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PREVALENCE OF ORTHODONTIC ANOMALIES IN 6 YEARS-OLD CHILDREN WITH DYSLALIA

РАСПРОСТРАНЕТОСТ НА ОРТОДОНТСКИ АНОМАЛИИ КАЈ ДЕЦА НА 6-ГОДИШНА ВОЗРАСТ СО ДИСЛАЛИЈА

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Abstract

Aim of the study: The aim of our research is to determine the frequency and distribution of orthodontic anomalies in female and male children at the age of 6 who have previously been diagnosed with dyslalia. **Methods:** The frequency and distribution of orthodontic anomalies were analyzed in a selected sample (n=586) of boys and girls at the age of 6, all with dyslalia.The performed analysis is retrospective, on data for patients recorded in an outpatient clinic for carried out diagnostic orthodontic-speech examinationsin the period 2015-2019 at the Public Health Institution "Center for Rehabilitation of Verbal Communication Pathology - Skopje". The data is statistically examined, represented in tables and figures and analysed descriptively. **Results:** 15% of children with dyslalia had orthodontic anomalies of teeth and jaws. Most often, in as many as 50% of cases, it is about sagittal occlusion anomalies, followed by vertical occlusion anomalies (26.1%), anomalies in the dental arches (19.3%), etc. Among children with dyslalia, girlsare more likely to have orthodontic anomalies than boys. **Conclusion:** The findings obtained from the research can serve for better planning and implementation of diagnostic-rehabilitation activities in relation to orthodontic anomalies and the formation of speech sounds, with the ultimate goal of enabling, to as many children as possible, conditions for adopting clear and distinct speech sounds. **Keywords:** dyslalia, articulation disorders, orthodontics, open bite.

Апстракт

Цел на трудот: Цел на нашето истражување е да се утврди фреквенцијата и дистрибуцијата на ортодонтски неправилности кај женски и машки деца на 6-годишна возраст кај кои претходно е дијагностицирана дислалија. **Методи:** На избран примерок (n=586) од машки и женски деца на 6-годишна возраст, сите со дислалија, анализирана е фреквенцијата и диструбицијата на ортодонтски аномалии. Извршената анализа е ретроспективна и тоа на податоци за пациенти заведени во амбулантски дневник за спроведени дијагностички ортодотско-логопедски прегледи во периодот 2015-2019 во ЈЗУ Центар за рехабилитација на патологија на вербалната комуникација - Скопје. Податоците се статистички обработени, табеларно и графички прикажани и дескриптивно анализирани. **Резултати:** 15% од децата со дислалија имаа ортодонтска аномалија на заби и вилици. Најчесто, во дури 50% од случаите се работи за сагитални неправилности во оклузија, потоа следуваат вертикални неправилности во оклузија (26,1%), неправилности во денталните лакови (19,3%) итн. Во рамки на половите групи, женските деца со дислалија почесто имаат ортодонтски аномалии на заби и вилици, отколку машките деца. **Заклучок:** Добиените наоди од истражувањето може да послужат за подобро планирање и спроведување на дијагностичко-рехабилитациски активности во однос на ортодонтските аномалии и изговорот на гласови, а со крајна цел на што поголем број деца да им се овозможат услови за усвојување на чист и јасен изговор на гласови. **Клучни зборови:** дислалија, артикулациски нарушувања, ортодонција, отворен загриз.

Introduction

Orthodontics is a specific part of dentistry which deals with the study and monitoring of the growth and development of the dentition and the accompanying anatomical structures, from birth to dental maturity, including all preventive and curative interventions in all dental irregularities that require repositioning of teeth with functional and mechanical means, in order to establish normal occlusion and adequate facial appearance[1]. Orthodontics, as a science

that deals with the study of the growth and development of the orofacial system[2], but also the sciences that monitor the properarticulation, have a common interest in the orofacial region, a region where one of the most important human functions, speech, takes place. Any anomalies of the structures of the orofacial region can affect the correct articulation, i.e., lead to speech problems. Orthodontic anomalies are one of the causes of incorrect articulation of certain speech sounds, i.e., especially of speech sound distortion.The orthodontic anomalies that most often lead to articulation disorders are bite anomalies, which include protrusion, progenia, crossbite, open bite and cleft lip and palate[3].

The incorrect articulation of one or more sounds or dyslalia is a common occurrence among school children, and if there are also orthodontic anomalies with them, it can lead to changes in the entire child's being, i.e. hinder normal psychological development, can be the cause of psychological trauma and failure at school[4].

Different studies show that the number of articulation disorders is higher in populations with orthodontic anomalies than in eugnatic patients[5]. Also, many authors agree that people with articulation disorderstend to have a proportionately high incidence of malocclusion[6] i.e. a misalignment or improper relationship between the teeth of the upper and lower dental arches as they approach each other as the jaws close. This does not necessarily mean that the malocclusion itself is the cause of the speech disorder. However, structural malformations of the maxillary and mandibular arches can impair the production of consonants and affect speech intelligibility[7]. The effect of malocclusion on dyslalia appears to be more relevant and frequent, and increases proportionally, depending on the severity of the malocclusion[8].

From the abovementioned, it is clear that there is a complex relationship between speech and the position of the teeth. Harvold suggested three mechanisms by which malocclusion and speech are interrelated: there may be an occlusal or skeletal problem and coincidently an articulating problem; there may be a genetic or metabolic disorder that affects the central nervous system, leading to poor motor control and possible malformed morphogenesis; and there may be true cause–effect where occlusal or structural anomalies could affect the articulating skills[9]. Therefore, it is of particular importance to study, from as many different aspects as possible, the conditions as well as the possible relationship between orthodontic anomalies and imprecise or incorrect articulation.

In our research, the goal is to determine the frequency and distribution of orthodontic anomalies in female and male children at the age of 6 who have previously been diagnosed with dyslalia. The obtained results should be the basis for future research to determine the possible connection of orthodontic anomalies with the incorrect articulation.

Materials and methods

A retrospective analysis of data for patients recorded in the outpatient clinic for diagnostic orthodontic-speech examination in the period 2015-2019 at the Public Health Institution “Center for Rehabilitation of Verbal Communication Pathology – Skopje” (hereinafter: the Center)was carried out. Diagnostic orthodontic-speech examinations are carried out by an expert team (specialist orthodontist; specialist in ear, nose and throat; clinical speech therapist-specialist; special educator and rehabilitator; audiometrist; social worker; psychologist) according to the adopted protocol of the Center. A sample (n=586) of male (n=389) and female (n=197) 6-year-old children, all with dyslalia, was selected from the data, in which the frequency and distribution of orthodontic anomalies was analyzed. The children have normal intellectual development, without mental retardation or impaired hearing.

The data was statistically examined, represented in tables and figures and analysed descriptively.With the descriptive method, the following parameters were analyzed: gender, type of orthodontic anomalies, other anomalies of the oral structures. The statistical analysis of the data obtained from the research was done in the statistical programs Statistica for Windows 7.0 and SPSS 17.0. Pearson Chi-square test was used to compare the analyzed variables between male and female respondents. Statistical significance was defined at the $p<0.05$.

Results

From the analyzed sample of data for children with dyslalia (n=586), children who had orthodontic anomalies of the teeth and jaws were first identified (Table 1).

It was determined that 15% of the children hadan orthodontic anomalies (n=88), of which 58% are male (n=51) and 42% are female (n=37).

Considered within gender groups, 13.1% of male childrenand 18.8% of female children had some orthodontic anomalies. The statistical analysis confirmed the difference in the distribution of children with and without orthodontic anomalies between males and femalesas non-significant (p=0.069).

Considered by groups of orthodontic anomalies, the results show that most often it is about sagittal occlusion anomalies (50%; n=44) (protrusion was most often registered within the group, n=19), followed by vertical occlusion anomalies (26.1%; n=23) (an open bite was most often registered within the group, n=15), anomalies in the dental arches (19.3%; n=17) (crowding in the dental arches was most often registered -mandibular crowding, n=9) and anomalies in the number of teeth (2.3%;

Table 1. Frequency and distribution of orthodontic anomalies in children with dyslalia, by gender and total

Orthodontic anomalies	Male		Female		Total		p-value
	N	(%)	n	(%)	N	(%)	
With	51	(13.1)	37	(18.8)	88	(15.0)	p=0.069
Without	338	(86.9)	160	(81.2)	498	(85.0)	
Total	389	(100.0)	197	(100.0)	586	(100.0)	

p (Pearson Chi-square test)

Table 2. Distribution of orthodontic anomalies, in children with dyslalia who have only one orthodontic anomaly, by gender and total

Orthodontic anomalies	Male			Female			Total	
	(n)	[1]	[2]	(n)	[1]	[2]	(n)	[3]
	43	**55.1%**		**35**	**44.9%**		**78**	
Sagittal occlusion anomalies	**23**	**57.5%**	**53.5%**	**17**	**42.5%**	**48.6%**	**40**	**51.3%**
Angle Class II, Division 1 Malocclusion (Protrusion)	9	50.0%	20.9%	9	50.0%	25.7%	**18**	**23.1%**
Angle Class II, Division 2Malocclusion (Deckbiss)				2	100.0%	5.7%	**2**	**2.6%**
Angle Class IIIMalocclusion	5	83.3%	11.6%	1	16.7%	2.9%	**6**	**7.7%**
Underbite	9	64.3%	20.9%	5	35.7%	14.3%	**14**	**17.9%**
Verticalocclusion anomalies	**11**	**55.0%**	**25.6%**	**9**	**45.0%**	**25.7%**	**20**	**25.6%**
Open bite	8	57.1%	18.6%	6	42.9%	17.1%	**14**	**17.9%**
Deep bite	3	50.0%	7.0%	3	50.0%	8.6%	**6**	**7.7%**
Anomalies of teeth number	**2**	**100.0%**	**4.7%**				**2**	**2.6%**
Hypodontia	1	100.0%	2.3%				**1**	**1.3%**
Hyperodontia	1	100.0%	2.3%				**1**	**1.3%**
Anomalies in the position of individual teeth	**1**	**100.0%**	**2.3%**				**1**	**1.3%**
Rotation	1	100.0%	2.3%				**1**	**1.3%**
Anomaliesof teeth shape	**1**	**100.0%**	**2.3%**				**1**	**1.3%**
Fusion	1	100.0%	2.3%				**1**	**1.3%**
Anomalies in the dental arches	**5**	**35.7%**	**11.6%**	**9**	**64.3%**	**25.7%**	**14**	**17.9%**
Crowding in the dental arches	4	36.4%	9.3%	7	63.6%	20.0%	**11**	**14.1%**
Spacing in the dental arches	1	33.3%	2.3%	2	66.7%	5.7%	**3**	**3.8%**

[1] – distribution of orthodontic anomalies between male and female children
[2] – distribution of orthodontic anomalies within the gender group
[3] – distribution of orthodontic anomalies in the total sample(n=78)

n=2). One case each with anomaliesin the position of individual teeth and anomalies in the shape of the tooth was registered. Transversal occlusion anomalies were not registered.

Among the children in whom an orthodontic anomalies were determined (n=88), the orthodontic anomaly was mostly isolated, independent (88.6%; n=78), then together with other anomalies of the oral structures (10.2%; n=9), and only one child was registered as having two orthodontic anomalies at the same time.

More specifically, depending on whether the children with dyslalia have only one or two orthodontic anomalies, or in addition to the orthodontic anomalies they also have other anomalies of the oral structures, and depending on gender, the results are as follows:

a) Children with dyslalia and only one orthodontic anomaly

In the cases of children with only one orthodontic anomaly (n=78), the results for orthodontic anomalies by group (Table 2) show that most often it is sagittal occlusion anomalies (51.3%; n=40), followed by vertical occlusion anomalies (25.6%; n=20), anomalies in the dental arches (17.9%; n=14) and anomalies in the number of teeth (2.6%; n=2). One case each with anomalyin the position of the individual teeth and anomaly in the teeth shape were registered, and transversal occlusion anomalies were not registered.

Regarding the distribution of orthodontic anomalies within gender groups, more than half of males have sagittal occlusion anomalies (53.5%), followed by male children with vertical occlusion anomalies (25.6%), and anomalies in the dental arches (11.6%) (Table 2, Male - column [2]).In female children, sagittal occlusion anomalies also dominate (48.6%), followed by equally represented vertical occlusion anomalies and anomalies in the dental arches (Table 2, Female - column [2]).

Table 3. Frequency and distribution of orthodontic anomalies in children with dyslalia who, in addition to one orthodontic anomaly, also have other anomalies of the oral structures, by gender and total

Orthodontic anomalies	Otheranomalies of the oral structures	Male			Female			Total	
		(n)	[1]	[2]	(n)	[1]	[2]	(n)	[3]
		7	**77.8%**		**2**	**22.2 %**		**9**	
Sagittal occlusion anomalies		**3**	**75.0%**	**42.9 %**	**1**	**25.0 %**	**50.0 %**	**4**	**44.4 %**
Angle Class II, Division 1 Malocclusion (Protrusion)	'Gothic' palate (High-arched palate)	1	100.0 %	14.3 %				**1**	**11.1 %**
Underbite	Short lingual frenulum	2	66.7%	28.6 %	1	33.3 %	50.0 %	**3**	**33.3 %**
Verticalocclusion anomalies		**2**	**100.0 %**	**28.6 %**				**2**	**22.2 %**
Open bite	Short lingual frenulum	1	100.0 %	14.3 %				**1**	**11.1 %**
Deep bite	Short lingual frenulum	1	100.0 %	14.3 %				**1**	**11.1 %**
Anomalies in the dental arches		**2**	**66.7%**	**28.6 %**	**1**	**33.3 %**	**50.0 %**	**3**	**33.3 %**
Spacing in the dental arches	Short lingual frenulum	2	66.7%	28.6 %	1	33.3 %	50.0 %	**3**	**33.3 %**

[1] – distribution of orthodontic anomalies and anomalies of the oral structures between male and female children
[2] – distribution of orthodontic anomalies and anomalies of the oral structures within the gender group
[3] – distribution of orthodontic anomalies and anomalies of the oral structures in the total sample(n=9)

b) *Children with dyslalia, orthodontic anomaly and other anomalies of the oral structures*

In cases, where in addition to one orthodontic anomaly there are also other anomalies of the oral structures (n=9), and in relation to orthodontic anomalies by group (Table 3), sagittal occlusion anomalies (44.4%; n=4), anomalies in the dental arches (33.3%; n=3)and vertical occlusion anomalies (22.2%; n=2) were most often registered, while the most common anomalies of the oral structures is a short lingual frenulum (89%; n=8), and one case of 'Gothic' palate.

Regarding the distribution of orthodontic anomalies within gender groups, 42.9% of males have sagittal occlusion anomalies, followed by males with vertical occlusion anomalies and anomalies of the dental arches with equal participation (28.6%) (Table 3, Males - column [2]). In female children, sagittal occlusion anomalies and anomalies in the dental arches are equally represented (Table 3, Females - column [2]).

c) *Children with dyslalia and two orthodontic anomalies*

Two orthodontic anomalies, at the same time, were registered in only one case of a male child, and it is a vertical occlusion anomaly (deep bite) and a teeth shapeanomaly (fusion).

Discussion

Several studies try to show the relationship between dyslalia and some changes in the stomatognathic system.There are different viewpoints and approaches to researching the relationship between dyslalia and orthodontic anomalies, all unique in their own way.In our research, the main goal was to determine the frequency and distribution of orthodontic anomalies in female and male children at the age of 6, who have already been diagnosed with dyslalia, in order to get a clearer picture of the possible influence of orthodontic anomalies on the proper articulation.The review of the literature, i.e. researches by other authors and the results obtained in our research, partially coincided in certain aspects, while in others they were different.

According to the results of our research, on the total sample of data relating to 6-year-old children with dyslalia (n=586), it was determined that 15% of the children (n=88) have orthodontic anomalies of the teeth and jaws.Karevska and Trajkovski 10, who conducted a research on the etiological factors that lead to speech disorders, with an orthodontic examinationdetermining that in their experimental group, which consisted of subjects with speech disorders, 60.4% had a pathological orthodontic finding.10This result is not in accordance with the result of our research, but it must be taken into account that Karevska and Trajkovski10 analyzed respondents from a wide age group, between the ages of 3 and 73, while in our research, all the respondents were 6-year-olds.Farronato et al. 8who conducted the study, which included children aged 6 to 10 years,regarding the connection between malocclusions and dyslalia, determined that only 1/6 of children with dyslalia (n=351) do not have malocclusion at the same time. These results are different from those in our research, with a note that children of a different age group were examined, and that the examinations were conducted in the department of orthodontics and the department of speech rehabilitation in the same hospital.The data from our research were obtained from diagnostic orthodontic-speech examinations carried out at the Public Health Institution“Center for Rehabilitation of Verbal Communication Pathology – Skopje”, which is visited by patients with speech disorders, so perhaps this is the reason for the small percentage of established orthodontic anomalies in children diagnosed with dyslalia.The results of the study by Vranić and Hunski 11, conducted at the SUVAG Center in Zagreb (Republic of Croatia), on a sample of 51 children aged 6 to 8 years with a diagnosis of dyslalia, showed that 64.6% of them had orthodontic anomalies. Although the respondents are of a similar age group to that of our research, it is notable that there is a large difference in the frequency of orthodontic anomalies. However, it can be pointed out that our research includes ten times more data on respondents with dyslalia (n=586) than the research by Vranić and Hunski (n=51).

In their research, Vranić and Hunski11 also covered the aspect of the gender structure of children diagnosed with dyslalia and orthodontic anomalies, and their results show that orthodontic anomalies are more common in male respondents with articulation disorders.These results are in contrast to the results obtained in our study where 13.1% of male children and 18.8% of female children diagnosed with dyslalia had some orthodontic anomaly. However, it must be pointed out that in our research, statistical analysis confirmed the difference in the distribution of children with and without orthodontic anomalies between male and female children with dyslaliaas non-significant (p=0.069).

Regarding whether children with dyslalia have only one orthodontic anomaly or two, or whether they have an orthodontic anomaly together with other anomalies of the oral structures, the possibilities for making a comparison with the same or similar research by other authors were limited.The results of our research showed that in children with a diagnosis of dyslalia and an established orthodontic anomaly (n=88), the orthodontic anomaly is mostly isolated, independent (88.6%), then together with other anomalies of the oral structures (10.2%), and only

one child registered two orthodontic anomalies at the same time. In their research,Farronato et al. 8 came to the conclusion that children with dyslalia with three or more forms of malocclusion are found much more often than those with two or only one form of malocclusion.

If we look at the orthodontic anomalies in children with dyslalia (n=88), by groups of orthodonticanomalies, the results of our research show that most often it is about sagittal occlusion anomalies (50%) (protrusion was most often registered within the group), followed by vertical occlusion anomalies (26.1%) (an open bite was most often registered within the group), anomalies in the dental arches (19.3%) (crowding in the dental arches was most often registered –mandibular crowding)and anomaliesin the number of teeth (2.3%).One case with anomalies in the position of individual teeth and anomalies of teeth shape was registered.Transversal occlusion anomalies were not registered. In the previous results, it was possible to make a partial comparison with the results and conclusions of other authors' research.What was notable in other authors' results is that open bite is the most frequently mentioned key orthodontic anomaly leading to speech disorders. Namely, according to Leavy, Cisneros and LeBlanc [12], who conducted a study on 150 patients, an open bite (.2 mm) was the key malocclusal factor underlying speech sound errors. The authors concluded that an open bite was the occlusal trait having the most potential to negatively impact sound production. According to the research by Didem, Neşe and Tülin 6the most consistently reported traits between the malocclusion and speech defects are anterior openbite, increased overjet and overbite, and maxillary spacing.Also Sahad et al.13found a significant relationship between open bite, anterior lisping, and/or tongue thrust during the articulation of the alveolars/t/,/d/,/n/, and/l/.On the other hand, according to Stojković and Anđelski 3, the orthodontic anomalies that most often lead to articulation disorders are the anomalies of the bite, which include protrusion, progenia, crossbite, open bite and cleft lip and palate. Farronato et al.8reported a correlation between Class III occlusion, diastema,increase in overjet, open and deep bite, and articulation disorders.

For the sake of greater relevance of the results, it is possible to include and determine the state of the dentition (primary or mixed dentition), dental anomalies (caries, tartar, etc.), other harmful habits (for example nail biting, thumb sucking, etc.), wearing an orthodontic appliance, history of orthodontic treatment in future research. In addition, it can be investigated and studied more deeply and in detail, i.e. to determine a specific connection of an articulation disorder of a certain speech sound (for example sound /s/, /r/, /l/, etc.) with orthodontic anomalies.

Conclusions

AThe findings obtained from the research can serve for better planning and implementation of diagnostic-rehabilitation activities in relation to orthodontic anomalies and the formation of speech sounds, with the ultimate goal of enabling, foras many children as possible, conditions for the formation of clear and distinct speech sounds.The findings show that timely and comprehensive diagnosis of children's articulation disorders and other anomalies in the orofacial region can be of crucial importance for one of the most important human functions - speech. At the same time, the importance of a multidisciplinary approach in the diagnosis and rehabilitation of speech disorders in children is evident. There is general consensus on the need for a combined approach involving different specialists, such as speech therapists and orthodontists.

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