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FREQUENCY OF SELF-REPORTED BRUXISM AMONG STUDENTS DURING THE COVID 19 PANDEMIC

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ABSTRACT

Introduction: Bruxism today represents a widespread, very complex phenomenon among the entire population. Awake or daytime bruxism most often occurs unconsciously during stressful situations and is manifested by clenching the teeth, while night-time bruxism is manifested by grinding the teeth during sleep. During the COVID-19 pandemic, students were affected by new measures leading to an increase in anxiety and stress levels producing an increase in parafunctional activities.

The aim of the research: The aim of the research was to examine the frequency of self-reported bruxism among students during the COVID-19 pandemic and to determine the difference in the frequency of self-reported bruxism between students in relation to gender and type of study.

Research methods: The research was based on filling out a questionnaire that contained questions about basic information regarding the respondent such as age, gender, the attending faculty, data on the presence/absence of bruxism and the influence of certain situations on the manifestation of bruxism.

The results: The research proved the high prevalence of self-reported bruxism among students. It has been proven that the frequency of teeth clenching during the day is statistically and significantly higher than the frequency of teeth grinding at night. No statistically significant difference was found between the Faculty of Dentistry and the Faculty of Pharmacy in the frequency of self-reported bruxism, nor between genders. A statistically significantly higher frequency of clenching and grinding of teeth was found in students in a situation when they were under stress.

Conclusion: Considering the high prevalence of bruxism among the student population, it is necessary to work on developing a protocol that will contribute to the prevention of bruxism and help reduce the risk of negative consequences on the stomatognathic system.

Keywords: Student's population, bruxism, Covid 19.

Introduction

The COVID-19 pandemic caused by the new Sars-CoV-2 coronavirus began in December 2019 in Wuhan (China) and continued to spread around the world. Because of globalization, climate change and numerous population migrations, there was an accelerated viral transmission and an unprecedented speed and spread of infection and the declaration of a pandemic by the World Health Organization. There were certain restrictions in people's lives and social circumstances, and the impact of the pandemic COVID-19 was visible at all levels of society, including the economic, business, educational and psychological levels. [1]

The human population has been forced to take certain epidemiological measures such as social distancing, wearing masks, closing facilities, working from home and travel restrictions to curb the transmission of the virus. This situation has led to health threats, economic uncertainty, and social isolation, each with the potential for serious adverse effects on both the physical and mental health of people. [2] These massive changes have also had consequences for students' educational experiences and their mental, physical and financial condition. In addition, this period was an annus horribilis for many students – an extended period of depressing news and for some it meant isolation, illness, loneliness, bereavement or financial difficulties.

Many studies have proven that students experienced increased anxiety, fear, stress and symptoms of depression while studying under the influence of COVID-19, with medical students having a higher prevalence of moderate and severe anxiety symptoms. [3, 4, 5]

Healthcare workers were at risk of contamination, had intensive working hours, lack of knowledge about the treatment of diseases caused by the Sars-CoV2 virus, which led to vital risks and challenges that caused them even ethical dilemmas. [6]

Dental practices and organizations such as the American Dental Association (ADA) have reported a significant increase in stress-related oral health conditions during the pandemic. According to a September 2020 ADA survey, 59.4% of dentists surveys reported an increased prevalence of bruxism among their patients, 53.4% reported an increase in chipped and cracked teeth and 53% reported an increase in temporomandibular joint disorder (TMJ) symptoms. These numbers only increased as the pandemic continued. When the ADA surveyed American dentists again in 2021, over 70% of dentists reported an evident increase in patients grinding and clenching their teeth. [7, 8]

This was confirmed by studies conducted in Poland, Israel and China identifying an increase in bruxism and TMJ disorders in the general population. [9, 10]

According to the international consensus of 2013, bruxism is defined as repetitive masticatory muscle activity characterized by clenching or grinding of the teeth and/or tightening or thrusting of the lower jaw being specified as sleep bruxism or awake bruxism. [11]

The aetiology of bruxism is still not exactly determined, and it is estimated that there three groups of factors that can cause bruxism: biological factors, exogenous and psychological factors. [12]

Przystańska A. and the authors state that awake bruxism occurs as a defensive reaction in the form of permanent muscle contraction during stress and anxiety. [13]

The COVID-19 pandemic has caused various troubles for a huge number of individuals around the world and it is considered to have a stress level of great stressful experience. [1]

Given that there is little epidemiological data on the impact of the COVID-19 pandemic on the prevalence of bruxism among the student population in our country, this research was conducted.

Materials and methods

The research was based on filling out a questionnaire that contained questions about basic data about the respondent such as age, gender, the attending faculty, data on the presence/absence of bruxism and the impact of certain situations on the manifestation of bruxism. [14]

Students of the Faculty of Dentistry and Pharmacy of the University of Sarajevo were involved in the research. Students filled out the questionnaire completely anonymously and voluntarily with informed consent. The Ethics Committee of the Faculty of Dentistry in Sarajevo has issued consent for the research of this project.

A total of 756 respondents were included in the research, of which 170 (22.5%) were men, and 586 (77.5%) were women. A total of 439 respondents were surveyed at the Faculty of Dentistry, while 317 respondents were surveyed at the Faculty of Pharmacy. The average age of the respondents was 22 years.

Statistical methods of data analysis

Statistical data analysis was performed using IBM SPSS Statistics v.21 software. Arithmetic means and standard deviations of quantitative variables, then absolute and relative frequencies of nominal variables were calculated from the descriptive statistical analysis. Parametric methods were used in the paper, namely Student t-test for testing two independent samples, Pearson's linear correlation, One-factor analysis of variance (ANOVA) for testing three independent samples with multiple post hoc testing with Tukey HSD test. Among the non-parametric statistical methods, the chi-square test was used. The research hypotheses were tested on an alpha level of 95% confidence, i.e., 5% risk.

The results were statistically processed and presented in tables.

The results

In terms of the frequency of self-reported bruxism among the surveyed students, a slightly higher percentage of them did not have bruxism (402 or 53.2%) compared to students who stated the presence of bruxism (354 or 46.8%). The Chi-square test did not confirm that there is a statistically significant difference between students who stated the presence of bruxism and those who did not have bruxism in the surveyed sample ($\chi 2$ = 3.048; p<0.081). The results are shown in Table 1.

Between students of the Faculty of Dentistry and Pharmacy, the chi-square test did not confirm statistical significance ($\chi 2$=0.188, p<0.664) in the frequency of self-reported bruxism, which is shown in Table. 2.

The Chi-square test was used to compare the frequency of the presence of self-reported bruxism between men and women, where statistical significance was not proven (p<0.496), and the obtained results are shown in Table 3.

Table 1. The frequency of presence of self-reported bruxism

Bruxism	n	%	χ^2	p
No	402	53,2	3,048	0,081
Yes	354	46,8		
Total	756	100		

χ^2 – value of the chi square test
p – probability of rejecting the null hypothesis at a risk of 5%

Table 2. The frequency of presence of self-reported bruxism among students of the Faculty of Dentistry and Pharmacy

		Self-reported bruxism present					
		No		Yes		Total	
		n	%	n	%	n	%
Faculty	Pharmacy	172	42,8	145	41,0	317	41,9
	Dentistry	230	57,2	209	59,0	439	58,1
	Total	402	100,0	354	100,0	756	100,0

χ^2 = 0,188, df=1, p<0,664

Table 3. The frequency of self-reported bruxism between the sexes of the subjects

		Self-reported bruxism present					
		No		Yes		Total	
		n	%	n	%	n	%
Gender	Male	86	21,4	84	23,7	170	22,5
	Female	316	78,6	270	76,3	586	77,5
	Total	402	100,0	354	100,0	756	100,0

χ^2 = 0,463, df=1, p<0,496

Regarding the results showing the differences between teeth clenching and teeth grinding The chi-square test showed a statistically significantly higher frequency of teeth clenching (p<0.000) compared to the frequency of grinding, grinding and clenching together, and the obtained results are shown in Table 4.

By comparing the results between different faculties in relation to the frequency of clenching and grinding teeth, the chi-square test did not prove that there is a statistically significant difference between the Faculty of Dentistry and the Faculty of Pharmacy in the frequency of grinding, clenching and grinding and clenching together, and the results obtained are shown in Table 5.

When it comes to teeth grinding, the largest percentage of respondents had it during the night. Teeth clenching was manifested in the highest percentage during the day. The results are shown in Table 7. The respondents who noticed that they grind their teeth statistically significantly (p<0.000) did so during the night. Respondents who noticed that they were clenching their teeth, statistically significantly noticed it during the day (p<0.000). When it comes to the observation of squealing by another person regarding the subject's teeth grinding, it was significant during the night (p<0.000).

Table 4. Comparison of the frequency of grinding, squeezing and grinding and squeezing

	n	%	χ^2	p
Teeth grinding	30	8,5		
Clenching the teeth	201	56,8	124,2	0,000
Grinding and clenching of teeth	123	34,7		
Total	354	100,0		

n – number of subjects
χ^2 – value of the chi square test
p – probability of rejecting the null hypothesis at a risk of 5%

Table 5. Comparison of the frequency of teeth grinding and clenching between the Faculty of Dentistry and Pharmacy

		Faculty					
		Pharmacy		Dentistry		Total	
		n	%	n	%	n	%
Symptoms of bruxism	Teeth grinding	16	11,0	14	6,7	30	8,5
	Clenching the teeth	77	53,1	124	59,3	201	56,8
	Grinding and clenching of teeth	52	35,9	71	34,0	123	34,7
	Total	145	100,0	209	100,0	354	100,0

χ^2 = 2,572, df=2, p<0,276

Table 7. Comparison of daytime and nighttime bruxism frequency

		n	%	χ^2	p
Have you noticed that you grind your teeth?	Yes, during the day	46	31,5	19,97	0,000
	Yes, during the night	100	68,5		
	Total	146	100,0		
Have you noticed that you are clenching your teeth?	Yes, during the day	201	63,2	22,19	0,000
	Yes, during the night	117	36,8		
	Total	318	100,0		
Did someone tell you to grind your teeth?	Yes, during the day	14	16,7	37,33	0,000
	Yes, during the night	70	83,3		
	Total	84	100,0		
Did someone tell you to clench your teeth?	Yes, during the day	37	52,1	0,13	0,722
	Yes, during the night	34	47,9		
	Total	71	100,0		

n – number of subjects, χ^2 – value of the chi square test, p – probability of rejecting the null hypothesis at a risk of 5%

By comparing the frequency of clenching and grinding teeth in certain situations among students, the chi-square test showed a statistically significantly higher frequency of clenching and grinding teeth ($p<0.000$) in a situation when they were under stress, which is attached in Table 8.

Table 8. Comparison of the frequency of clenching and grinding of teeth in specific situations

	n	%	χ^2	p
When you're under stress	235	64,2	333,5	0,000
When you are angry	87	23,8		
When you are maximally concentrated doing something	33	9,0		
When you are tired	11	3,0		
Total	366	100		

n – number of subject
χ^2 – value of the chi square test
p – probability of rejecting the null hypothesis at a risk of 5%

Discussion

The coronavirus pandemic that appeared in 2019 led to numerous changes and challenges in our lives that needed to be answered. Uncertain forecasts, impossibility of forecasting and planning, public health and movement restriction measures, online classes and changes in other life circumstances are just some of the stressful factors. This led to significant psychological changes in the general population, and especially in the lives of students. A higher frequency of self-reported bruxism and TMD disorders during the pandemic has been confirmed in numerous studies. [9, 10, 15, 16]

Despite multiple etiologic factors, stress, anxiety and genetic predisposition are thought to

be the dominant factors leading to involuntary masticatory muscle activity associated with teeth clenching/grinding. [17, 18, 19, 20]

Bruxism functions as a kind of perpetual motor because the increased symptoms that arise due to the abnormal functioning of the organism increasing the feeling of stress, and as a result, there is increased muscle tone and teeth grinding. [21]

In our research, the chi-square test did not confirm a statistically significant difference between the students who stated the presence of bruxism and those who did not have bruxism in the surveyed sample. However, the total percentage of 46.8% at both faculties who reported bruxism is extremely high, which indicates a high prevalence of self-reported bruxism among the student population. The total percentage of students with self-reported bruxism of 47.6% at the Faculty of Dentistry in Sarajevo correlates with the results obtained in a study among students at the Medical University in Lodz, where the total prevalence of awake bruxism was 47.8% and night-time bruxism was 58.9%. [22]

A slightly lower percentage of the presence of bruxism among students of 34.8% was reported among students of the Faculty of Dentistry in Pančevo in research conducted during the pandemic. [23]

In a study carried out at the Faculty of Medicine of the University of Split on the study of dental medicine before the COVID-19 pandemic, the frequency of bruxism was proven to be 47 % in students, which correlates with our results. [14]

The exceptionally high prevalence of bruxism (41.7%) in a study conducted among students at the Gulf-Medical University and among medical students in Vietnam (51.2%) in the period before the pandemic is explained by the fact that medical students are much more exposed to stress than their colleagues from other studies. They often feel exhausted during their studies due to the volume of material, difficulty sleeping, worries about the future as well as high parent's expectations. [24, 25] All these studies on the frequency of bruxism among students prove the extremely high prevalence of bruxism among students in general.

Regarding the difference in the frequency of bruxism between students of the Faculty of Dentistry and Pharmacy of the University of Sarajevo, statistical significance was not confirmed ($\chi 2 = 0.188, p<0.664$).

The highest percentage of surveyed students of both faculties with bruxism had symptoms of teeth clenching (26.6%), the smallest number of students had symptoms of teeth grinding during the night (4%). The chi square test showed a statistically significantly higher frequency of teeth clenching ($p<0.000$) compared to the frequency of teeth grinding. Since teeth, clenching was established during the day and grinding during the night, the frequency of awake bruxism was higher compared to night-time bruxism.

Our results are consistent with the results of the research conducted by Cavallo P et al. in Italy, which also showed the prevalence of awake bruxism in 37.9% of students, while the prevalence of night-time bruxism was 31.8%. [26] A higher prevalence of awake bruxism compared to night-time bruxism was demonstrated among dental students in Iraq and in Israel. [27, 28]

Przystańska A and the authors state that awake bruxism occurs as a defensive reaction in the form of permanent muscle contraction during stress and anxiety. [13]

Regarding the difference between the genders, no statistically significant difference was proven, although the female population was more represented. Such results were expected because, in our study, a larger number of surveyed students were female. Our results agree with research in Italy and Ajman, where no significant difference between the genders was also proven. [26, 29]

In a study at the Faculty of Dentistry in Turkey, a higher rate of bruxism among female students (75.2%) than among male students (51.7%) was demonstrated. [30] As well as in research at the Faculty of Medicine of the University of Split, where the frequency of both clenching and grinding was higher in female students. [14]

During this research, the most common situations in which students noticed that they were clenching and grinding their teeth were when they

were under stress (64.2%), then slightly less when they were angry (23.8%). They clenched and grinded their teeth the least when they were maximally concentrated doing something and when they were tired. The chi-square test showed a statistically significantly higher frequency of clenching and grinding teeth ($p<0.000$) in a situation when they were under stress. According to the self-assessment of students in a study at the Faculty of Medicine in Split, the events during which students most often grinded and clenched their teeth were when they were under stress (25.2%) and when they were angry (24%). [14]

Research among health students in Pakistan has proven a link between bruxism and stress, as bruxism was more common in students who experienced stress. [31]

Numerous studies of studies have also found a connection between psychological conditions such as hypersensitivity to stress, anxiety, depression and fear with bruxism. [32, 33, 23, 34]

Since the stress is considered one of the etiological causes of bruxism, the increase in stressors during the COVID-19 pandemic led to an increase in the prevalence of bruxism, sleep disorders, and TMD, which has been confirmed in numerous studies. [35, 36, 37]

The impact of the pandemic on dental education is considered more destructive, primarily because the educational process involves the learning of practical skills that students perform directly on the patient, which results in greater stress from the infection with COVID and possible harmful consequences, as well as the possibility of transmitting the infection to the closest family members. [38]

It should be noted that the data on the prevalence of bruxism in this study were obtained only based on self-report. In order to determine the true prevalence of bruxism, it is necessary to perform a clinical examination and polysomnography in addition to self-reporting of bruxism.

Conclusion:

Our research proved the high prevalence of bruxism among students.

The results showed that there is no statistically significant difference in the presence of bruxism between genders nor between different faculties. A higher frequency of awake bruxism compared to night-time bruxism has been proven.

Considering the high prevalence of bruxism among the student population, it is necessary to work on developing a protocol that will contribute to the prevention of bruxism and help reduce the risk of negative consequences on the stomatognathic system.

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CARIES PREVALENCE IN CHILDREN FROM THE MOSTAR CITY AREA

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ABSTRACT

A nationwide study from 2004 showed that the children's oral health in Bosnia and Herzegovina is poor with an average dmft index in six-year-olds being 6.2 (4.0), and DMFT 4.8 (3.9) in twelve-year-olds. After the aforementioned nationwide study, only a few regional epidemiological studies have been conducted on the territory of Bosnia and Herzegovina. All studies have shown that the state of oral health in children is poor. Although the WHO has clearly emphasized the importance of regularly conducting epidemiological research regarding children's oral health, there is a lack of recent data on the prevalence of caries in children in other areas of Bosnia and Herzegovina.

The aim of this study was to assess the prevalence of caries in children aged 2-18 years from the Mostar city area.

In this observational, descriptive study, 500 respondents aged 2-18 years participated. For subjects up to 6 years of age, the dmft index was recorded as an indicator of oral health, for subjects with mixed dentition the DMFT index of first permanent molars was used and for subjects aged 12-18 years, the DMFT index was used.

Data were analysed for 495 respondents, aged 2-18 years, of both sexes (253 female respondents and 242 male respondents).

The prevalence of dental caries in respondents aged up to 6 years is 53%. The prevalence of caries of the first permanent molars in subjects aged 6-12 years is 28.3%, while the prevalence of caries in subjects older than 12 years is 44.9%. The average dmft index of five-year-olds is 3.88 (SD 3.83), while the DMFT index of twelve-year-olds is 2.51 (SD 2.17).

The prevalence of caries and previous caries experience of children of all ages from the area of Mostar was lower compared to previous years, both for respondents from the same geographical area and compared to other areas of Bosnia and Herzegovina. New epidemiological studies are needed in order to determine the general oral health trends in Bosnia and Herzegovina.

Keywords: caries prevalence, previous caries experience, dmft, DMFT, children

Introduction

Oral health is an important and inseparable part of general health. Regular monitoring of past caries experience, i.e. the prevalence of caries in the population, enables the planning of health strategies ultimately aiming to improve oral health.

The World Health Organization (WHO) has recommended periodic national epidemiological surveys with clearly defined monitoring groups and oral health parameters [1]. Previous caries experience is an important indicator of oral health.

Children are a vulnerable population group that is part of an important monitoring group to follow up the state of oral health.

Although many epidemiological studies have shown that the prevalence of caries is decreasing, especially in developed countries, caries is still the most common disease in children of all age groups throughout the world [2-6].

A nationwide study from 2004 showed that children's oral health in Bosnia and Herzegovina is generally poor, with an average KEP index in twelve-year-olds being 6.2 (4.0), and 4.8 (3.9) in six-year-olds (3, 4, 5, 6). After this nationwide study, only a few regional epidemiological studies have been conducted on the territory of Bosnia and Herzegovina. In 2007 in the area of the cities of Foča, Čajniče and Kalinovik, an epidemiological children's oral health study including children aged 12 and 15 years was conducted [7]. In 2012, an examination of oral health in children aged 6-10 years was conducted in the same area [8]. In 2016, an epidemiological study was conducted in the Sarajevo Canton on the preschool age [9]. In the same year, the results of caries prevalence research on respondents aged 2-6 years from the Banja Luka city area were published [10]. All studies have shown that the state of oral health in children was poor.

Although the WHO has clearly emphasized the importance of regularly conducting epidemiological research on the state of children's oral health, there is a lack of data on the prevalence of caries in children in other areas of Bosnia and Herzegovina.

The Research Objective

The objective of this research study was to assess the prevalence of caries in children aged 2-18 years from the Mostar city area.

Material and methods

The observational, descriptive study included 500 respondents aged 2-18 years. Five respondents were excluded from the study due to incompletely collected data.

Examinations of respondents were carried out in 5 dental practises that are commonly used as teaching bases of the Faculty of Medicine of the University of Mostar, in the period from May to October 2022. The methodology recommended by WHO (1) was used. The respondents were divided into 3 groups; the first group consisted of respondents up to six years of age, the second group of respondents were aged 6-12 years and the third group of respondents were aged 12-18 years. A corresponding research card was prepared for each group.

For respondents up to 6 years of age, the KEP index was recorded as an indicator of oral health, for subjects with mixed dentition the KEP index of the first permanent molars was used, and for subjects aged 12-18 years, the KEP index was used. The research was approved by the Ethics Committee of the Faculty of Medicine of the University of Mostar.

Data were processed using The Statistical Package for Social Science, version 13.0 (SPSS Inc, Chicago, IL, USA). Data are presented with descriptive statistics.

Results

Data were analysed for 495 respondents, aged 2-18 years, of both sexes (253 female respondents and 242 male respondents).

In the group of respondents, aged up to 6 years, a total of 134 children (27.1%) were examined, in the group of subjects aged 6-12 years, 205 children were examined (41.4%), and in the group of subjects aged 12-18 years, 156 subjects were examined (31.5%).

The prevalence of caries in respondents aged up to 6 years was 53%. The prevalence of caries of the first permanent molars in subjects aged 6-12 years was 28.3%, while the prevalence of caries in subjects older than 12 years was 44.9%. Table 1 shows the prevalence of caries in children and the percentage of children without caries.

Table 1. Distribution of children with caries according to age groups

Age (years)	Caries free N (%)	Caries prevalence N (%)	Total N (%)
2-5	63 (47)	71 (53)	134 (100)
6-12	147 (71.7)	58 (28.3)	205 (100)
12-18	86 (55.1)	70 (44.9)	156 (100)

The average dmft index value, DMFT index of first permanent molars and DMFT index are shown in Tables 2, 3 and 4.

Table 2. Previous caries experience (dmft index) in subjects aged 2-5 years

	Min	Max	Mean	SD
d	0	16	2.14	3.06
m	0	3	0.10	0.44
f	0	5	0.75	1.30
dmft	0	19	2.99	3.48

In children of preschool age, the average value of the dmft index was 2.99 (SD 3.48), where the largest proportion was untreated caries. The mean value of the d component of the dmft index was 2.14 (SD 3.06).

In children aged 6-12 years, the average value of the DMFT index of permanent molars was 1.32 (SD 1.50).

Table 3. Previous caries experience (DMFT index of first permanent molars) in respondents aged 6-12 years

	Min	Max	Mean	SD
D	0	4	0.45	0.88
M	0	2	0.03	0.22
F	0	4	0.81	1.27
DMFT	0	4	1.32	1.50

Table 4. Previous caries experience (DMFT index) in respondents aged 12-18 years

	Min	Max	Mean	SD
D	0	18	0.92	1.76
M	0	4	0.22	0.62
F	0	15	2.26	2.45
DMFT	0	26	3.41	3.45

In children aged 12-18 years, the average value of the DMFT index was 3.41 (SD 3.45), where the largest share of teeth was with fillings. The mean value of the F component of the DMFT index was 2.45 (SD 3.45).

Table 5. shows the distribution of dmft index according to the age of the respondents

dmft	Age of respondents (years)				
	2 N (%)	3 N (%)	4 N (%)	5 N (%)	Total N (%)
0	2 (100)	10 (52.6)	19 (38.8)	13 (20.3)	44 (32.8)
1	0	2 (10.5)	7 (14.3)	6 (9.4)	15 (11.1)
2-3	0	2 (10.5)	9 (18.4)	18 (28.1)	29 (21.64)
4-5	0	2 (10.5)	9 (18.4)	10 (15.8)	21 (15.67)
6<	0	3 (15.8)	5 (10.1)	17 (27.4)	25 (18.66)
Total	2 (100)	19 (100)	49 (100)	64 (100)	134 (100%)

Table 5 shows the distribution of dmft index in different age groups of preschool children. The number of children without caries was lower in

older age groups. The largest number of children with six or more caries was found in five-year-olds.

Discussion

Oral diseases, including caries, are among the most widespread diseases today. Caries in permanent teeth is the most widespread disease in the world, while caries in deciduous teeth is in tenth place among all other diseases [2]. Caries is a global public health problem. The distribution of caries in the world is uneven. In the "Oral Health Country/Area Profile Project" database, the World Health Organization presented data on the state of oral health in all countries of the world [11]. In recent decades, developed countries have successfully brought caries under control, as the most common oral disease, thanks to the intensive implementation of public health preventive programs, as well as health education programs. Thanks to this, the prevalence of caries, among all age groups of the population, is drastically reduced. In many other countries, caries prevalence is still high.

A nationwide study from 2004, which aimed to determine the state of oral health in children aged 6 and 12 from the entire territory of Bosnia and Herzegovina, showed that the prevalence of caries was high in both age groups. The average DMFT index for twelve-year-olds was 4.8, while the average dmft index for six-year-olds was 6.2 [3, 4, 5, 6]. In relation to the epidemiological data on the prevalence of caries from certain parts of Bosnia and Herzegovina from 1985, where the average DMFT index in twelve-year-olds was 6.3, it is noticeable that there has been an improvement in children's oral health ever since [12]. Since there were no data about organized population prevention programs in the mentioned period, it could be assumed that the decrease in caries prevalence was due to generally better health education among the population.

According to Kunzel, there are two regions in Europe - the Western European region, which includes low-risk countries, and the Eastern European region, which includes high-risk countries 13. The average DMFT of 12-year-olds being 4.8, still ranks Bosnia and Herzegovina among high-risk countries.

Following the above nationwide study, in Bosnia and Herzegovina, research on the state of oral health in children was carried out regionally, among different age groups. Research conducted in the municipalities of Foča, Čajniče and Kalinovik in 2007, on respondents aged 12 and 15 years, showed that the prevalence of caries is still high, and that only 4% of respondents were free of caries. The largest number of children had a DMFT index value of 4 [7]. A survey of oral health among 15-year-old respondents from the area of Sarajevo showed that their average DMFT index was 7.6, and that only 2% of respondents were caries-free [6].

An epidemiological study from 2012, on respondents aged 6-10 years from the municipalities of Foča, Čajniče, Kalinovik and Rogatica, showed that of the total number of respondents, 96.1% of children had caries. Only 3.94% of respondents were caries-free [8]. During 2012 and 2013, research was conducted in the Banja Luka city area on the frequency of early childhood caries in children up to 2 years of age. According to the results of that research, the prevalence of early childhood caries was 34.9% [14]. The research on the prevalence of caries in children aged 2-5 years conducted in 2012 and 2013 in the Banja Luka city area, showed that 35.35% of respondents were caries-free [10].

In 2014, respondents from the area of Sarajevo Canton, aged 3-5 years, were examined. The results of that research showed that the average dmft index was 6.8, while the percentage of children without caries was 19% in three-year-olds, 8% in four-year-olds, and 1% in five-year-olds [9].

The results of our research conducted in Mostar in 2022, on respondents up to 18 years of age, showed the following results:

The average dmft index in children aged 2-5 years was 3.48. The largest share of the dmft index

refers to untreated caries (the d component of the dmft index was 3.06). The prevalence of caries in this age group was 53%, while the percentage of children without caries was 47%. If we compare the results of this research with those of respondents of the same age group from the area of Sarajevo, it can be observed that the average value of the dmft index in children from Mostar is lower (dmft value of 3.48, compared to dmft of 6.8 for children from the city of Sarajevo). Also, caries prevalence was lower compared to Sarajevo and Banja Luka. In Mostar, 47% of children were caries-free, compared to respondents of the same age group in Banja Luka (35.35% of children without caries) and Sarajevo (17% of children without caries) [9, 10]. Also, if we compare the results of the average dmft index of five-year-olds in Mostar from 2022, with the average dmft index of five-year-olds in Mostar in 2004, a decrease in the dmft index, from 5.1 in 2004 to 3.89 in 2022 [6] has been observed.

In subjects aged 6-12 years, the DMFT index of the first permanent molars was used as an oral health state indicator. The average value of the DMFT index of permanent molars was 1.32 (SD 1.50). The largest share of the DMFT index of the first permanent molars was made up of teeth with fillings (F component 1.27).

Respondents aged 12-18 years from the area of Mostar had an average DMFT index of 3.45, while 55% of respondents were caries-free. Even for this age group, lower DMFT index values and the total prevalence of caries were observed compared to the respondents from the areas of Foča, Čajniče and Kalinovik from 2007 (4% of respondents without caries).

At the same time, the average DMFT index of this group of respondents was lower compared to the group of twelve-year-olds from the nation-wide study conducted in 2004 (DMFT 3.45 in the Mostar area and average DMFT 4.8 for twelve-year-olds from Bosnia and Herzegovina).

If DMFT index values in twelve-year-olds in Mostar from 2022 were analysed and compared with DMFT index values in twelve-year-olds in Mostar from 2004, it can be observed that the average DMFT index in twelve-year-olds in 2022 was lower - the DMFT index in 2022 was 2.51, while in 2004 year, it amounted to 4.32 4, and in 2003, the average DMFT of twelve -years old in the area of Mostar was 6.1 [15]. The same trend was observed in fifteen-year-olds - the DMFT index values in fifteen-year-olds in Mostar in 2022 were 3.48, while the DMFT in fifteen-year-olds in Sarajevo in 2007 was 7.6 6.

Having analyzed caries prevalence values in subjects of all age groups, and having compared them with the available epidemiological data obtained by the studies conducted in different locations in Bosnia and Herzegovina, it can be concluded that there was a decrease in caries prevalence compared to previous years. Also, the average dmft and DMFT index values of primary and permanent dentition were lower compared to studies conducted in earlier years. Taking into account that previous caries experience was an important indicator of the state of oral health, and based on the data from this study, it can be concluded that the state of child oral health from the Mostar city area was better, compared to the period 18 years ago, when the last data were collected within the study conducted for Bosnia and Herzegovina. Also, the state of child oral health in Mostar was better, compared to the state of child oral health of all age groups from other regions of Bosnia and Herzegovina. Since there was no data on the implementation of any organised public health preventive programmes aimed at improving oral health in the area of Mostar, the improvement of oral health can only be interpreted as an increase in general health awareness and health literacy of the population.

Since the data from this study indicated a decreased caries prevalence and previous caries experience of the examined children population in the city of Mostar, it would be necessary to collect new epidemiological data on the children state of oral health of all age groups from other regions of Bosnia and Herzegovina in order to establish whether the trend of decreasing caries prevalence

and improvement of oral health has a general or regional character.

Conclusions

The prevalence of caries and previous caries experience in children of all ages examined in the Mostar area was lower compared to previous years, both in the case of respondents from the same geographical area and from other areas of Bosnia and Herzegovina. New epidemiological studies are needed in order to determine the general oral health trends in Bosnia and Herzegovina.

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SURVEY RESEARCH: SIGNIFICANCE OF IRRIGATION IN ENDODONTIC PROCEDURES

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ABSTRACT

The success of an endodontic treatment depends upon how efficiently the microbes are eradicated from the root canal. Irrigation is a key part of successful root canal treatment, because it is the only way to reach and impact those areas of the root canal wall which cannot be processed with mechanical instrumentation. It fulfils several more important mechanical, chemical and microbiological functions: it reduces friction between the instrument and dentine, improves the cutting effectiveness of the files, dissolves tissue, cools the file and tooth, and furthermore, it has a washing effect and an antimicrobial/antibiofilm effect.

Aim: The purpose of this study was to investigate various types of endodontic irrigants used by general dental practitioners (GDPs) and specialists in the Balkans as well as their effectiveness in practice.

Methodology: An online questionnaire consisted of fifteen questions related to the irrigant used in root canal treatment.

Results: Sodium Hypochlorite (84%) was the most preferred irrigant. Activation of irrigant was not routinely employed among dentists.

Conclusion: The present study revealed that focus should be made on continuous educational programs to update the dentists with recent information and protocols.

Keywords: Irrigation, endodontic treatment, endodontic irrigants, sodium hypochlorite

Introduction

The complex morphology of the endodontic space, poly-infection and resistance of microorganisms are the reasons why endodontic instruments and mechanical treatment alone cannot be effective during endodontic therapy. Mechanical treatment of root canals achieves cleaning and shaping of the main root canal, while certain parts of the root canal system, such as lateral canals, communications and apical delta are completely inaccessible for mechanical treatment. Between 35% and 53% of canal wall of the lateral canals, communications and apical delta are completely inaccessible for mechanical treatment and remain un-instrumented [1].

Untreated parts of the endodontic space are places of accumulation of microorganisms and their products which must be eliminated for a successful outcome of endodontic treatment.

Irrigation is the only way to reach and treat those areas of the root canal that are not touched by mechanical instrumentation. Therefore, irrigation is a key part of successful root canal treatment as it fulfills several important mechanical, chemical and (micro) biological functions, including healing of periapical tissues. [2] The goals of irrigation are the removal of pulp tissue (vital and necrotic), the organic component of the root canal, the destruction and inactivation of microorganisms from the canal system, as well as the removal of the inorganic component or smear layer. [3-5] Furthermore, irrigation removes dentinal debris that occurs during instrumentation and provides wetting of the canal and lubrication instrument. The goals of irrigation are achieved by flowing irrigants through the endodontic space representing the mechanical effect of irrigants, and by dissolving the organic and inorganic contents of the canal and inactivating bacteria, which represents the chemical effect of irrigants. [6-8]

Aim

The purpose of this study was to investigate various types of endodontic irrigants used by general dental practitioners (GDPs) and specialists in the Balkans as well as their effectiveness in practice.

Materials and methods

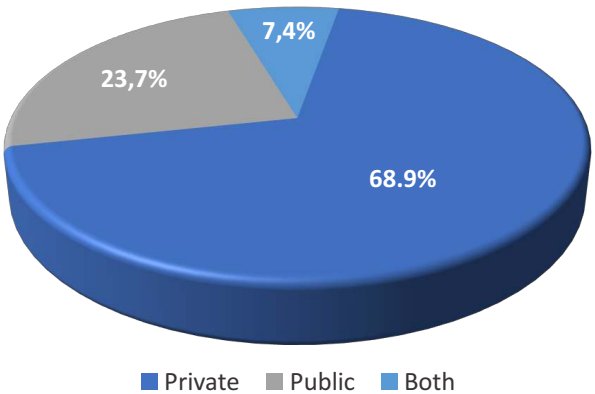
An online questionnaire was sent to a total of 600 dentists registered in the West Balkans states. It consisted of 16 questions regarding the gender, years of experience, the irrigant used, the concentration of irrigant used, its volume, whether the choice of irrigation differs depending on the pulpal or periapical diagnosis, the addition of irrigation, the diameter of the needle during irrigation, depth of needle penetration, duration of irrigation along the root canal and smear layer removal.

The survey was closed after 3 weeks. Blank or multiple answers were all treated as missing values; only single unequivocal replies were included in calculating frequencies and percentages.

Results

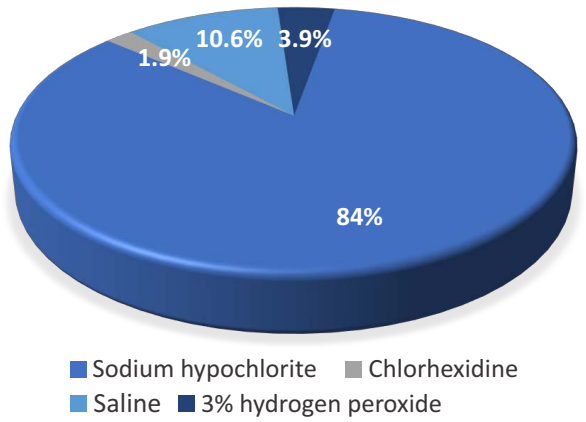
Out of 600 questionnaires mailed, 566 useable responses were received, of which almost 70% were answered by doctors of private practices (figure 1).

Figure 1.



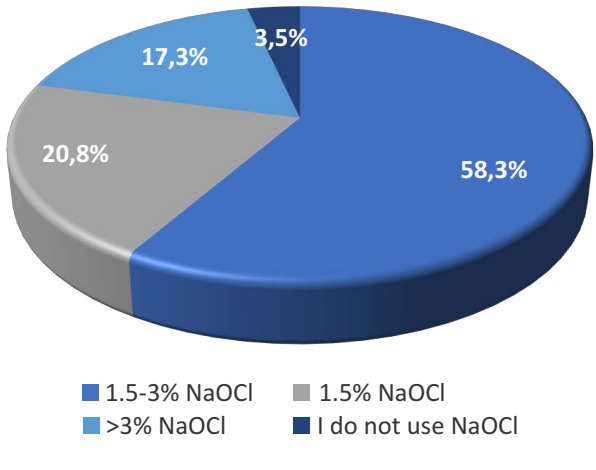
The results indicated that >84% of respondents were using sodium hypochlorite as their primary irrigant and 10% of respondents were preferring saline. (Figure 2).

Figure 2.



Most of the practitioners (58 %) use sodium hypochlorite (NaOCl) and only 3,5% of respondents have declared that they do not use NaOCl in their practice (Figure 3).

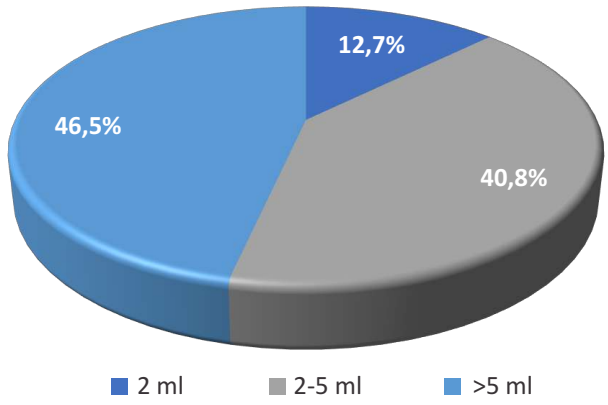
Figure 3.



Concentration of NaOCl preferred by dentists is 1.5-3% NaOCl (58.3%), where 20% of them use 1.5 %.

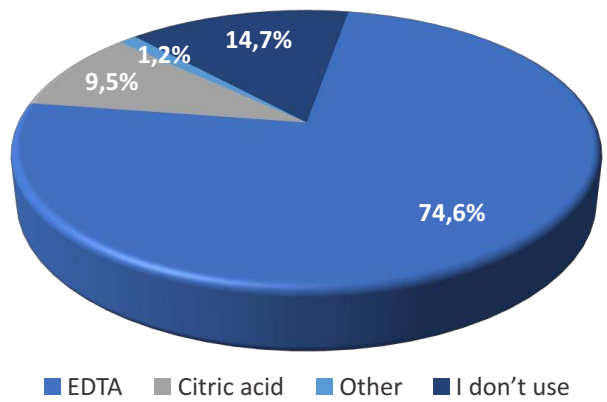
When rinsing one root canal, 46,5% of practitioners stated that they use more than 5 ml of irrigant (Figure 4).

Figure 4.



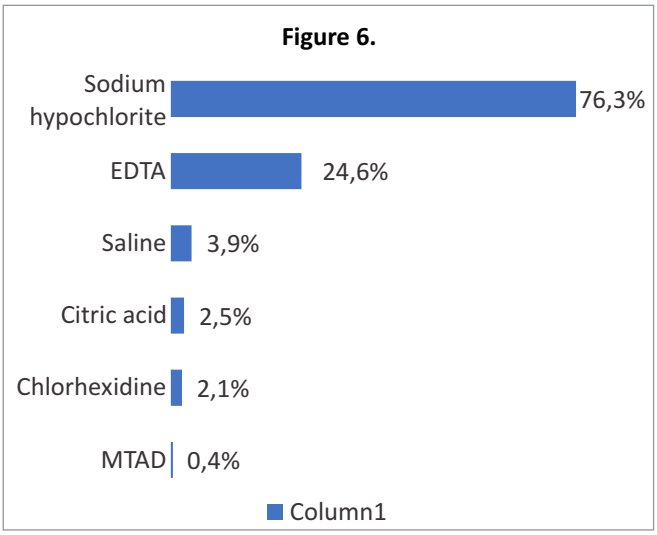
Almost 74,6% of respondents use EDTA as a chelator, and 10% use citric acid (Figure 5).

Figure 5.



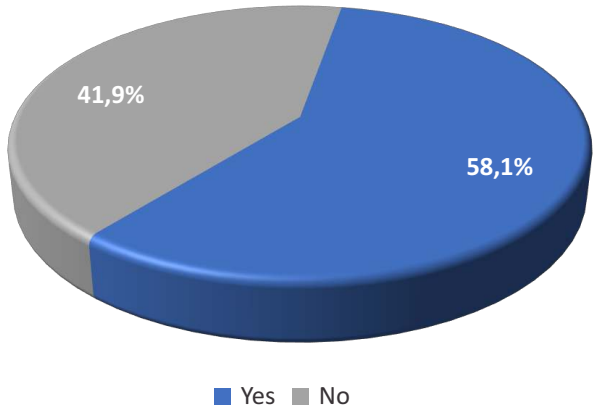
Most respondents (76,3%) considered NaOCl as the most effective at decomposing organic content, while 24,6% have chosen EDTA (Figure 6).

Figure 6.



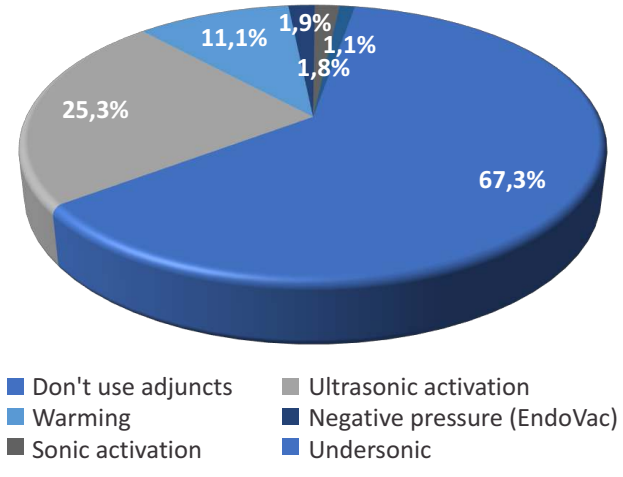
Less than 42% of respondents do not make a difference in the choice of irrigation depending on the pulpal or periapical diagnosis (Figure 7).

Figure 7.



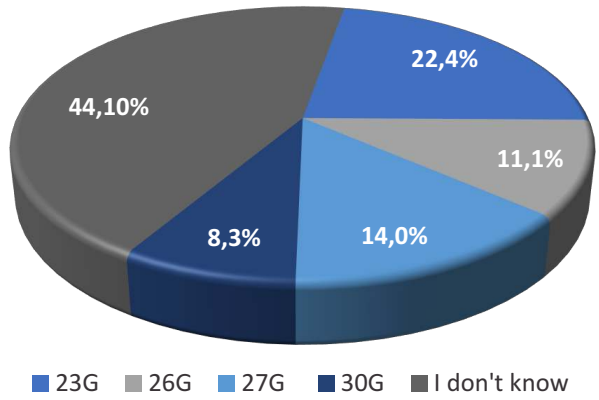
67,3% of practitioners answered that they do not use adjuncts for irrigation, 11.1% chose to warm the irrigation, and less than 26% use an ultrasonic activation (Figure 8).

Figure 8.



The efficacy of irrigation depends on the proximity of the needle to the working length. When asked what diameter of the needle they use for root canal irrigation, less than 44,10% of respondents answered that they do not know what the diameter of the needle is, while 22,4% use a 23G needle (figure 9). When asked how deep the penetration depth of the needle they use for

Figure 9.



irrigation, 31% answered 4mm, 30% 3mm, 27% 2mm and 13% answered 1 mm from the apical opening.

Discussion:

The aim of root canal treatment is to clean the root canal by considering biological, chemical and mechanical objectives. Irrigation plays a vital role in removing microbes and debris from the canals. It has several important functions which may vary according to the irrigant used: it reduces friction between the instrument and dentine, improves the cutting effectiveness of the files, dissolves tissue, cools the file and tooth and it has a washing effect and an antimicrobial/antibiofilm effect.

There is no single irrigating solution that alone sufficiently covers all of the functions required from an irrigant. Optimal irrigation is based on the combined use of two or several irrigating solutions, in a specific sequence, to predictably obtain the goals of safe and effective irrigation.

In a survey conducted in North Jordan, it was found that only 32.9% of general dentist respondents used sodium hypochlorite and 33.6% used hydrogen peroxide during root canal treatment. In this study, it was found that 84% of participants preferred Sodium hypochlorite solution while 10.6% of respondents used saline. [9]

Although 58.1% of respondents in this study stated that their choice of irrigant might change on the basis of pulpal and periapical diagnosis, their primary irrigant was still overwhelmingly sodium hypochlorite.

When asked about adjuncts used for irrigation, participants were given choices including ultrasonic activation, sonic activation, subsonic activation, negative pressure and irrigant warming. In this study 67% opted for the option none.

In this study it was found that almost 44% GPDs do not know do not know what the diameter of the needle they use during irrigation.

Conclusion

Irrigation definitely plays a key role in successful endodontic treatment. It is impossible to set a universal irrigation protocol because it depends on many factors and especially on the basic diagnosis. The basic guideline would be that it is necessary to combine irrigants in order to achieve the full effect of removing organic tissue, eliminating microorganisms as well as removing the remaining smear layer. [10]

Root canal rinses should be non-toxic, antibacterial, lubricating and dissolve organic and inorganic tissues removing the residual layer. Currently, no remedy meets all the requirements, so the solution to overcome the shortcomings of currently available irrigants is to use a combination of chemicals to rinse root canals with the activation of irrigation.

More similar studies should be conducted to know more about the irrigation preferences in root canal treatment and focus should be made on continuous educational programs to update the dentists with recent information and protocols.

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COMPARISON, VALIDATION, SENSITIVITY AND SPECIFICITY OF METHODS FOR OCCLUSAL CARIES DETECTION IN PREMOLARS

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ABSTRACT

Dental caries is still the most widespread oral disease. The occlusal surface is the most susceptible to caries. This is the area where reliable caries detection is the most difficult to perform. Occlusal caries is largely conditioned by the morphology of the fissure system, which can be described as extremely susceptible to biofilm adhesion. Although some researchers believe that the morphology of fissures and pits on the occlusal surface does not influence the development and progression of carious lesions, their shape and depth could make caries diagnosis difficult.

The aim of this study is to examine the possible differences between different methods for occlusal caries detection in premolars.

Material and methods: The study sample consisted of 116 premolars. All teeth were examined visually, and the appearance of the lesion was classified according to UniViSS criteria, then by using laser fluorescence (DIAGNOdent 2095) and digital retro-coronary radiographs. Validation method was cavity opening.

Results: Sensitivity, specificity, positive and negative predictive values were calculated for each diagnostic method, at diagnostic tresholds of enamel and dentin caries.

Conclusion: There is no difference in the values of sensitivity and specificity of visual inspection, laser fluorescence and digital radiography in the detection of occlusal caries on premolars. But, a comparison with similar research on molars, proved that there are differences among methods when performed on a different types of tooth.

Keywords: occlusal caries, caries detection, occlusal morphology, UniViSS, laser fluorescence, digital radiography.

Introduction

Dental caries is still the most widespread oral disease [1, 2]. In recent decades, a decline in the prevalence of caries throughout world has been observed. It is considered as a result of increase in scientific knowledge regarding the etiology, initiation, progression and prevention of this disease. However, the share of occlusal caries increased in parts of the population with reduced caries prevalence. Between 50 - 60% of occlusal surfaces are considered to be affected by caries. This is the area where reliable caries detection is the most difficult to perform. Therefore, there are continuous discussions about the difficulties associated with the detection of initial carious lesions on occlusal surfaces strengthening the interest in researching these lesions [3, 4, 5, 6, 7].

Early caries is closely related to occlusal morphology. Thus, caries is more common in the area of fissures and pits than on smooth surfaces. Occlusal caries is largely conditioned by the morphology of the fissure system, which can be described as extremely susceptible to biofilm adhesion. The dimensions of fissures and pits differ not only between different groups of teeth (premolars and molars) but also on the same area of the occlusal surface of the tooth. Fissures may plunge deep into the occlusal surface, may narrow or may have different depths in different parts of the occlusal surface. The depth of fissures ranges between 40 - 120 μm, the slope of fissure walls ranges from 35 to 100^0 and the width of fissures from 6 to 180 μm. According to the anatomical form, fissures can be classified into five types - V, U, I, IK, and Y type. Depending on the appearance of the groove bottom, fissures can be classified into narrow, deep and intermediate [8, 9, 10, 11, 12].

Although some researchers believe that the morphology of fissures and pits on the occlusal surface does not influence the development and progression of carious lesions, their shape and depth may make caries diagnosis difficult. The findings of some practitioners show that caries is far more common on teeth with pronounced occlusal morphology. This can be explained by difficulty of cleaning and self-cleaning of occlusal surfaces thus reducing diagnostic capabilities. The carious lesion begins on the walls of the fissure system and later joins at the bottom of the fissure, which further complicates the diagnosis. On the other hand, the shape of the fissure and the size of an angle between slopes of cusps at the entrance of the fissure allows or complicates the visual detection of the fissure bottom. Also, narrow fissures can sometimes cause the probe to become stuck due to their depth and morphology rather than the presence of caries [13].

This study aims to examine the possible differences between several methods for occlusal caries detection in premolars.

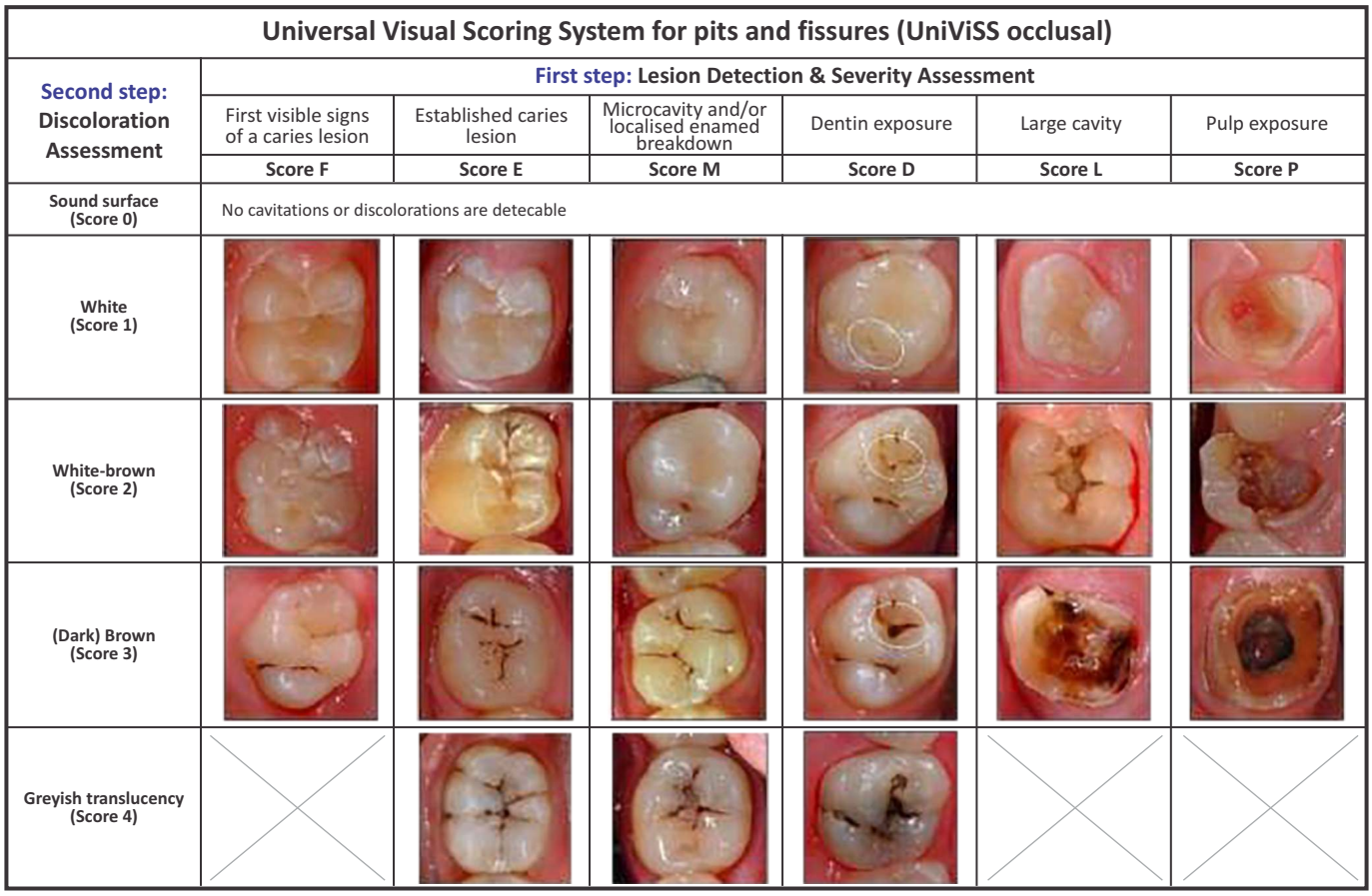
Material and methods

This study was approved by the Ethical Committee of the Faculty of Dentistry, University of Sarajevo (decision number: 09-545-4/11).

The study involved patients older than 16 years, who had been admitted to the Department of Dental Pathology and Endodontics at the Faculty of Dentistry, University of Sarajevo. The study included 64 examinees, and the study sample comprised of 116 premolars. Inclusive and exclusive criteria, examination procedures (visual examination using Universal Visual Scoring System – UniViSS (Picture 1.), laser fluorescence device - DIAGNOdent 2095 (KaVo, Biberach, Germany) [15] and digital radiography, using De Götzen xgenus® digital device (De Götzen S. r. l. Via Roma, 45-21057 Olgate Olona (VA)-Italy, software version 1.30.113) [16] and validation method [17] were previously described in studies of Basjman et al [18, 19]. Statistical analysis and data processing were performed as described in Bajsman et al [18].

Results

In 22 cases, although the validation method spoke in favor of the presence of caries in the enamel, it turned out that there was no caries



Picture 1. Universal Visual Scoring System for pits and fissures (UniViSS occlusal) [14]

lesion. In 37 cases, cavity opening confirmed enamel caries in concordance with UniViSS codes 1 and 2. In majority of cases (50) cavity opening confirmed caries below the enamel-dentin border (Table 1.).

Both, DIAGNOdent and the validation method confirm in 21 cases that there is no caries. In 5 cases, caries in the enamel were present, although the values of the DIAGNOdent readings did not support this. Caries below the enamel-dentin

Table 1. Cross-tabulation of UniViSS and validation method

		UniViSS				Total
		1 – opacity/ discoloration visible after drying	2 – opacity/ discoloration visible without drying	3 – localised enamel defect/ microcavity	4 – dentin exposure	
Validation method	0 – no caries	22	0	0	0	22
	1 – enamel caries	34	4	3	0	41
	2 – caries in the enamel half of dentin	37	9	1	3	50
	3 – caries affects more than half of dentin depth	3	0	0	0	3
Total		96	13	4	3	116

Table 2. Cross-tabulation of laser fluorescence and validation method

		Laser fluorescence			Total
		0 – no caries	1 – enamel caries	2 – dentin caries	
Validation method	0 – no caries	21	0	1	22
	1 – enamel caries	5	15	21	41
	2 – caries in the enamel half of dentin	3	11	36	50
	3 – caries affects more than half of dentin depth	0	1	2	3
Total		29	27	60	116

border was confirmed in 3 cases, although the value of DIAGNOdent readings indicated that there was no caries. In 1 case, although the DIAGNOdent reading spoke in favor of caries in dentin, the validation method refuted this (Table 2).

The correlation between UniViSS and DIAGNOdent values was positive and moderate at the confidence level of $p < 0.01$. The correlation between UniViSS and digital radiography, as well as the correlation between UniViSS and the validation method, is significant at the level of reliability of $p < 0.05$. DIAGNOdent and digital radiography show a significant correlation with the validation method at the level of reliability $p < 0.01$ (Table 4.).

The specificity values of UniViSS and digital radiography are slightly lower at the level of enamel caries. The specificity values for these two diagnostic methods are very high (1.00). Laser fluorescence shows the highest values of sensitivity and specificity at the level of caries in enamel. In terms of AUC values, laser fluorescence also shows the best values. UniViSS and digital radiography show lower sensitivity values at the diagnostic threshold of dentin caries. The sensitivity value of laser fluorescence is slightly

Table 3. Cross-tabulation of digital radiography and validation method

		Digital radiography			Total
		0 – no caries	3 – radiolucency in the enamel half of dentinal depth	4 – radiolucency in the pulpal half of dentinal depth	
Validation method	0 – no caries	22	0	0	22
	1 – enamel caries	36	4	1	41
	2 – caries in the enamel half of dentin	23	27	0	50
	3 – caries affects more than half of dentin depth	0	0	3	3
Total		81	31	4	116

Table 4. Spearman's correlation coefficient

			UniViSS	DiagnoDent	Digital radiography	Validation method
Spearman's rho	UniViSS	Correlation Coefficient	1,000	,264(**)	,199(*)	,204(*)
		Sig. (2-tailed)	.	,004	,032	,028
		N	116	116	116	116
	DiagnoDent	Correlation Coefficient	,264(**)	1,000	,268(**)	,569(**)
		Sig. (2-tailed)	,004	.	,004	,000
		N	116	116	116	116
	Digital radiography	Correlation Coefficient	,199(*)	,268(**)	1,000	,548(**)
		Sig. (2-tailed)	,032	,004	.	,000
		N	116	116	116	116
	Validation method	Correlation Coefficient	,204(*)	,569(**)	,548(**)	1,000
		Sig. (2-tailed)	,028	,000	,000	.
		N	116	116	116	116

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Table 5. Sensitivity values (SE), specificity values (SP), positive predictive values (PPV), negative predictive values (NPV), and values under the ROC curve (AUC) for UniViSS, laser fluorescence – DIAGNOdent (LF), and digital retrocoronal radiography (RVG) for enamel caries (D2) and dentin caries (D3)

D2					
	SE (95% CI)	**SP** (95% CI)	**PPV** (95% CI)	**NPV** (95% CI)	**AUC** (95% CI)
UniViSS	**0.17** (0.07 – 0.32)	**1.00** (0.84 – 1.00)	**1.00** (0.59 – 1.00)	**0.39** (0.27 - 0.53)	**0.585** (0.454 – 0.708)
LF	**0.88** (0.74 – 0.96)	**0.95** (0.77 – 0.93)	**0.97** (0.86 – 1.00)	**0.81** (0.61 – 0.93)	**0.908** (0.808 – 0.966)
RVG	**0.12** (0.04 – 0.26)	**1.00** (0.84 – 1.00)	**1.00** (0.48 – 1.00)	**0.38** (0.26 – 0.52)	**0.561** (0.430 – 0.686)
D2					
	SE (95% CI)	**SP** (95% CI)	**PPV** (95% CI)	**NPV** (95% CI)	**AUC** (95% CI)
UniViSS	**0.26** (0.15 – 0.40)	**0.89** (0.78 – 0.95)	**0.65** (0.41 – 0.85)	**0.60** (0.50 – 0.70)	**0.574** (0.478 – 0.667)
LF	**0.72** (0.58 – 0.84)	**0.65** (0.52 – 0.77)	**0.62** (0.48 – 0.75)	**0.75** (0.61 – 0.85)	**0.724** (0.632 – 0.804)
RVG	**0.54** (0.39 – 0.68)	**0.92** (0.82 – 0.97)	**0.84** (0.67 – 0.95)	**0.72** (0.60 – 0.81)	**0.726** (0.634 – 0.806)

better, but lower compared to a diagnostic threshold of enamel caries. There is a noticeable decrease in the value of the specificity of laser fluorescence. A possible explanation could be chosen diagnostic threshold for dentin caries (DIAGNOdent reading value> 20), that could have led to overestimation. Choosing a higher diagnostic threshold (DIAGNOdent reading value $\geqslant$ 30) would probably lead to better results. However, the stated diagnostic threshold was chosen considering the incidence of caries in our population, when even a discreet overestimation of the results is not an error. In populations with low caries incidence, a higher diagnostic threshold is appropriate and recommended [2. AUC values at the level of caries in dentin for all three diagnostic methods range between weak and good (Table 5.)

Discussion

For the validation of diagnostic methods, the values of sensitivity (SE), specificity (SP), positive (PPV) and negative (NPV) predictive values were observed.

Examining the values of sensitivity, specificity, positive and negative predictive values of visual inspection (UniViSS), laser fluorescence and digital radiography on permanent molars with an identical study design, Bajsman et al [18 recorded higher values of sensitivity and specificity of these diagnostic methods at the level of enamel caries. Positive and negative predictive values at the same diagnostic level are comparable. At the level of dentin caries, the sensitivity values of all diagnostic methods are lower. Laser fluorescence on premolars shows a higher value of specificity (0.65) compared to the value recorded on molars (0.27), as well as digital radiography, where the value of specificity on premolars is 0.92 and on molars 0.77. Positive predictive values on premolars are slightly lower for all methods, and consequently, negative predictive values are slightly higher, compared to the values recorded on molars.

It is a known fact that the morphology of the occlusal surface and the three-dimensional pattern of the fissure system have impact on occlusal caries initiation. Salman [9, in his study of the influence of occlusal morphology on the severity of occlusal caries, states that there is a statistically significant correlation at the level of $p \leqslant 0.001$. Because there is a difference in the complexity of occlusal fissures and pits on premolars and molars, one of the objectives of this study was to determine whether there is a difference in the performance of methods for diagnosing occlusal caries on premolars and molars.

Analyzing the correspondence between radiological and clinical depth of carious lesions on a sample of premolars and molars using a similar study design, Bajsman et al [19 concluded that the depth of carious lesions is higher on molars than on premolars and that digital radiograms underestimate the depth of carious lesions. This is explained by the complexity of occlusal morphology and numerous morphological details that can be superimposed on each other. The more morphological details, the more complex the radiological analysis are.

The results showed that there is a difference in the diagnostic performance of the tested methods on premolars and molars regarding both diagnostic thresholds.

Valera et al [11] point out that there are no statistically significant differences between premolars and molars regarding the presence or absence of pits and fissures. In both premolars and molars, the prevalence of caries is dependent on occlusal morphometry. Prevalence is higher when fissures and pits are more pronounced. Despite similar morphometry, the prevalence of caries is significantly higher in molars compared to premolars. The prevalence of caries on molars is higher due to their position in the dental arch because this position makes physiological self-cleaning and implementation of prophylactic, oral hygiene measures by the patient difficult.

Antonnen [20] points out that the values recorded by the laser fluorescence method in children on premolars are lower than the values recorded on molars. This is explained by the

simpler anatomy of premolar fissures concerning fissures and fossae on occlusal surfaces of molars. The largest number of lesions observed on occlusal surfaces of premolars in our research were characterized as enamel caries by visual examination. This can be explained by simpler occlusal morphology and easier maintenance of oral hygiene and the implementation of prophylactic measures due to the position of the premolars in dental arches. Therefore, remineralization of initial carious lesions on premolars could take place to a greater extent than on molars.

According to the chronology of eruption, the first permanent molars erupt before the second permanent molars, but also before the first and second premolars. They also have the most complex occlusal morphology. Their presence within the oral cavity is the longest of all teeth of the trans canine sector, and therefore are most susceptible to caries and lesions with cavitation being very often restored. Torres et al [21] explain the far higher number of premolars with completely healthy occlusal surfaces, compared to molars, in an in vivo study of the application of visual inspection and retro-coronary radiography in the diagnosis of occult occlusal caries, taking the abovementioned facts into account.

Chong et al [22] compared visual-tactile examination with conventional digital radiography and DIAGNOdent in the diagnosis of occult occlusal caries on extracted premolars. Spearman's correlation coefficient was used to compare different methods. The specificity of visual-tactile examination compared to digital radiography was 0.54. The specificity of DIAGNOdent in the diagnosis of occlusal caries compared to visual and tactile examination was 0.56. The specificity of DIAGNOdent compared to digital radiography was 0.32. In this study, Spearman's correlation coefficient between laser fluorescence and digital radiography is rho = 0.268 ($p < 0.01$). The authors conclude that DIAGNOdent gave similar sensitivity values but lower specificity values compared to visual-tactile examination in the diagnosis of occult dentin caries on the examined sample.

Pourhaschemi et al [23] compared in vitro visual examination, conventional retro-coronary radiography and laser fluorescence in the diagnosis of occlusal caries on a sample of 80 premolars. The validation method was the histological section. Visual examination was performed according to Extrand criteria. The sensitivity value of visual inspection was 0.44, specificity 0.78, positive predictive value 0.69 and negative predictive value 0.53 being comparable to the results of our study. For conventional retro-coronary radiography, sensitivity value was 0.27, specificity value 0.69, positive predictive values 0.44 and the negative predictive values 0.39. The values recorded in this study are better due to the application of digital techniques and image processing. For laser fluorescence, Pouraschemi et al point out that it showed a positive predictive value of 0.94 and a negative predictive value of 0.95. The diagnostic threshold for dentin caries was a DIAGNOdent value> 30. Laser fluorescence results are slightly better than results in our study due to the higher selected numerical threshold for dentin caries. The authors conclude that although the values of precision and reproducibility of the laser fluorescence method were higher than the values of the same parameters of visual examination and conventional retro-coronary radiography, it is still better to apply laser fluorescence with another method to diagnose occlusal caries and to reduce diagnostic errors.

Conclusion

There is no difference in the values of sensitivity and specificity of visual inspection (UniViSS), laser fluorescence and digital radiography in the detection of occlusal caries on premolars. But, a comparison with similar research on molars proved that there are differences among methods when performed on a different type of tooth, which is another confirmation of the complexity of occlusal morphology influencing the occurrence of caries and its detection.

Declaration of interest

There is not any conflict of interest for this material in the manuscript for all authors, between the authors, or for any organization.

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ROLE OF SERRAPEPTASE ON TRISMUS AFTER SURGICAL REMOVAL OF MANDIBULAR THIRD MOLAR

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ABSTRACT

Operative removal of submerged teeth represents most often surgical procedure in the field of oral surgery. Etiology of narrow jaw is correlated with continuous reduction of jaw and teeth. Since the teeth, as highly differentiated tissue reduces slower, the result is a disproportion between the size of the teeth and the jaws. Surgical procedure interrupts continuity of soft and bone tissue, resulting with swelling, trismus and pain. Trismus, caused by intramuscular inflammation, represents distressing factor for the patient. Serrapeptase has strong anti-inflammatory, antiedematous and mild analgetic effect and can be used for reducing post-operative reactions.

Materials and Methods: This study was conducted on 100 patients having surgical removal of mandibular third molar. Selected patients were randomly divided into two groups- control group or the serrapeptase group, irrespective of age and sex. Interincisal distance (mouth opening) was measured between the incisal edges of the central incisors using Nonius scale (Vernier calipers). The follow-up was carried out on the 1 st ,2 nd, 5 th and 7 th postoperative days.

Results: Improvement related to trismus has been demonstrated in serrapeptase group compared with control group in 7 days following up postoperative period.

Conclusion: The results in this study showed that serrapeptase was effective in reducing trismus after operative removal of submerged teeth.

Keywords: submerged teeth, trismus, serrapeptase

Introduction

Operative removal of submerged teeth represents most often, surgical procedure in the field of oral surgery. The most common post-operative effects are pain, trismus and facial swelling. Etiology of narrow jaw is correlated with continuous reduction of jaw and teeth. Since the teeth, as highly differentiated tissue reduces slower in comparison to jaws, the result is a dentoalveolar disproportion. Surgical procedures cause a significant amount of tissue injury, followed by the processes of inflammation and subsequently reparation and regeneration of the injured tissues. Operative removal of the third lower molars involves the elevation of a soft tissue flap, adequate bone guttering and odontectomy. These procedures lead to the release of various vasoactive chemical mediators. Though inflammation is a reparative process it causes significant distress due to pain and swelling.

Within 48-72 hours of the surgical procedure swelling usually reaches its maximum. Trismus, caused by intramuscular inflammation, could be an associated distressing factor for the patient. A meticulous surgical technique will not prevent pain, trismus or swelling, but can minimize the sequelae of inflammation [1]. By prescribing corticosteroids it is possible to reduce the intensity of the inflammatory process [2].

The vasoactive amines cause vasodilation resulting in increased blood flow to the inflamed area. The inflammatory process is necessary if healing is to occur, but inflammation also causes edema, pain and trismus [3].

To minimize the unwanted effects of inflammation, it becomes essential to control the process of inflammation. Serrapeptase (proteolytic enzyme from trypsin family) is a protease produced by *Enterobacterium serratia* which has strong anti-inflammatory performance. For the past thirty years serrapeptase is used in Europe and Japan with great success due to anti-inflammatory effect in post-operative period, but also as support for cardiovascular, immunological and respiratory functions in human body.

Recent research shows that Serine protease has a higher affinity for cyclooxygenase, both I and II, which is in tight connection with production of inflammatory mediators like interleukins (IL), prostaglandins (PGs) and thromboxane (TXs) [4].

A prospective study conducted by Al-Khateeb and Nusair after third molar surgery showed significant reduction in swelling achieved with the use of serrapeptase [5]. Authors also suggest anti-sclerotic, fibrinolytic and caseinolytic effects of serrapeptase [6-8].

It is also presented that serrapepdase decreases capillary permeability induced by histamine, bradykinin and serotonin; destroys abnormal exudates and proteins; controls the absorption of decomposed products through blood and lymph [9].

The aim of this study was to determine whether serrapeptase has an effect on the severity of trismus in postoperative recovery of the patient.

Materials and methods

Operative procedure

Operative removal of the third lower molar begins with local anesthesia through inferior alveolar block, lingual and buccal nerve block. Standard Terrence-Wards incision was placed and bone was exposed with mucoperiosteal flap. Using round bur whit adequate saline rinse (using fisiodispenser) bone removal was carried out on buccal and distal side of the tooth. With an elevators and forceps, the tooth was extracted from the socket. After the sharp bony edges were smoothened, the socket was irrigated with saline solution. When full hemostasis was achieved, the wound is closed with 3-0 silk suture.

Sample of respondents

This study was conducted on 100 patients who had surgical removal of mandibular third molar. Selected patients were divided into two groups - control group and the serrapeptase group, irrespective of age and sex.

Inclusion criteria was healthy patients, undergoing impacted third lower molar removal for the

indications of deep caries with pulpitis, pericoronitis and orthodontic reasons.

Exclusion criteria was patients with systemic diseases.

All patients were given full information about purpose of the study and effects of the drugs used and all patients signed a consent form to participate in the research.

In one group, patients were given 500 mg amoxicilin every 8 th hours for 7 days and ibuprofen 400 mg postoperatively.

In the other group, patients were given amoxicillin 500 mg every 8 th hours for 7 days, ibuprofen 400 mg postoperatively and serrapeptase 60000 i.u. one daily.

The follow-up was carried out on the 1 st ,2 nd, 5 th and 7 th postoperative days. Interincisal distance (mouth opening) was measured between the incisal edges of the central incisors using Nonius scale (Vernier calipers).

Results

The results are presented by table and graphs. Data analysis was carried out by Microsoft Excel 2016. Table 1 and graphs 1 and 2 present more pronounced trismus in the control group of patients in all measurements. The most pronounced difference between the control group and the serrapeptase group is the second day of surgery.

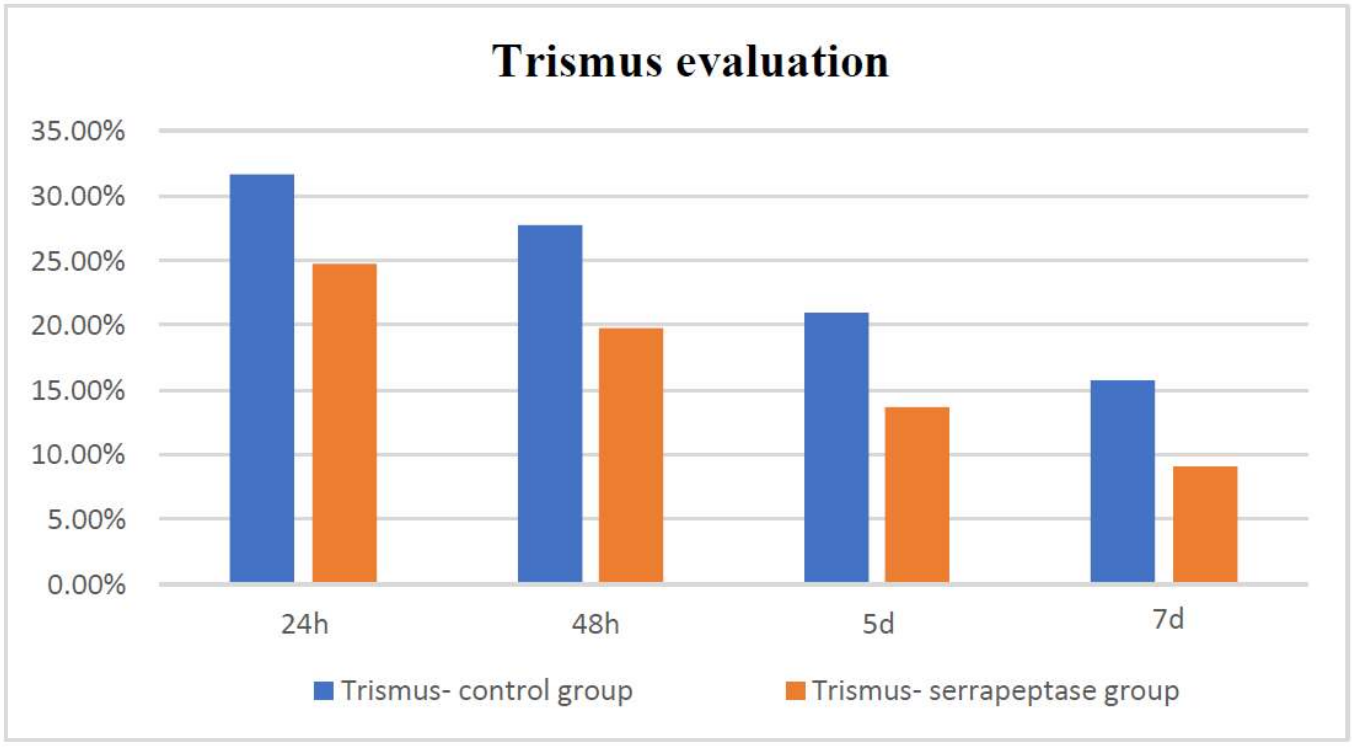
Table 4. Trismus evaluation

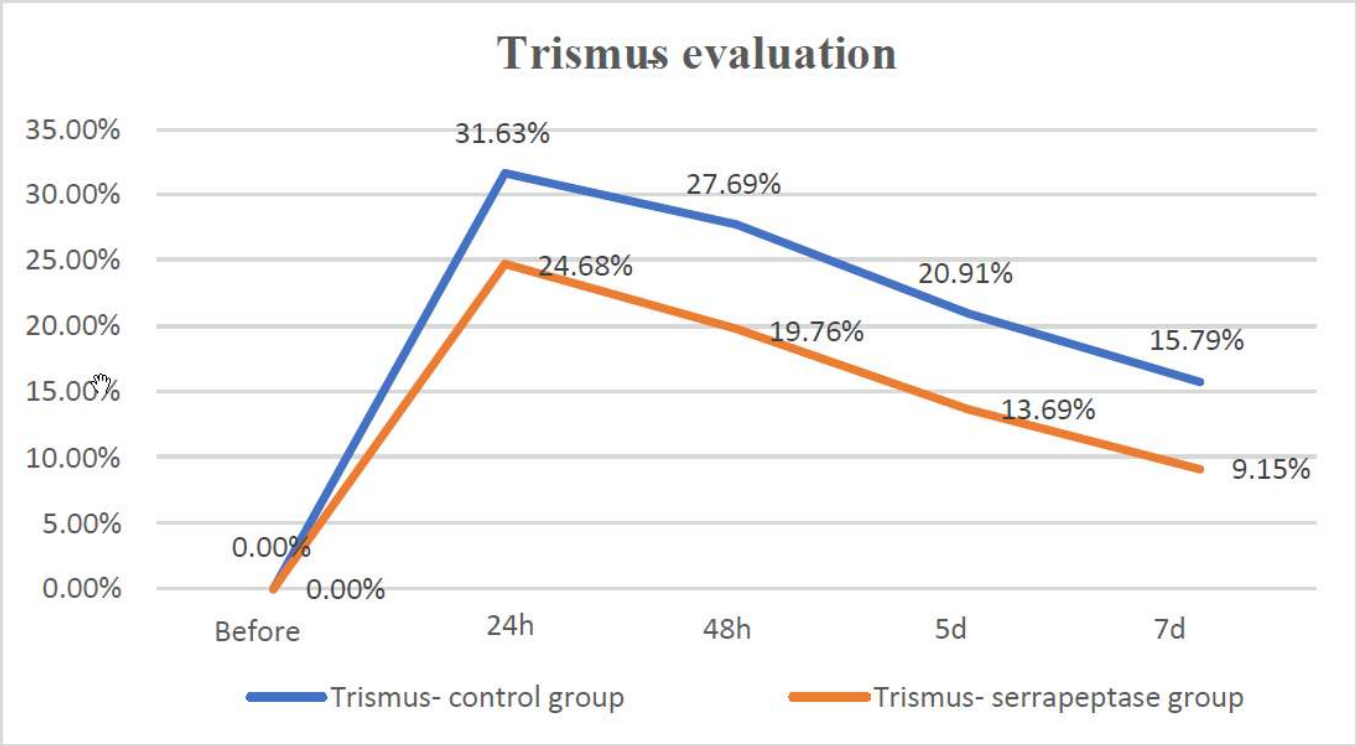
	Postoperative period	Trismus - control group	Trismus - serrapeptase group
1.	24 h	31.63%	24.68%
2.	48 h	27.69%	19.76%
3.	5 days	20.91%	13.69%
4.	7 days	15.79%	9.15%

On day 7 there is still insignificant trismus (6,64% higher in control group), suggesting that these drugs are not completely effective in relieving trismus on 7th postoperative days.

Discussion

Serrapeptase is a proteolytic enzyme being used for effective relief from pain and swelling





alone or in combination with steroids and NSAID's [10]. During chronical inflammation use of NSAID's have many limitations and side effects. Inflammation causes edema, pain and trismus but the inflammatory process is necessary for healing [1].

Idea of using enzymes, as extremely potent substances, as a therapy for inflammation is attractive. It is usually administered orally, absorbed through the intestine and directly transported into the bloodstream. However, due to its peptide nature, there is greater tendency to undergo enzymatic degradation in the gastrointestinal tract, leading to poor bioavailability. Researchers have demonstrated that enzyme possesses the unique ability to dissolve the dead and damaged tissue without harming living tissues, although the exact molecular mechanism of serrapeptase is not known completely. One of the anti-inflammatory activities of serropeptase is increasing the viscosity of accumulated fluid facilitating drainage. [11]

Bhagat et al. in systematic review on serrapeptase compiled the findings of various randomized controlled trials in medical and dental practice. In our study, descriptive statistical methods showed the difference in the expression of trismus in the postoperative period between the control and serrapeptase groups. For all measurements in the postoperative period, there is less pronounced trismus in the serrapeptase group. On the seventh postoperative day, patients still have mild trismus, but less pronounced in the serrapeptase group [8].

Concerning the safety of use, there are not any published studies on some serious adverse drug reactions to serrapeptase, although as possible reactions are mentioned muscle and joint pain, anorexia, nausea, skin reactions and coagulation disturbances.

Researchers suggests that serrapeptase could significantly enhance the effectiveness of antibiotics (including ampicillin,cyclacillin, cephalexin, minocycline and cefotiam) against biofilm and can inhibit biofilm formation. A statistically significant improvement in trismus has been presented in comparison with steroids and NSAID's [12, 13].

Conclusion

The results in this study showed that serrapeptase was more effective in reduction of trismus after operative removal of submerged teeth compared to standard protocols. Administration of serrapeptase can accelerate recovery from trismus and can bring benefits for patients. Studies conducted on this topic can serve as an argument for introducing serrapeptase in standard postoperative protocol, along with antibiotics and pain reliever for reducing postoperative complications.

Declaration of interest

The authors declare no conflict of interest.

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HOW MEDICATIONS AFFECT ORTHODONTIC TOOTH MOVEMENT

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ABSTRACT

Correction of orthodontic irregularities includes orthodontic tooth movement. The action of force initiates a series of biomechanical processes of bone remodeling leading to tooth movement. Different medications can affect orthodontic tooth movement - inhibiting (decrease tooth movement) or stimulating (increase tooth movement). Knowledge of medications effects is of particular importance to clinicians. The purpose of this review is to explain the mode of action of certain medications and to show their influence on orthodontic tooth movement.

Keywords: orthodontics, tooth movement, medications

Introduction

Correction of orthodontic irregularities includes orthodontic tooth movement. By the action of the force, a series of biomechanical processes of bone remodeling are initiated leading to tooth movement [1].

The process of orthodontic tooth movement begins when the orthodontic force applied to the crown of the tooth is transmitted through the root to the periodontal ligament and alveolar bone thus causes changes in the activity of these structures cells. Bone remodeling is a process of bone formation on tension side and bone resorption on pressure side [2]. During orthodontic tooth ovement, the remodeling process is associated with the influence of mediators that trigger inflammatory processes in the initial stages of orthodontic tooth movement - cyclic adenosine monophosphate (cAMP), prost-agladins , interleukins, cytokines. Since different medications can affect the level of prostaglandins and other mediators, pharmacological interventions can thus modify the response to the application of orthodontic force [3].

Many orthodontic patients consume vitamins, hormonal preparations, certain medications for the prevention or treatment of various diseases. Thus, it is necessary to know the mechanism of their action and effects on orthodontic tooth movement.

The purpose of this review is to explain the mode of action of certain medications and show their influence on orthodontic tooth movement. This can serve as a quick reminder for clinicians when managing therapy in patients using certain medications or supplements.

Considering the large number of medications that can affect orthodontic tooth movement, the first part will describe the influence of nonsteroidal anti-inflammatory drugs (NSAIDs), paracetamol, vitamin D3, calcium, bisphosphonates and anticonvulsants.

1. Nonsteroidal anti-inflammatory drugs (NSAIDs)

Nonsteroidal anti-inflammatory drugs (NSAIDs) are one of the most commonly used drug groups. They have analgesic, antipyretic and anti-inflammatory effect, and are used in the therapy of various diseases such as rheumatoid arthritis, osteoarthritis, gout, as well as for the prevention of cardiovascular diseases [4]. The main mechanism of action is based on the inhibition of prostaglandin synthesis by blocking cyclooxygenase (COX) – COX-1 and COX-2 enzymes [5]. Since prostaglandins play an important role in orthodontic tooth movement processes, it is clear that the use of drugs that block their synthesis will affect tooth movement. The most important groups of NSAIDs that differ in their chemical composition are: salicylates, arylalkanoic acids, arylpropionic acids (profens), oxicams and coxibs [3].

1.1. Salicylates (Aspirin)

Acetylsalicylic acid is the most widely used NSAID. It inhibits both types of COX thus directly inhibits prostaglandin synthesis. Clinically, this is manifested by slower orthodontic tooth movement in patients who have undergone long-term therapy with acetylsalicylic acid. Salicylates inhibit the synthesis of prostaglandins, influence the differentiation of osteoclasts and thereby reduce bone resorption [4].

One of the experiments conducted on rats showed that non-steroidal anti-inflammatory analgesics, such as aspirin and ibuprofen, reduce the number of osteoclasts, probably by inhibiting prostaglandin secretion, which significantly reduces orthodontic tooth movement. To the contrary, acetaminophen did not affect orthodontic tooth movement in rats, and this analgesic could be used in the treatment of pain caused by orthodontic tooth movement [6].

Therefore, before starting orthodontic therapy, it is necessary to consider the possibility of excluding the use of salicylates if this will not affect

the course of the disease for which this drug is prescribed.

1.2. Arylalkanoic acids (Diclofenac, Indomethacin)

Indomethacin has a strong analgesic, anti-inflammatory and antipyretic effect, and in higher concentrations it prevents platelet aggregation. It is used in patients with rheumatic diseases because it reduces pain, joint swelling and morning stiffness. It is a specific inhibitor of prostaglandin [7]. The results of several studies conducted on experimental animals – rats [8], pigs [9], cats [10] - showed a significant decrease of tooth movement after the application of indomethacin, regardless of the magnitude of the applied orthodontic force.

Diclofenac is among the most commonly used NSAID drugs used in the treatment of rheumatoid arthritis, spodylitis, toothache, post-traumatic and postoperative inflammatory conditions. The mechanism of action consists in the inhibition of prostaglandin synthesis by inhibiting COX-1 and COX-2 enzymes [11]. Carlos et al. observed that after 2 local applications of diclofenac injection (10mg/kg) there was a complete inhibition of molar movement in rats [12].

1.3. Arylpropionic acids (Ibuprofen, Flurbiprofen, Naproxen)

Numerous studies have established that ibuprofen has a similar effect on orthodontic tooth movement as other drugs from the NSAID group [6, 13, 14]. A study examining the movement of rat incisors by applying a force of 25 or 35 CN and after the administration of ibuprofen in a dose of 30 mg/kg, showed a significant reduction in the rate of orthodontic tooth movement [6].

The mechanism of action is based on the inhibition of prostaglandin synthesis due to the blockade of the COX enzyme. This leads to a reduction in the differentiation and activation of osteoclasts, which will lead to a significant reduction in tooth movement and thus prolongation of orthodontic therapy [15].

1.4. Coxib (Celecoxib, Rofecoxib, Valdecoxib)

Coxibs are a specific group of NSAID that selectively inhibit the COX-2 enzyme and are commonly used in the treatment of osteoarthritis and acute and chronic pain of other causes [4].

The results of studies, mostly conducted on experimental animals, have shown different effects of coxib on orthodontic tooth movement. Several studies observed that bone resorption was inhibited by celecoxib administration and concluded that COX-2-dependent prostaglandin synthesis is critical for bone resorption [16], resulting in reduced tooth movement after orthodontic force application [17]. De Carlos et al. compared the effects of rofecoxib, celecoxib and parecoxib on orthodontic tooth movement, and determined that celecoxib and parecoxib had no effect on orthodontic tooth movement [18].

NSAIDs are the most commonly used analgesics to control pain and discomfort, specifically ibuprofen and acetylsalicylic acid. These two medications have shown that they mostly lead to a decrease in prostaglandin E and osteoclast levels, and therefore slow down orthodontic treatment. However, in low doses, NSAIDs have little or no effect. Although all experiments show similar results, their effect on orthodontic displacement is not uniform. However, based on experiments and evidence, it is concluded that NSAIDs are inhibitors of prostaglandin synthesis thus decreasing orthodontic tooth movement.

2. Paracetamol (acetaminophen)

Paracetamol (acetaminophen) has pronounced analgesic and antipyretic effects with no anti-inflammatory effect. Unlike NSAIDs, which inhibit COX-1 and COX-2 enzymes, paracetamol inhibits the third isoform COX-3, which is found exclusively in the brain and spinal cord. Thus, paracetamol has minimal effects on prostaglandin synthesis [3].

Tests of the effect of paracetamol on orthodontic tooth movement in rabbits and rats showed that there is no effect on the rate of

movement of incisors and molars [3, 19]. Since paracetamol does not affect the rate of tooth movement, both studies recommend that paracetamol should be the medication of choice for reduction of pain associated with orthodontic tooth movement.

3. Vitamin D (1,25 dihydroxycholecalciferol)

The active metabolite of vitamin D is 1,25 dihydroxycholecalciferol. It regulates the level of calcium and phosphate in the serum, then stimulates bone deposition and inhibits the release of parathyroid hormone (PTH) and has an important role in the immune system.

The effect of vitamin D on orthodontic tooth movement has been studied in numerous studies. Kale et al observed that local application of vitamin D accelerates tooth movement in rats, and the assumption is that this effect is the result of balanced processes of bone resorption and apposition caused by vitamin D [20]. Intra-ligament injections of vitamin D metabolites cause an increase in osteoclastic activity thus leading to an increase in bone resorption producing an increase in tooth movement during orthodontic therapy [21]. A study conducted by Tehranchi et al. showed that patients with lower serum vitamin D concentrations did not show greater root resorption after completion of fixed orthodontic therapy [22].

4. Calcium

Calcium is a mineral necessary for various physiological processes such as muscle contraction, heart rhythm regulation, fluid balance and enzyme regulation. Dietary recommendations for calcium intake for children aged 4–8 years is 800 mg/day and for adults between 1000 and 1300 mg/day. It is often prescribed as a dietary supplement in order to prevent certain diseases (osteoporosis) [15].

The influence of dietary calcium on orthodontic tooth movement was investigated in dogs whose diets were high and low in calcium. The research results showed that those whose diet was low in calcium had significantly faster tooth movement compared to the group whose diet was rich in calcium [23].

Thyroid and parathyroid hormones, sex hormones and vitamin D play an important role in the regulation of calcium levels in the body. A special group of drugs that affect calcium homeostasis are bisphosphonates [24].

5. Bisphosphonates

Bisphosphonates have a strong inhibitory effect on bone resorption and are successfully used in the treatment of osteoporosis, Paget's disease and bone tumors. Bisphosphonates are incorporated into the bone matrix, and they are specific in that their half-life is 10 years or more, so they can affect bone metabolism for many years after stopping the medication [4]. Considering the possible effects of different bisphosphonates on orthodontic tooth movement, studies have shown that both alendronate and clodronate inhibit key factors mediating tooth movement.

Liu et al. applied clodronate to the subperiosteal region of a molar exposed to orthodontic force in rats and concluded that local application of clodronate not only reduces orthodontic tooth movement, but also reduces the number of osteoclasts and root resorption [25]. Local superiosteal application of clodronate shows an inhibitory effect on tooth movement and with a shorter application interval even at lower doses [26].

6. Anticonvulsants

Anticonvulsants are drugs that stop and prevent an epileptic attack, but do not act on the cause of the convulsions. The main mechanism of their action is an increase in inhibitory and a decrease in

excitatory transmission in the central nervous system, stabilization of the neuron membrane, slowing down of synaptic transmission [7].

Phenytoin causes gingival hyperplasia due to excessive proliferation of gingival collagen fibers, including the interdental papilla which significantly complicates orthodontic tooth movement [27].

Akhoundi et al. examined the effect of carbamazepine and valproic acid on orthodontic tooth movement in rats, and found that these drugs can reduce bone density which will cause accelerated orthodontic tooth movement [28].

Due to changes in bone metabolism and the consequent acceleration of orthodontic tooth movement, as well as an increased risk of gingival hyperplasia, patients using anticonvulsants should be monitored more often.

Today, there are many more adults and older patients who seek orthodontic treatment, either for aesthetic reasons or as a pre-prosthetic treatment. Considering that most of these patients have some chronic disease and therefore consume certain medications on a daily basis, it is necessary to know the mechanism of action of these medications as well as their possible side effects influences on orthodontic tooth movement. Knowing the effects of medications on orthodontic tooth movement is important for planning orthodontic treatment, as well as to predict possible difficulties for patients that can be expected during treatment. In addition, the importance of the medical history of each patient and data on the consumption of certain medications that can affect orthodontic treatment should be emphasized.

Conclusion

Different medications can affect orthodontic tooth movement - inhibiting or stimulating, which should be taken into account before starting orthodontic treatment in patients who consume medications daily. It is important to know the effects of the following medications:

- Aspirin has an inhibitory effect on orthodontic tooth movement.
- Acetaminophen (Paracetamol) does not affect the rate of tooth movement and therefore this should be the analgesic of choice for managing pain associated with orthodontic tooth movement.
- Vitamin D has a stimulating effect on orthodontic tooth movement.
- Reduced intake of calcium accelerates tooth movement.
- Bisphosphonates have an inhibitory effect on orthodontic tooth movement and can therefore prolong the duration of orthodontic treatment.
- Phenytoin makes orthodontic tooth movement more difficult, while carbamazepine and valproic acid accelerate orthodontic tooth movement.

Declaration of interest

The authors declare no conflict of interest.

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TREATMENT OF ORAL LESIONS AS SIDE EFFECTS AFTER ADMINISTRATION OF ERYTHRITOL POWDER CONTAINING 0,3% CHLORHEXIDINE AND 0,2% CHLORHEXIDINE DIGLUCONATE ORAL ANTISEPTIC: CASE REPORT

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ABSTRACT

Objective: The aim of this case report was to document a case of side effect reaction of the gingiva and oral mucosa after the use of Erythritol powder containing 0.3% chlorhexidine (Air Flow® Powder PLUS) and 0,2 % chlorhexidine digluconate oral antiseptic solution.

Case report: A 49-year-old female patient presented with severe erosive and suspected necrotic changes on lips and gums, upper lip swelling and severe pain which was present for 15 days. Previously, chlorhexidine digluconate 0,2 % was used in treatments with diode laser following the prophylaxis treatment which included the use of Erythritol powder containing 0.3% chlorhexidine. The patient was prescribed and successfully treated with a combination of antibiotics: Amoxicillin (a 500 mg) and Metronidazole (a 250 mg), Lysobact oriblets (6-8 a day), Panthenol solution for rinsing (3 times a day), and a magistral medicine with Pronisone for local application.

Conclusion: Due to the proven possible side effects of Erythritol powder containing 0.3% chlorhexidine and 0,2 % chlorhexidine digluconate, uncritical use of Erythritol powder containing 0.3% chlorhexidine and chlorhexidine digluconate should be avoided. The therapy applied in the presented case proved to be extremely effective in the treatment of changes that occurred as a side effect of the use of Erythritol powder containing 0.3% chlorhexidine and 0,2% chlorhexidine digluconate.

Keywords: erosive stomatitis, chlorhexidine, Erythritol, side effect, oral mucosa.

Introduction

Erosive stomatitis is a complex disease of the oral mucosa clinically presented with hyperemia, swelling, bleeding and erosive forms. This type of inflammation of the mucous lining may involve the cheeks, gums, tongue, lips and roof or floor of the mouth. The condition is painful and patients cannot eat normally due to pain and discomfort, indicating deterioration of health in general. Halitosis may also accompany the condition. Severe erosive stomatitis can also be associated with immunological diseases [1].

A possible reason for the onset of erosive stomatitis can be the intake of allergens or direct contact of the traumatic element with the oral mucosa of the patient. Air-flow treatment is widely used in prophylaxis and treatment of periodontal disease. It is used for teeth cleaning or polishing with a jet of compressed air containing an abrasive powder [2]. Different side effects of this treatment including gum erosions and emphysema have been described [3, 4, 5]. Erythritol is a sugar alcohol that is a water-soluble and non-toxic agent previously used as a food additive in canditory and baked products and calorie-reduced food as a sweetener [6]. In dental practice, it is used as a low-abrasive air-flow powder with a mechanical effect on biofilm and a biochemical effect on bacteria [7].

Case report

A 49-year-old female patient was referred to the Department of Oral Medicine and Periodontology because of severe erosive and suspected necrotic changes on lips and gums, upper lip swelling and severe pain lasting for 15 days. In the anamnestic details, the patient states that the symptoms started to appear after the dental treatment which included the ultrasonic teeth cleaning followed by air-flow treatment with Erythritol powder containing 0.3% chlorhexidine (Air Flow® Powder PLUS). The patient had information of chlorhexidine digluconate 0,2% solution used in treatments with diode laser following the prophylaxis treatment, stating that she had severe pain with a burning sensation at one of the visits where this form of treatment was used. The patient stated that she was prescribed Periodontal Gel Perioplus with CITROX®/P formula and 0,5 % chlorhexidine as a treatment for the oral lesions appeared after the treatment.

During the clinical examination, we observed a severe presentation of suspected necrosis in the gum tissue in the upper and lower jaw with erosions and ulcerations on lips mucosa (Figure 1). The marginal gingiva was distinctly ischemic and distinctly white in color. Lips were swollen and dry. There was no enlargement of regional lymph nodes on palpation. The patient complained of severe pain, difficulty in opening her mouth due to pain and difficulty in eating and drinking.

The patient was prescribed antibiotics: Amoxicillin (a 500 mg) and Metronidazole (a 250 mg), Lysobact oribletes (6-8 a day), Panthenol solution for rinsing (3 times a day), and a magistral medicine with Pronisone for local application.

Figure 1. First visit clinical presentation
A, B – Mucosa and gums in upper jaw
C, D – Mucosa and gums in lower jaw

In the second visit, five days after, a significant reduction of clinically visible changes is registered (Figure 2). The patient states a significant reduction in pain and easier consumption of food and drink. Therapy administered at the first visit was continued with the exclusion of antibiotics 10 days from the beginning of the treatment.

Fifteen days from the first visit, patients' condition is very satisfactory. The patient states the absence of pain and easier implementation of oral hygiene measures and consumption of food and drinks without expressed subjective difficulties. The presence of small lesions in the epithelialization is clinically visible (Figure 3), and the therapy was continued with Panthenol solution, magistral medicine with Pronisone, according to previous instructions, and additionally, the use of AD vitamin drops to coat locally on the oral mucosa.

Figure 2. Second visit clinical presentation
A, B – Mucosa and gums in upper jaw after five days
C, D – Mucosa and gums in lower jaw after five days

Figure 3. Third visit clinical presentation
A, B – Mucosa and gums in upper jaw after fifteen days
C, D – Mucosa and gums in lower jaw after fifteen days

Discussion

Necrotizing conditions of periodontal tissues are most severe disorders caused primarily by bacterial plaque and necrotizing ulcerative gingivitis, periodontitis, or stomatitis in which the affected area include other parts of the oral cavity, such as the tongue, cheeks or palate [8], are now thought as different stages of the same process [9]. In the case of the patient presented in this care report, we are not certain regarding the cause of the disease. According to the anamnestic data, Erythritol powder containing 0.3% chlor-hexidine for air-flow treatment and chlorhexidine digluconate 0,2% solution was used in the previous treatment of the patient, and the exact protocol and method of application of this agent are not known to us. Chlorhexidine is known to be used as a strong local antiseptic in the form of solutions, aerosols, medicinal ointments, creams and jellies, but we also know that on injured skin 1% solution of chlorhexidine causes pain of varying intensity and that the higher concentration of 0.2% chlorhexidine gluconate irritates the

conjunctiva [10]. Chlorhexidine digluconate is also used for root canal rinsing and is known for the formation of the brown deposits in the hard teeth structures, and this can be an explanation of the brownish deposits on patients lower teeth. Newer studies also suggest that the wider use of chlorhexidine gluconate in daily-use products and cosmetics is probably a reason for sensitization to this powerful antiseptic [10, 11]. Allergic reactions to chlorhexidine digluconate from mouthwashers have been reported in many studies [12]. Earlier published case report presented a case of hypersensitive reaction to 0.004% chlorhexidine digluconate in toothpaste including swelling with erythematous free and attached gingiva and studies presented cases of desquamations and ulcerations after the use of chlorhexidine digluconate products [13]. Chlorhexidine digluconate 1% gel caused mucosal and gingival reaction presented with white patches or ulcerations in 8 out of 12 patients included in a study by Almqvist and Luthman [14]. Air-flow Erythritol powder used in the presented clinical case contains 0.3% chlorhexidine, was added by the manufacturer for powder conserving purposes and not for the therapeutical effect [15], but it is not clear if the added chlorhexidine had some additional effect on the tissues, especially if used with an additional source of chlorhexidine in the treatment.

Conclusion

Due to the proven possible side effects of chlorhexidine digluconate, uncritical use of chlorhexidine digluconate should be avoided. When using products containing chlorhexidine digluconate, close control of the patient and knowledge of possible negative effects of its use, as well as possible therapeutic options for their treatment, are necessary. The cumulative effect of chlorhexidine when using multiple agents containing chlorhexidine should be further investigated.

The therapy applied in the presented case proved to be extremely effective in the treatment of changes occurred as a side effect of the use of Erythritol powder containing 0.3% chlorhexidine and 0,2% chlorhexidine digluconate antiseptic solution.

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Journal names should be abbreviated as in MEDLINE (http://www.medscape.com/Home/Search/ IndexMedicus/IndexMedicus.html).

Examples of citation:

Standard journal article:

Tashiro H, Shimokawa H, Sadamatu K, Yamamoto K. Prognostic significance of plasma concentrations of transforming growth factor-ß. Coron Artery Dis 2002; 13(3):139-143.

More than six authors:

Yetkin E, Senen K, Ileri M, Atak R, Tandogan I, Yetkin Ö, et al. Comparison of low-dose dobutamine stress echocardiography and echocardiography during glucose-insulin-potassium infusion for detection of myocardial viability after anterior myocardial infarction. Coron Artery Dis 2002; 13(3):145-149.

Books:

Heger JW, Niemann JT, Criley JM. Cardiology, 5th ed. Philadelphia: Lippincott, Williams & Wilkins; 2003.

Chapter in a book:

Braunwald E, Perloff JK. Physical examination of the heart and circulation. In; Braunwald E, Zipes DP, Libby P (eds). Heart disease; a textbook of cardiovascular medicine, 6th edn. Philadelphia: WB Saunders; 2001, pp. 45-81.

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