

DOI 10.31393/reports-vnmedical-2025-29(3)-02

УДК: 611.314:611.714+616.714.1-071.3

CORRELATIONS OF TELERADIOMETRIC INDICATORS OF “CRANIOFACIAL PROPORTIONS” 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

Brotskyi N. O., Dmitriev M. O., Popov M. V., Dudik O. P., Dyakova O. V., Gunas I. V.

National Pirogov Memorial Medical University, Vinnytsya (Pirohova 56 st., Vinnytsia, Ukraine, 21018)

Responsible for correspondence:
e-mail: opdihatopa@gmail.com

Received: May, 30, 2025; Accepted: July, 01, 2025

Annotation. The study of the relationships between the structural parameters of the facial skeleton and odontometric characteristics is important for understanding the individual characteristics of the maxillofacial region. Radiological analysis techniques allow us to accurately assess the anatomical relationships that form the harmony of the profile and position of the jaws. At the same time, anthropometric features, in particular the shape of the face, can significantly affect the relationship between the size of the teeth and the shape of the dental arches. The study of such patterns in young people without occlusion pathologies will contribute to the optimization of diagnostics and treatment planning in orthodontics. The aim of the study was to establish the features of the correlations between teleradiometric indicators of «craniofacial proportions» 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 indicators of «craniofacial proportions» according to the Ricketts method (angles NPog-Por, NBa-PtG, MeSgo-NPog, MeSgo-Por, POr-NA, N-CF-A and POr-SpP) were determined from the computer tomograms of 41 Ukrainian young men and 68 young women with physiological occlusion obtained from the data bank of the Research Center and Department of Pediatric Dentistry of the National Pirogov Memorial Medical University, Vinnytsya. In this contingent, the types of faces according to Garson were also determined. The assessment of correlations between the indicators of «craniofacial proportions» 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 teleradiometric indicators of «craniofacial proportions» according to the Ricketts method with the sizes of teeth and dental arches, it was established: in young men and young women without taking into account the type of face – respectively 3.27 % and 9.80 % of connections with the sizes of teeth of the upper jaw, 4.90 % and 9.80 % of connections with the sizes of teeth of the lower jaw and 6.35 % and 7.14 % with the sizes of dental arches; in young men and young women with a wide face type – respectively 8.16 % and 28.16 % of connections with the size of the teeth of the upper jaw, 13.06 % and 32.65 % of connections with the size of the teeth of the lower jaw and 11.90 % and 15.87 % with the size of the dental arches; in young women with a very wide face type – 6.94 % of connections with the size of the teeth of the upper jaw, 9.80 % of connections with the size of the teeth of the lower jaw and 13.49 % with the size of the dental arches. In all groups of young men and young women, pronounced manifestations of sexual dimorphism of the connections between teleradiometric indicators of «craniofacial proportions» according to the Ricketts method and computed tomography sizes of teeth and dental arches were established by the strength, number and direction of reliable and medium-strength unreliable correlations.

Keywords: dentistry, teleradiometry of «craniofacial proportions» indicators according to the Ricketts method, morphometry of computed tomography sizes of teeth and dental arches, correlations, young men and young women, physiological occlusion, facial type.

Introduction

One of the important directions of modern orthodontics is the study of the relationship between craniofacial morphology and the dimensions of the elements of the dentofacial system. The formation of a harmonious structure of the facial skeleton is largely determined not only by the morphogenesis of the jaws, but also by the parameters of the teeth and their location in the dental arches. The technique of teleradiographic analysis according to Ricketts allows for a comprehensive assessment of the mutual arrangement of the structures of the skull and face, which becomes especially valuable in combination with linear measurements of the dentition. Taking into account the morphotype of the face allows for the detailed analysis of interindividual features that may have prognostic significance in the formation of individualized

orthodontic treatment schemes.

The state of dental health among adolescents and young people is currently of serious concern due to the growing prevalence of anomalies in the development of teeth and jaws. According to many clinical studies, a significant percentage of patients have supernumerary teeth, which can change the configuration of the dental arches and cause disharmony of the jaw ratio. Thus, the frequency of detection of supernumerary teeth varies from 0.1 % to 3.8 % depending on the population [6, 10, 22]. Some studies report even higher rates – up to 5.6 % [15]. The presence of such structural anomalies is often accompanied by eruption disorders, tooth displacements and arch deformation, which directly affects the results of orthodontic analysis.

One of the common pathologies is retention and transmigration of the canines of the lower jaw. According to the results of a systematic analysis, the frequency of retention is about 2 %, and transmigration is recorded in 0.33 % of cases [5]. Such displacements significantly complicate diagnosis and treatment, as they change not only local, but also general morphometric ratios in the facial skull. At the same time, diastemas, especially in the medial line of the upper jaw, can be a consequence of both supernumerary teeth and peculiarities of the alveolar process morphology [14].

It is known that the anterior segment of the dentition is most vulnerable to caries and traumatic lesions, which also affects the accuracy of linear measurements in orthodontic analysis. A study conducted among the European population showed that the frequency of anterior teeth lesions exceeds 28 %, and in certain age groups – up to 38 % [8]. High incidence rates may be due to insufficient oral hygiene, microstructural features of the enamel in this area and trauma. This is important to consider when determining the size of the teeth for comparison with craniometric indices.

The question of the influence of jaw pathologies in childhood and adolescence on the further growth and development of the facial skeleton is also relevant. A large retrospective study conducted in India found that cysts and benign tumor-like formations are the most common among children under 15 years of age, accounting for up to 63 % of all cases of jaw pathologies [23]. Such processes can deform bone tissue, change the direction of jaw growth and, accordingly, affect the formation of the facial profile.

It is equally important to consider the general structure of common dental diseases, in particular caries, gingivitis and malocclusion. In world practice, approximately 60-70 % of school-age children have some form of occlusion disorder [24]. This indicates the need to study normal variants of the dentofacial structure in clinically healthy individuals in order to have guidelines for early diagnosis of pathological changes. X-ray analysis data, supplemented by accurate measurements of teeth and arches, can be an effective tool for such monitoring.

The prevalence of facial skeletal injuries, in particular Le Fort fractures in children and adolescents, although not a direct factor under normal conditions, can have long-term consequences for the formation of craniofacial symmetry. Such injuries occur with a frequency of 0.6 cases per 100 thousand people and are more often recorded in male adolescents [16]. Cases of post-traumatic changes in the jaw area emphasize the importance of a clear understanding of the norm, including teleradiometric ratios, for qualitative differentiation of pathology.

Thus, modern epidemiological data indicate a significant prevalence of both normal variants and pathological changes in the structure of the dentofacial system. The study of the relationship between the geometry of the facial skeleton and the size of dental elements in clinically healthy boys and girls allows us to clarify the limits of the norm taking into account the morphotype of the face. This knowledge is essential

for a personalized approach in orthodontics, prevention of relapses, and optimization of treatment strategies.

The purpose of the study is to establish the features of correlations between teleradiometric indicators of “craniofacial proportions” 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 tomograms 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 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 dental cone-beam tomograph Veraviewepocs 3D Morita (Japan) and Planmeca ProMax 3D Mid (Finland). The examination was performed in the software shell 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 OnyxCeph™, version 3DPro, from Image Instruments GmbH (Germany).

Facial type was determined according to the Garson morphological index [18]. 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.

For the analysis of lateral telero-radiographs, the Ricketts R. M. method was used [19]. We determined the following indicators of “craniofacial relations” according to the Ricketts method: the value of the NPog-POR angle – the angle of the depth of the face, characterizing the position of the chin in the sagittal plane (°); the value of the NBa-PtG angle – the angle of the facial axis, an important component of the analysis of the direction of growth of the lower jaw (°); the value of the MeSgo-NPog angle – the facial cone, an important component of the analysis of the growth of the lower jaw (°); the value of the MeSgo-POR angle – the angle that

characterizes the inclination of the body of the lower jaw relative to the Frankfurt plane (°); the value of the POr-NA angle – the angle of the depth of the upper jaw, characterizing the development of the upper jaw in the sagittal plane (°); the value of the N-CF-A angle – the angle of the height of the upper jaw, characterizing the development of the middle third of the face/upper jaw in the vertical plane (°); The value of the POr-SpP angle is the angle formed by the Po-Or and ANS-PNS lines, characterizing the inclination of the base of the upper jaw to the Frankfurt plane (°).

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 length of the root (MdLR, VoLR) and the length of the tooth (MdLD) in the mesio-distal (Md) and vestibulo-oral (Vo) directions [2, 3].

Determination of the dimensions of the *dental arches* [3] included measurements of the following distances: 33_43Bgr, 13_23Bgr, VestBM, PonPr, PonM, 13_23Apx, napx_6, dapx_6, mapex_6, 33_43Apx, mapx_46, dapx_46, DL_C, DL_F, DL_S, GL_1, GL_2 and GL_3.

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

Results. Discussion

When analyzing the significant correlations *between teleradiometric indicators of «craniofacial proportions» 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 correlations (r = from 0.31 to 0.48) were found only between the value of the POr-NA angle and the length of the root part of the lateral incisors and the width of the cervical part of the canines in the mesio-distal direction, the width of the coronal part of the lateral incisors, canines and second premolars, the width of the cervical part of the canines in the vestibulo-oral direction. In YM without taking into account the type of face, no significant or medium-strength non-significant relationships were found between the sizes of the teeth of the upper jaw and the size of the angles NBa-PtG, MeSgo-NPog, MeSgo-Por and POr-SpP. *Quantitative analysis of reliable correlations between teleradiometric indicators of «craniofacial proportions» 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 only 8 medium-strength direct correlations out of 245 possible (3.27 %).

When analyzing reliable and medium-strength unreliable correlations *between teleradiometric indicators of «craniofacial proportions» 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*, only single, mainly medium-strength direct reliable correlations were found. In YM without taking

into account the type of face, no reliable or medium-strength unreliable correlations were found between the sizes of the teeth of the lower jaw and the value of the MeSgo-NPog angle. *Quantitative analysis of reliable and medium-strength unreliable correlations between teleradiometric indicators of «craniofacial proportions» according to the Ricketts method with the sizes of the lower jaw teeth in YM without taking into account the type of face* revealed only 12 correlations out of 245 possible (4.90 %), of which 3.27 % were reliable direct medium-strength, 0.41 % were unreliable direct medium-strength, 0.41 % were reliable inverse medium-strength, and 0.82 % were unreliable inverse medium-strength.

When analyzing reliable and medium-strength unreliable correlations *between teleradiometric indicators of «craniofacial proportions» according to the Ricketts method with the dimensions of the dental arches in YM without taking into account the type of face*, only single, mostly reliable, medium-strength direct and inverse correlations were found. In YM without taking into account the type of face, no reliable or medium-strength unreliable correlations were found between the dimensions of the dental arches and the value of the POr-NA angle. *Quantitative analysis of reliable and medium-strength unreliable correlations between teleradiometric indicators of «craniofacial proportions» according to the Ricketts method with the sizes of dental arches in YM without taking into account the type of face* revealed only 8 correlations out of 126 possible (6.35 %), of which 3.17% were reliable direct correlations of medium strength, 2.38 % were reliable inverse correlations of medium strength, and 0.79 % were unreliable inverse correlations of medium strength.

When analyzing the reliable correlations *between teleradiometric indicators of «craniofacial proportions» according to the Ricketts method with the sizes of the upper jaw teeth in YW without taking into account the type of face*, multiple inverse correlations of medium (r = from -0.31 to -0.40) and weak (r = from -0.25 to -0.27) strength were found between the value of the N-CF-A angle and the width of the coronal part of the central incisors and canines, the length of the root part of the lateral incisors and canines in the mesiodistal direction, the length of the root part of the lateral incisors and canines, the width of the coronal part of the second premolars in the vestibulo-oral direction, and the length of the canines. *Quantitative analysis of reliable correlations between teleradiometric indicators of «craniofacial proportions» according to the Ricketts method with the sizes of the upper jaw teeth in YW without taking into account the type of face* revealed 24 correlations out of 245 possible (9.80 %), of which 0.82 % were direct of medium strength, 3.67 % were direct of weak strength, 2.86 % were inverse of medium strength, and 2.45 % were inverse of weak strength.

When analyzing reliable correlations *between teleradiometric indicators of «craniofacial proportions» according to the Ricketts method with the sizes of the lower jaw teeth in YW, without taking into account the type of face*, multiple straight lines of medium (r = from 0.30 to 0.32) and weak (r = from 0.24 to 0.28) strength of correlation were found between

the magnitude of the NPog-POR and NBa-PtG angles and the length of the root part of the lateral incisors and canines in the mesio-distal direction (only for the NPog-POR angle), the width of the coronal part of the central incisors and canines (only for the NBa-PtG angle), the length of the coronal part of the central and lateral incisors, the width of the cervical part of the central incisors in the vestibulo-oral direction; and also inverse average (r = from -0.30 to -0.39) and weak (r = from -0.24 to -0.26) correlation strength between the size of the N-CF-A angle and the width of the coronal part of the central and lateral incisors, canines and second premolars in the mesio-distal direction, the width of the coronal part of the canines in the vestibulo-oral direction, the length of the lateral incisors. In YW, regardless of the type of face, no significant correlations were found between the size of the teeth of the lower jaw and the size of the MeSgo-POR angle. *Quantitative analysis of reliable correlations between teleradiometric indicators of «craniofacial proportions» according to the Ricketts method with the sizes of the lower jaw teeth in YW without taking into account the type of face* revealed 24 relationships out of 245 possible (9.80 %), of which 1.63 % were direct of medium strength, 4.08 % were direct of weak strength, 1.22 % were inverse of medium strength, and 2.86 % were inverse of weak strength.

When analyzing the reliable correlations *between teleradiometric indicators of «craniofacial proportions» according to the Ricketts method with the sizes of dental arches in YW without taking into account the type of face*, only single, mostly direct correlations of medium strength were found. In YW without taking into account the type of face, no reliable correlations were found between the sizes of dental arches and the size of the MeSgo-POR and POR-SpP angles. *Quantitative analysis of reliable correlations between teleradiometric indicators of «craniofacial proportions» according to the Ricketts method with the sizes of dental arches in YW without taking into account the type of face* revealed only 9 correlations out of 126 possible (7.14 %), of which 3.17 % were direct correlations of medium strength, 1.59 % were direct correlations of weak strength, and 2.38 % were inverse correlations of weak strength.

When analyzing reliable and medium-strength unreliable correlations *between teleradiometric indicators of «craniofacial proportions» according to the Ricketts method with the sizes of the teeth of the upper jaw in YM with a wide face type*, multiple medium-strength direct reliable and unreliable (r = from 0.31 to 0.49) correlations were found between the value of the POR-NA angle and the width of the cervical part of the canines in the mesiodistal direction, the width of the coronal part of the lateral incisors, canines, second premolars and first molars, the width of the cervical part of the canines in the vestibulo-oral direction; as well as medium-strength reliable and unreliable direct (r = from 0.30 to 0.45) and inverse (r = from -0.33 to -0.43) correlations between the size of the N-CF-A angle and the width of the cervical part of the central and lateral incisors in the mesio-distal direction, the length of the coronal part of the central and lateral incisors in the

vestibulo-oral direction (direct), the length of the root part of the central and lateral incisors in the vestibulo-oral direction, the length of the second premolars (inverse). In YM with a wide facial type, no reliable or medium-strength unreliable relationships were found between the sizes of the teeth of the upper jaw and the size of the NPog-POR and MeSgo-POR angles. *Quantitative analysis of reliable and medium-strength unreliable correlations between teleradiometric indicators of «craniofacial proportions» according to the Ricketts method with the sizes of the upper jaw teeth in YM with a wide face type* revealed 20 correlations out of 245 possible (8.16 %), of which 2.45 % were reliable direct medium-strength, 2.86 % were unreliable direct medium-strength, 0.82 % were reliable inverse medium-strength, and 2.04 % were unreliable inverse medium-strength.

When analyzing reliable and medium-strength unreliable correlations *between teleradiometric indicators of «craniofacial ratios» according to the Ricketts method with the sizes of the lower jaw teeth in YM with a wide face type*, multiple medium-strength reliable and unreliable direct (r = from 0.32 to 0.44) and inverse (r = from -0.32 to -0.43) correlations were found between the value of the POR-NA angle and the width of the coronal part of the central and lateral incisors in the mesio-distal direction, the width of the coronal part of the central incisors and second premolars in the vestibulo-oral direction (direct), the length of the coronal part of the central incisors in the mesio-distal direction, the length of the coronal part of the canines in the vestibulo-oral direction, the length of the central incisors (inverse); as well as medium-strength, mostly unreliable, direct (r = from 0.31 to 0.41) and inverse (r = from -0.30 to -0.45) correlations between the magnitude of the N-CF-A angle and the length of the root part of the central and lateral incisors in the mesiodistal direction, the length of the crown part of the central incisors and canines in the vestibulo-oral direction (direct), the width of the crown part of the central incisors and first molars, the length of the crown part of the central and lateral incisors in the mesiodistal direction, the width of the crown part of the central incisors in the vestibulo-oral direction (inverse). *Quantitative analysis of reliable and medium-strength unreliable correlations between teleradiometric indicators of «craniofacial proportions» according to the Ricketts method with the sizes of the lower jaw teeth in YM with a wide face type* revealed 32 correlations out of 245 possible (13.06 %), of which 1.63 % were reliable direct medium-strength, 4.90 % were unreliable direct medium-strength, 2.04 % were reliable inverse medium-strength, and 4.49 % were unreliable inverse medium-strength.

When analyzing the reliable and medium-strength unreliable correlations *between teleradiometric indicators of «craniofacial ratios» according to the Ricketts method with the sizes of dental arches in YM with a wide face type*, multiple medium-strength inverse reliable (r = -0.42 in both cases) and direct unreliable (r = 0.30 and 0.34) correlations were found between the value of the NPog-POR angle and the distances DL_C and GL_1 (inverse), PonM and VestBM; mainly direct, unreliable (r = from 0.31 to 0.33), correlations

between the value of the NBa-PtG angle and the distances 13_23Bugr, 33_43Bugr and napx_6. In YM with a wide face type, no reliable or medium-strength unreliable correlations were found between the sizes of dental arches and the value of the N-CF-A angle. *Quantitative analysis* of reliable and medium-strength unreliable correlations between *teleradiometric indicators of «craniofacial proportions» according to the Ricketts method with the sizes of dental arches in YM with a wide face type* revealed 15 correlations out of 126 possible (11.90 %), of which 5.56 % were unreliable direct medium-strength, 3.17 % were reliable reverse medium-strength, and 3.17 % were unreliable reverse medium-strength.

When analyzing reliable and medium-strength unreliable correlations between *teleradiometric indicators of «craniofacial ratios» according to the Ricketts method with the sizes of the upper jaw teeth in YW with a wide face type*, multiple predominantly direct, medium-strength reliable and unreliable ($r =$ from 0.33 to 0.58) correlations were found between the value of the NPog-POR angle and the width of the cervical part of the central and lateral incisors and canines, the width of the coronal part of the lateral incisors and canines, the length of the root part of the lateral incisors and canines in the mesio-distal direction, the width of the coronal part of the canines and first molars, the width of the cervical part and the length of the coronal part of the canines in the vestibulo-oral direction, the length of the canines; direct reliable and unreliable, mostly medium-strength correlations ($r =$ from 0.31 to 0.72) between the size of the NBa-PtG angle and the width of the coronal part of the central and lateral incisors, canines, first and second premolars, first molars, the width of the cervical part of the lateral incisors, the length of the root part of the lateral incisors and canines in the mesiodistal direction, the width of the coronal part of the canines, first and second premolars, first molars, the width of the cervical part and the length of the root part of the canines in the vestibulo-oral direction, the length of the canines and second premolars; inverse of medium strength, mostly unreliable ($r =$ from -0.30 to -0.47), correlations between the value of the MeSgo-NPog angle and the width of the coronal part of the canines and first molars, the length of the root part of the central and lateral incisors, the width of the cervical part of the central incisors in the mesio-distal direction, the length of the coronal part of the central incisors and canines, the width of the coronal part of the second premolars and first molars in the vestibulo-oral direction, the length of the central and lateral incisors, first and second premolars; direct correlations of medium strength, mostly unreliable ($r =$ from 0.30 to 0.53) between the value of the POR-NA angle and the width of the coronal part of the central and lateral incisors, canines and first molars, the width of the cervical part of the central and lateral incisors, the length of the root part of the lateral incisors in the mesiodistal direction, the width of the coronal part of the canines and first molars, the width of the cervical part and the length of the coronal part of the canines in the vestibulo-oral direction; inverse, mostly of medium strength, reliable and unreliable ($r =$ from -0.30 to -0.64), correlations

between the magnitude of the N-CF-A angle and the width of the coronal part of the central incisors, canines, second premolars and first molars, the length of the root part of the lateral incisors and canines in the mesio-distal direction, the width of the coronal part of the canines, second premolars and first molars, the length of the root part of the lateral incisors and canines, the width of the cervical part of the canines in the vestibulo-oral direction, the length of the lateral incisors. *Quantitative analysis* of reliable and medium-strength unreliable correlations between *teleradiometric indicators of «craniofacial proportions» according to the Ricketts method with the sizes of the upper jaw teeth in YW with a wide face type* revealed 69 correlations out of 245 possible (28.16 %), of which 0.82 % were reliable direct strong, 6.53 % were reliable direct medium-strength, 9.80 % were unreliable direct medium-strength, 0.41 % were reliable inverse strong, 3.67 % were reliable inverse medium-strength, and 6.94 % were unreliable inverse medium-strength.

When analyzing reliable and medium-strength unreliable correlations between *teleradiometric indicators of «craniofacial relations» according to the Ricketts method with the sizes of the lower jaw teeth in YW with a wide face type*, multiple predominantly direct, medium-strength reliable and unreliable ($r =$ from 0.30 to 0.56) correlations were found between the value of the NPog-POR angle and the width of the cervical part of the central incisors and canines, the width of the coronal part of the lateral incisors and canines, the length of the root part of the lateral incisors and canines in the mesio-distal direction, the width of the coronal part of the central and lateral incisors, canines, second premolars and first molars, the width of the cervical part of the central and lateral incisors, the length of the coronal part of the central and lateral incisors and canines in the in the vestibulo-oral direction, the length of canines and second premolars; direct, mostly medium strength, reliable and unreliable ($r =$ from 0.30 to 0.60) correlations between the magnitude of the NBa-PtG angle and the width of the coronal part of the central and lateral incisors, canines, first and second premolars, first molars, the length of the root part of the central and lateral incisors and canines in the mesio-distal direction, the width of the coronal part of the central and lateral incisors, canines, first and second premolars, first molars, the width of the cervical part of the central and lateral incisors and canines, the length of the coronal part of the lateral incisors and canines, the length of the root part of the canines in the vestibulo-oral direction, the length of the lateral incisors, canines, first and second premolars; inverse of medium strength, mostly unreliable ($r =$ from -0.32 to -0.48), correlations between the value of the MeSgo-NPog angle and the width of the coronal part of the central incisors and second premolars, the length of the root part of the lateral incisors and canines, the width of the cervical part of the central incisors in the mesiodistal direction, the width of the coronal and cervical parts and the length of the root part of the lateral incisors in the vestibulo-oral direction, the length of the central and lateral incisors, canines and first premolars; direct correlations of average

strength are unreliable (r = from 0.31 to 0.39) between the value of the POr-NA angle and the width of the coronal part of the central and lateral incisors, canines, second premolars and first molars, the width of the cervical part of the central and lateral incisors and canines in the mesio-distal direction, the width of the cervical part of the central incisors, the length of the coronal part of the lateral incisors in the vestibulo-oral direction; inverse medium-strength, mostly significant (r = from -0.32 to -0.55) correlations between the size of the N-CF-A angle and the width of the coronal part of the lateral incisors, canines, first and second premolars, first molars in the mesio-distal direction, the length of the root part of the central and lateral incisors, the width of the cervical part of the lateral incisors and canines, the width of the coronal part of the canines in the vestibulo-oral direction, the length of the lateral incisors. In YW with a wide facial type, no significant or medium-strength non-significant correlations were found between the dimensions of the lower jaw teeth and the size of the POr-SpP angle. *Quantitative analysis* of reliable and medium-strength unreliable correlations between *teleradiometric indicators of «craniofacial proportions» according to the Ricketts method with the sizes of the lower jaw teeth in YW with a wide face type* revealed 80 correlations out of 245 possible (32.65 %), of which 0.41 % were reliable direct strong, 7.35 % were reliable direct medium-strength, 14.29 % were unreliable direct medium-strength, 4.49 % were reliable inverse medium-strength, and 6.12 % were unreliable inverse medium-strength.

When analyzing reliable and medium-strength unreliable correlations between *teleradiometric indicators of «craniofacial ratios» according to the Ricketts method with the sizes of dental arches in YW with a wide face type*, multiple medium-strength, mostly direct, reliable and unreliable (r = from 0.30 to 0.50) correlations were found between the value of the NBa-PtG angle and the distances mapx_46, dapx_46, DL_C, DL_F and DL_S; medium-strength, mostly unreliable, inverse (r = -0.34 and -0.54) and direct (r = 0.36 and 0.39) correlations between the value of the MeSgo-POr angle and the distances DL_C and DL_F (inverse), napx_6 and GL_3 (direct); medium strength, mostly direct, unreliable (r = from 0.31 to 0.35) correlations between the POr-NA angle and the DL_C, DL_F and DL_S distances. In YW with a wide face type, no reliable or medium strength unreliable correlations were found between the sizes of the dental arches and the POr-SpP angle. *Quantitative analysis* of reliable and medium strength unreliable correlations between *teleradiometric indicators of «craniofacial ratios» according to the Ricketts method with the sizes of the dental arches in YW with a wide face type* revealed 20 correlations out of 126 possible (15.87 %), of which 1.59 % reliable direct of medium strength, 7.94 % unreliable direct of medium strength, 3.97 % reliable inverse of medium strength, 2.38 % unreliable inverse of medium strength.

When analyzing the reliable and medium-strength unreliable correlations between *teleradiometric indicators of «craniofacial proportions» according to the Ricketts method*

with the sizes of the teeth of the upper jaw in YW with a very wide face type, multiple medium-strength direct reliable and unreliable (r = from 0.33 to 0.41) correlations were found only between the magnitude of the POr-NA angle and the length of the root part of the central incisors and canines in the mesio-distal direction, the length of the coronal part of the central incisors, the width of the coronal part of the second premolars in the vestibulo-oral direction, and the length of the first premolars. In YW with a very wide face type, no reliable or medium-strength unreliable correlations were found between the sizes of the teeth of the upper jaw and the magnitude of the NBa-PtG angle. *Quantitative analysis* of reliable and medium-strength unreliable correlations between *teleradiometric indicators of «craniofacial proportions» according to the Ricketts method with the sizes of the upper jaw teeth in YW with a very wide facial type* revealed 17 correlations out of 245 possible (6.94 %), of which 2.45 % were reliable direct medium-strength, 1.22 % were unreliable direct medium-strength, 0.41 % were reliable inverse medium-strength, and 2.86 % were unreliable inverse medium-strength.

When analyzing reliable and medium-strength unreliable correlations between *teleradiometric indicators of «craniofacial proportions» according to the Ricketts method with the sizes of the lower jaw teeth in YW with a very wide facial type*, multiple medium-strength inverse, mostly unreliable (r = from -0.31 to -0.36) correlations were found between the value of the MeSgo-POr angle and the length of the root part of the canines, the width of the coronal part of the first premolars in the mesiodistal direction, the width of the cervical part of the lateral incisors, the length of the root part of the canines in the vestibulo-oral direction, the length of the canines; medium-strength inverse, mostly unreliable (r = from -0.32 to -0.46) correlations between the magnitude of the N-CF-A angle and the width of the coronal part of the central and lateral incisors and canines, the length of the root part of the canines in the mesio-distal direction, the length of the canines; mainly inverse, moderately unreliable (r = from -0.30 to -0.36) correlations between the magnitude of the POr-SpP angle and the length of the coronal part of the central incisors, the width of the coronal part of the first premolars in the mesio-distal direction, the length of the root part of the central incisors and canines in the vestibulo-oral direction, the length of the central incisors. In YW with a very wide facial type, no reliable or moderately unreliable correlations were found between the dimensions of the lower jaw teeth and the magnitude of the NPog-POr angle. *Quantitative analysis* of reliable and medium-strength unreliable correlations between *teleradiometric indicators of «craniofacial proportions» according to the Ricketts method with the sizes of the lower jaw teeth in YW with a very wide facial type* revealed 24 correlations out of 245 possible (9.80 %), of which 0.82 % were reliable direct medium-strength, 2.04 % were unreliable direct medium-strength, 1.22 % were reliable inverse medium-strength, and 5.71 % were unreliable inverse medium-strength.

When analyzing reliable and medium-strength unreliable correlations between *teleradiometric indicators of*

«craniofacial proportions» according to the Ricketts method with the sizes of dental arches in YW with a very wide face type, multiple medium-strength, mostly inverse reliable (r from -0.34 to -0.49), correlations between the magnitude of the POr-NA angle and the distances VestBM, 13_23Bugr, 33_43Bugr, 33_43Apx, mapx_46, dapx_46 and GL_3 were found. Quantitative analysis of reliable and medium-strength unreliable correlations between teleradiometric indicators of «craniofacial proportions» according to the Ricketts method with the sizes of dental arches in YW with a very wide face type revealed 17 correlations out of 126 possible (13.49 %), of which 1.59 % were reliable direct medium-strength, 3.17 % were unreliable direct medium-strength, 6.35 % were reliable inverse medium-strength, and 2.38 % were unreliable inverse medium-strength.

Cephalometric parameters show marked differences depending on the facial morphotype. For example, in a study of a population from Southeast Asia, it was found that individuals with a mesofacial type are characterized by a moderate increase in the lower anterior facial height and gnathic angle, while in dolichofacial types a statistically significant increase in this indicator was observed ($p < 0.05$) [21]. Such differences directly affect the parameters of the dental arches - patients with an elongated face often show narrowing of the arches, as well as displacement of the frontal segment. Modeling of the transverse dimensions of the jaws in girls with a wide face type showed strong correlations between the width of the nasal part of the face, the Wits index and the transverse parameters of the lower jaw ($r = 0.68$, $p < 0.01$) [17].

These patterns are also supported by data on the influence of ethnicity on the ratio of soft tissue and bone structures. For example, a comparison of cephalometric norms of the Kurdish population in Iran showed a lower depth of the facial profile compared to Iranians from the central region, with a pronounced shift of the soft tissue point A and lower values of the nasolabial angle ($p < 0.01$) [9]. Northern Vietnamese were found to have a shorter anterior facial height and a lower inclination of the upper incisors than representatives of the Caucasian race ($p < 0.05$) [7]. Thus, the ethnic factor is an important variable in the calculation of cephalometric norms, which should be adapted to the local population.

Individual relationships between bone structures and soft tissues of the face are also important for the formation of a holistic morphofunctional model. In a three-dimensional study of the correlations of soft tissue and bone elements of the lower third of the face, a high level of agreement was found between the thickness of the chin and the position of the lower incisors in the sagittal plane ($r = 0.74$, $p < 0.001$) [11]. In other works, a direct relationship was found between the position of the upper incisors and the thickness of the soft tissues in the anterior segment: with vestibular inclination of the incisors, tissue thickening in the nasolabial triangle is observed [13].

In European populations, cephalometric standards also show variability. In Polish boys, for example, the average

values of the ANB angle were 2.4° , indicating moderate prognathia of the upper jaw, while in girls it was 3.1° [12]. In a study of norms for the Iranian population, it was found that in men the facial angle was on average 1.8° smaller than in women ($p < 0.01$), indicating sex differences in the harmonization of the facial profile [1].

A number of works have focused on modeling the relationships between teleradiometric and odontometric characteristics. For example, a regression analysis conducted in a sample of Ukrainian youth demonstrated that the length of the anterior part of the skull and the depth of the supramental fossa have a high prognostic potential for the width of the dental arch in the frontal segment (coefficient of determination $R^2 = 0.65$) [4]. This allows for the formation of adapted norms for orthodontic prediction, especially in an individual approach to patients with different face shapes.

A significant role in the construction of an orthodontic strategy is also played by the subjective assessment of facial aesthetics. In particular, a study that combined subjective analysis with objective cephalometric data found that the perception of facial harmony was most strongly correlated with the position of the upper incisors and the inclination of the facial axis ($r = 0.66$, $p < 0.05$) [20]. This indicates the importance of taking into account individual variants in the diagnosis and planning of interventions.

Summarizing the above, it can be stated that teleradiometric parameters according to the Ricketts method have a complex multifactorial dependence on the anatomical structure of the face, ethnic origin, morphotype, tooth position and soft tissue characteristics. The study of these correlations in the Ukrainian population of boys and girls with physiological occlusion, taking into account the type of face, is a scientifically sound step towards the formation of national standards that will contribute to the improvement of diagnostic and therapeutic approaches in orthodontics.

Conclusions and prospects for further development

1. In Ukrainian YM and YW with physiological occlusion without taking into account and taking into account the type of face, the features of multiple reliable and medium-strength unreliable relationships between teleradiometric indicators of «craniofacial proportions» according to the Ricketts method and the sizes of teeth and dental arches were established. The number and strength of such correlations increases when divided into facial types (most pronounced in YW with a wide face type).

2. In terms of the strength, number and direction of reliable and medium-strength unreliable correlations in Ukrainian YM and YW 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 relationships between teleradiometric indicators of «craniofacial proportions» according to the Ricketts method and computed tomography sizes of teeth and dental arches were established.

In further studies, it is planned to study the features and gender differences of correlations between teleradiometric indicators of «internal structures» 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.

References

- [1] Amini, F., Razavian, Z. S., & Rakhshan, V. (2016). Soft tissue cephalometric norms of Iranian class I adults with good occlusions and balanced faces. *International orthodontics*, 14(1), 108-122. doi: 10.1016/j.ortho.2015.12.003
- [2] Brotzkyi, N. O., Dmitriev, M. O., Arshynnikov, R. S., Drachuk, N. V., Popova, O. I., Moskalenko V. B., & Ruban, M. M. (2024). Models of linear dimensions necessary for constructing the correct shape of the dental arch in boys and girls with a wide face type depending on the characteristics of teleradiometric indicators according to the Ricketts method and computed tomography dimensions of the teeth. *Вісник Вінницького національного медичного університету – Reports of Vinnytsia National Medical University*, 28(4), 613-619. doi: 10.31393/reports-vnmedical-2023-28(4)-06 (02)
- [3] Brotzkyi, N. O., Dmitriev, M. O., Cherkasova, L. A., Smiukha, O. A., Beliaiev, E. V., Moroz, V. V., & Vakhovskiy, V. V. (2024). Regression models of computed tomographic dimensions necessary for building the correct shape of the dental arch in Ukrainian young men and young women with a physiological bite: without taking into account the type of face, depending on the features of teleradiometric indicators according to the Ricketts method and computed tomographic dimensions of teeth. *Reports of Morphology*, 30(3), 33-43. doi: 10.31393/morphology-journal-2024-30(3)-04
- [4] Chernysh, A. V. (2018). Regression models of individual cephalometric indicators used in the method of RM Ricketts. *Bio-medical and Biosocial Anthropology*, (32), 56-62. doi: 10.31393/bba32-2018-08
- [5] Dalessandri, D., Parrini, S., Rubiano, R., Gallone, D., & Migliorati, M. (2017). Impacted and transmigrant mandibular canines incidence, aetiology, and treatment: a systematic review. *European Journal of Orthodontics*, 39(2), 161-169. doi: 10.1093/ejo/cjw027
- [6] Demiriz, L., Durmuşlar, M. C., & Misir, A. F. (2015). Prevalence and characteristics of supernumerary teeth: A survey on 7348 people. *Journal of International Society of Preventive and Community Dentistry*, 5(1), 39-43. doi: 10.4103/2231-0762.156151
- [7] Ho, T. T. T., & Luong, Q. T. (2021). Dental-craniofacial characteristics of southern Vietnamese people with well-balanced face on cephalometric films and its comparison with caucasians and northern Vietnamese population. *Journal of International Society of Preventive and Community Dentistry*, 11(3), 316-323. doi: 10.4103/jispcd.JISPCD_13_21
- [8] Ifteni, G., Apostu, A., Aungurencei, O., Tanculescu-Doloca, O., DragosVirvescu, I. S., & Surlari, Z. (2018). Statistical study on the prevalence of dental lesions of the anterior segment of the dental arches and the call for treatment for these lesions – part II. *Romanian Journal of Oral Rehabilitation*, 10(1), 68-79.
- [9] Imani, M. M., Hosseini, S. A., Arab, S., & Delavarian, M. (2018). Characterization of soft tissue cephalometric norms of Kurdish population of Iran. *J Res Med Dent Sci*, 6(1), 335-42. doi: 10.5455/jrmds.20186155
- [10] Khandelwal, P., Rai, A. B., Bulgannawar, B., Hajira, N., Masih, A., & Jyani, A. (2018). Prevalence, characteristics, and morphology of supernumerary teeth among patients visiting a dental institution in Rajasthan. *Contemporary clinical dentistry*, 9(3), 349-356. doi: 10.4103/ccd.ccd_31_18
- [11] Kim, S. H., & Shin, H. S. (2018). Three-dimensional analysis of the correlation between soft tissue and bone of the lower face using three-dimensional facial laser scan. *Journal of Craniofacial Surgery*, 29(8), 2048-2054. doi: 10.1097/SCS.0000000000004781
- [12] Loster, J. E., Williams, S., Wiczorek, A., & Loster, B. W. (2015). The Polish face in profile: a cephalometric baseline study. *Head & face medicine*, (11), 5. doi: 10.1186/s13005-015-0065-x
- [13] Maddalone, M., Losi, F., Rota, E., & Baldoni, M. G. (2019). Relationship between the Position of the Incisors and the Thickness of the Soft Tissues in the Upper Jaw: Cephalometric Evaluation. *International Journal of Clinical Pediatric Dentistry*, 12(5), 391-397. doi: 10.5005/jp-journals-10005-1667
- [14] Osmólska-Bogucka, A. E., & Siemińska-Piekarczyk, B. (2015). Maxillary median diastema—review of the literature. *Dent Med Probl*, 52(3), 341-344.
- [15] Park, S. Y., Jang, H. J., Hwang, D. S., Kim, Y. D., Shin, S. H., Kim, U. K., & Lee, J. Y. (2020). Complications associated with specific characteristics of supernumerary teeth. *Oral surgery, oral medicine, oral pathology and oral radiology*, 130(2), 150-155. doi: 10.1016/j.oooo.2020.03.002
- [16] Perez Otero, S., Cassidy, M. F., Morrison, K. A., Brydges, H. T., Muller, J., Flores, R. L., & Ceradini, D. J. (2024). Analyzing Epidemiology and Hospital Course Outcomes of LeFort Fractures in the Largest National Pediatric Trauma Database. *Craniofacial Trauma & Reconstruction*, 17(4), NP154-NP162. doi: 10.1177/19433875241262616
- [17] Pozur, T. P. (2019). Modeling by regression analysis of the transverse dimensions of the upper and lower jaws and sagittal characteristics of the dental arch in young women with a very wide face, depending on the features of the odonto and cephalometric indicators. *Biomedical and Biosocial Anthropology*, (35), 29-37. doi: 10.31393/bba35-2019-05
- [18] Proffit, U. R., Fildz, G. U., & Saver, D. M. (2006). *Современная ортодонтия (пер. с англ. Д. С. Персина) [Modern orthodontics (translation from English by D. S. Persina)]*. М.: МЕДпресс-информ – М.: MEDpress-inform.
- [19] Ricketts, R. M. (1972). The value of cephalometrics and computerized technology. *Angle Orthod.*, (42), 179-199. doi: 10.1043/0003-3219(1972)042<0179:TVOCAC>2.0.CO;2
- [20] Siécola, G. S., Capelozza Filho, L., Lorenzoni, D. C., Janson, G., & Henriques, J. F. C. (2017). Subjective facial analysis and its correlation with dental relationships. *Dental press journal of orthodontics*, 22(2), 87-94. doi: 10.1590/2177-6709.22.2.087-094.oar
- [21] Sprenger, R., Martins, L. A. C., Dos Santos, J. C. B., de Menezes, C. C., Venezian, G. C., & Degan, V. V. (2017). A retrospective cephalometric study on upper airway spaces in different facial types. *Progress in orthodontics*, (18), 25. doi: 10.1186/s40510-017-0180-2
- [22] Syriac, G., Joseph, E., Rupesh, S., Philip, J., Cherian, S. A., & Mathew, J. (2017). Prevalence, characteristics, and complications of supernumerary teeth in nonsyndromic pediatric population of South India: A clinical and radiographic study. *Journal of pharmacy & bioallied sciences*, 9(1), 231-236. doi: 10.4103/jpbs.JPBS_154_17
- [23] Tandon, P., Shah, S., Dadhich, A., Saluja, H., & Chauhan, H. (2020). Incidence and distribution of jaw pathologies among 0–15 years age group at a tertiary rural health-care center of Maharashtra: a retrospective study of 10 years. *Contemporary Clinical Dentistry*, 11(1), 39-45. doi: 10.4103/ccd.ccd_328_18
- [24] Zou, J., Meng, M., Law, C. S., Rao, Y., & Zhou, X. (2018). Common dental diseases in children and malocclusion. *International journal of oral science*, 10(1), 7. doi: 10.1038/s41368-018-0012-3

КОРЕЛЯЦІЇ ТЕЛЕРЕНТГЕНОМЕТРИЧНИХ ПОКАЗНИКІВ ЧЕРЕПНО-ЛИЦЕВИХ СПІВВІДНОШЕНЬ 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., Попов М. В., Дудік О. П., Дякова О. В., Гунас І. В.**

Анотація. Дослідження взаємозв'язків між структурними параметрами лицевого скелета та одонтометричними характеристиками є важливим для розуміння індивідуальних особливостей будови щелепно-лицевої ділянки. Методики радіологічного аналізу забезпечують точну оцінку анатомічних співвідношень, що визначають гармонію профілю та положення щелеп. Водночас антропометричні особливості, зокрема форма обличчя, можуть істотно впливати на співвідношення між розмірами зубів і формою зубних дуг. Вивчення таких закономірностей у представників молодого віку без патологій прикусу сприятиме оптимізації діагностики та планування лікування в ортодонтії. Метою дослідження було визначення особливостей кореляцій між телерентгенометричними показниками черепно-лицевих співвідношень 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 показників черепно-лицевих співвідношень за методом Ricketts (кути NPog-Por, NBa-PtG, MeSgo-NPog, MeSgo-Por, POr-NA, N-CF-A та POr-SpP) з отриманих із банку даних науково-дослідного центру та кафедри стоматології дитячого віку Вінницького національного медичного університету ім. М. І. Пирогова комп'ютерних томограм 41 українського юнака та 68 дівчат із фізіологічним прикусом. Їм також визначили типи обличчя за Гарсоном. Оцінку кореляцій між показниками черепно-лицевих співвідношень за методом Ricketts і комп'ютерно-томографічними розмірами зубів і зубних дуг в юнаків і дівчат без та з урахуванням типу обличчя проведено у ліцензійному пакеті Statistica 6.0 за допомогою непараметричної статистики Спірмена. Унаслідок аналізу достовірних і середньої сили недостовірних кореляцій між телерентгенометричними показниками черепно-лицевих співвідношень за методом Ricketts із розмірами зубів і зубних дуг встановлено: в юнаків і дівчат без урахування типу обличчя – відповідно 3,27 % і 9,80 % зв'язків із розмірами зубів верхньої щелепи, 4,90 % і 9,80 % – із розмірами зубів нижньої щелепи та 6,35 % і 7,14 % – із розмірами зубних дуг; в юнаків і дівчат із широким типом обличчя – відповідно 8,16 % і 28,16 % зв'язків із розмірами зубів верхньої щелепи, 13,06 % і 32,65 % – із розмірами зубів нижньої щелепи та 11,90 % і 15,87 % – із розмірами зубних дуг; у дівчат із дуже широким типом обличчя – 6,94 % зв'язків із розмірами зубів верхньої щелепи, 9,80 % – із розмірами зубів нижньої щелепи та 13,49 % – із розмірами зубних дуг. В усіх групах юнаків і дівчат за силою, кількістю та напрямом достовірних і середньої сили недостовірних кореляцій встановлені виражені прояви статевого диморфізму зв'язків між телерентгенометричними показниками черепно-лицевих співвідношень за методом Ricketts та комп'ютерно-томографічними розмірами зубів і зубних дуг.

Ключові слова: стоматологія, телерентгенометрія показників черепно-лицевих співвідношень за методом Ricketts, морфометрія комп'ютерно-томографічних розмірів зубів і зубних дуг, кореляції, українські юнаки та дівчата, фізіологічний прикус, тип обличчя.