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ORIGINAL ARTICLE

ANALYSIS OF PHOTOMETRIC FULL-FACE PARAMETERS WITH A DISTAL BITE TAKING INTO ACCOUNT THE TYPES OF MANDIBULAR GROWTH

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ABSTRACT
The aim: Determination of the peculiarities of full-face aesthetics in patients aged 10-13 years with a distal bite with different types of mandibular growth.
Materials and methods: 74 patients aged 10-13 years with a distal bite and various types of mandibular growth took part in the study. The methods of photostatic image study described by I.I. Uzhumetskene (1970), V.P. Pereverzev (1979) were used in this research.
Results: To determine the type of face, a gl-me: zy-zy index was calculated. Index values ranging from 0.84 to 0.879 are indicative of a mesoprosopic (medium) type of face, an index less than 0.839 defines a europrosopic (broad) type, an index exceeding 0.88 is characteristic of a leptoprosopic (narrow) type. The facial shape in all patients was determined by the Izar facial-morphological index. Similarly, the facial shape can be determined by the facial tapered angle (< FTA). In all groups of teenagers, a decrease in the angle is noted, which is indicative of an elongated, narrow face. To assess the ratio of the middle and lower parts of the face, the gl-sn:sn-me index was used, which is normally equal to 1. In our case, this index was higher than normal in all groups of children as compared to the control group (1.01±0.03). The p-p:zy-zy and p-p:go-go indices are indicative of the harmonious facial development transversally.
Conclusions: Vertical and neutral-vertical type of mandibular growth results in a narrow (leptoprosopic) type of face; medium (mesoprosopic) and wide (europrosopic) types of face result from neutral, horizontal and neutral-horizontal types of growth. Irrespective of the type of mandibular growth, all patients with a distal bite have a short lower third of the face. The strongest aesthetic changes are reported in the group of patients with a predominance of the horizontal type of mandibular growth.

  KEY WORDS: distal bite, photometry, full-face, type of growth

INTRODUCTION

A persistent tendency of modern orthodontics to shift the diagnostic priorities from the hard tissues of the skeleton to the soft tissues of the face and identification of their correlation is connected with the growing aesthetic demand among the patients and the development of technologies that allow satisfying this demand [1, 2]. The primary task of an orthodontist is to restore the facial proportions, create an aesthetic half-face, full-face and a beautiful natural smile.

Distal bite is characterized by specific facial features, namely: a convex type of face, a tilted back chin, a short lower third of the face, a deep chin-lip fold, lips disproportion [3-6]. Orthodontic treatment of patients with this anomaly lead to significant changes in appearance, which may not meet the standards of aesthetic optimum if the chosen therapeutic approach is wrong [7].

The scientific orthodontic literature contains numerous methods of soft tissue analysis; however, the planning of facial attractiveness is still quite difficult in the treatment of distal bite.

For the purposes of face study, various measurements and identification of changes caused with the treatment, the method of full-face and half-face photometry of the patients is widely used in orthodontics.

We did not find any data in the scientific references available that would discover the connection between full-face photometric studies in patients with a distal bite and the type of their mandibular growth.

THE AIM

Determination of the peculiarities of full-face aesthetics in patients aged 10-13 years with a distal bite with different types of mandibular growth.
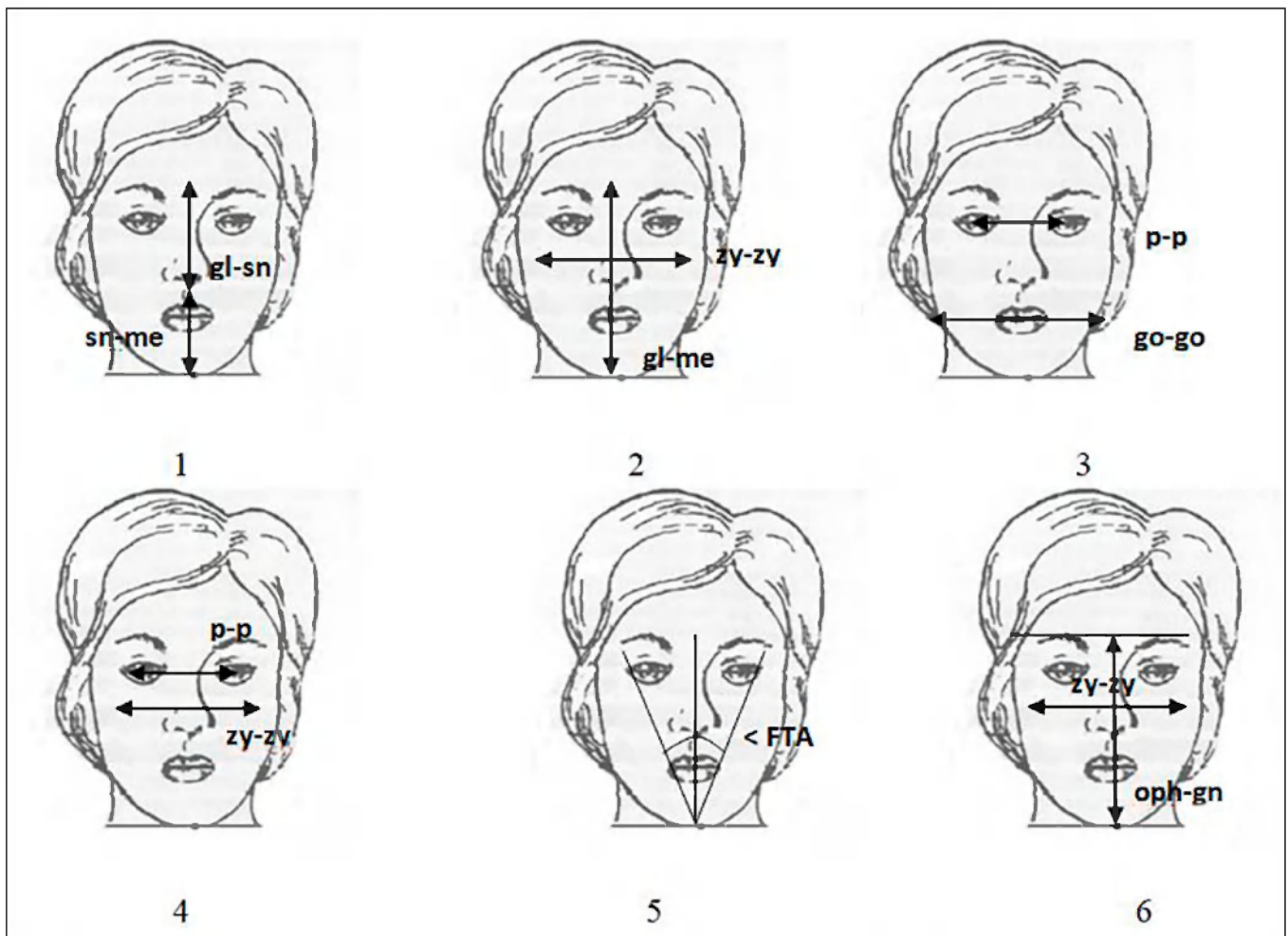
Fig. 1. Determination of full-face parameters: 1 - gl-sn: sn-me index (N = 1); 2 - gl-me: zy-zy index (N = 0,85); 3 - p-p: go-go index (N = 0,5); 4 - p-p: zy-zy index (N = 0,75); 5 – facial tapered angle (N = 45±5º); 6 - Izar facial and morphological index (N = 97-103).

MATERIALS AND METHODS

74 patients aged 10-13 years with a distal bite and 27 patients of the control group with abnormal position of individual teeth took part in the study. Patients were divided into five groups taking into account the type of mandibular growth determined with orthopantomograms according to the method proposed by the German researchers. The first group consisted of 28 patients with a neutral type of mandibular growth; the second group consisted of 13 patients with a vertical type; the third group included 11 patients with a horizontal type; the fourth and fifth groups were represented by children with a combined type of mandibular growth, of which 12 children had neutral-vertical type and 10 children had neutral-horizontal type of mandibular growth.

The study of facial aesthetics in children with a distal bite was carried out using photometry. For this, we applied the methods of studying full-face photostatic images of faces, which were described by T.F. Kosyreva (1996).

When assessing the full-face, the gl-sn: sn-me, gl-me: zy-zy, p-p: go-go, p-p: zy-zy indices and the facial tapered angle were determined. The Izar facial and morphological index was also determined (Fig. 1).

The results were processed statistically using the Student-Fischer test (p<0.05).

RESULTS

The results of full-face photometric study of patients with neutral, vertical, horizontal and combined types of mandibular growth are presented in Table I.

To determine the type of face, the gl-me: zy-zy index was calculated (Fig. 2). Index values ranging from 0.84 to 0.879 are indicative of a mesoprosopic (medium) type of face, an index less than 0.839 defines a europrosopic (broad) type, an index exceeding 0.88 is characteristic of a leptoprosopic (narrow) type. The study determined that the average value of the gl-me:zy-zy index in the control group, i.e. in children with abnormal position of individual teeth, was 0.86±0.01. In patients with a

Table I. Characteristics of full-face photometry indicators in patients aged 10-13 years with a distal bite

| Parameter | Control group n=27 | Types of mandibular growth | | | | | | | | | |
		Neutral n=28	P	Vertical n=13	P	Horizontal n=11	P	Neutral-vertical n=12	P	Neutral-horizontal n=10	P
gl-sn:sn-me index	1.01±0.03	1.15±0.02	<99.9	1.08±0.05	<95	1.19±0.02	99.9	1.05±0.02	<95	1.14±0.05	95
gl-me:zy-zy index	0.86±0.01	0.84±0.01	95	0.93±0.02	99	0.84±0.02	<95	0.89±0.01	99	0.84±0.02	<95
p-p:go-go index	0.51±0.01	0.58±0.01	99.9	0.57±0.01	99.9	0.59±0.01	99.9	0.55±0.02	<95	0.54±0.03	<95
p-p:zy-zy index	0.75±0.01	0.47±0.01	99.9	0.47±0.01	99.9	0.48±0.01	99.9	0.48±0.02	99.9	0.45±0.01	99.9
FMI by Izar	98.57±0.86	83.64±0.85	99.9	107.08±1.14	99.9	79.91±0.74	99.9	108.17±1.42	99.9	80.3±0.33	99.9
< FTA	42.68±0.65	37.21±0.6	99.9	36.15±1.02	99.9	39.18±1.26	>95	36.75±0.34	>99.9	38.1±0.72	99.9

vertical direction of mandibular growth, this index was higher (0.93±0.02 for vertical type of growth, 0.89±0.01 for neutral-vertical growth), which corresponds to a leptoprosopic (narrow) type of face. Concurrently, in children with neutral, horizontal and neutral-horizontal types of growth, the values of the index tend to decrease and border on mesoprosopic (medium) and europrosopic (wide) facial types (0.84±0.01, 0.84) ±0.02, 0.84±0.02, respectively).

The facial shape in all patients was determined by the Izar facial-morphological index (Fig. 3). This index is 98.57±0.86 in the control group. The statistically significant value of the facial morphological index in patients with neutral, horizontal and combined neutral-horizontal types of mandibular growth did not exceed 86 (83.64±0.85; 79.91±0.74; 80.3±0.33 respectively). This factor is indicatives of a wide face in children with the specified types of growth. The patients with vertical and neutral-vertical types of growth can be defined as having a narrow face with the Izar facial-morphological index 107.08±1.14 and 108.17±1.44, respectively.

Similarly, the facial shape can be determined by the facial tapered angle (< FTA) made by two lines connecting the lateral points of the eye sockets with the corners of the mouth (Fig. 4). The angle value in the control group is 42.68±0.65° on average; however, a decrease in the angle value is reported in all groups of teenagers, which is indicative of an elongated narrow face. The greatest difference in the downward direction of this indicator is established in the group with vertical and neutral-vertical types of mandibular growth, with 6.53 and 5.93 on average, respectively. In patients with neutral, horizontal and neutral-horizontal types of growth, this indicator was closer to the control group (medium facial shape), but peculiar to a narrow face (37.21±0.6; 39.18±1.26; 38.1±0.72, respectively). The obtained results somewhat do not correspond to the

given previous parameters, and they are unlikely to be unconditional for the purposes of the facial shape determination in patients with a distal bite.

To assess the ratio of the middle and lower parts of the face, the gl-sn:sn-me index was used, which is normally equal to 1 (Fig. 5). If a face is harmonious, both parts should be equal. In our case, in all groups of children, the index was higher than normal if compared to the control group (1.01±0.03). The highest values of the index are reported in groups of patients with neutral, horizontal and neutral-horizontal types of the mandibular growth (1.15±0.02, 1.19±0.02 and 1.14±0.05, respectively). In case of vertical and neutral-vertical types of growth, this indicator is significantly lower as compared to the above-mentioned groups (1.08±0.05 and 1.05±0.02, respectively), but higher than normal. The obtained data are indicative of a short lower part of the face compared to the average, which is not harmonious.

The harmonic development of the face transversally is indicated by the p-p:zy-zy and p-p:go-go indices, which normally are equal to 0.75 and 0.5, respectively (Fig. 6). In all studied groups, regardless of the type of mandibular growth, a decrease in the p-p:zy-zy index was reported from 0.48±0.01 with horizontal and neutral-vertical growth to 0.45±0.01 with neutral-horizontal growth.

In case of neutral-horizontal and horizontal types of growth, the p-p:go-go index shows a statistically significant increase in all patients from 0.54±0.03 to 0.59±0.01, respectively. Thus, the facial aesthetics of patients with a distal bite cannot be considered harmonious.

DISCUSSION
Specific facial features are observed in patients with a distal bite [3-5]. In the course of orthodontic treatment of patients with the mentioned anomaly, significant changes are observed in their appearance [6, 7].
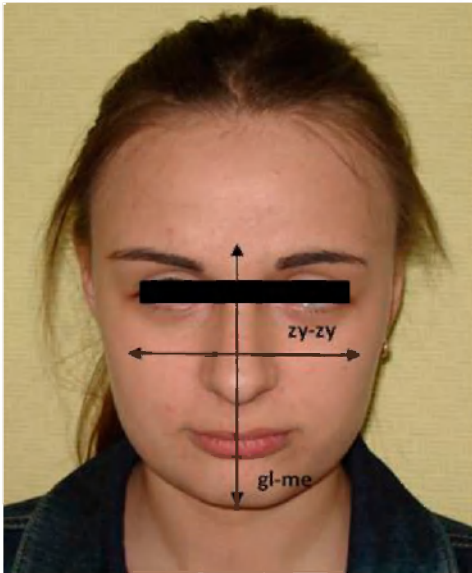
Fig. 2. Patient A., aged 13, neutral type of mandibular growth, gl-me:zy-zy index =0.95
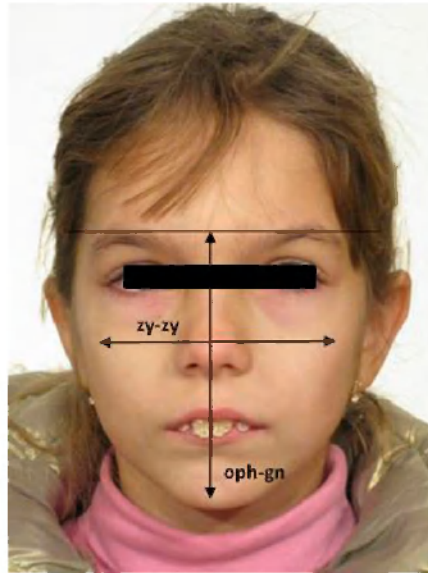

Fig. 3. Patient A., aged 10, vertical type of mandibular growth, Izar facial and morphological index = 1.17.
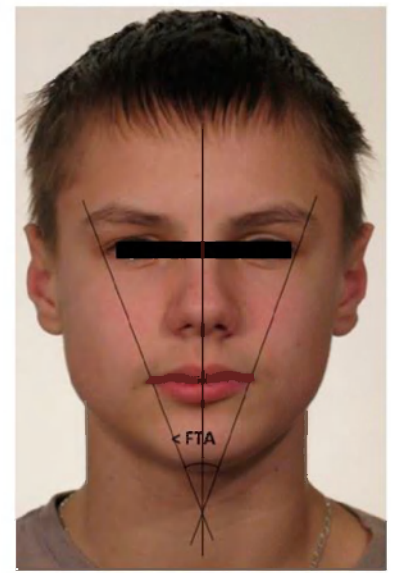

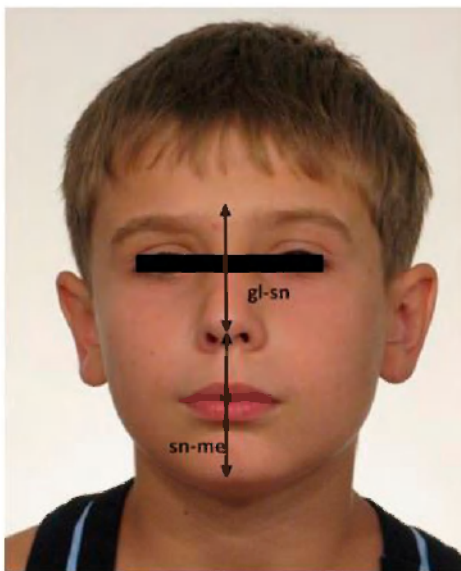**Fig. 4.** Patient A., aged 12, horizontal type of mandibular growth, facial tapered angle (< FTA) = 40°.

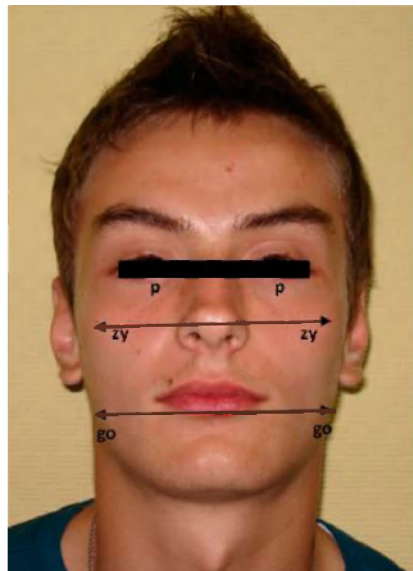**Fig. 5.** Patient A., aged 10, neutral-vertical type of mandibular growth, gl-sn:sn-me index = 1.0.

Fig. 6. Patient O., aged 13, neutral-horizontal type of mandibular growth, p-p:zy-zy index = 0.57 and p-p:go-go index = 0.51.

One of the informative diagnostic methods used to determine a orthodontic approach and a treatment plan for patients with a distal bite is photometry [1, 2]. However, we did not find any information in the domestic and foreign scientific orthodontic literature about full-face photometric studies in patients with the above-mentioned pathology of the bite, depending on the types of mandibular growth.

Facial photometry of 74 patients aged 10-13 years with a distal bite was compared with 27 patients with abnormal position of individual teeth.

The type or shape of the face was studied using the gl-me:zy-zy index. In patients with a vertical direction of mandibular growth, its increase was found in the case of a vertical direction (p=0.01) and in a neutral-vertical direction (p=0.01), which corresponds to a leptoprosopic (narrow) type of face. Meanwhile, in children with neutral, horizontal and neutral-horizontal types of growth, this index was reported to decrease and reach the boundary between mesoprosopic (medium) and europrosopic (wide) types of face.

Also, the facial shape was determined with Izar facial-morphological index, which is 98.57±0.86 in the control group. The high statistically guaranteed value of the facial-morphological index (p=0.001) shows that

patients with neutral, horizontal and combined neutral-horizontal types of mandibular growth have a wide face, and children who had vertical and neutral-vertical types of growth have a narrow face.

With regard to the facial tapered angle, which also characterizes the facial shape, it was established that this angle decreases in all groups of teenagers, which is indicative of an elongated narrow face. The biggest difference in the decrease of this parameter is reported in the group with vertical ($p=0.001$) and neutral-vertical ($p>0.001$) types of mandibular growth and is on average $6.53°$ and $5.93°$, respectively. In patients with neutral ($p=0.001$), horizontal ($p>0.05$) and neutral-horizontal ($p=0.001$) types of growth, this indicator was closer to the indicator of the control group (average facial shape), but still peculiar to a narrow face. The obtained results are somewhat contrary to the previous parameters and cannot be indisputable in determination of the facial shape in patients with class II$_1$ anomalies according to Angle.

To assess the face harmony, the gl-sn:sn-me index was used, which is normally equal to 1. In all groups of children, as compared to the control group (1.01 ± 0.03), the index was higher than normal. The highest increase in the index is reported in the groups of patients with neutral ($p<0.001$), horizontal ($p=0.001$) and neutral-horizontal ($p=0.05$) types of mandibular growth (1.15 ± 0.02, 1.19 ± 0.02 and 1.14 ± 0.05, respectively). With vertical ($p<0.05$) and neutral-vertical ($p<0.05$) type of growth, this indicator is significantly lower if compared to the mentioned groups (1.08 ± 0.05 and

1.05 ± 0.02, respectively), but still higher than normal. Changes in this index indicate a shortened lower part of the face as compared to the average value, which is not harmonious.

Also, the harmony of facial development was determined by the p-p:zy-zy and p-p:go-go indices, which are normally 0.75 and 0.5, respectively.

A decrease in the p-p:zy-zy index ($p=0.001$) and an increase in the p-p:go-go index were reported in all study groups, regardless of the type of mandibular growth, which indicates that the facial development of patients with occlusion anomalies of class II$_1$ according to Angle in the late period of mixed bite cannot be considered harmonious.

CONCLUSIONS

A full-face photometric study carried out in 74 patients aged 10-13 years with a distal bite and analysis of the obtained results of its disharmony indicates a characteristic complex of aesthetic symptoms depending on the type of mandibular growth. Vertical and neutral-vertical type of mandibular growth results in a narrow (leptoprosopic) type of face; medium (mesoprosopic) and wide (europrosopic) types of face result from neutral, horizontal and neutral-horizontal types of growth. Irrespective of the type of mandibular growth, all patients with a distal bite have a short lower third of the face. The strongest aesthetic changes are reported in the group of patients with a predominance of the horizontal type of mandibular growth.

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Conflict of interest:
The Authors declare no conflict of interest.

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