Diagnosis and Treatment Approaches of Dentists Regarding Peri-Implant Diseases. A Questionnaire Study

Diş Hekimlerinin İmplant Çevresi Hastalıklarla İlgili Tanı ve Tedavi Yaklaşımları. Bir Anket Çalışması

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ABSTRACT

INTRODUCTION: To determine the approach for diagnosis and treatment of peri-implant diseases in general dentists and to test whether graduation times make a difference in these approaches.

MATERIAL and METHODS: The survey consisting of four sections was filled out by 381 dentists on online.anketler.com. The first part included demographics, second section included questions about the characteristics of peri-implant mucosa and diagnosis of peri-implant diseases; third section included questions about the treatment of peri-implant diseases; and fourth section included questions about risk factors. R software for statistical analyzes was used.

RESULTS: There were no significant differences in responses regarding peri-implant mucosa characteristics and peri-implantitis risk factors according to graduation time (p>0,05). Although responses regarding peri-implantitis treatment options were generally similar (p>0,05), differences were observed in local antiseptic and systemic antibiotic use among the study groups (p<0,001, p=0,021, respectively). Differences were also observed in responses to options of surgical/resective/regenerative treatments among the study groups (p<0,03, p=0,004, p<0,018, respectively). Undergraduate education as a source of information was reported as 88,6% among recently graduated dentists and 29,9% among older dentists (p<0,05).

CONCLUSION: It would be beneficial to organize more and comprehensive training courses and seminars on peri-implant diseases for dentists who graduated a long time ago.

Keywords: *Peri-implant mucositis, peri-implantitis, questionnaire*

ÖZ

GİRİŞ: Uzmanlığı/doktorası olmayan diş hekimlerin implant çevresi hastalıkların tanı ve tedavi sürecindeki yaklaşımlarının belirlenmesi ve mezuniyet zamanlarının bu yaklaşımlarda fark yaratıp yaratmadığını test etmek amaçlanmıştır.

YÖNTEM ve GEREÇLER: Dört bölümden oluşan anketimiz onlineanketler.com platformunda 381 diş hekimi tarafından dolduruldu. Anketin ilk bölümünde tanıtıcı bilgi soruları yer aldı. İkinci bölümde implant çevresi mukozanın özellikleri ve implant çevresi hastalıkların tanısı hakkında; üçüncü bölümde bu hastalıkların tedavisi hakkında; dördüncü bölümde ise risk faktörleri hakkında sorular yer aldı. İstatistiksel analizler için R yazılımı kullanıldı.

BULGULAR: İmplant çevresi mukozada olması gereken özelliklere ve peri-implantitis risk faktörlerine yönelik cevaplarda diş hekimlerinin mezuniyet zamanına göre bir fark saptanmadı (p>0,05). Araştırma grupları arasında peri-implantitis tedavisine yönelik verilen cevaplar genellikle benzer olmasına karşın (p>0,05) lokal antiseptik ve sistemik antibiyotik kullanımına yönelik cevaplarda farklılıklar izlendi (p<0,001, p=0,021, sırasıyla). Cerrahi debridman, rezektif ve rejeneratif tedaviye yönelik yanıtlarda da mezuniyet zamanlarına göre farklılıklar izlendi (p<0,03, p=0,004, p<0,018, sırasıyla). Son 5 yıl içerisinde mezun olan katılımcılar bilgi kaynağı olarak %88,6 oranında üniversite eğitimini bildirirken mezuniyetinden beri 10 yıldan fazla zaman olmuş katılımcılar bilgiyi sadece %29,9 oranında lisans eğitiminden edindiklerini bildirdiler (p<0,05).

SONUÇ: Uzun zaman önce mezun olmuş hekimler için implant çevresi hastalıklar hakkında daha fazla ve kapsamlı eğitim programları, kurs ve seminerler düzenlenmesi faydalı olacaktır.

Anahtar Kelimeler: *Peri-implant mukozitis, peri-implantitis, anket*

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INTRODUCTION

Dental implants are considered a suitable treatment option for partial and complete edentulism. Along with the increasing number of implant procedures, the prevalence of peri-implant diseases has also risen.[1,2] Peri-implant diseases are defined as peri-implant mucositis, peri-implantitis, and defects in the surrounding hard and soft tissues.[3] Various treatment approaches, including resective, reconstructive, or combined therapies, may be preferred.[4-7] Despite these differing approaches, achieving complete resolution of the disease is challenging, and recurrence may occur after treatment.[4] There is no universally accepted procedure for treating peri-implant diseases.[1,8] Accurate diagnosis, appropriate application of treatment methods, knowledge of potential risk factors, and modification of these factors to promote implant health are crucial for the management of peri-implant diseases.[9-11]

The widespread use of dental implants has been accompanied by an increased incidence of peri-implant diseases.[12] Given this, it is important for dental graduates to possess adequate knowledge of peri-implant diseases. In the core curriculum of dental education, the learning objectives for peri-implant mucositis are defined as "the ability to diagnose, treat, or manage treatment" and "the ability to perform preventive dentistry interventions," while for peri-implantitis, they are "the ability to diagnose and possess knowledge of treatment, including referral to a specialist after performing necessary preliminary procedures" and "the ability to carry out preventive dental procedures." This curriculum was first approved by the Higher Education Council (YÖK) in 2016.[13] However, not all universities have simultaneously implemented this program. Delays and gaps in the curriculum regarding peri-implant diseases present a challenging factor for dental professionals who have not received specialized or doctoral training in the field.

The difficulties in treating peri-implant diseases underscore the importance of timely diagnosis and modification of risk factors in favor of implant health. From a preventive dentistry perspective, dentists must be able to diagnose peri-implant diseases, refer patients for treatment, and manage risk factors to prevent the occurrence of such diseases. The increasing number of patients referred to our faculty for peri-implantitis treatment has raised the need to assess the knowledge and competence of general dentists who do not have specialized or doctoral training in this field. Based on this, a survey was conducted to examine the approaches and knowledge levels of these dentists regarding the diagnosis and treatment of peri-implant diseases, as well as whether differences in their approach exist based on the time of their graduation.

MATERIALS AND METHODS

The survey study aimed at examining the approaches of dentists toward peri-implant diseases was approved by the Medical Research Ethics Committee of the Faculty of Medicine, Ege University, on October 22, 2020, with decision number 20-10.IT/11. After receiving ethical approval, the survey was conducted with 381 dentists via the platform "onlineanketler.com." The questionnaire used in the study was created by the authors for this research.

Inclusion and Exclusion Criteria

For participation in the survey, it was considered a requirement that dentists had no specialty or doctoral training in any field of dentistry. Participation in the survey was voluntary. Dentists with specialty or doctoral education in any area of dentistry were excluded from the study. Dentists who did not wish to complete the survey or accept the informed consent form were also excluded.

Questionnaire

The questionnaire designed to collect data in this study consisted of 20 questions, including one open-ended and 19 closed-ended items. In the first section of the survey, participants were asked questions regarding their age, gender, years since graduation, where they practice dentistry, sources of information on peri-implant diseases, and how they manage treatment when encountering peri-implant diseases. The second section contained questions about the characteristics of peri-implant mucosa and the diagnosis of peri-implant diseases. The third section focused on questions related to the treatment of peri-implant diseases, while the fourth section addressed questions concerning risk factors for peri-implant diseases. The final question was an open-ended question about peri-implant diseases.

Data Collection

Data for this study were collected between January 4, 2021, and July 29, 2022. The survey was created on the "onlineanketler.com" platform, and participants were provided with a link to access the survey online. The surveys were collected anonymously. At the beginning of the survey, before participants could proceed to the questions, an information section was included to explain the purpose and confidentiality of the study. Participants were required to check a consent box to proceed with the survey. To prevent dentists with specialized or doctoral degrees from completing the survey, those who selected "Yes" to the question "Do you have a specialty/doctoral degree?" were blocked from accessing the survey questions and redirected to the end of the survey.

Statistical Analysis

Based on the estimated number of 400,000 dentists in Turkey, it was determined that a sample size of at least

381 participants would be sufficient to predict the correct answer rate for any question in the survey at a 95% confidence interval with a lower limit of 45% and an upper limit of 55% (Epi Info™, a database and statistics program for public health professionals. CDC, Atlanta, GA, USA, 2011). Descriptive statistics, including frequencies and percentages, were provided for categorical variables. Statistical significance was considered at $p<0.05$, and all statistical analyses were performed using R software (R software, version 4.0.5, package: arsenal, R Foundation for Statistical Computing, Vienna, Austria; http://r-project.org). The relationship between two categorical variables was analyzed using Pearson's chi-square test (simulated p-value was used when applicable).

RESULTS

The survey was completed by 381 individuals through an online platform. The evaluation was based on the responses provided by these 381 participants. To examine whether the time since graduation influenced the responses regarding the topics evaluated, participants were grouped into three categories based on their years since graduation: those who graduated within the last 5 years, those who graduated between 5-10 years ago, and those who graduated more than 10 years ago.

1. Demographic Findings of All Participants

Among the participants, 53.3% were female and 46.7% were male (Table 1). Regarding the time since graduation, 53% of the participants had graduated within the last 5 years, 13.6% had graduated 5-10 years ago, and 33.3% had graduated more than 10 years ago. As for their workplace, 31.8% worked in private practices, 29.4% in polyclinics, and 28.3% in public clinics. Concerning sources of information on peri-implant diseases, 67.5% of participants obtained their knowledge during their university education, 43.6% from courses and seminars, 42% through self-study, and 5.8% from other sources. A significant portion of the participants (44.1%) reported that they referred patients for peri-implantitis treatment.

Table 1. Demographics

Demographics	Total
Age (mean±SS/min-max)	34.0±11.6 / 24.0-73.0
Gender (Female/Male) (N (%))	203 (%53.3) / 178 (%46.7)
Years Since Graduation (N (%))	
≤5 years	202 (%53.0)
5-10 years	52 (%13.6)
≥10	127 (%33.3)
Place of Practice (N (%))	
Private Practice	121 (%31.8)
Private Polyclinic	112 (%29.4)
Public Clinics	108 (%28.3)
Not Practicing	40 (%10.5)
Source of Information on Peri-Implant Diseases (N (%))	
Undergraduate Education	257 (%67.5)
Courses and Seminars	166 (%43.6)
Self-research	160 (%42.0)
Other Sources	22 (%5.8)
Preference for Peri-implantitis Treatment (N (%))	
Primarily perform treatment themselves. rarely consult a specialist	97 (%255)
Rarely perform treatment themselves usually consult a specialist	96 (%252)
Refer patient	168 (%441)
Not Practicing	40 (%105)

2. Responses Regarding the Characteristics of Peri-implant Mucosa and Clinical Diagnosis of Peri-implant Diseases

The answers to these questions are presented in Table 2. The majority of participants (59.6%) believed that peri-implant mucosa should be keratinized. 52.8% of participants considered the presence of keratinized tissue less than 2 mm as a risk for peri-implantitis. 46.5% of participants stated that they used plastic probes because they believed plastic probes were necessary for diagnosis, while 32.8% indicated that, although they thought a plastic probe was required, they did not use it because it was unavailable in their clinic. The majority of participants (46.5%) indicated that they suspected peri-

implantitis when the probing depth was 4 mm or more. They also stated that when there was more than 3 mm of bone loss in comparison to the initial bone level after 1 year of prosthetic restoration placement or when there was no radiographic evidence or probing measurements, they suspected peri-implantitis when bleeding occurred during probing (Table 2).

Table 2. Responses of All Participants to Questions Regarding the Characteristics of Peri-Implant Mucosa and the Clinical Diagnosis of Peri-Implant Diseases

Questions	Total
Most important characteristic of peri-implant mucosa	
Attached peri-implant mucosa	119 % (31.2)
Keratinized peri-implant mucosa	227 (%59.6)
Thick peri-implant mucosa in bucco-lingual direction	35 (%9.2)
Presence of keratinized mucosa around the implant	
If the amount of keratinized mucosa is less than 2mm, peri-implantitis develops	201 (%52.8)
Lack of keratinized mucosa does not affect peri-implantitis development	32 (%8.4)
There is no definitive conclusion	137 (%36.0)
Other	11 (%2.9)
Preferred probe when measuring probing depth in peri-implant diseases	
Uses plastic periodontal probe because they believe it should be used	177 (%46.5)
Thinks plastic probe should be used, but uses metal periodontal probe because it is not available in the clinic	125 (%32.8)
Does not think plastic probe should be used, therefore uses metal periodontal probe	41 (%10.8)
Uses examination probe because a plastic probe is not available	38 (%10.0)
Threshold probing depth for diagnosing peri-implantitis	
Probing depth of 4 mm or more	177 (%46.5)
Probing depth of 6 mm or more	125 (%32.8)
Probing depth of 8 mm or more	41 (%10.8)
Other	38 (%10.0)
Radiographic bone loss findings suggestive of peri-implantitis	
Progressing bone loss compared to the bone level one year after placing a fixed prosthetic restoration on the implant	222 (58.3%)
Bone loss of 3 mm or more with bleeding on probing, in the absence of initial radiographs or probing depth measurements	171 (44.9%)
1 mm of bone loss in addition to 4-5 mm probing depth six months after placing a fixed prosthetic restoration on the implant	150 (39.4%)
3 mm of bone loss observed on the implant during the placement of the healing abutment in two-stage implants	79 (20.7%)

3. Responses Regarding the Treatment of Peri-implant Diseases

For mechanical debridement, participants primarily preferred plastic instruments (58%) followed by titanium instruments (56.2%) (Table 3). Plaque control was commonly applied to implants with peri-implant mucositis, either always (73.8%) or usually (23.4%), and to implants with peri-implantitis, either always (77.7%) or usually (18.9%). Non-surgical treatment was preferred for peri-implant mucositis either always (37.5%) or usually (44.9%), and for peri-implantitis, either always (42.5%) or usually (37.5%). Oral rinses were preferred either always (42%) or usually (37.5%) for peri-implant mucositis and either always (48.6%) or usually (33.1%) for peri-implantitis. The majority of participants (78%) stated that they would consider non-surgical treatment for peri-implantitis before surgical treatment, as it would facilitate tissue manipulation. For peri-implant mucositis, the most common preferences for local antiseptic/antibiotic application and systemic antibiotics were "sometimes" (36.7%) and "rarely" (30.4%), respectively, while "sometimes" was the most common response for local antiseptic/antibiotic in peri-implantitis (34.1%). Systemic antibiotics were applied "generally" (28.9%), "sometimes" (27.8%), and "rarely" (2.7%) for peri-implantitis. For peri-implantitis treatment, surgical debridement was preferred either "sometimes" (39.6%) or "generally" (38.1%). Resective and regenerative treatments were occasionally preferred by participants (56.4% and 41.5%, respectively), while implantoplasty was rarely preferred (35.4%). When asked about the use of regenerative treatment during peri-implantitis treatment, most participants stated they would rarely, sometimes, or never apply implantoplasty (34.4%, 23.6%, and 20.2%, respectively). Regarding the effectiveness of current treatments, most participants considered them effective "sometimes" (44.4%) or "mostly" (39.4%) (Table 3).

Table 3. Questions Related to the Treatment of Peri-Implant Diseases (General Distribution)

Questions	Total
Instruments Used for Mechanical Debridement of Peri-Implant Tissues	
Titanium instruments	214 (%56.2)
Carbon fiber instruments	95 (%24.9)
Plastic instruments	221 (%58.0)
Ultrasonic scalers	145 (%38.1)
Stainless steel instruments	28 (%7.3)
Preferred Treatments for Patients with Peri-Implant Mucositis and plaque/calculus	
Plaque Control	
Always	281 (7%3.8)
Generally	89 (%23.4)
Sometimes	9 (%2.4)
Rarely	1 (%0.3)
Never	1 (%0.3)
Nonsurgical treatment	
Always	143 (%37.5)
Generally	171 (%44.9)
Sometimes	49 (%12.9)
Rarely	12 (%3.1)
Never	6 (%1.6)
Mouth rinse	
Always	160 (%42.0)
Generally	143 (%37.5)
Sometimes	52 (%13.6)
Rarely	21 (%5.5)
Never	5 (%1.3)
Local antiseptic/antibiotic	
Always	34 (%8.9)
Generally	78 (%20.5)
Sometimes	140 (%36.7)
Rarely	116 (%30.4)
Never	13 (%3.4)
Systemic antibiotic	
Alway	13 (%3.4)
Generally	57 (%15.0)
Sometimes	95 (%24.9)
Rarely	159 (%41.7)
Never	57 (%15.0)
Other	
Always	5 (%1.3)
Generally	14 (%3.7)
Sometimes	111 (%29.1)
Rarely	145 (%38.1)
Never	106 (%27.8)
Preference for Non-Surgical Treatment Before Performing Surgical Treatment on an Implant with Peri-implantitis	
Considers it ineffective, hence does not consider applying non-surgical treatment	22 (%5.8)
Considers it would facilitate tissue manipulation, hence considers applying non-surgical treatment	297 (%78.0)
Undecided	58 (%15.2)
Other	4 (%1.0)
Preferred Treatment for an Implant with Peri-implantitis	
Plaque control	
Always	296 (%77.7)
Generally	72 (%18.9)
Sometimes	6 (%1.6)
Rarely	4 (%1.0)
Never	3 (%0.8)
Nonsurgical treatment	
Always	162 (%42.5)
Generally	143 (%37.5)
Sometimes	63 (%16.5)
Rarely	8 (%2.1)
Never	5 (%1.3)
Mouth rinse	
Always	185 (%48.6)
Generally	126 (%33.1)
Sometimes	50 (%13.1)
Rarely	14 (%3.7)
Never	6 (%1.6)
Local antiseptic/antibiotic	
Always	56 (%14.7)
Generally	113 (%29.7)
Sometimes	130 (%34.1)
Rarely	70 (%18.4)
Never	12 (%3.1)
Systemic antibiotic	
Always	49 (%12.9)
Generally	110 (%28.9)
Sometimes	94 (%24.7)
Rarely	106 (%27.8)
Never	22 (%5.8)
Surgical treatment	
Always	40 (%10.5)
Generally	145 (%38.1)
Sometimes	151 (%39.6)
Rarely	37 (%9.7)
Never	8 (%2.1)
Resective treatment	
Always	9 (%2.4)
Generall	46 (%12.1)
Sometimes	215 (%56.4)
Rarely	102 (%26.8)
Never	9 (%2.4)
Regenerative treatment	
Always	11 (%2.9)
Generally	70 (%18.4)
Sometimes	158 (%41.5)
Rarely	112 (%29.4)
Never	30 (%7.9)
Implantoplasty	
Always	6 (%1.6)
Generally	41 (%10.8)
Sometimes	128 (%33.6)
Rarely	135 (%35.4)
Never	71 (%18.6)
Other	
Always	2 (%0.5)
Generally	17 (%4.5)
Sometimes	100 (%26.2)
Rarely	125 (%32.8)
Never	137 (%36.0)
Implantoplasty during Regenerative Treatment for Peri-implantitis	
Always	16 (%4.2)
Generally	67 (%17.6)
Sometimes	131 (%34.4)
Rarely	90 (%23.6)
Never	77 (%20.2)
Effectiveness of Current Peri-implantitis Treatment Techniques	
Always effective	2 (%0.5)
Generally effective	150 (%39.4)
Sometimes effective	169 (%44.4)
Rarely effective	55 (%14.4)
Never effective	5 (%1.3)

4. Responses Regarding Risk Factors for Peri-implant Diseases

When asked about the risk factors for peri-implantitis, participants primarily identified a history of periodontitis (94.8%), smoking (93.7%), and diabetes (87.9%) as significant contributors. Regarding factors that could contribute to peri-implantitis development, cement remnants (94.2%) and the implant superstructure (93.4%) were identified as the most significant factors (Table 4).

Table 4. Questions Related to Risk Factors for Peri-Implantitis (General Distribution)

Questions	Total
Known Risk Factors for Peri-Implantitis	
History of periodontitis	361 (%94.8)
Smoking habits	357 (%93.7)
Diabetes	335 (%87.9)
Cancer	140 (%36.7)
Other	59 (%15.5)
Factors That May Contribute To The Development of Peri-Implantitis	
Cement residues	359 (%94.2)
Genetics	208 (%54.6)
Implant superstructure	356 (%93.4)
Occlusal overloa	309 (%81.1)
Other	16 (%4.2)

5. Information Sources and Treatment Preferences Based on Years Since Graduation

The distribution of responses regarding the sources from which participants obtained information about peri-implant diseases showed statistically significant differences based on the years since graduation ($p<0.05$) (Table 5). Participants who graduated within the last 5 years predominantly obtained information from their university education (88.6%). Those who graduated 5-10 years ago reported using both university education and courses/seminars, with a statistically significant difference compared to other groups ($p<0.001$). Participants who graduated more than 10 years ago obtained information predominantly from courses/seminars (69.3%), self-study (57.5%), and other sources (11.8%), and these rates were statistically significantly higher than those of the other two groups ($p<0.001$). Participants who graduated within the last 5 years generally referred patients for peri-implantitis treatment (54.5%), while participants who graduated more than 10 years ago were more likely to perform the treatment themselves, rarely calling specialists (39.4%), with a statistically significant difference ($p<0.001$) (Table 5).

Table 5. Sources of Information on Peri-Implant Diseases and Preferences for the Treatment of Peri-Implantitis According to Graduation Years

Questions	≤5 years (N=202)	5-10 years 2 (N=52)	≥10 years (N=127)	*p*
Information Source on Peri-Implant Diseases				
Undergraduate education	179 (%88.6)*	40 (%76.9)	38 (%29.9)	< 0.001
Courses and seminars	48 (%23.8)	30 (%57.7)*	88 (%69.3)*	< 0.001
Self-research	68 (%33.7)	19 (%36.5)	73 (%57.5)*	< 0.001
Other	6 (%3.0)	1 (%1.9)	15 (%11.8)*	0.002
Preference for Peri-Implantitis Treatment				
Usually performs it,rarely calls a specialist	35 (%17.3)	12 (%23.1)	50 (%39.4)*	< 0.001
Usually calls a specialist, rarely performs it	47 (%23.3)	16 (%30.8)	33 (%26.0)	
Refers to a specialist	110 (%54.5)*	20 (%38.5)	38 (%29.9)	< 0.001
Other	10 (%5.0)	4 (%7.7)	6 (%4.7)	

* Significant difference from other groups

6. Responses to Questions Regarding Peri-implant Mucosa and Clinical Diagnosis by Years Since Graduation

The distribution of responses regarding the characteristics of peri-implant mucosa did not show statistically significant differences based on years since graduation ($p>0.05$) (Table 6). Responses regarding the appropriate probe to be used for probing depth measurement during peri-implant disease diagnosis were similar across all groups ($p>0.05$). There was no statistically significant difference in the responses regarding the probing depth threshold that would suggest peri-implantitis ($p>0.05$). Responses related to radiographic bone loss and its role in diagnosing peri-implantitis also did not show significant differences based on years since graduation ($p>0.05$) (Table 6).

Table 6: Responses to Questions Regarding the Characteristics of Peri-Implant Mucosa and the Clinical Diagnosis of Peri-Implant Diseases by Participants According to Years of Graduation

Questions	≤5 years (N=202)	5-10 years 2 (N=52)	≥10 years (N=127)	*p*
Most Important Characteristic of Peri-Implant Mucosa				0.244
Attached peri-implant mucosa	55 (%27.2)	21 (%40.4)	43 (%33.9)	
Keratinized peri-implant mucosa	124 (%61.4)	28 (%53.8)	75 (%59.1)	
Thick peri-implant mucosa in bucco-lingual direction	23 (%11.4)	3 (%5.8)	9 (%7.1)	
Information Regarding the Presence of Keratinized Mucosa Around Implants				0.147
If the amount of keratinized mucosa is less than 2 mm, peri-implantitis will develop	93 (%46.0)	32 (%61.5)	76 (%59.8)	
The absence of keratinized mucosa does not affect the development of peri-implantitis	20 (%9.9)	3 (%5.8)	9 (%7.1)	
There is no definitive result regarding this issue	84 (%41.6)	16 (%30.8)	37 (%29.1)	
Other	5 (%2.5)	1 (%1.9)	5 (%3.9)	
Preferred Probe for Measuring Pocket Depth in Peri-Implant Disease				0.061
Uses plastic periodontal probe because they believe it should be used	100 (%49.5)	22 (%42.3)	55 (%43.3)	
Thinks plastic probe should be used, but uses metal periodontal probe because it is not available in the clinic	71 (%35.1)	19 (%36.5)	35 (%27.6)	
Does not think plastic probe should be used, therefore uses metal periodontal probe	15 (%7.4)	4 (%7.7)	22 (%17.3)	
Uses examination probe because a plastic probe is not available	16 (%7.9)	7 (%13.5)	15 (%11.8)	
Threshold probing depth for diagnosing peri-implantitis				0.061
Probing depth of 4 mm or more	100 (%49.5)	22 (%42.3)	55 (%43.3)	
Probing depth of 6 mm or more	71 (%35.1)	19 (%36.5)	35 (%27.6)	
Probing depth of 8 mm or more	15 (%7.4)	4 (%7.7)	22 (%17.3)	
Other	16 (%7.9)	7 (%13.5)	15 (%11.8)	
Radiographic bone loss findings suggestive of peri-implantitis				
Progressing bone loss compared to the bone level one year after placing a fixed prosthetic restoration on the implant	127 (62.9%)	31 (59.6%)	64 (50.4%)	0.081
Bone loss of 3 mm or more with bleeding on probing, in the absence of initial radiographs or probing depth measurements	67 (33.2%)	29 (55.8%)	75 (59.1%)	
1 mm of bone loss in addition to 4-5 mm probing depth six months after placing a fixed prosthetic restoration on the implant	86 (42.6%)	20 (38.5%)	44 (34.6%)	
3 mm of bone loss observed on the implant during the placement of the healing abutment in two-stage implants	39 (19.3%)	12 (23.1%)	28 (22.0%)	

7. Responses Regarding Peri-implant Disease Treatment by Years Since Graduation

The preferences for mechanical debridement using titanium instruments, plastic instruments, ultrasonic devices, and stainless steel instruments did not differ significantly based on years since graduation (p>0.05). However, carbon fiber instruments were preferred significantly more by those who graduated more than 10 years ago (37.8%) compared to the other groups (p<0.001). For peri-implant mucositis, the frequency of preferences for plaque control, non-surgical treatment, and systemic antibiotics did not differ significantly by graduation year (p>0.05). However, the use of oral rinses was more commonly reported by those who graduated within the last 5 years (18.8%) compared to the other groups (p<0.031). Local antiseptic/antibiotic use was preferred more by participants who graduated more than 10 years ago (p<0.023) (Table 7).

For the preference of non-surgical treatment for peri-implantitis before surgical treatment, there was no significant difference between groups, except for those in the 5-10 year group, who reported a higher preference for not applying non-surgical treatment due to the belief that it would not be effective (p=0.002) (Table 7).

Table 7: Responses of Participants Regarding the Treatment of Peri-Implant Diseases Based on Years Since Graduation

Questions	≤5 years (N=202)	5-10 years 2 (N=52)	≥10 years (N=127)	*p*
Instruments Used for Mechanical Debridement of Peri-Implant Tissues				
Titanium instruments	111 (%55.0)	36 (%69.2)	67 (%52.8)	
Carbon fiber instruments	30 (%14.9)	17 (%32.7)	48 (%37.8)*	< 0.001
Plastic instruments	119 (%58.9)	29 (%55.8)	73 (%57.5)	
Ultrasonic scalers	78 (%38.6)	24 (%46.2)	43 (%33.9)	
Preferred Treatments for Patients with Peri-Implant Mucositis and plaque/calculus				
Plaque Control				0.466
Always	153 (%75.7)	39 (%75.0)	89 (%70.1)	
Generally	41 (%20.3)	13 (%25.0)	35 (%27.6)	
Sometimes	7 (%3.5)	0 (%0.0)	2 (%1.6)	
Rarely	0 (%0.0)	0 (%0.0)	1 (%0.8)	
Never	1 (%0.5)	0 (%0.0)	0 (%0.0)	
Nonsurgical treatment				0.790
Always	75 (%37.1)	23 (%44.2)	45 (%35.4)	
Generally	91 (%45.0)	24 (%46.2)	56 (%44.1)	
Sometimes	26 (%12.9)	5 (%9.6)	18 (%14.2)	
Rarely	7 (%3.5)	0 (%0.0)	5 (%3.9)	
Never	3 (%1.5)	0 (%0.0)	3 (%2.4)	
Mouth rinse				0.031
Always	76 (%37.6)	22 (%42.3)	62 (%48.8)	
Generally	79 (%39.1)	23 (%44.2)	41 (%32.3)	
Sometimes	38 (%18.8)*	2 (%3.8)	12 (%9.4)	
Rarely	7 (%3.5)	4 (%7.7)	10 (%7.9)	
Never	2 (%1.0)	1 (%1.9)	2 (%1.6)	
Local antiseptic/antibiotic				0.023
Always	12 (%5.9)	4 (%7.7)	18 (%14.2)*	
Generally	36 (%17.8)	8 (%15.4)	34 (%26.8)*	
Sometimes	80 (%39.6)	18 (%34.6)	42 (%33.1)	
Rarely	69 (%34.2)	18 (%34.6)	29 (%22.8)	
Never	5 (%2.5)	4 (%7.7)	4 (%3.1)	
Systemic antibiotic				0.501
Alway	5 (%2.5)	3 (%5.8)	5 (%3.9)	
Generally	25 (%12.4)	8 (%15.4)	24 (%18.9)	
Sometimes	46 (%22.8)	13 (%25.0)	36 (%28.3)	
Rarely	93 (%46.0)	21 (%40.4)	45 (%35.4)	
Never	33 (%16.3)	7 (%13.5)	17 (%13.4)	
Preference for Non-Surgical Treatment Before Surgical Treatment in Peri-İmplantitis				0.002
Considers it ineffective. hence does not consider applying non-surgical treatment	5 (%2.5)	8 (%15.4)*	9 (%7.1)	
Considers it would facilitate tissue manipulation, hence considers applying non-surgical treatment	165 (%81.7)	41 (%78.8)	91 (%71.7)	
Undecided	31 (%15.3)	2 (%3.8)	25 (%19.7)	
Other	1 (%0.5)	1 (%1.9)	2 (%1.6)	
Preferred Treatment for An Implant with Peri-Implantitis				
Plaque control				0.481
Always	153 (%75.7)	45 (%86.5)	98 (%77.2)	
Generally	39 (%19.3)	7 (%13.5)	26 (%20.5)	
Sometimes	5 (%2.5)	0 (%0.0)	1 (%0.8)	
Rarely	2 (%1.0)	0 (%0.0)	2 (%1.6)	
Never	3 (%1.5)	0 (%0.0)	0 (%0.0)	
Nonsurgical treatment				0.715
Always	86 (%42.6)	23 (%44.2)	53 (%41.7)	
Generally	80 (%39.6)	20 (%38.5)	43 (%33.9)	
Sometimes	31 (%15.3)	7 (%13.5)	25 (%19.7)	

Rarely	2 (%1.0)	2 (%3.8)	4 (%3.1)	
Never	3 (%1.5)	0 (%0.0)	2 (%1.6)	
Mouth rinse				0.096
Always	88 (%43.6)	22 (%42.3)	75 (%59.1)	
Generally	73 (%36.1)	21 (%40.4)	32 (%25.2)	
Sometimes	32 (%15.8)	6 (%11.5)	12 (%9.4)	
Rarely	5 (%2.5)	3 (%5.8)	6 (%4.7)	
Never	4 (%2.0)	0 (%0.0)	2 (%1.6)	
Local antiseptic/antibiotic				< 0.001
Always	19 (%9.4)	5 (%9.6)	32 (%25.2)*	
Generally	45 (%22.3)	19 (%36.5)	49 (%38.6)*	
Sometimes	89 (%44.1)*	16 (%30.8)	25 (%19.7)	
Rarely	43 (%21.3)	11 (%21.2)	16 (%12.6)	
Never	6 (%3.0)	1 (%1.9)	5 (%3.9)	
Systemic antibiotic				0.021
Always	18 (%8.9)	8 (%15.4)	23 (%18.1)*	
Generally	53 (%26.2)	14 (%26.9)	43 (%33.9)	
Sometimes	46 (%22.8)	16 (%30.8)	32 (%25.2)	
Rarely	69 (%34.2)*	12 (%23.1)	25 (%19.7)	
Never	16 (%7.9)	2 (%3.8)	4 (%3.1)	
Surgical treatment				0.036
Always	12 (%5.9)	5 (%9.6)	23 (%18.1)*	
Generally	79 (%39.1)	19 (%36.5)	47 (%37.0)	
Sometimes	89 (%44.1)	22 (%42.3)	40 (%31.5)	
Rarely	18 (%8.9)	6 (%11.5)	13 (%10.2)	
Never	4 (%2.0)	0 (%0.0)	4 (%3.1)	
Resective treatment				0.004
Always	4 (%2.0)	2 (%3.8)	3 (%2.4)	
Generall	21 (%10.4)	12 (%23.1)*	13 (%10.2)	
Sometimes	115 (%56.9)	24 (%46.2)	76 (%59.8)	
Rarely	61 (%30.2)	14 (%26.9)	27 (%21.3)	
Never	1 (%0.5)	0 (%0.0)	8 (%6.3)	
Regenerative treatment				0.018
Always	3 (%1.5)	2 (%3.8)	6 (%4.7)	
Generally	25 (%12.4)	11 (%21.2)	34 (%26.8)*	
Sometimes	90 (%44.6)	19 (%36.5)	49 (%38.6)	
Rarely	70 (%34.7)*	15 (%28.8)	27 (%21.3)	
Never	14 (%6.9)	5 (%9.6)	11 (%8.7)	
Implantoplasty				0.052
Always	4 (%2.0)	2 (%3.8)	0 (%0.0)	
Generally	20 (%9.9)	9 (%17.3)	12 (%9.4)	
Sometimes	79 (%39.1)	14 (%26.9)	35 (%27.6)	
Rarely	67 (%33.2)	20 (%38.5)	48 (%37.8)	
Never	32 (%15.8)	7 (%13.5)	32 (%25.2)	
Implantoplasty during Regenerative Treatment for Peri-implantitis				0.108
Always	11 (%5.4)	2 (%3.8)	3 (%2.4)	
Generally	35 (%17.3)	11 (%21.2)	21 (%16.5)	
Sometimes	73 (%36.1)	23 (%44.2)	35 (%27.6)	
Rarely	48 (%23.8)	10 (%19.2)	32 (%25.2)	
Never	35 (%17.3)	6 (%11.5)	36 (%28.3)	
Effectiveness of Current Peri-implantitis Treatment Techniques				0.959
Always effective	2 (%1.0)	0 (%0.0)	0 (%0.0)	
Generally effective	82 (%40.6)	20 (%38.5)	48 (%37.8)	
Sometimes effective	87 (%43.1)	23 (%44.2)	59 (%46.5)	
Rarely effective	29 (%14.4)	8 (%15.4)	18 (%14.2)	
Never effective	2 (%1.0)	1 (%1.9)	2 (%1.6)	

* Significant difference from other groups

There were no significant differences in the frequency of use for plaque control, non-surgical debridement, and oral rinses in the treatment of peri-implantitis (p>0.05). However, local antiseptic/antibiotic and systemic antibiotic application preferences were more frequently reported by those who graduated more than 10 years ago compared to those who graduated within the last 5 years (p<0.001, p=0.02). Additionally, surgical debridement was preferred significantly more by those who graduated more than 10 years ago (p=0.036). Resective treatment was most commonly chosen by participants who graduated 5-10 years ago (p=0.004), while regenerative treatment was more frequently chosen by participants who graduated more than 10 years ago (p=0.018). No significant difference was observed in preferences for applying implantoplasty during regenerative treatment for peri-implantitis (p>0.05). Responses regarding the effectiveness of current peri-implantitis treatment techniques showed no significant differences based on years since graduation (p>0.05) (Table 7).

8. Responses Regarding Risk Factors for Peri-implant Diseases by Years Since Graduation

There were no statistically significant differences in the responses regarding risk factors for peri-implantitis or factors contributing to peri-implantitis development based on years since graduation (p>0.05) (Table 8).

Table 8: Responses of Participants Regarding Risk Factors for Peri-Implant Diseases Based on Years Since Graduation

Questions	≤5 years (N=202)	5-10 years 2 (N=52)	≥10 years (N=127)	*p*
Known Risk Factors for Peri-Implantitis				
History of periodontitis	193 (%95.5)	48 (%92.3)	120 (%94.5)	0.638
Smoking habits	191 (%94.6)	48 (%92.3)	118 (%92.9)	0.758
Diabetes	177 (%87.6)	47 (%90.4)	111 (%87.4)	0.841
Cancer	77 (%38.1)	21 (%40.4)	42 (%33.1)	0.549
Other	24 (%11.9)	9 (%17.3)	26 (%20.5)	0.103
Factors That May Contribute To The Development of Peri-İmplantitis				
Cement residues	186 (%92.1)	50 (%96.2)	123 (%96.9)	0.159
Genetics	114 (%56.4)	31 (%59.6)	63 (%49.6)	0.353
Implant superstructure	185 (%91.6)	49 (%94.2)	122 (%96.1)	0.271
Occlusal overloa	164 (%81.2)	38 (%73.1)	107 (%84.3)	0.222
Other	7 (%3.5)	1 (%1.9)	8 (%6.3)	0.312

DISCUSSION

With the increasing use of dental implants, the prevalence of peri-implant diseases has also risen, prompting research to focus on this issue.[14] The rise in the frequency of peri-implant diseases has made it crucial for dental practitioners to possess adequate knowledge in this area. Therefore, the aim of our survey was to evaluate the diagnostic and treatment approaches to peri-implant diseases among general dentists who do not have specialized or doctoral qualifications.

When participants were asked about the sources of information they relied on regarding peri-implant diseases, those who graduated in the last five years reported obtaining most of their knowledge from university education (88.6%), while those who graduated 5-10 years ago primarily referred to undergraduate education, but also relied on courses and seminars. Participants who had graduated more than 10 years ago reported that only 29.9% of their knowledge came from undergraduate education, while 69.3% acquired it through courses and seminars, and 57.5% through self-research. Given the timing of changes in educational programs, it is likely that older graduates sought to address their knowledge gaps by attending courses and seminars or conducting independent research. The modifications in the undergraduate curriculum over the years may have contributed to this trend. There were no significant differences between the groups regarding the expected characteristics of peri-implant mucosa, the amount of keratinized mucosa, the probing depth threshold for peri-implantitis, or the preferred instruments for probing depth measurements. This suggests that general dentists who had insufficient information during their undergraduate education were able to acquire accurate knowledge through post-graduate education. In our study, bleeding on probing was not included as a separate question because, although it is important for the diagnosis of peri-implantitis, it can also be observed in peri-implant mucositis, making it

non-specific. Therefore, bleeding on probing could be asked along with other diagnostic features in future survey studies to gather more detailed information on the subject.

Participants who graduated in the last five years generally reported referring patients for peri-implantitis treatment (54.5%), whereas those with more than 10 years of experience indicated that they mostly treated the patients themselves (39.4%), with a lower rate of patient referral (29.9%). In the DUCEP program, peri-implantitis is taught only at the diagnostic and preventive level, and it is recommended that patients be referred to specialists for treatment. Peri-implant diseases can be complex to treat, and professional experience is important in this regard. Therefore, it is possible that recently graduated participants are more likely to refer patients for treatment due to limited experience in managing peri-implant diseases.

In our study, 38.1% of participants reported using ultrasonic devices for mechanical debridement, which is lower than in similar studies.[15-18] This difference may be due to the fact that the question in our survey did not emphasize the selection of appropriate ultrasonic tips for implants. The use of stainless steel instruments was also low (7.3%) compared to similar studies.[15-17] The preference for titanium instruments was found to be 56.2%, which is higher than in similar studies.[16,17] Both undergraduate education and continuing education in courses and seminars stress that instruments designed for teeth are not suitable for implants and that special tips and instruments should be used for implants. Therefore, titanium instruments are preferred more frequently than ultrasonic and stainless-steel instruments, likely due to the education provided in these settings. In a study by Mattheos et al.[16], the use of plastic instruments was 65.6% in the UK and 39.7% in Australia. In the study by Papathanasiou et al.[17], periodontists preferred plastic instruments 42.5% of the time. In our survey, the preference for plastic instruments was 58%. These surveys targeted specialists, whereas our survey was conducted among general dentists without specialization or doctoral qualifications, which may account for the differences in results.

The importance of plaque control in the treatment of peri-implant diseases is well established.[19,20] In our survey, the responses regarding plaque control in treatment were consistent with the literature and similar studies.[15-17] In a study by Khan et al.[15], 88.9% of participants always preferred plaque control. In our study, plaque control was consistently used by participants across all groups in the treatment of peri-implant mucositis. In our study, the most common frequencies for non-surgical debridement in peri-implant mucositis treatment were "always" (37.5%) and "usually" (44.9%). These results are consistent with the findings of Papathanasiou et al. (always 49.1%, usually 32.6%)[17]. The use of mouth rinses was a commonly used method in the treatment of both peri-implant mucositis and peri-implantitis, which aligns with similar studies.[15-17] In our study, the use of local antibiotics/antiseptics in peri-implant mucositis treatment was in line with the findings of Papathanasiou et al.[17], although in the study by Mattheos et al.[16], most clinicians reported that they never preferred local antibiotics. In our study, the frequency of local antibiotic/antiseptic use in peri-implant mucositis and peri-implantitis was similar. Similar findings were observed in the study by Papathanasiou et al.[17], while in two other studies[16,18], the preference for local antibiotics was lower. These differences in local antiseptic/antibiotic preferences may be due to variations in pharmaceutical markets between countries.

The frequency of systemic antibiotic use in peri-implantitis treatment was lower in our study compared to similar studies.[15,16,18] Participants with over 10 years of experience reported a higher frequency of systemic antibiotic use in peri-implantitis, while younger participants preferred it less. The growing awareness of antibiotic resistance in recent years may have contributed to this difference.

Participants in our survey (78%) reported considering non-surgical treatments before opting for surgical interventions in peri-implantitis, as these treatments facilitate tissue manipulation in more advanced cases. A higher proportion of participants who graduated within the last 5 years indicated this preference. Longer-graduated participants, most of whom work in the private sector, may have been influenced by the need for quicker solutions to patient problems in private practice. The most common answer for surgical debridement was "sometimes" (39.6%). In the study by Khan et al.[15], the most common response for surgical debridement was "usually" (51%). The lower frequency of surgical debridement in our study may be attributed to the fact that our participants were general dentists rather than specialists. While peri-implantitis is taught theoretically in undergraduate education, it is practiced in specialist training programs. When questioned about the preference for surgical debridement in peri-implantitis treatment, there was no significant difference between the groups, with similar responses of "sometimes," "usually," and "rarely" across all groups. However, dentists with more than 10 years of experience significantly preferred the "always" option compared to other groups. This finding may reflect the influence of their clinical experience and expertise.

Regarding the choice between resective or regenerative procedures for peri-implantitis, 56.4% of participants stated they would sometimes choose a resective procedure, while 41.5% would sometimes choose a regenerative approach. In the study by Khan et al.[15], 44.2% of participants generally preferred resective treatment, while 39.5% preferred regenerative treatment.

In the study by Papathanasiou et al.[17], the most frequent response was "sometimes" (45.5%). This suggests that regenerative procedures, which are more complex and require more experience, may be less frequently chosen by younger or less experienced dentists. In a study by Schmidlin et al.[18], non-specialist dentists preferred regenerative procedures (56%) over resective procedures (47%). In the same study, specialists preferred regenerative treatment (78.8%) over resective treatment (68.4%). Similarly, in the survey by Papathanasiou et al.[17], regenerative procedures were preferred more frequently (always 9.4%, usually 30.2%) compared to resective procedures (always 3.5%, usually 22.7%). The clinical experience, training, specialization, and the cost of biomaterials used may all influence these results.

There were limitations in the present study. The voluntary nature of survey participation may have led to a higher response rate from dentists interested in peri-implant diseases, potentially affecting the results. Additionally, the fact that the survey was distributed through the researchers' social media accounts may have contributed to a younger age distribution among participants, which could have influenced the responses.

CONCLUSION

Recent graduates have a relatively high level of knowledge about peri-implant diseases and their treatments. Older graduates, who did not acquire sufficient knowledge during their undergraduate education, have made efforts to acquire information through courses, seminars, and self-research. Therefore, more comprehensive education programs, courses, and seminars should be organized for older graduates. Further research into dentists' attitudes towards the diagnosis and treatment of peri-implant diseases will help identify gaps in knowledge and enable the development of additional educational initiatives. Future studies with a more balanced participant distribution and larger sample sizes will provide further insights into this topic.

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