

PRACA ORYGINALNA
ORIGINAL ARTICLE

ORAL HEALTH ABNORMALITIES IN CHILDREN BORN WITH MACROSOMIA ESTABLISHED DURING MIXED DENTITION PERIOD

Olga V. Garmash

KHARKIV NATIONAL MEDICAL UNIVERSITY, KHARKIV, UKRAINE

ABSTRACT

Introduction: The prevalence of soft tissue and hard tooth tissue diseases in the oral cavity and the morphofunctional disorders of craniofacial complex, require attention of specialists in various branches of medicine. Scientists began to pay attention to metabolic and other violations that have occurred in the fetal development and led to the occurrence of certain changes in the dental status of the child.

The aim of this research is to study the features of the dental health condition in the children of Northeast of Ukraine, who were born with macrosomia during the period of mixed dentition. The study takes into account intrauterine body length growth acceleration, intrauterine obesity or well-balanced acceleration of both the body weight and length gain.

Materials and methods: Thirty 6.5–11-year-old children with fetal macrosomia were examined (Main Group). A Comparison Group was comprised of sixteen children, whose weight-height parameters at birth were normal (fetal normosomia). All children in the Main group were split into four subgroups in accordance with weight-height parameters at birth using the V. I. Grischenko and his co-authors' harmonious coefficient. The evaluation of the hygiene status of the oral cavity, the dental caries intensity evaluation, and the quantitative analysis of minor salivary gland secretion have been performed. The prevalence of dentoalveolar abnormalities was evaluated.

Results: The highest values of caries intensity were recorded in macrosomic-at-birth children born with harmonious (well-balanced) intrauterine development, with intrauterine obesity and increased body length, or with intrauterine obesity and an average body length. Macrosomic children have reduced number of minor salivary glands per unit area in comparison with the normosomic-at-birth children. The saliva secretion of minor salivary glands in macrosomic children is reliably, by 16,5% on average, reduced. Children born with fetal macrosomia have long narrow faces and high palates more frequently than normosomic-at-birth children. Children born macrosomic have a significantly higher percentage (100% versus 73%) of dentoalveolar abnormalities in comparison with the normosomic-at-birth children.

Conclusions: The processes causing fetal macrosomia have a great impact on the dental status of children in the period of mixed dentition.

KEY WORDS: fetal macrosomia; caries; minor salivary glands; malocclusion

Wiad Lek 2019, 72, 5 cz. I, 823-831

INTRODUCTION

The prevalence of soft tissue and hard tooth tissue diseases in the oral cavity and the morphofunctional disorders of craniofacial complex, require attention of specialists in various branches of medicine. Changes in the structure of hard and connective tooth tissue and impaired blood supply caused by metabolic disorders have been already investigated. The pernicious influence of obesity, diabetes mellitus, and metabolic syndrome on the hard tooth tissue and mucous membrane condition in the oral cavity have been described in several papers [1, 2, 3].

Nevertheless, only a few dentists pay attention to the birth weight of the baby, when parents are consulting the dentist to find out what is causing child's one or the other dental problem. That is, the dentist has information about the current state of health, and the data on the course of the fetal period, as a rule, are lost eventually and are not taken into account in analyzing the causes and characteristics of the current dental status of the child. Over the years, scientists began to pay attention to metabolic and other violations that have occurred in the fetal development and led to the occurrence of certain changes in the dental status of the child [4, 5].

One of the variations in intrauterine metabolic disorders is fetal macrosomia, or a large birth weight. The fetal macrosomia means that the birth weight of a full-term newborn is greater than or equal to 4,000 g [6]. In recent decades, researchers from different countries have found out high caries intensity in children and adolescents, which were born with fetal macrosomia [7, 8].

The investigations we have conducted in previous years have also revealed the presence of a large number of soft tissue abnormalities in the oral cavity, the features in the timing of desiduous teeth eruption, hypoplastic changes in minor salivary glands, the high intensity of desiduous teeth caries in pre-school age children which were born macrosomic, as compared to the children whose weight-height parameters at birth were normal [9].

THE AIM

The aim of this investigation is to study the features of the dental state condition of the children born macrosomic in the Northeast of Ukraine during the period of mixed dentition. The study takes into account an intrauterine accelerated increase in the body length; intrauterine obesity,

or a harmonious acceleration of body weight gain and an increase in body length.

The principal research objectives are to: assess the condition of minor salivary glands in children who were born macrosomic, and compare it with those in children born with normal weight-height parameters; estimate caries indices in macrosomic children and compare with those in children born with normal weight-height parameters; reveal a connection between morphometric parameters of the face and the relative height of the palate in macrosomic children; reveal the prevalence of dentoalveolar abnormalities in macrosomic children, and compare them with the prevalence of those in children born normosomic.

MATERIALS AND METHODS

The dental examination of children has been carried out at the the University Dental Center (Department of Therapeutic Dentistry of the KhNMU) and at the Polyclinic Department of the Institute of Children and Adolescents Health Care of the Academy of Medical Sciences of Ukraine. Thirty (19 boys and 11 girls) virtually healthy 6.5–11-year-old children with fetal macrosomia were examined, and they comprised the Main Group. A Comparison Group was comprised of 16 apparently healthy children (11 boys and 5 girls), whose weight-height parameters at birth were normal (fetal normosomia), and whose state of dental health was different.

The weight-height parameters at birth of the participants in the study (Table I), namely, the harmonious coefficient (Grishchenko et al., 1991 [10]), form the basis for dividing all macrosomic children into four subgroups. The birth somatometric data was retrieved from the medical records or the delivery records from maternity hospitals.

Subgroup I consisted of 10 children macrosomic-at-birth (7 boys and 3 girls) with harmonious intrauterine development.

Subgroup II included 7 children macrosomic-at-birth (5 boys and 2 girls) who were born with a long body length and a relatively decreased intrauterine body weight.

Subgroup III consisted of 7 overweight children macrosomic-at-birth (5 boys and 2 girls) born with a long body length. These children were classified by V. I. Gryschenko as the children with intrauterine acceleration based on obesity background.

Subgroup IV comprised of the 6 children macrosomic-at-birth (3 boys and 3 girls) who were born with average weight parameters in combination with intrauterine obesity.

Each child's parents gave written consent to the participation in the study.

The dental status was evaluated using the document "Child or Adolescent Dental Record Sheet" [11]. All participants' evaluation of the oral cavity hygienic state, was carried out using the Fedorov-Volodkina 1971-year index. The prevalence of caries was determined as a percentage fraction. The intensity of caries and the significant caries index (SiC Index) [12] was determined in all participants

in the study. The rate of release of an unstimulated oral fluid was determined by collecting the fluid into graduated tubes for 10 minutes in the morning. The rate of secretion was measured in ml/min. Quantitative determination of the secretion of minor salivary glands was carried out according to the method of Yakovleva V.I. [13]. The acidity was measured using the pH indicator strips over a 4.4–8.0 interval at a 0.2 step. The facial index of Izar from [14] was used to measure facial morphology. The shape and size of the dentitions, and the character of occlusal contacts for molars, incisors, and canines were evaluated in three planes during intra-oral examination and by using plaster diagnostic casts. The anomalies of teeth were evaluated. A quantitative analysis of plaster diagnostic casts was conducted by measuring palatal height in accordance with the recommendations and taking into account the reference points set out in the paper [15].

Since there is a hereditary predisposition to the occurrence of dentoalveolar anomalies, the study of genetic predisposition to dental anomalies from the father, or mother, or close relatives of each child was conducted applying a clinical and anamnestic method.

The evaluation of the mean values of the parameters under study was performed using the MS Excel 2016 program. The difference in the mean of small groups hypothesis was tested by means of nonparametric statistics (according to the Mann-Whitney criterium) using the Statistica 6.0 package. In estimating the number of cases, when observing certain features in the groups and subgroups at the significance level p of 0.05, the binomial distribution of the random variable [16] was assumed.

RESULTS AND DISCUSSION

EXTRA-ORAL EXAMINATION

The children in the Main Group in most cases (26 children or 87%) the face was revealed to be disproportionate. In 21 children with macrosomia (70%) a decrease in the lower third of the face coupled with a deep mentolabial fold was recorded, and an increase in that was observed in 5 cases (17%). In the Comparison Group, the decrease in the lower third of the face was detected in 4 children (25%), and an increase was observed in 1 case (6%). A convex profile was observed in 21 Main Group children (70%), and in 4 Comparison Group children (25%). The explanation for these cases may be the distal occlusion or underdevelopment of the mandible. The concaved profile was observed in 5 Main Group children (17%) and in 1 Comparison Group child (6%).

The analysis of the Izar index calculations has shown that the predominant number of children – 21 (70.0% CI (Confidence Interval): 54.1% - 82.7%) in the Main Group had a narrow face, 6 children (20.0% CI: 9.9% - 34.7%) had average faces, and 3 children (10.0% CI: 3.8% - 22.1%) had broad faces. Narrow faces was in 5 (31,3% ДИ: 15,2% - 52,4%) and average faces was in 11 (68,8% ДИ: 47,6% - 84,8%) Comparison Group children. The analysis of the

Table I. Average children weight, height, and weight-height index at birth in the children with both fetal macrosomia and normosomia

Groups and subgroups	Comparison	Subgroup I	Subgroup II	Subgroup III	Subgroup IV
Birth weight (kg)	3.52	4.26*	4.20*	4.41*	4.30*
Birth length (cm)	52.5	56.3*	58.14*	54.9*	52.5
Weight-height index (kg/m ³)	24.42	23.86	21.02*	26.73*	29.70*

* – The difference between macrosomic subgroups and normosomic (comparison) group is significant (within the 0.95 confidence interval).



Figure 1. The image of the frontal area of the oral cavity of eight-year-old girl C., born with macrosomia (Subgroup IV); the Class III lip-tie (Horoshilkina F.Ya.); Angle Class II malocclusion with deep bite, narrowing and lengthening of the upper dentition, true diastema; mouth breathing, glossoptosis



Figure 3. The image of the frontal area of the oral cavity of eight-year-old boy B., born with macrosomia (Subgroup IV); the Class IV of tongue-tie (ankyloglossia). (Horoshilkina F.Ya.); narrowing of the lower dentition with front teeth crowding



Figure 2. The image of the frontal area of the oral cavity of seven-year-old boy M., born with macrosomia (Subgroup II); the Class III lip-tie (Horoshilkina F.Ya.), true diastema

averaged Isar indices revealed that the children in the Subgroup II, on average, had a significantly narrower face than the children in the Comparison Group ($p = 0.03829$).

Describing functional disorders, it should be noted that 5 (16.7% CI: 7.7% - 30.7%) of the children born with fetal macrosomia due to ankyloglossia, had problems with the

pronunciation of sounds. A similar situation was observed in children of younger age who were also born macrosomic [9]. The children in the Comparison Group have not shown any violation in sound pronunciation.

INTRA-ORAL EXAMINATION

The depth of the oral cavity vestibulum in macrosomic children of Subgroup II and of Subgroup IV, in most cases, corresponded to the norm and was comparable to the values for the children of the Comparison Group. However, in children of Subgroup I and Subgroup III in this age period, the averaged values of vestibulum's depth were significantly lower than in the Comparison Group, ($p = 0.02139$) and ($p = 0.00843$) respectively.

Out of the Main Group, anomalous attachment of the upper lip-tie (Fig. 1, 2) had 12 children (40.0% CI: 25.5% - 56.1%), namely, 4 children in each Subgroup II, III, and IV. Anomalous attachment of the upper lip-tie had also 3 children (18.8% CI: 7.3% - 38.3%) of the Comparison Group. A large percentage of anomalous frenula of the upper lip is the cause of the upper dentition true diastemas, which were observed in 9 children (30.0% CI: 17.3% - 45.9%) in the Main Group and in 2 children (12.5% CI: 4.0% - 30.2%) in the Comparison Group. Ankyloglossia (Fig. 3) was detected in 12 children (40.3% CI: 25.5% - 56.1%) in the Main Group and in 3 children (18,8% CI: 7,3% - 38,3%) in



Figure 4. The images of the oral cavity of eleven-year-old boy R., born with macrosomia (Subgroup II); deciduous and permanent teeth caries; Angle Class II malocclusion with deep bite; upper dental arch shortening with palatal tilting of the maxillary incisor crowns

the Comparison Group. It is noteworthy that four (66.7% CI: 35.9% - 88.2%) out of six children in Subgroup IV had ankyloglossia.

The state of oral hygiene in macrosomic children, in most cases, was comparable to the values for the children of the Comparison Group.

In Main Group children, the prevalence of caries was high (Fig.4) and was equal to 87% (CI: 73.5% - 94.4%) compared to 69% (CI: 47,6% - 84,8%) in the Comparison Group.

The assessment of caries intensity index (DMF(T) + df(t)) of the participants in the study is presented in Table II. Table shows that the average values of the Caries Intensity Index were significantly higher for the macrosomic children with intrauterine obesity (Subgroup IV), as compared to the normosomic children. The indicators of caries intensity were also significantly higher than those in Comparison Group in children from Subgroups I and IV in the period of temporary occlusion [9]. Children with intrauterine obesity with acceleration in the background (Subgroup III) and with harmonious intrauterine development (Subgroup I) had high caries intensity rates, on an average, because the carious process of the first permanent molars takes effect during the period of mixed dentition, although the difference is not reliable in comparison with the normosomic at-birth-children. In the period of the deciduous dentition, the younger children in Subgroup III [9] had indices of caries intensity at a level of that in the Comparison Group.

The averaged rate of unstimulated oral fluid secretion (Table III) in the children of the Main Group were lower than the estimated values in the children of the Comparison Group. This difference is reliable for children from Subgroups III, and IV.

The data on the secretion of minor salivary glands are also presented in Table III. Consequently, children with macrosomia at birth, when they turn the age of 6.5-11, as well as children of the preschool age [9], have a reduced number of minor salivary glands per unit area. The average

amount of minor salivary gland secretion is also significantly lower for persons in the Subgroups I, III, and IV. The results presented in Table III are also supported by our previous experimental studies on animals, that were born macrosomic [17, 18]. This data proves that fetal macrosomia accompanied by morphofunctional changes in the parotid and minor salivary glands. The data we have obtained are important facts for explaining the mechanism of the appearance of high intensity, prevalence of caries and lesions of the oral mucosa among children whose parameters at birth were higher than normal [19].

The value of the pH indicator (Table III) for all children in the Main Group is on average lower than in the children in the Comparison Group. This difference is reliable for children from Subgroup II.

INTRA-ORAL EXAMINATION AND ANALYSIS OF PLASTER DIAGNOSTIC CASTS

Results of palatine depth measurement are presented in Table IV. The average indices indicating the height of the palate are the highest in macrosomic children compared with the normosomic ones. This statement is valid for children of the Subgroup III, and according to the data presented in paper [15], the palate in children of this Subgroup is classified as "high".

Thus, children aged 6.5 to 11 years, born with macrosomia, have narrow faces and high palate more frequently than normosomic-at-birth children. These changes are more pronounced in this age period in the Subgroups II and III, which can be taken into account in preventive examinations, planning and providing orthodontic treatment. A combination of a narrow face and a distal occlusion usually characterizes children born with fetal macrosomia.

When evaluating the relation of the upper and lower first permanent molars in the sagittal plane, we found out that 20(66.7% CI: 50.6% - 80.1%) children in the Main Group had Class II malocclusion (*Angle's* classification), namely:

Table II. The values of DMF(T) + df(t) and Significant Caries Index (SiC Index) in the children with both fetal macrosomia and normosomia at birth

Groups and Subgroups	Comparison	Subgroup I	Subgroup II	Subgroup III	Subgroup IV
DMF(T) +df (t)	2.7	5	3.0	6.0	6.8* (p=0,04347)
SiC Index	4,8	8,3	5,5	12,5	10

DMF (T) – decayed missing and filled permanent teeth;

df (t) – decayed and filled deciduous teeth.

* – The difference between macrosomic subgroups and normosomic (comparison) group is significant (within the 0.95 confidence interval).

Table III. Mathematical expectation of the minor salivary glands secretion rate, unstimulated oral fluid flow rate and the salivary pH value in the children with both fetal macrosomia and normosomia at birth

Groups and Subgroups	Comparison	Subgroup I	Subgroup II	Subgroup III	Subgroup IV
The number of minor salivary glands in the area of 3.5 cm ²	15.3	13.1* (p=0,00020)	13.9* (p=0,00260)	14* (p=0,02565)	13.5* (p=0,01145)
The amount of secret which is secreted by one minor salivary gland, g/min × 10 ⁻⁴	1.83	1.64* (p=0,04602)	1.74	1.36* (p=0,00075)	1.27* (p=0,00932)
Unstimulated salivary secretion rate ml/min	0.32	0.30	0.29	0.25* (p=0,01161)	0.20* (p=0,00050)
Value of the hydrogen index (Ph)	6.8	6.6	6.5* (p=0,00294)	6.4	6.6

* – The difference between macrosomic subgroups and normosomic (comparison) group is significant (within the 0.95 confidence interval).

Table IV. Absolute and relative values of assessment of the depth of the hard palate in the children with both fetal macrosomia and normosomia at birth

Groups and Subgroups	Comparison	Subgroup I	Subgroup II	Subgroup III	Subgroup IV
Palatine height (h), mm	10.2	11.7 (p=0,03246)	12.0 (p=0,02384)	12.8* (p=0,01274)	12.0
Palatine width (l), mm	32.6	34.3	34.3	32.1	35.75
h/l relative units	0.31	0.34	0.36	0.40* (p=0,00901)	0.34

* – The difference between macrosomic subgroups and normosomic (comparison) group is significant (within the 0.95 confidence interval).

5 children (50%) in the Subgroup I, 4 children (57%) in the Subgroup II, 6 children (86%) in the Subgroup III, and 5 children (83%) in the Subgroup IV. This condition was recorded in 4 children (25.0% CI: 11.0% - 45.6%) of the Comparison Group. The relation of molars corresponding to Angle Class III malocclusion had 4 children (25.0% CI: 11.0% - 45.6%) of the Main Group: 3 children (30%) in the Subgroup I and 1 child (14%) in the Subgroup II; and 1 child (7.1% CI: 1.8% - 23.2%) in the Comparison Group.

The Angle class II canine relation was detected in 20 children (66.7% CI: 50.6% - 80.1%) of the Main Group and in 4 children (25.0% CI: 11.0% - 45.6%) of the Comparison Group. The Main Group examination revealed this disorder in 5 children (50%) of the Subgroup I, 5 children (71%) of the Subgroup II, 6 children (86%) of the Subgroup III, and 4 children (67%) of the Subgroup IV. The canine relation corresponding to class III malocclusion was detected in 4 children (13.3% CI: 5.6% - 26.5%) of the Main Group: 3 children (30%) in the Subgroup I and 1 child (14%) in the Subgroup II. This dental anomaly was detected in 1 child (6.3% CI: 1.6% - 20.6%) in the Comparison Group. Clinical

cases, when relation of molars corresponds to Class II malocclusion and relation of canines corresponds to Class I, can be explained by medial shift of canines in combination with the lower frontal teeth crowding.

In assessing the relation of incisors in the sagittal plane, we have observed that 8 children (26.7% CI: 14.7% - 42.3%) of the Main Group had a correct incisors relationship, namely: 3 children in the Subgroup I, 2 children in the Subgroup II, 1 child in the Subgroup III, and 2 children in the Subgroup IV. Three children in the Subgroup I and 1 child in the Subgroup IV had an edge-to-edge contact. Fifteen children (50.0% CI: 34.3% - 65.7%) of the Main Group were noted to have positive overjet (distance more than 2.5 mm), namely: 3 children in the Subgroup I, 3 children in the Subgroup II, 6 children in the Subgroup III and 3 children in the Subgroup IV. The reverse overjet (lower incisor edge occluding anterior to the upper incisors) was recorded in 2 children in the Subgroup II. In the Comparison Group, positive overjet was observed in 4 children (25.0% CI: 11.0% - 45.6%), the reverse overjet was recorded in 1 child (6.3% CI: 1.6% - 20.6%). The palatal



Figure 5. The images of the frontal area of the oral cavity of eight-year-old boy S., born with macrosomia (Subgroup I); Angle Class II malocclusion with deep bite; narrowing and lengthening of the upper and lower dentitions, a tortoanomaly of the tooth 31 (counter-clockwise) and tooth 41 (clockwise), hypoplasia of upper central incisors; shallow vestibulum, chronic catarrhal gingivitis, mouth breathing, glossoptosis



Figure 6. The image of the frontal area of the oral cavity of seven-year-old girl G., born with macrosomia (Subgroup III); Lingual-buccal crossbite with displacement of the lower jaw to the left, narrowing of the upper and lower dentitions, glossoptosis, infantile swallowing



Figure 7. The image of the frontal area of the oral cavity of seven-year-old boy V., born with macrosomia (Subgroup III); localized macrodontia

tilting of the incisors' crowns (Fig 4), which was observed in many participants of the study, may occur as a result of the mouth breathing, high palate and highly hypertonic upper lip muscles [20].

When evaluating the occlusion in vertical plane in the molar region, it was noticed there was a tight occlusal contact, (except the teeth that are in the eruptive stage), in most participants of the study. Two children (6.7% CI: 2.1% - 17.2%) of the Main Group (one child in the Subgroups I and III) had a posterior unilateral open bite. This anomaly was not detected in the Comparison Group.

Examining the occlusion in vertical plane in the canine region, we have observed that upper canine cusps were above the contact points of lower teeth in 16 children

(53.3% CI: 37.4% - 68.7%) of the Main Group: 6 children (60%) in the Subgroup I, 3 children (43%) in the Subgroup II, 4 children (57%) in the Subgroup III, and 3 (50%) in the Subgroup IV. Moreover, we noticed that upper canine cusp was above the contact point in 3 children (18.8% CI: 7.3% - 38.3%) of the Comparison Group. This fact can be explained by the delayed eruption of canines in comparison with the standard time of incisors eruption.

Evaluating the occlusion in vertical plane in the incisor region, we noticed that only 8 children (26.7% CI: 14.7% - 42.3%) out of the Main Group, had upper central incisors covered 1/3 - 1/4 of the anterior surface of the lower central incisors (norm). The norm was observed in 2 children (20%) of the Subgroup I, 3 children (43%) of the Subgroup II, 2 children (29%) of the Subgroup III, and 1 child (17%) of the Subgroup IV. In the Comparison Group the norm was found in 11 children (68.8% CI: 47.6% - 84.8%). Six children (20.0% CI: 9.9% - 34.7%) of the Main Group

had an anterior open bite malocclusion (1 to 3 mm), 1 child of the Main Group had no incisors. Fifteen children (50.0% CI: 34.3% - 65.7%) of the Main Group had a deep bite malocclusion (mild, moderate or severe) (Fig. 1, 4, 5). This anomaly was detected in 4 children (25.0% CI: 11.0% - 45.6%) of the Comparison Group. As a result of a deep bite malocclusion emergence of caries, periodontitis, joints problems, chewing and swallowing difficulties may develop later in life. If the treatment of these abnormalities occurs during the body growth period, the prognosis for a disease will be favorable [20]. Whereas cases of deep bite malocclusion were prevalent in macrosomic children born at the age of 3-6.5 years, we can assume a "tendency" to underdevelopment of the mandible in macrosomic children. This is confirmed by the mandibular anterior teeth crowding (Fig. 3).

Evaluating the occlusion in transverse plane in the molar region, we have observed the posterior cross bite malocclusion in 7 children (23.3% CI: 12.3% - 38.6%) of the Main Group and only in 1 child (6.3% CI: 1.6% - 20.6%) of the Comparison Group. A partial cross-bite without displacement of the mandible was detected in 3 children (30%) of the Subgroup I, 1 child (14%) of the Subgroup II, and in 2 children (33%) of the Subgroup IV. There was 1 child in the Subgroup III (Fig. 6) with a buccal-lingual cross-bite malocclusion with the lower jaw displacement.

The upper and lower canines' relation was found to be the most uniform (stable) dimension in the studied parameters. Evaluating the occlusion in transverse plane in the canine region, we have found normal relation between upper canines and mandibular teeth in 24 children (80.0% CI: 65.3% - 90.1%) of the Main Group and 15 children (93.8% CI: 79.4% - 98.4%) of the Comparison Group. One child (10%) of the Subgroup I, 4 children (57%) of the Subgroup II and 1 child (17%) of the Subgroup IV had palatal positioning of the maxillary canines relative to the mandibular corresponding teeth. The same positioning occurred in 1 child (6%) of the Comparison Group.

While evaluating the occlusion in transverse plane in the incisor region, we detected the shifted midline in 10 children (33.3% CI: 19.9% - 49.4%) of the Main Group: 3 children (30%) in the Subgroup I, 4 children (57%) in the Subgroup III, 3 children (50%) in the Subgroup IV, and we detected the shifted midline in 3 children (18.8% CI: 7.3% - 38.3%) of the Comparison Group. The high rate of this anomaly in macrosomic children of Subgroups III and IV can be explained by the adaptation of the mandible position to the changed form of the upper dentition, as well as interruption in sequence and timing of permanent teeth eruption.

The analysis of the mandibular dentition (frontal area) state in the sagittal plane revealed that 18 children (60.0% CI: 43.9% - 74.5%) had the shortening of dental arch, and 5 children (16.7% CI: 7.7% - 30.7%) of the Main Group had an extended dental arch length. The mandibular dentition shortening was found in 4 children (25.0% CI: 11.0% - 45.6%) of the Comparison Group. We analyzed the state of the maxillary dentition (frontal area) in the

sagittal plane and revealed the shortening of the dentition in 7 children (23.3% CI: 12.3% - 38.6%) of the Main Group and in 7 children (43.8% CI: 24.7% - 64.6%) of the Comparison Group. An extended dental arch length was observed in 18 children (60.0% CI: 43.9% - 74.5%) of the Main Group and in 2 children (12.5% CI: 4.0% - 30.2%) of the Comparison Group.

Since we observed a large percentage of the mandibular dentition shortening in the sagittal plane in macrosomic children aged 4.5-6.5 years [9], we can suggest several reasons for that. In our opinion, one of the causes of underdevelopment of the frontal area of the mandible, along with ankyloglossia or incorrect myofunctional habits, is a traumatic damage of the lower jaw (for example, injury in the zones of mandible growth during intrauterine compression) during pathological pregnancy or the delivery of a child with a large body weight.

The shortening of mandibular dentition (lateral area) in the sagittal plane was found in 7 children (23.3% CI: 12.3% - 38.6%) of the Main Group and in 3 children (18.8% CI: 7.3% - 38.3%) of the Comparison Group. The shortening of the dentition of the upper jaw in the sagittal plane was found in 8 children (26.7% CI: 14.7% - 42.3%) of the Main Group and in 3 children (18.8% CI: 7.3% - 38.3%) of the Comparison Group. An extended dental arch length of mandibular dentition was found in 2 children (7.1% CI: 2.3% - 18.3%) of the Main Group and in 1 child (6.3% CI: 1.6% - 20.6%) of the Comparison Group. An extended dental arch length of maxillary dentition was found in 1 child (3.3% CI: 0.8% - 11.6%) of the Main Group and in the children of the Comparison Groups it was not detected. It should be noted that this parameter was in most cases standard for children aged 4.5-6.5 years. In our opinion, the most probable reason for the dentition shortening during the period of mixed occlusion is a high prevalence of untreated deciduous teeth caries in children of the Main Group [9] with its typical localization on the approximal surfaces of teeth (Fig. 4).

When assessing the state of dentition in the vertical plane, we have found anomalies in 28 children (93.3% CI: 82.8% - 97.9%) of the Main Group and 4 children (28.6% CI: 12.8% - 50.8%) of the Comparison Group. Twenty-two children (73.3% CI: 57.7% - 85.3%) of the Main Group had dentoalveolar elongation of the frontal mandibular segment and dentoalveolar elongation of the frontal maxillary segment in 4 cases (13.3% CI: 5.6% - 26.5%). Dentoalveolar elongation of the frontal maxillary segment was recorded in 2 children (12.5% CI: 4.0% - 30.2%) and dentoalveolar elongation of the frontal mandibular segment was recorded in 1 child (6.3% CI: 1.6% - 20.6%) of the Comparison Group. At the same time, 18 children (60.0% CI: 43.9% - 74.5%) of the Main Group and 3 children (18.8% CI: 7.3% - 38.3%) of the Comparison Group had dentoalveolar shortening of the frontal maxillary segment. Taking into consideration that during both temporary [9] and mixed occlusion periods we have observed prevalence of changes in the vertical dimensions of the frontal area dentitions in the Main Group children in correlation to

Comparison Group children, we came to conclusion that fetal macrosomia associated with of these abnormalities.

The analysis of the mandibular dentition (lateral area) in the transversal plane revealed that 17 children (56.7% CI: 40.6% - 71.7%) of the Main Group and 4 children (25.0% CI: 11.0% - 45.6%) of the Comparison Group had the mandibular narrowing. Maxillary dentition (or lateral area) in the transversal plane was narrowed in 7 children (23.3% CI: 12.3% - 38.6%) of the Main Group. This abnormality was detected in 1 child (6.3% CI: 1.6% - 20.6%) of the Comparison Group.

The analysis of the frontal area mandibular dentition in the transversal plane showed that 3 children (10.0% CI: 3.8% - 22.1%) of the Main Group had the displacement of the lower dental midline in relation to the tongue frenum. In the Comparison Group, this anomaly was detected in 1 child (6.3% CI: 1.6% - 20.6%). The upper dental midline coincided with the middle palatine suture in all participants of the study.

The developmental disturbances in teeth structure were represented by hypoplastically altered enamel of permanent and deciduous teeth, which were seen in 8 children (26.7% CI: 14.7% - 42.3%) of the Main Group and 3 children (25% CI: 9.9% - 48.4%) of the Comparison Group.

Among the developmental disturbances in teeth size, there was a predominated relative generalized microdontia, which was observed in 3 children (10.0% CI: 3.8% - 22.1%) of the Main Group. Macrodonia of single tooth was revealed in 1 child (3.3% CI: 0.8% - 11.6%) of the Main Group (Fig. 7). In the Comparison Group one child (6.3% CI: 1.6% - 20.6%) had had supernumerary permanent tooth (mesiodent) and one child (6.3% CI: 1.6% - 20.6%) had supernumerary deciduous tooth.

There were different levels of pathological conditions among the dentoalveolar abnormalities. They are as follows: occlusion abnormalities, anomalies of the dentition shape and size, and teeth disturbances. The named anomalies do not occur apart from one another. Therefore, the description of the teeth position is not feasible, but the mandibular anterior teeth in 3 children (10.0% CI: 3.8% - 22.1%) of the Main Group were rotated in the longitudinal axis (Fig. 5). This fact deserves attention, because these children did not have ankyloglossia (tongue thrust) and crowded mandibular anterior teeth. The inadvertent abnormality may develop as a result of some local factors, and may also indicate the abnormality of the lower jaw frontal segment.

It is important to notice that in 11 (36,7% CI: 22,7% - 52,8%) of the Main Group children, the eruption of lower jaw central incisors occurred prior to the lower first permanent molars eruption. Interruption in sequence and timing of permanent teeth eruption is another sign confirming the underdevelopment of the mandible. There were no abnormalities of this kind found in the Comparison Group.

Along with intrauterine abnormalities [22], the role of hereditary occurrence of dentoalveolar deviations [23] is well known. Analyzing the obtained results, it should be noted that our study gives a comparison of genetic predisposition to dentoalveolar abnormalities occurrence in

the Main and Comparison Groups. Consequently, a large number of malocclusions 100% (CI: 88.4% - 100%) in the Macrosomic Group versus to the the Comparison Group 73% (CI: 51.9% - 88.2%) is due to some other factors associated with the fetal macrosomia.

We presume that children and adolescents born macrosomic have reduced mineral bone tissue density compared to normosomic-at-birth children. Our assumptions are confirmed by Littner and his co-authors' research results arguing that bone mineral density can be reduced in macrosomic newborns compared to normosomic ones, explaining this by a decreased intrauterine mobility of very large children [24]. The Schushan-Eisen I. et al. study [25] also confirmed significantly reduced bone mineral density in newborns with fetal macrosomia born from non-diabetic mothers. The authors prove that the bone tissue mineral density is reduced with every 100 g of the body weight of a newborn child, and the hypothesis of "reduced mobility" is also confirmed in the fetal macrosomia cases.

CONCLUSIONS

1. Caries intensity indices vary in the macrosomic-at-birth participants of our study in the period of mixed dentition, depending on the weight-height parameters of these children at birth. The high values of these indices were recorded in children born with harmonious (well-balanced) intrauterine development, with intrauterine obesity and acceleration or with intrauterine obesity and an average body length.
2. Macrosomic children have, on average, reduced number of minor salivary glands by 1-2 units in area of 3,5 cm², in comparison with the normosomic-at-birth children. The saliva secretion of minor salivary glands in macrosomic children is reliably ($p < 0.05$), by an average of 16,5%, reduced in comparison to the normosomic children.
3. Children aged 6.5-11 years and born with fetal macrosomia, have long narrow faces and high palate more frequently than normosomic-at-birth children. In the period of mixed dentition, these changes are more pronounced in macrosomic-at-birth children with long body length and a relatively decreased intrauterine body weight, and in overweight children born with a long body length. These features can be taken into account in preventive examinations, planning and conducting of orthodontic treatment.
4. Children born macrosomic have a significantly higher percentage of dentoalveolar abnormalities in the mixed dentition period in comparison with the normosomic-at-birth children (100% versus 73%).

Thus, the obtained results proved that the processes causing fetal macrosomia have a great impact on the dental status of children in the period of mixed dentition.

REFERENCES

1. Hayden C, Bowler JO, Chambers S, Freeman R et al. Obesity and dental caries in children: a systematic review and meta-analysis. *Community Dent Oral Epidemiol.* 2013; 41(4):289–308. doi: 10.1111/cdoe.12014.

2. Osawa H, Sugihara N, Ukiya T et al. Metabolic Syndrome, Lifestyle, and Dental Caries in Japanese School Children. *Bull Tokyo Dent Coll*. 2015;56(4):233–41. doi: 10.2209/tdcpublication.56.233.
3. Novotna M, Podzimek S, Broukal Z et al. Periodontal Diseases and Dental Caries in Children with Type 1 Diabetes Mellitus Mediators Inflamm. 2015; (51):379626. doi: [10.1155/2015/379626]
4. Drogomiretskaya MS, Ahmad Saleh Khalyaf Salama. Morfolohichni ta morfometrychni doslidzhennia tkanyn zubo-shchelepnoho aparatu u ditei z porushenym perebihom antenatalnoho periodu [The morphological and morphometric study of tissues of dentoalveolar system in children with impaired course of the antenatal period]. *Klinichna medytsyna* 2016;16 (XXI/1): 96–103. (UA).
5. Garmash OV, Ryabokon EN. The Effect of Fetal Macrosomia on the Neonate and Infant Dental Health *International Journal of Clinical Dentistry*. 2017; 10 (3): 200–210.
6. Morikawa M, Cho K, Yamada T et al. Fetal macrosomia in Japanese women. *J Obstet Gynaecol Res*. 2013;39(5):960–5. doi: 10.1111/j.1447-0756.2012.02059.x.
7. Yokomichi H, Tanaka T, Suzuki K et al. Macrosomic neonates carry increased risk of dental caries in early childhood: findings from a cohort study, the Okinawa child health study. *Japan. PLoS One*. 2015; 10(7), doi: 10.1371/journal.pone.0133872.
8. Julihn A, Molund U, Drevsäter E et al. High birth weight is a risk factor of dental caries increment during adolescence in Sweden. *Dent J*. 2014; 2(3): 118–33.
9. Garmash OV. Features of the dental state of children with fetal macrosomia in the period of the temporary dentition. *Visnyk problem biolohii i medytsyny*. 2018; 4 (1/146): 246–253. (UA).
10. Grischenko VI. Krupnyy plod (kliniko-morfologicheskoe issledovanie) [Large fetus (clinical and morphological study)]. In: VI. Grischenko, AF Yakovtsova. *Kiev: Zdorovya*;1991, p 183. (Ru).
11. Garmash OV, Ryabokon EN, Bahlyk TV. Karta reiestratsii stomatolohichnoho statusu dytyny abo pidlitka (dodatok do karty rozvytku novonarodzhenooho, istorii rozvytku dytyny abo medychnoi karty statsionarnooho khvoroho)[Child or Adolescent Dental Record Sheet][Cvidotstvo pro reiestratsiiu avtorskoho prava na tvir №73141 vid 25. 07. 17. (UA).
12. Bratthall D. Introducing the Significant Caries Index together with a proposal for a new oral health goal for 12-year-olds, *Int Dent J* 2000; 50: 378–384.
13. Iakovleva VY. Sposob kolychestvennoho opredeleniya sekreta melkykh sliynykh zhelez [Method for quantitative determination of secretion of minor salivary glands] *Zdravookhraneye Belorussyy*. 1980; 12: 57. (Ru).
14. Obratsov YuL, Laryonov SN. Propedevtycheskaia ortodontyia: uchebnoe posobyie [Propedeutic Orthodontics: Tutorial] SPb.: SpetsLyt, 2007:160. (Ru).
15. Mulazzani MC, Toniolo da Silva AM, Busanello-Stella A et al. Evaluation of hard palate depth: correlation between quantitative and qualitative method. *Rev. CEFAC*. 2013 Set-Out; 15(5):1292–1299.
16. Gerasimov AN. *Medical statistics*. Moscow: Medical News Agency; 2007: 480.
17. Garmash O, Gubina-Vakulik G, Vondrášek D. Three dimensional image analysis of minor salivary glands in 180-day rats born with macrosomia *Med J (Krag)* 2018; 52(1): 7–14.
18. Garmash OV., Gubina-Vakulyk GI. Morphofunctional status of parotid salivary glands in three-month-old rats with experimentally induced fetal macrosomia. *Pathologia* 2018; 15 (1): 81–87.
19. Yakovtsova AF, Sorokina IV, Aleshchenko IE. Imunnaya sistema ploda cheloveka pri krupnoplodii i ZVRP [Immune system of the human fetus in large and IUGR fetuses]. *Kharkov: BSF "Antiqua"*; 2004, p 218. (Ru).
20. Bahija B, K Sundeep H, Sham SB, et al. Influence of Mouth Breathing on the Dentofacial Growth of Children: A Cephalometric Study. *J Int Oral Health*. 2014; 6(6): 50–55.
21. Daokar S, Agrawal G. Deep Bite Its Etiology, Diagnosis and Management: A Review. *J Orthod Endod*. 2016; 2:4.
22. Joshi N, Hamdan AM., Fakhouri WD. Skeletal Malocclusion: A Developmental Disorder With a Life-Long Morbidity *J Clin Med Res*. 2014; 6(6): 399–408. doi: 10.14740/jocmr1905w.
23. Patel Z, Ifzah, Sheikh Habibullah. Genetics in orthodontics- a review. *EJPMR*, 2016;3(7): 539–545.
24. Littner Y, Mandel D, Mimouni FB et al. Decreased bone ultrasound velocity in large-for-gestational-age infants. *J Perinatol*. 2004;24(1):21–3.
25. Schushan-Eisen I, Cohen M, Leibovitch L et al. Bone Density Among Infants of Gestational Diabetic Mothers and Macrosomic Neonates *Maternal and Child Health Journal*. 2015; 19 (3): 578–582.

The study is a fragment of the research project "Character, structure and treatment of main dental diseases", state registration No. 0116U004975.

Authors' contributions:

According to the order of the Authorship.

Conflict of interest:

The Authors declare no conflict of interest.

CORRESPONDING AUTHOR

Olga Garmash

Apt 51, Heroiv Pratsi St., 4-V

61168 Kharkiv, Ukraine

tel: +38 066 6949665

e-mail: o.v.garmash@gmail.com

Received: 13.03.2019

Accepted: 26.04.2019