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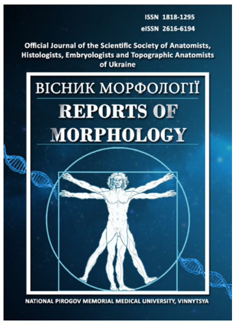


# Regression models of computed tomography dimensions necessary for constructing the correct shape of the dental arch in Ukrainian young men and young women with physiological occlusion and a wide facial type depending on the characteristics of teleradiometric indicators according to the Steiner or Tweed methods and computed tomography dimensions of the teeth

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*In modern orthodontics, an important task is the individualization of treatment planning taking into account the morphological and cephalometric characteristics of the patient. Of particular interest are indicators that reflect the relationship between bone structures and the position of the teeth in the jaws. The use of regression analysis allows you to create predictive models that increase the accuracy of diagnosis and the effectiveness of therapy. The study of these relationships among young people with certain anthropometric characteristics will contribute to the development of more informed orthodontic decisions by the doctor. The aim of the study is to develop regression models of linear dimensions necessary for constructing the correct shape of the dental arch depending on the features of teleradiometric indicators according to the Steiner or Tweed methods and computed tomography dimensions of teeth in Ukrainian young men (YM) and young women (YW) with physiological occlusion and a wide face type. On the obtained teleradiograms (25 YM and 25 YW with physiological occlusion and a wide face type), measurements were performed using the Steiner S. S. and Tweed C. H. methods, and on computed tomograms – morphometric study of teeth and dental arches. Regression models of linear dimensions necessary for constructing the correct shape of the dental arch were constructed using the “Statistica 6.0” license package. It was found that in YM, taking into account the Steiner or Tweed method, all 18 possible reliable models with a coefficient of determination greater than 0.6 were constructed (respectively $R^2$= from 0.835 to 0.973 and $R^2$= from 0.821 to 0.972, $p<0.001$); and in YW, taking into account the Steiner method, all 18 models ($R^2$= from 0.763 to 0.931, $p<0.001$) and taking into account the Tweed method, 17 models ($R^2$= from 0.733 to 0.952, $p<0.001$). When analyzing the frequency of occurrence in the models of computed tomography tooth sizes and teleradiometric indicators according to the Steiner or Tweed methods, it was established: in YM, the width of the crown part of the tooth in the mesio-distal and vestibulo-oral plane, teleradiometric indicators, and also (only when taking into account the indicators according to the Tweed method), the length of the tooth is most often included; in YW - teleradiometric indicators, the width of the crown part of the tooth in the mesio-distal and vestibulo-oral plane and the width of the cervical part of the tooth in the vestibulo-oral plane when taking into account the indicators according to the Steiner method, and when taking into account the indicators according to the Tweed method – teleradiometric indicators, the width of the cervical part of the tooth in the vestibulo-oral and mesio-distal plane and the*

*width of the crown part of the tooth in the mesio-distal and vestibulo-oral plane. When analyzing the frequency of occurrence in the models of the corresponding teeth, it was found that in YM the upper and lower incisors, upper canines and upper premolars are most often included, and in YW – the upper and lower incisors, lower canines, and (only when taking into account the indicators according to the Steiner method), the lower premolars.*
**Keywords:** *dentistry, teleradiometry, computed tomography dimensions of teeth and dental arches, regression analysis, Ukrainian young men and young women, physiological occlusion, face types.*

## Introduction

Dental malformations and maxillofacial pathologies remain one of the most pressing problems in modern dentistry, as they not only impair the aesthetics of the smile, but can also cause serious functional changes. According to a systematic review and meta-analysis by Lombardo G. et al., the prevalence of occlusion pathologies in children is 56 % in the primary, 70 % in the secondary and over 80% in the permanent dentition, indicating a significant frequency of occlusion disorders at all stages of maxillofacial development [18]. Such a high prevalence indicates the need for early diagnosis and accurate individual treatment planning. A study conducted among children in France showed that 24.3 % of orthodontic patients have at least one dental malformation, with the most common being anomalies of the size, number and position of the teeth [6]. In Turkey, such disorders were found in 28.2 % of the population, where retention, hypodontia and microdentia were most common [4]. Similar figures were recorded in Croatian patients, where the prevalence of anomalies reached 26.3 %, which once again confirms the universality of this problem in orthodontic practice [12].

It is important to emphasize that pathologies of the development of permanent occlusion are found not only in Europe, but also in other parts of the world. In a study conducted in Japan among 9584 high school students, it was found that 24.6 % had at least one anomaly of the permanent dentition [15]. Similar data were obtained in Australia – 27 % of participants had dentofacial anomalies, including supernumerary and congenitally absent teeth [8].

In a study of children in Saudi Arabia, the incidence of anomalies was 16.1 %, with microdentia, macrodentia, and malocclusion being the most common [1]. A somewhat lower incidence was observed in a Nigerian population, at 11.8 %, but the authors point out that the lack of early diagnosis may underestimate the true rate [21]. It should also be noted that the incidence of anomalies is significantly higher among orthodontic patients, where the incidence may exceed the average values in the general population [13]. Statistical data indicate significant variability in the incidence of anomalies depending on age, region, and characteristics of the studied samples. For example, in children aged 5-15 years in Turkey, 20.5 % were found to have at least one dental anomaly, the most common of which were conical teeth and fusions [2]. In a similar age range, 18.6 % of cases of anomalies were found among patients who sought orthodontic treatment in Croatia [12].

Overall, the increasing prevalence of dental developmental disorders and occlusion pathologies in children and adolescents in different countries of the world indicates the importance of early diagnosis and a personalized approach to orthodontic planning. Taking into account teleradiometric indicators and computed tomography data allows for a more accurate assessment of the anatomical features of each patient and the creation of regression models that can improve the quality and predictability of treatment.

*The purpose of the study* is to develop regression models of linear dimensions necessary for constructing the correct shape of the dental arch depending on the characteristics of teleradiometric indicators according to the Steiner or Tweed methods and computed tomography dimensions of teeth in Ukrainian young men (YM) and young women (YW) with a physiological bite and a wide facial type.

## Materials and methods

Primary computed tomography scans of 25 Ukrainian YMs (aged 17 to 21 years) and 25 Ukrainian YWs (aged 16 to 20 years) with physiological occlusion and a wide face type according to Garson [22] were obtained from the data bank of the Department of Pediatric Dentistry and the Research Center of the National Pirogov Memorial Medical University, Vinnytsya. Teleradiography (using the Veraviewepocs 3D Morita dental cone-beam tomograph, Japan) and computed tomography (using the Planmeca ProMax 3D Mid dental cone-beam tomograph, Finland) studies of YMs and girls were conducted on the basis of the principle of voluntary informed consent in the private dental clinic “Vinintermed” and in the “Planmeca 3D Maxillofacial Diagnostics Center”. 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.

Measurements according to the method of Steiner S. S. [27] and Tweed C. H. [26] were performed in the OnyxCeph³™ application version 3DPro (Image Instruments GmbH, Germany) on teleradiograms obtained in a standard way and created in the 3D Slicer v5.4.0 software with points marked on 3D objects. According to these methods, the angular and linear indicators shown in Figures 1-5 were determined. In addition, according to the Steiner method,

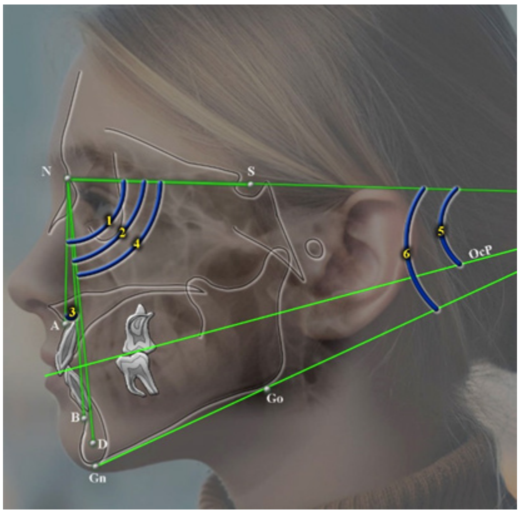


**Fig. 1.** Measuring angular indicators (°) according to the Steiner method. 1 – angle SNA_S, 2 – angle SNB_S, 3 – angle ANB_S, 4 – angle SND, 5 – angle SN-OcP, 6 – angle SN-GoGn.

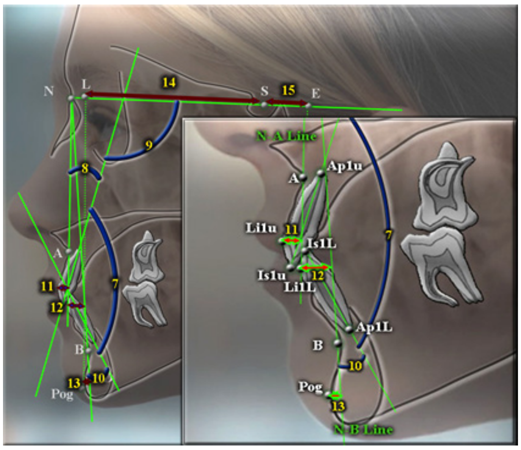


**Fig. 2.** Measurement of angular (°) and linear indicators (mm) according to the Steiner method. 7 – angle II, 8 – angle Max1-NA, 9 – angle Max1-SN, 10 – angle Mand1-NB, 11 – distance 1u-NA, 12 – distance 1l-NB, 13 – distance Pog-NB, 14 – distance S-L, 15 – distance S-E.

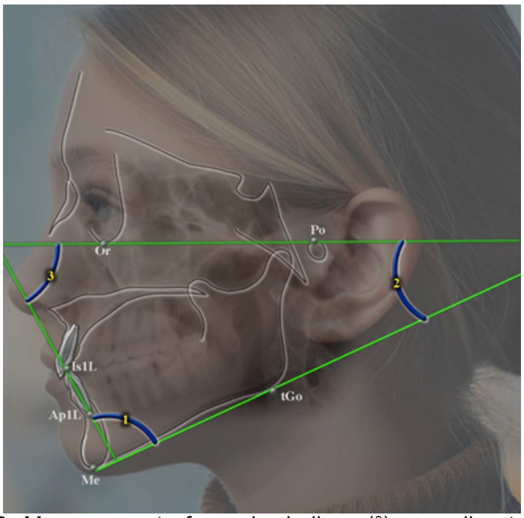


**Fig. 3.** Measurement of angular indices (°) according to the Tweed method. 1 – angle IMPA, 2 – angle FMA, 3 – angle FMIA.

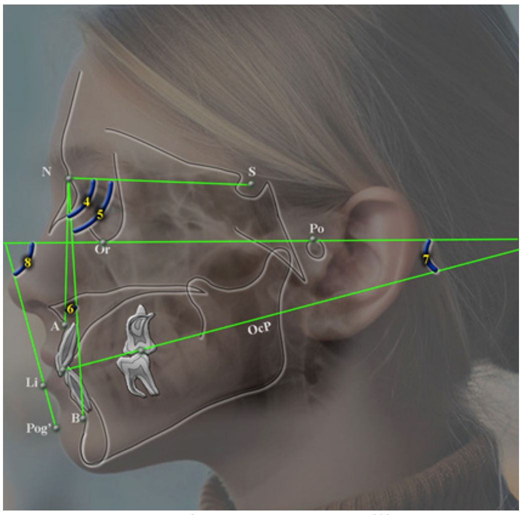


**Fig. 4.** Measurement of angular indices (°) according to the Tweed method. 4 – angle SNA_T, 5 – angle SNB_T, 6 – angle ANB_T, 7 – angle POr_OcP, 8 – angle Z.

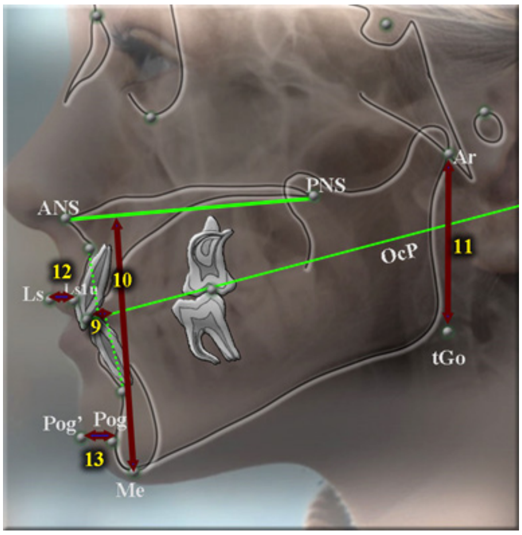


**Fig. 5.** Measurement of linear indicators (mm) according to the Tweed method. 9 – показник Wits, 10 – distance AFH, 11 – distance PFH, 12 – distance Ls1u_Ls, 13 – distance Pog_Pog'.

the Holdaway Ratio value was determined (the difference between the values of the 1l-NB and Pog-NB indicators, mm), and according to the Tweed method, the AFH_PFH ratio value was determined.

Morphometric study of teeth (Fig. 6-9) and dental arches (Fig. 10-13) was performed using software applications. 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.

Since previous studies [19] did not reveal any significant differences or trends in the comparison of computed tomography sizes of the same teeth on the right and left sides, we used the average values of the corresponding teeth: 11 or 41 – upper or lower central incisors, 12 or 42 – upper or lower lateral incisors, 13 or 43 – upper or lower

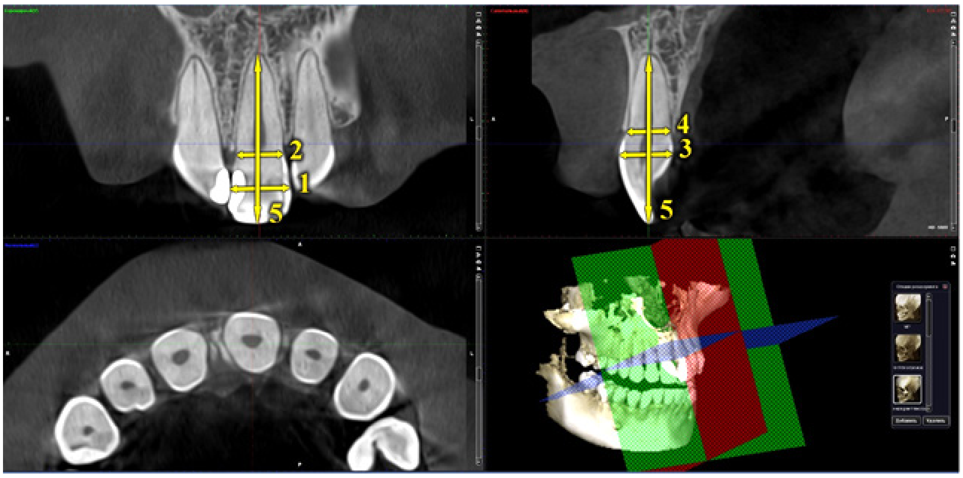


**Fig. 6.** Determination of metric characteristics of incisors and canines of the upper and lower jaws (mm). 1 – width of the crown part of the tooth in the mesio-distal plane (MdK); 2 – width of the cervical part of the tooth in the mesio-distal plane (MdC); 3 – width of the crown part of the tooth in the vestibulo-oral plane (VoK); 4 – width of the cervical part of the tooth in the vestibulo-oral plane (VoC); 5 – length of the tooth (same) in the mesio-distal and vestibulo-oral planes (MdLD).

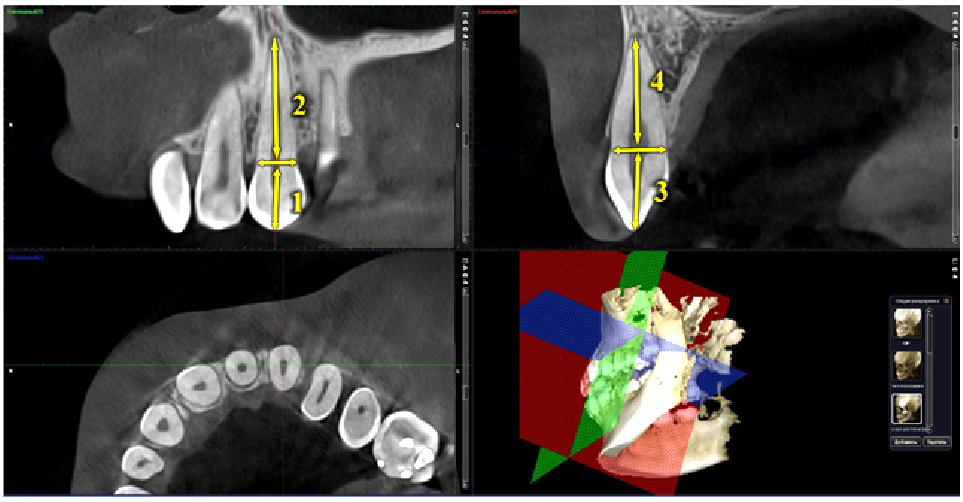


**Fig. 7.** Determination of metric characteristics of incisors and canines, upper and lower jaws (mm). 1 – length of the crown part of the tooth in the mesio-distal plane (MdLK); 2 – length of the root part of the tooth in the mesio-distal plane (MdLR); 3 – length of the crown part of the tooth in the vestibulo-oral plane (VoLK); 4 – length of the root part of the tooth in the vestibulo-oral plane (VoLR).

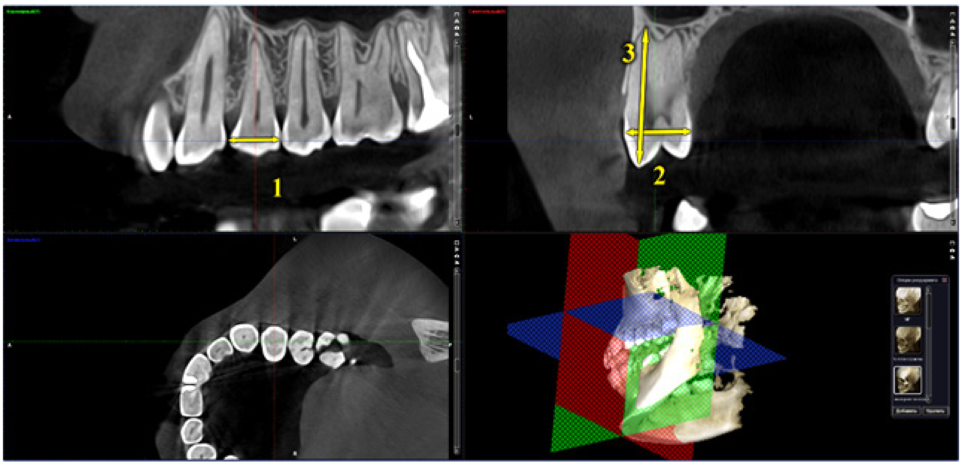


**Fig. 8.** Determination of metric characteristics of small angular teeth (premolars) of the upper and lower jaws (mm). 1 – width of the crown part of the tooth in the mesio-distal plane (MdK); 2 – width of the crown part of the tooth in the vestibulo-oral plane (VoK); 3 – length of the tooth in the vestibulo-oral plane (MdLD).

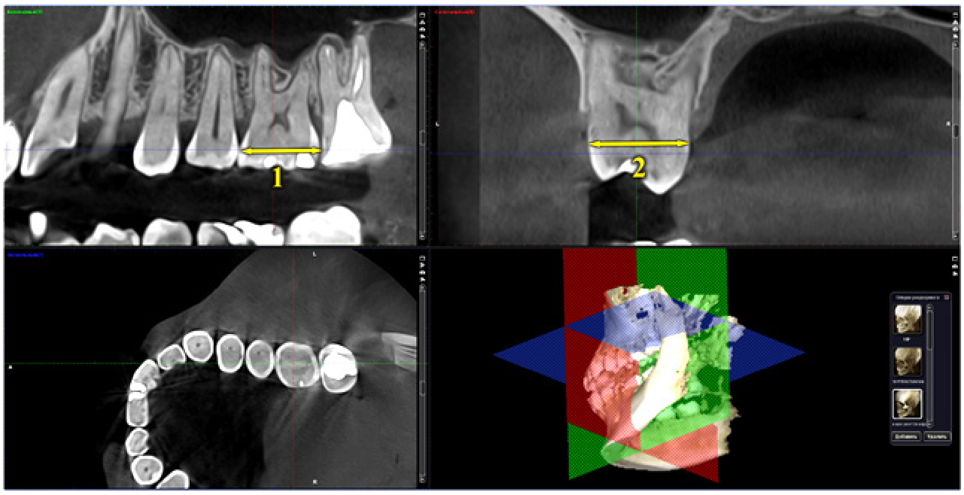


**Fig. 9.** Determination of metric characteristics of large canine teeth (molars) of the upper and lower jaws (mm). 1 – width of the crown part in the mesio-distal plane (MdK); 2 – width of the crown part in the vestibulo-oral plane (VoK).

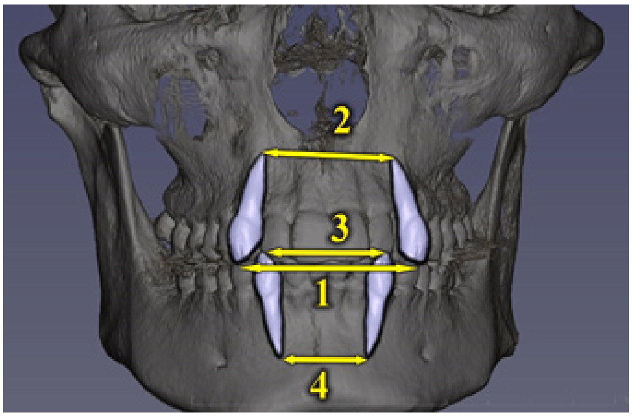


**Fig. 10.** Determination of the linear dimensions of the dental arches (mm): the distance between the eruption cusps (1 – distance 13_23Bugr) and the root tips (2 – distance 13_23Apx) of the canines on the upper jaw and between the eruption cusps (3 – distance 33_43Bugr) and the root tips (4 – distance 33_43Apx) of the canines on the lower jaw.

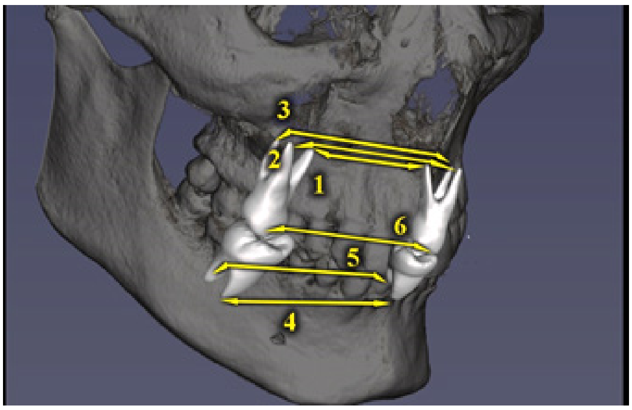


**Fig. 11.** Determination of the linear dimensions of the dental arches (mm): distances between the tips of the palatal (1 – distance mapex_6), medial vestibular (2 – distance napx_6), distal vestibular roots (3 – distance dapx_6), vestibular medial tubercles (6 – distance VestBM) of the upper first molars and the distal (5 – distance dapx_46) and medial (4 – distance mapx_46) roots of the lower first molars.

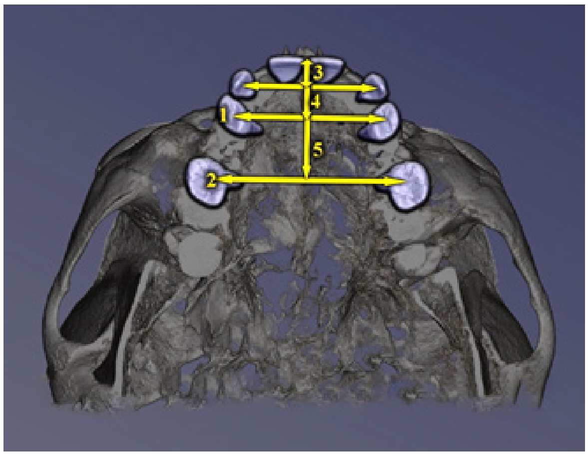


**Fig. 12.** Determination of linear dimensions of dental arches (mm): distances between premolar (1 – distance PonPr) and molar (2 – distance PonM) points according to Pon; distances between crowns of central incisors and lines connecting canines (3 – distance DL_C), first premolars (4 – distance DL_F) and molars (5 – distance DL_S) of the upper jaw.

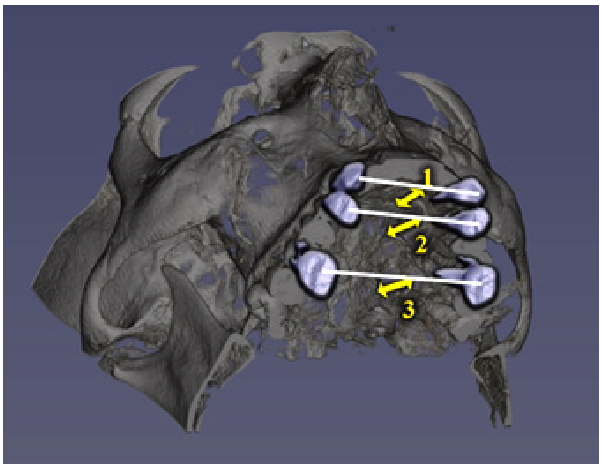


**Fig. 13.** Determination of linear dimensions of dental arches (mm): distances characterizing the position of the interdental (1 – distance GL_1), premolar (2 – distance GL_2) and molar (3 – distance GL_3) lines relative to the hard palate.

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.

Modeling of linear dimensions necessary for constructing the correct shape of the dental arch depending on the features of teleradiometric indicators according to the Steiner or Tweed method and computed tomography dimensions of the teeth was carried out using the stepwise regression analysis method in the licensed statistical package “Statistica 6.0”.

## Results

As a result of the conducted studies, it was found that in *YM* with a physiological bite and a wide face type, reliable regression models (with a coefficient of determination $R^2$>0.60) of linear dimensions necessary for constructing the correct shape of the dental arch depending on the features of teleradiometric indicators according to the *Steiner method* and computed tomography dimensions of the teeth have the form of the following equations:

*distance DL_C (YM with a wide face)*= -14.09 + 2.016×MdK11 + 0.513×VoLK13 + 0.524×VoK14 - 0.153×MdLR13 + 0.156×VoLR43 + 0.076×S-E - 0.411×VoK46 ($R^2$=0.938, $F_{(7.17)}$=36.90, p<0.001, Std.Error of estimate=0.375);

*distance GL_1 (YM with a wide face)*= -2.183 + 1.216×ANB_S - 1.624×VoLR12 + 2.136×MdK13 + 0.964×VoLR43 + 0.230×Max1-NA - 1.545×MdK46 + 1.954×MdK14 ($R^2$=0.891, $F_{(7.17)}$=19.92, p<0.001, Std.Error of estimate=1.013);

*distance DL_F (YM with a wide face)*= -21.60 + 2.295×MdK11 + 1.511×VoK12 + 0.341×VoLK13 + 0.793×MdK44 - 0.178×MdLR13 + 0.661×MdK15 ($R^2$=0.926, $F_{(6.18)}$=37.81, p<0.001, Std.Error of estimate=0.472);

*distance GL_2 (YM with a wide face)*= 57.38 + 2.958×MdK13 + 0.174×SN-GoGn - 3.234×VoK46 - 1.640×MdLR12 + 1.243×MdLR13 - 0.873×MdLR43 - 2.395×MdK14 ($R^2$=0.924, $F_{(7.17)}$=29.50, p<0.001, Std.Error of estimate=0.934);

*distance PonPr (YM with a wide face)*= 13.51 + 2.476×MdK12 + 0.679×MdLK43 + 2.248×VoK11 - 0.918×MdLK11 - 1.932×VoC42 + 1.371×VoK44 - 0.607×VoK14 ($R^2$=0.926, $F_{(7.17)}$=30.25, p<0.001, Std.Error of estimate=0.675);

*distance DL_S (YM with a wide face)*= -9.135 + 3.065×MdK11 - 0.341×MdLR12 + 0.259×VoLK11 + 0.817×VoK12 + 0.608×MdLK13 + 0.580×VoK14 + 0.110×Holdaway Ratio ($R^2$=0.965, $F_{(7.17)}$=67.24, p<0.001, Std.Error of estimate=0.411);

*distance GL_3 (YM with a wide face)*= 19.71 + 2.631×VoK43 + 1.697×MdK13 - 0.161×SNA_S - 0.418×MdLK42 - 0.698×MdLD45 + 0.867×MdLD15 - 0.312×ANB_S - 1.580×MdK16 ($R^2$=0.912, $F_{(8.16)}$=20.65, p<0.001, Std.Error of estimate=0.767);

*distance PonM (YM with a wide face)*= 38.95 + 3.244×VoK15 - 0.450×Mand1-NB + 1.503×VoK43 + 1.013×VoLK41 - 0.203×II + 0.376×1I-NB - 0.646×MdC43 ($R^2$=0.917, $F_{(7.17)}$=26.89, p<0.001, Std.Error of estimate=0.834);

*distance 13_23Bugr (YM with a wide face)*= -11.92 + 2.252×MdK12 + 0.668×MdLD15 + 0.668×VoLK41 + 1.670×VoK11 - 0.351×MdLD45 + 0.695×VoK16 - 0.149×Holdaway Ratio ($R^2$=0.942, $F_{(7.17)}$=39.55, p<0.001, Std.Error of estimate=0.611);

*distance 13_23Apx (YM with a wide face)*= 40.71 + 2.329×VoK45 - 1.185×VoK16 + 0.842×ANB_S - 2.870×VoK12 + 0.659×VoLR42 + 0.092×S-L - 0.621×MdLD15 ($R^2$=0.908, $F_{(7.16)}$=22.61, p<0.001, Std.Error of estimate=0.853);

*distance VestBM (YM with a wide face)*= 22.66 + 3.143×VoK15 - 0.352×Mand1-NB + 1.833×MdK43 - 0.786×VoLR13 + 0.691×MdLD11 - 1.953×VoK46 + 1.150×MdK46 + 0.298×1I-NB ($R^2$=0.951, $F_{(8.16)}$=38.67, p<0.001, Std.Error of estimate=0.740);

*distance napx_6 (YM with a wide face)*= 63.94 - 0.685×MdLD13 + 1.045×Pog-NB + 3.407×MdK12 - 5.280×MdK16 + 3.781×MdK15 + 3.002×MdC42 - 2.153×VoC42 - 0.564×VoLK42 ($R^2$=0.973, $F_{(8.16)}$=70.94, p<0.001, Std.Error of estimate=0.653);

*distance dapx_6 (YM with a wide face)*= -48.39 + 4.959×VoC13 + 2.379×MdK46 + 0.445×MdLD13 - 4.068×VoK12 + 0.535×SNA_S + 3.060×VoK44 - 2.595×VoK42 ($R^2$=0.919, $F_{(7.17)}$=27.79, p<0.001, Std.Error of estimate=1.486);

*distance mapex_6 (YM with a wide face)*= -41.63 + 4.950×MdK45 + 2.917×MdK12 + 5.366×MdK15 + 5.112×MdC41 - 0.637×MdLR42 - 2.495×MdC13 + 1.652×VoK12 ($R^2$=0.943, $F_{(7.17)}$=40.20, p<0.001, Std.Error of estimate=0.993);

*distance 33_43Bugr (YM with a wide face)*= 13.32 + 0.190×Pog-NB + 0.678×MdLK12 - 0.858×MdLR12 + 1.072×MdC11 + 1.607×MdC41 + 1.810×VoK41 - 0.558×VoK14 ($R^2$=0.835, $F_{(7.17)}$=12.32, p<0.001, Std.Error of estimate=0.770);

*distance 33_43Apx (YM with a wide face)*= 1.871 + 0.706×MdLK43 - 0.912×MdLK42 + 0.375×Max1-NA + 0.254×SN-GoGn - 0.918×MdLD44 + 0.684×MdLD13 + 1.060×VoC43 ($R^2$=0.908, $F_{(7.17)}$=23.89, p<0.001, Std.Error of estimate=0.813);

*distance mapx_46 (YM with a wide face)*= -22.52 + 5.124×MdK16 + 0.512×MdLD43 + 2.035×VoK16 - 3.429×MdK46 + 2.609×MdK43 + 0.396×MdLD41 - 0.075×Mand1-NB ($R^2$=0.958, $F_{(7.16)}$=52.67, p<0.001, Std. Error of estimate=0.698);

*distance dapx_46 (YM with a wide face)*= -22.84 + 4.431×MdK16 + 0.243×II - 0.411×S-E + 0.932×VoLK11 + 0.879×MdLK12 - 0.748×MdLK13 ($R^2$=0.906, $F_{(6.17)}$=27.29, p<0.001, Std.Error of estimate=1.060);

where, here and in the following equations, R2 – coefficient of determination; $F_{(!)}$=! – critical $_{(!)}$ and obtained (!) Fisher’s test value; p – confidence level; Std.Error of estimate – standard error of estimate.

In *YW* with a physiological bite and a wide face type, reliable regression models (with a coefficient of determination

$R^2$>0.60) of linear dimensions necessary for constructing the correct shape of the dental arch depending on the features of teleradiometric indicators according to the *Steiner method* and computed tomography dimensions of the teeth have the form of the following equations:

*distance DL_C (YW with a wide face)*= -0.093 + 0.179×Max1-SN + 1.157×VoK12 + 0.719×MdK46 - 0.166×MdLK42 - 0.228×SNB_S - 0.118×SN-GoGn - 0.167×1u-NA ($R^2$=0.913, $F_{(7.17)}$=25.51, p<0.001, Std.Error of estimate=0.417);

*distance GL_1 (YW with a wide face)*= 12.39 + 2.233×MdK11 - 4.399×VoC41 + 1.009×MdLD45 - 1.250×MdLD11 + 1.902×VoK42 - 0.909×MdLR41 + 0.931×MdLR11 - 0.504×VoLK41 ($R^2$=0.892, $F_{(8.16)}$=16.60, p<0.001, Std.Error of estimate=0.734);

*distance DL_F (YW with a wide face)*= -9.834 + 2.413×VoC12 + 0.777×MdK16 + 0.095×Max1-NA + 1.166×MdK43 - 0.313×MdLK42 + 0.266×Holdaway Ratio - 0.333×1l-NB ($R^2$=0.877, $F_{(7.17)}$=17.29, p<0.001, Std.Error of estimate=0.685);

*distance GL_2 (YW with a wide face)*= 21.90 - 2.580×VoLK43 + 1.441×VoLK42 - 0.160×Max1-SN + 3.278×MdK46 - 2.622×MdK16 + 0.974×MdLD44 - 0.671×VoLR42 ($R^2$=0.763, $F_{(7.17)}$=7.81, p<0.001, Std.Error of estimate=1.526);

*distance PonPr (YW with a wide face)*= -29.25 + 3.723×MdK11 + 2.317×VoK11 - 3.701×VoC41 + 2.216×MdLD43 + 2.762×MdK12 - 1.062×MdLD13 + 0.187×SN-OcP - 1.461×VoK44 ($R^2$=0.844, $F_{(8.16)}$=10.84, p<0.001, Std.Error of estimate=1.048);

*distance DL_S (YW with a wide face)*= -6.103 + 2.975×VoC12 + 1.527×MdK16 + 1.437×VoK41 + 0.136×Holdaway Ratio - 0.724×MdC12 ($R^2$=0.882, $F_{(5.19)}$=28.32, p<0.001, Std.Error of estimate=0.712);

*distance GL_3 (YW with a wide face)*= -6.576 + 0.702×VoLR43 - 2.803×VoK45 + 6.814×VoC42 - 4.457×VoK41 + 2.893×VoK14 + 1.012×VoK46 - 2.325×VoC43 + 0.114×Mand1-NB ($R^2$=0.863, $F_{(8.16)}$=12.63, p<0.001, Std. Error of estimate=1.011);

*distance PonM (YW with a wide face)*= 11.28 + 2.645×MdK11 + 0.910×MdLD11 - 6.292×VoC41 + 5.442×VoC42 + 0.112×S-L - 0.332×MdLR13 - 2.460×MdK41 + 0.265×S-E ($R^2$=0.838, $F_{(8.16)}$=10.36, p<0.001, Std.Error of estimate=1.218);

*distance 13_23Bugr (YW with a wide face)*= -3.712 + 2.160×MdK11 + 2.688×VoC12 + 0.065×II - 0.034×MdC43 - 0.648×MdC12 - 0.715×VoK44 + 0.434×VoLK11 ($R^2$=0.913, $F_{(7.17)}$=25.40, p<0.001, Std.Error of estimate=0.687);

*distance 13_23Apx (YW with a wide face)*= 3.447 + 3.207×MdK12 + 0.443×Pog-NB - 2.750×MdC42 + 1.611×MdC11 + 3.229×VoC43 - 2.508×VoC13 + 0.032×MdC43 ($R^2$=0.877, $F_{(7.17)}$=17.36, p<0.001, Std.Error of estimate=1.158);

*distance VestBM (YW with a wide face)*= 26.02 + 2.116×MdK11 + 0.544×MdLD11 - 3.954×VoC41 + 3.139×MdK42 + 0.752×VoLK43 - 1.731×VoK14 + 1.462×VoC43 ($R^2$=0.806, $F_{(7.17)}$=10.09, p<0.001, Std.Error of estimate=1.377);

*distance napx_6 (YW with a wide face)*= -18.22 + 2.396×MdLK42 - 2.455×MdK45 + 2.460×MdLD44 - 0.963×VoLR12 - 0.670×MdLR13 + 1.099×1l-NB + 0.132×II ($R^2$=0.881, $F_{(7.17)}$=18.02, p<0.001, Std.Error of estimate=1.489);

*distance dapx_6 (YW with a wide face)*= -38.58 - 2.970×MdLK41 + 4.608×MdLK11 + 1.444×S-E + 3.180×VoLK41 + 1.575×VoLR12 + 4.639×MdC41 - 3.659×MdK14 + 0.883×1l-NB ($R^2$=0.880, $F_{(8.16)}$=14.62, p<0.001, Std.Error of estimate=1.982);

*distance mapex_6 (YW with a wide face)*= 6.649 + 1.469×MdLK11 + 1.494×MdLD12 - 1.614×VoLR41 - 1.939×VoK44 + 0.761×MdLD43 + 0.458×S-E + 0.784×MdLK42 ($R^2$=0.821, $F_{(7.17)}$=11.16, p<0.001, Std.Error of estimate=1.773);

*distance 33_43Bugr (YW with a wide face)*= 13.06 - 0.201×SN-OcP - 1.679×VoK45 + 7.513×VoC42 + 0.608×S-E - 3.484×VoK41 + 0.124×Mand1-NB - 1.960×VoK13 + 0.354×VoLR12 ($R^2$=0.908, $F_{(8.16)}$=19.75, p<0.001, Std.Error of estimate=0.861);

*distance 33_43Apx (YW with a wide face)*= -0.439 - 1.418×MdLK42 + 3.373×MdC42 + 0.521×S-E + 1.245×MdLK13 + 3.486×MdK41 - 2.091×MdK11 ($R^2$=0.788, $F_{(6.18)}$=11.15, p<0.001, Std.Error of estimate=1.488);

*distance mapx_46 (YW with a wide face)*= -15.24 + 2.611×MdK11 - 0.070×MdC43 + 1.718×MdC13 - 4.065×VoK44 + 2.999×MdK16 + 2.705×VoK45 + 0.572×MdLD44 + 0.133×SN-OcP ($R^2$=0.931, $F_{(8.15)}$=25.32, p<0.001, Std.Error of estimate=1.043);

*distance dapx_46 (YW with a wide face)*= 23.36 + 4.483×MdC12 + 1.300×MdLD45 - 1.157×VoLK43 - 0.614×ANB_S - 4.627×MdK44 + 3.935×MdK43 ($R^2$=0.884, $F_{(6.17)}$=21.65, p<0.001, Std.Error of estimate=1.656).

In *YM* with a physiological bite and a wide face type, reliable regression models (with a coefficient of determination $R^2$>0.60) of linear dimensions necessary for constructing the correct shape of the dental arch depending on the features of teleradiometric indicators according to the *Tweed method* and computed tomography dimensions of the teeth have the form of the following equations:

*distance DL_C (YM with a wide face)*= -10.84 + 2.320×MdK11 + 0.546×VoLK13 + 0.820×VoK14 - 0.174×MdLR13 + 0.254×VoLR43 - 0.742×MdK16 - 0.672×VoK13 ($R^2$=0.939, $F_{(7.17)}$=37.26, p<0.001, Std.Error of estimate=0.373);

*distance GL_1 (YM with a wide face)*= 25.01 + 0.387×ANB_T - 0.279×VoLR12 + 0.815×MdLD14 - 0.888×MdLR12 - 2.417×MdK46 + 2.162×VoK15 - 1.002×VoK45 ($R^2$=0.927, $F_{(7.17)}$=30.95, p<0.001, Std.Error of estimate=0.829);

*distance DL_F (YM with a wide face)*= -21.43 + 2.438×MdK11 + 1.688×VoK12 + 0.369×VoLK13 + 0.673×MdK44 - 0.223×MdLR13 + 0.806×MdK15 - 0.026×AFH_PFH ($R^2$=0.945, $F_{(7.17)}$=41.74, p<0.001, Std.

Error of estimate=0.420);

*distance GL_2 (YM with a wide face)*= 40.15 + 2.623×MdK13 - 3.223×MdK46 - 1.091×MdLR41 + 0.545×VoLR13 - 0.127×AFH_PFH + 0.345×MdLD14 ($R^2$=0.821, $F_{(6.18)}$=13.80, p<0.001, Std.Error of estimate=1.390);

*distance PonPr (YM with a wide face)*= 13.51 + 2.476×MdK12 + 0.679×MdLK43 + 2.248×VoK11 - 0.918×MdLK11 - 1.932×VoC42 + 1.371×VoK44 - 0.607×VoK14 ($R^2$=0.926, $F_{(7.17)}$=30.25, p<0.001, Std.Error of estimate=0.675);

*distance DL_S (YM with a wide face)*= 11.83 + 1.943×MdK11 + 0.182×VoK15 - 0.634×MdLR12 - 0.137×FMIA + 0.070×Z + 1.251×MdC13 + 0.321×MdLD15 ($R^2$=0.972, $F_{(7.17)}$=83.56, p<0.001, Std.Error of estimate=0.370);

*distance GL_3 (YM with a wide face)*= -4.383 + 3.340×VoK43 + 3.866×MdK13 - 1.832×VoK45 - 0.082×IMPA + 4.081×MdC41 - 2.582×VoK41 - 1.026×MdC11 ($R^2$=0.908, $F_{(7.17)}$=24.07, p<0.001, Std.Error of estimate=0.758);

*distance PonM (YM with a wide face)*= 6.078 + 0.838×VoK15 + 0.218×FMIA + 0.607×VoLK43 - 0.740×MdLR41 + 0.105×AFH + 1.782×MdK44 + 0.480×MdLR11 ($R^2$=0.936, $F_{(7.17)}$=35.54, p<0.001, Std.Error of estimate=0.733);

*distance 13_23Bugr (YM with a wide face)*= -15.93 + 2.245×MdK12 + 0.852×MdLD15 + 0.699×VoLK41 + 1.917×VoK11 - 0.263×MdLD45 + 0.060×FMIA ($R^2$=0.922, $F_{(6.18)}$=35.45, p<0.001, Std.Error of estimate=0.690);

*distance 13_23Apx (YM with a wide face)*= 29.22 + 2.873×VoK15 - 0.135×Z - 2.233×VoK16 + 1.756×MdK11 - 3.626×MdK13 + 1.990×MdK45 + 1.346×MdK16 ($R^2$=0.922, $F_{(7.16)}$=26.97, p<0.001, Std.Error of estimate=0.786);

*distance VestBM (YM with a wide face)*= -12.40 + 2.605×VoK15 + 0.342×AFH + 0.106×FMIA + 0.995×VoLK41 + 0.088×AFH_PFH + 1.659×MdC12 - 0.389×MdLR13 ($R^2$=0.928, $F_{(7.17)}$=31.21, p<0.001, Std.Error of estimate=0.870);

*distance napx_6 (YM with a wide face)*= 69.62 - 0.923×MdLD13 + 0.675×Pog_Pog' + 4.327×MdK12 - 4.221×MdK16 + 1.118×VoLK41 + 0.408×MdLK43 - 0.618×MdLD11 ($R^2$=0.916, $F_{(7.17)}$=26.64, p<0.001, Std.Error of estimate=1.106);

*distance dapx_6 (YM with a wide face)*= 6.781 + 6.754×VoC13 + 2.626×MdK46 - 0.634×MdLD42 + 0.893×MdLD13 - 3.851×VoK12 - 0.286×POr_OcP - 2.826×VoK42 ($R^2$=0.885, $F_{(7.17)}$=18.60, p<0.001, Std.Error of estimate=1.779);

*distance mapex_6 (YM with a wide face)*= -30.91 + 3.987×MdK45 + 2.341×MdK12 - 0.142×POr_OcP + 3.716×MdK15 + 2.980×MdC41 + 0.627×MdLK11 ($R^2$=0.922, $F_{(6.18)}$=35.29, p<0.001, Std.Error of estimate=1.132);

*distance 33_43Bugr (YM with a wide face)*= -13.94 + 3.809×MdK42 + 2.276×MdK12 + 0.843×VoK44 - 0.840×MdLR13 + 0.433×MdLD43 + 1.043×VoK41 + 0.488×MdLR42 - 1.909×MdK44 ($R^2$=0.945, $F_{(8.16)}$=34.14, p<0.001, Std.Error of estimate=0.460);

*distance 33_43Apx (YM with a wide face)*= 2.858 - 0.455×Wits + 1.107×MdLK43 - 0.674×MdLK42 - 0.675×MdLD44 + 2.385×VoC12 + 2.203×MdC41 + 0.322×MdLD14 ($R^2$=0.823, $F_{(7.17)}$=11.28, p<0.001, Std.Error of estimate=1.127);

*distance mapx_46 (YM with a wide face)*= -27.24 + 5.126×MdK16 + 0.570×MdLD43 + 2.101×VoK16 - 3.409×MdK46 + 2.459×MdK43 + 0.456×MdLD41 ($R^2$=0.944, $F_{(6.17)}$=47.71, p<0.001, Std.Error of estimate=0.786);

*distance dapx_46 (YM with a wide face)*= -2.324 - 0.208×IMPA + 2.752×VoK16 + 2.680×MdC12 + 3.448×MdK16 + 0.225×SNA_T - 1.766×MdK46 ($R^2$=0.892, $F_{(6.17)}$=23.37, p<0.001, Std.Error of estimate=1.136).

In *YW* with a physiological bite and a wide face type, reliable regression models (with a coefficient of determination $R^2$>0.60) of linear dimensions necessary for constructing the correct shape of the dental arch depending on the features of teleradiometric indicators according to the *Tweed method* and computed tomography dimensions of the teeth have the form of the following equations:

*distance DL_C (YW with a wide face)*= -3.053 + 1.357×VoK41 + 0.740×MdK16 + 0.092×IMPA - 0.098×POr_OcP - 0.103×SNA_T - 0.205×Ls1u_Ls + 1.174×VoC41 - 1.006×VoC42 ($R^2$=0.854, $F_{(8.16)}$=11.68, p<0.001, Std.Error of estimate=0.557);

*distance GL_1 (YW with a wide face)*= 12.39 + 2.233×MdK11 - 4.399×VoC41 + 1.009×MdLD45 - 1.250×MdLD11 + 1.902×VoK42 - 0.909×MdLR41 + 0.931×MdLR11 - 0.504×VoLK41 ($R^2$=0.892, $F_{(8.16)}$=16.60, p<0.001, Std.Error of estimate=0.734);

*distance DL_F (YW with a wide face)*= -13.99 + 1.790×VoC12 + 1.813×MdK16 + 1.806×VoC41 - 0.234×MdLR41 - 0.987×MdC41 + 0.051×IMPA - 0.061×SNA_T ($R^2$=0.875, $F_{(7.17)}$=17.07, p<0.001, Std.Error of estimate=0.689);

*distance GL_2 (YW with a wide face)*= 2.938 - 1.644×VoLK43 + 0.902×VoLK42 - 5.768×VoC41 + 5.088×VoK13 + 2.382×VoK46 - 1.993×MdK13 ($R^2$=0.803, $F_{(6.18)}$=12.22, p<0.001, Std.Error of estimate=1.351);

*distance PonPr (YW with a wide face)*= -1.410 + 2.579×MdK11 - 0.325×Wits + 2.326×VoK11 - 2.816×VoC41 + 1.527×MdC11 + 0.461×MdLK43 ($R^2$=0.733, $F_{(6.18)}$=8.24, p<0.001, Std.Error of estimate=1.293);

*distance DL_S (YW with a wide face)*= 0.320 + 2.799×VoC12 + 1.312×MdK16 + 2.007×VoK41 - 0.921×MdC12 - 0.088×FMIA + 0.939×MdK42 - 0.360×VoLK13 - 0.250×MdLK42 ($R^2$=0.948, $F_{(8.16)}$=36.58, p<0.001, Std.Error of estimate=0.514);

*distance GL_3 (YW with a wide face)*= 0.260 + 0.726×VoLR43 - 2.748×VoK45 + 6.547×VoC42 - 3.996×VoK41 + 2.655×VoK14 + 1.117×VoK46 - 2.111×VoC43 - 0.101×FMIA ($R^2$=0.854, $F_{(8.16)}$=11.67, p<0.001, Std.Error of estimate=1.047);

*distance PonM (YW with a wide face)*= 10.59 + 2.663×MdK11 + 0.190×AFH + 0.945×MdLD11 - 0.717×MdLD41 - 3.170×VoC41 + 4.120×VoC42 - 1.428×VoK14 ($R^2$=0.832, $F_{(7.17)}$=12.06, p<0.001, Std.Error of estimate=1.203);

*distance 13_23Bugr (YW with a wide face)*= 8.380 + 2.243×MdK11 + 3.115×VoC12 - 0.262×Wits - 1.352×VoLK42 + 0.342×VoLK11 - 0.063×IMPA - 0.466×VoLR41 + 0.709×VoK46 ($R^2$=0.952, $F_{(8.16)}$=39.35, p<0.001, Std.Error of estimate=0.528);

*distance 13_23Apx (YW with a wide face)*= 13.04 + 3.790×MdK12 + 0.049×MdC43 - 3.256×MdC42 + 3.457×MdK11 - 4.129×MdK43 - 0.573×VoLR41 + 1.092×VoC43 ($R^2$=0.913, $F_{(7.17)}$=25.60, p<0.001, Std.Error of estimate=0.973);

*distance VestBM (YW with a wide face)*= 0.883 + 0.486×MdLD11 - 2.669×VoC41 + 4.298×MdK42 + 1.116×VoLK43 + 7.124×VoC43 - 7.006×VoK43 + 0.915×MdLK43 + 1.615×MdK16 ($R^2$=0.887, $F_{(8.16)}$=15.65, p<0.001, Std.Error of estimate=1.085);

*distance napx_6 (YW with a wide face)*= -33.76 + 2.036×MdLK42 + 2.189×MdLD44 - 0.774×VoLR12 - 0.981×MdLR13 + 0.302×AFH + 0.358×POr_OcP + 1.383×VoK11 ($R^2$=0.922, $F_{(7.17)}$=28.73, p<0.001, Std.Error of estimate=1.206);

*distance mapex_6 (YW with a wide face)*= -28.85 + 3.274×MdLK11 + 0.900×MdLD12 - 1.214×VoLR41 + 0.261×AFH + 1.334×MdLR41 + 0.122×IMPA ($R^2$=0.799, $F_{(6.18)}$=11.95, p<0.001, Std.Error of estimate=1.826);

*distance 33_43Bugr (YW with a wide face)*= 12.90 + 2.867×MdK16 + 2.897×VoC12 - 2.378×MdK46 - 0.437×Pog_Pog' - 0.786×MdLK42 + 0.110×AFH + 1.842×VoC43 - 0.034×MdC43 - 1.800×VoK44 ($R^2$=0.867, $F_{(9.15)}$=10.90, p<0.001, Std.Error of estimate=1.068);

*distance 33_43Apx (YW with a wide face)*= 14.08 - 2.210×MdLK42 + 4.444×MdC42 + 2.836×VoK12 - 3.511×VoC41 - 0.030×MdC43 + 1.079×MdLK13 - 0.244×Wits ($R^2$=0.787, $F_{(7.17)}$=8.99, p<0.001, Std.Error of estimate=1.533);

*distance mapx_46 (YW with a wide face)*= 4.651 + 2.875×MdK11 - 0.062×MdC43 - 0.048×IMPA - 3.729×VoK44 + 2.882×VoK45 + 0.610×MdLD44 + 1.889×MdK16 ($R^2$=0.900, $F_{(7.16)}$=20.66, p<0.001, Std.Error of estimate=1.214);

*distance dapx_46 (YW with a wide face)*= 3.787 + 2.781×MdC12 + 1.499×MdLD45 - 0.809×VoLK43 + 0.341×Z - 1.293×MdLR43 - 0.041×MdC43 + 1.703×MdC42 ($R^2$=0.917, $F_{(7.16)}$=25.28, p<0.001, Std.Error of estimate=1.445).

Since, in YW with a wide face type, in the constructed model *distance dapx_6* the value of the coefficient of determination is less than 0.6 ($R^2$=0.593, p<0.001), this model has no important practical significance.

## Discussion

Thus, in *YM* with physiological bite and *wide face type*, all 18 possible reliable (p<0.001 in all cases) models of linear parameters of dental arches were constructed depending on the features of teleradiometric indicators according to the *Steiner or Tweed method* and computed tomography sizes of teeth with a determination coefficient greater than 0.6 (respectively $R^2$= from 0.835 to 0.973 and $R^2$= from 0.821 to 0.972).

As a result of the analysis of the frequency of occurrence in the regression equations of teleradiometric indicators according to the *Steiner or Tweed* method and computed tomography dimensions of teeth in *YM* with physiological bite and *wide face type*, the following percentage of occurrence in the models of these indicators was established: taking into account teleradiometric indicators according to the *Steiner method* – the width of the crown part of the tooth in the mesio-distal (21.26 %) and vestibulo-oral plane (20.47 %), teleradiometric indicators according to the Steiner method (18.11 %), tooth length in the mesio-distal and vestibulo-oral plane (9.45 %), the length of the crown part of the tooth in the mesio-distal (7.09 %) and vestibulo-oral plane (5.51 %), the length of the root part of the tooth in the mesio-distal (6.30 %) and vestibulo-oral plane (3.94 %), width of the cervical part of the tooth in the mesio-distal (4.72 %) and vestibulo-oral plane (3.15 %); taking into account teleradiometric indicators according to the *Tweed method* – the width of the crown part of the tooth in the mesio-distal (25.41 %) and vestibulo-oral plane (18.85 %), teleradiometric indicators according to the Tweed method (15.57 %), the length of the tooth in the mesio-distal and vestibulo-oral plane (11.48 %), the length of the root part of the tooth in the mesio-distal (8.20 %) and vestibulo-oral plane (2.46 %), the width of the cervical part of the tooth in the mesio-distal (5.74 %) and vestibulo-oral plane (2.46 %), the length of the crown part of the tooth in the mesio-distal (4.92 %) and vestibulo-oral plane (4.92 %).

When analyzing the frequency of occurrence in the regression equations of the corresponding teeth in *YM* with a physiological bite and a *wide face type*, the following percentage of occurrence in the models of these indicators was established: taking into account teleradiometric indicators according to the *Steiner method* – upper incisors (19.69 % of all independent variables, including 7.87 % central incisors and 11.81 % lateral incisors), lower incisors (11.81 % of all independent variables, including 4.72 % central incisors and 7.09 % lateral incisors), upper canines (12.60 %), lower canines (9.45 %), upper small angular teeth (11.02 % of all independent variables, including 4.72 % first and 6.30 % second), lower small angular teeth (6.30 % of all independent variables, including 3.15 % first and 3.15 % second molars), upper first molars (5.51 %), lower first molars (5.51 %); taking into account teleradiometric indicators according to the *Tweed method* – upper incisors (19.67 % of all independent variables, including 9.02 % central incisors and 10.66 % lateral incisors), lower incisors (13.93 % of all independent variables, including 9.02 % central incisors and 4.92% lateral incisors), upper canines (12.30 %), lower canines (7.38 %), upper premolars (11.48 % of all independent variables, including 4.10 % first and 7.38 % second), lower premolars (9.02 % of all independent variables, including 4.92 % first and 4.10 % second), upper first molars (6.56 %), lower first molars (4.10 %).

In *YW* with physiological bite and *wide face type*, all 18 possible reliable (p<0.001 in all cases) models of linear parameters of dental arches were constructed depending on the features of teleradiometric indicators according to the *Steiner method* and computed tomography sizes of teeth and 17 reliable ($p<0.001$ in all cases) models depending on the features of teleradiometric indicators according to the *Tweed method* and computed tomography sizes of teeth with a determination coefficient greater than 0.6 (respectively $R^2$= from 0.763 to 0.931 and $R^2$= from 0.733 to 0.952).

As a result of the analysis of the frequency of occurrence in the regression equations of teleradiometric indicators according to the *Steiner or Tweed* method and computed tomography dimensions of teeth in *YW* with physiological occlusion and *wide facial type*, the following percentage of occurrence in the models of these indicators was established: when taking into account teleradiometric indicators according to the *Steiner method* – teleradiometric indicators according to the Steiner method (20.16 %), the width of the crown part of the tooth in the mesio-distal (17.83 %) and vestibulo-oral plane (13.18 %), the width of the cervical part of the tooth in the vestibulo-oral (10.85 %) and mesio-distal plane (8.53 %), the length of the tooth in the mesio-distal and vestibulo-oral planes (9.30 %), the length of the crown part of the tooth in the mesio-distal (6.98 %) and vestibulo-oral plane (5.43 %), the length of the root part of the tooth in the vestibulo-oral (4.65 %) and mesio-distal plane (3.10 %); taking into account teleradiometric indicators according to the *Tweed method* – teleradiometric indicators according to the Tweed method (16.94 %), width of the cervical part of the tooth in the vestibulo-oral (15.32 %) and mesio-distal plane (9.68 %), width of the coronal part of the tooth in the mesio-distal (14.52 %) and vestibulo-oral plane (14.52 %), length of the tooth in the mesio-distal and vestibulo-oral planes (8.06 %), length of the coronal part of the tooth in the mesio-distal (6.45 %) and vestibulo-oral plane (6.45 %), length of the root part of the tooth in the mesio-distal (4.03 %) and vestibulo-oral plane (4.03 %).

When analyzing the frequency of occurrence in the regression equations of the corresponding teeth in *YW* with a physiological bite and a *wide face type*, the following percentage of occurrence in the models of these indicators was established: taking into account teleradiometric indicators according to the *Steiner method* – upper incisors (22.28 % of all independent variables, including 12.40 % central incisors and 10.08 % lateral incisors), lower incisors (22.48 % of all independent variables, including 11.63 % central incisors and 10.85 % lateral incisors), upper canines (5.43 %), lower canines (10.85 %), upper premolars (2.33 % of all independent variables, including all first ones), lower premolars (10.85 % of all independent variables, including 6.98 % first and 3.88 % second ones), upper first molars (3.10 %), lower first molars (2.33 %); taking into account teleradiometric indicators according to the *Tweed method* – upper incisors (20.16 % of all independent variables, including 12.10 % central incisors and 8.06 % lateral incisors), lower incisors (28.23 % of all independent variables, including 16.13 % central incisors and 12.10 % lateral incisors), upper canines (4.03 %), lower canines (14.52 %), upper premolars (1.61 % of all independent variables, including all first), lower premolars (6.45 % of all independent variables, including 3.23 % first and 3.23 % second), upper first molars (4.84 %), lower first molars (3.23 %).

In the context of building regression models based on computed tomography measurements for the formation of the shape of the dental arch, it is extremely important to pay attention to the morphological features of the face and cephalometric parameters. A comparative analysis of previous studies demonstrates the presence of both a certain similarity and significant variability in the detected dependencies. In particular, the study by Al-Sheakli I. indicates a statistically significant difference in compliance with the golden ratio between the maxillae in representatives with different facial morphotypes. The highest compliance with the golden ratio was observed in the mesoprofile type (35.3 %), while in the dolichofacial and brachyfacial types – only 20 % and 25 %, respectively, which indicates a morphofunctional dependence between the type of face and the shape of the dental arch [3].

A significant contribution to the study of the morphometry of Ukrainian boys and girls was made by Dmytriev M. and colleagues, who showed differences in cephalometric parameters depending on gender. In particular, according to the Burstone method, the average values of the ANB angle in girls were higher (4.1±0.7 °) compared to boys (3.4±0.9 °), which may indicate the presence of compensatory mechanisms in the structure of the jaw apparatus [9]. In a subsequent work in 2020, using the Steiner method, the authors proposed mathematical models for calculating the coordinates of the central incisors, which can be the foundation for building regression models of the dental arch [10].

Normative cephalometric indicators for Ukrainian boys and girls were determined. In particular, the average facial axis angle was 91.2 ° in boys and 88.7 ° in girls, which allows differentiating approaches to predicting the spatial orientation of the dentition depending on gender [11].

The existence of clear relationships between craniofacial morphology and the order of eruption of permanent teeth in the lateral areas was confirmed. The shape of the skull and the length of the face have a direct impact on the symmetry and synchrony of eruption, which, in turn, can affect the formation of the dental arch and its spatial stability [5].

R. Basri et al., studied the golden ratio of facial proportionality among medical students. The highest percentage of harmony (58.3 %) was observed among individuals with a mesofacial type, which can be useful for modeling a harmonious dental arch in patients with a physiological bite [7].

Statistically significant differences in the transverse dimensions of the dental arch between boys and girls were established depending on the shape of the head and type of face. Thus, the width between the first premolars in individuals with a wide face exceeded the similar indicator in individuals with a narrow face by an average of 2.6 mm, which is of direct importance in planning orthodontic treatment [14].

P. Hatwal et al. established a correlation between the upper and lower facial height in the Garhwali population, which allows predicting the ratio of the jaw apparatus to soft tissues [16]. A similar relationship was confirmed by Mittal S. and colleagues, who found a relationship between the facial index and the ratio of canines in the population of North India ($r=0.42$; $p<0.01$) [20].

In individuals with a wide face, the volume of the sinuses is statistically significantly larger ($p<0.05$), which indicates the importance of taking into account craniometric indicators when planning the spatial shape of the arch [17].

Regression models of individual cephalometric parameters according to Schwarz are proposed, which can be adjusted during surgical intervention. The paper emphasizes the high variability of norms due to the morphotype of the face, which is fully consistent with our results [23].

Finally, anthropometric studies of students in Nepal and Iran have highlighted national differences in the distribution of facial types. For example, in Nepal, the leptoprosopic type prevails (56 %), while in Iran, the mesoprosopic type is more common (48 %), which is important for ethnically oriented prediction models [24, 26, 28].

Thus, the results of previous studies generally confirm the feasibility of using morphological and cephalometric parameters to predict the spatial characteristics of the dental arch. At the same time, the significant variability of the obtained data among different populations and facial types indicates the need to create local models adapted to the characteristics of the Ukrainian population, as implemented in our study [25, 29].

## Conclusion

1. In Ukrainian YM and YW with physiological bite and wide facial type, reliable ($p<0.001$), with a coefficient of determination greater than 0.6, models of linear parameters of dental arches were constructed depending on computed tomography sizes of teeth and features of teleradiometric indicators using the Steiner or Tweed methods (in YM all 18 possible when taking into account the Steiner method – $R^2$= from 0.835 to 0.973 or Tweed – $R^2$= from 0.821 to 0.972; in YW all 18 possible when taking into account the Steiner method – $R^2$= from 0.763 to 0.931 and 17 when taking into account the Tweed method – $R^2$= from 0.733 to 0.952).

2. When analyzing the frequency of occurrence in the models of computed tomography tooth sizes and teleradiometric indicators according to the Steiner or Tweed methods in YM, the width of the crown part of the tooth in the mesio-distal (21.26 % and 25.41 %, respectively) and vestibulo-oral plane (20.47 % and 18.85 %, respectively), teleradiometric indicators (18.11 % and 15.57 %, respectively), and also only when taking into account the indicators according to the Tweed method, the length of the tooth in the mesio-distal and vestibulo-oral plane (11.48 %). In YW, when taking into account the indicators according to the Steiner method – teleradiometric indicators (20.16 %), the width of the crown part of the tooth in the mesio-distal (17.83 %) and vestibulo-oral plane (13.18 %), the width of the cervical part of the tooth in the vestibulo-oral plane (10.85 %); and when taking into account the indicators according to the Tweed method – teleradiometric indicators (16.94 %), the width of the cervical part of the tooth in the vestibulo-oral (15.32 %) and mesio-distal plane (9.68 %), the width of the crown part of the tooth in the mesio-distal (14.52 %) and vestibulo-oral plane (14.52 %).

3. When analyzing the frequency of occurrence of the corresponding teeth in the YM models, the regression equations that take into account teleradiometric indicators according to the Steiner or Tweed methods most often include: upper incisors (19.69 % and 19.67 %, respectively), lower incisors (11.81 % and 13.93 %, respectively), upper canines (12.60 % and 12.30 %, respectively) and upper premolar teeth (11.02 % and 11.48 %, respectively). In YW: when taking into account teleradiometric indicators according to the Steiner or Tweed method – upper incisors (22.28 % and 20.16 %, respectively), lower incisors (22.48 % and 28.23 %) and lower canines (10.85 % and 14.52 %), and also only when taking into account indicators according to the Steiner method, lower premolars (10.85 %).

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## РЕГРЕСІЙНІ МОДЕЛІ КОМП'ЮТЕРНО-ТОМОГРАФІЧНИХ 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 МЕТОДАМИ STEINER АБО TWEED І КОМП'ЮТЕРНО-ТОМОГРАФІЧНИХ РОЗМІРІВ ЗУБІВ

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*У сучасній ортодонтії важливою задачею є індивідуалізація планування лікування з урахуванням морфологічних і цефалометричних особливостей пацієнта. Особливий інтерес становлять показники, що відображають взаємозв'язок між кістковими структурами та положенням зубів у щелепах. Застосування регресійного аналізу дозволяє створити прогностичні моделі, що підвищують точність діагностики та ефективність терапії. Вивчення цих взаємозв'язків серед молоді з певними антропометричними характеристиками сприятиме розробці більш обґрунтованих ортодонтичних рішень з боку лікаря. Мета дослідження – розробка регресійних моделей лінійних розмірів необхідних для побудови коректної форми зубної дуги в залежності від особливостей телерентгенометричних показників за методами Steiner або Tweed і комп'ютерно-томографічних розмірів зубів в українських юнаків і дівчат із фізіологічним прикусом і широким типом обличчя. На отриманих телерентгенограмах (25 юнаків і 25 дівчат із фізіологічним прикусом і широким типом обличчя) проводили вимірювання за методами Steiner C. C. і Tweed C. H., а на комп'ютерних томограмах – морфометричне дослідження зубів та зубних дуг. Регресійні моделі лінійних розмірів необхідних для побудови коректної форми зубної дуги побудовані за допомогою ліцензійного пакету «Statistica 6.0». В юнаків при урахуванні методу Steiner або Tweed побудовані усі 18 можливих достовірних моделей із коефіцієнтом детермінації більшим 0,6 (відповідно $R^2$= від 0,835 до 0,973 та $R^2$= від 0,821 до 0,972, p<0,001); а у дівчат – при урахуванні методу Steiner усі 18 моделей ($R^2$= від 0,763 до 0,931, p<0,001) і при урахуванні методу Tweed 17 моделей ($R^2$= від 0,733 до 0,952, p<0,001). При аналізі частоти входження до моделей комп'ютерно-томографічних розмірів зубів і телерентгенометричних показників за методами Steiner або Tweed встановлено: в юнаків найбільш часто входять ширина коронкової частини зуба у мезіо-дистальній і вестибуло-оральній площині, телерентгенометричні показники, а також (лише при урахуванні показників за методом Tweed) довжина зуба; у дівчат – телерентгенометричні показники, ширина коронкової частини зуба у мезіо-дистальній і вестибуло-оральній площині та ширина пришийкової частини зуба у вестибуло-оральній площині при урахуванні показників за методом Steiner, а при урахуванні показників за методом Tweed – телерентгенометричні показники, ширина пришийкової частини зуба у вестибуло-оральній і мезіо-дистальній площині та ширина коронкової частини зуба у мезіо-дистальній і вестибуло-оральній площині. При аналізі частоти входження до моделей відповідних зубів встановлено, що в юнаків найбільш часто входять верхні та нижні різці, верхні ікла та верхні малі кутні зуби, а у дівчат – верхні та нижні різці, нижні ікла, а також (лише при урахуванні показників за методом Steiner) нижні малі кутні зуби.*

**Ключові слова:** *стоматологія, телерентгенометрія, комп'ютерно-томографічні розміри зубів і зубних дуг, регресійний аналіз, українськи юнаки та дівчата, фізіологічний прикус, типи обличчя.*

**Author's contribution**

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