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ABSTRACT

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CORRELATION OF BIOMETRIC AND PHOTOMETRIC FEATURES OF THE FACIAL PROFILE IN DISTAL OCCLUSION

Introduction. The biggest complaints of patients with a distal occlusion and their parents relate to esthetic problems in the structure of the child's face. The expectations of patients and, especially, parents for the results of orthodontic treatment are also focused on a significant improvement in the patient's appearance. That is why knowing the real possibilities for a doctor to improve the child's facial esthetics through orthodontic treatment is extremely important for orthodontics.

Purpose of the study. To reveal the correlation between biometric and photometric features of the facial profile in patients with a distal occlusion with different types of mandibular growth in the late period of mixed dentition.

Materials and methods. 74 adolescents in the late period of mixed dentition with a distal occlusion and different types of mandibular growth were examined; and the type of mandibular growth was established on orthopantomograms. Biometric indicators of 74 pairs of diagnostic test models of jaws were studied. The transversal and sagittal parameters of the upper and lower dentition were studied, in particular: width in the area of canines, first premolars, first molars and the length of the anterior segment. 204 photos of faces in profile were analyzed. Angular parameters like Downs angle, gl-Ul-pg angle, Viazis angle, Th-me:NoV angle, profile T angle, labial LPA angle, chin-labial angle, nasolabial Ls-sn-cm angle were studied.

Results. In all patients with a distal occlusion, the correlation between biometric and photometric features of the facial profile is 100%. Studies have shown that not all morphometric parameters that were to be studied significantly affect patients' appearance. Weak relationships were prevalent for all patients with different types of mandibular growth.

When analyzing the influence of morphometric parameters on the esthetic features of the face profile, the largest number of strong and medium relationships was established for the neutral type of mandibular growth (4 strong and 7 medium) and neutral-horizontal type (1 strong and 12 medium). The studied morphometric indicators significantly affect the values of the gl-Ul-pg angle, the V (Viazis) angle, the Th-me/NoV angle, and the profile angle.

Conclusions. It should be noted that in patients with a distal occlusion in the late period of mixed dentition, who have a different type of mandibular growth, ambiguous interdependent relationships of biometric parameters with esthetic features of the facial profile are reported. In our opinion, this can be explained by the fact that the formation of this malocclusion is based on unequal growth and development of the morphological structures of the facial area, which requires further research.

Keywords: correlation, malocclusions, biometry, photometry, type of growth.

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СПІВЗАЛЕЖНІСТЬ БІОМЕТРИЧНИХ ТА ФОТОМЕТРИЧНИХ ОСОБЛИВОСТЕЙ ПРОФІЛЮ ОБЛИЧЧЯ ПРИ ДИСТАЛЬНОМУ ПРИКУСІ

Вступ. Найбільші скарги пацієнтів із дистальним прикусом та їх батьків зосереджуються на естетичних негараздах в будові обличчя дитини. Сподівання пацієнтів та, особливо, батьків на результати ортодонтичного лікування також концентруються на суттєвому поліпшенні зовнішнього вигляду пацієнта. Саме тому знання реальних можливостей лікаря в поліпшенні естетики дитини в результаті ортодонтичного лікування є конче актуальним для ортодонтії.

Мета дослідження. виявити співзалежність між біометричними та фотометричними особливостями профілю обличчя у пацієнтів із дистальним прикусом з різними типами росту нижньої щелепи в пізньому періоді змінного прикусу.

Матеріали і методи. Було проведено обстеження 74 підлітків у пізньому періоді змінного прикусу із дистальним прикусом з різними типами росту нижньої щелепи, які встановлювались на ортопантомограмах щелеп. Вивчено біометричні показники 74 пар контрольних-діагностичних моделей щелеп. Вивчалися трансверзальні та сагітальні параметри верхнього та нижнього зубних рядів, а саме: ширина в ділянці іклів, перших премолярів, перших молярів та довжина переднього відрізка.

Проаналізовано 204 фотознімки обличчя в профіль. Вивчалися кутові параметри: < Downs, < gl-Ul-pg, < Viazis, < Th-me/NoV, Профільний < T, Губний < LPA, < Підборідно-губний, Носо-губний < Ls-sn-cm.

Результати. У всіх пацієнтів з дистальним прикусом співзалежність між біометричними та фотометричними особливостями профілю обличчя складає 100%. Дослідження показали, що не всі морфометричні параметри, які підлягали вивченню, істотно впливають на зовнішній вигляд. Превалюючими

для всіх пацієнтів з різними типами росту нижньої щелепи були слабкі зв'язки.

При аналізі впливу морфометричних параметрів на естетичні показники профілю обличчя найбільша кількість сильних та середніх зв'язків встановлена при нейтральному типі росту нижньої щелепи (4 сильних та 7 середніх) та нейтрально-горизонтальному (1 сильний та 12 середніх). Морфометричні показники, які вивчались, істотно впливають на значення кута gl-Ul-pg, кута V (Viazis), кута Theme/NoV та профільного кута.

Висновки. Треба зазначити, що у пацієнтів з дистальним прикусом у пізньому періоді змінного прикусу, що мають різний тип росту нижньої щелепи, спостерігаються неоднозначні співзалежні зв'язки біометричних параметрів з естетичними показниками профілю обличчя. На нашу думку, пояснити це можна тим, що в основі формування цієї аномалії прикусу лежать неоднакові відхилення в рості та розвитку морфологічних структур лицевої ділянки, які потребують подальших досліджень.

Ключові слова: кореляція, зубощелепні аномалії, морфометрія, фотометрія, тип росту.

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INTRODUCTION

Malocclusions currently take one of the leading places in dental diseases. One of the factors causing dental diseases, especially nowadays, is the impact of stress on periodontal tissues [1], which leads to the formation of maxillofacial anomalies. It should also be taken into account that the use of various materials in orthodontic treatment can trigger allergic reactions from the upper respiratory tract, namely rhinitis [2]. It should be noted that bite abnormalities directly affect the state of the temporomandibular joint [3, 4].

The biggest complaints of patients with malocclusions of Angle's class II₁ and their parents relate to esthetic problems in the structure of the child's face [5]. The expectations of patients and, especially, parents for the results of orthodontic treatment are also focused on a significant improvement in the patient's appearance. That is why knowing the real possibilities for a doctor to improve the child's facial esthetics through orthodontic treatment is extremely important for orthodontics. The type of mandibular growth is a diagnostic criterion necessary for a final diagnosis, drawing up a treatment plan, choosing a method of orthodontic treatment and, as a result, the final result [6].

With the help of telerradiological and photometric study, the relationship was established between skeletal parameters and soft tissues, which characterize the facial profile [7].

Some parameters of the soft tissues of the facial profile, such as the thickness of the upper lip, the chin-lip angle, the length of the lower lip and its position to Ricketts and Burstone esthetic planes reflect close relationship with changes in bone structures. Strong and medium relationships that were detected between the parameters that characterize the shape, size and position of the maxillofacial skeleton and soft tissues of the face emphasize the need to improve diagnostics for the further successful correction of malocclusions of Angle's class II₁ [8].

Understanding the nature of this relationship will help to learn the peculiarities of the interdependence between bone structures and soft tissues in the case of bite anomalies, as well as to improve the diagnosis of disorders and facilitate successful treatment of maxillofacial anomalies [9, 10].

No information on the correlation between biometric and esthetic indicators in case of a distal occlusion, taking into account the types of mandibular growth, which can be determined using orthopantomography, as a mandatory method of examination of every orthodontic patient, was found.

Objective of the study. To reveal the correlation between biometric and photometric features of the facial profile in patients with a distal occlusion with different types of mandibular growth in the late period of mixed dentition.

MATERIALS AND METHODS

One of the important methods of diagnosis allowing for identification of deviations in the structure of dentition and jaws is a biometric study of diagnostic test models of jaws.

74 adolescents in the late period of mixed dentition with a distal occlusion with different types of growth of the lower jaw were examined; and the type of mandibular growth was established on orthopantomograms of the jaws. All patients submitted a written informed consent for use of orthodontic data for the study.

Studies were conducted in accordance with the rules of humane treatment of patients in compliance with the requirements of the Declaration of Tokyo of the World Medical Association, the International Recommendations of the Declaration of Helsinki on Human Rights, the Convention of the Council of Europe on Human Rights and Biomedicine, the Laws of Ukraine, the orders of the Ministry of Health of Ukraine, and the requirements of the Code of Ethics for doctors of Ukraine. This study was approved by the Ethics and Biomedical Ethics Commission of higher educational establishment 'Poltava State Medical University' No. 231 dated October 24, 2024.

Patients are divided into 5 groups, taking into account their type of mandibular growth. Biometric indicators of 74 pairs of diagnostic test models of jaws were studied. The transversal and sagittal parameters of the upper and lower dentition were studied, in particular: width in the area of canines, first premolars, first molars and the length of the anterior segment.

204 photos of faces in profile were analyzed. Angular parameters formed between the Frankfurt horizontal plane, oral tangent, nasal plane, chin line, gaze horizontal plane were studied, namely Downs angle, gl-UI-pg angle, Viazis angle, Th-me:NoV angle, profile T angle, labial LPA angle, chin-labial angle, nasolabial Ls-sn-cm angle.

Mathematical analysis and validation of the results were carried out with the Statistica software using standard Statistica 6.0 programs.

RESULTS AND THEIR DISCUSSION

Correlation between the biometric parameters of the upper and lower dentition and the esthetic measurements of the face in case of distal occlusion in adolescents in the late period of mixed dentition with different types of mandibular growth are presented in Table 1.

In all patients with a distal occlusion, the correlation between biometric and esthetic features of the facial profile is 100%. Studies have shown that not all biometric parameters that were to be studied significantly affect the appearance of patients. Weak relationship was prevalent for all patients with different types of mandibular growth.

We will analyze the correlation between biometric and esthetic features of the facial profile in patients with different types of mandibular growth, which had medium and strong relationship.

Analysis of correlation between biometric indicators and Downs angle showed mixed relationship. Logically, the interdependence on the direction of the force should be direct, except for the relationship of the angle with the length of the frontal section of the upper tooth row, i.e., the decrease in biometric parameters affects the decrease in the angle. The medium direct relationship with the vertical type of mandibular growth with the width between the canines of the upper tooth row ($P<98$) and the length of the frontal section of the lower tooth row ($P>98$) deserves attention. The same relationship is reported for the neutral-vertical type of growth – with the length of the frontal part of the upper tooth row ($P<95$), and in case of the neutral-horizontal type – with the width between the upper first premolars ($P<95$) and the lower canines ($P<95$); and a strong dependence was established between the first molars of the upper tooth row ($P>98$).

When studying the interdependence between the shape of the facial profile (gl-UI-pg angle) and the biometric measurements of the dentition, it is quite logical to identify the medium inverse relationship of the gl-UI-pg angle with the length of the upper dentition (the angle decreases when the length increases) and the direct relationship with the width between the canines and the length of the lower tooth row (the angle decreases when the specified parameters decrease) in patients with a vertical type of mandibular growth ($P<95$).

In the group of patients with a horizontal type of mandibular growth, it is logical to observe, as in the previous group, a medium inverse relationship with the length of the upper tooth row (an increase in the length leads to a decrease in the angle) and a direct relationship with the length of the lower tooth row (a decrease in the length leads to a decrease in the angle) ($P<95$).

In case of a neutral-vertical type of growth, a decrease in the width in the area of the first molars of the upper and lower tooth row and the premolar width of the lower tooth row leads to a decrease in the specified angle (direct medium correlation $P<95$).

The medium direct relationship of the shape of the facial profile is logical in case of a neutral-horizontal type of mandibular growth with the width between the canines of the upper tooth row and the molar width of the lower tooth row (a decrease in width leads to a decrease in the angle), as well as the medium inverse relationship with the length of the upper tooth row (the extension of the front section leads to the a decrease of the gl-UI-pg angle) ($P<95$).

An increase in the V angle (Viazis) was found in all patients during an esthetic study.

Table 1. Correlation between biometric and esthetic parameters of the facial profile

Type of growth	Upper jaw				Lower jaw			
	3/3	4/4	6/6	L	3/3	4/4	6/6	L
Downs angle								
neutral	-	-	-	-	-	-0.37	-	-
vertical	0.57	-	-	-	-	-	-	0.6
horizontal	-	-0.44	-	0.41	-	-	-	-
neutral-vertical	-0.66	-0.34	-	-0.42	-0.45	-0.58	-0.5	-0.57
neutral-horizontal	-	0.41	0.79	-	0.43	-	-	-
gl-UI-pg angle								
neutral	-0.67	-0.52	-0.58	-	-0.48	-0.37	-0.41	-
vertical	-	-	-	-0.32	0.31	-	-	0.33
horizontal	-	-	-0.35	-0.5	-	-	-0.37	0.63
neutral-vertical	-	-	0.42	0.46	-	0.42	0.52	-
neutral-horizontal	0.41	-0.39	-	-0.52	-0.35	-0.54	0.52	-
Viazis angle								
neutral	-0.81	-	-0.63	-	-0.89	-	-0.55	-
vertical	0.49	-	-	-	-	-	-0.34	-
horizontal	-0.36	-	-	-	-	-	-	-
neutral-vertical	-0.31	-0.51	-	-	-	-0.37	-	-0.31
neutral-horizontal	-	-	0.35	-	-	-0.31	-	-
Th-me:NoV angle								
neutral	-	0.38	0.86	-	-	0.74	0.41	-
vertical	-	-	-0.57	-0.5	-	-0.31	-0.37	-
horizontal	0.38	-	0.51	-	-	-	0.3	-
neutral-vertical	-	-0.35	-	-	-	-	-	-
neutral-horizontal	-	-0.43	-0.45	-	-	-	-0.77	0.41
Profile T angle								
neutral	0.61	0.38	-	0.33	0.50	-	-	-
vertical	0.53	-	-	-	-	-	-	-
horizontal	-	0.31	-	-	-	0.52	-	-
neutral-vertical	-	-0.42	-0.41	-0.59	-0.54	-0.37	-0.59	-0.31
neutral-horizontal	-	-0.32	-	-0.36	-	-	0.32	-0.33
Labial LPA angle								
neutral	-0.77	-0.47	-0.52	-	-	-0.84	-0.71	-0.32
vertical	-0.32	-	-0.34	-	-	-	-0.35	-
horizontal	-	-	-	-	-	0.48	-0.45	-
neutral-vertical	-	-0.31	-0.38	-	-0.39	-	-	-
neutral-horizontal	-0.44	-0.61	-	-	-0.37	-0.68	-	-0.35
Chin-labial angle								
neutral	-	-	0.36	-	0.41	-	-	-
vertical	-	-	-	-	-	-	-	-
horizontal	-	-	0.51	-	-	-	-	-
neutral-vertical	-0.38	-0.74	-	-	-0.57	-0.58	-0.37	-
neutral-horizontal	-	0.49	-	-	-	0.31	-	-
Nasolabial Ls-sn-cm angle								
neutral	-	-	0.32	-	-	-	-	-
vertical	0.37	-	-	-	-	-	-	-
horizontal	-	0.3	-	-	-	0.32	-	-
neutral-vertical	-	-	0.44	-	-	0.56	-	-
neutral-horizontal	0.59	-	0.31	-	-	-0.44	0.39	0.47

Analysis of interdependent relationship in patients with a neutral type of mandibular growth revealed strong inverse relationships with the width of the upper and lower tooth rows in the area between the canines, medium inverse relationships with the upper and lower width between the sixth teeth, i.e. narrowing of the tooth rows affects the increase of the angle ($P>99$).

The medium inverse relationship with the width between the lower first molars for patients with a vertical type of growth is significant ($P<95$).

A medium inverse relationship with the width of the upper tooth row between the canines was found in the patients with a horizontal type of growth ($P<95$).

In case of a combination of neutral and vertical type of growth, an inverse medium relationship ($P<95$) was established with the width of the upper tooth row between the canines, the first upper and lower premolars, the length of the frontal section of the lower tooth row (the angle increases when biometric indicators decrease).

In the group of patients with a neutral-horizontal type of growth, the medium inverse relationship with the lower premolar width is noted; the smaller is the width, the larger is the angle ($P<95$).

When establishing the interdependent relationships of the Th-me/NoV angle, which was less than normal in all patients, with biometric parameters, the following results were obtained. The decrease of the angle is affected by the narrowing between the first upper molars and the first lower premolars in case of a neutral type of growth (strong direct relationship at $P>99$). Also, in this group of patients, medium direct relationship with the width of the upper tooth row between the first premolars ($P=95$) and the first molars of the lower tooth row ($P>95$) was established, the decrease of which leads to a decrease in the angle.

The presence of medium direct correlations with the horizontal type of growth with the width between the canines of the upper tooth row and the upper and lower molar width (narrowing of the tooth rows entails a decrease in the angle) is significant ($P<95$).

In case of a neutral-horizontal type of growth, the medium direct relationship with the length of the front part of the lower tooth row ($P<95$) deserves attention.

Analysis of correlation between biometric parameters and the profile angle, the values of which are high in all patients, showed that there is a logical medium direct relationship with the frontal length of the upper tooth row in the case of a neutral type of growth, which means that an increase in length leads to an increase in the angle ($P<95$).

Medium inverse relationship was established with such biometric indicators as the premolar and molar width of both tooth rows, the width between the canines

and the length of the lower tooth row in the group of patients with a neutral-vertical type of growth, i.e. a decrease in the specified biometric indicators directly affects the increase in the profile angle ($P<95$).

In patients with a neutral-horizontal type of mandibular growth, the medium inverse relationship with the upper premolar width and the length of the lower dentition deserves attention ($P<95$).

In patients with a distal occlusion, it is logical that the width of the lower tooth row between the first premolars affects the value of the labial angle in case of a horizontal type of growth (medium direct relationship), that is, when the lower tooth row narrows in the area of the lower first premolars, a decrease in the specified angle is noted ($P<95$). All other data of codependent relationships have no basis.

As for the chin-labial angle, it should be noted that with a neutral type of mandibular growth, a medium direct relationship is established with the upper molar width ($P<95$) and between the canines of the lower dentition ($P>95$), that is, when one parameter decreases, the same happens to another.

In case of a horizontal type of growth, there is also a logical medium direct relationship of the chin-lip angle with the width of the upper tooth row in the area of the first molars ($P<95$).

In patients with a neutral-horizontal type of growth, it was established that the narrowing between the premolars of the upper and lower tooth row affects the decrease of the chin-labial angle (medium direct relationship, $P<95$). The remaining patients do not correspond to a logical explanation for the correlation between biometric and esthetic parameters.

Interdependent relationships between the nasolabial angle and biometric parameters indicate only one thing, namely, that there is a logical medium inverse relationship with the width of the lower tooth row in the area of the first premolars in case of a neutral-horizontal type of mandibular growth ($P<95$). The rest of the correlation results obtained are contradictory.

CONCLUSIONS

Summarizing the results obtained after the research focused on strong and medium relationships when studying the correlation between the esthetic data of the soft tissues of the facial profile and biometric indicators, the following conclusions can be drawn.

Analysis of the influence of biometric parameters on the esthetic indicators of the facial profile revealed the largest number of strong and medium relationships in cases of the neutral type of mandibular growth (4 strong and 7 medium) and a neutral-horizontal type (1 strong and 12 medium). The studied morphometric indicators significantly affect the values of the gl-UI-

pg angle, the V (Viazis) angle, the Th-me/NoV angle, and the profile angle.

It should be noted that ambiguous interdependent relationships of biometric parameters with esthetic indicators of the facial profile are observed in patients with a distal occlusion in the late period of mixed

dentition, who have a different type of mandibular growth. In our opinion, this can be explained by the fact that the formation of this bite anomaly is based on uneven growth and development of the morphological structures of the facial area, which requires further research.

PROSPECTS FOR FUTURE RESEARCH

Establishment of interdependent relationships between full-face biometric and esthetic features in patients with a distal occlusion with different types of mandibular growth.

AUTHOR CONTRIBUTIONS

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A – Work concept and design, B – Data collection and analysis, C – Responsibility for statistical analysis, D – Writing the article, E – Critical review, F – Final approval of the article.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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