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INFLUENCE OF PROSTHETIC THERAPY ON ESTHETICS AND ORAL HEALTH-RELATED QUALITY OF LIFE

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ABSTRACT

Improving the oral health - related quality of life (OHRQoL) and orofacial esthetics plays an important role in prosthetic therapy.

Objective: To examine the impact of different prosthetic therapies and gender on the assessment of orofacial esthetics and oral health-related quality of life.

Subjects and methods: The study included subjects who were divided into three groups according to the type of prosthetic therapy: complete dentures wearers (30), removable partial denture wearers (29) and fixed restoration wearers (30). All participants completed the OHIP 14 and the OES orofacial esthetic scale questionnaires. The participants rated their oral health with the OHIP 14 questionnaire. A higher score indicates a lower OHRQoL. The OES questionnaire rated orofacial esthetics. A higher number of points indicates greater satisfaction with esthetics.

Results: There was no significant difference in the mean scores of individual domains and the total OHIP scores between the examined groups in the assessment OHRQoL and orofacial esthetics ($p > 0.05$). ANOVA showed that men with complete dentures significantly felt a higher level of physical pain ($p<0.037$) compared to the other two groups. Women showed a higher level of social disability compared to men ($p <0.019$). There was a significant difference between the gender in the assessment of tooth shape ($p <0.006$), and on the total score OES scale ($p <0.034$).

Conclusion: Different types of prosthetic therapy had no impact on OHRQoL and orofacial esthetics. Women showed a higher level of social disability and less satisfaction with orofacial esthetics compared to men.

Keywords: Prosthetic therapy, Orofacial esthetic, OHRQoL

Introduction

Improving oral health-related quality of life (OHRQoL) and orofacial esthetics plays an important role in prosthetic therapy. According to the World Health Organization, health is a state of complete physical, mental and social well-being rather than the absence of disease [1]. Oral health as an important part of general health and can affect the physical and mental health of every person, being closely related to the quality of life. Tooth loss, partial or complete, affects all the functions, chewing, swallowing, speech but also the esthetic appearance of an individual. Therapy of such patients can be considered successful only if it includes patient satisfaction [2,3]. Previous definitions of oral health did not include other values of the patient, his perception or the patient's expectations and the possibility of adaptation. According to the new definition, the basic elements of oral health are:

1. Illness and condition which indicates the severity or degree of progression of the disease including pain and discomfort.

2. Physiological functions related to the function of chewing, swallowing, speaking, smiling.

3. Psychosocial function refers to the relationship existing between oral and mental health, the interaction of an individual in a society without discomfort [4].

Other factors determining oral health are the genetic, biological, physical and social environment, a person's behavior and access to health care. Factors influencing the assessment of oral health in persons such as age, previous experience, income, ability to adapt and patient's expectations are moderating factors. According to the new definition provided by the FDI "Oral health is multifaceted and includes the ability to speak, smile, smell, taste, touch, chew, swallow, and convey a range of emotions through facial expressions with confidence and without pain, discomfort and disease of the craniofacial complex "[4].

There is a large number of questionnaires that measure the quality of life depending on oral health. One of them is the Oral Health Impact Profile (OHIP). This questionnaire is a multidimensional and the most commonly used questionnaire. This questionnaire provided a subjective assessment of the patient about his oral health and impact to the quality of life. In this way, it is possible to measure the subjective assessment of the patient about the presence of dysfunction, pain, discomfort, disability and handicap caused by certain conditions of the stomatognathic system [5-9]. Since it takes a long time to complete the original version of the OHIP questionnaire, which contains 49 questions, today the shorter versions of the questionnaire have been developed such as OHIP-14 [8,9].

As esthetics is not sufficiently covered by the OHIP questionnaire which is not suitable for assessing orofacial esthetics, an orofacial appearance questionnaire 10, Orofacial Esthetic Scale (OES) has been developed measuring only the patient's orofacial esthetics and assesses the overall patient's satisfaction with esthetic appearance [10,11]. Prosthetic therapy re-establishes the impaired oral function but also the esthetic appearance of the patient. Prosthetic restorations used in the therapy of complete, partial edentulousness or tooth damage should be matched in color and shape with the gingiva, lips, smile as well as the patient's face. That is why the esthetic appearance of the patient is very important factor and the most common reason why patients need prosthetic therapy. Therefore, orofacial esthetics plays very important role in prosthetic therapy in accepting prosthetic restoration and patient adaptation. Previous studies have shown that the OES instrument is most often used for self-evaluation of orofacial esthetics [12].

Objective: The objective of this study was to examine the impact of different prosthetic therapies and gender on the assessment of orofacial esthetics and oral health-related quality of life.

Subjects and methods

The study included 89 patients from the Department of Prosthodontics and Dental Implantology, Faculty of Dentistry at the Sarajevo University. The sample included subjects of either gender, different age. This research was approved by the Ethics Committee of the Faculty of Dentistry with the Clinics of the University of Sarajevo. All participants were informed about the purpose of the research and signed an informed consent form.

According to the type of prosthetic therapy the participants were divided into three groups:

- complete dentures wearers (30),
- removable partial dentures wearers (29)
- and fixed restorations wearers (patients with single crowns or bridges in one or both jaws) (30).

All participants completed the OHIP 14 questionnaire [8,9] and the OES orofacial esthetic scale questionnaire [11,13,14]. The questionnaires also contained data on the age, gender and type of prosthetic restoration that the patient wears.

The participants rated their oral health with the OHIP 14 questionnaire by answering questions that were ranked from 0-4 on the Likert scale (0-never, 1-almost never, 2-occasionally, 3-quite often, 4-very often).

OHIP-14 contains seven domains that allow assessing the impact of oral health to the quality of life such as functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability and handicap. The total OHIP 14 score can be from 0-56. A higher score indicates a lower OHRQoL.

The second questionnaire is the OES Orofacial Esthetic Scale questionnaire, which participants completed rating their orofacial esthetics on a scale from 1-5 (1=completely dissatisfied; 5=completely satisfied), containing eight questions related to the appearance of the lower third of the face and teeth. A higher score indicates greater satisfaction with esthetics.

Statistical methods of data analysis

Statistical analysis of the data was performed using IBM SPSS Statistics v.21 software. Descriptive statistical analysis included the arithmetic means, standard deviations and ranges of min-max values on quantitative variables were calculated, followed by absolute and relative frequencies on nominal variables. The study presents parametric methods, student t-test for testing two independent samples and one-factor analysis of variance (ANOVA) for testing three independent samples. The level of significance was $p < 0.05$.

Results

In this study 89 patients, 29 (32.6%) men and 60 (64.7%) women, were included. The average age of men was 63±10 years while of women 57±11.5 years. Participants in the study were approximately equally represented in the groups according to the type of prosthetic therapy (complete dentures n = 30, removable partial dentures n = 29, fixed restorations n = 30) (**Table 1**).

Table 2. shows the mean values of scores for all seven domains of the OHIP questionnaire and the

Table 1. Type of prosthetic therapy in relation to the gender of the participants included in the study

		Man		Woman		Total	
		n	%	n	%	n	%
Type of prosthetic therapy	Complete denture	11	37,9	19	31,7	30	33,7
	Removable partial denture	11	37,9	18	30,0	29	32,6
	Fixed restoration	7	24,1	23	38,3	30	33,7
	Total	29	100,0	60	100,0	89	100,0

Table 2. The influence of the type of prosthodontic therapy on OHIP Score - OHIP-14 scores in the overall study sample

OHIP	Type of prosthetic therapy	n	Mean	S.D.	S.E.	min	max	F	p
Functional limitation	Complete denture	30	1,03	1,25	0,23	0	4	0,635	0,533
	Removable partial denture	29	1,07	1,51	0,28	0	4		
	Fixed restoration	30	0,70	1,42	0,26	0	5		
	Total	89	0,93	1,39	0,15	0	5		
Physical pain	Complete denture	30	2,30	2,12	0,39	0	8	2,916	0,060
	Removable partial denture	29	1,55	1,59	0,30	0	6		
	Fixed restoration	30	1,13	1,93	0,35	0	8		
	Total	89	1,66	1,94	0,20	0	8		
Psychological discomfort	Complete denture	30	2,23	2,25	0,41	0	8	1,720	0,185
	Removable partial denture	29	1,83	2,07	0,38	0	7		
	Fixed restoration	30	1,27	1,72	0,31	0	6		
	Total	89	1,78	2,04	0,22	0	8		
Physical disability	Complete denture	30	1,97	2,33	0,42	0	8	2,363	0,100
	Removable partial denture	29	1,48	2,18	0,40	0	8		
	Fixed restoration	30	0,80	1,71	0,31	0	8		
	Total	89	1,42	2,12	0,23	0	8		
Psychological disability	Complete denture	30	1,63	2,34	0,43	0	8	0,772	0,465
	Removable partial denture	29	1,34	2,24	0,42	0	8		
	Fixed restoration	30	0,93	1,98	0,36	0	8		
	Total	89	1,30	2,19	0,23	0	8		
Social disability	Complete denture	30	0,73	1,78	0,33	0	8	0,564	0,571
	Removable partial denture	29	0,34	1,52	0,28	0	8		
	Fixed restoration	30	0,77	1,76	0,32	0	7		
	Total	89	0,62	1,68	0,18	0	8		
Handicap	Complete denture	30	1,13	2,00	0,36	0	8	0,828	0,441
	Removable partial denture	29	0,62	1,59	0,29	0	7		
	Fixed restoration	30	0,67	1,47	0,27	0	6		
	Total	89	0,81	1,70	0,18	0	8		
OHIP Total score	Complete denture	30	11,03	11,34	2,07	0	46	1,467	0,236
	Removable partial denture	29	8,24	10,26	1,91	0	43		
	Fixed restoration	30	6,27	10,84	1,98	0	46		
	Total	89	8,52	10,89	1,15	0	46		

n – sample size **Mean** – Arithmetic mean **S.D.** – Standard deviation **S.E.** – Standard sample error **Min** – minimum values
Max – Maximum value **F** – value of the F test **p** – probability of rejecting the null hypothesis with 95% confidence level

Table 3. The influence of the type of prosthodontic therapy on OES score - mean values of the scores of the questions from the OES questionnaire and the mean value of the total OES scores depending on the type of prosthetic therapy

OES	Type of prosthetic therapy	n	Mean	S.D.	S.E.	min	max	F	p
OES 1	Complete denture	30	4,07	1,14	0,21	1	5	0,070	0,932
	Removable partial denture	29	4,17	0,97	0,18	2	5		
	Fixed restoration	30	4,13	1,17	0,21	1	5		
	Total	89	4,12	1,09	0,12	1	5		
OES 2	Complete denture	30	3,93	1,28	0,23	1	5	0,320	0,727
	Removable partial denture	29	4,17	1,00	0,19	2	5		
	Fixed restoration	30	4,07	1,14	0,21	1	5		
	Total	89	4,06	1,14	0,12	1	5		
OES 3	Complete denture	30	3,97	1,27	0,23	1	5	0,435	0,636
	Removable partial denture	29	4,17	0,97	0,18	2	5		
	Fixed restoration	30	3,90	1,16	0,21	1	5		
	Total	89	4,01	1,13	0,12	1	5		
OES 4	Complete denture	30	3,80	1,40	0,26	1	5	0,402	0,670
	Removable partial denture	29	4,07	1,19	0,22	1	5		
	Fixed restoration	30	3,83	1,15	0,21	1	5		
	Total	89	3,90	1,24	0,13	1	5		
OES 5	Complete denture	30	4,10	1,18	0,22	1	5	0,116	0,891
	Removable partial denture	29	4,21	1,24	0,23	1	5		
	Fixed restoration	30	4,23	0,97	0,18	1	5		
	Total	89	4,18	1,12	0,12	1	5		
OES 6	Complete denture	30	4,10	1,30	0,24	1	5	0,117	0,890
	Removable partial denture	29	4,24	1,02	0,19	2	5		
	Fixed restoration	30	4,17	1,02	0,19	1	5		
	Total	89	4,17	1,11	0,12	1	5		
OES 7	Complete denture	30	4,07	1,05	0,19	1	5	0,292	0,748
	Removable partial denture	29	4,21	0,94	0,17	2	5		
	Fixed restoration	30	4,00	1,17	0,21	1	5		
	Total	89	4,09	1,05	0,11	1	5		
OES 8	Complete denture	30	4,10	1,27	0,23	1	5	0,028	0,972
	Removable partial denture	29	4,14	0,99	0,18	2	5		
	Fixed restoration	30	4,17	0,99	0,18	1	5		
	Total	89	4,13	1,08	0,11	1	5		
OES Total score	Complete denture	30	32,13	8,00	1,46	14	40	0,209	0,812
	Removable partial denture	29	33,38	7,38	1,37	16	40		
	Fixed restoration	30	32,50	7,39	1,35	8	40		
	Total	89	32,66	7,53	0,80	8	40		

n – sample size **Mean** – Arithmetic mean **S.D.** – Standard deviation **S.E.** – Standard sample error **Min** – minimum values **Max** – Maximum value **F** – value of the F test **p** – probability of rejecting the null hypothesis with 95% confidence level

mean values of the total OHIP scores for complete dentures wearers (CD), removable partial dentures wearers (RPD) and fixed restorations wearers (FR). Complete dentures wearers had on average a higher score for the domains of physical pain, psychological discomfort, physical disability and the mean total score compared to the removable partial dentures and fixed restorations wearers. However, the results of one-way ANOVA tests showed that the difference in mean scores between individual domains as well as the total OHIP scores between CD, RPD and FR wearers was not significant (p= 0,236).

Table 3. shows the mean values of scores for individual questions from the OES questionnaire and the mean value of the total OES scores depending on the type of prosthetic therapy. The mean values of scores for individual questions related to orofacial esthetics were high in all three groups of participants. The results of the one-way ANOVA test showed that there was no significant difference between the mean values of scores for individual questions from the OES questionnaire and the mean values of the total OES scores (p = 0.812) (**Figure 1.**) between CD, RPD and FR wearers. Analysis of the influence of gender on OHRQO student t-test of independent samples revealed a statistically significant (t = -2,403, p <0,019) difference between the participants' gender in terms of social disability on the OHIP scale where woman showed a higher level of social disability (Mean=0,83) compared to men (Mean=0,17). ANOVA showed that men with CDs felt a higher level of physical pain (F=3,75, p <0.037) compared to men with RPD and FR. A statistically significant difference between the genders was in the assessment of tooth shape, where women rated tooth shape significantly less than men (p <0.006). The difference in the mean value of the total OES questionnaire scores between men (34.90 ± 6.14) and women (31.58 ± 7.94) was significant (p <0.034).

Discussion

Prosthetic therapy can be completely successful and complete only if, in addition to compensating for the lost tissues and functions, it has improved the quality of life and esthetic appearance of the patient. Numerous studies have proven that prosthetic therapy improves the quality of life [2,3, 13-16]. In this study, patients with different

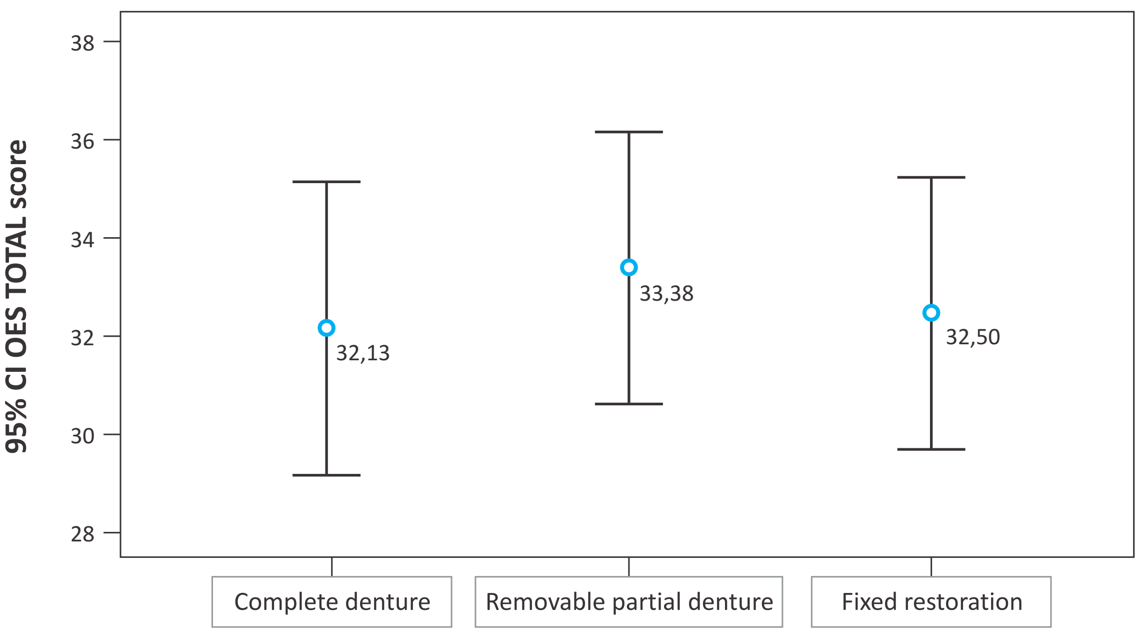

Figure 1. OES TOTAL score - mean value of the total OES score depending on the type of prosthetic therapy

prosthetic treatments, CD, RPD, and FR rated the oral health-related quality of life with the OHIP-14 questionnaire and satisfaction with the esthetic appearance of OES.

The results showed that in the evaluation of individual domains, complete denture wearers had a higher mean value of scores for physical pain, psychological discomfort and physical disability, and the total OHIP scores compared to wearers of removable partial dentures and fixed restoration. This indicates that the feeling of pain, reduced efficiency of chewing, speech and discomfort have affected the reduction of the quality of life in such persons. However, the difference between the mean values of all domains of the OHIP questionnaire as well as the mean values of the total OHIP scores was not significant between the examined groups. The reason for this is the small sample in this study and the large inter - individual variation being reflected in the high standard deviation. Physical pain, social disability and psychological discomfort are more present in wearers of complete dentures [2,17]. It has been proven that the domain of physical pain in CD wearers has the greatest impact to reducing the quality of life [18]. Numerous studies have shown that significantly lower values of the total OHIP scores indicate that patients are satisfied with the quality of life after prosthetic therapy, which is in accordance with the number of OHIP scores in this study [13, 15, 16, 18-20]. After conventional prosthetic treatments, quality of life, satisfaction and masticatory functions are improved. The improvement was greater in wearers of fixed than partial dentures but the least in wearers of complete dentures as proved in the study by Palomares et al. [19]. According to previous studies, after prosthetic treatment of CD, RPD and FR patients were satisfied with the quality of life [21, 22, 23]. Shaghaghian et al. stated that RPD wearers had the most present physical pain and physical disability and had to break off the meal [24]. Significant reduction of OHIP score, improvement of esthetics and masticatory effect was presented in patients who were previously wearers of conventional RPD and then treated with implant-supported partial dentures after one year [25]. Esthetics is an important factor in accepting all prosthetic restorations. In this study, scores on all eight questions were high in all three groups as well as the mean value of the overall OES score. The difference between the mean values of the total score for the examined groups was not significant indicating that all participants were satisfied with their appearance regardless of the type of prosthetic replacement (Figure 1). Also, these results may be explained by a small number of participants. Previous studies have indicated the patient's satisfaction with orofacial esthetics after prosthetic therapy [12-14,26,27]. However, when the gender influence was observed, the results showed that women with prosthetic restorations showed a higher level of social disability as a discomfort in society compared to men, and this, in turn, affected their quality of life. Women were less satisfied with the shape of the teeth and orofacial esthetics compared to men. Personal assessment of esthetics and the quality of life is influenced by numerous factors, such as gender, education, cultural environment, social norms, place of residence [17,21,28,29]. The results of the previous study showed significantly lower OHIP 14 score and higher OES score after all types of treatments - conventional CD, RPD, FPD and implant-supported CD, RPD and FPD as well as masticatory efficacy. However, CD wearers had the highest OHIP score after treatment. RPD wearers had the lowest OES score [13]. Mean values of total OES score were higher in CD wearers than in CD wearers in the upper and RPD in the lower jaw Kennedy Class I, which does not correspond to the findings of this study [14]. John et al. have stated in their studies that OHIP contains only four dimensions-Oral Function, Oro-facial Pain, Oro-facial Appearance and Psychosocial Impact which represent the basis for measuring the impact of oral health and the impact of therapy to the patient's satisfaction [30, 31]. The limitation of this study was a small sample, large inter-individual variation, as well as different prosthetic status in the antagonistic jaw.

Conclusion

Different types of prosthetic therapy had no impact on OHRQoL and orofacial esthetics. Women showed a higher level of social disability and less satisfaction with orofacial esthetics compared to men.

There is no conflict of interest.

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AGE-RELATED MORPHOLOGICAL AND MORPHOMETRIC CHANGES OF THE LOWER JAW AND THEIR INFLUENCE ON THE PHYSIOGNOMY OF THE LOWER THIRD OF THE FACE

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ABSTRACT

Knowledge of the dynamics of growth and postnatal changes of the mandible is of great importance when planning orthodontic procedures and procedures in the field of oral, maxillofacial and aesthetic surgery.

The aim of this study was to evaluate relationship between loss of teeth and morphological and morphometric changes in the mandible. For this purpose, 147 mandibles (100 with and 47 without teeth) selected from the osteological collection of the Department of Anatomy, Faculty of Medicine in Sarajevo were analyzed.

Morphometric measurements were performed using an vernier caliper and goniometer so as morphological analysis consisting of analysis of the trigonum mental shape.

The study showed that partial or total tooth loss in adulthood leads to changes in the shape and dimensions of the mandible reflecting in the appearance of the lower third of the face, and thus the entire physiognomy.

Keywords: morphometry, mandible morphology, face's lower third, aging.

Introduction

It is known that the morphological and morphometric characteristics of bones are primarily genetically determined, but their definite shape and dimensions are also influenced by a number of external factors [1,2]. The upper and lower jaws form the bony base of the oral cavity. Their morphological characteristics are conditioned by the basic function that the jaws perform, and that is chewing food. The development of the upper and lower jaw is a complex process that is significantly affected by the eruption and loss of teeth. Tooth loss contributes to a change in the entire physiognomy of the face because the loss causes a fall in the corners of the lips, wrinkles, loss of muscle tone and skin around the lips, which ultimately initiates changes in physical appearance.

The shape and size of the lower jaw (mandible) are of great importance for the appearance of the front of the head, primarily the shape and dimensions of the lower third of the face. The morphological and morphometric characteristics of the mandible changed during the phylogenetic development of the human species. Thus, according to certain morphological characteristics such as: protuberantia mentalis, angulus mentalis, angulus mandibulae, foramen mentale and foramen mandibulae, and the dimensions of the bone itself, the phylogenetic age of found osteological remains can be approximately determined.

The mandible changes dynamically during growth and development. The first changes are already visible during fetal development, when the reduction of the mandibular angle begins [3,4]. This is followed by postnatal changes resulting from the adjustment of the mandible to the action of masticatory muscle force and occlusion with the teeth of the upper jaw [5]. Once growth and development are complete, morphological and morphometric characteristics are fixed and do not change significantly until the moment of loss of a large number of teeth. Tooth loss causes partial resorption of the alveolar process and disappearance of occlusion, and the consequence of these processes is a re-increase in the mandibular angle and change the position of the mental opening located in old age closer to the upper edge of the bone body.

Changes in the oral cavity occur continuously and require constant repairs to reduce further damage and correct aesthetic and functional irregularities being the task of dentists, oral, maxillofacial and aesthetic surgeons. The success of any intervention depends on a good knowledge of the dynamics of facial changes caused by tooth loss. The aim of this study is to determine what are the morphological and morphometric changes that occur on the mandible after the loss of a large number of teeth.

Material and methods

147 preserved mandibles of adults of both sexes, selected from the osteological collection of the Department of Human Anatomy, Faculty of Medicine, University of Sarajevo, were used as material in this study.

The mandibles used in this study were divided into two groups. The first group (100 mandibles) consisted of mandibles with preserved teeth, aged 22 to 55 years, and the second group of mandibles (47 mandibles), which showed the loss of a large number of teeth or completely toothless mandibles, aged 56 to 74 years.

Morphometric measurements were performed using vernier caliper 0-1000mm, 0,05mm, Metric 530-502 (Mitutoyo Corporation, Japan), with an error of 0.01 mm, and a goniometer with an error of 0.5 °. For the goniometric method, we used one 360° scale (1°-increments) plastic UG with two 25-cm arms (3 M© Modular Shoulder System, 3 M©, St Paul, MN, USA).

The goniometer was used to obtain the value of two angles:

- mandibular angle - the angle that forms the lower edge of the body and the posterior edge of the ramus of the mandible (A),

- mental angle - the angle between the lines connecting the mental tubercle with the left and right anthropological point gonion (B).

A sliding caliper was used to obtain the values of the vertical and horizontal diameters of the mandible with and without teeth. The vertical diameters measured in this paper are:

- distance between the anthropological point of the gnathion and the interalveolar septum (C),
- distance between the foramen of the mental and the alveolar edge of the mandible (D),
- the distance between the foramen of the mental and the lower edge of the mandible (E),
- height of the mandible body - the length of the vertical that connects the alveolar extension (between the first and second molar tooth) with the lower edge of the mandible in the area of the foramen mental (F),
- maximum height of the ramus - the distance from the highest point on the mandibular condyle to the anthropogenic point of the gonion (G),

The horizontal diameters measured in this paper are:

- length of the mandibular body - the distance between the gnathion point (lowest symphysis point) and the gonion point (the point corresponding to the angle that builds the tangents drawn from the posterior edge of the ramus and the lower edge of the mandibular body) (H),
- distance between mental foramen of opposite sides (I),
- minimum width of the ramus - the minimum width of the ramus of the mandible measured perpendicular to the height of the ramus (J),
- maximum width of the ramus - the distance between the most prominent point on the front of the ramus and the line connecting the most prominent point of the condyle with the angle of the mandible (K), (**Figure 1**).

Specially designed forms were used to record the obtained results, and statistical data processing was performed using the statistical program SPSS version 21.0.

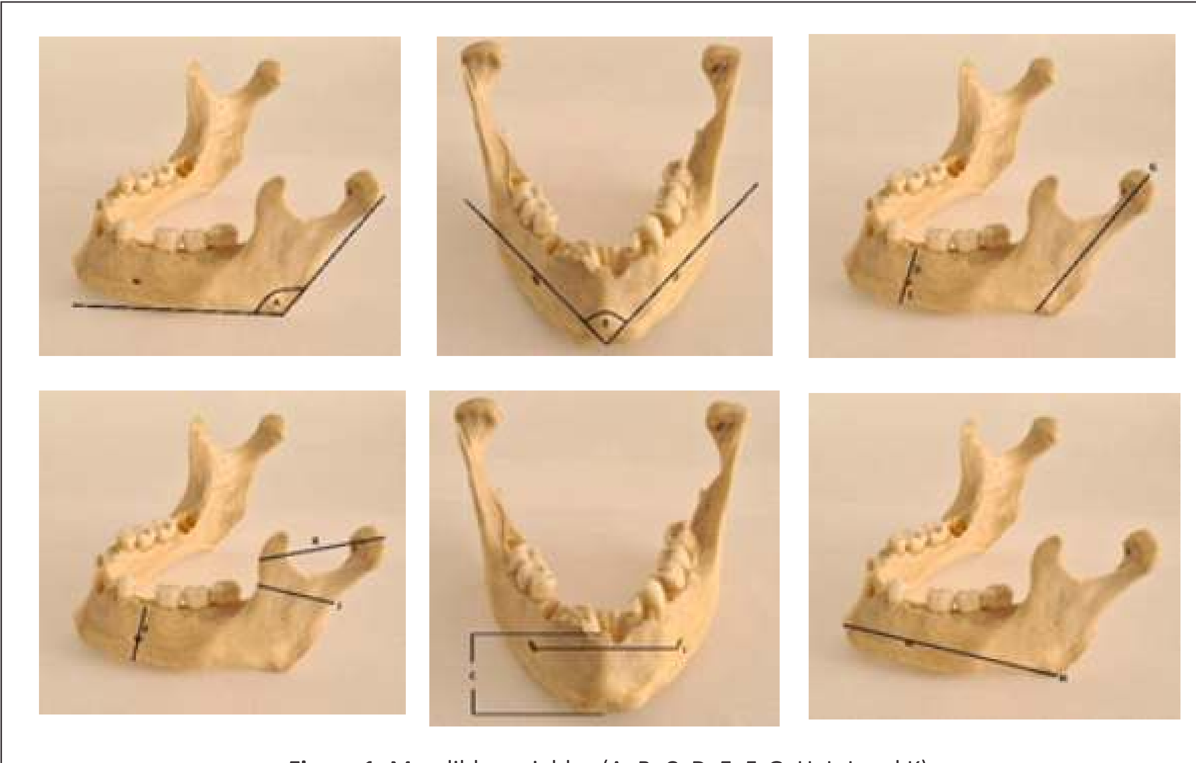

Figure 1. Mandible variables (A, B, C, D, E, F, G, H, I, J and K)

Morphological analysis in this paper referred to the analysis of the shape of the mental trigonum, and it consisted in registering the change in the size of the angle opposite the base of the triangle.

Results

The results of morphometric measurements on the mandibles with and without teeth are shown in the table. **Tables 1, 3 and 5** contain the results of measurements on the mandibles with teeth, and **Tables 2, 4 and 6** contain the results of measurements on the mandibles without teeth.

The analysis of the presented research results can state the following:

- due to tooth loss, the value of the mental angle changes significantly, i.e., it decreases by about 6.5 °, while changes in the value of the mandibular angle are statistically insignificant (Tables 1 and 2),
- all three diameters of mandibular body height are statistically significantly reduced with tooth

Table 1. Values of mandibular angles with teeth

	Mean value	SD	Min./Max.
Mandibular angle (A)	128.98°	±6.62	109°-146°
Mental angle (B)	61.96°	±7.90	41°-82°

Table 2. Values of mandibular angles without teeth

	Mean value	SD	T-test	P
Mandibular angle (A)	127.87°	±7.58	7.75	p > 0.05
Angulus mentalae (B)	55.56°	±7.15	0.14	p > 0.01

Table 3. Values of vertical dimensions of mandibles with teeth

	Mean value	SD	Min./Max.
Gnathion-interdental septum (C)	27.25	±4.55	7.8-39.5
Mental foramen - lower edge (D)	13.30	±1.67	7.8-17.7
Mental foramen - alveolar edge (E)	11.56	±3.92	0.01-19.9
Mandibular body height (F)	20.57	±3.91	10.8-28.9
Maximum ramus height (G)	58.74	±5.73	39.0-68.0

Table 4. Values of vertical diameters of mandibles without teeth

	Mean value	SD	T-test	P
Gnathion-interdental septum (C)	23.95	±4.86	6.52	p < 0.01
Mental foramen - lower edge (D)	12.91	±1.72	2.4	0.1 > p <0.05
Mental foramen - alveolar edge (E)	8.52	±3.67	7.74	p < 0.01
Mandibular body height (F)	17.58	±3.57	7.13	p < 0.01
Maximum ramus height (G)	58.56	±5.54	0.16	p > 0.05

Table 5. Values of horizontal diameters of mandibles with teeth

	Mean value	SD	Min./Max.
Mandibular corpus length (H)	84.21	±5.41	73.2-96.9
Distance between mental foramen (I)	43.48	±3.04	27.5-51.3
Minimum ramus width (J)	29.85	±3.75	18.0-38.9
Maximum ramus width (K)	35.29	±3.37	26.8-43.2

Table 6. Values of horizontal diameters of mandibles without teeth

	Mean value	SD	T-test	P
Mandibular corpus length (H)	83.77	±5.81	0.67	p > 0.05
Distance between mental foramen (I)	42.75	±3.93	2.86	p < 0.01
Minimum ramus width (J)	28.75	±4.27	2.61	p < 0.01
Maximum ramus width (K)	34.01	±3.87	2.91	p < 0.01

loss (diameters C, E and F) because the alveolar part of the bone is reduced, while the height of the mandibular ramus (diameter F) is not affected by tooth loss (Tables 3 and 4),

- loss of teeth does not lead to a statistically significant change in the length of the mandible (diameter H), but there is a significant reduction in its anterior width (diameter I),
- tooth loss also reduces the ramus of the mandible, i.e. its width and the distance between its processes (diameters J and K) are reduced, as presented in Tables 5 and 6,

Table 7. Influence of tooth loss on the shape of the trigonum mental

	Mental trigonum		
	Mandibles with teeth	Mandibles without teeth	
	40	12	$x^2=21.75$
	41	8	df = 2
	19	27	$p < 0.01$

- tooth loss leads to a significant change in the shape of the mental trigonum, there is an increase in the angle opposite to the base of the triangle, as a result of which the chin becomes smaller and wider (**Table 7**).

Discussion

This study showed that the loss of the alveolar ridge had a statistically significant effect on the reduction of all analyzed vertical diameters of the mandible except for the height of the ramus of the mandible. The explanation lies in the fact that the alveolar ridge does not enter into the composition of the ramus of the mandible, and therefore cannot affect the values of its height. Similar results were noted by Merrot et al. In their study, they found that the reduction of vertical diameters causes a decrease in the width of the mandible consequently leading to a decrease in the height of the lower part of the face 6.

This study found that with tooth loss, the value of the mental angle decreases statistically significantly, but not the mandibular angle, which causes a sharper profile of the lower third of the face. Previous studies have shown that the value of the mandibular angle decreases with age, i.e. that the value of the angle decreases by about 10% during the process of tooth eruption and under the influence of the masticatory muscles. Over the years, the masticatory musculature has a stronger effect on the ramus of the lower jaw thus affecting its direction of growth [7,8]. This thesis is partially confirmed by Nahhas et al., who found a reduction in mandibular angle in the period aging from 4 to 24 years [9].

Morphological analysis in the presented study showed that tooth loss causes significant changes in the shape of the mental trigonum, in the sense that there is an increase in the angle opposite the base of the trigonum making the chin smaller and wider. Due to the scarce literature on this topic, we are not able to compare this and some of the results presented in this paper.

It is known that the mandible is the most important bone structure which, with its size and shape, affects the appearance of the lower third of the face. To date, numerous studies have been published in which detailed data on embryonic development of the upper and lower jaw can be found [10,11]. However, in addition to the study of embryonic development, studies related to changes that occur in the mandible during life, due to the action of numerous factors, are also very important. There are few studies dealing with morphological and morphometric changes in the mandible, which occur as a result of the loss of a large number of teeth. And this study of ours is a small contribution to the promotion of this topic because the success of a large number of dental and surgical procedures depends largely on knowledge of morphological and morphometric changes (bone remodeling) occuring during life in the mandible. Remodeling, as a continuous and irreversible process, is known to mostly affect the alveolar ridge because its formation and resorption are affected by tooth eruption and loss

[12]. But bone is known to reshape in response to both muscle activity, hormonal and metabolic changes, under the influence of genes and under the influence of a number of other local and systemic factors [13]. How and to what extent these factors affect morphological and morphometric changes in the mandible will be shown in future studies in which we, the authors, will actively participate.

Conclusion

Extensive tooth loss in adulthood leads to a reduction in the vertical diameters of the lower jaw, a reduction in the width of its body, a reduction in mental angle, and significant changes in the shape of the mental trigonum. These changes in the shape and dimensions of the lower jaw are reflected in the appearance of the lower third of the face, and thus the whole physiognomy. The success of a number of dental and surgical interventions depends on knowledge of these morphological and morphometric changes in the lower jaw. For this reason, this study was made as a small contribution to the popularization of this topic.

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FLUORIDE UPTAKE OF ENAMEL TREATED WITH DIFFERENT FLUORIDE AGENT

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ABSTRACT

The aim of the paper was to examine the efficacy of individual topical fluoride preparations and CPP-ACP agents and to evaluate the efficacy of their combination on the processes in the initial carious lesion. The effectiveness of these agents was tested by assessing fluoride uptake using a fluoride-selective electrode.

Material and methods: The enamel samples used in this study were prepared with intact premolars extracted for orthodontic reasons. In order to produce an initial caries lesion, the enamel slabs were submitted to a pH cycling regimen. The specimens were distributed in four groups of 15 samples receiving the following treatment, respectively: Group I-1% NaF solution, Group II-1% TiF4 solution, Group III- 1% NaF+CPP-ACP, Group IV- 1% TiF4+CPP-ACP. Fluoride uptake was determined using a fluoride-selective electrode by measuring the concentration of fluoride ions in solution before and after immersion of the sample.

Results: The results showed that fluoride uptake was the largest in the IV experimental group (TiF4 +CPP-ACP). The fluoride uptake was evaluated as significantly higher compared to the other experimental groups. A surprising effect of blocking the influx of fluoride ions into the lesion occurred in group III.

Conclusion: The technique of the fluoride uptake measurement from the solution proved to be a relevant and valid method for estimating the initial carious lesion capacity for the fluoride ions absorption.

Keywords: white spot lesion, fluoride, fluoride-selective electrode, fluoride uptake, sodium fluoride, titanium tetrafluoride

Introduction

The current emphasis on new technologies of enamel remineralization suggests changes that occurred in our understanding of caries disease during the last century. Identifying white spots lesions (WSL) as an early symptom of carious disease, which can develop into cavitation, specified the moment when clinicians began to think about possibilities of non-invasive treatment to repair defects or even reverse the process of its occurrence.[1-3]

By their influence to the dynamics of the carious process, fluorides are proven to be very effective assets in slowing down the progression of carious destruction. [4] It is generally known that fluorides have two primary mechanisms by which they interfere with the dynamics of the carious process: the first is prevention of healthy enamel demineralization and the second is incorporation into previously demineralized enamel with the promotion of remineralization. The third mode of fluoride action is interference with bacterial metabolism. [5-9] The anticariogenic effect of fluoride depends on factors such as concentration, pH value, frequency and treatment duration, dosage and the optional addition of antimicrobial agents. [10,11]

Under the action of fluoride, changes have been observed to occur both on the surface and in the sub-surface zone of WSL. It has been shown that the critical pH at which demineralization and remineralization processes occur in maximum speed is between pH 4.3 to 5. A main microscopic feature of such WSL is a well-defined superficial layer. That layer mainly consists of fluorapatite crystals. [1,12] As the pH of oral fluids decreases, saliva and plaque become less saturated relative to hydroxyapatite, until the pH reaches a critical point below which the solution becomes unsaturated with respect to hard dental tissues. [6] Calcium hydroxylapatite then dissolves. As fluorapatite is less soluble compared to hydroxyapatite, the plaque fluid is still supersaturated compared to fluorapatite, and this mineral does not dissolve. Subsurface hydroxyapatite dissociates as resistant fluor hydroxylapatite forms on the surface. Competitive supersaturation in relation to fluor hydroxyl apatite is the main reason for maintaining the integrity of the surface layer. [1] As long as the surface layer of the enamel is intact and has a moderate mineral content, fluorides cannot diffuse into the body of the lesion.

Due to the very slow diffusion of ions in the body of the WSL, fluid supersaturation in the lesion is never achieved, nor is complete remineralization in the body of the lesion. Thus, the superficial well-mineralized layer protects the body of the lesion from further dissolution, but also from complete remineralization. [12] Therefore hypothetically, any procedure that temporarily alters the integrity of the surface well-mineralized layer should allow the diffusion of fluoride ions into the body of the lesion. This should allow complete remineralization of the body of the lesion. Hence, fluoride preparations are used in various formulations, in combination with other agents or methods that should improve the fluoride penetration into the body of the lesion. One of the standard methods is an acidic attack on the surface of well-mineralized layer. Fluoride agents can have very low pH. Such an agent is titanium tetrafluoride (TiF_4) with a pH value of around 2. Numerous studies show TiF_4 has a strong protective effect in enamel, not only due to reaching fluoride content (4 fluoride ions) but that a significant part can also be attributed to the protective reaction of the titanium component, further enhanced by the possibility of oxidative coating on the enamel.[13-16]

However, the fluoride's ability to promote remineralization in the enamel is limited by the presence of calcium in saliva. [17] For every two fluorine ions, ten calcium and six phosphate ions are needed to form one unit of fluorapatite. Thus, despite fluoridation, Ca and P ions deficiency may be a limiting factor for overall remineralization, especially in terms of xerostomia. [18,19]

Reparation of early carious lesions can be accelerated by exogenously introduced ions of calcium and phosphates. These findings led to the development of a remineralization system based on the complexes casein-phosphopeptidestabilized amorphous calcium phosphate (CPP-ACP;

Recaldent®) [8] and casein-phosphopeptide-stabilized amorphous calcium fluorophosphate (CPP-ACFP). [20-25] Casein is a protein derived from milk. It is a so-called "ion-binding" protein. CPP can bind 25 Ca ions, 15 phosphate groups, and 5 fluoride ions per molecule, and stabilize calcium phosphate in the solution. [2] CPP-ACFP (casein-phosphopeptide-amorphous calcium fluoro-phosphate) contains 18% Ca ions and 30% phosphate relative to its molecular weight. It provides all the necessary elements for enamel remineralization (calcium, phosphates, fluoride, and water). [2]

Therefore, the prospect of caries preventing action in the future is in the development of a system that will optimize and control the delayed release of fluoride ions in the oral cavity. Moreover, the concept is fundamentally changing by seeking to provide a simultaneous supply of calcium, phosphates and fluorides to increase the amount of fluorapatite produced. [2,12,17,18] Although plenty of time has passed since the introduction of fluoride ion-exchange systems into dental practice [17], the simultaneous introduction of calcium, phosphate and fluoride through ion-exchange systems is still the subject of research. [17-19]

The main obstacle to remineralization of the deep WSL zones is precisely the superficial well - mineralized layer, which pores are so narrow so that molecules carrying calcium and phosphate groups and fluoride ions cannot penetrate through them. If we apply solely topical fluoride agents, we achieve even better mineralization and additional pores reduction. This study's idea was to use a low pH agent which is able to transiently open diffusion pathways through the superficial well-mineralized enamel zone in order to allow remineralization of deeper layers of the lesion as well. This would, in theory, achieve the "healing" of the carious lesion through its entire depth being the main problem in remineralization challenge.

The aim of the research was to establish fluoride uptake of the enamel with initial caries lesions when treated only with 1% topical fluoride agents, and determine whether it is increased when these agents are used in combination with the CPP-ACP.

Materials and methods:

The study was conducted on enamel slabs origin of 60 intact permanent premolars extracted for orthodontic reasons. The teeth were firstly examined and the following specific inclusion criteria were established: intact teeth without obvious and initial carious lesions or WSL, or enamel cracks (infractions). In the teeth that satisfied the inclusion criteria, the root and crown were separated. Thereafter, each tooth crown was separated into two halves with a high-speed handpiece under water cooling. Enamel blocks were immersed in self-curing transparent acrylate and the enamel slabs surfaces were coated with acid resistant varnish. Self-adhesive tape with a round perforation 2mm in diameter was made by a rubber dam hole punch plier and placed over varnished enamel. The varnish was then removed with acetone through circular tape perforation. The performed procedure produced a uniform experimental surface of 3.14 square millimeters on each enamel slab.

Samples underwent a pH-cycling procedure with a daily regime of 3 hours of demineralization and the remaining time of remineralization. Demineralization consisted of immersing the samples in a sufficient amount of demineralization solution whose pH was set at 4.3. The remineralization solution had practically the same composition as artificial saliva. All the samples received 8 daily cycles. The precise composition of demineralization and remineralization solutions, as well as a description of the pH cycling regime, were given in the previous study [26]. Described pH-cycling regime produced WSL with an average depth of 50 micrometers, which was confirmed by scanning electron microscopy and cross-section microhardness testing.

Samples were randomly divided into four experimental groups, containing 15 samples each. The first group received topical fluoride treatment with 1% sodium fluoride (NaF) solution, group II received treatment with 1% titanium tetrafluoride (TiF_4) solution, and group III received combined treatment with 1%NaF + CPP-ACP (GC "Tooth

mouse" Recaldent®), while group IV received combined 1% TiF_4+CPP-ACP. Topical fluoride solutions were prepared with super clean distilled deionized water.

A topical fluoride treatment with 1% fluoride solutions consisted of the following: a 10 µl of 1% fluoride solution was carefully applied on to a round experimental window on the enamel with a micro-pipette and left to act for 15 minutes. Immediately thereafter, each sample was washed with 10 ml of TISAB solution and added with a burette (TISAB- total ionic strength adjusting buffer containing CDTA, solution for sample preparation for fluoride determination). The fluoride concentration in the solution was measured in the same vessel in which the topical fluoride treatment was performed.

The procedure for the combination of fluoride solutions and "Tooth Mouse" was more complicated, as there was no known reaction between the paste and the fluoride solutions used in the experiment. Theoretically, it was possible for the paste to bind a certain amount of fluoride ions by a chemical reaction and thus "mask" them. If the fluoride ions in the solution are not free but bounded in the form of various compounds, their precise concentration cannot be measured by the flour-selective electrode method. As the aim of this experiment was to determine the precise quantities of fluoride ions that the enamel "absorbed", based on the determined difference in the concentration of fluoride in the solution before and after enamel treatment, the nature of the possible chemical reaction between paste and fluoride solutions had great importance. Especially in the case of the combination of TiF_4 solution and Tooth Mouse paste, since a review of the literature could not establish that this combination has been the subject of the scientific research previously. First, an experiment was performed on a series of solutions, which aimed to determine whether the Tooth Mouse paste binds fluoride ions to itself. The concentration of fluoride ions in a series of fluoride solutions was measured before and after the addition of a precisely determined mass of the paste. The paste was weight with the precise analytical scale. When it was determined that the Tooth Mouse paste does not bind fluoride ions from either NaF solution or TiF_4 solution, portions of the paste weighing about 1-3 mg were applied onto disposed of enamel. At that point, 10 µl of fluoride solution was added by a micropipette. With a chemically pure dentin-adhesive applicator, the resulting mixture was rubbed on the enamel surface for 15 minutes. The applicator was left in the measuring vessel to avoid measurement error. The mixture of paste and fluoride was washed from the enamel surface and the applicator by the addition of 10 ml of TISAB solution. After the treatment, the samples were tested for the amount of fluoride absorbed from the solution (so-called fluoride uptake) by the fluoride selective electrode method.

The fluoride-selective electrode is mostly used nowadays in determining the concentration of fluoride in various samples due to its outstanding performance and ease of application. [27] The fluoride-selective electrode WTW, F 500, Fluorides, DIN CONNECTOR was used to measure the electrode potential in this study (Measuring range:0.02-gesät.mg/L, 10^{-6}-gesät.Mol/L; Bridge electrolyte- ELY/BR/503). First, the whole system was checked with a standard solution (WTW solution NaF 10g /l) used for activation, testing and calibration of the fluoride electrode. Solutions of known concentrations were then made from the standard solution to test the electrode action and construct a calibration curve.

The measurement consists in first making a series of so-called "blank tests" for each individual solution, i.e., the experimental group. "Blank test" was made by placing an identical amount of the active substance in a chemically clean container in which the measurement was performed, which would be applied to the enamel veneer, i.e., 10 µl, and diluted with an identical amount of TISAB solution (10ml). The concentration of ions measured in a solution containing an enamel sample was lower than the concentration of ions in the "blank test" precisely for the value that the enamel "absorbs" from the topical agent. The measurement was performed by immersing both,

the reference and the fluoride-selective electrode, simultaneously in a solution in which the concentration of fluoride ions was measured. The result was considered stable if the value that appears on the LCD of the measuring instrument remains unchanged for 3 seconds.

After each sample, both electrodes were washed with a copious amount of distilled deionized water, dried with super-absorbent paper, and then re-immersed in the new sample. After every twentieth measured sample, the electrodes were calibrated again in standard solutions of known concentrations, and the semipermeable membrane on their top was cleaned with a special polishing paper provided by the electrode manufacturer. Results are given in Table 1.

Results and statistical analysis

Shapiro-Wilk distribution normality test showed that group I has a distribution that deviates from the normal (Table 2).

To test the significance of differences between individual groups, an ANOVA test was performed. The values found by ANOVA analysis are given in Table 3.

Table 1. Fluoride uptake given in µMol of fluoride ions

Sample sequence no	Group I	Group II	Group III	Group IV
1.	0.80	2.85	0.51	2.27
2.	0.80	2.85	1.47	1.41
3.	1.99	2.55	0.51	3.82
4.	1.41	2.85	0.84	3.58
5.	1.41	2.23	0.84	2,54
6.	0.49	1.24	1.16	2.27
7.	1.70	2,85	0.51	4.29
8.	4.52	2.23	2.38	3.58
9.	1.70	2.85	0.17	3.33
10.	1.41	3.15	0.84	2.54
11.	4.29	2.23	1.47	4.29
12.	5.58	0.90*	0.51	6.35
13.	0.16	2.85	0.51	7.22
14.	0.49	1.91	0.84	6.53
15.	1.41	2.55	0.51	6.35

Group I: 1%NaF solution; Group II: 1% TiF4 solution; Group III: 1%NaF solution +Tooth mousse; Group IV: 1% TiF4 solution Tooth Mousse; *Result not included in statistical processing.

Table 2. Shapiro-Wilk distribution normality test

	Shapiro-Wilk		
	Statistic	df	Sig.
NaF F-uptake (I gr)	.782	8	.018
TiF_4 F-uptake (II gr)	.859	8	.117
NaF+Tooth Mousse F-uptake (III gr)	.919	8	.419
TiF_4+Tooth Mousse F –uptake (IV gr)	.920	8	.429

Table 3. ANOVA for the fluoride uptake values

	Sum of Squares	df	Mean Square	f	Sig.
Between Groups	75.345	3	25.115	15.08	.000
Within Groups	89.878	54	1.664	9.00	
Total	165.222	57			

Table 4. Post-hoc "Scheffe" test (Dependent Variable: fluoride uptake values)

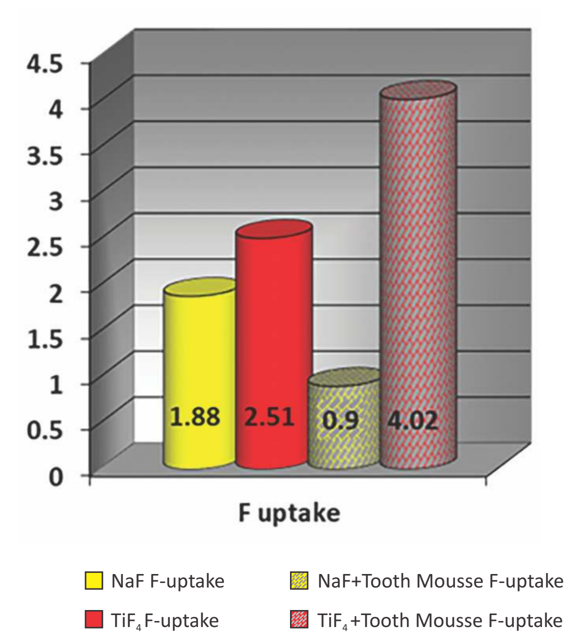
(I)Type of product /uptake	(J) Type of product /uptake	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
NaF	TiF_4	-.63624	.47942	.626	-2.0197	.7472
	NaF +Tooth Mousse	.98019	.47942	.255	-.4033	2.3637
	TiF_4+ Tooth Mousse	-2.14733(*)	.47108	.000	-3.5067	-.7879
TiF_4	NaF	.63624	.47942	.626	-.7472	2.0197
	NaF +Tooth Mousse	1.61643(*)	.48762	.018	.2093	3.0236
	TiF_4+Tooth Mousse	-1.51110(*)	.47942	.027	-2.8946	-.1276
NaF +Tooth Mousse	NaF	-.98019	.47942	.255	-2.3637	.4033
	TiF_4	-1.61643(*)	.48762	.018	-3.0236	-.2093
	TiF_4+Tooth mousse	-3.12752(*)	.47942	.000	-4.5110	-1.7441
TiF_4+Tooth Mousse	NaF	2.14733(*)	.47108	.000	.7879.	3.5067
	TiF_4	1.51110(*)	.47942	.027	1276	2.8946
	NaF +Tooth Mousse	3.12752(*)	.47942	.000	1.7441	4.5110

* The mean difference is significant at the .05 level

Table 5. Statistically significant differences overview obtained using the post-hoc "Scheffe" test

Difference between groups	Sig.
Group I↔ Group II	.626
Group I ↔ Group III	.255
Group I ↔Group IV	.000
Group II↔ Group III	.018
Group II ↔ Group IV	.027
Group III ↔ Group IV	.000

Graph 1. Average values of fluoride uptake given in µMol of fluoride ions



In order to determine whether there are statistically significant differences between the groups, a post-hoc "Scheffe" test was performed, the values of which are given in Tables 4 and 5.

Discussion

The fluoride uptake evaluation performed in this study was somewhat specific in methodology. The specifics consist of the following:

- The nature of the chemical bond that fluorides have in/on enamel was not the subject of this study, and therefore, no analysis of fluoride concentration in enamel was performed, but simply the WSLs ability to "absorb" fluoride ions was examined.
- Therefore, the experiment was designed so that the topical fluoride agent and enamel were placed in a closed system in which the loss of active fluorine ions was prevented during the manipulation and measurement. The concentration of fluoride ions was previously determined in the solution to treat the enamel with, and then re-measured after the enamel with an artificial initial carious lesion was added to this closed system. Therefore, any decrease in the concentration of fluoride ions in this closed system is considered to be a direct consequence of their incorporation into the enamel.
- The experiment aimed to determine the effect of a paste with bio-available calcium and phosphates on the chemistry of the "absorption" of fluorine by enamel.

Artificial initial carious lesion produced by pH-cycling has the capacity to "absorb" fluoride ions, depending on the concentration of fluoride in the topical fluoride agent, as well as the potency of the topical agent. The potency of a topical fluoride agent is not only a consequence of the concentration of fluorine ions but also of other physicochemical characteristics such as the degree of ion reactivity, solubility constants, stability of the agent in aqueous solution, etc.

Founded degree of fluoride uptake was slightly higher by 1% TiF4 solution (2.51 ± 0.5 μMF-) compared to 1% NaF solution (1.88 ± 1.62 μMF-), but the difference found was not significant (Sig. = 0.626).

A particular challenge was to determine the effect of a paste with bio-available calcium and phosphates on the chemistry of "absorption" of fluorine by enamel. Namely, the literature review found that TiF4 has not been tested in combination with CPP-ACP agents. The presence of the CPP-ACP agent reduces fluoride uptake of 1% NaF, but not significantly. On the other hand, the combination of TiF4 and CPP-ACP significantly increased fluoride uptake. The mean value for 1% TiF4 was 2.51 ± 0.5 μMF-, while for 1% TiF4 +Tooth Mousse was 4.02 ± 0.027μMF-. The difference found is significant and amounts to Sig. = 0.027 (Table 5).

As a series of tests have shown that CPP-ACP derivatives do not bind fluoride ions, it can be concluded that "blocking the entry" of fluoride ions into the enamel in experimental group III was caused by some other physicochemical mechanism.

Comparison of the results obtained in this research with the results of other authors must include additional recalculation (Table 6), as well as some necessary adaptations mainly for the following reasons:

- Previous research on fluoride uptake did not refer to the influence of TiF4, and especially not to the combination of TiF4 + CPP-ACP derivatives. For this reason, fluoride uptake can be compared mainly to NaF.
- The researchers examined "uptake" by chemical analysis of the enamel. Chemical analysis of enamel fluorides implies that KOH soluble fluorides release first, the so-called loosely bound fluorides, followed by acid extraction of structurally bound fluorides, which mainly exist in the form of fluorapatite. (28)
- Enamel blocks from different studies were of different origins. Many authors work on bovine enamel slabs, which are similar to human enamel, but the existence of differences in chemical composition should not be overlooked. Other authors have worked on human enamel, but one that already contains a certain amount of fluoride ions in the form of

Table 6. Mean values of fluoride ions amount converted into mass units of fluoride ions per unit area of enamel

Group	The amount of ions F- in µMol	Ion mass F- in µg applied to 0.0314 cm^2	Uptake in µg F-/cm^2
Group I	1.88	35.72	1137.570
Group II	2.51	47.69	1518.789
Group III	0.90	17.10	544.586
Group IV	4.02	76.38	2432.480

fluorapatite, thanks to the fact that enamel comes from the teeth of people living in areas with fluoridated drinking water. In addition, the enamel blocks went through different models of pH-cycling, with differently long regimes of de- and remineralization, as well as with different concentrations of acid that demineralize.

Most authors express "fluoride uptake" as units of mass per unit area (µg F-/cm2). The results of our research, therefore, require recalculation in order to be comparable. The recalculated values are given in Table 6.

Thus, Casals [8] found that ion incorporation in enamel after treatment with 4 different kinds of toothpaste available on the market ranged from 3.6 to 40.4 µg F^-/cm^2. As can be clearly seen from the results, the range is quite wide, and the amounts of “absorbed” fluoride ions were very low compared to our research. Casals used standard toothpaste available on the market, with very low fluoride concentrations adapted for everyday use, ranging between 500 and 2000 ppm fluoride (parts per million). In this study, a solution for topical fluoridation was used with a very high concentration of fluoride, which is intended only for professional use in the dental office with all precaution measures. Thus, the concentration of fluorine in our 1% NaF solution was around 10.000 ppm of fluorine, as well as in other solutions intended for professional topical fluoride treatment. Therefore, such a big difference in fluoride uptake values should not surprise. Zero [11] found the fluoride uptake is between 16 and 19 µg F^-/cm^2 for 100 ppm NaF solution. Campus [27] found that the uptake was 34.9 µg F^-/cm^2 for 1500 ppm F as NaF +1000ppm F as SMFP (Fluocaril ®Bifluore 250).

In the research of Attin et al. [29], preparations for professional topical fluoride treatment (Mirafluoride and Duraphat) were used. The fluorides were divided into KOH soluble (loosely bound) and structurally bound fluorides (fluorapatite). However, as the concentration of structurally bound fluorides was given as a mass per volume unit of enamel (µg F^- per cm^3 of enamel), unfortunately, these results were not comparable with our research. Moi [28] and co-workers found that fluoride uptake after treatment with 0.05% NaF was 3.5 µg F^-/cm^2 in the form of CaF_2 (loosely bound) + 2.2 µg F^-/ cm^2 in the form of FA (tightly bound).

Conclusions

The method of measuring fluoride uptake from the solution proved to be a relevant and valid method for assessing the capacity of the initial carious lesion to "absorb" fluoride ions. A statistically significant difference in the efficiency of 1% TiF_4 and NaF solution could not be determined from the point of view of F-uptake. In other words, both were potent fluoride topical agents that have provided a sufficient amount of fluoride ions for the initial carious lesion. Fluoride uptake turned out to be the largest for the combination of TiF_4 +Tooth Mousse and the

smallest for the combination of NaF +Tooth Mousse. Tooth Mousse does not react with TiF_4 in terms of binding or blocking free fluoride ions. The nature of the chemical interaction between Tooth Mousse and TiF_4 was synergistic in terms of a statistically significant increase in fluoride uptake over pure TiF_4 solution. On the other hand, the nature of the interaction of the paste Tooth Mousse and NaF was the opposite and reduced the F-uptake in relation to NaF itself, although not significantly.

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SURVEY RESEARCH: SMOKING HABITS AMONGST STUDENTS

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ABSTRACT

Smoking has been one of the major threats to social health in the past few decades. The problem is concerning, causing over eight million annual deaths worldwide. The most common way of tobacco consumption is burning (cigarettes) but there are other ways: waterpipe tobacco, pipe tobacco, smokeless tobacco products, etc. With the appearance of alternative smoking systems such as heated tobacco products, electronic nicotine delivery systems and electronic non-nicotine delivery systems brought to the prevalence of smokers in general. Some of these systems don't contain tobacco, however, they often have harmful or potentially harmful ingredients (flavors, glycerol, etc.). Cigarette smoke may cause cancer, cardiovascular and respiratory diseases, but we often forget about the changes and problems tobacco smoke causes to our oral health. Some of them are periodontal problems, mucosa changes, pigmentation and demineralization of the enamel.

This study aims to find out in which ways our targeted group consumes tobacco, whether they know the health risks tobacco consumption brings and the ways it affects people in their environment.

The method used in this research is a questionnaire. This study will help in creating a database of opinions and behaviors that will help dental professionals when dealing with a smoker patient. Therefore, dental professionals will have a better idea of how to advise and which measures to take when treating such patients.

Keywords: Smoking, smoking effect on health, smoking techniques, tobacco, hookah, dental health, students.

Introduction

There is no doubt that smoking is an addiction. Tobacco smoke is a mixture of substances formed by incomplete combustion of tobacco leaves at high temperatures and the most common ingredients are nitrogen, carbon dioxide, carbon monoxide, oxygen, nicotine, polycyclic aromatic hydrocarbons and metals. Nicotine is an addictive ingredient. Addiction is a chronic recurrent brain disease that develops from repeated use of a drug containing a psychoactive substance for a long period of time. This causes changes in the addict's brain thus leaving drugs to have long-term negative effects on the brain, consequently to experience and behavior, which is the basis for the definition of addiction as a chronic relapsing disease. The definition of the World Health Organization is most often used, according to which "addiction to drugs (psychoactive substances, drugs) is a special mental and physical condition of the organism that is created by the action of the agent that creates addiction. It is characterized by the experience of being forced to take an addictive substance from time to time or regularly, in order to experience its desired effect, or to avoid the inconvenience of not taking the drug. "Addiction is characterized by compulsive drug use and use, even despite awareness of the negative health consequences. [1, 2]

Most smokers would like to quit smoking, and each year about half of smokers try to get rid of this addiction permanently. However, only about 6 percent of smokers manage to quit on the first try. [3] Most smokers will have to make more attempts before they can quit permanently. [4, 5]

Tobacco use is the leading cause of premature deaths, given that 1.3 billion people consume tobacco, almost 6 million deaths are attributed to it and it is expected that by 2030 that number will increase to 8 million. The World Health Organization (WHO) points out that smoking remains the main but preventable cause of death in the world. [6, 7, 8]

Smoking conventional cigarettes is a risk factor for cardiovascular disease, stroke, lung cancer and chronic diseases of the respiratory system. Studies have shown that smoking is associated with joint diseases and an increased number of limb fractures and harmful effects on muscles, tendons and ligaments. [4]

Side smoke makes up about 85% of the smoke in an enclosed space and is most responsible for the development of cardiovascular diseases among non-smokers. Carcinomas are one of the most dangerous diseases associated with smoking, primarily cancers of the respiratory organs. [4]

Conventional cigarette smoking harms almost all the organs in the body, but the consequences it leaves on the oral cavity are enormous, as the oral cavity is the first to be hit by tobacco smoke. Tobacco smoke acts chemically and thermally on the lip cavity. Thus, conventional smoking leaves consequences on both soft and hard dental tissues causing a wide range of consequences for oral health, from harmless conditions to carcinomas of the oral cavity. Many years of research have proven that smoking causes discoloration of teeth, composite fillings and other prosthetic replacements, halitosis (bad breath - Fetor ex Ore), alteration of taste and smell, delayed wound healing, periodontal disease, oral candidiasis, caries, leukoplakia and has a huge impact on the success of implant therapy. [9, 10, 11, 12, 13, 14]

The most serious diseases that are closely related to conventional smoking are oral precancerous lesions and oral cancer. Oral precancerous lesions are changes that, if left untreated, can lead to malignant alterations and the development of cancer. Oral precancers include leukoplakia, erythroplakia, lichen planus, etc. Oral leukoplakia, the most common premalignant lesion in the mouth, is far more common in smokers than in non-smokers. One study suggests that leukoplakia in the floor of the mouth is associated with smoking habits, while leukoplakia at the lateral borders of the tongue is more common among non-smokers. [15, 16, 17].

Extremely interesting studies linked the increased incidence of endodontic procedures with conventional smoking. The results of a longitudinal study by Kral and co-workers from 2006 suggest

that smoking may play a causal role in the development of lesions resulting in endodontic treatment and are 70 percent more likely to need endodontic treatment than non-smokers. [18]

Materials and Methods

This study aims to find out in which ways our targeted group consumes tobacco, whether they know the health risks tobacco consumption brings and the ways it affects people in their environment. We want to highlight the knowledge and lack of it when it comes to health risks and problems the consumers face with. The method used in research is a questionnaire/survey. Targeted group were students at colleges closely connected to public health such as medical, dental, health studies and pharmacy students.

In the survey we found out basic demographic information about our targeted group and what college they attended. We asked about their smoking habits and health changes they have noticed since they started smoking. One of the questions was to identify health problems and risks that smoking brings. [19, 20, 21]

Our research will help in creating a database of opinions and behaviors that will help dental professionals when dealing with a smoker patient. Therefore, dental professionals will have a better idea of how to advise and which measures to take when treating such patients.

Results

The questionnaire was sent out to the students at colleges closely connected to public health, medicine (23%), dentistry (35.1%), pharmacy (28.9%) and health studies (12. 6%) and most of these students were in their fifth year of study. (figure1, 4) was answered by 239 students (male, 20.5% and female, 79.5%) (figure 2). The prevailing age was 23 years (20.5%), 24 years (17.2%) and 22 years (14.2%) (figure 3).

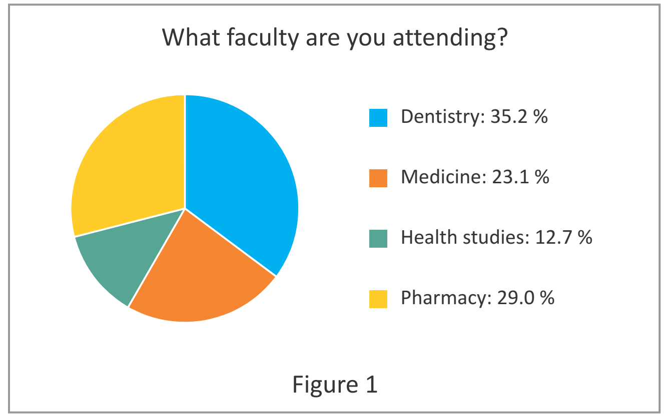
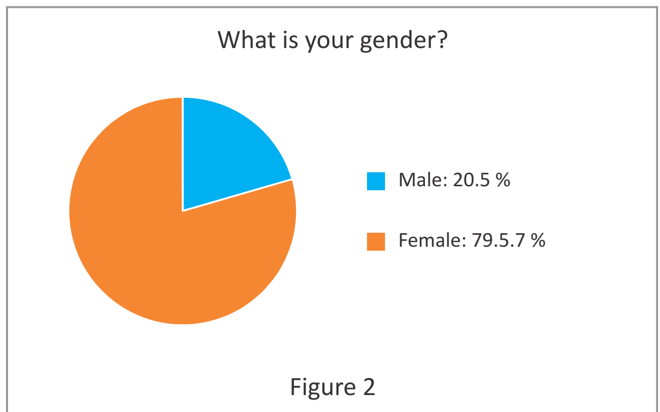


Figure 1



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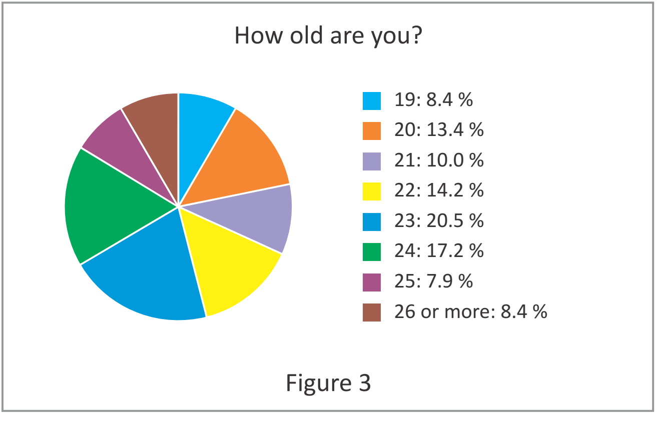

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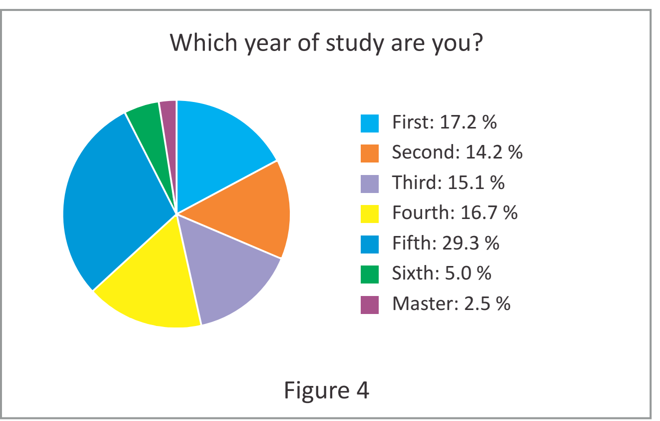

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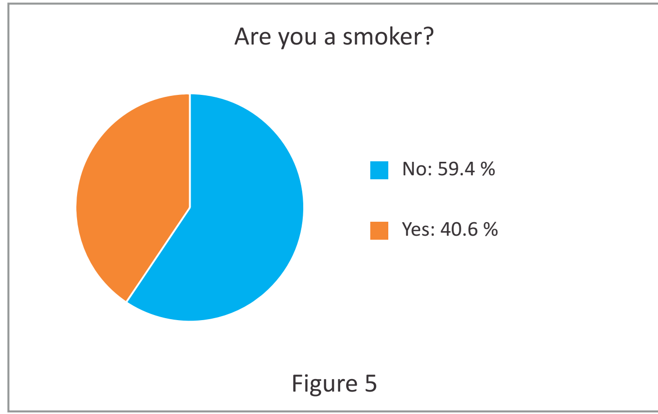

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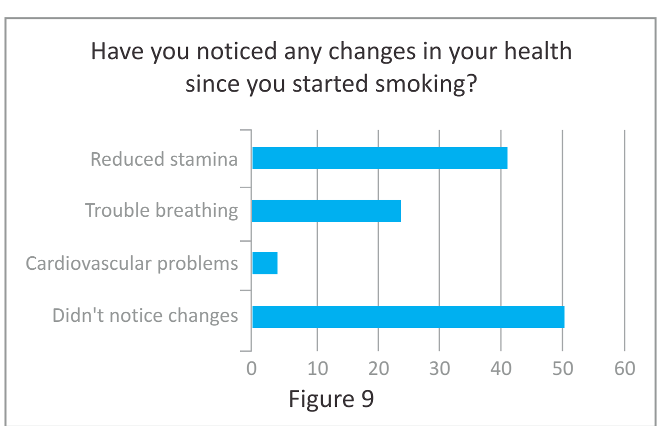

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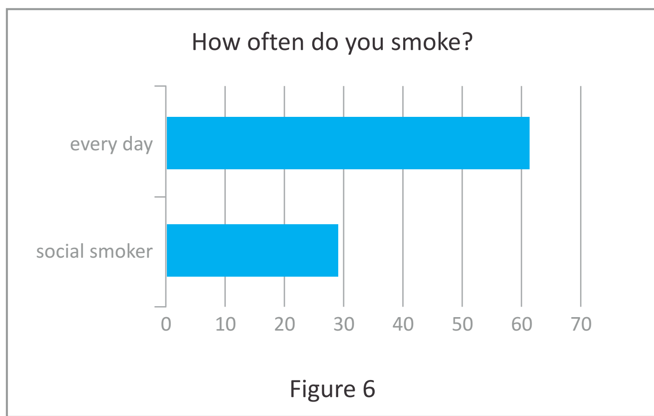

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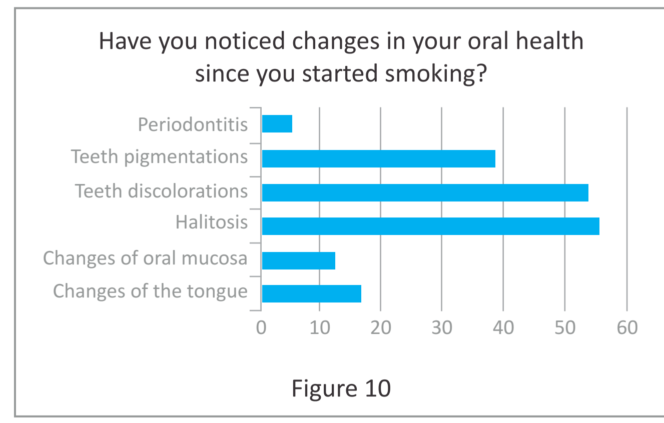

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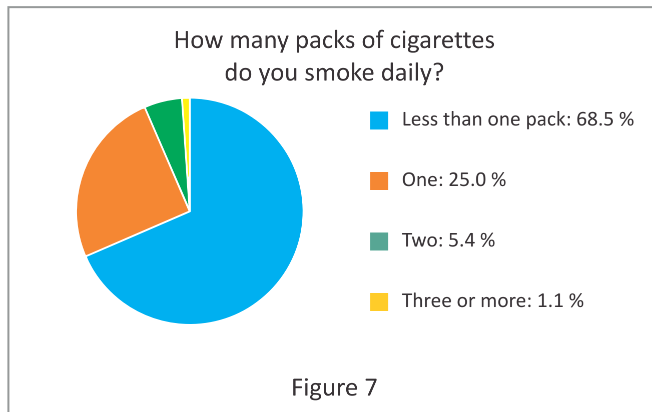

Figure 7

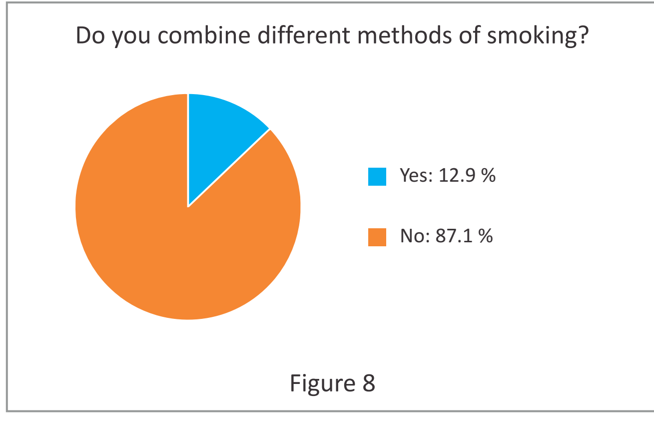

Figure 8

There were 142 (59.4%) nonsmokers and 97 (40.6%) smokers answering the questionnaire (figure 5).

When asked for how long they have been smoking they answered: less than a year 10 (10.1%), 1 to 5 years 49 (49.5%), more than 5 years 40 (40.4%).

67 (62%) of the smokers that answered the questionnaire smoke every day and 32 (29.6%) are social smokers (figure 6). Some of them only smoked on the weekends, some smoked one pack of cigarettes per week and some only smoked in stressful periods.

63 (68.5%) smoke less than a pack per day, 23 (25%) smoke one pack daily, 5 of them (5.4%) smoke two packs per day and 1 (1.1%) smoked 3 or more packs per day (figure 7).

84 (76.4%) smoke cigarettes, 19 (17.3%) smoke waterpipe, 17 (15.5%) use tobacco heating systems and 10 (9.1%) vape and only 12,9% of the students would combine the different methods of smoking (figure 8).

45 (41.3%) noticed lower stamina, 26 (23.9%) had trouble breathing, 4 (3.7%) had problems with cardiovascular system and 55 (50.5%) didn't notice any change in their wellbeing (figure 9).

4 (5.6%) of smokers noticed periodontitis, 39 (54.9%) noticed discoloration of the teeth, 28 (39.4%) had pigmentation on the teeth, 9 (12.7%) had changes on the oral mucosa, 12 (16.9%) noticed changes on their tongue and 40 (56.3%) noticed halitosis (figure 10).

When asked if they knew what kind of health problems smoking could cause 66 (41.5%) knew that smoking can cause heart attack, 60 (37.7%) blood clots, 51 (32.1%) circulation problems, 58 (36.5%) COPD, 79 (49.7%) breathing problems, 67 (42.1%) gum diseases, 40 (25.2%) teeth loss, 51 (32.1%) teeth sensitivity, 50 (31.4%) asthma, 20 (12.6%) type 2 diabetes, 32 (20.1%) higher infection risk, 13 (8.2%) decreased quality and loss of hearing, 14 (8.8%) decrease quality and loss of eyesight, 23 (14.5%) early menopause, 50 (31.4%) decreased fertility, 41 (25.8%) erectile disfunction, 43 (27%) sperm damage, 15 (9.4%) osteoporosis, 70 (44%) cancer. Only 2 (1.3%) thought smoking couldn't cause these problems and 86 (54.1%) knew that all of the mentioned health problems could be caused by smoking.

61 (58.7%) tried quitting and 43 (41.3%) didn't try quitting.

Conclusion

Although the number of smokers compared to nonsmokers is smaller, it's still concerning that these numbers are almost equal. Even though there are new methods of smoking, most of the student smoke cigarettes, which have been proved as the most harmful. Since these are relatively new smokers (have been smoking from 2 to 5 years) they still haven't noticed mayor changes in their health which usually come after decades of smoking. The best indicator of that is that most of the smokers only noticed discoloration and pigmentation of the teeth as well as bad breath coming from tobacco consumption and the least number of them noticed periodontitis and teeth lost appearing in older smokers. Study shows that the students are mostly aware of the health problems from notices on cigarettes packs and from those mostly talking about in the media, some by their doctors but they aren't that familiar with the less usual but serious health problems coming with cigarettes consumption.

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RESTORATIVE-PERIODONTAL INTERRELATIONSHIP

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ABSTRACT

A proper understanding of the relationship between periodontal tissues and restorative dentistry is the key to ensuring adequate form, aesthetics and durability of dentition. The literature analyzing the impact of the restorative procedure on periodontal tissues has been researched and it is possible to identify certain factors that are important for the preservation of the periodontium after the restorative procedure, such as restoration contours, roughness, overhangs, contact point and type of material. Special emphasis was placed on the position of the edge of the restoration and its impact on periodontal health. Also, it is necessary to know and understand the concept of biological width, the understanding of which is crucial for everyday practice and the correct approach to any restorative procedure. In the case of neglecting the concept of biological width, the restoration itself can cause more harm than good, which in the worst case leads to tooth loss. Overhanging dental restorations are a problem not only because of their incidence but also due to the fact that clinicians often neglect them even when they are clinically and radiologically obvious. There is much evidence to suggest that bleeding, gingivitis and bone loss are increased in tissues with overhanging restorations.

Keywords: biological width, edge of the restoration, overhangs, gingival and periodontal health

Introduction

The precondition for the success of any restorative treatment is a healthy periodontium. The relationship between restorative dentistry and periodontology is reflected in several ways, both by the edge of the restoration and the outline form of the crown, as well as by the response of the tissue to the preparation. The close relationship between iatrogenic factors and periodontal damage was first recognized by Black.[1]

Preserving periodontal health during and after restoration is a great challenge for dental practitioners because the tooth and its surrounding structures are under the continuous influence of microbiological flora, and the restorative procedure itself can worsen this condition. [2] Emphasis must be placed on the control of bacterial plaque, the contours of the restoration, the sensitivity to restorative materials and the location of the edge of the restoration. [3]

The restorative procedure affects the periodontium in several ways including the type of restorative material and the way it is placed, as well as the contours of the restoration. In the case of subgingivally placed restorations, the surface should be smooth, and the material should resist decay under the influence of plaque, and ideally prevent plaque formation. [2] In the case of gingival inflammation, it is necessary to eliminate the inflammation before the restorative procedure itself. The advantages of this approach are, among other things, that by reducing the size of the gingiva, proper preparation is easier and the risk of trauma to the gingival tissue is reduced. [3]

Any restorative procedure may have a long-lasting effect on the condition of the periodontium. Although most procedures cause periodontal tissue damage, such damage is in most cases reversible.[4] Special attention should be paid to situations in which the integrity of the soft tissue can be easily endangered, such as placement of temporary fillings, dental matrices, interdental wedges and rubber dam. [2]

Dental restorations are often associated with the development of gingival inflammation, especially when they are located subgingivally. Restorations can compromise biological width if placed deep into the sulcus or within the junctional epithelium. This may lead to the development of inflammation and loss of clinical attachment with apical migration of epithelial attachment and its re-establishment at a higher apical level.[1]

Restorative dentistry should have healthy periodontal support structures for its base. Nevertheless, practical situations testify that restorative procedures are usually performed without accompanying supportive periodontal therapy. Many times we place extensive restorations on inflamed and diseased periodontal structures. On the other hand, the longevity and success of the restoration depend on the health of the associated periodontal structures.

This paper presents a review of the literature that in different ways studies the relationship between the edge of the restoration and the gingiva and other periodontal tissues.

Biological width and its significance

The biological width (**Figure 1.)** is defined as the dimension of the soft tissue being attached to the tooth coronally from the crest of the alveolar bone. [5] The term was first introduced by Gargiulo

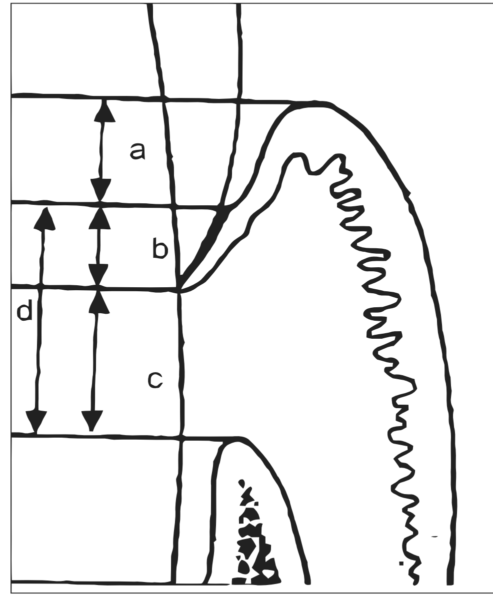

Figure 1. Schematic representation of biological width a) histological sulcus (0.69 mm), b) epithelial attachment (0.97 mm), c) connective tissue attachment (1.07 mm), d) biological width (b + c) (Retrieved from 5)

et al. He defines it as natural protection that develops around the teeth and protects the alveolar bone from infection and disease.[6] Gargiulo claims that the biological width is approximately 2.4 mm, of which 0.69 mm is gingival sulcus, the epithelial attachment is 0.97 mm and the connective tissue is 1.07 mm. The dimension of biological width is not constant and depends on the position of the tooth in the alveoli, as well as on the type of tooth.[2]

Intrusion into the biological width area by cavity preparation, caries, fracture or some restorative material may result in bacterial accumulation, inflammation, increased probing depth, or a combination of these problems. The total dimension of 2.04 mm is accepted as the minimum necessary distance between the edge of the restoration and the crest of the alveolar bone, which allows normal development and preservation of the attachment. This would, however, place the edge of the restoration exactly at the base of the gingival sulcus which would result in unfavorable conditions. A more realistic approach involves providing at least 3 mm from the alveolar crest to a healthy tooth structure, thus providing approximately 1 mm between the attachment and the restoration edge. [7]

If the patient feels discomfort in the gingival area when examining the edges of the restoration with a periodontal probe, it can be considered that the biological width has been compromised, which later leads to gingival hyperplasia, bleeding on probing, recession, bone loss and pocket formation. Biological width can also be estimated by measuring the distance to the bone level using a periodontal probe and subtracting the sulcus depth from the obtained value. If the distance from the base of the sulcus to the bone is less than 2 mm, it is considered that the biological width has been endangered. Disturbance of the biological width in proximal zones can be observed by interpretation of the radiological image.[2]

Reasons for endangering the biological width include attempts to achieve a healthy tooth structure, achieving an adequate length of preparation, previous restorations, existing caries, resorptive defects, traumatic and iatrogenic injuries and incorrect measurement of sulcus depth.[8] Placing the restoration margin in the area of biological width often leads to gingival inflammation, loss of clinical attachment and loss of alveolar bone. Subgingival restoration margin placement should be viewed as a compromise, while supragingival placed restoration edges are preferred. In situations where aesthetics do not play the most important role and where there is an adequate tooth structure, it is recommended to place the edges of the restoration supragingival. The problem arises in situations where setting the edge of the restoration subgingival is necessary. If the gingival sulcus is less than 1.5 mm deep, the dentist "creates" the sulcus himself during the preparation of the cavity to set the edge of the restoration subgingivally. This approach to preparation is usually at the expense of the intact dentogingival unit, resulting in permanent damage to the junctional epithelium and supraalveolar connective tissue. Under normal circumstances, where the depth of the gingival sulcus is 2-3 mm, the edge of the restoration can be placed 0.5 mm into the sulcus.[9]

Importance of the restoration edge position and surface roughness

The position of the restoration edge has a long-term effect on the health of the periodontium, because the accumulation of plaque on the restoration edge is a consistent finding and occurrence, both in research and clinical practice. With restorations whose edges are placed subgingivally, there is a greater accumulation of plaque and a higher frequency of secondary caries and periodontitis. [10] Supragingivally positioned edges of the restoration have a similar impact on periodontal health as unrestored tooth surfaces.[1]

When setting the restoration edge subgingivally, the depth of the gingival sulcus should serve as a guide. If the depth of the sulcus is 1.5 mm or less, the edge of the restoration should be placed 0.5 mm below the gingiva margin. This is particularly important in the frontal area and prevents the destruction of biological width in high-risk patients. If the depth of the sulcus is more than 1.5 mm, the edges should be placed one-half

the depth of the gingival sulcus, while for sulcus depths greater than 2 mm, the possibility of gingivectomy should be considered, which would give a sulcus depth of 1.5 mm and then proceed as in the first situation.[1] When the restoration significantly extends beyond the gingival sulcus, the clinical crown lengthening is suggested.[11]

Roughness in the subgingival zone of restoration largely contributes to the accumulation of plaque and the gradual onset of gingival inflammation. The edge placed subgingivally is difficult for proper finishing, which will later definitely lead to this area becoming a plaque retention place. Marginal adaptation should be optimal because rough restorations and open edges lead to the accumulation of bacterial pathogens and are associated with inflammation of periodontal structures.[9] What is important to note is that the tissue reacts more to the surface roughness of the material than to the composition of that material itself.[3] The surface roughness has also been shown to increase over time.[12] Compared to definitive restorations, temporary restorations have less acceptable contours, adaptation and roughness. Therefore, temporary restorations have a higher potential for plaque accumulation.[8]

Marginal roughness occurs as a result of the following causes:

1. grooves and irregularities present on the polished surface,
2. separating the edge of the restoration and cement from the cervical finish line, exposing the rough surface of the prepared tooth,
3. inadequate marginal adaptations of the restoration (subgingival margins usually have a gap of 20 to 40 μm between the edge of the restoration and the unprepared surface of the tooth),
4. dissolution and fragmentation of cement between cavity and restoration, thus creating space and cracks.

A well-polished and contoured surface of the composite filling does not adversely affect the health of the gingiva. The gingiva shows a weaker inflammatory response to well-polished and contoured restorations than to a cavitated carious lesion.[12]

Contours and contact points of restoration

Proper contours enable adequate maintenance of oral hygiene, create the desired shape of the gingiva and give the appropriate aesthetic effect in visible areas. There are conflicting reports on the adequate contour that is necessary for maintaining the health of the gingiva. Some authors believe that the contour of the crown should follow the true anatomy of the tooth to allow functional simulation and maintenance of gingival health. Others advise that undercontouring is necessary for better periodontal health.[13] The definition of undercontoured and overcontoured restoration is essentially unclear. The results of studies in humans and animals clearly show the connection between overcontouring and gingival inflammation, while undercontouring does not produce a harmful effect on the periodontium.[1]

The emergence profile is the part of the restoration that is in relation to the gingival tissue. The emergence profile of restoration in the aesthetic zone has two aspects: the subgingival form and the supragingival form. The subgingival form should follow the contours of the cement-enamel junction and provide support to the gingival tissue. Increased thickness of proximal subgingival contours leads to increased papillary height, while increased facial contours result in displacement of gingival tissue apically.[9] Flat contours of restoration are always acceptable in areas of the oral cavity where aesthetic requirements are not dominant. When the gingiva comes in contact with a flat uncontoured tooth surface, there is a tendency to develop a thick free gingival margin. This thickening of the gingiva is not pathological, but it requires a method of brushing teeth that will ensure the complete removal of plaque at the point of contact between the tooth and the gingiva. Overcontouring restorations or misplacing contours is a far greater risk of periodontal disease than the

lack of contour, because both, supra and subgingival plaque accumulation, can be increased at contoured edges. The higher the convexity, the harder it is to remove plaque.[3]

The teeth contact in the area is marked as the proximal contact, while the spaces below the contact are marked as embrasures. An embrasure is a V-shaped space that arises apically from the proximal contact, and the interdental space is the physical space between two adjacent teeth, and its shape and volume are determined by the morphology of the tooth. Preservation of the interdental papilla is one of the main concerns during tooth restoration. The absence or loss of the interdental papilla, which eventually leads to the absence or loss of the embrasure, can cause an aesthetic disturbance, phonetic problems and food impaction.[6] In essence, there is no periodontal damage in the case of increased space for the interdental papilla. It is therefore safe to use the minimum proximal contour and place the proximal contacts as occlusal as possible, thus ensuring a good approach to plaque control in the proximal area.[22] Good proximal contact acts as a barrier and prevents food impaction, thus contributing to periodontal health. While the role of deficient proximal integrity may be unclear, open contact leads to food impaction and is often uncomfortable for the patient. It is generally accepted that tight proximal contact is essential for gingival health.[13]

Effect of overhanging restorations on periodontal health

The overhanging restorations have long been considered a contributing factor to gingivitis and loss of periodontal attachment. A close link between iatrogenic factors, such as the existence of overhanging restorations and destructive periodontitis, was observed in the early years of the last century (Black 1912).[14]

The overhanging restorations alter the ecological balance of the gingival sulcus in a way that creates an area that favors the growth of gram-negative anaerobic bacteria and prevents adequate removal of accumulated plaque. It is believed that a change in the composition of the subgingival microbiota over time leads to the loss of periodontal support. The subgingival overhangs result in a change in the microbiota similar to that of adult chronic periodontitis.[15] Studies have shown that a foreign body in the area of biological width, making contact with the alveolar crest, leads to inflammation, bone and occasional root resorption.[16]

A high prevalence of overhanging margins associated with subgingival restorations was found.[17] The presence of overhangs in the wide range of 16% to 71%, as determined by studies, may be due to different definitions of overhangs and different ways of estimating.

Most overhangs on restorations can be successfully reconstructed without replacing the entire restoration.[18] Small supragingival overhangs can be easily removed using a variety of instruments such as periodontal scalers, curettes or files that seek to fragment and remove the overhang. Other devices and methods for removing overhangs on restorations are also recommended, such as diamond burs, curettes, ultrasonic and sonic instruments, chisels, abrasive discs and finishing burs and strips.[14] In the USA, 27 federal states allow dental hygienists the procedure of removing overhangs on restorations.[19]

A study conducted by Sameer et al, which aimed to compare short-term clinical changes in the periodontium after the removal of subgingival amalgam overhang, noted a significant decrease in plaque index.[20] Periodontal destruction caused by overhang is a slow and painless process, so most patients are unaware of it and it rarely occurs because of it. Unfortunately, even some dentists are not aware of the importance of removing overhangs on restorations.

Chemical influence of restorative materials

The health of the gingival tissue that covers the restoration has long been the subject of interest for

many researchers and various authors have determined the irritating effect of certain materials. More than 35 different elements are part of various dental alloys used in practice. Dental amalgam is made up of many components with varying levels of cytotoxicity. Some studies focused on the cytotoxicity of mercury, while others analyzed silver amalgam alloy powder which proved to be less toxic.[23] Although the cytotoxicity of amalgam may be as high as the cytotoxicity of mercury when measured immediately after trituration, it decreases over time. Selenium reduces the toxicity of heavy metals such as mercury, copper, silver, arsenic and cadmium and there is evidence that mercury toxicity can be altered by selenium supplementation.[24] Selenium concentrations of 0.1 to 0.2% in amalgam alloy powder were found to be most effective in reducing the cytotoxic effect of mercury. The release of large amounts of zinc is also one of the factors contributing to the cytotoxicity of amalgams. This may be the explanation for some cases of gingival inflammation in the absence of plaque.[25]

Various authors have investigated the antibacterial activity of amalgam depending on the composition and tested bacteria. The discrepancies in the research most likely exist due to the different sensitivity of the tested bacteria to the materials, and the exact data on the antibacterial effect is difficult to determine due to the complex structure and composition of the amalgam.[26,27] The elemental composition of amalgam acts as an antibacterial agent, unlike composite resins, which do not contain anything that would suppress or prevent the growth and development of microorganisms causing caries. In essence, both triethylene glycol methacrylate (TEGMA) and triethylene glycol dimethacrylate (TEGDMA), which are the main constituents of many composite resins, promote the growth of microorganisms. Copper ions have repeatedly shown that they have the greatest lethal effect on microorganisms.

Composite resin surfaces have been shown to increase sulcus fluid secretion relative to enamel control surfaces. Subgingival composite restorations can cause changes due to direct trauma to periodontal tissues, or they can increase the accumulation of subgingival plaque thus leading to the gradual development of inflammatory changes.[28] Release of various products from composite fillings can initiate an inflammatory response of the gingiva. Ferracane et al have proven that the release of toxic products from composite fillings is greatest during the first days after placement. After that, the cytotoxicity of the restoration gradually decreases.[29] The cytotoxicity mechanism should relate to the short-term release of free monomers during the period of conversion of monomers to polymers. The prolonged release of substances should be a consequence of erosion and degradation that occur over time.[30]

Conclusion

For the complete success of the restorative procedure, it is necessary to preserve the health of the gingiva and other periodontal tissues. Prior to the restorative procedure, it is necessary to analyze the condition of the periodontium and conduct initial periodontal therapy in a situation where the periodontium shows signs of severe inflammation and damage, which will guarantee the longevity of the restoration and the tooth itself. It is necessary to know the concept of biological width to properly approach the restoration procedure, without interfering with the area that can harm the health of the periodontium. There is already many evidence- based studies on how defective restoration and the edge of restoration can have a negative impact to gingiva, so prior knowledge needs to be applied to turn theory into practice.

Declaration of interest

The authors declare no conflicts of interest.

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DIAGNOSIS AND TREATMENT OF MANDIBULAR CYST - CASE REPORT

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ABSTRACT

Introduction: Jaw cysts are common in dental practice, but inadequate diagnostic approach can aggravate their treatment. The role of radiological methods is extremely important in diagnosing a cystic lesion and the choice of therapeutic approach because of the fact that odontogenic cysts are most frequently asymptomatic. They are often discovered during routine x-ray imaging.

The aim of the paper: The aim of the paper is to point out the importance of a detailed diagnostic approach on the case from our own casuistry, and also to underline therapeutic treatment of a pathological cystic lesion.

Materials and methods: In this paper we presented a case of a female patient to whom we detected, upon an accidental routine x-ray examination, a pathological change in the form of a cystic lesion in the mandible in the lower first molar region. Within the surgical protocol a surgical extraction of residual root of tooth 36 was performed, as well as mesial root resection of tooth 37 and a complete enucleation of the cystic formation. The wound was primarily sutured.

Result: After the surgical procedure, the patient had minimal postoperative problems such as swelling and occasional pain. Postoperative period was monitored through regular clinical and x-ray control check-ups. The wound has completely healed.

Conclusion: Aside from impeccable knowledge in anatomy, oral surgeons must be informed about all the possibilities that modern diagnostics provides in order to be able to successfully diagnose a pathological process, considering the fact that every mistake can be reflected on the therapeutic – operative outcome.

Key words: odontogenic cyst, radiological diagnostics, mandible.

Introduction

Cysts in the orofacial region represent a pathology which oral surgeons often encounter in their every-day clinical practice. Diagnosis of cystic lesions is a challenge for every surgeon because it is necessary to use detailed tests to differentiate between a benign growth and potential malignancy which are clinically and radiologically difficult to distinguish [1]. Cysts in the orofacial region have their own specific characteristics. A cyst is a term for a pathological cavity, consisting of two membranes – inner epithelial and outer connective one [2]. With its growth the cyst creates a cavity which can be filled with liquid, pulpous or gaseous content. The growth of a cyst always occurs in the direction of the least bone resistance [1]. Cysts whose formation is associated with a tooth are called cysts of odontogenic origin. Odontogenic cysts are the most common lesions in the group of jaw cysts and, according to some researches, of all jaw cysts their frequency is 89 - 94% [5].

With their growth, cystic lesions can cause increased bone osteoclastic activity, and the consequence of this is weakening and reduction of bone functionality. The relation of the cyst and adjacent anatomical structures is of great importance, with special emphasis to the relation to adjacent teeth, maxillary sinus and mandibular canal [5]. Modern diagnostic methods imply detailed anamnesis, clinical examination of all oral structures, radiological examinations, analysis of the cystic content punctuate, and for final confirmation, pathohistological analysis of tissue sample [3]. The aggravating factor of making an early diagnosis is the fact that cysts do not cause the onset of symptoms until they deform the surrounding anatomical structures with their growth or until inflammation occurs. In that case there are some significant clinical signs such as tooth discoloration, dental arch asymmetry, occurrence of persistent painless swelling [2]. From all of the above-mentioned the existence of cystic lesion is often diagnosed by random radiological examination.

Radiology methods that we use in diagnosing cystic lesions are: retro-alveolar imaging, orthopantomogram, computed tomography (CT) and three-dimensional tomography (CBCT) [3,5]. Odontogenic cysts manifest radiologically as well-limited unilocular or multilocular illumination. In the case of an inflamed lesion, it can be seen in the x-ray that cyst edges, otherwise clearly defined, become less clear [6]. A three-dimensional computed tomography (CBCT) is a modern diagnostic method providing a detailed insight into the size and position of a cystic lesion as well as its relation to the surrounding anatomical structures.

Treatment of odontogenic cysts is surgical, and the choice of a method depends on the size, localization and the type of cyst, as well as the general state and age of a patient. Formulating a correct diagnosis is important as a part of preoperative patient preparation and the choice of adequate surgical technique [2,3].

The aim of the authors of this paper is to point out the importance of detailed diagnostic approach with the emphasis to x-ray diagnostics in the detection of pathological cystic lesions, as well as the presentation of surgical protocol in its treatment.

Case report

In this paper we presented a case of a 14-year-old female child that was admitted to the Clinic for oral surgery at the Faculty of Dentistry in Sarajevo after an attempt of extracting the lower left first molar when the fracture of the crown of the tooth 36 occurred. According to the patient x-ray diagnostics was not performed before the intervention started. After detailed anamnestic processing, a clinical intraoral examination began revealing the missing of the crown of tooth 36. The mucosa in the mentioned region is of normal color, and pathologically unaltered (Figure 1). Palpation in the area of fornix vestibule in the region of tooth 36 shows a hard, spherical thickening of bone wall

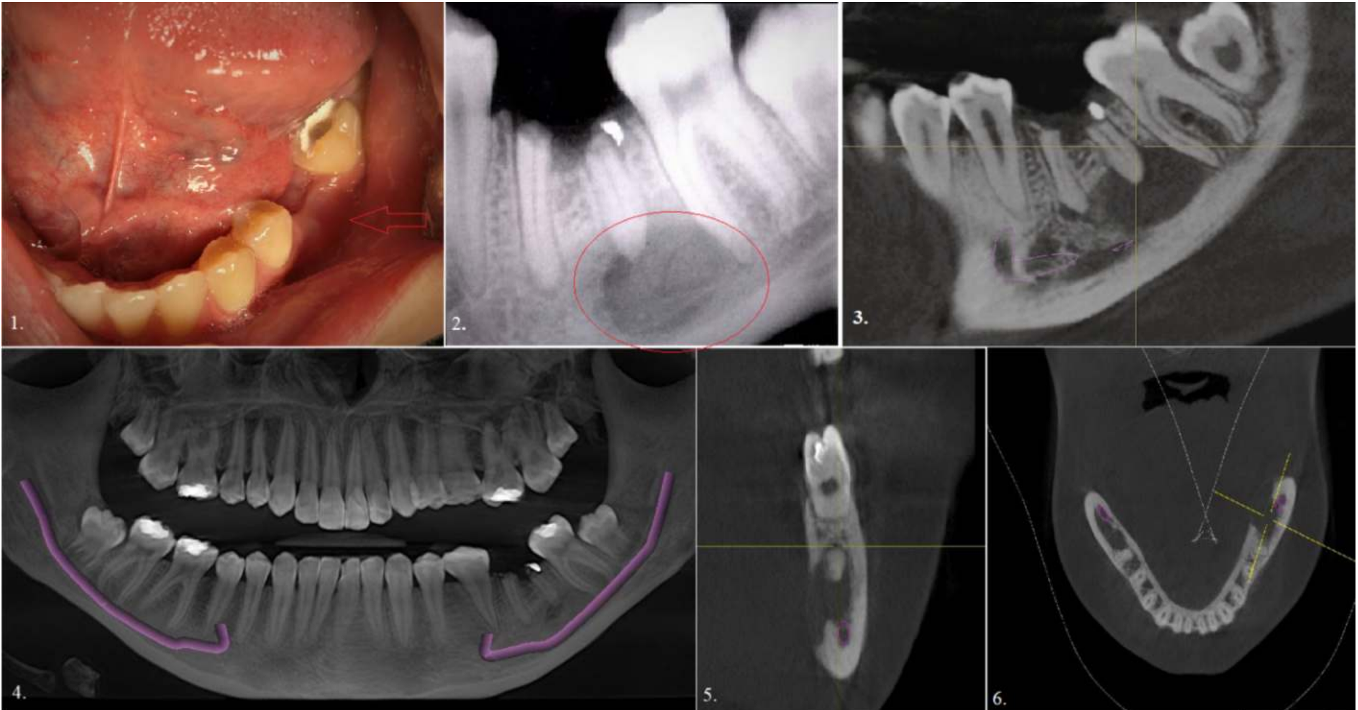

Figure 1. Preoperative clinical view; **Figure 2.** Preoperative radiographic view - radiolucency in the area of the distobuccal root 36; **Figure 3.** Sagittal CBCT image; **Figure 4.** Panoramic CBCT image; **Figure 5.** Coronal CBCT image; **Figure 6.** Axial CBCT image;

covered in unaltered mucosa. During the diagnostic processing as initial radiological method, we used X-ray image recording x-ray darkening being correspondent with remaining roots of tooth 36, as well as a radiolucent spherical lesion with the diameter of 1 x 1.5 cm clearly confined from the surrounding bone. The image clearly displays that the mesial root of tooth 37 is in contact with the cystic lesion (Figure 2). Additionally, radiological analysis shows a close relation of the pathological change with the mandibular canal so CBCT scan is performed in order to get a better orientation and planning of the surgical procedure (Figure 3-6). Based on all of the above-mentioned, a working diagnosis *Cystis mandibule in regio dentis 36 et radix relicta 36* is made, as well as an indication for surgical procedure where extraction of remaining roots of tooth 36 is planned, a resection of mesial root of tooth 37, as well as a cystectomy in the specified region. The surgical procedure was performed under local anesthesia. After administering conduction anesthesia (Septanest Forte, 40mg/ml +0,01 mg/ml, 1,7 ml, Septodont France) an incision cut is made. A mucoperiosteal flap of full thickness is elevated, and then buccal cortical lamella, which was extremely thin, is removed, and cystic envelope is revealed as well as residual roots of tooth 36 which are extracted (Figure 7,8). The cyst is removed from the surrounding bone by suitable curettes and is completely enucleated (Figure 9-11). A residual root apicoectomy is performed on tooth 37 which was preoperatively completely filled with gutta-percha points and a glass ionomer cement sealer. The bone defect is washed thoroughly with sterile saline solution (0.9 % sodium chloride). Inspection detects intact mandibular canal. The lobe is repositioned, and the wound is primarily sutured with individual sutures (Figure 12). Antibiotics are prescribed (Augmentin tablets 875mg + 125mg, GlaxoSmithKline, Ireland) every twelve hours for seven days, and the patient is given detailed instructions for the postoperative period. The surgical procedure went properly with minimal postoperative discomforts in terms of postoperative edema and pain. At the control

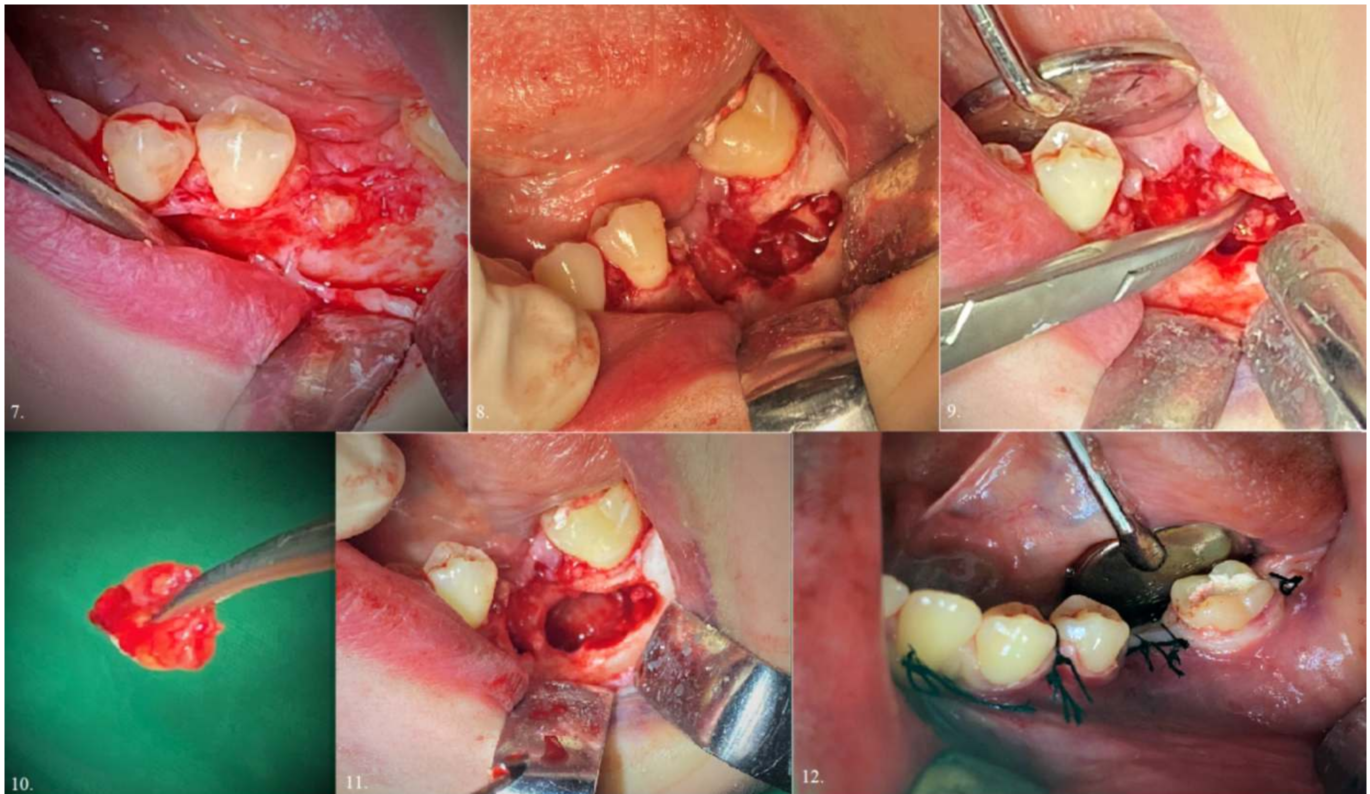

Figure 7. Incision; Elevated mucoperiosteal flap; **Figure 8.** The surgical wound after extraction of residual roots; **Figure 9.** Completely enucleated cystic lesion; Figure **10.** Macroscopic view of cystic lesion; **Figure 11.** Intraoperative view of the bone cavity after cyst enucleation; **Figure 12.** Repositioned and primarily sutured flap

examination the patient denied a numbing sensation on the left side of the mandible. The stitches were removed on the seventh day after operative procedure (Figure 13).

The postoperative course was monitored through regular control examinations in specified time intervals after two days, seven days, one month, and six months. At the last control clinical examination (6 months after the operative procedure) the orthopantomography image

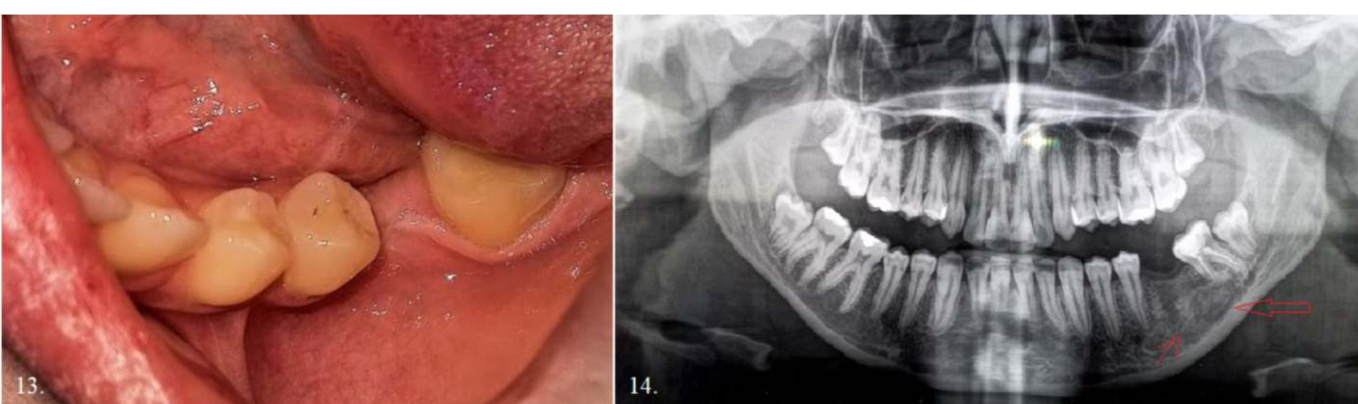

Figure 13. Successful wound healing can be noticed six months postoperatively; **Figure 14.** Panoramic X –ray image six months after surgery

dontal pocket [2,3]. They cause bone destruction with their growth, and sometimes even displacement of the teeth they are in contact with. Diagnosis is not possible by clinical examination until the cyst reaches large dimensions and outgrows the width of alveolar ridge and deforms the bone. Bone resorption is mostly expressed in the direction of least bone resistance and this distinguishes the tumor formation from the cystic one since tumor formation grows in all directions. Cystic lesions are most often discovered by accidental radiological examination. Making the correct diagnosis is of great importance in order to distinguish possible malignant changes of the jaw which require a more radical treatment [3,11].

Early detection of cystic lesions in jaw bones is of great importance. Odontogenic cysts and bone lesions do not occur very often in everyday clinical practice. Cysts possess the quality to grow slowly and it can take several years until they are discovered [3]. For that reason, making a timely diagnosis is an even bigger challenge. Odontogenic cysts can also grow faster if there is an inflammation of their contents, the so-called cystic sac [1,3].

It is very important to know clinical, especially radiological, properties by which cystic lesions are distinguished. Clinical and radiological findings often lead to differential diagnosis but the final diagnosis can only be confirmed by histopathological finding [7].

The diagnosis of cystic lesions begins with detailed anamnestic processing, a clinical examination of a patient – inspection and palpation of the suspect part of the jaw, and tooth percussion. In certain situations, it is necessary to conduct additional diagnostic methods such as puncture and clinical examination of the cystic content, as well as cytological examinations of the punctuate and cells, and also 3D computerized tomography of the jaw bones [3]. Ortho-pantomograph, computerized tomography and 3D computerized tomography are necessary for detailed analysis of radiolucent lesions in jaw bones. Computerized tomography (CT) and Cone beam computerized tomography (CBCT) have an immeasurable significance in estimating the edges of the lesions and their relation to other anatomical structures, such as the lower alveolar nerve. Regardless to the fact that most jaw lesions, which have well-defined sclerotic edges, are benign in nature, detailed radiological diagnostics plays very important role in establishing a diagnosis which is not clinically expected [8,9].

The aim is to select an optimal method which provides a maximal representation of details and all necessary diagnostic data [1]. Aside from diagnostic value, while choosing an imaging method, possible harmful effects of imaging on patient's health are also taken into consideration [9,10]. Cyst findings with clear clinical signs along with two-dimensional radiological image fulfill diagnostic criteria providing the surgeon enough information before the treatment of the cystic lesions. However, in the event of less clear cases, it is necessary to conduct three-dimensional imaging after the two-dimensional ones. In those cases, it is possible to select the methods of computerized tomography that entail two options: dental CT and CBCT. In dentistry, the advantage is given to CBCT because it provides a quality image with less radiation [3,7].

The knowledge of characteristic signs of radiolucent lesions of the jaw bones in x-ray images narrows the differential diagnostics and it is crucial for identification of those lesions [8]. Lesions in the jaw bones can be radiolucent, radiopaque or mixed [12]. The largest number of lesions (>80%) is radiolucent. Unilocular radiolucent lesions with well-defined edge most commonly indicate the presence of a benign slowly proliferating process, or a process of inflammatory etiology, while multilocular lesions with well-defined edges indicate a benign, but aggressive process. A combination of a radiolucent and radiopaque lesion can be the result of inflammatory, metabolic states, fibroskeletal lesions or malignant processes. Lesions with less defined edges represent an aggressive, inflammatory or neoplastic process [10,12].

Radiological diagnostics of cystic lesions is an essential step preceding surgical treatment of a cyst. Surgical method that the surgeon opts for depends on the size of a pathological process and detailed evaluation of anatomical structures the cystic lesion may be in contact with [1,3]. Cysts of smaller dimensions are removed by enucleation and primary wound closure by Partsch II

procedure. For the operation of larger cysts in the lower jaw there are descriptions of techniques of marsupialization or Partsch I method, as well as methods of permanent postoperative suction [13,14]. Technique of decompression, which firstly decreases the cyst volume and then after several months, depending on the shrinking intensity, enucleation is performed, can be applied for large cysts in the upper and lower jaw [14].

The presence of pathological cystic lesion can endanger the patient's health and normal function of the stomatognathic system, as well as development of further complications. Therefore, we want to emphasize that it is important to adhere to all available diagnostic methods in order to detect the pathological process in timely manner, and then to decide on the therapeutic method choice. Proper diagnostics saves time and avoids unnecessary demanding therapeutic procedures.

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Declaration of interest

The authors declare that there is no conflict of interest.

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IMPORTANCE OF CBCT IN ENDODONTIC DIAGNOSIS - A CASE REPORT

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ABSTRACT

Objectives: Although intraoral radiography remains method of choice for endodontic diagnostics, it has many limitations. When presented with a complex endodontic case, the clinician relies on the CBCT imaging method to provide more information.

Case study: A 33-year-old man presented with a fistula opening in the gingiva of the upper left second molar. From medical history, the patient explained that tooth 27 was previously endodontically treated and since then without any symptoms, but with present fistula. Tooth 26 was extracted and tooth 28 intact. Intraoral radiograph ond OPG showed insufficient intracanal filling but no periapical lesion. As we connected intraoral fistula with failure in endodontic treatment of tooth 27, we decided to do retreatment. But even a year after rooth canal retreatment, fistula still appeared occasionally. Finally CBCT gave us an accurate diagnosis. The broken root of tooth 26 was not wholly extracted, but present in this area with a significant bone loss. This information saved tooth 27 from extraction, as we first assumed that root canal retreatmen to tooth 27 failed. After surgically removing of broken root and granulations around it, the fistula stopped to appear.

Conclusion: When dealing with a complex endodontic cases, clinicians should rely on the CBCT imaging method to provide more information relevant for proper diagnosis.

Key words: intraoral fistula, CBCT imaging, endodontic diagnosis

Introduction

After completing the clinical exhamination, it is often necessary to continue inquiries using dental radiography techniques. Such exsposures will provide essential clues regarding the tooth's anatomy: morphology of pulp chamber, number, length and morphology of root canals, periodontal condition, periapical structures and previous dental treatment. The most widely used method for radiological evaluation is two-dimensional periapical radiography. Given this method does not provide sufficiently reliable information, we rely on an alternative approach – cone beam computed tomography (CBCT). Unlike other medical CT scanners, CBCT operates by focusing a cone-shaped beam on a two-dimensional detector by a single rotation around patients head. [1] The scanner is smaller in size and produces lower radiation doses thus being convinient for use in dentistry. Image produced by a CBCT scanner is actually a set of multiple two-dimensional images in three dimensions. Therefore, image is more reliable and precise. [1-10]

The purpose of this case report is to present importance of CBCT as a diagnostic tool helping clinicians to achieve the proper diagnosis in complex endodontic cases.

Case Study

The patient's first visit

In July 2020., a 33 year-old male patient visited our dental practice complaining to present intraoral fistula in the region of the upper left second molar. The fistula exists for a long time, disappearing after drainage and then reappeares in a few days. No other symptoms were present.

Tooth 26 was extracted years ago, tooth 28 intact and tooth 27 had a large composite filling. The patient informed us that tooth 27 had root canal treatment a few years ago.

We took an intraoral periapical radiograph (**Figure 1**.) to get more information about tooth 27 as we assumed that the fistula is a consequence of the potential failure in the root canal treatment.

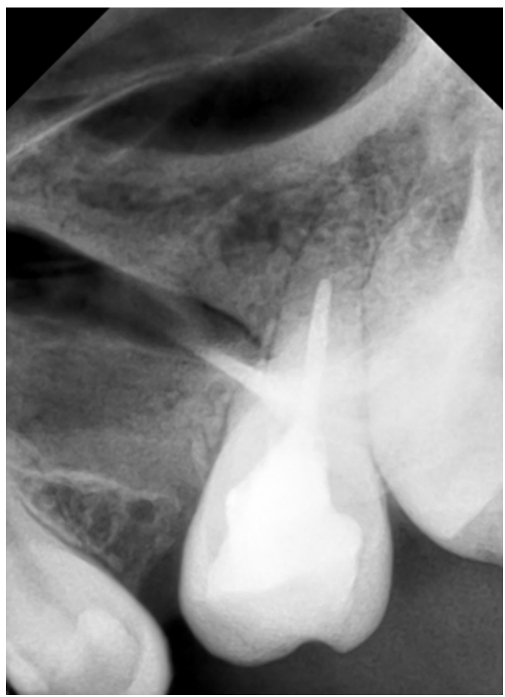


Figure 1. The periapical X-ray showed inadequate intracanal filling in the palatal canal of tooth 27

Periapical X-ray showed inadequate intracanal filling because the intracanal filling in the palatal canal was short compared to the radiographic apex. Since we needed more information about the mesial and distal roots of tooth 27, we also took a panoramic radiograph (**Figure 2.**). Obturation was inadequate in the mesial root, so we assumed that the root canal treatment on tooth 27 failed and therefore patient developed chronic apical periodontitis with suppuration.

Chronic apical periodontitis with suppuration is an asymptomatic endodontic diagnosis. The patient has little or no discomfort at all. Clinically, there is a history of intermittent discharge of pus

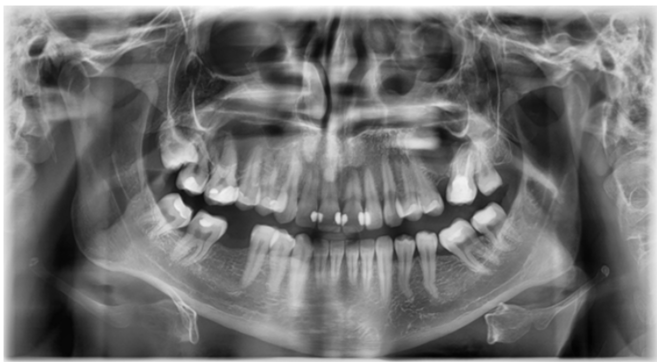


Figure 2. The patient's panoramic radiograph showing inadequate obturation in mesial canal

through the associated sinus tract allowing drainage. Tooth pulp is necrotic, and the tooth is nonresponsive to palpation, percussion and vitality tests. Radiographic examination reveals present osseus destruction with radiolucency in periapical area. [2]

In this case, we decided to do a root canal retreatment to get periapical healing and for the fistula to resolve. The other solution was to extract tooth 27 with an adjacent fistula.

The patient's second visit

At the subsequent visit, we perforemed a single-visit root canal retreatment on tooth 27 with a proper apical sealing and a composite filling. No acessory canals were found. We decided to monitor the tooth in the following months as we expected healing. In case of retreatment failure, extraction was the only option.

The patient's third visit

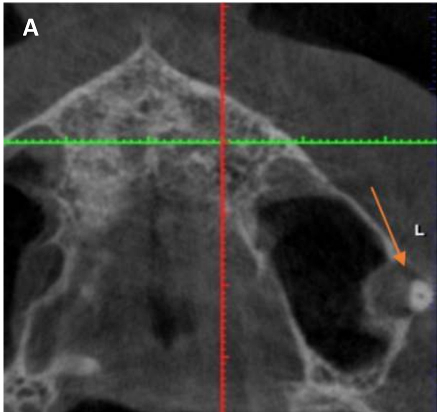
A year after retreatment, in July 2021, the patient came to our dental practice for a check-up. The fistula has never been resolved and occasionally continued reappearing. Fistula opening was not present during this visit, but we palpated an enlarged lesion on the alveolar bone in the same area. We assumed it was an abscess connected to tooth 27. But before extracting tooth 27, we decided to take a CBCT scan, as we were planning to replace it with an implant in the following time. What surprised us at the CBCT scan was a massive bone loss in the area apical and distal to the tooth 27 (**Figure 3.**). CBCT scans showed a fragment of a tooth root in the same area, which was never present on our intraoral radiograms or OPG. We assumed that bone loss and the present fistula might be connected to a radix relicta. After being informed of our findings, the patient remembered complications during tooth 26 extraction. The tooth fractured during extraction, and the prior dentist couldn't find, nor extract the fragmented root. After taking many intraoral radiographs and searching for fragmented root, it was, somehow, lost in dental alveoli. It wasn't visible on two-dimensional radiographs, as it was superpositioned by the roots of tooth 27. At that time, no CBCT scans were made. The previous dentist concluded that tooth 26 had only 2 roots.

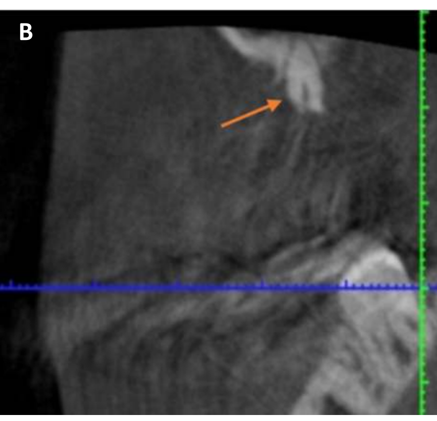
Understanding teeth morphology is essential for succes in most dental procedures, including teeth extractions. Presence of two-rooted maxillary first molars has rarely been reported in studies. This tooth typically has three roots. Some reports present first maxillary molars with buccal roots fusion, which is very rare. A total of 0,4% first maxillary molars have been reported to have this variation.[3]

We decided to surgically remove the radix relicta of the tooth 26 along with lesion next to it and give one more chance to tooth 27.

The patient's fourth visit

After elevating mucous flap distally and apically of tooth 27, root fragment of tooth 26 appeared in alveolar bone. It was surrounded by a massive amount of fibrous tissue and granulations (**Figure 4.**). No lesion around mesial, nor distal root of





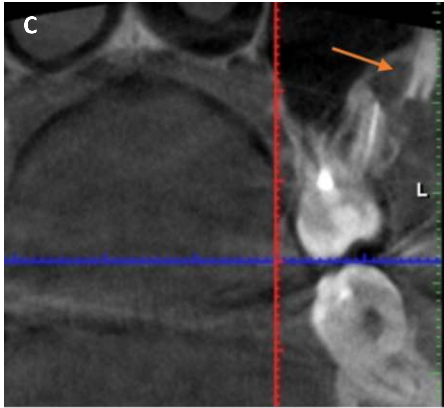


Figure 3. CBCT scans A- axial section, B – sagittal section, C – coronal section. Radix relicta of tooth 26 is present on all three sections, massive bone loss in the area.

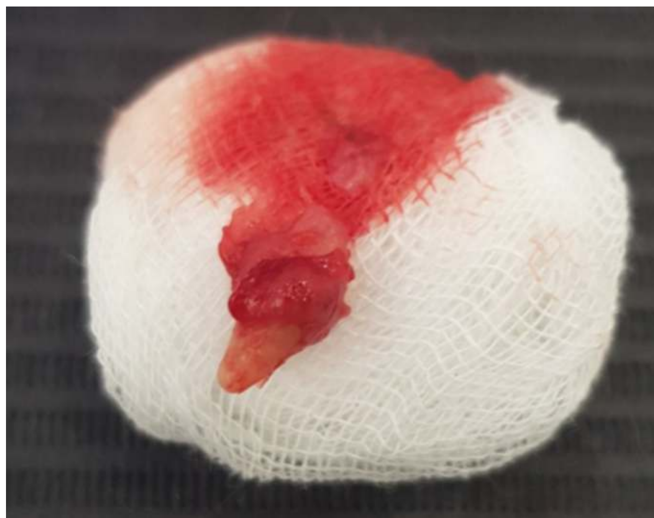


Figure 4. Removed radix relicta with adjecent lesion

tooth 27 were found, and bone loss was massive after removing the root fragment and lesion around it.

Two months follow-up

The intraoral fistula disappeared and resolved completely. No tumefaction was present when palpating vetibular area of the alveolar bone. We are expecting complete healing and bone formation in this area. Tooth 27 is still asymptomatic, and we decided not to extract it, as it wasn't the cause of intraoral fistula.

Discussion

A dentoalveolar fistula is a pathological pathaway between alveolar bone and thee oral cavity.4 In rare cases, it can manifest as a cutaneous fistula. They mostly occur as a result of infected cysts, mandibular or maxillary fractures, periodontal inflammation, necrotic teeth, and trauma. But the most common causes are pulpal necrosis and apical periodontitis.[5] Necrotic teeth and failed root canals become a potential site of bacterial colonization. Infection spreads into the periapical area of alveolar bone, resulting in apical periodontitis. Infection follows the path of least resistance in the bone and soft tissue. The location of muscle attachments and the position of root tips determine the location of the fistula opening to the surface of oral mucosa or face skin.[4]

Generally, diagnosis of the dentoalveolar fistula is not challenging, but they can be misdiagnosed in rare cases. To determine the fistula's origin, clinicians usually use periapical intraoral radiographs od panoramic radiographs. The amount of information obtained from intraoral and panoramic radiographs is limited due to compression of the three-dimensional anatomy structures being radiographed into a two-dimensional image. Some pieces of information are lost in this process and the image has a lower diagnostic value. Limitations of two-dimensional radiography techniques are overcome with three-dimensional imaging using Cone Beam Computed Tomography (CBCT). Therefore, in some cases, panoramic and periapical radiographs can be insufficient and CBCT should be considered.

CBCT is a three-dimensional extraoral imaging system specially developed for oral and maxillofacial radiography. CBCT provides undistorted images free from the superimposition of anatomy structures. It offers accurate three-dimensional visualization of anatomic and pathological structures and helps with detection of root fractures, root resorptions, periapical radiolucencies etc.[6]

In our case, we misdiagnosed the origin of the infection due to a lack of information on two-dimensional radiographs. After a one-year follow-up and failure of fistula to resolve, we took a CBCT scan to visualize infection more precisely. Periapical lesion and odontogenic fistula didin't originate from endodontically retreated tooth 27, but from infected radix relicta of tooth 26 after a failed extraction.

After adequately diagnosing the infection origin, treatment was simple. We surgically removed radix relicta with adjecent infection. The infection finally healed and the fistula disappeared.

Conclusion

Diagnostic accuracy is essential for endodontic treatment success, and the correct menagment of information obtained from the patient's history, clinical examinations and complementary test results poses a great challenge.

When dealing with complicated cases in endodontics, two-dimensional retroalveolar and panoramic radiographs are often insufficient. Therefore, clinicians can always rely on three-dimensional CBCT radiographs as this radiographic method is the best alternative. The use of cone beam computed tomography in dentistry is rapidly increasing. Units with small field of view offer high-resolution images of teeth and related structures and are, therefore, recommended when two-dimensional systems fail to provide sufficient information.[1] In recent years, CBCT devices became widely available and commonly used for many clinical indications. However, CBCT is still a form of CT adopted to maxillofacial imaging. The amount of patient exposure dose remains important question. Despite CBCT doses being lower from conventional CT, they are still significantly higher than those from conventional dental radiography. CBCT deliveres a 5-16 times higher dose to a patient than a typical panoramic radiograph. When CBCT imaging is preffered over other conventional techniques, it is imperative that it is fully medically justified so that patients are not exposed to unnecessary radiation.

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Declaration of interest

Author declares that there is no conflict of interest.

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