Features of teleroentgenographic parameters of the upper and lower jaws in Ukrainian young men and young women with orthognathic occlusion and with different types and profiles of the face according to Schwarz A. M.

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Numerous studies have shown that teleroentgenographic indicators differ in people of different races, ethnicities, different populations, inhabitants of different geographical areas and often differ from the values of such indicators described by the authors of classical methods of cephalometric analysis. The aim of the study was to establish teleroentgenographic parameters that can be most often corrected during orthodontic and surgical interventions and to determine their features in Ukrainian young men and young women with orthognathic occlusion depending on profiles and facial types according to Schwarz A. M. The results of studies of lateral teleroentgenogram of the head 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 using dental cone-beam tomography Veraviewepocs 3D Morita (Japan) are presented in this work. The morphometric teleroentgenographic parameters of the upper and lower jaws and inter-jaw parameters, which can most often change during surgical, orthodontic, cosmetic interventions in groups of persons with different profiles or types of faces according to Schwarz A. M., were determined. All significant differences between groups of young men with different facial profiles and between groups of young women with different facial profiles are of the same type: in both young men and young women with the first type of face profile - angle B is greater than in representatives with the third profile type, and angle MM is greater than in representatives with the third and second profile types; both in young men and young women with a second face type profile - distance R.asc. larger than the representatives with the first profile type; in both young men and young women with the third face profile type, the angle F is larger than in the representatives with the first profile type, the angle I is larger than in the representatives with the first and second profiles type, and the distances L-Mand and R.asc. larger than the representatives with the first profile type; the angle T have greater values in young men or young women with the first profile type of the face than with the second and third profiles type and have greater values in the representatives with the second profile type than with the first type profile of the face. Another picture is observed in the analysis of indicators in young men and young women with different face types. Thus, in persons with the third type of face the distance Max is greater than in persons with the first type and with the second type of face; the angle F in young men or young women with the third type of face is greater than in represents with the second and first types, and in representatives with the second type - greater than in young men or young women with the first type of face. Young men with the first type of face have higher values of angles G, B and T than young men with the third type and angle B than young men with the second type of face; in young men with the second type of face - greater values of angle I than in young men with the first type and angle B than in young men with the third type of face; young men with the third type of face have larger values of angle I and distance R.asc. than young men with the first type of face. In young women, only tendencies to
higher values of I and T angles were recorded in persons with the third type of face than with the first type. The obtained results indicate the need to divide young men and young women into separate groups according to the profile and type of person for an individualized approach to the definition and analysis of teleroentgenographic indicators in the population of Ukraine.

**Keywords:** young men, young women, orthognathic occlusion, lateral head teleroentgenography, cephalometric parameters, types and profiles of the face according to Schwarz A. M.

**Introduction**

X-ray cephalometric analysis using lateral teleroentgenography plays a leading role in understanding the anatomy of the human dental system, establishing its individual anatomical features [27] and is one of the most informative methods of diagnosing and clarifying congenital or acquired pathological anomalies of the dental system, determining the various clinical forms of such anomalies [20].

Numerous author's methods of cephalometric radiological researches and the analysis of the received radiographs offered in the last century remain actual, both for practical use, and for scientific researches. However, further research has shown that teleroentgenographic indicators have their own characteristics, differences in people of different races [1, 12, 16, 19, 24], ethnic groups [18, 23, 30], different populations [11, 21], residents of different geographical areas [22, 25], different countries [10, 15, 17] and often differ from the values of such indicators described by the authors of the methods.

This necessitates the determination of teleroentgenographic indicators typical for the inhabitants of Ukraine. In recent years, research has been conducted in this direction and cephalometric parameters for Ukrainian adolescents have been determined and analyzed by the methods of Steiner C. C. [3], Schmuth G. [4], McNamara J. J., Downs [5], Tweed [13]. According to the research of Chernysh A. V. et al., Dmitriev M. O. et al., not only cephalometric parameters in Ukrainian young men and young women were determined by the methods of Ricketts R. M., Harvold E. P. and Burstone C. J., but also differences in these indicators compared to the author's methods of cephalometric analysis [2, 6, 7].

All this became the basis for us to choose the direction of research and determine a specific method of cephalometric research to provide an even more informative method of diagnosing and clarifying congenital or acquired pathological anomalies of the dental system, establishing its anatomy of the human dental system, assigning and defining the anterior point of the palate and the posterior point of the palate, according to Schwarz A. M. [28, 29].

Cephalometric points were determined for the head according to the recommendations of Phulari B. S. [26] and Doroshenko S. I. and Kulginsky E. A. [9].

Cephalometric points were determined for measurements: A (subspinale) - the most posterior point of the occipital bone with the posterior surface of the neck of the mandible; ANS (spina nazalis anterior) - the top of the anterior nasal bone; forms the anterior point of the palatal plane (SpP); apMax - projection of point A on the line ANS-PNS (palatal plane SpP); PNS (spina nazalis posterior) - posterior nasal spine (posterior point of the palatal plane SpP); Pn (nasal perpendicular) - perpendicular line from the point N’ (skin nasion) to the line Se-N; Pog (pogonion) - the most anterior point of the chin protrusion, also determined by the tangent dropped from point N; Go (gonion) - the posterior point on the lower contour of the body of the lower jaw; MT2 - point of contact of the tangent line (MT2 according to Schwarz) to the branch of the mandible ramus.

**Materials and methods**

Lateral teleroentgenograms of the head were obtained in 49 young men aged 17 to 21 years and 76 young women aged 16 to 20 years with a physiological occlusion as close as possible to orthognathic (hereinafter orthognathic occlusion) using a dental cone-beam tomograph Veraviewepocs 3D Morita (Japan). Part of the primary teleroentgenographic indicators was obtained from the database of lateral teleroentgenograms of the research center of National Pirogov Memorial Medical University, Vinnytsya. Young men and young women were divided into separate groups with different profiles and different types of faces according to the recommendations of Schwarz A. M. [29] (Table 1).

The analysis of teleroentgenographic parameters was performed using licensed medical software for the diagnosis and treatment of dental patients. Measurements were performed according to the recommendations of Schwarz A. M. [28, 29]. Cephalometric points were determined according to the recommendations of Phulari B. S. [26] and Doroshenko S. I. and Kulginsky E. A. [9].

Cephalometric points were determined for measurements: A (subspinale) - the most posterior point of the anterior contour of the upper jaw; Ar (articulare) - the intersection of the anterior surface of the main part of the mandible; ANS (spina nazalis anterior) - the top of the anterior nasal bone; forms the anterior point of the palatal plane (SpP); apMax - projection of point A on the line ANS-PNS (palatal plane SpP); PNS (spina nazalis posterior) - posterior nasal spine (posterior point of the palatal plane SpP); Pn (nasal perpendicular) - perpendicular line from the point N’ (skin nasion) to the line Se-N; Pog (pogonion) - the most anterior point of the chin protrusion, also determined by the tangent dropped from point N; Go (gonion) - the posterior point on the lower contour of the body of the lower jaw; MT2 - point of contact of the tangent line (MT2 according to Schwarz) to the branch of the mandible ramus.

**Table 1. Quantitative distribution of young men and young women with different profiles and face types.**

<table>
<thead>
<tr>
<th>Research groups</th>
<th>By Schwarz A. M.</th>
<th>Young women</th>
<th>Young men</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 face profile</td>
<td>back face profile</td>
<td>37</td>
<td>23</td>
</tr>
<tr>
<td>2 face profile</td>
<td>straight face profile</td>
<td>15</td>
<td>9</td>
</tr>
<tr>
<td>3 face profile</td>
<td>front face profile</td>
<td>24</td>
<td>17</td>
</tr>
<tr>
<td>1 face type</td>
<td>back face type</td>
<td>23</td>
<td>13</td>
</tr>
<tr>
<td>2 face type</td>
<td>average face type</td>
<td>24</td>
<td>18</td>
</tr>
<tr>
<td>3 face type</td>
<td>front face type</td>
<td>29</td>
<td>18</td>
</tr>
</tbody>
</table>
from the point ppCond; N (nasion) - the most anterior point of the fronto-nasal suture (connection of the frontal bone and nasal bone in the mid-sagittal plane); tGoS (gonion according to Schwarz) - projection point of the angle of the mandible, which is formed at the intersection of the lines ppCond-MT2 and T2-Me, indicating the angle between the upper and lower jaws, formed by the lines ANS-PNS (palatal plane SpP) and Im-Me (mandibular plane MPS according to Schwarz); angle MM - maxillary-mandibular angle, determines the angle at which the upper jaw is located relative to the lower jaw in the sagittal plane, formed by lines A-B and ANS-PNS, angle T - profile angle T, formed by lines Sn-Pog' and Pn (nose perpendicular).

Statistical processing of the study results was performed in the license package "Statistica 6.0" using non-parametric methods of evaluation of the results. The reliability of the difference between the values of the independent quantitative values was determined using the U-test of Mann-Whitney.

Results

The limits of the percentile range of the distance Max for groups of young men and young women with different profiles and with different types of faces are established: young men - the first profile (47-50) mm, the second profile (47-50) mm, the third profile (48-53) mm; the first type (46-50) mm, the second type (46-50) mm, the third type (48-53) mm; young women - the first profile (44-47) mm, the second profile (44.5-48) mm, the first type (44-46) mm, the second type (44-46) mm, the third type (46-48) mm.

When comparing the distance Max between young men of different facial profiles or between young women of different facial profiles, no significant differences or tendencies to differences were found. On the other hand, both young men with the third type of face and young women with the third type of face have significantly higher values of this indicator, compared with young men or young women with the first type of face and compared with young men or young women with the second type of face (Table 2).

The limits of the percentile range of the values of the angle F in the groups of young men: the first profile (83-86)°, the second profile (84-88)°, the third profile (86-90)°; first type (81-83)°, second type (84-86)°, third type (88-90)° and in groups of young women: first profile (82-87)°, second profile (83-88)°, third profile (84-90)°; the first type (79-83)°, the second type (84-85)°, the third type (87-90)° face.

The values of the angle F in both young men and young women with the third facial profile are significantly higher than in the groups of young men or young women with the first facial profile. The angle F in both young men and young women with the third type of face is significantly greater than in members of the opposite sex with the first type and the second type of face, and in young men or young women...
with the second type of face - significantly greater than in young men, or in young women with the first type (see Table 2).

The limits of the percentile range of the values of angle I in the groups of young men: the first profile (83-86)°, the second profile (83-85)°, the third profile (85-89)°; the first type of face (83-85)°, second type (84-88)°, third type (85-89)° and in groups of young women: first profile (83-86)°, second profile (81-83)°, third profile (84-86)°; the first type (75-80)°, second type (70-75)°, the third type (65-70)° of the face.

Table 2. Teleroentgenographic morphometric parameters of the maxilla Max, F and I in young men and young women with different profiles or with different face types.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Young men (Max) (M±s)</th>
<th>p</th>
<th>Young women (Max) (M±s)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profile 1</td>
<td>48.00±2.71</td>
<td>&gt;0.05</td>
<td>45.73±4.27</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Profile 2</td>
<td>49.11±2.67</td>
<td>&gt;0.05</td>
<td>46.20±2.27</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Profile 3</td>
<td>52.12±10.53</td>
<td>&gt;0.05</td>
<td>46.29±4.07</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Type 1</td>
<td>47.38±2.53</td>
<td>&gt;0.05</td>
<td>44.61±2.37</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Type 2</td>
<td>49.94±10.31</td>
<td>&lt;0.01</td>
<td>45.75±5.08</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Type 3</td>
<td>50.94±3.26</td>
<td>&lt;0.05</td>
<td>47.31±3.30</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

Note: here and in the following tables, p1-2, p1-3, p2-3 - the significance of differences in the relevant indicators between young men or young women with different profiles or face types.

The limits of the percentile range of the values of angle I in the groups of young women with the second type of face (83-86)°, the third type of face (85-89)°, and in groups of young women: first profile (83-86)°, second profile (84-88)°, the third type (85-89)°; the first type (82-87)°, the second type (85-89)°, the third type (85-89)° face.

Distance R.asc. both in young men and young women with different profiles or with different face types.

Table 3. Teleroentgenographic morphometric parameters of the mandible L-Mand, R.asc. and G indicators in young men and young women with different profiles, or with different face types.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Young men (L-Mand) (M±s)</th>
<th>p</th>
<th>Young women (L-Mand) (M±s)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profile 1</td>
<td>84.52±2.11</td>
<td>&gt;0.05</td>
<td>84.86±3.81</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Profile 2</td>
<td>86.11±3.55</td>
<td>&lt;0.01</td>
<td>85.53±3.18</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Profile 3</td>
<td>87.59±3.37</td>
<td>&gt;0.05</td>
<td>86.88±4.61</td>
<td>&gt;0.001</td>
</tr>
<tr>
<td>Type 1</td>
<td>81.77±1.42</td>
<td>&lt;0.001</td>
<td>81.17±1.99</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Type 2</td>
<td>85.11±0.90</td>
<td>&lt;0.001</td>
<td>84.88±0.74</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Type 3</td>
<td>89.50±1.89</td>
<td>&lt;0.001</td>
<td>89.17±2.69</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Distance L-Mand in groups of young men: the first profile (73-78) mm, the second profile (76-84) mm, the third profile (78-86) mm; first type (74-81) mm, second type (72-83) mm, third type (78-83) mm and in groups of young women: first profile (69-74) mm, second profile (71-75) mm, third profile (71-78.5) mm; the first type (72-75) mm, the second type (70-75) mm, the third type (69-76) mm of the face.

The limits of the percentile range of the values of the distance L-Mand in groups of young men: the first profile (60-66) mm, the second profile (66-69) mm, the third profile (65-72) mm; first type (58-66) mm, second type (62-69) mm, third type (65-72) mm and in groups of young women: first profile (55-61) mm, second profile (56-65) mm, third profile (58-63.5) mm; the first type (55-64) mm, the second type (56-61.5) mm, the third type (57-62) mm of the face.
with the third facial profile are significantly larger than in the sex-appropriate groups of individuals with the second or third facial profile. Significant differences in this indicator both between groups of young men and between groups of young women with different face types were not found (see Table 4).

Limits of percentile range of values of angle T in groups: young men - the first profile (13-19)°, the second profile (10-11)°, the third profile (4-7)°; first type (10-18)°, second type (7-17)°, third type (5-12)° and in groups of young women - first profile (12-16)°, second profile (9-11)°, third profile (3-6.5)°; the first type (9-15)°, the second type (5.5-13)°, the third type (6-14)° of face.

The angle T in both young men and young women with the first facial profile is significantly greater than in members of the opposite sex with the second and third facial profiles, and in young men or young women with the second facial profile - significantly greater than in young men or young women with the third facial profile. In young men with the first type of face, there is a greater value of the angle T in young men with the second type of face than in young men with the third type, as well as in young women with the first type of face than in young women with the third type (see Table 4).

Discussion

One of the most popular in Ukraine is the method of cephalometry by Schwarz A. M. [29], who tried to get rid of certain shortcomings of other methods. Thus, Schwarz A. M. proposed for analysis certain anatomical structures of the head, located on the sagittal plane, or close to it, to obtain more stable indicators and level the influence of asymmetries between the right and left halves and layers
of images of structures on X-ray. He proposed the use for the construction of the corresponding basal plane, in relation to which the main analysis is performed, namely the points of the center of entry into the sella turcica and so on. M. O. Dmitriev et al. [8] determined craniometric and gnathometric parameters according to the method of Schwarz A. M. for Ukrainian young men and young women, established differences in these indicators between different sex groups and proved the existence of differences in a number of indicators compared with data from studies of Schwarz A. M.

We determined the percentile scales (25-75 percentile) of teleroentgenographic indicators of the upper and lower jaws and inter-jaw indicators in Ukrainian young men and young women with orthognathic occlusion with different types and profiles of the face according to Schwarz A. M.

Differences of the investigated indicators depending on profiles and types of the person are defined. It should be noted that all significant differences between groups of young men with different facial profiles and between groups of young women with different facial profiles are the same.

Both in young men and young women with the first facial profile: angle B is significantly larger than in young men or young women with the third facial profile (respectively, by 30.1 %, p<0.01 and by 10.4 %, p=0.05); MM angle is significantly higher than in young men or young women with the third profile (respectively, by 5.8 %, p<0.001 and by 4.4 %, p<0.001) and with the second profile (respectively, by 4.9 %, p=0.05 and by 3.2 %, p<0.01) of face.

Both in young men and young women with a second facial profile: distance R.asc. significantly higher than in young men or young women with the first profile (by 6.1 % and 3.5 %, respectively, p<0.05 in both cases).

Both in young men and young women with the third facial profile: the angle F is significantly larger than in the groups of young men or young women with the first facial profile (respectively, by 3.7 %, p<0.01 and 3.0 %, p=0.05); angle I is significantly higher than in young men or young women with the first profile (respectively, by 3.7 % and 4.7 %, p<0.001 in both cases) and than among young men or young women with the second profile (respectively, by 3.3 %, p<0.05 and 3.7 %, p<0.001); the distance of L-Mand is significantly greater than that of young men or young women with the first facial profile (respectively, by 12.0 % and 4.1 %, p<0.001 in both cases); distance R.asc. significantly higher than in young men or young women with the first facial profile (respectively, by 12.5 %, p<0.01 and by 4.7 %, p<0.05).

The profile angle T was expected to differ significantly in all study groups with different facial profiles, both in young men and young women, given that this indicator was the basis for the division into groups by facial profiles according to Schwarz A. M.: higher values in young men or in young women with the first profile of the face than with the second (respectively, by 56.4 %, p<0.001 and by 44.1 %, p<0.001) and with the third profiles (respectively, 3.34 times, p<0.001 and 3.32 times, p<0.001) and higher values in young men or young women with the second face profile than with the first profile (respectively, 2.14 times, p<0.001 and 2.31 times, p<0.001).

It should be noted that the index of the length of the upper jaw (Max) had no difference in the comparison groups, both young men and young women, and relative to the angle G recorded only a tendency to higher values in young men with the first facial profile, compared with young men with the third profile (by 2.6 %, p=0.063).

In total, 24 significant differences in the studied teleroentgenographic indicators were recorded between groups of young men or between groups of young women with different facial profiles. The largest number of differences was found between young men or young women with the first and third facial profiles in terms of F, I, L-Mand, R.asc., B, MM and T (58.3 % of the total). There were 25 % differences between the groups of young men or young women with the first and second facial profiles (according to R.asc., MM and T), and between the groups with the second and third profiles - 16.7 % (actually, except for the profile angle T, which differed significantly in all comparison groups, the differences between the groups with the second and third facial profiles, both in young men and young women were only in terms of angle I).

Summarizing and analyzing the features of the values of the studied teleroentgenographic indicators, between groups of young men and young women with different face types according to Schwarz A. M., the following similar differences were established.

In both young men and young women - in persons with the third type of face, the value of the distance Max is significantly greater than in persons with the first type of face (respectively, by 7.5 %, p<0.01 and 6.1 %, p<0.001) and than in persons with the second type of face (respectively, by 2.0 %, p<0.05 and by 3.4 %, p<0.01); the facial angle F was expected to be significantly different in all study groups with different facial types, both young men and young women, given that this indicator was the basis for the division into groups by facial types according to Schwarz A. M. - higher values in young men or in young women with the third type of face than with the second (respectively, by 5.2 %, p<0.001 and by 5.1 %, p<0.001) and with the first type (respectively, by 9.5 %, p<0.001 and by 9.1 %, p<0.001) and higher values in young men or young women with the second type of face than with the first type (respectively, by 4.1 %, p<0.001 and 4.6 %, p<0.001).

Only in young men with the first type of face significantly higher values of the angles G (by 3.9 %, p<0.05), B (by 46.2 %, p<0.001) and T (by 85.5 %, p<0.01) than in young men with the third face type and angle B (by 23.2 %, p<0.05) than in young men with the second type; with the second type of face significantly higher values of angle I (by 2.7 %, p<0.01) than among young men with the first type of face and angle B (by 18.7 %, p<0.05) than among young men
with the third type of face; with the third type of face significantly higher values of angle I (by 3.5 %, p<0.01) and distance R.asc. (by 8.8 %, p<0.05) than in young men with the first type of face.

In young women, only tendencies to higher values of angles I (by 2.7 %, p=0.068) and T (by 28.4 %, p=0.074) were recorded in persons with the third type of face than with the first type.

It should be noted that the indicators of the length of the mandible (L-Mand) and maxillary-mandibular angle (MM) had no differences in the comparison groups, both in young men and young women with different face types; young women with different face types also did not significantly differ in the distance R.asc. and angles G and B. Young women with the third type of face tend to have a greater value of angle I than young women with the first (by 2.4 %, p=0.068), and young women with the first type of face - a tendency to a greater value of the angle T than with the third type (by 28.4 %, p=0.074).

Thus, young men with different facial types found more pronounced variability of the studied indicators than in young women, both in terms of the number of differences (15 between groups of young men vs. 7 between groups of young women) and the number of indicators that were different - 7 indicators from 9 subjects in young men (Max, F, I, R.asc., G, B and T) against 4 in young women (Max, F, I and T).

Dmitriev M. O. et.al. research [8] found that a number of craniometric and gnatometric indicators in Ukrainian young men and young women differ from the values of indicators established in the author's method of teleroentgenographic studies by Schwarz A. M., determined in the inhabitants of Germany. The results of our research also revealed a number of differences in the studied indicators (distances Max, L-Mand, R.asc. and angles F, I, B, MM, T) in young men and young women with different profiles and face types according to Schwarz A. M. compared with the results of the author of the method and the results obtained by Dmitriev M. O. et.al. [8] for Ukrainian young men and young women with orthognathic occlusion in general, without division into types or facial profiles.

The obtained results testify to the expediency and necessity of taking into account not only belonging to a certain sex, age group or ethnicity but also belonging to certain groups by profiles and face types when evaluating teleroentgenographic morphometric parameters of upper and lower jaws and inter-jaw indicators in young Ukrainians.

Conclusions

1. The values of the percentile range of morphometric teleroentgenographic parameters of the upper and lower jaws and inter-jaw parameters in Ukrainian young men and young women with orthognathic occlusion with different profiles and face types according to Schwarz A. M. were established.

2. There are differences in certain indicators between groups of young men or young women with different profiles or types of faces. All significant differences between groups of young men with different facial profiles and between groups of young women with different facial profiles are the same - both in terms of indicators that differed and in the number of established differences. Instead, a more pronounced variability of the studied indicators was clearly established in young men with different face types than in young women with different face types, both in terms of the number of differences and the number of indicators that were different.

References


