N.R. Yemelyanenko
D.V. Proniaiev

Bukovynian State Medical University
Chernivtsi, Ukraine

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ANATOMICAL PECULIARITIES OF THE HUMAN NASAL SEPTUM STRUCTURE AT THE JUVENILE AGE

Yemelyanenko N.R., Proniaiev D.V. Anatomical peculiarities of the human nasal septum structure at the juvenile age.
Bukovynian State Medical University, Chernivtsi, Ukraine.
ABSTRACT. Objective: to examine peculiarities of the human nasal septum at the juvenile age, to determine the character of anatomical changes, age individual variability, progressive and regressive reformations. **Methods.** 20 biological specimens of the nasal septum at the juvenile age of human ontogenesis were examined by means of morphological methods. Peculiarities of the nasal septum structure at this period of development were studied according to the main aim of research. **Results.** Structural changes transforming the nasal septum occur at the juvenile age. Small crests are found in the point of junction of the osseous part with the cartilaginous one. In case the nasal septum is curved to the left the crests are found on the side of curvature (2 specimens) and on the side opposite to curvature (3 specimens). A small depression is found on two specimens (10%) in the anterior-inferior portion of the nasal septum (Jacobson's organ rudiment/vomeronasal organ). The majority of glands are found in the submucous layer of the nasal septum. The mucous membrane of the nasal septum is lined with high columnar ciliated epithelium. **Conclusions.** 1. Small crests are found in the point of junction of the osseous part with the cartilaginous one. 2. The majority of glands are found in the submucous layer of the nasal septum. 3. The biggest concentration of the blood vessels is found in the anterior-inferior portion of the nasal septum.
Key words: nasal septum, septal nasal cartilage, ethmoid bone; vomer.

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Topicality

The study of development, formation of syntopic interrelations of the nasal organs at different age periods is one of the leading ones in the approaches to investigate the human organism, as well as a topical task of embryologists, anatomists, traumatologists and surgeons. Examination of the nasal septum is especially reasonable when the effect of unfavourable environmental conditions (ecological, chemical, physical) has become considerably important [1-3]. The study of the dynamics of changes appears to be reasonable with the purpose to find interrelations and mutual effect of morphogenesis processes on the spatial-temporal orientation of the anatomical structures, as well as detection of the time and morphological preconditions of possible occurrence of variants of their structure and congenital defects. Investigation of etiology, pathogenesis and treatment of congenital and acquired diseases of the nasal septum, chronic tonsillitis, removal of polyps from the mucous membrane, treatment of chronic bleeding, post-traumatic injuries and surgical treatment of perforation of the nasal septum are urgent nowadays [4-6].

ENT specialists accentuate their attention on the growth of sickness rate of the upper respiratory tract, and pathology of the nasal cavity and paranasal sinuses, chronic tonsillitis and dental-maxillary defects in particular. The nasal septum is an important structure that controls aerodynamics of the air flow, provides heating, moistening, cleansing of the air, regulates hormonal balance of the whole organism to some extent [7].

Objective: to examine peculiarities of the human nasal septum at the juvenile age, to determine the character of anatomical changes, age individual variability, progressive and regressive reformations.

Methods

The study was performed on 20 specimens of the nasal portion of human dead bodies at the juvenile age. Skulls, specimens of the head, separate organ complexes, series of histological and topographic-anatomical sections of the nasal area were used. 5 X-ray images and 7 computed tomograms of the head were used. In modern medicine computed tomography

(CT) and magnetic resonance imaging (MRI) are important diagnostic methods possessing strongly marked anatomical basis and are included into the group of lifetime visualization diagnostic methods. They can be successfully applied first of all for the development of variant anatomy, that is, investigation of anatomical variability of organs, structures and parts; detection of changes in the topography of organs in case of pathology; elaboration and topographic-anatomical substantiation of new operative accesses; finding changes of organ topography occurring during and after surgery; computer modeling of organs. MRI enables to find the difference between involution and growth of the connective tissue of the nasal septum, clearly demonstrates the dynamics and degree of ossification of its components. The method of radiographic examination was applied for lifetime visualization of sizes, outlines and degree of ossification of the nasal septum. The specimens of the nasal septum prepared from dead bodies were examined by means of micro- and macro-dissection under the microscope.

To obtain histological specimens morphological material of a standard size no more than 0,5 x 0,5 cm was processed according to the standard scheme of histological methods concerning autopsy material. For this purpose pieces of organs were fixed during 24 hours in 10% neutral formalin solution, then washed in water for 24 hours, then dehydrated by means of passing through the graded alcohols of an ascending concentration to xylene and filled up in paraffin. The cuts of organs were dewaxed, washed in water and stained by the standard solution of hematoxylin and eosin according to Van Gieson technique. Stained cuts were placed into polystyrene. Serial sections 5 mcm thick were prepared on the microtome "МПС-2". The thickness of sections ranged between 5 and 10 mcm. Serial histological sections were prepared in one of the three planes of the body – sagittal, horizontal and frontal. Histological specimens were examined with the microscopes "ЛЮМАМ-Р8", "МІКМЕД-2", "МБС-10" and digital camera Olympus SP550UZ. The following magnifications were used: x25, x56, x100, x400. The licensed computer program ImageJ (1.48v, free license, W. Rasband, Institute of Health, USA, 2015) was applied for histomorphometric examination.

Results

The middle wall of the nasal cavity (nasal septum) is presented by the cartilaginous or osseous portions. The cartilaginous part is formed by a clearly seen cartilage of the nasal septum in the shape of irregular tetragonal lamina (Fig. 1).

The anterior-posterior size of the cartilage is 27,0±1,0 mm, vertical – 24,0±0,9 mm, and thickness – 3,0±0,05 mm. Its posterior-inferior margin in the shape of a small process is wedged between the anterior margin of the perpendicular lamina of the ethmoid bone and the anterior margin of the vomer. The osseous part is formed by the perpendicular lamina of the ethmoid bone.

Its anterior-posterior size is **32**,0±2,7 mm. The vertical size close to the anterior extremity of the lamina is 21,0±1,0 mm, and close to the posterior extremity – 16,0±0,24 mm. The thickness of its osseous wall is 2,5±0,07 mm. The perpendicular lamina forms anterior-superior portion of the osseous part of the nasal septum. It adjoins to the nasal spine of the frontal bone from above, and lower – to the nasal bones.

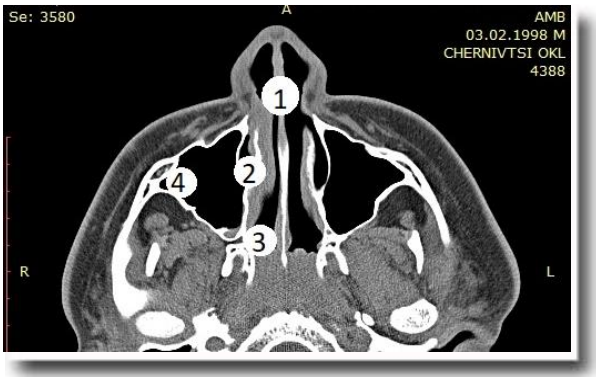

Fig. 1. Computed tomogram of the head. 17-year-old boy. 1 – nasal septum; 2 – lateral nasal wall; 3 – inferior nasal concha; 4 – maxillary sinus.

It is connected by its anterior extremity with the posterior extremity of the cartilage of the nasal septum, and inferiorly – with the anterior border of the vomer (Fig. 2).

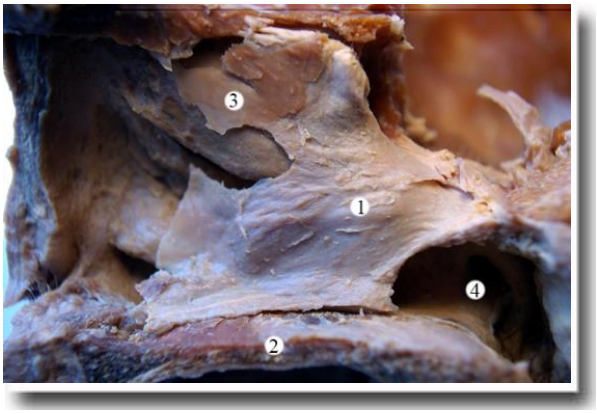

Fig. 2. Sagittal section of the human head (18 years old). Macrospecimen. 1 – nasal septum; 2 – hard palate; 3 – mucous membrane; 4– choana.

A small process is found on 5 specimens (33%) on the anterior-inferior extremity of the lamina directed forward and downward. The latter is wedged into the posterior margin of the cartilage of the nasal septum where similar depression is found. The posterior-inferior portion of the osseous portion of the nasal septum is supplemented with the vomer. Its anterior extremity is connected with the perpendicular lamina and cartilage of the nasal septum. The superior extremity of the vomer is in the form of wings involving the sphenoidal rostrum and adjoining to the pos-

terior surface of the sphenoid bone body. The longitudinal size of the vomer lamina is 36,0±0,8 mm, the longest vertical size is 22,0±0,5 mm. The thickness of the osseous wall is no bigger than 1,5 mm. In the point of wedging of it wings the wall becomes thicker – to 2,3-2,7 mm. Anterior-posterior size of the wings is1,0-2,0 mm, the width – 3,0-5,0 mm.

On 10 specimens (50%) the nasal septum is located relatively in the middle position and is smooth. On 4 specimens (20%) it is deviated to the left, and on 6 specimens (25%) – to the right (Fig. 3, 4).

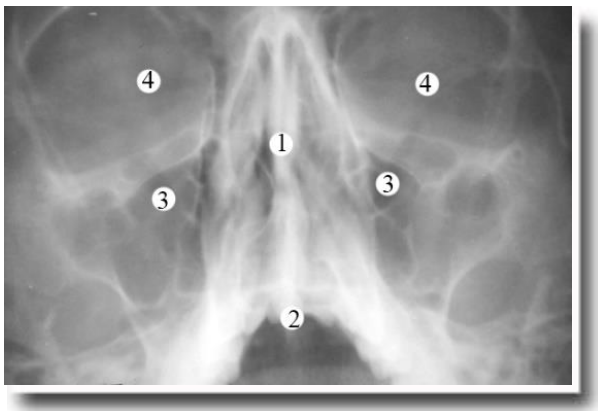

Fig. 3. X-ray image of the face in the frontal plate. 21-year-old patient. 1 – nasal septum; 2 – hard palate; 3 – maxillary sinuses; 4– eye socket.

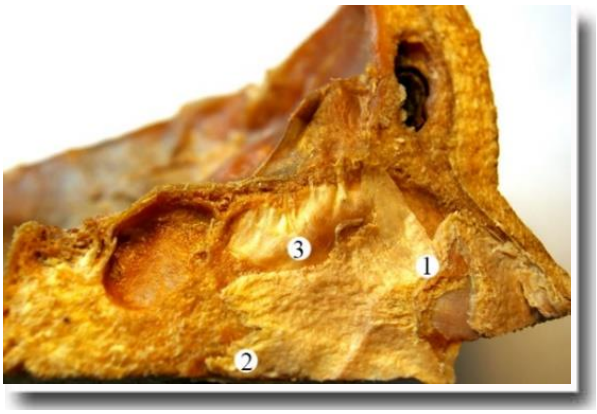

Fig. 4. Sagittal section of the human head (20 years old). Macrospesimen. 1 – nasal septum; 2 – hard palate; 3 – mucous membrane.

In addition, small crests are found in the point of junction of the osseous part with cartilaginous one. In case the nasal septum is curved to the left the crests are found on the side of curvature (2 specimens) and on the side opposite to curvature (3 specimens) (Fig. 5, 6). The anterior-posterior size of the nasal septum is 67,0±1,3 mm. Its biggest vertical size is 40,0±0,8 mm.

The mucous membrane is lined with the multinuclear columnar ciliated epithelium located on the basal membrane. The mucous membrane is 0,7-0,9 mm thick. The epithelial lining is 40 mcm thick. The mucous membrane in the anterior-inferior portion of the nasal septum becomes thicker. This thickness is in the form of the erectile tissue and mucous glands. Erectile bodies are presented by superficially located thin network of the blood vessels and deeply located bigger vascular network. Smooth muscular and elastic fibers are found in their wall. The thickness of the anterior-superior portion of the mucous membrane of the nasal septum is presented by aggregation of the glandular apparatus. Olfactory cells are located on the nasal septum, their processes are directed upwards, are connected into thin threads, and into bigger trunks close to the perforated lamina. A small depression is found on two specimens (10%) in the anterior-inferior portion of the nasal septum (Jacobson's organ rudiment/vomeronasal organ).

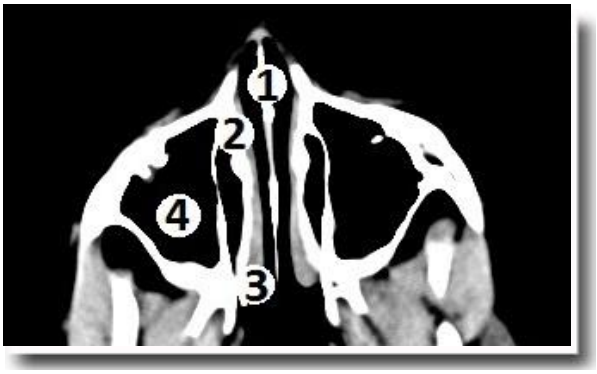

Fig. 5. Computed tomogram of the head. 18-year-old patient. 1 – nasal septum; 2 – lateral nasal wall; 3 – lower nasal concha; 4 – maxillary sinus.

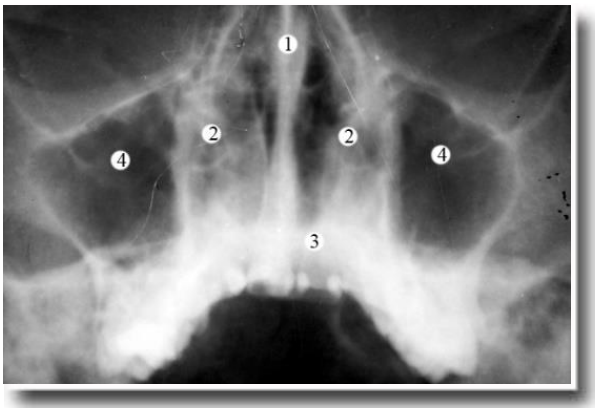

Fig. 6. X-ray image of the face in the frontal plane. 20-year-old patient. 1 – nasal septum; 2 – lateral nasal wall; 3 – hard palate; 4– maxillary sinus; 4 – eye sockets.

The majority of glands are found in the submucous layer of the nasal septum. Their number is smaller in the direction to the nasal vestibule and choanas.

Both anterior and posterior ethmoidal arteries penetrate through the ethmoidal openings into the upper wall of the nasal cavity. Then they are dichoptically divided into the branches of the second order (lateral and middle).

The lateral branch passes in the descending direction along the lateral wall closer to the hard frame. The middle branch reaches the nasal septum

practically horizontally. Every from the above branches in the area of the nasal septum is divided into 5-8 smaller branches of the third order in the shape of the fan. They are divided into the branches of the following orders.

Sphenoid-palatine artery passes through the sphenoid-palatine opening into the posterior portion of the nose where the posterior artery of the nasal septum passes to it.

The posterior artery of the nasal septum has a horizontal direction, passes into the posterior portion of the nasal septum where it is divided dichoptically inot the branches of the second order: upper and lower. The upper one is directed forward, is divided into the tertiary branches which anastomose with the posterior ethmoidal arteries. The lower artery is found closer to the lower margin of the nasal septum. It is divided into the branches of the third order which anastomose between themselves and form loops of different shape and size. In addition, arterial branches are divided into numerous thin small branches to the epithelial lining which are connected and form rather dense vascular network.

The network of the arterial vessels is most concentrated in the anterior-inferior part of the nasal septum where the trunks of the anterior ethmoidal artery and their anastomoses are branched with the posterior ethmoidal artery and posterior artery of the nasal septum.

A fine network of blood vessels is located most superficially topographically, than the vessels of a middle size, and big trunks of vessels are found most deeply.

Middle upper posterior nasal nerve branches pass into the mucous membrane of the posterior portions of the nasal septum beginning from the pterygopalatine node. They pass directly and are found in the mucous membrane of the nasal septum.

The nasal-palatine nerve passes in the descending direction, is branched into small branches in the mucous membrane of the nasal septum.

Discusssion

The following anatomical peculiarities were determined in the result of our investigation performed. Middle superior nasal branches originating from the pterygopalatine node enter the mucous membrane of the posterior portions of the nasal septum. We have determined that the mentioned branches topographically pass in the point of transition of the anterior wall of the sphenoidal sinus into the inferior one. They pass directly and are found in the mucous membrane of the sphenoidal sinus, partially the cells of the ethmoidal labyrinth and nasal septum. All the posterior nasal nerve branches of both lateral wall and nasal septum are topographically located in the mucous membrane close to the periosteum and perichondrium. On the basis of morphological examinations of the external structures of the posterior portions of the nasal cavity walls and nerve syntopia on them we suggest careful surgery based on cutting posterior nasal branches of the pterygopalatine node, contrary to rather complicated technically videotopmy it is the most rational and saving variant of vegetative neurotomia use by ENT specialists in a comprehensive treatment of polypous ethmoiditis. Intersection of the nerve branches originating from the pterygopalatine node is made on the level of the posterior end of the upper and middle nasal turbinate of the upper nasal passage, in the point of transition of the upper wall of the sphenoidal sinus into the inferior wall of the posterior portion of the nasal septum. In these places lateral posterior nasal branches and partially middle nasal nerve branches are located which branch out and participate in vegetative innervation of the ethmoidal labyrinth.

Conclusion

1. Structural changes transforming the nasal septum occur at the juvenile age. Small crests are found in the point of junction of the osseous part with the cartilaginous one. In case the nasal septum is curved to the left the crests are found on the side of curvature (2 specimens) and on the side opposite to curvature (3 specimens).

2. A small depression is found on two specimens (10%) in the anterior-inferior portion of the nasal septum (Jacobson's organ rudiment/vomeronasal organ).

3. The majority of glands are found in the submucous layer of the nasal septum.

4. The mucous membrane of the nasal septum is lined with high columnar ciliated epithelium.

5. The biggest concentration of the blood vessels is found in the anterior-inferior portion of the nasal septum.

Prospects for further development

Peculiarities of the nasal septum at the mature and old age of human life are reasonable to be investigated.

Information on conflict of interest

There are no potential or apparent conflicts of interest related to this manuscript at the time of publication and are not anticipated.

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Ємєльяненко Н.Р., Проняєв Д.В. Анатомічні особливості будови носової перегородки людини у юнацькому віці.

РЕФЕРАТ: Метою дослідження було вивчення особливостей перегородки носа людини у юнацькому віці, визначити характер анатомічних змін, вікову індивідуальну варіабельність, її прогресуючу та регресивну деформацію. **Методи.** За допомогою морфологічних методів досліджено 20 біологічних зразків перегородки носа юнаків. Особливості будови носової перегородки у період розвитку вивчалися відповідно до основної мети дослідження – виявити структурні зміни, у перегородці носа у юнацькому віці. **Результати.** У місці з'єднання кісткової частини з хрящової виявляються невеликі гребені. У випадку, якщо носова перегородка вигнута вліво, гребені знаходяться на стороні кривизни (2 зразка) і на протилежній стороні кривизні (3 зразка). Невелика увігнутість виявлена на двох зразках (10%) у передньо-нижній частині перегородки носа (рудимент органу Якобсона/вомероназальний орган). **Висновки.** 1. Невеликі гребені виявляються у місці з'єднання кісткової частини з хрящовою. 2. Більшість залоз знаходиться у підслизовому шарі носової перегородки. 3. Найбільша концентрація кровоносних судин виявляється у передньо-нижній частині перегородки носа.

Ключові слова: перегородка носа, хрящ носової перегородки, ґратчаста кістка; сошник.