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CORRELATIONS OF TELERADIOMETRIC «SKELETAL AND DENTO-SKELETAL» INDICES ACCORDING TO THE RICKETTS METHOD WITH THE SIZES OF TEETH AND DENTAL ARCHES IN UKRAINIAN YOUNG MEN AND YOUNG WOMEN WITH PHYSIOLOGICAL OCCLUSION WITHOUT AND WITH CONSIDERATION OF FACIAL TYPE

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Annotation. *The increasing prevalence of orthodontic pathology among adolescents necessitates a deeper analysis of morphological factors influencing the formation of the dentofacial system. Studying the relationships between maxillofacial structures and the dimensions of the dental arches taking into account the type of face is an important step towards early diagnosis and prevention of occlusion disorders. The aim of the study was to establish the features of correlations between «skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the dimensions of teeth and dental arches in Ukrainian young men and young women with physiological occlusion without and with the type of face. In 41 Ukrainian young men and 68 Ukrainian young women with physiological occlusion without and with Garson's facial type, teleradiometric «skeletal and dento-skeletal» parameters were determined by the Ricketts method (distances A-NPog, 6u-PTV, 1l-APog, 1u-APog, Xi-OcP and angles ANS-Xi-PM, Mand1-APog, Max1-APog), computed tomography dimensions of teeth and dental arches. Correlations between «skeletal and dento-skeletal» teleradiometric parameters and computed tomography dimensions of teeth and dental arches were assessed in the licensed package «Statistica 6.0» using nonparametric Spearman statistics. When analyzing reliable and medium-strength unreliable correlations between «skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the sizes of teeth and dental arches, it was established: in young men and young women, regardless of facial type, there were, respectively, 7.14 % (mostly direct medium-strength reliable) and 8.93 % (mostly direct medium- and weak-strength reliable) relationships with the sizes of teeth of the upper jaw, 6.79 % (mostly direct medium-strength reliable) and 11.07 % (mostly direct weak- and medium-strength reliable) relationships with the sizes of teeth of the lower jaw, and 9.03 % (mostly direct medium-strength reliable) and 19.44 % (mostly direct medium-strength reliable) with the sizes of dental arches; in young men and young women with a wide face type – respectively 12.86 % (mainly direct average strength unreliable) and 21.07 % (mainly direct average strength unreliable, inverse average strength reliable and unreliable) connections with the sizes of the teeth of the upper jaw, 15.36 % (mainly direct and inverse average strength unreliable) and 27.14 % (mainly inverse and direct average strength unreliable) connections with the sizes of the teeth of the lower jaw and 19.44 % (mainly inverse and direct average strength unreliable) and 24.31 % (mainly direct and inverse average strength reliable and unreliable) with the sizes of the dental arches; in young women with a very wide face type – 14.64 % (evenly direct and inverse average strength reliable and unreliable) connections with the sizes of the teeth of the upper jaw, 13.93 % (mostly inverse average strength reliable and unreliable) connections with the sizes of the teeth of the lower jaw and 27.78 % (mostly inverse average strength reliable and unreliable) with the sizes of the dental arches. In Ukrainian young men and young women with physiological occlusion, both without taking into account the type of face, and in representatives with a wide face type, pronounced manifestations of sexual dimorphism of the connections between «skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method and computed tomography sizes of the teeth and dental arches were established.*

Keywords: *dentistry, teleradiometry of «skeletal and dento-skeletal» indicators according to the Ricketts method, computed tomography sizes of teeth and dental arches, correlations, Ukrainian young men and young women, physiological occlusion, facial type.*

Introduction

Orthodontic pathology occupies one of the leading places among diseases of the dentofacial system in children and adolescents, and its prevalence continues to grow worldwide. Epidemiological studies indicate a high frequency of occlusal anomalies, which are formed in childhood and often require specialized intervention. For example, in Slovenia, more than 66 % of schoolchildren have some form of malocclusion, which indicates the scale of the problem even in countries with well-organized preventive programs [6]. A similar trend is observed in other regions: among Chinese orthodontic patients, a study by G. X. L. Chan et al. [4] found that class I skeletal relationships occur in 65.8 % of cases, class II in 25.7 %, and class III in 8.5 %, with a significant proportion of cases accompanied by various dental anomalies.

Dentomaxillofacial anomalies are often multifactorial, involving both hereditary and environmental influences, as well as morphological features of the maxillofacial apparatus. In patients with different facial types, these features may manifest themselves differently in the form of morphometric changes that are clearly recorded during teleradiographic examination. The Ricketts technique, which is one of the leading methods for assessing craniofacial parameters,

allows you to quantitatively describe the spatial relationships between the jaws, teeth and facial skeleton, which is important both for diagnosis and for predicting the course of orthodontic treatment.

A significant number of dental anomalies, including retention, displacement, edentia and hyperdontia, are often detected during routine orthodontic examination on radiographic images [9]. For example, in a study of orthodontic patients in South India, the most common dental anomalies were retention (6.9 %), hypodontia (4.8 %), and canine displacement (3.6 %) [18]. Similar results were obtained in the work of S. Jain and S. Debbarma [11], who indicated that more than 10 % of orthodontic patients had canine developmental anomalies, including ectopia and retention.

Among the anomalies that are of particular clinical importance, retention of the upper canines should be highlighted. According to a study conducted in a region of Sweden with an implemented systematic preventive program, the incidence of retention of the upper canines was 2.5 %, which confirms the effectiveness of early detection and interceptive treatment [12].

The increase in the incidence of dental anomalies and pathologies is also explained by the wider use of panoramic and cephalometric radiography. The patient's age is a critical factor in deciding whether to perform a radiographic examination, as the frequency of anomalies increases with age, peaking in adolescence [13]. In addition, a large proportion of orthodontic patients have concomitant dental pathologies, including pathological tooth migration, especially in patients with chronic periodontitis. In such individuals, the relationship between the morphometric parameters of the jaw and teeth undergoes changes, which further complicates the diagnosis [24]. This once again emphasizes the need for the use of objective instrumental methods that allow not only to assess the current condition, but also to predict possible complications of orthodontic treatment.

In clinical practice, it is important not only to detect existing anomalies, but also to plan treatment correctly, taking into account the individual anatomical features of the patient. The use of detailed analysis of dental and skeletal parameters allows determining the optimal therapeutic approaches depending on the type of anomaly [20]. This approach is particularly effective in populations with a high incidence of developmental anomalies, as shown in the studies of G. Pallikaraki and colleagues [16]: in Greek adolescents, more than 23 % had various dental anomalies, often combined with skeletal developmental disorders.

Thus, current studies convincingly demonstrate the need for a comprehensive approach to the assessment of orthodontic status, including both clinical and radiographic examination with the involvement of facial typology.

The purpose of the study – establishing the features of correlations between «skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the sizes of teeth and dental arches in Ukrainian young men and young women with physiological occlusion without and taking into account the type of face.

Materials and methods

Primary computed tomography scans of 41 Ukrainian young men (YM) (aged 17 to 21) and 68 Ukrainian young women (YW) (aged 16 to 20) with physiological occlusion were obtained from the data bank of the Research Center and Department of Pediatric Dentistry of the National Pirogov Memorial Medical University, Vinnytsya. All examinations of young men and young women were conducted on the basis of the principle of voluntary informed consent. The study was carried out within the framework of the research work of the Department of Pediatric Dentistry of the National Pirogov Memorial Medical University, Vinnytsya «Development and improvement of individual methods of diagnosis, treatment and prevention of dental anomalies, caries and its complications in children and adolescents», state registration No. 0120U105689. The Bioethics Committee of the National Pirogov Memorial Medical University, Vinnytsya (protocol No. 7 dated 11/8/2022) established that the conducted research does not contradict the basic bioethical norms of the Declaration of Helsinki, the Council of Europe Convention on Human Rights and Biomedicine (1977), relevant WHO provisions, and the laws of Ukraine.

Teleradiography and computed tomography studies were performed at the private dental clinic «Vinintermed» and at the «Planmeca 3D Maxillofacial Diagnostics Center» using a dental cone-beam tomograph Veraviewepocs 3D Morita (Japan) and Planmeca ProMax 3D Mid (Finland) in the software shells i-Dixel One Volume Viewer (Ver.1.5.0) J Morita Mfg. Cor and Planmeca Romexis Viewer (ver. 3.8.3.R 15.12.14) Planmeca OY. In addition to the teleradiography obtained in the standard way, teleradiography with points marked on 3D objects, created in the 3D Slicer v5.4.0 software, was used. Analysis and processing of telangiectasias were performed using the licensed software OnyxCeph³™, version 3DPro, from Image Instruments GmbH (Germany).

For the analysis of lateral cephalometric radiographs, the Ricketts R. M. method was used [19]. According to the Ricketts R. M. method, we determined the following «*skeletal and dento-skeletal*» indicators [2, 3] – A-NPog distance (mm), 6u-PTV distance (mm), 1l-APog distance (mm), 1u-APog distance (mm), Xi-OcP distance (mm), ANS-Xi-PM angle (°), Mand1-APog angle (°), Max1-APog angle (°).

Morphometry of incisors, canines, premolars and first molars included determination of the width and height of the tooth crown, the width of the dentine-enamel border, the length of the root and the length of the tooth in the mesio-distal and vestibulo-oral directions [2, 3].

Measurement of the dimensions of the *dental arches* [3] included: *in the transverse plane* – the distances between the canine eruption cusps on the lower (33_43Bugr) and upper (13_23Bugr) jaws, the vestibular medial cusps of the first molars (VestBM) of the upper jaw, the premolar (PonPr) and molar (PonM) points behind Pon, on the upper jaw the distances between the canine root tips (13_23Apx), between the tips of the medial (napx_6), distal (dapx_6) and palatal (mapex_6) roots of the first large canines, and

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on the lower jaw the distances between the canine root tips (33_43Apx), between the tips of the medial (mapx_46) and distal (dapx_46) first large canines; *in the sagittal plane* – the distances between the incisal point and the midpoints of the canine (DL_C), premolar (DL_F) and molar (DL_S) lines; *in the vertical plane* – the distances of the occlusal plane from the palate at the level of the canine (GL_1), premolar (GL_2) and molar (GL_3) lines.

Facial type was determined according to the Garson morphological index [17]. The following distribution of faces was established: young men – 6 with a very wide face, 25 with a wide face, 9 with an average face and 1 with a narrow face; young women – 30 with a very wide face, 25 with a wide face, 8 with an average face and 5 with a narrow face.

Correlations were assessed in the «Statistica 6.0» license package using Spearman's nonparametric statistics.

Results. Discussion

The following *multiple* average-strength, mostly direct reliable, and unreliable relationships were established *between «skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the sizes of the teeth of the upper jaw in YM without taking into account the type of face* – direct (r = from 0.30 to 0.44) between the value of the A-NPog distance and the width of the crown of the lateral incisors, canines and second premolars, the width of the dentino-enamel border of the canines in the vestibulo-oral direction, the length of the canine root in the mesio-distal direction, and also, mostly direct (r = from 0.30 to 0.49), between the value of the Xi-OcP distance and the length of the root of the central incisors and canines, the width of the dentino-enamel border of the central incisors in the mesio-distal direction and the length of the central incisors. In YM, regardless of facial type, no significant or moderately significant correlations were found between the size of the maxillary teeth and the Mand1-APog angle. *Quantitative analysis* of significant and moderately significant correlations *between «skeletal and dento-skeletal» teleradiometric indices according to the Ricketts method with the size of the maxillary teeth in YM, regardless of facial type*, revealed 20 relationships out of 280 possible (7.14 %), of which 4.64 % were direct relationships of moderate significance, 2.14 % were direct relationships of moderate significance, and 0.36 % were inverse relationships of moderate significance.

Multiple average direct reliable relationships (r= from 0.34 to 0.45) between *«skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the dimensions of the mandibular teeth in YM without taking into account the type of face were* found only between the value of the 6u-PTV distance and the width of the dentino-enamel border of the central and lateral incisors, the width of the crown of the central incisors in the mesiodistal direction, the width of the crown of the central incisors and first premolars in the vestibulo-oral direction. In young men without taking into account the type of face, no reliable or average unreliable relationships were found between the dimensions of the mandibular teeth and the value of the Mand1-APog angle. *Quantitative analysis* of reliable and medium-strength unreliable correlations *between «skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the sizes of the lower jaw teeth in YM without taking into account the type of face* revealed 19 relationships out of 280 possible (6.79 %), of which 5.00 % direct medium-strength reliable, 0.71 % direct medium-strength unreliable, 0.71 % reverse medium-strength reliable and 0.36 % reverse medium-strength unreliable.

The following *multiple* average strength, mostly direct, reliable and unreliable relationships were established *between «skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the dimensions of the dental arches in YM without taking into account the type of face* – direct (r = from 0.30 to 0.42) between the value of the A-NPog distance and the distances 13_23Apx, DL_C, DL_S and GL_1, and also, mostly direct (r = from 0.31 to 0.41), between the value of the ANS-Xi-PM angle and the distances mapx_46, dapx_46 and GL_2. In YM without taking into account the type of face, no reliable or average strength unreliable relationships were found between the dimensions of the dental arches and the value of the distances 1I-APog and Xi-OcP. *Quantitative analysis* of reliable and medium-strength unreliable correlations *between «skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the dimensions of dental arches in YM without taking into account facial type* revealed 13 relationships out of 144 possible (9.03 %), of which 5.56 % of direct medium-strength reliable, 2.08 % of direct medium-strength unreliable, and 1.39 % of inverse medium-strength unreliable.

The following *multiple* reliable, mostly direct, medium and weak connections were established *between «skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the sizes of the teeth of the upper jaw in YW without taking into account the type of face* – direct (r = from 0.25 to 0.37) between the value of the 6u-PTV distance and the length of the root of the lateral incisors and canines, the width of the crown of the canines in the mesio-distal direction, the length of the canines, as well as between the value of the 1u-APog distance or the Max1-APog angle and the width of the crown of the central incisors, first and second premolars in the mesio-distal direction, the length of the root of the central incisors (only with the 1u-APog distance), the width of the crown of the second premolars (only with the 1u-APog distance), the width of the dentine-enamel border of the lateral incisors and canines incisors (only with the Max1-APog angle) in the vestibulo-oral direction; inverse (r= from -0.32 to -0.36) and direct (r= 0.26 and 0.27) between the size of the Xi-OcP distance and the height of the crown of the central incisors and canines, the width of the crown of the second premolars in the mesio-distal direction (inverse), the length of the root of the central incisors in the mesio-distal direction, the height of the crown of the central incisors in the vestibulo-oral direction (direct). In YW, regardless of the type of face, no significant relationships were found between

the sizes of the teeth of the upper jaw and the size of the A-NPog distance. *Quantitative analysis* of significant correlations *between «skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the sizes of the upper jaw teeth in YW without taking into account the type of face* revealed 25 relationships out of 280 possible (8.93 %), of which 4.29 % were direct of medium strength, 3.21 % were direct of weak strength, 1.07 % were inverse of medium strength and 0.36 % were inverse of weak strength.

The following *multiple* reliable, mostly direct, medium and weak connections were established *between «skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the sizes of the lower jaw teeth in YW without taking into account the type of face* – direct (r = from 0.25 to 0.38) between the values of the distances 1l-APog, 1u-APog or the Mand1-APog angle and the width of the crown and dentino-enamel border of the central incisors, the width of the crown of the second premolars (except for the Mand1-APog angle) and the first molars (except for the 1u-APog distance) in the mesio-distal direction, the width of the crown and dentino-enamel border of the lateral incisors in the mesio-distal direction and the width of the dentino-enamel border of the central incisors in the vestibulo-oral direction (only for the distance 1u-APog), the width of the crown of the first molars in the vestibulo-oral direction (only for the Mand1-APog angle), as well as between the value of the 6u-PTV distance and the width of the crown, the length of the root of the lateral incisors and canines in the mesio-distal direction, the width of the dentino-enamel border of the central incisors and the height of the crown of the lateral incisors in the vestibulo-oral direction, the length of the canines; inverse (r= from -0.26 to -0.35) and direct (r= 0.25 and 0.33) between the value of the Xi-OcP distance and the width of the crown of the central incisors and canines, the width of the dentino-enamel border of the central incisors in the vestibulo-oral direction (inverse), the length of the root of the canines in the vestibulo-oral direction, the length of the canines (direct). *Quantitative analysis* of reliable *correlations between «skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the sizes of the lower jaw teeth in YW without taking into account the type of face* revealed 31 relationships out of 280 possible (11.07 %), of which 3.57 % were direct of medium strength, 5.36 % were direct of weak strength, 1.07 % were inverse of medium strength and 1.07 % were inverse of weak strength.

The following *multiple* reliable direct and inverse, mostly medium-strength, relationships were established between *«skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the sizes of dental arches in YW without taking into account the type of face* – mainly direct (r= from 0.24 to 0.59), and inverse (r= from -0.25 to -0.57) between the values of the distances 1l-APog, 1u-APog or the angles Mand1-APog, Max1-APog and the distances DL_C, DL_F, DL_S (direct), GL_1 (inverse, except for the angle Mand1-APog), and only between the value of the angle Mand1-APog and the distances 13_23Apx, dapx_6 and mapex_6; and also between the value of the A-NPog distance and the distances DL_F and DL_S (direct), 13_23Bugr, 33_43Apx, mapx_46 and dapx_46 (inverse). In YW, regardless of the type of face, no significant relationships were found between the dimensions of the dental arches and the value of the 6u-PTV distance. *Quantitative analysis* of significant correlations *between «skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the dimensions of the dental arches in YW, regardless of the type of face*, revealed 28 relationships out of 144 possible (19.44 %), of which 10.42 % were direct of medium strength, 2.08 % were direct of weak strength, 3.47 % were reverse of medium strength and 3.47 % were reverse of weak strength.

The following *multiple* medium-strength, mostly direct, unreliable, relationships were established *between «skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the sizes of the teeth of the upper jaw in YM with a wide facial type* – mostly direct (r= from 0.30 to 0.53), between the values of the 6u-PTV, 1l-APog and 1u-APog distances and the width of the crown and dentino-enamel border of the lateral incisors in the vestibulo-oral direction, the width of the crown of the canines, first and second premolars and first molars in the vestibulo-oral direction (only for the 6u-PTV distance), the length of the canine root in the vestibulo-oral direction (only for the 1l-APog and 1u-APog distances), the length of the first premolars (only for the 1l-APog distance); between the value of the Mand1-APog angle and the height of the crown of the central incisors and canines in the vestibulo-oral direction, the length of the root of the lateral incisors in the mesio-distal direction, the length of the first premolars; between the value of the Max1-APog angle and the length of the root of the central and lateral incisors, the width of the dentino-enamel border of the lateral incisors in the vestibulo-oral direction, the height of the crown of the lateral incisors in the mesio-distal direction; as well as direct (r= from 0.30 to 0.45) and inverse (r= from -0.38 to -0.46) relationships between the Xi-OcP distance and the width of the dentino-enamel border of lateral incisors and canines, the root length of central incisors and canines in the mesio-distal direction, the height of the crown of central incisors in the vestibulo-oral direction (direct), the width of the crown of the first and second premolars in the mesio-distal direction, the width of the crown of central incisors in the vestibulo-oral direction (inverse). *Quantitative analysis* of reliable and medium-strength unreliable correlations *between «skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the sizes of the upper jaw teeth in YM with a wide facial type* revealed 36 relationships out of 280 possible (12.86 %), of which 2.86 % were direct medium-strength reliable, 7.14 % were direct medium-strength unreliable, 1.07 % were reverse medium-strength reliable, and 1.79 % were reverse medium-strength unreliable.

The following *multiple* average strength reliable and unreliable direct and inverse relationships were established *between «skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the sizes of the lower*

jaw teeth in YM with a wide facial type: direct (r= from 0.30 to 0.58) between the value of the 6u-PTV distance and the width of the crown and dentino-enamel border of the central and lateral incisors in the mesio-distal direction, the width of the crown of the central incisors, canines and first premolars, the width of the dentino-enamel border of the central incisors in the vestibulo-oral direction; direct (r= from 0.32 to 0.48) and inverse (r= from -0.35 to -0.51) between the value of the 1l-APog distance and the Max1-APog angle and the width of the crown of the central incisors in the mesio-distal direction (direct), the width of the crown of the second premolars, the height of the crown of the central incisors and canines in the vestibulo-oral direction (inverse), the height of the crown of the central and lateral incisors in the mesio-distal direction, the length of the root of the central and lateral incisors in the vestibulo-oral direction (only for the Max1-APog angle), the width of the crown of the canines in the mesio-distal direction, the length of the root of the canines in the vestibulo-oral direction (only for the 1l-APog distance) (direct), the length of the root of the lateral incisors in the mesio-distal direction direction (only for the Max1-APog angle), the width of the crown of the first molars in the vestibulo-oral direction (only for the 1l-APog distance) (reverse); mainly reverse (r= from -0.35 to -0.51), between the values of the 1u-APog and Xi-OcP distances and the height of the crown of the central incisors and canines, the width of the crown of the first and second premolars, the width of the dentine-enamel border of the canines in the vestibulo-oral direction (for the 1u-APog distance), the width and height of the crown of the lateral incisors in the mesio-distal direction, the width of the crown of the second premolars, the length of the root of the lateral incisors in the vestibulo-oral direction (for the Xi-OcP distance). *Quantitative analysis* of reliable and medium-strength unreliable correlations *between «skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the sizes of the lower jaw teeth in YM with a wide facial type* revealed 43 relationships out of 280 possible (15.36 %), of which 2.86 % of direct medium-strength reliable, 5.36 % of direct medium-strength unreliable, 1.79 % of reverse medium-strength reliable and 5.36 % of reverse medium-strength unreliable.

The following *multiple* average strength reliable and unreliable, direct and inverse relationships were established between *«skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the sizes of dental arches in YM with a wide face type* – mainly direct (r= from 0.33 to 0.55) between the value of the A-NPog distance and the distances 13_23Apx, DL_C, DL_S, GL_1 and GL_2; mainly direct (r= from 0.35 to 0.44) between the value of the ANS-Xi-PM angle and the distances 33_43Apx, mapx_46, dapx_46 and GL_2; inverse (r= from -0.31 to -0.47) between the value of the 1u-APog distance and the distances PonM, VestBM, napx_6, 33_43Bugr and GL_3. *Quantitative analysis* of reliable and medium-strength unreliable correlations *between «skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the dimensions of dental arches in YM with a wide facial type* revealed 28 relationships out of 144 possible (19.44 %), of which 3.47 % were direct medium-strength reliable, 5.56 % were direct medium-strength unreliable, 1.39 % were reverse medium-strength reliable, and 9.03 % were reverse medium-strength unreliable.

The following *multiple*, mostly medium-strength, direct and inverse reliable and unreliable relationships were established between *«skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the sizes of the teeth of the upper jaw in YW with a wide face type*: direct reliable and unreliable (r= from 0.30 to 0.69) between the value of the 6u-PTV distance and the width of the crown of the central and lateral incisors, canines, first and second premolars, the length of the root of the lateral incisors and canines in the mesiodistal direction, the width and height of the crown, the width of the dentine-enamel border and the length of the root of the canines, the width of the crown of the second premolars and first molars in the vestibulo-oral direction, the length of the canines; straight, unreliable (r= from 0.30 to 0.39) between the value of the Mand1-APog angle and the width of the dentino-enamel border of the lateral incisors and canines, the width and height of the crown of the canines in the vestibulo-oral direction, the width of the crown of the central incisors in the mesio-distal direction; mostly straight, unreliable (r= from 0.30 to 0.35) between the value of the Max1-APog angle and the width of the crown of the central incisors, first and second premolars, the height of the crown of the central and lateral incisors in the mesio-distal direction, the width of the crown of the second premolars in the vestibulo-oral direction; inverse, mostly unreliable (r= from -0.31 to -0.57), between the value of the A-NPog distance and the root length of the central incisors and canines in the mesiodistal direction, the height of the crown of the lateral incisors in the vestibulo-oral direction, the length of the central incisors and first premolars; inverse, mostly reliable (r= from -0.32 to -0.50), between the value of the ANS-Xi-PM angle and the width of the crown of the lateral incisors, first and second premolars, the width of the dentino-enamel border of the lateral incisors in the mesio-distal direction, the width of the crown of the lateral incisors and first molars, the width of the dentino-enamel border of the canines in the vestibulo-oral direction; mostly inverse, reliable and unreliable (r= from -0.30 to -0.68) between the Xi-OcP distance and the width of the crown of the central and lateral incisors, canines, second premolars and first molars, the width of the dentino-enamel border and the height of the crown of the central incisors in the mesio-distal direction, the width of the crown of the central incisors, canines, second premolars and first molars, the width of the dentino-enamel border of the central and lateral incisors and canines, the length of the root of the central and lateral incisors in the vestibulo-oral direction. *Quantitative analysis* of reliable and medium-strength unreliable correlations *between «skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the sizes of the upper jaw teeth in YW with a wide face type* revealed 59 relationships out of 280 possible (21.07 %), of which 0.36 % were direct strong

reliable, 2.14 % were direct medium-strength reliable, 7.50 % were direct medium-strength unreliable, 0.36 % were reverse strong reliable, 5.36 % were reverse medium-strength reliable, and 5.36 % were reverse medium-strength unreliable.

The following *multiple*, mostly medium-strength, unreliable, direct and inverse relationships were established *between «skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the sizes of the lower jaw teeth in YW with a wide face type* – direct reliable and unreliable (r= from 0.30 to 0.56) between the value of the 6u-PTV distance and the width of the crown of lateral incisors, canines, first and second premolars, first molars, the length of the root of lateral incisors and canines in the mesio-distal direction, the width of the crown of central incisors, canines, second premolars and first molars, the width of the dentine-enamel border of central and lateral incisors and canines, the height of the crown of lateral incisors and canines, the length of the root of canines in the vestibulo-oral direction, the length of lateral incisors and canines; reliable and unreliable correlations (r= from 0.30 to 0.61) between the Mand1-APog angle and the width of the crown of the central incisors, canines, second premolars and first molars, the width of the dentino-enamel border of the central incisors in the mesio-distal direction, the width of the crown and dentino-enamel border and the height of the crown of the canines in the vestibulo-oral direction; mainly direct non-significant (r= from 0.31 to 0.47), and inverse non-significant (r= from -0.34 to -0.37) between the value of the Max1-APog angle and the width of the crown of the canines and second premolars, the width of the dentino-enamel border of the lateral incisors and canines in the mesio-distal direction, the width of the crown and dentino-enamel border of the central incisors in the vestibulo-oral direction (direct), the length of the root of the central incisors in the mesio-distal direction, the length of the first and second premolars (inverse); inverse, mostly unreliable (r= from -0.30 to -0.76), between the Xi-OcP distance and the width of the crown of lateral incisors, canines and first molars, the length of the root of central and lateral incisors, the width of the dentine-enamel border of lateral incisors and canines in the vestibulo-oral direction, the width of the crown of central incisors, second premolars and first molars, the height of the crown of central incisors in the mesio-distal direction; mostly inverse, significant and non-significant (r= from -0.30 to -0.58) between the value of the A-NPog distance and the root length of the central and lateral incisors and canines in the mesiodistal direction, the width of the crown of the first premolars and the height of the crown of the central incisors in the vestibulo-oral direction, the length of the central and lateral incisors, canines, first and second premolars; mostly inverse, non-significant (r= from -0.32 to -0.39) between the value of the ANS-Xi-PM angle and the width of the crown of the central incisors and canines, the width of the dentine-enamel border of the central incisors, the height of the crown of the canines in the vestibulo-oral direction, the width of the crown of the first and second premolars in the mesiodistal direction. *Quantitative analysis of reliable and medium-strength unreliable correlations between «skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the sizes of the lower jaw teeth in YW with a wide face type* revealed 76 relationships out of 280 possible (27.14 %), of which 0.36 % were direct strong reliable, 4.64 % were direct medium-strength reliable, 9.29 % were direct medium-strength unreliable, 0.36 % were reverse strong reliable, 2.86 % were reverse medium-strength reliable, and 9.64 % were reverse medium-strength unreliable.

The following *multiple*, mostly medium-strength, reliable, direct and inverse relationships were established *between «skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the sizes of dental arches in YW with a wide face type* – mostly reliable, direct (r= from 0.35 to 0.56) and inverse (r= from -0.38 to -0.60) between the value of the ANS-Xi-PM angle and the distances napx_6, GL_2 and GL_3 (direct), DL_C, DL_F and DL_S (inverse); mostly reliable, direct (r= from 0.58 to 0.65) and inverse (r= from -0.31 to -0.47) between the value of the Max1-APog angle and the distances DL_C, DL_F and DL_S (direct), napx_6, GL_1 and GL_2 (inverse); mostly direct, reliable and unreliable (r= from 0.35 to 0.56) between the value of the distance 1u-APog and the angle Mand1-APog and the distances DL_C, DL_F, DL_S and only the angle Mand1-APog with the distances VestBM and mapex_6; mostly inverse reliable (r= from -0.32 to -0.56) between the value of the distance Xi-OcP and the distances dapx_6, 33_43Bugr, mapx_46, DL_C, DL_F and DL_S. *Quantitative analysis* of reliable and medium-strength unreliable correlations *between «skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the sizes of dental arches in YW with a wide face type* revealed 35 relationships out of 144 possible (24.31 %), of which 1.39 % were direct strong reliable, 5.56 % were direct medium-strength reliable, 6.25 % were direct medium-strength unreliable, 0.69 % were reverse strong reliable, 6.25 % were reverse medium-strength reliable and 4.17 % were reverse medium-strength unreliable.

The following *multiple* medium-strength direct and inverse, mostly unreliable relationships were established *between «skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the sizes of the teeth of the upper jaw in YW with a very wide face type* – mostly direct unreliable (r= from 0.30 to 0.47), between the value of the A-NPog distance and the height of the crown of the central and lateral incisors and canines, the width of the crown of the first and second premolars in the vestibulo-oral direction, the width of the crown of the first premolars in the mesio-distal direction; mainly direct reliable and unreliable (r= from 0.33 to 0.41), between the size of the Xi-OcP distance and the root length of the central and lateral incisors and canines, the width of the dentino-enamel border of the lateral incisors and canines in the mesio-distal direction, the height of the crown of the central incisors in the vestibulo-oral direction, the length of the lateral incisors; inverse reliable and unreliable (r= from -0.30 to -0.47) between the size of

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the ANS-Xi-PM angle and the width of the crown of the lateral incisors, canines and first premolars in the mesio-distal direction, the width of the crown of the central and lateral incisors, canines, first and second premolars, the width of the dentino-enamel border of the central and lateral incisors in the vestibulo-oral direction; direct (r= from 0.30 to 0.35) and inverse (r= -0.30 and -0.51), mostly unreliable, between the value of the ANS-Xi-PM angle and the width of the dentine-enamel boundary and the height of the crown of the central incisors in the mesiodistal direction, the length of the central incisors (direct), the height of the crown of the lateral incisors and canines in the mesiodistal direction (inverse); *Quantitative analysis* of reliable and medium-strength unreliable correlations *between «skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the sizes of the upper jaw teeth in YW with a very wide facial type* revealed 41 relationships out of 280 possible (14.64 %), of which 3.21 % of direct medium-strength reliable, 4.29 % of direct medium-strength unreliable, 3.21 % of reverse medium-strength reliable, and 3.93 % of reverse medium-strength unreliable.

The following *multiple*, mostly medium-strength, direct and inverse reliable and unreliable relationships were established between *«skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the sizes of the lower jaw teeth in YW with a very wide facial type* – inverse (r= from -0.30 to -0.57) between the value of the ANS-Xi-PM angle and the width of the crown of the central and lateral incisors, canines, first and second premolars, the width of the dentino-enamel border of the central and lateral incisors in the vestibulo-oral direction, the width of the dentino-enamel border of the lateral incisors and canines, the width of the crown of the first premolars in the mesio-distal direction; direct (r= from 0.31 to 0.41) and inverse (r= from -0.34 to -0.44) between the value of the A-NPog distance and the root length of the central and lateral incisors in the mesiodistal direction, the height of the canine crown in the vestibulo-oral direction (direct), the height of the central and lateral incisor crown in the mesiodistal direction, the width of the dentino-enamel border of the canine in the vestibulo-oral direction (inverse); direct (r= from 0.40 to 0.51) and inverse (r= from -0.31 to -0.49) between the Mand1-APog angle and the root length of the central incisors in the mesiodistal direction, the length of the first and second premolars (direct), the crown width and the root length of the central incisors in the vestibulo-oral direction, the crown height of the central incisors in the mesiodistal direction, the length of the central incisors (inverse); mainly direct (r= from 0.33 to 0.52), and inverse (r= from -0.30 to -0.61) between the size of the Xi-OcP distance and the width of the dentino-enamel border of the central and lateral incisors, the length of the root of the central and lateral incisors and canines in the mesio-distal direction, the height of the crown of the lateral incisors and canines in the vestibulo-oral direction, the length of the first premolars (direct), the height of the crown of the central and lateral incisors and canines in the mesio-distal direction (inverse). In YW with a very wide face type, no significant and medium-strength non-significant relationships were found between the size of the mandibular teeth and the size of the 6u-PTV distance. *Quantitative analysis* of reliable and medium-strength unreliable correlations between *«skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the sizes of the lower jaw teeth in YW with a very wide face type* revealed 39 relationships out of 280 possible (13.93 %), of which 2.86 % were direct medium-strength reliable, 2.50 % were direct medium-strength unreliable, 0.36 % were reverse strong reliable, 4.29 % were reverse medium-strength reliable and 3.93 % were reverse medium-strength unreliable.

The following *multiple*, mostly medium-strength, reliable, direct and inverse relationships were established between *«skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the sizes of dental arches in YW with a very wide face type* – reliable and unreliable direct (r= from 0.33 to 0.41) and inverse (r= from -0.31 to -0.62) between the value of the A-NPog distance and the distances 13_23Apx, DL_F and DL_S (direct), 13_23Bugr, VestBM, 33_43Apx, mapx_46, dapx_46 and GL_3 (inverse); mostly reliable, direct (r= from 0.33 to 0.56) and inverse (r= from -0.31 to -0.55) between the value of the distances 1l-APog, 1u-APog or the angle Max1-APog and the distances 13_23Apx, napx_6 (except for the angle Max1-APog), DL_F and DL_S (direct), VestBM, mapx_46, dapx_46 and GL_1 (inverse). In YW with a very wide face type, no reliable and medium-strength unreliable relationships were found between the dimensions of the dental arches and the value of the angle ANS-Xi-PM. *Quantitative analysis* of reliable and medium-strength unreliable correlations *between «skeletal and dento-skeletal» teleradiometric indicators according to the Ricketts method with the sizes of dental arches in YW with a very wide facial type* revealed 40 relationships out of 144 possible (27.78 %), of which 0.69 % were direct strong reliable, 8.33 % were direct medium-strength reliable, 2.08 % were direct medium-strength unreliable, 0.69 % were reverse strong reliable, 9.03 % were reverse medium-strength reliable and 6.94 % were reverse medium-strength unreliable.

The results of numerous studies devoted to the analysis of the relationships between dento-maxillary dimensions, facial parameters and teleradiometric indicators confirm the presence of clear correlations that have both diagnostic and prognostic significance. In particular, a number of authors have established that the dimensions of the central incisors of the upper jaw may have a significant relationship with the width of the nose, interpupillary distance, mouth width and other facial features [7, 10].

In individuals of the Saudi population, the average width of the central incisor in men was recorded as 8.77±0.57 mm, in women – 8.36±0.59 mm. At the same time, the authors found that the width-to-height index of the anterior teeth in men (0.83±0.04) significantly exceeded the similar indicator in women (0.79±0.05) [1].

In a study by P. Chunhabundit et al. [5], it was found that

the width between the wings of the nose has a significant positive correlation (r=0.68, p<0.05) with the total width of the three anterior teeth of the upper jaw.

The mesoprosopic facial type is most often associated with a normal location of the third molars, while euryprosopes and leptoprosopes showed a significantly higher frequency of retention (p<0.05) [8]. In patients with a brachycephalic facial type, the risk of impaction of the third molars was 43.2 %, compared with 29.8 % among dolichocephals. At the same time, in mesocephals this indicator remained intermediate – 36.7 % [22]. Such statistics clearly demonstrate the influence of skeletal type on jaw development and spatial characteristics of the teeth.

It is important to note that several studies have confirmed significant differences between the left and right maxillary central incisors in terms of width and shape. S. V. Vadavadagi et al. [23] reported that on average the right maxillary central incisor unit was 0.14 mm wider than the left (p<0.05), which is potentially important for symmetrical restoration planning.

Y. A. Oh et al. [14] analyzed the width-to-length ratio of the clinical crown in a Korean population. The average index was 0.78 for central incisors, 0.75 for lateral incisors, and 0.70 for canines, indicating a gradual decrease in proportions with distal movement. Similar values were confirmed in the work of A. Orozco-Varo et al. [15], where the length of the central incisor was 10.5±0.9 mm, and the width was 8.5±0.7 mm (index – 0.81).

It is also worth mentioning the study of Jain A. R. et al. [10], in which, based on a systematic review, it was proven that the ratio between the interpupillary distance and the total width of the six anterior teeth of the upper jaw is on average 1.2:1 in men and 1.15:1 in women, which once again emphasizes the need for an individual approach to treatment planning.

It was found that with an increase in height by 4 mm, the volume of the lower third of the face increased by 5.8 %, which improved the visual perception of the face in 87 % of evaluators [21].

Thus, summarizing the data of the above studies, it can be stated that there is a system of regular relationships between skeletal, dento-skeletal and facial parameters. Their analysis opens up wide opportunities for optimizing diagnostics, forecasting and planning individualized orthodontic or orthopedic interventions. The results obtained by us regarding Ukrainian boys and girls with physiological occlusion logically continue the above trend and provide grounds for expanding further morphometric studies on national samples.

Conclusions and prospects for further development

1. In Ukrainian *YM* and *YW* with physiological occlusion, *without taking into account the type of face*, multiple relationships of teleradiometric «skeletal and dento-skeletal» indicators according to the Ricketts method were established: in *YM* – medium strength, mostly direct, reliable, and unreliable (r = from 0.30 to 0.49) with the sizes of the teeth of the upper jaw, medium strength, direct, reliable (r = from 0.34 to 0.45) with the sizes of the teeth of the lower jaw and medium strength, mostly direct, reliable and unreliable (r = from 0.30 to 0.42) with the sizes of the dental arches; in *YW* – reliable, mainly direct, medium and weak strength with the sizes of the teeth of the upper (r= from 0.25 to 0.37) and lower (r= from 0.25 to 0.37) jaws, as well as mainly medium strength, reliable direct (r= from 0.24 to 0.59) and reverse (r= from -0.25 to -0.57) with the sizes of the dental arches.

2. In Ukrainian *YM* and *YW* with physiological bite *with a wide facial type*, multiple connections of teleradiometric «skeletal and dento-skeletal» indicators according to the Ricketts method have been established: in *YM* – medium strength, mainly direct and unreliable (r= from 0.30 to 0.53) with the sizes of the teeth of the upper jaw, medium strength reliable and unreliable direct (r= from 0.30 to 0.58) and inverse (r= from -0.35 to -0.51) with the sizes of the teeth of the lower jaw, as well as medium strength reliable and unreliable direct (r= from 0.33 to 0.55) and inverse (r= from -0.31 to -0.47) with the sizes of the dental arches; in *YW* – mostly medium strength, reliable and unreliable direct (r= from 0.30 to 0.69) and inverse (r= from -0.30 to -0.68) with the sizes of the teeth of the upper jaw, mostly medium strength unreliable, direct (r= from 0.30 to 0.61) and inverse (r= from -0.30 to -0.76) with the sizes of the teeth of the lower jaw, as well as mostly medium strength reliable, direct (r= from 0.35 to 0.65) and inverse (r= from -0.31 to -0.60) with the sizes of the dental arches.

3. In Ukrainian *YW* with physiological occlusion *with a very wide facial type*, multiple relationships of teleradiometric «skeletal and dento-skeletal» indicators according to the Ricketts method were established: medium strength, mostly unreliable, direct (r= from 0.30 to 0.47) and inverse (r= from -0.30 to -0.51) with the sizes of the teeth of the upper jaw, mainly medium strength, reliable and unreliable connections direct (r= from 0.31 to 0.52) and inverse (r= from -0.30 to -0.61) with the sizes of the teeth of the lower jaw, as well as mainly medium strength reliable, direct (r= from 0.33 to 0.56) and inverse (r= from -0.31 to -0.62) with the sizes of the dental arches.

In further studies, it is planned to study the features and gender differences of correlations between other teleradiometric indicators according to the Ricketts method and computed tomography dimensions of teeth and dental arches in Ukrainian YM and YW with physiological occlusion without and taking into account facial type.

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КОРЕЛЯЦІЇ ТЕЛЕРЕНТГЕНОМЕТРИЧНИХ «СКЕЛЕТНИХ І ЗУБО-СКЕЛЕТНИХ» ПОКАЗНИКІВ ЗА МЕТОДОМ RICKETTS ІЗ РОЗМІРАМИ ЗУБІВ І ЗУБНИХ ДУГ В УКРАЇНСЬКИХ ЮНАКІВ І ДІВЧАТ ІЗ ФІЗІОЛОГІЧНИМ ПРИКУСОМ БЕЗ ТА З УРАХУВАННЯМ ТИПУ ОБЛИЧЧЯ

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Анотація. *Зростання поширеності ортодонтичної патології серед підлітків зумовлює необхідність глибшого аналізу морфологічних факторів, що впливають на формування зубощелепної системи. Вивчення взаємозв'язків між*

щелепно-лицевими структурами та розмірами зубних дуг з урахуванням типу обличчя є важливим кроком до ранньої діагностики і профілактики порушень оклюзії. Метою дослідження було встановлення особливостей кореляцій між «скелетними та зубо-скелетними» телерентгенометричними показниками за методом Ricketts із розмірами зубів і зубних дуг в українських юнаків і дівчат із фізіологічним прикусом без та з урахуванням типу обличчя. У 41 українського юнака та 68 українських дівчат із фізіологічним прикусом без та з урахуванням типу обличчя за Гарсоном проведено визначення телерентгенометричних «скелетних і зубо-скелетних» показників за методом Ricketts (відстаней A-NPog, 6u-PTV, 1l-APog, 1u-APog, Xi-OcP та кутів ANS-Xi-PM, Mand1-APog, Max1-APog), комп'ютерно-томографічних розмірів зубів і зубних дуг. Оцінку кореляцій між «скелетними та зубо-скелетними» телерентгенометричними показниками та комп'ютерно-томографічними розмірами зубів і зубних дуг проведено у ліцензійному пакеті «Statistica 6.0» за допомогою непараметричної статистики Спірмена. При аналізі достовірних і середньої сили недостовірних кореляцій між «скелетними та зубо-скелетними» телерентгенометричними показниками за методом Ricketts із розмірами зубів і зубних дуг встановлено: в юнаків і дівчат без урахування типу обличчя – відповідно 7,14 % (переважно прямих середньої сили достовірних) і 8,93 % (переважно прямих середньої й слабкої сили достовірних) зв'язків із розмірами зубів верхньої щелепи, 6,79 % (переважно прямих середньої сили достовірних) і 11,07 % (переважно прямих слабкої й середньої сили достовірних) зв'язків із розмірами зубів нижньої щелепи та 9,03 % (переважно прямих середньої сили достовірних) і 19,44 % (переважно прямих середньої сили достовірних) із розмірами зубних дуг; в юнаків і дівчат із широким типом обличчя – відповідно 12,86 % (переважно прямих середньої сили недостовірних) і 21,07 % (переважно прямих середньої сили недостовірних, зворотніх середньої сили достовірних і недостовірних) зв'язків із розмірами зубів верхньої щелепи, 15,36 % (переважно прямих і зворотніх середньої сили недостовірних) і 27,14 % (переважно зворотніх і прямих середньої сили недостовірних) зв'язків із розмірами зубів нижньої щелепи та 19,44 % (переважно зворотніх і прямих середньої сили недостовірних) і 24,31 % (переважно прямих і зворотніх середньої сили достовірних і недостовірних) із розмірами зубних дуг; у дівчат із дуже широким типом обличчя – 14,64 % (рівномірно прямих і зворотніх середньої сили достовірних і недостовірних) зв'язків із розмірами зубів верхньої щелепи, 13,93 % (переважно зворотніх середньої сили достовірних і недостовірних) зв'язків із розмірами зубів нижньої щелепи та 27,78 % (переважно зворотніх середньої сили достовірних і недостовірних) із розмірами зубних дуг. В українських юнаків і дівчат із фізіологічним прикусом, як без урахування типу обличчя, так і у представників із широким типом обличчя, встановлені виражені прояви статевого диморфізму зв'язків між «скелетними та зубо-скелетними» телерентгенометричними показниками за методом Ricketts та комп'ютерно-томографічними розмірами зубів і зубних дуг.

Ключові слова: *стоматологія, телерентгенометрія «скелетних і зубо-скелетних» показників за методом Ricketts, комп'ютерно-томографічні розміри зубів і зубних дуг, кореляції, українські юнаки та дівчата, фізіологічний прикус, тип обличчя.*