal processes are serrated and concave; the internal surfaces are rough, and present two well-marked ridges, the superior and inferior turbinated crests, the former articulating with the middle turbinated portion of the ethmoid bone and the latter with the inferior turbinated bones on each side.

The *cartilaginous framework of the external nose* is formed of a median septum and two lateral segments on both sides. The *cartilage of the septum* is a smooth triangular plate inserted posteriorly into a groove in the perpendicular plate of the ethmoid bone; anteriorly, where it is thicker, it is connected above with the nasal bones and adjacent lateral cartilage, and below with the vomer and the palatine processes of the superior maxillary bones. The septal cartilage separates the anterior portions of the nasal cavities, and up to the seventh year of age is usually straight, but subsequently it is apt to incline to one side (usually the left), according to the deviation of the vomer (Plate 28, No. 39). Sometimes it is perforated, and thus establishes a communication between the cavities. The *lateral cartilages* consist of an *upper* triangular piece and a *lower* oval piece on each side, which together give shape to the wings and tip

of the nose and support the integument. Each upper cartilage is attached above to the margin of the nasal bone and adjoining nasal process, in front to the septum, and below to the lower cartilage. The latter is curved upon itself so as to form the outer and inner boundaries of the external orifice of the nostril. It approaches its fellow of the opposite side internally, and thus forms the upper part of the *columna nasi*, the partition between the nostrils. When the lower lateral cartilages are not in contact there is a median furrow which is sometimes well marked at the tip of the nose. These cartilages are connected to each other and to the bones by a tough fibrous membrane, the *perichondrium*. In this tissue, in relation to the superior maxillæ, there are usually several nodules,—*sesamoid cartilages*. The elasticity of these cartilages preserves the size and shape of the nostrils, and enables the muscles moving them to expand or contract the orifices so important in respiration. The *skin* over the root of the nose below the forehead, on the sides and the greater part of the dorsum, is thin and loose; but over the wings (*alæ*) and on the point it is thick and very adherent to the parts beneath, and remarkable for the number and size of its sebaceous follicles. Owing to the presence of the latter, the lower part of the nose is frequently the seat of acne. Inflammation of the skin over the cartilaginous portion of the nose is very painful, and is usually accompanied by local congestion, the pain depending upon the tenseness of the part and the congestion upon the free blood-supply of the region. There is very little fat in the cellular tissue between the skin and the alar cartilages.

The muscles in connection with the nose are, on each side, the *pyramidalis nasi*, the *compressor naris*, the *depressor alæ nasi*, and the smaller *dilatator* muscles. The *pyramidales nasi* muscles arise from the upper borders of the right and the left *compressor naris* muscle, having an angular interspace between them, and pass upward over the bridge of the nose, joining each other in the middle line, and blending their outer fibres with the orbicular muscles of the eyelids, their inner fibres being prolonged into the *occipito-frontales* muscles (Plate 15, No. 4). The principal action of these muscles is to produce transverse wrinkles at the root of the nose, by drawing down the inner angles of the eyebrows;

but by reversing their action and tightening the skin over the alar cartilages they may also serve as dilators of the nostrils. The *compressor muscles* of the nose are triangular in shape, arising on each side of the face, from the inner sides of the canine fossæ of the superior maxillæ, and join by a common aponeurosis over the dorsum of the nose. These muscles compress the alæ and produce the pinched appearance seen in labored breathing. Their origins are concealed by the elevator muscles of the upper lip and the wing of the nose (Plate 18, No. 4, and Plate 19, No. 5).

The *depressores alarum nasi muscles* arise from the superior maxillary bones, above the second incisor teeth, and, being placed between the mucous lining of the upper lip and the orbicular muscle of the mouth, their fibres radiate to the septum and back parts of the alæ of the nose. These muscles serve to constrict the anterior nares by drawing the alæ downward.

The *dilatator—anterior and posterior—muscles* are very delicate bundles of fibres, which pass respectively from the alar cartilage to the overlying skin, and from the sesamoid cartilages and nasal process of the superior maxilla to the margin of the nostrils. In ordinary respiration, especially in sleep, these little muscles resist the tendency of the nostrils to close from atmospheric pressure, by raising and everting the alæ, but in dyspnoea their action is marked, as it also is in the expressions of pride, anger, and disdain.

The *arteries* of the nose are the *lateralis nasi* from the facial (Plate 18, No. 6), the nasal branch from the superior coronary artery to the septum, and the nasal branches from the ophthalmic and infra-orbital arteries. The great vascularity of the skin over the nose renders it well adapted for plastic surgery in this region. The *nasal veins* empty into the facial and ophthalmic veins. The *nerves of the nose* are branches from the facial nerve which supply the muscles, branches from the infra-orbital and infra-trochlear nerves, and the *naso-lobular* filament from the nasal branch of the ophthalmic, which, after descending in a groove on the inner surface of the nasal bone, becomes subcutaneous at the junction of the nasal bone and upper lateral cartilage and supplies the tip and lobule of the nose (Plate 53, Fig. 1, No. 17). This latter nerve establishes connections with the eye, as is demonstrated by the lachrymation which follows

any intense irritation about the nostrils. There are numerous lymphatic vessels about the nose, which follow the course of the facial vein and mostly empty into the lymphatic glands of the submaxillary region (Plate 16). Within the margins of the nostrils there are numerous stiff curved hairs, *vibrissæ*, which grow from the inner surface of the alæ and septum as far as the place where the skin joins the mucous lining of the nasal cavities.

The nasal fossæ, or nasal cavities, are the two very irregularly shaped air-chambers, separated by the septum nasi, which open on the face by the *anterior nares* and on the pharynx by the *posterior nares*, and communicate at their outer sides with the sinuses of the ethmoid, sphenoid, frontal, and superior maxillary bones. They also communicate with the orbits by the lachrymal canals, with the mouth by the anterior palatine canals, and with the cranium by the olfactory foramina. Each nasal fossa is narrower above than below, and higher at the centre than at either the anterior or the posterior opening. The roof of each nasal fossa is formed by the nasal bone, the nasal spine of the frontal bone, the cribriform plate of the ethmoid bone, the body of the sphenoid bone, and the sphenoidal turbinated bones. The floor is formed by the horizontal plates of the superior maxillary and palate bones, and is wider at the centre than at either end. The inner wall is the smooth septum formed principally by the perpendicular plate of the ethmoid bone, the vomer, and the septal cartilage. The outer wall is formed by the nasal processes and inner surfaces of the superior maxillary, lachrymal, ethmoid, palate, and inferior turbinated bones, and the internal pterygoid plate of the sphenoid bone. The *turbinated bones* are delicate, spongy, scroll-shaped bony shelves, which give greater extent of surface to the mucous lining of the nose, projecting from the outer wall and dividing each nasal cavity into the *superior*, *middle*, and *inferior nasal meatuses*, or passage-ways (Plate 12, No. 29). The *superior meatus* is the smallest, and occupies the upper and back part of the nasal fossa, between the superior and middle turbinated bones. In the dried skull the spheno-palatine foramen opens at the back part of the outer wall of the superior meatus, but in the recent state this opening is covered by the pituitary mucous membrane. The *posterior ethmoidal cells* communicate with the superior meatus imme-

PLATE 16.

Dissection of the superficial muscles of the right side of the head, face, neck, thorax, and arm. From a well-developed male, aged thirty-five years. The superficial lymphatic glands and vessels of the face and neck are drawn on the photograph (after notes of many dissections) to show their arrangement and position.

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| 1. The epicranial aponeurosis. | 18. The submaxillary lymphatic glands. |
| 2. The temporal muscle, with the temporal lymphatic vessels. | 19. The digastric muscle. |
| 3. The posterior auricular lymphatic glands. | 20. The hyoid bone. |
| 4. The superficial jugular lymphatic glands. | 21. The thyro-hyoid muscle. |
| 5. The mastoid attachment of the sterno-cleido muscle. | 22. The omo-hyoid muscle. |
| 6. The occipital lymphatic glands and vessels. | 23. The pomum Adami of the thyroid cartilage. |
| 7. The splenius muscle. | 24. The carotid lymphatic glands. |
| 8. The levator anguli scapulæ muscle. | 25. The sterno-thyroid muscle. |
| 9. The scaleni muscles. | 26. The sterno-hyoid muscle. |
| 10. The trapezius muscle. | 27. The supra-clavicular lymphatic glands. |
| 11. The deltoid muscle. | 28. The clavicular attachment of the sterno-mastoid muscle. |
| 12. The compressor naris muscle. | 29. The sternal attachment of the sterno-mastoid muscle. |
| 13. The buccinator muscle. | 30. The clavicular portion of the pectoralis major muscle. |
| 14. The anterior auricular lymphatic glands. | 31. The sternal portion of the pectoralis major muscle. |
| 15. The supra-parotid lymphatic glands. | 32. The triceps muscle. |
| 16. The masseter muscle. | 33. The serratus magnus muscle. |
| 17. The depressor anguli oris muscle. | 34. The biceps muscle. |



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diately behind the superior turbinated bone in the upper wall. The *middle meatus* is larger than the superior, is situated between the middle and inferior turbinated bones, and extends along the posterior two-thirds of the outer wall of the nasal fossa. At its anterior part a long narrow passage, the *infundibulum*, leads upward into the anterior ethmoidal cells and thence to the frontal sinus. About the centre of the outer wall is the orifice, of variable size, which leads into the sinus of the superior maxillary bone, the *antrum of Highmore*. The *inferior meatus* is the space between the inferior turbinated bone and the floor of the nasal fossa, extending the entire length of the outer wall of the nose.

The lachrymal canal, or nasal duct, which conveys the tears from the lachrymal sac to the nose, opens into the anterior part of the inferior meatus. The lachrymal sac occupies the groove formed by the lachrymal bone and the nasal process of the superior maxillary bone (page 86). The *nasal duct* is twelve millimetres, or about half an inch, in length, and is directed downward, backward, and a little outward. Its opening in the inferior meatus in life is guarded by a valvular fold of the mucous lining, the *valve of Hasner*, and its position is two and one-half centimetres, or about one inch, behind the opening of the nostril, and one and three-fourths centimetres, or three-fourths of an inch, above the floor of the nose. The pharyngeal opening of the Eustachian tube is behind the inferior turbinated bone (Plate 12, No. 32). There is a great difference between the form and dimensions and character of the various openings of the nasal fossæ as they exist in the dried skull and as they present themselves in the recent-state. This is chiefly dependent upon the arrangement of the *Schneiderian* or *pituitary membrane*, the vascular mucous membrane which lines the nasal cavities and the passages connected with them. This membrane is continuous with the skin at the inner borders of the anterior nares, with the mucous membrane of the pharynx through the posterior nares, and with the conjunctiva through the nasal ducts and the lachrymal canaliculi, and is prolonged into the various sinuses communicating with the nasal fossæ already described. A coryza, or inflammation of the nasal mucous membrane, may thus implicate any of these structures, and a "cold in the head" or an attack of "hay fever" furnishes a demonstration of these

relationships. The mucous membrane varies much in thickness, vascularity, and appearance in these different parts. It is thickest and most vascular over the turbinated bones, where it forms projections especially in relation to the front and back part of the inferior turbinated bone, and thus encroaches upon the dimensions of the space of the nasal cavity. It is also quite thick on the septum, but in the intervals between the turbinated bones and on the floor of the fossæ it is thinner. The lining membrane within the cells and sinuses is very thin and pale, and very different from the proper lining of the nose. In the middle meatus the opening of the infundibulum is nearly closed by a fold of the membrane, and the opening into the antrum of Highmore is greatly diminished from its size in the dried bone, appearing usually as a round hole, about the centre of the middle meatus, and nearly two and one-half centimetres, or an inch, above the floor of the nose. The mucous lining of the nasal cavities is peculiarly modified in the nostrils, in the air-passages, and in the olfactory region. In the nostrils it is furnished with papillæ, a few hairs, and a squamous epithelial lining; in the air-passages the epithelium is columnar and ciliated; but upon the upper portion of the septum and upon the superior and middle turbinated bones, where the olfactory nerves are distributed, the epithelium is entirely columnar. These columnar cells terminate in fine processes, between which the microscope reveals nucleated fusiform cells, the so-called *olfactory cells*.

The *anterior nares* are the oval openings of the nasal cavities on the face, and are placed horizontally, so that in order to examine the septum and inferior turbinated bones the head should be thrown back (Plate 53, Fig. 1). A finger can be readily introduced into the nostril and passed far enough back to reach another finger introduced into the posterior nares through the mouth. The posterior nares are about the same height as the anterior (three centimetres, or one and a quarter inches), and measure transversely in the dried state twelve millimetres, or about half an inch, but in life the mucous lining considerably diminishes them. The ordinary deviation of the septum may block one nostril more or less, and interfere with the clearness of the voice, especially in singing. The floors of the nasal cavities are generally wider at the centre, where the passages are also

higher than elsewhere, and foreign bodies often become lodged here. The introduction of forceps to remove the latter, or for the extraction of nasal polypi, should be along the floor of the inferior meatus, and they should be opened so as to grasp the object vertically.

The *posterior nares* when the mouth is opened are usually blocked by the folds of the soft palate being drawn upward, and are thus cut off from the pharynx. Owing to this disposition, the "*nasal douche*" can be used so that the fluid introduced into one nostril shall pass over the soft palate and return by the other nostril.

The vascularity of the mucous membrane of the nose is due to the numerous capillaries which anastomose freely beneath its surface. The arteries of the nasal cavities are the anterior and posterior ethmoidal branches of the ophthalmic arteries, which supply the roof of the nose, the ethmoidal cells, and the frontal sinuses; the nasal arteries, from the internal maxillary, which supply the septum, the meatuses, and the turbinated bones; and the posterior dental arteries, from the internal maxillary arteries, which supply the antra. The veins of the interior of the nose terminate in the ethmoidal veins, which enter the ophthalmic vein. In children there is almost always a communication between the nasal veins and the superior longitudinal sinus through the foramen cæcum. This is usually closed about puberty, but may continue in the adult and perhaps explain persistent hemorrhage or the spread of inflammation from the nasal cavities to the meninges of the brain. There is a venous plexus (*rete nasi*) about the inferior turbinated bone which resembles a kind of cavernous tissue, very prone to bleed. Bleeding from the nose—or *epistaxis*—is generally due to some interference with the venous circulation. There are also venous communications with the frontal vein, and through the spheno-palatine foramen with the zygomatic plexus. The mucous membrane of the nose is abundantly furnished with sensory nerves. The *roof* is supplied by the nasal branches from the ophthalmic and filaments from the Vidian nerves; the *septum*, by branches from the nasal nerves, the spheno-palatine (or Meckel's) ganglions (Plate 3, Fig. 2, No. 6), and the naso-palatine nerves; the *floor*, by branches from the naso-palatine and anterior palatine nerves; and the *outer walls*, by filaments from the spheno-palatine

ganglions, and branches from the nasal, anterior dental, and anterior palatine nerves. The *olfactory nerves*, about twenty on each side, are derived from the olfactory bulbs, and pass through the foramina in the cribriform plate of the ethmoid bone. They are arranged in three sets on each side, and each nerve is invested with a fibrous prolongation from the dura mater. The *inner* set supply the upper part of the septum; the *middle* are the smallest, and are spread over the roof of the nose; the *outer* are the largest, and are divided into two groups, the anterior group supplying the mucous membrane over the superior turbinated bone, and the posterior group being distributed over the os planum and the middle turbinated bone. It will be noticed that the olfactory nerves are situated high up in the nasal cavities, and hence in the effort to smell intently the nostrils are always dilated. The partial loss of smell in some cases of facial paralysis has been ascribed to inability to dilate the nostrils. The olfactory nerves ramify between the mucous membrane and the bone, communicating freely with one another, and forming plexuses with elongated meshes. The fibres of these nerves are non-medullated, with a sparsely nucleated neurilemma. Interspersed between the columnar epithelial cells in the olfactory region there are peculiar cells having a nucleated body with two processes. These are called the *olfactory cells*, because one of the cell processes terminates on the surface of the mucous membrane and the other is believed to be in connection with the terminal filaments of the olfactory nerves.

THE REGION OF THE FACE.

The landmarks of the face (Plates 1 and 28) include, besides the bony prominences of the orbits (page 79) and the nose (page 108), the malar eminences and their backward prolongations into the zygomatic arches, which support the cheeks, and the angles, lower border, and mental eminence of the inferior maxillary bone, the latter giving prominence and character to the chin.

The skin of the face is generally very fine and thin, and adherent to the parts beneath, except over the eyelids, where it is peculiarly delicate and the subcutaneous cellular tissue is very loose. In relation to the *alæ* of