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Cranial deformities as a risk factor in the harmonious development of oral and maxillofacial region

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Abstract

Background: There is no information about cranio-facial asymmetry among school children and the influence of this pathology on the quality of life.
Material and methods: The study presents a descriptive analysis of 3923 children ages 7 to 18 years. In this scientific work were involved three types of schools: 421 children from schools with severe neurological disorders; 2157 children from auxiliary schools with special educational needs; and 1345 children from pre-university schools. Buccal examination included the dento-maxillary analysis in three planes (sagittal, vertical, and horizontal) and cranial anatomical shape was examined for all children.
Results: In total 3923 children were examined, of which 632 (16%) were determined with cranial asymmetry. Among 2157 children from auxiliary schools for children with special educational needs 18% were detected with cranial deformities. In schools for children with neurological disabilities cranial asymmetries were detected in 44.18%, and in pre-unuversity schools 4.76 % were found with cranial deformities. A high incidence (twice more) of dental alveolar anomalies were found in children with cranial deformities, compared to those without deformities in the sagittal plane, 15.5% of children with cranial deformities were found with dento-alveolars anomalies and 7.84% in children without cranial deformation was (P<0.001). Similar results were found in the determination of occlusion anomalies in the horizontal and vertical planes.
Conclusions: The high incidence of cranial deformities was found among handicapped children and children from schools with special educational needs. A few children with cranial deformities were found among children from pre-university schools. It was proved that a high risk of dento-alveolar anomalies have children with cranial deformities.

Key words: cranial deformities, malocclussion, plagiocephaly, craniosynostosis, handicapped children.

Introduction

The first information about the anatomy, morphometry, the classification of the cranium deformities appears in the works of Herodotus and Halicarnassis, Chios, Hipposcratus. Since ancient times is known about the tendency to model skull shape with a view to improve the intelligence of personality. From other sources we learned that the trepanation of the skull was known in prehistoric times and was performed in medical and mystic purposes [3,4,5,14]. Cranial deformities problem is actual today and became particularly acute with the launch of the campaign "Back to Sleep" by US pediatricians association. If in 1974 it was reported an incidence of positional plagiocephalies of 1 from 300 live births, so in 1996 their incidence increased from 1 to 60 neonates [9,10]. The incidence of craniostenoses is reported constant: 1: 1000 newborns. Bruneteau and Mulliken, WojciechDec suggest an incidence of cranial deformities approximately 48% of all live newborns depending on the examination criteria [7, 11].

Significant and rapid increase in the incidence of cranial deformations generated new problems related to child development. Many authors show that children with cranial deformities have increased risk for development of pathological manifestations of neurodevelopment, risk for cognitive deficits or learning/language disabilities, otolaringological and ophthalmological problems, even cosmetic etc. [13,14,15,20]. Dane St. John and al. have shown in their study the connection between skull shape and position of the mandible. This study supports the clinical observation that the mandibular asymmetry in deformational posterior plagiocephaly is secondary to rotation of the cranial base and anterior displacement of the temporomandibular and not the result of primary mandibular deformity [19].

However, the vast majority of studies are carried out in child's early development period and there is almost no remote information on development of cranial deformities and changes made by this pathology. Sybill Dee Stock Naidoo, in their study shows that information is very poor and can not explain cranial deformities role in the development of a child during the school period [8]. Approximately all studies regarding the incidence, neurological development, otolaringological development, ophtalmological development etc. of children with cranial deformities found have not taken into account the socioeconomic position of patients [21, 24].

Trying to create a treatment plan for cranial deformities has generated very controversial opinions. While some authors consider the superiority of treatment by using the methods of orthopedic or surgical remodeling of the skull, others plead for self-remodeling of the skull or considered the skull deformity a minor cosmetic problem. In this area there are different opinions, which are probably caused by the lack of long-term studies [18,16,12,15,8,22,23].

Currently there is limited published data on the long-term observation of children with cranial deformities. The studies that are in the literature have been conducted with small numbers of participants and include patients in early stage of life. Health care providers have little evidence-based research to guide parents in treatment decision making for cranial deformities. There is a need to examine the differences in long term symmetry of the skull among school children who have cranial anomalies vs. whom have not that remains scarce and ill-defined.

Proceeding from the above, in this study we aimed to assess the frequency of cranial deformities in children of school age in the Republic of Moldova and make the analysis of dento-maxillary status of children with and without cranial deformities.

Material and methods

The study was made at the Department of oral and maxillofacial surgery of the Faculty of Dentistry of Nicolae Testemitanu State University of Medicine and Pharmacy of the Republic of Moldova, in the period 2012 - 2014. The study was included in the State Program with the title: the Oral Health of children in the Republic of Moldova. The aim of the study was to determine the presence of oral diseases, quality of child's life and factors that may influence the presence of oral diseases. The study involved specialists in pedodontics, orthodontics, neurosurgeon, pediatric neurologist, maxillafacial surgeon, together with the team of plastic surgeons from Wake Forest University, Weanstom Salem, USA. Examination of children was performed under the information agreement accepted by the department of bioethics of Nicolae Testemitanu State University of Medicine and Pharmacy. The study presents a descriptive analysis of 3923 children ages 7 to 18 years. In this scientific work were involved three types of schools: schools for children with severe neurological disorders; auxiliary schools for children with special educational needs; and children from pre-university schools. In the first group 421 children with disorders were examined: 50.9% girls, 49.1% boys. Children examined had mental retardation (F70-F79), cerebral palsy (G80 - G83), episodic and paroxysmal disorders (G40 - G47), sequelae of inflammatory diseases of the central nervous system (G09) neurotic disorders, stress and somatoform (F40 - F48), congenital malformations, deformations and chromosomal abnormalities (Q00-Q99), other diseases of the nervous system (G90 - G99).

In the second group 2157 children were examined, 63.2% boys, 36.8% girls. In this group we have included children from auxiliary schools for children with special educational needs. In the third group of study 1345 children were examined: 48.9% boys, 51.1% girls. In this category healthy children from pre-university schools were included. All children were examined in medical units of their schools. All staff of schools was present at the examining. Clinical examination was performed in accordance with the questionnaire prepared beforehand and confirmed by the department of bioethics of Nicolae Testemitsanu State University of Medicine and Pharmacy of the Republic of Moldova. This questionnaire included general questions (age, gender, locality, examined school category) as well as special (buccal examinaton and exrtabucal examination: head and neck region).

Buccal examination included the dento-maxillary analysis in three planes (sagittal, vertical, horizontal). In the sagittal plane protrusion changes of the maxilla and mandible were found, in the vertical plane: open or deep bite changes, and horizontally: the presence of unilateral and bilateral laterognathia. Examination standards were used for the diagnosis of malocclusions. The term normal occlusion includes minimal deviations from ideal parts that do not generate aesthetic and functional changes. To determine the maxilla and mandible relation, children were examined in well lit classes. The tools used for the examination of the oral cavity were wooden spatula of single-use and sterile gloves. Each patient was examined in two positions: with wide open mouth and teeth in central occlusion in a sitting position or in bed. School doctor, nurse and teachers participated in examinations. Data were recorded in questionnaires prepared beforehand. Extrabuccal clinical examination included determination of cranial form by inspection and palpation as simple, modest, direct and accessible methods. In this study all forms of cranial deformities, classified as plagiocephalies and craniostenoses were taken into account. Plagiocephalies were determined by ear flags asymmetry, unilateral bulging in front or occipital part, or both, narrow skull in vertical, horizontal or sagittal plane, according to the Argenda classification [1]. When examining some forms of cranial deformities, it was difficult to determine the position of plagiocephaly or craniostenosis, that is why they have been categorized in the intermediate group, called "other forms of deformities". When during clinical inspection children were determined with cranial deformities, a wig cap was placed on each participant, in order to confirm the presence of deformity [1,2].

The results were analyzed using Epi-info-2002 and Excel from the package Microsoft office. The data were interpreted as M ± m (average error) by means of the criterion t-Student. All statistical methods were obtained from the Statistics for Windows, version 6. The difference was regarded as conclusive when $p<0.05$ [31].

Results

In total 3923 children were examined, of which 632 (16%) were determined with cranial asymmetry. 12.4% of these children were found with cranial deformities of plagiocephaly type, 1% – with craniostenoses and 2.7% with other deformities. Out of 2157 children from auxiliary schools for children with special educational needs 18% were detected with cranial deformities. In schools for children with neurological disabilities cranial asymmetries were detected in 44.18% of 421examined children and in pre-university schools from 1345 children 4.76% were found with cranial deformities ($P<0.001$).

In total 3923 children were examined. 2157 of these children were from auxiliary schools for children with special educational needs, 421 from school for children with neurological disabilities, 1345 children were from pre-university schools. 632 (16%) of 3923 examined children were detected with cranial deformities. As a result of this study, it was found that the rate of cranial deformities is directly proportional to the nature of the examined school. We found statistically true that in schools for children with neurological disabilities 44.18% cases were found with cranial deformations, in schools for children with special educational needs – 17.71%, while in pre-university schools – 4% ($P<0.001$).

Table 1

Cranial deformities in children

Type of examined school	Auxiliary schools	Schools for children with neurological disabilities	Pre-university schools	Total, n	Total %	
Children without cranial deformities	1775 82.29%	235 55.82%	1281 95.24%	3291	83.89	
Children with cranial deformities of craniostenosis type	25 1.16%	8 1.90%	7 0.52%	40	1.02	
Children with cranial deformities of plagiocephaly type	330 15.30%	|99 23.52%	56 4.16%	485	12.36	X^2 647.225 P<0.0001
Other deformities	27 1.25%	79 18.76%	1 0.07%	107	2.73	
Total n	2157	421	1345	3923		
Total %	54.98	10.73	34.28		100.00	

Cranial deformities of plagiocephaly type were found with an increased rate compared to craniostenoses and other deformities. Thus, cranial deformities type plagiocephaly skull were found 23 times more compared to craniostenoses. In schools for children with neurological disorders 23.52% of cases were deformities of plagiocephaly type, while 1.90% were craniostenoses, in auxiliary schools 15.30% of cases were plagiocephalies and 1.16% – craniostenoses, but in pre-university schools 4.16% plagiocephalies and 0.52% craniostenoses (P<0.001). In the present study we found that plagiocephalies of I, II, III degrees are most commonly encountered in all categories of examined schools being from 3.19% to 3.75% with a decrease in deformities of IV and V degrees (1.76% and 0.18%), (P<0.001), (tab. 1).

Table 2

Sagittal occlusion disorders

Cranial deformities Maxilla protrusion	Without n/%	With n/%	Total n/%	$X^2$37.769 P< 0.000
Present	258 7,84	98 15,51	356 9,07	
Absent	3038 92,16	543 84,49	3567 90,93	
Total	3291 83,89	632 16,11	3923 100	

Table 3

Jaw deformations in the sagittal plane

Cranial deformities Mandible	Without n/%	With n/%	Total n/%	$X^2$11770 P< 0.001
Absent	3225 97%	605 95%	3831 97,63%	
Present	66 2%	27 4,27%	93 2,37%	
Total	3291 83,89%	632 16,11%	3923 100	

After analyzing examinations of alveolar and dental systems, made in the three reference planes (sagittal, vertical and horizontal), it was found statistically true their increased rate, almost two times higher in children with deformities compared to those without cranial deformities. Dentoalveolar deformities in the sagittal plane – protrusion of the maxilla in children with cranial deformities was 15.5% and in children without cranial deformation was 7.84% (P<0.001). 4.27% of children with deformities were detected with the maxilla protrusion compared to those without deformities: 2.01%. So, it was revealed a high incidence (twice more) of dental alveolar deformities in the sagittal plane in children with deformities, compared to those without deformities (P<0.001), (tab. 2, 3).

Table 4

Horizontal occlusion disorders

Cranial deformities Open occlusion	Without n/%	With n/%	Total n/%	X^2 32.964 P< 0.0001
Absent	3115 94,65%	560 88,61%	3675 93,68%	
Unilaterally present	110 3,34%	43 6,80%	153 3,90%	
Bilaterally present	66 2,01%	29 4,59%	96 2,42%	
Total	3291 83,89%	632 16,11	3923 100	

Similar results were found in the determination of occlusion anomalies in the horizontal plane. Unilateral and bilateral laterodeviations were statistically true with a double frequency in the group of children with cranial deformities in comparison with those without (P<0.0001). Unilateral laterodeviations in children with deformities were 6% and bilateral deviations were 4.59%. While in children without cranial deformities, unilateral laterodeviations were 3.34% and bilateral were 2.01% (tab. 4). Dento-maxillar anomalies of open occlusion type were found in 11.71% of children with cranial defor-

mities and only in 5.59% of children without cranial deformities (P<0.001), (tab. 5). But we did not find this difference in disturbances of deep occlusion type (tab. 6). At the same time, we can say that the risk of development of malocclusion in the three planes is increased in children with cranial deformities).

Table 5

Vertical occlusion disorders

Cranial deformities / Deep occlusion	Without n/%	With n/%	Total n/%	$X^2$8464 P<0.0001
Present	693 21.06%	101 15,98%	794 20,24%	
Absent	2598 78,94%	531 84,02%	3129 79,76%	
Total	3291 83,89%	632 16,11%	3923 100	

Table 6

Vertical occlusion disorders

Cranial deformities / Open occlusion	Without n/%	With n/%	Total n/%	X^2 32297 P<0001
Absent	3107 94,41%	558 88,29%	3665 93,42%	
Present	184 5,59%	74 11,71%	258 6,58%	
Total	3291 83,89%	632 16,11%	3923 100	

Discussion

Studies with various aspects of cranial deformities are common worldwide. A multilateral analysis of this problem began in Moldova in 2004 with the establishment of a collaborative partnership and scientific cooperation between Nicolae Testemitsanu State University of Medicine and Pharmacy, Chisinau, the Republic of Moldova, and Wake Forest University, North Carolina, Weanstom-Salem, between the departments of Head and neck surgery in children, neurosurgery, neurology and plastic surgery. During this period we have established the basis for plastic surgery in young children, as well as orthopedic remodeling of cranial relief with the help of wig caps donated by the team of plastic surgeons from the USA. This study was done on a group of 3293 children of school age who have not received treatment for orthopedic or surgical remodeling of the skull during early child development. As a result of statistical analysis we found that the frequency of cranial deformities constituted 16% of the examined children. Analysis of results showed high incidence of cranial deformities present among children with neurological disorders (48.18%). Almost a half of the examined children were found with cranial deformities. Their frequency was two times higher than in children from auxiliary schools for children with special educational needs (15.30%) and ten times higher compared to children from pre-university schools (1.16%). Deformities of craniostenosis type did not vary significantly in all groups of examined children and were much fewer compared to deformities of plagiocephaly type. Thus, in schools for children with neurological disabilities 23.52% of children had deformities of plagiocephaly type and 1.90% of children had deformities of craniostenosis type. Children from auxilliary schools with special needs had cranial deformities of plagiocephaly type 15 times more often compared with cranial deformities of craniostenosis type (15.30% versus 1.16%). The smallest gap was found in pre-university schools, where the prevalence of plagiocephaly deformities was only 4 times higher compared to craniostenoses (4.16% versus 0.52%) (P<0.001).

In the context that many authors establish a correlation between cranial deformities and high risk of development of neurological problems in these children [24,21,25] in this study we found that cranial deformities among handicapped children and those with special educational needs prevail compared to children from pre-university schools.

Some researchers in their study have demonstrated anthropometrical changes at the cranial base in children with cranial deformities [19,26]. Others have shown the changes in brain morphometry in magnetic resonance images [27]. In this study we found that along with changes in the cranial skeleton, neurological differences also persist at maxillo-dental level. Thus, the frequency of malocclusions in the three planes (sagittal, horizontal and vertical) is two times higher in children with cranial deformities compared to those without deformities, regardless the category of examined school.

Onyeaso C.O. determined that malocclusions among children from special schools are more common compared with healthy children [29]. Ana Cristina et al. tried to choose in their research the determinant factors of malocclusion in children with special needs [28]. At the same time, Bright Thilander et al. in their research have found a frequency of 88.1% of dentoalveolar abnormalities among healthy shool children [30]. Valentina Trifan notes an increased incidence of maxillofacial anomalies in the Republic of Moldova among healthy children [32]. In present study we found that the rate of malocclusions is two times higher in children with cranial deformities, than in those without cranial deformities.

Performing a literature study, we found that views on the indication, management, and period of treatment are very controversial. Saeed et al. found that deformities of plagiocephaly type do not require treatment and the skull self-remodels with age [17]. Plastic surgeons plead for orthopedic treatment, in comparison with pediatric neurosurgeons [12]. Sybill Dee Stock Naidoo in the study shows that it is difficult to demonstrate the efficacy of orthopedic or surgery treatment, as there are only a few studies on the long-term treatment outcomes [8]. So, as to the time of indicating the treatment or the self-modeling, opinions differ [22,23,24]. Present study demonstrates the increased risk of diseases of the maxillo-dental system in children of school age with cranial deformities and the higher incidence of cranial deformities among school children with special needs and handicapped children which requires appropriate treatment in cranial remodeling as early as possible.

Conclusions

Cranial deformities persist during school period of child's development. High incidence of cranial deformities was found in school children with neurological disabilities (48.18%), 2.5 times higher than in children from auxiliary schools with special educational needs (15.30%) and ten times higher compared with children from pre-university schools (1.16%). Cranial deformities carry an increased risk for dentomaxilar deformities in the three reference planes. High risk of cranial deformities to develop dentomaxilla anomalies, suggests the idea of orthopedic or surgical treatment of skull remodeling during early child period.

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