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## **Covid tongue – a case report**

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### **Abstract**

**Introduction:** COVID-19 is still a current issue. Despite the rollout of vaccines, the virus continues to spread and cause new cases, hospitalizations, and deaths. It's important to note that not everyone with COVID-19 will experience oral manifestations, and these symptoms can also be caused by other conditions. "Covid tongue" is a term used to describe one of the potential symptoms of the infection.

**The aim** is to analyze the correlation between COVID-19 and oral lesions

**Material and methods:** The study was conducted at private practice. Clinical and laboratory examinations were made.

**Results:** A case of a patient with a covid tongue manifestation is presented. The symptoms were mild, and home quarantine was enough. The symptoms subsided for 2 weeks, after which the patient, on the advice of his GP, tested again and gave a negative test by RT-PCR. The diagnose was based on clinical appearance and confirmed by laboratory testing. Symptoms include inflammation, white lesions, discoloration, changes in taste sensation (loss of taste) and dry mouth. For treatment of this patient the chlorhexidine mouthwash was prescribed, brushing twice daily and flossing, as well as multivitamins.

**Conclusion:** In cases where covid has oral manifestations, the most correct approach is to combine the efforts of health professionals and to take an interdisciplinary approach.

**Key words:** COVID tongue, Coronavirus disease 2019 (COVID-19), oral manifestations; tongue diagnosis

### **Introduction**

COVID-19 is still a current issue. The pandemic, caused by the SARS-CoV-2 virus, began in late 2019 and has since spread globally, affecting millions of people. Despite the rollout of vaccines, the virus continues to spread and cause new cases, hospitalizations, and deaths (1, 2). The impact of COVID-19 is widespread and includes not only public health but also the economy, education, and social interactions. Efforts to control the spread of the virus and prevent further outbreaks continue, and research into treatments and vaccines continues

Oral manifestations of COVID-19 are symptoms that affect the mouth and oral cavity. Some of the most common oral manifestations of COVID-19 include: sore throat; dry mouth; loss of taste or smell; toothache; swollen glands; reddish-gray or white tongue; lesions or ulcers in the mouth (3). It's important to note that not everyone with COVID-19 will experience oral manifestations, and these symptoms can also be caused by other conditions. If you suspect you may have COVID-19, it's important to get a proper medical diagnosis. (4)

"Covid tongue" is a term used to describe one of the potential symptoms of COVID-19, the disease caused by the SARS-CoV-2 virus. People with COVID-tongue may experience a change in the appearance of their tongue, such as redness, white spots, or a bumpy texture. Most commonly is presented as depapillated areas on the tongue surrounded by a white border. The oral lesion resembles geographic tongue. In contrast, this lesion does not migrate, and there is anamnestic data of past infectious disease. Even if the disease was asymptomatic, a laboratory test can easily prove that the patient has contracted COVID. (5)

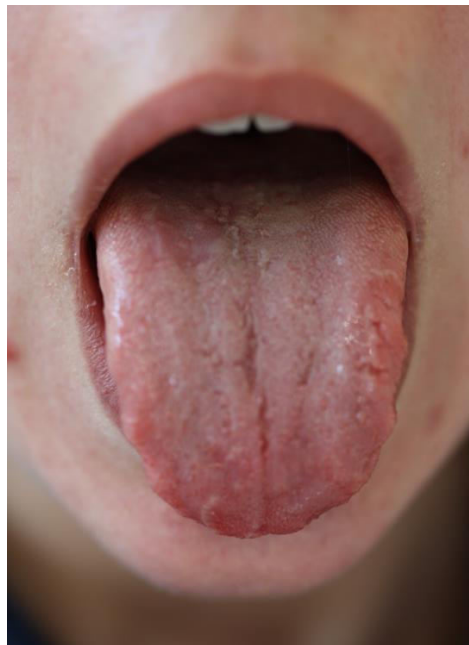
### **Material and methods**

The study was conducted at private practice, along with the Department of Conservative Dentistry and Oral Pathology, Medical University - Varna. A declaration of an informative consent is signed by the patient. Clinical and laboratory examinations were made.

### **Results**

A 36-year-old woman with laboratory-confirmed COVID-19 case admitted to our clinic two months after her non-critical illness. The patient was with two doses of vaccines (Moderna). As reported in her history there was no need of hospitalization. The symptoms were mild, and home quarantine was enough. The symptoms subsided for 2 weeks, after which the patient, on the advice of his GP, tested again and gave a negative test by RT-PCR.

The diagnose was based on clinical appearance and confirmed by laboratory testing. Symptoms include inflammation, white lesions, discoloration, changes in taste sensation (loss of taste) and dry mouth. For treatment of this patient the chlorhexidine mouthwash was prescribed, brushing twice daily and flossing, as well as multivitamins.



*Fig.1 A 36-year-old woman with laboratory-confirmed COVID-19*

### **Discussion**

However, it's important to note that not everyone with COVID-19 will experience this symptom and it can also be a symptom of other conditions, so it's essential to get a proper medical diagnosis if you suspect you may have COVID-19. One of the less discussed symptoms of COVID-19 is its impact on the tongue. It can cause a variety of changes to the tongue, ranging from a red and swollen appearance to white patches or ulcers. Reports of these symptoms have been found in patients with mild or severe COVID-19. (5)

It is estimated that nearly 60% of COVID-19 patients have experienced changes in their tongue, ranging from simple discoloration to full lesions. Some of the more common symptoms include redness, white patches, and even blistering or swelling of the tongue. These changes can often be a source of discomfort for those affected and can lead to difficulty eating or talking. (5)

When the diagnose is make, the differential diagnosis of the present condition must include herpetic glossitis, Melkersson–Rosenthal syndrome, lichen planus, fungal infection, geographic tongue. In this

case, the patient mentioned that the depapillation of the tongue was noticed in the first week of the illness. This, along with other symptoms, indicate an active infection and it's important to seek medical attention.

In one study, a patient with mild to moderate COVID-19 was observed to develop white patches on their tongue that were suspected to be caused by the virus. In another case, a COVID-positive patient developed reddish and swollen spots on their tongue and was diagnosed with a condition called erythematous glossitis. These cases demonstrate that the virus can cause changes in the tongue, although further study is needed to understand how often this occurs (5,6).

Also of concern are reports of ulcerative lesions found on COVID-19 positive patients' tongues. In one case, a patient presented with ulcerative lesions on the tip of their tongue that spread to the sides and base. These lesions are likely caused by the virus, and could further complicate a person's recovery from COVID-19, potentially leading to increased risk for secondary bacterial infections (7).

A healthcare provider should perform a thorough examination, take a medical history, and possibly order tests to determine the cause of the symptoms and provide appropriate treatment when he sees patient with such complains. Fortunately, the changes to the tongue are usually temporary, and in most cases, they will resolve on their own. However, if symptoms persist or worsen over time it is important to consult a doctor for treatment.

Treatment for the tongue changes associated with COVID-19 is currently limited, but doctors may recommend antibiotics or antivirals to manage symptoms and prevent further complications. Oral hygiene practices such as brushing twice daily and flossing regularly are important steps that can help reduce inflammation and improve overall mouth health. Additionally, patients should avoid smoking, tobacco, and alcohol as much as possible, since these substances can irritate the tongue and make it more vulnerable to infection. Furthermore, eating a balanced diet rich in antioxidants and drinking plenty of water are also essential for promoting good oral health. Taking regular breaks from wearing face masks is also encouraged to help reduce inflammation on the tongue caused by prolonged mask wearing (8). By following these steps, patients can protect their tongues (and overall health) from the impacts of the virus.

Given the potential impact of COVID-19 on the tongue, it is important for people to be aware of these symptoms and seek medical care if they suspect they may have the virus. Early detection and treatment is key in managing COVID-19, so it is important to be vigilant about any changes that occur in the mouth or on the tongue. As more research becomes available, we will gain a better understanding of how the virus affects the tongue and establish better guidelines for diagnosis and treatment.

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### **Correlation of dietary intake of vitamin D and dental caries in adults living with obesity**

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#### **Abstract**

**Introduction:** The pleiotropic functions of vitamin D have been actively studied in recent decades, including its importance in protecting oral health. It has been reported that a sufficient level of vitamin D could have an impact on the appearance and progression of dental caries.

**The aim** of the present study was to assess the amount of average daily dietary intake of vitamin D and its relationship to the prevalence of dental caries in people with Obesity (PwO) aged 18 to 60 years.

**Material and Methods:** The study included: 192 adults (65 with overweight (BMI = 25.0–29.9 kg/m<sup>2</sup>) and 127 with obesity (BMI > 30.0 kg/m<sup>2</sup>) – 90 men and 102 women. To estimate the dietary intake of vitamin D, the method of 24-hour recall was applied. The prevalence of dental caries is assigned using the DMFT index.

**Results:** The results show a statistically significant difference between the average daily intake of vitamin D for women (M=3.221 mcg/d, SD=2.352 mcg/d) and men (M=2.883 mcg/d, SD=1.631 mcg/d):  $t(192)=1.843$ ,  $p=0.061$ . Correlation analysis to establish a relationship between dietary intake of vitamin D and dental caries in the subjects has found a significant negative coefficient ( $\rho(192) = -0.136$ ,  $p < 0.05$ ).

**Conclusion:** The results show that the nutritional intake of vitamin D is insufficient, and there is a weak correlation between vitamin D deficiency and the development of dental caries.

**Key words:** Vitamin D, dental caries, obesity

#### **Introduction**

The functions of vitamin D have been ardently studied in recent decades. Vitamin D is also very effective in protecting oral health. It has been reported that a sufficient level of vitamin D is able to stop the onset and progression of dental caries in tooth structures and prevent their loss [1]. Currently, food sources for providing vitamin D are becoming more and more relevant and necessary due to the sedentary indoor life of people [2].

**The present study aims** to assess the amount of average daily dietary intake of vitamin D and its relationship to the prevalence of dental caries in overweight and obese people aged 18 to 60 years.

#### **Material and methods**

The study has covered 192 people (65 with overweight (BMI= 25.0-29.9 kg/m<sup>2</sup>) and 127 with obesity (BMI>30.0 kg/m<sup>2</sup>)) aged 18 to 60 years. Vitamin D intake has been assessed by applying the 24-hour memory recall method of dietary intake, including one working day and one non-working day of the week. In addition, the prevalence of dental caries was assessed using the DMFT index by assessing the total number of teeth that were carious (D), missing (M), due to caries, or obturated (F).

**Results**

The subjects' average daily vitamin D intake is below the recommended dietary intake of 15 mcg/day. In the analysis of the results for average daily dietary intake of vitamin D according to the age and sex of the subjects, descriptive analysis and t-test have been applied. The results show a statistically significant difference between the average daily intake of vitamin D for women (M=3.221 mcg/d, SD=2.352 mcg/d) and men (M=2.883 mcg/d, SD=1.631 mcg/d):  $t(192) = 1.843, p = 0.061$ . The magnitude of the difference (M=0.099, CI 95=0.016, 1.841) is less than the typical magnitude of the effect  $d = 0.20$ , according to Cohen (1988). It was found that there was no statistically significant difference when comparing the results of the two age groups (for 18-30 y (M=2.642 mcg/d, SD=3.418 mcg/d) and 31-60 y (M=2.433mcg/d, SD=3.221mcg/d)),  $t(192) = 0.349, p = 0.621$ , with less than the typical magnitude of the effect  $d = 0.20$  (Cohen, 1988).

**Table 1. Vitamin D status and diet intake according to DMFT**

	N	Mean	SD	Std. Error	95% CI		Min.	Max.
					Lower	Upper		
<b>Up to 2 DMF</b>	11	6.4163	6.74832	1.50216	3.5138	2.4173	0.87	26.62
<b>Up to 4 DMF</b>	43	2.1014	1.67351	0.13234	1.2249	2.3011	0.36	7.31
<b>Over 4 DMF</b>	138	1.5260	1.57616	0.11507	1.3464	2.2455	0.47	8.42
<b>Total</b>	192	3.5326	3.25337	0.30168	1.7431	2.5639	0.41	26.63

It is notable by the data analysis that most of the studied individuals have a dental caries intensity higher than 4 DMF (Table 1). Correlation analysis to establish a relationship between dietary intake of vitamin D and dental caries in the subjects has found a statistically significant negative coefficient ( $\rho(192) = -0.136, p < 0.05$ ), indicating that the higher dietary intake of vitamin D results in the less pronounced intensity of dental caries. Applying Cohen's guidelines (Cohen, 1988), the effect extent is small (Table 2).

**Table 2. Spearman correlations between vitamin D intake and tooth caries**

Caries			
<b>Spearman's rho</b>	<b>Vit. D</b>	Correlation Coefficient	-0.136**
		Sig. (2-tailed)	0.006
		N	192

\*\**. Correlation is significant at the 0.01 level (2-tailed).*

**Discussion**

Dental caries and periodontal diseases are complex multifactorial diseases that remain the two most prevalent worldwide [3]. This infectious disease has a complex and multifactorial etiology.

Environmental factors such as a cariogenic diet high in carbohydrates, some nutritional deficiencies, cariogenic bacteria, poor oral hygiene are the most widely studied risk factors.

The current recommendations of the World Health Organization (WHO) for the daily intake of Vitamin D for adults are 15 mcg (600 IU) [4]. Vitamin D is associated with many biological functions due to its endocrine, autocrine, and paracrine activities. Its reported functions include: the regulation of calcium and phosphate metabolism and their deposition in mineralized tissues, as well as the impact on innate immunity, involvement in cognitive functions, role in blood pressure maintenance, and effects related to health outcomes (cardiometabolic conditions, general mortality, and aging).

Vitamin D regulates calcium levels and plays a key role in craniofacial development and maintaining good oral health, being associated with two general oral diseases – dental caries and periodontal disease. It has a key role in forming enamel, dentine, and alveolar bone. A diet rich in vitamin D, calcium, and phosphate can improve enamel remineralization and has been associated with reduced rates of dental caries for a long time [5]. Despite numerous studies on vitamin D and dental caries, the precise mechanism by which this vitamin affects the development of dental caries has not been clarified yet.

Parthasarathy and colleagues [6] have analyzed the relationship between dental caries and vitamin D3. They indicate that receptors for this vitamin are present in the cells of the immune system, which binds to vitamin D3 and increases the formation of an antimicrobial protein that prevents dental caries. Recently, extensive literature has been published on vitamin D3 and its crucial role in dental health and the general health of the human body [7].

Disrupted tooth mineral composition is more prevalent in individuals suffering from vitamin D deficiency. However, the results obtained on the relationship between vitamin D levels and dental caries are contradictory. Thus, according to some studies, low vitamin D levels are associated with a higher prevalence of tooth caries. However, other studies have not observed such a relationship. Our correlation analysis has found that vitamin D levels and dental caries experience are negatively related, but the degree of correlation is not substantial.

### **Conclusion**

Vitamin D is vital for dental health. The results in our study have shown a weak and negative relationship between vitamin deficiency and the development of dental caries.

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## **Incidence of dental caries among adults with overweight and obesity in Sofia**

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### **Abstract**

Obesity and dental caries are public health problems, that share some common and modifiable influences. The present study **aims** to assess the relationship between BMI, diet, and oral hygiene level with the intensity of dental caries, represented by the DMFT index in adults aged 18 to 64 years who are people with Obesity (PwO).

**Material and Methods:** The study covered 192 people (65 with overweight (BMI = 25.0–29.9 kg/m<sup>2</sup>) and 127 with obesity (BMI > 30 kg/m<sup>2</sup>) aged 18 to 60 years. The assessment of individuals includes the oral hygiene level through the **Silness & Løe** index, a questionnaire on the frequency of food intake (FFQ), and the intensity (incidence) of dental caries using the DMFT index.

**Results:** The results of Spearman's Rank correlation indicate that there is a significant positive correlation between the intensity of dental caries and the carbohydrate intake of the subjects (rsp=0.627, p< 0.05) and a negative correlation between oral hygiene of individuals and DMFT (rsp= -0.637, p<0.05).

**Conclusion:** The study shows the significant role of diet and eating habits of PwO and the development of dental caries in them.

**Key words:** dental caries, overweight, obesity

### **Introduction**

The primary cause of obesity is a high-calorie carbohydrate-rich diet and low energy expenditure. It has been proven that excessive intake of fermentable carbohydrates, mainly sucrose, is also associated with the initiation of dental caries [1]. Dental caries is a multifactorial disease influenced by several behavioral factors, such as oral hygiene, fluoride use, and individual dietary habits [1]. The increased amount of fermentable carbohydrates and their frequent intake are the most severe risk factors for its development, affecting dental structures and the pathogenic potential of dental plaque [2].

### **Aim**

The present study is aimed to assess the relationship between BMI, diet, and oral hygiene level with the intensity (incidence) of dental caries represented by the DMFT index in overweight and obese adults aged 18 to 60 years.

### **Material and methods**

The study covers 192 individuals – 65 overweight (BMI= 25.0–29.9 kg/m<sup>2</sup>) and 127 obese (BMI>30.0 kg/m<sup>2</sup>) aged 18 to 60 years – 90 men and 102 women. Nutrition has been assessed using a food and beverage frequency questionnaire (FFQ). The assessment of the level of oral hygiene status is carried out applying the **PLI index of Silness & Løe (simplified)**: the amount of dental biofilm in the area of the gingival third of the crowns of teeth 16, 12; 24; 36; 32; 44 is determined if teeth are present or

adjacent to the missing teeth. The intensity (incidence) of dental caries is assessed using the DFMT index.

### Results

It has been found that only 6% of the study subjects have good oral hygiene. Individuals with poor (59%) and unsatisfactory (35%) oral hygiene prevail, which requires correction of their oral hygiene habits and creating a proper attitude towards their oral health. Statistical reliability has been established when comparing the relative shares of the three defined groups: good and unsatisfactory ( $\chi^2=22,5$   $p<0.05$ ); unsatisfactory and poor ( $\chi^2 =37,1$   $p<0.05$ ); good and poor ( $\chi^2 =96,8$   $p<0.05$ ).

**Table 1. Correlation between eating habits and dental caries in the subjects.**

Eating habits	≤ 2 times a week	3-6 times a week	1–6 times a week	Spearman's Correlation		K-W test
	DMFT	DMFT	DMFT	rho	p-value	p-value
Cereals	2.52 ±4.5	4.55±6.36	3.28 ±4.02	0.08	0.317	0.5142
Pasta products	4.48 ±2.8	4.27±2.65	4.81 ± 3.55	-0.08	0.285	0.5628
Sugar, chocolate and confectionery	3.07± 3.12	7.09 ±3.51	4.63±1.27	-0.36	<0.0001*	<0.0001*
Junk food	4.08±3.27	4.74±3.22	4.79 ± 2.89	0.13	0.1046	0.2675
Chips, crackers	3.4 ± 3.03	4.23±2.91	6.34± 3.96	0.18	0.019*	0.0339*
Jam, honey	2.69 ± 3.64)	2.63±3.88	5.73± 4.55	-0.22	0.0046*	0.0006*
Milk (fresh and sour)	4.49±3.19	5.35±2.6	3.49±3.33	-0.12	0.119*	0.0171*
Dairy products, including cheese and cottage cheese	4.57± 2.8	4.39±3.19	3.89±3.48	-0.15	0.0527	0.1501
Fruits	3.98 ± 2.71	4.53 ±3.62	3.44± 3.92	0.04	0.576	0.0548
Vegetables	1.85± 3.05	3.77±4.38	3.87 ± 2.78	0.03	0.7132	0.9166
100% fruit juice	3.5± 2.98	6.4 ± 2.83	4.26± 3.17	0.06	0.4074	0.0484*
Carbonated drinks	2.06± 3.18	3.6 ± 2.78	5.06±5.02	0.34	<0.0001*	<0.0001*
Sweetened drinks	2.26±2.77	3.78 ±1.56	2.78± 1.42	0.34	<0.0001*	<0.0001*

The intensity (incidence) of dental caries is high in patients with frequent carbohydrate intake, especially between meals, which will increase the risk of caries development (Table 1). Analysis of consumed food shows unhealthy food preferences. Both soft, carbohydrate foods and so-called 'junk food' are consumed. They are highly sticky foods with high cariogenic potential. Carbonated and fruit beverages with added sugar also have such cariogenic potential.

**Table 2. Correlation of dental caries, oral hygiene and nutrition**

Indicators	DMFT	Oral hygiene	Nutrition - carbohydrate intake
DMFT	1.000		
Oral hygiene	- 0.637*	1.000	
Nutrition - carbohydrate intake	0.627*	- 0.728*	1.000

\*  $p < 0,05$

According to the correlation analysis of the incidence of dental caries represented by the DMFT index, the oral hygiene and the dietary habits of the subjects related to the carbohydrate intake, a positive correlation was found between the DMFT and the carbohydrate intake of the subjects ( $r_{sp}=0.627$ ,  $p < 0.05$ ) and a negative correlation between oral hygiene of individuals ( $r_{sp}=-0.637$ ,  $p < 0.05$ ) and dental caries (DMFT). Furthermore, such a negative relationship was also established between the dietary intake of carbohydrate foods that are highly sticky to the tooth surface and the oral hygiene of the subjects ( $r_{sp}=-0.728$ ,  $p < 0.05$ ) (Table 2).

### Discussion

Unhealthy eating patterns and frequent consumption of carbohydrate foods are the most significant factors that contribute to the cariogenicity of the diet and play an essential role in the development of dental caries, as demonstrated in our study. Frequent consumption of sugary foods and beverages between meals can result in an increased incidence of tooth decay in people who have poor oral hygiene. Few epidemiological studies have measured the frequency of intake and the amount of sugar in dental caries [3].

Today, dental caries is the most significant oral disease, which has a medical and socioeconomic impact [4]. Since nowadays, the prevention of dental caries focuses on the dietary habits of individuals and their behavior related to oral health, implementing proper oral hygiene and dietary habits is crucial. Therefore, the appropriate diet, consumption of fermentable carbohydrates, regular brushing, and flossing constitute an essential strategy that health professionals apply to identify dietary risk habits related to the development of dental caries.

Studies on the relationship between BMI and dental caries reveal that obesity and overweight increase the prevalence of caries [5]. This may be influenced by lifestyle and dietary habits [6], which is also confirmed by our study. The association between BMI and dental caries is still a topic of discussion because not all studies have found a positive relationship between BMI and dental caries [7]. Most studies have found a positive or negative correlation between dental caries and BMI [8]. It is suggested that the contradictory results may be due to variations in genetic susceptibility to caries and obesity, lifestyle, and dietary habits, which are unique to each individual.

Dietary habits significantly contribute to obesity and the incidence of dental caries. Dietary patterns such as increased consumption of non-alcoholic beverages, fast food, and refined sugars have led to substantial dietary changes in populations being considered common risk factors for obesity and dental caries. The relationship of dental caries with unhealthy eating habits and the development of obesity at a young age has been reported [9]. Plaque accumulation, dietary habits, and oral hygiene have a decisive impact on the incidence of dental caries, represented by the DMFT index [9].

### Conclusion

The study has shown the considerable role of diet and eating habits in overweight and obese patients regarding the development of dental caries in such patients. A strong and significant correlation has been found between the incidence of dental caries, oral hygiene habits, and diet.

### **Acknowledgments**

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## **Tinnitus and daily discomfort**

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### **Abstract**

**Purpose:** Tinnitus has a direct influence on the mood, habits and affects the quality of life of patients, that is why timely diagnosis and treatment of this condition are a priority. Individual perception of tinnitus is related to psychological and general health factors. Many authors discuss disorders in patient comfort, a consequence of tinnitus. Accent is placed on the various factors influencing the full daily life of patients suffering from tinnitus.

**Aim:** To examine the quality of life in terms of daytime concentration, duration of tinnitus, suicidal thoughts and other factors in patients with tinnitus.

**Material and methods:** The object of the study are 152 patients who passed through the clinical halls of the Faculty of Dental Medicine - Varna, University Medical and Dental Center and the audiovestibular laboratory. All patients were clinically examined and evaluated on various indicators. The assessment of tinnitus was performed using a specialized questionnaire, which is completed by the patient. Results: 65.3% of the patients indicate that they are more irritable in their relations with family and friends due to tinnitus. 73.3% of the surveyed patients indicated that they were afraid that the noise could harm their physical health. 68.7% found tinnitus to be so unpleasant that they could not ignore it. Only 7.3% of patients report having suicidal thoughts related to the duration of tinnitus.

**Conclusion:** Considering tinnitus as a cause of emotional distress and suicidal thoughts, we would also point out tinnitus as a severe diagnosis with an unfavorable outcome.

**Key words:** discomfort, tinnitus, daily life, disorders

### **Introduction**

The general condition of patients with tinnitus, as well as their daily comfort, can be affected by treatment with removable and fixed prosthetic constructions and a number of other factors [1, 2, 3]. Tinnitus can also be a result of disturbances in occluso-articulation relationships after prosthetic treatment [4, 5] and disbalance of occlusal forces in patients of different ages [6, 7]. Tinnitus has a direct influence on the mood, habits and affects the quality of life of patients. Individual perception of tinnitus is related to psychological and general health factors [8]. Many authors [9, 10] discuss disorders in patient comfort, a consequence of tinnitus. Accent is placed on the various factors influencing the full daily life of patients suffering from tinnitus.

### **Aim**

The aim of the present study is to examine the quality of life in terms of daytime concentration, duration of tinnitus, suicidal thoughts and other factors in patients with tinnitus.

### **Materials and methods**

The object of the study are 152 patients who passed through the clinical halls of the Faculty of Dental Medicine - Varna, University Medical and Dental Center and the audiovestibular laboratory at the Faculty of Dental Medicine – Varna for a period of two years (2019 - 2020).

All patients were clinically examined and evaluated on various indicators. The assessment of tinnitus was performed using a specialized questionnaire, which is completed by the patient. The purpose of this questionnaire is to determine whether tinnitus has any effect on patients' mood, habits and behavior. The

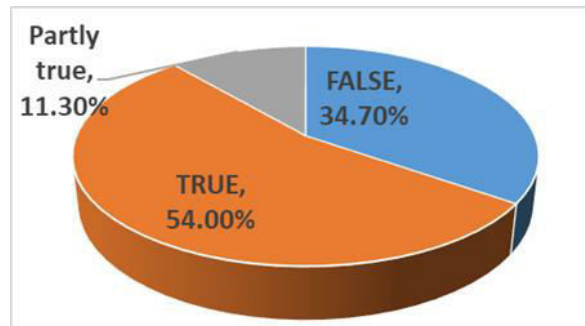
questions are evaluated on a three-point scale: 0 – false, 1 – partly true and 2 – true. The points are summed in a general assessment, which determines the degree of influence of tinnitus:

- I degree of severity - minor violations - 0 - 7 points;
- II degree of severity - moderate violations - 8 - 12 points;
- III degree of severity - serious violations - 13 - 18 points;
- IV degree of severity - very severe violations - 19 - 24 points.

The clinical study was conducted after obtaining permission from the Commission on Ethics of Research at the Medical University - Varna. All participants in the study signed an informed consent. The results were processed with SPSS v. 20.0, using the following analyzes: dispersion analysis, variation analysis - arithmetic mean  $\pm$  standard deviation (mean $\pm$ SD), correlation analysis - Pearson's ratio and Spearman's ratio, regression analysis - univariate linear regression, risk analysis - Odds Ratio (OR), comparative analysis (hypothesis evaluation)–  $\chi^2$ , F and t-test, graphic and tabular method of representing the obtained results.

## Results

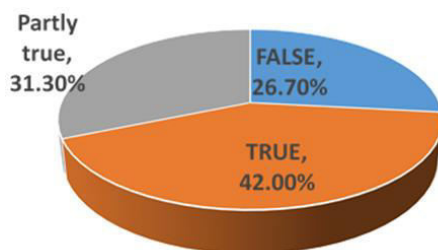
About 2/3 (65.3%) of the patients indicate that they are more irritable in their relations with family and friends due to tinnitus (Fig. 1).



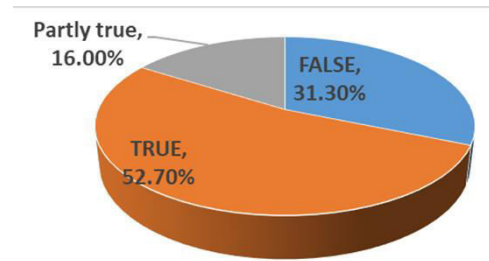
**Fig. 1. Because of the tinnitus I am more irritable in the family and with friends.**

All-day tinnitus is typical for 16.3%. 14% feel victimized by this noise. About 3/7 (73.3%) of the surveyed patients indicated that they were afraid that the noise could harm their physical health (Fig. 2), without establishing a connection with sex and the performed prosthetic treatment. The majority of patients (68.7%) found tinnitus to be so unpleasant that they could not ignore it.

Nearly 70% of patients report having difficulty falling asleep due to tinnitus. In the analysis of sleep difficulties and tinnitus by sex, it was found that women find it harder to fall asleep than men (88.5% for women and 58.2% for men;  $p < 0.001$ ) (Fig. 3).



**Fig. 2. I am afraid that the noise may damage my physical health.**



**Fig. 3. Comparative analysis of patients' opinions by gender and difficulty falling asleep due to tinnitus**

## **Discussion**

Hearing impairments are the most important risk factors for the development of tinnitus. Other diseases such as brain tumors, neck injuries, temporomandibular dysfunction or emotional disorders, usually covered by other disciplines (eg neurology, psychiatry, orthopedics, cardiology, dentistry or neurosurgery), may be critically involved in the etiology and diagnostics of tinnitus [11]. Therefore, the requirements for comprehensive diagnosis and treatment of tinnitus can only be met through an integrated multidisciplinary approach.

Although there are differences in the prevalence reported in the literature, in all studies the prevalence of tinnitus was higher in patients with TMD (temporomandibular dysfunction) (35,8% to 60,7%), than in patients without TMD (9,7% to 26,0%) [12]. This suggests that pathological changes in TMJ play a crucial role in the development of tinnitus. Older age, hearing loss and male gender are confirmed as risk factors for the development of tinnitus [13]. However, our findings show that female patients with TMD have a higher risk of tinnitus than men with TMD.

According to our study, irritability and lack of concentration are mostly commented as factors that disrupt the daily comfort of patients. Other authors point out sleep disturbances and feelings of exhaustion as the main complaints of patients with tinnitus [14, 15]. There are also publications where patients believe that tinnitus seriously damages their physical health, doubt whether they will ever recover, and even have suicidal thoughts [16]. In our studies, this percentage is relatively low (7.3%). Patients may also report facial pain or headache, and these symptoms are one of the most common forms of TMJ dysfunction, and most specialists often misdiagnose these symptoms. It is a risk factor for the pathology of tinnitus, which is the subject of our study. The influence of emotional factors on the development of temporomandibular joint dysfunction and the frequent accompaniment of otolaryngological symptoms should also be noted.

## **Conclusion**

Tinnitus itself is not a life-threatening condition, but it can be the first sign of potentially dangerous diseases that can even become life threatening if not diagnosed and treated. Considering tinnitus as a cause of emotional distress and suicidal thoughts, we would also point out tinnitus as a severe diagnosis with an unfavorable outcome.

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## **Direct oral anticoagulants. Dental update**

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### **Abstract**

**Purpose:** Specific guidelines for dental treatment of patients taking direct oral anticoagulants are still missing. **Material and methods:** A comprehensive search of the PubMed and Scopus databases was conducted to identify studies on the topic. **Results:** Eight studies were included in the review. **Conclusions:** The possible bleeding complications in concomitant intake of DOAC are manageable with local haemostasis measurements.

**Key words:** direct oral anticoagulants, dabigatran, rivaroxaban, apixaban, edoxaban, bleeding, oral surgery.

### **Introduction**

Limitations of the long-time used *warfarin* and *acenocoumarol* led to the fast implementation of the direct oral anticoagulants (*Dabigatran, Rivaroxaban, Apixaban, Edoxaban and Betrixaban*). Specific guidelines for DOAC therapy and dental treatment still vary significantly for each DOAC <sup>[1]</sup>.

#### **Direct oral anticoagulants are two main groups:**

##### **1. Direct thrombin inhibitors (F II )**

**Dabigatran (Pradaxa 110 / 150mg twice daily)** reaches peak plasma concentration for 1-3 hours with elimination half-life 12 to 17 hours. Dabigatran has **an antidote: Idarucizumab** (Praxbind®) registered May 2016, completely reverses the anticoagulant effect of dabigatran within per minutes. Indicated in emergency procedures and life-threatening or uncontrollable bleeding. <sup>[2,3,5]</sup>.

##### **2. Direct Factor Xa Inhibitors**

**Rivaroxaban (Xarelto 10/15/20mg once daily)** reaches peak plasma concentration for 2-3 hours and has a half-life of 6-8 hours. Factor Xa returns to normal after 24 hours. There is no known antidote of rivaroxaban. <sup>[1,4,8]</sup>.

**Apixaban (Apixaban, Eliquis 2.5 / 5 mg )** reaches peak plasma concentration for 3-4 hours with a half-life of 9-12 hours. <sup>[1,4,8,9]</sup>. On March 1, 2019 the European Medicines Agency (EMA) approved Ondexxya (andexanet alfa) - the first antidote to factor Xa inhibitors – **apixaban and rivaroxaban**. Indicated in life-threatening or uncontrollable bleeding <sup>[3, 6]</sup>.

**Betrixaban (Dexxience 40 - 80mg once daily)** is approved by FDA on June 2017. Due to an increased risk of bleeding and absence of an antidote in 2018, did not receive an authorization from the European Medicines Agency (EMA) <sup>[1,4,6]</sup>.

**Edoxaban (Lixiana 15 mg, 30 mg, 60 mg once daily)** Edoxaban reaches peak plasma concentration for 1-2h and has a half-life 10 - 14 hours. <sup>[13]</sup>

### Protocol for outpatient dental surgical treatment in patients on direct anticoagulation

Bleeding risk assessment includes:

1. Bleeding risk according to the **dental treatment (Table №1)**.

*Table №1. Dental procedures and risk of bleeding <sup>[1]</sup>*

Dental procedures with a low risk of bleeding	Dental procedures with a moderate risk of bleeding	Dental procedures with a high risk of bleeding
Local anesthesia by terminal, intraligamentary or wire anesthesia Wire anesthesia	Simple tooth extractions (1-3 teeth) Intraoral incision and drainage Subgingival curettage	- Extractions of more than 3 teeth; complicated surgical extractions; gingival/periodontal; pre-prosthetic surgery, periradicular surgery; extending the clinical crown; dental implants; biopsy.

2. **The individual risk of bleeding** is determined through HAS-BLED index – Table №2.

(Bleeding complication is considered in case of prolonged, excessive or uncontrolled, by initial haemostatic measures).

*Table №2. HAS-BLED index for evaluation risk of bleeding <sup>[7]</sup>*

	<i>A risk factor</i>	<i>Points</i>
H	Hypertension	1
A	Impaired kidney or liver function	1 or 2
S	Stroke	1
B	Previous heavy bleeding	1
L	Volatile value of INR	1
E	Age >65 years	1
D	concomitant antithrombotic therapy/NSAIDs; Alcohol intake $\geq$ 8 drinks/week	1 or 2
	Maximum index	9

#### Laboratory control

No routine test is useful in determining the degree of anticoagulation. At urgency, thrombin clotting (TT) and ecarin clotting time (ECT) are the most sensitive tests determination on anticoagulation. Edoxaban prolongs prothrombin time (PT) and activated partial thromboplastin time (aPTT). <sup>[13,17,18]</sup>

#### Drug interruption time before dental surgical treatment

Considering the elimination life of DOACs, if dental treatment with a **moderate risk of bleeding** is necessary, the morning dose on the day of the dental treatment with a twice-daily intake (apixaban, dabigatran) should be skipped. A single morning dose (rivaroxaban, betrixaban) should be delayed and in evening dose (rivaroxaban, betrixaban) no change is needed as long as 6 hours have passed since the dental treatment <sup>[1,3]</sup>.

In procedures *with a high risk of bleeding* or *other factors increasing the risk of bleeding*, a preoperative interruption may be necessary after consultation with the treating physician for 2–4 days (Table № 3) <sup>[1, 8]</sup>

Table № 3. Direct oral anticoagulants

Characteristic	Dabigatran (Pradaxa)	Rivaroxaban (Xarelto)	Apixaban (Eliquis)	Betrixaban
Mechanism of action	direct thrombin inhibitor (F II)	direct F Xa inhibitor	direct FXa inhibitor	Selective direct Xa
Dosage	<b>150mg twice daily</b> CrCl 30 - 50 ml/min; or high bleeding risk <b>110mg twice daily</b>	CrCl $\geq$ 50 ml/min <b>20 mg once daily</b> At CrCl 30-49ml/min <b>15mg once a day</b>	CrCl $\geq$ 50 mL/min <b>5 mg twice daily</b> At CrCl 50-25 ml/min <b>2.5mg twice daily</b>	CrCl $\geq$ 50 mL/min <b>80 mg once daily</b> CrCl 15-30 ml / min : <b>40mg once daily</b>
Interruption time before dental surgical treatment	CrCl $\geq$ 80 ml/min – <b>12 – 24h before treatment</b> CrCl 50-80 ml/min - <b>24-48 hours before treatment</b> CrCl 30-49 ml/min - <b>48-72 hours before treatment</b>	CrCl > 50 ml/min <b>12 - 24h before treatment</b> CrCl 30-50 ml/min <b>48 hours before treatment</b> CrCl <30 ml/min - contraindicated.	CrCl > 50 ml/min <b>12 - 24h before treatment</b> CrCl 30-50 ml/min) <b>48 hours before treatment</b> CrCl <30 ml/min - contraindicated.	CrCl > 30 ml / <b>19-27h before treatment</b>
Resumption of therapy after dental treatment	At low risk of bleeding: <b>6-8</b> hours after surgery. At high risk of bleeding: <b>48 - 72</b> hours after surgery.	At low risk of bleeding: <b>6-8</b> hours after surgery. At high risk of bleeding: <b>48 - 72</b> hours after surgery.	At low risk of bleeding: <b>6-8</b> hours after surgery. At high risk of bleeding: <b>48 - 72</b> hours after surgery.	At low risk of bleeding: <b>6-8</b> hours after surgery. At high risk of bleeding: <b>48 - 72</b> hours after surgery.
Monitoring	Extended TT Prolonged aPTT Thrombin clotting time	Extended RT A modified Anti-Xa test specific for rivaroxaban	Extended RT A modified Anti-Xa test specific for apixaban	
Antidote	<b>Idarucizumab</b> (Praxbind) 2.5g/50ml	Ondexxya (andexanet alfa)	Ondexxya (andexanet alfa)	None

★ The last ones guidelines recommend stopping on dabigatran for 5 days at CrCl patients \_ from 31–50 ml / min and bigger of 5 days at patients with CrCl <30 ml / minADP [1, 16].

The planned dental surgical treatment should be *at the beginning of the day* to control immediate bleeding and *at the beginning of the week* to control late bleeding. **The volume of the surgical procedure:** extraction of a 3 teeth per visit, or a small-volume surgical procedure. **Local haemostasis:** The surgical intervention should be maximally atraumatic with the use of a **local hemostatic measures** (collagen/ gelatin sponge, suturing of the wound). **Parenteral hemostasis:** In case of active bleeding in the absence of a specific antidote, prothrombin complex concentrate, fresh frozen plasma, or four-factor prothrombin complex can be administered [1,5]. **Pain control:** Paracetamol is considered the safest analgesic in concomitant anticoagulant treatment [1,8]. **Resumption of therapy with DOAC after dental treatment:** - At low risk of bleeding: 6-8 hours after surgery; - At high risk of bleeding: 48 - 72 hours after surgery.[1, 8].

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## **Impact of diabetes mellitus on oral-dental health- a case report**

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### **Abstract**

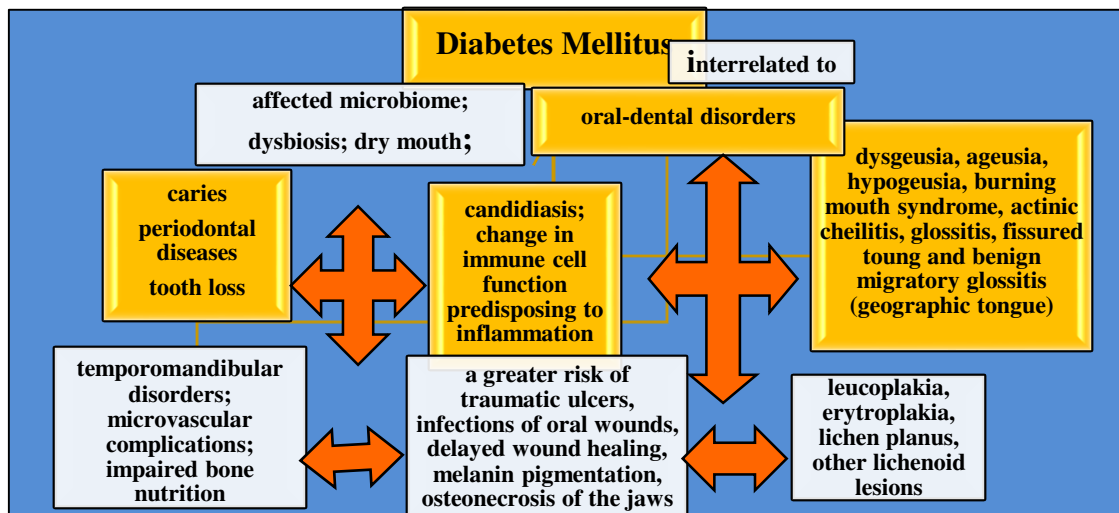
Researchers focus on the fact that the incidence and prevalence of type 1 diabetes are increasing in the world. Based on the WHO Type 1 diabetes is characterized by insufficient insulin production and is associated to the necessity of daily application of insulin. Lots of scientists accentuate the bi-directional associations between oral health and diabetes mellitus. The state of dysglycaemia afflicts on oral-dental health. In parallel, oral infections related to local and systemic inflammatory responses, exercise impact upon blood glucose levels. The aim is to analyze the interrelation between Diabetes Mellitus and the condition of hard teeth structures and gingival tissue in child's age. By application of definite diagnostic criteria is established that it concerns a patient with a caries non-resistant early mixed dentition. Based on the clinical parameters of PLI, GI and PBI we assess a state of a moderate to a severe degree of generalized plaque-associated gingivitis modified by the endocrine disorder of Diabetes Mellitus type 1. The adequate and efficient management of such interdisciplinary healthcare problems is associated to the need of combined efforts, competence and knowledge of medicine and dental medicine doctors directed to the improved quality of life on individual and population level.

**Key words:** diabetes mellitus type 1, children, oral health, plaque-associated gingivitis

### **Introduction**

In the context of a meta-analysis has been established that the incidence of type 1 diabetes amounts to 15 per 100,000 people and the world-wide prevalence is 9.5% under conditions of 95% of confidence interval (CI) and statistical significance. Researchers focus on the fact that the incidence and prevalence of type 1 diabetes are increasing in the world. As a consequence, there is a risk for the insulin to be with limited access, especially in underdeveloped and developing countries [1]. In 2021 8.4 million people around the world were diagnosed with type 1 diabetes. There has been outlined a tendency the number of the affected people to be elevated to 17.4 million by 2040. Based on medical statistics' investigations performed by the International Diabetes Federation there has been established a prognosis of rising burdens of the world-wide distribution of diabetes mellitus equal to 1.6% of the total population for the period between 2019 and 2045 [2]. Based on the WHO Type 1 diabetes (insulin-dependent, juvenile or childhood-onset) is characterized by insufficient insulin production and is associated to the necessity of daily application of insulin. Type 1 Diabetes Mellitus symptomatically corresponds to polyuria, polydipsia, constant hunger, weight loss, vision changes and fatigue. These symptoms may be clinically manifested suddenly [3]. The systemic complications of diabetes mellitus, determined as "the silent killer", include cerebrovascular disease, heart attack, permanent kidney damage, peripheral neuropathy, retinopathy and blindness, diabetic food infections [1-3]. Lots of scientists accentuate the bi-directional associations between oral health and diabetes mellitus. The state of dysglycaemia afflicts on oral-dental health. In parallel, oral infections related to local and systemic inflammatory responses, exercise impact upon blood glucose levels. These relationships are presented in fig. 1 [4-8].

Fig. 1. Interrelation between diabetes mellitus and oral-dental disorders [4-8]



### Aim

Analysis of the interrelation between Diabetes Mellitus and oral-dental state in child's age.

### Material and methods

A declaration of an informative consent is signed by a parent of the subject in child's age. The oral examination is conducted under conditions of artificial light using a periodontal probe with an atraumatic edge and a dental mirror. The caries index dft/DMFT is applied for recording: decayed primary and permanent teeth, respectively d and D; filled primary and permanent teeth- indicated with f and F; M- for registration of the missing permanent teeth. The plaque index PLI Silness-Löe is utilized for the evaluation of the thickness of the bacterial plaque in the cervical zone on four surfaces (vestibular, lingual, mesial and distal) of the representative teeth 16, 62, 64, 36, 82 and 84. No plaque accumulated on the tooth surface is equal to 0. A thin layer of plaque adhering to the gingival margin and the cervix of the tooth scratched by a probe, but not visible with an unaided eye amounts to the figure of 1. A moderate quantity of dental plaque is registered with the figure 2. A thick layer of plaque accumulated on the gingival margin and cervical zone of one or more of the four teeth surfaces corresponds to the figure of 3. The gingival index GI Löe-Silness is based on the following scoring criteria: 0- healthy gingiva; 1- slight oedema and hyperaemia of gingival tissue; 2- oedema and hyperaemia of gingiva accompanied by provoked bleeding; 3- oedema, hyperaemia and spontaneous bleeding of gingiva. All the values of PLI and GI recorded on the examined surfaces of the Ramfjord teeth are summarized and divided by 24. Scores of PLI in the range between 0.1 and 0.9 correspond to good oral hygiene state; rating in the interval from 1.0 to 1.9 is indicative for fair oral hygiene state; values from 2.0 to 3.0 are equivalent to poor oral hygiene condition. Values of GI in the interval between 0.1 and 1.0 is interpreted as a mild degree of gingivitis. A moderate degree of gingivitis corresponds to scores from 1.1 to 2.0. The index of GI in the range from 2.1 and 3.0 is indicative for a severe degree of gingivitis [8, 9]. The clinical parameter of Papillary Bleeding Index by Saxer and Muhlemann (PBI) is applied for evaluation of the state of gingival tissue based on the predisposition of gingiva towards bleeding. An atraumatic periodontal probe penetrates into the gingival sulcus on the base of papilla and moves in coronal direction mesial and distal towards the top of the papilla. In the first and third quadrant of the dentition PBI is recorded on the palatal, respectively lingual surface. In the second and fourth quadrant PBI is registered on the vestibular surface. The percentage value of PBI from 10% to 30% corresponds to localized gingival inflammation. Scores of PBI higher than 30% are associated to conditions of

generalized gingivitis [8, 9]. A recording of the anamnestic data of the child is performed with the active participation of its parents.

### **Case description**

**Clinical case:** A clinical case of a male at the age of 6 years and 5 months suffering from Diabetes Mellitus type 1.

**Anamnestic data:** The endocrine disorder was diagnosed at the age of 1 year and 6 months. Based on the anamnestic data is established a non-balanced dietary regime, with improper control of blood glucose. The child uses regularly fluorides'-containing tooth paste, but sometimes skips evening tooth brushing procedures. The patient uses neither a mouth wash, nor interdental flosses. The subject visits the dental office only in emergency. Besides the registered behavioral traits, the frequent hospitalizations of the child related to the common health disorder of diabetes mellitus on the background of the low educational qualification of the parents and low social-economic status of the family are the environmental variables associated to the high risk of tooth decay.

### **Clinical examination**

The subject of the current clinical case report is with diagnosed traumatic stage of Early Childhood Caries. It concerns a patient under conditions of caries non-resistant early mixed dentition. The epidemiological index of dft equals to 60% due to the primary teeth 55, 54, 52, 51, 61, 62, 64, 65, 75, 74, 84, 85, affected by non-complicated and complicated carious lesions. The index of DMFT amounts to 50% due to the newly-erupted first permanent molars 16 and 26 with established carious lesions. The lower first permanent molars 36 and 46 have to be regularly examined based on the definitely high risk of initiation and progression of a carious process. The score of the plaque index PLI is equal to 1.46, indicative for fair oral hygiene level. In parallel, the gingival index GI amounts to the value of 1.96, which corresponds to the moderate to severe degree of gingival inflammation. The clinical parameter of PBI is calculated on the level of 85%, that is associated to a generalized gingivitis. The established considerably higher value of GI compared to PLI corresponds to the diagnosis of a moderate to a severe generalized plaque-associated gingivitis modified by the endocrine disorder of Diabetes Mellitus type 1.

### **Discussion**

Diabetes mellitus is characterized as one of the most widely distributed chronic disease that afflicts the oral health. Scientists established that the level of the epidemiological index DMFT in the children suffering from type 1 diabetes was significantly higher compared to the controls ( $p < 0.001$ ) [6]. Researches accentuated the enhanced incidence of gingival inflammation among patients with type 1 diabetes, even under conditions of not considerable accumulation of dental plaque. Authors ascertained the predominant role of caries risk factors in diabetic children, especially these with poorly controlled diabetes in comparison to healthy participants. The state of these patients require increased frequency of oral inspections and implementation of prophylactic programs, as well as thorough investigations in the future [6, 7, 9]. In the context of a study devoted to the specifics of oral-dental health of children with diagnosed diabetes mellitus type 1 some specific interrelations were accentuated. The diabetic children were characterized by accelerated dental development till the age of 10 years and a delay after the age of 10. Diabetic children and adolescents were more considerably affected by gingival inflammation, confirmed by the application of the clinical indicators of PLI and GI. The values of these parameters demonstrated statistical differences between both of the groups [7]. In a great number of researches were ascertained higher plaque levels and higher incidence of chronic gingivitis both in adults and in children suffering from diabetes. A definitely higher risk of periodontitis has been evaluated among children with type 1 diabetes [6, 7, 9].

## **Conclusion**

The adequate and efficient management of such interdisciplinary healthcare problems is associated to the necessity of combined efforts, competence and knowledge of medicine and dental medicine doctors directed to the improved quality of life on individual and population level in the context of complex prophylactic cares.

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## **Sublingual lipoma - a diagnostic challenge**

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### **Abstract**

**Purpose:** Lipomas are benign tumors of adipose tissue, commonly found in the human body, and much less commonly - in the oral cavity. The presented case report aims to highlight the possible intraoral location of such masses, which is crucial for making an accurate diagnosis. **Materials and methods:** The described clinical case of sublingual lipoma in a 73-year-old man was characterized as a slow-growing, painless mass in the left sublingual region. Due to the significant size of the mass, the patient had difficulties in eating and speaking. Making an accurate diagnosis was a challenge for the clinician due to the atypical location of the lesion in this case. **Results:** The sublingual lipoma was removed under local anesthesia by extirpation of the mass together with the capsule and preservation of the surrounding structures. **Conclusion:** In very rare cases, lipomas can involve the floor of the mouth, which makes it difficult to make a provisional diagnosis due to the clinical presentation, which is similar to that of other tumors affecting this area. Therefore, it is necessary to know the typical sites of these lesions and to differentiate them from other similar masses.

**Key words:** lipoma, floor of the mouth, benign tumor

### **Introduction**

Lipomas are relatively common benign tumors of mesenchymal origin. In about 15-20% of the cases, lipomas are found in the head and neck region. Their incidence in the oral cavity is much lower and they account for 1 to 5% of all benign oral lesions(1). The etiology of oral lipoma is unclear. However, several factors have been considered, such as mechanical and endocrine factors, inflammation, obesity, chromosomal abnormalities, radiation, injury, chronic irritation, etc.(2). A case of oral lipoma of viral genesis associated with Human Papilloma Virus (HPV) has been described in the literature(3). In the oral cavity, they clinically present as a well-demarcated, slow-growing lesion, the consistency of which varies from soft to dense, with dimensions rarely exceeding 20 mm in diameter(3–5). Common locations of lipomas in the oral cavity include: parotid region, buccal mucosa, tongue, submandibular region, palate, floor of the mouth, etc.(2,4–6). In their study on 125 lipomas in the oral and maxillofacial region, Furlong et al. found only 5 cases in the floor of the mouth(7). Histologically, in its classic form, a lipoma presents as a neoplasm composed of mature adipocytes, usually surrounded by a thin fibrous capsule(7,8). Clinically, oral lipomas are asymptomatic and are most often found incidentally during a routine preventive examination. As the size of the mass increases, speech and eating difficulties may occur(9–11).

### **Case report**

A 73-year-old male patient presented with complaints of a mass in the left sublingual region. The patient reported that the swelling had appeared about 5 years earlier and had gradually increased in size over that period. Due to its large size, the tumor caused eating and speaking difficulties for the patient. A mass with dimensions of about 3 x 5 cm, involving the left sublingual region, was found on examination. In relation to the surrounding tissues, the mass was pedunculated to the frontal area of the mandible, reaching distally to the first lower molar (Fig. 1). The lesion had a smooth surface and was well-demarcated, rounded, without change in the overlying mucosa, under which yellowish matter was visible

in places. There were no ulcerations and signs of inflammation (Fig. 2). Clinical examination by palpation found a painless tumor with a soft elastic consistency, not adherent to the surrounding tissues. Submandibular gland kneading resulted in secretion of a normal amount of clear saliva. No aspirate was obtained by fine-needle aspiration biopsy. Orthopantomography showed that the mass was connected neither to the jaw nor to the dentoalveolar apparatus (Fig. 3).

Surgical removal of the lipoma was performed by dissection and preservation of the underlying structures; the adipose mass was removed together with its capsule. No complications occurred during the healing period. The histopathological analysis found mature adipose tissue enclosed in a thin fibrous capsule, from which fine fibrous septa originated and spread through the benign tumor. In addition, thin-walled hyperemic vessels were found in the capsule and adipose tissue. The morphological picture corresponds to the histological diagnosis of a benign mesenchymal tumor of adipose tissue – lipoma (Fig. 4).

### **Discussion**

Lipomas are one of the most common mesenchymal masses, which affect mainly the dermis, and are more typically found in the skin of the back, limbs, neck and face. In significantly rarer cases, such masses can be observed in the oral cavity, and at the same time, they are one of the rarest mesenchymal tumors in this region, accounting for just under 4.4%(6,12). The incidence of oral lipoma is highest between the fifth and sixth decades of life(10,12–14). In the case described by us, the oral lipoma affected the sublingual region. In such cases, because of the uncommon location, the clinician's attention is not always focused on this type of pathology. The development of such lesions is clinically asymptomatic, features slow growth, and depends on the location of the lesion. They may remain unnoticed by the patient for a long time, which can cause a delay in making an accurate diagnosis. During its development, a sublingual lipoma may interfere with the patient's nutritional status, speech and tongue movement, as in the presented clinical case. In some cases, muscle dysfunction and loss of sensation due to compression of a branch of the trigeminal nerve may occur along with these symptoms(9). More often, oral lipomas appear as soft, lobulated or smooth yellowish masses that can be moved, with a dough-like consistency. Due to the vague clinical presentation, the period from the onset to seeking medical help varies significantly - from one month to 10 years, and a case of 50-year evolution has been described in the literature(13,15). In addition to the patient's history and the objective clinical examination, ultrasonography, magnetic resonance imaging (MRI) and computed tomography (CT) can be used as paraclinical tests to make an accurate diagnosis(1,9). The gold standard for the diagnosis of lipomas is histopathological analysis(12). Several histological types of lipomas have been identified – classic lipoma, its variants (fibrolipoma, angiolipoma, osteolipoma, chondroid lipoma, myolipoma, spindle cell lipoma, sialolipoma, myxoid lipoma), diffuse lipomatosis, hibernoma; classic lipoma and fibrolipoma are the most common of these variants, and hibernoma is the rarest(4,10,12,13,16). On ultrasonography, a lipoma appears as an oval or elliptical hypoechoic mass with a partially or completely intact capsule. Tumors in the floor of the mouth can be a diagnostic challenge, which is why it is necessary to take a thorough history and make a thorough examination of the affected region. Such a mass can be a diagnostic issue due to the development of a secondary process as a result of the obstruction of the excretory salivary duct and the formation of a mucocele or ranula. Despite their common characteristics, a superficial oral lipoma has a yellowish tinge and intact salivary secretion, with no aspirate on aspiration biopsy, while a retention cyst is bluish-white in color and saliva is present in the formed cystic cavity. Treatment of oral lipomas includes extirpation of the mass together with the capsule, after which recurrence is extremely rare. The cases of recurrence observed in intramuscular lipomas can be explained by the fact that they are not well-demarcated and not encapsulated, due to which radical surgical excision cannot be achieved, whereby parts of them remain

connected to the muscle fibers(4). Oral lipomas in the floor of the mouth should be removed by radical excision, taking care not to affect the surrounding anatomical structures in the area.

### **Conclusion**

It is not uncommon for the clinician to encounter a number of lesions involving the floor of the mouth, so knowing the pathological processes and their registration in the course of development are extremely important. Although in rare cases, an oral lipoma may affect the sublingual space, therefore, when assessing the changes, this benign process should be considered as a differential diagnosis. In this regard, the use of additional paraclinical methods (CT, MRI, ultrasonography) and confirmation of the clinical diagnosis by histopathological analysis are of paramount importance for the subsequent treatment plan.



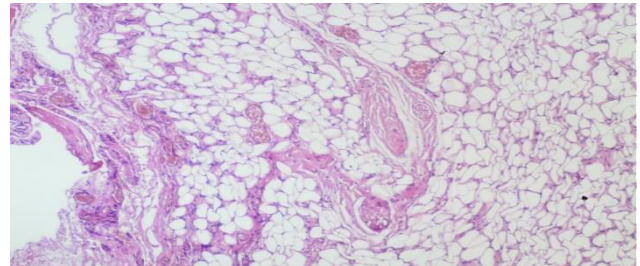
**Fig.1 Preoperative clinical examination**



**Fig.2 Oral lipoma involving the left sublingual region**



**Figure 3 Orthopantomography of the patient**



**Fig.4 Histopathological analysis (x 100). Adipocytes separated by fibrous septa spreading through the tumor**

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## **Customized titanium abutment- advantages and disadvantages**

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### **Abstract:**

**Introduction:** The dental implant abutment - temporary /permanent, functional and aesthetic is the main connecting element between the implant and the implant prosthetic restoration. Appropriately selected type, material and design of abutment, alongside with precise implant supra-structure implementation guarantee successful implant supported restoration. **Aim:** This presentation demonstrates the fully digital application, advantages and disadvantages of customized titanium abutments. **Materials and methods:** Implant supported restoration was applied to a 42-year-old patient with fractured tooth 46 and missing tooth 47 using customized titanium abutments. **Result:** The fully digital application of customized titanium abutments allowed all structural, biological, functional and aesthetic factors to be optimally considered in planning and creation of implant supra-structure. **Conclusion:** The customized titanium abutment allows specific 3Dimensional design of transmucosal part that aim to achieve preservation of the existing alveolar bone and soft tissues. Together with their other advantages, biological compatibility of titanium alloys and a wide range of construction solutions, they ensure a predictable and long-lasting result.

**Key words:** fully digital application, peri-implant soft tissue (PIST), customized titanium abutment (CTA), implant supra-structure (ISS), emergence profile (EP)

**Introduction:** Implant prosthetics is based on in-depth knowledge, accumulated clinical experience and respect for the peri-implant tissues - alveolar bone and mucosa. Along with the prosthetically guided 3D positioning of the implant and the provision of sufficient supporting alveolar bone, a very important factor is the correctly planned and executed transmucosal part of the implant supra-structure. Being in contact with the peri-implant mucosa, the latter is responsible for preserving its architectonics, biological stability and barrier function regarding the body internal environment. Stock abutments have standardized dimensions and geometric shapes, which under certain conditions limit their application and usually require modification according to the particular clinical case. The customized abutment became popular immediately after the introduction of the so-called “UCLA abutments”. Critical to these abutments is the inherent error in a cast method and the risk of compromise implant/abutment connection [1]. Computer-aided design/computer-aided manufacturing (CAD/CAM) technology allows restorative dentists to create a custom-made restoration including customized titanium or zirconium abutment production .

The **purpose** of this work is to describe a case of two replaced by implants teeth, restored using fully digital application of customized titanium abutments and discuss the advantages and disadvantages of the latter.

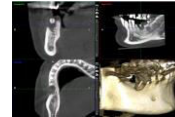
### **Materials and methods:**

A 42-year-old female patient, in good general health, non-smoker, complained of periodic swelling and dull pain in the area of tooth 46. Intraoral examination revealed that tooth 46 is an abutment in a three-unit porcelain fused to metal (PFM) bridge, restoring missing tooth 47. The soft tissue in the area was red and swollen, suppuration was present, probing depth was over 10mm at the buccal site of distal root of 46. The radiographic examination confirmed the suspicion of a fractured tooth 46 root , which determined its unfavorable prognosis. The prosthetic treatment plan included: removal of PFM bridge (48, -, 46); extraction of tooth 46; placement of implants in the position of teeth 46 and 47 and their

prosthetics. The patient signed an informed consent to proceed with the treatment plan. (Fig.1, Fig.2)



**Fig. 1 Clinical status:**  
**lower right quadrant, 40 days after 46 extraction**

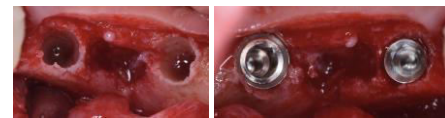


**Fig.2 CBCT revealed a large lesion located around distal root of tooth**

Atraumatic extraction of tooth 46 was followed by very careful debridement and saline rinsing of the medial root socket and the bone defect formed around the distal root of the tooth from granulation tissue. 40 days later, with an epithelialized post-extraction area, an intraoral scan was performed (i Tero element, Align Technology, Inc), which, together with the cone-beam computed tomography (CBCT) allowed digital planning the position of the future implants and making a teeth-supported surgical guide. (Exocad, Darmstadt, Germany), (Fig.3). Two implants were placed in tooth 47 position 4,7 mm × 10 mm ISQ 79 and tooth 46 position 4,1 mm × 10 mm ISQ 74 Tapered Screw-Vent, (Zimmer Biomet Dental, Warsaw, USA). The osteotomy of the implant bed was done with Versah burs (Versah, the osseodensification company, Jackson, USA), which ensured the maximum amount of autogenous bone around the implant in position 46 (Fig.4). The horizontal bone deficiency was restored with bone substitute Puros Allograft Cortical Particulate 0,25-1,0mm, membrane Copi Os Pericardium Membrane (Zimmer Biomet Dental, Neunkirchen, Germany).



**Fig.3 Implant site, teeth supported surgical guide**



**Fig.4 Implant placement, following correct 3D orientation**

Customized healing abutments made by implant temporary abutments (Zimmer Biomet Dental, Warsaw, USA) and PMMA were fixed. Their design is consistent with the dental anatomy which corresponds to the transmucosal part of the implant supra-structure on the one hand, and provides sufficient supra-implant space for the formation and stabilization of the blood clot on the other hand. The flap margins were adapted and fixed to tightly fit the customized healing abutments (Fig.5). Six months later, we had osseointegrated implants and peri-implant soft tissue, with architectonics matching the future implant restoration (Fig.6)



**Fig.5 Customized healing abutment (milled by PMMA) preparation, fixation to the implant, ensuring healing and creating the soft tissue architectonick at the same time**

An intraoral scan with scan body was done and sent to Zimmer milling center (Fig.7). Zfx, Gen-Tek Pre-milled Abutment blanks were used for the production of Customized Titanium Abutments (CTA), the design of which copies the one already created by the customized healing abutment and implant provisionals (Fig.8). They were clinically tested for correct fit to implants and peri-implant soft tissue, and two splinted full-contour zirconium crowns were made to allow screw fixation of implant supra-structure.

The crowns were cemented to the customized titanium abutment with Multilink (Vivadent Ivoclar, Liechtenstein) and the whole screw-retained implant supra-structure of two implant crowns and abutments was fixed to the implant with 20N/cm loading. The access to the screw was blocked using PTFE (polytetrafluoroethylene) and composite on top following the occlusal morphology. Clinical and

radiographic evidence shows a good integration of implant prosthetic restoration to the implants (Fig.9).



**Fig. 6 Intraoral scanning monitoring during osseointegration**



**Fig.7 Having the PIST bed prepared for final prosthetic stage, impression was taken**



**Fig. 8 CTA design follows tooth geometry, created by healing abutment. CTA was milled by pre-milled Ti alloy blanks. CTA in place, correct crown margin position.**



**Fig. 9 Full contour split zirconium crowns cemented on CTA**

The success criteria observed during year 1 were inspected both clinically - intraoral scan (i Tero element, Align Technology, Inc) and radiographically.

### **Result:**

The fully digital application of customized titanium abutments allowed all structural, biological, functional and aesthetic factors to be optimally considered in planning and creation of implant supra-structure.

### **Discussion:**

There are a number of advantages that support the use of customized titanium abutments in implant prosthetic restoration: **The material** they are made of - Titanium has good mechanical stability, low density, high strength/weight ratio and excellent corrosion resistance. Alloyed with Aluminium 6%, Vanadium 4% iron 0,25% and oxygen 0,2% to well-known 5 grade Ti alloy is widely used for biomedical application. Compared to other grades, Grade 5 Ti Alloy has better mechanical properties and is suitable for dental implants and abutments. Biological tolerance measured through ions serum concentration months and years after implantation shows results below toxicity level as well as hypersensitivity rarely observed [2].

**Customized abutment design.** Three parts of implant abutment can be defined- implant connection segment, transmucosal segment and prosthetic segment. As part of customized titanium abutment, prosthetic segment could be fully individualised in shape and size following the relation to the adjacent teeth, opposing teeth and anatomy of the restored teeth.

**Optimized emergence profile:** Optimal EP should be related to the implant position, supra-implant mucosa characteristics. When discussing an implant abutment EP we must be aware that the shape and dimensions of this component have a significant long-term impact on the level of the peri-implant hard and soft tissues. Improper abutment EP design will compromise the blood supply to the area, ultimately leading to loss of health and volume of the peri-implant tissues. Correctly created, it supports the papilla and the free mucosal margin while at the same time allowing the formation of the necessary biological space. There are many different outlines of the emergence profile contour and each one should be individually coordinated with the features of peri-implant soft tissue. The fourth advantage is related with **construction possibilities.**

Bio-mechanical properties of customized titanium abutment are guaranteed since the material is pre-fabricated homogenous mass processed under strictly controlled conditions. Moreover, the software developed for customized abutments [3] design and fabrication facilitates the **laboratory workup** and clinical protocol. The CTA is **monolithic piece** which makes distribution of stress and load better, as well as volume ratio between prosthetic and transmucosal part of abutment.

**Implant angulation correction:** Large discrepancies in the angulation of the implant and the abutment can result in weakening its mechanical resistance or inability to be used. Customized abutments are able to correct angulation when implants are placed in tilted positions and, compare to stock abutments, provide better potential for ideal crown contours and peri-implant soft-tissue support, leading to optimal aesthetic result. [4,5]

The implant crown could be cemented or screw retained on CTA. Last but not least is **correct crown margin position** - just below the mucosa margin, which make removing of excess cement easily controlled. The crown /CTA interface is remote from the implant platform while in customized zirconia supra-structures the connection between the titanium base and the abutment is located at a smaller distance. The main disadvantage of CTA is the aesthetic problem in case of thin biotype, related to colour of the titanium alloy and two-part implant supra-structure.

**Tabl.1 CTA- advantages/disadvantages**

ADVANTAGES	CTA-advantages/disadvantages		
MATERIAL	5 Grade Ti Alloy	mechanical properties	biological tolerance
CUSTOMIZED ABUTMENT DESIGN	fully individualised prosthetic segment off abutment		
OPTIMIZED EMERGENCE PROFILE	papilla and free mucosal margin support		biological space formation
COSTRUCTION POSSIBILITIES	laboratory workup		monolithic piece
	implant angulation correction		correct crown margin position
DISADVANTAGES			
AESTHETIC OUTCOME	titanium alloy colour		

**Conclusion:**

The Customized titanium abutment allows specific 3Dimensional design of transmucosal part that aim to achieve preservation of the existing alveolar bone and soft tissues. Together with their other advantages, biological compatibility of titanium alloys and a wide range of construction solutions, they ensure a predictable and long-lasting result.

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## **Behaviour and anxiety assessment of children aged 4-6 in dental treatment with Brix 3000**

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### **Abstract**

#### **Aim**

Behaviour assessment through Frankl scale and anxiety via Facial Image Scale of children aged 4-6 in treatment of dentin carious lesions of primary teeth with Brix 3000.

#### **Materials and Methods**

72 children aged 4-6 are the subject of the current study, having at least one approximal carious lesion ICDAS II code 05. The children are separated in two groups: group 1 – 42 children, enzyme excavated with Brix 3000 and group 2 (control group) – 30 children, conventional preparation treatment.

#### **Results**

Following excavation with Brix 3000, children with positive attitude towards dental treatment, according to Frankl, are increasing in comparison with the initial study, significantly more than those in the control group.

During the anxiety assessment using the Facial Image Scale significantly higher number children are registered at level 1 after treatment with Brix 3000.

#### **Conclusion**

Enzyme excavation with Brix 3000 leads to a decrease in anxiety levels during childhood dental treatment.

**Key words:** *Brix 3000, Frankl, Facial Image Scale*

### **Introduction**

The implementation of high quality dental care in childhood depends, largely, on the behavior of the children. The factors that could have impact on the child are social, the social-economic status of the family, training, socialization [1].

Three different terms are used in the dental medicine: fear, anxiety and phobia of dental treatment [2].

The dental anxiety is one of the most frequent problems in the treatment of children and it is associated with negative expectations, relating to traumatic experiences, negative attitude in the family, fear of pain and trauma, as well as previous unsuccessful and painful treatment [3]. According to Eitner, the refusal of treatment leads to increasing dental anxiety and an increase in the amount of carious lesions [4].

The chemio-mechanical means of excavation are an effective alternative to the conventional ones for the removal of carious dentin with chemical means. They act selectively and are self-limiting by chemically breaking down the affected dentin [5,6].

A new material, called Brix 3000, has been produced. It is a gel which contains papain 3000 U/mg 10%. The papain is bio-capsulated by using the exceptional EBE technology (Encapsulating Buffer Emulsion) that immobilizes and ensures stability and increases the enzyme activity [7,8].

#### **Aim**

Behaviour assessment through Frankl scale and anxiety via Facial Image Scale of children aged 4-6 in treatment of dentin carious lesions of primary teeth with Brix 3000.

#### **Materials and methods**

72 children aged 4-6 are the subject of the current study, having at least one approximal carious lesion ICDAS II code 05. The children are separated in two groups: group 1 – 42 children, enzyme excavated with Brix 3000 and group 2 (control group) – 30 children, conventional preparation treatment.

Algorithm for the conduct of standardized dental treatment and assessment of the children's behavior

1<sup>st</sup> visit – the parents receive detailed information on the psychological tests which are going to be used.  
2<sup>nd</sup> visit – Behavior assessment in accordance with Frankl scale as well as anxiety assessment using Facial Image Scale. To influence the child's behavior in a dental environment the 'Say, Show, Do' method is applied, explaining to the child what Brix 3000 is and how it works in simple terms. Minimally invasive treatment is conducted on a preselected approximal dental carious lesion code 05 ICDAS II on the first or second molar.

## Results

### Before treatment

The results demonstrated that there is no statistically credible difference in the behaviour of the children in accordance with Frankl scale before treatment, irrespective of the forthcoming treatment method. There is also no difference in the children examined in terms of anxiety, evaluated through Facial Image Scale.

### After treatment

Table № 1 shows a comparative analysis of the behaviour according to Frankl's scale, between the two groups.

**Table 1. Behaviour according to Frankl after treatment with Brix 3000**

After treatment	Behaviour according to Frankl scale									
	Definitely negative		Negative		Positive		Definitely positive		Total	
	N	%±sp	N	%±sp	N	%±sp	N	%±sp	N	%
Group 1	0	0%	8	19.05±6.06	24	57.14±7.64	10	23.81±6.57	42	100%
Group 2	0	0%	12	40±8.94	16	53.3±9.11	2	6.7±4.55	30	100%
Pearson Chi-Square=16.364 <sup>a</sup> p<0.05										

Following excavation with Brix 3000, children with definitely positive attitude towards dental treatment, according to Frankl, are increasing in comparison with the initial study, significantly more than those in the control group.

Table № 2 demonstrates a comparative analysis of dental anxiety according to Facial Image Scale, between the two groups.

**Table 2. Dental anxiety according to Facial Image Scale**

After treatment	(Facial Image Scale)										Total	
	5 <sup>th</sup> level		4 <sup>th</sup> level		3 <sup>rd</sup> level		2 <sup>nd</sup> level		1 <sup>st</sup> level			
	N	%±sp	N	%±sp	N	%±sp	N	%±sp	N	%±sp	N	%
Group 1	0	0%	2	4.76±3.29	15	23.81±6.57	9	21.43±6.33	16	38.10±7.49	42	100%
Group 2	0	0%	8	26.7±8.07	14	46.67±9.11	6	20±7.30	2	6.7±4.55	30	100%
Alternative T-test			t=2.51 p<0.05		t=0.93 p>0.05		t=0.15 p>0.05		t=3.58 p<0.05			
Pearson Chi-Square=32.913 <sup>a</sup> p<0.05												

During the anxiety assessment using the Facial Image Scale after treatment, no children are registered in both groups with anxiety level 5 (the saddest person), whereas a significantly higher number of children are registered at level 1 (the happiest person) with Brix 3000 excavation.

## Discussion

Following the implementation of enzyme excavation with Brix 3000, a tendency to improve the behavior of the patients towards the dental treatment, examined according to Frankl, was noticed. When comparing both methods – with a bur and with Brix 3000, it could be observed that the enzyme method is well-received by the children since there is a noticeable increase in the number of highly positive children, as per Frankl.

We also obtained similar results by the self-assessment of the children using the Facial Image Scale for assessing the dental anxiety. When concluding the enzyme excavation with Brix 3000, again, there was a trend toward a reduction in treatment anxiety and children's preference for more smiling faces. Comparing the enzyme preparation method with the conventional one, we found that Brix 3000 excavation resulted in a more significant reduction in dental treatment anxiety than bur preparation.

Many studies can be identified in the literature for assessing children's fear and anxiety towards dental treatment using various tests. A study of 90 children aged 4-6 assesses the fear in accordance with four different scales. According to each of them, children experience fear and anxiety before treatment. They also reach the conclusion that the fear of dental treatment is more often observed in younger children [9]. *Abreu et al* assess the dental anxiety in children by comparing three different methods via Facial Image Scale. The results obtained are the following: the fear of dental treatment is the greatest immediately before the initiation of the procedure in all three methods of excavation. Fear levels after excavation are mostly reduced in the atraumatic technique of excavation [10]. All the referenced studies match our results.

### **Conclusion**

1. After the conclusion of the chemio-mechanical excavation with Brix 3000, the number of children with highly positive behavior in accordance with Frankl's scale increases depending on their initial status, in comparison to the children after conventional cavity preparation;
2. In using the chemio-mechanical excavation with Brix 3000 in treatment of primary teeth, a reduction of anxiety of children could be observed, registered through the Facial Image Scale, in comparison to the conventional cavity preparation with a bur.

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## **Microorganisms in the treatment of carious lesions of primary teeth with brix 3000**

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### **Abstract**

**Aim** Researching the microbial associations isolated from carious, partially infected, affected and sound dentin in treatment of primary teeth using Brix 3000.

**Materials and Methods** 42 carious lesions of primary molars, treated with Brix 3000 were divided into three groups: group 1 – 10, excavated to healthy dentin; group 2 – 10, excavated to affected dentin, group 3 – 22 cases of closed asymptomatic pulpitis, excavated to partially infected dentin.

**Results** In 57 % of the clinical cases, the microbial associations of cariogenic microorganisms consist of 2 microorganisms, with *S. mutans* present in each of them. In 13.36 % of the closed asymptomatic pulpitis cases, microbial associations with 3 and 4 microorganisms could be observed.

Following excavation to partially infected dentin in the pulpitis, *S. mutans* is individually isolated in more than 2/3 of the cases. After excavation to sound and affected dentin, no microorganisms are isolated. No microbial growth in either of the cases could be observed in 3 months.

**Conclusion** In the course of excavation, the microorganisms is substantially lowered while being minimally preserved in partially infected dentin, and lacking both in affected and sound dentin.

**Key words:** microorganisms, carious lesion, Brix 3000

### **Introduction**

The concept of the development of the dental caries changes over the centuries, especially with the inclusion of microorganisms in its etiology since 1800. With the evolution of the contemporary opportunities for the identification, cultivation and determination of the quantities of the different microorganisms, the studies focus on specific microorganisms having major contribution in the initiation and development of the carious process [1,2].

One of the hypotheses for the development of the dental caries claims that only gram-positive microorganisms, e.g. *S. mutans*, *S. sobrinus*, *Lactobacillus spp.*, cause it. This hypothesis is based on studies where only these microorganisms are isolated – this is called the specific plaque hypothesis. It is known today that dental caries could be developed with only small amounts of these microorganisms. This leads to the inception of the ecological plaque hypothesis of Phil Marsh. According to his hypothesis, the dental caries is due to an imbalance of the bacterial types leading to a change in the local conditions of the environment as well as to a dysbiosis. The microorganisms connected to the caries could also be found in healthy dental structures but in very small quantities incapable of causing a disease [3,4].

A new material, called Brix 3000, has been produced. It is a gel which contains papain 3000 U/mg 10%. The papain is bio-capsulated by using the exceptional EBE technology (Encapsulating Buffer Emulsion) that immobilizes and ensures stability and increases the enzyme activity. In this way, a higher efficiency of proteolysis is achieved in order to remove the collagen tissue in the degraded tissue, a higher antibacterial and antifungal activity, as well as a higher antiseptic effect on the tissues [5,6].

### **Aim**

Researching the microbial associations isolated from carious, partially infected, affected and sound dentin in the treatment of primary teeth using Brix 3000

**Materials and methods**

42 carious lesions of primary molars are the subject of the current study, treated through a combined methodology of cavity preparation and excavation with Brix 3000, divided into three groups: group 1 – 10, excavated to healthy dentin; group 2 – 10, excavated to affected dentin, group 3 – 22 cases of closed asymptomatic pulpitis, excavated to partially infected dentin. Microbiological samples are taken before carious dentin excavation, following excavation and after 3 months. The sow is executed on a blood agar, on a selective agar for lactobacilli, and in a Brain-Heart infusion broth environment.

**Results**

Table No 1 demonstrates the microbial associations from carious dentin before treatment with Brix 3000.

**Table 1. Microbial associations from carious dentin before treatment**

Microbial associations	Type microorganisms	Asymptomatic closed pulpitis		Deep dentin carious lesions		Total
		N	%	N	%	
1 MO 12 cases	<i>S. mutans</i>	6	14.75%	4	9.8%	29.5%
	<i>S. epidermidis</i>	0	0%	2	4.95%	
2 MO 24 cases	<i>S. mutans + S. mitis</i>	2	4.76%	0	0%	57.14%
	<i>S.mutans+S.parasanguis</i>	2	4.76%	0	0%	
	<i>S.mutans+Lactobacillus spp</i>	2	4.76%	12	28.57%	
	<i>S. mutans+Actinomyces viscosus</i>	2	4.76%	0	0%	
	<i>S.mutans+S.epidermidis</i>	2	4.76%	0	0%	
3 MO 4 cases	<i>S. mutans+S.sanguis+ S. parasanguis</i>	2	4.76%	0	0%	9.52%
	<i>S.mutans+Lactobacillus spp+ S. mitis</i>	2	4.76%	0	0%	
4 MO 2 cases	<i>S.mutans+Lactobacillus spp+S.sanguis+Neisseria</i>	2	3.84%	0	0%	3.84%

The microbial associations in deep dentin carious lesions are mainly represented by two microorganisms (*S. mutans + Lactobacillus spp.*) In 6 cases, one microorganism is isolated (*S. mutans* or *S. epidermidis*). In closed asymptomatic pulpitis the microbial associations are more diverse. In 6 cases *S. mutans* is isolated separately. In 10 cases there are microbial associations containing two microorganisms, with *S. mutans* being in a combination with different one. In 13.36 % of the cases, microbial associations with 3 and 4 microorganisms could be observed.

Table 2 demonstrates the microbial associations from partially infected dentin after excavation with Brix 3000.

**Table 2. Microbial associations from partially infected dentin after excavation**

Microbial associations	Type microorganism	Closed asymptomatic pulpitis	
		N	%
1 MO	<i>S. mutans</i>	16	72%
2 MO	<i>S. mutans + S. sanguis</i>	2	9.4%
	<i>S. mutans + S. epidermidis</i>	2	9.4%
	<i>S. mutans + S. mitis</i>	2	9.4%
Total		22	100%

Following excavation to partially infected dentin in the pulpitis, *S. mutans* is individually isolated in more than 2/3 of the cases, whereas a combination with another microorganism is isolated in a total of 6 cases.

After excavation to sound and affected dentin at deep dentin carious lesions, no microorganisms are isolated.

No microbial growth in either of the cases could be observed in 3 months.

### Discussion

Our results demonstrate that microbial associations from two MO could be found in the carious dentin in 57 % of the cases, with 1 MO in in about 30 % of the cases, whereas with three and four – in only six cases, only in closed asymptomatic pulpitis. It is noteworthy that *S. mutans* is present in all combinations. The complex microbial associations are identified mainly in pulpitis. After excavation of the carious dentin, the variety of MOs is significantly lowered. In partially infected dentin combinations of only 2 MOs could be observed, with *S. mutans* being present again. In 16 of the cases *S. mutans* is isolated only from the partially infected dentin. This undoubtedly shows its participation in the progression of the carious lesion and its microbial resistance in the deep layers of already excavated carious dentin to certain levels.

Studies prove the antimicrobial activity of papain, which is the main component of Brix 3000. Goyal *et al* compared the conventional method of preparation with the enzyme method, examining 25 children from 5 to 9 years of age. Microbiological samples were taken before and after excavation of the carious dentin. The results they 176 obtained were a significant reduction in the number and quantity of *S. mutans* and *Lactobacillus spp* [7]. Similar results were obtained by other authors who found a reduction in the amounts of *S. mutans* and *Lactobacillus spp*. [8]. These results support ours. There is evidence in the literature that papain can inhibit bacterial growth because it can cleave peptide bonds in microorganisms to dipeptides and amino acids. The enzyme papain, which belongs to the group of sulfhydryl proteases, has a sulfhydryl residue in its active spot that acts on the bacterial cell wall and cytoplasmic membrane. This also accounts for its antimicrobial action [9].

### Conclusion

A greater variety of microbial associations could be observed in closed asymptomatic pulpitis in comparison with a deep dentin carious lesion in primary teeth. In the course of excavation, the microorganisms is substantially lowered while being minimally preserved in partially infected dentin, and lacking both in affected and sound dentin. In 3 months no microorganisms are isolated.

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**Comparative evaluation of microhardness on artificial enamel lesions on smooth surfaces after application of three contemporary agents: an in-vitro study**

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**Abstract**

**Aim.**The objective of the current work is to compare the effect of self-binding peptide P<sub>11-4</sub>, casein phosphopeptide-amorphous calcium fluoride phosphate, and caries infiltration on artificial enamel lesions on smooth surfaces after pH-cycling in a bioreactor system using surface microhardness investigation. **Materials and Methods.** This is a randomized ethics-approved in vitro study. Artificial caries lesions were assessed by enamel surface microhardness evaluation at baseline level (B-SMH), after demineralization (D-SMH), and 21 days after pH-cycling model (C-SMH). **Results.** The average scores of the SMH categories were not statistically different between groups. **Conclusion.** In the conditions of this study, all three contemporary agents showed an improvement in enamel microhardness, without statistically significant difference between them. The SAP P<sub>11-4</sub> group shows a better effect compared to CPP-ACFP, Caries infiltration and the control group.

**Key words:** Initial caries, pH-cycling, surface microhardness

**Introduction**

Treating artificial early enamel lesions is a critical modality in modern dental practice. Selecting an appropriate protocol for treating white spots lesions (WSLs) and accurate and reliable monitoring of the lesion dynamics are crucial to avoid further operative treatment. The methodology of investigation the treatment effects in the majority of studies is focused on the mechanical or radio-graphical changes of caries lesion, such as microhardness testing and microradiography where the results mainly reflect the changes in mineral content of caries lesion[1–3]. The commercially available products for treatment of WSLs - MI Varnish, Curodont Repair and ICON, have been proved as efficient. Though, their efficacy has not been compared, especially after pH cycling in a bioreactor, which was the aim of our study.

**Materials and methods**

A total of 48 specimens from premolars extracted due to orthodontic reasons from patients aged 14 to 20 years were included in this research. The surface microhardness of the enamel specimens was measured using a digital Vickers microhardness tester (Tukon 1102, Wilson Hardness, Germany). The load applied was 100 g, with an indentation time of 10 s. Artificial caries lesions were created by subjecting the specimens to 5 days demineralization in an acidified solution. All 48 samples were randomly divided into 4 groups of 12 each: Curodont Repair (Credentis AG, Windisch, Switzerland) -

Group CR; CPP-ACPF (MI Varnish GC Corporation, Tokyo, Japan) Group V; Infiltration of low viscosity resin - ICON Vestibular (DMG, Hamburg, Germany) - Group I; Control group, no treatment - Group NT; After treatment of the samples with the indicated means, according to their protocol of application, a model of pH-cycling in a bioreactor system was applied (CDC Biofilm Reactor) to recreate as realistically as possible the conditions of the oral environment typical of childhood. The pH cycling was carried out for a period of 7 days(Active incubation- under the following conditions: temperature 37 °C; stirring speed of the medium - 120 rpm; growth medium flow (artificial saliva) - 11ml / min ), with demineralization attacks (20% sucrose) being 5 per day (20 minutes each, in total), corresponding to 3 main meals and 2 snacks, while at rest during the day and at night, the solution was maintained alkaline by means of a remineralizing solution, i.e. artificial saliva with a pH of 7,2. The remaining 14 days are passive incubation (constant temperature and stirring). Depending on the sample distribution, quantitative data were presented as by mean and standard deviation (mean ± SD) or median and interquartile range (IQR). Shapiro-Wilk test was applied to inform about the distribution. One-way ANOVA was used to compare means of normally. A 2-sided p-value of <0.05 was considered statistically significant. Statistical analyses were performed using SPSS Statistics v. 26 software (IBM Corp. Released 2019. Armonk, NY: USA).

### Results

Measurements of central tendency and spread as well as the test statistics were summarized in Table 1. The average scores of the SMH categories were not statistically different between groups. SMH baseline measurements were consistent among groups. Although lacking statistical significance in comparison to the means of the other groups, the greatest demineralization score (117.34±48.48) and the highest remineralization score (160.16±51.15) were reported in the CR Group. The means of the SMH categories were statistically significantly different for all within group comparisons (Table 1).

**Table 1. Descriptive and inferential statistics**

Group†	B-SMH mean±SD	D-SMH mean±SD	C-SMH mean±SD	Difference between SMH measurments within groups	
CR	286.80±51.04	117.34±48.48	160.16±51.15	→ RMA	0.000
V	295.08±46.79	99.71±27.95	149.23±47.37	→ RMA	0.000
I	294.70±47.25	84.85; 76.30*	112.55; 81.60*	→ Friedman's test	0.000
NT	290.48±47.25	105.10±24.02	113.25±37.48	→ RMA	0.000
	One-way ANOVA	Kruskal-Wallis test	Kruskal-Wallis test		
<b>Difference between SMH measurments between groups</b>	0.971	0.915	0.079		

\*median; IQR

## **Discussion**

Nowadays initial carious lesions can be treated non-invasively or minimally invasively, by new remineralization systems that either regenerate lesion body structure or provide ions favouring subsurface mineral gain[4]. The potential of CPP-ACP combined with fluoride to promote lesion remineralization has been demonstrated in a number of vitro and in vivo studies[5]. In early enamel lesions on smooth surfaces, infiltration with light-curing resin can cease their development or delay surgical treatment by several years[6]. The patented Curolox Technology with its Curodont product line claims to provide an opportunity for an effective, safe and non-invasive treatment of initial caries[7, 8]. The comparison between traditional remineralization and biomimetic regeneration, as earliest forms of treatment, and the application of resin infiltration, as an intermediate step between non-invasive and operative treatment, will shed further light on the non-operative clinical options for dental caries management. SMH analyses have been broadly used to assess the demineralization and remineralization changes that occur in the enamel. SMH evaluations are considered as simple, fast, and easy to measure in a nondestructive manner[1–3]. The rationale behind the pH-cycling model is based on mimicking the in vivo periodic alternation of pH, occurring in the oral cavity when sugars are metabolized, leading to caries formation [9, 10].

## **Conclusion**

The obtained experimental data using newly created protocol reveals that there is the good effect of the treatment with self-assembling peptide P11-4 , casein phosphopeptide-amorphous calcium fluoride phosphate, and caries infiltration on artificial enamel lesions, without statistical significant difference between.

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### **The influence of apical foramen preparation on intracanal cryotherapy- an *in vitro* study**

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#### **Abstract**

**Purpose:** In clinical endodontic practice, it has been found that even with the best possible diligence of the dentists, some patients are likely to experience pain after endodontic treatment. Intracanal cryotherapy appears to be a modern method to deal with this problem. **Materials and methods:** 30 extracted premolars were prepared with WaveOne Gold and were irrigated with 2.5°C 10 ml 0.9% NaCl for 5 min. Thermosensors were attached to the middle and apical root surfaces. **Results:** The time to reach a temperature difference of 10°C was significantly shorter for root canals prepared with the largest size of 45/.05. A temperature difference of 10°C between baseline and lowest recorded values is reached regardless of apical preparation size. **Conclusions:** The lowest temperature values are reached fastest with a wide apical preparation.

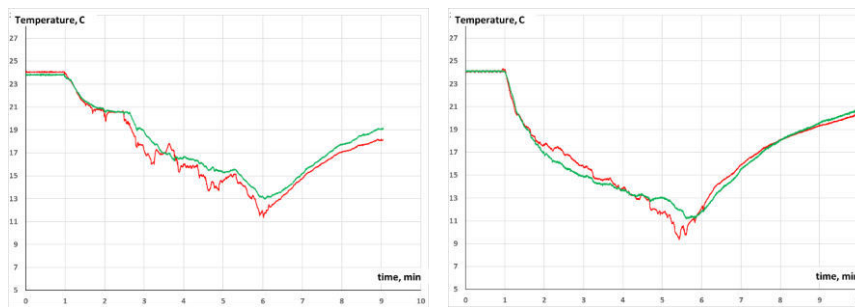
**Introduction:** No precise protocol for the conduct of cryotherapy in endodontics has been established. The volume of irrigation solutions varies from 5 ml [1,2], 10 ml [3,4] to 20 ml [5,6,7], as well as the duration - between 1 min [1,4] and 5 min [2,3,5,6,7]. The requirements for the preparation in order to achieve an adequate cryotherapeutic effect have also not been clarified. Although intracanal cryotherapy is an accessible and inexpensive method, further studies are still needed to establish specific and clearly defined parameters with precise control for safe use in clinical practice [8].

**Materials and methods:** 30 extracted single-root premolars were standardized to 15 mm root length. Preparation was performed with WaveOne Gold Primary 25/.07 for the first group, WaveOne Gold Medium 35/.06 for the second group, WaveOne Gold Large 45/.05 for the third group. Two lines were marked dividing the roots into 3 parts, each 5 mm, measured with an endodontic ruler. The teeth were fixed to a specially designed plastic stand. Thermosensors were attached to the middle and apical root surfaces. Experimental irrigation with 2.5°C 10 ml 0.9% NaCl for 5 min was done with EndoVac system. Syringes and Endovac microcannulas were kept in a tray with ice in a fridge until used. The syringe in use was wrapped in ice-gel during the experiment.



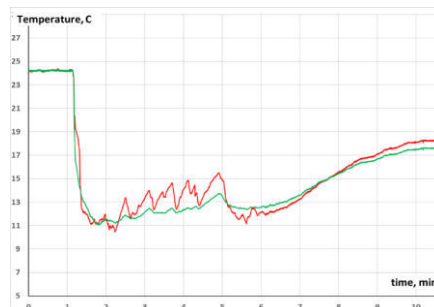
**Figure 1. Samples after endodontic treatment to apical size 25/.07, 35/.06, 45/.05**

**Results and discussion:**



**Figure 2. Temperature changes in dynamics during irrigation with 2.5°C 10 ml 0.9% NaCl at foramen 25/.07 (A) and foramen 35/.06 (B)**

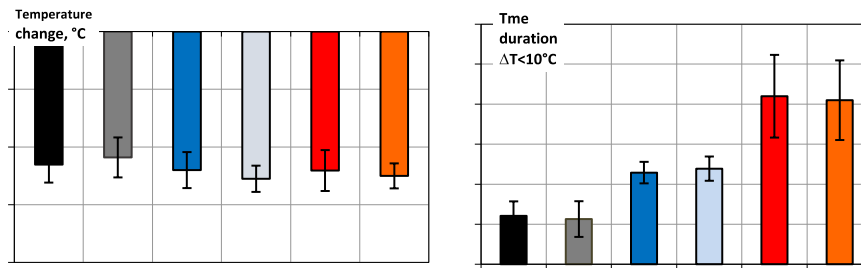
The aim of the present study was to determine the influence of the preparation and the size of the apical foramen on the cryotherapeutic effect of 2.5°C 10 ml 0.9% NaCl irrigation. Analysis of Fig. 2A demonstrates a gradual decrease in temperatures in both the middle and apical zones, a brief retention of the lowest temperatures, and a gradual recovery to the values originally measured. The fluctuations in temperatures are more distinct in the apical zone which is evidence of the effectiveness of the EndoVac system. The results obtained at apical foramen 35/.06, reflected in Fig. 2B, present a more rapid decrease in temperatures, a longer retention of the lowest values reached and a more gradual recovery to baseline values, compared to the results at apical foramen 25/.07. Temperature fluctuations for apical and middle thirds of root surfaces were similar to those at apical foramen 25/.07.



**Figure 3. Temperature changes in dynamics during irrigation with 2.5°C 10 ml 0.9% NaCl at foramen 45/.05**

The experiment at apical foramen size 45/.05 was characterized by the fastest decline in temperatures, the longest retention of the lowest values reached, and the most gradual rise in temperatures, compared to sizes 25/.07 and 35/.06 (Fig. 3). It can be concluded that at wide apical preparation size, the lowest temperature values are reached the fastest.

There was no statistically significant difference in the lowest temperatures reached in the apical and middle thirds of the root surface in all preparations. This result is indicative that cryotherapy is applicable and effective regardless of the size of the apical preparation (Fig. 4A). The time to reach a temperature difference of 10°C was significantly shorter for root canals prepared with the largest size of 45/.05.



**Figure 4. A) Lowest temperatures reached B) Retention time for a temperature difference of 10 degrees between initial and lowest temperature during irrigation with 2.5°C 10 ml 0.9% NaCl for apical and middle root surfaces at foramen 25/07, 35/06, 45/05**

The time for which temperatures were maintained 10°C lower than initial temperatures and the influence of the amount of apical preparation on this factor were also monitored. In the present study, this time was found to be the longest at over 4 min for the apical foramen 45/05 preparation (Fig. 4B).

De Gregorio et al. [9] analyzed the influence of apical preparation and taper on the volume of irrigation solution delivered to full working length at different canal curvatures using a negative pressure system. The authors concluded that apical preparation to 40/06 significantly increased the volume and exchange of irrigant to full working length, regardless of root canal curvature. Our results fully support this view by demonstrating that the lowest temperature values that persist for the longest time are obtained with apical foramen preparation at 45/05. Another *in vitro* study found that sodium hypochlorite did not diffuse into the apical 3 mm of working length, even after the apical foramen was prepared to instrument No. 30 [10]. At the same time, an *in vivo* study by Salzgeber [11] concluded that by increasing the size of the apical foramen to No.30 with a taper greater than 2%, the irrigation solution penetrated to full working length, even extruding into the periapical tissues. According to Schoeffel, both studies should be considered together, since apparently the critical apical size required to ensure complete penetration of the irrigating solution is No. 35 with a conicity greater than 2% [12]. This conclusion is consistent with the results in a study by Zehnder et al. who, using clear plastic blocks, showed that only after the apical foramen size reaches No.35 can one colored irrigation solution successfully mix with another during instrumentation [13]. The data of the present study correspond with the results of the aforementioned authors. No statistically significant difference was observed with respect to the desired 10°C temperature difference, which was achieved in all preparations. However, a significant difference was found in the rate of attainment and retention time of this difference. It was significantly faster for preparations 35/06 and 45/05. Therefore, for the irrigation solution to reach the apical zone it is critical that the apical preparation size is at least 35/06.

### Conclusions:

1. The lowest temperature values are reached fastest with a wide apical preparation.
2. A temperature difference of 10°C between baseline and lowest recorded values is reached regardless of apical preparation size.
3. The time to reach a temperature difference of 10°C is significantly shorter for canals with a wide apical preparation size.
4. The retention time for a temperature difference of 10° between the baseline and lowest values recorded is longest for wide apical preparation size.

### Acknowledgments:

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## **Combination of bleaching and resin infiltration for the treatment of dental fluorosis**

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### **Abstract**

Dental fluorosis is an enamel developmental defect that can negatively affect aesthetic appearance and patient's self-esteem. Aim: to present a clinical case of a young patient with moderate dental fluorosis treated by combination of bleaching and resin infiltration. Clinical case: A female patient, aged 14, presenting a moderate case of fluorosis (TFI-4), asked for esthetic improvement. The proposed treatment plan was entirely non-operative – a combination of in-office bleaching (BlancOne Click) and resin infiltration (Icon Vestibular, DMG). Results: A significant reduction of the brown discolorations was visible after bleaching and the colour of teeth was nearly completely harmonized after resin infiltration. The 3-year follow up showed stable results. Conclusion: The combination of bleaching and resin infiltration is a non-invasive approach for the treatment of moderate and severe cases of dental fluorosis.

**Key words:** bleaching, dental fluorosis, resin infiltration

### **Background**

Dental fluorosis appears as a range of visual changes in enamel causing tooth discoloration from white opaque areas scattered irregularly over the tooth to more severe cases of brown stains with discrete or confluent pitting and even corroded-looking appearance. Such enamel developmental defects negatively affect aesthetic appearance and patients' self-esteem. This is particularly true for young patients. For these cases, however, treatment plan has to be flexible and to present both an acceptable aesthetic result and tooth preserving approach. Resin infiltration has shown to be a micro-invasive treatment for white spots of different origin. In more severe cases of discolorations, combination of treatment options has to be considered.

### **Case description**

A young female patient, aged 14, presenting a moderate case of fluorosis, asked for aesthetic improvement of her upper frontal teeth (Figure 1a). Anamnesis revealed excessive fluoride intake during enamel development. Intraoral examination revealed fluorosis lesions on all teeth graded as TF-4, presenting regions of white opacities, as well as brown staining, mainly in the area of the incisal edge. Taking into consideration the patient's young age, the proposed treatment plan was entirely non-operative – a combination of in-office bleaching and resin infiltration. On the patient's and parents' desire, as well as because of a future orthodontic treatment necessary, only the upper central incisors were treated.

The treatment protocol of bleaching was performed with BlancOne Click (5, 6% hydrogen peroxide) (Figure 1b, 1c), applied for 10 min and photoactivated with Bluedent 12BL bleaching device. A desensitizing agent was applied. After a period of 3 weeks, resin infiltration was performed with Icon Vestibular, DMG, following the producer's instructions (Figure 1d).

After professional cleaning of teeth, etching gel (Icon Etch – 15% HCl) was applied for 2min, then rinsed with water spray for 30s and air dried. The etching step was repeated 3 times to gain sufficient access to the lesion body. In the next treatment step Icon Dry (99% alcohol ) was applied for 30s, also giving a preview of the future masking effect of the infiltrant. Infiltration was performed with Icon Infiltrant (TEGDMA) twice – first time for 3min, excess was removed, then lightcured 40s and second time for 1min and lightcured 40s. The final procedure was polishing using 3M SofLex polishing disks.

## Results

After the bleaching a significant reduction of the brown discolorations was visible. After the resin infiltration the colour of the central incisors was nearly completely harmonized. The patient was very satisfied with the final aesthetic look and the non-invasiveness of the procedure. The 3-year follow up showed stable results (Figure 2e).



**Figure 1. Case presentation – a) initial situation, b) bleaching, c) after bleaching, d) after resin infiltration and e) follow-up.**

## Discussion

The unaesthetic appearance due to dental fluorosis can have a negative effect on the patients' quality of daily life, psychological and social behavior [1]. Several techniques have been advocated to improve the aesthetic imbalance caused by dental fluorosis [2, 3]. Minimally invasive procedures include removing the surface-stained areas by enamel bleaching, microabrasion, and resin infiltration techniques alone [4] or in combination [5, 6, 7, 8], whereas invasive approaches include veneers and crowns. These methods have shown varying degrees of success and are chosen depending on the severity degrees of dental fluorosis, patient's selection, and the dentists' medical concept and technical level. Bleaching has become popular in recent years because it is safe, inexpensive, and minimally invasive and can remove external or internal discoloration from teeth [3]. Resin infiltration was originally developed to treat incipient caries and has also been recommended for the disappearance of white spot lesions. Resin infiltration can prevent the further progression of enamel lesions and stains because this treatment occludes the microporosities within the enamel by infiltration with low-viscosity light-curing resins that have been optimized for rapid penetration into the porous enamel. The performance or masking effect of resin infiltration in hypomineralized or carious enamel has been demonstrated to be effective for mild to moderate dental fluorosis. In-office bleaching before resin infiltration significantly enhances the masking effect of infiltration, allowing also moderate to severe cases to be still treated non-invasively [4, 5].

## Conclusion

The combination of bleaching and resin infiltration is a non-invasive approach for the treatment of moderate and severe cases of dental fluorosis, especially in young patients where tooth tissue preservation is of highest importance.

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## **Algorithm for prevention and follow-up of white carious lesions in patients with fixed orthodontic technique**

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### **Abstract**

**Purpose:** White carious lesions disrupt aesthetics and it is necessary to look for effective methods to influence them. The presence of orthodontic appliances in the oral cavity makes the bacterial microflora more acidogenic and elevated levels of *S. mutans* are found. This leads to increased caries in the conditions of unsatisfactory oral hygiene. The aim of the present study is to create an algorithm for the prevention of white carious lesions in patients with fixed orthodontic technique. **Material and methods:** The subject of the study are 67 children undergoing orthodontic treatment with braces, who were clinically examined and interviewed about hygienic and eating habits and behavior. **Results:** The largest relative share of children indicate that they brush their teeth twice a day. The analysis of the duration of brushing shows that girls brush their teeth the longest (2-3 min) ( $p < 0.05$ ). At the age of 16, the shortest duration of brushing was found. **Conclusion:** Plaque control during orthodontic treatment is a challenge. Therefore, training and motivation for oral hygiene are key factors for the success of treatment.

**Key words:** white spot lesions, prevention, fixed orthodontic treatment, algorithm

### **Introduction**

White carious lesions disrupt aesthetics. It is important for both the patient and the dentist to apply effective prevention against white carious lesions and inflammation of the periodontium, which could compromise both aesthetics and function, and thus the patient's self-esteem (Fig. 1).



**Fig. 1. Improper oral hygiene of a patient with orthodontic treatment.**

In the fixed technique with the placement of braces, space-maintainers, rings, arches, rubber bands, etc. more predilection zones are created for the accumulation of dental plaque, as it is difficult to conduct oral hygiene, and the self-cleaning of saliva is limited [1, 2]. All these changes help to increase the levels of cariogenic microorganisms mainly around the elements of the orthodontic appliance and adhesives [3]. It was reported that in the presence of orthodontic appliances in the oral cavity, the bacterial microflora becomes more acidogenic and elevated levels of *S. mutans* are found [4, 5]. The most reliable behavioral health indicator for patients with fixed orthodontic appliances is the level of oral hygiene. Patients should be well informed and competent about home oral health care and procedures to be carried out for the prevention of oral diseases, both in the treatment with prosthetic appliances and in orthodontic treatment [6].

### **Aim**

The aim of the present study is to create an algorithm for the prevention of white carious lesions in patients with fixed orthodontic technique.

### Materials and methods

The subject of the study in the study are 67 patients undergoing orthodontic treatment with a fixed orthodontic technique, who are further interviewed for a change in their behavior regarding hygiene and eating habits. The oral profile of children according to age, sex and change in hygiene and eating habits and behavior was studied. A survey was conducted using an original, direct questionnaire. The survey consists of 12 questions. Two of the questions are demographic, three questions are related to oral hygiene and the other seven questions are focused on the study of dietary preferences and changes in behavior after the placement of fixed orthodontic appliances. The patients were clinically examined and evaluated according to various indicators at the University Medical and Dental Center of the Faculty of Dental medicine – Varna. The results were processed with SPSS v. 20.0, using the following analyzes: dispersion analysis (ANOVA), variation analysis - arithmetic mean  $\pm$  standard deviation (mean $\pm$ SD), regression analysis - univariate linear regression, comparative analysis (hypothesis evaluation)- $\chi^2$ , F and t-test and graphic and tabular method of representing the obtained results. The clinical trial was conducted after obtaining permission from the Commission for Ethics of Scientific Research at Medical University –Varna. All participants in the study have signed an informed consent.

### Results

In the analysis of hygiene habits, we found that there is no significant difference in the behavior of boys and girls, but it can be said that girls brush their teeth more often (Fig. 2). The largest relative share of both boys (65.12%) and girls (56.72%) indicate that they brush their teeth twice a day - usually in the morning after sleep and in the evening before sleep.

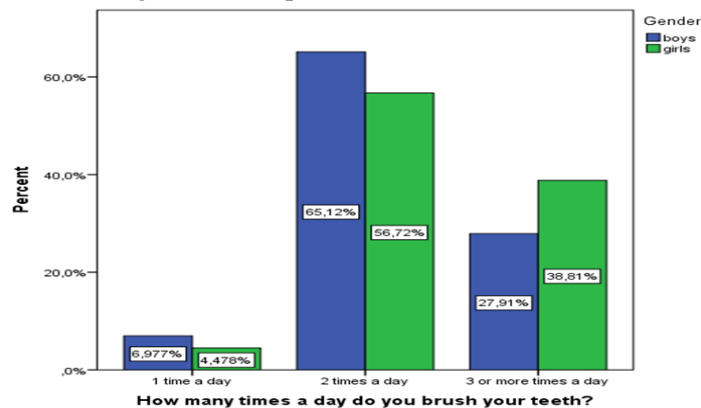
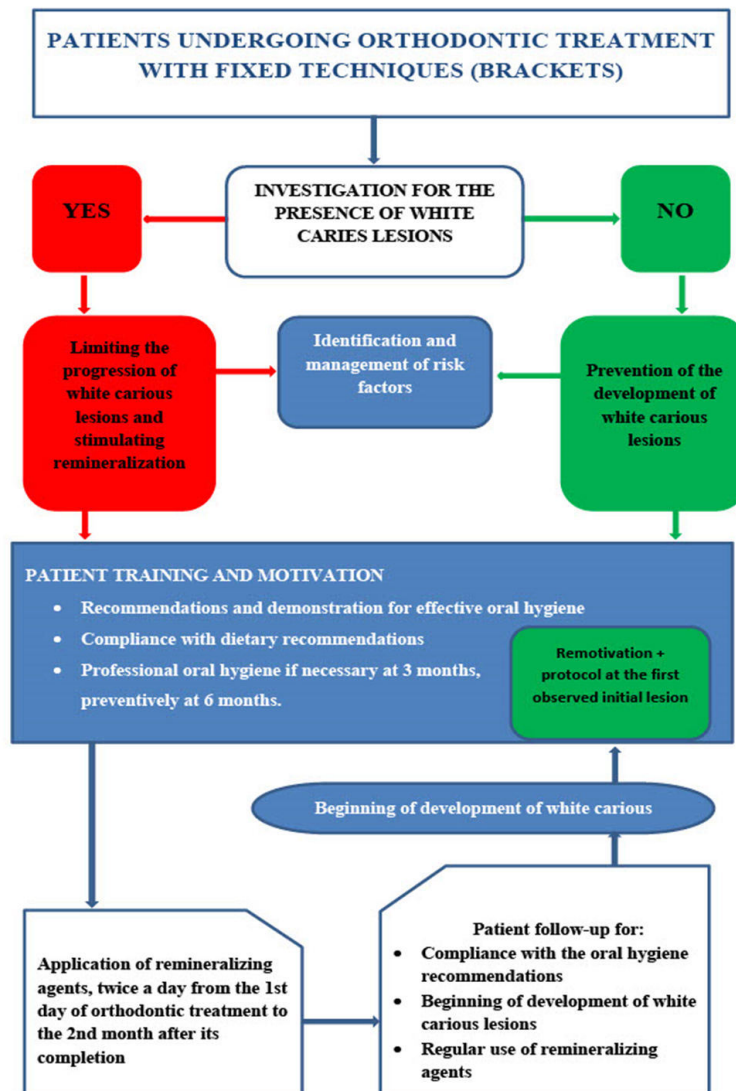


Fig. 2. Frequency of brushing teeth by gender.

Over ¼ (27.91%) of boys and over 1/3 (38.81%) of girls indicate that they brush their teeth three or more times a day, which suggests that they do so after each meal. The analysis of the duration of brushing shows that girls (71.43%) and children aged 12 (11.59%), 13 (21.74%) and 14 (21.74%) brush their teeth the longest (2-3 min) ( $p < 0.05$ ). At the age of 16, the shortest duration of brushing was found (40.0% brush their teeth for 1 minute), after which the duration of brushing began to increase again. This trend persists for both boys and girls.

Based on the data obtained from the survey and the summarized results of the studies, as well as the assessment of caries risk, an algorithm for prevention and follow-up of white carious lesions in patients with fixed orthodontic appliances was created (Fig. 3).



*Fig. 3. Algorithm for prevention and follow-up of patients performing treatment with fixed orthodontic technique.*

## Discussion

Prevention must first begin with training and motivating the patient to maintain oral hygiene and diet control. It is recommended to mechanically control the plaque by brushing at least twice a day, with a fluoride toothpaste 1450 ppm, especially in the areas close adjacent to orthodontic appliances. During follow-up visits, the patient's motivation should be reassessed and, if deemed necessary, professional oral hygiene should be performed and the patient should be remotivated (Fig. 3). Professional oral hygiene at 3 months in high-risk patients and at 6 months in low-risk patients reduces the risk of developing white carious lesions and helps maintain good oral hygiene.

Due to the high risk of developing white carious lesions (WSL) in patients with poor oral hygiene, it is imperative to improve the level of plaque control before starting orthodontic treatment. Teeth cleaning is more difficult and time consuming for patients with fixed appliances, so detailed instructions on oral hygiene are important in teaching them how to maintain adequate care at home - especially between the braces and the gingival margin [7, 8]. The frequency of brushing, the patient's age, the duration of treatment prior to wearing another fixed orthodontic appliance and the activity of the process are the main factors influencing the evolution of the lesions in the direction of progression, stationary or

regression. The specifics of the diet (preferences for liquid and sticky food) at the beginning of treatment make patients at risk for the initiation of white carious lesions.

### **Conclusion**

White carious lesions in patients undergoing orthodontic treatment should be managed using a multifactorial approach. The most important strategy is to prevent demineralization and biofilm formation.

The algorithm created by us provides guidelines for prevention and follow-up of white carious lesions in patients with fixed orthodontic technique. Prevention protocols have been developed and proposed according to the degree of risk.

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## **Orthodontic retention protocols practiced by members of the Bulgarian orthodontic society**

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### **Abstract**

**Introduction:** Retention is the final stage of the orthodontic treatment which aims to prevent posttreatment relapse. Every orthodontically treated malocclusion is prone to a certain degree of relapse. The application of a specific retention protocol and the use of retainers varies among clinicians.

**Aim:** The purpose of the questionnaire is to survey the most commonly practiced orthodontic retention procedures among Bulgarian orthodontists and to make a comparison of the results with those of similar conducted studies.

**Materials and methods:** The study participants were orthodontists registered with the Bulgarian Orthodontic Society. The questionnaire consisted of 19 questions investigating the timing of retention protocol selection, the factors determining the application of a specific retainer, types of retainers used in upper and lower jaw and retention follow-up examinations.

**Results:** Vacuum-formed retainers are most commonly prescribed for maxillary retention and fixed retainers for retention in the mandible. The average retention period for adolescent patients is 2-5 years and prolonged retention or lifetime retention is for adult patients. Orthodontists schedule the first control examination during the first or second month of the retention period.

**Conclusions:** Vacuum-formed retainers are the first choice for retention in the upper arch and bonded retainers in the lower arch. Short-term retention is prescribed for adolescent patients and long-term or lifelong retention for adult patients. The orthodontic practitioners prefer early follow-up retention examinations.

**Key words:** orthodontic retention, vacuum-formed retainer, fixed retainer

### **Introduction**

Every orthodontically treated malocclusion is prone to a certain degree of relapse and the application of orthodontic retainers is always necessary to prevent posttreatment relapse. [1] The application of a specific retention protocol and the use of retainers varies among clinicians. Despite the great number of questionnaires investigating the retention procedures in orthodontic practice, there is still no agreement on the most effective retention strategies. [2][3] The decision on how orthodontic retention should be performed and which retention devices should be used is mainly individually and subjectively taken, rather than based on scientific evidence.[2] Different authors emphasize the need for development of standardized practical guidelines regarding orthodontic retention procedures. [4] [5]

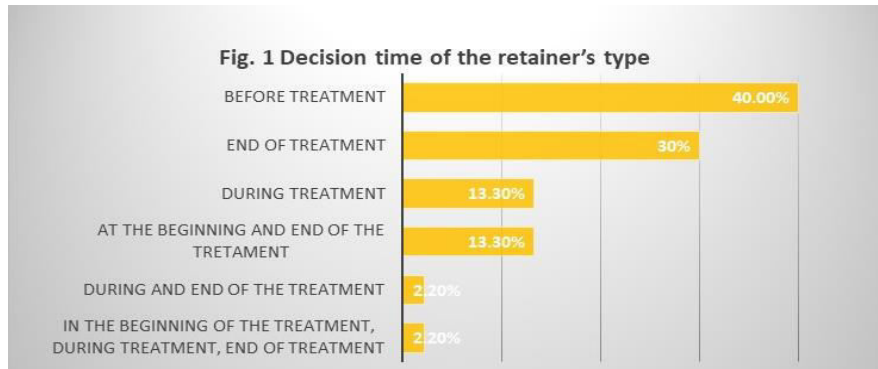
The purpose of this questionnaire is to survey the most commonly practiced orthodontic retention procedures among Bulgarian orthodontists and to make a comparison of the results with those of similar conducted studies.

### **Materials and methods**

The study participants were orthodontists registered with the Bulgarian Orthodontic Society. A web-based questionnaire was developed and sent via email to all registered society members. The questionnaire included questions regarding the following information: general background of the practitioner, the timing of retention protocol selection, types of retainers used in the upper and the lower dental arch, average duration of the retention period and schedule of the follow-up appointments. The data analysis was performed using the Statistical Package for Social Sciences (SPSS) software version 25 (2017) and Minitab version 18.1 (2017) to derive descriptive statistics.

**Results**

The questionnaire was sent to 97 orthodontists and the return rate was 46.4%. The relative share of women is significantly higher than that of men ( $p < 0.001$ ). The majority of the orthodontists had 6-15 years (33.3%) or more than 25 years (31.1%) orthodontic clinical experience. Most of the orthodontists make the decision for the usage of a specific retainer either in the beginning (40 %) or at the end of the orthodontic treatment (30%). (fig. 1)



**Fig. 1** Distribution of participants according to the time when they choose the retention protocol

The most commonly prescribed maxillary retainer was a vacuum-formed retainer (VFR) (35.6%), followed by a dual retention – a combination of a VFR and a fixed retainer (FR) (24.4%). On the other hand, FR or HR were less frequently used as retention appliances in the maxilla. In the lower jaw, orthodontists most frequently used FR (66.7%) ( $p = 0.003$ ) and less frequently a combination of VFR and FR (9%) or HR (6.7%) (table 1). Patients were advised to wear a maxillary removable retainer for 17-19 hours (49%) per day, whereas mandibular retainers were prescribed to be worn 9-16 hours (42.2%) per day. (table 2)

The average duration of the retention period for adolescent patients with FR was 2-5 years (40%). On the other hand, the duration of retention for adult patients is longer - 2 to 5 years (27%) and lifetime (36%). More than half of the respondents schedule the first control examination in the retention phase between the 1st and the 2nd month of retention.

**Tabl.1.** Frequency of maxillary and mandibular Retainer use by type.

Maxilla		Mandible	
Vacuum-formed retainer	35.6%	Fixed retainer	66.7%
Fixed retainer, Vacuum-formed retainer, Hawley retainer	24.4%	Vacuum-formed retainer+fixed retainer	17.7%
Vacuum-formed retainer+Fixed retainer	15.6%	Fixed retainer, Vacuum-formed retainer, Hawley retainer	8.9%
Fixed retainer	13.3%	Hawley retainer, Fixed retainer	3.0%
Vacuum-formed retainer, Hawley retainer	4.0%		
Hawley retainer	1.0%		

**Tabl.2** Duration of wear of removable retainers

Retainer wear	Maxillary removable retainer	Mandibular removable retainer
0-8 hours	15.60%	17.80%
9-16 hours	22.20%	42.20%
17-16 hours	49.00%	26.80%
others	13.20%	13.20%

**Discussion**

The results show that the majority of the participants determine the type of retainer at the beginning of the treatment and at the end of the treatment, which coincides with the results of the study by Bibona et al. [6] VFRs are the most popular appliances for retention in the upper jaw as well as combination of VFRs with FR [7]. The results confirm the increased trend for application of VFRs in the upper arch which can be attributed to their clinical effectiveness for preventing incisor relapse [8] and better patients' acceptance [9][10]. In comparison to similar studies, HRs were less frequently used among Bulgarian orthodontists [11]. Similarly to other studies, orthodontists prefer to use FR as retention devices in the mandible [7][11][12] which can be attributed to their clinical effectiveness for preventing incisor relapse [8] and better patients' acceptance [13].

In general, orthodontists prefer to apply prolonged wear of removable retainers in the maxilla rather than in the mandible [14]. The average retention period with a fixed retainer for adolescent patients was 2-5 years which can be explained with the evidence that retainers should be kept at least until the completion of skeletal growth [13]. Long-term or life-long retention was employed for adult patients to counteract the unpredictable nature of age changes.

### **Conclusion**

Vacuum-formed retainers are prescribed for retention in the upper arch and bonded retainers in the lower arch. Most of the orthodontists prescribe short-term retention to adolescent patients and long-term or life-long retention to adult patients.

### **Abbreviations:**

VFR- vacuum-formed retainer

HR- Hawley retainer

FR- Fixed retainer

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## **Algorithm for early prevention and treatment of mouth breathing children**

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### **Abstract**

**Introduction:** Humans have the innate ability to breathe through the nose, but because of different reasons they can become mouth breathers, something which has a serious impact on them, as well as on the development of their orofacial region [3,4,5,6]. **Purpose:** The purpose of our study is to create an algorithm for early prophylaxis and treatment of children with different degree of expressiveness of the predisposing factors in the appearance of mouth breathing. **Materials and methods:** A total of 1667 children from Varna aged between 3 and 12 years were examined. The results of the clinical examination of every child were assessed according to 19 indicators. A total of 120 cephalometries of children in mixed dentition were analyzed. The mouth breathing children were examined through the methods of anterior and posterior rhinoscopy, acoustic rhinometry and rhinomanometry performed by an otolaryngologist. **Results:** The results of our studies show that 24,7 % of the examined children are diagnosed with difficulty breathing through the nose and 19% habitual mouth breathing. In primary and mixed dentition in first and second degree of adenoid hypertrophy, it is essential to repair breathing through the nose with the help of exercises that stimulate normal breathing. In third degree of adenoid hypertrophy, it is essential to remove the hypertrophic tissue partially or completely and begin myofunctional therapy and subsequent treatment of the concomitant deformation. **Conclusion:** Multidisciplinary treatment approach in children presenting difficulty in nose breathing and incomplete skeletal growth is extremely important.

**Key words:** mouth breathing, adenoid hypertrophy, treatment

### **Introduction**

Breathing through the nose, as well as breathing through the mouth delivers oxygen to the lungs but with different consequences and different levels of oxygen absorption [1,2]. Humans have the innate ability to breathe through the nose, but because of different reasons they can become mouth breathers, something which has a serious impact on them, as well as on the development of their orofacial region [3,4,5,6]. The condition in which we have partial or complete, temporary or permanent obstruction of the airways, we define it as difficulty breathing through the nose. When there is no present morphological or anatomical reason for the appearance of mouth breathing, it is characterized as habitual mouth breathing.

### **Aim**

The aim of our study is to create an algorithm for early prophylaxis and treatment of children with different degree of expressiveness of the predisposing factors in the appearance of mouth breathing.

### **Materials and methods**

A total of 1667 children from Varna aged between 3 and 12 years were examined. The results of the clinical examination of every child were assessed according to 19 indicators, outlined in the statistical table. A total of 120 cephalometries of children in mixed dentition were analyzed by using 16 angular,

linear and proportional indicators. The way of breathing for every child was evaluated with the help of dental mirror (Mirror test), using the method of Horoshilkina. Aiming at establishing the degree of nasal obstruction, the condition of the nasal mucosa, the hypertrophy of the adenoid vegetations, the presence of secretions, the deviations of the nasal septum or presence of polyp in the nose or tumors, the patients were examined through the methods of anterior and posterior rhinoscopy, acoustic rhinometry and rhinomanometry performed by an otolaryngologist.

### Results

The results of our studies show that 24,7 % of the examined children are diagnosed with difficulty breathing through the nose, 19% with bad habit of breathing through the mouth and 56,3% are nose breathing. In primary dentition the principal reason for nasal obstruction is allergic rhinitis (54,50%), and in early mixed dentition is adenoid hypertrophy (40,90 %).

Out of all examined children with difficulty breathing through the nose 24,00% are with first degree of nasal obstruction, 39,30% are with second degree, followed by 36,70% with third degree. When comparing the frequency and the type of dentoalveolar deformations, our results show that in primary dentition I class prevails, whereas in mixed dentition II class prevails.

Based on the obtained results, we established a risk profile and the possibility of involvement in the degree of dentoalveolar deformations in children with difficulty breathing through the nose. We established the significance of the following risk factors (table 1):

**Table1. Risk profile of involvement in the degree of dentoalveolar deformations in mouth breathing children**

Factors:		OR	95% CI	p
<b>1.Dentoalveolar deformations</b>	<b>Open bite</b>	<b>8,17</b>	<b>4,91-24,33</b>	< 0,01
	Bilateral crossbite	6,19	3,96-14,19	<0,001
	Distal occlusion	5,26	3,93-7,94	< 0,001
	Overjet 4-6 mm	1,69	1,51-1,93	< 0,001
<b>2.Etiologic factors</b>	<b>Recurrent tonsillitis</b>	<b>5,59</b>	<b>3,94-6,45</b>	<0,001
	Habitual mouth breathing	2,38	1,72-3,03	<0,001
<b>3.Other factors</b>	<b>Absence of point Stomion</b>	<b>4,06</b>	<b>1,81-9,11</b>	< 0,001
	Females	2,46	1,94-3,14	<0,001
	Infantile swallowing	2,19	1,08-4,24	< 0,05

The research data from the cephalometry used for the establishment of the risk of occurrence of severe dentoalveolar deformations in mixed dentition are presented in table 2. The results show that children at higher risk are the ones with decreased values of the SNB angle. (OR=2.22,odds ratio) (table 2).

**Table 2. Risk factors established on the cephalometry leading to involvement of dentoalveolar deformations in mouth breathing children**

<b>Factors:</b>	<b>OR (odds ratio)</b>	<b>95% CI (confidence interval)</b>	<b>P</b>
<b>Decreased values of SNB</b>	2,22	1,55-3,92	< 0,01
<b>Negative hyoid triangle</b>	2,0	1,44-3,29	< 0,01
<b>Decreased values of the upper pharyngeal width</b>	1,41	0,66-2,97	< 0,05
<b>II skeletal class</b>	1,15	1,0-1,36	< 0,001

The obtained results gave us the basis to suggest a protocol regarding early prevention and treatment guidelines.

**ALGORITHM FOR PREVENTION AND TREATMENT OF CHILDREN WITH DIFFICULTY BREATHING THROUGH THE NOSE IN PRIMARY DENTITION**

In primary dentition in **first and second degree** of adenoid hypertrophy, it is essential to repair breathing through the nose with the help of exercises that stimulate normal breathing, including exercises for orbicularis oris muscle and muscles of mastication. During this period, surgical treatment of children with second degree of adenoid hypertrophy is not recommended, since between the age of 5 to 7 years old its reverse development is expected. On the other hand, in first degree of hypertrophy there is about 75% of free upper airways that is sufficient for proper nose breathing.

In primary dentition in **third degree** of adenoid hypertrophy, obstruction of the upper airways between 50-75% is noticed. More frequently, it is essential to remove the hypertrophic tissue partially or completely, according to the estimation of the otolaryngologist. After 1 month a checkup is considered necessary so that the type of breathing is determined. In spontaneous rehabilitation of breathing through the nose and absence of accompanying dentoalveolar deformations, checkups every 6 months are considered necessary. If maintaining habitual mouth breathing, it is essential to begin myofunctional therapy and subsequent treatment of the concomitant deformation.

**ALGORITHM FOR PREVENTION AND TREATMENT OF CHILDREN WITH DIFFICULTY BREATHING THROUGH THE NOSE IN MIXED DENTITION**

In early and late mixed dentition in **first degree** of adenoid hypertrophy accompanied with distal occlusion (SNB<80, ANB>4) it is necessary to restore breathing through the nose with the help of exercises for stimulation of normal breathing and exercises for orbicularis oris muscle and muscles of mastication. It is important to normalize the occlusal relationships after proper nose breathing is achieved with the help of functional appliances.

In early and late mixed dentition in **first degree** of adenoid hypertrophy accompanied with mesial occlusion (SNB>80, ANB<0) it is necessary to restore breathing through the nose with the help of exercises for stimulation of normal breathing, as well as stimulation of the correct position of the tongue at rest and during swallowing, with the aim of relieving the lower airways. For relieving the upper airways, expansion of the upper jaw and mesial traction of the maxilla are considered essential.

In early and late mixed dentition in **second and third degree** of adenoid hypertrophy accompanied with distal occlusion it is mandatory to eliminate the reasons that cause mouth breathing. To ensure adequate free space in the upper airways, it is necessary to surgically remove partially or completely the hypertrophic tissues. A greater percentage of children require rehabilitation of nose breathing with the help of exercises for stimulation of normal breathing and exercises for orbicularis oris muscle and muscles of mastication. It is important to normalize the occlusal relationships, after proper nose breathing is achieved, with the help of functional appliances.

In early and late mixed dentition in **second and third degree** of adenoid hypertrophy accompanied with mesial occlusion, for relieving of the air space in the upper airways, it is essential to surgically remove, partially or completely, the hypertrophic tissues. Because of the big compression in the upper jaw, before the achievement of proper nose breathing, it is mandatory for the upper jaw to be expanded with subsequent mesial traction of the maxilla. For relieving of the lower airways, after the attained expansion and position of the tongue, exercises for rehabilitation of the proper position of the tongue at rest and during swallowing are required.

### **Discussion**

Multidisciplinary treatment approach in children presenting difficulty in nose breathing and incomplete skeletal growth is extremely important. The treatment approach of orthodontic patients with incomplete growth is not to restrict development of the upper jaw, especially if this growth is caused by the natural tendency to meet the functional needs. A similar opinion is shared by Morias [7], Alagiozova [8] and Menezes [9]. In children with primary dentition in first and second degree of adenoid hypertrophy it is necessary to conduct a specific medicament treatment with the help of the otolaryngologist. The role of the orthodontist is to restore nose breathing and the tone of orbicularis oris muscle and muscles of mastication, through suitable myogymnastics. In primary dentition in third degree of adenoid hypertrophy and unsuccessful therapeutic treatment, it is essential to remove the hypertrophic tissue partially or completely according to the evaluation of the otolaryngologist. After surgical intervention, during the period of 1 to 3 months, a checkup is recommended to evaluate any changes in the way of breathing. If mouth breathing is maintained as a bad habit, after elimination of the etiologic factor, it is necessary to begin myofunctional therapy and subsequent treatment of the concomitant deformation [8,10].

### **Conclusion**

Based on the multidisciplinary treatment approach in primary and mixed dentition, orthodontic planning includes therapeutic or surgical treatment according to the estimation of the otolaryngologist, depending on the degree of nasal obstruction and follow-ups in cases of spontaneous rehabilitation of breathing through the nose and if necessary secondary prevention for the occlusal relationships with the purpose of achieving normal occlusion. If maintaining mouth breathing as a bad habit, we recommend exercises for proper nose breathing, myogymnastics of different muscle groups according to the estimation of the orthodontist and improvement in the position of the lower jaw and occlusal relationships.

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**Dental age estimation using demirjian method in bulgarian subjects with mixed and permanent dentition: a digital orthopantomographic study**

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**Abstract**

Identification of age is very important for a variety of reasons, including orthodontic treatment planning and timing, legal responsibility, employment, etc. **Aim:** The aim of this study was to assess the accuracy of Demirjian et al. (1973) method for dental age estimation (DAD) in Bulgarian subjects. **Materials and methods:** Digital Orthopantomograms of 295 children aged 7-16 years, who fit the inclusion criteria of the study were obtained and randomized into four age groups according to Van der Linden classification. Assessment of mandibular teeth development was undertaken using Demirjian et al. (1973) method. **Results:** The results of study showed that DAD overestimated Chronological age (CA) in all four age groups for both genders ( $p \leq 0.05$ ). The most significant overestimation was in age group 10, 00-11, 99 years, where for boys CA was overestimated by 0.9 -1.49 years and for girls by 1.55- 1.98 years. Only in group of 10,00-11,99-year-old females, gender dependent correlation with the difference of CA-DAD was found ( $r=0.33$ ;  $p=0.01$ ). **Conclusion:** Demirjian et al. (1973) method for assessing DAD in Bulgarian children in mixed and permanent dentition aged 7-16 years cannot be considered an accurate and reliable method, as it showed a significant difference with the actual age of over 12 months in most age groups in both genders.

**Key words:** Age estimation, Demirjian method (DAD), Chronological age (CA), Orthodontic diagnosis

**Introduction**

Bagic et al. (2008) stated that evaluation of DA played important role in numerous disciplines such as Orthodontics, Forensic Dental Medicine, Archaeology, Palaeontology and Paediatric Dentistry. [3] Numerous research suggested that the process of mineralization of permanent teeth was under negligible impact of local and systemic factors, endocrine diseases and nutritional habits. [9, 4] Other authors like Willems et al. (2001) pointed out that the processes of initiation and maturation of tooth germ are under significant genetic control with ethnical variability. [28, 7, 16]. Nolla (1960) declared that Dental age (DA) estimation methods based on the defining of tooth mineralization stages outweigh those based on tooth eruption sequence. [23] In 1973 Demirjian et al. presented method of DA evaluation by assessing the stages of mineralization of seven mandibular left permanent teeth. [8] This method is the most widely used one nowadays. [24]

**Aim**

The aim of this study was to assess the accuracy of Demirjian et al. (1973) method for dental age estimation (DAD) in Bulgarian subjects.

**Materials and methods**

The children aged 7 to 16 years were recruited from the Orthodontic department of Faculty of Dental Medicine, Medical University of Varna, Bulgaria. 295 outpatients agreed to participate -115(39%) males and 180 (61%) females ( $\chi^2= 14,32$ ,  $P < 0,0001$ ). The participants were randomized in four age groups according to Van der Linden classification [27]

The chronological age (CA) of each subject was calculated by subtracting the date of the orthopantomographic examination from the date of birth after converting both to a decimal age (rounded to two decimal places). The age was calculated by coding scheme- by a quarter (.25) age between  $> 1$  и  $\leq 3$  months • With two quarters (.50) age between  $> 3$  и  $\leq 6$  months • With three quarters (.75) age

between  $> 6$  и  $\leq 9$  months, round numbers-the age in years. On digital OPG one of the eighth developmental stages (A–H) of the seven teeth in the left mandible were evaluated from the central incisor to the second molar in the left mandibular quadrant with Demirjian et al. method (1973) [8].

## **Results**

**Age group 7,00-9,99 years :** For boys DAD overestimated the CA by 0.18 -0.51 years (P=0.0002), whereas the CA was overestimated by 0.35- 0.9 years for girls (P=0,0001).

**Age group 10,00-11,99 years:** For boys CA was overestimated by 0.9 -1.49 years (t=-7.43, P=0.000), whereas the CA was overestimated by 1.55- 1.98 years for girls (P=0.000). We found gender dependent correlation with the difference CA-DAD (r=0.33; P=0.01).

**Age group 12,00-13,99 years:** For boys DAD overestimated CA by 0.66 -1.51 years (P=0.000), whereas the CA was overestimated by 0.84- 1.17 years for girls (P=0.000).

**Age group 14,00-15,99 years:** For boys CA was overestimated by 0.18 -0.83 years (P=0.004), whereas the CA was overestimated by 0.04- 1.62 years for girls (P= 0.02).

## **Discussion**

The Demirjian method of age estimation is a widely used method in different populations [14, 19, 20, 21, 22, 26]. The results for accuracy of DAD are controversial with overestimation or underestimation of the CA reported. Studies of Maber et al. (2006) and Liversidge et al. (2012) showed that Demirjian method defined underestimated the CA. [17, 15]. The results of our study disclaimed this hypothesis. Most studies performed by many researchers demonstrated results where DAD overestimated the CA. [11, 18, 5, 1]. The results of our research showed that DAD overestimated CA in all four age groups for both genders. Differences in the results among the sample population could be attributed to different variables including genetic variations of individuals, social and economic wellbeing, racial difference, diet habits and lifestyle. Currently another important factor greatly influencing somatic growth and dental development was highlighted-the ethnicity. Different researchers stated that the methods of dental age estimation without counting the ethnicity could be reliable for homogeneous society but not in modern heterogeneous ones, formed by globalization process. [ 10,16] Researches like Ambarkova V. et al (2013), Jeta Kelmendi et al. (2018), Hegde S. et al. (2017) compare the accuracy of Demirjian method with other for dental age estimation in their studies and declared inferiority of DAD for estimation of AC. [2, 13, 12]. Acceptable ranges of age difference between estimated and chronological age in forensic anthropology of children until adolescence varies from 0.5 year as a stringent up to 1.00 year as a maximum acceptable difference. [25, 6] The results of our study showed that evaluation of dental age using Demirjian et al. (1973) method significantly overestimated the CA for both genders.

## **Conclusion**

Demirjian et al. (1973) method for assessing DAD in Bulgarian children in mixed and permanent dentition aged 7-16 years cannot be considered an accurate and reliable method, as it showed a significant difference with the actual age of over 12 months in most age groups in both genders. Assessing dental age by other dental age evaluation methods for Bulgarian children would be beneficial.

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## **Evaluation of skeletal maturity using maxillary canine calcification stages: a digital x-ray study**

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### **Abstract**

**Purpose:** The purpose of this study was to evaluate the correlation and efficacy of using the calcification stages of maxillary permanent left canine (tooth 23) to predict the circumpubertal growth phases in Bulgarian subjects. **Material and methods:** 388 digital x-rays (panoramic radiograms and lateral cephalograms) were evaluated of 194 children in CVM stage II, III and IV. Mineralization of maxillary canine was assessed with Demirjian et al. method and skeletal age with Baccetti et al. method. **Results:** A high correlation was found between the mineralisation stages of tooth 23 and skeletal age for girls ( $r=0,75$ ;  $P\leq 0,05$ ) and for boys ( $r=0,64$ ;  $P\leq 0,05$ ). For boys in CVM II mineralization stage G was defined in 63,2% of the studied canines ( $P<0,0001$ ). In stage CVM III 50 % of studied teeth have reached stage H ( $P=0,115$ ). In post-pubertal stage CVM IV 100% of the canines were evaluated in stage H. For girls in CVM II tooth 23 was assessed with developmental stage G in 53,8% ( $P=0,013$ ). The pubertal peak stage was dominated by mineralization stage G in 62,5% ( $P<0,0001$ ). In stage CVM IV 93,0% of studied teeth were evaluated in stage H ( $P<0,0001$ ). **Conclusion:** The prepubertal stage CVM II can be easily predict with incomplete phase of development of maxillary left canines -stages F and G in both genders. The post-pubertal stage CVM IV observed at least a year after the pubertal spurt was completely dominated by stage H for both genders.

**Keywords:** dental age, left maxillary canine, skeletal maturity, pubertal spurt, Demirjian, Baccetti

### **Introduction**

In the planning of orthodontic treatment anticipation of growth potential of the facial skeleton is essential to ensure the successful outcome. There are wide individual variations in the timing, duration and velocity of growth and therefor assessment of individual development stages is required. Some authors claimed significant correlation between calcification stages of different teeth (canines, premolars, second and third molars) and skeletal age [4, 7, 8, 9, 12, 13, 14].

### **Purpose**

The purpose of this study was to evaluate the correlation and efficacy of using the calcification stages of maxillary permanent left canine (tooth 23) to predict the circumpubertal growth phase in Bulgarian subjects.

### **Materials and methods**

A total of 388 digital x-rays (panoramic radiograms and lateral cephalograms) were evaluated of 194 Bulgarian children in CVM stage II, III and IV. Sixty-nine boys and one hundred twenty-five girls aged 7 to 17 years were recruited. After gaining informed consent from the patient and their custodians, the patients were randomized to one of three groups, i.e., to a group with skeletal age CVM II, group with CVM III or group with CVM IV.

Orthopantomograms were used to assess the developmental stages of the upper left maxillary canine (tooth 23) into eight stages from A to H with Demirjian method [5]

The skeletal maturity was assessed with Baccetti et al. method, based on morphological characteristics of second, third and fourth cervical vertebrae-C2, C3, C4. [2] The six maturational stages are as followed:

Stage CVM 1: C2, C2, and C4 inferior border are flat and the vertebrae are trapezoidal in shape. CVM 2: Concavities at lower border of C2 and C3 and Bodies of C3 and C4 are or rectangular horizontal in

shape. CVM 3: Concavity at the lower border of C2, C3, C4 and bodies of C3, C4 are rectangular horizontal in shape. CVM 4: Distinct concavity at the lower border of C2, C3, C4. at least one of C3 and C4 is nearly square in shape. CVM 5: Accentuated Concavities of the lower border of C2, C3, C4. C3 and C4 are square in shape. CVM 6: Deep concavity at the lower border of C2, C3, C4. C3 and C4 is rectangular vertical (heights are greater than widths)[1,2]

The target group of the present study included patients within the circumpubertal growth period (CVM stages II, III and IV), because of the importance of this period for orthodontic treatment success. Data were analyzed with Spearman's rank correlation coefficient at a significance level of  $P \leq .05$ .

## **Results**

For girls in pre-pubertal stage CVM II, observed at least a year before pubertal growth spurt 100 % of the studied left maxillary canines (tooth 23) were immature with open apical foramen. Developmental stage G dominated in 53,8% of studied female subjects ( $P=0,013$ ). The prevalence of stage F was high 38,5%, whereas stage E presented in only 7,7%. In stage CVM III-the pubertal growth spurt, the number of maxillary canines in stage G increased to 62,5 % ( $P<0,0001$ ) and teeth assessed in phase of complete root development H were 35.7% of the studied subjects. During the post-pubertal stage CVM IV, observed at least a year after the pubertal peak with little growth potential left 93,0 % of assessed teeth 23 ( $P<0,0001$ ) were evaluated in stage H and completed development.

For boys in CVM II developmental stage G dominated in 63,2% of the studied cases ( $P<0,0001$ ). The number of teeth assessed in stage F is high 26,3%. Stage H presented in only 10,5 % of teeth 23 during the pre-pubertal growth phase. In stage CVM III the number of teeth with complete root development-stage H significantly increased to 50% ( $P=0,115$ ). The percentage of maxillary canines in stage G was high-38,9% and stage F was still presented in 11,1%. In stage CVM IV all the left maxillary canines (100%) were evaluated in stage H by the Demirjian method [5].

## **Discussion**

Because of superimposition of the structures on the panoramic radiographs, the mandibular teeth are usually evaluated for the identification of the calcification stages. The evidence points to an apparent positive correlation between dental and cervical vertebrae maturation.[3]. On the other hand, the CVM method shows a high level of correlation with the hand wrist method-a golden standard for evaluation of skeletal age. [11, 15]. The visibility of maxillary canines is quiet good comparing to other maxillary teeth, and it can be used for easy estimation of teeth maturational stages especially on digital x-rays allowing magnification. The maxillary canine has the most prolong time for formation, the deepest germ in the bone and the longest path to passage through eruption thus is suitable for observation and evaluation of its calcification stages. Congenital absence of permanent canines has been reported as a rare occurrence, though several studies have reported hypodontia affecting maxillary canine. [10]. It may occur as part of a syndrome or as a non-syndromic form.[6]. Trakiniene G. et al. (2016) reported in their research that the maxillary canine could be used as indicator of pre-peak of pubertal growth spurt until the apical foramen was still opened. The results of their study showed a high correlation between CVM stages and calcification stages of tooth 23 ( $r=0.812$ ,  $P<0.01$ ) [16].

In our study a high correlation was found between the mineralisation stages of tooth 23 and CVM stages for girls ( $r=0,75$ ;  $P \leq 0,05$ ) and for boys ( $r=0,64$ ;  $P \leq 0,05$ ). For the group of male subjects, the prepubertal phase was dominated by immature stage G and maxillary canine could be used as indicator of pre-peak of pubertal growth spurt until the apical foramen was still opened. During the CVM III-pubertal growth spurt almost three-quarter of studied teeth were with completed root development. For the group of female subjects in CVM II, maxillary canine could be used as indicator of pre-peak of pubertal growth spurt until the apical foramen was still opened especially in stage F. The stage G dominated during phase CVM II and CVM III. The dental maturation stages of the maxillary left canines

for both genders show satisfactory diagnostic performance only for the identification of the pre-pubertal CVM II phase (F and G stages of tooth 23) and post-pubertal growth phases CVM IV (H stage of tooth 23) with no reliable indicators for the onset of the pubertal growth phase CVM III.

### Conclusion

The prepubertal stage CVM II can be easily predict with incomplete phase of development of maxillary left canines -stages F and G in both genders. The post-pubertal stage CVM IV observed at least a year after the pubertal spurt was completely dominated by stage H for both genders. The calcification stages of tooth 23 as indicator of skeletal maturity could be clinically used with caution, until this method is verified with a larger sample group.

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## **Frequency of mesiodens in orthodontic patients – clinical and radiographical discussion.**

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### **Abstract**

The purpose of the present study is to determine the frequency of the biological phenomenon - mesiodens, its clinical symptoms and different forms of manifestation. A prospective clinical-epidemiological study was conducted, including 93 patients with diagnosed hyperdontia among 2676 orthodontically treated patients. Mesiodens was found in 25 among all patients, a frequency of 0.93%, and represented 29.76% of patients with true hyperdontia. Distribution by gender is 68% for men and 32% for women. The more common manifestation is impacted mesiodens - 84%. All cases of horizontally positioned mesiodens are complicated by the retention of the central incisor. The most frequently observed problem is rotation of incisors in 40% of cases, followed by incisor retention in 32% and less often diastema – 24%. In 84% of cases, the diagnosis of mesiodens is made through X-ray examination. The recommended x-ray method is CBCT, because it establishes not only the localization, but also the morphology of the supernumerary tooth.

**Key words:** Mesiodens, Hyperdontia, Frequency

### **Introduction**

Mesiodens is a supernumerary erupted or non-erupted tooth that develops between the two maxillary central incisors. Mesiodens is usually located in the midline of the premaxilla, which embryogenesis differs from other facial bones. This specificity creates conditions for the development of additional teeth or other anomalies. The etiology of mesiodens is not clearly defined, as in other forms of hyperdontia. Two groups of factors influence its formation: genetics and the influence of local factors during the development of dental germs. The fact that this phenomenon occurs more often in men than in women - approximately twice as often – is supporting the role of the genetic factor.

Patients with erupted mesiodens are diagnosed at a younger age compared to those with impacted mesiodens, in whom additional orthodontic problems related to upper incisor position, dental arch alignment and even changes in occlusal relationships are found [1]. One of the common disorders resulting from the localization of mesiodens is impaction of the upper central incisors. This disorder is a challenge for orthodontists in view of the level of development of the mixed dentition, due to the lack of a stable support zone in the distal segments for the orthodontic traction of the impacted central incisors [2][3]. The authors divide mesiodens according to its morphology into 2 types: eumorphic and dysmorphic[4][5][6]. The first type resembles a normal central incisor in size and shape, whereas the second type – dysmorphic - has different shapes: molar-like, tubercular, but the conical shape is more common.

Researchers report a frequency of mesiodens of 0.15% to 1.9% in the permanent dentition, with a rate twice as high in males compared with females[7][8]. This form of hyperdontia comprises almost half of the cases of established supernumerary teeth[1][7]. A single mesiodens was found in the majority of cases, 76.8%, while 23.2% showed two mesiodens, again situated (erupted or not) around the midline [9].

**The aim** of the present study is to determine the frequency of the biological phenomenon - mesiodens, its clinical symptoms and different forms of manifestation.

### **Material and methods**

For the purpose of this study, a prospective clinical-epidemiological study was conducted including 93 patients diagnosed with hyperdontia, of whom 59 (63.4%) were male and 34 (36.6%) were female. The patients were a sample of individuals diagnosed with hyperdontia and associated phenomena - (geminated/fused teeth, dens in dente, odontoma collection, concomitant hypo-hyperdontia) from all patients treated in the clinic - 2676, over a period of 10 years. The mean age of the entire study population was  $11.35 \pm 4.75$  years ranging from 3 to 28. While the mean age of the patients in whom mesiodens was detected was  $10.48 \pm 3.95$  in the interval between 6 and 21 years. The data were processed using the statistical package IBM SPSS Statistics 25.0. A significance level rejecting the null hypothesis was taken as  $p < 0.05$ .

**Results**

The prevalence of mesiodens (25 patients) in relation to the whole group of patients (2676) was 0.93%, and in relation to the group of patients with hyperdontia (93 patients) was 26.9%, while the percentage of mesiodens in relation to the true forms of hyperdontia (84 patients) found by us was 29.76%, which actually represents 1/3 of all cases.

Patients with mesiodens were distributed according to sex as follows: 17 males (68%) and 8 females (32%), which is a 2.12:1 ratio and proves the gender aspect of this anomaly.

Two patients (8%) had evidence of another type of supernumerary tooth in addition to mesiodens - one of them had a central incisor with underdeveloped root and the second patient had a supernumerary lateral incisor. Four patients (16%) had two mesiodens and 21 patients (84%) had one mesiodens, resulting in a ratio of 1/5.4 for two mesiodens to one mesiodens.

Again, only four patients had an erupted mesiodens, whereas 84% of cases were impacted mesiodens. In the group of patients with two mesiodens, 75% of them (3 patients) had retention of one mesiodens, whereas in the fourth patient the impaction involved both supernumerary teeth. Table 1 shows that the total number of patients with impacted mesiodens was 21, of which 20 (95.2%) had one impacted mesiodens and one (4.8%) had two impacted mesiodens. This distribution was clearly reflected by applying Fisher's exact test with  $p = 0.190$ .

Impacted Mesiodens	Frequency	Mesiodens		Total
		1 mesiodens	2 mesiodens	
1 impacted mesiodens	n 17	100.0	75.0	20
	%			95.2
2 impacted mesiodens	n 0	0.0	25.0	1
	%			4.8
<b>Total</b>	n 17	100.0	100.0	21
	%			100.0

**Table 1: Analysis of the relationship between the indicators of impacted mesiodens**

Mesiodens with inverted direction	Frequency	Mesiodens		P
		1 mesiodens	2 mesiodens	
Normal direction	n 17	81.0	25.0	0,053
	%			
Inverted direction	n 4	19.0	75.0	
	%			

**Table 2: Analysis of the correlation between mesiodens and mesiodens with inverted direction**

Eight patients (32%) were diagnosed with an adjacent tooth (central incisor) that was impacted. In all cases involving central incisor retention, there was also observed mesiodens retention. In 7 clinical cases (28%), mesiodens had an altered crown-root direction. In those with one mesiodens, 4 or 19% had a mesiodens with an inverted direction, whereas in those with two mesiodens, 3 or 75% had one of the mesiodens with an inverted direction. The correlation between the two parameters was borderline significant - ( $p < 0.1$ ). Because of the high percentage of impacted mesiodens, clinical diagnosis of the problem is much less frequent than radiological identification. Table 3 shows that only 4 clinical cases had a situation of erupted mesiodens that were detected on clinical examination. In the remaining 21 cases the diagnosis was made after radiological examination. In three of the cases an erupted mesiodens was found and after radiological examination - another impacted mesiodens.

Impaction of an adjacent tooth was observed in 32% of the clinical cases (8 patients) associated with the presence of mesiodens, most often the central incisors. In one case, both central incisors were impacted.

In 10 patients (40%) was observed more dramatic incisor rotation. Prominent diastema over 2 mm was reported in 6 patients (24%).

Impacted supernumerary tooth	Frequency	Type of detection		P
		Radiological examination	Clinical examination	
Erupted mesiodens	n	0	4	<0,001
	%	0,0	57,1	
1 mesiodens - impacted	n	17	3	0,005
2 mesiodens (impacted and erupted)	%	94,4	42,9	
2 impacted mesiodens	n	1	0	
	%	5,6	0,0	

**Table 3: Analysis of the relationship between the indicators of impacted supernumerary and type of detection – review**

Parameter	Frequency	Mesiodens		Total
		1 mesiodens	2 mesiodens	
<b>Rotated Incisors</b>				
No	n	13	2	15
	%	61,9	50,0	60,0
Yes	n	8	2	10
	%	38,1	50,0	40,0
<b>Impacted incisor</b>				
No	n	14	4	18
	%	66,7	100,0	72,0
Yes	n	7	0	7
	%	33,3	0,0	28,0
<b>Diastema over 2mm</b>				
No	n	17	2	19
	%	81,0	50,0	76,0
Yes	n	4	2	6
	%	19,0	50,0	24,0
<b>Impacted incisors</b>				
No	n	20	4	24
	%	95,2	100,0	96,0
Yes	n	1	0	1
	%	4,8	0,0	4,0

**Table 4: Frequency distribution of the following parameters: Rotated incisors; Impacted incisor; Diastema over 2 mm; Impacted incisors in the presence of mesiodens**

### Discussion

Our established frequency of mesiodens of 0.93% is in complete coincidence with the cited frequency of this problem of 0.15% to 3% in the literature. The gender correlation of mesiodens was demonstrated, with its 68% prevalence in males. The cited frequency of mesiodens in males in other studies ranged from 64.1% to 82.8%[9-12]. In the observed cases of mesiodens the spike-like form was most common. In our study were reported 84% of cases in which radiological examination alone proved the presence of an impacted mesiodens. In three of the cases, the clinical examination had already revealed an erupted mesiodens, but after the radiological examination, another impacted mesiodens was found. Other authors have reported mesiodens impaction rates between 56% and 78.8%, and Akay[10] as high as 92.3%.

Therefore, there should be a strong suspicion for mesiodens, especially in cases involving dramatic changes in the position of the central incisors or their impaction. Altan et al.[13] observed clinical complications in 76.8% of patients with mesiodens. CBCT provides three-dimensional images of the mesiodens and adjacent bone structures and teeth[14]. In addition, CBCT will give us valuable information about the position, direction and morphology of the supernumerary tooth and its relationship with other structures. It is an important evidential method to detect mesiodens and differentiate them from morphologically atypically developed central incisors, e.g. incisors with Talon cusp. In a clinical case with suspected mesiodens and fused central and lateral incisors, it was proven by CBCT that there were only fused teeth - the lateral and central incisors, which is actually hyperdontia and an additional talon cusp on the central incisor, which resembles mesiodens.

Mesiodens can be classified according to their position relative to the incisor axes as: vertically positioned, inverted and horizontal. In our study, in 7 cases (28%), the mesiodens had a reversed crown-root orientation, and in one of the cases it was combined with an erupted and normally positioned mesiodens. In 5 patients (20%) the impacted mesiodens had a horizontal position and resulted in central incisor impaction. In the remaining 13 cases (52%), the mesiodens had a vertical position, with 4 patients with erupted and 9 patients with non-erupted mesiodens. Akay et al. described a vertical orientation in 38.5%, inverted in 32.3% and horizontal in 23.1%. Most published studies have described mesiodens with vertical position[10][**Error! Reference source not found.**].

All disorders associated with the presence of an erupted or impacted mesiodens lead to aesthetic problems, because they affect the frontal segment. The most frequently observed irregularity is incisor rotation in 40% of cases, followed by their impaction (32%), and less frequently diastema (24%). The most common treatment approach is extraction of the supernumerary tooth and orthodontic treatment to

level the dental arch - 60% of cases; after the mesiodens is extracted, the orthodontic treatment is initiated, which includes orthodontic traction of the impacted central incisor - in 32% of the cases; Mesiodens is observed and not extracted until apical development of adjacent teeth is complete - 4% of cases; Mesiodens is extracted and no orthodontic treatment is performed - 4% of cases.

### **Conclusion**

We recommend the use of CBCT examination in order to identify the localization and morphology and also the number of mesiodens. 3D imaging assists surgical and orthodontic treatment planning and reduces the risk of affecting surrounding developing structures.

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## **Comparison of different imaging techniques for the detection of separated endodontic instruments**

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### **Abstract**

**Purpose:** The study aimed to evaluate three radiographic methods in recognizing the presence of separated endodontic instruments. The ability to measure and observe different parameters, valuable for the diagnostic process, was analyzed. The advantages and disadvantages of each method were pointed out.

**Material and methods:** 200 digital periapical radiographies, 200 CBCT and 200 panoramic radiographies were randomly selected in the time period 2019-2021. Team of three dentists assessed the images for the incidence of separated endodontic instruments, their location, type, length, teeth and canals with highest frequency of this complication. The data was structured and analyzed with Microsoft Excel v. 16.0.

**Results:** 55 separated instruments (13%) were found on digital periapical radiographies. 33 of the fragments (60%) were determined as lentulo spiral fillers. The length of the separated instruments was an arithmetic mean of 3.5 mm. On CBCT, only 3 instruments (0,6%) were definitely present. Their types could not be determined. On panoramic radiographies, 10 teeth were suspected to have separated instruments, 7 instruments were definitely present (0,7%). The separation was prevalent in mesial roots of mandibular and maxillary molars.

**Conclusions:** The digital periapical radiography is essential method in the primary discovery of separated endodontic instruments. CBCT is irreplaceable for the treatment planning and decision-making process. Panoramic radiography do not deliver enough information.

**Key words:** separated endodontic instrument, radiography, frequency

**Introduction** The separation of endodontic file is a procedural iatrogenic complication<sup>1</sup> that can occur at every step of the endodontic therapy. Radiographic assessment is necessary for the subsequent decision-making process and treatment planning. The sensitivity of three radiographic methods in identifying separated instruments was compared.

**Material and methods** The present study was conducted December 2021 with randomly selected images from 2019-2021. 200 digital periapical radiographies (DPR), 200 cone-beam computed tomographies (CBCT) and 200 panoramic radiographies were included in the research. All the images were analyzed by 3 calibrated endodontists. Any disagreement was resolved through discussion and consensus was reached. Each tooth was observed individually and a specially designed questionnaire was filled. The questions were as follows: How many instruments are visible on the image? How many of them are in one tooth? What is the type of the instrument? What is the length of the segment? In which tooth is the instrument? In which canal is the instrument? In which third of the canal is the instrument

located? What is the location of the instrument according to the curvature? All data was collected and classified by categories into a spreadsheets and frequency analysis was conducted.

**Results** As shown on table 1, for total of 427 endodontically treated teeth, 55 separated instruments (13%) were found on digital periapical radiography. In 6 cases we observed more than one instrument in a single tooth. Lentulo spiral fillers were identified 33 times, which presents 60% of all instruments found on DPR. The other 22 segments cannot be determined by type. The length of the separated instruments was an arithmetic mean of 3.5 mm. The separation occurs most commonly in mandibular (44%) and maxillary molars (29%), with greater rates in the mesial roots (38% for mandibular molars and 15% for maxillary molars). The vast majority of instrument separation take place in the middle part of the canal (55%), engaged in the canal curvature (36%). The team was able to detect all of the broken instruments (100%), even in the presence of other canal filling materials.

For total of 469 endodontically treated teeth, the team was able to detect only three separated instruments (0.6%) on CBCT. Their type could not be determined. The length was an arithmetic mean of 6mm. All segments were situated in mandibular molars. Two of them were in mesial roots, in the middle part of the canal, in the curvature (67%). One of them was in distal root, in the apical part of the canal with extrusion in the periodontium, after the curvature (33%).

Table 1 *Detection of separated endodontic instruments with three radiographic methods. Frequency.*

Parameters	DPR		CBCT		Panoramic radiography	
	N	%	N	%	N	%
<b>Teeth with endodontic treatment</b>	427	–	469	–	1026	–
<b>Separated instruments</b>	55	13%	3	0.6%	7	0.7%
<b>Cases with more than one separated file in one tooth</b>	6	1%	0	0%	0	0%
<b>Type of the instrument</b>						
lentulo spiral filler	33	60%	0	0%	0	0%
other	22	40%	3	100%	7	100%
<b>Length of the segment</b>	1.5-9.5mm		4.4-11mm		–	
<b>Type of the tooth</b>						
Mandibular molar	24	44%	3	100%	4	57%
- mesial root	21	38%	2	67%	4	100%
- distal root	3	5%	1	33%	0	0%
Maxillary molar	16	29%	0	0%	0	0%
- mesiobuccal root	8	15%	0	0%	0	0%
- distobuccal root	5	9%	0	0%	0	0%
- palatal root	3	5%	0	0%	0	0%
Mandibular premolar	7	13%	0	0%	2	29%
Maxillary premolar	7	13%	0	0%	1	14%
Maxillary incisor	1	1%	0	0%	0	0%
<b>Part of the canal</b>						
Cervical	4	7%	0	0%	0	0%
Middle	30	55%	2	67%	4	57%
Apical	20	36%	0	0%	3	43%
Apical with extrusion	1	2%	1	33%	0	0%
<b>Location relative to the canal curvature</b>						
before	5	9%	0	0%	0	0%
in	20	36%	2	67%	4	57%
after	17	31%	1	33%	3	43%
straight canal	13	24%	0	0%	0	0%

On panoramic radiography, from 1026 endodontically treated teeth, 7 teeth were with separated instruments (0.7%). The team suspected 10 more separated instruments but it was not possible to distinguish between separated instrument and other canal filling material. Neither type nor length could be identified. Most of the cases were again in mandibular molars (57%), in the mesial roots, in the middle part of the canal (57%), in the canal curvature (57%).

**Discussion** CBCT has been described as the “gold standard”<sup>2</sup> for imaging the oral and maxillofacial area. However, in cases with separated endodontic instruments the metal causes a beam-hardening phenomenon and artifacts (fig.1).

Fig.1 Separated endodontic instruments:

- a) tooth 15 on DPR;
- b) tooth 15 on CBCT;
- c) tooth 46 on DPR;
- d) tooth 46 on CBCT.

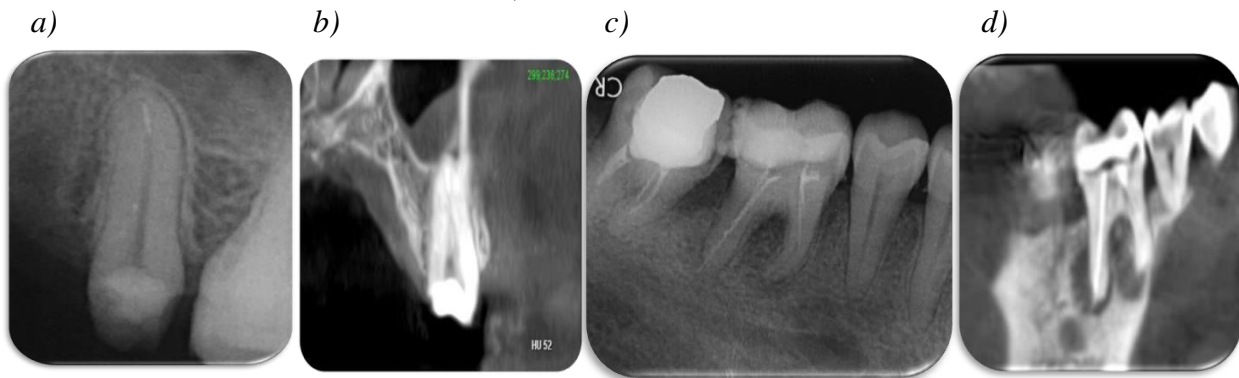
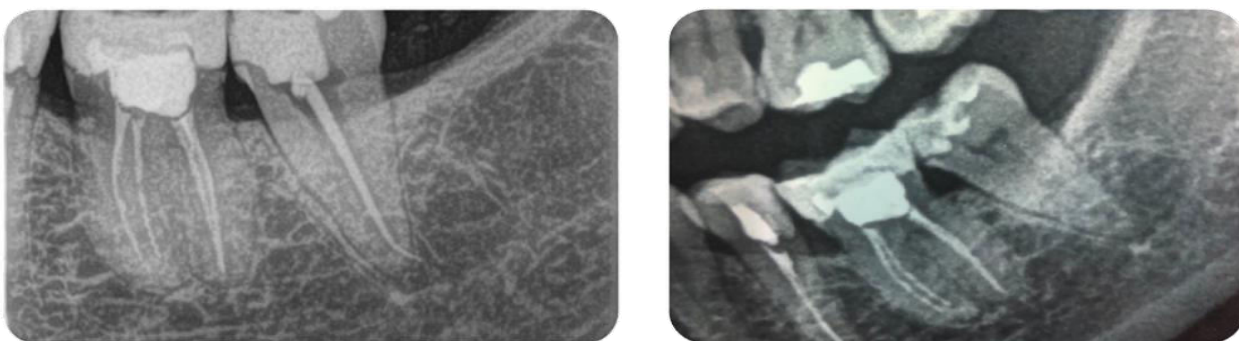


Fig.2 Tooth 36 with separated instrument in the mesial root.

- a) visible on DPR;
- b) non-visible on panoramic radiography.



According to Schulze et al.<sup>3</sup>, artifacts may interfere with the diagnostic process performed on CBCT data set. Therefore, every user should be aware of their presence. In addition to a canal filling material, the instrument could be missed, whereas on periapical radiography the segment is easily identified. Flares Baratto-Filho et al.<sup>4</sup> compared the accuracy, sensitivity and specificity of DPR and CBCT and concluded that DPR is better imaging diagnostic exam to evaluate the presence of separated endodontic instruments in comparison with different tomographic protocols. Brito et al.<sup>5</sup> emphasized that especially in the presence of filling, the decision to perform CBCT examination must take into consideration its low accuracy. Kalogeropoulos et al.<sup>6</sup> studied the impact of CBCT evaluation on treatment planning after endodontic instrument fracture. They reported that CBCT

preoperative evaluation may significantly aid with treatment planning and management of cases with instrument fracture in mesial roots of molars. Canal merging in such cases would influence the treatment plan. Our study agree that the digital periapical radiography should be the first choice exam and it is sufficient in most of the cases. The instrument could be missed on CBCT, therefore CBCT should be performed only after DPR, for highlighting complex canal anatomy and for minimally-invasive treatment strategy planning. We might guess that we found highest number of separated instruments on DPR because of its higher accuracy, sensitivity and specificity and not because there were no instruments on the other images. This is shown on figure 3, where the same teeth are presented on panoramic radiography and DPR. The segment is visible in the mesial root of tooth 36 on DPR, whereas it cannot be detected on panoramic radiography.

**Conclusions** The digital periapical radiography should be a method of choice in the primary discovery of separated endodontic instruments. CBCT is irreplaceable for the treatment planning and decision-making process. Panoramic radiography do not deliver enough information.

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