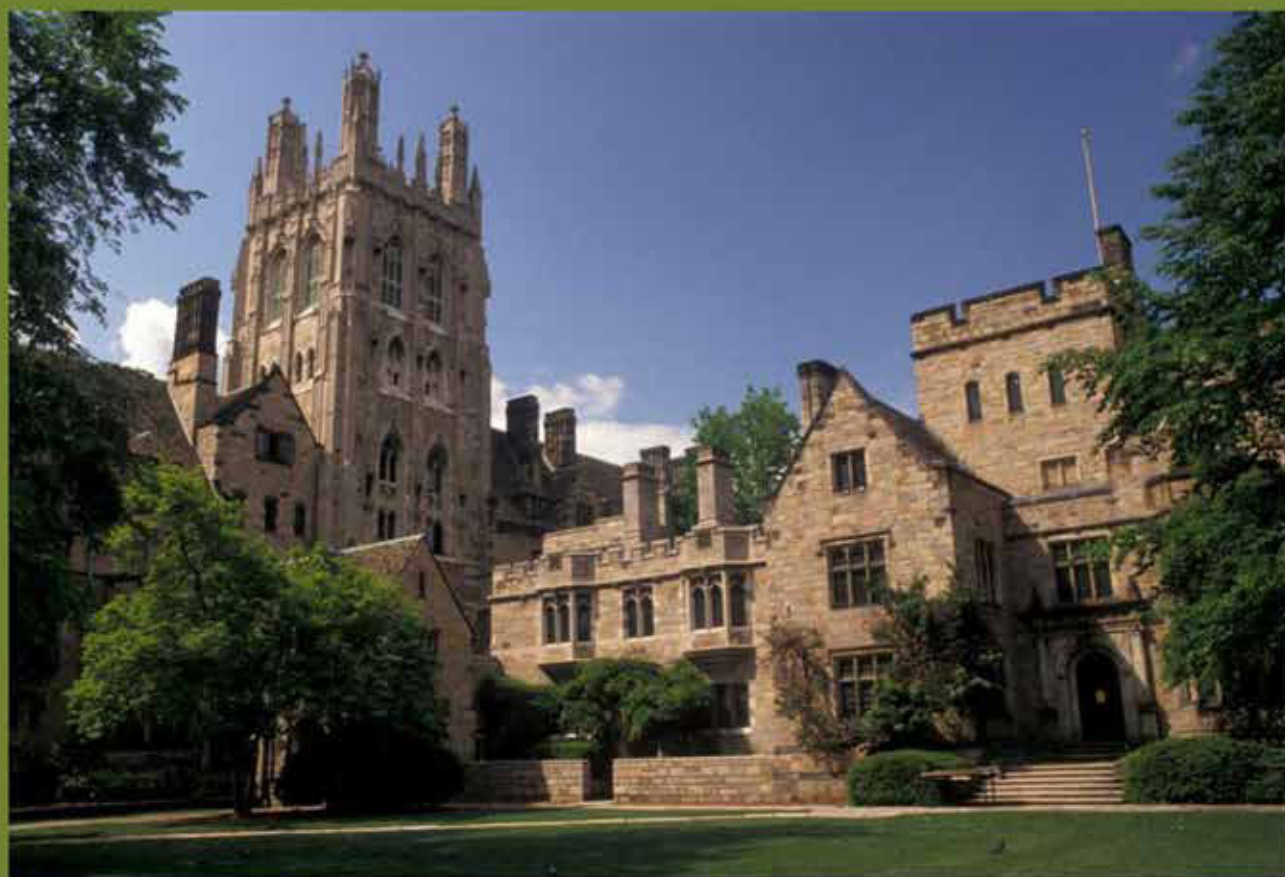


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## ***The anlage and development of the nasal cavity in the human embryogenesis period***

**Abstract:** We have morphologically investigated 49 histological sections of the human embryos. We have found out that at the beginning of the embryonic period nasal placodes are developed, and in the middle of the period nasal fossae are formed. Nasal fossae are limited by the horseshoe-shaped protuberances which are thickened in the shape of rolls, that is the primary stage of the front and side nasal outgrowths development. Further there happens an intensive development of the nasal fossae and adjacent structures, as a result of which they change into nasal chambers. At the end of the embryonic period there happens a nasal chambers break in the primary oral cavity with the formation of the primary choanae. Due to the middle nasal outgrowth junction a nasal septum is formed. Primary nasal cavity and primary oral cavity are separated by a primary palate.

**Keywords:** nasal area, embryo, anatomy, human ontogenesis.

**Introduction.** Nowadays there are no doubts in the necessity of the medical aspects of modern embryology development which are helpful in solving such important medical practical tasks as sterility [1,2], treatment of the inborn and inherited diseases, organs and tissues transplantation, etc.[3,4,5]. Due to the WHO annually among 140 million new born children in the world many have serious abnormalities. Without a well-grounded investigation of the different factors indicating normal and pathological processes of the embryonic development [6], the antenatal care is impossible [7]. The problem connected with the critical periods indicating in the structural changes of organs and systems needs further investigation [8]. Numeral abnormalities occurring in medical practice in most cases can be explained on the basis of the origin investigation and the interconnection of the organs and structures which with time get peculiar forms, after having investigated their unusual topography and realized peculiar embryonic phenomena. A lot of researches are

dedicated to the nasal cavity development [9], though not any publication gives specific information of anlage terms and further differentiation of the embryo which takes place in its development.

Thus, the data presented in the native and foreign literature about normal anatomy of the nasal cavity are insufficient, and many of them have narrow characteristics which don't allow stating the unique morphologically theoretical basis in this area.

**Materials and conclusions.** 49 histological sections of the human embryos were investigated by means of: series of the histological sections, microscopy, plastic and graphic reconstruction and morphometry.

**Results discussion.** Due to the investigation of the series of the histological preparations of the 4-week embryonic development 4,0 – 5,0 of the Vertex-Coccyx Length (VCL) there is an oral fossa limited by the frontal protuberance, at the bottom by a heart-shaped protuberance and on the sides – upper-jaw outgrowth, its back border is formed by a maxillary arch.

Nasal cavity as it is does not exist yet. Though, at the bottom and on the sides of the frontal protuberance tightly placed ectodermic cells develop two thickened plates presented by 4-5 layer cylindrical epitheliums. At the periphery of the plates epithelial cells slightly come out above the ectodermic level forming the horseshoe-shaped protuberances which is open in the oral fossa.

In the area of the middle part of the mentioned epithelial thickening in the 6,00 VCL embryos there forms a little deepening of the epithelium in the liable mesenchyme – that is the primary stage of the nasal placodes anlage. They are placed in the craniocaudal direction and their size is no more than 120 mcm and 66 mcm. The epithelium thickness of the nasal placodes is 18 mcm, in some cases 22 mcm, maximum distance between their medial edges is 1080 mcm.

While investigating the series of the embryonic histological sections of 7,0-7,5 VCL we have found out that the epithelium invagination of the nasal placodes becomes much more significant, and on the free space of placodes there forms a deepening - the primary stage of the nose fossae formation, the sides of which are covered by a 4-6 layer cylindrical epithelium 34-38 mcm thick. The depth is not more than 62 mcm. The craniocaudal size of the fossae anlage is no more than 176 mcm and 86 mcm. Their longitudinal axis goes almost vertically. Caudal edges of the

fossae are placed a bit closer to each other – in the distance of 1340 mcm. Distance between cranial edges is 1394 mcm.

Horseshoe-shaped protuberances which border the edges of the nasal fossae thicken in the shape of rolls. Open edges of the nasal fossae are directed to the edges of the primary oral cavity. The mentioned rolls present the primary stage of development of the middle and side nasal outgrowths which border the nasal fossae. The diametrical size of the middle nasal outgrowth is no more than 216 mcm, and vertical HO mcm. The diametrical size of the side nasal outgrowth is not more than 190 mcm. Distance between the medial edges of the middle nasal outgrowths is 1130 mcm.

While investigating the series of the histological sections and plastic reconstructing the nasal cavity in the 8,0 – 8,8 VCL embryos we found out that epithelium which covers the nasal fossae continues evaginating in the lying mesenchyme in the dorsal direction. The size of the nasal outgrowths enlarges too, which grow in the caudal direction and overhang the primary mouth cavity.

Nasal fossae are covered by cylindrical epithelium 34 – 42 mcm thick, the nuclei of its cells are placed in 4-6 rows. The depth of the nasal fossae is 98 mcm, height – 186 mcm, width – 98 mcm. And distance between them is 1300 mcm.

The diametrical size of the middle nasal outgrowths in the embryos of 8,8 VCL is 260 mcm, vertical – 280 mcm, side nasal outgrowth – 226 and 244 mcm according. Middle nasal outgrowths gradually approach each other. Distance between them is less than 1090 mcm.

Downward and laterally from the side nasal outgrowths the upper jaw outgrowths are placed which grow medially and somewhat to the front. They approach to the side nasal outgrowths, though on this stage of development they are not united yet. They are separated by a little fissure connected with the embryonic eye.

In the embryos 9,5 – 10,0 mm VCL there happens an intensive growth of the nasal fossae and adjacent structures. While investigating plastic reconstructions of the nasal area in embryos 10,0 mm VCL found out that the nasal fossae as a result of intensive growth and evagination of epithelium in the mesenchyme change into nasal chambers, which grow in dorsal and somewhat caudal direction, but there is no connection between them yet. Nasal chambers are covered by high multi-layer cylindrical epithelium.

On the histological sections nasal chambers have a half-moon form open to the opposite side of the second chamber, their caudal edges are placed closer than cranial. Depth of the nasal chambers is 546  $\mu\text{m}$ , they are placed in the distance of 158  $\mu\text{m}$  from the primary oral cavity though divided by a mesenchyme 112  $\mu\text{m}$  thick which is placed between the epithelium covering nasal chambers and epithelium covering primary oral cavity. Height and width of the nasal chambers almost don't change, height – 212  $\mu\text{m}$ , width – 108  $\mu\text{m}$ . The interior surface of the nasal chambers is smooth.

The front back axis of the nasal chambers is placed obliquely. Their primary sections are placed in the distance 1284  $\mu\text{m}$ , and back edges – 1126  $\mu\text{m}$ .

On the described development stage nasal outgrowths highly enlarge, especially the middle ones, the diametral size of which is 664  $\mu\text{m}$ , vertical 754  $\mu\text{m}$ , size of the side nasal outgrowths – 446 and 420  $\mu\text{m}$  accordingly. Nasal outgrowths are presented by a mesenchyme covered by a layer of epithelial cells, nuclei of which are placed in two rows.

On the medial surfaces of every middle nasal outgrowth there is a well-marked protuberance which results in a gradual connection of the middle nasal outgrowth. Distance between them is quite big – 856 – 884  $\mu\text{m}$ .

By the surfaces facing each other middle and side nasal outgrowths border the primary nostrils which remain unclosed, as the upper-jaw outgrowths do not connect with the side nasal outgrowths. Medial edges of the upper-jaw outgrowths are placed on the level of free lower edges of the middle nasal outgrowths.

In the embryos 11,0 – 12,0 mm VCL there happens a further development of the nasal chambers to the back and somewhat caudally in the direction to the primary oral cavity, but there is no connection between them yet. Distance between nasal chambers and primary oral cavity is 86  $\mu\text{m}$ , depth of the nasal chambers is 548  $\mu\text{m}$ , and height – 224  $\mu\text{m}$ .

Upper, lower and back sides of the nasal chambers are smooth, and on the medial side in its middle part there is a deepening – the anlage of the Jacobson's organ.

Middle nasal outgrowths are directed downward and laterally. Their longitudinal size in embryos 12,0 mm VCL is 926  $\mu\text{m}$ , and 788  $\mu\text{m}$  wide. Side nasal outgrowths are 854  $\mu\text{m}$  long, and 608  $\mu\text{m}$  wide, they are directed downward



and medially. The distance between two facing each other edges of the middle nasal outgrowths is 858 mcm.

The upper-jaw outgrowths continue developing; their front back size enlarges to 1524 mcm, and height – up to 758 mcm. On this development stage they connect to the side nasal outgrowths. Their free edge is placed next to the down edge of the middle nasal outgrowth.

At the end of the embryonic period (embryos 13,0 – 14,0 mm VCL) there is a break of the nasal chambers in the primary oral cavity which results in the connection between the primary nasal cavity and primary oral cavity and throat.

Both halves of the primary nasal cavity have a curved form – directed first dorsally, then a bit caudally to the primary oral cavity. The front back size of the primary nasal cavity is 692 mcm. Distance between upper edges is 1328 mcm, and lower – 996 mcm. The height of the primary nasal cavity is no more than 664 mcm, and width – 184 mcm. Every half of the primary nasal cavity begins with the opening – primary nostril. It is limited by a laterally side nasal outgrowth 772 mcm long, and 558 mcm wide, and medially by the front edge of the nasal septum which develops in the result of the middle nasal outgrowths connection. Vertical size of the nasal septum is 668 mcm, diametral – 882 mcm, front back – 486 mcm.

To the back vertical size to the primary nasal cavity gradually narrows down and in the places of break in the primary oral cavity primary choanae develop. Distance between primary choanae is not more than 890 mcm.

Primary nasal and primary oral cavities are divided by a primary palate, 288 mcm thick, 1136 mcm wide, 278 mcm long.

On this development stage on the back side of the primary oral cavity there appears a small protuberance – the anlage of the palate outgrowth. Such protuberance is presented by a mesenchyme of the upper-jaw outgrowth covered by a 3-4 row layer of epithelium. On the front sections it is cone-shaped with the top directed to the tongue and places on the level of its lower edge. The height of its palate outgrowth is 210 mcm, the front back size is not more than 426 mcm, and its free edge goes forward in the primary oral cavity for 108 mcm.

All the sides of the primary nasal cavity are smooth. Upper jaw outgrowths already connect with the side nasal outgrowths.

**Conclusions:**

1. Till the end of the embryonic period primary nasal cavity forms, separated from primary oral cavity by a primary palate and opens through primary choanae.
2. Nasal septum is formed by connection of middle nasal outgrowths.
3. Permanent palate develops in the result of evagination of the side oral cavity epithelium.

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