Determination of cephalometric parameters according to the COGS method, related to the profile of the soft tissues of the face depending on the types of faces in Ukrainian young men and young women with an orthognathic bite

Nesterenko Ye. A., Shinkaruk-Dykovytska М. М., Muntian V. L., Prokopenko S. V., Kyrychenko V. I.
National Pirogov Memorial Medical University, Vinnytsia, Ukraine

The use of cephalometric analysis of lateral telerentgenograms allows orthodontists, maxillofacial surgeons and other related specialists to organize a patient’s treatment plan. However, for the full application of this method, it is necessary to determine in advance which indicators for it can be considered the norm, and which are already a pathology. The purpose of the study is to establish the peculiarities of cephalometric parameters according to the COGS method, related to the profile of the soft tissues of the face, in Ukrainian young men and young women with an orthognathic bite with different facial types. 46 young men and 72 young women who belonged to the residents of Ukraine of the Caucasian race in three generations and had an orthognathic bite were subjected to cephalometry according to the COGS method of indicators related to the profile of the soft tissues of the face. The face type was determined according to Garson’s morphological index. Statistical processing of the obtained results was carried out in the license package “Statistica 6.0” using non-parametric estimation methods. Among Ukrainian young women with different types of faces, the following reliable or trends of differences in telerentgenometric indicators related to the profile of soft tissues of the face according to the COGS method were established: young women with a very wide face have smaller values of the Gl'-Sn-Pog' angle and the Sn-Gn'/H-Gn' ratio (compared to the middle and narrow faces) and the angle Cotg-Sn-Ls and the distance Ls-(Sn-Pog') (compared to the middle face); young women with a wide face have larger values of the Ls-(Sn-Pog') distance and smaller values of the Stms-I distance (compared to the average face type); women with a narrow face have larger values of the Gl'-Sn distance and the Gl'-Sn/Sn-Me' ratio (compared to the medium face), the Sn-Gn'/H-Gn' ratio (compared to the wide face) and smaller values of the distance Sm-(Li-Pog') (compared to the wide face). Among Ukrainian young men with different types of faces, the following reliable or trends of differences in telerentgenometric indicators related to the profile of soft tissues of the face according to the COGS method were established: representatives with a very wide face have larger values of the Gl'-Pog' distance (compared to an average face) and smaller values of Sn-Gn'/H-Gn' ratio and Stms-I distance (compared to the average face); representatives with a wide face have larger values of the Gl'-Sn/Sn-Me' ratio (compared to the average face) and smaller values of the Gl'-Sn/Sn-Me' ratio (compared to very wide and wide faces). Minor manifestations of sexual dimorphism of cephalometric parameters determined by the COGS method related to the profile of the soft tissues of the face were also established between young men and young women with different facial types.

Keywords: teleradiography, cephalometry according to the COGS method, cephalometry, indicators of the profile of soft tissues of the face, young men, young women, orthognathic bite, facial types, gender differences.
class III. Among the most common signs of malocclusion, the authors noted bulging teeth, an increase in the space between the teeth, overbite, crossbite, front open bite [2]. Another common pathology is the presence of supernumerary teeth. According to the literature, this pathology occurs in 0.3-0.8 % of people with non-permanent and 1.5-3.5 % of people with permanent dentition. It is also noted that this pathology occurs more often among men than women (the ratio of patients is 2:1, respectively) and more often on the upper jaw than the lower [3]. Manifestations of sexual and age-related dimorphism were also found when studying the prevalence of impacted teeth [16]. Agenesis of teeth occurs in 2.2-10.1 % of people and has a pronounced ethnic heterogeneity of distribution. It is most common among the white population of Australia, where it is found in 6.3 %, the least common among the white population of North America - 3.9 % [5].

The cost of orthodontic treatment varies considerably depending on the method used and the country. In Finland, the average cost of providing orthodontic care to children and adolescents varies between 517-926 euros, in Great Britain it is 36-2941 euros [18].

The prevalence and diversity of orthodontic pathology, the high cost of its treatment have led to the rapid development of instrumental methods for both diagnosis and treatment of this pathology. One of the methods of treatment planning is cephalometric analysis, which became widespread and recognized in the first half of the 20th century [20, 23].

The accuracy of cephalometric analysis of lateral teleroentgenograms is extremely high. Thus, when compared with direct craniometric measurement, the error is less than 1 mm. In general, when comparing the data, the Co-Gn, Go-Me, Co-ANS indicators had higher values in direct craniometry, while all other indicators had lower values [7]. Currently, scientific and technical progress allows, in addition, to use computer tomography data for cephalometric analysis. Nevertheless, the use of traditional lateral teleroentgenograms is almost in no way inferior in terms of informativeness and accuracy to data obtained by analyzing computer tomography data [13].

However, this method requires appropriate clinical research to be implemented in the practice of orthodontists.

The purpose of the study is to establish the peculiarities of cephalometric parameters according to the COGS method, related to the profile of the soft tissues of the face, in Ukrainian young men and young women with an orthognathic bite with different facial types.

Materials and methods
46 young men (YM) (aged 17 to 21) and 72 young women (YW) (aged 16 to 20) underwent a cephalometric study of lateral teleroentgenograms obtained using a Veraviewecpocs 3D Morita dental cone-beam tomograph. All young men and women applied to the private dental clinic "Vinintermed" for a diagnostic examination, belonged in three generations to residents of Ukraine of the Caucasian race and had a physiological bite that was as close as possible to the orthognathic one. Committee on Bioethics of National Pirogov Memorial Medical University, Vinnytsya (protocol № 8 From 30.09.2021) found that the studies do not contradict the basic ethical standards of the Declaration of Helsinki, the Council of Europe Convention on Human Rights and Biomedicine (1977), the relevant WHO regulations and laws of Ukraine.

Cephalometry was performed according to the COGS method [6]. The OnyxCeph™ software, version 3DPro, from Image Instruments GmbH, Germany (software license Nr:URSQ-1799) was used for this analysis. The face type YM and YW is determined, respectively, by the value of Garson's morphological index [19].

The main cephalometric points and measurements according to the COGS method, including indicators of the structures of the soft profile of the face (Fig. 1):

- \( \text{Gl}'-\text{Sn}-\text{Pog}' \) (facial convexity angle, convex) - the angle formed by the lines \( \text{Gl}'-\text{Sn} \) and \( \text{Sn}-\text{Pog}' \);.
- \( \text{Gl}'-\text{Sn} \) (maxillary prognathism) - distance from the point \( \text{Gl}' \) to point Sn, which is measured parallel to the horizontal line HR-Line (mm);
- \( \text{Gl}'-\text{Pog}' \) (mandibular prognathism) - distance from the point \( \text{Gl}' \) to point Pog', which is measured parallel to the horizontal line HR-Line (mm);
- \( \text{Sn}-\text{Gn}'-\text{C} \) (lower face - neck angle, lower face - throat angle) - the angle formed by the lines \( \text{Sn}-\text{Pog}' \) and \( \text{Me}'-\text{C}(H) \).

Fig. 1. Indicators of soft facial profile structures using the COGS method, characterizing the shape of the facial profile: 1 - angle \( \text{Gl}'-\text{Sn}-\text{Pog}' \); 2 - distance \( \text{Gl}'-\text{Sn} \); 3 - distance \( \text{Gl}'-\text{Pog}' \); 4 - angle \( \text{Sn}-\text{Gn}'-\text{C} \).
Calculated indicators of soft facial profile structures according to the COGS method, characterizing the shape of the facial profile and the position and shape of the lips (Fig. 2):

- **Gl'-Sn/Sn-Me'** - vertical height ratio, vertical Facial Profile;
- **Sn-Gn'/C-Gn'** - lower vertical height-depth ratio;
- **Sn-Stms/Stmi-Me'** (vertical lip-chin ratio) - ratio of distances Sn-Stms and Stmi-Me' (%).

Indicators of the structures of the soft profile of the face according to the COGS method, characterizing the position and shape of the lips (Fig. 3):

- **Cotg-Sn-Ls** (nasolabial angle) - the angle formed by the lines Cotg-Sn and Sn-Ls (°);
- **Ls-(Sn-Pog')** (upper lip protrusion) - distance from the point Ls to line Sn-Pog' (mm);
- **Li-(Sn-Pog')** (lower lip protrusion) - distance from the point Li to line Sn-Pog' (mm);
- **Sm-(Li-Pog')** (mentolabial sulcus) - distance from the point Sm to line Li-Pog' (mm);
- **Stms-I** (maxillary incisor exposure) - distance from the point Stms to point Is1u (mm).

Statistical processing of the results was carried out in the license package "Statistica 6.0" using non-parametric estimation methods. Mean values and standard deviation were determined. The significance of the difference in values between independent quantitative values was determined using the Mann-Whitney U-test.

### Results

The following distribution of young people according to the value of the Garson index was established: YM - 5 with a very wide face, 22 with a wide face, 11 with an average face, 8 with a narrow face; YW - 25 very wide face, 25 wide face, 10 medium face, 12 narrow face.

Tables 1 and 2 present the results of telerontgenometric values according to the COGS method, related to the profile of the soft tissues of the face in boys or girls with an orthognathic bite with different types of faces.

Also, between YM and YW with different types of faces, the following gender differences in the indicators related to the profile of soft tissues of the face were established, namely, larger values:

- in YM, larger values of the distance Gl'-Sn (with wide, p<0.05 and the average face, p=0.057), the distance Gl'-Pog' (with the average face, p=0.062), as well as the angle Sn-Gn'-C (with wide face p<0.05);
- in YW larger values are the Sm-(Li-Pog') and Stms-I distances (with a very wide face, p=0.059, p=0.089), Sm-(Li-Pog') distances (with a wide face, p=0.001 and medium face, p=0.05), the Cotg-Sn-Ls angle (with a narrow face, p=0.083) and the Gl'-Sn/Sn-Me' ratio (with a wide face, p<0.05).

### Discussion

When comparing Ukrainian YM or YW with an orthognathic bite with different facial types of indicators...
related to the profile of facial soft tissues according to the COGS method, more pronounced differences are established between YW with different facial types, namely (see Table 2):

in YW with a very wide face, significantly smaller values or trends of the G'f-Sn-Pog' angle and the Sn-Gn'/H-Gn' ratio (compared to the medium and narrow face types), the Cotg-Sn-Ls angle, and Ls-(Sn-Pog') distances (compared to the average face type);

in YW with a wide face, there is a tendency for larger Ls-(Sn-Pog') distance values (compared to the average face type) and a tendency for smaller Stms-I distance values (compared to the average face type);

YW with narrow face have significantly greater, or trends toward, greater values of Gf-Sn distance (compared to medium face type), Sn-Gn'/H-Gn' ratio (compared to wide face type), Gf-Sn/Sn-Me' ratio (compared to the medium face type), as well as a significantly smaller value of the Sm-(Li-Pog') distance (compared to the wide face type).

Between Ukrainian YM with different types of faces, a significantly smaller number of reliable, or trends, indicators of differences related to the profile of the soft tissues of the face according to the COGS method were established (see Table 1):

in YM with a very wide face, there is a tendency towards larger values of the Gf-Pog' distance (compared to the

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<th>Table 1. The value of COGS teleroentgenometric indicators related to the profile of facial soft tissues in YM with different types of face (M±σ).</th>
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<td>Ratio Gf/Sn/Sn-Me'</td>
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<td>Ratio Sn-Stms/Stmi-Me</td>
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<td>Distance Stms-I</td>
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Notes: here and in the following table, M±σ - sample mean ± standard deviation; p<sub>1-2</sub>, p<sub>1-3</sub>, p<sub>1-4</sub>, p<sub>2-3</sub>, p<sub>2-4</sub>, p<sub>3-4</sub> - the validity of the differences in scores between the corresponding face types in YM or YW.

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<th>Table 2. The value of COGS teleroentgenometric indicators related to the profile of facial soft tissues in YW with different facial types (M±σ).</th>
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average face type) and a tendency towards smaller values of the Sn-Gn'/H-Gn' ratio and the Stms-I distance (compared to average face type);

in broad-faced YM, a tendency towards higher Sn-Stms/Stmi-Me ratio values (compared to the average face type) and a tendency towards lower values of the Gl'-Sn/Sn-Me' ratio (compared to the average face type);

in YM with a narrow face, significantly higher, or a trend towards higher values of the ratio of Gl'-Sn/Sn-Me' (compared to very wide and wide face types).

Minor manifestations of sexual dimorphism of indicators related to the profile of the soft tissues of the face were also established, namely: larger values, in most cases in YM with wide and medium face types - values of Gt'-Sn distances, Gt'-Pog' distances (only with an average face type), Sn-Gn'C angle (only with a wide face type); and in YW - values of Sm-(Li-Pog) and Stms-I distances (with very wide face type), Sm-(Li-Pog') distance (with wide and medium face types), Copgt-Sn-Ls angle (with narrow face type) and Gt'-Sn/Sn-Me' ratio (with wide face type).

COGS analysis is an excellent tool that is actively used for the assessment and planning of orthodontic treatment, which involves various types of surgical interventions, such as osteotomies, genioplasty and other interventions on the maxillo-dental apparatus [8, 11, 12, 15].

In a previous study, we analyzed COGS cephalometric parameters that characterize the position of individual teeth in boys and girls with an orthognathic bite and different facial types. As a result, pronounced manifestations of sexual dimorphism were found for both linear and angular indicators, namely, YW have higher values of the OP-HP angle, and YM have higher values of most linear dimensions [14].

Indeed, taking into account as many parameters as possible is important when conducting cephalometric studies. Yes, the type of face affects the position of the hyoid bone. Significant differences were found for SNB, ANB and NSH indicators in different groups [1].

It is also important to take into account the age of the examined persons. Bergman R. T. with co-authors [4] investigated changes in the soft tissue structures of the face of persons aged 6 to 18 years using COGS analysis. In particular, with age, such indicators as the lower face height, the thickness of the upper and lower lips, the length of the upper lip and the lower lip-chin length increase, the interlabial gap and the contour of the furrow of the lower jaw decrease. Some indicators do not change with age: the angle of the face profile, the nasolabial angle, the upper and lower protrusion of the lips.

The existence of sex differences in terms of indicators of soft tissue structures of the face is also a proven fact. In men, higher values of the thickness of the soft tissues of the face were found in representatives of the maxillofacial class I, II and III. The most significant differences were found for the index of the furrow of the upper lip (t=3.772; p<0.001) [17].

And of course, the ethnic component is important. A group of researchers [9] revealed soft tissue cephalometric indicators that are different (p<0.05) for Nigerians, Ghanaians and Senegalese: length of the upper lip, Li-esthetic line, angle of the tip of the nose, N-Pr-Pg, Pg-Ls, B-N pogonion and pogonion-mandibular angle. In addition, such indicators as the nasolabial angle, mentolabial angle, depth of the nose, general convexity of the soft tissues of the face are excellent for the mentioned nationalities and Europeans.

Differences were also found for the Japanese population, which, compared to the European population, has higher average face projection values [22].

Regarding the inhabitants of Northern India, differences were also found in the COGS analysis indicators compared to European data, namely, they have lower values of the base of the skull, height of the face, higher values of the chin protrusion and the inclination of the mandibular incisors [10]. A similar kind of study, however, regarding residents of East India revealed the following features compared to European data: higher values of protrusion of the upper and lower lips, prognathia of the lower jaw [21].

Conclusion

1. Between Ukrainian YW (more pronounced) or YM with different types of faces who have an orthognathic bite, reliable or trends of discrepancies of teleroentgenometric indicators related to the profile of soft tissues of the face according to the COGS method were established.

2. Between YM and YW with the corresponding facial types, the manifestations of sexual dimorphism of teleroentgenometric indicators related to the profile of the soft tissues of the face according to the COGS method are slightly expressed.

References


із дуже широким обличчям - більші значення величини відстані \(G'\text{-}Pog'\) (порівняно з середнім обличчям) та менші значення величини співвідношення \(Sn\text{-}Gn'/H\text{-}Gn'\) і відстані \(Stms\text{-}I\) (порівняно з середнім обличчям); у представників із широким обличчям - більші значення величини співвідношення \(Sn\text{-}Stms/Sm\text{-}Me\) (порівняно з середнім обличчям) та менші значення величини співвідношення \(G'\text{-}Sn'/Sn\text{-}Me'\) (порівняно з середнім обличчям); у представників із вузьким обличчям - більші значення величини співвідношення \(G'\text{-}Sn'/Sn\text{-}Me'\) (порівняно з дуже широким і широким обличчям). Між юнаками та дівчатами з різними типами обличчя також встановлені незначні прояви статевого диморфізму цефалометричних параметрів визначених за COGS-методом, що відносяться до профілю м'яких тканин обличчя.

Ключові слова: телерентгенографія, цефалометрія за COGS-методом, кефалометрія, показники профілю м'яких тканин обличчя, юнаки, дівчата, ортогнатичний прикус, типи обличчя, статеві розбіжності.