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Regression models of teleroentgenographic indicators of the position of teeth and the profile of face soft tissues in juvenile aged persons with different face types according to Schwarz A.M.

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Considering the differences in the values of teleroentgenographic (TRG) indicators in different racial, gender, ethnic, age, population, geographical population groups and numerical methods of TRG analysis, determination of normative values of cephalometric, gnatometric TRG-indicators, their interdependencies in the population of different countries is extremely important both for human anatomy and for the practice of dentists. This fully applies to residents of Ukraine of different age groups. The aim of the work is to develop and analyze regression models of teleroentgenographic indicators of tooth position and facial soft tissue profile according to Schwarz A.M. in Ukrainian young men and young women with different facial types. Lateral teleroentgenograms of 49 young men (aged 17 to 21 years) and 76 young women (aged 16 to 20 years) with physiological occlusion as close as possible to orthognathic were analyzed. In the license package "Statistica 6.0" regression models of indicators of position of teeth and profile of soft tissues of the face according to the method of Schwarz A.M. depending on basic cephalometric and gnatometric indicators separately for boys and for girls with different types of the face are constructed. In young men, 16 of the 24 possible reliable regression models were constructed, in which the coefficient of determination is greater than 0.6 (R^2 =from 0.609 to 0.998). For young men with 1st (back face type) and 3rd (front face type) face types, the following models were created with respect to 5 indicators from 8 possible (respectively, angles Max1-SpP S-arz, distances Sn-Pn and Pog'-Por, angles Gl'LSpog' and SnPog'-Pn; R^2 = from 0.609 to 0.998 and angles Max1-SpP S-arz and Mand1-MP Schwars, distances Sn-Pn and Pog'-Por, angle Gl'LSpog'; R^2 = from 0.609 to 0.946), and for young men with 2nd face types (average face type according to Schwarz AM) - for 6 indicators (angles Max1-SpP S-arz and Mand1-MP Schwars, distances Sn-Pn and Pog'-Por, angles Gl'LSpog' and SnPog'-Pn; R^2 = from 0.690 to 0.990). In young women, 17 of the 24 possible reliable models with R^2 greater than 0.6 (R^2 = 0.628 to 0.958) were constructed. For young women with 1st type of face 6 indicators are modeled - angles Max1-SpP S-arz, distances Sn-Pn and Pog'-Por, angles Gl'LSpog' and SnPog'-Pn, the distance of Li-SnPog' (R^2 = from 0.663 to 0.958). For young women with 2nd face type, the following models were created for 7 indicators - angles Max1-SpP S-arz and Mand1-MP Schwars, distances Sn-Pn and Pog'-Por, angles Gl'LSpog' and SnPog'-Pn, distances Li-SnPog' (R^2 = from 0.628 to 0.891). For young women with 3rd face type the smallest number of models with R^2 larger than 0.6 was built, compared to all groups of persons with different face types - only 4 models for Max1-SpP S-arz angle, Pog'-Por distance, angles Gl'LSpog' and SnPog'-Pn (R^2 from 0.718 to 0.847).

Keywords: young men, young women, teleroentgenographic indicators, regression models, indicators of teeth location, indicators of facial soft tissues, facial types according to Schwarz A.M.

Introduction

Determination of cephalometric parameters, morphometry of parameters of craniofacial structures, indicators of the human dental apparatus have always occupied an important place both in anatomical research

and in the practice of dentists, surgeons, cosmetologists, etc. The most valuable, informative and accessible method for determining such indicators was X-ray cephalometric analysis using lateral teleroentgenography. The method of teleroentgenography allows to obtain a lifetime image of the head and its bone structures, soft tissues of the face in full accordance with their actual size and location, allows to obtain both qualitative and quantitative linear and angular morphometric parameters [1, 16, 18]. But there are still a number of unresolved problems in determining and interpreting the results of teleroentgenography - there are dozens of author's methods of such research, which are used by researchers and practitioners intuitively, based on their own experience and preferences, or the priorities of their choice in a particular country or medical institution; frequent discrepancy between the author's indicators established on certain samples of the population and the indicators received by researchers on other samples depending on racial [2, 14, 17], ethnic [21, 25, 32], population [13, 22] features of the population of different geographical zones, different countries [12, 20, 23].

Therefore, determining the features of cephalometric, gnathometric teleroentgenographic (TRG) indicators of the population of different countries is extremely important for both human anatomy and practice, especially dentists, orthopedists, orthodontists, specialists in maxillofacial surgery. In recent years, a number of scientific and practical developments in this direction have appeared in Ukraine [8, 9, 27]. An important place among such studies is occupied by works on mathematical modeling of individual teleroentgenographic indicators of various methods of cephalometric analysis, inherent in persons with orthognathic occlusion, which is necessary primarily for practical use in dentistry [5, 6, 10, 15, 24].

The aim of the work is to develop and analyze regression models of teleroentgenographic indicators of tooth position and facial soft tissue profile according to Schwarz A.M. in Ukrainian young men and young women with different face types.

Materials and methods

We analyzed lateral teleroentgenograms in residents of Ukraine of the youth age group - 49 young men (aged 17 to 21 years) and 76 young women (aged 16 to 20 years) with a physiological bite that was as close as possible to orthognathic (hereinafter "orthognathic bite"). Teleroentgenograms were obtained on a dental cone-beam tomograph Veraviewepocs 3D Morita (Japan). Some of the primary indicators of teleroentgenograms were obtained from the database of the research center of National Pirogov Memorial Medical University, Vinnytsya.

Determination of teleroentgenographic parameters was performed using licensed medical software OnyxCeph^{3TM}, version 3DPro (Image Instruments GmbH, Germany). Measurements were performed according to the recommendations of Schwarz A.M. [29, 30]. Cephalometric

points were determined according to the recommendations of Phulari B.S. [26] and S.I. Doroshenko and E.A. Kulginsky [11].

The obtained teleroentgenographic indicators were divided into 3 groups [6, 7]. Indicators of group 1 - metric characteristics of the skull, defined in the classical methods of A. Bjork [3], C.J. Burstone [4], J.R. Jarabak [19], R.M. Ricketts [28], A.M. Schwarz [29, 30] and S.S. Steiner [31] and which in the process of surgical and orthodontic treatment usually do not change, but act as basic indicators of cephalometric analysis in relation to which the lateral radiographs determine the inclination, position of the upper and lower jaws, closing plane and individual teeth. The second group of indicators - teleroentgenographic indicators of the upper and lower jaws, inter-jaw indicators according to the method of A.M. Schwarz [29, 30], the definition of which is most often focused during orthodontic surgery when necessary to correct the length, width, angles and position of the upper and lower jaws.

The third group of indicators included teleroentgenographic indicators of the position of the teeth and the profile of the soft tissues of the face according to the method of A.M. Schwarz [29, 30]: angle Max1-SpP S-arz (°) - is formed by lines Ap1u-Is1u (inclination of the central axis of the upper medial incisor) and ANS-PNS (palatal plane, SpP); angle Mand1-MP Shwars (°) - is formed by lines Ar1L-Is1L and Me-Im and determines the position of the axes of the mandibular incisors relative to the mandibular plane according to A.M. Schwarz; angle II (°) - inter-cutter angle, formed by lines Ap1u-Is1u (central axis of the upper medial incisor) and Ar1L-Is1L (central axis of the lower medial incisor); distance Sn-Pn (mm) - determines the position of the point Sn relative to the perpendicular Pn; Pog'-Por distance (mm) - the distance from the Pog' point to the orbital perpendicular Por (determines the position of the chin relative to the perpendicular to the Frankfurt plane, drawn through the orbit); angle Gl'LS Pog' (°) - formed by lines Gl'-Ls and LsPog' (determines the convexity of the face); the angle SnPog'-Pn (°) - formed by the lines SnPog' and the perpendicular Pn and the distance Li-SnPog' (mm) - determines the position of the point Li relative to the line SnPog'.

Young men and young women were divided into separate groups with different face types according to A.M. Schwarz [29] depending on the values of the facial angle F, which is determined between the Se-N lines (line from the constructive point Se) (sellia turcica entru) in the middle of the distance between back and front inclined wedge-shaped processes to point N (nasion)) and N-A ((line from point N (nasion) to point A (subspinale), the most posterior point of the anterior contour of the upper jaw)): 1 type (back face type according to Schwarz A.M.) - 13 young men or 23 young women, angle F up to 83°; 2 type (average face type according to Schwarz A.M.) - 18 young men or 24 young women, angle F from 84° to 87°; 3 type (front face type according to Schwarz A.M.) - 18 young men, or 29 young

women, angle $F > 87^\circ$.

Conducted mathematical modeling of teleroentgenographic indicators of 3 groups depending on TRG indicators of 1 or 2 groups in young men and young women with different face types according to Schwarz A.M. using the method of step-by-step regression analysis in the license package "Statistica 6.0". The following conditions were observed during the regression analysis: the final version of the obtained model must have a coefficient of determination (R^2) of not less than 0.60; the value of the F-criterion is not less than 3.0; the number of independent variables of the equation should be as small as possible.

The Biomedical Ethics Commission of National Pirogov Memorial Medical University, Vinnytsya, Ukraine has established that the conducted research and applied research methods correspond to the international and domestic bioethical and moral and legal requirements and laws of Ukraine (protocol №8 dated 5.10.2017).

Results

The results of simulation of teloradiographic indicators of the position of the teeth and the profile of the soft tissues of the face in adolescents with different types of faces according to Schwarz A.M. have the form of the following regression equations.

For young men with 1 face type:

Max1-SpP S-arz (young men type 1) = $38.09 + 0.515 \times \text{MM} - 0.633 \times \text{N-Se} + 0.595 \times \text{Max}$ ($R^2=0.839$; $F_{(3,9)}=15.59$; $p<0.0007$; Error of estimate=1.671);

Sn-Pn (young men type 1) = $-41.32 + 0.148 \times \text{B} + 0.320 \times \text{H} + 0.303 \times \text{T} + 0.199 \times \text{R.asc}$ ($R^2=0.946$; $F_{(4,8)}=34.84$; $p<0.0000$; Error of estimate=0.7564);

Pog'-Por (young men type 1) = $-159.8 - 1.017 \times \text{T} + 1.598 \times \text{H} + 0.608 \times \text{N-S}$ ($R^2=0.968$; $F_{(3,9)}=90.76$; $p<0.0000$; Error of estimate=1.199);

Gl'LSpog' (young men type 1) = $159.6 - 1.705 \times \text{T} - 1.269 \times \text{R.asc.} + 0.932 \times \text{H} + 0.927 \times \text{S-E}$ ($R^2=0.933$; $F_{(4,8)}=27.78$; $p<0.0001$; Error of estimate=2.288);

SnPog'-Pn (young men type 1) = $100.3 + 1.013 \times \text{T} - 1.002 \times \text{H} - 0.125 \times \text{F}$ ($R^2=0.998$; $F_{(3,9)}=1755$; $p<0.0000$; Error of estimate=0.248),

where here and in the future: R^2 - coefficient of determination; $F_{(i,j)}=!!$, $!!$ - critical ($!!$) and received ($!!$) the value of the Fisher test; St. Error of estimate - standard error of the standardized regression coefficient; MM - maxillary-mandibular angle, determines the angle at which the upper jaw is located relative to the lower jaw in the sagittal plane and is formed by lines A-B and ANS-PNS ($^\circ$); N-Se (the length of the front of the skull base by Schwarz A.M.) - the distance from point Se to point N (mm); Max (length of the upper jaw) - distance from the constructive point apMax to point PNS (mm); B (basal angle) - indicates the angle between the upper and lower jaws and is formed by lines ANS-PNS (palatal plane SpP) and Im-Me (mandibular plane MPS by Schwarz) ($^\circ$); H - angle H by

Schwarz A.M., formed by the lines Po-Or and Pn, determines the angle of inclination of the Frankfurt plane to the base of the skull ($^\circ$); T (profile angle T) - formed by lines Sn-Pog' and Pn (nasal perpendicular) ($^\circ$); R.asc (the length of the branch of the mandible) - the distance from the constructive point R.asc to the constructive point tGoS (mm); N-S (the length of the anterior cranial base by Jarabak J.R.) - the distance from point N to point S (mm); S-E (the length of the back of the skull base by Steiner C.C.) - the distance from point S to the constructive point E (mm); F (facial angle) - formed by lines Se-N and N-A and determines the location of the anterior contour of the upper jaw in the sagittal plane to the base of the skull ($^\circ$).

In young men with 1 type of face, the coefficients of determination of regression equations (R^2) of Mand1-MP Schwars, II angles and Li-SnPog' distances are from 0.312 to 0.590 and therefore are not relevant for practical use by dentists.

For young men with 2 face type:

Max1-SpP S-arz (young men type 2) = $60.25 + 0.780 \times \text{MM} - 0.508 \times \text{N-S-Ba}$ ($R^2=0.690$; $F_{(2,15)}=16.70$; $p<0.0002$; Error of estimate=3.073);

Mand1-MP Schwars (young men type 2) = $103.7 - 0.996 \times \text{T} + 0.436 \times \text{G} - 0.849 \times \text{I} + 0.202 \times \text{S-ar:ar-Go}$ ($R^2=0.807$; $F_{(4,13)}=13.57$; $p<0.0001$; Error of estimate=3.641);

Sn-Pn (young men type 2) = $-42.73 - 0.295 \times \text{P-PTV} + 0.422 \times \text{POr-NBa} + 0.345 \times \text{H}$ ($R^2=0.930$; $F_{(3,14)}=62.12$; $p<0.0000$; Error of estimate=1.106);

Pog'-Por (young men type 2) = $-63.93 + 0.377 \times \text{R.asc.} - 0.645 \times \text{T} + 0.736 \times \text{H}$ ($R^2=0.972$; $F_{(3,14)}=165.0$; $p<0.0000$; Error of estimate=1.524);

Gl'LSpog' (young men type 2) = $175.8 - 1.323 \times \text{T} + 0.444 \times \text{POr-NBa} - 2.645 \times \text{N-S:S-Ar'}$ ($R^2=0.892$; $F_{(3,14)}=38.72$; $p<0.0000$; Error of estimate=2.554);

SnPog'-Pn (young men type 2) = $83.53 + 1.013 \times \text{T} - 0.934 \times \text{H}$ ($R^2=0.990$; $F_{(2,15)}=765.2$; $p<0.0000$; Error of estimate=0.613),

where here and in the future: N-S-Ba (by Bjork A.) - the angle formed by the S-N lines (front of the skull base) and S-Ba ($^\circ$); G (gonial angle, angle of the lower jaw) - is formed by lines ppCond-MT2 and T2-Me, which intersect at a point tGoS ($^\circ$); I (inclination angle) - determines the angle of inclination of the upper jaw (spinal plane) to the nasal perpendicular ($^\circ$); S-ar:ar-Go (by Jarabak J.R.) - indicator of the ratio of distances S-ar and ar-Go; P-PTV (by Ricketts R.M.) - the distance from point Po to point Pt, parallel to the Frankfurt plane (mm); POr-NBa (cranial inclination angle (deflection) by Ricketts R.M.) - the angle formed by the lines Po-Or and Ba-N ($^\circ$); N-S:S-Ar' (by Bjork A.) - indicator of the ratio of distances ar'-S and N-S.

In young men with facial type 2, the coefficients of determination of the regression equations (R^2) of the angle II and the distance Li-SnPog' are equal to 0.515 and 0.574, respectively, and such models are impractical for practical use.

For young men with 3 face type:

Max1-SpP S-arz (young men type 3) = $17.23 + 1.692 \times \text{MM} - 1.370 \times \text{I} - 0.623 \times \text{T} + 3.347 \times \text{N-S:S-Ar}'$ ($R^2=0.609$; $F_{(4,13)}=5.063$; $p<0.0111$; Error of estimate=3.615);

Mand1-MP Schwars (young men type 3) = $198.7 - 1.455 \times \text{MM} + 0.986 \times \text{B} + 0.615 \times \text{N-CC} - 0.641 \times \text{Max}$ ($R^2=0.848$; $F_{(4,13)}=18.13$; $p<0.0000$; Error of estimate=3.146);

Sn-Pn (young men type 3) = $-174.3 + 0.794 \times \text{H} + 0.845 \times \text{F} - 0.653 \times \text{B} + 0.440 \times \text{P-Or-NBa} + 0.342 \times \text{T} + 0.425 \times \text{I}$ ($R^2=0.946$; $F_{(6,11)}=32.05$; $p<0.0000$; Error of estimate=1.241);

Pog'-Por (young men type 3) = $-207.3 + 0.958 \times \text{F} + 1.397 \times \text{H} - 0.815 \times \text{T} + 0.451 \times \text{N-CC}$ ($R^2=0.889$; $F_{(4,13)}=26.16$; $p<0.0000$; Error of estimate=2.170);

Gl'LSpog' (young men type 3) = $147.1 - 0.780 \times \text{T} + 0.569 \times \text{B} + 0.981 \times \text{R.asc.} - 1.103 \times \text{Max}$ ($R^2=0.807$; $F_{(4,13)}=13.57$; $p<0.0001$; Error of estimate=3.272),

where here and in the future: N-CC (by Ricketts R.M.) - anterior length of the skull base, the distance from point N to point CC (mm).

In young men with 3 type face, the coefficients of determination of regression equations (R^2) of angles II, SnPog'-Pn and distance Li-SnPog' are from 0.237 to 0.518 and therefore do not matter for practical use by dentists.

For young women with 1 face type:

Max1-SpP S-arz (young women type 1) = $113.7 - 1.168 \times \text{H} + 0.781 \times \text{MM} + 0.566 \times \text{R.asc.} - 0.557 \times \text{Length of Mandible}$ ($R^2=0.699$; $F_{(4,17)}=9.874$; $p<0.0003$; Error of estimate=3.284);

Sn-Pn (young women type 1) = $-165.8 + 1.271 \times \text{H} + 1.132 \times \text{F} - 0.215 \times \text{G} - 0.114 \times \text{N-S-Ar}$ ($R^2=0.899$; $F_{(4,17)}=37.78$; $p<0.0000$; Error of estimate=1.342);

Pog'-Por (young women type 1) = $-106.0 - 1.145 \times \text{MM} + 0.877 \times \text{I} + 0.934 \times \text{H} - 0.598 \times \text{P-PTV} + 0.599 \times \text{F}$ ($R^2=0.895$; $F_{(5,16)}=27.40$; $p<0.0000$; Error of estimate=1.856);

Gl'LSpog' (young women type 1) = $180.0 - 1.760 \times \text{T} + 0.599 \times \text{R.asc.} - 0.376 \times \text{N-CC} - 0.576 \times \text{I} + 0.431 \times \text{MM}$ ($R^2=0.925$; $F_{(5,16)}=39.58$; $p<0.0000$; Error of estimate=1.931);

SnPog'-Pn (young women type 1) = $103.2 + 0.698 \times \text{T} - 0.743 \times \text{H} - 0.402 \times \text{N-CC} + 0.150 \times \text{R.asc.} - 0.412 \times \text{F} + 0.288 \times \text{Max}$ ($R^2=0.958$; $F_{(6,15)}=56.53$; $p<0.0000$; Error of estimate = 0.839);

Li-SnPog' (young women type 1) = $-8.556 + 0.315 \times \text{B} + 0.368 \times \text{T} + 0.394 \times \text{P-PTV} + 0.299 \times \text{Max}$ ($R^2=0.663$; $F_{(4,17)}=8.350$; $p<0.0006$; Error of estimate=1.525),

where here and in the future: Length of Mandible - the length of the mandible (the distance from the projection of the Pog point on the line tGo-Me to the point tGo) (mm); N-S-Ar (sella angle by Bjork A.) - the angle between the anterior cranial base and the lateral cranial base, which determines the position of the temporomandibular joint and glenoid fossae and is formed by the lines N-S and S-ar ($^\circ$).

In young women with 1 type face, the coefficients of determination of regression equations (R^2) of Mand1-MP Schwars and II angles are equal to 0.121 and 0.481, respectively, so such models are impractical for practical use.

For young women with 2 face type:

Max1-SpP S-arz (young women type 2) = $186.5 + 1.360$

$\times \text{MM} - 0.680 \times \text{S-ar:ar-Go} - 1.156 \times \text{I} - 7.242 \times \text{N-S:S-Ar}' - 0.553 \times \text{N-S-Ba}$ ($R^2=0.863$; $F_{(5,17)}=21.36$; $p<0.0000$; Error of estimate = 2.395);

Mand1-MP Schwars (young women type 2) = $174.6 - 1.086 \times \text{MM} + 0.726 \times \text{B}$ ($R^2=0.648$; $F_{(2,20)}=18.42$; $p<0.0000$; Error of estimate=3.667);

Sn-Pn young women type 2) = $-213.6 + 0.971 \times \text{H} + 1.544 \times \text{F} + 0.245 \times \text{N-S} + 0.294 \times \text{B} - 0.156 \times \text{MM} - 0.284 \times \text{P-Or-NBa}$ ($R^2=0.891$; $F_{(6,16)}=21.75$; $p<0.0000$; Error of estimate=1.194);

Pog'-Por (young women type 2) = $-110.8 + 0.262 \times \text{Length of Mandible} - 0.709 \times \text{T} + 1.278 \times \text{H}$ ($R^2=0.880$; $F_{(3,19)}=46.51$; $p<0.0000$; Error of estimate=2.118);

Gl'LSpog' (young women type 2) = $244.5 - 0.894 \times \text{T} - 0.538 \times \text{N-S-Ba}$ ($R^2=0.660$; $F_{(2,20)}=19.42$; $p<0.0000$; Error of estimate=3.827);

SnPog'-Pn (young women type 2) = $91.49 + 0.583 \times \text{T} - 1.529 \times \text{H} + 0.341 \times \text{N-S-Ba} + 0.158 \times \text{N-CC}$ ($R^2=0.807$; $F_{(4,18)}=18.85$; $p<0.0000$; Error of estimate = 2.011);

Li-SnPog' (young women type 2) = $2.919 + 0.221 \times \text{T} - 0.169 \times \text{ar-Go} + 0.233 \times \text{S-E}$ ($R^2=0.628$; $F_{(3,19)}=10.68$; $p<0.0002$; Error of estimate=1.324),

where here and in the future: ar-Go (by Burstone C.J.) - the length of the branch of the mandible, the distance from point Ar to point Go (mm).

The coefficient of determination of the regression equation (R^2) of the angle II in young women with 2 type face is equal and such a model has no practical significance.

For young women with 3 face type:

Max1-SpP S-arz (young women type 3) = $-214.9 + 1.005 \times \text{MM} + 0.934 \times \text{N-Se} + 1.371 \times \text{H} - 0.822 \times \text{Max} + 0.632 \times \text{I} + 0.498 \times \text{P-PTV}$ ($R^2=0.718$; $F_{(6,22)}=9.332$; $p<0.0000$; Error of estimate=3.727);

Pog'-Por (young women type 3) = $-84.28 + 0.294 \times \text{R.asc.} - 0.806 \times \text{T} + 1.152 \times \text{H} - 0.214 \times \text{ar-Go}$ ($R^2=0.844$; $F_{(4,24)}=32.54$; $p<0.0000$; Error of estimate=2.013);

Gl'LSpog' (young women type 3) = $417.6 - 1.177 \times \text{T} - 1.341 \times \text{F} - 4.469 \times \text{N-S:S-Ar}' - 0.538 \times \text{N-CC} - 0.297 \times \text{S-ar:ar-Go} - 0.478 \times \text{N-S-Ar}$ ($R^2=0.847$; $F_{(6,22)}=20.34$; $p<0.0000$; Error of estimate=2.411);

SnPog'-Pn (young women type 3) = $40.28 + 0.633 \times \text{T} - 0.655 \times \text{H} + 0.223 \times \text{MM}$ ($R^2=0.822$; $F_{(3,25)}=38.50$; $p<0.0000$; Error of estimate=1.654).

In young women with 3 type face, the coefficients of determination of the regression equations (R^2) of the Mand1-MP Schwars angle and the distances Sn-Pn and Li-SnPog' are from 0.494 to 0.597 and therefore do not matter for practical use in dentistry. The regression equation for angle II in young women with 3 type face was not constructed at all.

Discussion

A number of works have proved the fundamental possibility of modeling teleroentgenographic parameters of the dental apparatus in Ukrainian young men and young women depending on cephalometric parameters. However,

the coefficients of determination R^2 , which in the evaluation of regression models are interpreted as the conformity of the model to the data and indicate the efficiency of the model in different researchers differ significantly. I.V. Gunas and co-authors [15] constructed and analyzed regression models of TRG parameters used in the method of C.J. Burstone in young men and young women with normal occlusion and a harmonious face. Moreover, the authors managed to obtain regression models with $R^2 > 0.6$ for all 6 studied indicators of the second group and for all 7 indicators of the third group, depending on the indicators of the first group.

A.V. Chernysh and co-authors [6] built regression models of individual cephalometric parameters in young men and young women used in the method of E.P. Harvold: young men have all possible models of TRG-indicators, which are included in the second group, depending on the indicators of the first group with R^2 from 0.616 to 0.940, and young women have built such models only for indicators of the length of the upper and lower jaws with R^2 , respectively, 0.857 and 0.792. Also, these researchers built reliable models of the third group (angle Ap1uAp1l-DOP) depending on the indicators of the first and second groups, both for young men ($R^2 = 0.626$) and for young women ($R^2 = 0.584$).

A.V. Chernysh also performed simulations of the cephalometric parameters used in the R.M. Ricketts method [5]. The author constructed for both young men and young women by 2 possible models of indicators of the second group (distances Go-CF and Xi-Pm) depending on the indicators of the first group (respectively, $R^2 = 0.884$ and 0.928 and $R^2 = 0.735$ and 0.719) and 7 of the 8 possible reliable models in young men of the indicators included in the third group (distances 6u-6l, Overjet, Overbite, 6u-PTV, 1l-APog, 1u-APog and Xi-OcP) depending on the indicators of the first and second groups and only 5 such models in young women (distances 6u-PTV, 1l-APog, 1u-APog and Xi-OcP and angle Max1-APog).

Instead, M.O. Dmitriev and co-authors [10], modeled gnatometric TRG parameters used in methods by A.M. Schwarz, J.Mc Namara, B.B. Downs, R.A. Holdway, P.F. Schmuth, C.C. Steiner and C.H. Tweed, depending on the parameters of basal cranial structures in young Ukrainian residents with orthognathic occlusion. In young men out of 43 possible regression models, the authors obtained only 4 reliable models with a coefficient of determination greater than 0.5 (for indicators of effective upper jaw length, upper jaw length, SND angle and distance S_L), and in young women, no models with a coefficient of determination greater than 0.5 were constructed at all.

According to the results of our mathematical modeling by stepwise regression analysis of eight teleroentgenographic indicators of the position of the teeth and soft tissues of the face, which were included in the third group according to the method of A.M. Schwarz depending on the first group (basic cephalometric TRG-

indicators) and the second group of indicators (gnatometric TRG-indicators of the upper and lower jaws) according to the method of A.M. Schwarz in young men with orthognathic occlusion and with different face types according to A.M. Schwarz, constructed 16 of the 24 possible reliable regression models in which the coefficient of determination is greater than 0.6 ($R^2 =$ from 0.609 to 0.998). For young men with the first and third face types, the following models were created for five indicators (respectively, the angle Max1-SpP S-arz, the distances Sn-Pn and Pog'-Por, the angles Gl'LSpog' and SnPog'-Pn; $R^2 =$ from 0.839 to 0.998 and angles Max1-SpP S-arz and Mand1-MP Schwars, distances Sn-Pn and Pog'-Por, angle Gl'LSpog'; $R^2 =$ from 0.609 to 0.946), and for a group of young men with the second type face - about 6 indicators (angles Max1-SpP S-arz and Mand1-MP Schwars, distances Sn-Pn and Pog'-Por, angles Gl'LSpog' and SnPog'-Pn; $R^2 =$ from 0.690 to 0.990).

For young women built almost the same number of models - 17 of the 24 possible reliable regression models in which the coefficient of determination is greater than 0.6 ($R^2 =$ from 0.628 to 0.958). But the number of models for certain groups of people with different face types, as well as the indicators for which such models were created in young women differed slightly. For young women with the first type of face, the following models were created for 6 indicators - in addition to the same five indicators ($R^2 =$ from 0.699 to 0.958), as for young men of the first group, a model was built for the distance Li-SnPog' ($R^2 = 0.663$). For young women with the second type of face, the following models were created for 7 indicators - in addition to the same six indicators ($R^2 =$ from 0.660 to 0.891), as for young men with the second type of face, a model was also built for the distance Li-SnPog' ($R^2 = 0.628$). Instead, for young women with the third type of face, the smallest number of models with coefficients of determination greater than 0.6, compared to all groups, both young men and young women with different facial types - only 4 models for the angle Max1-SpP S-arz, Pog'-Por distances, Gl'LSpog' and SnPog'-Pn angles (with R^2 from 0.718 to 0.847). Compared with the group of young men with the third type of face, young women with this type of face were not built models with a coefficient of determination greater than 0.6 for the angle Mand1-MP Schwars and the distance Sn-Pn, instead - such a model was created for the angle SnPog'-Pn.

It should be noted that for Max1-SpP S-arz, Gl'LSpog' and Pog'-Por distances, models with a coefficient of determination greater than 0.6 have been developed for both young men and young women of all face types. For the Sn-Pn distance, such models are designed for young men of all face types and for young women of all face types except the third type, and for the SnPog'-Pn angle, on the contrary, for young women of all face types and for young men of all face types except the third type. The Mand1-MP Schwars angle was modeled with a coefficient of determination greater than 0.6 in young men with the second and third facial types and in young women with the

second facial type, and the Li-SnPog' distance was modeled only in young men with the first and second facial types.

The inter-incisor angle II in all models of young men with different face types and young women with the first and second face types was modeled with coefficients of determination less than 0.6, and in young women with the third face type the model of this indicator was not built at all.

Regression equations of Li-SnPog' distance values had coefficients of determination less than 0.6 in young men of all face types (R^2 from 0.312 to 0.574) and in young women with 3 face types ($R^2 = 0.494$), and coefficients of determination of regression equations of Mand1-MP Schwarz angle values were less than 0.6 in young men with 1 facial type ($R^2 = 0.569$) and in young women with 1 and 3 facial types (respectively, $R^2 = 0.121$ and $R^2 = 0.597$).

In young men with different types of faces to the constructed models of teleroentgenographic indicators, which were included in the third group according to the method of Schwarz A.M. most often includes the following TRG indicators of the first and second groups: profile angle T (21.4%), angle H according to A.M. Schwarz (16.1%) and angles MM (maxillary-mandibular angle), B (basal angle, angle between upper and lower jaws) and distance R.asc. (length of the branch of the mandible) (7.1%).

In young women models of teleroentgenographic indicators of the third group according to the method of A.M. Schwarz most often includes the following TRG indicators of the first and second groups: profile angle T and angle H according to A.M. Schwarz (13.9% each), angle MM (maxillary-mandibular angle) (11.1%) and angle F (facial angle) (6.9%).

In our opinion, the practical application of the created

regression models of teleroentgenographic indicators of tooth position and soft tissue profile of the face depending on the basic cephalometric indicators and gnatometric indicators of the upper and lower jaws based on sex, face type will provide an individual approach to the patient and the best consequences of treatment in case of need of surgical correction of these indicators at inhabitants of Ukraine of youthful age.

Conclusions

1. In young men, residents of Ukraine with orthognathic occlusion and with different types of faces according to A.M. Schwarz, constructed 16 of 24 possible reliable regression models with coefficients of determination greater than 0.6 ($R^2 =$ from 0.609 to 0.998) groups of teleroentgenographic indicators of the position of the teeth and the profile of soft tissues of the face, which can be corrected during surgery, orthopedic interventions in dentistry depending on the group of basic, invariable cephalometric indicators and the group of teleroentgenographic indicators of the upper and lower jaws. In young women with different face types, 17 of the 24 possible models in which the coefficient of determination is greater than 0.6 ($R^2 =$ from 0.628 to 0.958) were constructed.

2. The created models are suitable for use in the practice of dentists, cosmetologists in order to provide an individualized approach to determining the tactics, scope and improvement of the consequences of interventions when necessary to correct these indicators in adolescents.

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РЕГРЕСІЙНІ МОДЕЛІ ТЕЛЕРЕНТГЕНОГРАФІЧНИХ ПОКАЗНИКІВ ПОЛОЖЕННЯ ЗУБІВ ТА ПРОФІЛЮ М'ЯКИХ ТКАНИН ОБЛИЧЧЯ В ОСІБ ЮНАЦЬКОГО ВІКУ З РІЗНИМИ ТИПАМИ ОБЛИЧЧЯ ЗА SCHWARZ A.M.

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Зважаючи на існування відмінностей значень телерентгенографічних (ТРГ) показників в різних расових, статевих, етнічних, вікових, популяційних, географічних за місцем проживання групах населення та чисельних методик ТРГ аналізу, визначення нормативних значень цефалометричних, гнатометричних ТРГ-показників, їх взаємозалежностей у населення різних країн є вкрай важливим як для анатомії людини, так і для практичної діяльності лікарів-стоматологів. Це в повній мірі стосується і мешканців України різних вікових груп. Мета роботи - розробка та аналіз регресійних моделей телерентгенографічних показників положення зубів та профілю м'яких тканин обличчя за Schwarz A.M. в українських юнаків і дівчат з різними типами обличчя. Проаналізовані бокові телерентгенограми 49 юнаків (вік від 17 до 21 року) та 76 дівчат (вік від 16 до 20 років) з фізіологічним прикусом, максимально наближеним до ортогнатичного. В ліцензійному пакеті "Statistica 6.0" побудовані регресійні моделі показників положення зубів та профілю м'яких тканин обличчя за методикою Schwarz A.M. в залежності від базових цефалометричних та гнатометричних показників окремо для юнаків і для дівчат з різними типами обличчя. В юнаків побудовані 16 із 24 можливих достовірних регресійних моделей, в яких коефіцієнт детермінації є більшим, ніж 0,6 ($R^2 = \text{від } 0,609 \text{ до } 0,998$). Для юнаків з 1 (задній тип обличчя) та з 3 (передній тип обличчя) типами обличчя створені такі моделі щодо 5 показників з 8 можливих (відповідно, кута Max1-SpP S-arz , відстаней Sn-Pn і Pog'-Por , кутів G'LS-Pog' і Sn-Pog'-Pn ; $R^2 = \text{від } 0,609 \text{ до } 0,998$ та кутів Max1-SpP S-arz і Mand1-MP Schwars , відстаней Sn-Pn і Pog'-Por , кута G'LS-Pog' ; $R^2 = \text{від } 0,609 \text{ до } 0,946$), а для юнаків з 2 типом обличчя (середній тип обличчя за Schwarz A.M.) - щодо 6 показників (кутів Max1-SpP S-arz і Mand1-MP Schwars , відстаней Sn-Pn і Pog'-Por , кутів G'LS-Pog' і Sn-Pog'-Pn ; $R^2 = \text{від } 0,690 \text{ до } 0,990$). В дівчат побудовано 17 з 24 можливих достовірних моделей з R^2 більшими, ніж 0,6 ($R^2 = \text{від } 0,628 \text{ до } 0,958$). Для дівчат з 1 типом обличчя змодельовані 6 показників - кута Max1-SpP S-arz , відстаней Sn-Pn і Pog'-Por , кутів G'LS-Pog' і Sn-Pog'-Pn , відстані Li-SnPog'

(R^2 = від 0,663 до 0,958). Для дівчат з 2 типом обличчя створені такі моделі щодо 7 показників - кутів Max1-SpP S-arz і Mand1-MP Schwars, відстаней Sn-Pn і Pog'-Por, кутів Gl'LSpog' і SnPog'-Pn, відстані Li-SnPog' (R^2 = від 0,628 до 0,891). Для дівчат з 3 типом обличчя побудована найменша кількість моделей з R^2 більшими, ніж 0,6, порівняно з усіма групами осіб з різними типами обличчя - всього 4 моделі для показників кута Max1-SpP S-arz, відстані Pog'-Por, кутів Gl'LSpog' та SnPog'-Pn (R^2 від 0,718 до 0,847).

Ключові слова: юнаки, дівчата, телерентгенографічні показники, регресійні моделі, показники розташування зубів, показники м'яких тканин обличчя, типи обличчя за Schwarz A.M.