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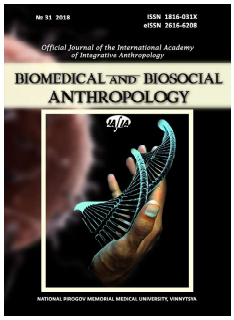

Modeling by using regression analysis of teleroentgenographic individual indicators used in the method of Charles J. Burstone

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In spite of the existence of numerous developed methods of cephalometric analysis, which should help to choose the right direction of orthodontic treatment, usually the doctor has to act intuitively, based on his experience, because their development didn't take into account numerous factors (ethnicity, age, gender, etc.). Improving these techniques, considering the above-mentioned factors, would significantly increase their effectiveness, and hence the quality of providing dental care to the population. The purpose of the work is to construct and analyze a regression model of teleroentgenographic indicators used in the method of C. J. Burstone in young men and women with normal occlusion close to orthognathic bite and harmonic face. Primary side teleroentgenograms of 38 young men (aged 17-21 years) and 55 young women (aged 16-20 years) with normal occlusion close to orthognathic bite and harmonic face, obtained from the Veraviewepocs 3D device, Morita (Japan), taken from the bank data of research center of National Pirogov Memorial Medical University, Vinnytsya. Cephalometric measurements were performed according to the recommendations of C. J. Burstone. All indicators were divided into three groups: 1 - metric characteristics of the skull, which usually do not change during surgical and orthodontic treatment; 2 - indicators of the tooth-jaw system, the definitions of which most often need to be guided by the orthodontic treatment of growing patients and orthodontic surgery, which allows people with already formed bone skeleton to change the width, length, angles and position of the bones of the upper and lower jaws; 3 - indicators that actually characterize the position of each individual tooth relative to each other, to the bony cranial structures and face profile. Regression models of individual teleroentgenographic indicators used in the method of C. J. Burstone, built using the licensed package "Statistica 6.0". Constructed all 6 reliable models of indicators included in the second group (anterior lower facial height ANS-Gn/Me, maxillary length ANS-PNS, ramus length Ar-Go, mandibular length Go-Pog, anterior upper facial height N-ANS and posterior upper facial height PNS-N) depending on the indicators of the first group (posterior section of cranial base Ar-Pt, anterior skull base length N-CC, angle of the cranial tilt POr-NBa, anterior section of cranial base Pt-N and distance P-PTV); as well as all 7 reliable models of indicators included in the third group (distances 1u-NF, 1l-MP, 6u-NF, 6l-MP and angles OP-HP, Max1-NF/Max1-SpP, Mand1-Mp/Mand1-MeGo) depending on the indicators of the first and second (distance A-B, A-NPog, Go-CF, Max-Mand, N-A, N-B, N-Pog and Xi-Pm and angles MeGo-NPog, MP-HP, NAPog, N-ANS-Pog, N-CF-A, NPog-POr, POr-CFXi i POr-ANSPNS) groups. It was established that in young men the model of telerentgenographic indices included in the second group depending on the indicators of the first group and included in the third group, depending on the indicators of the first and second groups, have a higher determination coefficient than in young women (R2 from 0.806 to 0.918 in young men and from 0.510 to 0.768 for young women, and from 0.750 to 0.993 for young men and from 0.510 to 0.986 for young women). In the analysis of entering into the regression models of the relevant predictors found that in young men among the teleroentgenographic indicators of the first group included in the models of indicators of the second group most often included - distances P-PTV (33.3%), Pt-N and N-CC (by 25.0%); and in young women- distances N-CC (38.5%) and P-PTV

(30.8%). It was also found that among young men among the teleroentgenographic indicators of the first and second groups that were included in the models of the third group of indicators most often included - distance ANS-Gn/Me (12.8%), the magnitude of the angles NAPog, POr-CFXi and POr-ANSPNS (by 9.4%); and in young women-distance ANS-Gn/Me (13.2%), distances A-B and PNS-N and the magnitude of the angle NAPog (by 7.9%).
Keywords: *regression analysis, side teleroentgenograms of the head, cephalometry, C.J. Burstone analysis, young men and women with orthognathic bite.*

Introduction

At the 20th century there was a rapid development of medicine, including the dental branch. New times demanded a new level of medical care, in particular the creation of a methodology that would allow for a proper assessment of the location of different structures of the tooth-jaw system. Thus, the concept of cephalometric analysis of side teleroentgenograms was developed, which allowed planning of further steps of patient's treatment.

Particular attention deserves the technique proposed by Charles J. Burstone in 1978, better known now as a COGS analysis [23]. Its essence lies in the fact that it represents the horizontal and vertical positions of the bones of the facial skull with the help of a constant system of coordinates in the form of direct linear measurements for bone size and angular measurements for bone shapes [8, 9, 21, 24].

However, as with most other methods proposed by various authors at different times (Wits, Downs, Ricketts, Harvold, McNamar, Arne Bjork, Charles H. Tweed, Joseph Jarabak, Viken Sassouni, Cecil C. Steiner, etc.), it has a significant disadvantage, namely a monotonous sample that makes it impossible to use it fully [1, 6, 15, 20, 22], because the study, which resulted in the creation of a COGS analysis, was conducted on middle-aged Caucasian men, living in the United States.

At the beginning it was only a theory, but subsequent research revealed discrepancies in the features of cephalometric indices in representatives of different races, age groups and gender groups. All this pushed scientists from all over the world to seek normative indicators among representatives of different nationalities, residents of various administrative-territorial regions, and within them, manifestations of sexual dimorphism and peculiarities in different age periods [2-5, 7, 26, 27].

The *purpose* of the work is to construct and analyze a regression model of teleroentgenographic indicators used in the method of C. J. Burstone in young men and women with normal occlusion close to orthognathic bite and harmonic face.

Materials and methods

Primary side teleroentgenograms of 38 young men (aged 17-21 years) and 55 young women (aged 16-20 years) with normal occlusion close to orthognathic bite and harmonic face, obtained from the Veraviewepocs 3D device, Morita (Japan), taken from the bank data of research center of National Pirogov Memorial Medical University, Vinnytsya.

The analysis of side teleroentgenograms was carried out using the methods of R. M. Ricketts, C. J. Burstone, E. P. Harvold, described in detail in previous studies [10, 11, 14].

All indicators of the above methods, we were divided into three groups.

The *first group* included metric characteristics of the skull, which usually do not change during surgical and orthodontic treatment. Most of these indicators are basic in modern cephalometric analyzes. Relative to them, side teleroentgenograms determine the inclination, anterior-posterior or vertical position of the gnatic structures (upper and lower jaws, occlusal plane, individual teeth). The *second group* included indicators of the tooth-jaw system, the definitions of which most often need to be guided by the orthodontic treatment of growing patients and orthodontic surgery, which allows people with already formed bone skeleton to change the width, length, angles and position of the bones of the upper and lower jaws. The *third group* includes indicators that actually characterize the position of each individual tooth relative to each other, to the bony cranial structures and facial profile. It is this group of indicators most often corrected in the process of orthodontic treatment of tooth-jaw abnormalities.

According to the cephalometric C. J. Burstone method [8], we conducted modeling of the indicators included in the second group, depending on the indicators of the first group: **ANS-Gn/Me** Anterior Lower Facial Height (mm); **ANS-PNS** Maxillary Length (mm); **Ar-Go** Ramus Length (mm); **Go-Pog** Mandibular Length (mm); **N-ANS** Anterior Upper Facial Height (mm); **PNS-N** Posterior Upper Facial Height (mm).

Also, indicators by C. J. Burstone, included into the third group, were determined depending on the indicators of the first and second groups: **1u-NF** Distance of Incisal Edge of 1u to Palatal Plane (mm); **1l-MP** Distance of Incisal Edge of 1L to Palatal Plane (mm); **6u-NF** Distance of Mesial Cusp of 6u to Palatal Plane (mm); **6l-MP** Distance of Mesial Cusp of 6l to Mand.Plane (mm); **OP-HP** Angle of Occl. to Horizontal Plane (°); **Max1-NF/Max1-SpP** Angle of Axis of 1u to Palatal Plane (°); **Mand1-Mp/Mand1-MeGo** Angle of Axis of 1l to Mand. Plane (°).

The construction of regression models of individual teleroentgenographic indicators used in the method of C. J. Burstone was carried out in the licensed package "Statistica 6.0". In the direct stepwise regression analysis, we determined the following conditions: 1 - the final version of the regression equation should have a determination factor

of at least 0.50; 2 - the value of the F-criterion is not less than 3.0; 3 - the number of free members included in the regression equation should be as low as possible.

Results

The results of modeling of teleroentgenographic indicators by the method of C. J. Burstone *included in the second group, depending on the indicators of the first group*, have the form of the following linear equations.

For young men:

ANS-Gn/Me = -1.645 - 1.056 x P-PTV + 0.395 x N-CC (R^2=0.834; $F_{(2.35)}$=103.1; p<0.001; Error of estimate=4.589);

ANS-PNS = 8.153 + 0.664 x Pt-N - 0.276 x P-PTV (R^2=0.888; $F_{(2.35)}$=138.9; p<0.001; Error of estimate=2.648);

Ar-Go = -4.663 - 0.847 x P-PTV + 0.439 x Pt-N (R^2=0.806; $F_{(2.35)}$=72.58; p<0.001; Error of estimate=4.392);

Go-Pog = 0.893 + 0.895 x Pt-N - 0.742 x P-PTV (R^2=0.899; $F_{(2.35)}$=155.7; p<0.001; Error of estimate=4.107);

N-ANS = -12.28 + 0.819 x N-CC+ 0.622 x POr-NBa (R^2=0.855; $F_{(2.35)}$=103.1; p<0.001; Error of estimate=3.468);

PNS-N = -7.211 + 0.861 x N-CC+ 0.325 x POr-NBa (R^2=0.918; $F_{(2.35)}$=197.0; p<0.001; Error of estimate=2.585);

where, here and in the future, R^2 - coefficient of determination; $F_{(!,!!)}$=!!,!! - critical (!,!!) and got (!!,!!) value of Fisher's criterion; St. Error of estimate - standard error of the standardized regression coefficient; N-CC - anterior skull base length (mm); POr-NBa - angle of the cranial tilt (deflection) (°); Pt-N (anterior section of cranial base), defines the length of the front of the skull base, parallel to the horizontal line by Burstone (mm); P-PTV - distance from point Po to point Pt parallel to the Frankfurt plane (mm).

For young women:

ANS-Gn/Me = 5.402 + 0.677 x N-CC + 0.564 x Ar-Pt (R^2=0.565; $F_{(2.52)}$=33.76; p<0.001; Error of estimate=4.130);

ANS-PNS = 2.327 + 0.518 x Pt-N - 0.408 x P-PTV + 0.282 x POr-NBa (R^2=0.669; $F_{(3.51)}$=34.40; p<0.001; Error of estimate=2.545);

Ar-Go = -4.708 + 0.536 x N-CC + 0.727 x Ar-Pt (R^2=0.510; $F_{(2.52)}$=27.11; p<0.001; Error of estimate=4.397);

Go-Pog = -4.773 + 0.942 x N-CC - 0.707 x P-PTV (R^2=0.768; $F_{(2.52)}$=86.27; p<0.001; Error of estimate=3.650);

N-ANS = -8.586 + 0.496 x N-CC - 0.560 x P-PTV + 0.343 x POr-NBa (R^2=0.714; $F_{(3.51)}$=42.27; p<0.001; Error of estimate=2.726);

PNS-N = 0.284 + 0.521 x N-CC - 0.526 x P-PTV (R^2=0.723; $F_{(2.52)}$=67.91; p<0.001; Error of estimate=2.518);

where, here and in the future, Ar-Pt (posterior section of cranial base), defines the length of the back of the skull base, parallel to the horizontal line by Burstone (mm).

The results of modeling of teleroentgenographic parameters by the method of C. J. Burstone *included in the third group, depending on the indicators of the first and second groups*, have the form of the following linear equations.

For young men:

1u-NF = 7.565 + 0.519 x ANS-Gn/Me - 0.585 x B-Pog - 0.295 x POr-ANSPNS - 0.167 x POr-CFXi + 0.153 x Go-Pog - 0.163 x Ar-Go (R^2=0.969; $F_{(6.31)}$=162.9; p<0.001; Error of estimate=1.071);

1l-MP =5.502 +0.465 x ANS-Gn/Me + 0.124 x N-ANS + 0.243 x NAPog - 0.148 x N-ANS-Pog (R^2=0.976; $F_{(4.33)}$=331.8; p<0.001; Error of estimate=0.994);

6u-NF= -4.374 + 0.306 x ANS-Gn/Me + 0.113 x Xi-Pm (R^2=0.939; $F_{(2.35)}$=267.8; p<0.001; Error of estimate=1.209);

6l-MP = 4.144 + 0.258 x ANS-Gn/Me + 0.265 x Go-CF + 0.275 x A-NPog - 0.128 x PNS-N (R^2=0.942; $F_{(4.33)}$=132.8; p<0.001; Error of estimate=1.120);

OP-HP = 6.356 + 0.804 x N-Pog - 1.513 x A-B - 1.542 x N-B + 0.163 x P-PTV + 0.737 x NAPog (R^2=0.993; $F_{(5.32)}$=917.8; p<0.001; Error of estimate=0.491);

Max1-NF/Max1-SpP = 70.40 + 0.362 x N-Pog + 0.773 x POr-ANSPNS + 0.635 x POr-CFXi - 0.405 x NAPog - 0.600 x B-Pog (R^2=0.750; $F_{(5.32)}$=19.24; p<0.001; Error of estimate=3.114);

Mand1-Mp/Mand1-MeGo = 54.26 + 1.073 x MeGo-NPog + 0.250 x N-ANS-Pog + 0.388 x A-B + 0.518 x N-A - 0.491 x POr-CFXi - 0.388 x POr-ANSPNS (R^2=0.843; $F_{(6.31)}$=27.73; p<0.001; Error of estimate=3.307);

where, here and in the future, A-B - distance from point A to point B, on occlusion plane (apOcP-ppOcP) (mm); A-NPog - bulge, distance from point A to line N-Pog (mm); ANS-Gn/Me - lower face height, distance from point ANS, to point Gn (mm); Ar-Go - the length of the mandible ramus, the distance from the Ar point to the point tGo (mm); B-Pog - distance from point Pog to point B, parallel to mandibular plane (mm); Go-CF - rear face height, the distance from the point of Go, to the point of CF (mm); Go-Pog - the length of the base of the mandible, the distance from the point Pog to the point tGo (mm); MeGo-NPog - facial cone, the angle formed by the lines of Me-Go and N-Pog (°); N-A - the distance characterizing the position of the upper jaw, the distance from the perpendicular to the horizontal line by Burstone lowered from point N, and the point A (mm); NAPog - the angle of the skeletal profile, defines convexity of the face, is formed by the lines N-A and A-Pog (°); N-ANS - front upper face height, defines the length of the upper part of the front face height, distance from point N to ANS (mm); N-ANS-Pog - the angle of the convexity of the profile formed by the lines of N-ANS and ANS-Pog (°); N-B - the distance characterizing the position of the lower jaw, the distance from the perpendicular to the horizontal line by Burstone lowered from the point N, and the point B (mm); N-Pog - the distance characterizing the position of the chin, the distance from the perpendicular to the horizontal line by Burstone lowered from the point N, and the point Pog (mm); PNS-N - posterior upper face height defines the length of the upper part of the posterior face height from the PNS point to the horizontal line by Burstone (mm); POr-CFXi - angle formed by lines Po-CF and CF-Xi, characterizes the position of the mandible ramus (°); POr-ANSPNS (also known as POr-SpP) - angle formed by lines Po-Or and ANS-PNS (°); Xi-Pm - distance from the point Xi, to the point Pm (mm).

For young women:

1u-NF = 0.035 +0.483 x ANS-Gn/Me - 0.321 x N-ANS - 0.178 x P-PTV - 0.132 x N-A + 0.192 x PNS-N - 0.129 x Max-Mand (R^2=0.916; $F_{(6.48)}$=86.96; p<0.001; Error of estimate=0.956);

1l-MP = 3.820 + 0.260 x N-ANS - 0.185 x Ar-Pt + 0.099 x NAPog + 0.558 x ANS-Gn/Me - 0.142 x PNS-N (R^2=0.931; $F_{(5.49)}$=131.6; p<0.001; Error of estimate=0.982);

6u-NF= -2.405 + 0.352 x ANS-Gn/Me + 0.353 x A-B - 0.280 x A-NPog - 0.215 x PNS-N + 0.128 x Xi-Pm + 0.098 x N-CF-A (R^2=0.842; $F_{(6.48)}$=42.78; p<0.001; Error of estimate=0.966);

6l-MP = -1.301 + 0.393 x Go-CF + 0.178 x N-ANS-Pog + 0.227 x P-PTV - 0.144 x A-B - 0.066 x N-Pog + 0.216 x ANS-Gn/Me (R^2=0.935; $F_{(6.48)}$=114.5; p<0.001; Error of estimate=1.016);

OP-HP = 7.021 + 0.776 x N-Pog - 1.580 x A-B + 0.713 x NAPog - 1.544 x N-B - 0.115 x ANS-Gn/Me (R^2=0.986; $F_{(5.49)}$=669.2; p<0.001; Error of estimate=0.524);

Max1-NF/Max1-SpP = 4.493 + 1.239 x NPog-POr + 0.862 x POr-ANSPNS - 0.492 x N-A - 0.468 x Go-CF + 0.429 x Go-Pog - 0.879 x B-Pog (R^2=0.510; $F_{(6.48)}$=8.32; p<0.001; Error of estimate=4.077);

Mand1-Mp/Mand1-MeGo = -8.826 + 1.609 x MeGo-NPog + 0.764 x NAPog + 0.521 x MP-HP - 0.365 x N-CF-A (R^2=0.685; $F_{(4.50)}$=27.17; p<0.001; Error of estimate=3.849);

where, Max-Mand - interjaw difference, difference between distances ANS-Cond and Cond-Pog (mm); MP-HP - the angle of the lower jaw to the horizontal line by Burstone, formed by the lines tGo-Me and HP (°); N-CF-A - the angle of the upper jaw height, angle formed by lines N-CF and CF-A (°); NPog-POr - face depth, angle between the face plane (N-Pog) and the Frankfurt plane (Po-Or) (°).

Discussion

Differences in the features of cephalometric indices with the parameters obtained by C. J. Burstone are presented in many studies. For example, a group of Iraqi scientists determined the norms of cephalometric indices, respectively, by methodology of C. J. Burstone for the Iraqi population. The study involved 60 people (30 boys and 30 girls) aged 18-25 who belonged to the Arab race, had aesthetically satisfying facial features and physiological bite. Compared to the norms for C. J. Burstone, Iraqis have a larger face convex, maxillary prognathism, a greater protrusion of the upper lip, a duller angle of the nasolabial triangle, a larger protuberance of the lower lip, and protuberance of maxillary incisor. When comparing the data obtained from boys and girls, it was found that the ratio of vertical height and nasolabial angle is higher in girls, and the lower face-throat angle is greater in young men [18, 19]

Nivedita Sahoo et al. [25] found the features of cephalometric indices by the method of C. J. Burstone for the population of East India. The study involved 200 people living in the region of India aged 18-30 (100 men and 100 women) who had a balanced facial profile, no history of medical interventions and anomalies of tooth-jaw system. Compared with the data of C. J. Burstone, higher rates of prognathism of the mandible, protrusion of the upper and lower lip in the population of East India were revealed.

Unfortunately, in comparison with foreign works, such studies of domestic scientists are of a small nature, which leads to finding a solution to this problem [12, 13, 16, 17], including by means of mathematical modeling of normative individual values of the necessary teleroentgenographic parameters.

For young men and women with normal occlusion, close to orthognathic bite and harmonious face, were constructed all 6 possible reliable models of teleroentgenographic indices by the method of C. J. Burstone which entered the *second group*, depending on the indicators of the *first group*. It is established that in young men the determination coefficient in models is much higher than in young women (in young men R^2 from 0.806 to 0.918, and in young women - from 0.510 to 0.768). Both in young men and women, the models most often included P-PTV distances (33.3% for young men and 30.8% for young women) and N-CC (25.0% for young men and 38.5% for young women). In addition, in young men and women, the models include the distance Pt-N (25.0% in young men and 7.7% in young women) and the angle of the cranial inclination POr-NBa (16.7% in young men and 15.4% in young women). Only in young women models of teleroentgenographic indicators using the method of C. J. Burstone belong to the second group, depending on the indicators of the first group includes the value of the distance Ar-Pt (15.4%).

In the modeling of teleroentgenographic indices that were included in the *third group* according to the method of C. J. Burstone depending on the indicators of the *first* and *second groups*, both in young men and in young women with normal occlusion close to orthognathic bite and harmonic face, all seven possible reliable regression models were also constructed. During of models analyses, it was also found that in young men the determination coefficient is higher than that of young women (in young men R^2 from 0.750 to 0.993, and in young women - from 0.510 to 0.935). And in young men and girls the models most often included models of *distances* ANS-Gn/Me (12.8% in young men and 13.2% in young women). In addition, in young men and young women include models of A-B *distances* (6.25% in young men and 7.9% in young women), N-Pogs (6.25% in young men and 5.3% in young women), B-Pogs (6.25% in young men), PNS-N (3.1% for young men and 7.9% for young women), P-PTV, G-CF, NA and N-ANS (3.1% for young men and 5.3% for young women), P NPog, NB, Xi-Pm and Go-Pog (3.1% for young men and 2.6% for young women) and *angles* NAPog (9.4% for young men and 7.9% for young women), POr-ANSPNS (9.4% for young men and 2.6 % of young women), N-ANS-Pog (6.25% for young men and 2.6% for young women) and MeGo-NPog (3.1% for young men and 2.6% for young women). Only in young men, according to the method of C. J. Burstone, which are included in the third group depending on the indicators of

the first and second groups, the magnitude of the angle POr-CFXi (9.4%) and the distance Ar-Go (3.1%) are included in the models of teleroentgenographic indicators; and only in young women - the magnitude of the distances Ar-Pt and Max-Mand (by 2.6%) and the angles N-CF-A (5.3%), MP-HP and NPog-POr (by 2.6%).

The constructed regression models of teleroentgenographic indicators used in the method of C. J. Burstone in young men and women with normal occlusion close to orthognathic bite and harmonious face will allow to develop a computer program that will enable orthodontists to automatically calculate the necessary cephalometric indices. Creation of a complete base of normative cephalometric indicators in accordance with the method of C. J. Burstone will allow the provision of dental care at the modern, individual level, taking into account the age, gender, ethnicity and even regional belonging of the person.

Conclusions

1. In young men and women with normal occlusion close to the orthognathic bite, all 6 possible models of teleroentgenographic indices using the C. J. Burstone method were included in the second group, depending on the indicators of the first group with the determination coefficient from 0.806 to 0.918 in young men and from 0.510 to 0.768 in young women; as well as all 7 possible models included in the third group, depending on the indicators of the first and second groups with the determination coefficient from 0.750 to 0.993 in young men and from 0.510 to 0.986 in young women.

2. In young men, among the teleroentgenographic indices of the first group have entered the models of the second group according to the method of C. J. Burstone most often included - distances P-PTV (33.3%), Pt-N and N-CC (by 25.0%); and in young women - distances N-CC (38.5%) and P-PTV (30.8%).

3. In young men, among the teleroentgenographic indices of the first and second groups that were have entered the models of the third group by the method of C. J. Burstone most often included - the distance ANS-Gn/Me (12.8%), the magnitude of the angles NAPog, POr-CFXi and POr-ANSPNS (by 9.4%); while in young women - ANS-Gn/Me distance (13.2%), A-B and PNS-N distances, and an NAPog angle (by 7.9%).

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МОДЕЛЮВАННЯ ЗА ДОПОМОГОЮ РЕГРЕСІЙНОГО АНАЛІЗУ ІНДИВІДУАЛЬНИХ ТЕЛЕРЕНТГЕНГОГРАФІЧНИХ ПОКАЗНИКІВ, ЩО ВИКОРИСТОВУЮТЬСЯ В МЕТОДИЦІ CHARLES J. BURSTONE

Гунас І. В., Черниш А. В., Черкасов В. Г., Черкасова О. В.

Не зважаючи на існування численних розроблених методик цефалометричного аналізу, що мають допомогти обрати правильний напрямок ортодонтичного лікування, зазвичай лікарю доводиться діяти інтуїтивно, на основі свого досвіду, адже при їх розробці не приймалися до уваги численні фактори (етнічна приналежність, вік, стать тощо). Удосконалення даних методик з врахуванням вищезгаданих факторів дозволило б значно збільшити їх ефективність, а отже і якість надання стоматологічної допомоги населенню. Мета роботи - побудувати та провести аналіз регресійних моделей телерентгенографічних показників, що використовуються в методиці C. J. Burstone в юнаків і дівчат з нормальною оклюзією наближеною до ортогнатичного прикусу та гармонійним обличчям. Первинні бокові телерентгенограми 38 юнаків (віком від 17 до 21 року) та 55 дівчат (віком від 16 до 20 років) з нормальною оклюзією наближеною до ортогнатичного прикусу та гармонійним обличчям, отримані за допомогою пристрою Veraviewepocs 3D, Morita (Япония), взяті з банку даних науково-дослідного центру Вінницького національного медичного університету ім. М. І. Пирогова. Цефалометричні вимірювання проводили згідно рекомендацій C. J. Burstone. Усі показники були розділені на три групи: 1 - метричні характеристики черепа, які зазвичай не змінюються в ході хірургічного та ортодонтичного лікування; 2 - показники зубощелепної системи, на визначення яких найбільш часто необхідно орієнтуватись при виконанні ортодонтичного лікування зростаючих пацієнтів та ортодонтичної хірургії яка дозволяє у осіб вже із сформованим кістковим скелетом змінювати ширину, довжину, кути та положення кісток верхньої та нижньої щелеп; 3 - показники які власне характеризують положення кожного окремого зуба по відношенню один до одного, до кісткових черепних структур та профілю обличчя. Регресійні моделі індивідуальних телерентгенографічних показників, що використовуються в методиці C. J. Burstone, побудовані за допомогою ліцензійного пакету "Statistica 6,0". Побудовані усі 6 достовірних моделей показників що увійшли до другої групи (передня нижня висота лиця ANS-Gn/Me, довжина верхньої щелепи ANS-PNS, довжина гілки нижньої щелепи Ar-Go, довжина основи нижньої щелепи Go-Pog, передня верхня висота лиця N-ANS і задня верхня висота лиця PNS-N) в залежності від показників першої групи (задня частина основи черепа Ar-Pt, передня довжина основи черепа N-CC, кут краніального нахилу POr-NBa, передня частина основи черепа Pt-N та відстань P-PTV); а також усі 7 достовірних моделей показників що увійшли до третьої групи (відстані 1u-NF, 1I-MP, 6u-NF, 6I-MP та кути OP-HP, Max1-NF/Max1-SpP, Mand1-Mp/Mand1-MeGo) в залежності від показників першої та другої (відстані A-B, A-NPog, Go-CF, Max-Mand, N-A, N-B, N-Pog і Xi-Pm та кути MeGo-NPog, MP-HP, NAPog, N-ANS-Pog, N-CF-A, NPog-POr, POr-CFXi і POr-ANSPNS) груп. Встановлено, що в юнаків моделі телерентгенографічних показників, які увійшли до другої групи в залежності від показників першої групи та які увійшли до третьої групи в залежності від показників першої й другої груп мають вищій коефіцієнт детермінації, ніж у дівчат (R^2 відповідно від 0,806 до 0,918 в юнаків і від 0,510 до 0,768 у дівчат; та від 0,750 до 0,993 в юнаків і від 0,510 до 0,986 у дівчат). При аналізі входження до регресійних моделей відповідних предикторів встановлено, що в юнаків серед телерентгенографічних показників першої групи які увійшли до моделей показників другої групи найбільш часто входили - відстані P-PTV (33,3%), Pt-N і N-CC (по 25,0%); а у дівчат - відстані N-CC (38,5%) і P-PTV (30,8%). Також встановлено, що в юнаків серед телерентгенографічних показників першої і другої груп які увійшли до моделей показників третьої групи найбільш часто входили - відстань ANS-Gn/Me (12,8%), величина кутів NAPog, POr-CFXi та POr-ANSPNS (по 9,4%); а у дівчат - відстань ANS-Gn/Me (13,2%), відстані A-B і PNS-N та величина кута NAPog (по 7,9%).

Ключові слова: *регресійний аналіз, бокові телерентгенограми голови, цефалометрія, аналіз C. J. Burstone, юнаки та дівчата з ортогнатичним прикусом.*

МОДЕЛИРОВАНИЕ С ПОМОЩЬЮ РЕГРЕССИОННОГО АНАЛИЗА ИНДИВИДУАЛЬНЫХ ТЕЛЕРЕНТГЕНГОГРАФИЧЕСКИХ ПОКАЗАТЕЛЕЙ, ИСПОЛЬЗУЕМЫХ В МЕТОДИКЕ CHARLES J. BURSTONE

Гунас И. В., Черниш А. В., Черкасов В. Г., Черкасова Е. В.

Несмотря на существование многочисленных разработанных методик цефалометрического анализа, которые должны

помочь выбрать правильное направление ортодонтического лечения, обычно врачу приходится действовать интуитивно, на основе своего опыта, ведь при их разработке не принимались во внимание многочисленные факторы (этническая принадлежность, возраст, пол и т.д.). Совершенствование данных методик с учетом вышеупомянутых факторов позволило бы значительно увеличить их эффективность, а следовательно, и качество оказания стоматологической помощи населению. Цель работы - построить и провести анализ регрессионных моделей телерентгенографических показателей, используемых в методике C. J. Burstone у юношей и девушек с нормальной окклюзией приближенной к ортогнатическому прикусу и гармоничным лицом. Первичные боковые телерентгенограммы 38 юношей (в возрасте от 17 до 21 года) и 55 девочек (в возрасте от 16 до 20 лет) с нормальной окклюзией приближенной к ортогнатическому прикусу и гармоничным лицом, полученные с помощью устройства Veraviewepocs 3D, Морита (Япония), взяты из банка данных научно-исследовательского центра Винницкого национального медицинского университета им. Н. И. Пирогова. Цефалометрични измерения проводили согласно рекомендациям C. J. Burstone. Все показатели были разделены на три группы: 1 - метрические характеристики черепа, которые обычно не меняются в ходе хирургического и ортодонтического лечения; 2 - показатели зубочелюстной системы, на определение которых наиболее часто необходимо ориентироваться при выполнении ортодонтического лечения растущих пациентов и ортодонтической хирургии которая позволяет у лиц уже со сформированным костным скелетом изменять ширину, длину, углы и положения костей верхней и нижней челюстей; 3 - показатели, которые собственно характеризуют положение каждого отдельного зуба по отношению друг к другу, к костным черепным структурам и профиля лица. Регрессионные модели индивидуальных телерентгенографических показателей, используемых в методике C. J. Burstone, построены с помощью лицензионного пакета "Statistica 6,0". Построенные все 6 достоверных моделей показателей вошедшие во вторую группу (передняя нижняя высота лица ANS-Gn/Me, длина верхней челюсти ANS-PNS, длина ветви нижней челюсти Ar-Go, длина основания нижней челюсти Go-Pog, передняя верхняя высота лица N-ANS и задняя верхняя высота лица PNS-N) в зависимости от показателей первой группы (задняя часть основания черепа Ar-Pt, передняя длина основания черепа N-CC, угол краниального наклона POr-NBa, передняя часть основания черепа Pt-N и расстояние P-PTV) а также все 7 достоверных моделей показателей вошедшие в третью группу (расстояния 1u-NF, 1l-MP, 6u-NF, 6l-MP и углы OP-HP, Max1-NF/Max1-SpP, Mand1-Mp/Mand1-MeGo) в зависимости от показателей первой и второй (расстояния AB, A-NPog, Go-CF, Max-Mand, NA, NB, NPog и Xi-Pm а также углы MeGo-NPog, MP-HP, NAPog, N-ANS -Pog, N-CF-A, NPog-POr, POr-CFXi и POr-ANSPNS) групп. Установлено, что у юношей модели телерентгенографических показателей, вошедших во вторую группу в зависимости от показателей первой группы и вошедших в третью группу в зависимости от показателей первой и второй групп имеют более высокий коэффициент детерминации, чем у девушек (R^2 соответственно от 0,806 до 0,918 у юношей и от 0,510 до 0,768 у девушек, и от 0,750 до 0,993 у юношей и от 0,510 до 0,986 у девушек). При анализе включения к регрессионным моделям соответствующих предикторов установлено, что у юношей среди телерентгенографических показателей первой группы вошедших к моделям показателей второй группы наиболее часто входили - расстояния P-PTV (33,3%), Pt-N и N-CC (по 25,0%); а у девушек - расстояния N-CC (38,5%) и P-PTV (30,8%). Также установлено, что у юношей среди телерентгенографических показателей первой и второй групп вошедших к моделям показателей третьей группы наиболее часто входили - расстояние ANS-Gn/Me (12,8%), величина углов NAPog, POr-CFXi и POr-ANSPNS (по 9,4%); а у девушек - расстояние ANS-Gn/Me (13,2%), расстояния A-B и PNS-N и величина угла NAPog (по 7,9%).

Ключевые слова: *регрессионный анализ, боковые телерентгенограммы головы, цефалометрия, анализ C. J. Burstone, юноши и девушки с ортогнатическом прикусом.*