e-ISSN: 2822-6755

Dicle Dental Journal

Volume: 25 Issue: 4 Year: 2024

The Official Journal of
Dicle University Faculty of Dentistry

https://dergipark.org.tr/tr/pub/dicledentj

EDITORIAL BOARD

EDITORIAL BOARD

CONTENTS

Original Articles

Case Reports

Original Article

Dicle Dent J. 2024;25(4):96-101.

Retrospective assessment of dental implant applications: cross-sectional study

Hazem Alhelou, Nuran Yanıkoğlu, Zeynep Çintosun

Department of Prosthetic Dentistry, Faculty of Dentistry, Atatürk University, Erzurum, Turkiye

Cite this article as: Alhelou H, Yanıkoğlu N, Çintosun Z. Retrospective assessment of dental implant applications: cross-sectional study. *Dicle Dent J.* 2024;25(4):96-101.

Received: 23/09/2024 ◆ **Accepted**: 13/11/2024 ◆ **Published**: 30/12/2024

ABSTRACT

Aims: The aim of this study was to retrospectively examine the demographic and clinical conditions of the patients operated between 2020 and 2023 and the characteristics of the implants placed and to evaluate them using descriptive statistics.

Methods: In this study, 6990 implants were evaluated in a total of 1586 patients aged 17-80 years, whose implant treatments were performed between 2020 and 2023 in Atatürk University Faculty of Dentistry, Department of Periondotology and Department of Oral, Dental and Maxillofacial Surgery. The demographic data obtained were analyzed by descriptive statistical techniques to examine a series of characteristics such as age, gender, edentulous status, implanted sites, type of post-treatment restoration and implant locations, type of post-treatment restoration and the brand and model of implants used.

Results: 52.1% (n=827) of the patients were female and 47.9% (n=759) were male. The highest number of patients (n=480) was in the 40-49 age group. The most commonly implanted tooth was the mandibular 1st molar, and the most commonly implanted area was the mandibular molar region. It was determined that 70.8% of the implants were performed in the periodontology clinic. When evaluated according to the type of prosthetic restoration, the highest proportion of patients was 49.4% (n=1366) with fixed partial edentulism terminated with teeth. The lowest number of patients was complete edentulism and overdenture restoration with 5.9% (n=162).

Conclusion: In this study; demographic and clinical characteristics of dental implant applications and the results were explained with descriptive statistical analysis methods. Retrospective evaluation of the features of clinical applications and prosthetic rehabilitation of implants is very valuable in terms of guiding treatment planning processes.

Keywords: Eduntulism, dental implant, implant supported prosthesis, retrospective study

INTRODUCTION

Dental implant therapy now has a routine clinical application in dental practice.[1-3] It is also an important component of prosthetic procedures that improves patient satisfaction and quality of life.[4-7] Tooth loss is the most common reason for the increasing demand for dental implant treatment, followed by retention and stability problems of conventional prostheses, patient expectations, clinician preferences and the known success of implant prostheses.[8]

Treatment with dental implants has been followed in many long-term clinical trials, primarily focusing on implant survival.[9] This method is considered superior to conventional treatment methods. Despite high success and survival rates with dental implants, failures do occur. The requirement of this study was to evaluate the effectiveness of current treatment approaches using data obtained from the large and diverse patient population of Atatürk University. Patient health, age, gender, condition, smoking, bone quality, oral hygiene and implant care habits, unresolved infection, implant-related factors such as implant size, implant characteristics, implant location, and other factors such as clinicians' experience have previously been recognized as determining factors for implant success, survival and failure.[9-12] However, with the rapid increase in scientific developments and the increase in the clinical experience of the physician, the patient portfolio suitable for implant treatment has expanded.[13] The study adds to this portfolio by developing a better and more reliable treatment method, easier identification of the prosthetic options in relation to the preferences of different patient groups and assistance in future treatment planning.

The main aim of this study is to make a detailed retrospective analysis of dental implant surgery and prosthetic applications performed in our clinic in a specific time period. In this context, the age and gender distribution of the patients, the reasons for implant placement, the types of implant restorations and the brands of implants placed were all analyzed.

Corresponding Author: Hazem Alhelou, hazem.alhelu@gmail.com

METHODS

In this study, patients who underwent implant treatments in Atatürk University Faculty of Dentistry, Department of Oral and Maxillofacial Surgery and Department of Periondotology and patients whose implant prostheses were completed in the Department of Prosthodontics between 2020 and 2023 were included in this study. Patients were analyzed in terms of age and gender, edentulous status, number of implants, brand and type of implants, type of restoration on implant, implant sites, and type of restoration after treatment. The data were obtained by evaluating the information in the HIS. Atatürk University Ethics Committee approval was obtained for our study (Date: 25.04.2024, Decision No: 2024/04), which was planned in accordance with the Declaration of Helsinki. Bego, Bioinfinity, Bredent, Cowelmedi, Direct, DYNA, EVOSS, Implance, ITI, Medentika, Megagen, MS implant, Nobel, Nucleoss, OSSTEM, Profil, ROOTT, SWISS, Tidal, Trias, X gate brand implant systems were evaluated. A total of 6990 dental implants in 1586 patients were analyzed using Turcasoft software (Turcasoft Yazılım Ltd.Şti. Yenimahalle Atakum/Samsun, Turkiye), TurcaSoft Medical Viewer X-ray program and data from patient files.

Age groups and gender comparisons were made for a total of six age groups: 18-29, 30-39, 40-49, 40-49, 50-59, 60-69 and 70 years and older.[14] Anterior mandible, anterior maxilla, anterior maxilla, premolar mandible, premolar maxilla, premolar maxilla, molar mandible and molar maxilla where the six groups in which implant placement locations were evaluated. According to the type of restoration, crown-bridge restoration, single crown and overdenture prosthesis were evaluated. For each missing tooth, the age and gender of the missing tooth were analyzed.

Statistical Analysis

Numbers (percentages) were used to summarize the data according to groupings. Pearson's chi-square test, Yates' adjusted chi-square test and Fisher's exact chi-square test were used in statistical studies. Statistical significance level was accepted as $p<0.05$. IBM SPSS statistics 26.0 application was used for analysis.

RESULTS

In the study, 6990 implants applied to a total of 1586 patients aged between 17 and 80 years were evaluated. Of the patients, 52.1% (n=827) were female and 47.9% (n=759) were male. The highest number of patients was in the 40-49 age group with 30.3% (n=480), followed by the 50-59 age group with 23.4% (n=371) and the 30-39 age group with 19.1% (n=302). While 11.8% (n=187) were in the 60-69 age group, 13.8% (n=220) were in the 18-29 age group. Patients aged 70 years and older constituted the group with the lowest number of patients (1.6%; n=26). The mandibular left first molar was the most frequently implanted tooth number with 543 implants, while the mandibular right first molar was the second most frequently implanted tooth number with 509 implants. A statistically significant relationship was found between tooth number and age ($p<0.0001$) (Table 1).

The rate of implant placement for tooth number 11 in the 40-49 age group was statistically significantly higher than in the 18-29 and 30-39 age groups. The number of implants placed for tooth number 32 was statistically significantly higher in the 40-49 age group. It was found to be statistically significant that more implants were placed in teeth numbered 36 and 37 among people aged between 40 and 49 years (Table 1).

The majority of the patients were female with 52.1% (n=827). When the age distribution of the patients was analyzed, the age group with the highest number of patients was 40-49 years old with 30.3% (n=480), while the age group with the lowest number of patients was 70 years and older with 1.6% (n=26) (Table 2).

According to the anatomical sites of the implants, the molar mandible accounted for 24.3% of all implants (n=1697), followed by the molar maxilla (19.5%) for the second highest number of implants. The anterior mandible had the least number of implants (11.0%) (n=768) (Table 3).

When the implants were analyzed according to tooth numbers, tooth number 36 had the highest implant rate (7.8%; n=543), followed by tooth number 46 (7.3%; n=509). The fewest implants were placed in tooth number 41 with 0.8% (n=53) (Figure 1).

When evaluated according to the type of prosthetic restoration performed, the highest proportion of patients was 49.4% (n=1366) with fixed partial edentulism with tooth termination, followed by single tooth deficiency with 33.8% (n=935) and lower fixed complete edentulism with 8.4% (n=232). In single edentulous cases, tooth 36 was restored at the highest rate, while tooth 41 was restored at the lowest rate. The lowest number of patients was complete edentulousness and overdenture restoration with 5.9% (n=162) (Figure 2).

When the distribution of patients according to the clinic where their surgical operations were performed was analyzed, it was seen that the periodontology clinic was preferred by the most patients with 70.8% (n=4952), followed by the surgery clinic with 29.2% (n=2038).

When analyzed according to the type of implant brand, the most preferred implant brand was Nucleoss with 27.2% (n=1900), followed by OSSTEM with 26.6% (n=1861), Implance with 22.3% (n=1560), Direct with 6.8% (n=474) and Bredent with 5.7% (n=401). The least implants were X gate and ITI brand with the same rate of 0.03% (n=2) (Figure 3).

DISCUSSION

Dental implants are now widely used in the treatment of missing teeth.[15-17] The range of implant indications has expanded significantly in recent years due to evolving patient profiles and continuously improving implant technologies. Despite the increasing number of implant treatments in Turkiye in recent years, quantitative data on this subject is still unclear. This can be explained by the recent implementation of faculty automation systems in Turkiye and the inadequate ability of existing automation systems to document implantation procedures. Simultaneously, implant treatment has become widely used in patients with single

Table 1. Distribution of implants according to tooth numbers and age groups

	Age					
Tooth number	**18-29**	**30-39**	**40-49**	**50-59**	**60-69**	**70 and above**
	Number (%)	**Number (%)**	**Number (%)**	**Number (%)**	**Number (%)**	**Number (%)**
11	17_{a} (20.0)	14_{a} (16.5)	32_{a} (37.6)	17_{a} (20.0)	4_{a} (4.7)	1_{a} (1.2)
12	54_{a} (26.7)	22_{b} (10.9)	40_{b} (19.8)	71_{a} (35.1)	12_{b} (5.9)	$3_{a,b}$ (1.5)
13	55_{a} (27.9)	16_{b} (8.1)	$45_{b,c}$ (22.8)	56_{c} (28.4)	$24_{b,c}$ (12.2)	$1_{a,b,c}$ (0.5)
14	$62_{a,b}$ (18.7)	86_{b} (26.0)	82_{c} (24.8)	$76_{a,c}$ (23.0)	20_{c} (6.0)	$5_{a,b,c}$ (1.5)
15	24_{a} (7.3)	80_{b} (24.4)	$105_{b,c}$ (32.0)	$65_{a,c}$ (19.8)	$52_{b,c}$ (15.9)	$2_{a,b,c}$ (0.6)
16	32_{a} (8.2)	102_{b} (26.3)	110_{a} (28.4)	92_{a} (23.7)	$50_{a,b}$ (19.2)	$2_{a,b}$ (0.5)
17	0_{a} (0.0)	16_{b} (8.4)	79_{c} (41.8)	$54_{b,c}$ (28.6)	40_{c} (21.1)	$0_{a,b,c}$ (0.0)
21	43_{a} (43.4)	$3_{b,c}$ (3.0)	$25_{c,d}$ (25.3)	26_{d} (26.3)	1_{b} (1.0)	$1_{a,b,c,d}$ (1.0)
22	$43_{a,b}$ (22.1)	23_{c} (11.8)	53_{c} (27.2)	34_{c} (17.4)	$30_{b,c}$ (15.4)	12_{a} (6.2)
23	43_{a} (20.2)	$39_{a,b}$ (18.3)	54_{b} (25.4)	$59_{a,b}$ (27.7)	18_{b} (8.5)	$0_{a,b}$ (0.0)
24	58_{a} (15.8)	$57_{a,b}$ (15.6)	122_{a} (33.3)	64_{b} (17.5)	61_{a} (16.7)	$4_{a,b}$ (1.1)
25	21_{a} (6.3)	90_{b} (26.9)	83_{a} (24.8)	111_{b} (33.1)	25_{a} (7.1)	$5_{a,b}$ (1.5)
26	35_{a} (9.2)	89_{b} (23.3)	139_{b} (36.4)	$107_{a,b}$ (28.0)	10_{c} (2.6)	$2_{a,b,c}$ (0.5)
27	0_{a} (0.0)	27_{b} (14.2)	58_{b} (30.5)	59_{b} (31.0)	46_{b} (24.2)	$0_{a,b}$ (0.0)
31	17_{a} (28.3)	$7_{a,b,c,d}$ (11.7)	$14_{c,d}$ (23.3)	$5_{b,d}$ (8.3)	17_{a} (28.3)	$0_{a,b,c,d}$ (0.0)
32	6_{a} (4.3)	4_{a} (2.9)	66_{b} (47.8)	24_{a} (17.4)	38_{b} (27.5)	$0_{a,b}$ (0.0)
33	0_{a} (0.0)	12_{b} (6.4)	28_{b} (15.0)	57_{c} (30.5)	47_{c} (25.1)	43_{d} (23.0)
34	4_{a} (6.1)	63_{b} (25.5)	38_{c} (15.4)	76_{b} (30.8)	63_{b} (25.5)	$3_{a,b,c}$ (1.2)
35	$22_{a,b,c}$ (8.6)	$60_{c,d}$ (23.4)	$88_{b,d}$ (34.4)	44_{a} (17.2)	$26_{a,b,c,d}$ (20.2)	16_{e} (6.3)
36	87_{a} (16.0)	136_{a} (25.0)	196_{a} (36.1)	84_{b} (15.5)	40_{b} (7.4)	0_{b} (0.0)
37	21_{a} (6.8)	48_{a} (15.5)	152_{b} (49.2)	68_{a} (22.0)	19_{a} (6.1)	$1_{a,b}$ (0.3)
41	$11_{a,b,c,d}$ (20.8)	$6_{c,d,e}$ (11.3)	2_{e} (3.8)	$13_{b,d}$ (24.5)	21_{a} (39.6)	$0_{a,b,c,d,e}$ (0.0)
42	$18_{a,b,c,d,e}$ (12.6)	$23_{d,e}$ (16.1)	$19_{c,e}$ (13.3)	71_{b} (49.7)	$12_{a,c,d,e}$ (8.4)	$0_{a,b,c,d,e}$ (0.0)
43	39_{a} (20.9)	6_{b} (3.2)	40_{c} (21.4)	$55_{a,c}$ (29.4)	44_{a} (23.5)	$3_{a,b,c}$ (1.6)
44	7_{a} (2.8)	17_{a} (6.7)	87_{b} (34.4)	94_{b} (37.2)	46_{b} (18.2)	$2_{a,b}$ (0.8)
45	55_{a} (20.6)	39_{b} (14.6)	71_{b} (26.6)	$65_{a,b}$ (14.6)	$37_{a,b}$ (13.9)	$0_{a,b}$ (0.0)
46	117_{a} (23.0)	118_{a} (23.2)	116_{b} (22.8)	114_{b} (22.4)	44_{b} (8.6)	0_{b} (0.0)
47	18_{a} (5.4)	34_{a} (10.1)	123_{b} (36.6)	96_{b} (28.6)	65_{b} (19.3)	$0_{a,b}$ (0.0)

a, b, c: Different characters in each row indicate a statistically significant difference ($p<0.05$)

Table 2. Distribution of implants by age

Patient age	**18-29**	**30-39**	**40-49**	**50-59**	**60-69**	**70 and above**	**Total**
n	220	302	480	371	187	26	1586
%	13.8	19.1	30.3	23.4	11.8	1.6	100.0

Table 3. Distribution of implants by region

Implanted region	**(n)**	**%**
Anterior maxilla	991	14.2
Anterior mandible	768	11.0
Premolar maxilla	1361	19.5
Premolar mandible	1024	14.6
Molar maxilla	1149	16.4
Molar mandible	1697	24.3
Total	6990	100.0

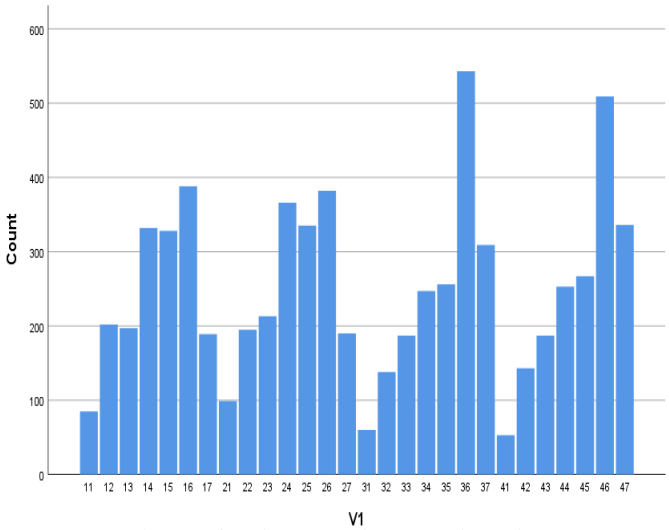

Figure 1. Distribution of implants according to tooth numbers

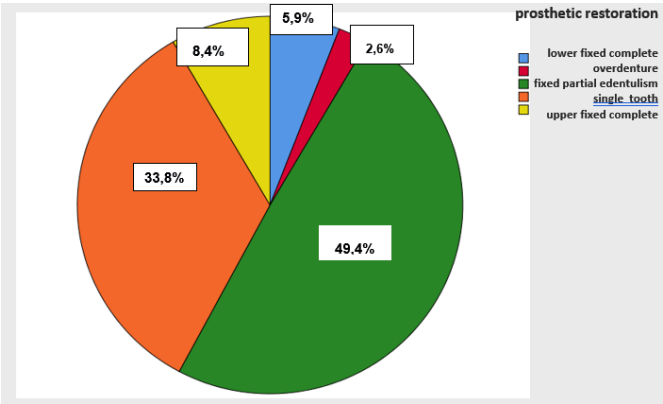

Figure 2. Distribution according to the type of prosthetic restoration

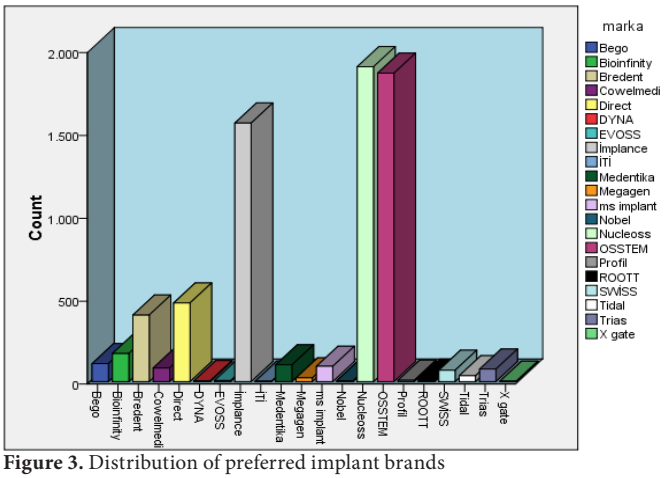

Figure 3. Distribution of preferred implant brands

missing teeth as well as in partially or completely edentulous patients.[18] Physicians benefit from retrospective evaluation of the characteristics of clinical applications of dental implants that have existed for some time.[19,20] In this study, we examined the clinical and demographic data of patients who underwent dental implant surgery between 2020 and 2023, as well as the characteristics of the preferred implants.

Dental implants are becoming increasingly necessary as people age and experience more tooth loss. In the study by Sarı et al.[21] the mean age of dental implants was 52.43 years. When the age range of the patients was evaluated; 2 patients (3.44%) between the ages of 18-25, 4 patients (6.89%) between the ages of 26-35, 12 patients (20.6%) between the ages of 36-45, 11 patients (18.9%) between the ages of 46-55, 24 patients (41.3%) between the ages of 56-65, and 5 patients (8.62%) over the age of 65. According to Bural et al.,[14] the mean age of dental implants was 52.12 years and the most common age groups were 40-49 years (20.7% of implants), 60-65 years (25.2% of implants) and 50-59 years (30.8% of implants). According to Brennan et al.,[22] the mean age was 53.4 years and the 40-60 age group was the most common age group to receive dental implants, followed by the 20-40 age group and the 60-80 age group. The mean age of 159 patients in Mundt's[23] study of 663 implants was reported to be 54 years. According to Urvasızoğlu et al.,[24] the mean age was 41.1 years, with 46-55 years being the most popular age group for dental implants, followed by 36-45 years. Polat et al.[25] found the mean age and age range for men and women to be 51.7 years and 18-70 years and 51.2 years and 22-75 years, respectively. The age range of the patients in our study was 17-80 years, with a mean age of 52.43 years. In our study, when the age range in which the most dental implants were applied was evaluated, the highest number of patients was in the 40-49 age group with 30.3% (n=480), followed by the 50-59 age group with 23.4% (n=371) and the mean age was 45.1 years. Differences in sample sizes between the studies are thought to be the reason for the difference in these results.

According to the findings of our study, 52.1% of the patients were female and 47.9% were male. Most studies conducted concurrently with our study showed that more female patients received implant treatment compared to male patients.[24,26,27]

The use of implants has increased every year due to their proven effectiveness. In the last 20 years, the patient profile has shifted from total edentulism to partial edentulism and dental implant indications have increased.[26] Sar et al.[21] 2022, it was reported that the most common edentulous condition was partial edentulism ending in edentulism 60.5%, while the least common edentulism was partial edentulism ending in edentulism 7.04%. Bural et al.[14] 2013, 48.2% of dental implants were placed to treat total edentulism, while the remaining 23.2% were placed to treat partial edentulism. Polat et al.[25] 2019, it was reported that 80% of partial edentulism was treated with dental implants. Urvasızoğlu et al.[24] 2016 reported that partial edentulism with edentulous termination was the most common edentulous condition among patients undergoing dental implant surgery. When evaluated according to the type of prosthetic restoration performed in our study, the highest proportion of patients was fixed partial edentulism with edentulous termination with 49.4%, followed by single edentulousness with 33.8% and lower fixed complete edentulism with 8.4%. The lowest number of patients was complete edentulism and overdenture restoration with 5.9%. The difference between the studies may be related to differences in the content of the selected patient cohort and the institutions consulted. It was observed that the implants evaluated in our study were also frequently applied in cases of partial edentulism with edentulous termination and single tooth deficiency clinical pictures.

In the study by Sarı et al.[21] 54.4% (n=99) of one hundred and eighty-two dental implants were placed in the upper jaw and 45.6% (n=83) in the lower jaw. Of these implants, 28.5% (n=52) were localized in the anterior region (incisor and canine teeth region) and 71.5% (n=130) were localized in the posterior region (1st premolar and later). In their study, Urvasızoğlu et al.[24] found that 53.2% of 233 dental implants were placed in the upper jaw and 46.8% in the lower jaw. Urvasızoğlu et al.[28] 2019, 52.4% of 498 dental implants were placed in the upper jaw and 47.6% in the lower jaw. Polat et al.[25] In their study, 56.2% of the 315 dental implants analyzed were placed in the upper jaw and 43.8% in the lower jaw. Adalı et al.[29] 2018, it was reported that 51.6% of the dental implants placed were localized in the upper jaw and 48.3% in the lower jaw. In our study, it was determined that 50.1% of 6990 implants placed in 1586 patients were placed in the upper jaw and 49.9% in the lower jaw. The data were found to be in parallel with previous studies. However, it was determined that the rates were very close to each other as the number of implants and patients

examined increased. The most implanted region was the molar mandible with 24.3% and the second most implanted region was the molar maxilla with 19.5%.

In our study, 25.2% of the implants were localized in the anterior region and 74.8% in the posterior region. Vehemente et al.[30] showed that dental implants were more commonly placed in the posterior region. Polat et al.[25] found that 28.2% of dental implants were placed in the anterior region and 71.7% in the posterior region. Adalı et al.[29] found that 27.8% of dental implants were placed in the anterior region and 72.1% in the posterior region. These results are consistent with our study. They found that significantly more implants were placed in the anterior maxilla and mandible for the treatment of total edentulism, whereas significantly more implants were placed in the posterior maxilla and mandible for the treatment of partial edentulism.[14] The fact that dental implants were more localized in the posterior region in our study is thought to be a parallel result of the fact that partial edentulism ending in edentulousness was the most common implant indication in our study.

In our study, after the mandibular first molar region, the maxillary first molar region was the most implanted tooth region. The region with the least implant placement was the mandibular incisor region. In the study by Sarı et al.[21] the most implanted region was the mandibular canine 15.3%. This was followed by the maxillary first molar 14.2%. The least implanted region was the maxillary lateral tooth 0.54%. In the study by Urvasızoğlu et al.,[24] the maxillary first molar region and mandibular first molar region were found to have the most and the lower anterior region the least implants, respectively. In a study by Akın et al.[31] on tooth loss, it was found that tooth number 18 was the most frequently lost tooth, followed by the first molars. We think that the high prevalence of tooth loss in the first molar regions explains the frequency of dental implant applications in these regions.

In our study, when the patients' choice of implant brand type was evaluated, the most common implant brand was Nucleoss with 27.2% (n=1900), followed by OSSTEM with 26.6% (n=1861), Implance with 22.3% (n=1560), Direct with 6.8% (n=474) and Bredent with 5.7% (n=401). When the distribution of patients according to the clinic where their surgical operations were performed was evaluated, the highest number of patients preferred periodontology clinic with 70.8% (n=4952), while 29.2% (n=2038) of the patients preferred surgery clinic. When it comes to the physician preference of the patients, implantologists and surgeons were the most preferred. We believe that the cost and the recommendation of the physicians were effective in the choice of the patients.

CONCLUSION

Within the limitations of the study, the information gathered from this study could be a significant referral source for implant manufacturers, distributors and practitioners alike. The information may be used to predict patterns in the success of dental implantology, especially for building implant reserves.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission of the Atatürk University Ethics Committee (Date: 25.04.2024, Decision No: 2024/04).

Informed Consent

Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

REFERENCES

1. Brånemark PI, Adell R, Breine U, Hansson BO, Lindström J, Ohlsson A. Intra-osseous anchorage of dental prostheses. I. Experimental studies. *Scand J Plast Reconstr Surg*. 1969;3(2):81-100. doi:10.3109/02844316909036699
2. Brånemark PI, Hansson BO, Adell R, et al. Osseointegrated implants in the treatment of the edentulous jaw. Experience from a 10-year period. *Scand J Plast Reconstr Surg Suppl*. 1977;16:1-132.
3. Brånemark PI, Adell R, Albrektsson T, Lekholm U, Lundkvist S, Rockler B. Osseointegrated titanium fixtures in the treatment of edentulousness. *Biomaterials*. 1983;4(1):25-28. doi:10.1016/0142-9612(83)90065-0
4. Allen PF, McMillan AS. A longitudinal study of quality of life outcomes in older adults requesting implant prostheses and complete removable dentures. *Clin Oral Implants Res*. 2003;14(2):173-179. doi:10.1034/j.1600-0501.2003.140206.x
5. Emami E, Heydecke G, Rompré PH, de Grandmont P, Feine JS. Impact of implant support for mandibular dentures on satisfaction, oral and general health-related quality of life: a meta-analysis of randomized-controlled trials. *Clin Oral Implants Res*. 2009;20(6):533-544. doi:10.1111/j.1600-0501.2008.01693.x
6. Heydecke G, Locker D, Awad MA, Lund JP, Feine JS. Oral and general health-related quality of life with conventional and implant dentures. *Comm Dent Oral Epidemiol*. 2003;31(3):161-168. doi:10.1034/j.1600-0528.2003.00029.x
7. Sonoyama W, Kuboki T, Okamoto S, et al. Quality of life assessment in patients with implant-supported and resin-bonded fixed prosthesis for bounded edentulous spaces. *Clin Oral Implants Res*. 2002;13(4):359-364. doi:10.1034/j.1600-0501.2002.130403.x
8. Müller F, Wahl G, Fuhr K. Age-related satisfaction with complete dentures, desire for improvement and attitudes to implant treatment. *Gerodontology*. 1994;11(1):7-12. doi:10.1111/j.1741-2358.1994.tb00096.x

9. Levin L, Sadet P, Grossmann Y. A retrospective evaluation of 1,387 single-tooth implants: a 6-year follow-up. *J Periodontol*. 2006;77(12):2080-2083. doi:10.1902/jop.2006.060220
10. Eckert SE, Wollan PC. Retrospective review of 1170 endosseous implants placed in partially edentulous jaws. *J Prosthet Dent*. 1998;79(4):415-421. doi:10.1016/s0022-3913(98)70155-6
11. Lazzara R, Siddiqui AA, Binon P, et al. Retrospective multicenter analysis of 3i endosseous dental implants placed over a five-year period. *Clin Oral Implants Res*. 1996;7(1):73-83. doi:10.1034/j.1600-0501.1996.070109.x
12. Lekholm U, Gunne J, Henry P, et al. Survival of the Brånemark implant in partially edentulous jaws: a 10-year prospective multicenter study. *Int J Oral Maxillofac Implants*. 1999;14(5):639-645.
13. Mattheos N, Ucer C, Van de Velde T, Nattestad A. Assessment of knowledge and competencies related to implant dentistry in undergraduate and postgraduate university education. *Eur J Dent Educ Off J Assoc Dent Educ Eur*. 2009;13(Suppl 1):56-65. doi:10.1111/j.1600-0579.2008.00546.x
14. Bural C, Bilhan H, Çilingir A, Geçkili O. Assessment of demographic and clinical data related to dental implants in a group of Turkish patients treated at a university clinic. *J Adv Prosthodont*. 2013;5(3):351-358. doi:10.4047/jap.2013.5.3.351
15. Fischer K, Stenberg T. Three-year data from a randomizd, controlled study of early loading of single-stage dental implants supporting maxillary full-arch prostheses. *Int J Oral Maxillofac Implants*. 2006;21(2):245-252.
16. Juodzbalys G, Raustia AM, Kubilius R. A 5-year follow-up study on one-stage implants inserted concomitantly with localized alveolar ridge augmentation. *J Oral Rehabil*. 2007;34(10):781-789. doi:10.1111/j.1365-2842.2006.01679.x
17. Luongo G, Di Raimondo R, Filippini P, Gualini F, Paoleschi C. Early loading of sandblasted, acid-etched implants in the posterior maxilla and mandible: a 1-year follow-up report from a multicenter 3-year prospective study. *Int J Oral Maxillofac Implants*. 2005;20(1):84-91.
18. Fugazzotto PA, Gulbransen HJ, Wheeler SL, Lindsay JA. The use of IMZ osseointegrated implants in partially and completely edentulous patients: success and failure rates of 2,023 implant cylinders up to 60+ months in function. *Int J Oral Maxillofac Implants*. 1993;8(6):617-621.
19. Machtei EE, Mahler D, Oettinger-Barak O, Zuabi O, Horwitz J. Dental implants placed in previously failed sites: survival rate and factors affecting the outcome. *Clin Oral Implants Res*. 2008;19(3):259-264. doi:10.1111/j.1600-0501.2007.01466.x
20. Wittneben JG, Buser D, Salvi GE, Bürgin W, Hicklin S, Brägger U. Complication and failure rates with implant-supported fixed dental prostheses and single crowns: a 10-year retrospective study. *Clin Implant Dent Relat Res*. 2014;16(3):356-364. doi:10.1111/cid.12066
21. Sarı M, Tümer MK. Retrospective Assessment of Dental Implant Applications: Cross-Sectional Study. *Turk Klin J Dent Sci*. 2022;28(2):245-251. doi:10.5336/dentalsci.2021-83695
22. Brennan M, Houston F, O'Sullivan M, O'Connell B. Demographics of implant placement and complications of a patient subgroup in a dental hospital population. *J Ir Dent Assoc*. 2010;56(2):85-92.
23. Mundt T, Mack F, Schwahn C, Biffar R. Private practice results of screw-type tapered implants: survival and evaluation of risk factors. *Int J Oral Maxillofac Implants*. 2006;21(4):607-614.
24. Urvasizoğlu GG, Saruhan N, Ataol M. Evaluation of demographic and clinical characteristics of dental implant applications. *J Atatürk Uni Fac Dent*. 2016;26(3):394-398. doi:10.17567/ataunidfd.290237
25. Polat ME, Saruhan N, Gojayeva G. Demographic evaluation of patients with dental implants. *J Biotechnol Strateg Health Res*. 2019;3(2):85-90. doi:10.34084/bshr.580426
26. Bornstein MM, Halbritter S, Harnisch H, Weber HP, Buser D. A retrospective analysis of patients referred for implant placement to a specialty clinic: indications, surgical procedures, and early failures. *Int J Oral Maxillofac Implants*. 2008;23(6):1109-1116.
27. Eltas A, Dündar DS, Uzun İH, Malkoç MA. Evaluation of dental implant success and patient profile: a retrospective study. *J Atatürk Uni Fac Dent*. 2013;23(1):1-8.
28. Urvasizoğlu G, Türen T. Prevalence and treatment of intraoperative and early complications encountered in dental implant procedures: a retrospective clinical study. *J Atatürk Uni Fac Dent*. 2019;29(2):259-267. doi:10.17567/ataunidfd.498763
29. Adalı E, Yüce MÖ, Günbay T, Çıplak G. Retrospective evaluation of success rates of different dental implants. *J Atatürk Uni Fac Dent*. 2018;28(2):174-181. doi:10.17567/ataunidfd.418844
30. Vehemente VA, Chuang SK, Daher S, Muftu A, Dodson TB. Risk factors affecting dental implant survival. *J Oral Implantol*. 2002;28(2):74-81. doi:10.1563/1548-1336(2002)028<0074:RFADIS>2.3.CO;2
31. Akin C, Mutlu ŞN, Güntekin N. The relationship between increasing age and severity of tooth loss in adult patients. *Necmettin Erbakan Uni J Dent*. 2020;2(2):64-68.

Original Article

Dicle Dent J. 2024;25(4):102-110.

Evaluation of parents' attitudes and behaviors towards products and practices containing fluoride

Çetin Durmaz, Buket Ayna, Yelda Polat

Department of Pediatric Dentistry, Faculty of Dentistry, Dicle University, Diyarbakır, Turkiye

Cite this article as: Durmaz Ç, Ayna B, Polat Y. Evaluation of parents' attitudes and behaviors towards products and practices containing fluoride. *Dicle Dent J*. 2024;25(4):102-110.

Received: 15/10/2024 • **Accepted**: 26/11/2024 • **Published**: 30/12/2024

ABSTRACT

Aims: The aim of this study was to evaluate parents' attitudes and behaviors about fluoride-containing products and practices.

Methods: The study was conducted between April 2023 and February 2024. Parents of children who applied to Dicle University Faculty of Dentistry, Department of Pediatric Dentistry voluntarily participated in the study and a total of 350 parents participated. A face-to-face questionnaire consisting of 2 sections and a total of 26 questions was administered to the parents.

Results: Among the parents who participated in our study, 56.86% stated that they had never heard of fluoride before. Those who had heard of fluoride stated that they had heard about it from school screenings and dentists. 16.86% of the parents stated that fluoride is harmful, but 68% of them did not have any information about it. 78.8% of the parents stated that they did not know the effect of brushing teeth with fluoride toothpaste on the prevention of dental caries and 76.57% stated that they did not look at the fluoride content when choosing toothpaste. 84% of the parents stated that they did not know the fluoride applications made by the physician and 74.57% stated that they would not have their children do it. The vast majority of those who would not have their children fluoridated (73.95%) stated that they would not do so because they did not have information about fluoride. We found that 92% of the parents did not know systemic fluoride applications, 90% did not know whether the drinking water they used contained fluoride, and 93.43% did not know whether fluoride in drinking water helps prevent dental caries formation.

Conclusion: Considering the high caries risk and oral hygiene deficiencies in our country, the need to use fluoride in dental treatments is increasing. Therefore, the public's lack of knowledge and concerns about fluoride should be addressed and the use of preventive treatments such as fluoride should be increased.

Keywords: Child, dental treatment, parent, fluoride, caries

INTRODUCTION

Oral and dental health is extremely important for healthy growth of the child. Dental caries is one of the main factors that impair oral health.[1] In order to prevent this situation and to ensure good oral hygiene, preventive oral and dental health practices should be started in the early period, including the first years of infancy. Parents' attitudes are very important in terms of providing their children with preventive oral dental health habits at an early age. Therefore, informing parents, who constitute the main target group, about preventive practices will be effective in preventing possible caries in children.[2,3]

Fluoride is one of the most frequently preferred agents among preventive applications in our country and in the world. Fluoride is used by dentists both as a therapeutic and prophylactic agent. Fluoride has topical and systemic applications. When the protective effect of fluoride is evaluated, it is known that topical applications made after the eruption of teeth provide more benefit compared to systemic applications.[4] Fluoride applications, which have therapeutic effect at the right dose in both topical and systemic use, may cause dental and skeletal fluorosis cases in overdose. Dentists should have a detailed knowledge of human metabolism and the toxic aspects of the organism in order to avoid the undesirable effects of fluoride in the short and long term. However, recent studies have shown that there is a prejudice against topical fluoride products and fluoride toothpastes.[5]

The goal of the World Health Organization (WHO) and the World Dental Association (FDI) is to achieve a DMFT (D: caries M: missing F: filled T: total) index below 1 in children. In the report of the last study conducted in Turkiye, DMFT values of 3.64±4.04 in the 5-year age group, 1.57±2.16 in the 12-year age group and 2.72±2.96 in the 15-year age group were reported, and these figures are above the WHO

Corresponding Author: Çetin Durmaz, cetindrmz12@gmail.com

targets.[6] Considering the high DMFT rate in our country, it is important for dentists to raise awareness by informing parents about fluoride and to use fluoride at the right time, in the right indication and at the appropriate dose.

In this study, we aimed to evaluate the attitudes and behaviors of parents about fluoride-containing products and applications.

METHODS

The study was carried out with the permission of the Dicle University Faculty of Dentistry Ethics Committee (Date: 29.03.2023, Decision No: 2023-15). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

This study is a descriptive study conducted to evaluate the attitudes and behaviors of parents about fluoride-containing products and practices. The population of this study consisted of parents of children who applied to Dicle University Faculty of Dentistry, Department of Pediatric Dentistry, who volunteered to participate in the study. The sample size of the study was targeted with at least 321 observations in total. A total of 350 parents participated in this study.

In local theses dealing with similar topics, the Council of Higher Education Documentation Center was used, while the EBSCOHOST database was used in international studies. As a data collection tool, a questionnaire was created with validated questions used in previous local and international studies. The questionnaire form, which was modified from similar studies in the literature, consists of 2 parts. The first part of the questionnaire consists of 4 personal information questions. In the second part, there are 22 questions evaluating the behaviors and attitudes of parents. In total, there are 26 questions in the questionnaire.

The data obtained in this study were analyzed with the licensed IBM SPSS V.21 package program. Frequency distribution tables for the variables were evaluated. Chi-square analysis was applied when examining the relationships between groups of nominal variables. In 2x2 tables, Fisher's exact test was used in cases where the expected values in the cells did not have sufficient volume, and in RxC tables, Pearson Chi-square analysis was applied with the help of Monte Carlo Simulation. When interpreting the results, 0.05 was used as the significance level and it was stated that there was a statistically significant relationship in case of $p<0.05$ and there was no statistically significant relationship in case of $p>0.05$.

RESULTS

The frequency distribution table for the personal information of the parents is shown in Table 1, and the frequency distribution table for their attitudes and behaviors is shown in Table 2.

Table 3 shows the results of the analysis of the relationship between the degree of closeness and parental attitudes and behaviors; Table 4 shows the results of the analysis of the relationship between educational status and parental attitudes and behaviors.

Table 1. Frequency distribution table for parents' personal information

		n	%
Degree of closeness	Mother	184	52.57
	Father	166	47.43
Education status	Primary education	172	49.14
	High school	69	19.71
	University	109	31.14
Number of children	1	27	7.71
	2	79	22.57
	3	107	30.57
	>3	137	39.14
Age of the child attending the clinic	0-3 years	21	6
	4-6 years	61	17.43
	7-12 years	180	51.43
	>12 years	88	25.14
Total		350	100

Of the parents who participated in our study;

- 56.86% had never heard anything about fluoride before,
- 68% do not know whether fluoride is harmful,
- 74.57% do not know whether the toothpaste they use contains fluoride or not,
- 76.57% did not consciously check whether toothpaste contains fluoride or not,
- 78.86% did not know the effect of brushing teeth with fluoride toothpaste on the prevention of dental caries,
- 84% did not know the topical fluoride applications applied by the physician,
- 74.57% would not have topical fluoride application by a dentist and 73.95% of those who would not have topical fluoride application would not have it because they did not have information about fluoride,
- 82.86% did not know the effect of topical fluoride applications applied by the physician on the prevention of dental caries,
- 92% did not know systemic fluoride applications,
- 90% do not know whether the drinking water they use contains fluoride,
- 93.43% stated that they did not know whether fluoride in drinking water helps prevent tooth decay.

DISCUSSION

Despite being a largely preventable condition, dental caries is a major public health problem, especially in children, and according to WHO, it affects 60% to 90% of school-age children. Considered together with economic and social conditions, prevention of dental caries is an imperative. Avoiding preventive treatments has consequences at the individual and societal level. Even today, parents may exhibit behaviors such as delaying vaccination, refusing certain vaccines or refusing

Table 2. Frequency distribution table for parents' attitudes and behaviors

		n	%
Is information about oral and dental health adequately communicated in our country?	Yes	124	35.43
	No	226	64.57
What are your ways of accessing information on oral and dental health?	Television	101	28.86
	Internet	142	40.57
	Newspaper	20	5.71
	Dentist	216	61.71
	Social environment	117	33.43
Information read and heard about oral and dental health	I don't believe it	125	35.71
	I am skeptical	89	25.43
	I question its veracity	136	38.86
Can tooth decay be prevented?	Yes	255	72.86
	No	69	19.71
	I don't know	26	7.43
Is brushing teeth effective in preventing tooth decay?	Yes	273	78
	No	59	16.86
	I don't know	18	5.14
When did you start brushing your child's teeth?	As soon as the first tooth erupts	19	5.43
	After driving a few teeth	76	21.71
	After driving all the teeth	240	68.57
	Not brushing	15	4.29
How often does your child brush their teeth?	2 times a day and more	139	39.71
	1 time a day	145	41.43
	1 time a week	48	13.71
	Nothing	18	5.14
Do you use toothpaste when brushing your child's teeth?	Yes	324	92.57
	No	26	7.43
Have you heard anything about fluoride before?	Yes	151	43.14
	No	199	56.86
If yes, where did you hear about it?	Television	13	8.61
	Internet	25	16.56
	Friends/relatives	7	4.64
	Oral health brochures	9	5.96
	From the dentist	49	32.45
	My child's school screening	42	27.81
	Other	6	3.97
Is fluoride harmful?	Yes	59	16.86
	No	53	15.14
	I don't know	238	68
What do you look for when choosing toothpaste for your child?	I don't pay attention to anything	70	21.60
	Price	87	26.85
	Taste	100	30.86
	Advertisement	115	35.49
	Box design and color	47	14.51
	Dentist's recommendation	79	24.38
	Suggestions from friends and acquaintances	32	9.88
	Contents	127	39.20
If your child uses toothpaste, does it contain fluoride?	Yes	48	13.71
	No	41	11.71
	I don't know	261	74.57
When using toothpaste, do you consciously determine whether it contains fluoride or not?	Yes	82	23.43
	No	268	76.57
Is brushing with fluoride toothpaste effective in preventing tooth decay?	Yes	60	17.14
	No	14	4
	I don't know	276	78.86
Are you familiar with topical fluoride applications administered by a dentist?	Yes	56	16
	No	294	84
Would you have your child receive topical fluoride application by a dentist?	Yes	89	25.43
	No	261	74.57
If your answer is no; please tell us why?	Since I don't know about fluoride	193	73.95
	I have it done at school	27	10.34
	Children do not need fluoride	6	2.3
	Fluoride is harmful to general health	28	10.73
	Fluoride is a toxic agent	7	2.68
	Fluoride is harmful to teeth	0	0
Are topical fluoride applications applied by a dentist effective in preventing dental caries?	Yes	56	16
	No	4	1.14
	I don't know	290	82.86
Do you know systemic fluoride applications?	Yes	28	8
	No	322	92
Does the drinking water you use contain fluoride?	Yes	15	4.29
	No	20	5.71
	I don't know	315	90
Does fluoride in drinking water help prevent tooth decay?	Yes	18	5.14
	No	5	1.43
	I don't know	327	93.43
Total		350	100

*More than one answer option was selected

vaccination altogether.[7] Similarly, this attitude of parents is also observed against fluoride applications. In a study, 63% of the posts about fluoride on a social media platform were found to be anti-fluoride.[8] Considering that fluoride applications have an important place among current preventive treatments, this situation becomes alarming.[5]

Therefore, good communication with parents becomes a very important issue in order for the measures to be taken in children to be effective. Understanding the reasons of parents who hesitate or refuse to apply preventive measures is a critical step to increase the effectiveness of fluoride applications, which have an important place in preventive dentistry.

In a study evaluating the trust in news about oral and dental health in the media in our country, 80% of the participants stated that they thought that information about oral and dental health did not reach the public sufficiently and it was also reported that 60% of the participants questioned the accuracy of this information.[9] Similarly, in our study, it was learned that the majority of the participants (64.57%) thought that they were not sufficiently informed about oral and dental health and some of them (38.86%) questioned the accuracy of the information they read and heard about oral and dental health.

Fluoride is one of the trace elements important for human metabolism.[10] Fluorides in the form of compounds are used in dentistry to protect oral and dental health. Fluoride has been proven to prevent dental caries in both children and adults.[11] In a study conducted in Eskişehir, it was found that 74.3% of parents had heard about fluoride from school screenings or dentists. However, it was reported that they were not informed about the substances in which fluoride is found and the role of brushing with fluoride toothpaste in preventing dental caries.[12] On the contrary, it was found that the majority (56.86%) of the parents who participated in our study had not heard anything about fluoride before, and those who had heard something about fluoride usually heard it from dentists or school screenings. When the parents were evaluated separately, 60.87% of the mothers and 52.41% of the fathers stated that they had never heard anything about fluoride before; 34.72% of the mothers and 30.38% of the fathers stated that they had heard about fluoride from dentists. In a study in which it was reported that the education levels of the participants were primary school (13.5%), secondary school (13.1%), high school (35.4%) and university (37.8%) graduates, when the answers given to the question about having heard about fluoride before were analyzed, it was found that the fluoride knowledge levels of the participants with higher education levels were significantly higher and a significant relationship was found between oral and dental health habits and education levels.[13] In another study in which it was reported that 17.6% of the parents' education level was primary school, 19.7% was secondary school, 33.2% was high school and 29.5% was university, it was reported that the rate of those with primary school graduates who had no fluoride knowledge was higher than both high school and university graduates.[14] In our study, 81.98% of primary school graduates, 59.42% of high school graduates and 15.6% of university graduates had not heard anything about fluoride before, while 18.02% of primary

Table 3. Analysis results on the relationship between degree of closeness and parental attitudes and behaviors

		Degree of closeness							
		Mother		Father		Total		Chi-square test	
		n	%	n	%	n	%	Chi-square	p
Is information about oral and dental health adequately communicated in our country?	Yes	64	34.78	60	36.14	124	35.43	0.071	0.79
	No	120	65.22	106	63.86	226	64.57		
What are your ways of accessing information on oral and dental health?	Other routes	71	38.59	63	37.95	134	38.29	0.015	0.903
	Dentist	113	61.41	103	62.05	216	61.71		
Do you read and hear information about oral and dental health?	I don't believe it	68	36.96	57	34.34	125	35.71	6.456	0.04
	I am skeptical	55	29.89	34	20.48	89	25.43		
	I question its veracity	61	33.15	75	45.18	136	38.86		
Can tooth decay be prevented?	Yes	135	73.37	120	72.29	255	72.86	0.087	0.957
	No	36	19.57	33	19.88	69	19.71		
	I don't know	13	7.07	13	7.83	26	7.43		
Is brushing teeth effective in preventing tooth decay?	Yes	144	78.26	129	77.71	273	78	0.051	0.975
	No	31	16.85	28	16.87	59	16.86		
	I don't know	9	4.89	9	5.42	18	5.14		
When did you start brushing your child's teeth?	As soon as the first tooth erupts	15	8.15	4	2.41	19	5.43	8.667	0.034
	After driving a few teeth	45	24.46	31	18.67	76	21.71		
	After driving all the teeth	117	63.59	123	74.1	240	68.57		
	Not brushing	7	3.8	8	4.82	15	4.29		
How often does your child brush their teeth?	2 times a day and more	75	40.76	64	38.55	139	39.71	3.538	0.316
	1 time a day	69	37.5	76	45.78	145	41.43		
	1 time a week	30	16.3	18	10.84	48	13.71		
	Nothing	10	5.43	8	4.82	18	5.14		
Do you use toothpaste when brushing your child's teeth?	Yes	173	94.02	151	90.96	324	92.57	0.784	0.376
	No	11	5.98	15	9.04	26	7.43		
Have you heard anything about fluoride before?	Yes	72	39.13	79	47.59	151	43.14	2.546	0.111
	No	112	60.87	87	52.41	199	56.86		
If yes, where did you hear about it?	Television	5	6.94	8	10.13	13	8.61	*	0.03
	Internet	7	9.72	18	22.78	25	16.56		
	Friends/relatives	3	4.17	4	5.06	7	4.64		
	Oral health brochures	3	4.17	6	7.59	9	5.96		
	From the dentist	25	34.72	24	30.38	49	32.45		
	My child's school screening	28	38.89	14	17.72	42	27.81		
	Other	1	1.39	5	6.33	6	3.97		
Is fluoride harmful?	Yes	20	10.87	39	23.49	59	16.86	10.685	0.005
	No	27	14.67	26	15.66	53	15.14		
	I don't know	137	74.46	101	60.84	238	68		
What do you look for when choosing toothpaste for your child?	Other causes	105	60.69	92	60.93	197	60.8	0.002	0.966
	Contents	68	39.31	59	39.07	127	39.2		
If your child uses toothpaste, does it contain fluoride?	Yes	23	13.29	21	13.91	44	13.58	7.682	0.021
	No	12	6.94	25	16.56	37	11.42		
	I don't know	138	79.77	105	69.54	243	75		
When using toothpaste, do you consciously determine whether it contains fluoride or not?	Yes	32	18.5	42	27.81	74	22.84	3.972	0.046
	No	141	81.5	109	72.19	250	77.16		
Is brushing with fluoride toothpaste effective in preventing tooth decay?	Yes	31	16.85	29	17.47	60	17.14	0.602	0.74
	No	6	3.26	8	4.82	14	4		
	I don't know	147	79.89	129	77.71	276	78.86		
Are you familiar with topical fluoride applications administered by a dentist?	Yes	29	15.76	27	16.27	56	16	0.017	0.898
	No	155	84.24	139	83.73	294	84		
Would you have your child receive topical fluoride application by a dentist?	Yes	56	30.43	33	19.88	89	25.43	5.127	0.024
	No	128	69.57	133	80.12	261	74.57		
If your answer is no; please tell us why?	Since I don't know about fluoride	101	78.91	92	69.17	193	73.95	*	0.099
	I have it done at school	15	11.72	12	9.02	27	10.34		
	Children do not need fluoride	2	1.56	4	3.01	6	2.3		
	Fluoride is harmful to general health	8	6.25	20	15.04	28	10.73		
	Fluoride is a toxic agent	2	1.56	5	3.76	7	2.68		
Are topical fluoride applications applied by a physician effective in preventing tooth decay?	Yes	32	17.39	24	14.46	56	16	*	0.805
	No	2	1.09	2	1.2	4	1.14		
	I don't know	150	81.52	140	84.34	290	82.86		
Do you know systemic fluoride applications?	Yes	17	9.24	11	6.63	28	8	0.493	0.482
	No	167	90.76	155	93.37	322	92		
Does the drinking water used contain fluoride?	Yes	8	4.35	7	4.22	15	4.29	4.337	0.114
	No	6	3.26	14	8.43	20	5.71		
	I don't know	170	92.39	145	87.35	315	90		
Does fluoride in drinking water help prevent tooth decay?	Yes	12	6.52	6	3.61	18	5.14	*	0.486
	No	3	1.63	2	1.2	5	1.43		
	I don't know	169	91.85	158	95.18	327	93.43		
Total						350	100		

Table 4. Analysis results on the relationship between educational level and parental attitudes and behaviors

		Education status									
		Primary school		High school		University		Total		Chi-square test	
		n	%	n	%	n	%	n	%	Chi-square	p
Is information about oral and dental health adequately communicated in our country?	Yes	58	33.72	28	40.58	38	34.86	124	35.43	1.035	0.596
	No	114	66.28	41	59.42	71	65.14	226	64.57		
What are your ways of accessing information on oral and dental health?	Other routes	70	40.7	26	37.68	38	34.86	134	38.29	0.975	0.614
	Dentist	102	59.3	43	62.32	71	65.14	216	61.71		
Do you read and hear information about oral and dental health?	I don't believe it	65	37.79	30	43.48	30	27.52	125	35.71	9.354	0.053
	I am skeptical	49	28.49	15	21.74	25	22.94	89	25.43		
	I question its veracity	58	33.72	24	34.78	54	49.54	136	38.86		
Can tooth decay be prevented?	Yes	121	70.35	51	73.91	83	76.15	255	72.86	2.201	0.699
	No	39	22.67	13	18.84	17	15.6	69	19.71		
	I don't know	12	6.98	5	7.25	9	8.26	26	7.43		
Is brushing teeth effective in preventing tooth decay?	Yes	131	76.16	54	78.26	88	80.73	273	78	2.909	0.573
	No	34	19.77	11	15.94	14	12.84	59	16.86		
	I don't know	7	4.07	4	5.8	7	6.42	18	5.14		
When did you start brushing your child's teeth?	As soon as the first tooth erupts	2	1.16	1	1.45	16	14.68	19	5.43	*	0.001
	After driving a few teeth	24	13.95	14	20.29	38	34.86	76	21.71		
	After driving all the teeth	138	80.23	52	75.36	50	45.87	240	68.57		
	Not brushing	8	4.65	2	2.9	5	4.59	15	4.29		
How often does your child brush their teeth?	2 times a day and more	60	34.88	30	43.48	49	44.95	139	39.71	14.191	0.028
	1 time a day	67	38.95	28	40.58	50	45.87	145	41.43		
	1 time a week	33	19.19	9	13.04	6	5.5	48	13.71		
	Nothing	12	6.98	2	2.9	4	3.67	18	5.14		
Do you use toothpaste when brushing your child's teeth?	Yes	159	92.44	64	92.75	101	92.66	324	92.57	0.009	0.996
	No	13	7.56	5	7.25	8	7.34	26	7.43		
Have you heard anything about fluoride before?	Yes	31	18.02	28	40.58	92	84.4	151	43.14	120.079	0.001
	No	141	81.98	41	59.42	17	15.6	199	56.86		
If yes, where did you hear about it?	Television	3	9.68	4	14.29	6	6.52	13	8.61	*	0.057
	Internet	2	6.45	8	28.57	15	16.3	25	16.56		
	Friends/relatives	2	6.45	1	3.57	4	4.35	7	4.64		
	Oral health brochures	2	6.45	2	7.14	5	5.43	9	5.96		
	From the dentist	7	22.58	3	10.71	39	42.39	49	32.45		
	My child's school screening	13	41.94	10	35.71	19	20.65	42	27.81		
	Other	2	6.45	0	0	4	4.35	6	3.97		
Is fluoride harmful?	Yes	7	4.07	9	13.04	43	39.45	59	16.86	112.058	0.001
	No	10	5.81	10	14.49	33	30.28	53	15.14		
	I don't know	155	90.12	50	72.46	33	30.28	238	68		
What do you look for when choosing toothpaste for your child?	Other causes	116	72.96	32	50	49	48.51	197	60.8	19.386	0.001
	Contents	43	27.04	32	50	52	51.49	127	39.2		
If your child uses toothpaste, does it contain fluoride?	Yes	1	0.63	7	10.94	36	35.64	44	13.58	96.641	0.001
	No	8	5.03	6	9.38	23	22.77	37	11.42		
	I don't know	150	94.34	51	79.69	42	41.58	243	75		
	Total	159	100	64	100	101	100	324	100		
When using toothpaste, do you consciously determine whether it contains fluoride or not?	Yes	6	3.77	11	17.19	57	56.44	74	22.84	98.644	0.001
	No	153	96.23	53	82.81	44	43.56	250	77.16		
Is brushing with fluoride toothpaste effective in preventing tooth decay?	Yes	8	4.65	12	17.39	40	36.7	60	17.14	50.734	0.001
	No	6	3.49	2	2.9	6	5.5	14	4		
	I don't know	158	91.86	55	79.71	63	57.8	276	78.86		
Are you familiar with topical fluoride applications administered by a dentist?	Yes	9	5.23	8	11.59	39	35.78	56	16	47.564	0.001
	No	163	94.77	61	88.41	70	64.22	294	84		
Would you have your child receive topical fluoride application by a dentist?	Yes	41	23.84	13	18.84	35	32.11	89	25.43	4.375	0.112
	No	131	76.16	56	81.16	74	67.89	261	74.57		
If your answer is no, please tell me why?	Since I don't know about fluoride	117	89.31	42	75	34	45.95	193	73.95	*	0.001
	I have it done at school	8	6.11	8	14.29	11	14.86	27	10.34		
	Children do not need fluoride	1	0.76	1	1.79	4	5.41	6	2.3		
	Fluoride is harmful to general health	4	3.05	3	5.36	21	28.38	28	10.73		
	Fluoride is a toxic agent	1	0.76	2	3.57	4	5.41	7	2.68		
Are topical fluoride applications applied by a physician effective in preventing dental caries?	Yes	11	6.4	9	13.04	36	33.03	56	16	*	0.001
	No	1	0.58	1	1.45	2	1.83	4	1.14		
	I don't know	160	93.02	59	85.51	71	65.14	290	82.86		
Do you know systemic fluoride applications?	Yes	2	1.16	3	4.35	23	21.1	28	8	37.594	0.001
	No	170	98.84	66	95.65	86	78.9	322	92		
Does the drinking water you use contain fluoride?	Yes	2	1.16	1	1.45	12	11.01	15	4.29	*	0.001
	No	2	1.16	4	5.8	14	12.84	20	5.71		
	I don't know	168	97.67	64	92.75	83	76.15	315	90		
Does fluoride in drinking water help prevent tooth decay?	Yes	1	0.58	2	2.9	15	13.76	18	5.14	*	0.001
	No	1	0.58	2	2.9	2	1.83	5	1.43		
	I don't know	170	98.84	65	94.2	92	84.4	327	93.43		
Total								350	100		

school graduates, 40.58% of high school graduates and 84.4% of university graduates had heard something about fluoride before. In a study in which the responses to the question about the relationship between the source from which information about fluoride was obtained and the level of education were analyzed, it was reported that the rate of university graduate parents who obtained information from the internet was higher than that of primary school, middle school and high school graduates.[14] In our study, it was found that there was no statistically significant relationship between the source of fluoride information and educational status.

Although adverse health effects (e.g. decreased cognitive ability, endocrine disruption, cancer) have been attributed to fluoride use over the years, the majority of evidence from large cohort studies and systematic reviews does not support the association of such health problems.[15] Regarding cognitive ability, in a study on maternal urinary fluoride levels and children's IQ, a multicenter prospective cohort study that also used maternal urinary fluoride levels followed children born in Canada between 2008 and 2012. The study results showed that maternal exposure to high levels of fluoride was associated with lower IQ scores in boys and girls; however, it ignored confounding variables that did not adjust for differences in socioeconomic status or maternal IQ, and no IQ difference was found when the entire population was assessed.[16] A prospective study in New Zealand did not support an association between fluoridated water and IQ measurements. The available evidence does not support that consumption of water fluoridated at 0.7 ppm F is associated with a decrease in IQ.[17] In a study conducted in Iran, it was reported that more than 50% of the participants were not informed about the harmful effects of fluoride.[18] Similarly, when the harmfulness of fluoride was questioned to the parents who participated in our study, it was observed that 68% of the parents did not have any information. When the parents were evaluated separately, it was found that 74.46% of the mothers and 60.84% of the fathers did not know whether fluoride was harmful or not ($p<0.05$). In a study in which the educational status of the parents was evaluated, 24.2% were primary school graduates, 17.7% were middle school graduates, 33.9% were high school graduates, and 24.2% were university/graduate graduates, and the relationship between educational status and opinions about fluoride-containing toothpastes was evaluated, a statistically significant relationship was found and it was reported that the opinion that fluoride-containing toothpastes were toxic/harmful increased with increasing educational level.[19] In some other studies, it was reported that the opinion that fluoride is harmful increased with increasing education level.[19,20] Similarly, in our study, 4.07% of primary school graduates, 13.04% of high school graduates and 39.45% of university graduates stated that fluoride was harmful, while 5.81% of primary school graduates, 14.48% of high school graduates and 30.28% of university graduates stated that fluoride was not harmful, and a statistically significant relationship was found between the harmfulness of fluoride and educational level ($p<0.05$).

In a study by Liu et al.[21] on toothpaste selection, it was reported that parents mostly chose toothpaste according to the physician's recommendation and taste. Among the parents who participated in our study, 39.2% stated that they chose toothpaste based on its ingredients and 35.49% stated that they chose toothpaste based on advertisements. When the parents were evaluated separately, 39.31% of the mothers and 39.07% of the fathers stated that they looked at the ingredients when choosing toothpaste. In a previous study, when the answers to the question about toothpaste selection were analyzed, significant differences were observed according to the level of education, and it was reported that 50% of the participants paid attention to the ingredients when choosing toothpaste. This result was particularly influenced by individuals with postgraduate education, which constituted 60% of the participants. Participants with a lower level of education (52%) stated that they paid attention to cost when choosing toothpaste.[9] Similarly, in our study, 27.04% of primary school graduates, 50% of high school graduates and 51.49% of university graduates paid attention to toothpaste content, while 72.96% of primary school graduates, 50% of high school graduates and 48.51% of university graduates paid attention to other reasons. There is a statistically significant relationship between the level of education and the factors considered when choosing toothpaste for children and the results of our study are consistent with the data in the literature.

The most important method of maintaining oral hygiene is tooth brushing. The use of toothpastes containing fluoride is considered indispensable for daily oral care.[22] In a study by Suma Sogi et al.[23] approximately 35% of the parents stated that they preferred fluoride toothpaste. In our study, only 13.71% of the parents stated that they used fluoride toothpaste. When the parents were evaluated separately, 13.29% of the mothers and 13.91% of the fathers stated that they preferred fluoride toothpaste. This may be explained by the fact that 74.57% of the parents were not aware of the presence of fluoride in toothpaste. In our study, 0.63% of primary school graduates, 10.94% of high school graduates and 35.64% of university graduates stated that the toothpaste used contained fluoride, while 5.03% of primary school graduates, 9.38% of high school graduates and 22.77% of university graduates stated that the toothpaste used did not contain fluoride. There is a statistically significant relationship between the fluoride content of the toothpaste used and the level of education.

In a study conducted in Konya, it was reported that 33% made a conscious choice when asked whether they consciously chose toothpaste containing fluoride when choosing toothpaste.[24] In our study, the rate of parents consciously looking at the fluoride content when choosing toothpaste was found to be 23.43%. When the parents were evaluated separately, 18.5% of the mothers and 27.81% of the fathers stated that they consciously looked at the fluoride content when choosing toothpaste. This can be explained by the fact that 56.86% of our participants had not heard anything about fluoride. In another study, the relationship between education level and the use of fluoride-free toothpaste was found to be statistically significant, and it was reported that the rate of use of fluoride-free toothpaste increased in parents with undergraduate and higher education levels.[19] It has been observed that especially families with higher education levels prefer fluoride-free

toothpastes.[25] However, in our study, while 3.77% of primary school graduates, 17.19% of high school graduates and 56.44% of university graduates consciously determine whether toothpaste contains fluoride or not, 96.23% of primary school graduates, 82.81% of high school graduates and 43.56% of university graduates make an unconscious choice when using toothpaste. There is a statistically significant relationship between the consciousness of fluoride content when using toothpaste and educational status. The results of our study were found to be consistent with the data in the literature.

In a study conducted by Mani et al.[26] in Malaysia, the knowledge, attitudes and behaviors of parents about the prevention of early childhood caries were examined. In this study, it was reported that 85.3% of the parents believed that using fluoride toothpaste was important in preventing dental caries. In contrast, in our study, 78.86% of the parents answered that they did not know anything about this subject. When the parents were evaluated separately, 79.89% of the mothers and 77.71% of the fathers stated that they did not know whether brushing with fluoride toothpaste was effective in preventing dental caries. In a previous study, it was reported that the correct response rate increased significantly with increasing education level when the answers given to the questions of the parents about whether brushing the teeth with fluoride toothpaste was effective in preventing dental caries were analyzed.[12] In another study in which it was reported that 13.5% of the participants were primary school graduates, 13.1% were middle school graduates, 35.4% were high school graduates and 37.8% were university graduates, when the answers to the question whether fluoride was effective in preventing dental caries were analyzed, it was reported that the answers of the participants with higher education level were significantly higher and a significant relationship was found between oral and dental health habits and education level.[13] In a study by Hendaus et al.,[27] it was reported that there was no significant difference between the educational level of the family and the knowledge of the families about the protective properties of fluoride. In our study, it was found that 4.65% of primary school graduates, 17.39% of high school graduates and 36.7% of university graduates thought that brushing teeth with fluoride toothpaste was effective in preventing dental caries and 3.49% of primary school graduates, 2.9% of high school graduates and 5.5% of university graduates thought that brushing teeth with fluoride toothpaste was not effective in preventing dental caries. It was observed that there was a statistically significant relationship between the effectiveness of brushing teeth with fluoride toothpaste in the prevention of dental caries and the level of education. It is thought that these differences in education level may affect the results of the studies.

Professionally applied topical fluoride treatments are effective in reducing the prevalence of dental caries. The most commonly used agents for professionally applied fluoride treatments are 5% NaF varnish and APF gel. Meta-analyses of 23 clinical trials, most of which were conducted twice a year, support the use of fluoride varnish on primary and permanent teeth to prevent caries.[28] Fluoride varnish appears to be effective in preventing caries in high caries risk children younger than five years.[29] Unit doses of 5% fluoride varnish are the only professional topical fluoride agent recommended for children younger than six years for safety reasons.[28] In a questionnaire study, it was reported that the participants were asked whether they knew about topical fluoride applications and 87.9% of the participants stated that they did not know.[13] Similarly, 84% of the parents who participated in our study did not know topical fluoride applications. When the parents were evaluated separately, 84.24% of the mothers and 83.73% of the fathers stated that they did not know the topical fluoride applications applied by the physician. In a study in which it was reported that 13.5% of the participants were primary school graduates, 13.1% were middle school graduates, 35.4% were high school graduates and 37.8% were university graduates, it was reported that the fluoride knowledge levels of the participants with higher education level were significantly higher when the responses inquiring whether they knew topical fluoride applications were analyzed.[13] In our study, 5.23% of primary school graduates, 11.59% of high school graduates and 35.78% of university graduates knew the topical fluoride applications applied by the physician, while 94.77% of primary school graduates, 88.41% of high school graduates and 64.22% of university graduates did not know the topical fluoride applications applied by the physician and there was a statistically significant relationship between the knowledge of topical fluoride applications applied by the physician and the educational status. The results of our study were found to be consistent with the data in the literature.

According to a study conducted in Turkiye, 70.1% of the participating parents did not allow topical fluoride application by the dentist to their children and the reason for this was that they generally did not have information about fluoride.[12] Similarly, it was found that 74.57% of the parents who participated in our study did not allow topical fluoride application to their children and 73.95% of these people did not have information about fluoride. When the parents were evaluated separately, 69% of the mothers and 80.12% of the fathers stated that they would not allow their children to receive topical fluoride application by a dentist. 78.91% of the mothers and 69.17% of the fathers stated that they would not allow this application because they had no knowledge about fluoride. When the educational status was analyzed in our study, 76.16% of primary school graduates, 81.16% of high school graduates and 67.89% of university graduates did not give permission for topical fluoride application to their children; 89.31% of primary school graduates, 75% of high school graduates and 45.95% of university graduates stated that they did not have information about fluoride as the reason for this situation.

According to the study conducted by Petersen et al.,[30] 79% of the mothers of children attending primary schools in Romania and according to the study conducted by Suma Sogi et al.,[23] approximately 70% of the parents of children younger than 72 months stated that fluoride is important in preventing dental caries. In our study, the rate of parents who stated that topical fluoride applied by a physician prevents caries was 16% and 84% of the parents were not informed about this subject. When the parents were evaluated separately, 17.39%

of the mothers and 14.46% of the fathers stated that topical fluoride applications applied by the physician were effective in preventing dental caries. This may be explained by the participants' lack of knowledge about fluoride and low level of education. In our study, 93.02% of primary school graduates, 85.51% of high school graduates and 65.14% of university graduates stated that they did not know the effect of topical fluoride applications on the prevention of dental caries.

Systemic fluoride applications are performed as multivitamin-fluoride combinations, adding fluoride to salt, lozenge, drops, tablets or milk, and fluoridation of school or drinking water.[31] The most commonly used way of systemic fluoride administration is fluoridation of drinking water. Adding fluoride to drinking water is an economical and effective way to prevent caries. However, the amount of fluoride added should be adjusted depending on the fluoride levels of natural drinking and spring waters in the region, the amount of water consumed daily in the region and other fluoride protection programs implemented.[32] Since the 2015 standardization of optimal fluoride levels in drinking water to 0.7 ppm F, dental fluorosis has been occurring less frequently.[33] In a study, it was reported that 81.2% of the participants who were asked whether systemic fluoride applications were known did not know.[13] Similarly, 92% of the parents who participated in our study did not know systemic fluoride applications. When the parents were evaluated separately, 90.76% of the mothers and 93.37% of the fathers stated that they did not know systemic fluoride applications. When educational status was analyzed in our study, 98.84% of primary school graduates, 95.65% of high school graduates and 78.9% of university graduates stated that they did not know systemic fluoride applications.

In a study conducted in Eskişehir, it was reported that parents were asked whether their drinking water contained fluoride and 73.8% of the parents did not know.[12] Similarly, 90% of the parents who participated in our study stated that they did not know whether their drinking water contained fluoride. When the parents were evaluated separately, 92.39% of the mothers and 87.35% of the fathers stated that they did not know whether the drinking water used contained fluoride. When educational status was analyzed in our study, 97.67% of primary school graduates, 92.75% of high school graduates and 76.15% of university graduates reported that they did not know whether the drinking water they used contained fluoride.

In a study conducted in Australia in which the knowledge and attitudes of parents of 12-24-month-old children about oral and dental health were evaluated, it was reported that 51.3% of the parents believed that fluoride in drinking water was beneficial in preventing dental caries.[34] Only 5.14% of the parents who participated in our study reported that fluoride in drinking water was effective in preventing dental caries, and 93.43% reported that they had no knowledge on this subject. When the parents were evaluated separately, 91.85% of the mothers and 95.18% of the fathers stated that they did not know whether fluoride in drinking water helps prevent dental caries. The most important reason for this is thought to be the participants' lack of knowledge about fluoride. In a study, it was reported that the accuracy rate of the answers given to the questions inquiring the effect of fluoride in drinking water on the prevention of dental caries increased significantly with increasing educational level, but this rate decreased significantly at postgraduate education level.[12] In our study, 0.58% of primary school graduates, 2.9% of high school graduates and 13.76% of university graduates stated that fluoride in drinking water helps prevent dental caries, while 0.58% of primary school graduates, 2.9% of high school graduates and 1.83% of university graduates stated that fluoride in drinking water does not help prevent dental caries. It was observed that there was a statistically significant relationship between the status of fluoride in drinking water helping to prevent dental caries and educational status, and the results of our study were consistent with the data in the literature.

CONCLUSION

The results of our study show that parents do not have sufficient knowledge about fluoride and oral health and cannot make informed decisions. Necessary measures should be taken to increase the level of knowledge of parents and to enable them to make more informed decisions.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission of the Dicle University Faculty of Dentistry Ethics Committee (Date: 29.03.2023, Decision No: 2023-15).

Informed Consent

Informed consent was obtained from all participants in the study.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

REFERENCES

1. Javed F, Feng C, Kopycka-Kedzierawski DT. Incidence of early childhood caries: a systematic review and meta-analysis. *J Investig Clin Dent.* 2017;8(4):1-6.
2. U.S. Department of Health and Human Services. Oral Health in America: A Report of the Surgeon General. Rockville MD.S. Department of Health and Human Services National Institute of Dental and Craniofacial Research National Institutes of Health; 2000.

3. Alshehri A, Nasim VS. Infant oral health care knowledge and awareness among parents in Abha city of Aseer Region Saudi Arabia. *SJDR.* 2015;6(2):98-101.

4. Türk Pedodonti Derneği. Florür Durum Raporu. 2019.

5. Chi DL. Parent refusal of topical fluoride for their children: clinical strategies and future research priorities to improve evidence-based pediatric dental practice. *Dent Clin North Am.* 2017;61(3): 607-617.

6. Türkiye Ağız Diş Sağlığı Profili Araştırma Raporu - 2018. Available from: https://shgmadsdb.saglik.gov.tr.

7. Yazan E, Gencay K, Tuna EB. Aşı reddi ve topikal fluorid reddi arasındaki ilişki. *Selcuk Dent J.* 2020;7(1):134-140.

8. Basch CH, Milano N, Hillyer GC. An assessment of fluoride related posts on Instagram. *Health Promot Perspect.* 2019;9:85.

9. Kayalıdere E, İlayda T, Dörter C. Bireylerin farklı medya araçlarından diş sağlığı ile ilgili edindiği bilgilerinin değerlendirilmesi. *Eur J Res Dent.* 2021;5(1):29-37.

10. Mehri A. Trace elements in human nutrition (II) - an update. *Int J Prev Med.* 2020;11:2. doi:10.4103/ijpvm.IJPVM_48_19

11. Bryant BS, Retief DH, Bradley EL, Denys FR. The effect of topical fluoride treatment on enamel fluoride uptake and the tensile bond strength of an orthodontic bonding resin. *Am J Orthod.* 1985;87(4):294-302.

12. Jahandideh A, Tüloğlu N. Ebeveynlerin ağız-diş sağlığındaki koruyucu uygulamalar hakkındaki bilgilerinin değerlendirilmesi. *Süleyman Demirel Üni Sağ Bil Derg.* 2019;10(4):403-412.

13. Birant S, Koruyucu M, Ozcan H, Ilisulu C, Kasimoglu Y, Ustun N, Seymen F. Investigating the level of knowledge of the community about oral and dental health. *Eur J Dent.* 2021;15(1):145-151.

14. Öter B, Karabulut B, Güven Polat G, Çehreli SB. Ailelerin florürlü ağız bakım ürünlerine bakış açılarının ve davranışlarının değerlendirilmesi. *Ata Diş Hek Fak Derg.* 2019;29(3):373-380.

15. U.S. Department of Health and Human Services Panel on Community Water Fluoridation. U.S. Public Health Services recommendation for fluoride concentration in drinking water for the prevention of dental caries. *Public Health Rep.* 2015;130(4): 318-331.

16. Green R, Lanphear B, Hornung R, et al. Association between maternal fluoride exposure during pregnancy and IQ scores in offspring in Canada. *JAMA Pediatr.* 2019;173(10):940-948.

17. Broadbent JM, Thomson WM, Ramrakha S, et al. Community water fluoridation and intelligence: prospective study in New Zealand. *Am J Public Health.* 2015;105(1):72-76.

18. Tahani B, Yadegarfar G, Ahmadi A. Knowledge, attitude, and practice of parents of 7-12-year-old children regarding fissure sealant therapy and professional fluoride therapy. *J Educ Health Promot.* 2017;6:106.

19. Ak AT, Aksoy H, Özdaş DÖ. Türk ailelerinin florlu diş macunu ve topikal flor uygulamaları hakkında bilgi ve görüşlerinin değerlendirilmesi: pilot çalışma. *Ege Üni Diş Hek Fak Derg.* 2018; 39(3):160-164.

20. Ota J, Yamamoto T, Ando Y, Aida J, Hirata Y, Arai S. Dental health behavior of parents of children using non-fluoride toothpaste: a cross-sectional study. *BMC Oral Health.* 2013;13:74.

21. Liu M, Zhu L, Zhang B, Petersen PE. Changing use and knowledge of fluoride toothpaste by schoolchildren, parents and schoolteachers in Beijing, China. *Int Dent J.* 2007;57(3):187-194.

22. Lindenmüller H, Lambrecht JT. Oral care. *Curr Probl Dermatol.* 2011;40:107-115.

23. Suma Sogi HP, Hugar SM, Nalawade TM, Sinha A, Hugar S, Mallikarjuna RM. Knowledge, attitude, and practices of oral health care in prevention of early childhood caries among parents of children in Belagavi city: a questionnaire study. *J Family Med Prim Care.* 2016;5(2):286-290.

24. Çobanoğlu N, Sağ Güngör F, Dönmez N, Alnaftachi N. Diş hekimliği fakültesine başvuran hastaların diş macunu tercihleri ve diş macunlarındaki flor ile ilgili görüşleri. *Selcuk Dent J.* 2021; 8(1):56-60.

25. Carpiano RM, Chi DL. Parents' attitudes towards topical fluoride and vaccines for children: are these distinct or overlapping phenomena? *Prev Med Rep.* 2018;10:123-128.

26. Mani SA, John J, Ping WY, Ismail NM. Early childhood caries: parent's knowledge, attitude and practice towards its prevention in Malaysia. *Oral Health Care-Pediatric.* 2012;1:1-18.

27. Hendaus MA, Jama HA, Siddiqui FJ, Elsiddig SA, Alhammadi AH. Parental preference for fluoride varnish: a new concept in a rapidly developing nation. *Patient Prefer Adherence.* 2016;10:1227-1233.

28. Weyant RJ, Tracy SL, Anselmo T, et al. Topical fluoride for caries prevention: executive summary of the updated clinical recommendations and supporting systematic review. *J Am Dent Assoc.* 2013;144(11):1279-1291.

29. Chou R, Pappas M, Dana T, et al. Screening and Interventions to Prevent Dental Caries in Children Younger Than Age Five Years: A Systematic Review for the U.S. Preventive Services Task Force. Evidence Synthesis No. 210. AHRQ Publication No. 21-05279-EF-1. Rockville, Md.: Agency for Healthcare Research and Quality; 2021:15-18.

30. Petersen PE, Danila I, Samoila A. Oral health behavior, knowledge, and attitudes of children, mothers, and schoolteachers in Romania in 1993. *Acta Odontol Scand.* 1995;53(6):363-368.

31. Horowitz HS. The water fluoridation and other systemic fluorides. J Dent Res. 1990;69:760-764.

32. McClure FJ. Water Fluoridation. The Search and the Victory. Bethesda, MD: National Institute of Dental Research; 1970:75-82.

33. American Academy of Pediatric Dentistry. Fluoride therapy. In: The Reference Manual of Pediatric Dentistry. Chicago Ill.: American Academy of Pediatric Dentistry; 2023:352-358.

34. Gussy MG, Waters EB, Riggs EM, Lo SK, Kilpatrick NM. Parental knowledge, beliefs and behaviours for oral health of toddlers residing in rural Victoria. *Aust Dent J.* 2008;53(1):52-60.

Case Report

Dicle Dent J. 2024;25(4):111-117.

Immediate loading and Hind's technique

Faris Akyüz, Saadet Nur İstanbulluoğlu, Emine Göncü Başaran

Department of Prosthodontics, Faculty of Dentistry, Dicle University, Diyarbakır, Turkiye

Cite this article as: Akyüz F, İstanbulluoğlu SN, Göncü Başaran E. Immediate loading and Hind's technique. *Dicle Dent J.* 2024;25(4):111-117.

Received: 13/09/2024 • **Accepted**: 10/12/2024 • **Published**: 30/12/2024

ABSTRACT

Immediate loading aims to rapidly restore the patient's aesthetics, function, and phonation by placing a temporary prosthesis on dental implants immediately after or shortly following the surgical procedure. The goal of immediate loading with a temporary prosthesis during the same session as tooth extraction is to preserve or enhance both hard and soft tissues. Temporary restorations are a key step in guiding the design of permanent prosthetic restorations. Clinical studies support the successful outcome of immediate implant placement into fresh extraction sockets. This case presentation discusses immediate loading and Hind's technique in the anterior region. Due to mobility issues, it was deemed appropriate to extract teeth numbered 11, 21, and 22. Immediate implant placement was decided for the 11 and 22 regions. On the same day, prosthetic rehabilitation was provided with a temporary prosthesis on the implants. After three months, the temporary prosthesis was removed, an impression was taken using Hind's technique to match the shaped emergence profile, and the permanent prosthesis was fabricated. The immediate loading of the implants prevented the patient from experiencing a period of edentulism, facilitated soft tissue healing, and established the emergence profile for the permanent restorations. It was observed that the tissues shaped with Hind's technique were transferred to the laboratory more accurately, resulting in more precisely fabricated permanent restorations. Immediate implant loading provides more aesthetics, fonetic and predictable treatment. The immediate implant placement protocol not only shortens the overall treatment time and minimizes the number of surgical interventions but also maximizes the utilization of the existing bone to achieve optimal primary stability for the implant.

Keywords: Hind's technique, immediate implant placement, temporary restorations, immediate loading, emergence profile, temporary abutment

INTRODUCTION

Today, patients undergoing implant treatment are often unfamiliar with prosthetic immediate loading protocols. Frequently, when patients require extraction of anterior teeth, they prefer traditional fixed partial dentures or resin-bonded bridges over implant treatment, to avoid even a brief period of edentulism.[1,2]

In the planning phase of treatment, it should be determined whether the implant will be placed immediately after tooth extraction or after the alveolar bone and soft tissue have healed a few weeks or a few months after tooth extraction. This decision is based on the identification and understanding of the changes that will occur in the alveolar bone and soft tissue following tooth loss.[3]

Timing After Tooth Extraction

- Immediate implants: Placement on the day of extraction,
- Early implants: Placement 6 to 8 weeks after tooth extraction,
- Delayed/late/conventional implants: Placement after 3 months or later.

Timing of Loading/Restoration

- Immediate loading/restoration: Within 48 hours after implant placement ,
- Early loading/restoration: >48 hours and <12 weeks ,
- Delayed (conventional) loading: 3 months or more after implant placement,[4]
- With increasing research and clinical case reports, the immediate implant placement and immediate loading protocol is a clinically documented protocol.[5]

The concept of placing an immediate dental implant into a tooth extraction socket was first described by Schulte and Heimke in 1976. Lazzara further supported immediate implant placement into fresh extraction sockets with three case reports in 1989. Since then, immediate implant placement in partially

Corresponding Author: Faris Akyüz, farisakyuz@gmail.com

Dicle Dent J. 2024;25(4):111-117.

edentulous patients has significantly increased in dentistry. Today, especially in cases of anterior tooth loss, waiting approximately six months after tooth extraction for implant placement is no longer an attractive option for patients. Consequently, the timing of implant placement has become an important topic in dentistry.[6]

Hind's technique is one of the immediate loading protocols in implantology. This method involves placing the implant immediately after tooth extraction and fabricating a temporary prosthesis during the same session.

The advantages of this technique are that it quickly meets the aesthetic and functional needs of the patient, prevents patients from being toothless for a long time, especially in the anterior region, helps the patient to relax socially and psychologically, and contributes to better integration of the implant with the bone.[7]

CASE

A 44-year-old male patient presented to the Dicle University Faculty of Dentistry department of Prosthodontics with complaints of mobility in the upper anterior teeth. Radiographic and clinical examinations revealed advanced bone resorption and periodontal pocketing in teeth numbered 11, 21, and 22. Due to mobility, extraction of teeth 11, 21, and 22 was deemed appropriate, and tomographic data confirmed adequate bone quantity for primary stability. Immediate implantation in regions 11 and 22 was planned (10x3.7 mm Bioinfinity, Turkiye) (Figure 1).

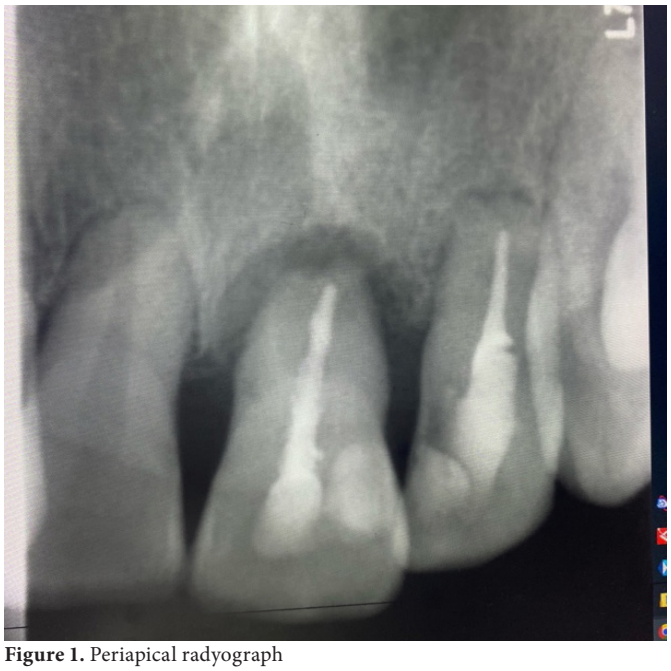

Figure 1. Periapical radyograph

On the same day, aesthetic and biological contouring of the gingiva was performed using composite resin on screw-retained non-hex PEEK abutments. A temporary restoration was fabricated on the PEEK abutments using a layering technique with restorative composite resin (Charisma composite, KULZER) that did not impede hemostasis. The temporary restoration was protected from occlusal and lateral contact (Figure 2-4).

Figure 2. Temporary peek abutment

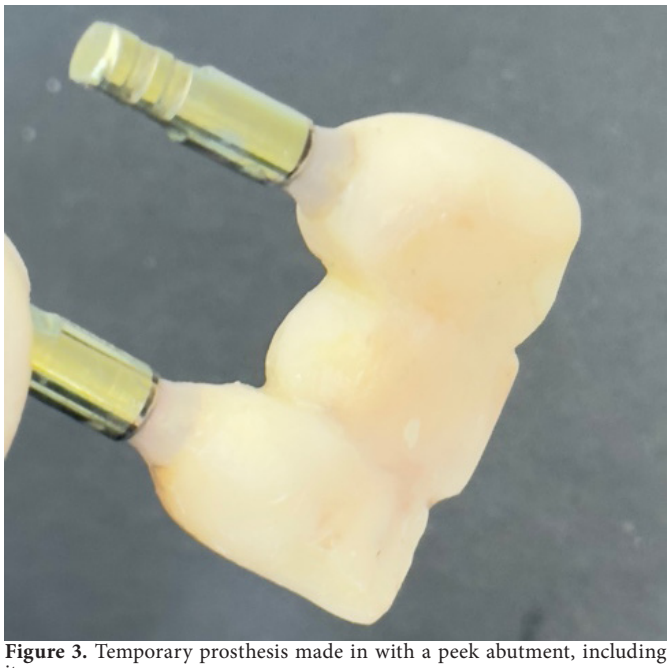

Figure 3. Temporary prosthesis made in with a peek abutment, including its appearance

Figure 4. Intraoral view of the immediately placed temporary restoration

The screw-retained temporary restoration was kept in the mouth for 3 months to allow for the completion of the osseointegration process and gingival shaping (Figure 5). Periapical radiography showed that our patient had excessive bone loss. Since the patient had periodontitis, no further surgical treatment was performed. Our aim was to organize the tissue with a temporary restoration and to create an emergence profile. The screw-retained temporary restoration was removed after 3 months, and closed impression posts were used to take an impression. In the laboratory, open impression posts were prepared with pattern resin, and an acrylic open tray was made (Figure 6, 7).

Figure 5. Emergence profile established by the provisional restoration

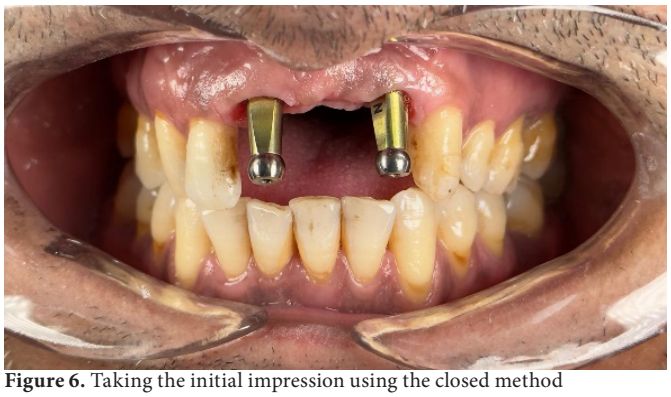

Figure 6. Taking the initial impression using the closed method

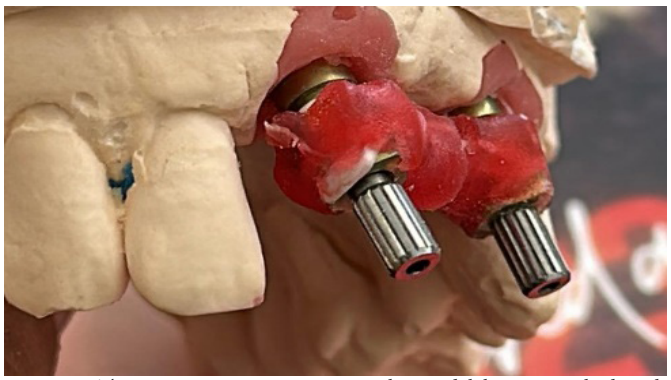

Figure 7. The open impression post on the model being atteched with pattern resin

Before the open impression procedure, the screw-retained temporary restoration was removed and secured to the implant analog. A small plastic cup was filled with A- type silicone impression material (Elite HD+, Zhermack, Italy) and the provisional restoration and analog were buried until the interproximal contact areas were submerged according to Hind's technique. Reference marks were made on the silicone impression material for orientation (Figure 8).

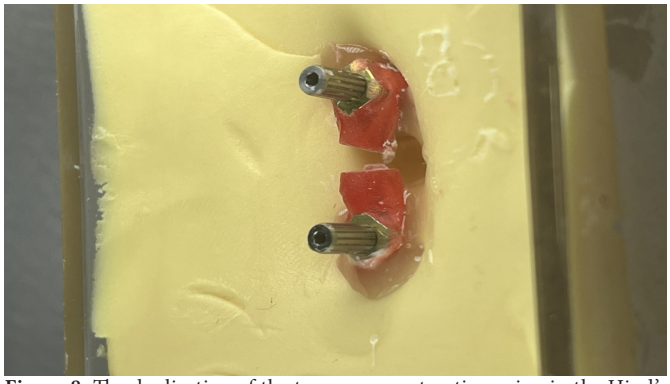

Figure 8. The duplication of the temporary restoration using in the Hind's technique

The provisional restoration was removed from the mold and placed back into the mouth to prevent the shape of the tissue from changing. The registration of the cervical part of the provisional restoration was transferred to the cup filled with silicone impression material. Open impression posts bonded with pattern resin were placed in the impression material in the mold and the space in between was filled with dual cure composite resin (GC G-CEM ONE Self-adhesive dual cure resin cement) and cured. The customized open impression posts were removed from the mold and placed in the mouth and the compatibility of the impression post with the periapical film was checked (Figure 9).

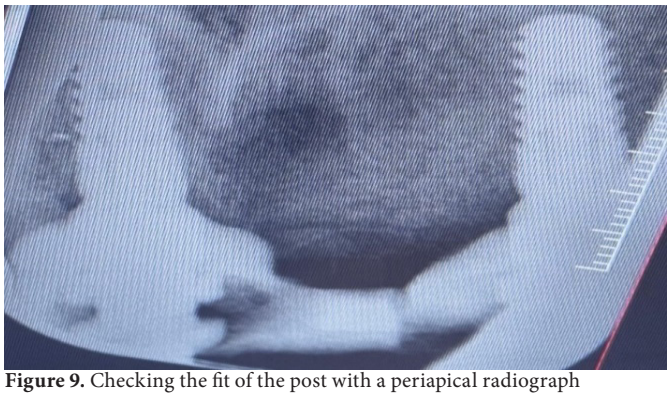

Figure 9. Checking the fit of the post with a periapical radiograph

The impression process was performed in a single step with type A silicone-based impression material and open tray impression technique. The impression posts in the impression tray were connected with analogs (Figure 10).

The temporary restoration was reinserted into the patient's mouth. Occlusal records were taken, and impressions were made of the opposing arch for the final bite registration, followed by shade selection. Due to the screw access channel remaining on the vestibular surface, a cemented restoration was chosen, and 15-degree angled abutments were used (Figure 11).

The final restoration was planned as a three-unit fixed partial denture. The framework was designed using zirconia material (3Y-TZP UPCERA, CHINA) (Figure 12). Mechanical polishing was applied to the portion of the prosthesis in contact with the soft tissue, and glazing was performed on the crown portion. (Figure 13). Follow-up examinations were conducted at 1 and 6 months. No complications were observed during this period (Figure 14, 15).

Figure 10. Transfer of the emergence profile of the provisional restoration to the permanent impression

Figure 11. Intraoral view of angled abutments

Figure 12. Intraoral view of zirconia based

Figure 13. Final restoration

Figure 14. Periapical view of final restorations at 1 months

DISCUSSION

In this case presentation, one of the most suitable techniques for immediate loading cases has been discussed. The advantages of the immediate implant placement protocol include a significant reduction in waiting time, a decrease in the number of surgical procedures, and optimal utilization of the existing bone for primary stability of the implant. Additionally, post-extraction osteogenic activity may enhance bone-implant contact.[8]

The interval between tooth extraction and implant placement is a crucial factor in the aesthetic and functional success of the final restoration. It has been observed that the resorption rate in the alveolar bone decreases by approximately 5-7 mm

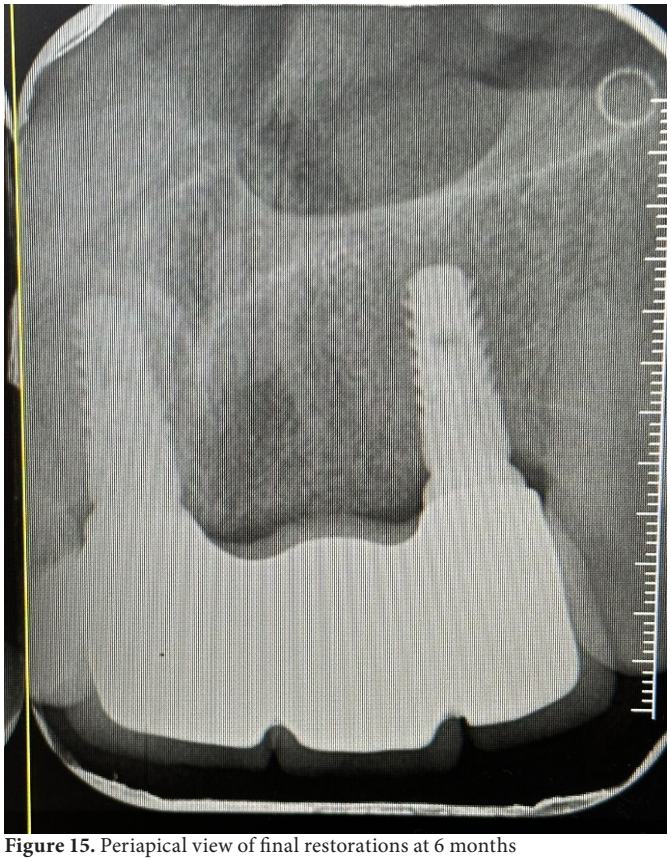

Figure 15. Periapical view of final restorations at 6 months

over a period of 6-12 months post-extraction, with most of the reduction occurring within the first 4 months.[9] Furthermore, bone loss in the alveolar bone also affects the gingival profile.[10,11] Considering this, implants are placed as soon as possible to avoid significant bone loss.[12]

In a study by Drago et al.,[13] a placement torque of 30 Ncm was indicated as appropriate for primary stabilization in implants placed with immediate loading. Slagter et al.[14] found that, with primary stability values ranging from a minimum of 25 Ncm to 35 Ncm, the immediate placement of prosthetic restorations significantly reduced bone loss in immediate implants.

In recent years, the option of prosthetic rehabilitation with immediate loading has become popular. Barone et al.[15] have conducted studies supporting this procedure.

Degidi et al.[16] reported that the 5-year success rate for implants immediately loaded with temporary restorations is 97.2%.

Chen et al.[17] reviewed studies on the 1-3-year follow-up results of immediately placed implants and noted that, in 25 out of 35 studies, the success rate of immediate implantation was over 95%.

Two different materials are used as temporary abutments on implants: titanium and polyetheretherketone (PEEK). Titanium is generally not recommended for use as a temporary abutment due to difficulties in adjustment in a clinical setting and its color disadvantages.[18]

In contrast, temporary PEEK abutments are preferred due to their ease of adjustment in clinical settings and their white color, which enhances aesthetic appearance and success rates.[19]

Within the limitations of a laboratory study, the results suggest that biofilm formation on the surface of PEEK is equal or lower than on the surface of conventionally applied abutment materials such as zirconia and titanium. As abutment surfaces are usually prone to subgingival biofilm formation, which are-in most cases-not regularly removed, it is wishful that materials employed for the fabrication of implant abutments feature low biofilm formation on their surface.[20]

In prosthetic design, screw-retained temporary restorations are more commonly used than cemented restorations. One of the main reasons for this is that remnants of cement, which can cause peri-implantitis, are not present in screw-retained systems. Additionally, the ability to easily remove and adjust the temporary restoration is another reason for preferring screw-retained systems. However, if the screw access channel creates aesthetic problems on the buccal aspect of the restoration, a cemented restoration may be used temporarily.[21,22]

The most commonly used materials for temporary restorations are acrylic and composite resins.[21] Studies have not demonstrated a significant advantage of composite or acrylic materials over each other in terms of aesthetics, marginal bone loss, and periodontal measurements.[21-23]

However, in cases with fewer implants, composite temporary materials are preferred over laboratory-produced acrylic temporary prostheses due to their ability to reduce the number of clinical visits and facilitate faster placement of the temporary prosthesis. Temporary restorations should be left in occlusion and protected from contacts during lateral movements for at least 6 weeks.[22,24] Any discoloration in the soft tissue caused by ischemia during shaping should resolve within 10 minutes.[25]

A temporary restoration placed in the same session results in more stable mesial and distal papillae, buccal midline mucosal levels, and horizontal soft tissue dimensions.[26]

The use of temporary restorations with immediate loading of implants is crucial for achieving an optimal emergence profile for the final restoration in conjunction with soft tissue healing. Hind's technique facilitates the transfer of healed anatomical tissues to the laboratory, allowing for the creation of a precise model and more accurate fabrication of the final restorations. This ensures that the laboratory technician can produce a restoration with appropriate contour, function, and aesthetics.[7]

When bone volume is reduced, either augmentative procedures are necessary, or the existing bone structure should be modified to achieve both aesthetic and functional suitability. In the study by Mengel et al.,[27] it is recommended to avoid augmentative procedures in patients with periodontitis. Furthermore, it must be considered that augmented structures in these patients are highly prone to significant resorption.

To protect damaged tissues and ensure a complication-free healing process, implant placement should be performed as minimally invasive as possible.[28] In this case gingival emergency profiles have been created however due to the high inter-occlusal distance, tooth lengths were optimized by utilizing gingival porcelain. In fixed prostheses, the use of restorative materials that match gingival color is essential to maintain optimal tooth dimensions.[29,30]

CONCLUSION

Restoring aesthetic and functional losses in anterior tooth loss is crucial. During approximately three years of follow-up, no complications or failures were observed. This study demonstrates the success of Hind's technique in transferring the emergence profile created with a temporary prosthesis to the laboratory. Additionally, it shows that immediate implant placement and immediate prosthesis application in aesthetic areas represent a predictable treatment option.

ETHICAL DECLARATIONS

Informed Consent

The patient signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

REFERENCES

1. Branemark PI. Osseointegration and its experimental background. *J Prosthetic Dent.* 1983;50(3):399-410.
2. Albrektsson T, Brånemark PI, Hansson HA, Lindström J. Osseointegrated titanium implants: requirements for ensuring a long-lasting, direct bone-to-implant anchorage in man. *Acta Orthopaed Scand.* 1981;52(2):155-170.
3. Jan L, Niklaus PL. Klinik Periodontoloji ve Diş Hekimliğinde İmplant Uygulamaları. Nobel Tıp Kitabevleri. 2017.
4. Grütter L, Belser UC. Implant loading protocols for the partially edentulous esthetic zone. *Int J Oral Maxillofac Implants*. 2009; 24(Suppl):169-179.
5. Gallucci GO, Hamilton A, Zhou W, Buser D, Chen S. Implant placement and loading protocols in partially edentulous patients: a systematic review. *Clin Oral Implants Res*. 2018;29(Suppl 16): 106-134. doi:10.1111/clr.13276
6. Dhami B, Shrestha P, Gupta S, Pandey N. Immediate implant placement: current concepts. *J Nepal Soc Periodontol Oral Implantol.* 2019;3(1):18-24.
7. Hinds KF. Custom impression coping for an exact registration of the healed tissue in the esthetic implant restoration. *Int J Periodont Restorat Dent.* 1997;17(6):584-591.
8. De Rouck T, Collys K, Cosyn J. Single-tooth replacement in the anterior maxilla by means of immediate implantation and provisionalization: a review. *Int J Oral Maxillofac Implants*. 2008; 23(5):897-904.
9. Chen ST, Wilson TG Jr, Hämmerle CH. Immediate or early placement of implants following tooth extraction: review of biologic basis, clinical procedures, and outcomes. *Int J Oral Maxillofac Implants*. 2004;19(Suppl):12-25.
10. Schropp L, Wenzel A, Kostopoulos L, Karring T. Bone healing and soft tissue contour changes following single-tooth extraction: a clinical and radiographic 12-month prospective study. *Int J Periodontics Restorative Dent*. 2003;23(4):313-323.
11. Schropp L, Kostopoulos L, Wenzel A. Bone healing following immediate versus delayed placement of titanium implants into extraction sockets: a prospective clinical study. *Int J Oral Maxillofac Implants*. 2003;18(2):189-199.
12. D'Addona A, Ghassemian M, Raffaelli L, Manicone PF. Soft and hard tissue management in implant therapy-part I: surgical concepts. *Int J Biomater*. 2012;2012:531202. doi:10.1155/2012/531202
13. Drago CJ, Lazzara RJ. Immediate occlusal loading of Osseotite implants in mandibular edentulous patients: a prospective observational report with 18-month data. *J Prosthodont*. 2006; 15(3):187-194. doi:10.1111/j.1532-849X.2006.00099.x
14. Slagter KW, den Hartog L, Bakker NA, Vissink A, Meijer HJ, Raghoebar GM. Immediate placement of dental implants in the esthetic zone: a systematic review and pooled analysis. *J Periodontol*. 2014;85(7):e241-e250. doi:10.1902/jop.2014.130632
15. Barone A, Rispoli L, Vozza I, Quaranta A, Covani U. Immediate restoration of single implants placed immediately after tooth extraction. *J Periodontol*. 2006;77(11):1914-1920. doi:10.1902/jop.2006.060072
16. Degidi M, Piattelli A, Gehrke P, Felice P, Carinci F. Five-year outcome of 111 immediate nonfunctional single restorations. *J Oral Implantol*. 2006;32(6):277-285. doi:10.1563/0.795.1
17. Chen ST, Buser D. Clinical and esthetic outcomes of implants placed in postextraction sites. *Int J Oral Maxillofac Implants*. 2009;24(Suppl):186-217.
18. Glauser R, Sailer I, Wohlwend A, Studer S, Schibli M, Schärer P. Experimental zirconia abutments for implant-supported single-tooth restorations in esthetically demanding regions: 4-year results of a prospective clinical study. *Int J Prosthodont*. 2004; 17(3):285-290.
19. Tetelman ED, Babbush CA. A new transitional abutment for immediate aesthetics and function. *Implant Dent*. 2008;17(1):51-58. doi:10.1097/ID.0b013e318167648c
20. Hahnel S, Wieser A, Lang R, Rosentritt M. Biofilm formation on the surface of modern implant abutment materials. *Clin Oral Implants Res*. 2015;26(11):1297-1301. doi:10.1111/clr.12454
21. Parpaiola A, Sbricoli L, Guazzo R, Bressan E, Lops D. Managing the peri-implant mucosa: a clinically reliable method for optimizing soft tissue contours and emergence profile. *J Esthet Restor Dent*. 2013;25(5):317-323. doi:10.1111/jerd.12046
22. Ganddini MR, Tallents RH, Ercoli C, Ganddini R. Technique for fabricating a cement-retained single-unit implant-supported provisional restoration in the esthetic zone. *J Prosthet Dent*. 2005; 94(3):296-298. doi:10.1016/j.prosdent.2005.06.010
23. Sayin B. Estetik bölgede yapılan implant tedavilerinde farklı dişeti şekillendirme materyalleri kullanımının değerlendirilmesi: klinik ve biyokimyasal çalışma. 2019.
24. Levin BP. Immediate temporization of immediate implants in the esthetic zone: evaluating survival and bone maintenance. *Compend Contin Educ Dent*. 2011;32(4):52-62.
25. Yao JW, Wang HL. Assessment of peri-implant soft tissue adaptive pressure and time after provisional restorations. *Int J Periodontics Restorative Dent*. 2019;39(6):809-815. doi:10.11607/prd.4063
26. Nevins M, Wang HL. Implant therapy: Clinical approaches and evidence of success 2nd Edition 2019 Book 544. p.
27. Mengel R, Flores-de-Jacoby L. Implants in regenerated bone in patients treated for generalized aggressive periodontitis: a prospective longitudinal study. *Int J Periodontics Restorative Dent*. 2005;25(4):331-341.

28. Thöne-Mühling M, Peleska B, Gockel F, Lotzmann U, Mengel R. Template-guided flapless implant insertion and prosthetic rehabilitation with telescopic crowns in a patient with treated generalized aggressive periodontitis: a case report. *Quintessence Int*. 2012;43(3):179-185.

29. Meijer HJ, Raghoebar GM, Van 't Hof MA. Comparison of implant-retained mandibular overdentures and conventional complete dentures: a 10-year prospective study of clinical aspects and patient satisfaction. *Int J Oral Maxillofac Implants*. 2003; 18(6):879-885.

30. Ekelund JA, Lindquist LW, Carlsson GE, Jemt T. Implant treatment in the edentulous mandible: a prospective study on Brånemark system implants over more than 20 years. *Int J Prosthodont*. 2003;16(6):602-608.

Case Report

Dicle Dent J. 2024;25(4):118-120.

Aesthetic rehabilitation of a case of polydistema with direct composite restoration: case report, 2-year follow-up

Bahar Yavuz, İbrahim Halil Avcılar, Elif Pınar Bakır

Department of Restorative Dentistry, Faculty of Dentistry, Dicle University, Diyarbakır, Turkiye

Cite this article as: Yavuz B, Avcılar İH, Bakır EP. Aesthetic rehabilitation of a case of polydistema with direct composite restoration: case report, 2-year follow-up. *Dicle Dent J.* 2024;25(4):118-120.

Received: 28/11/2024 • **Accepted**: 25/12/2024 • **Published**: 30/12/2024

ABSTRACT

Diastema are small gaps between the teeth. Polydiastema can be caused by harmful habits, genetic or systemic disorders. Direct composite resin restorations are a minimally invasive and aesthetic treatment option that can be safely used in cases of diastema. This case report describes the treatment of an anterior polydiastema case with direct composite resin restorations. A 20-year-old woman who presented to our clinic with aesthetic complaints had no systemic disease in her medical history. After all treatment options were explained to the patient, it was decided to restore the teeth aesthetically with direct resin composite restorations. After the restoration was completed, finishing and polishing procedures were performed. After 3 months, 6 months, 1 year and 2 years, the physical properties, marginal integrity and aesthetic properties of the restorations were checked. In the control examination, it was determined that the restorations met the patient's aesthetic expectations, and the marginal integrity was preserved.

Keywords: Diastema, polydiastema, composite resin, aesthetic

INTRODUCTION

With the increasing awareness of people, aesthetics has become as important as phonation and function in dental treatment applications. While the expectation of patients in the past was the absence of pain, today this concern has been replaced by aesthetic concern.[1] Especially color, shape and position disorders related to anterior teeth cause both aesthetic problems and psychosocial problems in patients. Among these, the aesthetic problems that come to mind first are caries, diastema, discoloration, fluorosis, hypoplasia, crowding, abrasions or fractures due to prenatal and postnatal antibiotic use or diseases.[2] Diastema are small gaps between the teeth. Diastema can be caused by differences in tooth size (such as narrow or conical shaped teeth) or by the difference between the gap in the arch and tooth size. Diastema that appears more than once in the jaw is also called "polydiastema." Polydiastema can be caused by bad habits, genetics or systemic diseases. There are different treatment procedures including orthodontic, prosthetic, and operative dentistry procedures to eliminate such aesthetic problems that can be very common in society. Operative dentistry treatment option is absolutely necessary to achieve a satisfactory result. Operative dentistry is characterized by offering simple, fast, predictable and cost-effective solutions. Orthodontics requires the use of fixed appliances, which means a more complex, longer and more expensive treatment. Prosthodontic treatments are more invasive procedures.[3] In operative dentistry, the use of direct composite resin restorations is prominent. Adding direct composite resin restorative material to the proximal surfaces after acid roughening is a cheaper, practical and protective treatment alternative.

With this treatment option, which requires little or no preparation on the tooth, it is thought that the adhesion life of the finished restoration to the enamel is sufficient. Studies to improve the durability and color stability of composite resins have led to the expansion of their aesthetic and functional use.[1]

In this case report, the treatment of polydiastema in the anterior region (teeth 13, 12, 11, 21, 22, 23) using composite resins by non-invasive direct method is described.

CASE

A 20-year-old female patient presented to Dicle University, Faculty of Dentistry, Department of Restorative Dental Treatment with the presence of polydiastema in her anterior teeth and aesthetic complaints related to tooth color. In clinical and radiographic examination, the color of the teeth was determined according to the presence of diastema between the

Corresponding Author: Bahar Yavuz, bhryvz1084@gmail.com

canine and canine teeth in the maxillary arc. It was seen that the teeth were A2 color. Treatment options and complications were explained to the patient and written informed consent was obtained. The treatment options were discussed with the patient, and it was decided to treat the diastemas with direct composite resin restoration (Figure 1-3).

The patient's teeth numbered 13, 12, 11, 21, 22, 23 were acidified with 37% orthophosphoric acid (K-Etchant Syringe, Kuraray for 30 seconds. After the acid was washed off, the teeth were dried with air spray and adhesive resin (GC Dental G-Premio Bond, Japan) was applied to the enamel surfaces and polymerized with LED light device for 20 seconds. After placing the transparent tape, the restorations were completed by using composite resin material (OA2 and A2; Estelite Sigma Quick, Tokuyoma Dental, Japan) with layering technique using hands-free technique. Each layer was polymerized with an LED light device for 20 seconds (Woodpecker Led-B Light device, Guilin Woodpecker Medical Industry, Ltd Guangxi, China). Finishing and polishing were performed using AlO3 disks (Sof-Lex; 3M Espe) and polishing rubbers in the order of coarse grain to fine grain (Figure 4-6).

The patient was informed about oral hygiene habits and follow-up appointments and discharged. The patient was evaluated aesthetically and functionally 2 years later (Figure 7).

Figure 1. Left lateral view before the procedure

Figure 2. Intraoral view before the procedure

Figure 3. Right lateral view before the procedure

Figure 4. Left lateral tooth appearance after the procedure

Figure 5. Intraoral view after the procedure

Figure 6. Right lateral tooth appearance after the procedure

Figure 7. Appearance of the patient 2 years later

DISCUSSION

Anterior tooth discoloration and the presence of diastema has become an important problem in patients, especially in young patients. Diastemas can be treated with surgical, prosthodontic, orthodontic, orthodontic or restorative procedures or a combination of them depending on the case and the cause.[4] In the treatment of diastema cases, a treatment protocol is determined by considering many criteria such as the age of the patient, the size of the diastema, time and cost. Aesthetic rehabilitation with the direct adhesive method is inexpensive and conservative. Both the physician and the patient are satisfied with this application. One of the most important advantages of this method is that the appropriate color, shape and position of the tooth can be achieved in a single session. This technique is minimally invasive or non-invasive and reversible restoration applications when necessary. It is much easier to repair small fractures or defects than other treatments. In addition, it allows for different treatments in large fractures or restoration losses.[5] In addition to these advantages, this technique also has disadvantages. These disadvantages include fragility of the materials, surface roughness, microleakage, polymerization shrinkage and low abrasion resistance.[6] However, it has also been emphasized that indirect composite resins and ceramic-based restorations whose polymerization is completed outside the mouth are less affected by oral fluids and their color stability is more successful than direct adhesive restorations.[7]

Direct adhesive restorations have shown positive results in the literature. Direct adhesive restorative materials applied to anterior teeth provide successful aesthetic results and are long-lasting and more economical materials compared to indirect restorations.[8]

In this case report, the treatment of interdental diastemas with direct composite resin restorations is described. Two years later, the restorations were evaluated aesthetically and functionally in clinical controls and no problems were observed. Composite resin restorations, which offer practical use, low cost and short processing time, can be preferred for aesthetic rehabilitation in cases of anterior polydiastema.

Wedge laterals are also a common tooth form abnormality that can negatively impact patient psychology due to the smaller shape and size that can distort the smile and disrupt harmony with other teeth.

All-ceramic crowns, laminate veneers and direct or indirect composite resins can be used in the treatment of wedge laterals. Considering good physical properties, quality aesthetics and marginal integrity, composite resins, especially hybrid composites, are reliable materials.[9]

CONCLUSION

This case report demonstrates that direct adhesive restorations of existing diastemas can be successful if properly indicated, with good patient motivation and under the right conditions.

ETHICAL DECLARATIONS

Informed Consent

The patient signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

REFERENCES

1. Sadioğlu B, Çobanoğlu N. Anterior bölgedeki polidiastema vakasının direkt kompozit rezin restorasyon ile estetik rehabilitasyonu: olgu sunumu. *Selcuk Dent J.* 2022;9(4):103-106.
2. Yüzügüllü B, Tezcan S. Renk değişimine ve mine erozyona uğramış dişlerde laminat veneer restorasyon seçeneklerin endikasyon bakımından karşılaştırılması. *CUC Diş Hek Fak Derg.* 2005;8(2): 133-137.
3. De Araujo EM Jr, Fortkamp S, Baratieri LN. Closure of diastema and gingival recontouring using direct adhesive restorations: a case report. *J Esthet Restor Dent.* 2009;21(4):229-240. doi:10.1111/j.1708-8240.2009.00267.x
4. de Araujo EM Jr, Baratieri LN, Monteiro S Jr, Vieira LC, de Andrada MA. Direct adhesive restoration of anterior teeth: part 2. *Pract Proced Aesthet Dent*. 2003;15(5):351-359.
5. Wolff D, Kraus T, Schach C, et al. Recontouring teeth and closing diastemas with direct composite buildups: a clinical evaluation of survival and quality parameters. *J Dent.* 2010;38(12):1001-1009.
6. Tuğut F, Ünal M, Kapdan A, Demir H, Dogan OM. Komplike kron kırığı olgusunda cam eiber post destekli kompozit restorasyonu: olgu raporu ve 18 aylık takip. *AU Dis Hek Fak Derg,* 2009;19(3): 207-212.
7. Walls AW, Steele JG, Wassell RW. Crowns and other extra-coronal restorations: porcelain laminate veneers. *Br Dent J.* 2002;193(2): 73-76.
8. Macedo G, Raj V, Ritter AV. Longevity of anterior composite restorations. *J Esthet Restor Dent.* 2006;18(6):310- 311.
9. Mittal N, Mohandas A. Managament of peg-shaped lateral with new minimal invasive restorative technique-component: a case report. *Indian J Dent Adv.* 2018;10(1):53-55.

Case Report

Dicle Dent J. 2024;25(4):121-125.

Rare benign fibroosseous lesion in the mandibular angulus: a case presentation

Kardelen Demirezer

Department of Oral and Maxillofacial Radiology, Faculty of Dentistry, İnonu University, Malatya, Turkiye

Cite this article as: Demirezer K. Aesthetic rehabilitation of a case of polydistema with direct composite restoration: case report, 2-year follow-up. *Dicle Dent J*. 2024;25(4):121-125.

Received: 29/11/2024 ◆ **Accepted**: 27/12/2024 ◆ **Published**: 30/12/2024

ABSTRACT

Fibro-osseous lesions are a poorly defined group of processes affecting the jaws and craniofacial bones characterized by the replacement of normal bone with fibrous tissue containing a newly formed mineralized product, and include developmental lesions, reactive or dysplastic lesions and neoplasms. Fibro-osseous lesions of the jaws frequently include fibrous dysplasia, cemento osseous dysplasia and ossifying fibroma. Although the histological appearance and clinical and radiographic features of most of these lesions are similar, they show a wide range of biological behaviours. Therefore, the treatment varies. The case described in this article presents a 50-year-old male patient with a fibroosseous lesion located in the right mandibular angulus. Based on the histologic findings, fibroosseous the lesion was diagnosed. The patient was referred to surgery. No invasive procedure was performed for treatment and regular clinical and radiological follow-up was recommended. Fibroosseous lesions in this region is very rare in the literature. This situation makes the case valuable.

Keywords: Fibroosseous lesion, cone-beam computed tomography, mandibular angulus

INTRODUCTION

Because different disease processes can be seen similarly, imaging lesions in the maxilla and mandible can be challenging. Primary bone lesions or odontogenic origins are the main sources of lesions.[1]

In benign fibro-osseous lesions of the jaws, fibrous connective tissue develops variable amounts of osteoid, bone, or cement-like calcifications replaces normal bone. Benign fibroosseous lesions fall into three disease categories: developmental (fibrous dysplasia), neoplastic (ossifying fibromas), and perhaps periodontal ligament dysplastic lesions of (osseous dysplasia).[2] The two most prevalent fibro-osseous lesions of the jaw are peripical and localised cemento-osseous dysplasias. Florid cemento-osseous dysplasia (FCOD) is a condition that occurs when lesions with comparable microscopic and radiological characteristics appear in two or more quadrants of the jaw.[3]

In the literature, fibroosseous lesions have been categorised in a variety of ways. The World Health Organisation (WHO) released the most recent categorisation in 2017.[4] For oral pathologists, fibro-osseous lesions of the jaws frequently present a diagnostic conundrum. Therefore, histopathological findings alone cannot be used to provide a definitive diagnosis. A combination of patient age, sex, location of the lesion, duration of symptoms, imaging features, radiographic and histological factors should be taken into account to reach the correct diagnosis.[5,6] In dentistry, panoramic radiography (PAN) is the most widely utilised diagnostic imaging method. For the diagnosis of a number of clinical and physiological disorders affecting the oral and maxillofacial regions, panoramic radiography is recommended. However, because of its three-dimensional structure, cone-beam computed tomography (CBCT) is superior to two-dimensional PAN. In addition to visualising anatomical structures in the axial, coronal, and sagittal planes, these techniques which include multi-planar reconstruction, minimum/maximum intensity projection , and volume rendering can also precisely depict the location, size, shape, and relationship of lesions to surrounding tissues, which aids in the diagnostic process.[7-9] Therefore, the patient's cbct images were analysed for more detailed imaging.

In this case report, we present a case of benign fibroosseous lesion located in the angulus region of the mandible in a 50-year-old male patient who presented to our clinic.

CASE

A 50-year-old male patient was admitted to the Department of Oral and Maxillofacial Radiology, İnönü University in 2024

Corresponding Author: Kardelen Demirezer, kardelen.demirezer@inonu.edu.tr

Dicle Dent J. 2024;25(4):121-125.

due to persistent pain in the right maxillary and mandibular region for three years. Medical anamnesis revealed no systemic disease and no history of drug use. No extraoral findings were observed. Intraoral examination revealed only left first premolar tooth in the maxillary region, right lateral and canine teeth in the mandibular region, lateral, first and second premolar teeth on the left side. Palpation revealed no tenderness, paresthesia, dental pain, luxation, or mucosal discoloration. Digital panoramic radiographic images did not reveal any different findings (Figure 1). CBCT was requested for more detailed imaging. CBCT examination of the right mandibular in the angulus region, a mixed lesion area with hypodense surroundings and hyperdense contents was observed (Figure 2). Its widest dimension was measured as 9.7x5.5 mm in sagittal section (Figure 3).

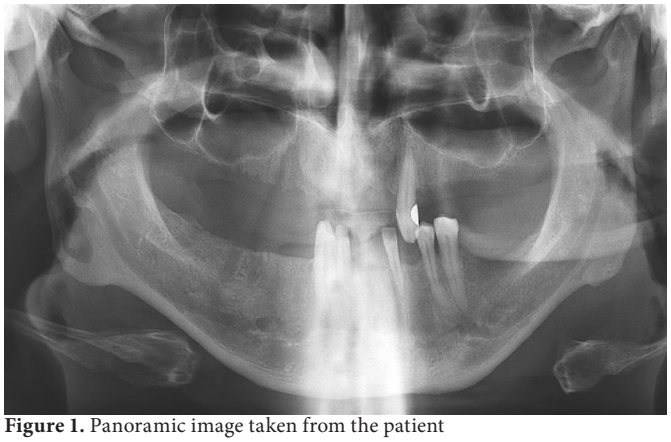

Figure 1. Panoramic image taken from the patient

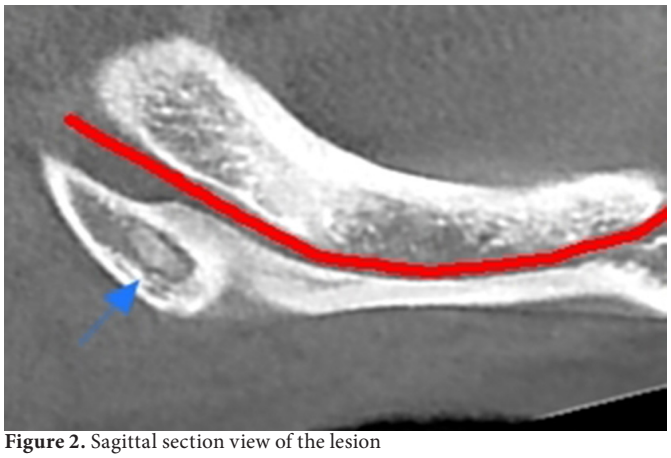

Figure 2. Sagittal section view of the lesion

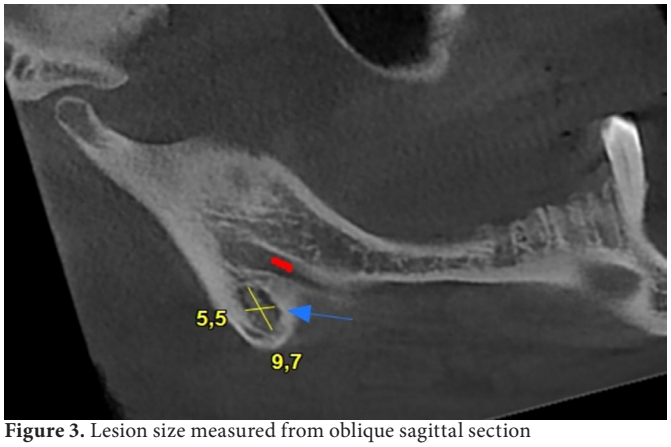

Figure 3. Lesion size measured from oblique sagittal section

The lesion is not associated with the mandibular canal and perforation and expansion of the lingual cortical bone was observed (Figure 4). No perforation was observed in the buccal cortical bone. Because of the patient's complaint of persistent pain and mixed radiologic appearance, the preliminary diagnosis of osteoblastoma or osteid osteoma was considered. Aspirin was therefore prescribed. However, it was learnt that the patient did not use the medication regularly. The patient was referred to oral and maxillofacial surgery. A biopsy was taken from that area and sent to pathology.

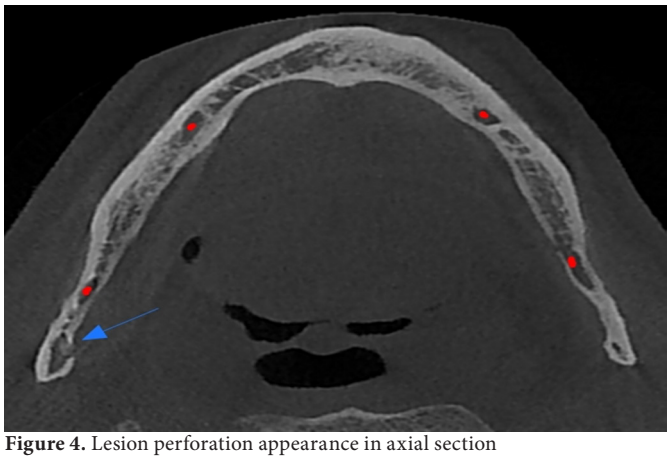

Figure 4. Lesion perforation appearance in axial section

MICROSCOPIC FINDINGS

In the pathology report, off-white colored hard tissue fragments measuring 0.9x0.6x0.2 cm in size that it was written. Histopathologic diagnosis was fibroosseous lesion. As a result of the examinations performed in the department of oral and maxillofacial surgery, no surgical procedure related to the lesion was found to be necessary. Therefore, the patient was recommended regular clinical and radiological follow-up.

DISCUSSION

Benign fibro-osseous lesions are a broad set of pathological disorders that have similar microscopic characteristics but differ in their clinical behaviour. They are characterised by the replacement of normal bone with fibrous tissue that then experiences aberrant mineralisation.

As a result, their care is quite individualised. Clinical biological behaviour must always be documented through long-term follow-up.[10,11] The internal structure of every benign fibrooseous lesion (BFOL) evolves in three stages. In essence, these radiological alterations start off as a radiolucent stage, develop into a more mature mixed stage with interior structures that are both radiolucent and radiopaque, and then finally become a radiopaque stage.[12]

Florid cemento-osseous dysplasia (FCOD) might show up on radiographs as very opaque masses, mixed lesions, or patches of radiolucency. The lesions have a tendency to become more radiopaque with time. In toothed areas, lesions are present in more than one quadrant.[13]

A localised change in normal bone metabolism known as periapical osseous dysplasia (POD) causes normal spongious bone to resorb and be replaced by fibrous tissue, amorphous

bone, aberrant bone trabeculae, or a combination of these. The lesion is situated around the apex of the tooth.[14]

Both monostotic and polyostotic forms of fibrous dysplasia (FD), a common benign bone disease, are present. It is a part of the Mazabraud and McCune-Albright syndromes and is occasionally linked to aneurysmal bone cysts. Imaging characteristics rely on the underlying histology of a particular lesion and are distinctive but not specific. Unevenly woven bone spindles dispersed within a fibrocellular matrix-which is typically not mineralized-are typical microscopic observations. Additionally, there may be cartilage foci, which occasionally have the potential to cause a destructive misdiagnosis of chondrosarcoma.[15] Early FD of the craniofacial bones is radiolucent, can be unilocular or multilocular, and has borders that are either well or poorly defined. The built-in FD has mottled radiopaque patterns, typically resembling frosted glass, orange peel, or fingerprints, with poorly defined borders that blend into the surrounding normal bone as the lesions mature and bone defects are mixed, giving it a radiolucent/radiopaque appearance.[16]

Ossifying fibroma (OF) is classified as a benign bone neoplasm. Both the maxilla and the mandible may be impacted. The mandibular posterior area is where it is most frequently observed. This bone tumour is composed of fibrous, highly cellular tissue with variable levels of calcified tissue that resembles cementum, bone, or both. The lesion has a heterogeneous density. A combination of radiopaque and radiolucent tissue could make up the interior structure. Tumour growth may result in mandibular canal or tooth displacement. It should be totally removed since it will keep growing if treatment is not received.[6,17]

Rarely does osteoblastoma, a bone-forming tumour, affect the maxilla and mandible, particularly the posterior jaw. The tumor's rarity, ambiguous clinical-radiologic presentation, and histopathologic characteristics that can mimic osteosarcoma can make differential diagnosis challenging.Histologically and clinically, the differential diagnosis of osteoblastoma ranges from benign and malignant tumors such as cementoblastoma, osteoid osteoma, fibrous dysplasia, ossifying fibroma, focal cemento-osseous dysplasia and low-grade osteosarcoma.[18]

The benign tumour known as osteoid osteoma (OO) is distinguished by an overabundance of non-mineralized bone matrix. Although it can occur in unusual places, it is most frequently found in the spine or the long bones of the lower limbs. This lesion is characterised by pain and vasomotor abnormalities that manifest long before the distinctive histologic and radiographic features do. Anti-inflammatory medications are used to reduce pain after using aspirin or other non-steroidal medications. It is difficult to differentiate radiographically from ossifying fibroma, cementoma, and osteoid osteoma. The lesion has histological similarities to osteoblastoma.[19-22]

In the case described here, due to the persistent pain complaint and mixed radiologic appearance initially suggested the possibility of osteoblastoma and osteid osteoma. Histopathology revealed a benign fibroosseous lesion. All BFOLs are divided into three phases according to their internal structure. Essentially, these radiological changes begin with a radiolucent phase and then go into a more mature mixed phase with interior structures that are both radiopaque and radiolucent, and ultimately end with a radiopaque phase. Some may also be accompanied by a simple bone cyst.[23]

When the studies on fibroosseous lesions in the literature are examined, radiographic features vary according to the stage of the lesion. As the lesion matures, its internal structure has a more mixed appearance.[24-28] This case also exhibits a mixed appearance. Crane et al.[29] examined the clinical and radiological features of fibroosseous lesions of the jaws and showed that the lesions seen in cemento-osseous dysplasia have a classic mixed radiolucent and radiopaque appearance. Makkad et al.[30] presented a case of ossifying fibroma with mixed appearance located in the mandible. Mainville et al.[2] described the radiological and clinical features of various benign fibroosseous lesions. Their internal structure varies according to the maturation stage and it is stated that they generally exhibit a mixed appearance at the mature stage. Considering all BFOLs, the diagnosed patients were predominantly female.[25]

When we look at the gender distribution of fibroosseous lesions in the literature, Soluk-Tekkesin et al.[23] In their study of 276 cases, the patients were predominantly female. Similarly, Worawongvasu et al.[6] In their study of 122 cases in Thailand, the patients were predominantly female. De Oliveira et al.[25] In 383 cases, 82% of patients women were predominantly observed. In their study, Akashi et al.[31] fibroosseous lesions were more common in women. Our current case is was a male patient.

Looking at the regions where fibroosseous lesions are seen in the literature, Suarez-Soto et al.[32] in a study of 19 cases in the craniofacial region found that the most common fibroosseous lesion was found in the mandibular region, followed by the maxillary and malar regions, respectively. Periapical cemento-osseous dysplasia is most commonly seen in the anterior mandibular teeth. The involvement of these lesions in more than one quadrant is known as fluorid cemento-osseous dysplasia.[1] Phattarataratip et al.[33] in a study of 207 patients found that most of the fibrous dysplasia and juvenile ossifying fibroma affected the maxilla and most of the ossifying fibroma and ossifying dysplasia affected the mandible. In the case described in this article, the lesion was located in the angulus mandibular region. When the literature is examined, there are different cases affecting the central nervous system.

Fibro-osseous lesions are rarely seen in the CNS. Qian et al.[34] described 4 cases affecting the central nervous system in their study.Similarly, in the study of Albu et al.[35] in a 53-year-old woman, the lesion was consistent with a fibro-osseous lesion of the central nervous system. Panoramic radiography is an extraoral radiography method that provides two-dimensional information about the teeth and maxillofacial region. Because it makes it easier to see all of the teeth, the mandible, the maxilla, including the majority of the maxillary sinus, the hard palate, and the temporomandibular joints (TMJs) at once, it is useful for diagnosis and treatment planning.[8] With the development of CBCT, three-dimensional images are increasingly being used in dentistry to visualise teeth and

adjacent surrounding structures.[36] Compared to panoramic imaging, cone beam computed tomography (CBCT) provides high resolution and clarity, allows three-dimensional imaging and has become a radiographic modality used in many areas of dentistry.[37] CBCT, in the jaws high spatial resolution images of lesions that occur or involve the jaws can be used wherever it is desired to be displayed.[38] CBCT was preferred in this case because it gives detailed information about the relationship of the lesion with the surrounding anatomical structures without any superposition.

CONCLUSION

The fibroosseous lesion described in this case is located in the right angulus region. In the literature, the possibility of fibroosseous lesions in the angulus region is very rare. This makes the case described here valuable.

ETHICAL DECLARATIONS

Informed Consent

The patient signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

REFERENCES

1. Mosier, K.M. Lesions of the jaw. *Semin Ultrasound CT MRI.* 2015; 36(5):444-450.
2. Mainville GN, Turgeon DP, Kauzman A. Diagnosis and management of benign fibro-osseous lesions of the jaws: a current review for the dental clinician. *Oral Dis*. 2017;23(4):440-450. doi:10.1111/odi.12531
3. Fenerty S, Shaw W, Verma R, et al. Florid cemento-osseous dysplasia: review of an uncommon fibro-osseous lesion of the jaw with important clinical implications. *Skeletal Radiol*. 2017;46(5): 581-590. doi:10.1007/s00256-017-2590-0
4. Wright JM, Vered M. Update from the 4th Edition of the World Health Organization classification of head and neck tumours: odontogenic and maxillofacial bone tumors. *Head Neck Pathol.* 2017;11(1):68-77. doi:10.1007/s12105-017-0794-1
5. Chauhan I, Roy S, Garg V, Manchanda K. Fibro-osseous lesions of the jaws: an insight. *Int J Contemp Dent Med. 2014*,828-835.
6. Worawongvasu R, Songkampol K. Fibro-osseous lesions of the jaws: an analysis of 122 cases in Thailand. *J Oral Pathol Med.* 2010;39(9):703-708. doi:10.1111/j.1600-0714.2010.00932.x
7. Izzetti R, Nisi M, Aringhieri G, Crocetti L, Graziani F, Nardi C. Basic knowledge and new advances in panoramic radiography imaging techniques: a narrative review on what dentists and radiologists should know. *Appl Sci.* 2021;11(17):7858.
8. Różyło-Kalinowska I. Panoramic radiography in dentistry. *Clin Dent Rev.* 2021:5(1):26.
9. Mao WY, Lei J, Lim LZ, Gao Y, Tyndall DA, Fu K. Comparison of radiographical characteristics and diagnostic accuracy of intraosseous jaw lesions on panoramic radiographs and CBCT. *Dentomaxillofac Radiol.* 2021;50(2):20200165. doi:10.1259/dmfr.20200165
10. Kolomvos N, Theologie-Lygidakis N, Christopoulos P, Iatrou I. Benign fibro-osseous lesions of the jaws in children. A 12-year retrospective study. *J Craniomaxillofac Surg.* 2013;41(7):574-580. doi:10.1016/j.jcms.2012.11.029
11. de Noronha Santos Netto J, Machado Cerri J, Miranda AM, Pires FR. Benign fibro-osseous lesions: clinicopathologic features from 143 cases diagnosed in an oral diagnosis setting. *Oral Surg Oral Med Oral Pathol Oral Radiol.* 2013;115(5):e56-e65. doi:10.1016/j.oooo.2012.05.022
12. MacDonald DS. Classification and nomenclature of fibro-osseous lesions. *Oral Surg Oral Med Oral Pathol Oral Radiol.* 2021;131(4): 385-389. doi:10.1016/j.oooo.2020.12.004
13. Sarmento DJ, Monteiro BV, de Medeiros AM, da Silveira EJ. Severe florid cemento-osseous dysplasia: a case report treated conservatively and literature review. *Oral Maxillofac Surg.* 2013; 17(1):43-46. doi:10.1007/s10006-012-0314-0
14. White SC, Pharoah MJ. White and pharoah's oral radiology: principles and interpretation. Elsevier Health Sciences. 2018.
15. Fitzpatrick KA, Taljanovic MS, Speer DP, et al. Imaging findings of fibrous dysplasia with histopathologic and intraoperative correlation. *AJR Am J Roentgenol.* 2004;182(6):1389-1398. doi:10.2214/ajr.182.6.1821389
16. Feller L, Wood NH, Khammissa RA, Lemmer J, Raubenheimer EJ. The nature of fibrous dysplasia. *Head Face Med.* 2009;5:22. doi:10.1186/1746-160X-5-22
17. Liu Y, Wang H, You M, et al. Ossifying fibromas of the jaw bone: 20 cases. *Dentomaxillofac Radiol.* 2010;39(1):57-63. doi:10.1259/dmfr/96330046
18. Kaur H, Verma S, Jawanda MK, Sharma A. Aggressive osteoblastoma of the mandible: a diagnostic dilemma. *Dent Res J (Isfahan).* 2012;9(3):334-337.
19. Matthies L, Rolvien T, Pakusa TJ, et al. Osteoid osteoma of the mandible-clinical and histological findings. *Anticancer Res.* 2019; 39(1):291-296. doi:10.21873/anticanres.13110
20. Chaudhary M, Kulkarni M. Osteoid osteoma of mandible. *J Oral Maxillofac Pathol.* 2007;11(2):52-55.
21. Jones AC, Prihoda TJ, Kacher JE, Odingo NA, Freedman PD. Osteoblastoma of the maxilla and mandible: a report of 24 cases, review of the literature, and discussion of its relationship to osteoid osteoma of the jaws. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2006;102(5):639-650. doi:10.1016/j.tripleo.2005.09.004
22. Liu CJ, Chang KW, Chang KM, Cheng CY. A variant of osteoid osteoma of the mandible: report of a case. *J Oral Maxillofac Surg.* 2002;60(2):219-221. doi:10.1053/joms.2002.29830
23. Soluk-Tekkesin M, Sinanoglu A, Selvi F, Cakir Karabas H, Aksakalli N. The importance of clinical and radiological findings for the definitive histopathologic diagnosis of benign fibro-osseous lesions of the jaws: study of 276 cases. *J Stomatol Oral Maxillofac Surg.* 2022;123(3):364-371. doi:10.1016/j.jormas.2021.04.008

24. Eversole R, Su L, ElMofty S. Benign fibro-osseous lesions of the craniofacial complex. *Head Neck Pathol.* 2008;2(3):177-202. doi: 10.1007/s12105-008-0057-2

25. Kato CNAO, Nunes LFM, Chalub LLFH, Etges A, Silva TA, Mesquita RA. Retrospective study of 383 cases of fibro-osseous lesions of the jaws. *J Oral Maxillofac Surg*. 2018;76(11):2348-2359. doi:10.1016/j.joms.2018.04.037

26. MacDonald DS. Maxillofacial fibro-osseous lesions. *Clin Radiol*. 2015;70(1):25-36. doi:10.1016/j.crad.2014.06.022

27. MacDonald-Jankowski DS. Fibro-osseous lesions of the face and jaws. *Clin Radiol*. 2004;59(1):11-25. doi:10.1016/j.crad.2003.07.003

28. Speight PM, Carlos R. Maxillofacial fibro-osseous lesions. *Curr Diagnos Pathol.* 2006;12(1):1-10.

29. Crane H, Walsh H, Hunter KD. Fibro-osseous lesions of the jaws. *Diagnos Histopathol.* 2024.

30. Makkad RS, Naidu GS, Nagi R, Sagtani A, Patil S, Shrivastava S. Multiple fibro-osseous lesions of the jaws: a report of a rare case with a literature review. *Imaging Sci Dent*. 2021;51(4):461-466. doi:10.5624/isd.20210021

31. Akashi M, Matsuo K, Shigeoka M, et al. A case series of fibro-osseous lesions of the jaws. *Kobe J Med Sci*. 2017;63(3):E73-E79.

32. Suarez-Soto A, Baquero-Ruiz de la Hermosa MC, Minguez-Martínez I, et al. Management of fibro-osseous lesions of the craniofacial area. Presentation of 19 cases and review of the literature. *Med Oral Patol Oral Cir Bucal*. 2013;18(3):e479-e485.

33. Phattarataratip E, Pholjaroen C, Tiranon P. A clinicopathologic analysis of 207 cases of benign fibro-osseous lesions of the jaws. *Int J Surg Pathol*. 2014;22(4):326-333. doi:10.1177/106689 6913511985

34. Qian J, Rubio A, Powers JM, et al. Fibro-osseous lesions of the central nervous system: report of four cases and literature review. *Am J Surg Pathol*. 1999;23(10):1270-1275. doi:10.1097/00000478-199910000-00013

35. Albu G, Deák G, Mencser Z, Vajtai I. Fibro-osseous lesion of the central nervous system. *Orv Hetil*. 2001;142(22):1165-1167.

36. Reia VCB, de Toledo Telles-Araujo G, Peralta-Mamani M, Biancardi MR, Rubira CMF, Rubira-Bullen IRF. Diagnostic accuracy of CBCT compared to panoramic radiography in predicting IAN exposure: a systematic review and meta-analysis. *Clin Oral Investig*. 2021;25(8):4721-4733. doi:10.1007/s00784-021-03942-4

37. Neves FS, Souza TC, Almeida SM, Haiter-Neto F, Freitas DQ, Bóscolo FN. Correlation of panoramic radiography and cone beam CT findings in the assessment of the relationship between impacted mandibular third molars and the mandibular canal. *Dentomaxillofac Radiol*. 2012;41(7):553-557. doi:10.1259/dmfr/22263461

38. MacDonald D. Lesions of the jaws presenting as radiolucencies on cone-beam CT. *Clin Radiol*. 2016;71(10):972-985. doi:10.1016/j.crad.2016.05.018