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VERTICAL IRREGULARITIES INFLUENCE ON THE MAXILLARY AND MANDIBULAR DENTOALVEOLAR BASIC HEIGHT AND DEPTH

ВЛИЈАНИЕТО НА ВЕРТИКАЛНИТЕ НЕПРАВИЛНОСТИ ВРЗ МАКСИЛАРНАТА И МАНДИБУЛАРНАТА ДЕНТОАЛВЕОЛАРНА ВИСИНА И ДЛАБОЧИНА

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Abstract

The factors influencing the harmony and disharmony of the face are both inherited regardless of one another, not as a complex that leads to the creation of different facial configurations. The facial configuration and facial expression depend primarily on the constitutional build of the skeleton, the position of the upper and lower jaw, the bite type, the facial bones position and alignment, the soft-tissue components covering the facial base, as well as the nose, lip and chin size. The lower face height influence over the vertical facial proportions is strong. The goal of our research is to evaluate the maxillary and mandibular dentoalveolar basic height and depth in individuals with vertical irregularities. Realizing the set goal, we have conducted research over 90 individuals form both sexes aged 13-15. The respondents had no previous orthodontic treatment, had no great craniofacial disorders and had complete dentition. Depending on the vertical incisal rate characteristics - overbite, the respondents were divided in three groups: the first group consisted of respondents with open bite, meaning the overbite was smaller or equal to -1 mm, the second group consisted of respondents with deep bite, meaning the overbite was over +4 mm, and the third control group consisted of respondents with normal overlap, meaning the overbite was more than +1 mm, but lower or equal to +4 mm. The obtained results show that the maxillary parameters MxAABH and MxPABH, as well as the mandibular MdAABH and MdPABH are the biggest in respondents with open bite, while the length of MxAD is the greatest in respondents with deep bite. **Keywords:** overbite, maxillary and mandibular dentoalveolar height and maxillary alveolar depth.

Апстракт

Факторите кои влијаат врз хармонијата и дисхармонијата на лицето се наследуваат независно едни од други, а не како комплекс што доведува до создавање на различни конфигурации на лица. Конфигурацијата и изразот на лицето зависат првенствено од конституционалната градба на неговиот скелет, од положбата на горната и долната вилица, од видот на загризот, од положбата и склопот на коските на лицето, од мекоткивните компоненти кои ја покриваат основата на лицето како и од големината на носот, усните и брадата. Влијанието на долната лицева висина во формирањето на вертикалните лицеви пропорции е силно. Целта на нашето испитување е да се процени максиларната и мандибуларната дентоалвеоларна базална висина и длабочина кај индивидуи со вертикални неправилности. За реализирање на поставената цел се извршени испитувања кај 90 индивидуи од обата пола на возраст од 13-15 години. Испитаниците претходно не се ортодонтски третирани, без големи краниофацијални нарушувања и со присуство на комплетна дентиција. Во зависност од карактеристиките на вертикалната инцизална стапалка - overbite испитаниците беа поделени во три групи: првата група ја формираа испитаници со отворен загриз каде што overbite е помал или еднаков на -1 mm, втората група беа испитаници со длабок загриз каде overbite е над + 4mm, и трета контролна група со испитаници со нормален преклоп на инцизивите, каде што overbite е повеќе од +1 mm, но помалку или еднакво на +4 mm. Добиените резултати од испитувањето покажаа дека максиларните параметри MxAABH и MxPABH, како и мандибуларните MdAABH и MdPABH се најголеми кај испитаниците со отворен загриз, додека должината на MxAD е најголема кај испитаниците со длабок загриз. **Клучни зборови:** overbite, максиларна и мандибуларна дентоалвеоларна висина и максиларна алвеоларна длабочина.

Introduction

During growth and development of the craniofacial system, in the human face formation process, a large number of physiological variations are possible, caused by different physiological and especially genetic factors.

The facial configuration and facial expression depend primarily on the constitutional build of the skeleton, the position of the upper and lower jaw, the bite type, the facial bones position and alignment, the soft-tissue components covering the facial base, as well as the nose, lip and chin size.

Sassouni[19] and Schudy[20] designated two different types of face forms in literature known as: skeletal open bites or hyperdivergent and skeletal deep bites or hypodivergent face type. Both open and deep bites are vertical irregularities.

Bojadziev[5,6] estimates that the vertical dimension depends on the alveolar lateral segment development (their distal parts) and on the maxilla and mandibular condyle development. That way, one insignificant growth in the mandibular condyle development and insufficient development in the alveolar processes of the mandibular distal parts, over which a mandibular anterior rotation is attached, leads to vertical equilibrium with geometric sagittal components, even though the vertical and sagittal growth and development are independent of one another. Because of these reasons, he estimates that intermolar height conditions the anteroposterior relation of the chin to the mandible.

A connection between the structure of the front part of the maxilla and mandible and the lower part of the face exists, in the case of the open or deep bite the dentoalveolar development can be insufficient to compensate the oversized or undersized detachment of the jaw system. A connection between the structures of the front part of the maxilla and mandible with the lower face height can exist.

In open or deep bites, the vertical dentoalveolar development can be insufficient to compensate for the great or small distance between the jaws. Patient observation with long face usually shows tight medium sagittal projection from the maxilla and mandible. This compensation follows the mechanism of elongation of vertical dimensions, reducing the labiolingual dimensions from the basic and alveolar bone in the front part of both jaws, this way a normal or deep bite can occur even in individuals with elongated faces.

According to Fields[11], the skeletal differences in children with long and short faces originate from their mandibular morphology.

Harzer and Stockli[(cit.2,3)] found greater dentoalveolar height in front parts of both jaws in respondents with open bites, compared to respondents with normal and deep bites.

Ellis[10], Frost[12], Subtenly[21-22] and Lopez-Gavito[16] point to significant differences between patients with normal and deep bites, only in dentoalveolar region of the maxilla.

According to Beckmann[2,3] there is significant proportion between overbite and maxillary values and mandibular dentoalveolar height, symphysis size and maxillary and mandibular size.

Also, according to Beckmann[2,3] and Haskel[12] there is a connection between the size of the mandibular symphysis, the chin and the vertical dimension and morphological and dentoalveolar structure of both jaw systems. Determining this connection can be useful in predicting the treatment success in overbite problems.

Betzenberger[4] examined skeletal and dentoalveolar changes in cases with open and deep bites, concluding that differences in anterior and posterior vertical facial height exists and posterior maxillary and mandibular dentoalveolar height in groups with different vertical incisal rate exist. The respondents with deep and normal bite have significantly different process lengths for the maxillary anterior, alveolar and basic height parameters.

The goal of our research is to evaluate the maxillary and mandibular dentoalveolar basic height and depth in individuals with vertical irregularities and normal occlusion.

Material and method

For the realization of the set goal, examinations were conducted on 90 individuals from both sexes, aged 13-15, randomly chosen from the Clinic of Orthodontics at PHO – Dental Clinical Centre “St. Pantelejmon” in Skopje.

Selecting the respondents taking part in realizing the set goal was based on the following criteria: individuals that had not previously undergone orthodontic treatment, with no great craniofacial disorders and with complete dentition.

In relation to the characteristics of the vertical incisal rate, the respondents were divided in three groups and classified as:

- The first group consisted of respondents with open bite, where the vertical incisal rate was lower or equal to -1 mm,
- The second consisted of respondents with deep bite, where the vertical incisal rate was over +4 mm, and
- The third group consisted of respondents with normal incisal overlap, where the vertical incisal rate was more than +1 mm, but lower or equal to +4 mm. This group was also the control group.

Every group consisted of 30 respondents, 15 female and 15 male that came in the period from 2009 to 2015.

For the respondents from the research groups standardized clinical and diagnostic procedures were conducted with x-ray cranial imaging in a standardized way in Norma lateralis.

The linear parameters we used in the research are:

1. **Maxillary anterior alveolar basal height (MxAABH mm)** - the distance from the middle

point of the alveolar meatus on the maxillary central incisor and the cross section point from the palatal plane and the longitude axis of the maxillary central incisor.

2. **Maxillary anterior depth (MxAD mm)** - The distance between points A-A`.
3. **Maxillary posterior alveolar basal height (MxPABH mm)** - The vertical distance between the middle point of the alveolar meatus on the maxillary first permanent molar and the palatal plane.
4. **Mandibular anterior alveolar basal height (MxAABH mm)** - The distance between the middle point of the alveolar meatus on the mandibular central incisor and the cross section point from the palatal plane and the longitude axis of the mandibular central incisor.
5. **Mandibular posterior alveolar basal height (MxPABH mm)** - The vertical distance between the middle point of the alveolar meatus on the mandibular first permanent molar and the palatal plane.

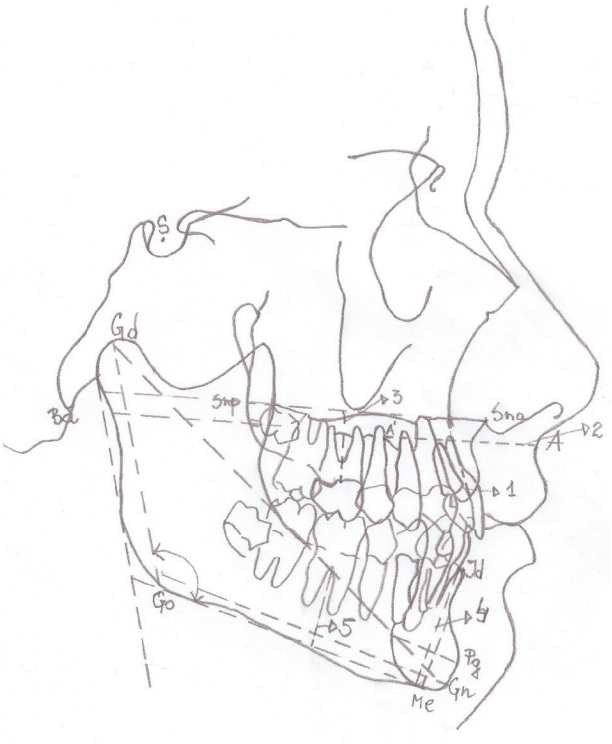

Figure 1. *Cephalometric parameters used in this study*

The statistical data analysis was conducted in SPSS for Windows 17.0 program.

- For data testing we used the Shapiro-Wilk`s W test.
- For data depiction descriptive statistics was used.
- For comparison of the analyzed parameters between the three analyzed groups, we used One way Anova, and for the inter-group differences we used the Tukey test.
- For comparison of the analyzed parameters in relation to gender, the Student "t" test was used.
- The levels of probability for achieving null hypothesis, concordant with international standards for bio-medical sciences were 0.05 and 0.01.

Results

Table 1. Maxillary anterior alveolar basal height in groups with open, deep and normal bite

Group	Maxillary anterior alveolar basal height MxAABH		
	mean±SD	min-max	median
Open bite	23.6±3.7	17-34	24
Deep bite	15.6±3.0	10-21	15.5
Normal bite	18.3±2.3	15-21	18
tested differences	F=34.9 p<0.01 post hoc open vs. deep p<0.01 open vs. normal p<0.01 deep vs. normal p<0.01		

Respondents with open, deep and normal bite have significantly different average lengths for the parameter MxAABH (F=34.9, p<0.01). Respondents with open bite have a significantly greater average depth for the parameter MxAABH compared to respondents with deep bite (23.6±3.7 mm vs 15.6±3.0 mm) and with normal bite (23.6±3.7 mm vs 18.3±2.3 mm). Analysis results for gender influence on the average depth on MxAABH show that it significantly depends on gender in the deep bite group. Male respondents with deep bite have a significantly shorter average length of MxAABH compared to female respondents with deep bite (14.15±2.9 mm vs 17.1±2.5 mm).

Table 2. Maxillary anterior depth in groups with open, deep and normal bite

Group	Maxillary anterior depth MxAD		
	mean±SD	min-max	median
Open bite	12.2±1.4	10-15	12
Deep bite	17.1±1.5	14-19.5	17.75
Normal bite	14.05±2.2	11-20	14
tested differences	F=40.8 p<0.01 post hoc open vs. deep p<0.01 open vs. normal p<0.01 deep vs. normal p<0.01		

The average length of the maxillary anterior depth MxAD in the open, deep and normal bite is 12.2±1.4 mm, 17.1±1.5 mm and 14.05±2.2 mm respectively.

Post hoc analysis for testing the intergroup differences shows that the respondents with open bite have significantly shorter MxAD average length compared to the respondents with deep and normal bites (F=40.8 ; p<0.01). In all three analyzed groups, the gender has no significant influence over the average length of the MxAD parameter.

Table 3. Maxillary posterior alveolar basal height in groups with open, deep and normal bite

Group	Maxillary posterior alveolar basal height MxPABH		
	mean±SD	min-max	median
Open bite	19±3.0	13-24	19
Deep bite	13.0±2.5	8-17.5	13
Normal bite	15.3±2.3	12-20	15
tested differences	F=25.9 p<0.01 post hoc open vs. deep p<0.01 open vs. normal p<0.01 deep vs. normal p<0.01		

Respondents with open bite have a significantly greater average depth for the parameter MxPABH compared to respondents with deep bite (19±3.0 mm vs 13.0±2.5 mm) compared to the control group (19.3±3.0 mm vs 15.3±2.3 mm). In the deep bite group a shorter MxPABH average length was measured, compared to the control group (19.3±3.0 mm vs 15.3±2.3 mm). Analysis results for gender influence over the average length of MxPABH showed that the MxPABH average length does not significantly rely on gender in both respondent groups.

Table 4. Mandibular anterior alveolar basal height in groups with open, deep and normal bite

Group	Mandibular anterior alveolar basal height MdAABH		
	mean±SD	min-max	median
Open bite	32.35±3.7	24-40	32.5
Deep bite	22.95±2.6	19-27	23.5
Normal bite	26.8±2.1	22-30	27
tested differences	F=53.7 p<0.01 post hoc open vs. deep p<0.01 open vs. normal p<0.01 deep vs. normal p<0.01		

For the value of F=53.7 and p<0.01, significant difference is confirmed in the average length of the MdAABH parameter between the three analyzed groups. The significant difference is due to the significantly shorter average length of this parameter in the deep bite group, relating to the open bite group (22.95±2.6 mm vs 32.35±3.7 mm) and relating to the control group (22.95±2.6 mm vs 26.8±2.1 mm), as well as significantly shorter average length of this parameter in the normal bite group, relating to the open bite group (26.8±2.1 mm vs 32.35±3.7 mm). The MdAABH parameter length significantly relies on the gender in the open bite group (t=2.92 p<0.01), and does not significantly rely on gender in the deep bite group (t=0.502 p>0.05) as well as the normal bite group (t=1.073 p>0.05).

The average length of the linear dimension MdPABH in the three analyzed groups (open, deep and normal bite) is 25±3.3 mm; 22±2.0 mm and 22.35±1.8 mm, respectively. The MdPABH parameter tested difference

Table 5. Mandibular posterior alveolar basal height in groups with open, deep and normal bite

Group	Mandibular posterior alveolar basal height MdPABH		
	mean±SD	min-max	median
Open bite	25±3.3	17-31	25
Deep bite	22±2.0	18-27	22
Normal bite	22.35±1.8	19-26	22
tested differences	F=8.99 p<0.01 post hoc open vs. deep p<0.01 open vs. normal p<0.01 deep vs. normal p<0.01		

between the three groups is statistically significant (F=8.99, p<0.01). The intergroup difference with post hoc analysis shows that this significance is due to significantly longer average length of MdPABH in the open bite group relating to the deep and normal bite groups. Gender function analysis shows that males and females have insignificantly different average depth of this parameter in the open bite group (t=0.673 p>0.05), and significant differences in the deep bite group (t=4.103 p<0.01) as well as the normal bite group (t=2.702 p<0.05).

Discussion

For the MdAABH parameter, a statistically highly significant difference between the average values in the three groups exists (P<0.01). Our results are nearly equal to Ceylan's results for the open bite group, and for the deep bite group as well as for the control group in which they were identical[6].

For the MxAD parameter, we confirm a significant difference between the average values in the three analyzed groups. The intergroup difference shows that the respondents with open bite have significantly shorter average MxAD length. The obtained data does not correspond to Ceylan's results where the average lengths in the respondent groups are completely identical[6].

In the open bite group, a longer average MxPABH length was measured. Our results for the three groups are completely concordant with the Beckmann[2,3], Fields[8] and Ceylan[6] findings, and in relation to gender there is no statistically significant difference.

For the value of F=53.7 and p<0.01, a significant difference is confirmed in the average length of the MdAABH parameter between the three analyzed groups. The significant difference is due to the significantly shorter average of this parameter in the deep bite group in relation to the open bite group. Our results are concordant with the Beckmann[2,3] and Ceylan[6] results, according to which the skeletal differences in children with long and short face originate from mandibular morphology, meaning the length of the mandible and ramus in children with long and short face do not differ from the same values in children with normal face length, however the gonial angle is significantly greater or smaller depending on the anomaly.

The intergroup difference for the MdPABH parameter shows that this significance is due to significantly longer average length in the open bite group relating to the deep and normal bite groups.

Conclusion

The height of the MxAABH parameter was highest in the open bite group, and shortest in the deep bite group, compared to the control group. In the deep and normal bite groups the MxAABH length is longer in female respondents as opposed to male respondents.

MxAD length is longest in the deep bite group, and shortest in the open bite group compared to the control group.

MxPABH height is longest in the open bite group, and shortest in the deep bite group compared to the control group.

Significant differences in gender function in MxAD and MxPABH parameters were not noticed.

The height of the MdAABH and MdPABH parameters is highest in respondents with open bite, and shortest in respondents with deep bite. In male respondents, from the open bite groups the height of the MdAABH parameter is higher than in female respondents, however the values for MdPABH in male respondents from the deep and normal bite groups are greater than those for female respondents.

Radiological and craniofacial results contribute to better understanding of the vertical abnormalities and can assist in determining a correct and precise diagnosis and adequate planning of the orthodontic treatment.

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