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Prevalence and awareness level of temporomandibular joint dysfunction among undergraduate and graduate dentistry students

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ABSTRACT

Aims: The aim of this study is to investigate the presence and prevalence of temporomandibular joint dysfunction (TMD) among undergraduate and graduate dentistry students, as well as their awareness of TMD.

Methods: After the study details and research questions were explained to the volunteer participants, survey forms were distributed. Participants were instructed not to write their names on the forms, which were collected in random order. The survey included the Fonseca anamnestic index, translated into Turkish by the researchers, along with additional demographic questions. Responses were analyzed using descriptive statistics, the Chi-square test, or the Fisher exact test. Differences between groups were determined with Dunn's Bonferroni test. p-values below 0.05 were considered statistically significant.

Results: According to the Fonseca Anamnestic Index, there is a significant association between TMD and gender. The rate of severe TMD in females (96.77%) was found to be significantly higher than in the mild TMD and no TMD groups. A significant relationship was also observed between class level and TMD ($p=0.023$); however, this difference is attributable to graduate students. Moderate TMD (26.25%) and severe TMD (25.81%) levels were higher among graduate students compared to the no TMD group (8.94%). No significant association was found between living arrangements (living with family or alone) and TMD. Additionally, no relationship was established between the department in which graduate students were enrolled and the presence of TMD.

Conclusion: This study conducted with undergraduate and graduate dentistry students primarily highlights the relationship between TMD, gender, and class level. The findings suggest a high level of TMD awareness and motivation for treatment among participants. The study did not establish a relationship between class level and TMD at the undergraduate level, nor between the department of study and TMD at the graduate level.

Keywords: Temporomandibular joint dysfunction, dentistry students

INTRODUCTION

The temporomandibular joint (TMJ) is defined as the area where the mandible articulates with the temporal bone at the base of the skull. TMJ is one of the most complex joint in the body. Since this joint allows hinge movements in one plane, it is considered a ginglymoid joint. However, it also permits gliding movements, classifying it as an arthrodial joint. Therefore, it is technically regarded as a ginglymoarthrodial joint. The TMJ is formed by the mandibular condyle fitting into the mandibular fossa of the temporal bone. The articular disc, a structure that separates these two bones from directly articulating, forms the joint. The TMJ is classified as a compound joint. By definition, a compound joint requires the presence of at least three bones, but the TMJ consists of only two bones. Functionally, the articular disc serves as a non-ossified bone that allows for the joint's complex movements.

Since the articular disc functions as a third bone, the craniomandibular joint is considered a compound joint.¹

Temporomandibular joint dysfunction (TMD) is a general term used for a group of musculoskeletal disorders characterized by pain and/or dysfunction in the masticatory muscles, TMJ, and associated structures, commonly seen in young adults and the middle-aged population.² TMD is one of the primary causes of chronic pain in the orofacial region.³ Epidemiological studies indicate that 75% of adults display at least one sign of dysfunction upon examination, and one-third present with a symptom. However, it is noted that only 5% of adults with TMD symptoms require treatment.⁴

According to a meta-analysis by Valesan et al.,⁵ the general prevalence of TMD is approximately 31% among adults/





elderly and 11% among children/adolescents. Additionally, the most common TMD is disc displacement with reduction, seen in approximately 26% of adults/elderly and 7.5% of children/adolescents. Patients with TMD, symptoms are mostly observed between the ages of 20 and 40.⁶ Among the young population, TMD symptoms are four times higher in females than in males.⁷ Symptoms of TMD include restricted mandibular movements, pain in the masticatory muscles, TMJ pain, joint sounds during function, widespread myofascial pain, and limitations in mouth opening, as well as locking or deviation.⁸

The etiology of TMD is uncertain and is often multifactorial,⁹ involving various physical and psychosocial factors.¹⁰ Some of these factors include capsular inflammation or injury, muscle pain, abnormal occlusion, parafunctional habits, stress, anxiety, or abnormalities of the intra-articular disc.⁹

Diagnosis of TMD

The diagnosis of TMD generally involves detailed anamnesis and physical examination methods.⁶ Although various imaging techniques, such as conventional radiography (transcranial plain radiograph in open and closed mouth positions), panoramic mandibular radiography, ultrasonography, computed tomography, magnetic resonance imaging (MRI), and radionuclide imaging techniques can be used for diagnosis, MRI is considered the gold standard for imaging the disc and other structures.¹¹

Treatment of TMD

TMD treatment can be classified into definitive and supportive therapies. While definitive treatments aim to eliminate the etiology, supportive treatments focus on reducing symptoms. The goals of treatment include eliminating etiological and pathological factors, reducing symptoms, restoring joint mobility, and improving posture. Initial treatment for TMD involves simple approaches such as patient education, a soft diet, reduction of parafunctional habits, physical therapy, medical treatment, improvement of sleep quality, and the use of occlusal splints.^{12,13} In advanced cases, surgical treatments may be required as a non-conservative approach.

In 1992, Fonseca modified Helkimo's indexes and developed an anamnestic questionnaire to classify TMD symptoms.¹⁴ This questionnaire consists of 10 questions that screen for pain in the TMJ, head, and back regions; pain during chewing; parafunctional habits; movement restrictions; joint sounds; perceived malocclusion; and feelings of emotional stress.¹⁵ This index is a simple, easy, and low-cost tool to indicate TMD symptoms in a non-patient population, making it a useful pre-screening tool for TMD.¹⁶

The aim of this study is to assess the presence of TMD and evaluate TMD awareness among undergraduate students at the faculty of dentistry and doctoral students in the field of dentistry at the Institute of Health Sciences at Başkent University using the Fonseca Anamnestic Questionnaire.

METHODS

The study was approved by the Ethics Committee for Clinical Researches of Başkent University (Date: 22.11.2024, Decision No: 24/229). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of

Helsinki. Written and verbal informed consent was obtained from the volunteers after they were informed about the study and agreed to participate.

This study was administered among undergraduate students from the Faculty of Dentistry and graduate students from the Institute of Health Sciences at Başkent University. A total of 407 voluntary participants, consisting of 288 females and 119 males, took part in the study. The age range of participants varied between 18 and 28. The students were divided into two groups: undergraduate and graduate. Subsequently, they were further categorized into subgroups based on their academic year: undergraduate students (1st, 2nd, 3rd, 4th, and 5th years) and graduate students (<2 years, >2 years). Volunteers were informed about the study's objectives, risks, and benefits. The survey was designed using Google Forms and distributed to participants through digital platforms. Data collection was conducted electronically. Responses with inconsistencies, multiple selections for single-choice questions, or missing answers were excluded from the study.

Participants were asked to complete a questionnaire consisting of two main sections. The first section included questions on demographic information and TMJ history. In the second section, participants answered Fonseca's 10-question survey, which covers factors such as chewing, parafunctional habits, movement limitations, and joint sounds. The questionnaire was translated into Turkish by the researchers. Each question offered three response options: "yes," "no," and "sometimes." Participants were instructed to mark only one option per question, with "yes" responses scoring 10 points, "sometimes" responses scoring 5 points, and "no" responses scoring 0 points. The Fonseca Anamnestic Questionnaire, reported as a valid and reliable tool, was used to determine the severity of TMJ disorders.^{17,18} The questionnaire score was totaled, and TMD severity was classified based on the total score:¹⁸ no TMD (0-15 points), mild TMD (20-40 points), moderate TMD (45-65 points), and severe TMD (70-100 points) (Table 1).

Table 1. Fonseca Anamnestic Questionnaire questions

Question	Yes (10 points)	No (0 points)	Sometimes (5 points)
Do you have difficulty opening your mouth wide?			
Do you have difficulty moving your lower jaw sideways?			
Do you experience fatigue/pain in your muscles while chewing?			
Do you frequently have headaches?			
Do you experience neck pain or stiffness?			
Do you have pain in your ear or jaw joint?			
Have you ever heard any clicking sound from your jaw joint during chewing or mouth opening?			
Do you have a habit of clenching or grinding your teeth?			
Do you feel that your teeth do not come together properly?			
Do you consider yourself a tense (nervous) person?			
(Classification of TMD severity by anamnestic index: 0-15 points = No TMD; 20-40 points = Mild TMD; 45-65 points = Moderate TMD; 70-100 points = Severe TMD) TMD: Temporomandibular joint dysfunction			



In addition to the Fonseca Anamnestic Questionnaire, nine questions prepared by the researchers were asked to determine the participants' awareness of TMD and to gather demographic information:

- What is your gender?
- Which year are you currently studying in?
- Do you live with your family or alone?
- Do you have any knowledge about TMJ and muscle disorders?
- Do you think you have a temporomandibular joint or muscle disorder?
- If present, are you considering treatment?
- What is your doctoral studies department?
- How many years have you completed in your graduate studies?
- How many hours do you work per day?

Statistical Analysis

Statistical analyses were performed using SPSS (Statistical Package for Social Sciences) software, version 25.0. Descriptive analyses included mean, standard deviation, median, minimum, and maximum values. For categorical variables, frequencies and percentages were used. Relationships between categorical variables were examined using the Chi-square test or Fisher exact test. Differences between groups were determined by Dunn's Bonferroni test. *p*-values below 0.05 were considered statistically significant.

RESULTS

A total of 407 individuals voluntarily participated in this study, of whom 288 (70.76%) were female and 119 (29.24%) were male. Among the participants, 83.78% (*n*=341) were undergraduate students, while 16.22% (*n*=66) were graduate students. The class levels of the undergraduate students, the departments in which the graduate students are pursuing their doctorates, their educational degrees, and study durations are presented in Table 2.

		n	%
Year of study (undergraduates, <i>n</i> =341)	1	96	28.15
	2	88	25.81
	3	95	27.86
	4	35	10.26
	5	27	7.92
Doctoral program (graduate students)	Prosthodontics	28	42.42
	Periodontology	13	19.70
	Endodontics/restorative dentistry	9	13.64
	Oral and maxillofacial surgery	16	24.24
Year of graduate study	<2	33	50.00
	>2	33	50.00
Hours worked per day	9 hours	38	57.58
	9-12 hours	16	24.24
	12+	12	18.18

The mean score for TMD among undergraduate and graduate students was calculated as 31.73 ± 21.50 . The proportions of mild and moderate TMD were 42.51%, and 19.66% respectively. Severe TMD was observed in 7.62% of participants (Table 3).

Table 3. Distribution of TMD severity

	Mean score (31.73 ± 21.50)	n	%
TMD	No TMD	123	30.22
	Mild TMD	173	42.51
	Moderate TMD	80	19.66
	Severe TMD	31	7.62

TMD: Temporomandibular joint dysfunction

There was a significant association between TMD and gender among undergraduate and graduate students ($p < 0.001$). In females, the rates of severe TMD (96.77%) and mild TMD (70.52%) were significantly higher compared to the no TMD group (60.98%) ($p = 0.012$ and $p = 0.001$, respectively). In males, the rates of severe TMD (3.23%) and mild TMD (29.71%) were significantly lower than those without TMD group (38.89%). While mild and moderate TMD levels were similar between males and females, the rate of severe TMD was significantly higher in females (10.42%) than in males (0.84%) ($p = 0.001$). A significant relationship was also found between class level and TMD ($p = 0.023$). However, this difference was attributable to graduate students. Among graduate students, the levels of moderate TMD (26.25%) and severe TMD (25.81%) were higher compared to those without TMD group (8.94%). The rate of severe TMD (90.32%) was significantly higher among those who answered "yes" to the question "Do you have any knowledge about TMJ and muscle disorders?" compared to other TMD groups ($p < 0.001$; $p < 0.001$; $p = 0.024$, respectively). Similarly, the rates of mild and moderate TMD were higher than in those without TMD group ($p < 0.001$). Among those who responded "yes" to the question "Do you think you have a temporomandibular joint or muscle disorder?" TMD severity increased at all levels, with a statistically significant increase observed in moderate and severe TMD levels ($p < 0.001$) (Table 4).

There was a significant association between TMD and gender among graduate students ($p = 0.038$). The rate of severe TMD in females (100%) was significantly higher compared to the no TMD group (36.36%). In males, the rate of severe TMD (0%) was significantly lower than in the no TMD group (63.64%). While mild and moderate TMD levels were similar between males and females, the rate of severe TMD was significantly higher in females (20.51%) than in males (0%). Among those who responded "yes" to the question "Do you think you have a temporomandibular joint or muscle disorder?" moderate and severe TMD levels were significantly higher ($p < 0.001$) (Table 5).

DISCUSSION

This study have provided the presence and severity of TMD and assesses the level of awareness about TMD among students enrolled in undergraduate and graduate degrees in dentistry. The Fonseca anamnestic questionnaire was used to explore the presence and severity of TMD.

The responses to the questionnaire in our study were consistent when other studies were regarded. Studies that



Table 4. Relationship between TMD and parameters among undergraduate and graduate students

		TMD								p value
		No TMD		Mild TMD		Moderate TMD		Severe TMD		
		n	%	n	%	n	%	n	%	
Gender	Female	75	60.98	122	70.52	61	76.25	30	96.77	<0.001
	Male	48	39.02	51	29.48	19	23.75	1	3.23	
Year of study	1	34	27.64	44	25.43	15	18.75	3	9.68	0.023
	2	32	26.02	38	21.97	13	16.25	5	16.13	
	3	28	22.76	45	26.01	14	17.50	8	25.81	
	4	11	8.94	12	6.94	7	8.75	5	16.13	
	5	7	5.69	8	4.62	10	12.50	2	6.45	
	PG	11	8.94	26	15.03	21	26.25	8	25.81	
Living situation	Alone	64	52.03	88	50.87	29	36.25	17	54.84	0.098
	With family	59	47.97	85	49.13	51	63.75	14	45.16	
Knowledge of TMJ and muscle disorders	Yes	82	66.67	116	67.05	62	77.50	26	83.87	0.095
	No	41	33.33	57	32.95	18	22.50	5	16.13	
Self-perceived presence of TMJ disorders	Yes	2	1.63	30	17.34	50	62.50	28	90.32	<0.001
	No	121	98.37	143	82.66	30	37.50	3	9.68	
Considering treatment	Yes	28	22.76	63	36.42	43	53.75	22	70.97	<0.001
	No	95	77.24	110	63.58	37	46.25	9	29.03	
Chi-square test, TMD: Temporomandibular joint dysfunction, TMJ: Temporomandibular joint										

Chi-square test, TMD: Temporomandibular joint dysfunction, TMJ: Temporomandibular joint

Table 5. Relationship between TMD and parameters among graduate students

		TMD								p value
		No TMD		Mild TMD		Moderate TMD		Severe TMD		
		n	%	n	%	n	%	n	%	
Gender	Female	4	36.36	15	57.69	12	57.14	8	100.00	0.038
	Male	7	63.64	11	42.31	9	42.86	-	-	
Living situation	Alone	8	72.73	20	76.92	9	42.86	4	50.00	0.083
	With family	3	27.27	6	23.08	12	57.14	4	50.00	
Knowledge of TMJ and muscle disorders	Yes	11	100.00	24	92.31	21	100.00	8	100.00	0.745
	No	-	-	2	7.69	-	-	-	-	
Self-perceived presence of TMJ disorders	Yes	-	-	11	42.31	21	100.00	8	100.00	<0.001
	No	11	100.00	15	57.69	-	-	-	-	
Considering treatment	Yes	10	9.09	8	30.77	14	66.67	7	87.50	<0.001
	No	9	90.91	18	69.23	7	33.33	1	12.50	
Doctoral program	Prosthodontics	6	54.55	14	53.85	4	19.05	4	50.00	0.260
	Periodontology	1	9.09	4	15.38	7	33.33	7	12.50	
	Endodontics/restorative dentistry	2	18.18	3	11.54	2	9.52	2	25.00	
	Oral and maxillofacial surgery	2	18.18	5	19.23	8	38.10	8	12.50	
Year of graduate study	<2	6	54.55	15	57.69	11	52.38	1	12.50	0.159
	>2	5	45.45	11	42.31	10	47.62	7	87.50	
Hours worked per day	9 hours	7	63.64	16	61.54	11	52.38	4	50.00	0.506
	9-12 hours	1	9.09	7	26.92	7	33.33	1	12.50	
	12+	3	27.27	3	11.54	3	14.29	3	37.50	
Fisher exact test, TMD: Temporomandibular joint dysfunction, TMJ: Temporomandibular joint										

Fisher exact test, TMD: Temporomandibular joint dysfunction, TMJ: Temporomandibular joint

have used the Fonseca Anamnestic Questionnaire to examine the prevalence of TMJ disorders have reported varying results. In this study, TMD ranging from mild to severe was observed in 284 out of 407 participants (70%). This rate is consistent with the prevalence reported in studies conducted among the Turkish population and among students from different faculties of dentistry, which ranges between 42% and 68%.^{16,19-21}

When considering the gender, the proportion of females with severe TMD (96.77%) was significantly higher compared to males (3.23%) ($p < 0.001$). This finding aligns with other studies in the literature, which generally report a higher frequency and severity of TMD in female patients than in males.²²⁻²⁴ A systematic review and meta-analysis by Bueno et al.²⁵ indicated that females are more prone to developing TMD, potentially due to hormonal, cultural, and social



factors, high stress in work environments, and variations in pain sensitivity. The prevalence of major depression is also higher in females than in males.²⁶ Although the etiology of TMD is multifactorial, depression and stress are among the contributing factors,²⁷ which may help explain the observed gender differences.

In analyses conducted by class level, a significant association was found between class level and TMD ($p=0.023$). However, this difference was attributed to graduate students, as moderate TMD (26.25%) and severe TMD (25.81%) levels were significantly higher among graduate students compared to the no TMD group (8.94%). In a study by Ahuja et al.,²⁸ graduate students reported higher stress levels due to personal and clinical factors compared to undergraduate students. Variables such as academic workload, clinical duties, financial responsibilities, and career planning are reported as stress sources among graduate students, which may explain the higher prevalence of TMD observed in this group. Further analysis among graduate students also revealed that the rate of severe TMD was higher, especially among those in their studies for more than two years (87.5%), compared to those in their first two years (12.5%). This finding suggests an increased prevalence of TMD among students in the latter half of their doctoral studies, likely due to the academic pressure and concerns about the future that intensify as the doctoral process progresses.

Severe TMD was observed in 12.12% of graduate students. Among those with severe TMD, 50% worked 9 hours per day, 12.50% worked 9-12 hours, and 37.50% worked more than 12 hours daily. Of the participants with moderate and mild TMD, 52.38% and 61.54%, respectively, worked 9 hours per day, while 14.29% and 11.54% worked more than 12 hours per day. The literature indicates that factors such as long hours at the computer and poor posture are associated with TMD.²⁹ However, the findings from this study did not establish a significant association between increased working hours and the prevalence of TMD.

Among participants with severe TMD, 54.84% lived alone, while 45.16% lived with family. In contrast, among participants without TMD symptoms, 52.03% lived alone, and 47.97% lived with family. These results indicate no significant difference between living arrangements and TMD presence ($p=0.098$). However, the literature suggests that family support and social environment factors may help reduce stress,¹⁰ warranting further investigation into this topic.

In the assessment of TMD awareness, the majority of participants across all TMD severity groups and the non-TMD group responded "yes" to the question, "Do you have any knowledge about TMJ and muscle disorders?" Awareness was highest in the non-TMD group (98.37%), followed by the severe TMD (90.32%) and moderate TMD (62.50%) groups. The group with the lowest awareness level was those with mild TMD. These findings are not unexpected, considering that TMD symptoms, pain thresholds, and adaptation mechanisms vary from person to person. Additionally, mild TMD symptoms may change over time and may sometimes remain asymptomatic for extended periods. Nevertheless, based on the analysis results, TMD awareness level was found to be statistically significant in relation to TMD severity ($p<0.001$).

Among participants with severe TMD, 70.97% expressed a willingness to undergo treatment, while 29.03% answered "no" to this question. In contrast, 63.58% of participants with mild TMD were not inclined to seek treatment. This result suggests that motivation for treatment is low when TMD severity is mild. However, delaying treatment may lead to an increase and frequency of TMD symptoms, potentially making the treatment more complex and prolonged.

The findings of this study indicate that TMD prevalence is high among dentistry students and that awareness levels need to be increased. However, TMD generally presents with mild to moderate severity. This condition, which is especially more prevalent among female and graduate students, highlights the need for ergonomic awareness training and the development of stress management strategies during the dental education process.³⁰

Limitations

This study was administered solely among undergraduate and graduate students of the Faculty of Dentistry at Baškent University, which limits the generalizability of the results to a broader student population. Additionally, the number of graduate students included in the study is significantly lower than that of undergraduate students, which may have influenced the results.

The research is cross-sectional, meaning it only reflects the TMD status of participants at a specific point in time. Consequently, it does not provide information on the development and progression of TMD over time. Long-term follow-up studies could be beneficial for a better understanding of the developmental process and trends of TMD.

Although the Fonseca Anamnestic Questionnaire used in this study is considered a valid and reliable tool for assessing TMD symptoms, it relies on subjective evaluations and is not supported by clinical examination. The data obtainable from survey studies for TMD detection are quite limited. Based on the information gathered, clinical and radiographic examinations are necessary for participants exhibiting TMD symptoms to confirm a TMD diagnosis.

CONCLUSION

The study found that TMD prevalence is significantly higher in female students compared to male students.

Analysis between undergraduate and graduate students indicated that TMD severity was higher among students in advanced academic years.

In evaluations conducted among graduate students, the rate of severe TMD was found to be higher among those who had been in their program for more than two years compared to those in their first two years.

Participants with knowledge about TMJ and muscle disorders were more aware of TMD symptoms and were more frequently found in the severe TMD group.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission of by the Ethics Committee for Clinical Researches of Baškent University (Date: 22.11.2024, Decision No: 24/229).



Informed Consent

All patients 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

- Okeson JP. Chapter 1. Functional Anatomy and Biomechanics of the Masticatory System. The Clinical Management of Temporomandibular Disorders and Occlusion, 8th Edition, 2019:2-86.
- LeResche L. Epidemiology of temporomandibular disorders: implications for the investigation of etiologic factors. *Crit Rev Oral Biol Med*. 1997;8(3):291-305. doi:10.1177/10454411970080030401
- Durham J, Newton-John TR, Zakrzewska JM. Temporomandibular disorders. *BMJ*. 2015;350:h1154.
- Buescher JJ. Temporomandibular joint disorders. *Am Fam Physician*. 2007;76(10):1477-1482.
- Valesan LF, Da-Cas CD, Réus JC, et al. Prevalence of temporomandibular joint disorders: a systematic review and meta-analysis. *Clin Oral Investig*. 2021;25(2):441-453.
- Gauer RL, Semidey MJ. Diagnosis and treatment of temporomandibular disorders. *Am Fam Physician*. 2015;91(6):378-386.
- Phillips JM, Gatchel RJ, Wesley AL, Ellis E 3rd. Clinical implications of sex in acute temporomandibular disorders. *J Am Dent Assoc*. 2001; 132(1):49-57.
- Liu F, Steinkeler A. Epidemiology, diagnosis, and treatment of temporomandibular disorders. *Dent Clin North Am*. 2013;57(3):465-479.
- Buescher JJ. Temporomandibular joint disorders. *Am Fam Physician*. 2007;76(10):1477-1482.
- Rollman GB, Gillespie JM. The role of psychosocial factors in temporomandibular disorders. *Curr Rev Pain*. 2000;4(1):71-81.
- Tognini F, Manfredini D, Melchiorre D, Bosco M. Comparison of ultrasonography and magnetic resonance imaging in the evaluation of temporomandibular joint disc displacement. *J Oral Rehabil*. 2005;32(4): 248-253.
- Yüceler Ö, Öztürk Ö, Uğar Çankal DA. Temporomandibular eklem bozukluklarında güncel tedavi yaklaşımları. *ADO Klin Bil Derg*. 2022; 11(3):318-331.
- Okeson JP. Chapter 11. General Considerations in the Treatment of Temporomandibular Disorders. The Clinical Management of Temporomandibular Disorders and Occlusion, 8th Edition, 2019:260-295.
- Schmitter M, Kress B, Leckel M, Henschel V, Ohlmann B, Rammelsberg P. Validity of temporomandibular disorder examination procedures for assessment of temporomandibular joint status. *Am J Orthod Dentofacial Orthop*. 2008;133(6):796-803.
- Schiffman E, Ohrbach R, Truelove E, et al. Diagnostic criteria for temporomandibular disorders (DC/TMD) for clinical and research applications: recommendations of the International RDC/TMD Consortium Network* and Orofacial Pain Special Interest Group†. *J Oral Facial Pain Headache*. 2014;28(1):6-27.
- Ertaş Ü, Ataol M, Aşçı YE. Measuring the awareness of patients by classifying the severity of temporomandibular joint disorders with the Fonseca Anamnestic Questionnaire. *Turk Klin J Dent Sci*. 2021;27(4): 545-550.
- Berni KC, Dibai-Filho AV, Rodrigues-Bigaton D. Accuracy of the Fonseca Anamnestic Index in the identification of myogenous temporomandibular disorder in female community cases. *J Bodyw Mov Ther*. 2015;19(3):404-409.
- Campos JA, Carrascosa AC, Bonafé FS, Maroco J. Epidemiology of severity of temporomandibular disorders in Brazilian women. *J Oral Facial Pain Headache*. 2014;28(2):147-152.
- Ayalı A, Ramoğlu R. Kuzey Kıbrıs'ta diş hekimliği fakültesi öğrencilerinde temporomandibular eklem disfonksiyonu'nun prevalansı ve şiddetinin araştırılması. *Atatürk Üni Diş Hek Fak Derg*. 2014;24(3):367-372.
- Malikov I, Sezen Erhamza T, Yurt Öncel S. Kırıkkale Üniversitesi Diş Hekimliği Fakültesi Öğrencileri'nde temporomandibular eklem rahatsızlıklarının sıklığı ve şiddetinin değerlendirilmesi. *Kırıkkale Üni Tıp Fak Derg*. 2024;26(1):70-75.
- Tunç H, Ögünç A. Diş hekimliği fakültesi öğrencilerinde temporomandibular disfonksiyon ve ilişkili faktörlerin değerlendirilmesi. *NEU Dent J*. 2023;3(5):195-201.
- Poveda Roda R, Bagan JV, Díaz Fernández JM, Hernández Bazán S, Jiménez Soriano Y. Review of temporomandibular joint pathology. Part I: classification, epidemiology and risk factors. *Med Oral Patol Oral Cir Bucal*. 2007;12(4):E292-E298.
- Ferrando M, Andreu Y, Galdon MJ, Dura E, Poveda R, Bagan JV. Psychological variables and temporomandibular disorders: distress, coping, and personality. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2004;98(2):153-160.
- Lee LT, Yeung RW, Wong MC, McMillan AS. Diagnostic sub-types, psychological distress and psychosocial dysfunction in southern Chinese people with temporomandibular disorders. *J Oral Rehabil*. 2008;35(3):184-190.
- Bueno CH, Pereira DD, Pattussi MP, Grossi PK, Grossi ML. Gender differences in temporomandibular disorders in adult populational studies: a systematic review and meta-analysis. *J Oral Rehabil*. 2018; 45(9):720-729.
- Cyranowski JM, Frank E, Young E, Shear MK. Adolescent onset of the gender difference in lifetime rates of major depression: a theoretical model. *Arch Gen Psychiatry*. 2000;57(1):21-27.
- Dağ C, Özalp N, Dağ M. Temporomandibular eklem ve temporomandibular düzensizlik. *ADO Klin Bil Derg*. 2011;5(1):782-790.
- Ahuja V, Ranjan V, Passi D, Jaiswal R. Study of stress-induced temporomandibular disorders among dental students: an institutional study. *Natl J Maxillofac Surg*. 2018;9(2):147-154.
- Carlsson GE, Le Resche L. Epidemiology of temporomandibular disorders. In: Sessle BJ, Bryant PS, Dionne RA, editors. Temporomandibular Disorders and Related Pain Conditions. Seattle: IASP Press; 1995. p. 211-226.
- Collin V, O'Selmo E, Whitehead P. Stress, psychological distress, burnout and perfectionism in UK dental students. *Br Dent J*. 2020; 229(9):605-614. doi:10.1038/s41415-020-2281-4

Evaluation of dental students' perspectives of specialization in periodontology

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ABSTRACT

Aims: The aim of this study was to define the perspective of dentistry students on specialization and to evaluate their thoughts and attitudes regarding specialization in the Periodontology department.

Methods: Our study was an epidemiological descriptive study consisting of a questionnaire applied to 274 students (167 female, 107 male) studying in the 3rd, 4th and 5th years at Kırıkkale University Faculty of Dentistry. Demographic data and students' perspectives on dentistry were evaluated and their thoughts and attitudes regarding specialization in periodontology were determined. Data analysis was performed using descriptive statistical methods and the Chi-square test.

Results: A high percentage of students (73.8%) participating in the study indicated that they were considering specialization in dentistry. It was reported that the most important criteria considered in the selection of specialization were interest in the specialization (53.5%) and job opportunities/financial returns of specialization education (32.0%). The Periodontology department (16.3%) was the 4th most desired department to specialize in. 35.6% of the students included in the study stated that the Oral and Maxillofacial Surgery department was the most important department in terms of patient care, while 21.8% stated that the Periodontology department was the third most important department in terms of dentistry. The students stated that they were most impressed by the Periodontology department with clinical experience (44.4%).

Conclusion: According to our study results, it was determined that students' first perceptions about dentistry began to form during their clinical periods and that factors such as their clinical experiences and the influence of faculty members were effective in their career choices.

Keywords: Dental specialties, dentistry, periodontology

INTRODUCTION

Dentistry, one of the most respected professions in the world and in Turkey, is changing and developing to provide better service to patients, just like every other branch. For years, dentists in our country have successfully applied standard dental treatments. However, in complicated and difficult cases, patients' efforts to reach specialist doctors in their fields have created some needs.¹ In parallel with this demand, since 2012, dentistry faculties in our country have started to provide specialist training in 8 different branches, just like in medical medicine. A dentist with a 5-year dentistry education can then work in a specific field for 3-4 years, receive the title of specialist dentist, and continue his/her career as an academican at universities or as a specialist dentist in private oral and dental health clinics.²

Various factors have been identified in the dental literature regarding whether to specialize in dentistry and the choice of specialization. Factors such as social or professional status; higher financial income, job security, social status in society,

personal interest, and past experiences have been reported as the most important factors affecting specialization choices. However, the demographic characteristics of a population are also important determinants affecting the motivation and future expectations of dentistry students.^{3,4} The interest in specialization in dentistry in Türkiye is increasing day by day due to the increase in the number of dentists graduating in recent years and the tendency to specialize in certain areas in order to keep up with market conditions.

In a study evaluating specialisation in the field of restorative treatment, 139 4th and 5th grade students were evaluated. According to the results of the study, it was seen that the most popular specialisation was oral, dental and maxillofacial surgery and 45.3% of the participants chose this field as their first choice. The majority of the participants, 66.9%, reported that they first heard about restorative dentistry in the preclinical department. According to the questionnaire, 47.5% of the students stated that the restorative dentistry



department was primarily influenced by their clinical experiences.⁵ In another study, dental students' perceptions of their speciality areas were evaluated. Questionnaires were distributed to 494 students at the University of Pennsylvania School of Dentistry. Data were collected from 380 traditional four-year students and thirty advanced students. Enjoyment of providing care in a speciality or area was identified as the most important factor in choosing a speciality career. Half of the participants decided not to specialise. Continuing post-doctoral education in general dentistry and opening a private practice in general dentistry were the most frequently reported plans after completing dental school.⁶ Another study evaluated the perception and understanding of endodontic specialisation among dental students and newly graduated dentists. Their satisfaction with preclinical education, use of magnification in learning, and interest in pursuing endodontics as a future career were also examined. The study revealed that the majority of participants expressed high confidence in the diagnosis and treatment of endodontic cases. Perception did not differ significantly according to gender, level of education, teeth treated or experience of the supervising instructor. The study emphasises the importance of modifying the undergraduate dental curriculum to provide more preclinical training on extracted teeth, with a focus on determining working length and radiograph acquisition. These changes may help to reduce stress associated with endodontic procedures, improve treatment outcomes and increase patient satisfaction.⁷

Periodontology is the branch of science that studies the health, diseases and treatments of the tissues that support teeth and dental implants. Periodontal diseases are the main cause of tooth loss, especially in adults, and according to the World Health Organization (WHO) reports, they are among the most common diseases in the world. It is accepted that there is a two-way interaction between periodontal diseases and systemic diseases, and clinical findings of many systemic diseases are found in periodontal tissues.⁸⁻¹⁰ The scope of the science of periodontology is gradually expanding, and since undergraduate education alone is not sufficient, specialization training is a necessity. Specialization training is a competency-based training process that includes advanced theoretical knowledge and clinical practices not included in undergraduate education.

Although there is little current literature on students' expectations regarding specialization in dentistry and the factors affecting their choice of specialization after entering the faculty of dentistry,¹¹⁻¹⁴ no study has been found in our country examining the place of the periodontology department in the future plans and career goals of dentistry students. The aim of this study is to determine the perspective of dentistry students on specialization and to evaluate their thoughts and attitudes regarding specialization in the periodontology department.

METHODS

Data Collection

The study was conducted in accordance with the ethical rules of the Declaration of Helsinki and approved by the Kırıkkale University Non-interventional Researches Ethics Committee (Date: 17.04.2024, Decision No: 2024.03.19). Prior to the

study, all individuals participating in the study were given detailed information about the purpose and methodology of the study, and students who agreed to participate in the study were obtained using an informed consent form. The study included 3rd, 4th and 5th grade students studying at Kırıkkale University Faculty of Dentistry in the 2023-2024 academic year. Survey questions, modified from a previously published article,^{8,11} were delivered to students via Google Forms. In the first part of the survey, demographic data and students' perspectives on dentistry were evaluated, while in the second part, their thoughts and attitudes regarding specialization in periodontology were determined.

Statistical Analysis

The data obtained in the study were analyzed using an SPSS for the Windows 25.0 program. Descriptive statistical methods (number, percentage, min-max values) were used to evaluate the data. Descriptive statistical methods and the Chi-square test were used in the evaluation of the data. The $p < 0.05$ value was considered statistically significant.

RESULTS

The average age of the individuals included in the study was 22.70 ± 1.74 , between the ages of 20 and 34. 60.9% were female ($n=167$), 39.1% ($n=107$) were male. 33.8% ($n=93$) were 3rd-year students, 33.5% ($n=92$) were 4th-year students, and 32.4% ($n=89$) were 5th-year students. The responses to the survey questions were examined. The distribution of the responses to the questions is shown in Table 1.

A high percentage of students (73.8%) participating in the study, indicated that they were considering specialization in dentistry. The idea of specialization did not differ by grade level. When the gender distribution of these students was examined, the number of female who wanted to receive specialist training was significantly higher than male (Table 2).

In the question asking about the most important criterion when choosing a specialty, 147 students (53.5%) stated that interest in the specialty was the most important, while 88 students (32.0%) stated that it depended on the job opportunity/financial return of the specialty education. The duration of the specialty program was chosen by the least number of student ($n=2$).

The students listed the top three departments they dreamed of specializing in as oral, and maxillofacial surgery (41.5%), orthodontics (20.2%) and prosthodontics (18.5%). Periodontology ranked fourth with 16.3%. The least preferred department was oral and maxillofacial radiology (2.6%). Female and male did not give significantly different answers to this question ($p=0.425$). The answers they gave at the class level showed a significant difference for oral and maxillofacial surgery, pedodontics, orthodontics and restorative dentistry departments ($p=0.042$, $p=0.041$, $p<0.001$, $p=0.005$, respectively) (Table 3).

41.1% of the participants thought that the orthodontics department would provide the most financial gain. The least profit would be provided by the endodontics department (0.4%). Only 1.5% of the participants thought that the Periodontology department provided the most financial gain.



Table 1. Distribution of students' answers to survey questions

	n	Percent (%)
What are the top three specialties you dream of pursuing?		
Oral and maxillofacial radiology	20	2.6
Prosthodontics	145	18.5
Oral and maxillofacial surgery	180	23.0
Pedodontics	48	6.1
Endodontics	40	5.1
Periodontology	128	16.3
Orthodontics	158	20.2
Restorative dentistry	65	8.3
Are you considering specializing in any field of dentistry?		
Yes	203	73.8
No	14	5.1
Undecided	57	20.7
What is the most important criterion you consider when choosing a specialty?		
Interest in the specialty field	147	53.5
The impact of the faculty where you will receive your specialty training	7	2.5
The competence of the faculty members in the specialty field	11	4.0
The impact of the city where you will receive your specialty training	17	6.2
Duration of the specialty program	2	0.7
Job opportunities/financial benefits of the specialty training	88	32.0
Other	2	0.7
Which specialty do you think would provide the highest financial earnings?		
Oral and maxillofacial radiology	5	1.8
Prosthodontics	73	26.5
Oral and maxillofacial surgery	68	24.7
Pedodontics	10	3.6
Endodontics	1	0.4
Periodontology	4	1.5
Orthodontics	113	41.1
Restorative dentistry	0	0
Which specialty do you believe is the most important in terms of patient care?		
Oral and maxillofacial radiology	31	11.3
Prosthodontics	25	9.1
Oral and maxillofacial surgery	98	35.6
Pedodontics	10	3.6
Endodontics	32	11.6
Periodontology	60	21.8
Orthodontics	7	2.5
Restorative dentistry	11	4.0
Which specialty do you believe is the most effective in the field of dentistry?		
Oral and maxillofacial radiology	19	6.9
Prosthodontics	38	13.8
Oral and maxillofacial surgery	114	41.5
Pedodontics	6	2.2
Endodontics	30	10.9
Periodontology	34	12.4
Orthodontics	15	5.5
Restorative dentistry	18	6.5
When did you first learn about the field of periodontology?		
Pre-university	91	33.1
University selection period	42	15.3
Clinical observation period / theoretical lecture period	137	49.8
Clinical period	4	1.5
What was the most impactful introductory experience you had related to the field of periodontology?		
Clinical observation period / theoretical lecture period	65	23.6
Clinical experience	96	34.9
The faculty member teaching the periodontology lecture	94	34.2
Textbook	7	2.5
Internet/websites	6	2.2
Other	6	2.2
How would you evaluate your first experience with periodontal treatment?		
Mostly positive	122	44.4
Somewhat positive	90	32.7
Undecided	44	16.0
Somewhat negative	15	5.5
Mostly negative	3	1.1
What is your overall perception of the future demand and outlook for the field of periodontology?		
Mostly positive	149	54.2
Somewhat positive	82	29.8
Undecided	35	12.7
Somewhat negative	6	2.2
Mostly negative	2	0.7
If you want to specialize in periodontology, what is the main reason behind that choice?		
Contribution to professional life	95	34.5
Patients' needs	64	23.3
Financial gain	55	20.0
Personal skills	43	15.6
Other	17	6.2

**Table 2. Distribution of considering specialization by gender [n (%)]**

	Male	Female	Total	X ²	p
Are you considering specializing in any field of dentistry?					
Yes	72 (35.5%)	131 (64.5%)	203 (100.0%)	5.766	0.044
No	9 (64.3%)	5 (35.7%)	14 (100.0%)		
Undecided	26 (24.3%)	31 (18.6%)	57 (100.0%)		

Of the students included in the study, 35.6% stated that oral and maxillofacial surgery was the most important department in terms of patient care, while 21.8% stated that Periodontology was the most important department in terms of patient care. No significant difference was observed at the class level ($p=0.157$).

When asked, 'Which specialty do you think is the most effective department in terms of dentistry?', 41.5% of the students responded as oral and maxillofacial surgery department. The least effective department was pedodontics with 2.2%. Periodontology ranked third among all departments with 12.4%. A significant difference was observed at the class level ($p=0.012$). Participants in the 5th grade stated Prosthodontics as the most effective department compared to participants in the 3rd grade while 4th grade students stated that the most effective department, compared to 5th grade students, was the oral and maxillofacial surgery department (Table 3).

49.8% of the students participating in the study stated that they learned about the Periodontology department for the first time during the clinical observation period/theoretical course period. Moreover, 33.1% of them stated that they knew about it before university. Students stated that they were most influenced by the periodontology department through clinical experience (34.9%). A similar rate (34.2%) also stated that the lecturer/theoretical course teaching the periodontology lecture was also effective.

44.4% of the participants stated that their first experience with periodontal treatment was mostly positive. Students stated that there will be a high demand for the periodontology department in the future (54.2%). The students participating in the study stated that the most important reason for wanting to specialize in periodontology was its contribution to professional life with a rate of 34.5%.

DISCUSSION

This study was designed to determine the opinions of third, fourth and fifth year dentistry students about the periodontology department and where periodontology fits into their career plans. In studies evaluating perspectives on specialization in different branches, only 4th and 5th year

Table 3. Distribution of answers to questions according to class level

	3 rd year	4 th year	5 th year	Total	X ²	p
	n (%)	n (%)	n (%)	n		
Are you considering specializing in any field of dentistry?						
Yes	74 (36.5%)	71 (35.0%)	58 (28.6%)	203	9.244	0.055
No	3 (21.4%)	2 (14.3%)	9 (64.3%)	14		
Undecided	16 (28.1%)	19 (33.3%)	22 (38.6%)	57		
Which specialty do you believe is the most important in terms of patient care?						
Oral and maxillofacial radiology	11 (35.5%)	12 (38.7%)	8 (25.8%)	31	19.214	0.157
Prosthodontics	6 (24.0%)	9 (36.0%)	10 (40.0%)	25		
Oral and maxillofacial surgery	37 (37.8%)	40 (40.8%)	21 (21.4%)	98		
Pedodontics	2 (20.0%)	1 (10.0%)	7 (70.0%)	10		
Endodontics	10 (31.3%)	8 (25.0%)	14 (43.8%)	32		
Periodontology	22 (36.7%)	17 (28.3%)	21(35.0%)	60		
Orthodontics	1 (14.3%)	2 (28.6%)	4 (57.1%)	7		
Restorative dentistry	4 (36.4%)	3 (27.3%)	4 (36.4%)	11		
Which specialty do you believe is the most impactful in the field of dentistry?						
Oral and maxillofacial radiology	8 (42.1%)	5 (26.3%)	6 (31.6%)	19	28.629	0.012
Prosthodontics	5 (13.2%)	14 (36.8%)	19 (50.0%)	38		
Oral and maxillofacial surgery	40 (35.1%)	50 (43.9%)	24 (21.1%)	114		
Pedodontics	1 (16.7%)	1 (16.7%)	4 (66.7%)	6		
Endodontics	11 (36.7%)	7 (23.3%)	12 (40.0%)	30		
Periodontology	13 (38.2%)	7 (20.6%)	14 (41.2%)	34		
Orthodontics	7 (46.7%)	5 (33.3%)	3 (20.0%)	15		
Restorative dentistry	8 (44.4%)	3 (16.7%)	7 (38.9%)	18		
What are the top three specialties you dream of pursuing?						
Oral and maxillofacial radiology	7 (3.4%)	5 (2.1%)	8 (4.3%)		0.887	0.648
Prosthodontics	43 (36.3%)	58 (52.9%)	44 (39.2%)		5.887	0.054
Oral and maxillofacial surgery	62 (56.7%)	68 (64.3%)	50 (45.8%)		6.308	0.042
Pedodontics	11 (6.4%)	14 (9.0%)	23 (17.6%)		6.365	0.041
Endodontics	8 (4.2%)	15 (9.8%)	17 (12.0%)		4.505	0.102
Periodontology	46 (39.4%)	39 (32.7%)	43 (38.1%)		1.070	0.588
Orthodontics	71 (67.0%)	52 (46.3%)	35 (29.7%)		26.062	<0.001
Restorative dentistry	21 (15.0%)	13 (8.2%)	31 (25.5%)		10.686	0.005



students were included.^{13,14} However, since both clinical observation courses and periodontology theoretical lecture begin in the 3rd year, 3rd year students were included in this study along with 4th and 5th year students.

Receiving specialization training in dentistry helps dentists achieve higher income potential and professional prestige in their careers. This training is an important step in advancing in their field of specialization and advancing their careers, and plays an important role in both professional development and patient care quality. For these reasons, the increasing number of graduated dentists in our country is leading doctors to specialize. In this study, a very large percentage of participants stated that they were considering specialization. When gender distribution is examined, it is found that female who want to receive specialization training are significantly more than male. While in the early 2000s, one in every five dentists in some developed countries was a female and this rate was even lower among specialist dentists, in recent years the rate of female dentists and female dentistry students has been increasing. According to statistical studies conducted in Europe, dentistry is increasingly becoming a branch in which female predominate.¹⁵ In fact, especially in developed countries, the number of female dentists receiving specialization training has begun to exceed their male colleagues.¹⁶ The rates of students participating in this study who are inclined to receive specialization training according to their gender distribution are similar to the trends of their colleagues in developed countries today.

In a study conducted, it was observed that there was no difference in the first preferences at the class level when their desire for specialisation was evaluated. When specialisation tendencies at the class level were examined, no statistical difference was observed between the classes in the study.⁷ In our study, oral, dental and maxillofacial surgery was the department in which specialisation was considered the most.

Many professional, economic and personal factors play a role in a person's decision to specialize.¹⁷ In this study, it was observed that the most important factor that participants paid attention to when choosing a specialization was having a personal interest in the relevant specialization, regardless of the student's gender and grade. There are studies supporting this situation in the literature.^{6,18,19} In their 2018 study, Alrashdan et al.²⁰ revealed that the choice of specialization according to the economic income and levels of the countries; financial expectations, reputation of the specialization, duration and cost of the education to be received differed among nations. Similarly, in our study, financial return and job opportunities were the second most important factors affecting the choice of specialization. Positive statements and wishes about periodontology may have been not preferred among students when the issue of financial gain came into play, causing positive opinions to appear contradictory.

The first three departments that the participants considered specializing in were oral and maxillofacial surgery, orthodontics, and prosthetic dentistry. Periodontology ranked 4th. This ranking varies in different studies.^{6,11,21} Erhamza et al.¹¹ reported in their study that females dream of specializing in the oral and maxillofacial surgery, orthodontics and pedodontics departments at a much higher rate than males. While an undergraduate dentistry student receives training on the basic information of a wide variety of

specializations, when he/she enters a specialization training program, he/she learns the most in-depth information about a specific field of knowledge and practice. However, students choose the specialization they are interested in based on their undergraduate experiences. Therefore, we believe that increasing the educational curriculum that students enjoy during their undergraduate education will increase their orientation towards the specialization of the relevant department. Dhima et al.⁶ showed that male prefer the oral and maxillofacial surgery department more than female. In the same study, it was observed that females want to specialize in the pedodontics department more than males. In a similar study conducted in our country, it was found that females want to specialize in the oral and maxillofacial surgery department more.¹³ In this study, the departments considered as specialization areas did not create a difference between females and males. This may be due to individual differences and the individual's interest in that area, regardless of gender.

Only 1.5% of the participants thought that the periodontology department provided the most financial gain. However, in contrast, the fact that the periodontology department was the 4th most preferred department in terms of specialization suggests that interest in the specialty rather than financial gain is more decisive.

Aksoy et al.¹³ found that the oral and maxillofacial surgery, pedodontics and oral and maxillofacial radiology departments were important in terms of patient care, respectively. Erhamza et al.¹¹ reported that the oral and maxillofacial surgery department was selected with a high rate in terms of patient care in their study. Similarly, the Periodontology department was ranked second in terms of patient care and third as the most effective department in terms of dentistry in this study. These findings may be due to the idea that periodontal treatments are important both in preventing tooth loss and in maintaining general health.

The positive or negative evaluation of clinical experiences has an impact on students' future specialization choices.²² Students' first experiences with the periodontology department are mostly positive, supporting the idea that this will have a positive impact on their choice of specialization.

Limitations

Only students continuing their education at one university participated in the study. The inclusion of only one university in the study can be considered as a limitation. This information should be kept in mind when interpreting the data within this limitation.

CONCLUSION

The specialization process in dentistry is an important decision that will shape the lives of students. In making this decision, it is important for students to complete their knowledge about the specialization branch they are considering, to determine their abilities in this specialization branch, and to guide students with the right guidance. According to the results of our study, the decision to become a specialist and choose a department is a personal decision and is formed by the experiences and interests of the student throughout their undergraduate life. The job opportunities and financial returns of specialization education are other



determining criteria in terms of specialization choice. More universities participating in the study and reaching a wider population will provide more detailed information on the subject. In addition, survey studies using more advanced scales can be beneficial in revealing the decision-making patterns in the selection of a specialization branch in dentistry.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission of the Kırıkkale University Non-interventional Researches Ethics Committee (Date: 17.04.2024, Decision No: 2024.03.19).

Informed Consent

Informed consent was obtained from all patients participating in this 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

- Efeoğlu A, Erdemir Demirhan A, Öncel Ö. Geçmişten günümüze türk diş hekimliği. Türk Dünyası Araştırmaları Vakfı, İstanbul. 2000.
- Tıpta Uzmanlık Kurulu. Tıpta ve Diş Hekimliğinde Uzmanlık Eğitim Yönetmeliği. Available from: <http://www.tuk.saglik.gov.tr/pdfdosyalar/mevzuat/TUEY.pdf> [18 Temmuz 2009].
- Halawany HS, Binassfour AS, AlHassan WK, et al. Dental specialty, career preferences and their influencing factors among final year dental students in Saudi Arabia. *Saudi Dent J*. 2017;29(1):15-23.
- Eliav E, Scotti R, Pellegrino G, et al. Specialties in dentistry. *Quintessence Int*. 2010;41(10):807-883.
- Atilan Yavuz S, Ozdemir ZM, Surmelioglu D. Evaluation of dentistry students' perspectives of specialization in restorative dentistry. *Cumhuriyet Dent J*. 2023;26(4):426-430.
- Dhima M, Petropoulos VC, Han RK, Kinnunen T, Wright RF. Dental students' perceptions of dental specialties and factors influencing specialty and career choices. *J Dent Educ*. 2012;76(5):562-573.
- AlMaslamani MJ, AlNajar IJ, Alqedra RA, ElHaddad M. Dental undergraduate students' perception of the endodontic specialty. *Saudi Endodontic J*. 2024;14(1):113-120.
- Kinane DF, Stathopoulou PG, Papapanou PN. Periodontal diseases. *Nat Rev Dis Primers*. 2017;3:17038.
- Genco RJ, Sanz M. Clinical and public health implications of periodontal and systemic diseases: an overview. *Periodontol*. 2000. 2020; 83(1):7-13.
- Bui FQ, Almeida-da-Silva CLC, Huynh B, et al. Association between periodontal pathogens and systemic disease. *Biomed J*. 2019;42(1):27-35.
- Erhamza TS, Çiğirim SÇ. Diş hekimliği fakültesi öğrencilerinin ortodonti uzmanlığına bakış açıları. *Selcuk Dent J*. 2021;8:427-435.
- Duman B, Kızılcı E, Demiroğlu C. Diş hekimliği fakültesi öğrencilerinin pedodonti anabilim dalında uzmanlaşma konusundaki tercihlerinin değerlendirilmesi *Selcuk Dent J*. 2022;9(1):147-152.
- Aksoy A, Yanıkoğlu N. Diş hekimliği fakültesi öğrencilerinin protetik diş tedavisi anabilim dalında uzmanlaşma konusundaki motivasyonlarının değerlendirilmesi. *J Dent Fac Atatürk Uni*. 2019; 29(4):623-630.
- Akgül N, Özpala G, Yazkan B, Yenidünya G. Pamukkale Üniversitesi Diş Hekimliği Fakültesi öğrencilerinin restoratif diş tedavisi lisans eğitimi ve uzmanlığına ilişkin görüşlerinin değerlendirilmesi. *Selcuk Dent J*. 2023;10(3):547-553.
- Adams T. Feminization of professions: the case of women in dentistry. *Can J Sociol*. 2005;30(1):71-94.
- Furtinger V, Alyeva R, Maximovskaya L. Is European Dentistry becoming a female profession? *Acta Stomatol Croat*. 2013;47(1):51-57.
- Arora R, Panwar NK, Dhar V. Reason for choosing pediatric dentistry as career-survey among postgraduate dental students. *J Oral Health Comm Dent*. 2011;5(2):86-89.
- Kanmodi K, Badru A, Akinloye A, Wegscheider W. Specialty choice among dental students in Ibadan, Nigeria. *Afr J Health Professions Educ*. 2017;9(1):21-23.
- Oku O, Oku A, Edem B, Edentekhe T, Kalu Q. Specialty choices amongst graduating medical students in University of Calabar, Nigeria: Implications for anaesthesia practice. *Highland Med Res J*. 2014;14(2): 90-94.
- Alrashdan MS, Alazzam M, Alkhader M, Phillips C. Career perspectives of senior dental students from different backgrounds at a single Middle Eastern institution. *BMC Med Educ*. 2018;18(1):283.
- Zarchy M, Kinnunen T, Chang BM, Wright RF. Increasing predoctoral dental students' motivations to specialize in prosthodontics. *J Dent Educ*. 2011;75(9):1236-1243.
- Çelik Ç, Tuncer D. Diş hekimliği fakültesi öğrencilerinde strese neden olan faktörlerin değerlendirilmesi. *Atatürk Üni Diş Hek Fak Derg*. 2016; 25(2):189-194.



Students' preference for dentistry: effective factors and personality analysis

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ABSTRACT

Aims: The aim of this study was to understand the personality traits and occupational preferences of dental students and to evaluate the possible relationships between these two factors.

Methods: In this study, research was conducted on volunteer students studying at Niğde Ömer Halisdemir University Faculty of Dentistry in the 2023-2024 academic year. The research questions and the Eysenck Personality Questionnaire Revised/Shortened Form (EKA-GGK) were administered to the participants through face-to-face interviews. Sociodemographic characteristics, reasons for choosing a profession and personality traits of the students were evaluated.

Results: 20.32% of the participants preferred dentistry because it is a prestigious profession in the society, followed by financial return (18.32%) and job guarantee (14.97%). There was no significant relationship between the results of the Eysenck Personality Scale and the reasons for choosing dentistry as a profession ($p>0.05$). In the study, the neuroticism sub-dimension was found to be significantly higher in female participants than in male participants ($p=0.017$). Extraversion, psychoticism and lying sub-dimensions did not show a significant difference according to variables such as gender, age, number of siblings, mother's education level and income level. However, it was observed that the level of father's education was effective on the extraversion score; children of fathers who graduated from high school had higher extraversion scores compared to children of fathers with secondary school or lower education level ($p=0.045$).

Conclusion: Social status and financial return were the most important reasons for students to choose dentistry, while family desire was less effective. The results of the Eysenck Personality Scale showed that the students were generally emotionally balanced, open to social relationships, compliant with social norms and non-aggressive individuals.

Keywords: Dentistry, dental student, students' preference, personality traits, occupational preferences

INTRODUCTION

Professions in the field of health sciences attract a great deal of attention due to their wide range of job opportunities and the high value society places on these professions.¹ In many countries, especially in developing countries, only a small percentage of the population qualifies for dental education.² In order to be successful in the dental profession, individuals who have strong manual skills, are prone to effective social relations, can communicate effectively with people and have the ability to access up-to-date information continuously are required.³ The process of deciding on a career choice is complex, and choosing a career such as dentistry is no exception. Career choice is personal and can vary depending on one's goals, values, and interests. Salary, working hours, and financial stability can be important factors in career choice. The stability provided by the job and the status in society can be among the factors that shape career choice. The nature of the occupation should be compatible with personal interests and abilities. The difficulty and fulfillment

of the occupation may be influential in the choice. People's desire to interact with other people can influence career choice. Some may prefer to choose a social profession. One's abilities, interests and manual skills may be a determining factor in career choice.^{4,5} Studies investigating the reasons for preferring dental faculties have been conducted especially in developed countries. These studies were conducted in countries such as Denmark, the United Kingdom,^{6,7} North America,⁵ Ireland,⁸ and Kuwait,⁹ as well as in England.¹⁰ Although effective factors have been studied in students choosing the dental profession in Türkiye, personality types have not been analyzed.^{3,11,12} Dental career choices are shaped by interest-based and altruistic motivations in different regions, with some areas emphasizing both the moral and economic aspects of the profession, while others prioritize lifestyle advantages. This study is particularly significant in that it examines the personality factors underlying career choices in specific professional fields like dentistry. While





existing literature often focuses on the motivations behind career choices, this study takes an important step by exploring the potential relationships between personality traits and professional preferences. This approach can facilitate a better understanding of the fundamental factors that influence the process of choosing a career in dentistry.

Although studies in the literature, especially in developed countries, have examined the reasons for choosing the dental profession in detail, these studies mostly focused on motivations for choice and did not adequately examine the relationship between personality traits and occupational preferences. The aim of this study was to understand the personality traits and occupational preferences of dental students and to evaluate the possible relationships between these two factors.

Null Hypothesis (H0)

There is no statistically significant relationship between the personality traits of dental students and their career choices.

METHODS

The study was approved by the Niğde Ömer Halisdemir University Faculty of Medicine Non-interventional Clinical Researches Ethics Committee (Date: 26.12.2023, Decision No: 2023/104). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki. The study was conducted with volunteer students studying at Niğde Ömer Halisdemir University Faculty of Dentistry in the 2023-2024 academic year. The research questions and personality inventory were applied to the participants face to face. Participants were informed about the study. Informed consent was obtained from the participants before the questions to be asked. The first part included questions about the participants' sociodemographic characteristics and reasons for choosing dentistry (Table 1).

Eysenck's Personality Questionnaire Revised/Abbreviated Form (EKA-GGK): Developed by Eysenck, Eysenck and Barrett, the EKA-GGK was adapted into Turkish by Karancı et al.¹³ and permission to use the scale was obtained. The scale consists of four sub-dimensions named extraversion, neuroticism, psychoticism and lying and 24 items. In the scale where each factor is evaluated with 6 items, the participant is asked to respond to 24 questions in the form of yes (1) - no (0). The score for each personality trait varies between 0 and 6. Considering the criteria that a high score in a sub-dimension indicates the dominance in that personality trait, items 5, 7, 10, 17 and 19 in the lying sub-dimension, items 15 and 20 in the extraversion dimension, and items 3, 16 and 22 in the psychoticism sub-dimension were reverse coded. Each sub-personality dimension score was obtained by summing the scores obtained from the questionnaire items forming the relevant dimension (Table 2).

Statistical Analysis

The Shapiro-Wilk test was used to determine whether the variables meet the normality assumption. Median (minimum-maximum) values were given for continuous variables that did not meet the normality assumption. In comparisons between two groups, Mann-Whitney U test

Table 1. Survey form on sociodemographic characteristics and reasons for choosing dentistry

1. Your age:.....
2. Gender:.....
3. Your mother's education level:
a. None
b. Primary school
c. Secondary education
d. University or higher
4. Is your mother alive?
a. Yes
b. No
5. Your father's education level:
a. None
b. Primary school
c. Secondary education
d. University or higher
6. Is your father alive?
a. Yes
b. No
7. How many siblings do you have?
a. 1
b. 2
c. 3 or more
d. None
8. What is your family income level?
a. Low (minimum wage or below)
b. Medium (13,000-50,000)
c. High (51,000 and above)
9. Do you have any systemic diseases?
a. Yes
b. No
10. What is your reason for choosing dentistry? (You can select more than one option)
a. Job security
b. My family's request
c. I believe I am suitable based on my abilities
d. Guidance from teachers
e. Guidance from dentists I know
f. Due to receiving dental treatment
g. It is a prestigious profession in society
h. Financial benefits
i. Comfortable working conditions
j. Other:.....

was used in cases where the normality assumption was not met. Kruskal-Wallis H test was used when the normality assumption was not met in comparisons of three or more groups. The relationship between the sub-dimensions of the scale was examined by Spearman correlation analysis. SPSS (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0) program was used for statistical analysis and $p < 0.05$ (α) was considered statistically significant.



Table 2. Eysenck Personality Test

Please answer each question below by marking 'yes' or 'no'. There are no right or wrong answers, and no trick questions. Respond quickly and avoid spending too much time thinking about the exact meaning of the questions

Does your mood often fluctuate between happiness and unhappiness?
Yes
No
Are you a talkative person?
Yes
No
Does being in debt make you anxious?
Yes
No
Are you a very lively person?
Yes
No
Have you ever been greedy by taking more than your fair share?
Yes
No
Do you use drugs that might have strange or dangerous effects?
Yes
No
Have you ever blamed someone else for something you knew was your own fault?
Yes
No
Do you prefer to follow your own path rather than adhere to rules?
Yes
No
Do you often feel tired of everything?
Yes
No
Have you ever taken something that belonged to someone else (even a pin or button)?
Yes
No
Would you describe yourself as a nervous person?
Yes
No
Do you think marriage is outdated and should be abolished?
Yes
No
Can you easily bring life to a rather dull party?
Yes
No
Are you an anxious person?
Yes
No
Do you tend to stay in the background in social situations?
Yes
No
Does knowing there are mistakes in your work make you worried?
Yes
No
Have you ever cheated in any game?
Yes
No
Do you often complain about your nerves?
Yes
No
Have you ever exploited someone for your own benefit?
Yes
No
Are you mostly quiet when with others?
Yes
No
Do you often feel lonely?
Yes
No
Is it better to follow societal rules than to do what you think is right?
Yes
No
Do others often consider you a very lively person?
Yes
No
Do you always practice what you preach to others?
Yes
No

RESULTS

The mean age of the participants was 19.45 ± 1.30 years, 55.3% were female and 44.7% were male. In the age distribution, 25% were 17-18 years old, 53.9% were 19-20 years old, and 21.1% were 21 years and older. The mother's education level was 38.2% middle school and below, 27.6% high school, 34.2% university; the father's education level was 28.9% middle school and below, 34.2% high school, 36.8% university. All of the mothers and 98.7% of the fathers of the participants were alive. The distribution of the number of siblings was 26.3% single siblings, 36.8% two siblings, 18.4% three siblings, 18.4% four or more siblings. Monthly income was 19.7% low, 69.7% medium, 10.5% high. Systemic diseases were present in 6.6% of the participants (Table 3).

Table 3. Sociodemographic characteristics of individuals participating in the study

Variables	n	%
Age (mean $\pm$ SD)	19.45 $\pm$ 1.30	
Gender		
Female	42	55.3
Male	34	44.7
Age		
17-18	19	25.0
19-20	41	53.9
21-23	16	21.1
Mother's education level		
Middle school or below	29	38.2
High school	21	27.6
University	26	34.2
Father's education level		
Middle school or below	22	28.9
High school		34.2
University	28	36.8
Mother alive		
Yes	76	100.0
Father alive		
Yes	75	98.7
No	1	1.3
Number of siblings		
≤ 1	20	26.3
2	28	36.8
3	14	18.4
≥ 4	14	18.4
Monthly income (TL)		
Low	15	19.7
Medium	53	69.7
High	8	10.5
Systemic disease		
Yes	5	6.6
No	71	93.4

SD: Standard deviation

When the reasons for preferring dentistry were analyzed, it was seen that the statement "It is a prestigious profession in the society" had the highest rate of 20.32%. The second



highest rate belonged to the statement “Financial return”. The rates were “Job guarantee” with 14.97%, “I think I am suitable when I consider my abilities” with 12.83%, “My family’s request” with 9.63%, and “Comfortable working conditions” with 8.56% (Table 4).

Table 4. Reasons why the individuals participating in the study preferred dentistry

Reasons for Preference	n	%
Job guarantee	28	14.97
My family’s request	18	9.63
Considering my abilities, I think I am suitable	24	12.83
Guidance from teachers	4	2.14
Guidance from dentists you know	5	2.67
Due to dental treatment	6	3.21
Being a prestigious profession in the society	38	20.32
Tangible return	36	19.25
Comfortable working conditions	16	8.56
Other	12	6.42

Since the question is multiple choice, it is expressed as a percentage

Eysenck Personality Scale was used in the study. Although the scale has four sub-dimensions, the neuroticism sub-dimension has a minimum score of 0, a maximum score of 6, a median value of 3, a mean of 2.89 and a standard deviation of 1.63. Extraversion sub-dimension has a minimum score of 0 and a maximum score of 6, with a mean of 3.45, a median value of 4 and a standard deviation of 1.90. Psychoticism sub-dimension has a minimum score of 0 and a maximum score of 5, with a mean of 1.66, a median of 1.16 and a standard deviation of 1.16. The minimum score of the lying sub-dimension was 0, the maximum score was 6, the mean was 3.50, the median value was 3 and the standard deviation was 1.59 (Table 5).

Table 5. Descriptive statistics of the scale used in the study

Eysenck Personality Inventory (n=76)	Median	Min	Max	x	SD
Neuroticism	3	0	6	2.89	1.63
Extraversion	4	0	6	3.45	1.90
Psychoticism	2	0	5	1.66	1.16
Lie	3	0	6	3.50	1.59

Min: Minimum, Max: Maximum, x: Mean, SD: Standard deviation

The neuroticism score, which is a sub-dimension of the Eysenck Personality Scale, differed between genders, with females having a higher score ($p=0.017$). Extraversion, psychoticism and lying sub-dimension scores did not differ between genders ($p>0.05$). There was no significant difference between the age distribution of the individuals who participated in the study in terms of neuroticism, extraversion, psychoticism and lying sub-dimensions of the Eysenck Personality Scale ($p>0.05$). It was also determined that the sub-dimensions of the Eysenck Personality Scale did not differ between the mother’s education levels ($p>0.05$). There was a difference between the father’s education levels in terms of the extraversion score, which is a sub-dimension of the Eysenck Personality Scale ($p=0.045$). In the subgroup analyzes, it was determined that the extraversion score of individuals whose fathers had high school education level was higher than individuals whose fathers had secondary school and below education level ($p=0.042$). There was

no significant difference between father education levels in terms of Eysenck Personality Scale sub-dimensions neuroticism, psychoticism and lying scores ($p>0.05$). It was also determined that the Eysenck Personality Scale sub-dimensions did not differ between the distribution of the number of siblings ($p>0.05$). The Eysenck Personality Scale sub-dimensions did not differ according to monthly income levels ($p>0.05$). Since the reasons for preference were stated as multiple choice, it was determined that the Eysenck Personality Scale sub-dimensions did not differ between the distributions determined according to the frequency of the selected answers ($p>0.05$) (Table 6).

Table 6. Comparison of Eysenck Personality Scale sub-dimensions in terms of sociodemographic characteristics

Variables		Neuroticism	Extraversion	Psychoticism	Lie
Gender	Female	3 (0-6)	4 (0-6)	2 (0-5)	4 (0-6)
	Male	2 (0-6)	4 (0-6)	2 (0-3)	3 (0-6)
p value ^a		0.017	0.574	0.799	0.066
Age	17-18	3 (0-6)	4 (0-6)	2 (0-4)	4 (0-6)
	19-20	3 (0-6)	3 (0-6)	2 (0-4)	3 (1-6)
	21-23	2 (0-6)	4 (2-6)	2 (0-5)	3.5 (0-6)
p value ^b		0.203	0.151	0.747	0.999
Mother education level	Middle school and below	3 (0-6)	3 (0-6)	1 (0-5)	4 (0-6)
	High school	2 (0-6)	4 (0-6)	2 (0-4)	3 (0-6)
	University	3 (0-6)	4 (0-6)	2 (0-4)	3 (1-6)
p value ^b		0.484	0.608	0.309	0.345
Father education level	Middle school and below	3 (1-6)	2.5 (0-6)	1.5 (0-5)	4.5 (2-6)
	High school	3 (0-6)	4 (0-6)	2 (0-3)	3 (0-6)
	University	3 (0-6)	4 (0-6)	2 (0-4)	4 (0-6)
p value ^b		0.527	0.045	0.635	0.072
Number of siblings	≤1	2.5 (0-6)	4 (0-6)	2 (0-4)	4 (1-6)
	2	3 (1-6)	3.5 (0-6)	2 (0-5)	3 (0-5)
	3	3 (0-6)	3.5 (1-6)	2 (0-4)	3.5 (1-6)
	≥4	2 (0-6)	4 (0-6)	1.5 (0-4)	4.5 (0-6)
p value ^b		0.379	0.936	0.596	0.249
Monthly income (TL)	Low	2 (0-6)	4 (0-6)	1 (0-3)	4 (1-6)
	Middle	3 (0-6)	4 (0-6)	2 (0-5)	3 (0-6)
	Good	3.5 (2-6)	4 (1-5)	2 (0-4)	3.5 (2-5)
p value ^b		0.084	0.931	0.550	0.295

$p<0.05$ significance level, Variables are given with median (minimum-maximum) values, a: Mann-Whitney U test, b: Kruskal-Wallis H test, TL: Turkish Liras

DISCUSSION

In this study, the reasons for preference and personality characteristics of dental students were analyzed. The null hypothesis (H_0) that there is no statistically significant relationship between the personality traits of dental students and their career choices was accepted. Reasons for choosing the dental profession and perceptions towards the profession have been addressed in various studies in different countries.^{4,17-19} However, there is a limited number of studies on this subject in Türkiye and the personality traits



of students and the possible relationship between these traits and career choice have not been sufficiently investigated.^{3,20-22}

It has been reported that the factors for choosing dentistry as a career may vary among students in different countries and over time.¹⁴ In this study, when the reasons for students to choose dentistry were analyzed, it was observed that the most common motivation was that the profession had a prestigious position in the society. This finding shows that social status and prestige are among the determining factors in choosing the dental profession. In addition, "financial return" ranks second and it is revealed that economic benefit also plays an important role. On the other hand, family desire and working conditions ranked last among the reasons for choice.

Similarly, Mohebbi et al.¹⁶ found that high income level and good social status were among the most common motivations for dental students' career choice. In addition, Hashemipour et al.¹⁴ reported that good income and human relations were important motivators for choosing dentistry. Crosley et al.⁴ emphasized status and security as well as regular working hours, self-employment opportunity and independence among the reasons why dental students prefer this profession. In addition, Siddiqui et al.¹⁸ stated that dentistry is often chosen as an alternative to medical school and factors such as professional satisfaction and career flexibility are among the important motivations. In addition, Du Toit et al.¹⁹ reported that reasons such as maintaining work-life balance thanks to flexible working hours, spending more time for family and supporting those in need were important motivations for choosing the dental profession. When we look at the studies conducted in Türkiye, in the study by Küçükeşmen et al.³ more than half of the students stated that "they wanted to be a physician or dentist, but they entered the faculty of dentistry because of the score ranking in the university entrance exam". In this case, family desire also came to the fore after the score they earned. In this study, family desire came after financial income and social status among the reasons for preference. In the study by Büyükbayraktar et al.²⁰ evaluating the perceptions of dentistry and medical faculty students about their profession, dentistry students considered working conditions as a more important factor than medical faculty students. Köşker et al.²¹ found that young people who chose dentistry as a profession were mostly influenced by their families, and that the presence of a family member working in the health field was especially effective on these preferences. In the study by Ayar et al.,²² the reputation, lifestyle and ease of finding a job were among the prominent reasons for students' motivation to become dentists. A review of the literature reveals that the choice of dentistry as a profession varies depending on the geography, culture, and socioeconomic conditions in which students live.^{9,10,11,16,18}

In this study, no statistically significant relationship was found between the reasons for choosing a profession and the results of the Eysenck Personality Scale ($p > 0.05$). However, when the personality traits of the students were analyzed, it was observed that they scored low to medium in the neuroticism sub-dimension, medium in the extraversion and lying sub-dimensions, and low in the psychoticism sub-dimension. These results suggest that students are generally emotionally balanced, open to social relationships, and empathetic. These characteristics can be considered as a positive result for a patient-oriented profession. Furthermore, Chamberlain et al.²³ found that Conscientiousness was positively correlated

with academic performance, and low Neuroticism combined with high Conscientiousness, particularly its Deliberation facet, strongly predicted professional behavior scores. Another study examining the personality traits of dental professionals within the framework of the big five model evaluated differences among occupational groups. In terms of neuroticism, oral and maxillofacial surgeons had the lowest scores, while general dental practitioners had the highest, with dental nurses falling between these two groups. Moreover, orthodontists and oral and maxillofacial surgeons exhibited lower neuroticism levels compared to dental nurses. However, no specific findings were reported regarding extraversion, as the study primarily focused on neuroticism, conscientiousness, and agreeableness.²⁴ Moreover, the low to moderate neuroticism scores indicate that students are mostly able to cope with stress, although they may have some anxiety tendencies. Additionally, moderate scores in the extraversion and lying sub-dimensions reflect a tendency toward social adaptation and compliance with social norms,²⁵ whereas low psychoticism scores indicate that students are non-aggressive and adhere to norms.

The small sample size may be a reason why no statistically significant relationship was found, which could limit the power to detect potential connections between personality traits and career choice. Consequently, this study, by conducting a thorough analysis of personality factors influencing career choices in a specific professional field like dentistry, can serve as an important reference point for future research. Illuminating the relationships between personality traits and professional preferences may enable the development of more targeted and personalized educational programs and career counseling services.

Studies on dental students in Ireland and the United Kingdom also support these findings. In Ireland, the personality traits of dental students were found to be largely in line with age and gender norms. Among students in the United Kingdom, extraversion scores were higher than expected and neuroticism scores of male students were lower than expected.²⁶ Furthermore, in a study conducted among dental hygienists, it was found that extraverted and less neurotic students had the highest scores in department satisfaction and personality types had a significant effect on department satisfaction and academic achievement.²⁷

In another study, a questionnaire-based method was used to assess the personality styles of students applying to a dental undergraduate program. The Keirsey Temperament Classifier was used to measure students' personality preferences in the dimensions of extraversion, sensing, thinking and judgment. The study confirmed the dominance of the judgmental temperament type. This shows that students generally tend to be organized, planned, responsible and rule-bound.²⁸ In addition, in this study, the neuroticism scores of female students were significantly higher than those of male students ($p = 0.017$). Similarly, in Tatlıhoğlu's study,²⁹ it was found that women had higher emotional instability/neuroticism scores than men. Father's education level created a significant difference in the extraversion sub-dimension, and it was determined that extraversion scores of students whose fathers were high school graduates were higher than those of students whose fathers had secondary school or lower education level ($p = 0.042$). Existing evidence suggests that personality traits are affected by parental attitudes and educational level.^{30,31} In



Yeşilyaprak's study,³⁰ it was found that the mother's education level positively affected the personality structure of female students, but there was no significant relationship between the father's education level and personality traits.

Limitations

The study may have certain limitations regarding the number of participants and their diversity. Particularly in Türkiye, where participants are selected from a single region or university, generalizing the findings to dental students in different geographic or cultural environments may be challenging. To increase statistical power and generalize findings, future studies should aim for a larger and more diverse sample. Expanding the geographic scope of the research can help in understanding cultural and regional differences in career motivation and personality traits.

CONCLUSION

It was observed that the most important reasons for students to prefer dentistry were the social status and financial return provided by the profession. The desire of the family was found to be a less determining factor in preferences. According to the results of the Eysenck Personality Scale, the neuroticism levels of the students were found to be low-moderate, extraversion and lying sub-dimensions were found to be moderate, and psychoticism was found to be low. In other words, it shows that students are generally emotionally balanced, moderately open to social relations, compatible with social norms and far from aggressiveness.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was approved by the Niğde Ömer Halisdemir University Faculty of Medicine Non-interventional Clinical Researches Ethics Committee (Date: 26.12.2023, Decision No: 2023/104).

Informed Consent

All patients 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

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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.

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REFERENCES

1. Çiftçi GE, Bülbül SF, Bayar Muluk N, Çamur Duyan G, Yılmaz A. Sağlık bilimleri fakültesini tercih eden öğrencilerin, üniversite ve meslek tercihlerinde etkili olan faktörler (Kırıkkale Üniversitesi örneği). *Kartal Eğitim Araştırma Hastane Tıp Derg.* 2011;22(3):151-160.
2. Zadik D, Gilad R, Peretz B. Choice of dentistry as a career and perception of the profession. *J Dent Educ.* 1997;61(10):813-816.
3. Küçükşenmen Ç, Kırzioğlu Z. SDÜ Diş Hekimliği Fakültesi Öğrencileri'nin meslek seçiminde etkili olan faktörlerin değerlendirilmesi. *AÜ Diş Hek Fak Derg.* 2012;39(3):117-128.
4. Crossley ML, Mubarik A. A comparative investigation of dental and medical student's motivation towards career choice. *Br Dent J.* 2002; 193(8):471-473.
5. Scarbecz M, Ross JA. Gender differences in first-year dental students' motivation to attend dental school. *J Dent Educ.* 2002;66(8):952-961.
6. Vigild M, Schwarz E. Characteristics and study motivation of Danish dental students in a longitudinal perspective. *Eur J Dent Educ.* 2001; 5(3):127-133.
7. Morris S. What kind of people want to become dentists? General dental council recruitment working party survey of first year undergraduate dental students. *Br Dent J.* 1992;173(4):143-144.
8. Brand AA, Chikte UM, Thomas CJ. Choosing dentistry as a career - a profile of entering students to the University of Sydney, Australia. *Aust Dent J.* 1996;41(3):198-205.
9. Khalaf ME, Abubakr NH, Alenezi H, Ziada H. The motivation and confidence in choosing dentistry as a career amongst dental students: a mixed-methods study. *Eur J Dent Educ.* 2022;26(1):66-75.
10. Niven V, Cabot L, Scambler S, et al. Dentistry as a professional career: the views of London's secondary school pupils (2011-2017). *Br Dent J.* 2022;232(7):396-406. doi:10.1038/s41415-022-4044-x
11. Gökay GD, Görürgöz C, Kılınc A. Effect of morality or capitalist ideology in choosing dentistry as a career in Türkiye: a cross sectional study. *BMC Med Educ.* 2024;24(1):274.
12. Sezer B, Kolay D, Şen Yavuz B, Güneylilgiz Kazaz T, Kargül B. Motivations, attitudes for choosing dental profession and preferred dental specialties amongst Turkish dental students. *Eur J Dent Educ.* 2022;26(2):422-433.
13. Karancı A, Dırık G, Yorulmaz O. Eysenck kişilik anketi-gözden geçirilmiş kısaltılmış formu'nun (EKA-GGK) Türkiye'de geçerlik ve güvenilirlik çalışması. *Türk Psikiyatri Derg.* 2007;18(3):1-8.
14. Hashemipour M. Dental students' motivation for entering dentistry in Kerman School of Dentistry. *Iran J Med Educ.* 2006;6(1):109-115.
15. Khami M, Murtomaa H, Jafarian M, Vehkalahti M, Virtanen J. Study motives and career choices of Iranian dental students. *Med Principles Pract.* 2008;17(3):221-226.
16. Mohebbi SZ, Gholami M, Chegini M, et al. Impact of career choice motivation on academic burnout in senior dental students: a cross-sectional study. *BMC Med Educ.* 2021;21(1):1-8.
17. Knevel RJ, Gussy MG, Farmer J, Karimi L. Nepalese dental hygiene and dental students' career choice motivation and plans after graduation: a descriptive cross sectional comparison. *BMC Med Educ.* 2015;15(1): 219.
18. Siddiqui M, Sultan A, Mehta A, Juneja A. Career intentions, choices, and motivation of undergraduate dental students toward dentistry. *Arch Med Health Sci.* 2022;10(1):136-140.
19. Du Toit J, Jain S, Montalli V, Govender U. Dental students' motivations for their career choice: an international investigative report. *J Dent Educ.* 2014;78(4):605-613.
20. Büyükbayraktar Çoban Z, Ağadayı E, Karahan S. Diş hekimliği ve tıp fakültesi öğrencilerinin diş hekimliği mesleğine yönelik algılarının değerlendirilmesi. *Tıp Eğitim Dünyası.* 2022;21(63):84-94.
21. Köşker P, Demirbaş Kaya A. Öğrencilerin diş hekimliği fakültesini tercih nedenleri ve fakülte ile ilgili ilk izlenimleri. *EÜ Dişhek Fak Derg.* 2014;35(2):32-36.
22. Ayar MK. Sociodemographic characteristics and career decisions of students in dental school of Turkish foundation university. *RJPBCS.* 2017;8(2):1770.
23. Chamberlain TC, Catano VM, Cunningham DP. Personality as a predictor of professional behavior in dental school: comparisons with dental practitioners. *J Dent Educ.* 2005;69(11):1222-1237.
24. Adam N, Barber S, Gray-Burrows K, Bates C, Shah R, Hodge T. Personality differences in dental professionals: a cross-sectional survey. *Am J Orthod Dentofacial Orthop.* 2023;164(6):868-878.
25. Headey B. EPI (Eysenck Personality Inventory) Neuroticism Scale. In: Maggino, F. (eds) Encyclopedia of Quality of Life and Well-Being. Research. Springer, Cham. 2023. doi:10.1007/978-3-031-17299-1_905
26. Fenlon MR, McCartan BE, Sheriff M, Newton TJ. Personality of dental students in two dental schools in the United Kingdom and in Ireland. *Eur J Dent Educ.* 2021;5(4):173-176.
27. Kim C-S, Cheon S-H, Cho M-S. The relationship between the personality types and satisfaction of education in dental hygiene students. *J Korean Soc Dent Hygiene.* 2014;14(6):943-949.
28. Morris DO. Personality types of dental school applicants. *Eur J Dent Educ.* 2000;4(3):100-107.
29. Tatlıoğlu K. Üniversite öğrencilerinin beş faktör kişilik kuramı'na göre kişilik özellikleri alt boyutlarının bazı değişkenlere göre incelenmesi. *Tarih Okulu Derg.* 2014;7(XVII):939-971.
30. Yeşilyaprak B. Kişilik gelişiminde aile faktörlerinin etkisine ilişkin bir araştırma. *Sosyal Politika Çalış Derg.* 1993;3(3):1.
31. Kaya M. Ailede anne-baba tutumlarının çocuğun kişilik ve benlik gelişimindeki rolü. *Ondokuz Mayıs Üni İlahiyat Fak Derg.* 1997;9(9): 193-204.



Knowledge level and clinical approaches of dentists in Türkiye on controlled extraction of poorly prognosed permanent first molars

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ABSTRACT

Aims: This pilot study aims to evaluate the level of knowledge and clinical approaches of general dentists and dentists with different specialties in Türkiye about the controlled extraction of young permanent first molars (PFM) with poor prognosis in children.

Methods: The survey study consisted of 23 questions measuring the demographic data of dentists, dentists' opinions and information needs about the controlled indications and extraction criteria of PFM teeth. The survey questions were administered online via Google Form on a voluntary basis. Shapiro Wilk's, Kolmogorov Simirnov and Kruskal-Wallis H tests were used for statistical analysis of the parameters.

Results: A total of 261 dentists participated in the present survey study, including 48 pediatric dentists, 11 orthodontists, 12 oral and maxillofacial surgeons, 34 dentists with a different specialty and 156 general dentists. 93.1% of the participants stated that they considered controlled extraction of PFM teeth in children at the ideal age range as a treatment method. The ratio of all dentists practicing controlled extraction as a treatment in children was 52.11%. It was observed that dentists, except pediatric dentists and orthodontists, had a low level of knowledge about compensation and balancing extractions. The average knowledge score was 6.08 (out of 9) in terms of the answers given to the questions regarding the level of knowledge. Pediatric dentists and orthodontists had the highest knowledge score, while general dentists and oral and maxillofacial surgeons had the lowest knowledge score.

Conclusion: It was determined that general dentists considered controlled extraction of PFMs as a treatment method but preferred to refer the patient to pediatric dentists or orthodontists at the point of application. Pediatric dentists and orthodontists had higher knowledge scores regarding controlled extraction. The ratio of dentists who thought that the subject of controlled extraction was not sufficiently covered in undergraduate or graduate courses and that there was a lack of guideline on this subject was quite high.

Keywords: Permanent first molar, controlled extraction, pediatric dentist, survey

INTRODUCTION

The eruption of permanent first molars (PFM) is the first step in the transition to permanent dentition and guides the eruption of subsequent teeth.¹ Although PFM teeth play a key role in occlusion, they have been reported to be the most caries-prone teeth in permanent dentition.²⁻⁴ Other genetic factors such as their anatomical structure including deep pits and fissures, incomplete tooth brushing habits of children due to the age range in which this tooth erupts, neglect of this tooth by parents thinking that it is a deciduous tooth, eruption before mineralization is completed, long-term adjacent to deciduous teeth, its position in the infraocclusion at the posterior of the arch and molar incisor hypomineralization (MIH) cause these teeth to become susceptible to caries.⁵⁻⁷ It is a very challenging process to treat these teeth that decay at an early age, especially before the root development is completed.

In PFM teeth with excessive loss of, crown destruction extraction may be the last treatment option when restoration becomes impossible.⁸⁻¹⁰ However, uncontrolled extractions performed on PFM teeth during the growth and development period may cause mesial or distal contact tooth to fall into the extraction cavity, displace and elongate in the opposite posterior direction, and unilateral extractions may lead to midline deviation, skeletal and dental asymmetry, unilateral chewing habits and consequently temporomandibular joint disorders.¹¹

At the right time and in the appropriate occlusion, the treatment applied for the formation of a new and near-ideal occlusion in the future by extracting the contralateral PFM tooth adjacent to the PFM tooth and/or the contralateral PFM tooth in the same arch; Demir et al.¹² called it 'controlled





extraction', Dastori et al.¹³ called it 'enforced extractions of first permanent molars or EExPFMs', Royal College of Surgeons of England Guideline¹⁴ called it 'extraction of permanent molars with poor prognosis'. We considered this procedure as a general title 'controlled extraction of poor prognosis permanent first molars or CExpPFS'. In controlled PFM extractions, the goal is to move the permanent second molars (PSM) mesial in parallel and to ensure that they make contact with the second premolar.¹⁵ Controlled extraction guidelines may recommend the extraction decision for other PFM teeth with or without caries in appropriate cases.¹² Since it is not possible for every dentist to access expert consultation in clinical routine, dentists may hesitate when making extraction decisions. In addition, the accumulation of data on this subject in the literature is based on retrospective studies and there may be differences of opinion today. The aim of this survey study is to raise awareness of the issue by evaluating the level of knowledge and clinical approaches of general dentists and specialist dentists regarding the controlled extraction of young permanent PFM with poor prognosis in children.

METHODS

This study was conducted within the scope of Dicle University Faculty of Dentistry Ethics Committee (Date: 26.04.2023, Decision No: 2023-17). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki. A 23-question survey was designed to evaluate the level of knowledge and clinical approaches of dentists in Türkiye regarding the CExpPFM teeth. The survey included 8 questions on demographic data and 14 questions on the criteria and indications for CExpPFM teeth as well as their knowledge requirements about these extractions. The survey form was modeled after questions that have been previously administered on a similar topic and proven to be valid.^{12,13,16,17} We aimed to evaluate the specialty knowledge scores of the participating dentists through questions^{9,10,12-16,18,19} regarding the level of knowledge in the present study. National clinical guidelines for the extraction of PMS in children were used as a guide for this assessment.^{10,14,18,19} In the present study was conducted online via Google Form among dentists in the fields of pediatric dentistry, orthodontics, oral and maxillofacial surgery, other specialties and general dentists working in dental faculties, oral and dental health hospitals, private dental clinics in Türkiye. Incomplete survey and participants whose consent was not obtained at the beginning of the survey were not included in the study. The questions in the survey form consisted of multiple-choice questions and questions that could be answered by marking on checkboxes.

Statistical Analysis

Data evaluation: The data obtained in this study were analyzed with the licensed IBM SPSS version 21 (IBM SPSS Statistics, Armonk, NY) package program. Descriptive statistics related to the parameters were evaluated. Shapiro Wilk's' and/or Kolmogorov Smirnov tests were used to investigate whether the variables were from normal distribution due to the number of units. While interpreting the results, 0.05 was used as the significance level; in case of $p < 0.05$, it is known that the variables do not come from a normal distribution, and in case of $p > 0.05$, it is known that the variables come from a normal distribution. When

examining the differences between the groups, Kruskal-Wallis H test was used in case the variables did not come from a normal distribution. In case of significant differences in the Kruskal-Wallis H test, post-Hoc multiple comparison test was used to compare the groups with differences. While interpreting the results, 0.05 was used as the significance level and it was stated that there was a significant difference in case of $p < 0.05$ and there was no significant difference in case of $p > 0.05$.

RESULTS

Of the 261 survey participants, 57.85% were female and 42.15% were male dentists. Of the participating dentists, 59.39% had a professional experience of 1-5 years, 18.77% had a professional experience of 6-10 years, and 21.84% had a professional experience of 11 years or more. According to their titles; 155 general dentists, 28 specialist dentists, 51 research assistants, 18 assistant professors, 6 associate professors and 3 professors participated in the present study. Of the participants, 156 were general dentists and 105 were specialists. Of the specialists, 48 were working in pediatric dentistry, 11 in orthodontics, 12 in oral and maxillofacial surgery, and 34 in one of the other specialties.

It was stated that 80.08% of the participants were aware of the concept of CExpPFM teeth. 93.1% of the participants said that they considered CExpPFM teeth in the ideal age range as a treatment method. The percentage of physicians who thought that the cavity created by the controlled extraction of young PFM teeth at the ideal age range could be closed by the PSM tooth was 87.36%. The ratio of dentists who applied controlled extraction of PFM teeth as a treatment in children was 52.11%. In the multiple-choice question 12, which asks about the factors that determine the indication when deciding to extract a PFM tooth. (-age -cooperation -oral hygiene and DMFT -conservative, restorative, excessive crown destruction such that prosthetic treatments cannot be applied - periodontal or endodontic problems - presence of apical pathology - severity of dental pain - presence of molar-incisor hypomineralization - socioeconomic status - tooth alignment or crowding - planned orthodontic treatment - presence and stage of development of PSM and permanent third molars (PTM) - existing malocclusion - all), 45.38% of the respondents chose 'All' and answered this question correctly according to the controlled extraction guidelines of PFM teeth.^{14,19} Dentists stated that the most important factors affecting the indications for PFM extraction in children were the age of the patient and the presence of excessive crown destruction to the extent that conservative, restorative and prosthetic treatments could not be applied later on. When we asked the participants about the ideal timing for controlled extraction of PFMs, 76.25% of the dentists indicated that this period is between 8-10 years of age. However, according to the Nolla classification,¹ the ideal extraction time of PFM teeth, when the 6th stage is over and the 7th stage is not yet completed, was marked at a low rate by non-specialized dentists (26.92%) except pediatric dentists and orthodontists. Except for stage 7, the other stages were marked by 51.48%. The question 'In which jaw do you think the appropriate age interval timing is more critical when performing controlled tooth extraction in PFMs?' was answered by 79.31% of the participants as mandible. 73.56% of the



respondents reported that the presence of the DBA tooth germ influenced their decision to plan controlled extraction. 53.26% of the physicians stated that they had an opinion about compensation and balancing extractions. 50.57% of the participants reported that in a case in which they planned a compensation extraction; the presence of the tooth to be compensated in the maxilla positively affected the extraction decision. In the multiple-choice question 18, in which we asked what influenced the extraction decisions when planning the compensation and balancing extractions of PFM teeth in the presence of favorable conditions (a. The prognosis of the tooth included in the compensation or balancing extraction affects my extraction decision. b. Whether the tooth to be extracted is in the mandible or maxilla affects my decision to perform compensation extraction. c. The presence/absence of crowding affects my decision to perform balancing extraction. d. The presence of class 3 malocclusion affects my decision to perform compensation and balancing extraction. e. All). 63.11% of the dentists marked on the 'all' option. In the 20th question regarding the indication options, we presented to the dentists in the presence of severe caries and excessive loss of material in only one of the PFMs of a healthy 9-year-old male patient, the treatment attitude of the dentists, except for orthodontists and pediatric dentist, in PFM teeth was "consulting an orthodontist or pediatric dentist". Most of the dentists participating in the study think that the subject of controlled extraction of PFM teeth is not sufficiently covered in undergraduate or graduate courses. Almost all of the dentists stated that they needed more information about controlled extraction of PFM teeth (Table 1).

The mean knowledge score was 6.08 (out of 9) in terms of the answers given to the questions regarding the level of knowledge (Table 2). There is a statistically significant difference between the specialties of dentists in Türkiye in terms of knowledge score on PFM controlled extraction ($p < 0.05$). The knowledge score of non-specialists was significantly lower than all specialists. Among the specialists, pediatric dentists and orthodontists have the highest knowledge score and oral and maxillofacial surgeons have the lowest knowledge score (Table 3).

DISCUSSION

When the literature on controlled extraction of PFMs was reviewed, it was observed that there were not enough survey studies with this scope and variety of questions and there were very few studies evaluating the knowledge levels of dentists regarding controlled extraction guidelines.^{12,13,16} Therefore, it is thought that the results of the present survey study will contribute to the literature.

There is no guideline on controlled extraction protocol by The American Academy of Pediatric Dentistry (AAPD) yet.¹³ The Royal College of Surgeons of England published their guidelines on controlled extraction in 2009 and updated them in 2014.¹⁴ According to the present survey results, the treatment approach to controlled extraction showed great differences between general and specialist dentists. In Türkiye, there are no guidelines yet on whether this condition should be managed by a pediatric dentistry specialist or a general dentist.

Eighty percent of the dentists surveyed stated that they had knowledge about controlled extraction. In the survey conducted by Dastouri et al.¹³ in the United Arab Emirates, this rate was 68.9%. It was thought that the participation of more specialist dentists (40%) in the present survey made a difference compared to similar survey results. In the survey of Dastouri et al.,¹³ 74.2% of the dentists reported that they did not practice controlled tooth extraction in the clinic. In the present survey, 50.2% of the dentists practiced controlled extraction. Similar to the study conducted in the United Arab Emirates, it was observed that pediatric dentists practiced controlled extraction more frequently.

Dastouri et al.,¹³ asked whether the age of the child affected the decision to indicate extraction of a PFM tooth and 62.8% answered 'Yes'. Demir et al.¹² reported that 93.7% of dentists stated that patient age affected their treatment choices. According to the present survey, the most important factors affecting the indication for extraction by dentists were 'patient age' and the presence of 'crown destruction so severe that conservative, restorative and prosthetic treatments of PFM cannot be applied', while the least influential factors were 'severity of dental pain' and 'presence of MIH'. One of the important factors affecting the incidence of caries in PFM teeth is MIH, which has a global prevalence of approximately 13%.²⁰ There are guidelines indicating that extraction of PFM teeth severely affected by MIH may be a good treatment alternative.^{10,14,19,21} In question 12 of the survey, 26.15% of the physicians stated that the presence or absence of MIH in this tooth would affect their indications when deciding to extract a PFM tooth.

In a meta-analysis, 39 maxillary PFM teeth extracted at the ideal time had 72% excellent gap closure and 80% better spontaneous closure in upper jaw extractions performed at 8-10.5 years of age. In a pooled analysis of 489 mandibular PFM teeth, it was reported that 48% had good to excellent gap closure when extracted at the ideal stage and 50% better spontaneous closure was obtained in mandibular extractions performed at 8-10.5 years of age.¹⁸ In the survey of Dastouri et al.,¹³ 61% of dentists knew the ideal extraction timing. In the present survey, 87.6% of dentists reported that the appropriate age range for CExpPFMs is 8-10.5 years. However, according to the Nolla classification¹ the ideal extraction time of PFM teeth, when stage 6 is over and stage 7 is not yet completed, was marked by a very low percentage of general dentists (26.92%), except for pediatric dentists and orthodontists.

Gill et al.²² reported that with controlled extraction of PFM teeth at the appropriate time, the PFM tooth can move to mesial and establish an ideal contact relationship with the second premolar. Farrokhi et al.¹⁶ reported that all pediatric dentists and 90% of orthodontists thought that when PFM teeth were extracted according to an appropriate treatment plan, they could be replaced by PFM teeth. Similarly, in the present survey, all pediatric dentists and 91.5% of orthodontists made markings. It was concluded that the age range that pediatric dentists and orthodontists are interested in, the chance to follow the patients, the fact that their knowledge about the eruption times and development of teeth remains up to date, and the inclusion of this subject in their specialty training are effective in this result.

Teo et al.²³ reported that the mesial angulation of the PFM teeth and the presence of a PTM were more influential on



Table 1. Frequency distribution table of the answers given to the survey questions according to specialization areas responses to the (survey percentages of “yes” answers are given)

		Pediatric dentistry		Orthodontics		Oral and maxillofacial surgery		Other specialty		General dentistry		Total	
		n	%	n	%	n	%	n	%	n	%	n	%
Are you familiar with the concept of CExpPFM?	Yes	46	95.83	10	90.91	11	91.67	28	82.35	114	73.08	209	80.08
	No	2	4.17	1	9.09	1	8.33	6	17.65	42	26.92	52	19.92
	Total	48	100	11	100	12	100	34	100	156	100	261	100
Do you consider CExpPFM at the ideal age as a treatment?	Yes	48	100	11	100	11	91.67	32	94.12	141	90.38	243	93.1
	No	0	0	0	0	1	8.33	2	5.88	15	9.62	18	6.9
	Total	48	100	11	100	12	100	34	100	156	100	261	100
Do you think that the space created by CExpPFM teeth in the ideal age range can be closed by the PSM teeth?	Yes	48	100	10	90.91	10	83.33	31	91.18	129	82.69	228	87.36
	No	0	0	1	9.09	2	16.67	3	8.82	27	17.31	33	12.64
	Total	48	100	11	100	12	100	34	100	156	100	261	100
Have you used CExpPFM teeth in children as a treatment?	Yes	43	89.58	5	45.45	1	8.33	8	23.53	79	50.64	136	52.11
	No	5	10.42	6	54.55	11	91.67	26	76.47	77	49.36	125	47.89
	Total	48	100	11	100	12	100	34	100	156	100	261	100
Which of the following influences your indication when deciding to extract a PFM tooth in children (Multiple selection allowed)?	Other answers	10	20.83	5	45.45	7	58.33	16	47.06	102	65.38	140	53.64
	All of them	38	79.17	6	54.55	5	41.67	18	52.94	54	34.62	121	46.36
	Total	48	100	11	100	12	100	34	100	156	100	261	100
Which of the following do you think is the appropriate age range for controlled extraction of PFMs?	<8	2	4.17	1	9.09	4	33.33	4	11.76	27	17.31	38	14.56
	8-10.5	46	95.83	10	90.91	8	66.67	28	82.35	107	68.59	199	76.25
	>11	0	0	0	0	0	0	2	5.88	22	14.1	24	9.2
	Total	48	100	11	100	12	100	34	100	156	100	261	100
According to the Nolla classification you see below, which stage of furcation development of the PFM tooth would you consider to be the ideal extraction time for PFM teeth?	Other stages	9	18.75	3	27.27	5	41.67	23	67.65	114	73.08	154	59
	6 th and 7 th stages	39	81.25	8	72.73	7	58.33	11	32.35	42	26.92	107	41
	Total	48	100	11	100	12	100	34	100	156	100	261	100
In which jaw do you think the timing of the appropriate age range is more critical when performing CExpPFMs?	Mandibula	40	83.33	9	81.82	9	75	30	88.24	119	76.28	207	79.31
	Maxilla	8	16.67	2	18.18	3	25	4	11.76	37	23.72	54	20.69
	Total	48	100	11	100	12	100	34	100	156	100	261	100
Does the presence of a PTM tooth germ affect your decision to plan CExpPFM teeth?	Yes	43	89.58	10	90.91	6	50	28	82.35	105	67.31	192	73.56
	No	5	10.42	1	9.09	6	50	6	17.65	51	32.69	69	26.44
	Total	48	100	11	100	12	100	34	100	156	100	261	100
Do you have any idea about compensation (opposite arch PFM extraction) and balance (symmetrical arch PFM extraction) extractions in controlled tooth extraction?	Yes	43	89.58	8	72.73	9	75	14	41.18	65	41.67	139	53.26
	No	5	10.42	3	27.27	3	25	20	58.82	91	58.33	122	46.74
	Total	48	100	11	100	12	100	34	100	156	100	261	100
Compensation and balancing of PFM teeth will be performed if there are suitable conditions. Which of the following will influence your decision (Multiple choices allowed)?	Other answers	6	12.5	4	36.36	6	50	11	32.35	76	48.72	103	39.46
	All of them	42	87.5	7	63.64	6	50	23	67.65	80	51.28	158	60.54
	Total	48	100	11	100	12	100	34	100	156	100	261	100
In a case where you are planning to perform a compensation extraction (extraction of the opposite arch PFM tooth); in which jaw will the tooth you will extract for compensation be located, which will positively affect your compensation extraction decision?	Mandibula	19	39.58	5	45.45	4	33.33	15	44.12	86	55.13	129	49.43
	Maxilla	29	60.42	6	54.55	8	66.67	19	55.88	70	44.87	132	50.57
	Total	48	100	11	100	12	100	34	100	156	100	261	100
Which of the following would be your extraction decision for a healthy 9-year-old male patient with severe caries and excessive loss of material in only one of the PFMs?	I'll consult an orthodontist or a pediatric dentist	5	10.42	3	27.27	7	58.33	19	55.88	73	46.79	107	41
	I plan endodontic and restorative treatment of a PFM tooth with severe caries when other PFMs are healthy	16	33.33	2	18.18	2	16.67	11	32.35	54	34.62	85	32.57
	I only plan to extract the PFM tooth with severe decay	7	14.58	2	18.18	2	16.67	2	5.88	19	12.18	32	12.26
	With a PFM tooth with severe caries, I also plan compensation and balancing extractions in the presence of favorable conditions	20	41.67	4	36.36	1	8.33	2	5.88	10	6.41	37	14.18
	Total	48	100	11	100	12	100	34	100	156	100	261	100
Do you think that the subject of CExpPFM teeth is sufficiently covered in your undergraduate or graduate dentistry courses?	Yes	17	35.42	3	27.27	1	8.33	3	8.82	22	14.1	46	17.62
	No	31	64.58	8	72.73	11	91.67	31	91.18	134	85.9	215	82.38
	Total	48	100	11	100	12	100	34	100	156	100	261	100
Do you think there is a lack of guideline on CExpPFM teeth?	Yes	40	83.33	8	72.73	9	75	29	85.29	120	76.92	206	78.93
	No	8	16.67	3	27.27	3	25	5	14.71	36	23.08	55	21.07
	Total	48	100	11	100	12	100	34	100	156	100	261	100
Do you think you need more information about CExpPFM teeth?	Yes	42	87.5	10	90.91	11	91.67	34	100	145	92.95	242	92.72
	No	6	12.5	1	9.09	1	8.33	0	0	11	7.05	19	7.28
	Total	48	100	11	100	12	100	34	100	156	100	261	100

CExpPFM: Controlled extraction of permanent first molars with poor prognosis, PFM: Permanent first molars, PSM: Permanent second molars, PTM: Permanent third molars

**Table 2. Frequency distribution table regarding the level of knowledge of dentists in Turkiye about CExpPFM**

	n	Mean	Median	Min	Max	SD
Knowledge level of dentists in Turkiye on CExpPFMs	261	6.08	6	2	9	1.71

CExpPFM: Controlled extraction of permanent first molars with poor prognosis, Min: Minimum, Max: Maximum, SD: Standard deviation

Table 3. Differences in the level of knowledge of dentists in Turkiye about CExpPFM according to their specialty

	The level of knowledge of dentists in Turkiye on CExpPFMs						Kruskal-Wallis H test		
	n	Mean	Median	Min	Max	SD	Mean rank	H	p
Pediatric dentistry	48	7.77	8	5	9	0.97	206.79	78.322	0.001
Orthodontics	11	7	7	4	9	1.61	170.45		
Oral and maxillofacial surgery	12	5.83	6	2	8	1.9	117.33		
Other specialty	34	6.47	6.5	3	9	1.4	143.43		
General dentistry	156	5.43	5	2	9	1.54	101.73		
Total	261	6.08	6	2	9	1.71	5-4 5-2 5-1 4-1 3-1		

CExpPFM: Controlled extraction of permanent first molars with poor prognosis, Min: Minimum, Max: Maximum, SD: Standard deviation

the spontaneous closure of the extraction cavity than the developmental stage of the PFM tooth. The force generated by the developing PTM tooth may help the PFM tooth to close the extraction cavity.²² In the survey of Demir et al.,¹² 64.4% of the respondents checked the presence of a PTM tooth when deciding on controlled extraction. In the present survey, this rate was similar with 73.56%.

In the study by Farrokhi et al.,¹⁶ 70% of pediatric dentists and less than 50% of other specialists answered the question "If appropriate conditions are present, balancing and compensatory extraction of PFM teeth can be performed to maintain occlusal relationship and symmetrical dental arch. In present survey, 89.6% of pediatric dentists and 41.7% of general dentists stated that they had an opinion.

In Farrokhi et al.'s¹⁶ survey, all orthodontists and pediatric dentist marked that the overall and long-term prognosis of the PFM teeth, and the type of underlying malocclusion were important in deciding whether to perform compensatory or compensatory extraction of PFMs. In present survey, most of the dentists stated that the prognosis of the tooth and the indications for Class III malocclusion were important.

Teo et al.²³ stated that extraction timing alone is not sufficient for gap closure, especially in the lower jaw. Hallet et al.²⁴ found that in patients with Angle class I skeletal bite and buccal segment crowding, the most favorable closure occurred in the lower jaw. In another study, it was reported that following the extraction of the PFM tooth in the maxilla, the PSM tooth achieved a good occlusal position, while the occlusal result in the lower jaw was more variable and less predictable.²⁵ Therefore, the timing of extraction of PFM teeth becomes more important in the mandible.²⁶ In present study, it was determined that the majority of dentists answered this question correctly according to the controlled extraction guidelines.

According to Demir et al.,¹² 96% of physicians think that "The PFM of the maxilla is over-erupted" after the extraction of the PFM of the mandibula. Farrokhi et al.¹⁶ reported that 70% of pediatric dentists, 30% of orthodontists, and 12.5% of oral and maxillofacial surgeons stated that if mandatory extraction of the mandibular PFM tooth is required, compensation extraction of the maxillary PFM tooth should be performed. In present survey, half of the dentists reported that the fact that the tooth to be extracted for compensation

was in the maxilla positively affected the decision for compensation extraction.

Taylor et al.¹⁷ reported that 30.2% of general dentists were in favor of consulting pediatric dentists for treatment planning of PFM teeth with poor prognosis. Dastouri et al.,¹³ 89.9% said they would consult/refer to other specialists. In present survey, this rate was 46.76% in general dentists and 55.88% in oral and maxillofacial surgeons.

As a result of the statistical analysis of in present survey study, the mean knowledge score was determined as 6.08 (out of 9). In the study by Farrokhi et al.,¹⁶ in which they determined the knowledge level scores among dental specialists only, pediatric dentist had the highest knowledge level and endodontists, and maxillofacial surgeons had the lowest knowledge level. In Turkiye, knowledge scores were highest among pediatric dentist and orthodontists and lowest among general dentists and oral and maxillofacial surgeons.

The question "Do you think you need more information about CExpPFM teeth?" was answered yes by almost all of the physicians. Demir et al.¹² received 'yes' answer from 87.1% of the participants in their similar question. As a result of these data, it was observed that the subject of controlled extraction should be included more in the undergraduate and postgraduate education of dentists. However, respondents did not show sufficient interest in the survey and refrained from answering the survey, which resulted in a lower than targeted sample size in some specialization areas.

CONCLUSION

It was observed that pediatric dentists and orthodontists are more likely to apply the application protocol and have more knowledge on this subject. It was determined that there is not yet a consensus on compensation and balancing extraction, which the guidelines recommend in certain scenarios. It was seen that a reliable, precise and evidence-based template should be established on this subject.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission Dicle University Faculty of Dentistry Ethics Committee (Date: 26.04.2023, Decision No: 2023-17).



Informed Consent

Informed consent was obtained from all patients participating in the study.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

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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

- Nolla CM. The development of the permanent teeth. *J Dent Child*. 1960; 27:254-266.
- Ong DC, Bleakley JE. Compromised first permanent molars: an orthodontic perspective. *Aust Dent J*. 2010;55(1):2-14.
- Al-Samadani KH, Ahmad MS. Prevalence of first permanent molar caries in and its relationship to the dental knowledge of 9-12-year-olds from jeddah, kingdom of Saudi Arabia. *ISRN Dent*. 2012;2012:391068.
- Thaker BA, Dave BH, Thaker A, Shah SS, Chari DN. The prevalence and severity of dental caries in permanent molars amongst 8-10 years of children in Vadodara, Gujarat: an epidemiological study. *Adv Hum Biol*. 2021;11(Suppl 1):99-105.
- Songur F, Simsek Derelioglu S, Yilmaz S, Koşan Z. Assessing the impact of early childhood caries on the development of first permanent molar decays. *Public Health Front*. 2019;7:448094.
- Wang J-D, Chen X, Frencken J, Du M-Q, Chen Z. Dental caries and first permanent molar pit and fissure morphology in 7-to 8-year-old children in Wuhan, China. *Int J Oral Sci*. 2012;4(3):157-160.
- Lynch RJ. The primary and mixed dentition, post-eruptive enamel maturation and dental caries: a review. *Int Dent J*. 2013;63(Suppl 2):3-13.
- Williams J, Gowans A. Hypomineralised first permanent molars and the orthodontist. *Eur J Pediatr*. 2003;4(3):129-132.
- Alkhadra T. A systematic review of the consequences of early extraction of first permanent first molar in different mixed dentition stages. *J Int Soc Prev Community Dent*. 2017;7(5):223-226.
- Cobourne M, Williams A, Harrison M. National clinical guidelines for the extraction of first permanent molars in children. *Br Dent J*. 2014; 217(11):643-648.
- Kiraz M, Yüksel BN, Sarı Ş. Daimi birinci büyük azı dişlerinin kontrollü çekimleri: derleme. *Acta Odontol Turc*. 2018;35(2):56-61.
- Demir P, Aydoğdu H, Sar IŞ. Knowledge, attitude and clinical practice of dentists about extraction of first permanent molars. *J Clin Pediatr Dent*. 2022;46(1):12-19.
- Dastouri M, Kowash M, Halabi M, Salami A, Khamis A, Hussein I. United Arab Emirates dentists' perceptions about the management of broken down first permanent molars and their enforced extraction in children: a questionnaire survey. *Eur Arch of Paediatr Dent*. 2019;21(1): 31-41.
- Cobourne MT, Williams A, McMullen R. A guideline for the extraction of first permanent molars in children. Royal College of Surgeons of England Guideline. 2014a RCSEng (Royal College of Surgeons of England). 2014. <https://www.rcseng.ac.uk/-/media/files/rcs/fds/publications/a-guideline-for-the-extraction-of-first-permanent-molars-in-children-rev-sept-2014.pdf>. Accessed 15 December 2024.
- Albadri S, Zaitoun H, McDonnell S, Davidson L. Extraction of first permanent molar teeth: results from three dental hospitals. *Br Dent J*. 2007;203(7):E14.
- Farrokhi F, Pakshir H, Karandish M, Askarin M. Design of a knowledge evaluation questionnaire for dental specialists on preservation and extraction indications of the first permanent molars. *J Dent*. 2022;23(1): 20-28.
- Taylor GD, Pearce KF, Vernazza CR. Management of compromised first permanent molars in children: cross-sectional analysis of attitudes of UK general dental practitioners and specialists in paediatric dentistry. *Int J Paediatr Dent*. 2019;29(3):267-280.
- Eichenberger M, Erb J, Zwahlen M, Schätzle M. The timing of extraction of non-restorable first permanent molars: a systematic review. *Eur J Paediatr Dent*. 2015;16(4):272-278.
- Lakhani S, Noble F, Rodd H, Cobourne MT. Management of children with poor prognosis first permanent molars: an interdisciplinary approach is the key. *Br Dent J*. 2023;234(10):731-736.
- Schwendicke F, Elhennawy K, Reda S, Bekes K, Manton DJ, Krois J. Global burden of molar incisor hypomineralization. *J Dent*. 2018;68:10-18.
- Ashley P, Noar J. Interceptive extractions for first permanent molars: a clinical protocol. *Br Dent J*. 2019;227(3):192-195.
- Gill D, Lee R, Tredwin C. Treatment planning for the loss of first permanent molars. *Dent update*. 2001;28(6):304-308.
- Teo TK, Ashley PF, Derrick D. Lower first permanent molars: developing better predictors of spontaneous space closure. *Eur J Orthod*. 2016;38(1):90-95.
- Hallett G, Burke P. Symmetrical extraction of first permanent molars. Factors controlling results in the lower arch. *Trans Eur Orthod Soc*. 1961:238-255.
- Plint DA. The effect on the occlusion of the loss of one or more first permanent molars. Report of the congress *Eur Orthod Soc*. 1970:329-336.
- Crabb JJ, Rock WP. Treatment planning in relation to the first permanent molar. *Br Dent J*. 1971;131(9):396-401.



Hydrogel in dentistry

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ABSTRACT

Hydrogels have a polymeric structure that can hold water in their three-dimensional networks thanks to their hydrophilic structure. Hydrogels have the capacity to hold water or biological fluids, have a structure similar to living tissues, and have the ability to swell and shrink under various effects. They have also become a popular material used in the health field due to their biocompatibility. In addition, providing the desired functionality, being recyclable and sterilizable are the positive aspects of this material. Due to these positive features, hydrogels are considered a material worth working on because they are suitable for dentistry practice. Therefore, various studies have been conducted with hydrogels due to the need for biocompatible materials in dentistry. These studies have also shown that they have found an area of use in dentistry as in the medical world and have provided useful developments. This review aims to examine the studies conducted with hydrogels in terms of dentistry.

Keywords: Smart, hydrogel, dentistry

INTRODUCTION

A hydrogel is a three-dimensional polymer network consisting of synthetic or natural materials that has a high-water content and a high degree of elasticity. They are an ideal material for a range of applications because they have a soft rubbery consistency comparable to real tissues and can hold significant amounts of water or biological fluids under physiological conditions. In order to treat or replace tissues and organs, or to interact with the biological system of living tissues, hydrogels must possess specific features, such as the required functionality, reversibility, sterilizability, and biocompatibility.¹⁻³

The first synthetic hydrogel was developed by Wichterle and Lim in 1954.⁴ The first use in the biomedical field dates back to the 1960s, when cross-linked polyhydroxyethyl methacrylate (PHEMA) was developed by Wichterle and Lim and later patented as a soft contact lens.⁵

Most dental applications, including the treatment of periodontitis, the restoration of endodontic pulp-dentin complexes, and general tooth regeneration, need the use of biomaterials. The potential for soft biomaterials like hydrogels to function as a matrix for encasing cells exists. To work in the tooth structure, the hydrogel must have the proper anatomical size and form.⁶

The aim of this review is to provide an overview of the use of hydrogel, a current biomaterial, in dentistry.

CLASSIFICATION OF HYDROGELS

Polymeric hydrogels can be classified depending on their preparation method, ionic charge, physical structure and cross-linking status.⁷ This classification is shown schematically.

According to preparation method;

- Homopolymer hydrogels
- Copolymer hydrogels
- Multipolymer hydrogels
- IPN (interpenetrated network structure) hydrogels

According to the subgroups they contain;

- Neutral (non-ionic) hydrogels
- Ionic hydrogels

Anionic hydrogels

Cationic hydrogels

Polyampholytic hydrogels

According to their physical structure;

- Amorphous hydrogels
- Semi-crystalline hydrogels
- Hydrogen bonded hydrogels

According to cross-linking situations;

- Physically cross-linked hydrogels
- Chemically cross-linked hydrogels

By sources;

- Natural hydrogels
- Synthetic hydrogels

According to their chemical stability;

- Biodegradable hydrogels
- Non-biodegradable hydrogels





According to water content;

- Low swelling degree (20-50%)
- Medium degree of swelling (50-90%)
- High swelling degree (90-99.5%)
- Super-absorbent (>99.5%)

SMART POLYMERS

Polymers to be used in various applications must have properties that can respond to stimuli from the external environment, similar to real systems. Polymers prepared for this purpose and showing reversible physical or chemical properties by undergoing structural change as a result of any stimulus from the external environment are called “stimulus-sensitive polymers or smart polymers”.⁸ Stimulus-responsive hydrogels produced from polymers can be classified according to the stimulus type as follows:

- Temperature sensitive hydrogels
- pH sensitive hydrogels
- Electric field sensitive hydrogels
- Photosensitive hydrogels
- Magnetic field sensitive hydrogels

CLINICAL APPLICATION OF DIFFERENT HYDROGELS

Hydrogel scaffolds have lately been readily available in tissue engineering. They are a distinct three-dimensional (3D) network of polymers, with water serving as the liquid component. They can transfer nutrients throughout their structure and hold a lot of water and biological fluids because of their hydrophilic nature. They have biocompatibility, expected and predicted degradation patterns, are naturally crosslinked, can preserve network integrity, and have customizable mechanical properties. They become insoluble at high water concentrations as a result. Furthermore, because of their extraordinary flexibility and elasticity similar to a genuine ECM, hydrogels provide the essential cell support needed for tissue regeneration.⁹⁻¹²

Fibrin from natural hydrogels; It offers very efficient scaffolding materials that can be applied to stem cells or primary cells to regenerate adipose tissues, heart tissues, liver, ocular, nerve tissues, skin, bones, cartilage, alone or in combination with other materials. Fibrin is thus one of the most adaptable bioengineering materials with a broad range of applications to promote tissue regeneration, wound healing, and tooth regeneration.^{13,14}

Chitosan, which is one of the natural hydrogels; oral administration has been found to be non-toxic.¹⁵ Chitosan, in the form of nanoparticles and films, aids in the in situ treatment of oral mucositis and periodontal tissues with fungus using antibiotics like metronidazole and nystatin. Chitosan systems in the form of nanoparticles and films also have the advantage of being pH sensitive. The thiole-based chitosan formulation is entrapped in muco-adhesive patches to treat dental caries with sustained antibacterial drug release, preventing the growth of cariogenic *Streptococcus mutans*.¹⁶

Diniz et al.¹⁷ developed an injectable, biodegradable scaffold made of oxidized alginate microbeads encased with gingival

mesenchymal stem cells and periodontal ligament. Stem cells were introduced to alginate hydrogel in vitro. The scaffold system demonstrated strong swelling capacity as well as osteo- and adipo-differentiation.

Emdogain (EMD) is a commercially available synthetic polymer that is primarily used to repair intrabony periodontal abnormalities and to restore soft tissues. EMD's primary use is to promote the growth of new periodontal attachments for alveolar bone, periodontal ligament, and acellular cementum. EMD has the capacity to promote periodontal tissue regeneration. It is the dental biomaterial that has received the most research and is frequently utilized in surgical treatments including guided tooth tissue regeneration and root tip excision.¹⁸

STUDIES DONE

For doctors and researchers, the regeneration of injured or missing biological tissues is a significant problem. These biological tissues' extracellular matrix (ECM) is made up of a complex web of fibrous proteins and glycosaminoglycans that bind cells and control cellular function and interaction via a range of signals. The ECM's resident cells create and modify it on a regular basis.¹⁹ There are still no natural or artificial biomaterials that can duplicate the ECM and replicate all of its features. However, at this time, the traditional method in tissue engineering approaches is the use of native scaffolds, such as polymeric scaffolds, ceramic scaffolds, or mixtures of multiple scaffold types loaded with suitable cells and signaling chemicals.²⁰

Using an in vitro injectable three-dimensional (3D) cell distribution method, Jones et al.²¹ set out to test the idea that a PEGDA-HA-based hydrogel (polyethylene glycol diacrylate-hyaluronic acid) mixed with gelatin and fibronectin could increase hDPSC survival and spread. They came to the conclusion that tailored tissue mimicking may be facilitated by an injectable scaffold with adjustable mechanical and biological components.

Han et al.²² reported the use of an agarose hydrogel biomimetic mineralization system loaded with calcium and phosphate to induce dentin remineralization and the formation of an oriented dense parallel-packed HA layer on the dentin surface in a rabbit model in vivo. They showed how treating conditions such as erosion, abrasion and dentine hypersensitivity could have practical application.

In order to create scaffolds with the appropriate cell adhesion and angiogenesis capabilities and to assess the survival and development of dental pulp stem cells, Xia et al.²³ used self-assembled peptide hydrogels. They have developed a three-dimensional (3D) milieu that encourages stem cell adhesion and angiogenesis based on the data they collected using the functionalized self-assembly peptide scaffold. This environment has enormous promise for dental pulp tissue creation and regeneration.

In the study of Aksel et al.,²⁴ in which they aimed to evaluate a colloidal microgel for angiogenic and odontogenic differentiation of cells in the presence of cell-derived extracellular matrix (ECM) proteins using a 3D culture model, colloidal microgels allowed cellular organization that could improve penetration and nutrition in a full-length root canal system and concluded that the bioactivity of cell-



derived ECM proteins can be altered depending on external stimuli.

Moshaverinia et al.²⁵ conducted a study to develop an injectable and biodegradable scaffold based on oxidized alginate microbeads encapsulating the periodontal ligament and gingival mesenchymal stem cells and to investigate stem cell viability and osteogenic differentiation of stem cells in vitro. Alginate has been shown to be a promising candidate as a non-toxic scaffold for periodontal ligament stem cells and gingival mesenchymal stem cells. The degradation profile and swelling kinetics of the alginate hydrogel were found to be strongly dependent on the degree of oxidation, indicating its tunable chemistry and degradation rate. This study demonstrated for the first time that the immobilization of periodontal ligament stem cells and gingival mesenchymal stem cells in alginate microspheres provides a promising strategy for bone tissue engineering.

An injectable, heat-sensitive hydrogel consisting of chitosan, sodium glycerophosphate (-GP), and gelatin was created by Xu et al.²⁶ to stop alveolar bone loss, reduce inflammation, and promote the healing of periodontitis. The mixture underwent a sol-gel transition at body temperature. Aspirin and erythropoietin could be released from these hydrogels to cause anti-inflammatory effects and control tissue regeneration. The potentials of the hydrogel system in applications for treating periodontitis have been shown by the release profile, which suggests that the released components are non-toxic both in vitro and in vivo.

In the study of Bae et al.,²⁷ in which they aimed to modify zirconium dioxide (ZrO₂) with a light-curing hyaluronic acid hydrogel and then evaluate the bone regeneration potential of the modified zirconium dioxide, they suggested that surface functionalized ZrO₂-5 and 7 could be used as implant materials in dental applications. They also suggested that growth and differentiation factor-5 may be useful as an effective osteogenic differentiation factor to accelerate new bone formation.

In order to address intrabony periodontal abnormalities, Yan et al.²⁸ prepared and evaluated an enzymatically solidified chitosan hydrogel in vivo. It was discovered that these hydrogels were highly biocompatible and biodegradable. Tan et al.²⁹ provided sufficient and continuous stimulation with hydrogels containing growth factors to assist the repair of periodontal tissue in a rat model. Future treatments for periodontal bone abnormalities and intermittently accelerated osteogenic orthodontic treatment may use these hydrogels instead of bone transplantation in the clinic. Additionally, it may be possible to improve the osteoconductivity of such biomaterials by combining bioactive glass nanoparticles with the heat-sensitive hydrogels.

A temperature sensitive gel has a tremendous effect on the treatment of periodontal disease. Swain et al.³⁰ employed moxifloxacin hydrochloride heat sensitive smart gel for subgingival application to enhance the local effect of periodontitis and extend residence time in the diseased cavity. This gel was created utilizing a mix of temperature sensitive hydrogel and gellan gum. The medicine and gel did not appear to be incompatible, and the gel maintained its antibacterial properties. Sheshala et al.³¹ also created in situ gel formulations of moxifloxacin for the treatment of periodontitis using polylactic acid (poloxamer-based)

and chitosan as heat-sensitive and adhesion polymers. The retention duration in the afflicted area is extended by all formulations' suitable viscosity and ease of syringe passage, according to earlier research. The pH of all formulations was neutral and did not irritate the oral mucosa.

To test their suitability for the treatment of periodontitis, Bansal et al.³² created in situ gels containing the antibiotics metronidazole and levofloxacin for in vitro research and antimicrobial trials. No interactions between the medication and the carrier gel were seen in the studies. The duration of the drug's action can be prolonged for up to 48 hours, and the gel's high viscosity made it easier to store it in the periodontal pocket for an extended amount of time. In addition, in situ gels have more potent antibacterial properties than carrier gels. The authors therefore proposed that periodontal pockets with deep infections may be treated using the created in situ gel.

In their study of Pakzad et al.³³ for use as a biodegradable drug delivery system to be injected into periodontal pockets to allow injectable heat-sensitive chitosan/gelatin/ β -glycerolphosphate hydrogel to allow sustained metronidazole release, the gelation time of chitosan/gelatin/ β -glycerolphosphate was determined, and it has been shown that the gelation temperature can be adjusted by adjusting the β -glycerolphosphate and gelatin concentrations. The gel strength of chitosan/gelatin/ β -glycerolphosphate increased significantly as the gelatin content increased. Results of the antibacterial activity of Chitosan/gelatin/ β -glycerolphosphate-Metronidazole showed inhibition of anaerobic gram-positive *Clostridium sporogens*. Cytotoxicity testing showed that the chitosan/gelatin/ β -glycerolphosphate hydrogel showed no significant toxicity and was biocompatible.

The approach of treating periodontal disease has gradually changed from resective surgical techniques to regenerative ones as we have gained a better understanding of periodontal wound healing.³⁴ Hydrogel-based therapeutics offer some encouraging examples in this regard. In a recent preclinical investigation, gingival mesenchymal stem cells were enclosed in alginate gelatin methacrylate (GelMA) hydrogels, which demonstrated faster wound healing in a mouse model.³⁵ Laboratory-produced tissue-engineered human oral mucosa equivalents (EVPOME) were employed in clinical research of intraoral grafting to assess the effectiveness in establishing a well-integrated surface epithelium. The fundamental substrate on which the cells were seeded was AlloDerm®. The clinical end-use case required a robust ECM matrix that could keep its integrity after being threaded with a needle and suture. Grafts would be surgically inserted and sutured under a flap of skin in this scenario.³⁶

In their study, Struillou et al.³⁷ aimed to evaluate bone regeneration using a dog model with surgically induced periodontal defects for 12 weeks using a layered biomaterial consisting of a biphasic calcium phosphate (BCP) coated with a crosslinking hydrogel that acts as a polymer membrane of silylated hydroxypropyl methylcellulose. They found that the hydrogel can act as an occlusive barrier promoting bone regeneration. Future clinical trials in humans are needed to confirm the results of this study.

Yan et al.'s³⁸ study, which investigated metronidazole (MTR)- and chlorhexidine (CHX)-loaded hydrogels as prospective



applications in intracanal medicines for root canal disinfection, evaluated the antibacterial effectiveness against *Enterococcus faecalis* (*E. faecalis*), *Streptococcus mutans* (*S. mutans*), and *Prevotella intermedia* (*P. intermedia*). Human dental pulp stem cells (hDPSCs) were also tested for biocompatibility. The viability of *E. faecalis*, *S. mutans*, and *P. intermedia* was dramatically decreased in vitro in MTR@gGels and CHX@gGels, according to DCT, CCK-8, CFU, and live/dead stained biofilm findings. Significant biocompatibility with hDPSCs was demonstrated by CCK-8 findings. In vivo demonstrations of the filling and removal of gGels from root canals have been made. As a result, they came to the conclusion that MTR and CHX loaded hydrogels might have a place in intracanal medications for root canal disinfection.

For the treatment of oral herpes infections HSV, Chaudhary and Verma created an oral mucosal drug delivery system for the topical and systemic delivery of acyclovir. The duration of medication activity is extended by using a temperature-sensitive gelling method, improving the bioavailability of acyclovir in the oral mucosa. Drug release studies demonstrated the sustained drug release properties of the hydrogels. All preparations showed sustained release properties. In situ injection of the medication gel formulation through the oral mucosa inhibited the first pass effect. In order to boost the bioavailability of medications, heat sensitive in situ gels offer a practical option for local and systemic delivery. It was determined that by improving patient compliance, this approach can be used to treat oral herpes infections locally.³⁹

CONCLUSION

It is important that the materials used in dentistry are released over time after the drugs are applied. Hydrogels have become a focus of interest in the world of dentistry and medicine due to their ability to imitate the extracellular matrix, oscillation depending on stimulation over time and removal from the environment and have found various areas of use. Hydrogels have been the subject of various studies due to their properties. But more studies are needed regarding the effect of different materials on different cells.

ETHICAL DECLARATIONS

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

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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

- Rosiak JM, Yoshii F. Hydrogels and their medical applications. *Nucl Instrum Methods Phys Res Sect.* 1999;151(1-4):56-64.
- El-Hefian EA, Elgannoudi SE, Mainal A, Yahaya AH. Characterization of chitosan in acetic acid: rheological and thermal studies. *Turk J Chem.* 2010;34(1):47-56.
- Khan MBH, Othman KA, Razak HM. Akil Synthesis and physicochemical investigation of chitosan-PMAA-based dual-responsive hydrogels. *J Polym Res.* 2013;20:1-8.
- Kishida A, Ikada Y. Hydrogels for biomedical and pharmaceutical applications, Polymeric Biomaterials, Revised and Expanded. 2nd ed (Eds S. Dumitriu). Marcel Dekker, Newyork. 2002;133-145.
- Wichterle O, Lim D. Hydrophilic gels for biological use. *Nature.* 1960;185:117-118.
- Murray PE, Garcia-Godoy F, Hargreaves KM. Regenerative endodontics: a review of current status and a call for action. *J Endod.* 2007;33(4):377-390.
- Swami SN. Radiation synthesis of polymeric hydrogels for swelling controlled drug release studies, Doctor of Philosophy, University of Western Sydney New South Wales, Australia. 2004.
- Kim SJ, Park SJ, Kim SI. Properties of smart hydrogels composed of polyacrylic acid/poly(vinyl sulfonic acid) responsive to external stimuli, *Smart Mater Struct.* 2004;13(2):317-322.
- Chang B, Ahuja N, Ma C, Liu X. Injectable scaffolds: Preparation and application in dental and craniofacial regeneration. *Mater Sci Eng R Rep.* 2017;111:1-26.
- Fan C, WangDA. Macroporous hydrogel scaffolds for three-dimensional cell culture and tissue engineering. *Tissue Eng Part B Rev.* 2017;23(5):451-461.
- Mantha S, Pillai S, Khayambashi P, et al. Smart hydrogels in tissue engineering and regenerative medicine. *Materials* 2019;12(20):3323.
- Yang JM, Olanrele OS, Zhang X, Hsu CC. Fabrication of Hydrogel Materials for Biomedical Applications. In Novel Biomaterials for Regenerative Medicine; Chun HJ, Park K, Kim CH, Khang G. Eds.; Springer: Singapore, 2018;197-224.
- Ahmed TA, Dare EV, Hincke M. Fibrin: a versatile scaffold for tissue engineering applications. *Tissue Eng Part B Rev.* 2008;14(2):199-215.
- Riopel M, Trinder M, Wang R. Fibrin, a scaffold material for islet transplantation and pancreatic endocrine tissue engineering. *Tissue Eng Part B Rev.* 2015;21(1):34-44.
- Soran Z, Aydın RS, Gümüşderelioğlu M. Chitosan scaffolds with BMP-6 loaded alginate microspheres for periodontal tissue engineering. *J Microencapsul.* 2012;29(8):770-780.
- Pichayakorn W, Boonme P. Evaluation of cross-linked chitosan microparticles containing metronidazole for periodontitis treatment. *Mater Sci Eng C Mater Biol Appl.* 2013;33(3):1197-1202.
- Diniz IM, Chen C, Ansari, S, et al. Gingival mesenchymal stem cell (GMSC) delivery system based on RGD-coupled alginate hydrogel with antimicrobial properties: a novel treatment modality for peri-implantitis. *J Prosthodont.* 2016;25(2):105-115.
- Sculean A, Windisch P, Döri F, Kogelovich T, Molnár B, Gera I. Emdogain in regenerative periodontal therapy. A review of the literature. *Fogorv Szle.* 2007;100(5): 220-232.
- Galler KM, Hartgerink JD, Cavender AC, Schmalz G, D'Souza RN. A customized self-assembling peptide hydrogel for dental pulp tissue engineering. *Tissue Eng Part A.* 2012;18(1-2):176-184.
- Galler KM, Aulisa L, Regan KR, D'Souza RN, Hartgerink JD. Self-assembling multidomain peptide hydrogels: designed susceptibility to enzymatic cleavage allows enhanced cell migration and spreading. *J Am Chem Soc.* 2010;132(9):3217-3223.
- Xia K, Chen Z, Chen J, et al. RGD- and VEGF-mimetic peptide epitope-functionalized self-assembling peptide hydrogels promote dentin-pulp complex regeneration. *Int J Nanomed.* 2020;15:6631-6647.
- Han M, Li QL, Cao Y, Fang H, Xia R, Zhang ZH. In vivo remineralization of dentin using an agarose hydrogel biomimetic mineralization system. *Sci Rep.* 2017;7:41955.
- Xia K, Chen Z, Chen J, et al. RGD- and VEGF-mimetic peptide epitope-functionalized self-assembling peptide hydrogels promote dentin-pulp complex regeneration. *Int J Nanomed.* 2020;15:6631-6647.
- Aksel H, Sarkar D, Lin MH, Buck A, Huang GT. Cell-derived extracellular matrix proteins in colloidal microgel as a self-assembly hydrogel for regenerative endodontics. *J Endod.* 2022;48(4):527-534.
- Moshaverinia A, Chen C, Akiyama K, et al. Alginate hydrogel as a promising scaffold for dental-derived stem cells: an in vitro study. *J Mater Sci Mater Med.* 2012;23(12):3041-3051.
- Xu X, Gu Z, Chen X, et al. An injectable and thermosensitive hydrogel:



- Promoting periodontal regeneration by controlled-release of aspirin and erythropoietin. *Acta Biomater.* 2019;86:235-246.
27. Bae MS, Kim JE, Lee JB, et al. ZrO₂ surface chemically coated with hyaluronic acid hydrogel loading GDF-5 for osteogenesis in dentistry. *Carbohydrate Polymers.* 2013;92(1):167-175.
 28. Yan XZ, van den Beucken JJ, Cai X, Yu N, Jansen JA, Yang F. Periodontal tissue regeneration using enzymatically solidified chitosan hydrogels with or without cell loading. *Tissue Eng Part A.* 2015;21(5-6):1066-1076.
 29. Tan J, Zhang M, Hai Z, et al. Sustained release of two bioactive factors from supramolecular hydrogel promotes periodontal bone regeneration. *ACS Nano.* 2019;13(5):5616-5622.
 30. Swain GP, Patel S, Gandhi J, Shah P. Development of moxifloxacin hydrochloride loaded *in-situ* gel for the treatment of periodontitis: *in-vitro* drug release study and antibacterial activity. *J Oral Biol Craniofac Res.* 2019;9(3):190-200.
 31. Sheshala R, Quah SY, Tan GC, Meka VS, Jnanendrappa N, Sahu PS. Investigation on solution-to-gel characteristic of thermosensitive and mucoadhesive biopolymers for the development of moxifloxacin-loaded sustained release periodontal in situ gels. *Drug Deliv Transl Res.* 2019;9(2):434-443.
 32. Bansal M, Mittal N, Yadav SK, et al. Periodontal thermoresponsive, mucoadhesive dual antimicrobial loaded in-situ gel for the treatment of periodontal disease: preparation, in-vitro characterization and antimicrobial study. *J Oral Biol Craniofac Res.* 2018;8(2):126-133.
 33. Pakzad Y, Ganji F. Thermosensitive hydrogel for periodontal application: in vitro drug release, antibacterial activity and toxicity evaluation. *J Biomater Appl.* 2015;30(7):919-929.
 34. Cho YD, Kim KH, Lee YM, Ku Y, Seol YJ. Periodontal wound healing and tissue regeneration: a narrative review. *Pharmaceutics.* 2021;14(5):456.
 35. Ansari S, Pouraghaei Sevari S, Chen C, Sarrion P, Moshaverinia A. RGD-modified alginate-gelma hydrogel sheet containing gingival mesenchymal stem cells: a unique platform for wound healing and soft tissue regeneration. *ACS Biomater Sci Eng.* 2021;7(8):3774-3782.
 36. Izumi K, Neiva RF, Feinberg SE. Intraoral grafting of tissue-engineered human oral mucosa. *Int J Oral Maxillofac Implants.* 2013;28(5):e295-e303.
 37. Struillou X, Fruchet A, Rakic M, et al. Evaluation of a hydrogel membrane on bone regeneration in furcation periodontal defects in dogs. *Dent Mater J.* 2018;37(5):825-834.
 38. Yan Y, Zhou P, Lu H, et al. Potential apply of hydrogel-carried chlorhexidine and metronidazole in root canal disinfection. *Dent Mater J* 2021;40(4):986-993.
 39. Chaudhary B, Verma S. Preparation and evaluation of novel in situ gels containing acyclovir for the treatment of oral herpes simplex virus infections. *Sci World J.* 2014;24:280928.



Office type vital teeth bleaching: presentation of four cases

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ABSTRACT

The tooth color, which is primarily determined by the dentin tissue, is also influenced by the color, transparency, and thickness of the enamel. Color changes in teeth that occur over time due to intrinsic or extrinsic factors are a significant aesthetic issue that requires treatment. Discoloration, especially in the front teeth, leads to a loss of self-confidence in patients, and as a result, they are unable to smile comfortably. It is usually possible to remove extrinsic stains, which are associated with poor oral hygiene and the consumption of certain foods and beverages throughout the day, using mechanical cleaning methods. In the removal of intrinsic stains, vital whitening (bleaching) is preferred over more invasive treatment methods. Vital tooth whitening, which is considered a minimally invasive approach, includes procedures performed by the dentist in the office (in-office) or at home by the patient under the dentist's guidance. In both applications, the active ingredient in the materials used is hydrogen peroxide (H_2O_2) or carbamide peroxide. These agents can be used alone or in combination with activation methods such as heat or light. The aim of this study is to demonstrate the effectiveness of in-office whitening treatments in various discoloration cases.

Keywords: Tooth discoloration, vital bleaching, hydrogen peroxide

INTRODUCTION

In recent years, the pervasive influence of visual-based mass media has significantly increased individuals' awareness of their appearance, thereby highlighting the importance of smiling as both a social and aesthetic norm. This shift in societal values is reflected in the field of dentistry, where the primary objective is to offer patients a natural and aesthetically pleasing smile that aligns with their personal aspirations.¹ Thanks to aesthetic dentistry applications, both the issues affecting the smile, such as those in the teeth, gums, and surrounding tissues, are addressed, and patients' speech, biting, and chewing functions are enhanced.^{2,3}

The change in tooth color largely depends on how the incoming light is absorbed or reflected by the tooth surface. Therefore, any damage to the tooth structure may lead to a change in its appearance.⁴

There are various causes of tooth discoloration, including environmental, genetic, and developmental factors. Tooth discoloration, which can be classified based on its etiology or localization, is fundamentally a multifactorial phenomenon. These discolorations may result from aging, inadequate oral hygiene, intra-pulp hemorrhages due to trauma, pre- or post-dental treatments, as well as the consumption of tea, coffee, tobacco, food dyes, or tetracycline-like antibiotics.^{5,6}

Exogenous discoloration, which typically develops as a result of the consumption of food and beverages throughout the

day and is exacerbated by inadequate oral hygiene, can be addressed through the use of toothpaste and mechanical plaque removal procedures. While external discoloration primarily affects the enamel, internal discoloration involves the dentin or the enamel-dentin complex. The most significant causes of internal staining include genetic factors such as amelogenesis imperfecta and dentinogenesis imperfecta, certain blood disorders (e.g., erythroblastosis fetalis, porphyria), aging, trauma, febrile illnesses during dental development, corrosion products from amalgam restorations, improper cleaning of the pulp chamber following endodontic treatment, excessive fluoride intake, or the use of tetracycline derivatives.^{6,7}

Most internal discolorations can be effectively treated using bleaching procedures, which have become a routine practice in modern aesthetic dentistry. Tooth whitening is widely regarded as a more conservative alternative compared to prosthetic approaches or composite/porcelain laminate veneer restorations. The principle of tooth whitening lies in the application of chemical agents to the tooth surface, which oxidize organic pigments and thereby lighten the tooth color. Specifically, the oxidizing agents penetrate the spaces between inorganic salts within the tooth structure, react with the organic components, and convert highly pigmented molecules into lighter-colored chains.⁸⁻¹¹





There are various bleaching techniques designed for both vital and devital teeth, commonly employing hydrogen peroxide (HP), carbamide peroxide (CP) solutions or gels, or ozone gas.¹² In the devital tooth whitening procedure, also known as the 'walking bleach' technique, the primary objective is to achieve color alteration by allowing the bleaching agent, placed in the access cavity following root canal treatment, to diffuse into the dentinal tubules.^{5,13}

Among the various methods for whitening vital teeth, office-based whitening performed by a dentist is one of the most preferred options. Additionally, there are at-home bleaching techniques (home bleaching/nightguard bleaching) conducted by the patient under the supervision of a dentist. Over-the-counter bleaching methods, involving products purchased directly from pharmacies or markets without professional consultation or supervision, are also commonly used.^{9,15}

Office-based teeth whitening is an effective and scientifically validated method, as it ensures the controlled application of whitening agents by the dentist, protects the soft tissues, and provides clinically acceptable results within a short period. Typically, gel-based products containing 30-38% hydrogen peroxide are utilized. The whitening efficiency increases with the concentration of hydrogen peroxide. Some commercial products contain carbamide peroxide or a combination of hydrogen peroxide and carbamide peroxide. Upon the breakdown of carbamide peroxide, hydrogen peroxide and urea are released.^{16,17}

When these oxidizing agents are applied to the tooth surface, they rapidly penetrate both the enamel and dentin, transforming into free radicals. The bleaching process occurs as a result of the reaction between the free radicals and the organic substances that have infiltrated the tooth structure. As the process continues, a point is reached where only hydrophilic, colorless structures remain in the surrounding environment.¹⁸

CASES

In the medical history of four patients, two male and two female, who presented to the Department of Restorative Dental Treatment at Dicle University Faculty of Dentistry with complaints of tooth discoloration and requests for whitening treatment, various factors were assessed. Upon further questioning, the presence of systemic diseases, history of trauma, medications used, region of residence (with respect to fluoride levels in drinking water), dietary habits, and any previous whitening treatments were explored. Based on the collected information, it was determined that the patients did not have any hereditary diseases, were not using medications, did not smoke, and did not experience pain or sensitivity in their teeth. In intraoral examinations, it was observed that the teeth were vital, free of caries, and the gingival tissues were healthy. No cracks, erosions, or abrasions were observed, and radiographic evaluations revealed no periapical pathology. In light of this information, it was decided to perform whitening treatment in a single session using hydrogen peroxide-based agents, containing 35% to 40% hydrogen peroxide, developed specifically for in-office use. The patients were informed about the treatment plan, and their informed consent was obtained. Intraoral images were captured and recorded before

the treatment (prior to plaque removal and oral hygiene education). In all cases, plaque and calculus were removed from the tooth surfaces using a fluoride-free paste. Isolation was achieved by utilizing a lip retractor, cotton pellets, and a saliva ejector. To protect the gingiva from potential bleaching agent leakage, a light-cured resin barrier with a thickness of 1-2 mm and a width of 4-6 mm was applied to cover the cervical area of the teeth by 0.5 mm and polymerized with an LED light source (LED E plus polymerization filling device).

Case 1

In a 34-year-old male patient, a light-cured resin barrier (Dental Dam, Schutz Dental, Germany) was applied to protect the gingiva and polymerized with an LED light source (Figure 1).



Figure 1. Initial photo

Bleaching gel containing 35% hydrogen peroxide (Bleach'n smile automix system, [Schutz Dental, Germany]) was applied to the vestibular surfaces of the teeth to be whitened for 10 minutes at a thickness of 1 mm according to the manufacturer's instructions. After bleaching, the gel on the tooth surfaces was washed away with an air-water syringe. After the teeth were dried, the degree of whitening was found to be insufficient, and the whitening agent was applied for a second time for 10 minutes with the same method. It was washed away again with plenty of water and photographed (Figure 2).



Figure 2. Application of bleaching agent to the teeth and after washing



After the patient expressed her satisfaction, the treatment session was terminated by carefully removing the gingival barrier and applying the desensitizing agent in the kit [after bleaching care gel (Schutz Dental, Germany)] to prevent tooth sensitivity. The patient was informed about avoiding food, beverages and bad habits that may cause discoloration, and an appointment was made for a follow-up visit after 3 months (Figure 3).



Figure 3. Appearance after teeth whitening treatment and 3 months after treatment

Case 2

In the case of a 32-year-old female patient who could not tolerate the lip retractor, we performed the isolation procedure using cotton pellets and saliva absorbent. As described in case 1, a light-cured resin barrier was applied to protect the gums and polymerized with an LED light source (Figure 4).



Figure 4. Initial photograph and application of resin barrier to the gingiva

Bleaching gel containing 35% hydrogen peroxide [Bleach'n smile automix system, (Schutz Dental, Germany)] was

applied to the vestibular surfaces of the teeth to be whitened for 10 minutes at a thickness of 1 mm according to the manufacturer's instructions. At the end of the specified time, the bleaching gel was washed away with an air-water syringe and the teeth were dried, and the procedure was terminated after the patient considered the degree of whitening sufficient (Figure 5). Following careful removal of the gingival barrier, the desensitizing agent in the kit was applied to prevent tooth sensitivity. The patient was informed about avoiding food, beverages and bad habits that may cause discoloration, and an appointment was made for a follow-up visit after 3 months (Figure 6).



Figure 5. Whitening agent application and after treatment



Figure 6. Appearance 3 months after treatment

Case 3

In a 37-year-old male patient (Figure 7), a light-cured resin barrier (Opal Dam, Ultradent, USA) was applied to protect the gingiva and polymerized with an LED light source as described in the cases above.

Whitening gel containing 40% hydrogen peroxide (Opalescence Boost, Ultradent, USA) was applied to the vestibular surfaces of the teeth to be whitened for 20 minutes at a thickness of 1 mm according to the manufacturer's instructions (Figure 8).



Figure 7. Initial photo



Figure 8. Application of bleaching agent

After bleaching, the gel on the tooth surfaces was washed away with an air-water syringe. After drying the teeth, the degree of whitening was found to be insufficient, and the whitening agent was applied for 20 minutes for the second time with the same method. It was washed again with plenty of water and removed. At the end of this period, the whitening level was deemed sufficient, and the procedure was terminated. The patient was informed about avoiding food, beverages and bad habits that may cause discoloration, and an appointment was made for a follow-up visit one week later (Figure 9).



Figure 9. Appearance one week after treatment

Case 4

In a 28-year-old female patient, a light-cured resin barrier (Opal Dam, Ultradent, USA) was applied to protect the gingiva and polymerized with an LED light source as described in the cases above (Figure 10).

Whitening gel containing 40% hydrogen peroxide (Opalescence Boost, Ultradent, USA) was applied to the vestibular surfaces of the teeth to be whitened for 20 minutes at a thickness of 1 mm according to the manufacturer's instructions (Figure 11). As in case 3, whitening was found to be insufficient after 20 minutes and the whitening agent was applied for another 20 minutes. After this period, the gel on the tooth surfaces was washed away with the help of an air-

water syringe and the whitening level was deemed sufficient and the procedure was terminated.



Figure 10. Initial photo



Figure 11. Application of bleaching agent

The patient was informed about avoiding foods, drinks and bad habits that may cause discoloration again and was advised to come for regular check-ups (Figure 12, 13).



Figure 12. Appearance after treatment



Figure 13. Before and after treatment



DISCUSSION

Nowadays, patients' aesthetic expectations have become as important as pain relief and the restoration of masticatory function. As a result, teeth whitening treatments have become increasingly popular. The efficacy of whitening procedures is influenced by various factors, including the type and severity of discoloration, the patient's age, the concentration of the whitening agents used, and the duration of the treatment. Vital teeth whitening techniques are relatively straightforward, minimally invasive procedures that allow for the alteration of tooth color. These procedures are typically performed through home-based or office-based applications using commercial products containing varying concentrations of hydrogen peroxide (15-40%) or carbamide peroxide (10-22%).¹⁹⁻²¹

The primary reason for the preference of office whitening techniques, which typically utilize high-concentration (35%) hydrogen peroxide-containing products, is their ability to deliver rapid outcomes while ensuring that the procedures remain entirely under the control of the dentist. In office-based applications, whitening efficiency can be achieved within 10-60 minutes, depending on the concentration of the agents used, and the desired effect can be enhanced by incorporating heat or light devices.^{24,2}

In our cases, we used hydrogen peroxide in the range of 35-40% without the application of heat or light sources. For the patients in cases 1 and 2, who were concerned about their ability to tolerate whitening agents for extended periods, 35% hydrogen peroxide, Bleach'n smile automix system (Schutz Dental, Germany) material was selected due to its ability to show results more quickly. According to the manufacturer's instructions, the effectiveness of this material is observed rapidly after a 10-minute application. If necessary, a second 10-minute application can also be added. In contrast, for the patients in cases 3 and 4, who had no such concerns and demonstrated better compliance, 40% hydrogen peroxide, Opalescence Boost (Ultradent, USA) was preferred. According to the manufacturer's guidelines, this material is recommended for a 20-minute application, with the treatment being extendable for an additional two or three 20-minute sessions if needed.

As the concentration and application duration of the bleaching agent increase, both the whitening effect and the risk of sensitization rise proportionally. Due to the use of high concentrations of hydrogen peroxide, office-based whitening treatments, which yield more satisfactory results in a shorter time, may cause reversible tooth sensitivity.^{26,27}

Patients predisposed to tooth sensitivity should be thoroughly educated and cautioned regarding this potential risk. In cases where conditions such as erosion, abrasion, or gingival recession are present, these issues must be addressed and resolved prior to initiating bleaching procedures.²⁸

In home bleaching, color stability can be maintained for a longer duration as the oxidizing molecules penetrate deeper into the tooth structure. However, this method has certain disadvantages, including a longer treatment period (2-6 weeks) compared to office-based whitening procedures, as well as the potential for gingival and tooth sensitivity following the treatment.^{22,23}

Although the safety of tooth whitening treatments has been established, studies have reported that these procedures may lead to morphological changes on the enamel surface, increased surface roughness, and reduced surface hardness of restorations.^{29,30} Numerous studies have demonstrated that restoration materials are adversely affected by hydrogen peroxide. High concentrations of hydrogen peroxide have been reported to cause chemical degradation in the composite resin matrix, increase surface roughness, decrease surface hardness, and induce cracks. Additionally, carbamide peroxide and its derivatives have been shown to cause oxidation, corrosion, and dissolution, accelerating the deterioration of amalgam restorations and resulting in the release of mercury.^{31,32}

Studies have indicated a 25-60% reduction in the bond strength of adhesive restorations immediately following tooth whitening. A study conducted by Türkün et al.³³ reported that composite resin restorations placed two weeks after bleaching exhibited the highest bond strength.

The increase in enamel roughness caused by bleaching agents makes teeth more susceptible to external staining. For these reasons, it is recommended to apply bleaching agents for the durations specified by the manufacturers. During the bleaching procedures conducted in accordance with the manufacturer's guidelines, no sensitivity issues were observed in our patients. Nevertheless, remineralizing agents were applied to all teeth to prevent subsequent dentin sensitivity.

An additional critical criterion for success in vital teeth whitening treatments is patient satisfaction and the stability of the achieved color. In the cases we treated, an acceptable whitening effect and patient satisfaction were attained in a single session, and follow-up assessments revealed that the teeth maintained their color.

CONCLUSION

The key to success in teeth whitening treatments lies in selecting techniques and materials that are appropriate for the specific case, meeting patient expectations, and providing patients with adequate information about the treatment process and outcomes. The vital teeth whitening method, when an appropriate treatment plan is established, should be preferred as it offers rapid results in a short time, ensures patient satisfaction, and is relatively simple and safe compared to other treatment options.

ETHICAL DECLARATIONS

Informed Consent

All patients 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

- Samorodnitsky-Naveh G, Geiger S, Levin L. Patients' satisfaction with dental esthetics. *J Am Dent Assoc.* 2007;138(6):805-808.
- Rodríguez-Martínez J, Valiente M, Sánchez-Martín MJ. Tooth whitening: from the established treatments to novel approaches to prevent side effects. *J Esthet Restor Dent.* 2019;31(5):431-440.
- Tin-Oo MM, Saddki N, Hassan N. Factors influencing patient satisfaction with dental appearance and treatments they desire to improve aesthetics. *BMC Oral Health.* 2011;11(6):1-8.
- Algarni A, Ungar PS, Lippert F, et al. Trend-analysis of dental hard-tissue conditions as function of tooth age. *J Dent.* 2018;74:107-112.
- Kırlı MÇ, Şen ÖG. Re-establishing the aesthetics of four different cases of discolored endodontically treated teeth through whitening treatment. *Turk Clin J Dent Sci.* 2021;27(3):514-520.
- Burke S, Efes, BG. Tooth discoloration and current treatments. *Eur J Sci Technol.* 2022;43:55-68.
- Ciftci V, Kılavuz S, Bulut FD, Mungan HN, Bisgin A, Dogan MC. Congenital erythropoietic porphyria with erythrodontia: a case report. *Int J Paediatr Dent.* 2019;29(4):542-548.
- Benahmed AG, Gasmi A, Menzel A, et al. A review on natural teeth whitening. *J Oral Biosci.* 2022;64(1):49-58.
- Suliman MA. An overview of tooth-bleaching techniques: chemistry, safety and efficacy. *Periodontol.* 2008;48(1):148-169.
- Bansode PV, Pathak SD, Wavdhane MB, Duduskar GU. In office vital bleaching: a case report. *Int J App Dent Sci.* 2022;8(1):296-299.
- Zimmerli B, Jeger F, Lussi A. Bleaching of nonvital teeth. A clinically relevant literature review. *Schweiz Monatsschr Zahnmed.* 2010;120(4):306-320.
- Al-Omiri MK, Abul Hassan RS, AlZarea BK, Lynch E. Improved tooth bleaching combining ozone and hydrogen peroxide-a blinded study. *J Dent.* 2016;100(46):30-35.
- Plotino G, Buono L, Grande NM, Pameijer CH, Somma F. Nonvital tooth bleaching: a review of the literature and clinical procedures. *J Endod.* 2008;34(4):394-407.
- Daokar SG, Mantri AR, Patil KS, Wahane KD, Jethwani D, Patel K. In office teeth bleaching: a case report. *IJMSIR.* 2020;5(5):203-207.
- Joiner A. Tooth colour: a review of the literature. *J Dent.* 2004; 32(Suppl):3-12.
- Meireles S, Heckmann S, Santos I, Della Bona A, Demarco F. A double blind randomized clinical trial of at-home tooth bleaching using two carbamide peroxide concentrations: 6-month follow-up. *J Dent.* 2008;36(11):878-884.
- Demir N, Karci M, Ozcan M. Effects of 16% Carbamide peroxide bleaching on the surface properties of glazed glassy matrix ceramics. *BioMed Res Int.* 2020;2020:1864298.
- Mounika A, Mandava J, Roopesh B, Karri G. Clinical evaluation of color change and tooth sensitivity with in-office and home bleaching treatments. *Indian J Dent Res.* 2018;29(4):423-427.
- Kothari S, Gray AR, Lyons K, Tan XW, Brunton PA. Vital bleaching and oral-health-related quality of life in adults: a systematic review and meta-analysis. *J Dent.* 2019;84:22-29.
- Surmelioglu D, Usumez A. Effectiveness of different laser-assisted in-office bleaching techniques: 1-year follow-up. *Photobiomodul Photomed Laser Surg.* 2020;38(10):632-639.
- Bernardon JK, Sartori N, Ballarin A, Perdigão J, Lopes GC, Baratieri LN. Clinical performance of vital bleaching techniques. *Oper Dent.* 2010;35(1):3-10.
- Perdigão J, Baratieri LN, Arcari GM. Contemporary trends and techniques in tooth whitening: a review. *Pract Proced Aesthet Dent.* 2004;16(3):185-192.
- Li Y, Greenwall L. Safety issues of tooth whitening using peroxide-based materials. *Br Dent J.* 2013;215(1):29-34.
- He LB, Shao MY, Tan K, Xu X, Li JY. The effects of light on bleaching and tooth sensitivity during in-office vital bleaching: a systematic review and meta-analysis. *J Dent.* 2012;40(8):644-653.
- Faus-Matoses V, Palau-Martínez I, Amengual-Lorenzo J, Faus-Matoses I, Faus-Llácer VJ. Bleaching in vital teeth: combined treatment vs in-office treatment. *J Clin Exp Dent.* 2019;11(8):754-758.
- Eppe M, Meyer F, Enax J. A critical review of modern concepts for teeth whitening. *Dent J.* 2019;7(79):1-13.
- Martin J, Fernandez E, Bahamondes V, et al. Dentin hypersensitivity after teeth bleaching with in-office systems. Randomized clinical trial. *Am J Dent.* 2013;26(1):10-14.
- Pashley D. Consensus-based recommendations for the diagnosis and management of dentin hypersensitivity. *Comp Contin Educ Dent.* 2008;29(8):1-35.
- Cheng YL, Musonda J, Cheng H, Attin T, Zheng M, Yu H. Effect of surface removal following bleaching on the bond strength of enamel. *BMC Oral Health.* 2019;19(50):1-6.
- Martin JM, de Almeida JB, Rosa EA, et al. Effect of fluoride therapies on the surface roughness of human enamel exposed to bleaching agents. *Quintessence Int.* 2010;41(1):71-78.
- Torbali Ç, Çökkeçeci I, Arisu HD. Effect of vital bleaching on composite resin surface hardness. *ADO J Clin Sci.* 2024;13(1):247-255.
- Aktas E, Bakir S, Bakir EP, Eratilla V. The effects of vital whitening agents on the surface properties of three different restoration materials. *Biomed Res.* 2020;31(2):43-47.
- Türkün M, Kaya A. Effect of 10% sodium ascorbate on the shear bond strength of composite resin to bleached bovine enamel. *J Oral Rehabil.* 2004;31(12):1184-1191.