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TELERADIOGRAPHIC INDICATORS IN YOUNG MEN AND YOUNG WOMEN WITH ORTHOGNATHIC OCCLUSION DETERMINED ACCORDING TO THE BJORK METHOD

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Relevance

The field of dentistry has been experiencing rapid development for decades, due to the emergence of new technologies and developments in the field of diagnosis, treatment and prevention and the large number of pathologies faced by practicing dentists. In particular, it should be noted that the latter factor plays not the least role in the development of odontology.

Indeed, data on the prevalence of occlusal pathology are disappointing. Survey data of preschool children in Brazil indicate that 63.2 % of them have at least one pathology of occlusion, among which the most common are overbite, overbite and posterior cross-bite (32.9 %, 34.6 % and 18.7 % respectively) [1].

The analysis of the incidence among school-age people of malocclusion in the period from 1991 to 2018 was conducted in China. A total of 117,682 schoolchildren collected data. The overall prevalence of occlusal pathology was 47.92 % (95 % CI: 58.6 %-71.9 %). Class I bite pathology was detected in 30.07 % (95 % CI: 25.37 %-35.48 %), class II in 9.91 % (95 % CI: 7.41 %-13.79 %) and class III in 4.76 % (95 % CI: 3.85 %-6.54 %). The most common pathology was a deep bite (16.67 %, 95 % CI: 11.50 %-23.08 %) [2].

Given these factors, the role of the quality of dental care is more important than ever. Against this background, the relevance of research aimed at improving existing data on methods of cephalometric analysis of teleradiograms, a powerful tool that allows orthodontists to properly plan and evaluate the course of treatment.

Domestic researchers are actively conducting research in this area [3-6] and studied the normative cephalometric indicators in accordance with various author's methods. However, work on adapting the Bjork methodology still remains isolated and fragmentary.

The aim of the study was to establish the sex differences of cephalometric parameters according to the Bjork method in Ukrainian young men and young women with orthognathic occlusion with different face types and their differences from the value of these indicators for residents of European origin.

Materials and methods

Analysis of lateral radiographs (performed on a dental cone-beam tomograph Veraviewepocs 3D Morita) was performed on 49 Ukrainian young men (aged 17 to 21 years) and 76 young women (aged 16 to 20 years) with a physiological bite as close as possible to orthognathic (hereinafter orthognathic).

The main cephalometric points and measurements were determined and performed according to one of the modern modifications of the Bjork method [7] used in the specialized medical diagnostic software OnyxCeph of the German company ImageInstruments – CFT-Bjork (Fig. 1 and 2): 1) angle Pr-N-A – formed by lines A-N and N-Pr, characterizes the position of the maxillary processus alveolaris (°); 2) angle CL/ML – formed by lines Id-Pog and c-Me, characterizes the position of the mandibular processus alveolaris (°); 3) the angle ILs/NL – formed by the central axis of the upper medial incisor and the line SpP, characterizes the position of the upper medial incisor to the palatal plane (°); 4) the angle ILi/ML – is formed by the central axis of the lower medial incisor and the line tGo-Me, characterizes the position of the lower medial incisor to the plane of the mandible (°); 5) angle A-N-B – formed by lines A-N and N-B, characterizes the position of the jaws to each other (°); 6) the angle OLs/NL – formed by the lines SpP and OcP, characterizes the position of the closing plane to the palatal plane (°); 7) angle OLi/ML – formed by lines tGo-Me and OcP, characterizes the position of the closing plane to the mandibular plane (°); 8) angle NL/ML – formed by lines tGo-Me and SpP, characterizes the position of the closing plane to the palatal plane (°); 9) angle S-N-A – formed by lines S-N and N-A, characterizes the position of the upper jaw in the sagittal plane (°); 10) angle S-N-B – formed by lines S-N and N-B, characterizes the position of the lower jaw in the sagittal plane (°); 11) angle NSL/NL – formed by lines S-N and SpP, characterizes the inclination of the upper jaw to the anterior base of the skull (°); 12) angle NSL/ML – formed by lines S-N and tGo-Me, characterizes the inclination of the body of the lower jaw to the anterior base of the skull (°); 13) angle N-S-Ar – formed by lines N-S and S-Ar, characterizes the position of the temporomandibular joint (°); 14) angle N-S-Ba –

formed by lines N-S and S-Ba, characterizes the angle of the skull base (°); 15) angle ML/RL – formed by lines Ar-tGo and tGo-Me, characterizes the angle of the lower jaw (°); 16) angle OLf/NSL – formed by lines S-N and OcP, characterizes the position of the closing plane to the base of the skull (°); 17) angle ILs/ILi – is formed by the central axes of the upper and lower medial incisors, characterizes the inclination of the upper and lower medial incisors to each other (°); 18) distance Is-NCL – the distance from the point Ls to the line Ns-Pog`, characterizes the position of the upper lip (mm); 19) distance Ii-NCL – the distance from point Li to the line Ns-Pog`, characterizes the position of the lower lip (mm); 20) the ratio N-S:S-Ar' – the ratio of the distances N-S and S-Ar', characterizes the position of the projection of the temporomandibular joint on the line N-S (con.un.); 21) distance Wits – the distance between the projections of points A and B on the closing plane (POcp), characterizes the linear ratio of the lower and upper jaws along the folding plane (mm); 22) angle S-N-Pog – formed by lines S-N and N-Pog, characterizes the position of the lower jaw in the sagittal plane (°); 23) distance Is-Olf – the distance between the point Is and the closing plane (POcp), characterizes the vertical location of the cutting edge of the medial cutter (mm); 24) distance Ii-Is – the distance from the point Is to Ii in the vertical plane, characterizes the inter-cutter overlap in the vertical plane (mm); 25) distance Overjet – the distance from the point Is to Ii in the sagittal plane, characterizes the inter-cutter distance in the sagittal plane (mm); 26) angle A-N-Pog – formed by lines A-N and N-Pog, characterizes the inter-jaw position in the sagittal plane (°).

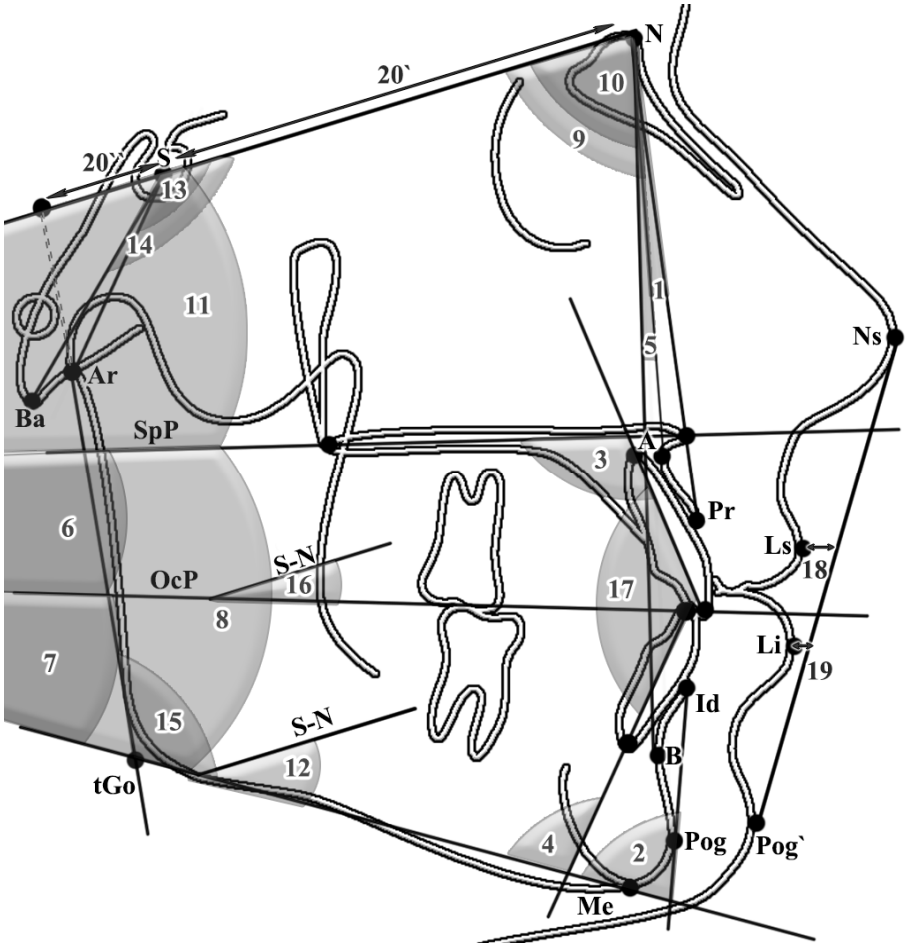

Fig. 1. The main cephalometric points and measurements according to the Bjork method:
1 – angle Pr-N-A; 2 – angle CL/ML; 3 – angle ILs/NL;
4 – angle ILi/ML; 5 – angle A-N-B; 6 – angle OLs/NL;
7 – angle OLi/ML; 8 – angle NL/ML; 9 – angle S-N-A;
10 – angle S-N-B; 11 – angle NSL/NL;
12 – angle NSL/ML; 13 – angle N-S-Ar;
14 – angle N-S-Ba; 15 – angle ML/RL;
16 – angle OLf/NSL; 17 – angle ILs/Ili;
18 – distance Is-NCL; 19 – distance Ii-NCL;
20 – the ratio of N-S:S-Ar'.

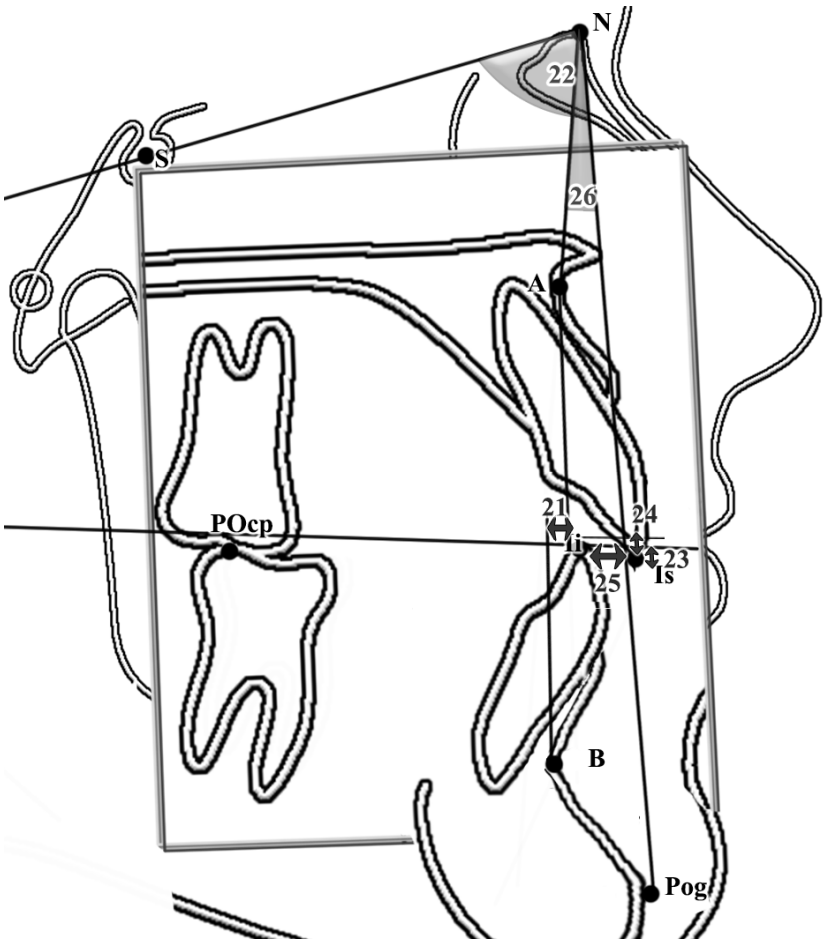

Fig. 2. The main cephalometric points and measurements according to the Bjork method:
21 – Wits distance; 22 – angle S-N-Pog;
23 – Is-Olf distance; 24 – distance Ii-Is;
25 – distance Overjet; 26 – angle A-N-Pog.

Statistical processing of the results was performed in the license package "Statistica 6.0" using non-parametric evaluation methods.

Research results and their discussion

For structuring and convenience of perception of cephalometric indicators we used the distribution of teleradiographic parameters proposed by Dmitriev M. O. [8]: the first group – metric characteristics of the skull, which usually do not change during surgical and orthodontic treatment (Table 1); the second group – indicators which with the help of surgical methods can change the width, length, angles and positions of the upper and lower jaws (Table 2); the third group – indicators that characterize the position of each individual tooth relative to each other, cranial structures and the profile of the soft tissues of the face (Table 3).

Table 1

Comparison of Bjork teleradiography indicators belonging to the first group between Ukrainian young men and young women, as well as with the value of these Bjork indicators for residents of European origin (M±σ)

Indicators	Young men	Young women	p	According to Bjork	p_{ym}	p_{yw}
N-S-Ar (°)	125,4±5.6	124,6±5.9	0,5780	124,0±5,0	0,1967	0,5546
N-S-Ba (°)	129,0±5,5	129,5±5,7	0,6600	130,0±5,0	0,3460	0,6143
N-S:S-Ar' (conventional units)	3,582±0,556	3,784±0,765	0,1432	3,9		

Notes: *here and in the following tables, 1. p – the reliability of the difference between the values of the respective indicators between Ukrainian young men and young women;*
2. pym – the reliability of the difference between the values of the relevant indicators between Ukrainian young men with the values obtained by Bjork for residents of European origin;
3. pyw – the significance of the difference between the values of the respective indicators between Ukrainian young women with the values obtained by Bjork for residents of European origin.

Table 2

Comparison of Bjork teleradiography indicators belonging to the second group between Ukrainian young men and young women, as well as with the value of these Bjork indicators for residents of European origin (M±σ)

Indicators	Young men	Young women	p	According to Bjork	p_{ym}	p_{yw}
S-N-A (°)	82,90±3,32	82,19±3,96	0,2940	80,7±3,5	**0,0018**	**0,0325**
S-N-Pog (°)	82,22±3,57	81,55±3,59	0,2163	76,1±3,5	**0,0000**	**0,0000**
S-N-B (°)	80,60±3,38	80,39±3,46	0,5490	77,0±3,0	**0,0000**	**0,0000**
A-N-Pog (°)	0,688±2,441	0,650±2,492	0,8141	4,6±2,5	**0,0000**	**0,0000**
A-N-B (°)	2,294±1,961	1,807±2,108	0,2758	3,7±2,5	**0,0025**	**0,0000**
NSL/NL (°)	7,253±3,099	6,854±3,638	0,4758	6,0±3,0	**0,0437**	0,1703
NSL/ML (°)	26,00±6,47	28,53±5,43	**0,0282**	33,1±6,0	**0,0000**	**0,0000**
NL/ML (°)	18,74±5,20	21,68±4,66	**0,0026**	27,3±5,0	**0,0000**	**0,0000**
Ii-Is (мм)	2,598±1,173	2,091±0,859	**0,0244**	2,5±2,0	0,7674	0,1172
ML/RL (°)	118,6±6,1	119,9±6,8	0,2278	127,2±5,0	**0,0000**	**0,0000**

Table 3

Comparison of Bjork teleradiography indicators belonging to the third group between Ukrainian young men and young women, as well as with the value of these Bjork indicators for residents of European origin (M±σ)

Indicators	Young men	Young women	p	According to Bjork	p_{ym}	p_{yw}
Pr-N-A (°)	2,296±0,990	2,679±1,122	**0,0254**	2,0±2,0	0,3546	**0,0162**
CL/ML (°)	72,31±5,31	72,19±5,98	0,9174	70,0±6,0	**0,0454**	**0,0468**
ILs/NL (°)	110,9±5,5	111,2±5,8	0,7139	110,0±6,0	0,4387	0,2645
ILi/ML (°)	96,84±7,35	95,20±6,84	0,2025	97,0±7,0	0,9119	0,1547
ILs/ILi (°)	133,6±7,9	131,9±8,4	0,3872	125,5±9,0	**0,0000**	**0,0001**
Overjet (мм)	2,204±0,978	2,126±0,873	0,6060	2,5±2,5	0,4415	0,2325
Wits (мм)	-0,180±2,829	-1,588±2,817	**0,0075**	0		
OLs/NL (°)	7,459±3,852	9,284±3,814	**0,0128**	13,1±3,5	**0,0000**	**0,0000**
OLi/ML (°)	15,34±3,95	15,80±4,04	0,4557	18,1±4,0	**0,0002**	**0,0021**
OLf/NSL (°)	13,24±5,09	15,09±4,35	**0,0386**	16,9±4,0	**0,0001**	**0,0199**
Is-OLf (mm)	0,967±1,127	0,661±1,021	0,1666	1,2±1,2	0,3220	**0,0073**
Is-NCL (mm)	-4,753±2,292	-5,251±2,429	0,3984	-3,3±2,0	**0,0011**	**0,0000**

When comparing the cephalometric parameters used in the Bjork method, between Ukrainian young men and young women with orthognathic occlusion, in young men found significantly (p<0.05-0.01) larger values of the distances Ii-Is (see Table 2) and Wits (see Table 3); and in young women – significantly (p<0.05-0.01) higher values of the angles NSL/ML and NL/ML (see Table. 2) and Pr-NA, OLs/NL and OLf/NSL (see Table. 3). No significant differences or trends in sex differences were found between the Bjork cephalometric parameters belonging to the first group (see Table 1). Thus, for a third of the indicators that can be used to change the width, length, angles and positions of the upper and lower jaws, as well as a third of the indicators that characterize the position of each tooth relative to each other, cranial structures and soft tissue profile facial pronounced sexual differences. Moreover, young men have higher values of linear indicators, and young women – angular.

When comparing the cephalometric parameters obtained in Ukrainian young men and young women with orthognathic occlusion with the indicators used in the specialized medical diagnostic software OnyxCeph³™, which are used as normative indicators for residents of European origin according to the CFT-Bjork method, the following differences were found:

Among the indicators of the second group – in young men significantly (p<0.05-0.001) larger values of the angles S-N-A, S-N-Pog, S-N-B, and NSL/NL and significantly (p<0.01-0.001) smaller values of the angles A-N-Pog, A-N-B, NSL/ML, NL/ML and ML/RL; in young women significantly (p<0.05-0.001) larger values of the angles S-N-A, S-N-Pog and S-N-B and significantly (p<0.001) smaller values of the angles A-N-Pog, A-N-B, NSL/ML, NL/ML and ML/RL (see Table 2);

Among the indicators of the third group – in young men significantly (p<0.05-0.001) larger values of the angles CL/ML and ILs/ILi and significantly (p<0.01-0.001) smaller values of the angles OLs/NL, OLi/ML, OLf/NSL and distances Is-NCL; in young women significantly (p<0.05-0.001) larger values of the angles Pr-NA, CL/ML and ILs/ILi and significantly (p<0.05-0.001) smaller values of the

angles OLs/NL, OLi/ML, OLf/NSL and distances Is-OLf and Is-NCL (see Table. 3);

Among the indicators of the first group – significant or no differences were found (see Table 1).

Thus, when comparing the indicators obtained in Ukrainian young men and young women with orthognathic occlusion with normative data for residents of European origin by CFT-Bjork, the vast majority of cephalometric parameters, which can be used to change the width, length, angles and positions of the upper and lower jaws, as well as characterizing the position of each individual tooth relative to each other, cranial structures and the profile of the soft tissues of the face have pronounced differences.

Foreign studies devoted to the study of the peculiarities of cephalometric indicators by the Bjork method have a fairly wide geographical area. This kind of clinical study covered 201 Iranians and found a relationship between anterior-posterior cephalometric parameters and chin parameters, namely: a correlation between B-B1-GN and SitoLi-PGs [9].

Examination of a sample of Egyptians revealed predictors of excessive occlusion in people with different face types. Thus, regression analysis revealed that individuals with a short face type as such a predictor are related to the dentoalveolar height of the molar and incisor of the mandible and basal height and the inter-incision angle [10].

Age features of changes in soft tissue elements of the face were studied in a sample of 300 women, ethnic residents of Yemen of three age categories – prepubertal group (7.34±0.65 years), pubertal group (11.11±1.07 years) and postpubertal group (22.17±3.04 years). It was found that significant indicators between different age groups were all linear and angular indicators except Ls-Sn Pog', Li-Sn Pog', GSn Pog' and nasolabial angle [11].

In Colombians, carriers of the rs6184 genotype associated with growth hormone have been shown to have Bjork cephalometric parameters. Individuals carrying the rs6184 genotype have low ANB angle values and high upper and lower jaw lengths [12].

Oh E. and co-authors [13] revealed ethnic differences in Bjork cephalometric parameters for European and Asian children with class III occlusion pathology. The inclination of the upper jaw and the shape of the posterior cranial fossa were different.

Features of teleradiographic indicators are established for residents of Iraq with different types of faces. High values of GA, LGA, AFH and LAFH have been found in people with leptoprosopic facial type [14].

Statistically significant correlations between SN-MP, S-Go, Ar-Go, N-Me and ANS-Me and the height of the tooth-alveolar process ($p<0.05$) were found in Javanese with class I occlusion pathology [15].

Successful studies to study the features of cephalometric parameters by the Bjork method are also presented in the works of scientists from Saudi Arabia [16], Germany [17], Greece [18], India [19, 20] and Croatia [21].

The obtained results confirm the need to determine not only age and sex, but also regional standards for the correct use of the method of assessment of cephalometric indicators by Bjork in Ukraine.

Conclusions

The following sex differences of cephalometric parameters according to the Bjork method were established between Ukrainian young men and young women with orthognathic occlusion: the values of distances Ii-Is and Wits were significantly higher in young men; and in young women – significantly higher values of the angles NSL/ML, NL/ML, Pr-N-A, OLs/NL and OLf/NSL.

The following differences in cephalometric parameters, proposed as normative indicators for residents of European origin by the CFT-Bjork method, were found: Ukrainian young men and young women had significantly higher values of S-N-A, S-N-Pog, S-N-B, CL/ML and ILs/ILi angles and significantly lower values of angles A-N-Pog, A-N-B, NSL/ML, NL/ML, ML/RL, OLs/NL, OLi/ML, OLf/NSL and distances Is-NSL; only Ukrainian young men have significantly higher values of the NSL/NL angle; only Ukrainian young women have significantly larger values of the angle Pr-N-A and significantly smaller values of the distance Is-OLf.

Prospects for further research

The obtained results will allow scientists in further research to more accurately analyze teleradiograms according to the Bjork method, and dentists will have a more reasonable approach to the interpretation of the obtained results in patients.

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Summary

When comparing the cephalometric parameters used in the Bjork method, between Ukrainian young men (n=49) and young women (n=76) with orthognathic occlusion in young men, significantly (p<0.05-0.01) greater values of distances Ii-Is and Wits; and in young women – significantly (p<0.05-0.01) larger values of the angles NSL/ML and NL/ML and Pr-N-A, OLs/NL and OLf/NSL. The following differences in cephalometric parameters proposed as normative indicators for residents of European origin according to the CFT-Bjork method were established: Ukrainian young men and young women had significantly (p<0.05-0.001) higher values of S-N-A, S-N-Pog, S-N-B, CL/ML and ILs/ILi and significantly (p<0.01-0.001) smaller values of angles A-N-Pog, A-N-B, NSL/ML, NL/ML, ML/RL, OLs/NL, OLi/ML, OLf/NSL and distances Is-NSL; only in Ukrainian young men significantly (p<0.05) larger values of the angle NSL/NL; only in Ukrainian young women significantly (p<0.05) larger values of the angle Pr-N-A and significantly (p<0.01) smaller values of the distance Is-OLf.

Key words: cephalometry according to the Bjork method, Ukrainian young men and young women with orthognathic occlusion, sex differences.

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ОСОБЛИВОСТІ ТЕЛЕРЕНТГЕНОГРАФІЧНИХ ПОКАЗНИКІВ У ЮНАКІВ І ДІВЧАТ З ОРТОГНАТИЧНИМ ПРИКУСОМ, ЯКІ ВИЗНАЧАЮТЬ МЕТОДОМ BJORK

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Резюме

Цефалометричні методи аналізу стали незамінним інструментом лікаря- ортодонта в останні десятиліття. З ростом чисельності методів і їх стрімким поширенням у різних куточках світу виникла необхідність у оновленні теоретичних знань і накопичення нових даних задля повноцінної адаптації того чи іншого методу для певних категорій населення. Така ж робота нині виконується й українськими дослідниками. Цефалометричний аналіз методом Bjork досі лишається одним із популярних методів, не адаптованим для українців, що значно звужує можливості його застосування в Україні.

Мета роботи – установити статеві розбіжності цефалометричних параметрів методом Bjork в українських юнаків і дівчат із ортогнатичним прикусом із різними типами обличчя та їхні розбіжності від величини даних показників для жителів європейського походження.

Аналіз бокових телерентгенограм (виконаних на дентальному конусно-променевому томографі «Veraviewepocs 3D Morita») проведено 49 українським юнакам (віком від 17 до 21 року) і 76 дівчатам (віком від 16 до 20 років) із фізіологічним прикусом, максимально наближеним до ортогнатичного. Основні цефалометричні точки й вимірювання визначали і проводили згідно з однією із сучасних модифікацій методики Bjork (1966), що використовується в спеціалізованому медичному діагностичному програмному забезпеченні «OnyxCeph» німецької компанії «ImageInstruments», – CFT-Bjork. Статистичну обробку результатів проводили в ліцензійному пакеті "Statistica 6.0" із використанням непараметричних методів оцінки.

При порівнянні цефалометричних показників, що використовуються в методиці Bjork, між українськими юнаками і дівчатами з ортогнатичним прикусом у юнаків установлено достовірно ($p<0,05$-$0,01$) більші значення відстаней Ii-Is і Wits; а в дівчат – достовірно ($p<0,05$-$0,01$) більші значення кутів NSL/ML і NL/ML та Pr-N-A, OLs/NL і OLf/NSL. Між цефалометричними показниками за методом Bjork, що належать до першої групи (метричні характеристики черепа, які зазвичай не змінюються в ході хірургічного й ортодонтичного лікування), достовірних або тенденцій статевих розбіжностей не встановлено. Установлено такі розбіжності цефалометричних параметрів, що пропонуються в ролі нормативних показників для жителів європейського походження за методикою CFT-Bjork: в українських юнаків і дівчат достовірно ($p<0,05$-$0,001$) більші значення кутів S-N-A, S-N-Pog, S-N-B, CL/ML і ILs/ILi та достовірно ($p<0,01$-$0,001$) менші значення кутів A-N-Pog, A-N-B, NSL/ML, NL/ML, ML/RL, OLs/NL, OLi/ML, OLf/NSL і відстані Is-NCL; лише в українських юнаків достовірно ($p<0,05$) більші значення величини кута NSL/NL; лише в українських дівчат достовірно ($p<0,05$) більші значення величини кута Pr-N-A і достовірно ($p<0,01$) менші значення величини відстані Is-OLf. В українських юнаків і дівчат цефалометричні показники за методом Bjork, що належать до першої групи, не мають достовірних або тенденцій розбіжностей з аналогічними показниками, які пропонуються в ролі нормативних для жителів європейського походження за методикою CFT-Bjork.

Отже, для третини показників, яким за допомогою хірургічних методів можна змінювати ширину, довжину, кути й положення верхньої й нижньої щелеп (друга група), а також третини показників, які характеризують положення кожного окремого зуба відносно один одного, черепних структур і профілю м'яких тканин обличя (третя група) установлено виражені статеві розбіжності. Причому, в юнаків установлено більші значення лінійних показників, а в дівчат – кутових. При порівнянні показників, отриманих в українських юнаків і дівчат із ортогнатичним прикусом, із нормативними даними для жителів європейського походження за методикою CFT-Bjork, переважна більшість цефалометричних параметрів, що належать до другої й третьої груп, мають виразні розбіжності.

Отримані результати дозволять науковцям у подальших дослідженнях коректніше проводити аналіз телерентгенограм за методикою Bjork, а лікарям-стоматологам більш обґрунтовано підійти до трактування отриманих результатів у пацієнтів.

Ключові слова: цефалометрія методом Bjork, українські юнаки й дівчата з ортогнатичним прикусом, статеві розбіжності.