KAPITEL 11 / CHAPTER 11 [11]
THE INFLUENCE OF CLINICAL AND DIAGNOSTIC PARALLELS OF RESISTANT NASOPHARYNGEAL OBSTRUCTION IN PATIENTS WITH DENTO-MAXILLOFACIAL ANOMALIES ON TREATMENT TACTICS

DOI: 10.30890/2709-2313.2025-36-02-006

Introduction.

Humans have two types of breathing: nasal and oral. Nasal breathing is physiological for the body, as the nasal cavity performs several important functions for the body [1]. The impact of impaired nasal function on the body is thoroughly studied not only by otolaryngologists, therapists, pediatricians, neuropathologists, but also by dentists since the pathology of the upper respiratory tract plays a significant role in the clinic of general diseases. This is evidenced by extensive specialized literature, which indicates major changes in the body when the function of nasal breathing is impaired [12]. These changes affect external respiration (A.I. Yunins, 1956), blood circulation (N.A. Nadjarian, 1948; D.S. Blyakher, 1968), digestion (V.V. Gromov, 1941), morphological and biological composition of blood (E.D. Lysytsyn, 1962), lymph and blood circulation of the brain (V.A. Chudnosovetov, 1941), the state of vascular walls (S.F. Gamayunov, 1934), higher nervous activity (E.S. Viktorova, 1937). The pathological state of the upper respiratory tract has a particularly harmful effect on the body of a growing child. Graber Lee W. (2017) believes that because airway obstruction can have long-term adverse effects, the importance of assessing objective airway status warrants further longitudinal study.

In the scientific literature, the fact of the interconnection of the respiratory tract and the development of the jaws is sufficiently and unambiguously covered. It is known that the respiratory organs and the jaw apparatus are quite closely related. Thus, the correct development of the respiratory tract directly proportionally depends on the harmonious development of the jaws and cranial skeleton, and, conversely, the correct formation of the jaws directly proportionally depends on the correct development and

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condition of the respiratory tract. A decrease in the patency of the upper respiratory tract is a factor that contributes to the formation of bite pathology and temporomandibular joint dysfunction [2, 3].

Many different theories of the mechanism of dento-mandibular deformations with complicated nasal breathing have been described, namely: 1) the air jet during mouth breathing presses on the palate and deforms the jaws (Blox, 1889, Michel, 1908); 2) distal occlusion occurs as a result of enlarged tonsils and difficult nasal breathing, when the patient tilts the raised head forward to facilitate breathing (M.M. Vankevich 1929); 3) mesial occlusion arises as a result of constant protrusion of the lower jaw when the lingual tonsil increases to facilitate breathing (Herbst, 1908; Isard, 1930); 4) open occlusion occurs during mouth breathing due to the pressure of the tongue on the lower front teeth (Misch, 1922); 5) the balance of the muscles of the maxillofacial region is disturbed during mouth breathing (Angel, Körbitz, 1910; Izard), etc. All theories boil down to mechanical compression of the upper jaw.

According to many authors, the prevalence of dento-maxillofacial anomalies (DMA) and deformities among children continues to be quite high - from 35-75% [4, 5, 6, 7]. The prevalence of orthodontic pathologies in Ukraine is quite significant and ranges from 67.8% to 87.5% in children [8, 9, 10] and from 64.3% to 84.3% in adolescents and adults [2, 9, 10], and among some categories, such as children with hearing deprivation - 100% [11].

A number of factors, both endogenous and exogenous, affect the process of formation of the child's dentition. Endogenous factors include genetic predisposition, disorders of intrauterine development, congenital anomalies, diseases of young children, endocrine pathology. Among the exogenous: violations of the rules of artificial feeding and violations of the functions of the dento-maxillofacial apparatus (chewing, swallowing, breathing, speech) - bad habits, injuries, transferred inflammatory processes in the soft and hard tissues of the DMF area, violations of the terms of changing teeth and their premature removal [12].

It is known from early sources that Mayer was the first to deal with the problem of upper airway obstruction, who in 1869 described patients who adapted to mouth breathing and clinically had a hoarse voice, open mouth, and swollen lips [13]. In 1872, Tomes first introduced the term "adenoid face" and suggested that enlarged adenoids are the cause [7]. Tomes' work was widely supported by many orthodontists around the world, and in 1939 Todd and Broadbent introduced the term "long face syndrome" into orthodontic practice.

The mechanisms of the occurrence of anomalies in children with impaired nasal breathing were also studied by M.M. Vankevich (1929), who discovered that mouth breathing changes the myodynamic balance of antagonist and synergist muscles. When the pharyngeal tonsils are enlarged, children throw their head back, especially during sleep, and thereby move the lower jaw back. This position of the lower jaw for a long time can lead to the appearance of a prognathic (distal) occlusion. With hypertrophy of the lingual tonsils, the passage of air from the nasal cavity becomes difficult. To facilitate breathing, the child sticks out its tongue during the day, and during sleep its lower jaw occupies a mesial position. As a result of the displacement of the tongue from the epiglottis, conditions are created to facilitate the passage of the air stream and a progenic (mesial) occlusion is gradually formed. The position of the tongue also changes, the activity of chewing and buccal muscles increases, which leads to the formation of incisor disocclusion [14].

Betelman A.I. (1965) explains the occurrence of sagittal anomalies of the bite with a number of etiological factors and distinguishes three main ones from them: genetic, congenital and acquired. The author refers to acquired etiological factors: diseases of the neuroendocrine system, infectious diseases, childhood diseases (including rickets), nasopharyngeal pathology, bad habits, etc. [15].

S.A. Vynogradova etc. (1981, 1987) established the dependence of the type of maxillofacial deformation on the nature of the pathology of the ENT organs. The authors found that crossbite and prognathic occlusion are most common in nasal septum curvature and chronic rhinitis. Progenic occlusion occurs in chronic rhinitis with hypertrophy of the tonsils. Mouth breathing is a consequence of inflammatory processes in the nasal cavity, which forms the characteristic position of the head in a child during sleep - leaning back. This contributes to the development of a prognathic occlusion. After orthodontic and ENT treatment, the head position is normalized and breathing function improves [16, 17].

Allergic rhinitis and adenotonsillar hypertrophy, according to clinicians Bellanti J.A. et al. (2000), are the main cause of airway obstruction. It is usually associated with various symptoms: lack of nasal airflow, sneezing, itching, runny nose, snoring with possible onset of obstructive sleep apnea syndrome (OSAS), and increased respiratory infections such as ear infections, sinusitis, and angina [18].

Distel V.A., Suntsov V.G., Wagner V.D. (2001) pay special attention to pathologies of the upper respiratory tract as etiological factors in the occurrence of distal occlusion [19]. Khoroshilkina F.Ya. (2006) believes that constant habitual breathing through the mouth can be caused by various functional and morphological disorders: permanent obstruction in the upper respiratory tract in the form of adenoid vegetations, hypertrophy of the palatine-pharyngeal tonsils, pathological changes in the mucous membrane of the upper respiratory tract; the habit of breathing through the mouth as a result of fixing the reflex, even after removing the obstruction of the upper respiratory tract; reduced function of the muscles that close the oral cavity, which allows the air stream to pass through the existing gap and leads to the position of the tongue between the rows of teeth; pronounced sagittal gap between the central incisors, which makes it difficult to close the lips. With such a violation, the bridge of the nose is sometimes wide, the nostrils are narrow, the lips are not closed, the contour of the chin is double. The tongue in the oral cavity shifts: the tip back or forward, the back is located lower. The space between the root of the tongue and the soft palate increases. Such changes lead to the occurrence of anomalies and deformations of the upper and lower jaws and, as a result, the occurrence of sagittal anomalies of the occlusion [7].

C. Grippaudo, E.G. Paolantonio (2016) and colleagues also examined the relationship between mouth breathing and occlusion problems in their paper. The authors examined 3017 children using the ROMA index and found that respiratory pathology leads to the formation of occlusion anomalies, in addition, the number of pathologies increases as the degree of the index increases, because the obstruction of the upper respiratory tract changes the structure of craniofacial growth [20]. The relationship between impaired nasal breathing and dentofacial morphology has long been widely studied by Rubin R.M. et al. (1980), and they found that the pattern of craniofacial growth can be affected by unbalanced muscle function characteristic of mouth breathing [21].

Therefore, frequent inflammatory processes in the upper respiratory tract, the presence of lymphoid tissue in the nasopharynx, as an additional element of the narrowing of the upper respiratory tract, and the period of active growth are three factors that are present in children and which, at the same time, are ideal conditions for the appearance of persistent mouth breathing and DMA formation.

Thus, a definition of polymorbidity (comorbidity) is proposed as a combination of different factors (diseases) united by common pathogenetic mechanisms. One of the ways of occurrence of polymorbidity is cause-and-effect. The development of the disease leads first to functional (disorders of nasal breathing), and later to organic (dento-maxillofacial) disorders in the system of organs located in adjacent anatomical and physiological zones, and further development of a number of nosological forms. The only difference between the classical definition of comorbidity for adults and the elderly from children and adolescents with DMA is the possibility of reverse development in the latter during the period of growth under the conditions of timely and correct treatment. Concomitant or combined pathology is always more difficult to treat and correct and, in case of failure, can cause the formation of significant persistent DMA, which can progress and remain for life [22].

Item 1. Reasons provoking the appearance of mouth breathing (MB): chronic nasopharyngitis (CNP) with hypertrophy of the pharyngeal tonsil (HPT) and hypertrophy of the palatine tonsils (HPAT), allergic and vasomotor rhinitis, displacement of the nasal membrane (DNM), chronic rhinosinusitis with polyps (CRSwP), congenital unilateral (partial or complete) choanal atresia. Elimination of the cause of persistent nasal obstruction (PNO) occurs thanks to medical measures and natural mechanisms. An example of a natural mechanism can be the age-related involution of the nasopharyngeal tonsil in the period of 8-10 years from birth. Treatment of otorhinolaryngological problems that lead to DMA can be conservative, surgical, and complex. Allergic and vasomotor rhinitis are treated conservatively in children and adolescents; DNM, choanal atresia and HPAT are mostly with surgical methods; HPT and CRwP are usually with combined methods. Parents often refer to DMA as an aesthetic problem, especially at the beginning of their formations, and the prospect of surgical treatment inclines them to correct the bite by forming correct habits, myogymnastics, using orthodontic plates and bracket systems. Of course, all the listed measures are modern effective means of DMA correction. However, impaired nasal breathing complicates orthodontic treatment. Children with impaired nasal breathing without prior rehabilitation of the nose and pharynx find it very difficult to get used to devices, and sometimes refuse them altogether. However, the removal of adenoid growths does not always give the desired result, because most children continue to breathe through their mouths. Along with orthodontic treatment, such children were prescribed myogymnastics and exercises to restore nasal breathing. In children who regularly engage in myogymnastics and exercises to restore breathing, the period of hardware treatment is shortened by 5–6 months. Unrestored nasal breathing during treatment leads to the recurrence of the anomaly after orthodontic treatment. To prevent dento-maxillofacial anomalies, children with nasal breathing disorders need to perform ENT rehabilitation and physical therapy in a timely manner [23, 24].

In our research, we used the following methods and methods to study the function of nasal breathing and the causes of its disturbance in patients with DMA, to evaluate the results of treatment, and also to determine the need for surgical treatment: 1) Collection of anamnesis. When collecting the anamnesis, we asked the following clarifying questions: when exactly the parents record a violation of nasal breathing - during the day, at night, and during the day and at night. Attention was focused on two groups of causes of nocturnal nasal breathing disorders: related and unrelated to the horizontal position of the body during sleep. The causes associated with the horizontal position include vasomotor phenomena in the cavernous bodies of the inferior nasal conchas, the suction power of the lungs, displacement of the hypertrophied palatine tonsils to the back wall of the pharynx, the patient's weight.

 ISBN 978-3-98924-078-0

Among the reasons not related to the horizontal position: dry air in the room at night, too big a pillow, etc. Sometimes, during the survey of parents, it is possible to find out whether the child breathes through the nose while sleeping with the mouth open. 2) Endoscopic examination of ENT organs. The use of video endoscopy makes it possible to examine the anatomical structures of the nasal cavity in sufficient detail, as well as to more accurately assess the condition of the nasopharynx (with an assessment of not only the size of the pharyngeal tonsil, but also its relationship to the lamina and the mouth of the auditory tubes, as well as an assessment of the size of the free space between the back edge of the lower wall nasal cavity and pharyngeal tonsil during nose inhalation) in dynamics. Video endoscopy provides an opportunity to objectively examine the posterior and upper parts of the nasal cavity, the entire dorsal and distal part of the nasal septum, which cannot be evaluated during routine anterior rhinoscopy. The following endoscopes were used: 0°, children's — with a diameter of 2.7 mm, adult — with a diameter of 4 mm, 70°, with a diameter of 4 mm. The nasal cavity was examined from the front parts of the nasal septum, the size and position of the lower nasal conchas, the severity of swelling, the nature of the discharge, and the color of the mucous membrane were evaluated. Next, the rear ends of the lower turbinates and the condition of the nasopharynx were evaluated. In the reverse direction from the nasopharynx, the middle nasal passage was examined. Assessment of the condition of the internal nasal valve was performed without prior anemization and application anesthesia, while the angle and area of the internal nasal valve were determined. The deep parts of the nasal cavity were examined after lubricating the mucous membrane of the nasal cavity with a cotton probe impregnated with a 10% solution of lidocaine and 0.1% adrenaline. After local anesthesia and anemization of the mucous membrane of the nasal cavity, the endoscope was advanced in the direction along the bottom of the nasal cavity, the lower conchae to the nasopharynx. The area of increased nasal septum and degree of severity of this area depending on the condition of the front end of the middle turbinate were studied in detail. DNM, deformations of intranasal structures and rhinitis were recorded: separation of the medial legs of the inferolateral cartilage; protrusion of the bottom of the nasal cavity;

deformations of the proximal part of the quadrilateral cartilage; deformities of the front nasal bone and intermaxillary bone; protrusion of the caudal part of the upper lateral cartilage; hypertrophy of the front part of the lower concha; complete or partial atresia of the nasal bridge; pathological mobility (collapse) of the wing of the nose, deformation of the quadrilateral cartilage; deformation of the lower nasal ridge; protrusion of the turbinal bone; hypertrophy of the lower conchae; hypertrophy of the middle nasal conchae; air hypertrophy of the middle nasal conchae; air hypertrophy of the lattice bladder; adhesions, deformation of the blade; complete or partial choanal atresia; hypertrophy of the posterior part of the lower conchae; hypertrophy of the posterior part of the middle turbinate, curvature of the anterior nasal valve, perforation of the nasal septum, vasomotor rhinitis, allergic rhinitis [25]. 3) Rhinomanometry. Frontal active rhinomanometry with a complex of functional tests was performed for all patients using an OPTIMUS rhinomanometer (range of measurement of air flow ±1200 cm^3/s, differential pressure ±1200 Pa, polling frequency of measuring channels 100 Hz. Registration of indicators R150 (nasal resistance), R2 (V2) , the z-coefficient (the coefficient of nasal resistance, inversely proportional to the square of the flow rate, which is equivalent to the turbulent mode of air flow movement) in the patient is performed in turn in each half of the nose according to the following protocol: measurement of all indicators in the derived state; measurement of these indicators 20 minutes after a double anemization of the mucous membrane of the nasal cavity with the use of decongestants, due to which the effect of the edematous nasal component is evaluated. All parameters are measured during the Kotla test and the test with the expansion of the nasal valve. These tests make it possible to evaluate the effect of the front parts of the nasal cavity (mainly the anterior nasal valve) on the structure of nasal breathing. By excluding the anterior parts of the nasal cavity from the breathing process, an isolated evaluation of the influence of the architecture of the posterior parts of the nasal cavity on the structure of nasal breathing becomes possible. 4) Observation by an allergist with general and specific allergy diagnostics (in case of suspected allergic rhinitis) and allergen-specific immunotherapy (ASIT). 5) Observation by an orthodontist dentist (with teleradiogram, panoramic radiography of the jaws, palatal seam radiograph, hand radiograph, cone beam computed tomography (CBCT) - depending on the needs of each specific orthodontic pathology).

To assess the size of the upper respiratory tract, orthodontists use, among other things, CBCT and image processing on special software with the construction of panoramic and three-dimensional reconstructions of the respiratory tract [6, 7]. The volume of the oropharyngeal area is measured on 3D reconstructions on mid-sagittal and axial sections based on such a diagnostic criterion as the total volume of the oropharyngeal airways. The width of the upper part of the pharynx is measured from a point on the back inner wall of the soft palate (in the middle of the soft palate) to the back wall of the pharynx. The width of the lower part of the pharynx is measured from the point of intersection of the back of the tongue and the lower border of the lower jaw to the closest point of the back surface of the pharynx. During CBCT, the condition of all teeth, jaw bones, and maxillary sinuses can be assessed to rule out concomitant pathology. In our opinion, such an extremely important study can only show the feedback of the influence of an improperly developed maxillofacial system on some parts of the respiratory tract. However, this way of evaluating the narrowing of the airways of the respiratory tract does not allow to evaluate and correct a direct cause and effect relationship, since the upper limit for measuring the size and volume of the oropharynx during CBCT is lower than the nasopharynx with pharyngeal tonsils, nasal membrane, and nasal conchae. Visualization of the maxillary sinuses also does not provide complete information about physiological nasal breathing since the paranasal sinuses do not participate in the patency of the nasal cavity during inhalation. During CBCT, variants of curvatures of the nasal membrane can be recorded, but it is not possible to determine the degree of influence of its deformation on the function of nasal breathing [2, 3].

Item 2. To study the relationship between the reduced total volume of the oropharynx in DMA and the fact of any cause of PNO, we analyzed the results of studies of 192 patients aged 6 to 18 years. The main group No. 1 included 63 patients with DMA who were referred to otolaryngologists by orthodontists after fixation of a reduced total volume of the oropharynx after CBCT for DMA. The main group #2 included 94 patients whose reason for consulting an otolaryngologist was mouth breathing and any form of DMA. The comparison group was 35 patients with DMA without complaints of persistent difficulty in nasal breathing (DNB). When analyzing the results of this part of the study, it turned out that even among patients of the control group, at least one cause of DNB was found in 6 out of 35 (17.14%) cases. Only in 22 of 63 (34.9%) patients with reduced total oropharyngeal volume after CBCT (P>0.05) and in 73 of 94 (77.66%) patients with mouth breathing (P<0.01) any cause of PNO was detected (hypertrophy of pharyngeal and/or palatine tonsils, DNM and/or allergic rhinitis (AR), CRwP, etc.). That is, the reduced volume of the oropharyngeal area on CBCT can serve as a control of the effectiveness of orthodontic correction, and not as a way of solving the question of its involvement in DNB.

Item 3. To study the frequency of PNO among children and adolescents with DMA on the background of MB, we analyzed the data of 94 patients. When grading the age category in the studied groups, we considered the time of age-related involution of the pharyngeal tonsil and the fact of the increase of the nasal cavity and nasopharynx due to the growth of the bones of the facial skull. A summary of the study regarding the presence of PNO in patients with DMA and MB is presented in Tab. 1.

Table 1 - Frequency of persistent nasopharyngeal obstruction among children and adolescents with dento-maxillofacial anomaly and mouth breathing

Positive result	Children aged 6-12 years N=51	Children aged 13-18 years N=43	Children aged 6-18 years with MB without DMA N=35	P
abs	44	29	22	P1-3<0,05 P2-3>0,05
%	86,27	67,44	62,86	

Only 29 out of 43 (67.44%) patients with DMA and MB in the age group of 13-18 years had actual PNO. And although it is more than in the comparison group (MB without DMA), it is not reliable (P>0.05%). In the age category of 6-12 years, real PNO in DMA with MB was found in 44 out of 51 (86.27%) patients at P<0.05. That is, younger children (up to 12 years old) more often fall under the definition of persistent nasal breathing disorder with MB, and older children (13-18 years old) more often breathe through their mouths without a real nasal breathing disorder, that is, they have a habit of keeping their mouth open (HKMO) and not require surgical treatment.

To study the structure of the prerequisites for the occurrence of DMA with DNB, 149 patients were divided into 2 groups depending on age. The first main group included 78 children aged 6 to 12 years, the second – 71 children aged 13 to 18 years. The control group consisted of 32 DMA patients with otorhinolaryngological diseases that did not lead to PNO, in which MB was absent. The research groups were representative in terms of gender and age. When grading the age category in the studied groups, we considered the periods of temporary and the first stage of permanent bite.

The summary of the study regarding the prerequisites of mouth breathing in DMA by age group is presented in Tab. 3.

Most often, DMA with high reliability is accompanied by AR, but in children 13-18 years old, 57 out of 70 in 81.43% of cases at P<0.01, and in children 6-12 years old, 43 out of 78 in 55.13% of cases at P <0.05. And, although respiratory allergic manifestations appear in a child quite early, usually as early as 3-4 years of life, it is obvious that it is possible to correct the effectiveness of nasal breathing in allergic rhinitis with pharmacotherapy, and from the age of 5 with specific immunotherapy (purely conservative methods of treatment in contrast to the treatment of pharyngeal tonsil hypertrophy) if it leads to DMA, then at a later age. Also, it is important to note that allergic rhinitis is a very common disease among the population of various age groups and in children and adolescents, it reaches 25% among all otorhinolaryngological pathologies. Therefore, one should not forget about options for double and even triple formulations of diagnoses. For example, AR is quite often combined with HPT, especially in younger children.

Table 3 - The structure of otorhinolaryngological nosologies in the studied groups, considering age categories

Prerequisites of nasal breathing disorders	Studied groups						Total with DMA at PNO		P
	DMA with PNO *(6-12 p)* N=78		DMA with PNO *(13-18 p)* N=71		DMA without PNO *(6-18 p)* N=32				
	abs.	%	abs.	%	abs.	%	abs.	%	
Displacement of the nasal membrane	19	24,36	22	30,99	9	28,13	41	27,7	P1-2>0,05; P5-1>0,05
Allergic rhinitis	43	55,13	57	80,28	12	37,5	100	67,57	P2-3>0,05;
Hypertrophy of the pharyngeal tonsil	58	74,36	26	36,62	6	18,75	84	56,76	P3-1 >0,05; P3-4 <0,05
Chronic rhinosinusitis with nasal polyps	4	5,19	20	28,17	4	12,5	24	16,22	P2-4 <0,01; P1-4 <0,05
Hypertrophy of palatine tonsils	37	47,44	18	25,35	11	34,38	55	37,16	P3-5 <0,05 P2-5 <0,05

HPT, on the contrary, causes DMA more often in the age category 6-12 years: 58 out of 78 in 74.36% of cases (P<0.05), and in the category 13-18 years more often than in the control group: 26 out of 70 in 37.14% of cases, but not reliably (P>0.05). It is important to remember that HPT is often combined with HPAT and/or AR (Tab. 4). In this case, the risk of DMA formation is much higher. In case of occurrence of HPT against the background of AR, as with a disease that cannot be treated surgically and requires pharmacological control of symptoms and pathogenetic treatment by the method of allergen-specific immunotherapy at all stages of DMA correction, one

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should think about a conservative option of managing patients by an otorhinolaryngologist and an allergist.

HPAT somewhat more often accompanies DMA at the age of 6-12 years compared to the age category of 13-18 years and the control group, but not significantly (P>0.05). It must be remembered that HPAT is the only pathology that, if necessary, is treated exclusively surgically, but such a diagnosis on its own usually does not cause DMA.

DNM did not significantly induce DMA in both primary groups compared to the control group. This is due to the fact that displacement of the membrane quite often leads to an asymmetric version of breathing through the nose, when one half of the nose breathes worse than the other, but overall nasal breathing can be satisfactory (according to the results of rhinomanometry). Over time, especially in children, this situation can be significantly corrected during the growth of the facial skeleton and the increase in the overall size of the nasal cavity. It should be noted that in our study we did not consider the usual anatomical deviations of the nasal membrane that are present in most people. It is the separation of normal anatomical deviations from clinically significant DNM and the determination of other parallel conditions of the nasopharyngeal zone that is an important function of an otorhinolaryngologist in solving the issue of treatment tactics for DMA, because, unlike adenotomy, surgery for submucosal resection of the nasal membrane (SRNM) in childhood, it has greater limitations due to concern for the growth zones at the border of the cartilaginous and bony parts of the nasal membrane.

CRwP slightly more often leads to such a violation of nasal breathing, which contributes to DMA, in patients of the II main group compared to the control group: 20 of 70 in 28.57% of cases, but at P>0.05. But in comparison with the I main group it is more reliable (P<0.05). In patients of the I main group, CRwP was the cause of DMA even less often than in patients of the control group: 4 out of 78 in 5.19% of cases and 6 out of 32 in 18.35% of cases, respectively. Perhaps this is due to the fact that CRwP is often a complication of RA and takes longer to develop, so it is the cause of DMA at an older age.

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Tab. 3 also shows that there were 149 patients with DMA with PNO in the studied group, and the number of nosological forms was 304, and in the control group 32 and 42, respectively. Tab. 4 presents all variants of diagnoses found during the study in patients with DMA.

Table 4 - Distribution of the structure of otorhinolaryngological pathology in patients of the main and control groups

Nosologies and their combinations	Number of patients	
	DMA with PNO N=149	DMA without PNO N=32
DNM	5	9
HPT	6	10
CRSwP	0	4
AR	0	12
HPAT	0	5
AR+DNM+ CRSwP	13	0
DNM+HPT	4	0
DNM+AR	15	0
HPT+AR	36	0
HPT+HPAT	34	1
HPAT+AR	21	0
AR+ CRSwP	11	0
HPT+AR+DNM	4	0
Total nosologies	304	42

On average, 1 child with DMA with PNO has 2±1.2 nosological forms in the diagnosis, and 1±0.5 in children with DMA without PNO. Only 11 out of 149 (7.38%) patients with DMA in PNO have an otorhinolaryngological diagnosis with one nosology. Whereas in patients with DMA without PNO, this percentage is 96.88% (31

ISBN 978-3-98924-078-0

out of 32 patients).

Tab. 3 also shows that children and adolescents have only one disease that takes part in the formation of DMA with PNO and is not treated surgically - AR. But, in our study, it turned out that AR is not an independent cause of DMA with PNO.

Based on the structure of options for nasopharyngeal obstruction by nosological forms, almost every patient has potential indications for surgical treatment of DMA in PNO. Usually, the treatment of each specific patient is considered individually depending on the degree of hypertrophy, the relationship to other structures of the nasopharynx and its shape (in the case of the pharyngeal and palatine tonsils), the degree of violation of the total flow volume (with rhinomanometry with DNM), the degree of polyposis (with CRwP).

Since HPT often appears in the results of our research, it is an integral part of the child's nasopharynx and the lymphoid barrier in upper respiratory tract infections and, at the same time, becomes a reason for thinking: operate\not operate and treat conservatively - let's dwell on information about it in more detail.

Pharyngeal tonsil (PT) well developed in childhood. Starting from the age of 10, it gradually decreases, so it is often completely atrophied in adults. Adenoid growths are most often observed in children aged 3-10 years, but they can appear earlier or later than this age. Today, PT is considered as a peripheral organ of the immune system, which at a certain age is in the nasopharynx of healthy children [10]. There is still confusion in terminology regarding the size of a normal adenoid and the degree of its hyperplasia in a pathological condition. It is generally accepted to divide hyperplasia into 3 degrees. 1st degree – the pharyngeal tonsil covers 1\3 of the choana, 2nd degree – 2\3, 3rd degree – the entire choana. Thus, the 1st and 2nd degree of hyperplasia is a variant of the norm regarding the patency of the nasopharynx for the flow of air through it. The condition of the patient's nasal breathing does not always depend on the value of PT, often hypertrophy of the I or II degree due to the chronic inflammatory process causes and supports the phenomena of sinusitis and nasopharyngitis, which, in turn, are manifested by a long runny nose and nasal congestion [26, 36].

Acute and chronic diseases of the lymphoid pharyngeal ring are a common pathology, and such patients make up 60–65% of outpatients with an otolaryngological profile. Since DMAs develop precisely against the background of persistent difficulty in nasal breathing, our research refers to CNP. Chronic inflammation of PT or CNP is a common disease in the pediatric population that affects the child's somatic and functional development and quality of life (Purnell P.R. et al. 2019, Smiianov Y.V. et al. 2019). Even though the term "chronic nasopharyngitis" is registered both in ICD 10 (code "J31.1") and in ICD 11 (code "CA09.1"), most clinicians used the unclassified term "chronic adenoiditis" until recently and it is often confused with HPT (adenoid vegetations) (Laiko A.A. et al. 2020, Wang H., 2020 et al.). To date, there are no universally accepted reliable differential diagnostic criteria for CNP and PT hypertrophy. The diagnosis is formed in mainly based on the patient's complaints of difficult nasal breathing, nasal discharge, postnasal drip, hoarseness, hearing loss, cough. A standard examination of the nasopharynx (posterior rhinoscopy) reveals an enlarged PT, with the presence of mucous-purulent secretions, an increase in the lymph nodes of the posterior cervical group (Patel A. et al., 2020, Liu H. et al., 2021). Subfebrility is an important diagnostic criterion. Computed tomography, magnetic resonance imaging, or radiography in the lateral projection are sometimes used as an additional method (Surov A. et al., 2016, Purnell P.R. et al., 2019, Liu J.L. et al., 2021). However, only the use of endoscopic examination of the nasopharynx allows to visualize and differentiate the pathology of this part of the respiratory tract (Patel A. et al., 2020). Therefore, it is obvious that in real clinical practice the frequency of PT hypertrophy in patients with nasopharyngitis is significantly overestimated, especially in comorbidity with DMA, and such patients are usually candidates for adenotomy. However, adenotomy often does not solve the problem, as symptoms persist in 19-26% of patients (Byars S.G. et al., 2018). Quite often, revision surgery is indicated for such patients. A meta-analysis regarding the need for repeated adenotomy shows that its main reason was the concomitant inflammatory process (Paramaesvaran S. et al., 2020, Francis D.O. et al., 2017). Therefore, many questions arise regarding the choice of adequate conservative CNP therapy [27, 28, 29, 30, 31].

According to the predominant etiological component, viral, bacterial and allergic forms of CNP can be distinguished, although it is quite difficult to clinically determine which etiological factor is predominant in each specific case (Cho K.S. et al., 2018, Cao C. et al., 2018). As is known, the association of PT lymphoid tissue with the respiratory epithelium is a morphological substrate of viral damage, in particular, DNA-containing γ-herpesvirus type 4 - Epstein-Barr (EBV), which has distinct lymphotropic properties (Günel C. et al., 2015). Studies using immunological methods have demonstrated that Epstein-Barr virus can be involved in hypertrophy of pharyngeal lymphoid tissue in children and adolescents (Jamiyan T. et al., 2018, Ondrejka S.L. et al., 2020). The virus is not eliminated from the human body and can manifest itself in various variants of the clinical course, in particular latent and chronic forms, which are characterized by a long course with periodic exacerbations. Therefore, the success of conservative therapy with regard to the stable establishment of nasal breathing in the case of lifelong viral persistence of EBV in HPT with DMA is questionable.

Although the pathogenetic role of bacterial infection in patients with CNP has not been proven, there is a hypothesis that the nasopharyngeal microbiome plays a significant role in its development (Flynn M, Dooley J., 2021, Man W.H. et al., 2019, Esposito S. et al., 2018). It has been shown that colonization by pathogens Streptococcus pneumonia, Haemophilus influenzae, Staphylococcus aureus, etc. is associated with a higher frequency of respiratory diseases (Chapman T.J. et al., 2020, Huang C.C. et al., 2021, McCauley K.E. et al., 2021, Kim S.K. et al., 2019). There is a proven connection between the state of the nasopharyngeal microbiome and hypertrophy of the pharyngeal tonsils and obstructive sleep apnea syndrome (Johnston J.J., Douglas R. 2019). Therefore, many studies have studied the effectiveness of CNP antibacterial therapy, but its effectiveness is not high (Geiger Z. et al., 2022). There is an assumption that the ineffectiveness of antibiotic therapy is related to bacterial biofilms in the nasopharynx (Chao Y. et al., 2017, Bair K.L. et al., 2020, Luke N.R. et al., 2007). In any case, the effectiveness of local and systemic antibacterial therapy is appropriate only for exacerbations of CNP and has a questionable effect on the sustained improvement of the PT condition and, accordingly, on the condition of nasal breathing in DMA. A slightly different approach to the treatment of chronic bacterial nasopharyngitis is mucosal vaccines. Their use has a positive effect on natural resistance factors and the adaptive immune response in CNP. In order to restore a certain immune resistance to infectious agents with CNP against the background of recurrent infections, the child must either, if not often, then probably regularly get sick, or be immunized by taking pathogenic weakened lysates of bacteria, those that most often cause acute and chronic diseases of the respiratory tract. For infections associated with mucous membranes, regardless of whether they are accompanied by bacterial colonization of the epithelium, or penetration and multiplication in the epithelium, or are limited only to their penetration through the epithelium, secretory IgA (sIgA), which, by binding with adhesins on the surface of bacteria, block the attachment of the latter to epithelial cells [32, 33]. The protective effect of sIgA is realized in case of re-infection or by local immunization. 3 considering this, the creation of protective artificial immunity to microorganisms, instead of the transfer of regular and frequent respiratory infections, can be achieved by the introduction of purified bacterial adhesins, which is confirmed in the literature by many data on the immunomodulatory effects of bacterial lysates in tonsillitis, bronchitis, SARS [34, 35].

CNP is pathogenetically based on chronic inflammation, so nasal steroids have been proposed as an adjunctive medical treatment option, but with very short-term and little success (Sakarya E.U. et al., 2017, Passali D. et al., 2016). The effectiveness of topical corticosteroids was significantly higher in patients with a combination of HPT and allergic rhinitis (AR), which can be tentatively defined as "allergic CNP" (Lou Z., 2018). However, in allergy sufferers, the use of topical steroids requires long-term use, especially if the causative allergen continues to act. The situation changes when the patient turns 5 years old, and allergen-specific immunotherapy (ASIT) becomes possible as a way of producing intolerance to allergens that cannot be removed from the patient. ASIT allows you to significantly reduce the duration and burden of pharmacotherapy, but it does not work quickly, because for the first 4 months the patient takes very small and small doses of allergens. In addition, not one of the options for conservative treatment and even their combination does not lead to the complete disappearance of the pharyngeal tonsil, and concomitant conditions in the nasopharyngeal zone (displacement of the nasal membrane, hypertrophy of the palatine tonsils) contribute to an incomplete restoration of nasal breathing, which would be sufficient for correction DMA [36, 37].

Thus, chronic non-infectious PT inflammation in allergic patients, local immunodepression associated with EBV infection, recurrent upper respiratory tract infections are the three main elements contributing to the long course and progression of CNP with unsatisfactory results of conservative and surgical treatment. The dubious results of conservative treatment are explained by the fact that all 3 conditions are not curable and require, if not constant, then regular monitoring and taking symptomatic or pathogenetic therapy, which alleviates the condition of nasal breathing, but does not make it consistently satisfactory for successful correction of DMA. Doubtful results of surgical treatment are explained by the fact that removing the consequences of one or another inflammation or hyperplasia does not eliminate the causes of these phenomena and require pharmacological control of symptoms after surgery. This increases the role of the otorhinolaryngologist in assessing the significance of the size and condition of the PT and its relationship to the structures of the nasopharynx in the development of DMA in this patient, as well as in the development of complex treatment tactics.

Since AR is the most frequent companion of all causes of DNB with DMA, affects the size of PT and can be complicated by CRSwP, let's stop on this pathology as well. Allergic rhinitis is an intermittent or permanent inflammation of the mucous membrane of the nose and its sinuses, caused by the action of allergens, characterized by congestion, secretions, itching of the nose, sneezing (only a few symptoms are possible). The prevalence among the population ranges from 7-22%. There are two main forms of allergic rhinitis: seasonal (or intermittent) (with hay fever) and year-round (or persistent). In turn, these forms are divided, depending on the type of "causal" allergen: seasonal allergic rhinitis - into pollen and fungal, year-round allergic rhinitis - into household, epidermal, food and professional. Allergic rhinitis can have a mild, medium-severe and severe course. A severe course is characterized, in addition to the low effectiveness of pharmacotherapy, by the presence of complications: nonspecific hyperreactivity of the nasal mucosa, polysensitization, nasal polyps, and bronchial asthma. The development of seasonal allergic rhinitis requires more time, since the causative pollen allergens do not act on the child's body all the time, and sensitization in this case takes longer - from about 5 years of age. From the perspective of persistent DNB in DMA, seasonal allergic rhinitis is less important, firstly, because its symptoms are not constant throughout the year, and secondly, because the leading symptoms are itching, sneezing, rhinorrhea, and allergic conjunctivitis. On the other hand, persistent allergic rhinitis develops faster, is characterized by constant manifestations throughout the year (with worsening during the heating season) and the predominant manifestation is nasal congestion. It is diagnosed with the help of anamnesis data, rhinoscopy, general laboratory criteria (blood eosinophilia, increase in total Ig E of blood serum, eosinophilic cationic protein) and specific allergy testing (skin and laboratory). Treatment of AR has 3 directions: elimination of the causative allergen, symptomatic pharmacotherapy and ASIT, as a way of forming non-reception by the patient's immune system of allergens that cannot be removed. ASIT is possible only when the causative allergens are identified and the child is at least 5 years old.

To study the effectiveness of the treatment of patients with DMA in persistent DNB, 101 patients aged 6 to 18 years who were indicated for surgical treatment (adenotomy (AT) or adenotonsillotomy (ATT) and/or SRNM and/or polypoethmoidotomy (PET), divided into 2 main groups depending on the presence or absence of AR in a given patient. The main group No. 1 included 36 patients with any variant of the diagnosis + AR. 34 patients with any variant of the diagnosis without AR were included in the main group No. 2. The control group consisted of 31 patients with a similar otorhinolaryngological diagnosis, in whom surgical treatment was not carried out due to lack of consent or was carried out late, at a later age after long attempts at conservative treatment. The fact that the SRNM operation was performed on a total of 6 patients (in the older age group), AT - 74, ATT - 36, PET - 3 needs to be clarified. Shaver AT under general anesthesia was performed under the control of endoscopic technique. During tonsillotomy, 1/3 of the tonsil was removed depending on the plane in which the tonsil was hypertrophied. With DMA, the upper pole of the palatine tonsil most often required reduction (60 out of 72 tonsils). Tonsillotomy, in our study, was not performed as an independent operation. In all cases, surgical treatment was performed before orthodontic treatment. Patients of all groups were treated comprehensively with conservative appointments of an otorhinolaryngologist, allergist and orthodontist, depending on the specific pathology of each patient. A positive result of DMA correction was considered to be a physiological occlusion or close to it 1 year after the end of orthodontic treatment. The term of treatment (otolaryngological, allergological and orthodontic) and observation is from 3 to 4 years.

A summary of the results of complex treatment of patients with DMA in PNO is presented in Tab. 5.

Table 5 - Evaluation of the results of treatment of patients with DMA with PNO depending on the fact of timely surgical intervention in the nasopharyngeal area

Positive result	Surgical treatment on the background of AR N=36	Surgical treatment N=34	Total with timely surgical treatment N=70	Without surgical treatment when indicated for this N=31	P
abs	24	29	53	12	P1-4<0,01 P2-4<0,01 P3-4<0,05
%	66,67	85,29	75,71	38,71	

In both main groups, timely surgical treatment led to positive results of DMA treatment in PNO compared to the control group at P<0.05. In the group with surgical treatment on the background of AR, 29 out of 34 (85.29%) patients and in 24 out of 36 (66.67%) in the group with surgical treatment without AR. In the main group No. 2, the results are slightly better and in comparison with the control group at P<0.01, and in the main group No. 1 - slightly worse, but better compared to the control group at P<0.05. In the group where patients had a concomitant disease of the nasopharyngeal zone that affected DNB and were treated, including conservatively (AR), the results were somewhat worse than in the group of patients who did not have concomitant conditions with the need to control symptoms with pharmacotherapy, but with P> 0.05.

Findings that hold after all phases of our multicenter study. Endoscopic ENT examination and rhinomanometry allow in 77.66% of cases (P<0.01) to determine the underlying cause of persistent difficulty in nasal breathing. In 17.14% of patients with DMA without complaints of persistent difficulty in nasal breathing, at least one cause of nasopharyngeal obstruction is detected when examined by an otorhinolaryngologist. 13.37% of children in the age category of 6-12 years and 32.56% of children in the age category of 13-18 years have dento-maxillofacial abnormalities with mouth breathing without persistent nasopharyngeal obstruction, that is, they have the habit of keeping their mouth open and do not need surgical treatment. More often (at P<0.05) in children 6-12 years old, DMA with PNO is accompanied by HPT, and in children 13-18 years old - AR at (P<0.01). AR is the leading cause of DMA in PNO in both age groups but was never the sole cause of this pathology in our studies. AR can be an aggravating factor in the treatment of DMA with PNO, as a factor of persistent DNB that cannot be influenced by surgery. The factor in the occurrence of DMA in PNO is a combination of several reasons on the part of the patient's nasopharyngeal zone, which complicates the course of the disease with a more guaranteed development of DMA. Timely surgical intervention in the nasopharyngeal zone for DMA with PNO reliably at P<0.05 leads to positive results of DMA treatment 1 year after the end of orthodontic treatment.

Summary.

If we refer to otorhinolaryngological pathology with nasopharyngeal obstruction and the development of DMA in children and adolescents as a comorbid condition, the relevance of the issue of comprehensive and timely qualified treatment, including surgical treatment, depending on the cause of the development of MB, becomes clear. The situation forces scientists to propose a more detailed consideration of issues of differential diagnosis of otorhinolaryngological pathology to improve treatment and improve the prognosis for the patient, especially in conditions of a time-limited growth period.