http://dx.doi.org/10.35630/2199-885X/2020/10/3.30

A BIOMETRIC APPROACH TO DIAGNOSIS AND MANAGEMENT OF MORPHOLOGICAL CHANGES IN THE DENTAL STRUCTURE

Received 19 July 2020;
Received in revised form 28 August 2020;
Accepted 31 August 2020

Alexander Lepilin[1], Vladimir Shkarin[2], Ghamdan Al-Harazi[3], Sergey Dmitrienko[4]✉, Dmitry Domenyuk[5], Alexandra Potrysova[6], Stanislav Domenyuk[7]

[1] *Department of Surgical Dentistry and Maxillofacial Surgery, Saratov State Medical University, Saratov, Russia*
[2] *Department of Public Health and Healthcare at Post-Graduation Faculty, Volgograd State Medical University Volgograd, Russia*
[3] *Department of Orthodontic, Pedodontic and Preventive Dentistry, Faculty of Dentistry, Sana'a University, Yemen;*
[4] *Department of Dentistry, Volgograd State Medical University Volgograd, Russia*
[5] *Department of General Practice Dentistry and Child Dentistry, Stavropol, Russia*
[6] *Department of Pediatric Dentistry and Orthodontics, Sechenov First Moscow State Medical University, Moscow, Russia*
[7] *North Caucasus Federal University, Stavropol, Russia*

✉ *s.v.dmitrienko@pmedpharm.ru*

ABSTRACT — Clinical examinations, biometric studies of jaw diagnostic models and cone-beam computed tomography were performed involving 104 people in their first adult period with a full set of permanent teeth, the physiological occlusion and the mesognathic type of dental arches. Clinical and X-ray-morphometric explanation of the proportional parameters of the dental and alveolar triangles, taking into account the medial incisors individual position, allowed us developing, substantiating and testing a biometric diagnostic approach to treat morphological changes in the dental structure. Patients, depending on the interincisal angle, featured the mesotrusion type (interincisal angle, 130°-140°), the protrusion type (interincisal angle below 129°) and the retrusion type of the dental arches (interincisal angle above 141°). The study revealed that the distance between the central points of the dental and alveolar triangles on both jaws could be described with the trusion type of arches. The smallest distance between the peaks of the dental and alveolar triangles was to be observed in people with the retrusion type of the arches and microdontia (upper jaw, 1.5±0.07 mm; lower jaw, 0.5±0.02 mm); the average value was recorded in patients with the mesotrusion type and normodontia (upper jaw, 2.5±0.06 mm; lower jaw, 1.5±0.05 mm); the maximum distance was observed in people with the protrusion type of the arches and macrodontia (upper jaw, 3.5±0.08 mm; lower jaw, 2.5±0.07 mm). The morphometric data interpretation can be used to describe the physiological occlusion, when choosing the tactics and the methods of orthodontic treatment for patients with disturbed shape and size of the dental arches, as well as when designing artificial dental arches for patients with full or partial adentia, thus seeking to achieve a balanced articulation balance.

KEYWORDS — biometric diagnostics, dental arches, alveolar arches, microdontia, macrodontia, normodontia, protrusion of incisors, retrusion of incisors, mesotrusion of incisors.

INTRODUCTION

The issues focusing on studying human constitution features, which are the basis of clinical and anthropological area, attract both theoretical and clinical medicine, while classical anthropometric methods are perfectly complemented by advanced innovation-based research approaches, at the same time enhancing the precision and effectiveness of the obtained outcomes [1, 14, 19, 28, 35].

The goal of personalized medicine, taken as a rapidly progressing field of healthcare, is entitled to improve patient treatment protocols following the constitutional and typological body features, which are determined by a whole set of phenotypic and genetic markers, offer an objective reflection of its morphological, functional and biochemical specifics, are stable in ontogenesis, and reveal individual anatomical variability with minor intra-individual change [3, 11, 13, 23].

Diagnostics and treatment of dental issues with morphological changes should be based not only on a thorough clinical and paraclinical examination, but also on a personalized approach in view of a set of anthropometric and X-ray cephalometric indicators that are mutually complementary [6, 10, 16, 25, 29, 36, 42].

Lack of highly reliable data on clinical, X-ray and anthropometric examination of patients with maxillofacial pathology under complex clinical conditions explains the need for reviewing conventional diagnostic schemes in order to improve the effectiveness of orthodontic and prosthetic treatment [8, 12, 21, 33, 38].

The basis of the modern concept of *norm* relies on the idea of *optimal individual norm*, i.e. the condition of sufficiently guaranteed morphological, functional and aesthetic balance in the dental system and the facial skeleton as a whole, which should be the aim of orthodontic and prosthetic treatment [40].

Orthodontic and prosthetic treatment is based on knowing the patterns of individual-typological craniofacial variability. The variability of the dental arches' shape and morphometric parameters is the basis for employing orthodontic and prosthetic treatments, while a detailed study of dental arches is not only of fundamental theoretical importance, yet also has applied value in identifying dental anomalies, interpreting biometrics, as well as when through the treatment and rehabilitation of patients with occlusal disorders [2, 15, 22, 26, 32, 39, 43].

A detailed study of the variant anatomy of the shape and morphometric parameters of dental arches allows personalized prosthetic, orthodontic, and surgical intervention, which is of high clinical significance when it comes to diagnosing and planning of further treatment tactics [4, 7, 20, 27, 31, 34, 37, 45].

Lack of effectiveness in orthodontic measures, which is due to non-compliance with the biological principles of the tooth movement (excessive load, reduced retention period), as well as the impossibility of installing teeth in a neutral zone while seeking a balance between the muscles of the external and internal functional circles, will not contribute to improving the dental arches shape and size as well as to the compensation for occlusal relationships, which, in turn, will lead to relapsing dental anomalies [17, 44].

Of reasonable interest are works by researchers who point at correlations between the size of the dental and alveolar arches in the upper jaw, as well as their match with the face parameters. The ratio of the face diagonal dimensions to the similar parameters of the alveolar arches has been found to be 2.5, while the ratio of the frontal-distal diagonal of the upper alveolar arch to the lower one is 1.06. The authors recommend using the obtained data for clinical dentistry when treating patients with dental arches anomalies and defects [18, 30].

Experts present the main parameters of dental arches in children through the period of baby teeth bite, as well as in case of congenital maxillofacial pathology [5, 9, 24, 41].

Analysis of research by national and foreign experts shows that there are no methods for constructing dental and alveolar triangles based on the permanent anatomical marks position in people with physiological occlusion in the permanent teeth bite. There have been no morphometric values identified, which determine the dental and alveolar triangles size, whereas the data on the dependence of the interincisal angle and the dental arches belonging to the trusion type is not complete, which points at the rationale and purpose of the study.

Aim of study: to develop a diagnostic biometric approach to studying dental and alveolar arches in order to plan the tactics of orthodontic and prosthetic treatment in patients with morphological changes in the dental structure.

MATERIALS AND METHODS

The study involved 104 people in their first adulthood featuring a full set of permanent teeth and physiological occlusion. According to the age periodization of postnatal ontogenesis as approved by the International Symposium on Age Physiology (Moscow, 1965), the first adult period for men is the age of 22–35, and for women — 21–35. All the participants offered their informed consent. The Committee for Bioethics confirmed that the protocols complied with the international and national ethics requirements (Helsinki Declaration of the World Medical Association on the ethical principles of human medical research, 1964) with amendments, the 64th WMA General Assembly, Fortaleza, Brazil, October 2013.

The patients were divided into three groups based on the dental arches type and on the individual position of the medial incisors. Group 1 included 39 people with mesotrusion type of dental arches and mesotrusion of the central incisors, with an interstitial angle of 130–140°. In Group 2 (n=34), the patients featured the protrusion type of dental arches with physiological protrusion of the medial incisors, and a decrease in the interincisal angle (less than 129°). In Group 3 (n=31), the patients had an interincisal angle of above 141°, as well as the retrusion type of dental arches with physiological retrusion of the central incisors (Fig. 1).

Teleroentgenograms and cone-beam tomograms were obtained on a 21-slice digital panoramic X-ray machine PaX-i3D SC with the function of a computer tomograph and a cephalostat FOV with accessories (VATECH Global, South Korea) following the scanning Protocol for Sim Plant. Processing, storage and export of the X-ray images were done with the Ez Dent-iTM software, multiplanar reconstruction and three-dimensional (3D) reconstruction were performed with the tomograph software for 3D diagnostics Ez 3D-i™; the saved data was viewed, with an option of import done using the Viewertm software. The tomographic section thickness was 1 mm; the reconstruction step was 1 mm, whereas the rotation step was 1 mm.

The main reference point for the biometric study of the dental arches was the anterior incisal (central) point, which was located between the medial incisors at the cutting edge, and which we indicated as in_d

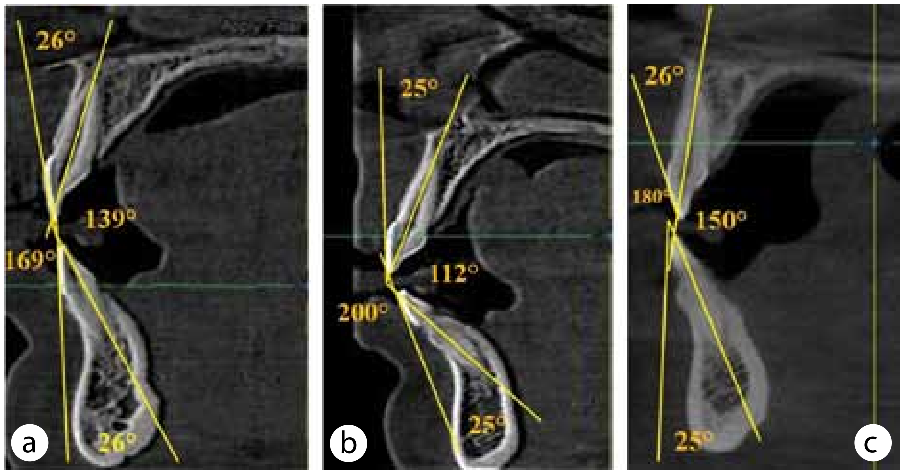

Fig. 1. *Cone-beam computed tomography images of patients with mesotrusion (a), protrusion (b) and retrusion (c) of central incisors*

(incisivus dentale). The tops of the vestibular distal tubercles were marked with the m_d points (molares dentale). The junction of the molar points determined the base of the dental triangle and corresponded to the dental arches width between the second molars. The sides of the dental triangle (which was isosceles, as a rule) matched the frontal-distal diagonal of the dental arch (in_d–m_d). The height of the triangle was measured from its top ind to the m'_d point, taken as the intersection of the perpendicular drawn from the ind point to the conditional line between the second molars (md–md). To measure and build the alveolar triangle, the central point was put on the alveolar process (alveolar part) in the interdental space between the incisors, and marked as inal (incisivus alveolare). The molar alveolar points mal (molares alveolare) were placed on the alveolar process (alveolar part) in the interdental space between the second and third molar on the lingual side. If the third molar was missing, the reference point was placed on the distal surface of the lingual distal odontomer near the tooth neck. The alveolar triangle was built similarly to the dental one (Fig. 2).

The measurements were performed on both jaws using an electronic caliper with a precision of 0.01 mm. The dimensions identified included the base, the height, and the sides of the alveolar and dental triangles, after which they were compared. The distance between the central points of the arches (the apexes of the triangles) was estimated as well.

Statistical data processing was done using the Microsoft Excel 2013 software and the SPSS Statistics (Version 22) statistical software package. To try the normal data distribution hypothesis, the Shapiro-Wilk's test (W-test) was employed. The statistical significance of the intergroup values was calculated using the non-parametric Mann-Whitney U-test with Bonferroni correction, while the reliability of the dynamics difference-related features was calculated through the Wilcoxon T-test. In other cases, the Student's T-test was used. When identifying correlations among the studied parameters, a non-parametric Spearman rank correlation coefficient was calculated. The critical level of a potential null statistical hypothesis was taken as equal to 0.05.

RESULTS AND DISCUSSION

Following the tasks set, we measured the parameters of the dental and alveolar triangles on cast models of the upper and lower jaws. Note to be made that all patients featured the mesognatic type of the dental arches, while the position of the incisors was due to the differences in the teeth size. The patients of Group 1 with the mesotrusion type arches, typically featured normodontia. In case of the protrusion type of the arches, the macrodontic dental system was to be observed more often, while in case of retrusion it was microdontia, which was reflected in the major indicators of dental and alveolar triangles (Fig. 3).

Table 1 offers the outcomes of studying upper jaw cast models in the groups in question.

The patients with the mesotrusion type of the dental arches had the dental triangle base (m_d–m_d) significantly exceeding that of the alveolar triangle (m_{al}–m_{al}), measuring 60.61±1.87 mm and 52.13±1.24 mm, respectively ($p \le 0.05$). Also, the sides of the dental triangle (in_d–m_d) were larger than the sides of the alveolar triangle (in_{al}–m_{al}) measuring 53.72±1.01 mm and 50.17±1.32 mm, respectively ($p=0.05$). We observed no statistically significant differences in the arches depth (the heights of the triangles), while the measurement outcomes were as follows: the dental triangle, in_d–m'_d = 44.35±1.41 mm; the alveolar triangle, in_{al}–m'_{al} = 42.87±1.14 mm ($p \ge 0.05$) (Fig. 4).

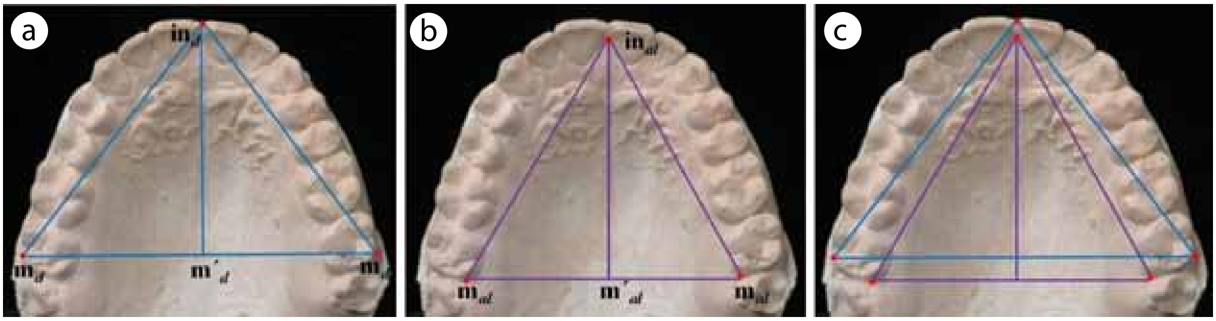

Fig. 2. *Methods for building dental (a) and alveolar (b) triangles, and matching them (c)*

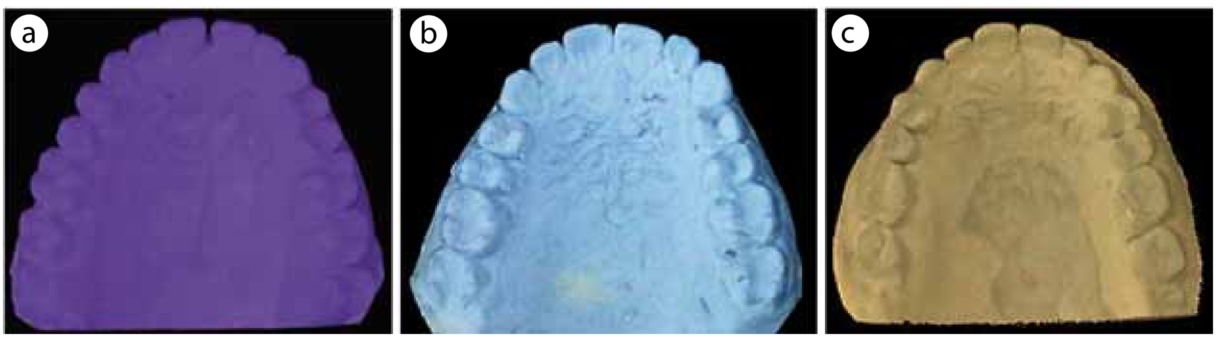

Fig. 3. *Upper jaw cast models in patients with mesotrusion type of dental arches and normodontia (a), protrusion type of dental arches and macrodontia (b), and retrusion type of dental arches and microdontia (c)*

Table 1. *Biometric parameters of upper jaw cast models in patients with mesotrusion, protrusion and retrusion type of dental arches (M±m, mm)*

Major parameters of arcade triangles	Linear dimensions of upper arcade triangles in people with meso-, pro-, and retrusion types of dental arches		
	mesotrusion	protrusion	retrusion
Basis of dental triangle (m_d-m_d)	60.61±1.87	66.53±1.62*	57.75±1.12*
Height of dental triangle (in_d-m'_d)	44.35±1.41	46.61±1.81*	42.01±1.97*
Side of dental triangle (in_d-m_d)	53.72±1.01	57.26±1.23*	50.98±1.57*
Basis of alveolar triangle (m_{al}-m_{al})	52.13±1.24	57.69±1.72*	49.36±1.65*
Height of alveolar triangle (in_{al}-m'_{al})	42.87±1.14	43.12±1,53*	41.07±1.71*
Side of alveolar triangle (in_{al}-m_{al})	50.17±1.32	54.87±1.38*	47.91±1.24*

Note: ** — statistically reliable regarding the parameters in the patients with the mesotrusion type of the dental and alveolar arches ($p \leq 0.05$)*

Fig. 4. *Images of oral cavity, patient with mesotrusion type of dental arches and normodontia (a — frontal, b — lateral right, c — lateral left projections)*

The transversal size values in patients with the protrusion type of the dental and alveolar arches (m_d–m_d = 66.53±1.62 mm and m_{al}–m_{al} = 57.69±1.72 mm, respectively) exceed similar values in people with the mesotrusion type (m_d–m_d = 60.61±1.87 mm and m_{al}–m_{al} = 52.13±1.24 mm, respectively) ($p \le 0.05$), while in Group 2, the sides of the triangles (in_d–m_d = 57.26±1.23 mm; in_{al}–m_{al} = 54.87±1.38 mm) were significantly larger than identical parameters of patients of the first group (in_d–m_d = 53.72±1.01 mm; in_{al}–m_{al} = 50.17±1.32 mm) ($p \le 0.05$). The sagittal dimensions (the height of the triangles) featured basically no significant differences both within the group and when comparing the patients of Groups 1 and 2 (Fig. 5).

The patients with the retrusion position of the incisors had odontometric indicators that corresponded to microdontia, which predetermined smaller (compared to the other groups) size of the dental and alveolar arches. The biggest decrease in the size values was observed at the triangles' bases (m_d–m_d = 57.75±1.12 mm; m_{al}–m_{al} = 49.36±1.65 mm) and the sides (in_d–m_d = 50.98±1.57 mm; in_{al}–m_{al} = 47.91±1.24 mm). However, the height of the dental (in_d–m'_d = 42.01±1.97 mm) and alveolar (in_{al}–m'_{al} = 41.07±1.71 mm) triangles slightly differed from respective values in Groups 1 and 2 ($p \ge 0.05$) (Fig. 6).

An analysis of the dental and alveolar arches central point's location (the triangles apexes) revealed that the distance between them belonged to the trusion type of the arches. The patients with the retrusion type had the shortest distance, 1.5±0.07 mm. In case of mesotrusion, the alveolar triangle was displaced by 2.5±0.06 mm, and for the protrusion type the respective value was 3.5±0.08 mm (Fig. 7).

Table 2 offers a view at the outcomes of biometric measurements of lower jaw cast models in the groups in question.

The morphological features that determine the relative positions and symmetry of the dental and alveolar triangles in case of the retrusion, mesotrusion and protrusion arches, involve both the upper and the lower jaw.

An analysis of morphometric indicators of mandibular dental and alveolar arches shows the following displacement of the apex (central point) of the alveolar triangle in relation to the dental triangle apex:1.5±0.05 mm for the mesotrusion position of the incisors; 2.5±0.07 mm for protrusion position of the incisors; 0.5±0.02 mm for the retrusion position of incisors.

In view of the above, the major parameters of the dental and alveolar triangles are determined by the types of the arches and odontometric parameters, which is to be taken into account when planning and performing orthodontic and prosthetic treatment, as well as when evaluating the final outcomes of such treatment in patients with maxillofacial anomalies and deformities.

CONCLUSIONS

1. The clinical and X-ray-morphometric explanation of the proportion dependence for the dental and alveolar triangles parameters (width, m_d–m_d/m_{al}–m_{al}; depth, in_d–m'_d/in_{al}–m'_{al}; frontal & distal diagonal, in_d–m_d/in_{al}–m_{al}), in view of the individual position of the medial incisors, allowed us developing, substantiating and testing a biometric diagnostic approach to studying the dental and alveolar arches in people with physiological occlusion in a permanent teeth bite.
2. The following points were used as the most stable anatomical references through building the dental (m_d–in_d–m_d) and alveolar (m_{al}–in_{al}–m_{al}) triangles: the incisal ind point located between the medial incisors near the cutting edge; the molar md point located at the vestibular distal tubercles apexes; the central inal point located on the alveolar process (alveolar part) in the interdental space between the incisors; the molar mal alveolar point located on the alveolar process (alveolar part) in the interdental space between the second and third molar on the lingual side.
3. In the patients with a physiological occlusion of permanent teeth, the value of the interincisal angle falling within the reference intervals of 130–140°, signals of the mesotrusion type of the dental arches. The patients with a physiological protrusion of the medial incisors and an interincisal angle below 129°, feature the protrusion type of the dental arches, whereas those with the physiological retrusion of the central incisors, and an interincisal angle exceeding 141° had the retrusion type of the dental arches.
4. In patients with the protrusion type of arches, on both the upper and lower jaw, the base (m_d–m_d, m_{al}–m_{al}), as well as the sides (in_d–m_d, in_{al}–m_{al}) of the dental and alveolar triangles exceed statistically reliably the similar indicators identified in people with the mesotrusion and retrusion types of the arches. The patients with the meso-, pro-, and retrusion types of the arches (both jaws) had the sagittal values of the dental (in_d–m'_d) and alveolar (in_{al}–m'_{al}) triangles revealing no statistically meaningful differences.
5. The patients with complete loss of teeth, due to bone atrophy of the alveolar processes and jaws,

Fig. 5. Images of oral cavity, patient with protrusion type of dental arches and macrodontia (a — frontal, b — lateral right, c — lateral left projections)

Fig. 6. Images of oral cavity, patient with retrusion type of dental arches and microdontia (a — frontal, b — lateral right, c — lateral left projections)

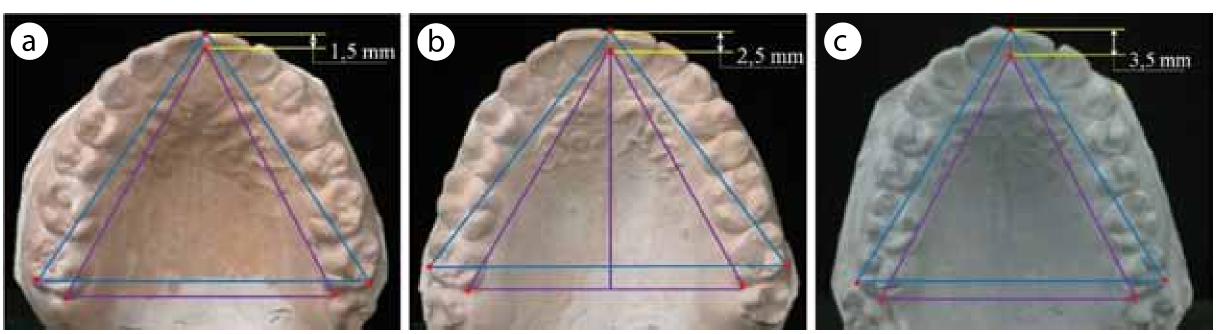

Fig. 7. Mutual position of dental and alveolar triangles for retrusion (a), mesotrusion (b) and protrusion arches (c)

Table 2. Biometric parameters of lower jaw cast models, patients with mesotrusion, protrusion and retrusion type of dental arches (M±m, mm)

Major parameters of arcade triangles	Linear dimensions of upper arcade triangles in people with meso-, pro-, and retrusion types of dental arches		
	mesotrusion	protrusion	retrusion
Basis of dental triangle (m_d-m_d)	55.27±1.56	61.05±1.84*	53.73±1.67*
Height of dental triangle (in_d- m'_d)	41.19±1.48	46.68±1.81*	38.60±1.73*
Side of dental triangle (in_d-m_d)	49.57±1.56	52.83±1.45*	47.03±1.48*
Basis of alveolar triangle (m_{al}-m_{al})	50.45±1.72	53.15±1.83*	47.99±1.64*
Height of alveolar triangle (in_{al}-m'_{al})	39.38±1.16	42.16±1.51*	37.32±1.39*
Side of alveolar triangle (in_{al}-m_{al})	46.77±1.52	49.84±1.39*	44.36±1.42*

*Note: * — statistically reliable regarding the parameters in the patients with the mesotrusion type of the dental and alveolar arches ($p \leq 0.05$)*

had their alveolar arches shape and size changed. Employing the identified morphometric reference intervals of the alveolar arches (base, m_{al}–m_{al}; side, in_{al}–m_{al}; height, in_{al}–m'_{al}) as reference points for building dental rows will allow reproducing the volume and the nature of the structure that were to be observed prior to the loss of teeth and bone atrophy in the alveolar processes and jaws, which is important when dealing with manufacturing prosthetic structures that are fully functional and aesthetic.

6. The distance between the central points of the dental (in_d) and the alveolar (in_{al}) triangles on both jaws features the trusion type of the arches. The smallest distance between the dental and alveolar triangles' apexes was to be observed in the patients with the retrusion type of the arches and microdontia (upper jaw, 1.5±0.07 mm; lower jaw, 0.5±0.02 mm); the average value was recorded in the patients with the mesotrusion type of the dental arches and normodentia (upper jaw, 2.5±0.06 mm; lower jaw, 1.5±0.05 mm), whereas the maximum distance was found in the patients featuring the protrusion type of the dental arches and macrodontia (upper jaw, 3.5±0.08 mm; lower jaw, 2.5±0.07 mm).
7. Morphometric data on the dental and alveolar arches parameters are reliable and diagnostically meaningful values that can be of applied significance in practical dentistry. Interpretation of morphometric data can be used to describe the physiological occlusion when choosing the tactics and methods of orthodontic treatment for patients with disturbed dental arches shape and size, as well as when designing artificial dental arches in patients with full or partial adentia, thus ensuring a balanced articulation function.
8. Manual reproduction of biometric diagnostics algorithms using conventional measuring tools and the table-based data of the normal values (base, height, side) of the dental triangles in patients with different teeth size (macro-, micro-, normodontia) will allow planning and controlling the course and the scale of teeth movement through all stages of orthodontic measures, thus helping eliminate dental anomalies.
9. Improved rational prosthetic treatment is reached through following the principle of a proper combination of the constitution-bound alveolar process with the shape of the teeth (Modrach, 1959), and effective harmonious functioning. The inclusion of basic parameters of the alveolar triangles in the treatment standards (protocols) for patients with total absence of teeth would allow not only reducing the time spent at the stage of installing toothless jaw models in the articulator, and facilitate achieving a proper match between the teeth shape, alveolar arches and the face, yet would also help build a balanced articulation structure, thus ensuring optimal functional and aesthetic outcomes.

REFERENCES

1. **Barrios C. A** Comparison of the Somatometric Measurements of Adolescent Males With and Without Idiopathic Scoliosis / Cortés S., Pérez-Encinas C., Escrivá M.D., Benet I., Burgos J., Hevia E., Pizá G., Domenech P//. – Spine – Aug 2011; 36(18). – P. 1470–1477. DOI:10.1097/BSD.0b013e31828af710
2. **Borodina V.V.** Biometry of permanent occlusion dental arches – comparison algorithm for real and design indicators // Archiv EuroMedica. 2018. Vol. 8; 1: P. 25–26. DOI: 10.35630/2199-885X/2018/8/1/25
3. **Clark E.M., Taylor H.J., Harding I., Hutchinson J., Nelson I., Deanfield J.E.** Association between components of body composition and scoliosis: a prospective cohort study reporting differences identifiable before the onset of scoliosis. J Bone Miner Res. 2014;29(8):1729–36. https://doi.org/10.1002/jbmr.2207
4. **Davydov B. N.** Applied significance of biometric diagnostics in planning dentistry treatment tactics. Medical alphabet.2020; (12):27–35. https://doi.org/10.33667/2078-5631-2020-12-27-35.
5. **Davydov B.N.** Anthropometric peculiarities of the maxillofacial region in children with congenital pathology in the period of the brew of the dairy teeth. Pediatric dentistry and prophylaxis. 2018; Vol. 17; 2 (65): 5–12. (In Russ.) DOI: 10.25636/PMP.3.2018.2.1.
6. **Davydov B.N.** Methodological approaches in diagnostics of anomalies of form and dimensions of dental arc taking into account individual morphological features. Medical alphabet.2020;(3):12–18. https://doi.org/10.33667/2078-5631-2020-3-12–18.
7. **Davydov B.N.** Modern concepts in approaches to determining individual position of media cutters in people with physiological types of bit // Medical alphabet. Series "Dentistry". – 2019. – Vol. 4. – 34 (409). – P. 16-22. DOI: 10.33667/2078–5631–2019–4–34(409)-16–22
8. **Davydov B.N.** Modern possibilities of clinical-laboratory and x-ray research in pre-clinical diagnostics and prediction of the risk of development of periodontal in children with sugar diabetes of the first type. Part I. Periodontology, 2018; Vol. 23; 3–23(88): 4–11. DOI:10.25636/PMP.1.2018.3.1
9. **Davydov B.N.** Morphological peculiarities of facial skelet structure and clinical and diagnostic approaches to the treatment of dental anomalies in children in the period of early change. Pediatric dentistry and prophylaxis. 2019; Vol. 19; 1 (69): 26–38. (In Russ.) DOI: 10.33925/1683-3031-2019-19-69-26-38.

10. **Davydov B.N.** Morphometric characteristics and correlation relationships of bone structures of TMJ-jaw joint in extending concepts of individually typological variability // Medical alphabet. Series "Dentistry". – 2019. – Vol. 3. – 23 (398). – P. 44–50. DOI: 10.33667/2078-5631-2019-3-23(398)-44-50

11. **Davydov B.N.** Peculiarities of microcirculation in periodont tissues in children of key age groups sufficient type 1 diabetes. Part I. Periodontology, 2019; Vol. 24; 1–24(90): 4–10. DOI: 10.25636/PMP.1.2019.1.1

12. **Davydov B.N.** Peculiarities of microcirculation in periodont tissues in children of key age groups sufficient type 1 diabetes. Part II. Periodontology. 2019;24(2):108–119. (In Russ.) DOI:10.33925/1683-3759-2019-24-2-108-119

13. **De Goma E.M., Rivera G., Lilly S.M., et al.** Personalized vascular medicine: individualizing drug therapy. Vascular Med 2011; 16(5):391–404. DOI:10.1177/1358863X11422251

14. **Dmitrienko S.V.** Analytical approach within cephalometric studies assessment in people with various somatotypes // Archiv EuroMedica. 2019. Vol. 9; 3: 103–111. https://doi.org/10.35630/2199-885X/2019/9/3.29

15. **Dmitrienko S.V.** Dynamics of periodontal fixing capacity through orthodontic treatment employing edgewise technique // Archiv EuroMedica. 2019. Vol. 9; 1: 151–152. https://doi.org/10.35630/2199-885X/2019/9/1/151

16. **Dmitrienko S.** Modern x-ray diagnostics potential in studying morphological features of the temporal bone mandibular fossa // Archiv EuroMedica. 2020. Vol. 10; 1: 116–125. https://doi.org/10.35630/2199-885X/2020/10/36

17. **Domenyuk D. A.** Anatomical and topographical features of temporomandibular joints in various types of mandibular arches. Medical News of North Caucasus. 2019;14(2):363–367. http://dx.doi.org/10.14300/mnnc.2019.14089 (In Russ.)

18. **Domenyuk D.A.** Changes of the morphological state of tissue of the paradontal complex in the dynamics of orthodontic transfer of teeth (experimental study). Periodontology, 2018; Vol. 23; 1–23(86): 69–78. DOI:10.25636/PMP.1.2018.1.15

19. **Domenyuk D.** Structural arrangement of the temporomandibular joint in view of the constitutional anatomy // Archiv EuroMedica. 2020. Vol. 10. № 1. P. 126–136. https://doi.org/10.35630/2199-885X/2020/10/37

20. **Fischev S.B., Puzdyryova M.N.** Morphological features of dentofacial area in peoples with dental arch issues combined with occlusion anomalies // Archiv EuroMedica. 2019. Vol. 9; 1: 162–163. https://doi.org/10.35630/2199-885X/2019/9/1/162

21. **Fomin I.V.** Effect of jaw growth type on dentofacial angle in analyzing lateral teleradiographic images // Archiv EuroMedica. 2019. Vol. 9; 1: 136–137. https://doi.org/10.35630/2199-885X/2019/9/2/136

22. **Fomin I.V., Ivanov S.Yu.** Efficiency of osseointegration properties manifestation in dental implants with hydroxyapatite plasma coating // Archiv EuroMedica. 2019. Vol. 9; 1: 138–139. https://doi.org/10.35630/2199-885X/2019/9/2/138

23. **Hamburg M.A., Collins F.S.** The path to personalized medicine. N. Engl. J. Med. 2010; 363(4): 301–304. DOI:10.1056/NEJMp1006304

24. **Harutyunyan Yu.** Undifferentiated connective tissue dysplasia as a key factor in pathogenesis of maxillofacial disorders in children and adolescents // Archiv EuroMedica. 2020. Vol. 10; 2: 83–94. https://dx.doi.org/10.35630/2199-885X/2020/10/2.24

25. **Ivanyuta S.O.** Individual-typological variability of structures of the craniofacial area in people with various constitutions // Entomology and Applied Science Letters. 2020. Vol. 7; 1: 20–32.

26. **Kondratyuk A.** Dependence of facial morphometric parameters from masticatory muscles tone in people with horizontal type of increased dental abrasion // Archiv EuroMedica. 2019. Vol. 9; 3: 91–96. https://dx.doi.org/10.35630/2199-885X/2019/9/3.26

27. **Kondratyeva T.** Methodological approaches to dental arch morphology studying // Archiv EuroMedica. 2020. Vol. 10; 2: 95–100. https://dx.doi.org/10.35630/2199-885X/2020/10/2.25

28. **Korobkeev A. A.** Variability of odontometric indices in the aspect of sexual dimorphism. Medical News of North Caucasus. 2019;14(1.1):103–107. https://doi.org/10.14300/mnnc.2019.14062 (In Russ.)

29. **Korobkeev A.A.** Types of facial heart depth in physiological occlusion. // Medical news of North Caucasus. 2018. – Vol. 13. – № 4. – P. 627–630. (In Russ., English abstract). https://doi.org/10.14300/mnnc.2018.13122.

30. **Korobkeev A.A.** Anatomical features of the interdependence of the basic parameters of the dental arches of the upper and lower jaws of man. Medical news of North Caucasus. 2018. – Vol. 13. – № 1–1. – P. 66–69. (In Russ., English abstract). https://doi.org/10.14300/mnnc.2018.13019

31. **Korobkeev A. A.** Clinical and computer-tomographic diagnostics of the individual position of medial cutters in people with physiological occlusion. Medical News of North Caucasus. 2020;15(1):97–102. DOI – https://doi.org/10.14300/mnnc.2020.15023 (In Russ.)

32. **Kupryakhin S.V.** Optimization of dental implantation combined with closed sinus lift in patients with low maxillary sinus floor // Archiv EuroMedica. 2019. Vol. 9; 2: 117–121. https://doi.org/10.35630/2199-885X/2019/9/2/117

33. **Lepilin A.V., Fomin I.V.** Diagnostic value of cephalometric parameters at graphic reproduction of tooth dental arches in primary teeth occlusion // Archiv EuroMedica, 2018. Vol. 8; 1: 37–38. https://doi.org/10.35630/2199-885X/2018/8/1/37

34. **Lepilin A.V.** Dependence of stress strain of dental hard tissues and periodontal on horizontal deformation degree // Archiv EuroMedica. 2019. Vol. 9; 1: 173–174. https://doi.org/10.35630/2199-885X/2019/9/1/173

35. **McElroy, A.** Medical Antropology in Ecological Perspective /A. McElroy, P.K.Townsend. – 4th Ed. – Boulder: Westview Press, 2004. – 466 p. DOI: 10.1525/maq.1998.12.3.392

36. **Pitts T, Brown D.** The 14 Keys to Pitts Case Management and Active Early Concepts. Pitts Protocol. 2015; 1:8–15. http://issuu.com/orthoclassic/docs/pitts_protocol_issue_1. Accessed October 12, 2015.

37. **Porfiriadis M.P.** Mathematic simulation for upper dental arch in primary teeth occlusion // Archiv EuroMedica, 2018. Vol. 8. № 1. P. 36–37.

38. **Porfyriadis M.P.** Scanning electron microscopy and X-ray spectral microanalysis in dental tissue resistance // Archiv EuroMedica. 2019. Vol. 9; 1: 177–185. https://doi.org/10.35630/2199-885X/2019/9/1/177

39. **Pitts T, Brown D.** The 14 Keys to Pitts Case Management and Active Early Concepts. Pitts Protocol. 2015; 1:8–15. http://issuu.com/orthoclassic/docs/pitts_protocol_issue_1. Accessed October 12, 2015.

40. **Proffit W.R., Fields H.W.** Contemporary orthodontics. – St. Louis: C.V. Mosby, 2000. – 768 p.

41. **Shkarin V.V., Ivanov S.Yu.** Morphological specifics of craniofacial complex in people with varioustypes of facial skeleton growth in case of transversal occlusion anomalie // Archiv EuroMedica. 2019. Vol. 9; 2: 5–16. https://doi.org/10.35630/2199-885X/2019/9/2/5

42. **Shkarin V.V., Grinin V.M., Khalfin R.A.** Specific features of transversal and vertical parameters in lower molars crowns at various dental types of arches // Archiv EuroMedica. 2019. Vol. 9; 2: 174–181. https://doi.org/10.35630/2199-885X/2019/9/2/174

43. **Shkarin V.V.** Specific features of grinder teeth rotation at physiological occlusion of various gnathic dental arches // Archiv EuroMedica. 2019. Vol. 9; 2: 168–173. https://doi.org/10.35630/2199-885X/2019/9/2/168

44. **Zelensky, V.A.** Integral indicator for orthodontic carequality control / V.A. Zelensky, M.V. Baturin, I.V. Zelensky, A.V. Kokareva, A.V. Zenina // Medical news of North Caucasus. 2014. – Vol. 9. – № 1. – P. 80–83. (In Russ., English abstract). DOI: 10.14300/mnnc.2014.09022.

45. **Voudouns J.C.** Interactive edgewise mechanisms: form and function comparison with conventional edgewise brackets // Airier. J. Orthodont. – 1997 – Vol. 111. – P. 119–140. https://doi.org/10.1016/S0889-5406(97)70208-7