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Gulimbay Babakhanov

*Tashkent Institute Tashkent Pediatric Medical Institute, 223, Bagishamal street, Tashkent, 100140.,
ndm2@mail.ru*

Sunnat Makhsudov

*Tashkent State Dental Institute, 103, Makhtumkuli street, Tashkent, 100047. Uzbekistan Dental
Association, 103, Makhtumkuli street, Tashkent, 100047.*

Saidakram Khasanov

Tashkent Pediatric Medical Institute, 223, Bagishamal street, Tashkent, 100140.

Maqsad Bobokhonov

Tashkent Pediatric Medical Institute, 223, Bagishamal street, Tashkent, 100140.

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Cover Page Footnote

Tashkent Pediatric Medical Institute, 223, Bagishamal street, Tashkent, 100140. Tashkent State Dental Institute, 103, Makhtumkuli street, Tashkent, 100047. Uzbekistan Dental Association, 103, Makhtumkuli street, Tashkent, 100047.

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NARROWING OF THE UPPER JAW AND NASAL CAVITY

Gulimbay Babakhanov¹, Sunnat Makhsudov^{2,3}, Saidakram Khasanov¹, Maqsad Bobokhonov¹¹Tashkent Pediatric Medical Institute, 223, Bagishamal street, Tashkent, 100140.²Tashkent State Dental Institute, 103, Makhtumkuli street, Tashkent, 100047.³Uzbekistan Dental Association, 103, Makhtumkuli street, Tashkent, 100047.

Resume

There are no intravital planimetric and volumetric measurements of the nasal cavity in rhinology. The available data are based on anthropometric studies of skeletal remains of the human skull, which have small clinical significance.

Aim. To study the vertical and transversal dimensions of the nasal cavity with the narrowing of the upper jaw in children using a facial teleroentgenography (facial TRG, syn: facial tele-X-ray cephalograms, teleradiography).

Materials and methods. The vertical and transversal dimensions of the nasal cavity, the degree of disturbance of the proportionality of these dimensions in the narrowing of the upper jaw was estimated on the basis of data of facial TRG of the head. Facial TRG was performed in 96 children: 50 with normal bite and without pathology of ENT organs (control group "I"), which were divided by periods of bite formation (replaceable bite - 30 children (control group "Ia") and permanent bite - 20 (control group "Ib")) and in 46 children aged 7- 12 years with narrowing of the upper jaw narrowing of the upper jaw and difficulty in nasal breathing. The severity of the narrowing of the upper jaw was assessed by NG Snagina (1966): the first subgroup ("IIa") is children with a moderately pronounced form of constriction (n = 20), the second subgroup ("IIb") with a pronounced form of constriction (n = 26). For the metric analysis of the facial TRG shell we used our own calculation scheme and the Lucien de Coster method.

Results. The dynamics of the vertical and horizontal narrowing of the wall of the nasal cavity occurs simultaneously, harmoniously and synchronously. The height of the nasal cavity depends on the depth of the hard palate. The severity of X-ray clinical picture of the deformation of the nasal septum depends on the depth of the hard palate and the height of the nasal cavity.

Conclusions. With pronounced narrowing of the upper jaw, the transversal size of the nasal cavity decreases synchronously, and when the hard palate ("gothic palate") is high, its vertical size decreases, and rough deformations of the nasal septum develop accordingly.

Keywords: narrowing of the upper jaw, Nasal cavity, Nasal septum, Cephalometric analysis.

Actuality of the problem

The narrowing of the upper jaw (NUJ) is a fairly common dentoalveolar anomaly (DAA) component 60-65% of the total number of identified dental-jaw anomalies [1,2,3,4,5,6,7,8).

The DAA is characterized by a deterioration of the aesthetics of the face, a violation of the bite and the function of the dental apparatus. According to YuL Obratsov, IA Varakina [9], SN Makhsudov [10], AA Abdukadyrov [11] in 60-75% of children with a pronounced form of DAA observed difficulty in nasal breathing.

There are empirical views on the changes in the architectonics of the bone and cartilage structure of the nasal cavity in the DAA [3,11,12,13,14,15,17,18,19,20,21,22,23,24,25], but not proven by metric methods. They stated that nasal breathing was improved through the use of clinical and functional studies. This was due to the lack of diagnostic methods for the in vivo topometry of the bone structures of the nasomaxillary complex (NMC), including the bone and cartilage wall of the nasal cavity. Specialists could not have an accurate idea of the proportionality of growth and development of individual anatomical structures of the NMC in the norm, and during its deformations. Therefore, in the literature one can find conflicting opinions about the nature of the deformations and anomalies of this area of the facial skeleton.

Considering the high information content, proportionality and accuracy of the image, as well as the identity of the digital facial (frontal) tele-X-ray cephalograms study (facial teleroentgenography, facial TRG, syn: teleradiography) we applied this method when studying the architectonics of the nasal wall in norm and during its deformations caused by the narrowing of the upper jaw in children.

Aim:

to study the vertical and transversal dimensions of the nasal cavity with the narrowing of the upper jaw in children using a facial tele-X-ray cephalograms (facial TRG).

Materials and methods

The vertical and transversal dimensions of the nasal cavity, the degree of disturbance of the proportionality of these dimensions in the narrowing of the upper jaw was estimated on the basis of data of the cephalometric method facial teleroentgenography (facial TRG) of the head.

Facial TRG was performed in n = 96 children.

The control group (I) was composed of children with normal bite and without pathology of ENT organs (n = 50), which were divided by periods of bite formation (subgroup of replaceable

bite "Ia" - 30 children and subgroup permanent bite "Ib" - 20).

The main group "II" consisted of n = 46 children aged 7-12 years with narrowing of the upper jaw and difficulty in nasal breathing. The severity of the narrowing of the upper jaw was assessed by NG Snagina (1966) [1] : the first subgroup "IIa" - children with a moderately pronounced form contraction (n = 20), the second subgroup "IIb" with a pronounced contraction (n = 26).

For the metric analysis, the facial TRG shell used its own calculation scheme [16,26,27] and the Lucien de Coster method [28].

Results and discussion

An analysis of the head of facial TRG in children of the control group (n = 50) revealed that in 97% of cases the anthropometric points, the lines between them and their correlation relationships, as well as the magnitude of the angles formed by the intersection of these lines, correspond to the average static norms. We paid attention to the transversal size of the nasal cavity: all children in the control group "I" had the widest sector (point D) located along the N-E line (norm). The results of the relationship between the length of the N-A1 line (height of the nasal cavity) and the length of the other sides of the triangle $\Delta NA1d$, as well as the angular values of the triangle, which corresponded to the norm (see Figure 1) were also taken into account.

Data on the angles and the relationship of the sides of the triangles, as well as the ratio of the areas of triangles in children of the control group "I" are shown in Table 1, 2 and 3.

In children with a moderately pronounced form of the narrowing of the upper jaw (n = 20) facial TRG, the indicators of the nasal cavity correspond to the norm. Only the dentoalveolar sector of the upper jaw is subjected to compressional changes (see Fig. 2). In children with a pronounced form of the narrowing of the upper jaw (n = 26), the metric indicators obtained were processed by trigonometric calculation using the formula $\sin \alpha = a/c$; it was revealed that the dynamics of the narrowing of the wall of the nasal cavity occurs simultaneously with the process of the narrowing of the upper jaw. It was also found that the deformation of the lateral and lower walls of the nasal cavity develop harmoniously and synchronously (see Fig. 3). The severity of deformation of the lower wall of the nasal cavity depends on the depth of palate, i.e. the deeper the dome of the hard palate (enlarged O1-A lines), the lower the height of the nasal cavity (open point N-A1) and, accordingly, there is a more pronounced

X-ray clinical picture of the deformation of the nasal septum and the horizontal width of the nasal

cavity is observed (similar to D-D).

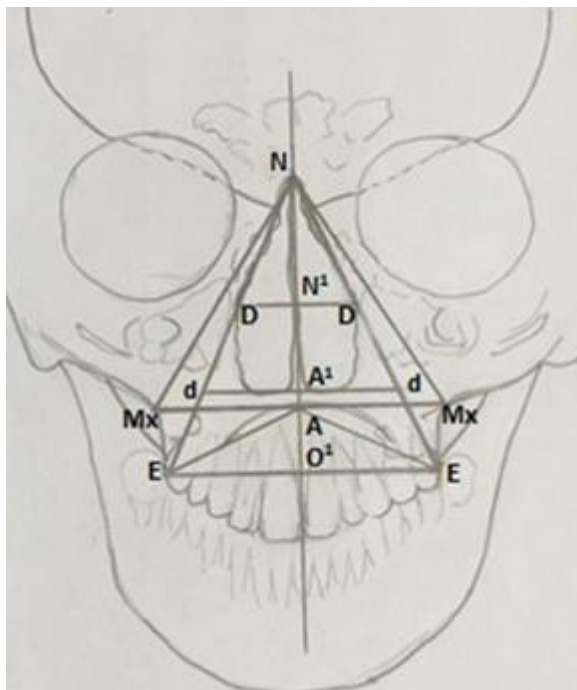


Figure 1. Normal facial TRG tests in children of the control group "I".

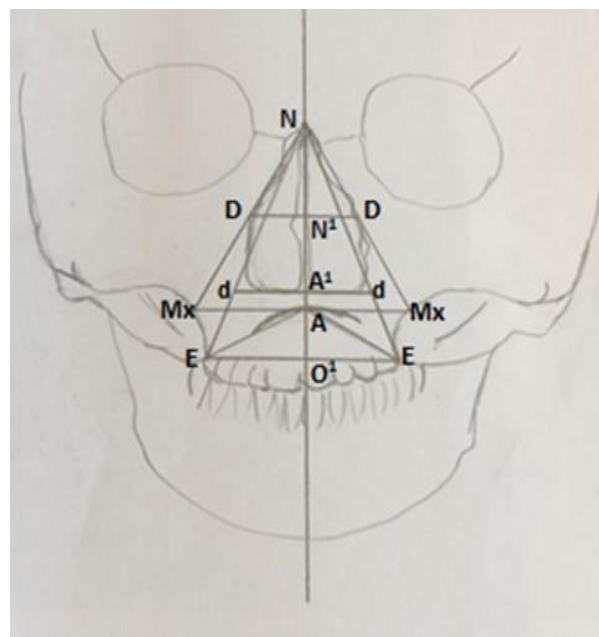


Figure 2. The location of anthropometric points and indicative lines on the patient's TRG, 12 years old, with a moderate narrowing of the upper jaw.

Geometrical designation of triangles	The width of each corner of the triangle (in degrees)								
	∠N	∠A	∠Mx	∠N¹	∠D	∠A¹	∠d	∠O¹	∠E
ΔN A Mx	30°	90°	60°						
ΔN N¹ D	24°			90°	66°				
ΔN A¹ d	24°					90°	66°		
ΔN E O¹	24°							90°	66°
ΔE A O¹		63°						90°	27°

Table 1. The average angular TRG indicators of the NMC of the facial skeleton in children of the control group "I".

Symbols of the sides of triangles	D-N ¹	Mx-A	E- O ¹	d-A ¹	N-Mx	N-A	N-d	N-A ¹	N-E	N- O ¹	A-E	A-O ¹
D-N ¹		9\16	3\5	9\11	3\10	9\25	9\25	2\5	9\35	18\65	9\17	6\5
Mx-A	16\9		19\15	16\11	8\15	16\25	16\25	32\45	16\35	32\65	16\17	32\15
E- O ¹	5\3	15\16		15\11	1\2	3\5	3\5	2\3	3\7	6\13	15\17	2\1
d-A ¹	11\9	11\16	11\15		11\30	11\25	11\25	22\45	11\35	22\65	11\17	22\15
N-Mx	10\3	15\8	2\1	30\11		6\5	6\5	4\3	6\7	12\13	30\17	4\1
N-A	25\9	25\16	5\3	25\11	5\6		1\1	10\9	5\7	10\13	25\17	10\3
N-d	25\9	25\16	5\3	25\11	5\6	1\1		10\9	5\7	10\13	25\17	10\3
N-A ¹	5\2	45\32	3\2	45\22	3\4	9\10	9\10		9\14	9\13	45\34	3\1
N-E	35\9	35\16	7\3	35\11	7\6	7\5	7\5	14\9		14\13	35\17	14\3
N- O ¹	65\18	65\32	13\6	65\22	13\12	13\10	13\10	13\9	13\14		65\34	13\3
A-E	17\9	17\16	17\15	17\11	17\30	17\25	17\25	34\45	17\35	34\65		34\15
A- O ¹	5\6	15\32	1\2	15\22	1\4	3\10	3\10	1\3	3\14	3\13	15\34	

Table 2. The average correlation linear ratio of the lengths of the sides of the triangles on the facial TRG NMC in children of the control group “I”.

Geometrical designation of triangles	ΔN_{dd}	ΔN_{EE}
ΔN_{dd}		10\19
ΔN_{EE}	19\10	

Table 3. The average correlation ratios of the areas of the triangles of the NMC of the facial skeleton on the facial TRG in children of the control group “I”.

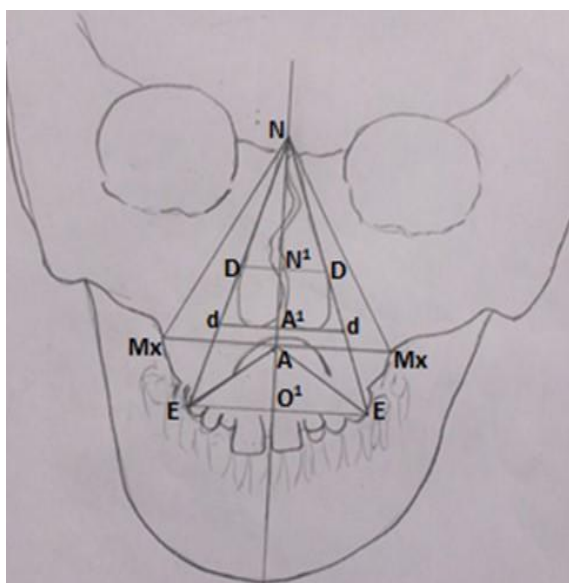


Figure 3. Location of anthropometric points and indicative lines on the patient's facial TRG, A., 10 years old, with a pronounced NARROWING OF THE UPPER JAW and nasal cavity.

Angular facial TRG indicators of triangles in children with a pronounced shape of narrowing of the upper jaw (n = 26) fluctuated on average

Δ NAMx: $\angle N$ -4° degrees, $\angle Mx$ $+4^\circ$ degrees; for Δ NN1D, Δ NA1d and Δ NEO1: $\angle N$ -4° degrees, $\angle E$ $+4^\circ$ degrees; by Δ EAO1: $\angle A$ -5° degrees. $\angle E$

+5° degrees. According to the trigonometric formula, the process of narrowing the nasal cavity in the observed children depends on the magnitude of the decrease in the angle N and on the increase in the angles $\angle d$, $\angle D$ and $\angle E$.

Comparison of the results of the facial TRG-metric analysis of the nasal cavity with the data obtained by the method of Lucien de Coster (1939) [18] once again confirms the existence of a correlation pattern between ΔN_{dd} and the X-ray projection area of the nasal cavity.

Conclusion

Determination of topometric changes based on the facies of the facial TRG with anomalies and deformations of the Nasomaxillary complex including the architectonics of the nasal wall in the vertical and transverse directions, provide valuable information about the state of the bone structures of this complex, which allows to diagnose the growth and development of bones including the bone and cartilage wall of the nasal cavity.

Identified telerentgenogramometric interdependence between the size of the nasal cavity and the architectonics of the bone palate:

- the greater the depth of the dome of the hard palate (A-O1), the smaller the height of the nasal cavity (N-A1), and the more pronounced the degree of deformation of the nasal septum;

- the greater the degree of narrowing of the upper jaw (E-E), the smaller the transversal size (D-D) of the nasal cavity (i.e., it synchronously and harmoniously narrows), together with the smaller its X-ray projection area;

- the greater the degree of narrowing of the upper jaw, the higher the level of standing of the dome of the hard palate and at the same time the thickness of the sagittal palatal suture increases.

In this way:

1. Facial TRG provides valuable information about the state of the bone structures of the nasal cavity, which allows to diagnose with high accuracy and plan targeted measures to prevent impairment of growth and development of the bones of the Nasomaxillary complex, including the bone and cartilage wall of the nasal cavity.

2. For pronounced narrowing of the upper jaw synchronously, the transversal size of the nasal cavity decreases, and when the hard sky (gothic palate) is high, its vertical size decreases.

3. The facial TRG tests used by us can be useful for planning the doctor's treatment tactics for rhinochondroosteoplastic surgeries,

orthodontic corrective interventions on the Nasomaxillary complex, for narrowing the upper jaw.

Conflicts of interest: The authors declare that the article content was composed in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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