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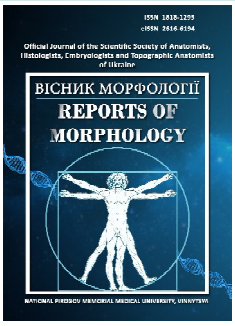

Determination of normative cephalometric parameters according to the Downs method for Ukrainian young men and young women with different face types

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Orthodontics is a rapidly evolving branch of dentistry in both theoretical and practical areas. Modern instrumental research methods used in it organically coexist with the already classical ones, perfectly complementing each other. It is such a classic method that is actively used in the practice of orthodontics is cephalometric analysis, which nevertheless requires updates over time and the emergence of new scientific data. The aim of the study was to establish the limits of percentile range and features of cephalometric parameters according to the Downs method in Ukrainian young men and young women with orthognathic occlusion depending on the type of face. 49 young men and 76 young women with orthognathic occlusion underwent a cephalometric study using the Downs method in OnyxCeph^3™ software, 3DPro version, Image Instruments GmbH, Germany (license № URSQ-1799). The division into facial types was performed using the Garson index. The licensed statistical package "Statistica 6.0" using non-parametric assessment methods analyzed the second (characteristics of the jaws by the method of Downs) and the third (indicators by the method of Downs that characterize the position of the teeth) groups of indicators. Studies have shown that most of the reliable or tendencies of differences in cephalometric parameters by the method of Downs in both young men and young women (more pronounced) with orthognathic occlusion, between different types of faces belong to the second group of indicators (dental characteristics of which surgical methods you can change the length, width, angles and positions of the upper and lower jaws). Manifestations of sexual dimorphism of cephalometric parameters by the method of Downs between young men and young women with appropriate facial types are insignificant and also, in almost all cases, belong to the second group of indicators. The established limits of percentile scope and features of cephalometric parameters according to the Downs method in Ukrainian young men and young women with orthognathic occlusion depending on the type of face will improve the existing methods of treatment of dental patients.

Keywords: *cephalometry according to the Downs method, young men and young women with orthognathic occlusion, face types, sex differences.*

Introduction

The development of a particular branch of medicine directly depends on the "demand" created by certain diseases in it, what socio-economic resonance they create, how they affect the quality of life and their prevalence. If we talk about orthodontics, the pathology of the dental and tooth-jaw system is extremely multisystemic and affects several systems of the human body and areas of activity. It can be a violation of the digestive and respiratory systems and a violation of speech and the overall beauty of the face, which in turn will negatively affect a person's social life.

If we are talking about such a component as prevalence, the data of researchers in different parts of the world are quite unanimous - the pathology of the dental and tooth-jaw system is a common phenomenon with a tendency to increase the number of cases. The global analysis of studies on the prevalence of occlusal pathology covered 53 studies. Among persons with permanent dentition, the prevalence of occlusion pathology of class III was 5.93 %, pathology of class II - 19.56 %, and pathology of class I - 74.7 %. In younger age groups with mixed type of dentition,

the distribution was 73 % for class III pathology, 23 % for class II pathology and 4 % for class I pathology. The most common pathologies were deep bite - 21.98 %, cross bite - 9.39 %, and open bite - 4.93 %. If we take into account the ethnic component, the highest prevalence of bite pathology of the first class was found in Africans, class II - in Europeans, and class III among the Mongoloids [4].

In a similar study, which included an analysis of 20 publications, the pathology of malocclusion class III ranged from 0 to 26.7 % depending on the region and ethnic group [13]. These findings already indicate a significant role of the constitutional component in the formation of the dental system.

An analysis of 25 articles on the prevalence of occlusal pathology among Iranian children (covering a total of 28,693 persons aged 3-18 years) revealed the prevalence of occlusion pathology of class I in 54.6 % of respondents, class II in 24.7 % and class III in 6.01 %. There was a greater prevalence of occlusion pathologies of III and I class among girls compared to boys (48.8 % and 44.6 % and 5.5 % and 4.5 %, respectively) [2].

The population of western Nepal is dominated by dental pathologies such as tooth accumulation, deep occlusion and the presence of increased gaps between teeth (61.3 %, 29.5 % and 10.5 %, respectively) [6].

In people with permanent dentition, residents of Brazil, the prevalence of occlusal pathology is 45.6 % [7]. The prevalence of cross-bite among schoolchildren in Italy is 3.7 % [12].

If we talk about the quality of life, and how the pathology of the bite affects it, then we can also note the unidirectional findings of research. Brazilian researchers in a study of 451 children aged 3 to 5 years found a relationship between the type of bite pathology and its impact on the quality of life of the child. A statistically significant association was found between anterior open occlusion and OHRQoL ($p<0.001$) [19]. The same data were obtained by Turkish scientists in a survey of preschool children [20].

At the same time, Dimberg L. and co-authors [8] obtained rather heterogeneous data - in some studies, the fact of the influence of occlusal anomalies on quality of life was found, in other cases, such a relationship was not found.

However, regardless of this, it is already clear that the pathology of the dental and maxillofacial system is a great challenge for modern orthodontics and finding solutions to this problem is an urgent issue today. The use of cephalometric research with the most individual approach to each patient, taking into account all his data can be the answer to this question, provided that adequate in volume and quality of research.

The aim of the study was to establish the limits of percentile range and features of cephalometric parameters according to the Downs method in Ukrainian young men and young women with orthognathic occlusion depending on the type of face.

Materials and methods

According to the Downs method, cephalometry was performed for 49 young men and 76 young women with orthognathic occlusion in the software OnyxCeph^{3}™, 3DPro version, Image Instruments GmbH, Germany (license № URSQ-1799).

Committee on Bioethics of National Pirogov Memorial Medical University, Vinnytsya (protocol № 9 From 21.11.2019) 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.

According to Dmitriev M. O. [9], all cephalometric indicators were divided into three groups. The first group includes indicators that usually do not change during surgical and orthodontic treatment, used in modern cephalometric analyzes of Schwartz, Ricketts, Steiner, Roth-Jarabak, Burstone and Bjork and were described by us in previous studies [11].

The main cephalometric points and measurements included to the second group of indicators according to the Downs method are shown in Figure 1.

The main cephalometric points and measurements included to the third group of indicators according to the Downs method are shown in Figure 2.

The division of young men and young women into facial types was performed using the Garson index [18].

The results were processed in the licensed statistical package "Statistica 6.0" using non-parametric evaluation

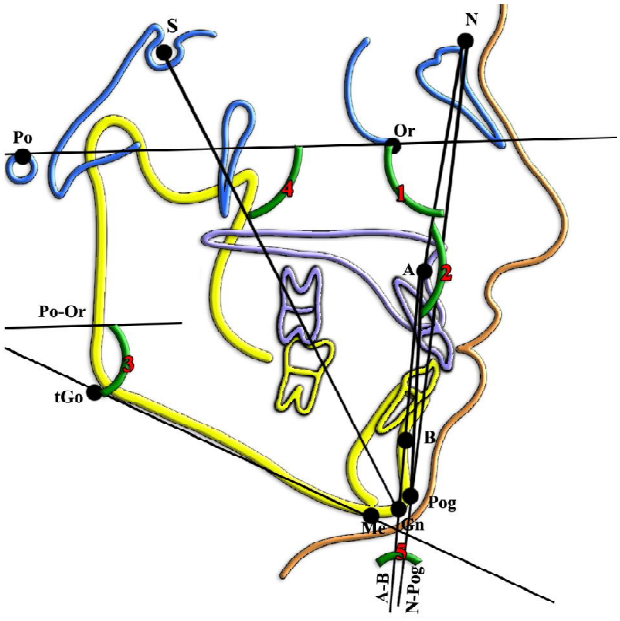

Fig. 1. The main cephalometric points and measurements according to Downs, which are in the second group of indicators: **1** - angle **POr_NPog** (angle NPog-POr according to Ricketts, changes have been described in previous studies [10]) (°); **2** - angle **NAPog** (°); **3** - angle **POr_MeGo** (°); **4** - angle **POr_GnS** (°); **5** - angle **AB_NPog** (°).

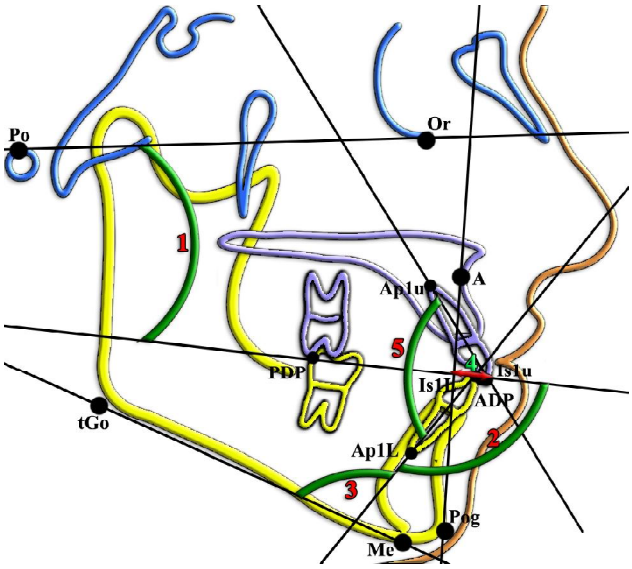

Fig. 2. The main cephalometric points and measurements according to Downs which are in the third group of indicators: **1** - angle **POR-DOP** (°); **2** - angle **1I-DOP** (°); **3** - angle **1I-MeGo** (°); **4** - distance **1u-APog** (mm); **5** - angle **II** (angle II according to Steiner, the changes are described in another article submitted for publication)

methods. The nature of the distributions for each of the variation series was estimated, the averages for each trait, the standard deviation and the percentile range limits were determined. The reliability of the difference between the values between the independent quantitative values was determined using the U-Mann-Whitney test.

Results

As a result of our research, we established the limits of the percentile range of cephalometric parameters according to the Downs method, which are included in the second and third groups of indicators, in Ukrainian young men and young women with orthognathic occlusion depending on facial type (Table 1).

Peculiarities and sex differences of cephalometric parameters according to the Downs method, which are included in the second and third groups of indicators, in Ukrainian young men and young women with orthognathic occlusion with different face types are shown in Table 2.

Table 1. Percentage scope limits (25,0th-75,0th percentl) of cephalometric parameters by the method of Downs in Ukrainian young men and young women with orthognathic occlusion depending on the type of face.

Indicator	Face type	Young men		Young women	
		25,0th percentl	75,0th percentl	25,0th percentl	75,0th percentl
NAPog (°)	Very wide	2.7	2.9	-4.5	1.3
	Wide	-3.2	5.5	0.2	5.8
	Average	-4.5	6.1	-0.1	4.7
	Narrow	-4.6	1.6	1.1	6.8

Continuation of table 1.

Indicator	Face type	Young men		Young women	
		25,0th percentl	75,0th percentl	25,0th percentl	75,0th percentl
AB-NPog (°)	Very wide	-7.1	-6.1	-5.2	-0.6
	Wide	-7.2	-2.8	-6.4	-2.1
	Average	-8.5	-2.6	-6.5	-1.7
	Narrow	-5.8	-2.9	-9.3	-2.7
POr-MeGo (°)	Very wide	7.5	19.6	16.1	20.9
	Wide	15.5	22.9	17.9	23.1
	Average	19.1	23.4	19.7	26.2
	Narrow	15.8	21.45	21.1	28.2
POr-GnS (°)	Very wide	52.6	57.4	53.8	58.1
	Wide	56.5	60.3	56.0	60.5
	Average	57.4	59.9	58.2	60.5
	Narrow	56.8	59.6	57.7	61.2
POr-DOP (°)	Very wide	2.7	4.3	4.4	7.0
	Wide	3.3	8.0	4.6	10.1
	Average	4.7	8.8	6.9	10.3
	Narrow	4.2	9.5	6.8	10.1
1I-DOP (°)	Very wide	15.6	25.9	13.1	23.0
	Wide	17.7	26.8	16.9	24.8
	Average	15.7	23.3	15.6	26.5
	Narrow	14.5	23.6	15.8	23.2
1I-MeGo (°)	Very wide	3.2	16.1	-1.3	11.1
	Wide	3.9	13.7	2.1	10.1
	Average	-1.1	10.2	-0.3	10.3
	Narrow	2.0	9.6	-2.0	9.3
1u-APog (mm)	Very wide	1.2	5.9	2.8	5.1
	Wide	3.6	5.5	3.8	6.2
	Average	2.7	5.0	2.8	6.7
	Narrow	2.0	4.5	3.2	5.5

Table 2. Peculiarities and sexual differences of cephalometric parameters according to the Downs method in Ukrainian young men and young women with orthognathic occlusion with different face types (M±σ)

Indicator	Face type	Young men	Young women	p
NAPog (°)	Very wide	2.400±4.881	-1.192±4.721	**=0.090**
	Wide	1.659±5.202	2.628±6.163*	>0.05
	Average	1.691±6.019	2.090±3.168*	>0.05
	Narrow	-1.538±4.378	3.858±3.487**&**	**<0.05**
AB-NPog (°)	Very wide	-6.480±1.439	-3.156±3.246	**<0.01**
	Wide	-5.032±3.058	-4.200±3.232	>0.05
	Average	-5.100±3.440	-3.870±2.647	>0.05
	Narrow	-4.550±2.636**t**	-5.483±3.479	>0.05

Continuation of table 2.

Indicator	Face type	Young men	Young women	p
POr-MeGo (°)	Very wide	13.44±6.23	18.52±3.63	>0.05
	Wide	18.90±5.78**t**	21.00±4.43*	>0.05
	Average	20.93±3.73*	23.35±4.30&**t**	>0.05
	Narrow	18.45±3.22	24.13±4.33**#***	**<0.01**
POr-GnS (°)	Very wide	54.60±2.79	56.20±2.58	>0.05
	Wide	57.54±4.01**t**	58.22±3.15*	>0.05
	Average	58.35±2.17*	59.36±1.72&	>0.05
	Narrow	58.11±2.12**t**	59.51±2.29&	>0.05
POr-DOP (°)	Very wide	4.180±5.691	5.552±2.912	>0.05
	Wide	4.845±4.824	6.696±3.620	>0.05
	Average	6.900±2.832	8.230±2.445*	>0.05
	Narrow	6.225±4.407	8.275±2.621*	>0.05
1l-DOP (°)	Very wide	20.36±8.79	18.57±7.21	>0.05
	Wide	21.69±6.11	21.13±5.55	>0.05
	Average	18.73±7.34	19.32±5.62	>0.05
	Narrow	18.19±5.67	19.33±4.81	>0.05
1l-MeGo (°)	Very wide	11.12±9.10	5.612±8.518	>0.05
	Wide	7.645±7.524	6.820±5.422	>0.05
	Average	4.682±7.524	4.220±5.907	>0.05
	Narrow	5.963±4.836	3.458±6.040	>0.05
1u-APog (mm)	Very wide	3.360±2.686	4.064±1.903	>0.05
	Wide	4.641±1.491*	5.040±1.791	>0.05
	Average	3.718±2.356	5.140±2.386	>0.05
	Narrow	3.050±1.310	4.400±1.741	**=0.097**

Notes: p - the significance of the difference in the values of the respective indicators between young men and young women with the same face types; *, &, **#** - significant differences (* - p<0.05, & - p<0.01, **#** - p<0.001) relevant indicators between very wide and other types of faces in young men and young women (higher values are noted); **t** - tendency of discrepancies of the corresponding indicators between very wide and other types of the face in young men or young women (higher values are noted); * - significant differences (* - p<0.05) relevant indicators between wide and medium, or wide and narrow face types in young men or young women (higher values are noted); **t** - tendency of discrepancies of the corresponding indicators between wide and average, or wide and narrow types of the person in young men or young women (higher values are noted).

Discussion

Thus, when comparing the cephalometric parameters by the method of Downs, belonging to the *second group* of indicators, between *young men or young women* with different facial types found both similar differences: both young men or young women with a very wide face type - significantly lower (p<0.05-0.001) or tendency (p=0.057-0.098) to lower values of *POr-MeGo* angles, which characterizes the angle of the mandibular plane relative to the Frankfurt plane (except for young men with a narrow face) and *POr-GnS*, which characterizes the angle the position of the *U-axis* relative to the Frankfurt plane than that of representatives with other face types; only in young women with a very wide face type - significantly (p<0.05-0.01) smaller values of the angle **NAPog**, which characterizes the position of the lower jaw, namely the anterior contour of the chin relative to the upper jaw in the sagittal plane than in women with other face types; only in *young women* with a wide face type - significantly lower (p<0.05) or a slight tendency (p=0.093) to smaller values of the angle **POr-MeGo** than in women with narrow and medium face types; *only in young men* with a very wide face type there is a tendency (p=0.079) to smaller values of the angle **AB-NPog**, which characterizes the position of the plane/line AB relative to the N-Pog line, than in representatives of a narrow face.

When comparing the cephalometric parameters by the method of Downs, belonging to the *third group* of indicators, between young men and young women with different face types almost no significant differences were found: *only in young women* with a very wide face type found significantly (p<0.05) smaller values of **POr- DOP**, which characterizes the slope of the closing plane on the Downs relative to the Frankfurt plane than in young women with medium and narrow face types; and *only in young men* with a very wide face type there is a significantly (p<0.05) smaller value of the distance **1u-APog**, which characterizes the position of the cutting edge of the upper medial incisor in the sagittal plane relative to the A-Pog line (takes a positive value when the cutting edge and negative if behind the line) than in representatives with a very wide type of face.

Minor manifestations of sexual dimorphism of cephalometric parameters by the Downs method were also found, namely: significantly (p<0.05-0.01) greater or insignificant tendency (p=0.097) to greater values *in young women with narrow face type* **NAPog** and **POr-MeGo** angles and distances **1u-APog**, as well as significantly (p<0.01) greater value of the angle **AB-NPog** *in young women with a very wide face type* than in young men with the corresponding face types; in young men with a very wide face type showed only a slight tendency (p=0.090) to higher **NAPog** angle values than young women with the corresponding face type.

Authors from various scientific institutions are actively addressing the topic of studying the peculiarities of cephalometric indicators according to the Downs method.

The team of authors established the features of cephalometric indicators for the population of the state of Maharashtra (India). Among the indicators that were statistically significantly different from the normative indicators according to Downs, researchers distinguish the facial angle (average difference compared to the normative indicators -1.10), convexity angle (4.70), incisor angle (-13.54), angle of the lower incisor plane jaws (5.61), FMIA (-7.91) and the angle for protrusion of the lower incisors (5.40) (in all cases p≤0.001) [1].

There were also differences in the cephalometric

parameters of the Downs method for residents of North India. These data showed statistically significant differences in the indicators of the facial angle and the angle of inclination of the occlusal plane [16].

An analysis of 238 teleradiograms of ethnic Iranians with a balanced face and no history of any surgery or pathology of the dental and tooth-jaw system revealed differences in cephalometric parameters for Iranians compared to Downs. Thus, Iranians have a greater angle of convexity of the face and the angle of IMPA [5]. In addition, these data are confirmed by a study conducted on the ethnic population of the city of Zanjan, which is also located in Iran [15].

In a study of a sample of ethnic Bangladeshis, the researchers found statistically significant differences from Downs data for facial angle, facial convexity angle, mandibular angle, Y-axis, and tilt of occlusal plane. In addition, the authors of the study identified manifestations of sexual dimorphism - higher values were observed in men [3].

Data from another study, also conducted on a sample of Bangladeshi residents, confirmed significant differences between cephalometric indicators of the local population and normative indicators for Downs. This study, in addition to the above results, also found that Bangladeshis have higher rates of AB plane, incisor angle, distances L1 to the mandibular plane, to the closing plane, U1 to the AB plane [14].

Pin-pin X. U. and Yan L. I. N. [17] found differences in cephalometric indices according to the Downs for the She and Han nationalities living in China. Statistically significant differences were found for MP-FH, U1-L1 and facial convexity ($p<0.05$).

In a Downs cephalometric examination of individuals belonging to the Mongoloid tribes of the state of Himachal Pradesh (India), scientists found a significant difference compared to the normative indicators for the convexity angle, inclination of the occlusal plane and incisor angle [21].

Summarizing the above data on the study of cephalometric and odontological indicators according to the method of analysis by Downs among different ethnic groups and nationalities, we can see a common tendency of authors to identify differences with normative indicators obtained by Downs methodology.

The data obtained by foreign scientists are fully consistent with the data obtained during our study, which in turn emphasizes the relevance and necessity of research aimed at identifying the constitutional features of cephalometric indicators among, above all, healthy population, which in turn will serve basis for further research, however, on pathological conditions.

Conclusions

1. In Ukrainian young men and young women with orthognathic occlusion, the limits of the percentile range of cephalometric parameters according to the Downs method depending on the type of face are found.

2. Practically all significant or trends in differences in cephalometric parameters by the method of Downs, both young men and young women (more pronounced), between different types of faces belong to the second group of indicators (dental characteristics of which surgical methods can change length, width, angles and positions of the upper and lower jaws).

3. Insignificant manifestations of sexual dimorphism of cephalometric parameters according to the Downs method have been found between young men and young women with appropriate facial types, which also, in almost all cases, belong to the second group of indicators.

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ВИЗНАЧЕННЯ НОРМАТИВНИХ ЦЕФАЛОМЕТРИЧНИХ ПАРАМЕТРІВ ЗА МЕТОДОМ DOWNS ДЛЯ УКРАЇНСЬКИХ ЮНАКІВ І ДІВЧАТ ІЗ РІЗНИМИ ТИПАМИ ОБЛИЧЧЯ

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Ортодонтія є розділом стоматології, що швидко розвивається як в теоретичному так і в практичному напрямках. Сучасні інструментальні методи дослідження, що використовуються у ній, органічно співіснують з вже класичними, ідеально доповнюючи одне одного. Саме таким класичним методом, що активно використовується у практиці ортодонта, є цефалометричний аналіз, котрий, тим не менш, вимагає оновлень відповідно до плину часу і появи нових наукових даних. Мета дослідження - встановити межі процентильного розмаху та особливості цефалометричних параметрів за методом Downs в українських юнаків і дівчат з ортогнатичним прикусом в залежності від типу обличчя. 49 юнакам і 76 дівчатам з ортогнатичним прикусом у програмному забезпеченні OnyxCeph³™, версії 3DPro, компанії Image Instruments GmbH, Німеччина (ліцензія № URSQ-1799) проведено цефалометричне дослідження за методикою Downs. Розподіл на типи обличчя проводили за допомогою індексу Гарсона. В ліцензійному статистичному пакеті "Statistica 6.0" з використанням непараметричних методів оцінки проведено аналіз другої (характеристики щелеп за методом Downs) та третьої (показники за методом Downs які характеризують положення зубів) груп показників. В результаті проведених досліджень встановлено, що більшість достовірних або тенденцій розбіжностей цефалометричних параметрів за методом Downs як в юнаків, так і у дівчат (більш виражено) з ортогнатичним прикусом, між різними типами обличчя відносяться до другої групи показників (зубо-щелепні характеристики, котрим хірургічними методами можна змінити довжину, ширину, кути та положення верхньої та нижньої щелеп). Прояви статевого диморфізму цефалометричних параметрів за методом Downs між юнаками та дівчатами з відповідними типами обличчя незначні і також, практично в усіх випадках, відносяться до другої групи показників. Встановлені межі процентильного розмаху та особливості цефалометричних параметрів за методом Downs в українських юнаків і дівчат з ортогнатичним прикусом у залежності від типу обличчя дозволять удосконалити існуючі методи лікування стаматологічних пацієнтів.

Ключові слова: *цефалометрія за методом Downs, юнаки та дівчата з ортогнатичним прикусом, типи обличчя, статеві розбіжності.*