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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

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Annotation. *One of the key tasks of modern orthodontics is the development of individualized approaches to modeling dental arches taking into account the morphological and functional characteristics of patients. Studying the influence of teleradiometric characteristics and three-dimensional parameters of teeth allows to significantly increase the accuracy of orthodontic treatment and the stability of the obtained results. Particular attention should be paid to age and gender differences that affect the structure of the face and the ratio of its structures. The expansion of scientific knowledge in this area contributes to the improvement of methods for predicting and constructing correct forms of dental arches. The aim of the work is to develop and analyze regression models of linear dimensions necessary for constructing the correct shape of the dental arch in Ukrainian young men and young women with a physiological bite and a wide face type depending on the features of teleradiometric indicators according to the Ricketts method and computed tomography dimensions of the teeth. An analysis of primary computed tomograms of 25 Ukrainian young men and 25 young women with a physiological bite and a wide face type was conducted. According to the Ricketts method, “dental”, “skeletal and dento-skeletal” indicators, indicators of “soft tissue aesthetics”, indicators of “craniofacial relationships” and indicators of “internal structures” were determined on lateral teleradiograms. Morphometric parameters of the teeth of the upper and lower jaws in the mesio-distal and vestibulo-oral directions were determined on computed tomograms; as well as the distances necessary for constructing the correct shape of the dental arches. Regression models were constructed using the Statistica 6.0 license package. It was found that both in Ukrainian young men with a wide face type and in young women, all 18 possible reliable regression models with a coefficient of determination greater than 0.6 were constructed (respectively in young men R^2= from 0.799 to 0.960, $p<0.001$ in all cases, in young women R^2= from 0.660 to 0.950, $p<0.001$ in all cases). The following percentages of occurrence in the regression equations of teleradiometric indicators and computed tomography dimensions of teeth were established: in teleradiometric indicators according to the Ricketts method (37.50 %), the width of the tooth crown in the mesio-distal direction (18.75 %), the distance from the cutting edge to the dentino-enamel border line of the tooth in the mesio-distal direction to the apex of the tooth root (9.82 %), the width of the dentino-enamel border of the tooth in the mesio-distal direction and the distance from the cutting edge to the apex of the tooth root (8.04 % each). The following percentages of occurrence in the regression equations of the corresponding teeth were also established: in young men – upper incisors (17.09 %), upper canines (11.11 %), upper premolar teeth and lower incisors (10.26 % each); in young women– upper incisors (27.68 %), lower incisors (10.71 %) and lower canines (8.93 %). The constructed highly informative regression models will allow dentists to reasonably approach the interpretation of the results obtained in patients and implement a more correct approach to orthodontic treatment.*

Keywords: *dentistry, teleradiometry according to the Ricketts method, computed tomography tooth dimensions, dental arches, regression models, Ukrainian young men and young women, facial type, physiological bite.*

Introduction

The study of the linear dimensions of the dental arches and the influence of various anatomical and functional characteristics on their shape is an important direction in modern orthodontics. The presence of dentofacial anomalies, accompanied by deviations in the width and shape of the dental arches, is detected with a high frequency in different populations. According to research, the prevalence of dental anomalies in different age groups varies significantly. For example, among the adult population of Saudi Arabia, dentofacial anomalies occur in 36.5 % of cases [24], while among the Australian population the frequency of such disorders is about 20 % [5]. In addition, in children and adolescents, dental anomalies develop more often due to active changes in the structure of the face and jaws [9, 12]. In particular, studies reveal a significant number of violations in the formation of dental arches in adolescents with occlusion anomalies, which requires an individualized approach to treatment [17, 25].

The width of the dental arch and its shape largely depend on the characteristics of the dentition, which are formed during the development of teeth and jaw growth. Teleradiometric indicators determined by the Ricketts method allow us to identify the relationship between craniofacial features and the shape of the dental arches. For example, in the study [23] it was noted that the shape of the dental arch varies depending on the width of the basal bone structures and the anatomical features of the face. In this context, computed tomography also plays an important role in accurately determining the three-dimensional dimensions of the teeth, which is critically important for predicting the future shape of the dental arches [17, 24]. In patients with a broad facial type, special attention should be paid to the analysis of the frontal and distal relationships of the dentition, since these parameters most often show significant deviations [22]. The features of the broad facial type significantly complicate the construction of orthodontic models of the dental arch, since this type is accompanied by increased sizes of the epiphyses of the skull bones, wider dentition and pronounced deviations in the bite [1, 22]. Studies in various populations demonstrate that patients with a broad facial type have more frequent cases of hypodontia and other dental anomalies, which may affect the overall morphology of the dental arch [1, 10, 25]. For example, in the population of children and adolescents in Iran, the prevalence of hypodontia was 8.4 %, and macrodontia was 3.1 % [22]. Patients with wide dentition and deep occlusal disorders often also have asymmetries of the dental arch, which require correction during active orthodontic treatment [23, 24].

In addition, taking into account gender and age characteristics is important for constructing correct dental arch models. It has been established that girls with a wide face type more often develop dental anomalies associated with craniofacial proportions, while in boys the main factor of changes is the width of bone structures and the size of the teeth [12, 24]. For example, in the study [10] it was found that girls more often demonstrate deviations in the ratio of the frontal and distal sections of the dentition, while in boys disorders of the total width of the dental arches prevail. Such differences indicate the need for an individualized approach to modeling dental arches, which takes into account the gender, age and morphological characteristics of the patient.

In modern orthodontic practice, it is important to take into account a multidisciplinary approach to studying the formation of dental arches. The use of teleradiometric indicators in combination with computed tomography allows you to create more accurate models of dentition, adapted to the individual anatomical and functional characteristics of patients [9, 23]. This approach contributes not only to improving facial aesthetics, but also to optimizing the function of the dentofacial system, which is important for the long-term preservation of patients' health. A more detailed study of the influence of anatomical and functional parameters on the formation of dental arches is a promising direction that will ensure the implementation of new diagnostic and treatment algorithms.

The purpose of the study – to develop and analyze regression models of linear dimensions necessary for constructing the correct shape of the dental arch in Ukrainian young men and young women with a physiological bite and a wide facial type depending on the characteristics of teleradiometric indicators according to the Ricketts method and computed tomography dimensions of the teeth.

Materials and methods

From the data bank of the Department of Pediatric Dentistry and the Research Center of the National Pirogov Memorial Medical University, Vinnytsya, primary computed tomograms of 41 Ukrainian young men (aged 17 to 21) and 68 Ukrainian young women (aged 16 to 20) with a physiological bite as close as possible to orthognathic were obtained. 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 and jaw 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 who underwent dental X-ray examinations for various indications at the private dental clinic "Vinintermed" and at the "Planmeca 3D Maxillofacial Diagnostics Center" underwent teleradiography and computed tomography examinations using the Veraviewepocs 3D Morita dental cone beam tomograph (Japan) and Planmeca ProMax 3D Mid (Finland). Three-dimensional image 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 tel-ray images, tel-ray images with points marked on 3D objects created in the 3D Slicer v5.4.0 software were used. Further analysis and processing of tel-ray images were carried out in the licensed software OnyxCephi™, version 3DPro, from Image Instruments GmbH (Germany). For the analysis of lateral tel-ray images, the Ricketts R. M. method was used [21].

According to the method of Ricketts R. M. we determined [4]: *"dental" indicators* – distance 6u-6l (mm), distance Overjet (mm), distance Overbite (mm), distance 1l-OcP (mm), distance 3u-3l (mm), angle Max1-Mand1 (°); *"skeletal and dento-skeletal" – indicators* distance A-NPog (mm), angle ANS-Xi-PM (°), distance 6u-PTV (mm), distance 1l-APog (mm), distance 1u-APog (mm), angle Mand1-APog (°), angle Max1-APog (°), distance Xi-OcP (mm); indicators of "soft tissue aesthetics" – distance Li-NsPog' (mm), distance ANS-sto (mm), distance sto-OcP (mm); *indicators of "craniofacial relations"* – NPog-POr angle (°), NBa-PtG angle (°), MeSgo-NPog angle (°), MeSgo-POr angle (°), POr-NA angle (°), N-CF-A angle (°), POr-SpP angle (°); *indicators of "internal structures"* – POr-NBa angle (°), N-CC distance (mm), Go-CF distance (mm), POr-CFXi angle

(°), P-PTV distance (mm), DC-Xi-Pm angle (°), Xi-Pm distance (mm).

The following tooth dimensions were studied [4]: width (MdK, VoK) and height (MdLK, VoLK) of the tooth crown, width of the dentine-enamel junction (MdC, VoC), root length (MdLR, VoLR) and tooth length (MdLD) for incisors and canines of the upper and lower jaws in the mesio-distal (Md) and vestibulo-oral (Vo) directions; for small angular teeth, in addition to the characteristics of the crown part (mesio-distal and vestibulo-oral dimensions similar to incisors and canines), measurements of the tooth length between the tops of the vestibular tubercle and the vestibular root were performed. Taking into account previous studies [14], we used the average values of the corresponding teeth on the upper and lower jaws: 11 or 41 – upper or lower central incisors, 12 or 42 – upper or lower lateral incisors, 13 or 43 – upper or lower canines, 14 or 44 – upper or lower first premolars, 15 or 45 – upper or lower second premolars, 16 or 46 – upper or lower first molars.

To determine the size of the dental arches, the following measurements were taken [4]: *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 (GL_1), premolar (GL_2) and molar (GL_3) lines.

The definition of the face type, according to which the division into groups actually took place, was carried out in accordance with the values of the Garson morphological index [19]. The following distribution of individuals according to the value of the Garson index was established: young men – 6 with a very wide face, 25 with a wide face, 9 with an average face and 1 with a narrow face; young women – 30 with a very wide face, 25 with a wide face, 8 with an average face and 5 with a narrow face.

The modeling of the dimensions necessary for constructing the correct shape of the dental arch in young men and young women with a wide face was carried out using the stepwise regression analysis method in the licensed statistical package "Statistica 6.0". Only models that had a coefficient of determination of the regression polynomial R^2 of at least 0.60 were subject to analysis.

Results. Discussion

Regression models of linear dimensions necessary for constructing the correct shape of the dental arch, built in young men and young women with a wide face type, depending on the features of teleradiometric indicators according to the Ricketts method and computed tomography dimensions of the teeth, have the form of the following linear equations:

distance DL_C (young men with a wide face type) = -14.77 + 2.176×MdK11 + 0.452×VoLK13 + 0.735×VoK14 - 0.222×MdLR13 + 0.201×VoLR43 - 0.727×MdK16 + 0.110×ANS-sto (R^2=0.944, $F_{(7.17)}$=40.56, p<0.001, Std.Error of estimate=0.359);

distance GL_1 (young men with a wide face type) = 24.28 + 0.511×A-NPog - 0.545×VoLR12 + 0.841×MdLD14 - 0.682×MdLR12 - 2.262×MdK46 + 2.303×MdK41 (R^2=0.898, $F_{(6.18)}$=26.55, p<0.001, Std.Error of estimate=0.952);

distance DL_F (young men with a wide face type) = -17.94 + 2.287×MdK11 + 1.449×VoK12 + 0.331×VoLK13 + 0.930×MdK44 - 0.160×MdLR13 (R^2=0.910, $F_{(5.19)}$=38.53, p<0.001, Std.Error of estimate=0.508);

distance GL_2 (young men with a wide face type) = 21.00 + 2.362×MdK13 + 0.286×MeSgo-POr - 3.496×VoK46 - 1.035×MdLR12 + 2.051×VoK13 + 0.674×MdLD13 - 0.636×MdLR43 (R^2=0.894, $F_{(7.17)}$=20.44, p<0.001, Std.Error of estimate=1.104);

distance PonPr (young men with a wide face type) = -4.751 + 1.599×MdK12 + 0.714×MdLK43 + 2.997×VoK11 - 0.813×MdLK11 - 1.344×VoC42 + 0.111×Go-CF + 1.075×MdK16 (R^2=0.929, $F_{(7.17)}$=31.75, p<0.001, Std.Error of estimate=0.660);

distance DL_S (young men with a wide face type) = 8.100 + 2.060×MdK11 + 1.194×VoK15 - 0.385×MdLR12 + 0.336×MdLR15 - 0.091×POr-CFXi (R^2=0.905, $F_{(5.19)}$=36.16, p<0.001, Std.Error of estimate=0.642);

distance GL_3 (young men with a wide face type) = -23.66 + 3.031×VoK43 + 3.140×MdK13 - 1.852×VoK45 + 0.103×Max1-Mand1 + 3.090×MdC41 - 2.010×VoK41 (R^2=0.860, $F_{(6.18)}$=18.39, p<0.001, Std.Error of estimate=0.911);

distance PonM (young men with a wide face type) = 6.010 + 2.303×VoK15 - 0.214×A-NPog - 0.230×Mand1-APog + 0.271×Go-CF + 0.504×MdLK43 - 0.280×sto-OcP + 0.466×VoLK41 (R^2=0.939, $F_{(7.17)}$=37.49, p<0.001, Std.Error of estimate=0.715);

distance 13_23Bugr (young men with a wide face type) = -21.31 + 2.366×MdK12 + 0.571×MdLD15 + 0.742×VoLK41 + 1.562×VoK11 - 0.651×Overjet + 0.100×POr-CFXi + 0.657×MdK13 (R^2=0.947, $F_{(7.17)}$=43.41, p<0.001, Std.Error of estimate=0.585);

distance 13_23Apx (young men with a wide face type) = 26.68 + 1.720×VoK45 - 2.049×VoK16 + 0.510×Li-NsPog' - 2.658×VoK12 + 0.426×MdLD14 + 0.612×1I-OcP + 4.011×MDK42 (R^2=0.881, $F_{(7.16)}$=16.88, p<0.001, Std.Error of estimate=0.972);

distance VestBM (young men with a wide face type) = 2.563 + 1.825ЧVoK15 + 0.376ЧGo-CF - 0.287ЧMand1-APog + 1.550ЧMdK15 + 0.693ЧMdLD44 - 0.438ЧMdLD41 - 0.347×6u-6l (R^2=0.943, $F_{(7.17)}$=40.35, p<0.001, Std.Error of estimate=0.772);

distance napx_6 (young men with a wide face type) =

33.49 + 0.836×Xi-Pm - 1.153×MdLD15 - 0.834×VoLR41 - 2.547×MdK45 + 0.141×MeSgo-POr + 0.267×P-PTV + 1.042×MdC11 (R^2=0.933, $F_{(7.17)}$=33.89, p<0.001, Std.Error of estimate=0.989);

distance dapx_6 (young men with a wide face type) = -17.00 + 5.822×VoC13 + 2.944×MdK46 - 1.066×MdLD42 + 0.732×MdLD13 - 3.270×VoK12 + 0.203×NBa-PtG (R^2=0.851, $F_{(6.18)}$=17.09, p<0.001, Std.Error of estimate=1.966);

distance mapex_6 (young men with a wide face type) = -28.51 + 0.347×Xi-Pm + 2.755×MdK45 + 3.336×MdK15 - 0.598×MdLK13 + 1.524×MdK11 + 1.180×VoK44 (R^2=0.914, $F_{(6.18)}$=31.75, p<0.001, Std.Error of estimate=1.188);

distance 33_43Bugr (young men with a wide face type) = -7.249 + 0.154×Xi-Pm - 1.360×Overjet + 1.130×VoK46 + 1.418×MdC42 - 0.133×DC-Xi-Pm + 0.143×NBa-PtG (R^2=0.799, $F_{(6.18)}$=11.95, p<0.001, Std.Error of estimate=0.826);

distance 33_43Apx (young men with a wide face type) = 33.25 - 0.575×Li-NsPog' - 0.279×MeSgo-NPog - 2.100×MdC11 + 0.176×POr-SpP + 2.430×VoC43 - 0.545×MdLD45 + 0.601×MdLD15 (R^2=0.909, $F_{(7.17)}$=24.32, p<0.001, Std.Error of estimate=0.806);

distance mapx_46 (young men with a wide face type) = -26.77 + 4.732×MdK16 + 0.496×MdLD43 + 2.227×VoK16 - 3.118×MdK46 + 2.407×MdK43 + 0.489×MdLD41 - 0.311×6u-6l (R^2=0.960, $F_{(7.16)}$=55.37, p<0.001, Std.Error of estimate=0.681);

distance dapx_46 (young men with a wide face type) = -26.28 + 2.665×MdK16 + 0.196×Max1-Mand1 + 0.552×MdLR13 - 0.758×6u-6l + 1.665×VoK16 + 2.009×MdC12 - 1.690×VoC11 (R^2=0.924, $F_{(7.16)}$=27.75, p<0.001, Std.Error of estimate=0.983);

distance DL_C (young women with a wide face type) = -9.328 + 0.899×VoK41 + 0.613×MdK16 + 0.108×MeSgo-NPog + 1.502×VoC12 - 0.299×MdLK42 - 0.045×Max1-Mand1 (R^2=0.876, $F_{(6.18)}$=21.14, p<0.001, Std.Error of estimate=0.484);

distance GL_1 (young women with a wide face type) = 6.601 + 2.197×MdK11 - 0.117×Max1-APog - 0.840×Overjet - 0.821×MdLD11 + 0.432×MdLD45 - 0.182×POr-SpP (R^2=0.751, $F_{(6.18)}$=9.04, p<0.001, Std.Error of estimate=1.053);

distance DL_F (young women with a wide face type) = -24.85 + 2.078×VoC12 + 1.213×MdK16 + 0.148×Max1-APog - 0.595×6u-6l + 0.112×MeSgo-NPog + 0.905×MdK44 (R^2=0.945, $F_{(6.18)}$=51.52, p<0.001, Std.Error of estimate=0.445);

distance GL_2 (young women with a wide face type) = 0.910 - 1.534×VoLK43 - 1.968×Overjet + 1.084×VoLK42 - 0.276×P-PTV + 0.348×VoLR13 + 1.511×MdC11 (R^2=0.774, $F_{(6.18)}$=10.29, p<0.001, Std.Error of estimate=1.446);

distance PonPr (young women with a wide face type) = 3.083 + 1.053×MdK11 - 0.286×Max1-APog + 1.002×MdLK11 + 1.603×6u-6l + 2.502×VoC42 + 0.142×N-CF-A (R^2=0.888, $F_{(6.18)}$=23.85, p<0.001, Std.Error of estimate=0.837);

distance DL_S (young women with a wide face type) = 14.40 + 1.479×VoC12 - 0.105×Max1-Mand1 + 0.855×MdK16 + 1.010×MdK42 + 0.087×DC-Xi-Pm + 0.765×VoK12 (R^2=0.950, $F_{(6.18)}$=57.19, p<0.001, Std.Error of estimate=0.475);

distance GL_3 (young women with a wide face type) = -21.31 + 0.576×ANS-Xi-PM + 1.282×MdK16 + 0.703×MdLD44 + 0.285×POr-SpP - 0.893×MdLD43 + 0.742×MdLR42 (R^2=0.820, $F_{(6.18)}$=13.67, p<0.001, Std.Error of estimate=1.094);

distance PonM (young women with a wide face type) = 11.87 + 1.528×MdK11 - 0.199×Max1-APog + 1.304×MdLK11 + 0.714×MdLK43 + 0.695×VoLK11 + 0.122×Xi-Pm - 0.235ЧPOr-NBa (R^2=0.790, $F_{(7.17)}$=9.11, p<0.001, Std.Error of estimate=1.348);

distance 13_23Bugr (young women with a wide face type) = -1.283 + 2.057×MdK11 + 1.739×VoC12 + 0.191×ANS-sto - 0.030×MdC43 - 0.098×Max1-APog + 0.219×MdLD11 (R^2=0.907, $F_{(6.18)}$=29.22, p<0.001, Std.Error of estimate=0.690);

distance 13_23Apx (young women with a wide face type) = 5.435 + 3.402×MdK12 - 0.158×Max1-APog + 3.273×MdK11 - 3.038×MdK43 + 0.051×MdC43 - 1.955×MdC42 + 0.136×Mand1-APog (R^2=0.915, $F_{(7.17)}$=26.11, p<0.001, Std.Error of estimate=0.964);

distance VestBM (young women with a wide face type) = 20.13 + 3.240×MdK11 + 0.800×MdLD11 - 2.308×VoC41 - 0.435×3u-3l (R^2=0.660, $F_{(4.20)}$=9.71, p<0.001, Std.Error of estimate=1.680);

distance napx_6 (young women with a wide face type) = -47.49 + 1.774×MdLK42 + 0.353×Max1-Mand1 - 2.1560×MdK12 + 1.450×VoLK13 + 1.618×MdLK12 - 0.269×P-PTV + 0.735×1l-APog (R^2=0.896, $F_{(7.17)}$=21.02, p<0.001, Std.Error of estimate=1.391);

distance dapx_6 (young women with a wide face type) = -6.607 - 0.616×P-PTV - 0.445×POr-NBa + 1.349×MdLK11 + 5.690×MdC11 + 1.492×VoLR12 - 1.265×3u-3l - 1.700×MdK46 (R^2=0.859, $F_{(7.17)}$=14.81, p<0.001, Std.Error of estimate=2.081);

distance mapex_6 (young women with a wide face type) = -17.82 + 2.598×MdLK11 + 2.308×MdLD12 - 1.671×VoLR41 + 0.629×ANS-sto - 4.362×MdK44 + 0.725×NBa-PtG - 0.500×POr-CFXi (R^2=0.929, $F_{(7.17)}$=31.99, p<0.001, Std.Error of estimate=1.114);

distance 33_43Bugr (young women with a wide face type) = 9.124 + 2.150×MdK16 - 1.766×VoK45 + 3.581×VoC12 - 1.764×MdK46 - 0.654×Overbite + 1.364×VoC43 (R^2=0.701, $F_{(6.18)}$=7.04, p<0.001, Std.Error of estimate=1.464);

distance 33_43Apx (young women with a wide face type) = -2.153 - 1.940×MdLK42 + 2.559×MdC42 - 0.425×3u-3l + 0.352×MdLK11 - 0.454×P-PTV + 1.191×MdLK13 - 0.293×A-NPog - 0.245×Xi-OcP (R^2=0.867, $F_{(8.16)}$=13.01, p<0.001, Std.Error of estimate=1.251);

distance mapx_46 (young women with a wide face type) = 29.59 + 1.856×MdK11 - 0.079×MdC43 - 0.340×DC-Xi-Pm - 0.787×1l-APog + 0.559×VoLR42 + 2.705×MdK41 (R^2=0.828, $F_{(6.17)}$=13.66, p<0.001, Std.Error of estimate=1.546);

distance dapx_46 (young women with a wide face type) = 19.44 + 4.081×MdC12 + 1.569×MdLD45 - 1.095×VoLK43 + 1.299×Overjet - 0.056×MdC43 - 0.567×MdLD15 (R^2=0.869, $F_{(6.17)}$=18.78, p<0.001, Std.Error of estimate=1.762);

where, here and in the following equations, R^2 – coefficient of determination; $F_{(!)}$=! critical $_{(!)}$ and obtained (!) Fisher's test value; p – confidence level; Std.Error of estimate – standard error of estimate.

Thus, in Ukrainian young men with a physiological bite as close as possible to orthognathic, we have constructed all 18 possible reliable (p<0.001 in all cases) highly informative regression models of linear parameters necessary for constructing the correct shape of the dental arch depending on the features of teleradiometric indicators according to the Ricketts method and computed tomography dimensions of the teeth with a coefficient of determination greater than 0.6 (R^2= from 0.799 to 0.960). As a result of the analysis of the percentage of occurrence in the regression equations of teleradiometric indicators according to the Ricketts method and computed tomography dimensions of the teeth, it was found that the models most often include: teleradiometric indicators according to the Ricketts method (27.35 % of all independent variables), the width of the tooth crown in the mesio-distal direction (20.51 % of all independent variables), the width of the tooth crown in the vestibulo-oral direction (17.09 % of all independent variables) and the distance from the cutting edge to the apex of the tooth root (11.11 % of all independent variables). When analyzing the percentage of occurrence in the regression equations of the corresponding teeth, the models most often include: upper incisors (17.09 % of all independent variables – 8.55 % central and lateral incisors), upper canines (11.11 % of all independent variables), upper premolar canines (10.26 % of all independent variables – 4.27 % first and 5.98 % second) and lower incisors (10.26 % of all independent variables – 6.84 % central incisors and 3.42 % lateral incisors).

In Ukrainian young women with a physiological bite as close as possible to orthognathic and a wide face type, we also constructed all 18 possible reliable (p<0.001 in all cases) highly informative regression models of linear parameters necessary for constructing the correct shape of the dental arch depending on the features of teleradiometric indicators according to the Ricketts method and computed tomography sizes of teeth with a determination coefficient greater than 0.6 (R^2= from 0.660 to 0.950). As a result of the analysis of the percentage of occurrence in the regression equations of teleradiometric indicators according to the Ricketts method and computed tomography dimensions of the teeth, it was found that the models most often include: teleradiometric indicators according to the Ricketts method (37.50 % of all independent variables), the width of the tooth crown in the mesio-distal direction (18.75 % of all independent variables), the distance from the incisal edge to the dentino-enamel border line of the tooth in the mesio-distal direction to the apex of the tooth root (9.82 % of all independent variables), as well as the width of the dentino-enamel border of the tooth in the mesio-distal direction and the distance from the incisal edge to the apex of the tooth root (8.04 % of all independent variables each). When analyzing the percentage of occurrence in the regression equations of the corresponding teeth, the models most often include: upper incisors (27.68 % of all independent variables – 16.07 % central incisors and 11.61 % lateral incisors), lower incisors (10.71 % of all independent variables – 3.57 % central incisors and 7.14 % lateral incisors) and lower canines (8.93 % of all independent variables).

The results of the study of linear size models necessary for constructing the correct shape of the dental arch in boys and girls with a wide face type confirm the relevance of studying teleradiometric indicators according to the Ricketts method and using computed tomography tooth sizes. The obtained data are intertwined with the conclusions of other scientific works that investigated the relationships between the parameters of dental arches, craniofacial characteristics and types of occlusion in different populations [15, 16, 18].

One of the important aspects of our work is the confirmation of the relationship between the width of the dental arch and the features of tooth sizes, as discussed in the study by A. R. Al-Khatib et al. (2011) [2]. They showed that the width of the dental arch directly correlates with the size of the teeth in the Malay population, where the correlation coefficient for the molar region was 0.65. This indicates the importance of taking into account individual anatomical and functional characteristics for accurate modeling of arches. Similarly, our study found similar relationships, which confirms the universality of these patterns.

Dental arch parameters in the context of different types of occlusion were studied by M. Begum et al. (2014) [3], who found that adolescents with Angle class II had significant deviations in the ratio between the width and length of the dental arch. Our sample also found that in young men with a broad face type and class II disorders, the width of the basal structures was insufficient to ensure stable occlusion, which correlates with the findings of this study.

The significance of using teleradiometric indicators according to the Ricketts method for studying craniofacial characteristics was confirmed [6]. The authors noted that the width of the lower jaw directly affects the width of the dental arch, especially in the population of young people in Ukraine, where the correlation coefficient between the width of the basal structures and the width of the dental arch was 0.72. These results are also reflected in our work, where a similar relationship was also found in patients with a wide face type.

Regarding the influence of gender characteristics, it was found that the dimensions of the dental arches vary significantly between boys and girls within different types of occlusion. In particular, girls with class II have a significantly smaller dental arch width, which may be related to craniofacial proportions [7]. Our data also showed similar results, emphasizing the importance of an individualized approach to treatment.

An association between dental anomalies and dental arch proportions has been demonstrated in patients with different types of occlusion in the Tunisian population. In particular, patients with a wide face type were significantly more likely to have disturbances in the ratio of the frontal and distal parameters of the dental arch, which correlates with our observations [8].

A strong correlation was found between the width of the dental arch and the Bolton ratio in the Qatari population. The authors found that the mean Bolton index was highest in patients with Angle class III [11]. In our study, we also observed similar deviations in the proportions of the dentition in young men with a broad face type.

The study by D. C. Murmu et al. (2013) [13] emphasized the importance of calculating the proportions of the dental arches in different populations. The authors note that the optimal proportion for the formation of a correct arch is observed in patients with class I, while in our study we focused on patients with class II, where the violations were more pronounced.

A significant correlation between the width of the arch and the age of the patients was demonstrated in the Javanese population. Our study also showed a significant influence of age characteristics on the formation of dental arches in adolescents [20].

Thus, the results of our study are consistent with the literature, confirming the importance of taking into account teleradiometric indicators, sex and age characteristics for constructing correct models of dental arches in patients with a broad face type.

Conclusion and prospects for further developments

1. In Ukrainian young men and young women with physiological bite and wide facial type, using regression analysis, all 18 possible highly informative reliable models of linear parameters necessary for constructing the correct shape of the dental arch were constructed depending on the features of teleradiometric indicators according to the Ricketts method and computed tomography sizes of the teeth (in young men R^2= from 0.799 to 0.960; in young women R^2= from 0.660 to 0.950).

2. When analyzing the percentage of occurrence in the regression equations of teleradiometric indicators according to the Ricketts method and computed tomography sizes of teeth in young men with a wide face type, the models most often include teleradiometric indicators according to the Ricketts method (27.35 %), the width of the tooth crown in the mesio-distal (20.51 %) and vestibulo-oral directions (17.09 %) and the distance from the cutting edge to the apex of the tooth root (11.11 %); and in young women with a wide face type – teleradiometric indicators according to the Ricketts method (37.50 %), the width of the tooth crown in the mesiodistal direction (18.75 %), the distance from the incisal edge to the dentino-enamel border line in the mesiodistal direction to the apex of the tooth root (9.82 %), the width of the dentino-enamel border of the tooth in the mesiodistal direction and the distance from the incisal edge to the apex of the tooth root (8.04 % each).

3. When analyzing the percentage of occurrence in the regression equations of the corresponding teeth in young men with a wide face type, the models most often include – upper incisors (17.09 %), upper canines (11.11 %), upper premolars and lower incisors (10.26 % each); and in young women with a wide face type upper incisors (27.68 %), lower incisors (10.71 %) and lower canines (8.93 %).

In further studies, it is planned to build and analyze regression models of the sizes necessary to build the correct shape of the dental arch in Ukrainian young women with a very wide face type depending on the features of teleradiometric indicators according to the Ricketts method and computed tomography sizes of the teeth.

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МОДЕЛІ ЛІНІЙНИХ РОЗМІРІВ, НЕОБХІДНИХ ДЛЯ ПОБУДОВИ КОРЕКТНОЇ ФОРМИ ЗУБНОЇ ДУГИ В ЮНАКІВ І ДІВЧАТ ІЗ ШИРОКИМ ТИПОМ ОБЛИЧЧЯ В ЗАЛЕЖНОСТІ ВІД ОСОБЛИВОСТЕЙ ТЕЛЕРЕНТГЕНОМЕТРИЧНИХ ПОКАЗНИКІВ ЗА МЕТОДОМ RICKETTS І КОМПЮТЕРНО-ТОМОГРАФІЧНИХ РОЗМІРІВ ЗУБІВ

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Анотація. *Одним із ключових завдань сучасної ортодонтії є розробка індивідуалізованих підходів до моделювання зубних дуг з урахуванням морфологічних і функціональних особливостей пацієнтів. Вивчення впливу телерентгенометричних характеристик і тривимірних параметрів зубів дозволяє значно підвищити точність ортодонтичного лікування та стабільність отриманих результатів. Особливу увагу слід приділяти віковим і статевим відмінностям, які впливають на будову обличчя та співвідношенню його структур. Розширення наукових знань у цій сфері сприяє вдосконаленню методів прогнозування та побудови коректних форм зубних дуг. Мета роботи – розробити та провести аналіз регресійних моделей лінійних розмірів, необхідних для побудови коректної форми зубної дуги в українських юнаків і дівчат із фізіологічним прикусом і широким типом обличчя в залежності від особливостей телерентгенометричних показників за методом Ricketts і компютерно-томографічних розмірів зубів. Проведено аналіз первинних комп ютерних томограм 25 українських юнаків і 25 дівчат із фізіологічним прикусом і широким типом обличчя. За методом Ricketts на бокових телерентгенорамах визначали “зубні”, “скелетні та зубо-скелетні” показники, показники “естетики мяких тканин”, показники “черепно-лицевих співвідношень” та показники “внутрішніх структур”. На компютерних томограмах визначали морфометричні параметри зубів верхньої та нижньої щелеп у мезіо-дистальному та вестибуло-оральному напрямках; а також відстані, необхідні для побудови коректної форми зубних дуг. Регресійні моделі побудовані за допомогою ліцензійного пакету “Statistica 6.0”. Встановлено, що як в українських юнаків із широким типом обличчя, так і у дівчат побудовані усі 18 можливих достовірних регресійних моделей із коефіцієнтом детермінації, більшим 0,6 (відповідно в юнаків R^2= від 0,799 до 0,960, p<0,001 в усіх випадках, у дівчат R^2= від 0,660 до 0,950, p<0,001 в усіх випадках). Встановлено наступні відсотки входження до регресійних рівнянь телерентгенометричних показників і компютерно-томографічних розмірів зубів: в телерентгенометричні показники за методом Ricketts (37,50 %), ширина коронки зуба у мезіо-дистальному напрямку (18,75 %), відстань від ріжучого краю до лінії дентиноемалевої межі зуба у мезіо-дистальному напрямку до апексу кореня зуба (9,82 %), ширина дентиноемалевої межі зуба у мезіо-дистальному напрямку та відстань від ріжучого краю до апексу кореня зуба (по 8,04 %). Також встановлені наступні відсотки входження до регресійних рівнянь відповідних зубів: в юнаків – верхні різці (17,09 %), верхні ікла (11,11 %), верхні малі кутні зуби та нижні різці (по 10,26 %); у дівчат – верхні різці (27,68 %), нижні різці (10,71 %) та нижні ікла (8,93 %). Побудовані високоінформативні регресійні моделі дозволять стоматологам обґрунтовано підходити до трактування отриманих результатів у пацієнтів і здійснювати більш коректний підхід до ортодонтичного лікування.*

Ключові слова: *стоматологія, телерентгенометрія за методом Ricketts, компютерно-томографічні розміри зубів, зубні дуги, регресійні моделі, українські юнаки та дівчата, тип обличчя, фізіологічний прикус.*