



Cephalometric characteristics of the upper respiratory tract in Ukrainian young men and young women with an orthognathic bite without and with the type of face taken into account

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CONFLICT OF INTEREST

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The upper respiratory tract is a component of the respiratory system, which ensures the performance of several key human functions at once. The variability of cephalometric indicators of this structure of the human body, depending on the peculiarities of body structure, nationality, sex, and other factors, is one of the current topics of discussion among modern scientists. The purpose of the study is to establish the peculiarities of the cephalometric characteristics of the upper respiratory tract in young people without pathology of the upper respiratory tract with an orthognathic bite without and taking into account the type of face. For 72 Ukrainian young women and 46 young men with an orthognathic bite and the absence of pathology of the upper respiratory tract, taken from the database of the research center and the pediatric dentistry department of National Pirogov Memorial Medical University, Vinnytsya, determination of cephalometric parameters of the upper respiratory tract itself was carried out. The face type of young women and young men was determined using Garson's morphological index. The statistical analysis of the obtained results was carried out in the licensed statistical package "Statistica 6.0" using non-parametric estimation methods. In Ukrainian young women and young men without and taking into account the type of face, the percentile range of cephalometric parameters of the upper respiratory tract proper was established (distance PASmin - the size of the retroglossal oropharyngeal airway space, distance PM-UPW - the size of the nasopharyngeal airway space, distance U-MPW - the size of the retropalatal oropharyngeal airway space, distance V-LPW - the size of the hypopharyngeal airway space, area UAA - the size of the upper airway area). Sex differences (significantly greater, or a tendency towards greater values in young men) of distance V-LPW values were found in representatives without taking into account the face type by 13.8 %, with a wide face type - by 11.6 % and with a narrow face type - by 15.9 %; as well as the size of the UAA area in representatives without taking into account the face type by 20.6%, with a very wide face type - by 21.2 %, with a wide face type - by 21.6 % and with an average face type - by 23.1 %. Both in young women and in young men, no reliable differences or trends in the magnitude of the cephalometric parameters of the upper respiratory tract between representatives with different types of faces were established.

Keywords: teleroentgenography, cephalometry, upper respiratory tract, young men, young women, orthognathic bite, facial types.

Introduction

The affiliation of certain structures of the respiratory tract to the upper respiratory tract is still debatable by anatomists, morphologists and ENT specialists. There are views according to which only the nasal cavity and nasopharynx belong to the upper respiratory tract [15], but the majority of researchers also include the oropharynx and larynx and even the paranasal sinuses [19].

The multifunctionality of this part of the respiratory tract is related to the variety of anatomical structures that form it and, accordingly, their morphological structure. Among the key functions, it is worth noting the heating and humidification of air, its filtration, the performance of protective, vocal, and olfactory functions [15].

In this regard, any pathology affecting this system will

cause a corresponding disorder of the above functions, each of which has a certain value in maintaining the homeostasis of the body [19].

Cephalometric indicators are an important indicator that can indicate the existence or threat of pathology of the upper respiratory tract. Cephalometry has found wide use both for assessing the state of the jaw-dental system and for assessing the structures of the upper respiratory tract. In addition, this method of research allowed scientists to understand the existence and power of the influence of various external and internal factors on the peculiarities of the parameters of the cephalometric indicators of this part of the respiratory tract, and vice versa - its influence on other structures of the body.

For example, let's take into account the influence of nasal and mouth breathing in children on especially cephalometric indicators. A study by Mu?oz I. C. L. and Orta P. B. [12] showed that mouth-breathing children have higher values of SNB, NS-Go Gn and NS-O PI ($p < 0.05$) than nose-breathing children. At the same time, nose-breathing children often have a high position of the hyoid bone and significantly smaller values of the air space of the nasopharynx ($p < 0.001$). Changes in cephalometric indicators depending on the type of breathing have also been confirmed in older age groups of children [20].

Craniofacial structures change in case of upper respiratory tract obstruction [3].

All these factors cause the increased interest of researchers in the study of cephalometric indicators of the upper respiratory tract. Work is being carried out on comparing the effectiveness of two- and three-dimensional studies [21], creating artificial neural networks for identifying the main anatomical landmarks in these structures [22].

Among the most promising directions of research, it is worth considering the study of normative cephalometric indicators of the upper respiratory tract in groups of different nationalities, sex and age, taking into account the peculiarities of odontological indicators and facial type.

The purpose of the study is to establish the peculiarities of the cephalometric characteristics of the upper respiratory tract in young people without pathology of the upper respiratory tract with an orthognathic bite without and taking into account the type of face.

Materials and methods

Primary lateral radiographs of 72 Ukrainian young women (YW) (aged 16 to 20 years) and 46 Ukrainian young men (YM) (aged 17 to 21 years) with an orthognathic bite and the absence of upper respiratory tract pathology were taken from the database of the National Pirogov Research Center and Department of Pediatric Dentistry Memorial Medical University, Vinnytsia.

All YW and YM in the private dental clinic "Vinintermed" underwent a telerradiographic examination (effective radiation dose up to 0.001 mSv) using a dental cone-beam tomograph Veraviewepocs 3D Morita (Japan). The licensed

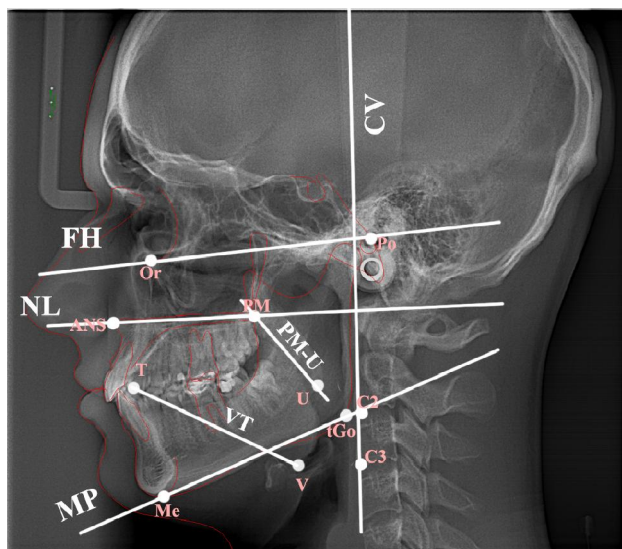


Fig. 1. Cephalometric lines used in cephalometric examination of the upper respiratory tract. CV - cervical plane (passes through points C2 and C3); FH - Frankfurt plane (passes through points Or and Po); MP - mandibular plane (passes through points Me and tGo); NL - nasal plane (passes through the ANS and PNS points); PM-U - longitudinal axis of the soft palate (passes through points PM and U); VT - longitudinal axis of the tongue (passes through points V and T).

medical software OnyxCeph³™, version 3DPro (Image Instruments GmbH, Germany) and the "UniqCeph" diagnostic program created at the National Pirogov Memorial Medical University, Vinnytsya were used for cephalometric analysis.

Committee on Bioethics of National Pirogov Memorial Medical University, Vinnytsya (protocol № 8 From 30.09.2021) found that the studies do not contradict the basic bioethical standards of the Declaration of Helsinki, the Council of Europe Convention on Human Rights and Biomedicine (1977), the relevant WHO regulations and laws of Ukraine.

The cephalometric lines used in the cephalometric study of the upper respiratory tract [16] are shown in Figure 1.

The following cephalometric parameters of the upper respiratory tract itself were determined (Fig. 2, 3):

- distance PASmin (also known as Retroglossal oropharyngeal airway space) - distance between points TB and TB' (mm);
- distance PM-UPW (also known as Nasopharyngeal airway space) - distance between the points PM and UPW (mm);
- distance U-MPW (also known as Retropalatal oropharyngeal airway space) - the distance between the points U and MPW (mm);
- distance V-LPW (also known as Hypopharyngeal airway space) - distance between points V and LPW (mm);
- area UAA (also known as Upper airway area) - outlined by a contour through the points: PM - UPW - MPW - TB' - LPW - V - PM (mm²);

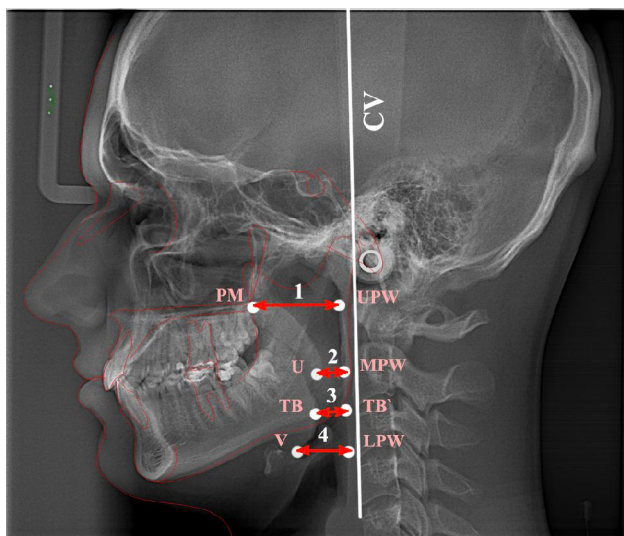


Fig. 2. Linear parameters used in the cephalometric study of the upper respiratory tract itself: 1 - distance PASmin, 2 - distance PM-UPW, 3 - distance U-MPW, 4 - distance V-LPW.

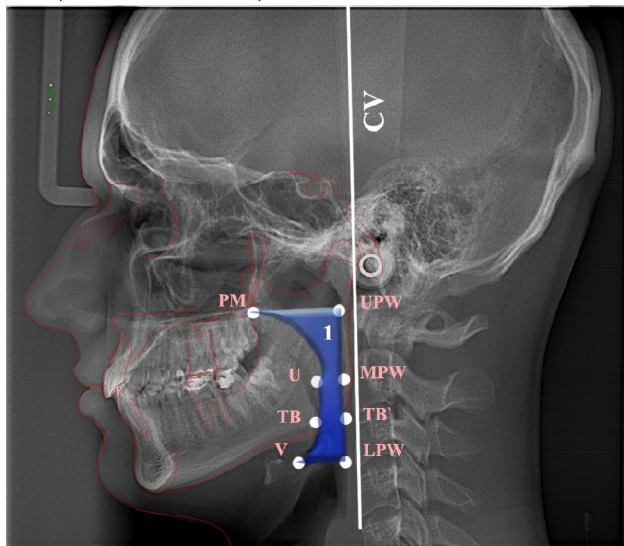


Fig. 3. Upper airway area (area UAA).

The type of face was determined using Garson's morphological index [14]. The following distribution by face types of YW and YM was established: YW - with a very wide face 25, with a wide face 25, with an average face 10, with a narrow face 12; YM - with a very wide face 5, with a wide face 22, with an average face 11, with a narrow face 8.

The statistical analysis of the obtained results was carried out in the licensed statistical package "Statistica 6.0" using non-parametric estimation methods. An assessment of the nature of distributions for each of the obtained variation series, the average for each characteristic being studied, the standard square deviation, and the percentile range of indicators was carried out. The significance of the difference in values between independent quantitative values was determined using the Mann-Whitney U-test.

Results

The percentile range of cephalometric parameters of the upper respiratory tract in Ukrainian YW and YM without pathology of the upper respiratory tract with an orthognathic bite without and taking into account the type of face are shown in Table 1.

When comparing the values of the cephalometric parameters of the upper respiratory tract proper between Ukrainian YW and YM with an orthognathic bite without and taking into account the type of face, it was established:

- the value of the V-LPW distance in YM regardless of face type (16.91 ± 3.04 mm), with a wide face (16.51 ± 3.05 mm) and with a narrow face type (17.53 ± 2.77 mm) is significantly greater or tends to greater values than in YW regardless of face type (14.58 ± 3.03 mm, $p < 0.001$), with a wide face (14.60 ± 3.44 mm, $p < 0.05$) and narrow face type (14.75 ± 2.55 mm, $p = 0.076$);
- the size of the UAA area in YM regardless of face type (734.7 ± 179.8 mm²), with a very wide face (718.0 ± 100.3 mm²), wide face (761.6 ± 207.3 mm²) and with an average face type (719.3 ± 166.1 mm²) is significantly greater than in YW regardless of face type (583.5 ± 144.8 mm², $p < 0.001$), with a very wide face (566.1 ± 131.4 mm², $p < 0.05$), wide face (597.0 ± 166.9 mm², $p < 0.01$) and with an average face type (553.4 ± 171.8 mm², $p < 0.05$).

When comparing the values of the cephalometric parameters of the upper respiratory tract proper in Ukrainian YW or YM with an orthognathic bite between different facial types, no reliable or trend differences in these parameters were established.

Discussion

Thus, as a result of the research conducted by us in Ukrainian YW and YM without pathology of the upper respiratory tract with an orthognathic bite without and taking into account the type of face, the percentile range of cephalometric parameters of the indicators of the upper respiratory tract itself was established. As a result of the analysis of the obtained results, pronounced manifestations of sexual dimorphism (larger values in YM) of the size of the lower oropharyngeal space were found in representatives without taking into account the type of face by 13.8 %, with a wide face - by 11.6 % and with a narrow face type - by 15.9 %; as well as the size of the area of the upper respiratory tract in representatives without taking into account the type of face by 20.6 %, with a very wide face - by 21.2 %, with a wide face - by 21.6 % and with an average face type - by 23.1 %. No significant differences or trends in cephalometric parameters of the upper respiratory tract proper in Ukrainian YW or YM with orthognathic bite between different facial types were established.

In children with different types of skeletal pattern (I group $2^\circ \leq ANB \leq 5^\circ$; II group $ANB > 5^\circ$), statistically significant differences in the size of the pharyngeal space of the respiratory tract were found (larger sizes were found in children of group I). Statistically significant differences were

Table 1. Percentile range (25.0th - 75.0th percent) of cephalometric characteristics of the proper upper respiratory tract in Ukrainian YW and YM without and taking into account the type of face.

Indicator	Sex	Total	Face type			
			Very wide	Wide	Average	Narrow
Distance PASmin (mm)	YW	7.4 - 11.5	8,9 - 12,2	7.6 - 11.8	7.2 - 10.2	6.7 - 11.1
	YM	8.3 - 11.2	9.5 - 11.0	8.2 - 11.0	8.3 - 13.7	8.2 - 12.6
Distance PM-UPW (mm)	YW	21.6 - 26.4	21.1 - 25.5	22.5 - 26.5	19.8 - 25.9	21.6 - 26.7
	YM	22.4 - 26.5	23.1 - 26.9	22.3 - 26.3	19.3 - 26.2	23.2 - 27.5
Distance U-MPW (mm)	YW	8.6 - 11.9	7.2 - 11.4	8.9 - 12.7	7.1 - 12.8	8.7 - 12.3
	YM	8.2 - 12.3	10.6 - 11.0	9.2 - 12.3	7.7 - 12.9	6.9 - 13.4
Distance V-LPW (mm)	YW	12.2 - 16.2	11.8 - 16.5	13.1 - 15.8	12.2 - 15.3	13.0 - 16.4
	YM	14.8 - 19.1	14.7 - 17.2	15.0 - 18.1	15.0 - 20.1	14.7 - 19.8
Area UAA (mm ²)	YW	480 - 663	481 - 624	469 - 639	385 - 614	565 - 684
	YM	622 - 855	636 - 770	611 - 890	595 - 855	584 - 826

Notes: YW - young women; YM - young men.

found for the indicators of airway area ($p < 0.01$), airway volume ($p < 0.01$), minimum axial area ($p < 0.05$) and the minimal space of the pharyngeal airway between the uvula and the back wall of the pharynx ($p < 0.05$) [1].

According to the cephalometric analysis according to McNamara, for individuals with different types of facial growth, features of the indicators of the upper respiratory tract were revealed. Individuals with a hyperdivergent type of growth had smaller values of the width of the upper and lower part of the pharynx compared to other groups ($p < 0.05$) [2].

The parameters of the upper respiratory tract are strikingly different in individuals with open bite, open skeletal and dental bite. So, people with an open bite have an anteroposterior narrowing of the upper respiratory tract. This is especially noted in the nasopharynx and oropharynx. A forward displacement of the hyoid bone is also noted. The same narrowing was noted in persons with an open skeletal bite. At the same time, an increase in the vertical dimensions of the respiratory tract was found in persons with a dental open bite [8].

Age-related changes in the development of the respiratory tract differ between men and women. R. D. C. Goncalves and others [5] found that in the period from 6 to 18 years the width of the respiratory tract increases, but if in general their width is greater in women, then for the upper respiratory tract it is the same for both sexes. Sharp increases in the width of the upper respiratory tract are noted in the period from 9 to 16 years.

The analysis of indicators of two age groups (the first 7-11 and the second 12-17 years) showed that the average value of the adenoid-nasopharynx ratio (A/N) was 0.45 and 0.44, PNS-ad1 and PNS-ad2 24 and 18.7 mm for age groups 1 and 2, respectively. The highest correlation with age was the length of the upper respiratory tract ($r = 0.557$, $p < 0.001$) [10].

B. Mislik and others [11] studied the effect of age on the

distance "p" (the shortest distance between the soft palate and the back wall of the pharynx) and "t" (the shortest distance between the tongue and the back wall of the pharynx). The results of statistical data processing revealed an insignificant effect of age only on the "p" distance ($p = 0.034$) and statistically significant correlations between both distances and anterior-posterior cephalometric data.

Studies devoted to the determination of normative indicators of the respiratory tract within different populations have a wide geographical distribution. So, the normative indicator of Chinese boys and girls was determined and compared with European data. In contrast to their European peers, Chinese children showed signs of sexual dimorphism - boys had a thicker soft palate ($p = 0.008$), a smaller depth of the retropalatal ($p = 0.011$), posterior lingual ($p = 0.034$) and hypopharyngeal ($p < 0.001$) parts of the pharynx. In addition, differences with European data were found regarding the depth of the posterior lingual part of the oropharynx and the position of the hyoid bone [6].

Significant manifestations of sexual dimorphism and features of indicators of the upper respiratory tract have also been established for the Indian population of various ages [7, 17].

According to McNamara's cephalometric analysis, normative indicators were established for the upper and lower respiratory tracts of children of European origin: PNS-Ad1 23.2 mm, Ad1-Ba 24.7 mm, PNS-Ba 47.6 mm, Ptm-Ba 45.7 mm, PNS-H 30.0 mm [13].

The increased interest of international scientists is growing in the study of the peculiarities of the respiratory tract in persons with different types of faces. Thus, the largest indicators of the width of the nasopharynx are found in brachyfacial individuals [4].

The existence of a statistically significant difference in the indicators of the posterior palatine space in brachyfacial and dolichofacial individuals was confirmed in the study of 45 teleroentgenograms using the Tweed analysis [18].

Also, a statistically significant negative correlation between the width of the upper part of the pharynx and the ANB angle was found during the cephalometric analysis [9].

Conclusions

1. The percentile range of cephalometric parameters of the upper respiratory tract proper in Ukrainian YW and YM with orthognathic bite without and taking into account the

type of face was established.

2. Pronounced manifestations of sexual dimorphism of the size of the lower oropharyngeal space were revealed (larger values in YM without taking into account the type of face, with wide and with narrow types of face) and the size of the area of the upper respiratory area (larger values in YM without taking into account the type of face, with very wide, with wide and with medium face types).

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ОСОБЛИВОСТІ ЦЕФАЛОМЕТРИЧНИХ ХАРАКТЕРИСТИК ВЕРХНІХ ДИХАЛЬНИХ ШЛЯХІВ В УКРАЇНСЬКИХ ЮНАКІВ І ДІВЧАТ ІЗ ОРТОГНАТИЧНИМ ПРИКУСОМ БЕЗ ТА З УРАХУВАННЯМ ТИПУ ОБЛИЧЧЯ

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Верхні дихальні шляхи є складовою респіраторної системи, що забезпечує виконання образу кількох ключових функцій

людини. Мінливість цефалометричних показників даної структури тіла людини в залежності від особливостей тілобудови, національності, статі та інших факторів є одним з актуальних предметів дискусій сучасних вчених. Мета дослідження - встановити особливості цефалометричних характеристик власно верхніх дихальних шляхів у осіб юнацького віку без патології верхніх дихальних шляхів із ортогнатичним прикусом без та з урахуванням типу обличчя. 72 українським дівчатам і 46 юнакам із ортогнатичним прикусом і відсутністю патології верхніх дихальних шляхів, взятих із бази даних науково-дослідного центру та кафедри стоматології дитячого віку Вінницького національного медичного університету ім. М. І. Пирогова, проведено визначення цефалометричних параметрів власно верхніх дихальних шляхів. Тип обличчя дівчат і юнаків визначали за допомогою морфологічного індексу Гарсона. Статистичний аналіз отриманих результатів проведений у ліцензійному статистичному пакеті "Statistica 6.0" з використанням непараметричних методів оцінки. В українських дівчат та юнаків без та з урахуванням типу обличчя встановлено процентильний розмах цефалометричних параметрів показників власно верхніх дихальних шляхів (distance PASmin - величина язикового ротоглоткового простору, distance PM-UPW - величина носоглоткового простору, distance U-MPW - величина запіднебінного ротоглоткового простору, distance V-LPW - величина нижнього ротоглоткового простору, ділянка UAA - величина площі верхньої дихальної ділянки). Виявлені статеві розбіжності (достовірно більші, або тенденція до більших значень в юнаків) величини distance V-LPW у представників без урахування типу обличчя на 13,8 %, з широким типом обличчям - на 11,6 % і з вузьким типом обличчя - на 15,9 %; а також величини ділянки UAA у представників без урахування типу обличчя на 20,6 %, з дуже широким типом обличчям - на 21,2 %, з широким типом обличчям - на 21,6 % і з середнім типом обличчя - на 23,1 %. Як у дівчат, так і в юнаків не встановлено достовірних або тенденцій відмінностей величини цефалометричних параметрів власно верхніх дихальних шляхів між представниками з різними типами обличчя.

Ключові слова: телерентгенографія, цефалометрія, верхні дихальні шляхи, юнаки, дівчата, ортогнатичний прикус, типи обличчя.
