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THE ANATOMY OF THE NASAL CHAMBERS.*

By HARRISON ALLEN, M. D.,
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The anatomy of the nasal chambers bears a close relation to their clinical states, and must always repay the physician who makes them the subject of study.

The descriptions which form this essay will be confined, in the main, to the structures which can be seen in the living subject.

I shall consider the shape of the anterior portion of the middle turbinated bone and associated parts, the shape of the posterior part of the same, the difference in diameter of the chambers, and the boundaries of the naso-pharynx directly back of the chambers.

The Shape of the Anterior Part of the Middle Turbinal.—The middle turbinal, when examined by anterior rhinoscopy, presents a stout anterior border which extends vertically, and an inferior border seen foreshortened, extending horizontally for a variable distance.

The vertical border varies both in position and shape. It may, as a rule, lie in the plane of the posterior border of the ascending process of the maxilla, or be advanced well

* Read before the American Laryngological Association at its tenth annual meeting.

into the external nose so as to be placed between the process last named and the septum. The border is, in the majority of instances, thin and compressed, and retains a diameter not over 2 or 3 mm., but it may be much wider, and attain in rare instances estimated diameters of 6 to 10 mm.* Examination of the ethmoid bone in the skeleton shows the increase of width to be due to the inflation of the bone by two or more interspaces occurring between the vertical walls. The anterior portion of the middle turbinated bone may be said to be separated from the posterior portion at a vertical plane which passes through the anterior ethmoidal foramen and the line of the suture between the malar and sphenoid bones. The part of the nasal chamber which lies between this plane and the ascending process of the maxilla is wider than elsewhere. It is bounded laterally by the uncinate process of the ethmoid bone and the lacrymal bone, inferiorly by the suture between the horizontal plates of the maxilla and the palatal bones, anteriorly by the plane of the posterior borders of the ascending process of the maxilla, and posteriorly by the plane of the anterior ethmoidal foramen. Hanging directly within this space is the anterior portion of the middle turbinated bone.

The following structures lying within the anterior part of the nasal chamber may become inflated—viz., the anterior portion of the middle turbinal, the anterior ethmoid cells,† and the points of junction of the middle and superior turbinal with the ethmoid bone proper. No inflated

* Greater diameters have been observed by Zuckerkandl ("Anat. der Nasenhöhle").

† The term cyst used by Bayer ("Centralbl. f. Laryng.," ii, 237) and Glassmacher ("Berl. k. Wochensch.," 1884, No. 30) is probably the same as the inflated part as above denoted. Since they are not morbid, but may simply become the seat of disease, it was thought best to avoid a term of pathology.

part occurs in the posterior portion. The anterior portion is never scrolled.

The inferior free border of the anterior portion of the middle turbinated bone may be abruptly bent and be free from surrounding parts or be pressed against them. The anterior portion is distinguished clinically from the posterior by the disposition shown for the bone to be covered with spicules or the whole region to be hyperostosed. The membrane is often abnormally thickened at this place alone. The bone, when denuded of its membrane, is found to be separated from the rest of the turbinal by a groove.

The septum being in no instance perfectly straight, but presenting wavy surfaces (even when not grossly deviating from a vertical plane), it is possible for the inflated anterior portion of the middle turbinated bone to be concealed at the sides while freely exposed in front.

Numbers of instances have been seen in which the anterior border was not inflected, but of wafer-like thickness, yet the bone was found to be greatly inflated a short distance back.

The importance of this knowledge in making clinical examinations is so evident as to call for no comment.

The anterior ethmoid cells often form a distinct structure. A rounded mass which resembles the larger end of a distended pea-pod may be seen occasionally projecting into the nasal chamber at the widened anterior part. It usually lies back of the uncinate process, which may be widened and placed nearly transverse to the chamber, and thus be held between it and the nasal septum (as in skull, No. 1,432, Peruvian, in the Academy of Natural Sciences of Philadelphia), or projects more directly forward than in the instances given, when it occupies the space between the uncinate process and the lacrymal bone, and can be seen only after this bone has been removed (see skull, Peruvian, McCracken

series, in the Academy of Natural Sciences of Philadelphia). The entire anterior portion of the ethmoid mass may be distended, but without a distinctly projecting mass being formed (No. 1,032, Peruvian, in the Academy of Natural Sciences of Philadelphia, will serve as an illustration).

I have seen cases where intense pain of an inflammatory type was located directly over this anterior inflated part of the ethmoid bone, which was relieved by drilling into the parts from in front.

The inflated parts at the places of junction of the turbinals with the main portion of the ethmoid are never of large proportions, but may exert injurious pressure against the septum, especially in the instance of the superior turbinal.

A question may here be answered as to the connection between the forms of the middle turbinated bone and disease of the bone and its membranes. I have found, both in children and adults suffering from atrophic catarrh, a simple and compressed anterior portion.

The lower free border anteriorly may be also inflated. An S-shaped anterior portion has been observed in adults only. The inflated form is, however, absent in all ages. In chronic nasal catarrh I have met with all the above varieties.

The Shape of the Posterior Part of the Middle Turbinal.—The hinder part of the middle turbinal as seen by posterior rhinoscopy either entirely occupies the upper part of the choana or inclines obliquely downward and inward. In the latter instance, a space is formed through which a small portion of the interior of the chamber can be seen. The superior turbinal is less commonly seen in the choana than is shown in the figures of the clinical text-books. I have commonly found the right middle turbinal less inclined than the left, and it may be horizontal at the upper part, a condi-

tion very rarely seen on the left side. The left turbinal is often nearly vertical and held in a narrowed choana. A deflected septum will be apt to compress the middle turbinal on the side toward which the septum inclines. But apart from this condition, the left middle turbinal may incline posteriorly to the vertical line.

In posterior rhinoscopy the parts are seen as they lie in various relations to the plane of the posterior naris, as this opening is defined in the skull. Observers commonly speak of the image as though it were framed in this plane. In truth, what is seen is a foreshortened view of the posterior portion of the nasal chamber seen through the naris. If care be not taken, a septal deviation which is within the chamber may be confounded with a thickening of the septum at the plane of the nares. In studying the skull, of course, this difficulty disappears. If a careful inspection satisfies the observer of the living subject that an irregular or triangular swelling exists on the septal side of the smaller of the two images of the nares, and that this swelling is associated with a middle turbinated bone which inclines to the vertical, a diagnosis of posterior deviation of the septum can be made, although the septum may be normal as seen from in front.

The Diameters of the Chambers.—That the two chambers may vary in size without deviation of the nasal septum was shown by me in a skull exhibited before the Association in 1883.* Since that time I have seen a number of crania which yield a similar appearance, and it would not be necessary to recall the observation if a statement had not been made by Dr. Morell Mackenzie † to the effect that he had examined 3,102 skulls in the collections of London and not

* "Trans. Am. Laryngolog. Assoc.," 1883, p. 84.

† "Diseases of the Throat and Nose," 1884, ii, 467.

found a single example of such asymmetry.* I was led by this statement to go over the ground as it was presented in the museums at Philadelphia.

In the Academy of Natural Sciences are collected 1,750 skulls of many nationalities; eighteen examples of left choanal asymmetry were met with. Of this number, only two showed septal deviation, and three only presented angularity of the left contour-line of the septum. In all the above the left choana was distinctly smaller than the right, and the general disposition was the same throughout the left nasal chamber.

The following crania make up the total as given above: Eight Peruvian (Nos. 892, 1,273, 1,489, 1,518, 1,376, San Maleo, 1,026, 1,691), one aged six months; two Hindoo (Nos. 1,554, 4), one aged eight years; two Narragansett North American Indians (Nos. 952, 951); and one each of the ensuing tribes: Otaheitan (No. 1,681), Carib (No. 692), Araucanian (No. 652), Fiji (No. ——), Columbia River Indians (No. 575), and one skull was unnamed (No. 1,489).

In nine examples it was observed that the right nasal chamber was the smaller. They were distributed as follows: Four Peruvians (Nos. 403, 1,366, 1,432, 67); and one of a Columbia River Indian (No. 574), and of the ensuing numbers (Nos. 1,489, 32, negro, 964, 959).

In the skull last named (No. 959) the nasal septum was deviated to the right.

The following include some measurements in centimetres and millimetres of the asymmetrical nares in Peruvian crania:

* In the figure of the choanæ in Quain's "Anatomy" (vol. i, Fig. 52, 9th edition) the left is the smaller.

No. of specimen.		Height.	Middle width.	Top width.	Width of turbinals.
892	R...	2·0	1·1		
	L...	2·0	1·0		
1,442	R...	2·3	1·3		
	L...	2·3	1·1		
1,489	R...	2·5	1·2		
	L...	2·4	1·0		
1,366	R...	2·5	1·5	0·7	
	L...	2·4	1·5	0·8	
1,518	R...	2·1	1·5	0·7	
	L...	2·4	1·4	0·4	
1,691	R...	2·3	1·3		
	L...	2·3	1·5		
67	R...	2·3	.....	....	1·1
	L ..	2·4	.....	.....	0·9
1,273	R...	2·8	1·5		
	L...	2·7	1·2		
1,033	R...	2·6	1·4		
	L...	2·4	1·6		
1,026 (Young)	R...	1·8	1·0		
	L...	1·6	0·9		

In the collection of 156 crania in the College of Physicians of Philadelphia—most of the specimens being from European localities—the asymmetry was noted in twenty-four.

Of this number, eleven exhibited the left choana as the smaller. The specimens were distributed as follows: Gypsy (No. 31), Magyar (No. 13), Kossack (No. 101), Roumanian (No. 96), Dalmatian (No. 132), "Gaming Steverin" (No. 138), Krain (No. 86), Anglo American (No. 5), Japanese (No. 50), Pole (No. 26), and one without locality.

The septum was straight in two examples only of the series—viz., in Nos. 86 and 138. It was nearly straight in No. 96.

The remaining thirteen skulls yielded a larger right choana, as follows: Wende (No. 85), Carniola (No. 87), Kumanéa (No. 71), Schlesien (No. 68), Austrian (No. 63), Calabria (No. 48), Ceragora (No. 29), Gypsy (No. 18),

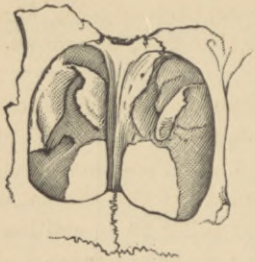

FIG. 1.

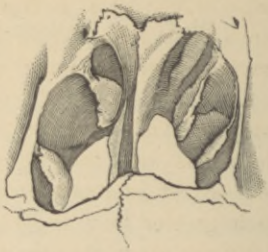

FIG. 2.

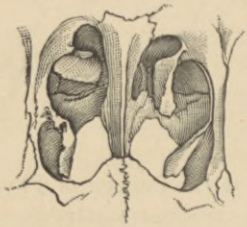

FIG. 3.

FIG. 4.

FIG. 5.

The above examples of asymmetry of the nasal chambers at the choanæ (the septum being straight or nearly so) are from the collection of the Academy of Natural Sciences of Philadelphia. The artist, in order to better illuminate the parts, inverted the specimens, thus sacrificing some of the details at the region of the inferior turbinals.

Italian (No. 107), Servian (No. 90), Gorale (No. 83), Genua (No. 113), Anglo-American (No. 28); five showed straight or nearly straight septa.

It is seen that the number of instances among recent European skulls (three only of the skulls in the College of Physicians were from ancient graves, and these were symmetrical) of contrasts in measurements of the choanæ is much greater than in the skulls of other races, and that within the group thus limited deflection of the septum is of more common occurrence.

It would appear that the best guide to nasal asymmetry as seen in crania is a comparison between the choanæ. The septum may be straight, be inclined to the smaller choana, or to the opposite side. The asymmetry appears to be determined by causes which exist independently of the deviation of the septum—always assuming that the posterior free border of the septum does not deviate from the vertical.

The study of crania is not the best standard for clinical study. From my experience, the number of instances of asymmetry of the choanæ is vastly greater than can be gleaned from ethnological cabinets.* The entire number has not been recorded, but it can be stated in general terms that a difference exists in the diameters of the choanæ, and that the left is the smaller, as a rule. Even when the contrast is slight, the left middle turbinal is commonly more vertically inclined than is the right.

The Boundaries of the Naso-pharynx directly back of the Choanæ.—The space directly back of the choanæ receives the turgescent ends of the turbinals when they can be no longer contained within the chambers. Above, the space is defined by the alæ of the vomer; below, by the velum in advance of the salpingo-palatal folds, and at the sides by the internal pterygoid plates and the orifices of the Eu-

* "Trans. Am. Laryngolog. Assn."

stachian tubes. As opposed to the vestibule which lies in advance of the true nasal chamber, the above space may logically constitute the *posterula*, if it be found convenient to employ a distinctive term.

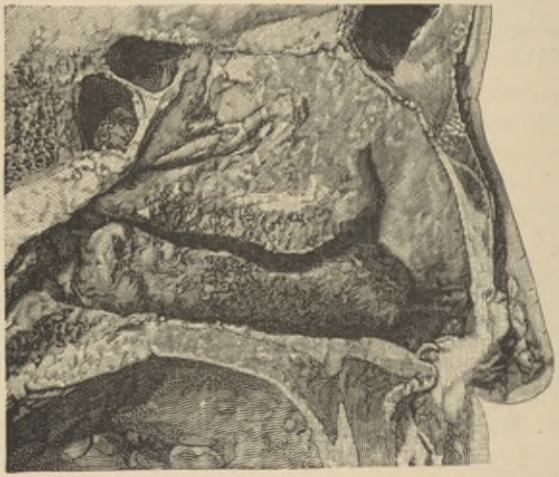

FIG. 6.—View of the left nasal chamber from a specimen prepared by the alin-jection method of Professor Wilder. The subject was believed to be free from disease of the nasal mucous surfaces. Since the saw used in making the section fractured the horizontal plate of the palatal bone, it is possible the measurements given in the text are approximately correct only. In any event it will be seen that the ends of the middle and inferior turbinal lie beyond the plane of the choana.

In a specimen of the human head which has been carefully injected by Professor Burt G. Wilder, of Cornell University, it is shown that, in a normal condition of the membranes, the mucosa and submucosa became infiltrated and distended in such wise as to cause projections of the lower and middle turbinals into the naso-pharynx.* The measure-

* I desire to return acknowledgments to Professor Wilder for an opportunity of exhibiting this interesting specimen.

ments in this specimen are as follows: Inferior turbinal beyond the end of horizontal plane of palatal bone, 5 mm.; middle turbinal beyond the end of horizontal plane of palatal bone, 7 mm.; from the end of vomerine alæ to the plane of the choanæ, 15 mm.

During life the presence of the posterior ends of the turbinals in the naso-pharynx is not unphysiological. I have frequently observed that perfect comfort is compatible with the existence of such masses. If, however, nasal breathing is arrested, if the turbinals are pressed against each other in the same chamber, if the Eustachian tubes are pressed upon, if the salpingo-palatal folds are impinged—and it must be said that one or more of the above conditions are apt to be present—the reduction of the swellings is demanded.

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