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CORRELATIONS OF TELERADIOMETRIC “DENTAL” 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

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Annotation. *Studying the relationship between the morphological characteristics of the dentofacial system and the parameters of the craniofacial region is important for understanding the mechanisms of formation of a harmonious bite. Analysis of such correlations allows predicting the features of the development of dental arches and developing personalized approaches to orthodontic treatment. Taking into account individual variations in the size of teeth and their correlation with craniofacial parameters contributes to the optimization of diagnostics and planning of orthodontic intervention. The study of these parameters in representatives of the Ukrainian population allows identifying characteristic morphological features and their variability. The aim of the study was to establish qualitative and quantitative features of correlations between “dental” 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. The computed tomographic sizes of teeth, dental arches and “dental” teleradiometric indicators according to the Ricketts method (distances 6u-6l, Overjet, Overbite, 1l-OcP, 3u-3l and angle Max1-Mand1) were determined from the data bank of the Research Center and Department of Pediatric Dentistry of the National Pirogov Memorial Medical University, Vinnytsya from primary computed tomograms of 41 Ukrainian young men (aged 17 to 21 years) and 68 Ukrainian young women (aged 16 to 20 years) with physiological occlusion. The Garson face types of this contingent were also determined. The assessment of correlations between “dental” teleradiometric indicators according to the Ricketts method and computed tomography dimensions of teeth and dental arches in young men and young women without and taking into account the type of face was carried out in the licensed package “Statistica 6.0” using nonparametric Spearman statistics. As a result of the analysis of reliable and medium-strength unreliable correlations between “dental” teleradiometric indicators according to the Ricketts method with the dimensions of teeth and dental arches, the following was established: in young men and young women without taking into account the type of face - respectively 4.76 % and 14.29 % of connections with the dimensions of the teeth of the upper jaw, respectively 11.43 % and 16.67 % of connections with the dimensions of the teeth of the lower jaw and respectively 8.33 % and 6.48 % with the dimensions of the dental arches; in young men and young women with a wide face type – respectively 13.81 % and 14.29 % of connections with the size of the teeth of the upper jaw, respectively 21.90 % and 12.38 % of connections with the size of the teeth of the lower jaw and respectively 16.67 % and 17.59 % of connections with the size of the dental arches; in young women with a very wide face type – 19.05 % of connections with the size of the teeth of the upper jaw, 19.05 % of connections with the size of the teeth of the lower jaw and 17.59 % of connections with the size of the dental arches. In young men and young women, both regardless of facial type and in representatives with a wide facial type, pronounced manifestations of sexual dimorphism of the relationships between “dental” teleradiometric indicators according to the Ricketts method and computed tomography dimensions of teeth and dental arches were established in terms of the strength, number, and direction of reliable and medium-strength unreliable correlations.*
Keywords: *dentistry, morphometry of computed tomography sizes of teeth and dental arches, teleradiometry of “dental” indicators according to the Ricketts method, correlations, Ukrainian young men and young women, physiological occlusion, facial type, sexual dimorphism.of limbs, trunk diameters, transverse dimensions of the pelvis), practically healthy and sick men and women, sexual differences.*

Introduction

Dental diseases and anomalies of the development of the dentofacial system are a significant medical and social problem in many countries of the world. The prevalence of malocclusion, tooth retention, supernumerary and impacted teeth remains high, which leads not only to aesthetic and functional disorders, but also significantly affects the quality of life of patients [2, 5, 8, 11]. It has been found that malocclusion may be associated with an increased risk of developing caries and periodontal diseases due to difficulties in maintaining proper oral hygiene. At the same time, its presence may complicate chewing, contribute to the development of temporomandibular dysfunctions and even impair speech [5].

Disturbances of the development of the dentofacial system have not only medical, but also economic consequences. Treatment of orthodontic anomalies is an expensive and lengthy process, requiring significant costs both for individual patients and for the healthcare system as a whole. According to a systematic review, the average cost of orthodontic treatment in different countries varies from 1500 to 8000 USD depending on the complexity of the case, which creates a significant financial burden on the families of patients [10]. In particular, in low-income countries, access to orthodontic

care is significantly limited, which further exacerbates the problem of uneven distribution of health services [10]. The prevalence of various orthodontic anomalies among children and adolescents is high. In particular, a study in Saudi Arabia showed that 62.4 % of schoolchildren have varying degrees of malocclusion [2]. Similar trends are observed in other populations: according to studies in Nepal, 13.4 % of orthodontic patients have canine retention, requiring additional surgical and orthodontic intervention [18]. At the same time, among Israeli orthodontic patients, 7.8 % have supernumerary teeth, which is also a risk factor for the development of occlusal disorders [9].

One of the important problems of modern orthodontics is the delay in the eruption of permanent teeth, which is associated with numerous local and general factors. It was found that in 15.7 % of cases, the delay in the change of teeth is associated with anomalies of the development of the dentofacial system, and in 7.2 % – with systemic disorders, which once again emphasizes the importance of an integrated approach to diagnosis and treatment [12]. Among other frequent anomalies are impacted third molars, which are found in 43.2 % of orthodontic patients and often require removal due to the risk of complications [14].

Monitoring the structure of anomalies of the dentofacial system in children from different regions is important for the development of effective preventive strategies and optimization of orthodontic treatment. A study in the Donetsk region of Ukraine showed that among children who sought orthodontic care, 29.8 % had a distal bite, 18.5 % had a mesial bite, and 11.2 % had an open bite, which requires individualized treatment approaches [15].

Thus, the significant prevalence of orthodontic anomalies, their impact on quality of life, and the economic burden they create necessitate further research in this area. Particular attention should be paid to studying the relationships between teleradiometric indicators, dental arch morphology, and tooth parameters, which will allow for improved diagnostics and increased efficiency of orthodontic treatment.

The purpose of the study is to establish qualitative and quantitative features of correlations between "dental" 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 facial type.

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 a physiological bite as close as possible to orthognathic 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 conducted at 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 8.11.2022) established that the conducted studies do not contradict the basic bioethical norms of the Declaration of Helsinki, the Council of Europe Convention on Human Rights and Biomedicine (1977), the relevant provisions of the WHO and the laws of Ukraine.

All young men and young women in the private dental clinic "Vinintermed" and in the "Planmeca 3D Maxillofacial Diagnostics Center" underwent teleradiography and computed tomography examination using the dental cone beam tomograph Veraviewepocs 3D Morita (Japan) and Planmeca ProMax 3D Mid (Finland). The studies were performed in the 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 standard teleradiograms, we used teleradiograms with points marked on 3D objects created in the 3D Slicer v5.4.0 software. Analysis and processing of teleradiograms were performed in the licensed software OnyxCeph³™, version 3DPro, from Image Instruments GmbH (Germany).

For the analysis of lateral teleradiograms, the method of Ricketts R. M. [21] was used. According to the method of Ricketts R. M., we determined the following *"dental" indicators* – distance 6u-6l (mm), distance Overjet (mm), distance Overbite (mm), distance 1l-OcP (mm), distance 3u-3l (mm), angle Max1-Mand1 (°).

Morphometry of incisors (11 or 41 – upper or lower central incisors, 12 or 42 – upper or lower lateral incisors), canines (13 or 43 – upper or lower canines), premolars (14 or 44 – upper or lower first premolars, 15 or 45 – upper or lower second premolars) and first molars (16 or 46 – upper or lower first molars) included determination of the width (MdK, VoK) and height (MdLK, VoLK) of the tooth crown, the width of the dentine-enamel junction (MdC, VoC), the root length (MdLR, VoLR) and the tooth length (MdLD) in the mesio-distal (Md) and vestibulo-oral (Vo) directions [6, 7].

Determination of the dimensions of the *dental arches* [7] included measurements: *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 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

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(GL_1), premolar (GL_2) and molar (GL_3) lines.

Facial type was determined according to the Garson morphological index [19]. The following distribution of persons has been 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

As a result of the analysis of reliable relationships *between "dental" 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, multiple* medium-strength direct (r = from 0.32 to 0.39) correlations were found between the value of the distance 6u-6l and the width of the crown and dentine-enamel border of the canines in the mesio-distal and vestibulo-oral directions; as well as medium-strength, mostly inverse (r = from -0.36 to -0.45), correlations between the value of the distance 3u-3l and the length of the root of the central incisors and canines in the mesio-distal direction, the height of the crown of the central and lateral incisors in the vestibulo-oral direction. In YM without taking into account the type of face, no reliable or medium-strength unreliable relationships were found between the sizes of the teeth of the upper jaw and the size of the Overbite, 1l-OcP distances and the Max1-Mand1 angle. *Quantitative analysis* of reliable correlations between "dental" 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 revealed 10 relationships out of 210 possible (4.76 %), of which 2.86 % were direct of medium strength, and 1.90 % were reverse of medium strength.

As a result of the analysis of reliable and medium-strength unreliable relationships *between "dental" teleradiometric indicators according to the Ricketts method with the sizes of the teeth of the lower jaw in YM without taking into account the type of face, multiple* medium-strength, mostly inverse, reliable (r= from -0.31 to -0.46) and unreliable (r= from -0.30 to -0.31) correlations were found between the value of the Overbite distance and the root length of the central and lateral incisors and canines in the vestibulo-oral direction, the length of the lateral incisors and canines, the width of the dentino-enamel border of the lateral incisors and canines in the vestibulo-oral direction, the width of the dentino-enamel border of the canines in the mesio-distal direction; between the value of the 1l-OcP distance and the root length of the central incisors in the vestibulo-oral direction, the width of the crown, the width of the dentino-enamel border and the height of the crown of the lateral incisors in the vestibulo-oral direction and the length of the canines; and also between the value of the 3u-3l distance and the width of the dentino-enamel border and the root length of the central and lateral incisors in the mesio-distal direction, the height of the crown of the central and lateral incisors in the vestibulo-oral direction. *Quantitative analysis* of reliable and medium-strength unreliable correlations *between "dental" 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* revealed 24 relationships out of 210 possible (11.43 %), of which 0.95 % reliable direct relationships of medium strength, 0.95 % unreliable direct relationships of medium strength, 6.67 % reliable inverse relationships of medium strength, 2.86 % unreliable inverse relationships of medium strength.

As a result of the analysis of reliable relationships *between "dental" teleradiometric indicators according to the Ricketts method with the dimensions of the dental arches in YM without taking into account the type of face, multiple* average strength, mainly inverse (r= from -0.32 to -0.47), and direct (r=0.32 and 0.34) correlations were found between the value of the Overbite distance and the distances 33_43Bugr, 33_43Apx (inverse) and 13_23Apx (direct); as well as between the value of the Max1-Mand1 angle and the distances DL_C, DL_S (inverse) and dapx_46 (direct). 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 distance 6u-6l. *Quantitative analysis* of reliable correlations *between "dental" teleradiometric indicators according to the Ricketts method with the sizes of dental arches in YM without taking into account the type of face* revealed 9 relationships out of 108 possible (8.33 %), of which 3.70 % were direct of average strength, 4.63 % were inverse of average strength.

As a result of the analysis of reliable relationships *between "dental" teleradiometric indicators according to the Ricketts method with the sizes of the teeth of the upper jaw in YW, regardless of the type of face, multiple*, mostly direct, medium (r= from 0.32 to 0.38) and weak (r= from 0.25 to 0.29) correlations were found between the value of the Overjet distance and the width of the dentino-enamel border of the central, lateral incisors and canines in the mesio-distal direction, the root length of the central incisors in the mesio-distal direction, the width of the crown of the lateral incisors in the mesio-distal direction, the width of the crown of the canines, first premolars and molars in the vestibulo-oral direction, the width of the dentino-enamel border and the height of the crown of the canines in the vestibulo-oral direction; between the value of the Overbite distance and the height of the crown of the central, lateral incisors and canines in the vestibulo-oral direction; between the value of the 1l-OcP distance and the width of the crown of the central incisors and first molars in the vestibulo-oral direction, the width of the dentino-enamel border of the central incisors in the vestibulo-oral direction, the width of the dentino-enamel border of the canines in the mesio-distal direction; and also between the value of the 3u-3l distance and the length of the root of the central, lateral incisors and canines in the vestibulo-oral direction, the width of the dentino-enamel border of the lateral incisors and canines in the mesio-distal direction, the length of the

first premolars. *Quantitative analysis* of reliable correlations *between "dental" 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 30 relationships out of 210 possible (14.29 %), of which 6.67 % were direct of medium strength, 4.76 % were direct of weak strength, 0.95 % were inverse of medium strength, and 1.90 % were inverse of weak strength.

As a result of the analysis of reliable *relationships between "dental" teleradiometric indicators according to the Ricketts method with the sizes of the teeth of the lower jaw in YW, regardless of the facial type, multiple*, mostly direct, medium (r= from 0.31 to 0.45) and weak (r= from 0.24 to 0.29) correlations were found between the value of the Overjet distance and the root length of the central and lateral incisors in the mesio-distal direction, the width of the crown of the central incisors and second premolars in the vestibulo-oral direction, the width of the dentino-enamel border of the central incisors in the vestibulo-oral direction, the height of the crown of the central, lateral incisors and canines in the vestibulo-oral direction, the width of the dentino-enamel border of the lateral incisors and canines in the mesio-distal direction; between the value of the 1l-OcP distance and the width of the crown, the width of the dentino-enamel boundary and the height of the crown of the central incisors in the vestibulo-oral direction, the width of the crown of the first premolars in the mesio-distal direction; between the value of the 3u-3l distance and the length of the central incisors and canines, the height of the crown of the central incisors and canines in the mesio-distal direction, the length of the root of the central, lateral incisors and canines in the vestibulo-oral direction; weak and medium strength direct (r= from 0.24 to 0.36) and inverse (r= from -0.26 to -0.37) correlations between the value of the Overbite distance and the height of the crown of the central, lateral incisors and canines in the vestibulo-oral direction, the length of the lateral incisors (direct), the width of the crown of the central incisors and first molars in the mesiodistal direction, the width of the crown of the first molars in the vestibulo-oral direction (inverse); as well as weak and medium strength inverse (r= from -0.24 to -0.34) correlations between the value of the Max1-Mand1 angle and the width of the crown of the central incisors and first molars in the mesiodistal direction, the width of the dentino-enamel border of the central and lateral incisors in the mesiodistal direction. *Quantitative analysis* of reliable correlations *between "dental" 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 35 relationships out of 210 possible (16.67 %), of which 6.19 % were direct of medium strength, 6.19 % were direct of weak strength, 1.90 % were inverse of medium strength, and 2.38 % were inverse of weak strength.

As a result of the analysis of the significant relationships *between the "dental" teleradiometric indicators according to the Ricketts method with the dimensions of the dental arches in YW without taking into account the type of face, multiple* inverse correlations of average strength (r = from -0.40 to -0.51) were found only between the angle value Max1-Mand1 and the distances DL_C, DL_F and DL_S. In YW without taking into account the type of face, no significant relationships were found between the dimensions of the dental arches and the distances 1l-OcP and 3u-3l. *Quantitative analysis* of the significant correlations *between the "dental" teleradiometric indicators according to the Ricketts method with the dimensions of the dental arches in YW without taking into account the type of face* revealed 7 relationships out of 108 possible (6.48 %), of which 1.85 % were direct relationships of weak strength, 4.63 % were inverse relationships of average strength.

As a result of the analysis of reliable and medium-strength unreliable relationships *between "dental" teleradiometric indicators according to the Ricketts method with the sizes of the teeth of the upper jaw in YM with a wide facial type, multiple* medium-strength direct correlations (r= from 0.32 to 0.48), mostly unreliable, correlations were found between the value of the 6u-6l distance and the length of the central incisors, the width of the crown of the lateral incisors, canines and second premolars in the vestibulo-oral direction, the width of the dentino-enamel border of the lateral incisors and canines in the vestibulo-oral direction, the width of the crown and the width of the dentino-enamel border of the canines in the mesio-distal direction, the height of the crown of the canines in the vestibulo-oral direction; medium-strength, unreliable, mostly inverse (r= from -0.33 to -0.38), correlations between the value of the Overbite distance and the length of the lateral incisors, the height of the canine crown in the mesiodistal direction, the length of the canine root in the vestibulo-oral direction; as well as medium-strength, mostly inverse, reliable (r= from -0.40 to -0.50) and unreliable (r= from -0.30 to -0.37) correlations between the value of the 6u-6l distance and the width of the dentino-enamel border of the central and lateral incisors in the mesiodistal direction, the height of the crown of the central and lateral incisors in the vestibulo-oral direction, the length of the root of the central, lateral incisors and canines in the mesiodistal direction. *Quantitative analysis* of reliable and medium-strength unreliable correlations *between "dental" teleradiometric indicators according to the Ricketts method with the sizes of the teeth of the upper jaw in YM with a wide facial type* revealed 29 relationships out of 210 possible (13.81 %), of which 1.43 % were reliable direct relationships of medium strength, 6.19 % were unreliable direct relationships of medium strength, 1.43 % were reliable inverse relationships of medium strength, and 4.76 % were unreliable inverse relationships of medium strength.

As a result of the analysis of reliable and medium-strength unreliable relationships *between "dental" teleradiometric indicators according to the Ricketts method with the sizes of the lower jaw teeth in YM with a wide facial type, multiple* medium-strength, mostly direct, reliable (r= from 0.41 to 0.48) and unreliable (r= from 0.33 to 0.36) correlations were found between the value of the 6u-6l distance and the width of the dentino-enamel border of the central incisors in the mesio-

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distal direction, the width of the crown of the central, lateral incisors and first premolars in the vestibulo-oral direction, the width of the dentino-enamel border and the height of the crown of the lateral incisors in the vestibulo-oral direction, the length of the second premolars; medium-strength inverse (r= from -0.30 to -0.45), mostly unreliable, between the value of the 1l-OcP distance and the width of the dentino-enamel border of the central incisors in the mesiodistal direction, the length of the root of the central incisors and canines in the mesiodistal direction, the length of the root of the central incisors in the vestibulo-oral direction, the length of the lateral incisors, canines and second premolars, the width of the crown of the lateral incisors and first premolars in the vestibulo-oral direction, the width of the dentino-enamel border and the height of the crown of the lateral incisors in the vestibulo-oral direction; mostly inverse, medium strength, reliable (r= from -0.40 to -0.61) and unreliable (r= from -0.30 to -0.38) correlations between the value of the Overbite distance and the root length of the central, lateral incisors and canines in the vestibulo-oral direction, the length of the lateral incisors and canines, the crown width and the width of the dentino-enamel border of the canines in the mesiodistal direction, between the value of the 3u-3l distance and the width of the dentino-enamel border and the root length of the central, lateral incisors and canines in the mesiodistal direction, the height of the crown of the central incisors and canines in the vestibulo-oral direction, between the value of the Max1-Mand1 angle and the height of the crown of the lateral incisors in the mesiodistal direction, the width of the crown of the lateral incisors in the mesiodistal direction in the vestibulo-oral direction, the width of the crown of the first molars in the mesiodistal direction. *Quantitative analysis* of reliable and medium-strength unreliable correlations *between "dental" teleradiometric indicators according to the Ricketts method with the sizes of the teeth of the upper jaw in YM with a wide face type* revealed 46 relationships out of 210 possible (21.90 %), of which 2.86 % reliable direct relationships of medium strength, 3.33 % unreliable direct relationships of medium strength, 0.48 % reliable reverse relationships of strong, 4.76 % reliable reverse relationships of medium strength, 10.48 % unreliable reverse relationships of medium strength.

As a result of the analysis of reliable and medium-strength unreliable relationships *between "dental" teleradiometric indicators according to the Ricketts method with the dimensions of the dental arches in YM with a wide face type, multiple* medium-strength, mostly unreliable, direct (r= from 0.31 to 0.38) and inverse (r=-0.33 and -0.41) correlations between the value of the 6u-6l distance and the distances DL_C, DL_F, DL_S (direct), mapx_46, dapx_46 (inverse); medium-strength (r= from -0.34 to -0.41), mostly inverse unreliable, correlations between the value of the Overbite distance and the distances 33_43Bugr, 33_43Apx, mapx_46; medium strength (r= from 0.32 to 0.51), mostly direct unreliable, correlations between the angle value Max1-Mand1 and distances 33_43Apx, mapx_46, dapx_46. *Quantitative analysis* of reliable and medium strength unreliable correlations *between "dental" teleradiometric indicators according to the Ricketts method with the sizes of dental arches in YM with a wide face type* revealed 18 relationships out of 108 possible (16.67 %), of which 1.85% reliable direct average strength, 6.48 % unreliable direct average strength, 2.78 % reliable inverse average strength, 5.56 % unreliable inverse average strength.

As a result of the analysis of reliable and medium-strength unreliable relationships *between "dental" teleradiometric indicators according to the Ricketts method with the sizes of the teeth of the upper jaw in YW with a wide facial type, multiple* medium-strength (r= from -0.30 to -0.50), mostly reverse unreliable, correlations were found between the value of the Max1-Mand1 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 in the mesio-distal direction, the height of the crown of the central and lateral incisors in the mesio-distal direction, the width of the dentine-enamel border of the lateral incisors and canines in the vestibulo-oral direction, the width of the crown of the canines and second premolars in the vestibulo-oral direction, the height of the crown of the canines in the vestibulo-oral direction, as well as between the value of the distance 6u-6l and the length of the central incisors, the length of the root of the central incisors in the mesio-distal direction, the width of the dentino-enamel border of the central incisors in the vestibulo-oral direction; medium strength (r= from 0.30 to 0.52), mostly unreliable straight correlations between the value of the distance 3u-3l and the length of the root of the central incisors and canines in the vestibulo-oral direction, the height of the crown of the lateral incisors in the mesio-distal direction, the length of the first and second premolars; medium-strength direct unreliable correlations (r= from 0.30 to 0.33) between the value of the Overbite distance and the length of the central incisors, the width of the crown of the lateral incisors and first molars in the vestibulo-oral direction, the height of the crown of the lateral incisors in the vestibulo-oral direction. *Quantitative analysis* of reliable and medium-strength unreliable correlations *between "dental" teleradiometric indicators according to the Ricketts method with the sizes of the teeth of the upper jaw in YW with a wide face type* revealed 30 relationships out of 210 possible (14.29 %), of which 1.90% reliable direct relationships of medium strength, 4.29 % unreliable direct relationships of medium strength, 0.48 % reliable reverse relationships of medium strength, 7.62 % unreliable reverse relationships of medium strength.

As a result of the analysis of reliable and medium-strength unreliable relationships between *"dental" teleradiometric indicators according to the Ricketts method with the sizes of the lower jaw teeth in YW with a wide facial type, multiple* medium-strength direct correlations (r= from 0.38 to 0.56), mostly reliable, correlations were found between the value of the Overjet distance and the width of the crown and the width of the dentino-enamel border of the central incisors in

the vestibulo-oral direction, the width of the dentino-enamel border of the lateral incisors and canines in the mesio-distal direction; mainly direct (r= from 0.32 to 0.50), medium-strength non-significant correlations between the value of the 3u-3l distance and the length of the central incisors, the height of the crown of the central incisors in the mesio-distal direction, the root length of the central incisors and canines in the vestibulo-oral direction, as well as inverse non-significant (r=-0.36 in both cases) with the width of the crown of the lateral incisors and canines in the mesio-distal direction; medium-strength inverse (r= from -0.30 to -0.49), mostly significant, and direct non-significant (r= from 0.30 to 0.39) correlations between the size of the Max1-Mand1 angle and the width of the crown of the central incisors and canines in the vestibulo-oral direction, the width of the dentino-enamel border of the central incisors in the vestibulo-oral direction, the width of the crown of the canines, second premolars and first molars in the mesio-distal direction (inverse), the length of the root of the central incisors in the mesio-distal direction, the length of the first and second premolars (direct). *Quantitative analysis* of reliable and medium-strength unreliable correlations *between "dental" teleradiometric indicators according to the Ricketts method with the sizes of the upper jaw teeth in YW with a wide face type* revealed 26 relationships out of 210 possible (12.38 %), of which 1.90 % reliable direct relationships of medium strength, 5.24 % unreliable direct relationships of medium strength, 1.90 % reliable inverse relationships of medium strength, 3.33 % unreliable inverse relationships of medium strength.

As a result of the analysis of reliable and medium-strength unreliable relationships *between "dental" teleradiometric indicators according to the Ricketts method with the dimensions of dental arches in YW with a wide facial type, multiple* medium-strength direct (r= from 0.31 to 0.40), mostly unreliable, correlations between the value of the distance 6u-6l and the distances PonPr, dapx_6, 33_43Bugr were revealed; mostly inverse, medium-strength (r= from -0.37 to -0.51) reliable and unreliable correlations between the value of the Overjet distance and the distances GL_1, GL_2, GL_3, napx_6; medium strength, mostly reliable, direct (r= from 0.33 to 0.49) and unreliable inverse (r=-0.30 in both cases) correlations between the size of the Overbite distance and the distances PonM, 13_23Apx, VestBM, mapex_6 (direct), GL_2, GL_3 (inverse); reliable, mostly medium strength inverse (r= from -0.55 to -0.65) correlations between the size of the Max1-Mand1 angle and the distances DL_C, DL_F, DL_S. In YW with a wide face type, no reliable or medium strength unreliable relationships were found between the sizes of the dental arches and the size of the 3u-3l distance. *Quantitative analysis* of reliable and medium-strength unreliable correlations *between "dental" teleradiometric indicators according to the Ricketts method with the dimensions of dental arches in YW with a wide facial type* revealed 19 relationships out of 108 possible (17.59 %), of which 4.63 % were reliable direct relationships of medium strength, 4.63 % were unreliable direct relationships of medium strength, 0.93 % were reliable inverse relationships of strong strength, 3.70 % were reliable inverse relationships of medium strength, and 3.70 % were unreliable inverse relationships of medium strength.

As a result of the analysis of reliable and medium-strength unreliable relationships *between "dental" teleradiometric indicators according to the Ricketts method with the sizes of the teeth of the upper jaw in YW with a very wide facial type, multiple* medium-strength unreliable inverse (r= from -0.30 to -0.34) correlations were found between the value of the 6u-6l distance and the length of the central incisors and first premolars, the length of the root of the central incisors and canines in the mesio-distal direction; medium strength direct (r= from 0.31 to 0.55), mostly reliable and inverse reliable (r= from -0.37 to -0.39) correlations between the value of the Overjet distance and the width of the dentino-enamel border and the root length of the central and lateral incisors in the mesiodistal direction, the length of the central incisors, the width of the crown of the central, lateral incisors, canines and first premolars in the vestibulo-oral direction, the height of the crown of the central, lateral incisors, canines and first molars in the vestibulo-oral direction, the width of the crown of the lateral incisors in the mesiodistal direction, the width of the dentino-enamel border of the canines in the vestibulo-oral direction (direct), the height of the crown of the central and lateral incisors in the mesiodistal direction, the length of the root of the canines in the vestibulo-oral direction (reverse); medium-strength direct (r= from 0.33 to 0.37), mostly unreliable and inverse reliable (r=-0.39 and -0.51) correlations between the value of the Overbite distance and the length of the central incisors, the height of the crown of the central incisors and canines in the vestibulo-oral direction, the width of the crown of the first premolars in the vestibulo-oral direction (direct), the length of the root of the canines in the vestibulo-oral direction, the width of the crown of the first molars in the mesio-distal direction (reverse); medium-strength direct correlations (r= from 0.30 to 0.42), mostly unreliable correlations between the value of the 1l-OcP distance and the width of the crown of the central incisors in the vestibulo-oral direction, the width of the dentino-enamel border of the central and lateral incisors in the vestibulo-oral direction; medium-strength direct (r= from 0.31 to 0.50), mostly reliable, and inverse reliable and unreliable (r=-0.38 and -0.32) correlations between the value of the 3u-3l distance and the root length of lateral incisors and canines in the vestibulo-oral direction, the width of the dentino-enamel border and the width of the canine crown in the mesio-distal direction, the width of the crown of the first molars in the mesio-distal direction (direct), the height of the crown of the central and lateral incisors in the vestibulo-oral direction (inverse). *Quantitative analysis* of reliable and medium-strength unreliable correlations *between "dental" teleradiometric indicators according to the Ricketts method with the sizes of the upper jaw teeth in YW with a very wide facial type* revealed 40 relationships out of 210 possible (19.05 %), of which 8.10 % were reliable direct relationships of medium strength, 5.24 % were unreliable direct relationships of medium strength, 2.86 % were

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reliable inverse relationships of medium strength, and 2.86 % were unreliable inverse relationships of medium strength.

As a result of the analysis of reliable and medium-strength unreliable relationships *between "dental" teleradiometric indicators according to the Ricketts method with the sizes of the lower jaw teeth in YW with a very wide facial type*, *multiple*, mostly reliable, medium-strength direct (r= from 0.32 to 0.65) and reliable and unreliable inverse (r= from -0.30 to -0.48) correlations were found between the value of the Overjet distance and the width of the dentino-enamel border of the central, lateral incisors and canines in the mesio-distal direction, the root length of the central and lateral incisors in the mesio-distal direction, the width of the dentino-enamel border of the central incisors in the vestibulo-oral direction, the height of the crown of the central, lateral incisors and canines in the vestibulo-oral direction, the width of the crown lateral incisors in the mesiodistal direction, crown width of second premolars in the vestibulo-oral direction (direct), crown height of central, lateral incisors and canines in the mesiodistal direction, root length of canines in the vestibulo-oral direction (reverse); medium-strength reliable and unreliable direct (r= from 0.32 to 0.39) correlations between the value of the 1l-OcP distance and the length of central and lateral incisors, crown height of lateral incisors in the mesiodistal direction, crown width of first premolars in the mesiodistal direction; mostly reliable, medium-strength direct correlations (r= from 0.35 to 0.58) between the value of the 3u-3l distance and the length of the central incisors and canines, the height of the crown of the central incisors and canines in the mesio-distal direction, the root length of the central, lateral incisors and canines in the vestibulo-oral direction, the width of the dentino-enamel border of the canines in the vestibulo-oral direction; mostly straight, medium-strength reliable (r= from 0.38 to 0.41) and unreliable (r= from 0.30 to 0.35) correlations between the size of the Max1-Mand1 angle and the length of the central incisors, the height of the crown of the central and lateral incisors in the mesiodistal direction, the length of the root of the central and lateral incisors in the vestibulo-oral direction, and the width of the crown of the canines in the vestibulo-oral direction. *Quantitative analysis* of reliable and medium-strength unreliable correlations *between "dental" teleradiometric indicators according to the Ricketts method with the sizes of the teeth of the upper jaw in YW with a very wide facial type* revealed 40 relationships out of 210 possible (19.05 %), of which 0.48 % were reliable direct strong, 10.48 % were reliable direct medium-strength, 4.29 % were unreliable direct medium-strength, 1.90 % were reliable reverse medium-strength, and 1.90 % were unreliable reverse medium-strength.

As a result of the analysis of reliable and medium-strength unreliable relationships *between "dental" teleradiometric indicators according to the Ricketts method with the dimensions of dental arches in YW with a very wide facial type, multiple* medium-strength, mostly reliable inverse (r= from -0.30 to -0.48), correlations between the value of the Overjet distance and the distances GL_3, mapx_46, dapx_46; medium-strength, mostly reliable direct (r= from 0.30 to 0.55), and mostly reliable inverse (r= from -0.31 to -0.56), correlations between the value of the Max1-Mand1 angle and the distances GL_1, GL_2, VestBM, mapx_46, dapx_46 (direct), DL_F, DL_S, 13_23Apx (inverse). In YW with a very wide face type, no reliable or medium-strength unreliable relationships were found between the dimensions of the dental arches and the value of the 1l-OcP distance. *Quantitative analysis* of reliable and medium-strength unreliable correlations *between "dental" teleradiometric indicators according to the Ricketts method with the dimensions of the dental arches in YW with a very wide face type* revealed 19 relationships out of 108 possible (17.59 %), of which 2.78 % were reliable direct relationships of medium strength, 5.56 % were unreliable direct relationships of medium strength, 5.56 % were reliable inverse relationships of medium strength, and 3.70 % were unreliable inverse relationships of medium strength.

It has been established that somatometric parameters can have a significant impact on dental status. For example, analysis of the relationship between general anthropometric indicators and the prevalence of caries showed the presence of statistically significant correlations ($r=0.41$, $p<0.05$), indicating an increased risk of developing carious lesions in individuals with higher somatometric indicators [1]. This confirms the need to take into account somatic characteristics when assessing the risks of developing dental pathologies.

A study of the relationship between the size of the dental arches and craniofacial parameters confirmed that the width of the anterior teeth of the upper jaw is proportional to the width of the face ($r=0.78$, $p<0.01$) [3]. Similar patterns were observed when studying the relationship between the interpupillary distance and the total mesiodistal width of the maxillary central incisors, where a correlation of $r=0.74$ ($p<0.01$) was recorded [4]. The revealed relationships allow predicting the size of the dental arches based on the anthropometric characteristics of the facial skull.

The parameters of the dentofacial system can also be associated not only with craniometric indicators, but also with general somatometric characteristics. In particular, it was found that the body mass index and body composition features have a statistically significant association with the number of lost teeth ($r=-0.52$, $p<0.01$) [17, 22]. In elderly patients, this relationship is even more pronounced ($r=-0.61$, $p<0.001$), which may be due to the complex influence of general health and metabolic factors.

Studies on the relationship between craniofacial dimensions and vertical occlusion dimensions also confirm the importance of anthropometric characteristics in the formation of the dentofacial complex. In representatives of different populations, a correlation between craniofacial dimensions and vertical occlusion dimensions was found at the level of $r=0.69$ ($p<0.01$), which confirms their significant role in predicting occlusal relationships [16, 24].

Particular attention was paid to the study of correlations between linear molar dimensions and teleradiometric indicators. The analysis showed that some craniometric param-

eters have a significant correlation with the morphological features of molars (r=0.63, p<0.01) [23]. These results confirm the need for a comprehensive approach to diagnosis and treatment in orthodontics, taking into account the relationship between different anatomical structures.

Studies of the relationship between dental characteristics and general somatometric indicators are supplemented by the analysis of body composition and bone density. It was found that women with tooth loss and periodontal status have a decrease in bone mineral density (p<0.05), which may be associated with the peculiarities of systemic calcium and phosphorus metabolism [13]. This factor must be taken into account when planning orthodontic treatment, since the state of bone tissue directly affects the remodeling processes during tooth movement. Another important aspect is the relationship between the dimensions of the central incisors of the upper jaw and the overall proportions of the face. It was found that the length of the central incisor is on average 25.4 % of the height of the middle third of the face, and its width is 16.8 % of the total width of the face (p<0.01) [20]. This emphasizes the importance of aesthetic and harmonious proportions when planning orthodontic and orthopedic treatment, as maintaining the correct relationships between dental and facial structures plays a key role in achieving optimal aesthetic results.

Conclusions and prospects for further development

1. In Ukrainian *YM and YW* with physiological occlusion *without taking into account the type of face*, the following multiple, mostly reliable, correlations of teleradiometric "dental" indicators according to the Ricketts method were established: in *YM* – of medium strength, mostly direct, reliable (r= from 0.32 to 0.44 – 2.86 % of the total) with the width of the crown and dentine-enamel border of the canines of the upper jaw; of medium strength (r= from -0.30 to -0.46 – 9.53 % of the total), mostly reverse, reliable and unreliable with most sizes of the incisors and canines of the lower jaw; medium strength reliable, mostly inverse (r= from -0.32 to -0.47 – 4.63 % of the total), with the distances 33_43Bugr, 33_43Apx, DL_C and DL_S; in *YW* – medium (r= from 0.32 to 0.38 – 6.67 % of the total) and weak (r= from 0.25 to 0.29 – 4.76 % of the total) forces reliable, mostly direct, with the width of the dentine enamel border, root length, width and height of the crown of the incisors and canines of the upper jaw; medium (r= from 0.31 to 0.45 – 6.19 % of the total) and weak (r= from 0.24 to 0.29 – 6.19 % of the total) forces are reliable, mainly direct, with most sizes of incisors and canines of the lower jaw; medium strength is reliable, mainly reverse (r= from -0.33 to -0.51 – 4.63 % of the total), with the size of the distances DL_C, DL_F and DL_S.

2. In Ukrainian *YM and YW* with physiological bite and *wide facial type*, the following multiple reliable and medium-strength unreliable correlations of teleradiometric "dental" indicators according to the Ricketts method were established: in *YM* – medium-strength, mostly unreliable, direct (r= from 0.31 to 0.37 – 6.19 % of the total) and inverse (r= from -0.30 to -0.37 – 4.76 % of the total) with the width and height of the crowns, the length of the root and the width of the dentine-enamel border of the incisors and canines of the upper jaw; mainly medium-strength reverse, reliable (r= from -0.40 to -0.61 – 5.24 % of the total) and unreliable (r= from -0.30 to -0.39 – 10.48 % of the total) with most sizes of incisors and canines of the lower jaw; mainly medium-strength unreliable, direct (r= from 0.31 to 0.40 – 6.48 % of the total) and reverse (r= from -0.31 to -0.38 – 5.56 % of the total) with the values of distances 33_43Bugr, 33_43Apx, mapx_46 and dapx_46; in *YW* – mostly unreliable, medium-strength straight (r= from 0.30 to 0.38 – 4.29 % of the total) and inverted (r= from -0.30 to -0.37 – 7.62 % of the total) with most of the sizes of the incisors and the width of the crowns of the second premolars of the upper jaw; mostly unreliable, medium-strength straight (r= from 0.30 to 0.39 – 5.24 % of the total) and inverted (r= from -0.30 to -0.38 – 3.33 % of the total) with most of the sizes of the central incisors, crown width, root length and width of the dentino-enamel border of the canines and crown width and length of the premolars of the lower jaw; mainly of medium strength reliable and unreliable, direct (r= from 0.31 to 0.49 – 9.26 % of the total) and inverse (r= from -0.30 to -0.65 – 8.33 % of the total) with the size of most of the sizes of dental arches.

3. In Ukrainian *YW* with physiological bite *with a very wide facial type*, the following multiple correlations of teleradiometric "dental" indicators according to the Ricketts method were established: mainly direct, of medium strength reliable (r= from 0.36 to 0.55 – 8.10 % of the total) and unreliable (r= from 0.30 to 0.35 – 5.24 % of the total) with most of the sizes of incisors and canines of the upper jaw; mainly direct correlations of medium strength, reliable (r= from 0.37 to 0.65 – 10.96 % of the total) and unreliable (r= from 0.30 to 0.36 – 4.29 % of the total) with most sizes of incisors and canines of the lower jaw; medium strength reliable and unreliable direct (r= from 0.30 to 0.55 – 8.34 % of the total) and inverse (r= from -0.30 to -0.56 – 9.26 % of the total) correlations with most sizes of dental arches.

4. In Ukrainian YM and YW with physiological occlusion, both without taking into account the facial type and in representatives with a wide facial type, pronounced manifestations of sexual dimorphism of the relationships between "dental" teleradiometric indicators according to the Ricketts method and computed tomography dimensions of teeth and dental arches were established in terms of the strength, number and direction of reliable and medium-strength unreliable correlations.

In further studies, it is planned to study the features and sexual differences of the correlations between "skeletal and dento-skeletal" 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 the facial type.

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

Броцький Н. О., Дмитрієв М. О., Беляєв Е. В., Піліпонова В. В., Кириченко І. М.

Анотація. *Вивчення взаємозв'язку між морфологічними характеристиками зубощелепної системи та параметрами черепно-лицевої області є важливим для розуміння механізмів формування гармонійного прикусу. Аналіз таких кореляцій*

дозволяє прогнозувати особливості розвитку зубних дуг і розробляти персоналізовані підходи до ортодонтичного лікування. Врахування індивідуальних варіацій у розмірах зубів та їх співвідношення з краніофаціальними показниками сприяє оптимізації діагностики та планування ортодонтичного втручання. Дослідження цих параметрів у представників української популяції дозволяє виявити характерні морфологічні особливості та їхню варіативність. Метою дослідження було встановлення якісних і кількісних особливостей кореляцій між «зубними» 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. Проведено визначення комп'ютерно-томографічних розмірів зубів, зубних дуг і «зубних» телерентгенометричних показників за методом Ricketts (відстані 6u-6l, Overjet, Overbite, 1l-OcP, 3u-3l та кут Max1-Mand1) із отриманих з банку даних науково-дослідного центру та кафедри стоматології дитячого віку Вінницького національного медичного університету ім. М. І. Пирогова комп'ютерних томограм 41 українського юнака (віком від 17 до 21 року) та 68 українських дівчат (віком від 16 до 20 років) із фізіологічним прикусом. Також визначені типи обличчя за Гарсоном даного контингенту. Оцінку кореляцій між «зубними» телерентгенометричними показниками за методом Ricketts і комп'ютерно-томографічними розмірами зубів і зубних дуг в юнаків і дівчат без і з урахуванням типу обличчя проведено у ліцензійному пакеті «Statistica 6.0» за допомогою непараметричної статистики Спірмена. В результаті аналізу достовірних і середньої сили недостовірних кореляцій між «зубними» телерентгенометричними показниками за методом Ricketts із розмірами зубів і зубних дуг встановлено: в юнаків і дівчат без урахування типу обличчя – відповідно 4,76 % і 14,29 % зв'язків із розмірами зубів верхньої щелепи, відповідно 11,43 % і 16,67 % зв'язків із розмірами зубів нижньої щелепи та відповідно 8,33 % і 6,48 % із розмірами зубних дуг; в юнаків і дівчат із широким типом обличчя – відповідно 13,81 % і 14,29 % зв'язків із розмірами зубів верхньої щелепи, відповідно 21,90 % і 12,38 % зв'язків із розмірами зубів нижньої щелепи та відповідно 16,67 % і 17,59 % із розмірами зубних дуг; у дівчат із дуже широким типом обличчя – 19,05 % зв'язків із розмірами зубів верхньої щелепи, 19,05 % зв'язків із розмірами зубів нижньої щелепи та 17,59 % із розмірами зубних дуг. В юнаків і дівчат як без урахування типу обличчя, так і у представників із широким типом обличчя, встановлені виражені прояви статевого диморфізму зв'язків між «зубними» телерентгенометричними показниками за методом Ricketts та комп'ютерно-томографічними розмірами зубів і зубних дуг за силою, кількістю та напрямком достовірних і середньої сили недостовірних кореляцій.

Ключові слова: *стоматологія, морфометрія комп'ютерно-томографічних розмірів зубів і зубних дуг, телерентгенометрія «зубних» показників за методом Ricketts, кореляції, українські юнаки та дівчата, фізіологічний прикус, тип обличчя, статевий диморфізм.*