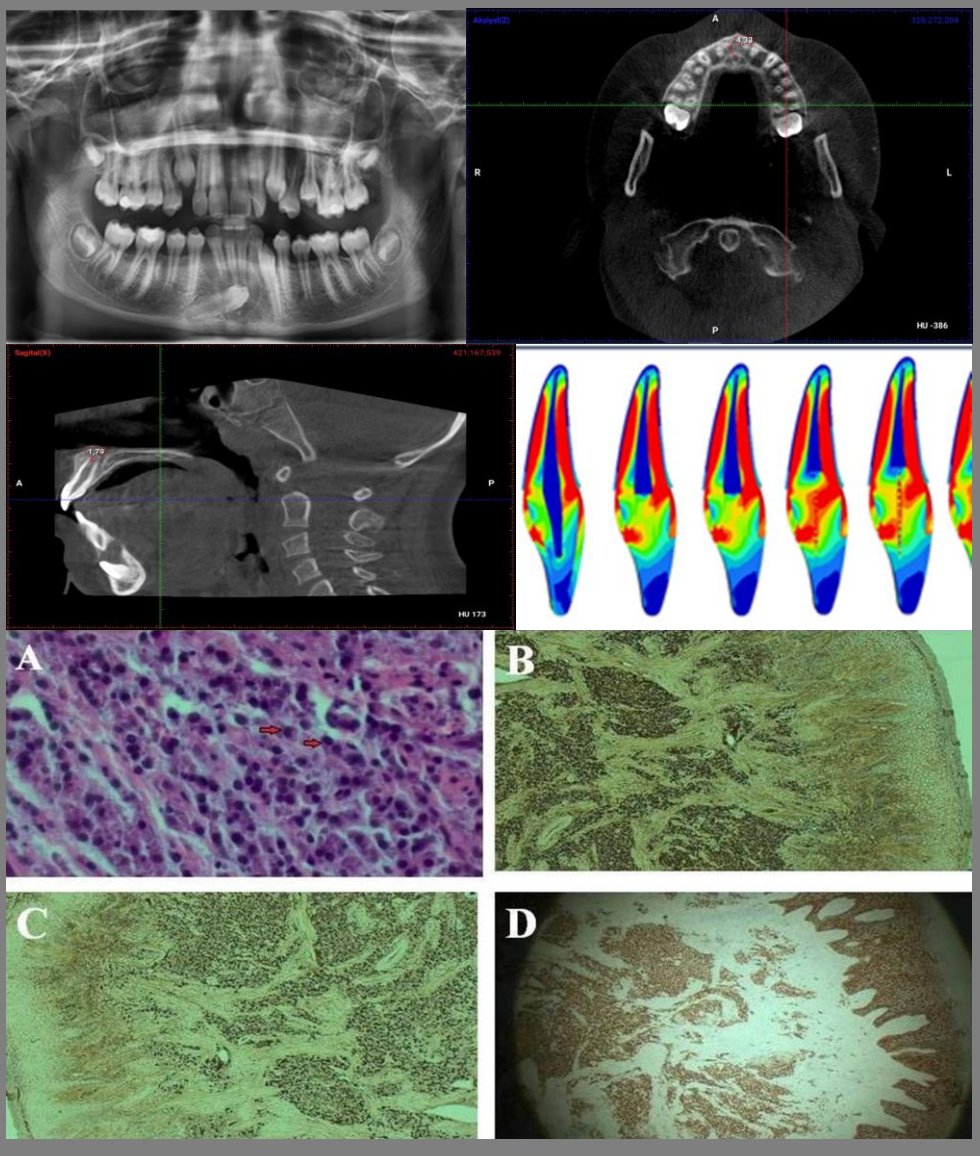
2023

HRU INTERNATIONAL JOURNAL OF DENTISTRY AND ORAL RESEARCH (IJDOR) - HRÜ ULUSLARARASI DİŞ HEKİMLİĞİ VE ORAL ARAŞTIRMALAR DERGİSİ

HRU IJDOR 2023; 3(2)



HRU International Journal of Dentistry and Oral Research dergisi (ISSN: 2792-0224), Harran Üniversitesi Diş Hekimliği Fakültesi'nin resmi yayın organıdır 28.08.2023

H RU International Journal of Dentistry and Oral Research

HRÜ Uluslararası Diş Hekimliği ve Oral Araştırmalar Dergisi
HRU International Journal of Dentistry and Oral Research
HRU IJDOR 2023; 3(2)

Table of Contents 2023 Vol.3–No.2

HRÜ Uluslararası Diş Hekimliği ve Oral Araştırmalar Dergisi
HRU International Journal of Dentistry and Oral Research
HRU IJDOR 2023; 3(2)

Received date: 25 March 2023 / **Accept date:** 13 June 2023
DOI: 10.61139/ijdor.1270887

Evaluation of Individual Noise Exposure in a Faculty Prosthodontic Clinic and Laboratory During the Post Covid-19 Pandemic

H.Yasemin Yay Kuscu[1*], Adnan Karaibrahimoglu[2], Zuhal Gorus[1]

1. Harran University, Faculty of Dentistry, Prosthodontic Department, Sanliurfa, Turkey.
2. Suleyman Demirel University, Faculty of Medicine, Biostatistics and Medical Informatics Dept, Isparta, Turkey.

***Corresponding author:** Kuscu HYY, MSc. PhD, Department of Prosthodontic, Faculty of Dentistry, Harran University, Şanlıurfa, Turkey.
E-mail : yaseminyay123@gmail.com

Abstract

Objective: Noise is one of the issues brought on by modern technologies. Because of the technology they employ, some occupational groups are more affected by noise. The COVID-19 pandemic has caused significant changes in healthcare around the world, such as dental clinics and prosthodontic laboratories were also affected by this change. The working circumstances in prosthodontic dental clinic and prosthodontic laboratories underwent numerous adjustments included reducing the number of patients, tightening hygiene protocols and obediencing distance rules during the pandemic process. However, some factors, such as individual noise exposure, are still overlooked or not sufficiently taken into account. This study was conducted during post COVID-19 pandemic in a faculty prosthodontic clinic and laboratory to assess the individual noise sensitivity of academician dentists, dentistry interns, and laboratory technicians to see if the levels of noise were significant enough to pose a health danger.

Materials and Methods: In February-March 2023, a noise assessment was conducted to evaluate the noise levels in a faculty prosthodontic clinic and a single dental laboratory. During 8-hour work periods, five specific sound level meters (Cesva DC 112, Spain) were put on the collars of academician dentists, dentistry interns, and laboratory technicians to assess individual noise sensitivity.

Results: This study involves 74 persons, including 4 academician dentists, 60 dentistry interns, and 10 laboratory technicians. In terms of Leq and Lex-8 hour noise sensitivity, there was a statistically significant difference between the groups ($p<0.05$). The average maximum (Leq) sound level among academician dentists was 73.50±0.67 decibels, 75.14±3.41 decibels for dentistry interns, and 84.64±9.12 decibels for laboratory technicians.

Conclusion: Working in areas divided by screens with clinical regulations after the COVID-19 pandemic has relatively reduced individual noise exposure that were slightly below the occupational exposure limits (85dBA) for academician dentists, dentistry interns, excluding dental technicians who were exposed to noise levels, suggesting that they are at risk for hearing impairment. Additional measures are recommended for these groups working in the prosthodontic clinic.

Research Article (HRU Int J Dent Oral Res 2023; 3(2): 65-69

Keywords: Noise exposure evaluation, Noise in a dental laboratory, Noise in a prosthodontic clinic, Health and safety, Risk assessment, Post Covid-19 Pandemic.

Received date: 25 March 2023 / Accept date: 13 June 2023
DOI: 10.61139/ijdor.1270887

Introduction

Noise is defined as an uncomfortable and unwanted sound, and it is the product of sound waves consisting of rapid vibrations in the air. Dentists and dental laboratory technicians are exposed to the noise in the working environment throughout the day. The resulting noise affects dentists, dental laboratory technicians and the efficiency of the work when conducting noise-generating operations such as tooth preparations, model trimming, operating with a micromotor. As the exposure level increases and the duration is extended, noise can cause temporary or permanent loss of hearing (1,2).

Although the exposure to workplace noise was below the limit, the detrimental effects of working performance, physiological and psychological conditions and a self-reported state of health on people in the area would be caused by poor noise quality. It was also found that the negative symptoms of sleep disorders, exhaustion, headache, frustration, discontent with life, hypertensive heart disease, and tinnitus were correlated with exposure to noise (3–5).

The unit of measure for noise or sound intensity is decibels (dB). The lowest sound that the human ear can hear is called the "hearing threshold". The hearing threshold sound intensity is 0 (zero) dB. "Pain threshold" indicates the value that the ear can not withstand greater sound intensity, which is 140 dB (4,6).

The exposure action and exposure limit values for workers are seen in the Noise Legislation*, which came into force when it was published in Official Gazette No. 28721 and 28 July 2013, respectively (7) (Table 1).

Table 1. Exposure limit values and exposure action values defined in the noise legislation

Current levels of limits	dBA/Leq	dBC/Lpeak
Lower exposure action values	80 daily/weekly	135 daily/weekly
Upper exposure action values	85 daily/weekly	137 daily/weekly
Legal limit	87 daily/weekly	140 daily/weekly

"Three physical parameters used as risk predictors are added by noise legislation*:

a) Peak sound intensity (L peak): refers to the peak value of the instantaneous noise pressure weighted by c-frequency.
b) Daily noise exposure level (Lex, 8h) (dBA re. 20 µPa): time-weighted average of noise exposure levels as specified by ISO 1999:1990 (International Organization for Standardization) for a nominal eight-hour working day. It includes all sounds, including impulsive noise, present at work.
c) Weekly exposure level to noise (Lex, W): time-weighted average daily exposure level to noise for a nominal week of five days of eight-hour working as specified by the ISO 1999:1990.

Minimum and maximum equivalent sound pressure level (Leq): defined as a steady constant noise level with total acoustic energy comparable to that of fluctuating concrete noise over a similar period of time" (8).

The Leq and L peak are measured simultaneously by most modern sound level meters and dosimeters. Noise measurements have been conducted in dental clinics and laboratories in various studies when dealing with different brand handpieces and different users in the same setting, and the noise level has been reported to be in the range of 60-99 decibels. The noise threshold value is stated to be similar to the risk of hearing loss (5,8–12).

The World Health Organization stated in the statement on hearing loss published in 2004 that noise below 25 dB will not cause any hearing impairment, noise between 26-40 dB may cause slight hearing impairment, 41-60 dB noise will cause moderate hearing impairment, 61-80 dB noise will cause severe hearing impairment, and 81 dB and above will cause profound hearing impairment including deafness (13).

Coronavirus disease (COVID-19), first identified in China in 2019, spread rapidly around the world and was accepted as a pandemic. Coronavirus 2 (SARS-CoV-2), which causes severe acute respiratory syndrome and causes Coronavirus disease (COVID-19), has spread to 216 countries. The COVID-19 pandemic has posed a significant challenge to healthcare systems as it spread rapidly, exceeding hospital capacity, and putting healthcare workers at high risk of exposure. As part of the new infection control policies, to reduce the risk of exposure and transmission to COVID-19, prosthetic procedures were performed within a specific area, with the distance between patients divided by 2 m in all clinical settings.

When the literature is reviewed, it has been reported that there are a limited number of studies evaluating individual noise exposure in an 8-hour working day in the post-COVID-19 pandemic period. The purpose of this research is to measure the amount of individual noise produced in a prosthodontic dental clinic and laboratory during the post-pandemic period.

The null hypothesis was that there would be no differences in key parameters of Leq, Lex-8 hour and L peak values that affect the individual noise exposure

Received date: 25 March 2023 / **Accept date:** 13 June 2023
DOI: 10.61139/ijdor.1270887

among academician dentists, dentistry interns and dental laboratory technicians.

Material and Methods

The ethical comitte of the Harran University granted the study the necessary ethical permission (HRU/23.02.26/23.01.2023). The respondents had to fulfill the following inclusion requirements in order to be qualified for participation. The following qualifications were working in a prosthodontic dental clinic throughout the study's defined time frame of February 2023 to 17 March 2023, using prosthodontic dental services at the aforementioned clinics during the study, and giving informed consent to participate in the study by answering "Yes" were all inclusion criteria.

In a prosthodontic dental clinic and a laboratory, noise level tests were conducted. The level of noise was measured by a sound level meter with a microphone (Cesva DC 112, Spain). The sound level meter responds to sounds close to the human ear and provides an objective measurement of sound levels that can be replicated. The sound level is measured in decibels (dB) on the A-scale, which has been developed to simulate the reaction of the human ear to the harmful impact of noise and is therefore required to assess the risk of hearing loss worldwide. 4 academician dentists, 60 dentistry interns and 10 laboratory technicians were among the participants who voluntarily agreed to carry a sound level meter during working hours. Individual noise measurements were taken over 3 weeks with 5 noise level meters and individual exposure values were determined.

At the prosthodontic dental clinic, the sound level meter's microphone was put on the academician dentist's and dentistry intern's collar at a distance of 15 cm from the ear. The noise level was similarly measured in the dental laboratory.

Before and after the noise exposure measurements, the sound level meters were calibrated. Over a 5-second interval, the noise was measured and the noise intensity in decibels was reported.

On the same day, 3 different values were obtained in noise measurements made according to task-based measurement strategy (Leq). At the same time intervals, L peak values were measured. As a result, Lex 8-hour personal exposure measurements were recorded.

The mean value of Leq (equivalent to the constant sound level at a particular time interval) and L (peak) (highest value) has been calculated and the total value has been registered.

Statistical Analysis

Using SPSS 20.0 (IBM Inc, Chicago, USA) with a significance level of 5 percent, the data were collected, tabulated and statistically analyzed. For numerical variables, descriptive statistics were described as mean ±standard deviation and for categorical variables as frequency (percentage).

Compliance of numerical variables to normal distribution was checked by the Kolmogorov-Smirnov test. However, due to the insufficient number of observation in the academician and laboratory group, non-parametric comparison methods were used. Kruskal-Wallis analysis and post hoc test were preferred for comparison of the groups. Significant comparison results are shown with the different letters.

Results

A total of 74 participants, including 4 academician dentists, 60 dentistry interns and 10 dental technicians participated in this study. Of the 74 participants, 42 (56.8%) were women and 32 (43.2%) were men (Table 2).

Table 2. The number and percentage of distribution of participants

Comparison Groups	Number of Tested Subjects	Percentage
Academician Dentists	Female(4)	5.41
	Male(0)	0
Dentistry Interns	Female(35)	47.30
	Male(25)	33.78
Dental Laboratory Technicians	Female(3)	4.05
	Male(7)	9.46
Total	74	100.0

In terms of Leq and Lex 8 hour noise measurement data, a statistically significant difference was found between academician dentists and dental laboratory technicians ($p<0,001$). Similarly, in terms of Leq and Lex

Received date: 25 March 2023 / **Accept date:** 13 June 2023
DOI: 10.61139/ijdor.1270887

8 hour noise measurement data, a statistically significant difference was found between dentistry interns and laboratory technicians (p<0,001).

Table 3. The mean, standard deviation (SD) values and results of one way ANOVA test for comparison of noise level among dentists, dentistry interns and dental laboratory technicians

	Academician Dentists (n:4) Mean±SD (median; min-max)	**Dentistry interns (n:60) Mean±SD (median; min-max)**	**Dental Laboratory Technicians (n:10) Mean±SD (median; min-max)**	**P**
Leq dBA	73.50±0.67 **a** (73.40;72.93-74.18)	75.14±3.41 **a** (74.50; 72.43-78.25)	84.64±9.12 **b** (84.00; 75.83-93.73)	<0.001 *
Lex 8 hour	73.68±1.09 **a** (73.45; 72.78-74.80)	75.26±3.40 **a** (74.75; 72.20-78.55)	84.84±9.27 **b** (84.00; 75.83-93.85)	<0.001 *
L Peak	120.10±2.80 **a** (120.60; 117.18-122.45)	126.01±8.10 **a** (124.40; 119.70-132.18)	131.00±14.66 **a** (129.60; 119.68-140.70)	<0.106

***:** Significant at P ≤ 0.05, Different superscripts are statistically significantly different
Significant at 0,05 level according to Kruskal-Wallis pairwise test

The results displayed in Table 3 demonstrate that the average equivalent sound pressure level (Leq) recorded during measurement ranged between 73.50±0.67 dBA among academician dentists, 75.14±3.41 dBA among dentistry interns and 84.64±9.12 dBA among dental technicians, and the median of the Leq was ranged between 73.40-84.00 dBA.

During the 8-hour working period, the highest noise level was found to be 74.80 dBA among dentists, 78.55 dBA among dentistry interns and 93.85 dBA among dental technicians.

Among the participants, academician dentists and dentistry interns measured values close to a noise exposure level of 85 dB, which is the allowable noise exposure limit during the 8-hour working period determined by the National Institute of Occupational Safety and Health, while values above the limit value were measured in the dental laboratory technicians group.

Discussion

This research was designed to determine personal sensitivity to dental device-generated noise and to take action if noise is detected above thresholds. Noise has been listed by the National Institute for Occupational Safety and Health as one of the leading causes of temporary or permanent hearing loss. The highest value for sensitivity to noise over an 8-hour working day has been recorded to be 85 dB. In dental clinics such as dental high-speed generators, Kilpatrick (3) suggested a range of sounds that could be dangerous to the hearing of dentists. The noise level in 89 dental clinics was calculated by Mojarad (10) et al. in a report. They found that in dental clinics, the highest sound level was 85.8 dB. They concluded that the maximum level of noise in dental clinics is very close to the limit of hearing loss, often below the noise level that harms the human ear (85dB).

In the present research, the equipment (Cesva DC 112, Spain) used to measure sound levels calculates the sound pressure level (in dB) by reflecting the ear's frequency response. This equipment calculates the measurement of A-weighted sound [dB(A)], the architecture of which mimics the human ear's reaction. Since human hearing responds to all frequencies differently, sound measured in frequency bands may be A-weighted or changed to account for the estimated frequency dependence of human hearing. The microphone of the sound level meter has been positioned 15 cm away from the participant's ear in this research that responds to sound in the same way as the human ear and offers objective, reproducible measurement of sound levels (2,10).

Noise levels were measured at 76.6 dB in the dental clinic and 87.2 in the prosthodontic laboratory, according to results from a study conducted by Singh et al.(12). In comparison, Choosong et al. (13) obtained noise levels of 58-66 dBA in one of the dental school in Thailand and concluded that this dental personnel were exposed to noise intensities lower than that causes hearing loss, but it can cause discomfort, conversation interruption and focus difficulty. Similar to these studies, in our study, noise levels were found to vary between 73.50 and 84.00 dBA.

In the Burk & Neitzel noise research (5), using partial or full-shift Time-Weighted Average (TWA) dosimetry measurements on 46 individuals, Leq interval levels of 3.75 min were found to range from 63.6 to 103.5 dBA. In the present research, 5-second interval Leq levels were ranged from 73.50±0.67 to 84.64±9.12 dBA. In the post-COVID-19-pandemic period, the difference in

Received date: 25 March 2023 / **Accept date:** 13 June 2023
DOI: 10.61139/ijdor.1270887

the measurement distance and the procedures performed, the difference in the number of people participating in our sample, and the difference in the measurement time of exposure to noise may be the explanation for our results being different from this research.

Sampaio Fernandes and his colleagues (5), measured the noise levels of dental equipment only turned on and during cutting operations in the range of 60-99 dB for dental student clinic and laboratory. The sound levels detected 73.68±1.09 dB for academician dentists and 84.84±9.27 dB for dental laboratory technicians in our study were similar to this study.

In this research, the personal noise exposure resulting in different clinical and laboratory work has been measured. The disparity in noise levels can be due to the use of different instruments for different periods of time in prosthodontic applications.

The level of noise exposure among academician dentists was slightly lower than among dentistry interns and significantly lower than laboratory technicians ($p<0.01$) because academician dentists used brand new turbines and rarely used the maximum speed of their handpieces during dental treatments.

The noise regulation published in 2003 in our country and the European legislation restricted exposure to everyday noise to 85 dB (4). During the Covid-19 pandemic, working in areas divided by screens has relatively reduced the individual noise exposure of academician dentists and dentistry interns. According to the results of this research, the noise exposure of academician dentists, dentistry interns and dental laboratory technicians is below 85 dBA, but according to the article issued by the World Health Organization in 2004, the academician dentists and dentistry intern groups are close to serious hearing risk values. The laboratory technician group is in danger of serious hearing loss and even deafness.

Conclusion

This research revealed that during post COVID-19 pandemic, academician dentists, dentistry interns and dental laboratory technicians were exposed to noise values close to the noise values measured in previous studies during their dental practice, even when working in areas divided by screens. The null hypothesis was partially rejected because there was no statistically significant difference between the groups in L peak values ($p<0.106$). The average noise levels (standard deviation) (Leq) for academician dentists, dentistry interns and laboratory technicians were 73.50±0.67 dBA, 75.14±3.41 dBA, 84.64±9.12 dBA respectively and Lex 8 hour noise measurement values were evaluated for academician dentists, dentistry interns and laboratory technicians were 73.68±1.09 dBA, 75.26±3.40 dBA, 84.84±9.27 dBA respectively ($p<0.01$). No significant differences were observed between academician dentists and dentistry interns across occupational groups, and noise levels were below the occupational exposure limits (85 dBA), but dental technicians were significantly close to the exposure threshold and therefore at risk for hearing loss. Laboratory workers were informed and warned about the use of hearing protection equipment.

References

1. Gurbuz M K, Çatli T, Cingi C, Yaz A, Bal C. Occupational safety threats among dental personnel and related risk factors. Journal of Craniofacial Surgery. 2013;24(6):599-02.
2. Goswami M, Singh D, Vashist B, Marwaha S. Noise levels and sound pollution associated with various operative procedures and equipments in a pediatric dental environment-A clinical study. Journal of Oral Biology and Craniofacial Research. 2017;7(3):182-1.
3. Ma K W, Wong H M, Mak C M. Dental environmental noise evaluation and health risk model construction to dental Professionals. Int J Environ Res Public Health. 2017;14(9):1084.
4. Kilpatrick H C. Decibel ratings of dental office sounds. J Prosthet Dent. 1981;45(2):175-8.
5. Sampaio Fernandes J C, Carvalho A P O, Gallas M, Vaz P, Matos P A. Noise levels in dental schools. European Journal of Dental Education. 2006;10(1):32-7.
6. Başak S S, Başak S. Diş hekimlerini etkileyebilecek fiziksel risk etmenleri. GÜSBD. 2018;7(1):184-92.
7. Regulation on the protection of employees from noise-related risks (internet). Official gazette no: 28721. 2013 July 28. available from: https://www.resmigazete.gov.tr/eskiler/2013/07/20130728-11.htm. [Last accessed on 2020 Dec 09].
8. Ahmed H O, Ali W J. Noise levels, noise annoyance, and hearing-related problems in a dental college. Archives of Environmental & Occupational Health. 2017;72(3):159-5.
9. Kadanakuppe S, Bhat P K, Jyothi C, Ramegowda C. Assessment of noise levels of the equipments used in the dental teaching institution, Bangalore. Indian J Dent Res. 2011;22:424-1.
10. Leonard D L, Charlton D G. Performance of high-speed dental handpieces subjected to simulated clinical use and sterilization. The Journal of the American Dental Association. 1999;130(9):1301-1.
11. Ai Z T, Mak C M, Wong H M. Noise level and its influences on dental professionals in a dental hospital in Hong Kong. Building Services Engineering Research & Technology. 2017;38(5):522-5.
12. Dutta A, Mala K, Acharya S R. Sound levels in conservative dentistry and endodontics clinic. J Conserv Dent. 2013;16:121-5.
13. World Health Organization. Occupational noise: Assessing the burden of disease from work-related hearing impairment at national and local levels. World Health Organization; Geneva, Switzerland: 2004. Environmental Burden of Disease Series, No.9.

Oral and Dental Health Habits and Approaches to Dental Treatment of Pregnants in a Turkish Subpopulation: A Survey Study

Katibe Tuğçe Temur[1*] , İsa Temur[2]

1. Niğde Ömer Halisdemir University, Faculty of Dentistry, Department of Oral and Maxillofacial Radiology, Niğde,Türkiye
2. Niğde Ömer Halisdemir University, Faculty of Medicine, Department of Obstetrics and Gynecology, Niğde, Türkiye.

***Corresponding author:** Temur KT., MDS. DDS.., Ass. Prof., Department of Oral and Maxillaofacial Radiology, Faculty of Dentistry, Niğde Ömer Halisdemir, Niğde,Turkey
E-mail: tugce.uzmez@hotmail.com .
DOI : 10.61139/ijdor.1303238

Abstract

Objective: In this study, we aimed to evaluate the oral and dental health habits of pregnant women in the Central Anatolian region and their approaches to dental treatments.
Methodology: This study was conducted in 293 randomly selected pregnant women who applied to the obstetrics and gynaecology outpatient clinic for pregnancy control and volunteered to participate in the study. The questionnaire was administered face-to-face after obtaining informed consent form from the pregnant women. The comparison of the answers to the questions according to age, education, and income was made with the chi-square test. The significance is $p<0.05$.
Results: 120 (41%) of the pregnant women reported that they rarely brushed their teeth, while 281 (95.9%) reported that they did not have any additional oral hygiene habits. 218 (74.4%) of the pregnant women reported that they did not go to the dentist during pregnancy and 251 (85.7%) of the pregnant women did not refer them to the dentist by the obstetrician and gynaecologist. There was a significant difference between income and education in tooth brushing frequency ($p<0.05$). There is a statistical difference according to the income level and education level of answering questions correctly about oral and dental health during pregnancy ($p<0.05$). The rate of going to the dentist and using dental floss while planning pregnancy was higher in the age group of 26-43 ($p<0.05$).
Conclusion: In this study, it was determined that the oral and dental hygiene habits of the pregnant women were not sufficient and they avoided dental treatment. In addition, it was observed that gynaecologists and obstetricians did not sufficiently refer women and pregnant women to the dentist. Training must be organized for pregnant women in the region in terms of oral and dental health and dental treatments during pregnancy.

Research Article (HRU Int J Dent Oral Res 2023; 3(2): 70-78

Keywords: Pregnant, oral and dental health, dental treatment.

Introduction

Hormonal and physiological changes during pregnancy cause systemic effects as well as changes in the oral cavity (1). In healthy pregnancies, physiological changes in the mother increase the maternal susceptibility to infectious diseases, including periodontal diseases (2). In addition to physiological changes during pregnancy, factors such as hormonal changes, inadequate oral care, changes in diet, changes in oral PH, suppression of the immune system can also impair or worsen the mouth and teeth (3). With the increase of estrogen and progesterone during pregnancy, it causes inflammation changes in gingival tissues and microbiological changes in subgingival tissues(4). Gingival bleeding, swelling, redness and pain during pregnancy differ by the trimesters (5). When the periodontal status of pregnancy is evaluated according to the trimesters and postpartum, the plaque level does not change during pregnancy, but the gingival index is at the highest in the third trimester during pregnancy, but it decreases in the third month postpartum (6). Maternal oral health during pregnancy is associated with infant oral health (7).

In the literature, it is reported that periodontal inflammation can be associated with negative pregnancy outcomes in the pregnant women such as preterm birth (8). Dental treatments and good oral care prior to and during pregnancy aim to provide an ideal oral health in

pregnant women (9). However, it is a well-known fact that preventive dental practices in developing countries such as Turkey are not a priority (10).

It is important for pregnant women to have information about oral and dental hygiene to prevent negative pregnancy outcomes that may be caused by poor oral and dental health. The attitudes of gynaecologists and obstetricians also have an influence on the oral health behaviour of mothers. Keeping the maternal oral and dental health at an optimum level helps to protect the oral health of the mother and newborn.

We aimed to examine oral hygiene habits and approaches to dental treatments during pregnancy in the Central Anatolia Region.

Material and Method:

This is a cross-sectional survey study. The study was obtained from the local ethics committee. (2023/10)

The study was conducted with randomly selected pregnant women who applied to Niğde Ömer Halisdemir University Research Hospital Gynecology and Obstetrics Polyclinic for checkups during pregnancy and volunteered to participate in the study.

The questionnaire was prepared by the specialist dentist (K.K.T) taking into account the existing literature (10). The questionnaire consists of questions about socio-demographic characteristics, gestational age, oral hygiene habits, level of knowledge about oral-dental health and pregnancy outcomes, going to the dentist and referral to the dentist. (Table-1) The questionnaire was administered face-to-face after obtaining informed consent form from the pregnant women.

Statistical analysis

Jamovi (Version: 2.3.21) was used in the statistical analysis. The answers were analyzed using the descriptive statistics. The answers were compared by age, education and income with the chi-square test. The significance was $p<0.05$.

Table-1: Survey

1. Gender: …… ……
2. Age: … …… ……
3. Monthly income:… ……. …….
4. Gestational age:… ……
5. Are you brushing your teeth?
   A. Yes B. No
6. Do you use dental floss?
   A. Yes B. No
7. Do you use mouthwash?
   A. Yes B. No
8. Do you smoke?
   A. Yes B. No
9. Do you drink alcohol?
   A. Yes B. No
10. Do you drink coffee often?
    A. Yes B. No
11. Do you know that cavities (tooth decay) and gum disease are caused by infection in the mouth?
    A. Yes B. No
12. Do you think that poor oral health will have a negative effect on pregnancy?
    A. Yes B. No
13. Do you think that poor oral health will have a negative effect on the baby?
    A. Yes B. No
14. Did you go to the dentist during pregnancy?
    A. Yes B. No
15. Do you have dental treatment during pregnancy?
    A. Yes B. No
16. Did you go to the dentist while planning a pregnancy?
    A. Yes B. No
17. Does bleeding gum increase during pregnancy?
    A. Yes B. No
18. Do your gums bleed when brushing teeth after conception?
    A. Yes B. No
19. Has your gynecologist suggested you go to the dentist?
    A. Yes B. No

Result

The sociodemographic characteristics of the participants are given in Table 2. 218 (74.4%) of the pregnant women reported that they did not go to the dentist during pregnancy and 231 (78.8%) reported that they did not undergo dental treatment during pregnancy. On the other hand, 20 (6.8%) of the pregnant women reported that they went to the dentist while planning pregnancy but 251 (85.7%) reported that they were not referred by the gynaecologist and obstetrician to the dentist before pregnancy. (Table 2-3)

120 (41%) of pregnant women reported they rarely brush their teeth, 10 (3.4%) reported flossing and 21 (7.2%) reported using mouthwash. 26 (8.9%) of the pregnant women were smokers. 197 (67.2%) of the pregnant women reported that caries and gum diseases were caused by mouth infection. 79 (27%) of the pregnant women believed that poor oral and dental health had a negative effect on the maternal and infant health. 205 (70%) of the pregnant women reported that gingival bleeding increased during pregnancy. (Table 2-3)

Table 2. Demographic characteristics of the participants

Characteristic	N = 293
Age range	
16-25	118 (40%)
26-43	175 (60%)
Monthly Income	
<5000	164 (56%)
5000-10000	63 (22%)
>10000	66 (23%)
Education level	
Primary education	152 (52%)
High school	79 (27%)
University	62 (21%)
Trimester	
1st trimester	83 (28%)
2nd trimester	87 (30%)
3rd trimester	123 (42%)

n (%)

There was a significant difference between the age groups in terms of flossing, frequent coffee consumption and going to the dentist while planning pregnancy ($p<0.05$). The group that used dental floss at the highest level and consumed coffee frequently and went to the dentist while planning pregnancy was the age group of 26-43. The lowest rate in all three factors was recorded in the age group of 16-25. No significant difference was found in terms of other questions ($p>0.05$). (Table 3)

There was a significant difference between incomes in tooth brushing frequency ($p<0.05$). Women in the income group of 10,000 TRY and above reported a considerably lower tooth brushing frequency compared to other groups and they formed the group with the highest tooth brushing frequency with twice a day. There was a significant difference in the answers given to the question "Do you know that caries (tooth decay) and gum diseases are caused by mouth infection" by income ($p<0.05$). Women in the income group of 10,000 TRY & above answered 'yes' to this question at a higher rate. There was a significant difference in the answers given to the question "Do you think poor oral health will have a negative effect on pregnancy" by income ($p<0.05$). Women in the income group of 5,000 TRY & below answered 'yes' to this question at a lower rate. There was a significant difference in the answers given to the question “Do you think poor oral health will have a negative effect on the baby?” by income ($p<0.05$). Women in the income group of 5,000 TRY & below answered 'yes' to this question at a lower rate. There was a significant difference in the answers given to the question “Did you go to the dentist when you were planning your pregnancy?” by income ($p<0.05$). Women in the income group of 10,000 TRY & above answered 'yes' to this question at a higher rate. There was a significant difference in the answers given to the question “Does gingival bleeding increase during pregnancy?” and "Do your gums bleed when you brush your teeth after conception?" by income ($p<0.05$). Women in the income group of 5,000 TRY & below answered 'yes' to this question at a higher rate. No significant difference was found in the answers given to other questions by income ($p>0.05$) (Table 4).

A significant difference was found in the tooth brushing frequency by the level of education ($p<0.05$). University graduates reported a considerably lower tooth brushing frequency compared to other groups, and they formed the group with the highest tooth brushing frequency with twice a day. There was also a significant difference in the use of dental floss and mouthwash ($p<0.05$). University graduates reported that they used dental floss and mouthwash at a higher level than those in the other groups.

Table 3. Comparison of the answers given to the survey questions about dentistry by age range

	16-25 (N=18)	26-43 (N=175)	Total (N=293)	p value
Toothbrushing Frequency				0.294
rarely	53 (44.9%)	67 (38.3%)	120 (41%)	
one	39 (33.1%)	76 (43.4%)	115 (39.2%)	
2	23 (19.5%)	30 (17.1%)	53 (18.1%)	
>2	3 (2.5%)	2 (1.1%)	5 (1.7%)	
Do you use dental floss?				0.047*
Yes	1 (0.8%)	9 (5.1%)	10 (3.4%)	
No	117 (99.2%)	166 (94.9%)	283 (96.6%)	
Do you use mouthwash?				0.501
Yes	7 (5.9%)	14 (8%)	21 (7.2%)	
No	111 (94.1%)	161 (92%)	272 (92.8%)	
Do you smoke?				0.538
Yes	9 (7.6%)	17 (9.7%)	26 (8.9%)	
No	109 (92.4%)	158 (90.3%)	267 (91.1%)	
Do you drink alcohol?				-
Yes	0 (0%)	0 (0%)	0 (0%)	
No	118 (100%)	175 (100%)	293 (100%)	
Frequent coffee consumption				0.003*
Yes	14 (11.9%)	46 (26.3%)	60 (20.5%)	
No	104 (88.1%)	129 (73.7%)	233 (79.5%)	
Do you know that cavities (tooth decay) and gum disease are caused by infection in the mouth?				0.670
Yes	81 (68.6%)	116 (66.3%)	197 (67.2%)	
No	0 (0%)	1 (0.6%)	1 (0.3%)	
I don't know	37 (31.4%)	58 (33.1%)	95 (32.4%)	
Do you think that poor oral health will have a negative effect on pregnancy?				0.849
Yes	31 (26.3%)	48 (27.4%)	79 (27%)	
No	36 (30.5%)	48 (27.4%)	84 (28.7%)	
I don't know	51 (43.2%)	79 (45.1%)	130 (44.4%)	
Do you think that poor oral health will have a negative effect on the baby?				0.849
Yes	31 (26.3%)	48 (27.4%)	79 (27%)	
No	36 (30.5%)	48 (27.4%)	84 (28.7%)	
I don't know	51 (43.2%)	79 (45.1%)	130 (44.4%)	
Did you go to the dentist during pregnancy?				0.624
Yes	32 (27.1%)	43 (24.6%)	75 (25.6%)	
No	86 (72.9%)	132 (75.4%)	218 (74.4%)	
Do you have dental treatment during pregnancy?				0.777
Yes	24 (20.3%)	38 (21.7%)	62 (21.2%)	
No	94 (79.7%)	137 (78.3%)	231 (78.8%)	
Did you go to the dentist while planning a pregnancy?				0.004*
Yes	2 (1.7%)	18 (10.3%)	20 (6.8%)	
No	116 (98.3%)	157 (89.7%)	273 (93.2%)	
Does bleeding gum increase during pregnancy?				0.574
Yes	93 (78.8%)	133 (76%)	226 (77.1%)	
No	25 (21.2%)	42 (24%)	67 (22.9%)	
Do your gums bleed when brushing teeth after conception?				0.371
Yes	86 (72.9%)	119 (68%)	205 (70%)	
No	32 (27.1%)	56 (32%)	88 (30%)	
Has your gynecologist suggested you go to the dentist?				0.183
Yes	13 (11%)	29 (16.6%)	42 (14.3%)	
No	105 (89%)	146 (83.4%)	251 (85.7%)	

Table 4. Comparison of the answers given to the survey questions about dentistry according to income

	<5000 (N=164)	5000-10000 (N=63)	>10000 (N=66)	Total (N=293)	p value
Toothbrushing Frequency					0.001*
rarely	72 (43.9%)	30 (47.6%)	18 (27.3%)	120 (41%)	
one	69 (42.1%)	19 (30.2%)	27 (40.9%)	115 (39.2%)	
2	18 (11%)	14 (22.2%)	21 (31.8%)	53 (18.1%)	
>2	5 (3%)	0 (0%)	0 (0%)	5 (1.7%)	
Do you use dental floss?					0.056
Yes	5 (3%)	0 (0%)	5 (7.6%)	10 (3.4%)	
No	159 (97%)	63 (100%)	61 (92.4%)	283 (96.6%)	
Do you use mouthwash?					0.136
Yes	11 (6.7%)	2 (3.2%)	8 (12.1%)	21 (7.2%)	
No	153 (93.3%)	61 (96.8%)	58 (87.9%)	272 (92.8%)	
Do you smoke?					0.581
Yes	17 (10.4%)	4 (6.3%)	5 (7.6%)	26 (8.9%)	
No	147 (89.6%)	59 (93.7%)	61 (92.4%)	267 (91.1%)	
Do you drink alcohol?					-
Yes	0 (0%)	0 (0%)	0 (0%)	0 (0%)	
No	164 (100%)	63 (100%)	66 (100%)	293 (100%)	
Frequent coffee consumption					0.103
Yes	27 (16.5%)	14 (22.2%)	19 (28.8%)	60 (20.5%)	
No	137 (83.5%)	49 (77.8%)	47 (71.2%)	233 (79.5%)	
Do you know that cavities (tooth decay) and gum disease are caused by infection in the mouth?					0.013*
Yes	103 (62.8%)	38 (60.3%)	56 (84.8%)	197 (67.2%)	
No	1 (0.6%)	0 (0%)	0 (0%)	1 (0.3%)	
I don't know	60 (36.6%)	25 (39.7%)	10 (15.2%)	95 (32.4%)	
Do you think that poor oral health will have a negative effect on pregnancy?					0.002*
Yes	32 (19.5%)	23 (36.5%)	24 (36.4%)	79 (27%)	
No	54 (32.9%)	9 (14.3%)	21 (31.8%)	84 (28.7%)	
I don't know	78 (47.6%)	31 (49.2%)	21 (31.8%)	130 (44.4%)	
Do you think that poor oral health will have a negative effect on the baby?					0.002*
Yes	32 (19.5%)	23 (36.5%)	24 (36.4%)	79 (27%)	
No	54 (32.9%)	9 (14.3%)	21 (31.8%)	84 (28.7%)	
I don't know	78 (47.6%)	31 (49.2%)	21 (31.8%)	130 (44.4%)	
Did you go to the dentist during pregnancy?					0.069
Yes	38 (23.2%)	13 (20.6%)	24 (36.4%)	75 (25.6%)	
No	126 (76.8%)	50 (79.4%)	42 (63.6%)	218 (74.4%)	
Do you have dental treatment during pregnancy?					0.226
Yes	31 (18.9%)	12 (19%)	19 (28.8%)	62 (21.2%)	
No	133 (81.1%)	51 (81%)	47 (71.2%)	231 (78.8%)	
Did you go to the dentist while planning a pregnancy?					< 0.001 *
Yes	2 (1.2%)	4 (6.3%)	14 (21.2%)	20 (6.8%)	
No	162 (98.8%)	59 (93.7%)	52 (78.8%)	273 (93.2%)	
Does bleeding gum increase during pregnancy?					< 0.001 *
Yes	139 (84.8%)	51 (81%)	36 (54.5%)	226 (77.1%)	
No	25 (15.2%)	12 (19%)	30 (45.5%)	67 (22.9%)	
Do your gums bleed when brushing teeth after conception?					< 0.001 *
Yes	132 (80.5%)	40 (63.5%)	33 (50%)	205 (70%)	
No	32 (19.5%)	23 (36.5%)	33 (50%)	88 (30%)	
Has your gynecologist suggested you go to the dentist?					0.071
Yes	21 (12.8%)	6 (9.5%)	15 (22.7%)	42 (14.3%)	
No	143 (87.2%)	57 (90.5%)	51 (77.3%)	251 (85.7%)	

Table 5. Comparison of the answers given to the survey questions about dentistry according to education

	primary education (N=152)	high school (N=79)	university (N=62)	Total (N=293)	p value
Toothbrushing Frequency					< 0.001 *
rarely	78 (51.3%)	33 (41.8%)	9 (14.5%)	120 (41%)	
one	55 (36.2%)	29 (36.7%)	31 (50%)	115 (39.2%)	
2	17 (11.2%)	15 (19%)	21 (33.9%)	53 (18.1%)	
>2	2 (1.3%)	2 (2.5%)	1 (1.6%)	5 (1.7%)	
Do you use dental floss?					0.004*
Yes	1 (0.7%)	3 (3.8%)	6 (9.7%)	10 (3.4%)	
No	151 (99.3%)	76 (96.2%)	56 (90.3%)	283 (96.6%)	
Do you use mouthwash?					0.007*
Yes	6 (3.9%)	5 (6.3%)	10 (16.1%)	21 (7.2%)	
No	146 (96.1%)	74 (93.7%)	52 (83.9%)	272 (92.8%)	
Do you smoke?					0.211
Yes	16 (10.5%)	8 (10.1%)	2 (3.2%)	26 (8.9%)	
No	136 (89.5%)	71 (89.9%)	60 (96.8%)	267 (91.1%)	
Do you drink alcohol?					-
Yes	0 (0%)	0 (0%)	0 (0%)	0 (0%)	
No	152 (100%)	79 (100%)	62 (100%)	293 (100%)	
Frequent coffee consumption					0.082
Yes	27 (17.8%)	14 (17.7%)	19 (30.6%)	60 (20.5%)	
No	125 (82.2%)	65 (82.3%)	43 (69.4%)	233 (79.5%)	
Do you know that cavities (tooth decay) and gum disease are caused by infection in the mouth?					< 0.001 *
Yes	77 (50.7%)	61 (77.2%)	59 (95.2%)	197 (67.2%)	
No	1 (0.7%)	0 (0%)	0 (0%)	1 (0.3%)	
I don't know	74 (48.7%)	18 (22.8%)	3 (4.8%)	95 (32.4%)	
Do you think that poor oral health will have a negative effect on pregnancy?					< 0.001 *
Yes	22 (14.5%)	29 (36.7%)	28 (45.2%)	79 (27%)	
No	37 (24.3%)	25 (31.6%)	22 (35.5%)	84 (28.7%)	
I don't know	93 (61.2%)	25 (31.6%)	12 (19.4%)	130 (44.4%)	
Do you think that poor oral health will have a negative effect on the baby?					< 0.001 *
Yes	22 (14.5%)	29 (36.7%)	28 (45.2%)	79 (27%)	
No	37 (24.3%)	25 (31.6%)	22 (35.5%)	84 (28.7%)	
I don't know	93 (61.2%)	25 (31.6%)	12 (19.4%)	130 (44.4%)	
Did you go to the dentist during pregnancy?					0.133
Yes	35 (23%)	18 (22.8%)	22 (35.5%)	75 (25.6%)	
No	117 (77%)	61 (77.2%)	40 (64.5%)	218 (74.4%)	
Do you have dental treatment during pregnancy?					0.186
Yes	27 (17.8%)	17 (21.5%)	18 (29%)	62 (21.2%)	
No	125 (82.2%)	62 (78.5%)	44 (71%)	231 (78.8%)	
Did you go to the dentist while planning a pregnancy?					< 0.001 *
Yes	3 (2%)	2 (2.5%)	15 (24.2%)	20 (6.8%)	
No	149 (98%)	77 (97.5%)	47 (75.8%)	273 (93.2%)	
Does bleeding gum increase during pregnancy?					< 0.001 *
Yes	130 (85.5%)	63 (79.7%)	33 (53.2%)	226 (77.1%)	
No	22 (14.5%)	16 (20.3%)	29 (46.8%)	67 (22.9%)	
Do your gums bleed when brushing teeth after conception?					< 0.001 *
Yes	117 (77%)	58 (73.4%)	30 (48.4%)	205 (70%)	
No	35 (23%)	21 (26.6%)	32 (51.6%)	88 (30%)	
Did your obstetrician and gynecologist recommend you to go to the dentist before pregnancy?					0.030*
Yes	20 (13.2%)	7 (8.9%)	15 (24.2%)	42 (14.3%)	
No	132 (86.8%)	72 (91.1%)	47 (75.8%)	251 (85.7%)	

There was a significant difference in the answers given to the questions “Do you know that cavities (tooth decay) and gum diseases are caused by mouth infection?” and “Do you think poor oral health will have a negative effect on the baby?” by the level of education ($p<0.05$). University graduates answered 'yes' to these three questions at a higher rate. There was a significant difference in the answers given to the question “Did you go to the dentist when you were planning your pregnancy?” by the level of education ($p<0.05$). University graduates answered 'yes' to this question at a higher rate than those in the other group. There was also a significant difference in the answers given to the question “Does gingival bleeding increase during pregnancy?” and "Do your gums bleed when you brush your teeth after conception?" ($p<0.05$). University graduates answered 'no' to these two questions at a higher rate ($p<0.05$). There was no significant difference in the answers given to other questions by the level of education ($p>0.05$) (Table 5).

Discussion

In this study, pregnant women reported at a high rate that they did not go to the dentist during pregnancy and avoided dental treatment and the rate of going to the dentist while planning pregnancy was low. In Australia, 30.5% of pregnant women reported going to the dentist in the last 6 months, with more than 50% unaware of the impact of poor oral and dental health on the pregnancy and the infant (11). In Malaysia, 29% of pregnant women went to the dentist (12). A study conducted in the USA indicated that only less than half of the pregnant women went to the dentist during their pregnancy (13). In a study conducted in India, 62.5% of pregnant women reported that dental treatments must be performed before pregnancy and they avoided dental treatments during pregnancy (15). Studies conducted in different regions of Turkey report that the rates of going to the dentist during pregnancy are 12.4% and 28.3% (15,16). Although the rate of going to the dentist during pregnancy and the positive approach to dental treatment in this study is close to the results of some other studies in the literature, this rate seems to be insufficient. The underlying reason may be the low socioeconomic and educational levels of the majority of the pregnant women participating in our study.

The rate of referral of the pregnant women by gynaecologists and obstetricians to the dentist was insufficient. Another current study reports that gynaecologists and obstetricians prohibited the pregnant women from going to the dentist at a high rate (17). A study conducted in France reports that 33.2% of gynaecologists and specialists routinely referred their patients to a dentist and 26.3% provided information about oral and dental health (18). It also reports that 36% and 42% of doctors in California in 2009 and 2012, respectively provided information to the pregnant women about their oral and dental health or referred them to a dentist (19). In the same study, the rate of women who applied to the dentist during pregnancy was 38% in 2009 and 42% in 2012 21. 56% of women in the US state of Virginia reported that they went to the dentist before pregnancy and 47% of women reported having dental treatment during pregnancy(20). A study in India reported that gynaecologists and obstetricians referred very few people (7.97% and 4.92%) to a dentist (21).

The available evidence is that oral and dental health during pregnancy is not a priority and hygiene habits are insufficient (22-23). In this study, 39.2% of pregnant women reported brushing their teeth once a day and 18.1% twice a day, with only 3.4% using dental floss and 7.2% mouthwash. Unlike this study, Kaydırak et al. reported that 83.3% of pregnant women in Turkey had regular tooth brushing habits. They explained that the high rate of regular tooth brushing resulted from the high education level of the participants (23). Kısa et al. obtained similar results. 39.1% of pregnant women reported that they did not brush their teeth regularly during pregnancy, 28.4% brushed their teeth more than once a day, and only 4.4% used additional hygiene products other than toothbrushes for dental hygiene (10).

This study reveals that oral and dental health of pregnant women and having accurate knowledge about negative pregnancy outcomes, infant health and negative effects on oral and dental health increase as the level of income increases. Similarly, pregnant women with high income levels have more regular brushing habits, and pregnant women with low income levels have higher gingival bleeding ($p<0.05$). In the literature, it is reported that the rate of going to the dentist is lower due to lower socioeconomic level (19,24). There was a significant difference in oral health habits and knowledge of pregnant women in different regions in India, which was explained by the difference in education level, economic level and sociocultural factors (25).

In this study, the group that used dental floss at the highest level and consumed coffee frequently and went to the dentist while planning pregnancy was the age group of 26-43. Kısa et al. reported that the rate of women with regular tooth brushing was higher among the women in the age group of 20-29 (10). On the other hand, some studies do not take into account the age factor (16,23). Further studies evaluating sociodemographic characteristics and oral hygiene habits are needed.

The study shows that the oral and dental health hygiene habits of pregnant women and their knowledge about the effect of oral and dental health and poor oral and dental health on pregnancy and infant increase as the level of education increases. University graduates went to the dentist while planning pregnancy at higher rates and gingival bleeding during pregnancy was lower in this group. In the literature, there are studies reporting that oral hygiene habits increase as the level of education increases, which supports this study (19). In the study, the rate of going to the dentist while planning pregnancy was the highest in university graduates.

Turkish women from the Central Anatolia were only included in the study and thus, the study cannot be generalized to Turkey. Multi-center studies that cover different regions are needed.

Conclusion

This study revealed that the oral and dental health habits of pregnant women were insufficient and they avoided dental treatment. It was also noted that gynaecologists and obstetricians did not refer women to the dentist before pregnancy at sufficient levels. Training about oral and dental health and dental treatments during pregnancy must be provided to the pregnant women in the region.

ETHICS COMMITTEE APPROVAL: Our study was approved by the Ethics Committee of XXX University (2023/10).

CONTRIBUTION RATES OF RESEARCHERS: Design: KTT, IT Data collection or data entry: KTT, IT, Analysis and interpretation: KTT, IT, Literature review: KTT, IT, Writing: KTT, IT.

FINANCIAL SUPPORT
The study received no financial support from any institution or organization.

CONFLICT OF INTEREST
There is no conflict of interest in this study.

References

1. Gajendra S, Kumar JV. Oral health and pregnancy: a review. N Y State Dent J. 2004;70(1):40-4.
2. Armitage GC. Bi-directional relationship between pregnancy and periodontal disease. Periodontology 2000. 2013;61:160-176.
3. Boutigny H, de Moegen M-L, Egea L, Badran Z, Boschin F, Delcourt-Debruyne E, Soueidan A. Oral infections and pregnancy: knowledge of gynecologists/obstetricians, midwives and dentists. Oral Health Prev Dent. 2016;14:41-47.
4. Wu M, Chen SW, Jiang SY. Relationship between gingival inflammation and pregnancy. Mediators Inflamm. 2015;2015:623427.
5. Gürsoy M, Pajukanta R, Sorsa T, Könönen E. Clinical changes in periodontium during pregnancy and post-partum. J Clin Periodontol. 2008;35:576-583.
6. Tilakaratne A, Soory M, Ranasinghe AW, Corea SM, Ekanayake SL, et al. Periodontal disease status during pregnancy and 3 months post-partum, in a rural population of Sri-Lankan women. J Clin Periodontol. 2000;27:787-792.
7. Mutluay AT, Safa MM. Koruyucu Ağız Diş Sağlığı Programlarında Annenin Eğitimi ve Ağız Sağlığının İyileştirilmesi ile Erken Çocukluk Çağı Çürüklerinin Önlenmesi. Turkiye Klinikleri J Dental Sci. 2019;25(2):175-81.
8. Radnai M, Gorzó I, Nagy E, Urbán E, Novák T, Pál A. A possible association between preterm birth and early periodontitis. A pilot study. J Clin Periodontol. 2004;31:736-741.
9. Azofeifa A, Yeung LF, Alverson CJ, Beltrán-Aguilar E. Oral health conditions and dental visits among pregnant and nonpregnant women of childbearing age in the United States, National Health and Nutrition Examination Survey, 1999-2004. Prev Chronic Dis.2014;11:E163.
10. Kısa S, Zeyneloğlu S. Doğum Sonu Servisinde Yatan Kadınların Gebelikteki Ağız Hijyeni Alışkanlıkları ve Diş Hekimine Gitme Durumları. TAF Preventive Medicine Bulletin. 2013;12:1.
11. George A, Johnson M, Blinkhorn A, Ajwani S, Bhole S, Yeo AE, Ellis S. The oral health status, practices and knowledge of pregnant women in south-western Sydney. Aust Dent J. 2013;58(1):26-33
12. Saddki N, Yusoff A, Hwang YL. Factors associated with dental visit and barriers to utilisation of oral health care services in a sample of antenatal mothers in Hospital Universiti Sains Malaysia. BMC Public Health. 2010;10:75.
13. Al Habashneh R, Guthmiller JM, Levy S, Johnson GK, Squier C, et al. Factors related to utilization of dental services during pregnancy. J Clin Periodontol. 2005;32:815-821.
14. Javali MA, Saquib SA, Abdul Khader M, Khalid I, AlShahrani AY, et al. Oral health knowledge, attitude, and practice of pregnant women in Deccan, South India: a cross-sectional prenatal survey. J Med Life. 2022;15:420-424.
15. Gokmen Karasu AF, Kutuk N, Aydin S, Adanir I, Ates S, et al. Dental health dispositions of pregnant women: A survey from a hospital clinic in Istanbul. J Obstet Gynaecol. 2017;37:752-756.
16. Topuz Ş, Güneş A, Duman NB. Kadinlarin gebelik dönemindeki ağiz diş sağliği durumlari. Sağlık Bilimleri Dergisi. 2021;30:50-55.
17. Morgan MA, Crall J, Goldenberg RL, Schulkin J. Oral health during pregnancy. J Matern Fetal Neonatal Med. 2009;22(9):733-9.
18. Cohen L, Schaeffer M, Davideau J-L, Tenenbaum H, Huck O. Obstetric Knowledge, Attitude, and Behavior Concerning Periodontal Diseases and Treatment Needs in Pregnancy: Influencing Factors in France. J Clin Periodontol. 2015;86:398-405.
19. Marchi KS, Rinki C, Shah M, Dove M, Terpak C, et al. Braveman P. Medical Provider Promotion of Oral Health and Women's Receipt of Dental Care During Pregnancy. Matern Child Health J. 2019;23:890-902.

20. Naavaal S, Brickhouse TH, Hafidh S, Smith K. Factors Associated with Preventive Dental Visits Before and During Pregnancy. J Womens Health (Larchmt). 2019;28(12):1670-1678.
21. Penmetsa GS, Meghana K, Bhavana P, Venkatalakshmi M, Bypalli V,et al. Awareness, Attitude and Knowledge Regarding Oral Health among Pregnant Women: A Comparative Study. Niger Med J. 2018; 59:70-73.
22. Gonik B, Wilson E, Mayberry M, Joarder BY. Pregnant Patient Knowledge and Behavior Regarding Perinatal Oral Health. Am J Perinatol. 2017;34:663-667.
23. Kaydirak MM, Şahin NH, Can MM, Koray M. Gebelerin ağız ve diş sağlığına ilişkin bilgi ve görüşleri. SDÜ Sağlık Bilimleri Dergisi.2018;9:11-16.
24. Thomas NJ, Middleton PF, Crowther CA. Oral and dental health care practices in pregnant women in Australia: a postnatal survey. BMC Pregnancy Childbirth.2008;8:13.
25. Chaitra T, Wagh S, Sultan S, Chaudhary S, Manuja N, et al. Knowledge, Attitude and Practice of Oral Health and Adverse Pregnancy Outcomes among Rural and Urban Pregnant Women of Moradabad, Uttar Pradesh, India. Journal of Interdisciplinary Dentistry 2018;8:5-12.

Tıp Fakültesi Öğrencilerinin İnfant Oral Sağlığı Hakkındaki Bilgi Düzeyi İnfant Oral Sağlığı

Knowledge Level of Medical Faculty Students on Infant Oral Health Infant Oral Health

Ayça Kurt [1*]

1. Recep Tayyip Erdoğan Üniversitesi Diş Hekimliği Fakültesi, Çocuk Diş hekimliği Anabilim Dalı, Rize, Türkiye

***Corresponding author**: Kurt A, Msc. PhD. Ass. Prof. Department of Pediatric Dentistry, Faculty of Dentistry, Recep Tayyip Erdoğan University, Rize-Türkiye.
E-mail: ayca.kurt@erdogan.edu.tr
DOI : 10.61139/ijdor.1298316

Özet

Amaç: Bu çalışmanın amacı, tıp fakültesi son sınıf öğrencilerinin, infantlara ait ağız-diş sağlığı bilgi düzeylerini belirlemektir.
Materyal ve Metod: Araştırmada veri toplama aracı olarak üç bölümden oluşan anket formu kullanılmıştır. İlk bölümde demografik bilgi formu, ikinci bölümünde 26 adet soru, üçüncü bölümünde "katılıyorum" ve "katılmıyorum" seçenekleri ile katılımcıların konu ile ilgili kendi görüşleri yer almaktadır. Bilgi düzeyi formundaki doğru cevapların ortalamaları ve toplam puanın cinsiyete göre karşılaştırılmasında bağımsız iki örneklem t testinden; yaş gruplarına göre karşılaştırmalarda ANOVA testinden yararlanılmıştır.
Bulgular: Araştırmaya katılan 67 öğrencinin %52,2'si kadın, %47,8'i erkektir. Araştırmaya katılan öğrencilerin infant oral sağlığı (İOS) hakkındaki bilgi düzeyi toplam puanı (10,53±3,72) "düşük düzeyde" (26 soruda) tespit edilmiştir.
Sonuç: Ağız diş sağlığının korunmasında, diş hekimine destek olan sağlık grubunun önemli bir kolu olan tıp hekimi adaylarının İOS konusunda yeterli düzeyde olmadıkları görülmüştür. Bu nedenle tıp fakültelerinin mezuniyet öncesi eğitimine ağız-diş sağlığı konularının eklenmesi yararlı olacaktır.

Research Article (HRU Int J Dent Oral Res 2023;3(2): 79-85

Anahtar Kelimeler: Ağız sağlığı, bebekler, farkındalık, intörn, tıp fakültesi.

Abstract

Background: The aim of this study is to determine the oral and dental health knowledge levels of the infants of the last year students of the faculty of medicine.
Materials and Methods: A three-part questionnaire was used as a data collection tool. In the first part, there is a demographic information form, in the second part there are 26 questions, in the third part there are "I agree" and "I do not agree" options and the participants' own views on the subject. Two independent sample t tests were used to compare the averages of the correct answers in the knowledge level form and the total score according to gender; and ANOVA test was used to compare the age groups.
Results: Of the 67 students who participated in the study, 52.2% were female and 47.8% were male. The total score (10.53±3.72) on the level of knowledge about infant oral health (IOH) of the students participating in the study was found to be "low" (in 26 questions).
Conclusion: It has been observed that candidates for medical doctors, who are an important branch of the health group that supports the dentist, do not have sufficient levels of IOH in the protection of oral health. For this reason, it will be useful to add oral-dental health subjects to the pre-graduation education of medical schools.

Research Article (HRU Int J Dent Oral Res 2023;3(2): 80-85

Key words: Awareness, ınfants, ınternship, medical faculty, oral health.

Giriş

İyi bir ağız sağlığı, besinlerin çiğnenmesi ve yutulmasında temel görev gören iyi bir dentisyona sahip olmak demektir(1). İnfant oral sağlığı (İOS), sağlıklı çocukluğun oluşumunda önemli yer tutmaktadır. Yetişkinlikteki ağız sağlığı, çocukluk dönemindekiyle iç içe ilişki içindedir. Bu sebeple koruyucu dental bakım, çocuğun yaşamının erken döneminde yani infant olarak tanımlandığı 0-11 aylık kısmında başlamalıdır. American Academy of Pediatric Dentistry (AAPD)(2), her çocuğun ilk süt dişinin sürmesi ile birlikte ilk diş hekimi ziyaretini yapmasının ve koruyucu dental bakım uygulamalarını yine bu dönemde alması gerektiğinin önemini belirtmektedir(3). Özellikle gelişememiş ve gelişmekte olan toplumlarda çocukların koruyucu profesyonel dental bakıma erişmesi anlamında gerçekler, yapılması gerekenlerle bağdaşmamakta ve özellikle çocukluğun infant döneminde profesyonel dental bakıma erişme düzeyi çok düşük seviyelerde kalmaktadır(1, 4).

Sağlık konusunda ilk profesyonel randevu, annenin gebe iken veya bebeği ve kendisi için doktora gitmesi ile oluşturulmaktadır. Bu nedenle çocuk diş hekimliğinin profesyonel ve evrensel rehberliği, tıp alanında çalışan sağlıkçıların dişlenme ve dental bakım ve ilk diş hekimi ziyareti konusunda aileleri eğitmesinin önemini vurgulamaktadır(5). Araştırmacılar, tıp pratisyenlerinin ağız sağlığı konusunda iyi eğitimli olmadıklarını ve çocukları diş problemleri ile alakalı konularda doğru bir şekilde yönlendiremediklerini belirtmektedir(1, 4, 6, 7). Ülkemizde de bu durum çok farklılık göstermemektedir. Ülkemizde son yıllarda yapılan araştırmalar, pediatristlerin oral sağlık konusunda yeterince bilgi sahibi olmadığını göstermektedir. Tüm bu veriler ışığında, diş hekimleri ve profesyonel sağlık çalışanlarının koruyucu dental bakım konusunda işbirliği içinde çalışması gerekliliği ortaya çıkmaktadır (8).

Daha önce sağlık profesyonellerinin çocukların ağız ve diş sağlığı ile ilgili farkındalık çalışmaları yapılmasına rağmen, görebildiğimiz kadarı ile ülkemiz sınırlarında direkt İOS ile ilişkili bilgiler açısından tıp fakültesi öğrencilerinin bilgi ve farkındalık durumu sorgulanmamıştır. Lisans programında kazanılan bilginin mezuniyet sonrası tıbbi uygulamanın yaklaşım ve yönünü etkilediği bilinmektedir(6). Tüm bu veriler ışığında bu çalışma, mezun olacak son sınıf tıp fakültesi öğrencilerinin, İOS hakkındaki bilgi ve tutumlarını değerlendirmeyi ve bu konuda bir farkındalık oluşturarak klinik tıbbi eğitim müfredatında İOS ve koruyucu dental bakım ile ilgili olarak diş hekimliği ve tıp fakültesinin ekip çalışmasını güçlendirmeyi amaçlamaktadır.

Gereç ve Yöntem

Araştırma Etik Onayı

Çalışma için gerekli etik onay; XXX Üniversitesi, Tıp Fakültesi Girişimsel Olmayan Klinik Araştırmalar Etik Kurul Başkanlığı'nca 2019/170 sayılı karar numarası ile verilmiştir.

Araştırma Tipi ve Evreni

Bu araştırma; Recep Tayyip Erdoğan Üniversitesi Tıp Fakültesi 2019-2020 akademik yılı son sınıf öğrencilerine gönüllü katılım ile anket uygulanması çalışmasıdır. Planlanan anket çalışması, kesitsel bir çalışmadır ve katılımcılara rızaları dahilinde bilgilendirilmiş gönüllü onam formu imzalatıldıktan sonra, A. K.'nın bire bir öğrencilere anketi dağıtıp bilgi vererek, aynı gün içinde anketleri toplaması ile yapılmıştır. Örneklem sayısını, 72 kişilik son sınıf tıp fakültesi öğrencilerinden gönüllü katılım gösterenler oluşturmuştur.

Araştırma Verilerinin Elde edilmesi

Anket soruları, konu ile alakalı geniş bir literatür taraması sonucu hazırlanmıştır ve iki bölümden oluşmaktadır. İlk kısım öğrencilerin demografik verilerini (yaş, cinsiyet, medeni durum, çocuk sahibi olup olmadığı, daha önce bu konuda eğitim alıp almadığı bilgisini içeren), ikinci kısım 30 adet konu ile alakalı anket sorularını içermektedir. İkinci kısım; İnfantların Diş Anatomisi ve Erüpsiyon Zamanları, İnfant Oral Bakımı, İnfant Beslenmesi, Annenin Oral Sağlığı, Erken Çocukluk Çağı Çürüğü, Florür, Oral Sağlık Konusunda Tutum, Davranışlar ve Tıp Müfredatında Dental Eğitim başlıklarını kapsayan 7 bölümden oluşmaktadır.

Anket sorularının doğru cevapları hazırlanırken American Academy of Pediatrics (AAP)(9), American Academy of Pediatric Dentistry (AAPD)(2), American Dental Association (ADA)' nın(10) güncel rehberliğinden yararlanılmıştır.

İlk 26 soru için doğru cevaplar 1 puan, yanlış cevaplar ve bilmiyorum seçeneği 0 puan olarak değerlendirilmiştir. Ortalama puan göz önünde bulundurularak yapılan hesaplamada; 0-11 puan aralığı düşük bilgi düzeyini, 12-20 puan aralığı orta bilgi düzeyini, 21-26 puan aralığı ise yüksek bilgi düzeyini temsil etmektedir. En düşük ve en yüksek puanlar sırasıyla 0 ve 26' dır. Son 4 soru ise, öğrencilerin, konu hakkındaki farkındalığı ve eğitim müfredatında konunun önemi açısından düşüncelerini anlamaya yönelik 'Katılıyorum' ve 'Katılmıyorum' seçeneklerinden birini işaretlemeleriyle kendi içinde ayrıca değerlendirilmiştir. Anketler her öğrenciye dağıtılmış ve anket sonunda doğru cevaplar ile ilgili ve konu ile alakalı genel bilgiler kısa bir sözlü eğitim tekniği ile anlatılmıştır.

İstatistiksel Analiz

Verilerin analizinde SPSS (Statistical Package Program for Social Science) 21.0 programı yazılımı kullanılmıştır. Demografik bilgiler, infant sağlığına ilişkin görüşler ve bilgi düzeyi formundaki doğru cevap sayı ve yüzdeleri frekans ve yüzde tablosunda gösterilmiştir. Bilgi düzeyi formundaki doğru cevapların ortalamaları ve toplam puanın cinsiyete göre karşılaştırılmasında bağımsız iki örneklem t testinden; yaş gruplarına göre karşılaştırmalarda ANOVA testinden yararlanılmıştır. ANOVA testinde anlamlı farklılık görüldüğünde farkın hangi gruplar arasında olduğunu belirlemek amacıyla LSD post hoc testi kullanılmıştır. Analizlerde güven aralığı %95 (anlamlılık düzeyi 0,05 $p<0,05$) olarak belirlenmiştir.

Bulgular

Öğrencilerin demografik özelliklerine göre frekans ve yüzde dağılımı Tablo 1'de gösterilmiştir.

İnfant oral sağlığı hakkındaki bilgi düzeyi ve farkındalık testinde verilen cevaplara ait betimsel istatistiklere Tablo 2'de yer verilmiştir. Araştırmaya katılan öğrencilerin infant oral sağlığı hakkındaki bilgi düzeyi toplam puanı (10,53±3,72) "düşük düzeyde" (26 soruda) tespit edilmiştir. En yüksek başarı gösterilen alan "oral sağlık konusunda tutum, davranışlar" (0,53±0,31) olmakla birlikte tüm alanlardaki başarı düşük düzeydedir.

Tablo 1. Öğrencilerin demografik özelliklerine göre dağılımı

Demografik Özellik	Gruplar	n	%
Cinsiyet	Kadın	35	52,2
	Erkek	32	47,8
Yaş	23 yaş	24	35,8
	24 yaş	23	34,3
	25 yaş ve üstü	20	29,9
Medeni durum	Evli	5	7,5
	Bekar	62	92,5
Daha önce koruyucu diş hekimliği eğitimi alma durumu	Evet	2	3,0
	Hayır	65	97,0

Tablo 2. İnfant oral sağlığı hakkındaki bilgi düzeyi doğru cevap sayı ve yüzdeleri

Sorular	n	%
İnfantların Diş Anatomisi ve Erüpsiyon Zamanları ($\bar{X}$±SS)[1]	0,44±0,26	
1. İnfantlarda ilk süt dişi ortalama ne zaman görülür?	38	56,7
2. 20 adet süt dişinin sürmesi hangi zaman aralığında tamamlanır?	27	40,3
3. Süt dişlerinde aşağıdaki hangi diş grubu yoktur?	9	13,4
4. Aşağıdakilerden hangisi natal dişin tanımıdır?	40	59,7
5. Natal diş aşağıdakilerden hangisine neden olmaz?	35	52,2
İnfant Oral Bakım, Beslenme ($\bar{X}$±SS)[1]	0,36±0,17	
6. Bebeğin her beslenmesinden sonra diş ve diş etleri temizlenmelidir.	29	43,3
7. İnfantlarda en iyi diş ve diş eti temizliği temiz ıslak bir bezden yardım alarak ağzı silmekle yapılır.	29	43,3
8. Dişlerin fırçalanmaya başlanması gereken ideal zaman nedir?	8	11,9
9. Kazara yutulan az miktar diş macunu bebeğin sağlığında önemli bir zarar teşkil etmez.	45	67,2
10. 2 yaş altında sürülmesi gereken diş macunu miktarı aşağıdakilerden hangisi ile ifade edilir?	15	22,4
11. İlk dişin sürmeye başlamasından itibaren bebeğin gece emmeleri sınırlandırılmalıdır.	12	17,9
12. Bebeğin biberon kullanımı ne zaman sonlandırılmalıdır?	15	22,4
13. İlk süt dişinin sürmesinden sonra devam eden gece emmeleri, tatlandırılmış emzik ve/veya gece alınan meyve suyu/şekerli içecek içeren biberonun oluşturduğu çürük yapıcı etkiye sahiptir.	48	71,6
14. Öğün aralarında bebeğin su/ süt/taze meyve alımı sınırlandırılmalıdır.	17	25,4
Annenin Oral Sağlığı ($\bar{X}$±SS)[1]	0,32±0,29	
15. Çürük dişlere sahip annelerin çocuklarında da çürük dişler olması muhtemeldir.	24	35,8
16. Anneden öpme ve ortak eşya kullanımı (kaşık, emziği annenin ağzına alması…) yolu ile çürük bebeğe geçiş yapar.	23	34,3

17. Aşağıdakilerden hangisi yanlıştır?	17	25,4
Erken Çocukluk Çağı Çürüğü ($\bar{X}$±SS)[1]	0,49±0,24	
18. Diş çürüğü nedir?	54	80,6
19. Süt dişlerindeki çürükler neye yol açarlar?	10	14,9
20. Aşağıdaki ifadelerden hangisi doğrudur?	40	59,7
21. Yeni doğanın ağız boşluğunda çürük bakterileri doğduğu ilk andan itibaren mevcuttur.	27	40,3
Florür ($\bar{X}$±SS)[1]	0,27±0,29	
22. Aşağıdakilerden hangisi yanlıştır?	11	16,4
23. Suların florlanması, gelişim dönemindeki dişler için ana florür kaynağıdır.	25	37,3
Oral Sağlık Konusunda Tutum, Davranışlar ($\bar{X}$±SS)[1]	0,53±0,31	
24. Süt dişindeki çürüklerin tedavi edilmesine gerek yoktur.	25	37,3
25. Bebeklerin ilk diş hekimi ziyareti ne zaman yapılmalıdır?	29	43,3
26. Düzenli diş hekimi ziyaretleri bebek ve çocuklardaki diş ve ağız problemlerini önleyebilir.	54	80,6
TOPLAM ($\bar{X}$±SS)[1]	10,53±3,72	

* Ortalamalar doğru cevap yüzdesi üzerinden hesaplanmıştır.

Öğrencilerin, İOS ve İOS' un müfredatla ilişkisine yönelik görüşlerine ait frekans ve yüzde dağılımı Tablo 3'te gösterilmiştir.

Tablo 3. Öğrencilerin infant oral sağlığı ile ilgili görüşleri

Bebeklerin tıbbi muayenelerinde ağız muayenesi de yapılmalıdır	**n**	**%**
Katılıyorum	64	**95,5**
Katılmıyorum	3	**4,5**
Şiddetli diş çürüğüne sahip hastalar için tıbbi personelin yapabileceği hiçbir şey yoktur	**n**	**%**
Katılıyorum	9	**13,4**
Katılmıyorum	58	**86,6**
Tıbbi müfredattaki dental sağlık ve bakım eğitimi yeterlidir	**n**	**%**
Katılıyorum	16	**23,9**
Katılmıyorum	51	**76,1**
İnfant oral sağlık bilgisi tıbbi eğitim müfredatına ilave edilmelidir	**n**	**%**
Katılıyorum	49	**73,1**
Katılmıyorum	**18**	**26,9**

* Ortalamalar doğru cevap yüzdesi üzerinden hesaplanmıştır.

Tartışma

Bu çalışmada; Recep Tayyip Erdoğan Üniversitesi Tıp Fakültesi son sınıf öğrencilerine uyguladığımız İOS anketi sonuçlarına göre öğrencilerin bilgi düzeyi düşük olarak tespit edilmiştir. En az doğru cevap, ankette yer alan "Dişlerin fırçalanmaya başlaması gereken ideal zaman nedir" sorusuna verilirken, en fazla doğru cevap "Diş çürüğü nedir?" sorusuna ve "Düzenli diş hekimi ziyaretleri bebek ve çocuklardaki diş ve ağız problemlerini önleyebilir" önermesine verilmiştir.

İnfantların oral sağlığı, bebeğin hayatının kalan kısmında da sağlıklı bir dentisyonun sürdürülmesi için büyük önem taşımaktadır. Bu amaçla, başta anne olmak üzere bakım verene koruyucu eğitim ve hem bakım veren hem de bebekleri için düzenli diş bakımı yapılması konusunda farkındalıklarının artırılması uygulamaları hayata geçirilmelidir(2). Günümüzde araştırma sonuçları hala, çocuklarda görülen en yaygın kronik hastalıklardan birinin diş çürüğü olduğunu vurgulamaktadır. Özellikle Hindistan gibi gelişmekte olan ülkelerde erken çocukluk çağı çürüğü (EÇÇ) prevalansı oldukça yüksektir(8, 11, 12). Diş çürüğünün bu yaygın prevalansında en büyük etken bebeklerin, çocukların ve ebeveynlerin/annelerin arasındaki bilgi ve farkındalık eksikliğidir. Annelerin ağız sağlığı eğitimi İOS için anahtardır(1). Pediatristler, aile hekimleri, kamu hastanelerinde görevli doktorlar; çocukların erken dönemdeki sağlık kontrolleri, aşıları, ve rahatsızlık durumlarında infantlar ve aileleri ile sürekli temas halindedirler. Bu nedenle hekimlerin İOS konusunda bilgi ve farkındalığının yeterli olması durumunda ebeveynin de, bebeğin ağız bakımı konusunda yeterince bilgi sahibi olması ve konu ile ilgili farkındalığının artması muhtemeldir(1, 4, 13).

Erken çocukluk çağı çürüklerine neden olan bakterilerin ve bunların bulaşıcı doğasına ilişkin eğitimin yanı sıra, ağız sağlığı risk değerlendirmesi, ileriye dönük rehberlik ve erken müdahale yöntemlerinin; tıp ve hemşirelik müfredatına dahil edilmesinin koruyucu diş hekimliği programlarında etkili olduğu gösterilmiştir(14, 15). Pediatrislerin ve genel diş hekimlerinin büyük çoğunluğunun, ebeveynlere çocuklarını bir yaşına kadar çocuk diş hekimi uzmanına götürmesini tavsiye etmediğini belirten son araştırmalar, tıp ve diş hekimliği topluluklarında artan İOS bakım ihtiyacını açıklamaktadır(16, 17). Çalışmamızda İOS bilgisinin tıbbi eğitim müfredatına ilave edilmesi görüşüne katılanlar % 73,1 oranıyla büyük çoğunluğu oluşturmakta ve öğrencilerin % 76,1' i tıbbi müfredattaki dental sağlık ve bakım eğitiminin yeterli olduğuna dair görüşe katılmamaktadaır. "Şiddetli diş çürüğüne sahip hastalar için tıbbi personelin yapabileceği bir şey yoktur" önermesine katılmayanların oranı % 86,6 dır. Koşan ve ark.(18) çalışmasında "Tıp doktorları ağız diş sağlığının gelişmesine ne düzeyde katkıda bulunabilir? " sorusuna tıp fakültesi öğrencilerinin % 61,7' si, katkı sağlayabileceğini

belirtmiştir.

Tıp fakültesi müfredatı, bebek ağız sağlığı konusunda herhangi bir resmi eğitimi içermemektedir ve pediatrik tıp stajyerliğinin bu tür bir eğitim vermiş olması çok küçük bir olasılıktır(6). Pediatri ve aile hekimliği stajlarının müfredatı ve hedefleri, bebek ağız sağlığı konusunda özel bir yeterlilikten söz etmemektedir. Bu bulgular, ağız sağlığı konusunda yeterli eğitim almadıklarını bildiren hekimlerin daha önceki çalışmalarını yansıtmaktadır(19-22).

Çalışmamızda, öğrenciler en fazla doğru cevabı "Oral Sağlık Konusunda Tutum, Davranışlar" bölümünde vermiştir. Koşan ve ark.(18) çalışmasında, ağız ve diş sağlığı ile ilgili sorulara doğru cevap veren hekim adaylarının yüzdesinin % 36,8- % 60,2 arasında olduğu rapor edilmiştir. Rabiei ve ark.(23) hekimlere; süt ve daimi dişlerin sürme yaşları, florürlü diş macunlarının kullanılma yaşları, diş fırçalamaya başlama yaşı, dental plak, anne sütü ve mamanın karyojenitesi ile ilgili sorular sormuşlardır. Hekimlerin % 40' ın altında doğru cevap verdikleri bildirilmiştir. Nijerya'da yapılan başka bir çalışmada ise tıp fakültesi öğrencilerinin ağız ve diş sağlığı bilgi düzeyleri, çalışmamızdaki gibi gruplanmış ve öğrencilerin % 47' sinin 'kötü" olarak sınıflandırıldığı bildirilmiştir(6).

Çalışkan' ın(22) tıp fakültesi öğrencilerinde yürüttüğü çalışmanın sonuçlarına göre süt dişleri çıkma zamanını doğru yanıtlayan öğrencilerin sıklığı % 34,4, Kumari ve ark.(4) çalışmasında % 72 iken bu oran bizim çalışmamızda % 56,7' dir. Çalışmamızda en az doğru cevaplar, "Florür" başlığı altındaki sorulara verilmiştir. Florürün kullanım yaşı ve oranı bilgisini ölçen çoktan seçmeli sorudaki doğru yüzdemiz % 16,4' tür. Shivaprakash ve ark.(3) çalışmasında, florür ile ilgili sözlü bilgi verme oranı % 63, Kumari ve ark.(4) florürün diş çürüğünü azalttığına dair bilgiye verilen doğru cevap yüzdesi % 81' dir. Bebeklerin beslenmesi ile ilgili sorular kısmında, bebeğe gece biberonu kullanımını bıraktırma yaşı sorusunda Shivaprakash ve ark.(3) % 38 oranında, Chung ve ark.(7) bu soruya verilen doğru cevap % 72, bu oran bizim çalışmamızda % 22,4 ' tür.

Araştırmalar, pratisyen hekimler arasında diş sağlığı bakımı konusunda bir eğitim programının uygulanmasının farkındalığı artırdığını, diş sorunlarına yönelik sevklerde önemli bir artış olduğunu ve tıbbi uzmanlar arasında ağız sorunlarının teşhis edilmesinin kolaylaştığını bildirmektedir(23-25). Bu durum, İOS 'un kalitesini artırmak için aşılması en kolay engelin eldeki imkanları değerlendirmek olduğunu göstermektedir, yani tıp fakültesi öğrencilerini eğitmek. Bugünün iyi eğitimli ve motive öğrencileri, yarın İOS' u teşvik eden, konu ile farkındalığı yüksek olan uzmanların yolunu açacaktır(1). British Columbia Üniversitesi(26), Harvard Üniversitesi(27) ve diğer birkaç üniversiteden(28, 29) diş hekimliği ve tıp öğrencilerini temel bilim dersleri için birleştiren birçok başarılı ortak programa ilişkin raporlar bulunmaktadır. Tıp öğrencilerinde İOS' u teşvik etmek ve böylece ekonomik yükü azaltmak için kurumlarımızda benzer işbirlikleri düşünülebilir.

Sonuçlar

Çalışmamızın bulguları; politikacılara, sağlık yönetim üyelerine, üniversite yönetim kuruluna ve bir bütün olarak tıp camiasına ağız sağlığı ile ilgili tıp müfredatındaki iç gözlem ihtiyacına ışık tutmaktadır. Araştırmanın sınırlı sayıda bir kesime ulaşması ve sadece tek bir fakülteden öğrencilerin değerlendirilmesi, çalışmanın limitasyonlarını oluşturmaktadır.

Bu çalışmanın limitasyonları dahilinde, çalışma bulgularına dayanarak aşağıdaki sonuçlara varılmıştır;

1. Tıp fakültesi öğrencileri, İOS hakkında yeterli bilgiye sahip değildir; bu nedenle etkili stratejiler yoluyla tıp öğrencilerinin bilgilerini artırmaya yönelik artan bir ihtiyaç vardır.
2. Tıp fakültesi öğrencileri, İOS ile ilgili konuların müfredattaki eksikliğine dikkat çekmektedir ve büyük çoğunluğu bu konu ile ilgili derslerin müfredata girmesi gerektiğini düşünmektedir.
3. Hem çalışma bulgularının, hem de öğrencilerin istekleri doğrultusunda tıp fakültesi eğitimine İOS ve genel diş hekimliği ile bilgilerin eklenmesi gerekliliği öngörülebilir.

Çalışmanın ileriye dönük İOS üzerindeki rolü, hekimlerin İOS danışmanlığını geliştirmesi ve vermesi gerektiğidir; böylelikle ebeveynlere ileriye dönük rehberlik sağlanabilir ve olumlu diş tutumları geliştirmede bir rehber olarak hizmet edilmiş olabilir. Bunun için hem tıp camiası hem de diş hekimliği meslekleri arasında ortak bir ekip kurularak bir bebek için koruyucu diş bakımı konusunda hekimlerin iyi bilgilendirilmesi gerekmektedir. Böylelikle, hekimlerin yeterli danışmanlık ve diş bakımı yapmalarını sağlayarak; ağız hastalıklarının erken teşhisini ve önlenmesini sağlamak ve profesyonel diş hekimliği hizmetlerine erişimde ciddi eşitsizlik sorunlarını ele almak için gerektiğinde uygun yönlendirmeler yapılmış olacaktır.

Kaynaklar

1.Thomas A, Habib R, Bekal KK, Shetty P, Shetty BS, Thomas A. Oral Health for Holistic Health-Medical Student's Knowledge and Attitude about Infant Oral Health. Journal of Advanced Oral Research 2015;6(3):34-8.
2. Guideline on infant oral health care. Pediatr Dent 2008;30(7 Suppl):90-3.
3. Shivaprakash PK, Elango I, Baweja DK, Noorani HH. The state of infant oral healthcare knowledge and awareness: disparity among parents and healthcare professionals. J Indian Soc Pedod Prev Dent 2009;27(1):39-43.
4. Kumari NR, Sheela S, Sarada PN. Knowledge and attitude on infant oral health among graduating medical students in Kerala. J Indian Soc Pedod Prev Dent 2006;24(4):173-6.
5. Prakash P, Lawrence HP, Harvey BJ, McIsaac WJ, Limeback H, Leake JL. Early childhood caries and infant oral health: Paediatricians' and family physicians' knowledge, practices and training. Paediatr Child Health 2006;11(3):151-7.
6. Adeghe H, Ehigiator O, Azodo C, Ehizele A. Nigerian clinical level medical students' knowledge of dental specialty. Ann Med Health Sci Res 2012;2(2):157-60.
7. Chung MH, Kaste LM, Koerber A, Fadavi S, Punwani I. Dental and medical students' knowledge and opinions of infant oral health. J Dent Educ 2006;70(5):511-7.
8. Mahejabeen R, Sudha P, Kulkarni SS, Anegundi R. Dental caries prevalence among preschool children of Hubli: Dharwad city. J Indian Soc Pedod Prev Dent 2006;24(1):19-22.
9. Pitt MB, Berger JN, Sheehan KM. Compliance of Parenting Magazines Advertisements with American Academy of Pediatrics Recommendations. Children (Basel) 2016;3(4).
10. Aravamudhan K, Frantsve-Hawley J. American Dental Association's Resources to Support Evidence-Based Dentistry. J Evid Based Dent Pract 2009;9(3):139-44.
11.Shingare P, Jogani V, Sevekar S, Patil S, Jha M. Dental caries prevalence among 3 to 14 year old school children, Uran, Raigad district, Maharashtra. J Contemp Dent 2012;2(2):11-4.
12.Moses J, Rangeeth B, Gurunathan D. Prevalence of dental caries, socio-economic status and treatment needs among 5 to 15 year old school going children of Chidambaram. J Clin Diagn Res 2011;5(1):146-51.
13.Pierce KM, Rozier RG, Vann WF, Jr. Accuracy of pediatric primary care providers' screening and referral for early childhood caries. Pediatrics 2002;109(5):E82-2.
14.Douglass JM, Douglass AB, Silk HJ. Infant oral health education for pediatric and family practice residents. Pediatr Dent 2005;27(4):284-91.
15.Fein JE, Quinonez RB, Phillips C. Introducing infant oral health into dental curricula: a clinical intervention. J Dent Educ 2009;73(10):1171-7.
16.Brickhouse TH, Unkel JH, Kancitis I, Best AM, Davis RD. Infant oral health care: a survey of general dentists, pediatric dentists, and pediatricians in Virginia. Pediatr Dent 2008;30(2):147-53.
17.Nowak AJ, Casamassimo PS. Using anticipatory guidance to provide early dental intervention. J Am Dent Assoc 1995;126(8):1156-63.
18.Koşan Z, Akgül N, Bedir B, Çalıkoğlu EO, Yılmaz S, Derelioğlu SŞ. Tıp ve diş hekimliği fakültelerinde ağız–diş sağlığı eğitimi yeterli mi? Öğrencilerin bilgi düzeylerinin karşılaştırması. Turkish Journal of Public Health 2017;15(3):201.
19.Özveren N, Kara SB, Şişman KY, Baltacı E. Knowledge, attitude, training and practices of pediatricians in relation to the prevention of oral diseases in the thrace region. Black Sea Journal of Health Science 2021:5-6.
20.Nagarakanti S, Epari V, Athuluru D. Knowledge, attitude, and practice of medical doctors towards periodontal disease. J Indian Soc Periodontol 2013;17(1):137-9.
21.Kılınç G, Günay T. Dokuz Eylül Üniversitesi Tıp Fakültesi son sınıf öğrencilerinin ağız diş sağlığı konusunda bilgi düzeyleri. Dokuz Eylül Üniversitesi Tıp Fak. Dergisi 2010;24(3):131-7.
22.Çalışkan D, Yaşar F, Tunçbilek A. Ankara Üniversitesi Tıp Fakültesi 9-10 Sömestr Öğrencilerinin Ağız ve Diş Sağlığı Konusunda Bilgi Düzeyleri. Ankara Üniversitesi Tıp Fak. Mecmusası 2002;55(2), 137-142.
23.Rabiei S, Mohebbi SZ, Patja K, Virtanen JI. Physicians' knowledge of and adherence to improving oral health. BMC Public Health 2012;12:855.
24.dela Cruz GG, Rozier RG, Slade G. Dental screening and referral of young children by pediatric primary care providers. Pediatrics 2004;114(5):e642-52.
25.Lewis CW, Grossman DC, Domoto PK, Deyo RA. The role of the pediatrician in the oral health of children: A national survey Pediatrics. 2000;106(6):E84.
26.Clark DC, Harrison RL, MacNeil MA, Walton JN, Waterfield JD, Blasberg B, et al. The new dental curriculum at the University of British Columbia: integrating with medicine. J Dent Educ 1998;62(9):718-22.
27.Howell TH, Matlin K. Damn the torpedoes--innovations for the future: the new curriculum at the Harvard School of Dental Medicine J Dent Educ 1995;59(9):893-8.
28.Graham E, Negron R, Domoto P, Milgrom P. Children's oral health in the medical curriculum: a collaborative intervention at a university-affiliated hospital. J Dent Educ 2003;67(3):338-47.
29.Mouradian WE, Reeves A, Kim S, Lewis C, Keerbs A, Slayton RL, et al. A new oral health elective for medical students at the University of Washington. Teach Learn Med 2006;18(4):336-42.

An Evaluation of the Relationship Between Roots of Maxillary Anterior Teeth and Neighboring Anatomical Structures in Children: A Cone Beam Computed Tomography Study

Kamile Nur Tozar [1*], Uğur Akdağ [1], Kadir Kaplanoğlu [2]

1. Adıyaman University, Faculty of Dentistry, Pediatric dentisry, Adıyaman, Turkiye
2. Adıyaman University, Faculty of Dentistry, Department of Oral and Maxillofacial Radiology, Adıyaman, Turkey

.

***Corresponding author**: Tozar KN, Msc. PhD. Ass. Prof. Department of Pediatric Dentistry, Faculty of Dentistry, Adıyaman University, Adıyaman-Turkey.
E-mail: wapurlu@gmail.com
DOI : 10.61139/ijdor.1291639

Abstract

Background: This study aimed to evaluate the distances between the roots of maxillary incisors and the nasopalatine canal and the floor of the nasal cavity, and the buccal cortical bone thickness at the apices of the roots of these teeth by Cone Beam Computed Tomography (CBCT) in children in the permanent dentition period.
Materials and Methods: CBCT images of 49 patients aged 6-14 years were evaluated. In the sagittal plane, the distances of the apices of the maxillary central teeth with the nasopalatine canal and with the floor of the nasal cavity were evaluated. Buccal cortical bone thickness at the apex of the roots of maxillary anterior teeth was examined. These data were compared in terms of gender and whether the teeth had open or closed apices.
Results: When the mean distance of the maxillary central teeth (11,21) to the nasopalatine canal was evaluated in terms of the open/closed apex status of the teeth and gender, there was no significant relationship ($p>0.05$). Among the maxillary anterior teeth (11, 21,12, 22), the root apex of tooth 22 was the farthest from the floor of the nasal cavity and the root apex of tooth 12 was the closest. It was found that the mean buccal cortical bone thickness of maxillary anterior teeth 11 and 21 with open apex was significantly higher than those with closed apex ($p<0.05$).
Conclusions: The buccal cortical bone thickness of maxillary central teeth with closed apexes is higher than that of open apexes, which makes apical surgical applications in this region difficult.

Research Article (HRU Int J Dent Oral Res 2023; 3(2): 86-90

Keywords: Anterior maxilla, cone-beam computed tomography, nasopalatine canal, nasal floor.

Introduction

Although the anterior maxilla is considered a safe region for surgical procedures, the anatomical structures in its neighborhood may increase the risk of complications (1,2). The anterior maxilla is an area that requires careful evaluation due to the frequent occurrence of traumatic injuries such as intrusion or lateral luxation in this region, apical surgical applications, overflow filling due to faulty root canal treatment, orthodontic treatment applications, and implant placement (3).

Maxillary incisors are the teeth most frequently affected by dental trauma (4). While crown fracture is the most common traumatic dental injury in permanent dentition, intrusive luxation injury is frequently reported in deciduous dentition (5,6). In injuries such as intrusion or lateral luxation, the roots of the maxillary anterior teeth may be displaced towards the adjacent nasopalatine canal, nasal cavity, and buccal cortical bone and damage these anatomical structures (1,7).

After a dental trauma, apical periodontitis or root resorption occurs due to devitalization, which is frequently encountered in maxillary anterior teeth (8). Therefore, endodontic treatment or apical surgery may be required for traumatized teeth depending on the case (9). In unsuccessful endodontic treatments, gutta-percha or canal filling paste may overflow from the tooth apex and damage adjacent anatomical structures (10). The root lengths of the maxillary anterior teeth, the distance between the roots of these teeth and the nasopalatine canal and the base of the nasal cavity, and the thickness of the buccal cortical bone differ in each person.

It was hypothesized that maxillary lateral teeth would be closer to the nasal cavity due to their longer root length compared to central teeth.

The aim of this study was to evaluate the distances of the roots of the maxillary incisors to the nasopalatine canal and also to the floor of the nasal cavity, and the thickness of the buccal cortical bone at the apices of the roots of these teeth using Cone Beam Computed Tomography (CBCT) in children in the permanent dentition period.

Materials and Methods

Our study was approved by the Non-Interventional Ethics Committee of Adiyaman University Faculty of Medicine (Decision number: 2022/7-36, Date: 25/10/2022).

In this study, we evaluated the images of patients aged 6-14 years who were admitted to the pedodontics clinic at Adiyaman University Faculty of Dentistry between 2017 and 2021 and underwent CBCT (Planmeca Promax 3D Mid Proface, Finland) on the maxillary anterior region. CBCTs of patients with artifacts or poor image quality in the maxillary anterior region were excluded from the study. In addition, CBCTs of patients with congenital deformities or syndromes affecting the orofacial region and patients who underwent surgery in the maxillofacial region due to jaw fracture were excluded.

The sample size was calculated based on the effect size of 0.50 at a significance level of 0.80 using the G power program. With these data, it was found that it would be sufficient to include 48 patients in the study for 4 groups in total, 12 for each group. Therefore, 48 patients were included in the study.

FOV size of CBCTs: 400 micron meters, FOV diameter: 160 mm, height: 100 mm. On CBCT, the distance between the maxillary central teeth (11,21) and the nasopalatine canal in the axial plane was calculated as the shortest distance from the apex of the maxillary central tooth to the anterior wall of the nasopalatine canal (Figure 1).

The distance between the maxillary anterior teeth (11,12,21,22) and the floor of the nasal cavity was calculated by measuring the distance from the point where the line passing through the long axis of the maxillary anterior teeth in the sagittal plane in the CBCT intersects the apex of the tooth to the closest distance drawn to the lower wall of the nasal cavity floor (Figure 2).

Buccal cortical bone thickness was calculated by measuring the distance from the anterior border of the buccal cortical bone to the long axis of the teeth at the level of the apices of the maxillary anterior teeth (11,12,21,22) (Figure 3).

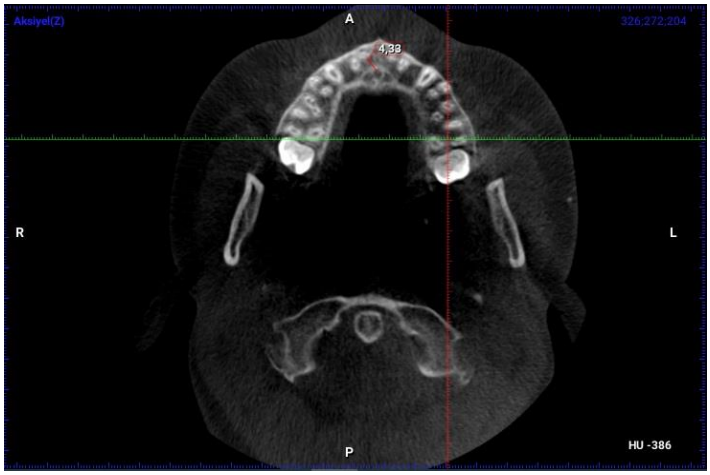


Figure 1: Measurement of the distance of the maxillary central teeth to the nasopalatine canal in the axial plane on CBCT.

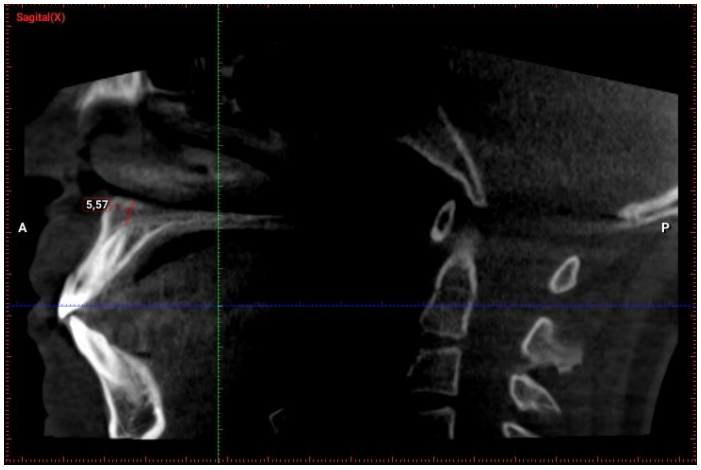


Figure 2: Measurement of the distance of the maxillary anterior teeth to the floor of the nasal cavity in the sagittal plane on CBCT.

The root apex openings of the maxillary anterior teeth were evaluated by CBCT and those with root apex openings of more than 1 mm were classified as open apex and those with root apex openings of less than 1 mm were classified as closed apex (Figure 4).

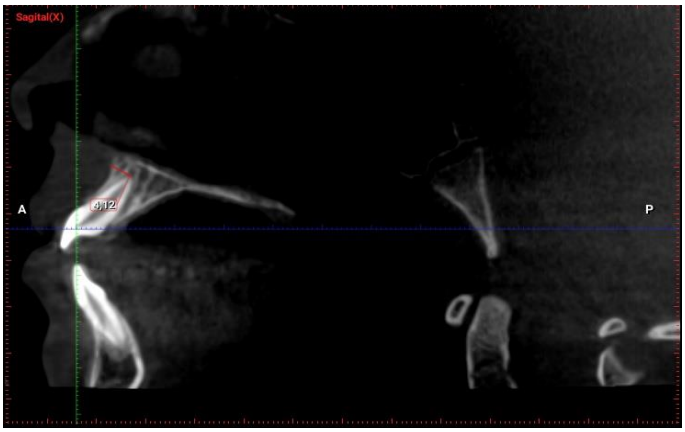


Figure 3: Measurement of the distance of the root apices of maxillary anterior teeth to the buccal cortical bone in the sagittal plane on CBCT.

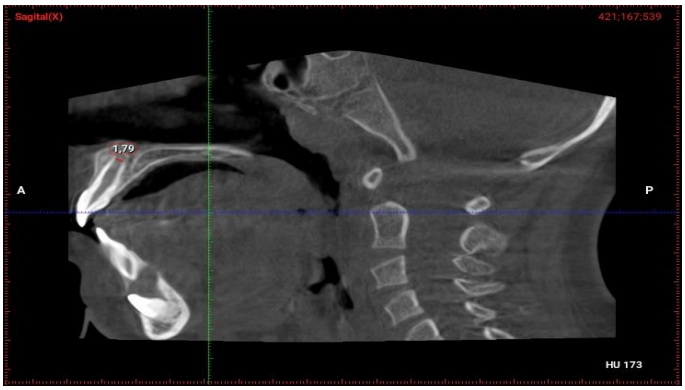


Figure 4: Evaluation of the apices of maxillary anterior teeth as open or closed in the sagittal plane on CBCT.

The mean distance between the maxillary anterior teeth and the floor of the nasal cavity and the distance between the maxillary central teeth and the nasopalatine canal were calculated and these values were compared in terms of gender and whether the teeth had open or closed apex.

Statistical Analysis

SPSS 22.0 computer program was used for data analysis. Number, mean, standard deviation, and percentage calculations were used for descriptive statistics. Student's t test, the Mann Whitney U test, one-way ANOVA, and the Kruskal Wallis test were used for comparisons within groups. Significance was evaluated as $p<0.05$.

Results

The study included 49 patients because the image quality in the maxillary anterior region was not acceptable in 16 of 65 patients who underwent CBCT. Of these 49 patients, 23 were male and 26 were female. The mean age of the patients included in the study was 12.1±1.8 years. In each of 49 patients, a total of 196 teeth, including 2 maxillary central and 2 maxillary lateral teeth, were examined. Among the maxillary anterior teeth in the examined CBCTs, 8 patients had 4 teeth with open apex and 41 patients had 4 teeth with closed apex.

The mean distances of the maxillary central teeth (11,21) to the nasopalatine canal in the examined CBCTs were calculated as 3.63 mm and 3.7 mm, respectively. There was no significant correlation in the mean distance of the maxillary central teeth (11,21) to the nasopalatine canal regarding the presence of open/closed apex and gender ($p>0.05$).

When the mean distances of the maxillary anterior teeth (11,21,12,22) to the nasal fossa were evaluated, it was observed that the distance of the base of the nasal cavity with tooth number 22 was the greatest and the distance with tooth number 12 was the least. The distances of the maxillary central teeth (11,21) to the floor of the nasal cavity were similar ($p=0.01$) (Table 1). There was no significant difference in the mean distance of the maxillary anterior teeth (11,21,12,22) to the floor of the nasal cavity when evaluated in terms of gender and open/closed apex status of the teeth ($p>0.05$).

Among the maxillary anterior teeth, the buccal cortical bone thickness was the highest in tooth number 12 and the lowest in tooth number 21 ($p=0.03$) (Table 2). When the mean buccal cortical bone thickness of maxillary anterior teeth was evaluated in terms of gender, no significant difference was found ($p>0.05$).

It was found that the mean buccal cortical bone thickness of maxillary anterior teeth 11 and 21 with open apex was significantly thicker than those with closed apex ($p<0.05$) (Table 3).

Table 1: Evaluation of the mean distance of maxillary anterior teeth from the floor of the nasal cavity

Tooth no	Average distance to the nasal cavity	p
11	5.53 mm	0.01*
21	5.62 mm	
12	4.19 mm	
22	7.52 mm	

** One-way ANOVA test, * significance at 0.05 level

Table 2: Evaluation of mean buccal cortical bone thickness of maxillary anterior teeth

Tooth no	Mean buccal bone thickness	p
11	3.83 mm	0.03*
21	3.55 mm	
12	4.19 mm	
22	3.99 mm	

*One-way ANOVA test. **Significance at 0.05 level

Table 3: Evaluation of the mean buccal cortical bone thickness of maxillary anterior teeth according to whether the teeth have an open or closed apex

Tooth no	Open apex	Closed apex	p
11	4.49 mm	3.7 mm	0.049*
21	4.21 mm	3.42 mm	0.035*
12	3.63 mm	4.31 mm	0.151
22	3.54 mm	4.07 mm	0.227

*One-way ANOVA test. **Significance at 0.05 level

Discussion

In maxillary anterior teeth, the relationship of these teeth with the nasopalatine canal and the floor of the nasal fossa and the thickness of the buccal cortical bone gain importance due to the frequent occurrence of traumatic dental injuries such as intrusion or lateral luxation, overflow filling during faulty root canal treatment, and apical surgery/implantation in this region (3).

The distance between the maxillary central tooth apices and the nasopalatine canal is needed due to complications such as paresthesia and bleeding occurring in this region (11). Gönül et al. calculated this distance as 2.56 ± 0.80 and found no significant difference between genders (11). In a study, it was reported that the distance between the apices of the maxillary central teeth and the nasopalatine canal varies between 4.01 and 5.00 mm and this distance increases with age (12). In the present study, the mean distance of the maxillary central teeth to the nasopalatine canal ranged between 3.63 and 3.7 mm, but no significant difference was found in terms of gender and open/closed apex.

Due to the flexibility of the alveolar bone, traumatic injuries such as intrusion and extrusion are common in the primary dentition, while the incidence of intrusion decreases during the permanent dentition (9). In the case presented by Thor, the maxillary deciduous central tooth was displaced towards the nasal cavity due to intrusion in a 3-year-old child. Martin stated in a case report that the maxillary permanent lateral tooth intruded into the nasal cavity as a result of trauma. In addition to these, many other studies have reported displacement of maxillary permanent incisors into the nasal cavity as a result of traumatic injury (13-16).

In their study, Ducommun et al. measured the shortest distance between the base of the nasal cavity and the apices of the maxillary central teeth and the lateral teeth as 8.54 mm and 9.49 mm, respectively (17).

In the present study, the shortest distance between the base of the nasal cavity and the apices of the maxillary central teeth was 5.53 mm, while the shortest distance to the lateral teeth was 4.19 mm. The difference in these values may be due to the variation in the selected population. In the present study, it was observed that the distance between the base of the nasal cavity and tooth number 22 was the greatest, while the distance between tooth number 12 was the least. In line with the present data, it should be taken into consideration that perforation in the nasal cavity may occur in cases of intrusion occurring in tooth number 12 due to its anatomical proximity.

Buccal cortical bone thickness is important for implant placement, periodontal surgery, and evaluation of bone perforation of the lesion in teeth with apical periodontitis (18). In addition, buccal cortical bone can be damaged in traumatic dental injuries such as lateral luxation (19). In a literature review, it was observed that a small number of maxillary anterior teeth had a buccal cortical bone thickness of more than 1 mm (20). In addition, the thickness of the buccal cortical bone increases from anterior to posterior in the dental arch and from coronal to apical along the root surface of the tooth (20). Koç et al. reported no significant relationship between buccal cortical bone thickness of maxillary anterior teeth and age and gender (21). In addition, in this study, the average buccal cortical bone thickness was the highest around the right canine with 1.91 mm and the lowest around the right lateral with 0.35 mm. Yıldız reported that the buccal cortical bone thickness between the maxillary lateral and canine teeth was greater than the bone thickness between the maxillary central and lateral teeth. In the present study, the average buccal cortical bone thickness of the maxillary anterior tooth number 12 was more than the other teeth, while the average buccal cortical bone thickness of the tooth number 21 was less than the other teeth.

It was reported that the buccal cortical bone thickness in the apical part of the maxillary anterior teeth was greater in males than in females (22).

In the present study, there was no significant difference when the buccal cortical bone thickness of maxillary anterior teeth was evaluated in terms of gender.

There exists no study in which the relationship of maxillary anterior teeth with the anatomical structures in this region was compared with the apex opening status and buccal cortical bone thickness of these teeth. In the present study, buccal cortical bone thickness was higher in maxillary central teeth with open apex than in teeth with closed apex. In line with these data, in cases requiring apical surgery in teeth with an open apex, the fact that the bone thickness is higher than in teeth with a closed apex should be taken into consideration during the operation.

This retrospective study has some limitations. The present study was conducted in a small population. Further studies in large populations are needed to obtain more precise data.

Conclusions

The buccal cortical bone thickness of maxillary central teeth with closed apexes is higher than that of open apexes, which makes apical surgical applications in this region difficult.

Acknowledgements
None
Conflicts of Interest statement
None

References

1. AlAli F, Atieh MA, Hannawi H, Jamal M, Harbi NA, Alsabeeha NHM, Shah M. Anterior Maxillary Labial Bone Thickness on Cone Beam Computed Tomography. Int Dent J. 2023;73(2):219-27.
2. Taschieri S, Weinstein T, Rosano G, Del Fabbro M. Morphological features of the maxillary incisors roots and relationship with neighbouring anatomical structures: possible implications in endodontic surgery. Int J Oral Maxillofac Surg. 2012;41(5):616-23.
3. Todi A, Singh MK, Kayal S, Das G, Chakraborty A. Assessment of insertion force for the placement of cortical implants in various anatomic sites in dried human skulls. J Indian Soc Periodontol. 2022;26(6):544-51.
4. Schatz JP, Ostini E, Hakeberg M, Kiliaridis S. Large overjet as a risk factor of traumatic dental injuries: a prospective longitudinal study. Prog Orthod. 2020;21(1):41.
5. Andersson L, Petti S, Day P, Kenny K, Glendor U, Andreasen JO. Classification, Epidemiology and Etiology. In: Andreasen JO, Andreasen FM, Andersson L, editors. Textbook and color atlas of traumatic injuries to the teeth. 5th ed. Hoboken: John Wiley & Sons Ltd; 2019;252–94.
6. Tewari N, Bansal K, Mathur VP. Dental Trauma in Children: A Quick Overview on Management. Indian J Pediatr. 2019 Nov;86(11):1043-1047.
7. Jain NV, Gharatkar AA, Parekh BA, Musani SI, Shah UD. Three-Dimensional Analysis of the Anatomical Characteristics and Dimensions of the Nasopalatine Canal Using Cone Beam Computed Tomography. J Maxillofac Oral Surg. 2017;16(2):197-204.
8. Hermann NV, Lauridsen E, Ahrensburg SS, Gerds TA, Andreasen JO. Periodontal healing complications following extrusive and lateral luxation in the permanent dentition: a longitudinal cohort study. Dent Traumatol. 2012;28(5):394-402.
9. Andersson L, Andreasen JO, Day P, Heithersay G, Trope M, Diangelis AJ, Kenny DJ, Sigurdsson A, Bourguignon C, Flores MT, Hicks ML, Lenzi AR, Malmgren B, Moule AJ, Tsukiboshi M, International Association of Dental Traumatology. International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 2. Avulsion of permanent teeth. Dent Traumatol. 2012;28(2):88-96.
10. Jonaityte EM, Bilvinaite G, Drukteinis S, Torres A. Accuracy of Dynamic Navigation for Non-Surgical Endodontic Treatment: A Systematic Review. J Clin Med. 2022;11(12):3441.
11. Gönül Y, Bucak A, Atalay Y, Beker-Acay M, Çalişkan A, Sakarya G, Soysal N, Cimbar M, Özbek M. MDCT evaluation of nasopalatine canal morphometry and variations: An analysis of 100 patients. Diagn Interv Imaging. 2016;97(11):1165-72.
12. Chatriyanuyoke P, Lu CI, Suzuki Y, Lozada JL, Rungcharassaeng K, Kan JY, Goodacre CJ. Nasopalatine canal position relative to the maxillary central incisors: a cone beam computed tomography assessment. J Oral Implantol. 2012;38(6):713-7.
13. Antunes AA, Santos TS, Carvalho de Melo AU, Ribiero CF, Goncalves SR, de Mello Rode S. Tooth embedded in lower lip following dentoalveolar trauma: case report and literature review. Gen Dent. 2012;60(6):544-7.
14. Costa VP, Barbosa MV, Goettems ML, Torriani MA, Castagno CD, Baldissera EF, Torriani DD. Primary incisor intruded through the nasal cavity: a case report. Gen Dent. 2016;64(3):64-7.
15. Yonezawa H, Yanamoto S, Hoshino T, Yamada S, Fujiwara T, Umeda M. Management of maxillary alveolar bone fracture and severely intruded maxillary central incisor: report of a case. Dent Traumatol. 2013;29(5):416-9.
16. Noleto JW, de Abreu NMR, Dos Santos Vicente KM, da Silva AVNA, Seixas DR, de Figueiredo LS. Intrusive luxation of permanent upper central incisor into the nasal cavity: A case report. Dent Traumatol. 2022;38(2):160-4.
17. Ducommun J, Bornstein MM, Wong MCM, von Arx T. Distances of root apices to adjacent anatomical structures in the anterior maxilla: an analysis using cone beam computed tomography. Clin Oral Investig. 2019;23(5):2253-63.
18. de Souza FN, de Siqueira Gomes C, Rodrigues AR, Tiossi R, de Gouvêa CV, de Almeida CC. Partially Edentulous Arches: A 5-Year Survey of Patients Treated at the Fluminense Federal University Removable Prosthodontics Clinics in Brazil. J Prosthodont. 2015;24(6):447-51.
19. Gurunathan D, Murugan M, Somasundaram S. Management and Sequelae of Intruded Anterior Primary Teeth: A Systematic Review. Int J Clin Pediatr Dent. 2016;9(3):240-50.
20. Tsigarida A, Toscano J, de Brito Bezerra B, Geminiani A, Barmak AB, Caton J, Papaspyridakos P, Chochlidakis K. Buccal bone thickness of maxillary anterior teeth: A systematic review and meta-analysis. J Clin Periodontol. 2020;47(11):1326-43.
21. Koç A, Kavut İ, Uğur M. Assessment of Buccal Bone Thickness in The Anterior Maxilla: A Cone Beam Computed Tomography Study. Cumhuriyet Dent J. 2019;22(1):102-7.
22. Yildiz, FN. Maksiller anterior bölgede bukkal kortikal kemik kalınlığının ve bukkal andırkatın alveoler kret boyutları ile ilişkisinin konik ışınlı bilgisayarlı tomografi ile değerlendirilmesi. Gazi Üniversitesi; 2018.

Farklı Fiberle Güçlendirilmiş Kompozit Rezinler ile Tedavi Edilen Kök Kanal Tedavili Maksiller Kesici Dişlerde Oluşan Stres Dağılımının Sonlu Elemanlar Analizi ile Değerlendirilmesi

Evaluation of Stress Distribution in Root Canal Treated Maxillary Incisors Treated with Different Fiber-Reinforced Composite Resins by Finite Element Analysis

Özge Sönmez Uzel[1*], Buket Ayna[1]

1.Dicle University Faculty of Dentistry, Department of Pediatric Dentistry, Diyarbakır, Türkiye.

***Corresponding author:** Uzel ÖS, MSc. Department of Pediatric Dentistry, Faculty of Dentistry, Dicle University, Diyarbakır, Turkey.
E-mail : dt.sonmezozge@gmail.com
DOI: 10.61139/ijdor.1310349

.

Özet

Amaç: Bu çalışmanın amacı, maksiller kesici dişte horizontal ve oblik iki farklı kırık tipine sahip diş modellerinde farklı fiberle güçlendirilmiş kompozit rezin (FGKR) restorasyonlarının fonksiyonel kuvvetler altında oluşturduğu stresin sonlu elemanlar analizi (SEA) yöntemiyle değerlendirilmesidir.
Materyal ve Metod: Kök gelişimi tamamlanmış bir maksiller kesici diş mikrobilgisayarlı tomografi cihazında taranmıştır. Elde edilen bilgilerle üç boyutlu kök gelişimi tamamlanmış maksiller kesici diş modeli oluşturularak, horizontal ve oblik kırığa sahip iki farklı grup oluşturulmuştur. Örnek model esas alınarak, kök kanal tedavisi yapılmış horizontal ve oblik kırık hattı oluşturulmuş, maksiller kesici diş modelleri farklı FGKR ile restore edilerek üç boyutlu olarak simüle edilmiştir. Ardından dişlerde fonksiyonel kuvvet altında oluşan stresler SEA yöntemiyle değerlendirilmiştir.
Bulgular: FGKR kullanılan modellerde kök dentininin servikal bölgesi ve restoratif materyalde oluşan stresler azalmıştır. Tüm modeller incelendiğinde hem kök dentininin servikal bölgesinde hem de restoratif materyalde en yüksek stres değerleri yalnızca kompozit rezin kullanılan modellerde görülmüştür. En düşük stres değerleri ise prefabrik uzun cam fiber post kullanılan modellerde görülmüştür. Horizontal kırık hattına sahip olan modellerde oblik kırık hattına sahip modellere göre oluşan streslerin daha fazla olduğu görülmüştür.
Sonuç: Kron fraktürüne sahip dişlerde FGKR kullanımı hem kök dentininin servikal bölgesinde oluşan stresleri hem de restoratif materyaldeki stresleri azaltmaya yardımcı olacaktır.

Research Article (HRU Int J Dent Oral Res 2023; 3(2): 91-98

Anahtar Sözcükler: FGKR, SEA, nanofil kompozit, post, komplike kron kırığı.

Abstract

Objective: The aim of this study is to evaluate the stress caused by different fiber reinforced composite resin (FRCR) restorations under functional forces in tooth models with two different types of horizontal and oblique fractures in the maxillary incisor using finite element analysis (FEA) method.
Materials and Methods: A maxillary incisor with complete root development was scanned in a microcomputed tomography device. With the information obtained, two different groups with horizontal and oblique fractures were formed by creating a maxillary incisor model with three-dimensional root development. Based on the sample model, root canal treatment was performed, horizontal and oblique fracture lines were created, maxillary incisor models were

restored with different FRCR and simulated in three dimensions. Then, the stresses occurring in the teeth under functional force were evaluated with the FEA method.
Results: In models using FRCR, the stresses on the cervical region of root dentin and restorative material were reduced. When all models were examined, the highest stress values in both the cervical region of root dentin and the restorative material were observed in models using only composite resin. The lowest stress values were observed in the models using prefabricated long glass fiber post. It was observed that the stresses occurring in the models with the horizontal fracture line were higher than the models with the oblique fracture line.
Conclusion: The use of FGKR in teeth with crown fractures will help reduce both the stresses in the cervical region of root dentin and the stresses on the restorative material. Models restored with FGKR created less stress and strengthened the tooth structure more.

Research Article (HRU Int J Dent Oral Res 2023; 3(2): x-x)

Keywords: FRCR, FEM, nanofil composite, post, complicated crown fracture.

Giriş

Çocuk diş hekimliğinde sıklıkla karşılaşılan travmatik dental yaralanmalar (TDY), çocuklarda diş çürüklerinden sonra en sık karşılaşılan durumdur (1). Süt dişlerinde lüksasyon yaralanmaları, daimi dişlerde ise kron kırıkları en fazla meydana gelen TDY'dir (2). Daimi maksiller kesici dişler bukkale eğimli olmaları ve bu sebeple düşme sırasında darbeyle karşılaşma ihtimallerinin fazla olmasından ötürü TDY'den en fazla etkilenen dişlerdir (3). TDY sonrası mine, dentin ve pulpayı içeren kırıklarda, kök gelişimini tamamlamış dişlerde pulpa nekrozu görülme oranı kök gelişimini tamamlamamış dişlere oranla daha yüksektir ve dişin canlılığının devam ettirilemediği durumlarda kök kanal tedavisi (KKT) sonrası fonksiyon, fonasyon ve estetiğin de geri kazandırılması gerekmektedir (4). Restoratif planlamada her zaman öncelikle direkt restorasyonlar gibi konservatif tedavi seçenekleri düşünülmeli; konservatif tedavi seçenekleri yetersizse daha az invaziv tedavi yöntemlerinden, invaziv tedavi yöntemlerine doğru bir tedavi yaklaşımı izlenmelidir (5).

Anterior dişler lateral ve kesme tipi kuvvetlerine sıklıkla maruz kalmaktadırlar. Marjinal sırtlar, singulum ve insizal kenar sağlamsa ve küçük bir giriş kavitesi ile KKT gerçekleştirilmişse, giriş kavitesinin kompozit rezinle restorasyonu yeterli olmaktadır (6). Bununla birlikte, TDY sonrası kron fraktürü gibi ciddi diş dokusu kayıplarında ise tutuculuk ve direncin sağlanması için post yerleştirilmesi gerekebilir (7).

KKT uygulanmış dişlerin restorasyonlarında rijit materyallerden yapılan postlar yerine elastiklik katsayısı dentine çok yakın olması sayesinde daha az kök kırığına sebep olması beklenen fiberle güçlendirilmiş kompozit rezin (FGKR) postların kullanımı metal postlara alternatif bir tedavi yaklaşımı oluşturmaktadır (8).

FGKR'ler, post amacıyla prefabrike postlar ve özelleştirilmiş postlar olarak klinikte kullanılmaktadırlar. Prefabrike fiber post sistemlerinin tasarımlarına uygun kanal preparasyon frezleri bulunmaktadır ve post boşluğunun bu frezlerle açılmasını takiben aynı seansta uygun simanlarla ilgili dişe uygulanmaktadırlar (9). Özelleştirilmiş post sistemleri genellikle doğrudan kök kanalına uygulanan cam veya polietilen fiberlerden oluşmaktadır. FGKR'lerin bu uygulaması birçok diş hekimi tarafından kullanılmasına rağmen, bu tekniğin diş hekimliğinde uygulanmasını destekleyen bilimsel çalışmalara ihtiyaç devam etmektedir (9, 10).

Son yıllarda baryum cam dolgulu kısa cam fiberle güçlendirilmiş bir kompozit rezin piyasa sürülmüştür (GC Everx Posterior®). Üreticiler bu kısa cam fiber ile güçlendirilmiş kompozit rezinin, KKT sonrası restorasyonun başarısızlığının esas nedeni olan çatlak oluşumunu önlediğini ve restorasyonu güçlendirdiğini iddia etmektedirler (11).

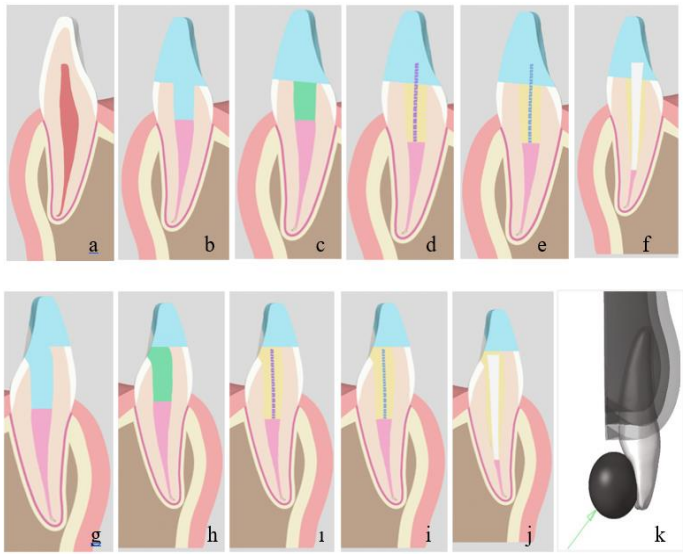
Diş hekimliğinde kullanılan materyallerin biyomekanik özelliklerini değerlendirmek ve restorasyonlarda oluşan streslerin incelenmesi amacıyla, bu yapıların stres analizlerinin yapılması sıklıkla başvurulan bir yöntemdir. Sonlu Elemanlar Analizi (SEA), çeşitli mekanik problemlere çözüm arayan bilgisayar destekli sayısal bir analiz yöntemidir. Bu sebeple, stres analiz çalışmalarının canlı dokuları simüle eden modeller üzerinde yapılması tercih edilmektedir (12).

Bu çalışmanın amacı, TDY sonrası en sık karşılaşılan horizontal ve oblik kron kırığında KKT'si sonrası kısa ve uzun farklı fiber post sistemleri ile kısa cam fiber takviyeli kompozit kullanarak yapılan restorasyonların fonksiyonel kuvvetler altında oluşturduğu stresi değerlendirmektir.

Gereç ve Yöntem

Bu çalışma Dicle Üniversitesi Diş Hekimliği Fakültesi Etik Kurulu tarafından 30.03.2022 tarihli 2022-18 numaralı karar ile onaylanmıştır. Çalışmada 13 yaşındaki erkek çocuğun, tek kök ve tek kanallı, kök gelişimi tamamlanmış, restorasyonsuz ve çürüksüz, avülse olmuş maksiller kesici diş verileri kullanılmıştır. Tomografi verisinden stl. (Standard Triangle Language) modelin elde edilmesi 3D Slicer yazılımında yapılmıştır. Tersine mühendislik ve üç boyutlu CAD faaliyetleri ANSYS Spaceclaim yazılımı, katı modellerin analiz ortamına uygun hale getirilmesi ve optimize ağ örgüsünün oluşturulması faaliyetleri ANSYS Workbench yazılımı ile gerçekleştirilmiştir. Oluşturulan sonlu elemanlar modellerinin çözümü için LS-DYNA çözücüsü kullanılmıştır. Tüm modellerde yükleme; çiğneme kuvvetini simüle edecek şekilde palatinalden labiale doğru, foodstuff üzerinden, 45^0 açıyla 100 N büyüklüğünde uygulanmıştır.

Model 1: Sağlıklı kök gelişimi tamamlanmış maksiller kesici diş modellenmiştir.
Model 2: KKT'li horizontal kırık hattına sahip maksiller kesici diş nanofil kompozit rezin ile restore edilerek modellenmiştir.
Model 3: KKT'li horizontal kırık hattına sahip maksiller kesici dişin mine sement sınırına kadar kök kanalı boşaltılarak, kısa fiberle güçlendirilmiş kompozit rezin kaviteye yerleştirilerek, kırık hattı nanofil kompozit rezin ile restore edilerek modellenmiştir.
Model 4: KKT'li horizontal kırık hattına sahip maksiller kesici dişin mine sement sınırının 2 mm altına kadar kök kanalı boşaltılarak, önceden doyurulmuş örgü yapıda cam fiber dual cure rezin siman ile simante edilerek, kırık hattı nanofil kompozit rezin ile restore edilerek modellenmiştir.
Model 5: KKT'li horizontal kırık hattına sahip maksiller kesici dişin mine sement sınırının 2 mm altına kadar kök kanalı boşaltılarak, leno dokuma polietilen fiber dual cure rezin siman ile simante edilerek, kırık hattı nanofil kompozit rezin ile restore edilerek modellenmiştir.
Model 6: KKT'li horizontal kırık hattına sahip maksiller kesici dişin kök kanal dolgu maddesi kök ucunda 4 mm kalacak şekilde boşaltılarak, önceden doyurulmuş tek yönlü cam fiber post dual cure rezin siman ile simante edilerek, kırık hattı nanofil kompozit rezin ile restore edilerek modellenmiştir.
Model 7: KKT'li oblik kırık hattına sahip maksiller kesici diş nanofil kompozit rezin ile restore edilerek modellenmiştir.
Model 8: KKT'li oblik kırık hattına sahip maksiller kesici dişin mine sement sınırına kadar kök kanalı boşaltılarak, kısa fiberle güçlendirilmiş kompozit rezin kaviteye yerleştirilerek, kırık hattı nanofil kompozit rezin ile restore edilerek modellenmiştir.
Model 9: KKT'li oblik kırık hattına sahip maksiller kesici dişin mine sement sınırının 2 mm altına kadar kök kanalı boşaltılarak, önceden doyurulmuş örgü yapıda cam fiber dual cure rezin siman ile simante edilerek, kırık hattı nanofil kompozit rezin ile restore edilerek modellenmiştir.
Model 10: KKT'li oblik kırık hattına sahip maksiller kesici dişin mine sement sınırının 2 mm altına kadar kök kanalı boşaltılarak, leno dokuma polietilen fiber dual cure rezin siman ile simante edilerek, kırık hattı nanofil kompozit rezin ile restore edilerek modellenmiştir.
Model 11: KKT'li oblik kırık hattına sahip maksiller kesici dişin kök kanal dolgu maddesi kök ucunda 4 mm kalacak şekilde kök kanalı boşaltılarak, önceden doyurulmuş tek yönlü cam fiber post dual cure rezin siman ile simante edilerek, kırık hattı nanofil kompozit rezin ile restore edilerek modellenmiştir (Şekil 1).



Şekil 1. Çalışma için hazırlanan modellerin şematik görüntüsü (a-j). Çelik küre modeliyle simule edilen çiğneme kuvveti (k).

Çalışmamızda modellenen tüm dokuların ve restorasyonda kullanılan tüm materyallerin fiziksel özelliklerini temsil eden elastik modülü ve poisson oranları ise mevcut literatürlerden alınmıştır (Tablo 1).

Tablo 1. Kullanılan materyallerin elastik modülü ve poisson oranları (13-22)

Materyal	Elastik Modül [MPa]	Poisson Oranı	Renkler
Kortikal kemik (13)	13700	0,30	
Trabeküler kemik (13)	1370	0,30	
Periodontal ligament (13)	68,9	0,45	
Dentin (13)	18600	0,31	
Gutta percha (13)	0,69	0,45	
Mine (14)	84100	0,33	
Mukoza (15)	3	0,45	
Pulpa (16)	3	0,45	
Kompozit rezin (Filtek Supreme XT,3M ESPE, St Paul, MN, USA) (17)	12700	0,35	
Uzun cam fiber post (Snowlight, Carbotech, USA) (18)	49000	0,28	
Dual cure rezin siman (Panavia F 2.0, Kuraray Medical Inc, Osaka, Japonya) (19)	18600	0,28	
Kısa fiber takviyeli kompozit rezin (EverXposterior, GC, Tokyo, Japan) (20)	12300	0,24	
Leno dokuma polietilen fiber (Ribbond, Ribbond Inc., Seattle, WA, USA) (21)	23600	0,32	
Örgü yapıda cam fiber (İnterlig, Angelus, Brazil) (22)	X,Y: 7000 Z: 46000	X,Y:0.29 Z:0.30	
Food stuff (çelik küre)	200000	0,30	

BULGULAR

Sağlıklı diş modeli ile horizontal ve oblik kırık hattına sahip diş modellerinde oluşan stress miktarları Tablo 2'de gösterilmektedir.

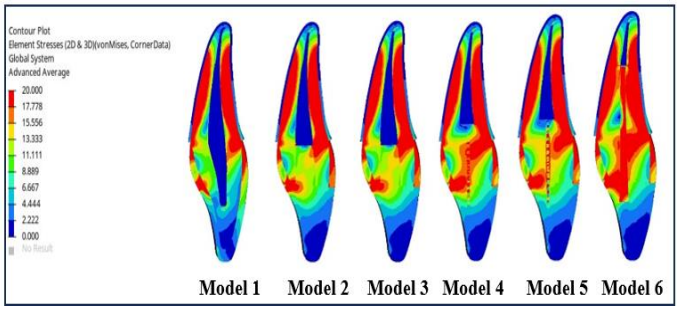
Tablo 2. Bütün modellerin stres miktarları ve modellerde kullanılan materyallerin iç stres miktarları

Model	Kullanılan Materyal	Servikal Stres (MPa)	Restorasyonda oluşan stres
Model 1	-	19.754	-
Model 2	Nanofil kompozit rezin	19.992	10.970
Model 3	Kısa fiber takviyeli kompozit rezin	19.917	10.839
Model 4	Örgü yapıda cam fiber post	19.572	10.206
Model 5	Leno dokuma yapıda polietilen fiber post	19.565	10.126
Model 6	Tek yönlü uzun cam fiber post	18.779	9.547
Model 7	Nanofil kompozit rezin	19.773	10.488
Model 8	Kısa fiber takviyeli kompozit rezin	19.761	10.302
Model 9	Örgü yapıda cam fiber post	19.503	10.006
Model 10	Leno dokuma yapıda polietilen fiber post	19.439	9.120
Model	Tek yönlü uzun	18.441	8.485

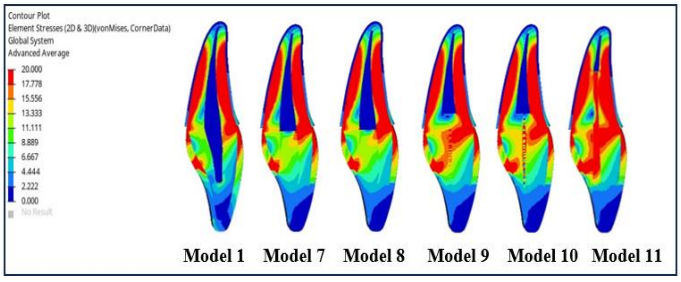
11	cam fiber post

Horizontal ve oblik kırık modelleri incelendiğinde en yüksek stres alanının kök dentinin servikal bölgesinin bukkal yüzeyi olduğu görülmüştür. Hem servikal kök dentininde hem de kırık restorasyonu için kullanılan kompozit rezin materyalinde oluşan stresler incelendiğinde, en yüksek stres değerlerini kompozit rezin ve kısa fiber takviyeli kompozit rezinin altyapı materyali olarak kullanıldığı modeller gösterirken, fiber post kullanılarak restore edilen dişler daha az stres değerleri göstermiştir. Kompozit rezinle restore edilen modeller kendi içinde kıyaslandığında kısa fiber takviyeli kompozit rezinin altyapı materyali olarak kullanıldığı modellerde daha az stresin meydana geldiği ve meydana gelen stresin sağlıklı diş modelinden daha yüksek olduğu gözlenmiştir. Farklı fiber post kullanılarak restore edilen modellerde ise en az stres değerini tek yönlü cam fiber post gösterirken onu sırasıyla leno dokuma yapıda polietilen fiber post ve örgü yapıda cam fiber post modeli takip etmiştir. Sağlıklı dişle kıyaslandığında fiber post kullanılan modellerde servikal bölgede daha az stres meydana geldiği gözlenmiştir (Şekil 2,3).

Horizontal ve oblik kırık modelleri karşılaştırıldığında, oblik kırık hattına sahip modellerde hem servikalde hem de restorasyonda meydana gelen stres değerlerinin horizontal kırık hattına sahip modellere göre daha düşük olduğu gözlenmiştir (Şekil 2,3).



Şekil 2. Sağlıklı diş modeli ve horizontal kırık hattına sahip diş modellerinin kıyaslanması.



Şekil 3. Sağlıklı diş modeli ve oblik kırık hattına sahip diş modellerinin kıyaslanması.

TARTIŞMA

Çocuk diş hekimliğinde, büyüme ve gelişim dönemindeki hastaların TDY sonrasında meydana gelen komplike kron kırıklarının KKT sonrası uygulanan post-kor restorasyonlarında kor ve kron genellikle kompozit rezinlerle tamamlanmaktadır (18). Günümüzde aşırı kron harabiyeti bulunan dişlerde dahi seramiklere alternatif olarak kompozit rezinler tercih edilmektedir (23). Bazı klinik raporlar, doğrudan kompozit rezin restorasyonların, geleneksel tam kron tedavisine alternatif olduğunu bildirse de, mevcut kompozit rezinlerin nispeten yüksek kırılganlığı ve düşük kırılma tokluğu kullanımlarını sınırlandırmaktadır (24, 25). Candan ve ark.'nın yaptıkları bir in vitro çalışmada farklı altyapı materyalleri kullanılmasının nanofil kompozit rezinin eğilme direncine etkisi değerlendirilmiştir. Bu çalışma sonucuna göre, yalnızca nanofil kompozit rezin kontrol grubunun en düşük eğilme direncine sahip olduğu, ulaşılan en yüksek eğilme direncinin akışkan kompozit rezinle birlikte fiber kullanılan örnek grubu olduğu bildirilmiştir (26). Pierrisnard ve ark.'nın yapmış oldukları bir SEA çalışmasında da 2 mm ferruleye sahip olan ve ferrulesiz diş modelleri yalnızca kompozit rezinle ve farklı post sistemleri ile simule edilmiştir. Çalışma sonuçları, en yüksek stresin kök dentininin servikal bölgesinde gözlendiğini ve en fazla stresin yalnızca kompozit ile restore edilen modellerde meydana geldiğini göstermiştir_(27). Yapılmış olan çalışma sonuçları, bu çalışmayla uyumlu olup en yüksek stres değerlerinin hem kök dentininin servikal bölgesi hem de restoratif materyal için yalnızca kompozit rezinle restore edilen modellerde gözlenmesini destekler niteliktedir.

Kompozit rezinlerin gelişimlerine rağmen özellikle yüksek stres altında kalan bölgelerde kırılma ve eğilme direncine dayanıklılıklarının yeterli olmaması sebebiyle kullanımlarının kısıtlı olduğu bildirilmiştir. Bu sebeple kompozit rezin materyallerin fiber ile güçlendirilmesi gündeme gelmiştir (26).

Eapen ve ark.'larının yapmış oldukları bir in vitro çalışmada, KKT'li dişlerdeki restorasyonlarda kompozit rezinlerin altında kısa fiber takviyeli kompozit rezinlerin alt yapı olarak kullanılması sayesinde kalan diş dokusunun daha fazla korunduğu ve kırılma direncinin daha yüksek olduğu bildirilmiştir (28). KKT sonrası farklı kaide materyallerinin stres üzerindeki etkilerini inceleyen bir SEA çalışmasında da kısa fiber takviyeli

kompozit rezinlerin dentinle benzer elastik modülüne sahip olması sebebiyle restorasyon içinde ve dişte meydana gelebilecek yüksek gerilimlerden kaçınmak amacıyla kullanımının avantajlı olduğu bildirilmiştir (29). Bu çalışmada elde ettiğimiz sonuçlar in vitro ve SEA çalışmaları ile paralellik göstermektedir. Kısa fiber takviyeli kompozit rezinin altyapı materyali olarak kullanıldığı modellerde meydana gelen streslerin, yalnızca nanofil kompozit rezin kullanılarak yapılan restorasyon modellerinden daha az stres oluşturduğu görülmektedir. Nanofil kompozit altındaki kısa fiber takviyeli kompozit, meydana gelen stresleri absorbe ederek hem kök dentinin servikal bölgesinde hem de kırık hattının restorasyonu için kullanılan kompozit rezinde meydana gelen stresleri azaltmıştır. Bununla birlikte, Garoushi ve ark. KKT sonrası maksiller kesici dişlerin statik yük taşıma kapasitesini ve başarısızlık tiplerini değerlendirmek amacıyla yaptıkları bir in vitro çalışmada deneysel olarak ürettikleri kısa fiber takviyeli kompozit rezin ve fiber postları karşılaştırmışlardır. Çalışma sonuçlarına göre kısa fiber takviyeli kompozit rezinle restore edilen örneklerin fiber post uygulanan örneklerden daha düşük kırılma direnci gösterdiği bildirilmiştir (30). Bu çalışmada da fiber post uygulanan modellerde meydana gelen streslerin kısa fiber takviyeli kompozit rezin kullanılan modellerden daha az stres oluşturması Garoushi ve ark.'nın çalışmasıyla paralellik göstermektedir. Kısa fiber takviyeli kompozit rezin, fiber postlar kadar stresleri absorbe edememiş ve hem kök dentinin servikal bölgesinde hem de uygulanan restoratif materyalde fiber post uygulanan modellere göre daha fazla stres birikimine neden olmuştur. Dentinin stresleri absorbe edici özelliklerini taklit etmek için 2013 yılında piyasaya sürülen kısa fiber takviyeli kompozit rezinin yeni bir materyal olması sebebiyle bu materyal üzerinde yapılan in vitro ve SEA çalışma sayısı sınırlıdır. Bu nedenle, kısa fiber takviyeli kompozit rezinlerin güçlendirme kapasitesi üzerinde yapılacak yeni çalışmalara ihtiyaç duyulmaktadır.

Junior ve ark.'nın yaptıkları bir in vitro çalışmasında tek kat ve çift kat halinde uygulanan iki farklı tip (cam ve polietilen) fiberin ısıl döngüye tabi tutulup tutulmamasına göre eğilme dirençleri karşılaştırılmıştır. Çalışma sonuçlarına göre çift kat halinde uygulanan polietilen fiber, değerlendirilen diğer kombinasyonlarla karşılaştırıldığında, ısıl döngüden bağımsız olarak en yüksek eğilme direncini göstermiştir (31). Bu in vitro çalışma sonucuyla benzer olarak bu SEA çalışmasında da leno dokuma yapıda polietilen fiberin örgü yapıda cam fibere göre stresleri daha çok absorbe etme yeteneği olduğunu ve meydana gelen stresleri azattığını söyleyebiliriz. Leno dokuma yapıda polietilen fiber kullanılan modellerde hem servikal bölgede hem de restoratif materyalde daha az stres meydana geldiği görülmüştür. Mevcut literatürler incelendiğinde özelleştirilmiş post olarak kısa cam fiber post ve kısa polietilen fiber postların karşılaştırıldığı çalışmalara ihtiyaç duyulduğu görülmektedir.

Ramesh ve ark. 'nın yapmış oldukları bir in vitro çalışmada da palatobukkal ve labiopalatal iki kırık modeline sahip maksiller kesici dişlerin leno dokuma yapıda polietilen fiber post ve prefabrik cam fiber fiber post uygulanması sonrası kırılma direnci karşılaştırılmıştır (32). Çalışma sonucuna göre, prefabrik cam fiber post leno dokuma yapıda polietilen fiber post ile karşılaştırıldığında daha yüksek kırılma direnci göstermiştir. Bu in vitro çalışma sonucuyla paralel olarak bu SEA çalışmasında da prefabrik uzun cam fiber post modellerinde hem servikal kök dentininde hem de restorasyon materyalinde meydana gelen stres değerlerinin özelleştirilmiş örgü yapıda cam fiber post ve leno dokuma yapısında polietilen fiber post gruplarından daha düşük değerlere sahip olduğu görülmüştür. Tek yönlü fiberlerin, dokuma ve örgü yapıdaki fiberlerle kıyaslandığında materyalin esneme direncini iki yönlü fiberlere göre daha fazla arttırdığı bilinmektedir (33). Buna bağlı olarak, prefabrik uzun cam fiber post modellerinde görülen daha az stres oluşumu tek yönlü fiberlerin esneme direncinin daha iyi olması ile açıklanabilir.

Post tutuculuğunu maksimum düzeye çıkarmaya yardımcı olmak için uygun post uzunluğu önem arz etmektedir. Fakat, tutuculuk için ideal post uzunluğu hala tartışmalı bir konudur (34). Adanır ve ark.'nın maksiller kesici dişte cam fiber post materyalinin post uzunluğunun fonsiyonel kuvvetler altında meydana gelen stres dağılımına etkisini inceledikleri SEA çalışmasında ise post uzunluğu arttıkça materyalin iç bünyesinde stresi daha fazla tuttuğu ve kök dentininde daha az stres oluşturduğu bildirilmiştir (35). Bu çalışmanın sonuçları uzun post kullanımının stres dağılımını azalttığı ve kırılma direncini arttırdığı çalışmalar ile benzerlik göstermektedir. Prefabrik uzun cam fiber post, stresleri absorbe ederek servikal kök dentininde ve restorasyon materyalinde meydana gelen stresleri azaltmıştır.

Literatürler incelendiğinde maksiller kesici dişlerde çok sık karşılaşılan iki farklı kırık tipinin restorasyonunda farklı FGKR restorasyonların ve yalnızca nanofil kompozit restorasyonların uygulanarak meydana getirdikleri streslerin değerlendirildiği benzer

bir çalışma bulunmamaktadır. Bununla birlikte, yapılmış olan bazı çalışmalarda restorasyon amacıyla dişin servikal bölgesine yerleştirilen farklı materyallerin (MTA, biodentin, gutta percha vb.) sağlıklı diş kontrol grubuyla kıyaslandığında daha az stres oluşturduğu bildirilmiştir (36, 37). Bu çalışmada da fiber post modellerinin kök dentininin servikal bölgesinde sağlıklı diş modelinden daha düşük stres değerleri göstermesini, servikal bölgeye yerleştirilen fiber materyallerinin elasik modülünün dentinin elastik modülüyle çok yakın değerlere sahip olması nedeniyle meydana geldiğini söyleyebiliriz. Yalnızca kompozit rezin ve kısa fiber takviyeli kompozit rezinin altyapı materyali olarak kullanıldığı modellerde ise servikal kök dentininde stresleri absorbe edecek bir materyal olmaması sebebiyle bu modellerde meydana gelen stres değerleri hem sağlıklı diş modelinden hem de diğer fiber post uygulanan modellerden daha yüksek değerleri göstermiştir.

Bu çalışmada FGKR uygulamasının kök dentininin servikal bölgesindeki stres değerlerini azalttığı gibi restoratif materyaldeki stres değerlerini de benzer şekilde azalttığı görülmüştür. Bu SEA çalışması sonuçları KKT'li dişlerin konservatif restorasyonlarında fiber post kullanımı sayesinde kırılma direncinde artış gözlendiğini bildiren çalışmalarla paralellik göstermektedir. (38, 39). Fiber post uygulanan modellerde restoratif materyalde, yalnızca nanofil kompozit rezinle restore edilen modellerden ve kısa fiber takviyeli kompozit rezinin altyapı materyali olarak kullanıldığı modellerden daha düşük stres değerleri gözlenmiştir. Yalnızca nanofil kompozitle restore edilen modeller, çalışmalarla paralel olarak fiber post uygulanan modellerden daha yüksek stres değerleri göstermiştir.

Yapılan SEA çalışmaları, çeşitli varsayımlara dayandığından ötürü bazı sınırlılıkları bulunmaktadır. Bu sebeple birkaç detay idealize edilmekte, basitleştirilmekte ya da göz ardı edilmektedir. Buna karşın bu yöntemin, gerçek koşulların laboratuvarda ya da in vivo olarak doğrulanamadığı koşullarda stres-gerinim modellerini analiz etmek amacıyla yararlı bir yöntem olduğu da bilinmektedir (40). Tüm bu nedenlere bağlı olarak, bu SEA çalışmasının da sınırlılıkları göz önünde bulundurulmalı, deneysel yöntemlerle ve uzun dönem klinik çalışmalar ile desteklenmesi gerektiği göz ardı edilmemelidir.

Sonuç

Bu çalışmanın sınırlılıkları dahilinde aşağıdaki sonuçlar çıkarılabilir:

1. FGKR kullanımı kök dentininde stres değerlerini azaltmıştır.
2. FGKR'nin post şeklinde kullanımı sağlıklı diş modelinden de daha az stres oluşumuna sebep olmuştur.
3. FGKR kullanımı restorasyon amacıyla kullanılan kompozit rezindeki stres değerlerini azaltmıştır.
4. Tüm modeller açısından değerlendirme yapıldığında, hem kök dentininin servikal bölgesinde hem de restoratif materyalde görülen en yüksek stres değerleri yalnızca kompozit rezin kullanılan modellerde görülmüştür.
5. Prefabrik tek yönlü uzun cam fiber post materyalinin tüm modellerde en düşük stres değeri oluşturduğu görülmüştür.
6. Kırık tipi açısından kıyaslama yapıldığında hem kök dentininin servikal bölgesi hem de restoratif materyal için tüm modellerle uyumlu olacak şekilde en düşük stres değerleri oblik kırık tipine sahip modellerde görülmüştür.

Teşekkür

Bu çalışma Dicle Üniversitesi Bilimsel Araştırmalar Projeleri Komisyonu Başkanlığı tarafından DİŞ.22.013 numaralı proje ile desteklenmiştir.

Kaynaklar

1.Gökcek M. Zonguldakta Travmatik Dental Yaralanmaların Retrospektif Analizi. Diş Hekimliğinde Uzmanlık Tezi, Zonguldak: Bülent Ecevit Üniversitesi Diş Hekimliği Fakültesi, 2017.
2.Andersson L. Epidemiology of traumatic dental injuries. Journal of endodontics. 2013;39(3):S2-S5.
3.Trope M. Avulsion of permanent teeth: theory to practice. Dental Traumatology. 2011;27(4):281-94.
4.Barnett F. The role of endodontics in the treatment of luxated permanent teeth. Dental Traumatology. 2002;18(2):47-56.
5.Bergman B, Lundquist P, Sjo U. Restorative and endodontic results after treatment with cast posts and cores. The Journal of prosthetic dentistry. 1989;61(1):10-5.
6.Scotti N, Eruli C, Comba A, Paolino D, Alovisi M, Pasqualini D, et al. Longevity of class 2 direct restorations in root-filled teeth: A retrospective clinical study. Journal of Dentistry. 2015;43(5):499-505.
7.Smith CT, Schuman N. Restoration of endodontically treated teeth: a guide for the restorative dentist. Quintessence international. 1997;28(7).
8.Aydemir M, Bağlar S. Post-kor sistemlerinin güncel siniflandirilması. Turkiye Klinikleri J Dental Sci. 2019;25(3):319-33.
9.Monticelli F, Grandini S, Goracci C, Ferrari M. Clinical behavior of translucent-fiber posts: a 2-year prospective study. Int J Prosthodont. 2003;16(6):593-6.
10.Kimmel S. Restoration and reinforcement of endodontically treated teeth with a polyethylene ribbon and prefabricated fiberglass post. General dentistry. 2000;48(6):700-6.

11.Keulemans F, Garoushi S, Lassila L. Fillings and core build-ups. In: Ozcan M, Vallittu P, eds. A Clinical Guide to Principles of Fiber-Reinforced Composites in Dentistry. UK: Elsevier; 2017, p:131-63.
12.Magne P. Efficient 3D finite element analysis of dental restorative procedures using micro-CT data. Dental materials. 2007;23(5):539-48.
13.Ko C-C, Chu C-S, Chung K-H, Lee M-C. Effects of posts on dentin stress distribution in pulpless teeth. The Journal of prosthetic dentistry. 1992;68(3):421-7.
14.Eraslan Ö, Eraslan O, Eskitaşcıoğlu G, Belli S. Conservative restoration of severely damaged endodontically treated premolar teeth: a FEM study. Clinical Oral Investigations. 2011;15(3):403-8.
15.Kydd WL, Mandley J. The stiffness of palatal mucoperiosteum. The Journal of Prosthetic Dentistry. 1967;18(2):116-21.
16.Belli S, Eraslan O, Eskitaşcıoğlu G. Effect of different treatment options on biomechanics of immature teeth: a finite element stress analysis study. Journal of endodontics. 2018;44(3):475-9.
17.Moszner N, Salz U. New developments of polymeric dental composites. Progress in polymer science. 2001;26(4):535-76.
18.MK Ş. Dört Farklı Cam Fiber Postun in vitro Bükülme Dirençlerinin ve Sonlu Eleman Metodu ile Stres Dağılımlarının Analizi. Doktora Tezi, Ankara: Gazi Üniversitesi Sağlık Bilimleri Enstitüsü, 2008.
19.Kaleli N, Ural Ç. Hibrid Abutment Kron Restorasyonlarda İmplant-Abutment Bağlantısının İmplant, Abutment ve Bazal Vidadaki Stres Dağılımı Üzerindeki Etkisinin İncelenmesi. Turkiye Klinikleri Dishekimligi Bilimleri Dergisi. 2020;26(1):43-50.
20.Barreto BCF, Van Ende A, Lise DP, Noritomi PY, Jaecques S, Sloten JV, et al. Short fibre-reinforced composite for extensive direct restorations: a laboratory and computational assessment. Clinical oral investigations. 2016;20(5):959-66.
21.Belli S, Eraslan O, Eraslan O, Eskitascioglu M, Eskitascioglu G. Effects of Na OC l, EDTA and MTAD when applied to dentine on stress distribution in post-restored roots with flared canals. International Endodontic Journal. 2014;47(12):1123-32.
22.Pornamazeh T, Geramy A, Heidari S, Rajabizadeh M, Kamali E, Ghadirian H. Comparison of the debonding force of metal, glass and polyethylene Fiber reinforced composite retainers: Mechanical and finite element analyses. International Orthodontics. 2022;20(4):100685.
23.Türkün LS. Conservative restoration with resin composites of a case of amelogenesis imperfecta. International dental journal. 2005;55(1):38-41.
24.Roeters JJ. Extended indications for directly bonded composite restorations: a clinician's view. J Adhes Dent. 2001;3(1):81-7.
25.Grandini S, Goracci C, Tay FR, Grandini R, Ferrari M. Clinical evaluation of the use of fiber posts and direct resin restorations for endodontically treated teeth. International Journal of Prosthodontics. 2005;18(5).
26.Candan Ü, Eronat N, Türkün M. Fiberle güçlendirmenin nanofil kompozitin eğme direncine etkisinin incelenmesi. Curr Res Dent Sci. 2015;25(1):13-20
27.Pierrisnard L, Bohin F, Renault P, Barquins M. Corono-radicular reconstruction of pulpless teeth: a mechanical study using finite element analysis. The Journal of prosthetic dentistry. 2002;88(4):442-8.
28.Eapen AM, Amirtharaj LV, Sanjeev K, Mahalaxmi S. Fracture resistance of endodontically treated teeth restored with 2 different fiber-reinforced composite and 2 conventional composite resin core buildup materials: an in vitro study. Journal of endodontics. 2017;43(9):1499-504.
29.Halaçoğlu DM, Yamanel K. The effects of different base materials on the stress distribution of the endodontically treated teeth: 3D FEA. Cumhuriyet Dent J. 2019;22(1):56-65.
30.Garoushi S, Vallittu PK, Lassila LV. Direct restoration of severely damaged incisors using short fiber-reinforced composite resin. Journal of dentistry. 2007;35(9):731-6.
31.Junior AdAG, Lopes MWF, da Silveira Gaspar G, Braz R. Comparative study of flexural strength and elasticity modulus in two types of direct fiber-reinforced systems. Brazilian oral research. 2009;23(3):236-40.
32.Ramesh P, Mathew S, Murthy SB, George JV, Hegde S, Premkumar R. Efficacy of Ribbond and a fibre post on the fracture resistance of reattached maxillary central incisors with two fracture patterns: a comparative in vitro study. Dental Traumatology. 2016;32(2):110-5.
33.Çetintaş Ş. İmplant Destekli Mandibular Overdenturelarda Fiberle Üretilmiş Altyapıların Stres Analizi. Doktora Tezi, Ankara: Gazi Üniversitesi Sağlık Bilimleri Enstitüsü, 2019.
34.Hunter A, Feiglin B, Williams J. Effects of post placement on endodontically treated teeth. The Journal of prosthetic dentistry. 1989;62(2):166-72.
35.Adanır N, Belli S, Eraslan O, Eskitaşçıoğlu G. Bir Cam Fiber Post Sistemiyle Restore Edilmiş Üst Birinci Kesici Diş Modelinde Post Uzunluğunun Fpnksiyonel Kuvvetler Altında Oluşan Stres Dağılımına Etkisi. Türk Dişhekimliği Dergisi. 2005;59:8-13.
36.Di Fiore PM, Reyes A, Dorn SO, Cron SG, Ontiveros JC. Evaluation of a calcium silicate-based cement as a root reinforcement material for endodontically treated maxillary anterior teeth. The Journal of Prosthetic Dentistry. 2016;115(1):35-41.
37.Bilgin S, Kahvecioğlu F. Kök ucu açik dişlerde sonlu elemanlar analizi kullanilarak farkli yönlerden gelen travmalarin oluşturduğu streslerin değerlendirilmesi. Selcuk Dent J. 202;7(2):318-25.
38.Scotti N, Scansetti M, Rota R, Pera F, Pasqualini D, Berutti E. The effect of the post length and cusp coverage on the cycling and static load of endodontically treated maxillary premolars. Clinical Oral Investigations. 2011;15(6):923-9.
39.Sorrentino R, Salameh Z, Zarone F, Tay FR, Ferrari M. Effect of post-retained composite restoration of MOD preparations on the fracture resistance of endodontically treated teeth. Journal of Adhesive Dentistry. 2007;9(1).
40.Akbaş M, Akbulut MB, Belli S. Sonlu Elemanlar Stres Analizi ve Endodontide Kullanımı. European Journal of Research in Dentistry. 2021;5(2):99-108.

Received date:17 May 2023 / **Accept date:** 05 August 2023

Comparison of Translucency and Flexural Strength of Zirconia Reinforced Lithium Silicate, Zirconia and Lithium Disilicate

Merve Utar [1*], Zülfikar Demirtağ [2]

1. Tepebaşı Oral and Dental Health Hospital,Ankara, Turkey.
2. Kırıkkale Oral and Dental Health Center, Kırıkkale, Turkey.

***Corresponding author:** Utar M, MSc. PhD, Tepebaşı Oral and Dental Health Hospital,Ankara, Turkey.
E-mail : mervearslan@kku.edu.tr
DOI: 10.61139/ijdor.1298690

.

Abstract

Objectives: Optimal mechanical and aesthetic properties are expected from all ceramic restorations in dentistry to maintain good prognosis. Zirconia restorations have had mechanical advantages and lithium disilicate ceramics have provided aesthetic advantages. This study intended to compare the four-point flexural strength and translucency of zirconia reinforced lithium silicate with solid zirconia and lithium disilicate.
Material and Methods: 90 bars (1x4x18 mm) for flexural strength test (n=30) and 30 square shaped (1x10x10 mm) samples for translucency measurement (n=10) were obtained from solid zirconia (BR-BruxZir), zirconia reinforced lithium silicate (VS-Vita Suprinity) and lithium disilicate (EM-Emax CAD) blocks. All BR samples were sintered, VS and EM were crystallized according to the manufacturer's recommendations. These samples were grinded and polished. Subsequently, they were ultrasonically cleaned and flexural strength values (MPa) were obtained in a universal test device. Color measurements were performed with a dental spectrophotometer using black and white backgrounds to determine the translucency values. Statistical analysis was performed using one-way ANOVA and Tukey HSD tests. Results: BR showed the highest mean flexural strength. There was no significant difference between EM and VS ($p>0.05$), while BR showed significantly different flexural strength ($p<0.05$). EM and VS showed similar translucency, whereas translucency of BR was significantly lower than other groups ($p<0.05$).
Conclusions: Lithium silicate reinforced with zirconia showed similar translucency with lithium disilicate. However, being reinforced with zirconia did not contribute to four point flexural strength.

Research Article (HRU Int J Dent Oral Res 2023; 3(2): 99-103

Keywords: Four-point flexural strength; lithium disilicate; translucency; zirconia; zirconia reinforced lithium silicate.

Introductıon

Innovations in the production of all-ceramic restorations have attracted attention for the last three decades due to the need for metal-free restorations [1]. Zirconia restorations provide mechanical advantages due to their high hardness and fracture toughness [2], and glass ceramic restorations provide an aesthetic advantage, but their fragility limits their use in areas where chewing force is intense [3]. Therefore, there is an increasing interest in anatomical zirconia restorations that do not require veneer porcelain and have good optical and mechanical properties [4,5]. Solid zirconia is a good alternative to metal-supported porcelain restorations. Its resistant to chipping provides the advantage of use in individuals with bruxism, and could be preferred in cases where there is not enough preparation distance for metal-supported porcelain restorations. Enhanced colloidal production increases the durability of zirconia and improves its translucency. Pre-colored blocks do not require any coloring process before sintering, and after sintering, translucency and color close to natural appearance can be obtained [6]. Lithium disilicate monolithic restorative materials' flexural strength is

Received date:17 May 2023 / **Accept date:** 05 August 2023

130±30 MPa in the blue phase, when they are in precrystalline form and contain metasilicate and lithium disilicate cores. After the designed restorations are obtained from the blocks, heat treatment is applied. During this heat treatment, metasilicates dissolve, lithium disilicate crystallizes and restoration is obtained according to the selected block color. At this point, the ceramic has a crystal content of 70%, 1.5 µm in size, and it has a 360 Mpa flexural strength [7]. It is reported that the recently introduced zirconia-reinforced lithium silicate CAD/CAM blocks combine the material properties of zirconia and glass ceramics. It is recommended to be used as an anatomical monolithic restoration due to its different colors and translucency [8].

The structure and composition of ceramics affect also the optical properties resulting from its interaction with light [9]. Optical properties have an important role in providing translucency close to the natural tooth and improving the aesthetic results. The CIELab system enables the detection of small color differences in materials and is based on the discrimination of red, green and blue color receptors. In this three-dimensional color space, there are three axes as 'L, a, b'. The 'L' color coordinate represents lightness-darkness; In the 'a' color coordinate, positive values increase green and negative values increase redness; In the 'c' color coordinate, positive values indicate yellowness and negative values indicate blueness. Differences in materials are calculated with the formula ($\Delta E= [(\Delta L)^2 + (\Delta a)^2 + (\Delta b)^2]^{1/2}$) [10]. Contrast ratio and/or translucency parameter (TP) are used to determine the translucency property of ceramics. TP is defined as the color difference obtained using black (B) and white (W) backgrounds of a certain thickness [11,12] and is calculated using the 'L,a,b' values with the following equation:

$TP= [(L_B-L_W)^2 +(a_B-a_W)^2 +(b_B-b_W)^2]^{1/2}$ [13]

The aim of this study is to evaluate the mechanical and optical properties of zirconia reinforced lithium silicate material, which was developed to eliminate the risky sides of glass ceramics from a mechanical point of view and polycrystalline ceramics from an aesthetic point of view, and to compare them with solid zirconia and lithium disilicate. The null hypotheses (H_0) of this study are as follows: 1) Flexural strengths of zirconia reinforced lithium silicate and lithium disilicate are similar. 2) Translucency of zirconia reinforced lithium silicate and lithium disilicate is similar.

Materıals and Methods

90 bars (1x4x18 mm) for flexural strength test (n=30) and 30 square shaped (1x10x10 mm) samples for translucency measurement (n=10) were obtained from solid zirconia (BR-BruxZir), zirconia reinforced lithium silicate (VS-Vita Suprinity) and lithium disilicate (EM-Emax CAD) blocks with a precision cutting device (Micracut 151 , Metkon Instruments Inc., Bursa, Turkey) at 250 rpm under water cooling. BR samples were sintered, VS and EM were crystallized according to the manufacturer's recommendations. These samples were grinded and polished with 240, 400, 800, 1200 and 2400 grit SiC. Then they were ultrasonically cleaned in distilled water for 10 minutes and the four-point flexural strength test was performed on a universal test machine (Lloyd LRX, Ametek Inc.). The values were recorded as MPa. The CIELab coordinates of the ceramic samples were determined using a dental spectrophotometer (Vita Easyshade V, Vita Zahnfabrik, Germany). Translucency parameters were measured and calculated for the same sample using black and white backgrounds according to the formula.

Results

The highest mean flexural strength was obtained in the BR, whereas the lowest mean flexural strength was observed in the EM. As a result of the comparisons, it was determined that there was no significant difference between EM and VS ($p>0.05$), however a statistically significant difference was found in the BR group compared to the other groups ($p<0.05$). Table 1 shows the mean flexural strength values (MPa) and comparisons.

In the translucency measurement results, the highest mean value was obtained in the EM and the lowest mean value was observed in the BR. Significantly lower translucency values were obtained in the BR compared to the EM and VS ($p<0.05$). There was no significant difference between EM and VS ($p>0.05$). Table 2 shows the mean translucency values and comparisons.

Bruxzir (BR)	IPS e.max CAD (EM)	Vita Suprinity (VS)
470,32 (98,31) [A]	139,15 (22,69) [B]	149,21 (32,99) [B]
** The same capital letters in the superscript show that there is no significant difference in the groups between the columns (p>0.05).*		

Table 1. Mean flexural strengths of the materials (standard deviation).

Bruxzir (BR)	IPS e.max CAD (EM)	Vita Suprinity (VS)
12,17 (0,60) [A]	21,26 (1,14) [B]	21,03 (0,73) [B]
** The same capital letters in the superscript show that there is no significant difference in the groups between the columns (p>0.05).*		

Table 2. Mean translucency values of the materials (standard deviation).

Discussion

Flexural strength and translucency measurements were made in this study, considering that lithium silicate blocks reinforced with zirconia could combine the aesthetic properties of lithium disilicate and the durability of solid zirconia. Lithium silicate reinforced with zirconia showed similar results to lithium disilicate in terms of flexural strength and translucency. Therefore, null hypotheses were accepted.

The production techniques used for dental ceramics and the structural properties of the materials are effective in determining their durability. Various shapes and sizes of pores, micro and macro cracks, milling parameters are among the factors affecting their durability[14,15]. Biaxial, three-point and four-point flexural strength tests can be used to investigate the mechanical properties of ceramic materials [16]. In this study, it has been shown that zirconia has a significantly higher flexural strength than lithium disilicate. Although it was thought that zirconia-reinforced lithium silicate ceramics would show flexural strength similar to zirconia or higher than lithium disilicate glass ceramics, the results did not confirm this. Therefore, it couldn't be said that lithium silicate containing glassy matrix reinforced with zirconia provides a significant advantage in terms of durability compared to lithium disilicate. In another study[17] the three-point flexural strength of the VS was found to be 179 ± 56 MPa, in our study the four-point flexural strength was determined as 149.21 ± 32.99. In another study[18] comparing LD and VS, the three-point flexural strength was found to be 289 MPa ± 20 and 230 ± 20 MPa respectively, and it was reported that LD had significantly higher flexural strength. It is thought that test mechanisms may lead to different results. The three-point test configuration exposes only a very small portion of the sample to maximum stress. Therefore, the three-point flexural strengths are likely to be much greater than the four-point flexural strengths. Although three-point flexural strength is easier to test, four-point flexural strength is preferred and recommended in determining the properties of materials [19]. In a study[20] on molar crowns, it was reported that zirconia was found to be higher than zirconia-reinforced lithium silicate and lithium disilicate, whereas zirconia-reinforced lithium silicate had significantly the lowest strength. In our study, VS has a higher mean flexural strength than EM, but no significant difference was found.

There are spectrophotometers, colorimeters and imaging systems for clinical evaluation of optical properties. Many devices can be used for color determination [21]. Spectrophotometers are devices that can be used in the evaluation of optical properties and the most accurate measurements can be easily obtained. They record the light transmission and reflection of the object [10]. The scattering of the light coming into the restoration under the surface is an important factor in obtaining the natural appearance. If the majority of the light is scattered or reflected, it causes the material to appear opaque, while the majority of it is transmitted or a small part of it is scattered, making it appear translucent [22]. If the material is completely transparent, all the light is transmitted and the white color is perceived; if it is completely opaque, all light is absorbed and black color is perceived. Generally, however, some of the

wavelengths (colors) are absorbed and others transmitted. In this case, the perceived color is determined by the transmitted wavelengths [23]. Metal oxides and opacifiers in ceramics can prevent the transmission of light and adversely affect the translucency feature, which has an important effect on the natural appearance of the restoration [24]. The translucency values of dental ceramics are affected by grain size, chemical structure, pores and crystalline content. Since zirconia does not contain a glassy matrix, it shows lower translucency than other ceramics due to its dense polycrystalline structure [25]. Higher crystalline content increases flexural strength and decreases translucency [26]. In this study, BR showed a significant difference in terms of translucency compared to other groups. Having a polycrystalline content caused it to exhibit lower translucency than other ceramics containing glassy matrix. In a similar study[27], VS showed higher translucency than EM. Bahgat et al[28] showed that VS (22.43±0.69) had a significantly higher translucency than EM (20.41±0.41), and Günal et al[29] showed that EM (16.13±0.33) had a significantly higher translucency than VS (14.26±0.52). In this study, the highest translucency value was observed in the EM group, but no significant difference was found between the translucency values of VS and EM. However, it is thought that the zirconia content in the glassy matrix reduces the translucency value compared to EM.

However, this study was not free of limitations. The specimens were manufactured and tested according to ideal conditions, therefore clinical conditions may not be reflected actually. Degree of technique sensitivity were not evaluated in terms of clinical use. The visual shade detections must also be experienced chairside with the tested ceramics in this study by different thicknesses and color devices.

Conclusıon

VS could not provide an advantage in combining the strength of zirconia and the aesthetic properties of lithium disilicate. Although it has similar properties with EM in terms of translucency, it does not differ in flexural strength. Further studies on the subject will be useful for making comparisons that will contribute to clinical use.

The authors declare no conflict of interest.

Acknowledgements

This study was supported by Kırıkkale University Scientific Research Projects Coordination Unit with 2018-78 numbered Project

References

1. Denry I, Holloway JA. Ceramics for dental applications: A review. Materials (Basel). 2010;3(1):351-368. doi:10.3390/ma3010351
2. Miyazaki T, Hotta Y, Kunii J, Kuriyama S, Tamaki Y. A review of dental CAD/CAM: Current status and future perspectives from 20 years of experience. Dent Mater J. 2009;28(1):44-56. doi:10.4012/dmj.28.44
3. Albakry M, Guazzato M, Swain MV. Biaxial flexural strength and microstructure changes of two recycled pressable glass ceramics. J Prosthodont. 2004;13(3):141-149. doi:10.1111/j.1532-849X.2004.04025.x
4. Lee WF, Feng SW, Lu YJ, Wu HJ, Peng PW. Effects of two surface finishes on the color of cemented and colored anatomic-contour zirconia crowns. J Prosthet Dent. 2016;116(2):264-268. doi:10.1016/j.prosdent.2015.12.012
5.Baldissara P, Wandscher VF, Marchionatti AME, Parisi C, Monaco C, Ciocca L. Translucency of IPS e.max and cubic zirconia monolithic crowns. J Prosthet Dent. 2018;120(2):269-275. doi:10.1016/j.prosdent.2017.09.007
6. Do U, Anleitung GD. Bruxzir® milling blanks english. 1200:1-2.
7. Culp L, McLaren EA. Lithium disilicate: the restorative material of multiple options. Compend Contin Educ Dent. 2010;31(9):1-8.
8.Suprinity V. No Title. Published 2022. https://www.vita-zahnfabrik.com/en/VITA-SUPRINITY-PC-44049.html
9. Norton CBCG. Ceramic Materials: Science and Engineering. Springer Science & Business Media; 2007.
10.Kim-Pusateri S, Brewer JD, Davis EL, Wee AG. Reliability and accuracy of four dental shade-matching devices. J Prosthet Dent. 2009;101(3):193-199. doi:10.1016/S0022-3913(09)60028-7
11.Johnston WM, Reisbick MH. Color and translucency changes during and after curing of esthetic restorative materials. Dent Mater. 1997;13(2):89-97. doi:10.1016/S0109-5641(97)80017-6
12. Johnston WM. Review of translucency determinations and applications to dental materials. J Esthet Restor Dent. 2014;26(4):217-223. doi:10.1111/jerd.12112
13. Johnston WM, Ma T, Kienle BH. Translucency parameter of colorants for maxillofacial prostheses. Int J Prosthodont. 1995;8(1):79-86. http://www.ncbi.nlm.nih.gov/pubmed/7710631
14. Quinn GD, Hoffman K, Quinn JB. Strength and fracture origins of a feldspathic porcelain. Dent Mater. 2012;28(5):502-511. doi:10.1016/j.dental.2011.12.005
15. Mackert J, Williams AL. Microcracks in dental porcelain and their behavior during multiple firing. J Dent Res. 1996;75(7):1484-1490. doi:10.1177/00220345960750070801
16. Anusavice KJ, Kakar K, Ferree N. Which mechanical and physical testing methods are relevant for predicting the clinical performance of ceramic-based dental prostheses? Clin Oral Implants Res. 2007;18(SUPPL. 3):218-231. doi:10.1111/j.1600-0501.2007.01460.x
17. Ottoni R, Griggs JA, Corazza PH, Della Bona Á, Borba M. Precision of different fatigue methods for predicting glass-ceramic failure. J Mech Behav Biomed Mater. 2018;88(August):497-503. doi:10.1016/j.jmbbm.2018.09.004
18. Furtado de Mendonca A, Shahmoradi M, de Gouvêa CVD, De Souza GM, Ellakwa A. Microstructural and Mechanical Characterization of CAD/CAM Materials for Monolithic Dental Restorations. J Prosthodont. 2019;28(2):e587-e594. doi:10.1111/jopr.12964
19. Desk O. Standard Test Method for Flexural Strength of Advanced Ceramics at Ambient. Order A J Theory Ordered Sets Its Appl. 2003;03:1-19. doi:10.1520/C1161-13.2
20.Kashkari A, Yilmaz B, Brantley WA, Schricker SR, Johnston WM. Fracture analysis of monolithic CAD-CAM crowns. J Esthet Restor Dent. 2019;31(4):346-352. doi:10.1111/jerd.12462

21.Chu SJ, Trushkowsky RD, Paravina RD. Dental color matching instruments and systems. Review of clinical and research aspects. J Dent. 2010;38(SUPPL. 2):2-16. doi:10.1016/j.jdent.2010.07.001
22.Sulaiman TA, Abdulmajeed AA, Donovan TE, et al. Optical properties and light irradiance of monolithic zirconia at variable thicknesses. Dent Mater. 2015;31(10):1180-1187. doi:10.1016/j.dental.2015.06.016
23. Chu SJ, Devigus A, Paravina R, Mielesezko A. Fundamentals of Color: Shade Matching and Communication in Esthetic Dentistry. Quintessence, 2004:7-19.
24. Brodbelt RHW, O'brien WJ, Fan PL. Translucency of Dental Porcelains. J Dent Res. 1980;59(1):70-75. doi:10.1177/00220345800590011101
25. Vichi A, Carrabba M, Paravina R, Ferrari M. Translucency of ceramic materials for CEREC CAD/CAM system. J Esthet Restor Dent. 2014;26(4):224-231. doi:10.1111/jerd.12105
26. Sakaguchi RL, Powers JM. Craig's Restorative Dental Materials. Philadelphia:Elsevier, 2012:253–75.
27. Sen N, Us YO. Mechanical and optical properties of monolithic CAD-CAM restorative materials. J Prosthet Dent. 2018;119(4):593-599. doi:10.1016/j.prosdent.2017.06.012
28. Linhares LA, Pottmaier LF, Gré CP, De Ré Silveira RC, Shibata S, Vieira LCC. Effect of zirconia addition to lithium disilicate ceramic on translucency and bond strength using different adhesive strategies. Dent Mater. 2015;31(October):e28. doi:10.1016/j.dental.2015.08.064
29. Gunal B, Ulusoy MM. Optical properties of contemporary monolithic CAD-CAM restorative materials at different thicknesses. J Esthet Restor Dent. 2018;30(5):434-441. doi:10.1111/jerd.12382

Case Report: Management of Oral Mucous Membrane Plasmacytosis with Gingivectomy

Ali Gökalp Terzioğlu[1*], Hasan Hatipoğlu[1], Ayşe Nur Değer[2], Nesibe Beyza Akdemir[2]

1. Kütahya Health Sciences University, Faculty of Dentistry, Department of Periodontology, Kütahya, Türkiye
2. Kütahya Health Sciences University, Faculty of Medicine, Department of Pathology, Kütahya, Türkiye

***Corresponding author**: Terzioğlu A .G., Msc. PhD. Department of Periodontology , Faculty of Dentistry, Kütahya Health Sciences University, Kütahya-Türkiye.
E-mail: aligokalp.terzioglu@ksbu.edu.tr
DOI:10.61139/ijdor.1248921

Abstract

Mucous membrane plasmacytosis (MMP) is a rare benign condition. Neoplastic lesions should be considered in the differential diagnosis for this condition, which is clinically involved in different anatomically locations and presents clinically different appearances. Cellular, polyclonal plasma cell infiltration of mucosal tissue is in this condition observed. This case report discusses diagnosis and treatment in a patient with oral involvement of MMP. In the case diagnosed with MMP, no recurrence was observed in the short-term follow-up. However, long-term follow-up of such cases is recommended. Detailed information about the diagnosis and treatment of this clinical condition is still needed.

Case Reports (HRU Int J Dent Oral Res 2023; 3(2):104-107

Key words: Mucous membrane plasmacytosis, biopsy, gingivectomy**.**

Introduction

First described by Zoon in 1952 and was located at the glans penis which he described as ‘’chronic benign balanoposthitis with plasmacytes’’ (1). Mucous membrane plasmacytosis (MMP) is a rare benign condition consists of an intense plasma cell infiltration of the mucous membrane. It is seen that this clinical picture in gingiva was also named as atypical gingivostomatitis, idiopathic gingivostomatitis and allergic gingivostomatitis in previous years (2). It was suggested that it was common with hypersensitivity reactions and defined also as an idiopathic, inflammatory clinical entity (3). This condition was thought to be and allergic reaction to unknown ingredient mouthwash, toothpaste and chewing gum other causes like decreased vitamin intake and local infections was suggested (4). Upper respiratory-digestive system and oral mucosal regions were seen as anatomical sites affected (5). Fogarty et al. presented a patient with disease progressed from gingiva to upper airway then treated with lower dose of radiation to achieve symptomatic improvement and minimal toxicity (6). In general, clinical examinations reveals a well-circumscribed, soft, slightly raised, edematous mass. If it occurs in the lip and gingival area, they complain of symptoms such as pain, swollen lips and gingiva. When it occurs in other parts of the air-digestive system, such as the larynx, pharynx, patients
moan about of oral pain, dysphasia, dysphonia and difficulty breathing (7).

There is no agreed upon or consistently successful treatment option for this clinical picture. Corticosteroids, surgical removal, antibiotics, low-dose radiation, cryotherapy are some of suggested therapies. Polyclonal plasma cell infiltration of mucosal tissue is represented in MMP which is a rare variant of mucositis (8). MMP is a rare, idiopathic and inflammatory mucositis that frequently presents as an erythematous lobulated mucosa. MMP is known for ulcerated plaques that are known to bleed (9). This report represents a case of MMP in the right maxillary canine area.

Case Reports

A 53 year-old female patient was referred to the Department of Periodontology, because of swelling in the right maxillary canine buccal area (Figure 1). The patient's medical history revealed that there was no significant systemic disease or allergy. According to the information given by the patient, the lesion has been present in the mouth at least for 9 months. In addition, clinic examination showed caries in the right lateral incisor. No other orofacial symptoms were observed.

Figure 1: Clinical appearance of the lesion.

Clinical periodontal examination revealed, pink, inflamed mass below the free gingival margin/interdental papilla. There was a notable ulceration on the center of the enlargement.

After the periodontal phase I treatment a further review for two weeks showed no improvement. The patient was not cooperative to the periodontal treatment. Desired oral hygiene levels could not be obtained in phase 1 treatment. However, it was decided to remove the lesion. Written informed consent was obtained from patient and ethics committee approval was not needed.

Infiltrative local anesthesia (Ultraver D-S) applied to area. External bevel incision is made and lesion is removed with a Kirkland type gingivectomy knife. Specimen is carefully examined (Figure 2) and sent to pathology department for advanced examination. Gingival contour is corrected with gingivoplasty procedure and a periodontal dressing was applied to the area. The patient was seen again in the 2nd week after the surgical procedure (Figure 3). However, the patient did not continue the following control sessions afterwards.

Dimensions of the biopsy specimen were 1.2x0.6x0.4 cm. The biopsy material was cream brown in color and its hardness was medium hard. Sections were observed in homogeneous appearance.

Figure 2: The appearance of the specimen.

Figure 3: Clinical appearance in the second week after the procedure.

Biopsy sections showed hyperplasia, irregular acanthosis with small formations of plasma cells under the epithelium. Plasma cells were companied but in few by lymphocyte, histiocytes and neutrophil leukocytes. Haematoxylin and eosin staining (H&E) revealed plasma cells with an eccentric nucleus with oval coarse chromatin, with abundant dark blue cytoplasm and perinuclear hoof, marked with arrows are observed (Figure 4 A). Immunochemical analysis of inflammatory cells under the epithelium showed that LCA, CD45, CD 79a, CD38, MUM1 staining were positive. Kappa, Lambda and CD138, staining was also positive (Figure 4 B-D). According to Ki67 staining proliferative index was %4. Pancytokeratine showed a positive staining in the surface epithelium. In the immunochemical analysis performed, it was noted that the infiltration in the plasma cells under the epithelium which were polyclonal.

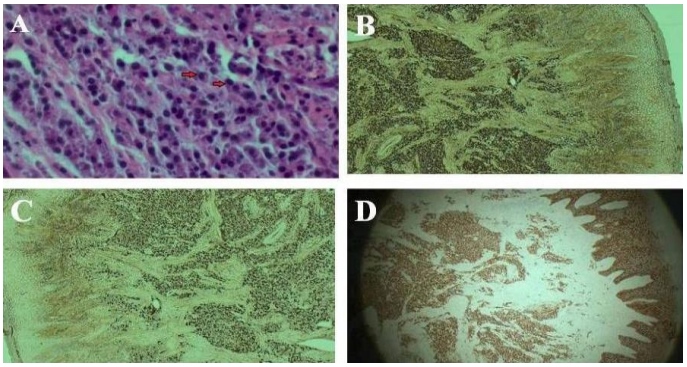


Figure 4: Pathological evaluation
A: H&E, x63 magnification;
B: Kappa, x5 magnification,
C: Lambda, x5 magnification,
D: CD138, x5 magnification.

Discussion

In the nomenclature cases have been reported with variety of titles such as idiopathic plasmacytosis (10,11), plasma cell orificial mucositis (12), oral papillary plasmacytosis (13) and mucous membrane plasmacytosis (5). The clinical differential diagnosis of MMP consist of Wegener granulomatosis, pemphigus, erythroplasia, erosive lichen planus, sarcoidosis, fungal infections, squamous cell carcinoma, mucous membrane pemphigoid, and allergic gingivostomatitis (14).

The diagnosis of MMP can be difficult considering histological resemblance with neoplastic lesions. Treatment of MMP is challenging because of lack of consensus on its management. There is one reported case that shows accompanying squamous cell carcinoma with unidentified etiopathogenetic relation (15).

Unlike plasma cell gingivitis, in which the link with allergic reactions is well established, the association between MMP and allergy is less well recognized (16). Previous reports have described the use of corticosteroids, antibiotics and surgical debulking procedures, with inconsistent results (6).

Najarian et al. achieved long lasting remission with cryotherapy. They used liquid nitrogen with the open-spray technique. Freeze time was 30 to 60 seconds for lower lip localized MMP. In this way they achieved 6 months remission and no functional side effects.[9] Mahler et al. used 2% fusidic acid combination with tetracaine 4 times a day. After regular use continuous improvement was achieved. There were no side effects to be specified and non-invasive treatment was accomplished (17).

MMP is rare type of mucositis, there are no long-term studies with large numbers, and regular clinical review is recommended. This report adds to the literature another case of the rare plasma cell disorder MMP of gingiva. It also demonstrates a successfully excisional treatment of the MMP.

Conclusion

Plasma cell malignancies occur from an anormal clonal proliferation of plasma cells. Despite the fact MMP is identified as idiopathic, other formations of plasma cell conditions may involve neoplastic diseases such as solitary plasmacytoma of bone and multiple myeloma. Therefore, a high index of suspicion is required to identify MMP and biopsy can be taken into consideration for ulcerated gingival enlargements.

One-sentence summary describing the key finding(s): Diagnosis and treatment stages of an individual with mucous membrane plasmacytosis are discussed.

Author contribution statement: All authors have made substantial contribution to the case. AGT and HH treated the patient. AND and NBA made the pathological evaluations. All authors drafted and approved the final version of the manuscript. AGT performed the measurement and involved in the follow-up.

References

1. Zoon JJ. Chronic benign circumscript plasmocytic balanoposthitis. Dermatologica 1952;105:1–7.
2. Bharti R, Smith DR. Mucous membrane plasmacytosis: a case report and review of the literature. Dermatol Online J. 2003;9(5):15.
3. Tong DC, Leaper MR, Colquhoun AN, Rich AM. An unusual presentation of oropharyngeal mucosal plasmacytosis related to toothpaste. J Laryngol Otol. 2008 Oct;122(10):1112-4.
4. Perry H. Idiopathic gingivostomatitis. Derm Clin 1987;5:719–22
5. Khan NA, McKerrow WS, Palmer TJ. Mucous membrane plasmacytosis of the upper aerodigestive tract. A case report with effective treatment. J Laryngol Otol. 1997 Mar;111(3):293-5.
6. Fogarty G, Turner H, Corry J. plasma-cell infiltration of the upper aerodigestive tract treated with radiation therapy. J Laryngol Otol 2001; 115: 928-930.
7. Bharti R, Smith DR. Mucous membrane plasmacytosis: a case report and review of the literature. Dermatol Online J. 2003 (5):15.
8. Makarenko VV, Vaezi AE, Brettler DB, Hutchinson L, Woda BA, Chen BJ. Laryngeal mucous membrane plasmacytosis with 15 year follow-up: Case report and literature review. Leuk Res Rep. 2019;13:100190.

9. Najarian DJ, Rao BK, Pappert AS. A case of mucous membrane plasmacytosis successfully treated with cryotherapy. Dermatol Online J. 2008;14(2):6. PMID: 18700109.
10. Timms MS, Sloan P. Association of supraglottic and gingival idiopathic plasmacytosis. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1991;71:451-3
11. Timms MS, Sloan P, Balzan AP. Idiopathic plasmacytosis of the oral and supraglottic mucosa. J Laryngol Otol 1988;102:646-8.
12. White JW Jr, Olsen KD, Banks PM. Plasma cell orificial mucositis. Report of a case and review of the literature. Arch Dermatol 1986;122:1321-4.
13. Grattan CE, Gentle TA, Basu MK. Oral papillary plasmacytosis resembling candidosis without demonstrable fungus in lesional tissue. Clin Exp Dermatol 1992;17:112-116.
14. Ferreiro JA, Egorshin EV, Olsen KD, Banks PM, Weiland LH. Mucous membrane plasmacytosis of the upper aerodigestive tract. A clinicopathologic study. Am J Surg Pathol Oct 1994;18:1048-53.
15. T. Pepper, et al., Squamous cell carcinoma arising in mucosal plasmacytosis, Br. J. Oral Maxillofac. Surg. 48 (3) (2010) 208–210.
16. MacLeod RI, Ellis JR. Plasma cell gingivitis related to the use of herbal toothpaste. Br Dent J 1989;166:375–6
17. Mahler V, Hornstein OP, Kiesewetter F. Plasma cell gingivitis: treatment with 2% fusidic acid. J Am Acad Dermatol 1996;34: 145–6.

WILLIAMS BEUREN SYNDROME, A SHORT COMMUNICATION OF A PECULIAR CASE

Michele Callea[1] ,Mehmet Sinan Dogan[2] , Silvia Vierucci[1] ,Marwa Abd El Salam[3] , Roberta D'Avenia[1] , Francisco Cammarata Scalisi[4] , Pamela Armi[1] , Elena Benedetti[1]

1. Pediatric Dentistry and Special Dental Care Unit, Meyer Children's Hospital, Florence, Italy.
2. Department of Pediatric Dentistry, Harran Universty, Şanlıurfa, Türkiye.
3. Pediatric Dentistry Unit, Nile oh Hope Hospital, Alexandria, Egypt.
4. Regional Hospital of Antofagasta, Antofagasta, Chile.

***Corresponding author:** Callea M, MSc. PhD, Department of Pediatric Dentistry, Special Dental Care Unit, Meyer Children's Hospital, Florence, Italy..
E-mail : michele.callea@meyer.it mcallea@gmail.com
DOI:10.61139/iidor.1282837

Abstract

Williams-Beuren syndrome (WBS) is a rare congenital disorder that includes cardiovascular problems, mental retardation, distinctive facial features and dental anomalies. This case report the treatment of a tooth fracture after dental trauma in a 13-year-old male with WBS syndrome. Intraoral clinical examination revealed anterior interdental space and enamel hypoplasia in incisors. Dental treatment included: The fracture tooth fragment was restored after basic behavioral orientation.

Case Report (HRU Int J Dent Oral Res 2023; 3(2): 108-111

Keywords: Williams-Beuren syndrome, tooth fracture, tooth anomalies.

Introduction

Williams-Beuren syndrome (WBS), is a rare congenital disorder involving cardiovascular problems, mental retardation, distinctive facial features and tooth anomalies. Williams-Beuren syndrome is caused by hemizygous deletion of 1.5 to 1.8 Mb on chromosome 7q11.23, which contains approximately 28 genes. (1-7) The prevalence of WBS is estimated to be one in every 7,500 live births. The disorder occurs equally in both sexes. There is no ethnic or racial discrimination.(8)

Intraoral findings of this syndrome include malocclusion, micrognathism, hypodontia, enamel hypoplasia, microdontia, short roots, diastema, pulp stones and conical teeth.(8,9)

In addition, poor fine motor skills in these patients cause difficulties in maintaining dental hygiene and increase the risk of dental caries. It is recommended to have dental check-ups up to the age of 1 or within 6 months after the first tooth erupts. Dental cleaning is recommended every 4 months. Caregivers should be instructed to assist with brushing and flossing.(10) The main complications in the dental treatment of the patients with WBS are heart disease and behavioral disorder. Cardiovascular diseases occur in 80% of WBS individuals.(11) For these reasons, WS-specific sedation and anesthesia recommendations

should be followed if dental procedures require anesthesia. (10)

Case Reports

We report on a case of a 13-year-old young male affected by WBS who had a fracture of 1.1. In order to make the restoration of the central incisor the rubber dam has been applied with a good compliance. (Figure 1-3); He had no cardiopathies, no tooth agenesis, a good compliance.
Table 1 summarized all clinical features related to WBS along with inheritance pattern (1-7)

Figure 1: Fracture of 1.1

Figure 2: Tooth isolated with rubberdam

Figure 3: Tooth aesthetically reconstructed by final result after polishing

Discussion

Williams syndrome pose challenges for several reason such as behavioral management foreseen fur such patients along with the anesthesiologic issues. The peculiarities of these cases are represented by the incoming event of the traumatic dental injury and the behavioral management of an entity usually difficult to treat due to scarce collaboration. (1-7)

S. Axelsson et al. reported in a study conducted on patients with WS, they found hypodontia, diastema, microdontia, and conical incisor anomalies.(12) This patient had some of these features, such as anterior open bite, tongue thrust, excessive interdental space, and hypoplasia. In this patient, a crown fracture occurred in the maxillary incisor as a result of dental trauma due to poor motor skills.

Patients with WBS syndrome may also have visual impairment, sensorineural hearing loss, hyperacusis, photophobia and hoarseness. Anterior open bite, tongue thrust, excessive interdental space, enamels hypomineralization in incisors, hypoplasia and caries lesions can be seen in intraoral clinical examination. Anxiety can be seen due to aversion to sounds and photophobia during dental treatment. Dental fear can be reduced with modulating sessions. Oral hygiene education and use of 0.05% sodium fluoride mouthwash are important.(13) This patient had a conical tooth anomaly in the upper incisors.

Conclusion

We report on a rare case of WBS syndrome highlighting with a sequence of imagines the trauma managment and treatment choice of such a rare entity.

Table 1: summarize clinical features of Williams Beuren syndromes along with molecular basis and inheritance pattern

-	**INHERITANCE**
-	-Autosomal dominant
-	**GROWTH**
-	*Height*
-	-Short stature
-	*Weight*
-	- Abnormal weight gain

- *Other*
- - Intrauterine growth retardation (IUGR)
- **HEAD & NECK**
- *Face*
- - Medial eyebrow flare - - Flat midface - - Periorbital fullness (puffy eyes) - - Epicanthal folds - - Long philtrum
- *Ears*
- - Sensorineural hearing loss, mild to moderate - Hyperacusis - - Phonophobia - - Abnormal brain auditory evoked responses (BAER) - Decreased or absent ipsilateral acoustic reflex response to maximum stimulation
- *Eyes*
- - Stellate pattern of iris - - Strabismus - - Altered visual acuity
- *Nose*
- - Depressed nasal bridge - - Anteverted nares
- *Mouth*
- - Thick lips
- *Teeth*
- - Hypodontia - - Microdontia
- **CARDIOVASCULAR**
- *Heart*
- - Supravalvular aortic stenosis - - Valvular aortic stenosis - - Bicuspid aortic valve - - Mitral valve prolapse - - Mitral regurgitation - - Coronary artery stenosis - - Pulmonary valve stenosis - - Atrial septal defect - - Ventricular septal defect
- *Vascular*
- - Peripheral pulmonary artery stenosis - - Systemic hypertension
- **RESPIRATORY**
- *Larynx*
- - Vocal cord paralysis
- **CHEST**
- *Ribs Sternum Clavicles & Scapulae*

- - Pectus excavatum
- **ABDOMEN**
- *External Features*
- - Inguinal hernia
- *Gastrointestinal*
- - Chronic constipation - - Diverticulosis - - Colic - - Difficulty feeding - - Gastroesophageal reflux - - Textured-food intolerance
- **GENITOURINARY**
- *Kidneys*
- - Small kidneys - - Solitary kidney - - Pelvic kidney - - Nephrocalcinosis - - Renal insufficiency - - Renal artery stenosis
- *Ureters*
- - Vesicoureteral reflux
- *Bladder*
- - Bladder diverticula - - Urethral stenosis - - Recurrent urinary tract infections - - Voiding frequency/urgency - - Enuresis - - Delayed toilet training
- **SKELETAL**
- - Joint contractures - - Joint laxity - - Osteopenia - - Osteoporosis
- *Spine*
- - Kyphoscoliosis
- *Limbs*
- - Joint limitation
- *Feet*
- - Hallux valgus
- **SKIN, NAILS, & HAIR**
- *Skin*

- -Decreased skin stiffness - -Easier stretching - -Soft skin - -Increased wrinkles - -Abnormal scarring - - Less pressure required to lift skin - - Longer retraction time after stretching - - Decreased viscoelasticity - - Premature aging, mild
- *Nails*
- - Hypoplastic nails
- *Hair*
- - Premature graying
- **NEUROLOGIC**
- *Central Nervous System*
- - Mental retardation (average IQ 56) - Relative sparing of language - - Poor visual-motor integration (Range 41-80) - - Poor visual-spatial construction - - Hypersensitivity to sound - - Hypotonia - - Hyperreflexia (particularly in lower extremities, more prevalent in adolescents and adults) - Poor balance - - Poor coordination - - Type I Chiari malformation
- *Behavioral Psychiatric Manifestations*
- - Attention deficit disorder - - Friendly personality - - Gregarious - - Cocktail party personality - - Strong attraction to music - - Anxiety - - Phobias - - Obsessive-compulsive traits
- **VOICE**
- - Harsh, brassy, or hoarse voice
- **ENDOCRINE FEATURES**
- - Hypercalcemia - - Glucose intolerance - - Diabetes mellitus - - Early-onset puberty (menarche about 2 years early) - Hypothyroidism, subclinical
- **LABORATORY ABNORMALITIES**
- - Hemizygous deletion at 7q11.23
- **MISCELLANEOUS**
- - Incidence 1 in 8,000 live births - - Main aspects of phenotype attributed to defects in GTF2IRD1 (604318) and GTF2I (601679)
- **MOLECULAR BASIS**
- - Contiguous gene syndrome resulting from hemizygous deletion 1.5 - 1.8 Mb on 7q11.2

References

1. Ferreira SB, Viana MM, Maia NG, Leão LL, Machado RA, Coletta RD, de Aguiar MJ, Martelli-Júnior H.Oral findings in Williams-Beuren syndrome. Med Oral Patol Oral Cir Bucal. 2018;23(1):e1-e6
2. Matsuno S, Tsuji M, Hikita R, Matsumoto T, Baba Y, Moriyama K. Clinical study of dentocraniofacial characteristics in patients with Williams syndrome. Congenit Anom (Kyoto). 2019;59(5):162-168.
3. Cogulu D, Hazan F, Dindaroglu FC. Orofacial Findings and Dental Management of Williams Syndrome. Genet Couns. 2015;26(4):437-42.
4. Hertzberg J, Nakisbendi L, Needleman HL, Pober B.Williams syndrome--oral presentation of 45 cases. Pediatr Dent. 1994;16(4):262-7.
5. Castro T, de Paula Martins Santos C, de Oliveira Lira Ortega A, Gallottini M.Oral characteristics and medical considerations in the dental treatment of individuals with Williams syndrome. Spec Care Dentist. 2019;39(2):108-113.
6 Axelsson S, Bjørnland T, Kjaer I, Heiberg A, Storhaug K. Dental characteristics in Williams syndrome: a clinical and radiographic evaluation. Acta Odontol Scand. 2003;61(3):129-36.
7. Axelsson S. Variability of the cranial and dental phenotype in Williams syndrome.
Swed Dent J Suppl. 2005;(170):3-67.
8. Çitir M, Zengin AZ. Multiple Unerupted and Supernumerary Teeth in a Patient with Williams-Beuren Syndrome: An Unusual Case. Turkiye Klinikleri. Dishekimligi Bilimleri Dergisi, 2019;25(3): 371-374.
9. Hertzberg J, Nakisbendi L, Needleman HL, Pober B. Williams syndrome–oral presentation of 45 cases. Pediatr Dent. 1994;16(4):262–267
10. Morris CA, Braddock SR, AAP COUNCIL ON GENETICS. Health Care Supervision for Children With Williams Syndrome. Pediatrics. 2020;145(2):e20193761
11. Andrade NS, Santos C, Castro T, Gallottini M. Medical considerations in dental treatment of patients with Williams-Beuren syndrome: report of four clinical cases. Clin Lab Res Dentistry. 2015; 21: 7.
12. Stefan Axelsson, Tore Bjørnland, Inger Kjær, Arvid Heiberg, Kari Storhaug (2003) Dental characteristics in Williams syndrome: a clinical and radiographic evaluation, Acta Odontologica Scandinavica, 2003;61(3): 129-136.
13.Torres CP, Valadares G, Martins MI, Borsatto MC, Díaz-Serrano KV, de Queiroz AM. Oral findings and dental treatment in a child with Williams-Beuren syndrome. Braz Dent J. 2015;26(3):312-6.

Cysts Observed in Chıldren: Case Serıes

Elif Esra Özmen[1], Veysel İçen[2], Tuğçe Nur Şahin[3*]

1. Karamanoğlu Mehmetbey University , Ahmet Keleşoğlu Faculty of Dentistry, Department of Oral, Dental and Maxillofacial Surgery, Karaman, Turkey.
2. Karamanoğlu Mehmetbey University , Ahmet Keleşoğlu Faculty of Dentistry, Department of Pediatric Dentistry, Karaman, Turkey.

***Corresponding author:** Şahin TN, Asst. Prof., Department of Pediatric Dentistry, Ahmet Keleşoğlu Faculty of Dentistry, Karamanoğlu Mehmetbey University, Karaman, Turkey.
E-mail : tnsahin@hkmu.edu.tr
DOI:10.61139/ijdor.1330035

Abstract

There can be a wide variety and prevalence of oral pathological conditions in children that can differ from adults in terms of symptoms and clinical course. This case presentation aims to raise awareness about the importance of early diagnosis and treatment of oral pathological lesions in pediatric patients. In three patients, two boys and one girl aged between 10 and 14, diagnosed with the radicular cyst, odontogenic keratocyst, and odontogenic myxoma, treatments such as marsupialization, enucleation, and enucleation with the associated impacted tooth were performed based on the size and type of the lesions. Postoperative follow-up of the patients is ongoing. Knowing pediatric oral lesions is crucial for accurate and differential diagnosis. When determining the treatment approach for these lesions in children, factors such as ongoing maxillofacial development, high osteogenic activity, and potential cooperation issues should be taken into consideration.

Case Reports (HRU Int J Dent Oral Res 2023; 3(2): 112-116

Keywords: Biopsy, Epidemiology, Lesion, Oral Pathology, Pediatric.

Introduction

Oral lesions present a wide variety and prevalence in both adult and pediatric populations. In 1950, Boyes provided the classical definition of pediatric oral lesions, suggesting that many pathological lesions occur early in life and emphasizing the importance of lesion classification (1).

Children are considered a distinct group within the population due to their smaller physical size and the differences in the clinical course of oral pathologies (2). Examples of these differences include specific types of lymphomas, hemangiomas, and certain maxillofacial lesions such as Langerhans cell histiocytosis, as their histopathological features and clinical outcomes may vary between children and adults. (3). A study conducted in Iraq reported the presence of various pathologies in the oral cavities of children (4). The first epidemiological study examining maxillofacial changes in children and adolescents was published in 1986 (5). Although numerous epidemiological studies on oral lesions have been conducted worldwide in recent years, research specifically focused on children is limited (6).

One of the most comprehensive studies conducted in Turkey evaluated 472 oral biopsy specimens from children aged 0-15 years over 8 years. Evaluation results revealed that the 6-12 age group was most affected, and the majority of lesions (49%) fell into the category of

inflammatory and reactive lesions. The most common cause of these lesions was the presence of trauma and difficulties in maintaining oral hygiene (7).

This study aims to raise awareness regarding the diagnosis and treatment of orofacial lesions in children.

Case Reports

A thirteen-year-old boy (Case 1) was referred to our department because of swelling in the right upper maxilla. Informed consent was obtained from the child's parent. The medical history revealed no systemic illnesses. Upon clinical examination, a healthy expansion covered with mucosa was observed. Radiological evaluation revealed a radiolucent lesion measuring 6 cm*3.5 cm, including the maxillary sinus in the right maxillary region (Figure 1a). Aspiration biopsy showed the presence of cyst fluid. After local anesthesia administration, a full-thickness mucoperiosteal flap was raised, and a biopsy was performed for pathological evaluation. The results indicated a 'radicular cyst.' The tooth associated with the cyst, tooth number 16, was extracted, and marsupialization treatment was applied to the area for a period of 4 months. Due to the patient's cooperation issue, the patient underwent surgery under general anesthesia after 4 months. Local anesthesia was applied to the area for bleeding control and postoperative pain management. A full-thickness mucoperiosteal flap was raised, and the relevant tissue was excised. The area was primarily sutured. Penicillin-based antibiotics were prescribed to prevent postoperative infection, and paracetamol-based analgesics were recommended for pain control. No complications were encountered during the patient's postoperative follow-up visits (Figure 1b).

A ten-year-old female child (Case 2) was referred to our department with complaints of recurrent swelling and purulent discharge in the right upper maxilla region. Informed consent was obtained from the child's parent. The medical history revealed no systemic illnesses. Upon clinical examination, a healthy expansion covered with mucosa was observed. Radiological evaluation revealed a radiolucent lesion measuring 7 cm*4 cm, including the maxillary sinus in the right maxillary region (Figure 2a). Aspiration biopsy did not reveal any cyst fluid, and no dental cause could be identified for the lesion. After local anesthesia administration, a full-thickness mucoperiosteal flap was raised, and a biopsy was performed for pathological evaluation. The pathological evaluation determined the diagnosis as 'Odontogenic keratocyst.' Marsupialization treatment was applied to the area for a period of 5 months. Due to the patient's cooperation issue, the patient underwent surgery under general anesthesia after 5 months. Local anesthesia was applied to the area for bleeding control and postoperative pain management. A full-thickness mucoperiosteal flap was raised, and the relevant tissue was excised. The area was primarily sutured. Penicillin-based antibiotics were prescribed to prevent postoperative infection, and paracetamol-based analgesics were recommended for pain control. No complications were encountered during the patient's postoperative follow-up visits (Figure 2b). The patient's caregiver was informed about the beneficial effect of regular follow-up visits due to the aggressive nature and recurrence risk of the lesion.

A 14-year-old boy (Case 3) was referred to our department because of impacted canine in the right mandible. Informed consent was obtained from the child's parent. The medical history revealed no systemic illnesses. Upon clinical examination, a healthy expansion covered with mucosa was observed, and a firm immobile swelling with shallow sulcus and palpable hardness was detected in the vestibular area of the right mandible. No purulent discharge, hyperemia, or ulceration was observed in the area. Radiological evaluation revealed a radiolucent lesion measuring 3 cm*3 cm, involving tooth number 43, in the right mandibular region (Figure 3a). The lesion was considered to be a dentigerous cyst resulting from the impaction of tooth number 43. After local anesthesia administration, a full-thickness mucoperiosteal flap was raised in an envelope-like manner, starting from tooth number 33 and extending to tooth number 45. The lesion was excised along with tooth number 43. The area was curetted until the sound bone was visualized. After bleeding control, the area was primarily closed. A biopsy was performed for pathological evaluation. Penicillin-based antibiotics were prescribed to prevent postoperative infection, and paracetamol-based analgesics were recommended for pain control. The pathological evaluation determined the diagnosis as 'Odontogenic myxoma.' No complications were encountered during the patient's postoperative follow-up visits (Figure 3b). The patient's caregiver was informed about the beneficial effect of regular follow-up visits due to the aggressive nature and recurrence risk of the lesion.

Figure 1a. Initial panoramic radiograph of the patient.

Figure 1b. Panoramic radiograph of the patient 3 months after the operation.

Figure 2a. Initial panoramic radiograph of the patient**.**

Figure 2b. Panoramic radiograph of the patient 3 months after the operation.

Figure 3a. Initial panoramic radiograph of the patient.

Figure 3b. Panoramic radiograph of the patient 3 months after the operation.

Discussion

Cysts are defined as pathological cavities lined with epithelium, surrounded by a distinct connective tissue wall and filled with fluid (8). The distribution of cystic lesions in the jaws during childhood differs from that in adults, which can be attributed to the odontogenesis, and three-dimensional growth of the maxillofacial bones (9). The most common cystic lesions encountered in children include radicular cysts, dentigerous cysts, eruption cysts, odontogenic keratocyst, and calcifying odontogenic cysts (10). While radicular cysts are described as the most common inflammatory odontogenic cysts in the jaws, some researchers argue that developmental odontogenic cysts may be more frequent (10). Indeed, the presence of a radicular cyst in our first case is consistent with the literature. Radiologically, radicular cysts are described as sclerotic-bordered unilocular radiolucent areas at the apex of the relevant tooth. When they reach larger sizes, they can cause resorption of adjacent tooth roots. If the cyst becomes infected, its well-defined and distinct structure may be lost. In our case, although a significant radicular cyst was observed, no root resorption was detected in neighboring teeth. Additionally, the differential diagnosis of radicular cysts is crucial. While they may resemble periapical granulomas when small in size, periapical granulomas can be distinguished by the absence of a radiopaque border around the radiolucent area and the typically smaller size of the lesion (usually less than 2 cm). They may also show similarities to lateral periodontal cysts and periapical cemental dysplasia (11). In terms of treatment, depending on the condition of the lesion and the tooth, endodontic treatment, apical resection, and enucleation can be preferred. Enucleation can be performed in conjunction with tooth extraction for large cysts. It is known that the recurrence rate is low when the cyst is completely removed (12). In our case, the significant size of the lesion led us to opt for tooth extraction and enucleation of the lesion.

Previously classified as a tumor, odontogenic keratocysts were redefined as cysts in the 2017 World Health Organization (WHO) classification. These cysts are believed to originate from remnants of the dental lamina. However, the exact mechanism of their formation is still debated (13). Various studies conducted on pediatric patients have yielded different results regarding the prevalence of odontogenic keratocysts (9, 10). In Case 2, the pathological diagnosis revealed an odontogenic keratocyst. While it is typically found in the ramus and posterior regions of the mandible, in our case, it was observed in the maxilla. It is reported to occur more frequently in males than females and often manifests in the second and third decades of life. Our case, however, contradicts the literature as it involves a female child in the first decade of life. Additionally, it is often asymptomatic according to the literature (14). However, unlike this situation, the reason that brought our case to us was the complaint of swelling and pain. Odontogenic keratocyst generally appears as a sclerotic-bordered unilocular radiolucent area, but in larger cysts, a multilocular appearance can be observed. In our case, despite the significant size of the lesion, the unilocular appearance stands out. The differential diagnosis includes ameloblastoma, traumatic bone cyst, lateral periodontal cyst, and odontogenic myxoma. In small-sized cysts, enucleation can be preferred alone or with curettage, while for larger cysts, enucleation following marsupialization is recommended. Due to their thin walls and the potential for reaching large sizes, these cysts can be fragmented during excision, leaving residual cystic tissues that may lead to recurrence (15). In our case, we initially chose marsupialization, followed by enucleation, due to the size of the lesion.

Myxomas are tumors that are characterized as benign but exhibit aggressive infiltration and a high recurrence rate. They can occur in various locations in the body, including the mandible and maxilla, as well as the heart, skin, and subcutaneous tissues of the head and neck (16). Although benign, their aggressive nature and high recurrence rate often bring ameloblastomas to mind in the differential diagnosis (17). Myxomas can occur in both males and females, predominantly in the age range of 20-30. While they are more commonly found in the mandible, they are rarely reported in the maxilla (18). Radiologically, they can exhibit a multilocular appearance resembling a honeycomb or soap bubble, but they can also appear unilocular, and they are completely radiolucent as they do not produce calcified material (19). In our case, the occurrence in the mandible is consistent with the literature, although it stands out due to its early onset. The radiological examination of our case reveals a unilocular radiolucent lesion. Odontogenic myxomas are described as the rarest tumors among jaw tumors (20).

Conclusion

It has been seen that cystic lesions, which are commonly observed in the jaws in children, are mostly asymptomatic and can be detected by routine dental examination. For this reason, with a detailed dental

examination, the distribution, localization, clinical and radiological findings of cystic lesions should be emphasized enough so that adequate treatment can be provided while developing the clinical differential diagnosis in the early period. In determining the treatment approach for these lesions in children, it should be taken into account that maxillofacial development continues, there is high osteogenic activity and there may be cooperation problems.

References

1. Boyes. Oral Pathology in children. Proc R SocMed 1950; 43: 503-506.
2. Cavalcante R, Turatti E, Daniel A, de Alencar G, Chen Z. Retrospective review of oral and maxillofacial pathology in a Brazilian paediatric population. Eur Arch Paediatr Dent 2016; 17: 115-122.
3. Wang Y-L, Chang H-H, Chang JY-F, Huang G-F, Guo M-K. Retrospective survey of biopsiedoral lesions in pediatric patients. J FormosMedAssoc 2009; 108: 862-871.
4. Abdullah BH, Qader OAJA, Mussedi OS. Retrospective analysis of 1286 oral and maxillofacial biopsied lesions of Iraqi children over a 30 years period. Pediatr Dent J 2016; 26: 16-20.
5. Skinner RL, Davenport Jr W, Weir J, Carr R. A survey of biopsied oral lesions in pediatric dental patients. Pediatr Dent 1986; 8: 163-167.
6. Shah SK, Le MC, Carpenter WM. Retrospective review of pediatric oral lesions from a dental school biopsy service. Pediatr Dent 2009; 31: 14-19.
7. Gültelkin SE, Türkseven MR. A review of pediatric oral biopsies in Turkey. IntDent J 2003; 53: 26-32
8. Özkurt B, Bodrumlu, E. Çocukluk döneminde çenelerde sık görülen kistik lezyonlar. *Aydın DentalJournal*, 2022, 8.1: 43-57.
9. Manor E, Kachko L, Puterman MB, Szabo G, Bodner L. Cystic lesions of thejaws - a clinicopathological study of 322 cases and review of the literature. Int J MedSci. 2012;9(1):20-6.
10. Iatrou I, Theologie-Lygidakis N, Leventis M. Intraosseous cystic lesions of the jaws in children: a retrospective analysis of 47 consecutive cases. Oral Surg Oral Med Oral Pathol Oral RadiolEndod. 2009;107(4):485-92.
11. Rajendra Santosh AB. Odontogenic Cysts. DentClin North Am. 2020;64(1):105-19
12. Nair PN, Pajarola G, Luder HU. Ciliated epithelium-lined radicular cysts. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2002;94(4):485-93.
13. Myoung H, Hong S-P, Hong S-D, Lee J-I, Lim C-Y, Choung P-H, et al. Odontogenic keratocyst: Review of 256 cases for recurrence and clinicopathologic parameters. Oral Surg Oral Med Oral Pathol Oral RadiolEndod. 2001;91(3):328-33
14. Borghesi A, Nardi C, Giannitto C, Tironi A, Maroldi R, DiBartolomeo F. Odontogenic keratocyst: imaging features of a benign lesion with an aggressive behaviour. Insights into imaging. 2018;9(5):883-97.
15. Mendes RA, Carvalho JF, van der Waal I. Characterization and management of the keratocystic odontogenic tumor in relation to its histopathological and biological features. Oral Oncol. 2010;46(4):219-25.
16. Canalis RF, Smith GA, Konrad HR. Myxomas of the head and neck. Arch Otolaryngol Head Neck Surg 1976;102:300-5
17. MacDonald-Jankowski DS, Yeung R, Lee KM, Li TK. Odontogenic myxomas in the Hong Kong Chinese; clinico-radiological presentation and systematic review. DentomaxillofacRadiol2002;32:71-83.
18. Peltola J, Magnusson B, Happonen RP, Borrman H. Odontogenic myxoma—a radiographic study of 21 tumors. Br J Oral MaxillofacSurg1994;32:298- 302.
19. Pratt M, Warnock G. Odontojenikmyxoma of themaxilla. Otolaryngology- Head and Neck Surgery1987;96:292-6.
20. Ghosh BC, Huvos AG, Gerold FP, Miller TR. Myxoma of thejawbones. Cancer, 1973;31:237-40.

Utilization of Nanomaterials In Prosthetic Dental Treatment

Hayriye Yasemin Yay Kuşçu[1*]

1. Harran University Faculty of Dentistry Prosthodontic Department, Şanlıurfa,Türkiye.

***Corresponding author:** Kuşçu Y H Y, MSc.,PhD, Ass. prof., Department of Prosthodıntic, Faculty of Dentistry, Harran University, Şanlıurfa, Turkiye.
E-mail : yaseminyay123@gmail.com.
DOI: 10.61139/ijdor.1270852

Abstract

Nanomaterials in prosthetic dental treatments have garnered significant attention in the field of dentistry. These nanomaterials are utilized in various forms, such as nanoceramics, nanocomposites, nanoimplants, and antimicrobial nanoparticles. Particularly, through nanotechnology advancements, these materials offer high mechanical strength, biocompatibility, and aesthetic properties, enhancing the success of dental restorations and prosthetics. Additionally, nanoparticles with antimicrobial properties provide protection against periodontal diseases and tooth decay. The development of nanoparticle synthesis methods and techniques has enabled the use of more effective and safe materials in prosthetic dental treatments. The impact of nanotechnology in dentistry allows for the development of more successful and sustainable treatment options for patients.

Review (HRU Int J Dent Oral Res 2023; 3(2): 117-123

Keywords: Nanomaterials, nanocomposites, nano-implants, nanoceramics, nanocoatings.

Introduction

Prosthetic dental treatment holds critical importance for restoring the function and aesthetics of missing teeth. In this field, the use of nanomaterials presents substantial potential, particularly due to materials with dimensions ranging from 1 to 100 nanometers (1). The biocompatibility, mechanical strength, tissue compatibility, and aesthetics of the materials used in this process are crucial for achieving successful results (2).

Nowadays, research in the field of nanotechnology evaluates the use of various nanomaterials, such as carbon nanotubes, nanocrystals, and nanofibers, in prosthetic dental treatment (3).

Nanomaterials significantly contribute to the development of biocompatible ceramics, polymers, and composites for prosthetic dental treatment. The nanoscale properties and performance of these materials assist in the production and application of more durable, aesthetic, and functional prostheses. Specifically, the integration of nanoscale ceramic particles into composite materials allows for the development of high-strength and aesthetically superior dental prostheses (4). Numerous studies have demonstrated that nanoparticles improve the biomechanical properties of polymer materials (5, 6). For instance, polymer materials prepared with the addition of nanotitanium dioxide (TiO_2) enhance mechanical strength, surface properties, thermal stability, and resistance to UV radiation (7). Additionally, the size, shape, and distribution of nanoparticles affect the color stability of prosthetic materials (8).

Nanoparticles represent a significant advancement in prosthetic dental treatment, particularly in the processing of materials in contact with oral mucosa. The antibacterial properties of nanoparticles reduce bacterial colonization of prosthestic materials in the oral cavity, thus lowering the risk of infection. Research has shown that the use of silver nanoparticles in prosthetic materials can reduce bacterial growth and biofilm formation (9). These features improve patient quality of life by extending implant success and lifespan (10).

However, there are potential risks and concerns associated with the use of nanomaterials in the field of dentistry. Considering the aging population and increasing dental health needs, progress in this field will become even more crucial in the future. Therefore, further research is needed on the biological interactions, toxicity profiles, and efficacy of materials at the nanoscale (10).

Materials and Methods

The main information sources are scientific databases such as PubMed, Scopus, Web of Science, and Google Scholar. In addition, books and conference papers related to the subject have also been reviewed. The scanning process has been performed using specific keywords and keyword combinations such as "prosthetic dental treatment", "nanomaterials", “nano composites”, “nano ceramics”, "nanotechnology", “nano resin”, “nano implant”,“nano coatings”, “antimicrobial nanoparticles”, "biomechanical properties”, “biocompatibility", "aesthetics" etc., to include English articles from 2013 to the present. According to this search data, 7160 studies were analyzed. 2846 studies were not included in the study because the full text could not be reached. 4264 studies that did not meet the research criteria were excluded. 50 studies were evaluated and included in the research.

Results

1.Nanoparticle Synthesis

Nanoparticles used in prosthetic dental treatment, which are generally a few hundred nanometers in size, can be composed of metal, metal oxide, or organic compounds. These substances can be synthesized through chemical or physical methods. Chemical methods typically involve dissolving metal ions in a solution and adding a reducing agent. This allows the metal ions to be reduced to nanoparticles through redox reactions. Physical methods, on the other hand, involve obtaining previously existing nanoparticles from a substance by mechanically or thermally reducing its size. The synthesis of nanoparticles is associated with numerous parameters, including the chemicals used, solvents, reducing agents, temperature, and pressure. For instance, the size of the nanoparticles can vary depending on the reaction temperature and the type of reducing agent used. The characterization of the resulting nanoparticles involves size, morphology, surface area, surface charge, chemical properties, and quantum properties (11) (12). The fundamental principles of nanoparticle synthesis include chemical or physical methods, liquid/gas phase reactions, precipitation methods, and microwave or ultrasonic methods (13). Among these methods, the most commonly used are sol-gel, hydrothermal, and precipitation methods (13).

The sol-gel method is a popular method for the synthesis of inorganic nanoparticles and allows for the production of homogeneous and versatile products using a controllable chemical reaction. Hydrothermal synthesis is a method performed under high temperature and pressure, and it is considered a suitable option for obtaining products with a crystalline structure (14). The precipitation method, on the other hand, is used to obtain nanoparticles synthesized by precipitating inorganic substances in solution and is particularly preferred for obtaining products with high purity and in large quantities (15).

Microwave synthesis, used for nanoparticle synthesis, is preferred due to the acceleration of chemical reactions by microwave energy (16). Ultrasonic methods are employed with the aim of controlling particle sizes and increasing homogeneity using high-frequency sound waves (17).

There are numerous methods available for nanoparticle synthesis in prosthetic dental treatment, and each method offers different advantages depending on the properties of the resulting products.

2.Nanomaterials

Nanomaterials used in dentistry can be examined in 6 classes as nanocomposites, nano hybrid resins, nano ceramics, nano implants, nano coatings, antimicrobial nanoparticles.

2.1.Nanocomposites

Nanocomposites are materials formed by the combination of inorganic filler particles at the nano-scale and an organic matrix (18). Nanocomposites typically comprise a resin matrix and nano-sized filler particles. The resin matrices are generally a methacrylate-based compound, such as bis-GMA (bisphenol A glycol dimethacrylate) or UDMA (urethane dimethacrylate). Bis-GMA and UDMA connect to each other during the polymerization process, forming a three-dimensional network structure. This network structure enhances

the overall strength and durability of the composite material. Moreover, the low water absorption of these resins makes them more suitable for intraoral applications. The atomic structure of these materials consists of a regular crystal structure. Each atom is typically linked to other atoms in a specific geometric arrangement. This regular structure provides high hardness and strength to the nanoparticles. The atomic dimensions of these particles allow them to distribute homogeneously within the material and interact effectively with the resin matrix.The atomic structure of nanocomposites depends on the atomic structures of these two components and their interactions with each other. These interactions typically occur through different types of interatomic forces, such as chemical bonds, van der Waals forces, and hydrogen bonds. The nano-scale filler particles provide enhanced polymerization and mechanical durability due to the increased surface area and better interaction with the composite matrix (19). Additionally, the lower polymerization contraction of nanocomposites reduces stress formation during restoration, thus lowering the risk of secondary caries formation (20).

The optical properties of nanocomposites offer an aesthetic appearance closer to natural tooth tissue. Nano-scale filler particles render the light transmittance and scattering of composites more compatible with the properties of a natural tooth (21). Consequently, the natural color and brightness of teeth enable restorations to have a more natural appearance (22).

Antimicrobial properties are also among the advantages of nanocomposites. Studies incorporating silver nanoparticles into nanocomposites demonstrate that these materials can enhance antimicrobial activity, potentially extending the lifespan of restorations (23) (24).

However, nanocomposites have some disadvantages. Due to the higher surface area and reactivity of nanoparticles, excessive polymerization heat production and thermal damage to the restoration's surroundings may occur in some cases (25). Furthermore, the cost of nanocomposites is higher compared to traditional composites (26).

In the future, it is expected that the properties of nanocomposites will be further improved and costs will be reduced, allowing for more widespread and effective use of these materials in dental applications. Additionally, new nanoparticle types and functional nanostructures may enable restorations to possess properties such as higher biocompatibility, antimicrobial efficacy, and mechanical durability.

2.2.Nanohybrid Resins

Nanohybrid resins are modern restorative materials used in prosthetic dental treatments and developed with nanotechnology. These materials comprise a combination of micro filler particles and nano filler particles, offering enhanced mechanical, optical, and ease-of-handling properties (27). In terms of mechanical properties, nanohybrid resins provide higher strength and wear resistance compared to traditional composites (28). Nano filler particles increase the surface area of the composite and ensure better interaction with the matrix, resulting in higher compressive resistance and wear resistance (18). These properties are crucial for the long-term performance and durability of restorations.

Optically, nanohybrid resins are expected to deliver aesthetic outcomes similar to natural tooth structure. The light transmission and scattering properties of nanofillers render restorations closer to the color and brightness of adjacent natural teeth (29, 30).

Regarding ease of application, nanohybrid resins' lower polymerization contraction reduces stresses during restoration, lowering the risk of secondary caries formation (20). Moreover, the improved moldability and reduced stickiness of these materials allow dentists to complete the treatment process more comfortably and quickly (31).

The wear resistance and surface roughness of nanohybrid resins may vary depending on the type and proportion of filler particles used (32). However, disadvantages such as performance variations depending on cost and filler particles must be considered. Therefore, selecting the most appropriate material and treatment method for each patient is essential. Further clinical and laboratory studies on the use of nanohybrid resins in dental applications will help us better understand their potential advantages and limitations.

2.3. Nanoceramics

Nanoceramics are complex materials that contain a range of different ceramic components and are often preferred in prosthetic dental treatment applications. These components generally include nanoparticles of ceramic materials such as silica (SiO_2), alumina (Al_2O_3), titania (TiO_2), and zirconia (ZrO_2). The atomic structure of the components is arranged so that silicon, aluminum, titanium,

zirconium atoms, and oxygen (O) atoms form a tetrahedral structure. Silica is usually used as the main component of the nanoceramic matrix. It is known for its excellent biocompatibility features and optical properties, making it an ideal choice for dental restorations. Silica particles also enhance the overall hardness and strength of the material. Alumina is often added to nanoceramics because it possesses high hardness and wear resistance features. This ensures the long-term durability and performance of nanoceramic restorations. Titania is added to nanoceramics to provide excellent biocompatibility, corrosion resistance, strength, and hardness. Zirconia is added to nanoceramics to provide high strength and hardness. Zirconia also provides excellent wear resistance to the material and helps the restorations to be long-lasting. The components of these nanoceramics are dispersed within a resin matrix. The resin matrix is a methacrylate-based compound, such as bis-GMA (bisphenol A glycol dimethacrylate) or UDMA (urethane dimethacrylate). This resin matrix holds the nano-ceramic particles together and gives them a specific shape. Nanoceramics possess higher strength and durability compared to traditional ceramics (33). The more homogeneous distribution of nanometer-sized ceramic particles and dense sintering prevent crack propagation, thereby increasing damage tolerance and providing higher mechanical durability (34). These properties are crucial for the long-term performance and durability of restorations used in prosthetic dental treatment. In terms of optical properties, nanoceramics are expected to provide aesthetic results similar to natural tooth structure. Nanoceramics that mimic natural teeth offer a closer appearance to the natural tooth color and brightness in restorations (35). Consequently, aesthetically satisfying outcomes can be achieved.

Regarding ease of processing, the low-temperature sintering properties of nanoceramics, along with their easy moldability and low adhesion, allow dental practitioners to complete the treatment process more comfortably and quickly, ensuring more accurate and well-fitting restorations (36).

Nanoceramics also have some disadvantages. In particular, the cost of such ceramics can be higher compared to traditional ceramics. Additionally, the complexity and sensitivity of the production process for nanoceramics may create challenges in quality control and compliance with standards (36).

2.4. Nanoimplants

Nanoimplants are an innovative type of dental implant used in prosthetic dental treatment and developed using nanotechnology. Nanoimplants accelerate the osseointegration process and shorten healing time through nanotopography and nanostructured coatings (37). These coatings, which involve the use of bone-like materials such as hydroxyapatite and biocalcium phosphate, establish a quicker and stronger connection with the surrounding bone, facilitating a successful treatment process (38). Additionally, the integration of bioactive molecules, such as antibacterial agents and growth factors, into the coatings reduces the risk of infection, supports bone regeneration, and helps prevent biofilm formation (39) (40).

Advancements in biomaterials have made it possible for next-generation nanoimplants to use not only titanium and titanium alloys but also ceramic and polymer-based materials (41).

While nanoimplants hold great potential in prosthetic dental treatment applications, it is important to continuously evaluate and analyze progress in this field. The clinical performance of next-generation implants should be assessed in conjunction with the determination of optimal surface properties, material selection, and advancements in coating technologies. Therefore, scientific research and clinical studies should continue to best utilize the potential of nanoimplants and achieve the best outcomes in prosthetic dental treatment applications (42). Further studies are needed regarding the production processes and costs of nanoimplants. Additionally, more information should be collected on the long-term success rates and safety profiles of these implants (41).

2.5. Nanocoatings

Nanocoatings used in prosthetic dental treatment serve to improve the surface properties of dental implants and other prosthetic materials. These coatings enhance treatment success by accelerating osseointegration, increasing biocompatibility, and reducing the risk of bacterial infection (43). The success of nanocoatings depends on factors such as surface properties, material selection, and application techniques. An ideal nanocoating should provide high biocompatibility, good mechanical properties, and antibacterial activity (44).

One type of nanocoating consists of titanium dioxide (TiO_2) nanoparticles. Due to the antibacterial properties and the ability to prevent biofilm formation of TiO_2 nanoparticles, these coatings help achieve successful results by improving the hygiene of dental implant surfaces (43).

Another significant type of nanocoating is hydroxyapatite (HA) nanocrystals. HA is preferred due to its similar chemical composition to the natural bone matrix and its demonstrated biocompatibility. HA nanocoatings support the osseointegration process by providing better cell adhesion and proliferation on implant surfaces (41).

Nanocoatings containing silver nanoparticles, colloidal silver, and other antimicrobial agents have been reported in studies to make the treatment process safer by reducing the risk of infection (45). Therefore, research on nanocoatings combined with antibacterial agents and drug delivery systems continues.

Graphene-based nanocoatings have also drawn attention in the field of prosthetic dental treatment. Graphene offers excellent mechanical properties, high conductivity, flexibility, biocompatibility, and antibacterial activity. These characteristics indicate that graphene-based nanocoatings could be a promising option for dental implants and other prosthetic applications (46).

2.6. Antimicrobial Nanoparticles

Antimicrobial nanoparticles are garnering increasing interest in the field of prosthetic dental treatment. These nanoparticles can be incorporated into materials used for dental restorations and implants with the aim of reducing infection risk and preventing bacterial colonization (47). This section will discuss the use of antimicrobial nanoparticles in prosthetic dental treatment and related studies.

Silver nanoparticles (AgNPs) are the most popular among antimicrobial nanoparticles. Silver nanoparticles exhibit broad-spectrum antimicrobial activity and are effective against both Gram-positive and Gram-negative bacteria (45). This property encourages the addition of AgNPs to materials used for dental implants and restorations to reduce the risk of infection (48).

Zinc oxide nanoparticles (ZnO NPs) are another nanomaterial that exhibits antimicrobial activity. By incorporating zinc oxide nanoparticles into materials used in dental prostheses and restorations, the antimicrobial properties of these products can be enhanced (49). ZnO NPs are particularly effective against bacteria species that cause tooth decay, and their addition to dental restoration materials provides a significant advantage (50).

Titanium dioxide nanoparticles (TiO_2 NPs) are another nanomaterial with antimicrobial effects. TiO_2 NPs display strong antimicrobial properties, particularly when exposed to ultraviolet (UV) light. Coatings of TiO_2 NPs applied to the surfaces of titanium alloys used in dental implants increase the implant's resistance to biofilm formation, reducing the risk of infection (43).

The use of antimicrobial nanoparticles can help achieve better results in prosthetic dental treatment. However, the biocompatibility and toxicity profiles of these nanoparticles should also be considered (48). Additionally, more research is needed on their short- and long-term effects.

Antimicrobial nanoparticles such as silver, zinc oxide, and titanium dioxide are being considered as ideal candidates for dental applications, including dental restorations and implants. The use of these nanomaterials is aimed at achieving better results in prosthetic dental treatment, particularly by preventing biofilm formation and controlling bacterial infections (47).

However, concerns related to biocompatibility, toxicity, and environmental impacts must also be considered when using antimicrobial nanoparticles (48). Therefore, it is essential to conduct comprehensive preclinical and clinical studies to ensure the safe and effective use of nanoparticles.

Furthermore, research is ongoing on next-generation nanomaterials and surface modification techniques to make antimicrobial nanoparticles more effective and safer for dental applications. These technologies can contribute to the development of more effective and sustainable antimicrobial strategies in dentistry.

In summary, the use of antimicrobial nanoparticles in prosthetic dental treatment offers new and effective antimicrobial strategies for dental restorations and implants. However, further research and clinical studies are needed to ensure the safe and effective use of this technology.

Discussion and Conclusion

This study has assessed the importance and potential benefits of using nanomaterials in prosthetic

dental treatment. Nanomaterials contribute to the development of innovative and effective treatment approaches in dentistry. These materials, used in restorative treatments, implantology, and aesthetic dentistry, provide improved mechanical properties, biocompatibility, antimicrobial activity, and natural appearance.

Nanocomposite and nanohybrid resins offer strong and durable options for aesthetic restorations, while nano-filled particles provide optical properties similar to natural tooth structure. Nanoceramics and nanoimplants deliver more durable and long-lasting treatment outcomes, along with improved biomechanical compatibility and biological integration. Antimicrobial nanoparticles contribute to reducing infection risk, thereby increasing the chances of treatment success.

However, there are also some potential disadvantages associated with the use of nanomaterials. These disadvantages include cost, toxicity risks, and the unknown long-term effects. Therefore, more research and clinical studies will provide further information on the effectiveness, safety, and applicability of these materials.

Referances

1. Oyar P. Diş Hekimliğinde Kullanılan Nanopartiküller, Kullanım Alanları Ve Biyouyumluluk. Atatürk Üniversitesi Diş Hekimliği Fakültesi Dergisi. 2015; 24(1): 125-133.
2. Bhardwaj A, Bhardwaj A, Misuriya A, Maroli S, Manjula S, Singh AK. Nanotechnology in dentistry: Present and future. Journal of international oral health: JIOH. 2014; 6(1):121.
3. Polini A, Bai H, Tomsia AP. Dental applications of nanostructured bioactive glass and its composites. Wiley Interdisciplinary Reviews: Nanomedicine and Nanobiotechnology. 2013; 5(4):399-410.
4. Besinis A, De Peralta T, Handy RD. The antibacterial effects of silver, titanium dioxide and silica dioxide nanoparticles compared to the dental disinfectant chlorhexidine on Streptococcus mutans using a suite of bioassays. Nanotoxicology. 2014; 8(1):1-16.
5. Dwivedi S, Dwivedi CD, Chandra A, Sharma N. Nanotechnology boon or bane for restorative dentistry; A review. Inte J Eng Sci Inv. 2013; 2(1):1-5.
6. St-Pierre L, Martel C, Crépeau H, Vargas MA. Influence of polishing systems on surface roughness of composite resins: polishability of composite resins. Operative dentistry. 2019; 44(3): E122-E132.
7. Uehara LM, Ferreira I, Botelho AL, da Costa Valente ML, Dos Reis AC. Influence of β-AgVO3 nanomaterial incorporation on mechanical and microbiological properties of dental porcelain. Dental Materials. 2022; 38(6):e174-e180.
8. Nayak AK, Mazumder S, Ara T, Ansari MT, Hasnain MS. Calcium fluoride-based dental nanocomposites. Applications of nanocomposite materials in dentistry. 2019: 27-45.
9. Makvandi P, Gu JT, Zare EN, Ashtari B, Moeini A, Tay FR, Niu LN. Polymeric and inorganic nanoscopical antimicrobial fillers in dentistry. Acta biomaterialia. 2020; 101:69-101.
10. Tomsia AP, Lee JS, Wegst UGK, Saiz E. Nanotechnology for dental implants. International Journal of Oral & Maxillofacial Implants. 2013 Nov-Dec; 28(6):e535-46.
11. Pérez RA, Delgado LM, Gutiérrez RA. Nanomaterials in dentistry: state of the art and future challenges. J Dent Res. 2014;93(11):1238-1244.
12. Li Y, Jia H, Cui X, Qin W, Qin S, Wu Y, Li Y. Bending properties, compression properties, biocompatibility and bioactivity of sulfonated carbon fibers/PEEK composites with graphene oxide coating. Applied Surface Science. 2022; 575:151774.
13. Xu VW, Nizami MZI, Yin IX, Yu OY, Lung CYK, Chu CH. Application of copper nanoparticles in dentistry. Nanomaterials. 2022; 12(5):805.
14. Beketova A, Theocharidou A, Tsamesidis I, Rigos AE, Pouroutzidou GK, Tzanakakis E. GC, Kontonasaki E. Sol–gel synthesis and characterization of ysz nanofillers for dental cements at different temperatures. Dentistry Journal. 2021; 9(11):128.
15. Schmalz G, Hickel R, van Landuyt KL, Reichl FX. Scientific update on nanoparticles in dentistry. International dental journal. 2018; 68(5):299-305.
16. Zaharia C, Duma VF, Sinescu C, Socoliuc V, Craciunescu I, Turcu RP, Negrutiu M. L. Dental adhesive interfaces reinforced with magnetic nanoparticles: Evaluation and modeling with micro-CT versus optical microscopy. Materials. 2020; 13(18):3908.
17. Pourhajibagher M, Bahrami R, Bahador A. An ex vivo evaluation of physico-mechanical and anti-biofilm properties of resin-modified glass ionomer containing ultrasound waves-activated nanoparticles against Streptococcus mutans biofilm around orthodontic bands. Photodiagnosis and Photodynamic Therapy. 2022; 40:103051.
18. Leprince JG, Palin WM, Hadis MA, Devaux J, Leloup G. Progress in dimethacrylate-based dental composite technology and curing efficiency. Dental Materials. 2013; 29(2):139-156.
19. Odermatt R, Par M, Mohn D, Wiedemeier DB, Attin T, Tauböck TT. Bioactivity and physico-chemical properties of dental composites functionalized with nano-vs. micro-sized bioactive glass. Journal of clinical medicine. 2020; 9(3):772.
20. Ilie N, Stark K. Curing behaviour of high-viscosity bulk-fill composites. J Dent. 2014;42(8):977-85.
21. Calheiros FC, Daronch M, Rueggeberg FA, Braga RR. Effect of temperature on composite polymerization stress and degree of conversion. Dental Materials. 2014; 30(6):613-618.
22. Jun SK, Kim DA, Goo HJ, Lee HH. Investigation of the correlation between the different mechanical properties of resin composites. Dental materials journal 2013; 32(1):48-57.
23. Cheng L, Zhang K, Weir MD, Melo MAS, Zhou XD, Xu HHK. Nanotechnology strategies for antibacterial and remineralizing composites and adhesives to tackle dental caries. Nanomedicine. 2015;10(4):627–41.
24. Melo MAS, Cheng L, Zhang K, Weir MD, Rodrigues LK, Xu HH. Novel dental adhesives containing nanoparticles of silver and amorphous calcium phosphate. Dental Materials. 2013; 29(2):199-210.
25. AlShaafi MM. Factors affecting polymerization of resin-based composites: A literature review. Saudi Dent J. 2017;29(2):48-58.
26. Unsal KA, Karaman E. Effect of additional light curing on colour stability of composite resins. International dental journal. 2022; 72(3):346-352.
27. Angerame D, De Biasi M. Do nanofilled/nanohybrid composites allow for better clinical performance of direct restorations than traditional microhybrid composites? A systematic review. Operative dentistry. 2018; 43(4):E191-E209.
28. Colak H, Ercan E, Hamidi MM. Shear bond strength of bulk-fill and nano-restorative materials to dentin. European journal of dentistry. 2016; 10(01):040-045.

29. Tauböck TT, Tarle Z, Marovic D, Attin T. Pre-heating of high-viscosity bulk-fill resin composites: effects on shrinkage force and monomer conversion. Journal of dentistry. 2015; 43(11):1358-1364.
30. Kundie F, Azhari CH, Muchtar A, Ahmad ZA. Effects of filler size on the mechanical properties of polymer-filled dental composites: A review of recent developments. Journal of Physical Science. 2018; 29(1):141-165.
31. El-Damanhoury HM, Platt JA. Polymerization shrinkage stress kinetics and related properties of bulk-fill resin composites. Oper Dent. 2014;39(4):374-82.
32. Vismara MVG, de Medeiros Mello LM, Di Hipólito V, González AHM, de Oliveira Graeff CF. Resin composite characterizations following a simplified protocol of accelerated aging as a function of the expiration date. journal of the mechanical behavior of biomedical materials. 2014; 35:59-69.
33. Zhang Y, Kelly JR. Dental Ceramics for Restoration and Metal Veneering. Dent Clin North Am. 2017;61(4):797-819.
34. Conrad HJ, Seong WJ, Pesun IJ. Current ceramic materials and systems with clinical recommendations: a systematic review. J Prosthet Dent. 2007;98(5):389-404.
35. Alghazzawi TF. Advancements in CAD/CAM technology: Options for practical implementation. J Prosthodont Res. 2016;60(2):72-84.
36. Gracis S, Thompson VP, Ferencz JL, Silva NR, Bonfante EA. A new classification system for all-ceramic and ceramic-like restorative materials. Int J Prosthodont. 2015;28(3):227-35.
37. Smeets R, Stadlinger B, Schwarz F, Beck-Broichsitter B, Jung O, Precht C, Kloss F, Gröbe A, Heiland M, Ebker T. Impact of Dental Implant Surface Modifications on Osseointegration. Biomed Res Int. 2016;2016:6285620.
38. Han J, Dong J, Zhao H, Ma Y, Yang S, Ma Y. Impact of different implant materials on osteoblast activity after oral implantation. Int J Clin Exp Med. 2019; 12(5):5389-5396.
39. de Avila ED, Lima BP, Sekiya T, Torii Y, Ogawa T, Shi W, Lux R. Effect of UV-photofunctionalization on oral bacterial attachment and biofilm formation to titanium implant material. Biomaterials. 2015;67:84-92.
40. O'Neill E, Awale G, Daneshmandi L, Umerah O, Lo KW. The roles of ions on bone regeneration. Drug Discov Today. 2018;23(4):879-890.
41. Shah FA, Thomsen P, Palmquist A. Osseointegration and current interpretations of the bone-implant interface. Acta Biomater. 2019;84:1-15.
42. Gittens RA, Olivares-Navarrete R, Schwartz Z, Boyan BD. Implant osseointegration and the role of microroughness and nanostructures: Lessons for spine implants. Acta Biomater. 2014;10(8):3363-71.
43. Albrektsson T, Wennerberg A. On osseointegration in relation to implant surfaces. Clin Implant Dent Relat Res. 2019; 21(1):4-7.
44. Wang J, Meng F, Song W, Jin J, Ma Q, Fei D, Zhang Y. Nanostructured titanium regulates osseointegration via influencing macrophage polarization in the osteogenic environment. International Journal of Nanomedicine, 2018; 13:4029.
45. Corrêa JM, Mori M, Sanches HL, Cruz ADD, Poiate E, Poiate IAVP. Silver nanoparticles in dental biomaterials. International journal of biomaterials, 2015; 2015.
46. Qi X, Jiang F, Zhou M, Zhang W, Jiang X. Graphene oxide as a promising material in dentistry and tissue regeneration: A review. Smart Materials in Medicine. 2021; 2:280-291.
47. Taheri S, Cavallaro A, Christo SN, Smith LE, Majewski P, Barton M, Vasilev K. Substrate independent silver nanoparticle based antibacterial coatings. Biomaterials. 2014; 35(16):4601-4609.
48. Chernousova S, Epple M. Silver as antibacterial agent: ion, nanoparticle, and metal. Angew Chem Int Ed Engl. 2013;52(6):1636-1653.
49. Palanikumar L, Ramasamy SN, Balachandran C. Size-dependent antimicrobial response of zinc oxide nanoparticles. IET nanobiotechnology. 2014;8(2):111-117.
50. da Silva BL, Caetano BL, Chiari-Andréo BG, Pietro RCLR, Chiavacci LA. Increased antibacterial activity of ZnO nanoparticles: Influence of size and surface modification. Colloids and Surfaces B: Biointerfaces. 2019; 177:440-447.