UDC: 611.314.018

EVALUATION OF DENTOALVEOLAR CHANGES IN MIXED AND PERMANENT DENTITION

АНАЛИЗА НА ДЕНТОАЛВЕОЛАРНИТЕ ПРОМЕНИ ВО МЕШОВИТА И ТРАЈНА ДЕНТИЦИЈА

Jonuzi Efendiler S.[1], Naumova-Trencheska M.[2], Jonuzi M.[1], Kjurchieva-Chuchkova G.[3], Bogdanovska B.[3], Gavrilovikj I.[3], Zuzelova M.[3]

[1]Private dental practices "Euro Orthodonci" Gostivar, Republic of North Macedonia, [2]Ministry of Defense of the Republic of North Macedonia, [3]Faculty of Dentistry, Department of Orthodontics, University "Ss Cyril and Methodius", Skopje, Republic of North Macedonia

Abstract

The dimensions of dental arches and occlusion have always been of concern to anthropologists, orthodontists and other specialists in the field of maxillofacial and reconstructive surgery. Encouraged by the individual variations of the normal size and shape of the dental arches developed under the influence of genetic factors and factors from the external environment, we set the following **goals**: by analyzing studio models of respondents aged 6-8 and 12-14 years of age, to determine the statistical significance of the defined parameters in the maxilla and the mandible. The study was performed on a sample of studio models in 55 subjects with normal occlusion of both sexes, divided in two age groups, 6-8 years with mixed dentition and 12-14 years with permanent dentition. Measurements were performed on the following parameters: anterior arch curve in maxilla and mandible (AC1, AC2), posterior arch curve in maxilla and mandible (PC1, PC2), the intermolar distance in maxilla and mandible (MM1, MM2), inter-canine distance in maxilla and mandible, palatinal depth (PD), palatinal length (PL) and mandibular length (ML). The obtained **results** from the comparative analysis of dental varnishes, in relation to age (6-8 and 12-14 years) of both sexes, showed larger values for certain parameters with statistical significance in the group from 12-14 years of male sex. In **conclusion**, the knowledge of the growth factors in occlusal and craniofacial variations is of great importance for basic research, but there is also clinical relevance in predicting growth in planning orthodontic treatment. **Keywords:** gnathometric variables of dental arches; gender; age.

Апстракт

Димензиите на денталните лакови и оклузијата од секогаш биле предмет на интерес на антрополозите, ортодонтите како и останатите специјалисти од областа на максилофацијалната и реконструктивна хирургија. Поттикнати од индивидуалните варијации на нормалната големина и форма на денталните лакови кои се развиваат под дејство на генетските фактори и факторите од надворешната околина,ги поставивме следните **цели**: преку анализа на студио модели на испитаници на возраст од 6-8 и 12-14 годишна возраст,да се утврди статистичка сигнификантност на дефинираните параметри во максила и мандибула. Испитувањето беше вршено на примерок од студио модели кај 55 испитаници со нормална оклузија од двата пола,поделени во две возрасни групи, од 6-8 год.со мешана дентиција и од 12-14 год. со перманентна дентиција. Беа извршени мерења на следните параметри:антериорна лакова облина во максила и мандибула(АЦ1, АЦ2), постериорна лакова облина во максила и мандибула(ПЦ1, ПЦ2), интермоларното растојание во максила и мандибула (ММ1, ММ2), палатинална длабина(ПД), палатинална должина (ПЛ) и мандибуларна должина (МЛ). Добиените **резултати** од компаративната анализа на денталните лакови, во однос на возраст (8-10 и 12-14 год.) кај двата пола,покажа за поедини параметри поголеми вредности со статистичка сигнификантноство групата од 12-14 год. од машки пол. Како **заклучок** познавањето на факторите кои ги регулираат оклузалните и краниофацијалните варијации е од голема важност за основните истражувања, но има и клиничка релевантност во предвидувањето на растот при планирање на ортодонтскиот третман.

Introduction

Orthodontic science has always been willing to find out the secrets of growth processes of the craniofacial complex. The growth and development of a person is a dynamic and complex process which leads to skeletal and muscular changes of the components of the craniofacial system. The morpho-functional association of cortex and muscular tissue in the last period has been developed in accordance with the biological maturation of the unit, conducted by the genetic message, the epigenetic factors and the influence of the environment in which it lives.

This established dynamic framework and harmony is not a basic guarantee for the proper growth and development of the cranial complex. The aesthetics of the teeth was of great significance in the life of human beings. Based on the dental appearance, the overall physiological attraction of the person is of great importance for the social, physiological and psychological life of the person Dimberg[1].

The numerous and diverse definitions encountered in the professional literature for normal occlusion should not be interpreted as a law, but as a starting point in determining the normal occlusion. Every normal occlusion, along common general features has its own personal characteristics, the expression of the genetic variation Bayome[2], Ferro[3]. The normal occlusion is characteristic for each individual and varies, depending on the period of life, and the type of dentition Trivino[4]. In the case of dysfunction or suppression, only one of these factors develops disorders in the individual somatic development and creates favoritism for the appearance of dental and craniofacial anomalies with the consequent morphological, functional and aesthetic deviations of Markovic[5].

The dimensions of the dental arches and the occlusion have been subject to the interest of anthropologists, orthodontists and specialists of maxillofacial and reconstructive surgery. Knowing the factors that regulate occlusal and craniofacial variations is of great importance for basic research, but they also have clinical relevance in predicting growth in planning orthodontic treatment.

The empirical experience points to the necessary need for determining and studying all the postulates that define the normal base and the relationships in the orofacial system. Individual variations in the size and shape of dental arches depend on genetic factors, internal causes, postnatal conditions in the environment, as well as ethnic and racial backgrounds. Angle (Markovic[5], Zuzelova[6]) concluded that the only way to achieve a balanced appearance should be a complete dentition. The shape of the dental arches during growth is strongly influenced by the function of lingual and mimic musculature.

From Broka (1873), various methods of dental analysis of studio models began to be used: Graber[7], Moyers, Bolton, Lundstrom, Korhaus, Adler, Combel (titled Salzman[8]). Correlative morphological and developmental analyzes of changes in postnatal growth and development are based on phylogenetic correlations[9], anthropometric studies[10] and serial cephalometric radiographs[11]. These studies largely determined the nature and direction of growth and development with its minor changes. Smaller changes for orthodontists have practical relevance, especially when it comes to changes in the width of the dental arches. In the longitudinal study of Goldstain[10], Salzman[8], Sato[12], Odajima[13], Mikami[14], normal changes in dental arches appear during growth and development. In recent years, Scher's[15], Brodie's[11], Scott's[16] reflection on dental arches has been largely driven by mathematical morphogenesis.

Channing and Wissler (titled from Björk)[17] were among the first examiners of the width of dental arches using the biometric technique. They state that the width between the canines after the age of eight and the width between the molars after their eruption is not increased. Sodermanns[18] points out that the width of the dental arches is inherited.

There are many studies in the literature about normal changes in the width of dental arches Lavelle[19] and ass., Sodermanns[18], Mills[20], Moorrees[21], Sillman[22], which can be summarized in such a way that: the increase in the dental arch width occurs in both groups of 9 to 13 years of age. In males, the arch width is 1.5 mm for the maxilla and 0.4 mm for the mandible. In female subjects, the maxillary arch width increases by only 0.8 mm, while the mandibular by 0.5 mm. The difference in the dimensions of the arch width between the maxilla and the mandible is interpreted by the divergent inclination of the maxillary alveolar procesus in comparison with the convergent inclination of the mandibular alveolar procesus. Sodermanns[18] points out that the width of the dental arches is inherited. Based on the above-mentioned facts, we find that the image that morphologically presents malocclusion, especially in the lower level, under the influence of the functional adaptation, is transformed into normal occlusion. In other cases, the morphological words of the ideal occlusion may be associated with serious functional disturbances, and accordingly, it cannot be referred to as a "normal occlusion".

Purpose

Inspired by the individual variations of the normal size and form of dental arches that occur during growth, and which depend on the hereditary and environmental factors, we set the following goals: by analyzing studio models from individuals with normal occlusion, at the age of 6-8 and 12-14 years, of both sexes from the Private dental practices "Euro Orthodonci" Gostivar, to determine whether there is statistical significance for the defined parameters in the maxilla and the mandible: anterior arch curves in maxilla and mandible (AC1, AC2); posterior arch curves in maxilla and mandible (PC1, PC2); intermolar distance in maxilla and mandible (MM1, MM2); palatinal depth (PD); palatinal length (PL) and mandibular length (ML) among adult groups, as well as gender polymorphism.

Material and methods

The examination was performed on a sample of studio models in 55 subjects with a normal occlusion of both sexes, divided in two groups according to age: 6-8

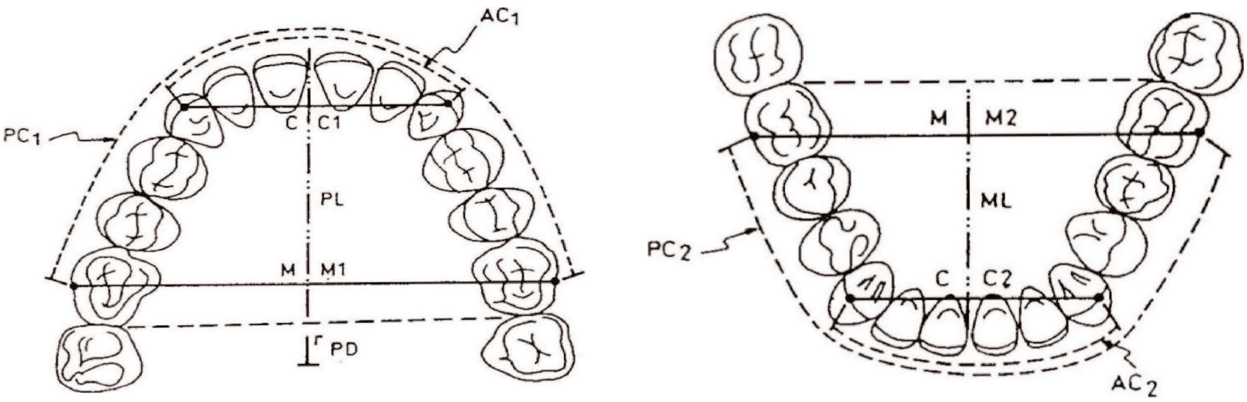

Figure 1. Schematic display of the parameters in the upper and lower dental arch

years old- mixed dentition and 12-14 years - permanent dentition, from Gostivar (Republic of North Macedonia).

The linear parameters were used in the research are the following,

- Interior arch curve in maxilla and mandible (AC1, AC2)
- Posterior arch curve in maxilla and mandible (PC1, PC2)
- Inter-canine distance in maxilla and mandible (CC1, CC2)
- Intermolar distance in maxilla and mandible (MM1, MM2)
- Palatinal length (PL)
- Palatinal depth (PD)
- Mandibular length (ML)

The parameters were measured with a flexible gauge and a calibrated ribbon used to measure the anterior and posterior arch form in the centimeters approximately to the first decile, a compass by Corkhaus. The following statistical methods are applied: Descriptive Statistics (Mean; Std.Deviation; ± 95.00% CI; Minimum; Maximum); Kolmogorov-Smirnov test, Lillifors test, Shapiro-Wilks W test (p), depending on the distribution of data; Differences in the analyzed parameters between two independent samples were tested with t-test - independent samples (t) and Mann-Whitney U Test (Z). The significance is determined with $p < 0.05$.

Results

The comparative analysis among the older group of males shows higher values in the 12-14 age group, with statistical significance for the parameters: AC2, PC1,

Table I. Comparison between male 6.0-8.0 years (1) & male 12.0-14.0 years (2)

Parameter	Mean 1	Mean 2	t-value	df	P	Valid N 1	Valid N 2
AC2	32.76667	34.07143	-2.40886	27	0.023096	15	14
PC1	87.90000	92.57143	-3.75853	27	0.000835	15	14
PC2	84.43333	85.07143	-0.38580	27	0.702671	15	14
CC1	33.53333	34.85714	-1.78161	27	0.086066	15	14
CC2	26.96667	27.64286	-0.85973	27	0.397506	15	14
MM1	48.36667	53.03571	-5.96064	27	0.000002	15	
MM2	44.63333	48.28571	-5.09202	27	0.000024	15	14
PD	15.20000	14.60714	0.86906	27	0.392477	15	14
PL	41.02000	38.00000	2.86014	27	0.008072	15	14
ML	31.72000	31.75000	-0.04186	27	0.966921	15	14

Table I.1. Comparison between male 6.0-8.0 years (1) & male 12.0-14.0 years (2)

Parameter	Rank Sum 1	Rank Sum 2	U	Z	p-level	Valid N 1	Valid N 2
AC1	166.5000	268.5000	46.50000	-2.55315	0.010676	15	14

Table II. Comparison between female 6.0-8.0 years (3) & female 12.0-14.0 years (4)

Parameter	Mean 3	Mean 4	t-value	df	P	Valid N 3	Valid N 4
AC2	31.86667	33.90909	-2.24874	24	0.033980	15	11
PC1	89.00000	90.72727	-3.22531	24	0.003612	15	11
PC2	80.93333	83.09091	-2.12278	24	0.044284	15	11
CC1	30.26667	33.18182	-4.51229	24	0.000144	15	11
CC2	23.23333	26.86364	-4.71010	24	0.000087	15	11
MM1	50.23333	52.22727	-2.26423	24	0.032876	15	11
MM2	43.10000	47.54545	-6.61297	24	0.000001	15	11
PD	1560000	13.27273	3.05684	24	0.005420	15	11

Table II.1. Comparison between female 6.0-8.0 years (3) & female 12.0-14.0 years (4)

Parameter	Rank Sum 6	Rank Sum 8	U	Z	p-level	Valid N 6	Valid N 8
AC1	185.5000	165.5000	65.50000	-0.882299	0.377616	15	11
PL	198.0000	153.0000	78.00000	-0.233550	0.815335	15	11
ML	204.0000	147.0000	81.00000	0.077850	0.937948	15	11

Table III. Comparison between male 6.0-8.0 yrs. (1) & female 6.0-8.0 yrs. (3)

Parameter	Mean 5	Mean 6	t-value	df	P	Valid N 1	Valid N 3
AC2	32.76667	31.86667	2.13932	28	0.041269	15	15
PC1	87.90000	89.00000	-1.73822	28	0.093160	15	15
PC2	84.43333	80.93333	4.82791	28	0.000044	15	15
CC1	33.53333	30.26667	6.40255	28	0.000001	15	15
CC2	26.96667	23.23333	8.64466	28	0.000000	15	15
MM1	48.36667	50.23333	-3.02120	28	0.005330	15	15
MM2	44.63333	43.10000	3.45618	28	0.001766	15	15
PD	15.20000	15.60000	-0.76443	28	0.451008	15	15
ML	31.72000	31.23333	1.52107	28	0.139456	15	15

Table III.1. Comparison between male 6.0-8.0 years (1) & female 6.0-8.0 years (3)

Parameter	Rank Sum 1	Rank Sum 3	U	Z	p-level	Valid N 1	Valid N 3
AC1	339.0000	126.0000	6.000000	4.417414	0.000010	15	15
PL	345.0000	120.0000	0.000000	4.666283	0.000003	15	15

Table IV. Comparison between male 12.0-14.0 yrs (2) & female 12.0-14.0 yrs (4)

Parameter	Mean 2	Mean 4	t-value	df	P	Valid N 2	Valid N 4
AC2	34.07143	33.90909	0.160007	23	0.874273	14	11
PC1	92.57143	90.72727	1.357139	23	0.187907	14	11
PC2	85.07143	83.09091	0.977310	23	0.338584	14	11
CC1	34.85714	33.18182	1.844751	23	0.077991	14	11
CC2	27.64286	26.86364	0.706680	23	0.486863	14	11
MM1	53.03571	52.22727	0.765760	23	0.451607	14	11
MM2	48.28571	47.54545	0.778557	23	0.444177	14	11
PD	14.60714	13.27273	1.439373	23	0.163517	14	11

Table IV.1. Comparison between male 12.0-14.0 yrs (2) & female 12.0-14.0 yrs (4)

Parameter	Rank Sum 2	Rank Sum 4	U	Z	p-level	Valid N 2	Valid N 4
AC1	231.5000	93.5000	27.50000	2.709872	0.006731	14	11
PL	206.0000	119.0000	53.00000	1.313877	0.188888	14	11
ML	185.0000	140.0000	74.00000	0.164235	0.869547	14	11

MM1, MM2 and PL. Similarly, the AC1 parameters shows significant differences for Z = -2.55 and p <0.05 (p = 0.01) (Table I.1)

Although female respondents aged 6.0 to 8.0 years have a higher palataldepth (PD) compared to the age group of 12.0-14.0 years, the difference for t = 3.06 and p <0.01 (p = 0.005) is significant (Table II). While the remaining parameters were higher with a statistical significance in the group of 12-14 years, the parameters AC1, PL and ML did not show any differences (Table II.1).

Table III and Table III.1 show the differences in the analyzed parameters between male and female respondents aged from 6.0 to 8.0 years.

Male subjects have higher average values with statistical significance for: AC2; PC2; CC1; CC2; MM1 and MM2 in relation to female respondents. While female respondents have higher average PC1 values compared to male respondents, the difference for t = -1.74 and p> 0.05 (p = 0.09) is not significant.

Also, male subjects have higher average values with statistical significance of the anterior arch curve of the maxilla (AC1), the difference Z = 4.42 ip <0.001 (p = 0.000), as well as for the palatinal length (PL), the difference for Z = 4.67 ip <0.001 (p = 0.000) is significant (Table III.1).

The comparative analysis between males and females aged 12-14 years is shown in Table IV. Male respondents, although having higher average values than female respondents, however, do not show any statistically significant differences.

While male subjects showed higher average values with statistical significance of anterior arch curve in the maxilla (AC1) compared to female respondents, the difference for Z = 2.71 ip <0.01 (p = 0.007) is significant (Table IV.1).

Discussion

During growth and development, the craniofacial system shows changes in the dimensions of individual bones and their relationship[11]. The neonatal face is characteristically small in relation to the cranium. However, the person undergoes postnatal progressive increase, and its various proportions noticeably change with age. All skeletal changes represent a response to the primary changes in the growth of the functional matrix.

Many attempts have been made to describe the ideal arch. It was done using deductive reasoning and measurable changes. Statistical analyzes were used to evaluate these changes and to describe the arch. Orthodontists are most aware of individual differences and variations in all people. It must be emphasized that a great deal of effort will be deducted from orthodontists if they formulate the plans and technique of treatment based on the average. It is not the intention to build the ideal arch as a clinical entity in its own right, but rather to have a tool for better development of arch structural problems. All orthodontic planning and constructions of the appliance must be individually tracked in order to ensure that the arch concept admirably helps the very appearance of the individual[19,20,12,22].

Many authors have described the changes in the dental arches during postnatal growth and development[23,24,25,10]. Our findings are mainly based on the findings of these authors. However, there are certain differences in terms of the time of greatest growth and development of dental arches in the width both in the maxillary and the mandible. The absolute values of the dental arch width are higher in this study than the examinations of Knott[26], Mills[27], Moyers[28], Ortega[29].

The mean values of the selected parameters in the examined groups were generally higher in boys than in girls, especially in the 12-14 year group, and we agree with the findings of[29,30]. The size and depth of the dental arches showed changes in comparison to 6-8 years, and 12-14 years in both groups. Our findings coincide with the findings of Silman[22], which showed that there are changes in the size and depth of dental arches from birth to 25 years. Also, Lavelle et al.[19] found that the biggest changes occur from 5-7 years and 11-13 years during the eruption of permanent teeth.

Dental eruption has a significant effect on the shape of the dental arches, the depth is determined directly by the growth of the alveolar bone and the size of the teeth[22,19,31]. Palatinal and maxillary length and mandibular posterior arch curve showed a decrease over the years.

The eruptive sequence of teeth, especially in the premolar region, according to Ash[24] is an important factor in reducing posterior arch parameters during mandible growth. However, the anterior and posterior arch curve also depends on the growth of the dental facial complex, and the degree of overbite and overjet expression. Appropriate maxillary and mandibular variables referring to inter-arch distances show a strong correlation between teeth eruption and the development of occlusion in relation to the development of oral motor functions.

The greatest increase in inter-canine distance occurs at the age of 12-15 in males and 9-11 years of age in female subjects. This difference is interpreted by the different times of peak puberty in male and female individuals. It is considered that the width of the dental arches is influenced by genetic and environmental factors, of which the most important is the genetic one. This examination confirms the findings of Sarhan[30], Gafni[32] and Bojaxiev[33].

Comparative analysis of male respondents between the two adult groups showed higher values in the group of 12-14 years, with statistical significance for the following parameters: AC2, PC1, MM1, MM2 PL and AC1 (Table I and II.1). Similarly, the comparative analysis in girls showed the existence of statistical significance for all examined parameters, that is, women respondents aged 12.0-14.0 years have higher average values (Table II). These findings agree with Bojaxiev[33] and ass. Argyropolus[23] i Goldstein[10]. Male respondents showed higher values in relation to girls with statistical significance for the following parameters: AC2, PC2, MM1, MM2 (Table III).Comparative analysis between male and female respondents aged 12.0-14.0 years does not show a statistical significance (Table IV), except for AC1 (Table IV.I).

Conclusion

The comparative analysis of dental arches, in relation to age (6-8 and 12-14 years), in both sexes shows higher values for individual examined parameters with statistical significance in the male group of 12-14 years.

Summing up all these results in the complete interaction of pre-emptive factors in relation to age and gender can support the fact that inheritance, external influence and individual growth are dominant in the creation of normal growth and the development of the orofacial system, that is, each individual needs to be analyzed separately, when orthodontists approach orthodontic treatment planning.

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