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REGRESSION MODELS OF TELERADIOGRAPHIC INDICATORS OF THE POSITION OF TEETH AND THE PROFILE OF FACE SOFT TISSUES IN UKRAINIAN YOUNG MEN AND YOUNG WOMEN WITH DIFFERENT FACE PROFILES ACCORDING TO SCHWARZ A. M.

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Annotation. The needs of modern dentistry require constant improvement of research methods of human dental apparatus, parameters of craniofacial structures, determination of congenital and acquired deformities of the dental apparatus and improving the consequences of treatment. Diagnosis of orthodontic pathology is based on the identification of a large number of different indicators, which requires the use of mathematical analysis not only to processing of received parameters, but also to mathematical modelling individual cephalometric, gnathometric indicators, facial soft tissue parameters that affect its profile and aesthetics. The aim of the work is to develop and analyze regression models of teleradiographic indicators of tooth position and facial soft tissue profile indices according to A. M. Schwarz in Ukrainian boys and girls with orthognathic occlusion and with different facial profiles. Lateral teleroentgenograms (TRG) of 49 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 were analyzed. In the licensed package "Statistica 6.0" regression models of teeth position and soft tissue profile according to the A. M. Schwarz method are built depending on the basic cephalometric (1st group) and gnathometric (2nd group) indicators separately for young men and young women with different facial profiles according to A. M. Schwarz. In young men, 21 of the 24 possible reliable regression models with coefficients of determination greater than 0.6 (R^2 = from 0.736 to 0.999) were constructed. For young men with 2 face profile (straight face profile), the following models of all 8 indicators were built, and the coefficients of determination in the models of this group of persons (R^2 = from 0.966 to 0.999) were the highest compared to the models of other groups of young men or young women. For young men with 3 face profile (front face profile), models were built for 7 indicators (except for the SnPog'-Pn angle indicator) with R^2 from 0.736 to 0.983. For young men with 1 face profile (back face profile), such models were created for 6 indicators (R^2 from 0.815 to 0.993) - in addition to the angle II and the angle SnPog'-Pn. A total of 18 models out of 24 possible were built for young women (R^2 = from 0.736 to 0.999). In young women with 2 face profile, as well as in young men with this profile, models were constructed for all 8 studied TRG-indicators of tooth position and facial soft tissue indicators according to A.M. Schwarz (R^2 = from 0.736 to 0.982), and for young women with 3 face profile - for 7 indicators (except for angle II) with R^2 from 0.604 to 0.740. For young women with 1 face profile, the smallest number of models of the studied indicators was constructed in comparison with all groups of young men or young women with different face profiles - only 3 models out of 8 possible: for Sn-Pn distance (R^2 = 0.828), Pog'-Por distance (R^2 = 0.844) and the angle SnPog'-Pn (R^2 = 0.982). Both young men and young women in the created models more often include indicators of 2nd group.

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

Introduction

The development of modern dentistry requires constant improvement of methods for studying the parameters of the human dental apparatus, parameters of craniofacial structures, determination of congenital and acquired deformities of the dental apparatus and improving the consequences of treatment. One of the most valuable and informative methods of radiological diagnostics in dentistry is the method of lateral teleradiography (TRG), which provides opportunities to obtain qualitative and quantitative characteristics of bone cephalometric parameters, indicators of the dental apparatus and soft tissues of the face [1, 2, 13, 14, 25].

Dozens of author's methods of cephalometric analysis are used by scientists and dentists all over the world, the choice of which is determined at the discretion of the researcher or doctor. At the same time, the differences in

the values of TRG indicators compared with the authors of the methods in the population of different racial, ethnic, population, age, geographical and other groups [10, 11, 18, 19, 21], which requires the use of group, or, even better - an individual approach in the interpretation of the obtained parameters.

Diagnosis of orthodontic pathology is based on the determination of a significant number of different signs, indicators, which requires the use of mathematical analysis not only to process the obtained parameters, but also for mathematical modeling in an individual appropriate cephalometric, gnathometric indicators, facial soft tissues that affect on its profile and aesthetics. This area of research in recent years has begun to develop in Ukraine, in particular, its center become National Pirogov Memorial Medical University, Vinnytsya, whose staff performed a

number of studies with modeling of individual linear sizes of teeth depending on cephalometric indicators [16, 17, 22], indicators required for the design of the correct shape of dental arches [20] and modeling of individual cephalometric and gnathometric indicators used in various methods TRG analysis [5, 6, 8, 12].

The aim of our work is to develop and analyze regression models of telerradiographic indicators of tooth position and facial soft tissue profile according to Schwarz A. M. in Ukrainian young men and young women with orthognathic occlusion and with different facial profiles.

Materials and methods

We analyzed lateral telerradiograms in 49 young men aged 17 to 21 years and 76 young women aged 16 to 20 years, residents of Ukraine with physiological occlusion as close as possible to orthognathic. Telerradiography studies were performed on a dental cone-beam tomography (Veraviewepocs 3D Morita). Analysis of lateral telerradiograms was performed using the licensed program OnyxCeph³™, a version of 3DPro (Image Instruments GmbH, Germany), developed for image analysis in dentistry.

There were 3 groups of TRG indicators [6, 7]: 1 group - metric characteristics of the skull from the classical methods of A. Bjork [3], C. J. Burstone [4], J. R. Jarabak [15], R. M. Ricketts, [24], A. M. Schwarz [26, 27] and C. C. Steiner [28] which are the basic indicators of cephalometric analysis in relation to which the lateral telerradiograms determine the inclination, position of the upper and lower jaws, the closing plane and individual teeth; Group 2 - indicators of the upper and lower jaws, interjawy indicators according to the method of A. M. Schwarz [26, 27], which are most often determined during orthodontic surgery if necessary to correct the length, width, angles and position of the upper and lower jaws.

Group 3 - TRG-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 [26, 27]: angle Max1-SpP S-arz (°) - 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-lm and determines the position of the axes of the mandibular incisors relative to the mandibular plane according to A. M. Schwarz; angle II (°) - inter-incisor 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'LSpog' (°) - formed by the 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'.

Cephalometric points were determined according to the recommendations of B. S. Phulari [23] and S. I. Doroshenko and E. A. Kulginsky [9].

Separate groups of young men and young women were formed depending on the profile of their face according to A. M. Schwarz [26, 27]:

- 1 profile (back face profile according to Schwarz A. M., angle T 12 ° and more) - 23 young men or 37 young women;
- 2 profile (straight face profile Schwarz A. M., angle T 8-12 °) - 9 young men or 15 young women;
- 3 profile (front face profile Schwarz A. M., angle T to 8 °) - 17 young men or 24 young women.

The angle T is the angle between the nasal perpendicular Pn and the line Pog'-Sn, where Pn is the nasal vertical (planum nasalis), which corresponds to the perpendicular lowered to the plane N-Se at the point n (skin vision); Pog' (skin Pogonion) - the most protruding skin point of the chin.

In the license package "Statistica 6.0" performed mathematical modeling of TRG indicators of the 3rd group depending on the TRG indicators of the 1st and 2nd groups in young men and young women with different facial profiles according to A. M. Schwarz by stepwise regression analysis. The following conditions were observed during the regression analysis: the final version of the obtained model must have a coefficient of determination (R²) 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.

Commission on Biomedical Ethics of National Pirogov Memorial Medical University, Vinnytsya established that the conducted research and applied research methods meet international and domestic biotic, moral and legal requirements and laws of Ukraine (Minutes №8 of 5.10.2017).

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Results. Discussion

The results of simulation of telerradiographic indicators of the position of the teeth and the profile of the soft tissues of the face in young men and young women with different facial profiles according to A. M. Schwarz have the form of the following regression equations.

For young men with face profile type 1:

Max1-SpP S-arz (young men profile type 1) = 122.0 + 0.979 x MM - 1.191 x F - 1.436 x N-S + 3.726 x N-S:S-Ar' + 0.844 x Max (R²=0.851; F_(5,17)=19.41; p<0.0000; Error of estimate=2.206);

Mand1-MP Shwars (young men with face profile type 1) = 76.84 + 0.787 x B - 0.776 x S-E - 0.514 x MM + 0.504 x H

+ 0.121 x S-ar:ar-Go ($R^2=0.882$; $F_{(5,17)}=25.42$; $p<0.0000$; Error of estimate=2.444);

Sn-Pn (young men with face profile type 1) = - 81.31 + 0.954 x F + 0.624 x H - 0.544 x I ($R^2=0.815$; $F_{(3,19)}=27.88$; $p<0.0000$; Error of estimate=1.648);

Pog'-Por (young men with face profile type 1) = - 103.2 - 0.178 x S-ar:ar-Go + 1.163 x H - 0.647 x T - 0.642 x B + 0.306 x G + 0.377 x S-ar ($R^2=0.948$; $F_{(6,16)}=48.37$; $p<0.0000$; Error of estimate=1.392);

Gl'LsPog' (young men with face profile type 1) = 201.4 - 0.791 x F - 0.908 x T - 1.602 x Max + 0.712 x MM + 0.595 x Length of Mandible ($R^2=0.868$; $F_{(5,17)}=22.28$; $p<0.0000$; Error of estimate=2.389);

SnPog'-Pn (young men with face profile type 1) = 86.72 + 0.976 x T - 0.960 x H ($R^2=0.993$; $F_{(2,20)}=1327$; $p<0.0000$; Error of estimate=0.4104);

where here and hereafter, R^2 is the coefficient of determination; $F_{(I, II)} = II, II$ - critical (I, II) and obtained (II, II) value of Fisher's criterion; 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 ($^\circ$); F (front angle) - is 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 ($^\circ$); N-S (length of the anterior cranial base according to J. R. Jarabak) - the distance from point N to point S (mm); N-S: S-Ar' (according to A. Bjork) - an indicator of the ratio of the distances ar'-S and N-S; Max (length of the upper jaw) - the distance from the design point apMax to the point PNS (mm); B (basal angle) - indicates the angle between the upper and lower jaws and is formed by the lines ANS-PNS (palatal plane SpP) and Im-Me (mandibular plane MPS Schwarz) ($^\circ$); S-E (length of the back of the skull base according to C. C. Steiner) - the distance from point S to the structural point E (mm); H is the angle H according to A. M. Schwarz, which is formed by the lines Po-Or and Pn, determines the angle of inclination of the Frankfurt plane to the base of the skull ($^\circ$); S-ar: ar-Go (by J. R. Jarabak) - an indicator of the ratio of distances S-ar and ar-Go; I (inclination angle) - determines the angle of inclination of the upper jaw (spinal plane) to the nasal perpendicular ($^\circ$); T (profile angle T) - is formed by lines Sn-Pog' and Pn (nasal perpendicular) ($^\circ$); G (gonial angle, mandibular angle) - is formed by lines ppCond-MT2 and T2-Me, which intersect at the point tGoS ($^\circ$); S-ar - the length of the lateral cranial base, the distance from point S to point ar (mm); Length of Mandible - the length of the mandible (distance from the projection of the Pog point on the line tGo-Me to the point tGo) (mm); T (profile angle T) - is formed by lines Sn-Pog' and Pn (nasal perpendicular) ($^\circ$).

In young men with facial profile type 1, the coefficients of determination of the regression equations (R^2) of the angle II and the distance Li-SnPog' are equal to 0.516 and 0.249, respectively, and therefore do not matter for practical

use by dentists.

For young men with facial profile type 2:

Max1-SpP S-arz (young men with facial profile type 2) = 47.35 + 1.555 x Max - 0.998 x R.asc. - 0.550 x G + 0.734 x H + 0.345 x B ($R^2=0.988$; $F_{(5,3)}=49.80$; $p<0.0044$; Error of estimate=0.855);

Mand1-MP Schwarz (young men with facial profile type 2) = 127.9 - 2.323 x R.asc. + 1.811 x H - 7.973 x N-S: S-Ar' - 1.388 x S-E ($R^2=0.987$; $F_{(4,4)}=73.12$; $p<0.0005$; Error of estimate=1.316);

II (young men with facial profile type 2) = 448.2 - 2.510 x I - 2.566 x N-S + 0.398 x N-S-Ar + 0.549 x ar-Go ($R^2=0.986$; $F_{(4,4)}=70.05$; $p<0.0006$; Error of estimate=1.310);

Sn-Pn (young men with facial profile type 2) = - 266.3 + 1.921 x F + 0.732 x H + 0.889 x N-CC - 0.273 x MM + 0.160 x G ($R^2=0.996$; $F_{(5,3)}=158.0$; $p<0.0008$; Error of estimate=0.4135);

Pog'-Por (young men with facial profile type 2) = - 53.73 + 1.386 x H - 1.573 x S-ar ($R^2=0.974$; $F_{(2,6)}=110.8$; $p<0.0000$; Error of estimate=0.666);

Gl'LsPog' (young men with facial profile type 2) = 332.8 - 1.173 x F - 1.371 x N-S + 0.865 x S-ar ($R^2=0.975$; $F_{(3,5)}=66.31$; $p<0.0002$; Error of estimate=0.894);

SnPog'-Pn (young men with facial profile type 2) = 116.3 - 0.910 x H - 0.465 x N-S + 1.733 x T - 0.103 x I - 0.038 x B ($R^2=0.999$; $F_{(5,3)}=859.0$; $p<0.0000$; Error of estimate=0.114);

Li-SnPog' (young men with facial profile type 2) = - 15.75 + 0.393 x I + 0.992 x N-S - 0.800 x N-CC - 0.467 x F ($R^2=0.966$; $F_{(4,4)}=28.33$; $p<0.0034$; Error of estimate=0.442);

where here and hereafter, R.asc (length of the mandibular branch) is the distance from the constructive point R.asc to the constructive point tGoS (mm); N-S-Ar (saddle angle according to A. Bjork) - 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 ($^\circ$); ar-Go (according to C. J. Burstone) - the length of the branch of the mandible, the distance from the point Ar to the point Go (mm); N-CC (according to R. M. Ricketts) - anterior length of the skull base, the distance from point N to point SS (mm).

For young men with face profile type 3:

Max1-SpP S-arz (young men with face profile type 3) = 258.0 - 1.006 x F + 2.084 x MM - 1.713 x I - 1.005 x N-S-Ba - 0.301 x S-ar:ar-Go ($R^2=0.848$; $F_{(5,11)}=12.30$; $p<0.0003$; Error of estimate=2.545);

Mand1-MP Schwarz (young men with face profile type 3) = 335.4 - 1.656 x MM - 1.044 x F + 0.932 x T - 0.172 x Max ($R^2=0.887$; $F_{(4,12)}=23.50$; $p<0.0000$; Error of estimate=3.426);

II (young men with face profile type 3) = 601.6 - 2.196 x F - 1.247 x H - 1.679 x I - 0.736 x B ($R^2=0.832$; $F_{(4,12)}=14.86$; $p<0.0001$; Error of estimate=4.917);

Sn-Pn (young men with face profile type 3) = - 51.35 + 0.228 x R.asc. + 0.663 x F + 0.822 x PO-NBa - 0.263 x G ($R^2=0.942$; $F_{(4,12)}=48.70$; $p<0.0000$; Error of estimate=1.370);

Pog'-Por (young men with face profile type 3) = - 118.4 +

$1.672 \times \text{ar-Go} - 2.595 \times \text{S-ar} + 0.984 \times \text{S-ar:ar-Go} + 0.693 \times \text{Max} + 0.773 \times \text{POr-NBa} + 0.344 \times \text{I}$ ($R^2=0.983$; $F_{(6,10)}=98.00$; $p<0.0000$; Error of estimate=1.260);

Gl'LsPog' (young men with face profile type 3) = $281.6 - 1.255 \times \text{F} - 0.525 \times \text{N-Se} + 0.488 \times \text{R.asc}$ ($R^2=0.736$; $F_{(3,13)}=12.10$; $p<0.0005$; Error of estimate=3.048);

Li-SnPog' (young men with face profile type 3) = $-38.30 + 0.460 \times \text{F} + 0.583 \times \text{B} - 0.545 \times \text{POr-NBa} + 0.039 \times \text{N-Se}$ ($R^2=0.794$; $F_{(4,12)}=11.57$; $p<0.0004$; Error of estimate=1.000).

where here and hereafter, N-S-Ba (according to A. Bjork) is the angle formed by the lines S-N (front part of the skull base) and S-Ba ($^\circ$); POr-NBa (cranial tilt (deflection) angle according to R. M. Ricketts) - the angle formed by the lines Po-Or and Ba-N ($^\circ$); N-Se (length of the anterior part of the skull base according to A. M. Schwarz) - the distance from the point Se to the point N (mm).

In young men with 3 facial profiles, the coefficient of determination of the regression equation (R^2) of the angle SnPog'-Pn is equal to 0.385 and such a model should not be considered in practical dental activities.

For young women with face profile type 1:

Sn-Pn (women with face profile type 1) = $-132.6 + 0.813 \times \text{F} + 0.614 \times \text{H} + 0.255 \times \text{Length of Mandible} + 0.401 \times \text{T} - 0.128 \times \text{N-S}$ ($R^2=0.828$; $F_{(5,29)}=27.99$; $p<0.0000$; Error of estimate=1.563);

Pog'-Por (women with face profile type 1) = $-160.3 + 1.354 \times \text{H} + 0.275 \times \text{R.asc.} + 0.532 \times \text{F} - 0.732 \times \text{T}$ ($R^2=0.844$; $F_{(4,30)}=40.46$; $p<0.0000$; Error of estimate=2.012);

SnPog'-Pn (women with face profile type 1) = $81.07 + 1.042 \times \text{T} - 0.913 \times \text{H}$ ($R^2=0.982$; $F_{(2,32)}=850.2$; $p<0.0000$; Error of estimate=0.415).

In young women with 1 facial profile, the coefficients of determination of regression equations (R^2) of angles Max1-SpP S-arz, Mand1-MP Schwars, II, Gl'LsPog' and distance Li-SnPog' are from 0.142 to 0.545 and are not relevant for practical use by dentists.

For young women with face profile type 2:

Max1-SpP S-arz (young women with face profile type 2) = $115.6 - 1.381 \times \text{F} + 1.006 \times \text{MM} - 1.599 \times \text{I} + 0.897 \times \text{N-Se} + 1.801 \times \text{T} + 0.784 \times \text{Max}$ ($R^2=0.947$; $F_{(6,8)}=23.91$; $p<0.0001$; Error of estimate=1.263);

Mand1-MP Schwars (young women with face profile type 2) = $181.4 - 1.575 \times \text{MM} + 3.298 \times \text{T} + 0.972 \times \text{B}$ ($R^2=0.854$; $F_{(3,11)}=21.53$; $p<0.0001$; Error of estimate=3.097);

II (young women with face profile type 2) = $106.1 + 1.636 \times \text{H} - 2.193 \times \text{I} + 2.321 \times \text{N-Se} - 1.359 \times \text{N-S}$ ($R^2=0.736$; $F_{(4,10)}=6.977$; $p<0.0060$; Error of estimate=4.375);

Sn-Pn (young women with face profile type 2) = $-165.2 + 0.614 \times \text{Max} + 0.471 \times \text{N-S-Ba} + 0.619 \times \text{F} + 0.611 \times \text{N-CC}$ ($R^2=0.886$; $F_{(4,10)}=19.47$; $p<0.0001$; Error of estimate=1.414);

Pog'-Por (young women with face profile type 2) = $-134.0 + 1.249 \times \text{H} + 0.242 \times \text{R.asc.} + 0.281 \times \text{F}$ ($R^2=0.862$; $F_{(3,11)}=22.91$; $p<0.0000$; Error of estimate=1.518);

Gl'LsPog' (young women with face profile type 2) = $434.1 - 1.155 \times \text{F} - 0.671 \times \text{MM} - 1.584 \times \text{N-Se} + 0.824 \times \text{Length of Mandible} - 0.506 \times \text{N-S-Ar}$ ($R^2=0.860$; $F_{(5,9)}=11.09$; $p<0.0012$;

Error of estimate=2.119);

SnPog'-Pn (young women with face profile type 2) = $75.21 - 0.915 \times \text{H} + 0.991 \times \text{T} - 0.187 \times \text{P-PTV}$ ($R^2=0.982$; $F_{(3,11)}=203.1$; $p<0.0000$; Error of estimate=0.343);

Li-SnPog' (young women with face profile type 2) = $-9.803 - 0.545 \times \text{Length of Mandible} + 0.247 \times \text{F} + 0.357 \times \text{N-Se} + 0.127 \times \text{ar-Go}$ ($R^2=0.805$; $F_{(4,10)}=10.31$; $p<0.0014$; Error of estimate=0.802),

where here and hereafter, P-PTV (according to R. M. Ricketts) is the distance from the point Po to the point Pt, parallel to the Frankfurt plane (mm).

For young women with face profile type 3:

Max1-SpP S-arz (young women with face profile type 3) = $-3.415 + 1.386 \times \text{MM} - 0.214 \times \text{S-ar:ar-Go} - 0.493 \times \text{I}$ ($R^2=0.668$; $F_{(3,20)}=13.41$; $p<0.0001$; Error of estimate=4.104);

Mand1-MP Schwars (young women with face profile type 3) = $217.1 - 0.753 \times \text{MM} + 1.199 \times \text{B} - 0.913 \times \text{I} - 0.709 \times \text{T}$ ($R^2=0.666$; $F_{(4,19)}=9.492$; $p<0.0002$; Error of estimate=5.040);

Sn-Pn (young women with face profile type 3) = $-138.8 + 0.802 \times \text{F} + 0.849 \times \text{H}$ ($R^2=0.654$; $F_{(2,21)}=19.83$; $p<0.0000$; Error of estimate=2.073);

Pog'-Por (young women with face profile type 3) = $-162.5 + 0.533 \times \text{F} + 1.371 \times \text{H} - 0.642 \times \text{T} + 0.257 \times \text{N-Se}$ ($R^2=0.740$; $F_{(4,19)}=13.50$; $p<0.0000$; Error of estimate=2.559);

Gl'LsPog' (young women with face profile type 3) = $173.0 + 1.015 \times \text{N-S-Ar} - 0.670 \times \text{N-S-Ba} - 0.488 \times \text{F}$ ($R^2=0.718$; $F_{(3,20)}=16.99$; $p<0.0000$; Error of estimate=3.458);

SnPog'-Pn (young women with face profile type 3) = $49.65 - 0.318 \times \text{H} + 0.103 \times \text{S-ar:ar-Go} - 0.183 \times \text{G} - 0.221 \times \text{N-Se} + 0.135 \times \text{MM}$ ($R^2=0.673$; $F_{(5,18)}=7.423$; $p<0.0006$; Error of estimate=1.641);

Li-SnPog' (young women with face profile type 3) = $16.28 - 0.312 \times \text{N-S-Ar} + 0.245 \times \text{Max} - 0.165 \times \text{MM} + 0.188 \times \text{N-S-Ba} + 0.144 \times \text{B}$ ($R^2=0.604$; $F_{(5,18)}=5.484$; $p<0.0031$; Error of estimate=1.428);

The coefficient of determination in the model of angle II in young women with 3 facial profiles is 0.305 and such a model should not be used in practice.

The need to create reliable models of TRG-indicators in the Ukrainian population, characteristic of people with orthognathic occlusion has led to the emergence of a number of studies in this direction, in which scientists used different methods of cephalometric analysis. The obtained results differed both in the number of constructed models with sufficiently high coefficients of determination, and in the efficiency of the models depending on the sex of the subjects.

Thus, when modeling individual cephalometric parameters used in the E. P. Harvold method in young men, all possible models of TRG indicators of the second group are built, depending on the indicators of the first group (R^2 from 0.616 to 0.940), while in young women such models are built only for the length of the upper jaw ($R^2 = 0.857$) and the length of the lower jaw ($R^2 = 0.792$). From the indicators of the third group for both young men ($R^2 = 0.626$)

and for young women ($R^2 = 0.584$) created reliable models of the angle Ap1uAp1l-DOP depending on the indicators of the first and second groups [6].

When modeling individual cephalometric parameters used in the method of C. J. Burstone in young men and young women with normal occlusion and a harmonious face built 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 [12].

According to the results of the same modeling of TRG indicators using the R. M. Ricketts method, 2 possible models of indicators of the second group (distances Go-CF and Xi-Pm) were created for both young men and young women, 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. Instead, only 5 such models of indicators of the third group were built for young women (distances 6u-PTV, 1l-APog, 1u-APog and Xi-OcP and angle Max1-APog) [5].

At the same time, in such modeling of gnatometric TRG parameters used in the methods of A. M. Schwarz (excluding facial types or profiles), C. H. Tweed, B. B. Downs, J. Mc Namara, P. F. Schmutz, R. A. Holdway, C. C. Steiner, depending on the parameters of basal cranial structures in young women from 43 possible regression models, none of $R^2 > 0.5$ was constructed, and in young men - only 4 models with $R^2 > 0.5$ were constructed [8].

According to the results of our mathematical modeling by stepwise regression analysis of eight TRG-indicators of tooth position and soft tissues of the face according to A. M. Schwarz depending on the indicators of the first group (basic cephalometric TRG-indicators) and the second group jaws according to A. M. Schwarz in young men with orthognathic occlusion and with different facial profiles, a total of 21 of 24 possible reliable regression models with coefficients of determination greater than 0.6 ($R^2 =$ from 0.736 to 0.999) were constructed.

For young men with the second facial profile, the following models were constructed for all 8 indicators studied, and the coefficients of determination in the models of this group of persons ($R^2 =$ from 0.966 to 0.999) were the highest compared to models of groups of young men with other facial profiles and young women with different face profiles.

For young men with the third facial profile, the following models were constructed for 7 indicators out of 8 studied (except for the SnPog'-Pn angle index, in the model of which R^2 is less than 0.6) with coefficients of determination from 0.736 to 0.983.

For young men with the first facial profile, such models were created for 6 indicators out of 8 studied ($R^2 =$ from 0.815 to 0.993) - in addition to the angle II, as well as for young men with the third facial profile and SnPog'-Pn angle,

in whose models R^2 were smaller than 0.6.

In young women with orthognathic occlusion and with different facial profiles, generally less than in young men, reliable regression models with coefficients of determination greater than 0.6 - 18 of the 24 possible ($R^2 =$ from 0.736 to 0.999).

In young women with the second facial profile, as well as in young men with this facial profile, models with coefficients of determination greater than 0.6 for all 8 studied TRG-indicators of tooth position and facial soft tissue indicators according to A. M. Schwarz ($R^2 =$ from 0.736 to 0.982).

For young women with the third facial profile, the following models were built for 7 indicators out of 8 studied (except for the angle II indicator, in the model of which R^2 is less than 0.6) with coefficients of determination R^2 from 0.604 to 0.740.

For young women with the first facial profile, the smallest number of models of the studied indicators of tooth position and soft tissues of the face according to A. M. Schwarz compared to all groups of young men or young women with different facial profiles - only 3 models out of 8 possible for Sn-Pn distance ($R^2 = 0.828$), Pog'-Por distances ($R^2 = 0.844$) and SnPog'-Pn angle ($R^2 = 0.982$).

It should be noted that models for Sn-Pn and Pog'-Por distances have been developed with coefficients of determination greater than 0.6 for both young men and young women of all facial profiles. For Max1-SpP S-arz, Mand1-MP Shwars and Gl'LSpog' angles, these models are designed for young men of all face profiles and for young women of all face profiles, except for young women with the first profile; for the SnPog'-Pn angle - for young women of all face profiles and for young men of all face profiles, except for young men with the third profile; and for Li-SnPog's distance, except for young men with 1 profile and young women with 1 face profile. The smallest number of models with $R^2 > 0.6$ is built for the angle II - for young men with the second and third facial profiles and young women with the second profile.

Interestingly, in our studies on modeling indicators of groups 3 depending on indicators of groups 1 and 2 in young men and young women with different face types, the Pog'-Por distance was also modeled in both young men and young women with all face types, and the angle SnPog'-Pn was modeled in the same way with coefficients greater than 0.6 in all groups except young men with the third type of face. Similarly, the smallest number of models with $R^2 > 0.6$ was constructed with respect to the incisal angle II, which in all models of young men or young women with different face types was modeled with coefficients less than 0.6, and in young women with the third face type model of this indicator was not built at all.

In young men with different facial profiles, the constructed models of teleradiographic indicators, which were included in the third group according to the A. M. Schwarz method, most often include the following TRG indicators of the first and second groups: facial angle F (13.6% of all indicators) - is part of 12 models; Schwarz angle H (determines the angle of inclination of the Frankfurt plane to the base of the skull;

11.4% of all indicators) - is part of 10 models; inclination angle I (7.95% of all indicators) - is part of 7 models; basal angle B and maxillary-mandibular angle MM (6.81% of all indicators) - each includes 6 models.

In young women, the models of teleradiographic indicators of the third group according to the method of A. M. Schwarz most often include the following TRG indicators of the first and second groups: facial angle F (14.5% of all indicators) - is part of 10 models; Schwarz angle H (13.0% of all indicators) - is part of 9 models; profile angle T (11.6% of all indicators) - is part of 8 models and maxillary-mandibular angle MM (10.1% of all indicators) - is part of 7 models.

In general, it should be noted that despite the smaller number of indicators of group 2 (9 indicators), compared to the number of indicators of group 1 (13 indicators), the frequency of entering the models of group 3 is higher for indicators of group 2, both for young men and young women (respectively, 56.8% and 59.4%). The same pattern was found by us in modeling the indicators of group 3 in young men and young women of different face types. Some indicators of group 1 were not included in any of the constructed models: in young men - P-PTV distance according to R. M. Ricketts; in young women, the S-ar distance according to Jarabak J. R., the S-E distance according to C. C. Steiner, the POr-NBa angle according to R. M. Ricketts and the N-S index: S-Ar' according to A. Bjork. It is quite logical to include more in the models of

teleradiographic indicators of the position of the teeth and the profile of the soft tissues of the face than the gnathometric indicators of the upper and lower jaws in comparison with the basic cephalometric TRG indicators.

Conclusions and prospects for further development

1. For young Ukrainian residents with a normal bite that is close to orthognathic, and with different facial profiles according to A. M. Schwarz regression models of teleradiographic indicators of tooth position and facial soft tissue profile depending on basic cephalometric TRG indicators, which are usually not subject to correction in orthodontic, surgical interventions in dentistry (1 group of indicators) and TRG indicators of jaws, which are corrected if necessary (2 group of indicators) were made: for young men - 21 out of 24 possible reliable regression models with coefficients of determination greater than 0.6 (R^2 = from 0.736 to 0.999); for young women - 18 models out of 24 possible (R^2 = from 0.736 to 0.999). Both for young men and young women created models more often include indicators of 2 groups.

The use of the built models in the practice of dentists, cosmetologists, taking into account both sex and facial profile of young patients will provide a more individual approach to determining pathological changes and tactics of correction of teeth and soft tissue profile and the consequences of treatment.

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РЕГРЕСІЙНІ МОДЕЛІ ТЕЛЕРЕНТГЕНОГРАФІЧНИХ ПОКАЗНИКІВ ПОЛОЖЕННЯ ЗУБІВ ТА ПРОФІЛЮ М'ЯКИХ ТКАНИН ОБЛИЧЧЯ В УКРАЇНСЬКИХ ЮНАКІВ І ДІВЧАТ З РІЗНИМИ ПРОФІЛЯМИ ОБЛИЧЧЯ ЗА SCHWARZ A. M.

Прокопенко О. С.

Анотація. Потреби сучасної стоматології вимагають постійного вдосконалення методів дослідження показників зубощелепного апарату людини, параметрів черепно-лицевих структур, визначення вроджених та набутих деформацій зубощелепного апарату та покращення наслідків проведеного лікування. Діагностика ортодонтичної патології базується на визначенні значної кількості різноманітних показників, що вимагає застосування методів математичного аналізу не тільки для обробки отриманих параметрів, але і для математичного моделювання індивідуальних цефалометричних, гнатометричних показників, показників м'яких тканин обличчя, які впливають на його профіль та естетику. Мета роботи - розробка та аналіз регресійних моделей телерентгенографічних показників положення зубів та профілю м'яких тканин обличчя за A. M. Schwarz в українських юнаків і дівчат з ортогнатичним прикусом та з різними профілями обличчя. Проаналізовані бокові телерентгенограми (ТРГ) 49 юнаків віком від 17 до 21 років та 76 дівчат віком від 16 до 20 років з фізіологічним прикусом, максимально наближеним до ортогнатичного. У ліцензійному пакеті "Statistica 6.0" побудовані регресійні моделі показників положення зубів та профілю м'яких тканин обличчя за методикою A. M. Schwarz залежно від базових цефалометричних (1 група) та гнатометричних (2 група) показників окремо для юнаків і для дівчат з різними профілями обличчя за A. M. Schwarz. В юнаків побудовано 21 із 24 можливих достовірних регресійних моделей з коефіцієнтами детермінації більшими, ніж 0,6 (R^2 = від 0,736 до 0,999). Для юнаків з 2 профілем обличчя (straight face profile) побудовані такі моделі усіх 8 показників, які досліджували, причому коефіцієнти детермінації в моделях цієї групи осіб (R^2 = від 0,966 до 0,999) були найвищими, порівняно з моделями інших груп юнаків або дівчат. Для юнаків з 3 профілем обличчя (front face profile) побудовані моделі для 7 показників (крім показника кута SnPog'-Pn) з R^2 від 0,736 до 0,983. Для юнаків з 1 профілем обличчя (back face profile) такі моделі створені для 6 показників (R^2 = від 0,815 до 0,993) - крім показника кута II та кута SnPog'-Pn. У дівчат загалом побудовано 18 моделей із 24 можливих (R^2 = від 0,736 до 0,999). У дівчат з 2 профілем обличчя, так само, як і в юнаків з таким профілем, побудовані моделі для усіх 8 досліджених ТРГ-показників положення зубів та показників м'яких тканин обличчя за A. M. Schwarz (R^2 = від 0,736 до 0,982), а для дівчат з 3 профілем обличчя - для 7 показників (крім кута II) з R^2 від 0,604 до 0,740. Для дівчат з 1 профілем обличчя побудована найменша кількість моделей досліджених показників порівняно з усіма групами юнаків або дівчат з різними профілями обличчя - всього 3 моделі з 8 можливих: для відстані Sn-Pn (R^2 = 0,828), відстані Pog'-Por (R^2 = 0,844) та кута SnPog'-Pn (R^2 = 0,982). Як в юнаків, так і у дівчат до складу створених моделей більш часто входять показники 2 групи.

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