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O.S. Prokopenko, E.V. Beliaiev, R.A. Kravets, L.I. Marynych, S.V. Prokopenko
National Pirogov Memorial Medical University, Vinnytsya

CORRELATIONS OF TELEROENTGENOGRAPHIC PARAMETERS OF THE JAWS WITH BASAL CRANIAL PARAMETERS IN UKRAINIAN JUVENILE MEN AND JUVENILE WOMEN WITH DIFFERENT FACIAL PROFILES ACCORDING TO SCHWARZ

e-mail: prokopenko16.08.1966@gmail.com

Peculiarities of correlations between TRG-indices of the upper and lower jaws, intermaxillary indices that can be corrected during surgical and orthopedic treatment, and TRG-indices of the skull, which usually do not change during such interventions in Ukrainian juvenile men and juvenile women with orthognathic bite with different facial profiles according to Schwarz, were established. In juvenile men with the first face profile (back profile), the revealed reliable connections were mostly direct of medium strength and strong, and in juvenile women, almost the same number of direct and reverse connections of mostly medium strength were established. In juvenile men with the second face profile (straight profile), reliable connections were exclusively strong direct and strong inverse, while in juvenile women direct connections of medium strength prevailed. Both juvenile men and juvenile women with the third face profile (front profile) have mainly direct reliable relationships of medium strength.

Key words: teleradiography, cephalometry, teleradiographic indices, cephalometric analysis according to Schwarz, face profiles, juvenile men and juvenile women, orthognathic occlusion, correlations.

О.С. Прокопенко, Е.В. Беляєв, Р.А. Кравець, Л.І. Маринич, С.В. Прокопенко

КОРЕЛЯЦІЇ ТЕЛЕРЕНТГЕНОГРАФІЧНИХ ПОКАЗНИКІВ ЩЕЛЕП ІЗ БАЗАЛЬНИМИ КРАНІАЛЬНИМИ ПОКАЗНИКАМИ В УКРАЇНСЬКИХ ЮНАКІВ І ДІВЧАТ ІЗ РІЗНИМИ ПРОФІЛЯМИ ОБЛИЧЧЯ ЗА SCHWARZ

Встановлені особливості кореляцій між ТРГ-показниками верхньої і нижньої щелеп, міжщелепними показниками, які можуть корегуватися під час хірургічного, ортопедичного лікування та ТРГ-показниками черепа, які зазвичай не змінюються під час таких втручань в українських юнаків і дівчат з ортогнатичним прикусом з різними профілями обличчя за Schwarz. В юнаків з першим профілем обличчя (задній профіль) виявлені достовірні зв'язки були переважно прямими середньої сили та сильними, а у дівчат встановлена майже однакова кількість прямих та зворотних зв'язків переважно середньої сили. В юнаків з другим профілем обличчя (прямий профіль) достовірні зв'язки були виключно сильними прямими та сильними зворотними, а у дівчат переважали прямі зв'язки середньої сили. Як у юнаків, так і в дівчат з третім профілем обличчя (передній профіль) встановлені переважно прямі достовірні зв'язки середньої сили.

Ключові слова: телерентгенографія, кефалометрія, телерентгенографічні показники, цефалометричний аналіз за Schwarz, профілі обличчя, юнаки та дівчата, ортогнатичний прикус, кореляції.

The study is a fragment of the research project "Optimizing diagnosis, orthopedic treatment and prevention of pathology of the dental-jaw system", state registration No. 0119U103951.

In modern dental practice, one of the main and most informative methods of research is the teleroentgenographic method, which provides the possibility of intravital determination of the structure of various parts of the skull, features of the location of the jaws, assessment of the symmetry of the maxillofacial structures, establishment of congenital or acquired pathological changes of the dento-jaw apparatus, etc., which is extremely important in planning and evaluating the efficacy of dental treatment [6, 7].

Researchers and practicing doctors use numerous original methods of cephalometric analysis, which were developed mainly in the last century, and normative cephalometric, gnathometric indicators, which are

recommended by the authors of the methods, were obtained during the study of the population of different countries. At the same time, further studies have established the peculiarities of teleroentgenographic (TRG) indices in representatives of different races, sexes, ethnic groups, populations, residents of different countries and geographical areas, which often differ from the values obtained by the authors of the methods [5, 8].

All this determined the relevance of the further development and improvement of both the methods of cephalometric analysis themselves and the objective interpretation of the obtained results with the establishment of both the peculiarities of cephalometric parameters and their correlations in different population groups, which fully applies to the residents of Ukraine [1, 3, 4, 9, 13].

The purpose of the study was to establish the relationship between teleradiographic parameters of the jaws according to the Schwarz A. M. method and basal cranial parameters in young residents of Ukraine with an orthognathic bite with different facial profiles according to Schwarz.

Materials and methods. Lateral teleroentgenograms of 49 young men (YM) aged 17 to 21 years and 76 young women (YW) aged 16 to 20 years with a physiological occlusion as close as possible to orthognathic (hereinafter referred to as orthognathic occlusion) were studied using a Veraviewepocs 3D Morita (Japan) dental cone-beam tomograph. Part of TRG-indices was obtained from the data bank of lateral teleroentgenograms of the research center of the National Pirogov Memorial Medical University, Vinnytsya.

The Biomedical Ethics Committee of the National Pirogov Memorial Medical University, Vinnytsya (protocol № 8 of September 30, 2021) found that the conducted research meets the bioethical and moral-legal requirements of the Helsinki Declaration, the Council of Europe Convention on Human Rights and Biomedicine (1977), the relevant provisions WHO and laws of Ukraine.

Both YM and YW were divided into 3 groups of people with different face profiles according to Schwarz A. M. [12]: 1 face profile (back face profile, lower jaw tilted back, profile angle T 12° and more) – 23 YM and 37 YW; 2 face profile (straight face profile, lower jaw straight, profile angle T 8-12°) – 9 YM and 15 YW; 3 face profile (front face profile, lower jaw slanted forward, profile angle T up to 8°) – 17 YM and 24 YW.

The analysis of TRG indices was performed using the licensed medical software OnyxCeph³™, version 3DPro (Image Instruments GmbH, Germany; software license № URSQ-1799). Measurements were carried out according to the recommendations of Schwarz A. M. [12]. Cephalometric points were determined according to the recommendations of Phulari B. S. [10].

The studied TRG indices were divided into 2 groups according to the recommendations of Dmitriev M. O. [1]. The first group includes craniometric indices, which usually do not change during surgical and orthodontic treatment, but are used as basic indices in cephalometric analysis methods. Relative to these indices, lateral teleroentgenograms determine the inclination, anterior-posterior or vertical position of the gnathic structures [11].

The second group included TRG indices of the maxillofacial apparatus according to Schwarz A. M., the determination of which is most often used during orthodontic, surgical, cosmetic interventions in patients who are in the process of growth, or in patients with a formed bone skeleton who can be helped by orthodontic surgery change the length, width, angles and location of the jaws: distance Max – length of the upper jaw (mm); distance Length of Mand. – length of the lower jaw (mm); distance R.asc. – length of the branch of the lower jaw (mm); angle F – face angle (°); angle I – inclination angle (°); angle G – gonial angle (°), angle B – basal angle (°); angle MM – maxillary-mandibular angle (°); angle T – profile angle T (°).

Correlations between TRG indices of the second and first groups were determined using the statistical method of Spearman in the licensed statistical package “Statistica 6.0”.

Results of the study and their discussion. When analyzing the multiple correlations of the second group of TRG indicators with the indicators of the first group in YM with the first face profile according to Schwarz, reliable relationships were established: strong straight lines – Max distances with the value of the N-Se (r=0.64), N-S (r=0.66) distances and distances R.asc. with the value of the ar-Go distance (r=0.72); strong inverses – of the angle G with the value of the distance ar-Go (r=-0.61) and the distance R.asc. with the S-ar:ar-Go index (r=-0.64); of average strength straight – angle G with the value of the angle POr-NBa (r=0.49), distance Length of Mand. with the value of the distances N-Se (r=0.57), N-S (r=0.44), ar-Go (r=0.47); Max distances with the value of the angles N-S-Ar (r=0.59), N-S-Ba (r=0.45) and the value of the distances S-E (r=0.57), N-CC (r=0.52); distance R.asc. with the value of the angle N-S-Ar (r=0.43), the angle MM with the value of the distances S-ar (r=0.50), S-E (r=0.45); angle I with the distance S-ar (r=0.50), S-E (r=0.51); angle T with the indicator S-ar:ar-Go (r=0.42); of the medium force are the inverses of angles B with the distance ar-Go (r=-0.54), G with the distance N-Se (r=-0.48), I with the index

N-S:S-Ar' (r=-0.57) and the distance Max with by the N-S:S-Ar' index (r=-0.43). It should be noted in YM with the first face profile according to Schwarz, the presence of numerous medium strength unreliable direct (r= from 0.30 to 0.39) and inverse (r= from -0.31 to -0.39) correlations between TRG indices of the second and first groups.

In YW with the first face profile according to Schwarz, reliable relationships are established between the same groups of indices: strong straight – R.asc distances with the value of the distances ar-Go (r=0.69) and S-ar (r=0.62); straight of medium strength – distances Length of Mand. with the value of the N-Se (r=0.39), N-S (r=0.42), S-E (r=0.39) and N-CC (r=0.56) distances; Max distances with the value of the N-Se (r=0.41), N-S (r=0.37) and N-CC (r=0.34) distances; distance R.asc. with the value of the N-Se (r=0.38) and S-E (r=0.42) distances and the value of the POr-NBa angle (r=0.49); MM angle with S-ar:ar-Go index (r=0.33); inverse of the average force – angles B and G with the value of the distance ar-Go (respectively, r=-0.50 and r=-0.44), distances Max and R.asc. with the value of the P-PTV distance (r=-0.37 in both cases); angles MM and I with the value of angles H (respectively, r=-0.58 and r=-0.56), N-S-Ar (respectively, r=-0.52 and r=-0.47) and N-S-Ba (respectively, r=-0.41 and r=-0.37). Also, in YW with the first face profile according to Schwarz, a few medium strengths unreliable direct (r= from 0.30 to 0.32) correlations between TRG indices of the second and first groups were recorded.

No reliable relationship with basal cephalometric parameters was established for F angle indices in both YM and YW and T angle in YW.

Our quantitative analysis of reliable correlations in Ukrainian YM and YW with an orthognathic bite with the first face profile according to Schwarz between TRG indices of the second and first groups revealed the following distribution of correlations: in YM – a total of 23 correlations out of 117 possible (19.7 %), of which strong direct 2.6 %, medium strength direct 12.0 %, strong reverse 1.7 %, medium strength reverse 3.4 %; in YW – a total of 23 out of 117 possible (19.7 %) of which 1.7 % are strong direct, 9.4 % medium direct power, 8.6 % medium reverse power.

Thus, the YM with the first Schwarz face profile has mostly medium-strength and strong forward correlations, and the YW with the first Schwarz face profile has almost equal numbers of mostly medium-strength forward and reverse correlations. In YM with the first face profile, among the TRG-indices of the second group, the largest number of reliable correlations with the TRG-indices of the first group was recorded with respect to the Max distance (7 correlations – 2 direct strong, 4 direct of medium strength and 1 reverse of medium strength), and in YW with the first profile of the face – distances R.asc. (7 correlations – 2 direct strong, 3 direct medium strength and 1 reverse medium strength).

When analyzing the multiple correlations of the TRG indices of the second group with the indices of the first group in YM with the second face profile according to Schwarz, the following reliable relationships were established: strong straight– Length of Mand distances with the value of the angle N-S-Ar (r=0.97) and the distance S-E (r=0.97), the distances Max and R.asc. with the value of the ar-Go distance (r=0.73 and r=0.88, respectively) and the G angle with the S-ar:ar-Go index (r=0.69); strong inverses – of the angle G with the value of the distance ar-Go (r=-0.76), the distance Length of Mand. with the N-S:S-Ar' index (r=-0.97) and with the value of the P-PTV distance (r=-0.87) and the R.asc distance with the S-ar:ar-Go index (r=-0.79). It should be noted in YM with the second face profile according to Schwarz, the presence of isolated strong and numerous medium-strength unreliable direct (r= from 0.31 to 0.62) and inverse (r= from -0.30 to -0.63) correlations between TRG indices of the second and first groups.

In YW with the second face profile according to Schwarz, the following reliable relationships are established between the TRG indices of the second group and the first group: strong straight– Max distances with the value of the N-Se (r=0.64), N-S (r=0.66) and R.asc distances with the value of the ar-Go distance (r=0.72); strong inverses of the angle G with the value of the distance ar-Go (r= -0.61) and the distance R.asc. with the S-ar:ar-Go index (r=-0.64); of medium strength straight – angle G with the value of the angle POr-NBa (r=0.49), distance Length of Mand. with the value of the distances N-Se (r=0.57), N-S (r=0.44), ar-Go (r=0.47); Max distances with the value of the angles N-S-Ar (r=0.59), N-S-Ba (r=0.45) and the value of the distances S-E (r=0.57), N-CC (r=0.52); distance R.asc. with the value of the angle N-S-Ar (r=0.43), the angle MM with the value of the distances S-ar (r=0.50), S-E (r=0.45); angle I with the distance S-ar (r=0.50), S-E (r=0.51); angle T with the index S-ar:ar-Go (r=0.42); of the average force are the inverses of angles B with the distance ar-Go (r=-0.54), G with the distance N-Se (r=-0.48), I with the index N-S:S-Ar' (r=-0.57) and the distance Max with by the N-S:S-Ar' index (r=-0.43). Also, in YW with the second face profile according to Schwarz, numerous unreliable direct (r= from 0.52 to 0.59) and inverse (r= from -0.30 to -0.48) correlations between TRG indices of the second and first groups were noted.

For the indices of angles B, MM, F, I, T in YM with the second facial profile and Max distance in YW with the second facial profile, no reliable relationships were established with the basal cephalometric indices of the first group.

Based on the results of a quantitative analysis of reliable correlations in Ukrainian YM and YW with an orthognathic bite with the second face profile according to Schwarz, the following distribution of correlations between TRG indices of the second and first groups was established: in YM – a total of 9 connections out of 117 possible (7.7 %), of which strong direct 4.3 % and strong reverse 3.4 %; in YW – a total of 14 out of 117 possible (12.0 %) of which strong straights 1.7 %, medium strength straights 5.1 %, strong reverses 2.6 %, medium strength reverses 2.6 %.

Thus, in YM with the second face profile according to Schwarz, strong direct relationships and strong inverse relationships between TRG indices of the second and first groups were established, and in YW with the second face profile according to Schwarz, direct relationships of medium strength prevailed. Both in YM and in YW with the second face profile, in all cases of reliable connections, individual indices had 1-2 strong or moderate direct or inverse correlations with the indices of the first group.

When analyzing the multiple correlations of TRG indices of the second group with the indices of the first group in YM with the third face profile according to Schwarz, reliable correlations were established: strong straight– Length of Mand distances with the value of the N-CC distance (r=0.65) and the distance R.asc. with the value of the distance ar-Go (r=0.73) and the value of the angle H (r=0.63); strong inverses – distances Length of Mand., Max and R.asc. with the value of the P-PTV distance (respectively, r=-0.64, r=-0.71 and r=-0.62); straight of medium strength – angle B with angle H (r=0.56); distances Length of Mand., Max and R.asc. with the value of the distance S-E (respectively, r=0.52, r=0.57 and r=0.56), the distance Max with the value of the distance N-S (r=0.55), the distance R.asc. with the value of the POr-NBa angle (r=0.56) and the MM angle with the value of the N-S-Ba angle (r= 0.57). Also, in YM with the third face profile according to Schwarz, numerous unreliable direct (r= from 0.30 to 0.46) and inverse (r= from -0.30 to -0.47) correlations between TRG indices of the second and first groups were noted.

In YW with the third face profile according to Schwarz, reliable relationships are established between these groups of indices: strong straight– Max distances with the value of the N-S distance and the R.asc distance with the POr-NBa angle (r=0.63 in both cases); strong inverses – of the F angle with the value of the H angles (r=-0.65), N-S-Ar (r=-0.70) and N-S-Ba (r=-0.66); straight of average strength – distances Length of Mand. with the value of the distances N-Se (r=0.55), N-S (r=0.50), S-ar (r=0.50), N-CC (r=0.42); distance R.asc. with the value of the angles H (r=0.50), N-S-Ar (r=0.47) and the value of the distances S-E (r=0.52), ar-Go (r=0.53); distance Max with the value of the distance N-Se (r=0.55), angle MM with the value of the distance N-S (r=0.41) and angle F with the value of the index N-S:S-Ar' (r=0.58); inverse of the medium force – angles B with the distance S-ar (r=-0.41), G with the distance N-Se (r=-0.42), MM with the distance P-PTV (r=-0.42), F with the distance S-E (r=-0.57) and N-CC (r=-0.52), angle I with angle H (r=-0.50). In addition, in YW with the third face profile according to Schwarz, a few medium-strength unreliable direct (r= from 0.30 to 0.39) and inverse (r= from -0.30 to -0.39) correlations were established between TRG indices of the second and first groups.

For the indices of angles G, F, I and T in young men with the third facial profile and angle T in YW with the third facial profile, no reliable relationships were established with the basal cephalometric indices of the first group.

According to the results of a quantitative analysis of reliable correlations in Ukrainian YM and YW with an orthognathic bite with the third face profile according to Schwarz, the following distribution of connections between TRG indices of the second and first groups was revealed: in YM – a total of 13 correlations out of 117 possible (11.1 %), of which strong direct 2.6 %, medium strong direct 6.0 %, strong reverse 2.6 %; in YW – a total of 22 out of 117 possible (18.8 %) of which strong straights 1.7 %, medium strength straights 9.4 %, strong reverses 2.6 %, medium strength reverses 5.1 %.

Thus, both in YM and in YW with the third face profile according to Schwarz, between the TRG-indicators of the second and third groups, mostly direct reliable relationships of medium strength were established. Both in YM and in YW, according to the third face profile according to Schwarz, TRG indicators of the second group, which were reliably correlated with the indices of the first group, had 1-2 reliable correlations each.

It should be noted that Ukrainian researchers have already carried out a number of studies on the establishment of relationships between cephalometric TRG-indices, determined with the help of various author's methods of cephalometric analysis in certain groups of residents of Ukraine. Thus, in the works of

Dmitriev O. M. [1], Moroz V. M. with co-authors [3] in YM and YW, residents of Ukraine with an orthognathic bite using the Steiner C. C. cephalometric technique, the relationships of the main cranial indices were established (group 1 TRG-indices) with the parameters of the upper and lower jaws (2nd group of TRG-indices) and the relationship between the indices of the location of the teeth of the upper and lower jaws and the indicators of the profile of the soft tissues of the face (3rd group of TRG-indicators) and their specific features in individuals different sex.

Vakhovskyi V. V. and others. [13, 14] established the qualitative and quantitative features of the relationship between TRG indices of the basal cranial structures (1 group of indicators), indices of the upper and lower jaws, intermaxillary indices (2 group of indices), and indices of the position of the teeth and the profile of the soft tissues of the face (3 group of indices) determined according to the method of Bjork A., Jarabak J. R and Sassouni V. in Ukrainian YM and YW with an orthognathic bite, and determined the manifestations of sexual dimorphism according to these connections in terms of their number, strength and direction.

The authors established [13] a greater number of reliable correlations of TRG-indices of the second group with TRG-indicators of the first group according to the Bjork method in YW (50.0 % of all possible correlations) than in YM (23.3 % of all possible correlations). In YM, the established reliable relationships were predominantly inverse of medium strength, and in YW there were almost equal numbers of average strength of direct and inverse relationships. According to the Jarabak method, the number of reliable correlations in YM and YW practically did not differ (48.4 % in YM and 41.1 % in YW). Moreover, in YM there was a significant predominance of direct correlations of medium strength (21.1 %), and in YW most of the correlations were of medium strength direct (17.9 %) and reverse (13.7 %). Between the indices of the first and third groups according to Bjork, a greater number of correlations was established in YM (12.8 %) than in YW (7.7 %). Both in YM and in YW, straight correlations of medium strength prevailed (respectively, 10.3 % and 5.1 %). According to Jarabak, a larger number of correlations was also determined in YM (22.5 %) than in YW (12.5 %), and in YM, direct average strength and inverse medium strength relationships prevailed (10.0 percent each), and in YW – inverse relationships of weak strength (10.0 %) [13].

When conducting a correlation analysis between TRG-indices of the second and third groups according to the cephalometric analysis methods of Bjork A., Jarabak J. R and Sassouni V. [14] it was established that: according to the Bjork method in YM – 46.9 % of reliable correlations out of all possible ones, and in YW – 38.5 %, and both in YM and in YW, straight lines of medium bond strength prevailed (respectively, 18.5 % and 15.4 %). According to the Jarabak method, 36.2 % of all possible reliable correlations were established in YM, and 44.7 % in YW were also mainly direct of medium strength (respectively, 11.8 % and 15.1 %). According to the Sassouni method, 42.8 % of reliable correlations between the indices of these groups were found in both YM and YW, and in YM all connections were direct of medium strength, and in YW – 35.7 % direct of medium strength and 7.1 % direct weak.

In the works of Marchenko A. V. [2, 9], the need to take into account the features of the craniotype when determining the metric indices of the tooth-jaw apparatus in YM and YW was proven, and the features of the correlations between the linear dimensions necessary for the construction of the correct form of the dental arch and the odontometric and cephalometric indices in YM were determined and YW with an orthognathic bite with different skull types – mesocephalic and brachycephalic.

Thus, both according to the results of the authors' previous research and our results regarding the correlations between craniometric and gnathometric indices in Ukrainian YM and YW with an orthognathic bite, significant differences in the number, strength, and direction of reliable relationships between YM and YW have been proven and the need to take into account features of the face type or craniotype of persons during such studies for the purpose of obtaining objective data.

Conclusions

1. In YM with the first face profile according to Schwarz, between TRG indices of the upper and lower jaws and basal craniometric indices, mostly direct correlations of medium strength and strong are established, and in YW with the first face profile according to Schwarz, an almost equal number of direct and inverse correlations are established mostly of medium strength.

2. In YM with the second facial profile according to Schwarz, strong direct relationships and strong inverse relationships were established between TRG-indices of the upper and lower jaws and basal

craniometric indicators, and in YW with the second facial profile according to Schwarz, direct relationships of the medium strength prevailed.

3. Both in YM and in YW with the third face profile according to Schwarz, between TRG indicators of the upper and lower jaws and basal craniometric indices, mostly direct reliable relationships of medium strength were established.

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