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EVALUATION OF THE USAGE PREVALENCE AND KNOWLEDGE LEVELS OF THE DENTISTS ABOUT ORAL SCANNERS AND 3D PRINTERS*

DİŞ HEKİMLERİNİN AĞIZİÇİ TARAYICI VE 3B YAZICILAR İLE İLGİLİ BİLGİ SEVİYELERİNİN DEĞERLENDİRİLMESİ

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ABSTRACT

The recent study aimed to evaluate the knowledge levels of dentists on intraoral scanners and 3D printers with their usage prevalence of them in Türkiye. A link to the survey was sent via e-mail to 1782 dentists in different branches who participated in this survey, which had 27 questions in four subgroups, including demographic information, general digital dentistry, intraoral scanners, and 3D printers. The total number of dentists who answered the questionnaire was determined as 305. Considering the distribution of the ages, %21.3 (n=65) of the participants were 23-28 years, %32.1 (n=98) were 29-35 years, and %46.6 (n=142) were 36 and over years. A statistically significant difference was found in the use of intraoral scanners and 3D printers in work places (p<0.001, p<0.001). A statistically significant difference was found regarding branches in intraoral scanner usage.While the rate of using intraoral scanners by 54.5% of restorative dentists is higher than other branches (p<0.001), orthodontists were found to be more active users of 3D printers (47.9%, p=0.001). According to the results of our study, it has been observed that dentists generally obtain information aboutintraoral scanners and 3D printers through individual efforts and only a few dentists in Türkiye can integrate these devices into their everyday practices.

Keywords: Digital dentistry; Intraoral scanner; 3D printer.

ÖZ

Bu çalışmanın amacı, diş hekimlerinin ağız içi tarayıcılar ve 3B yazıcılar hakkındaki bilgi düzeylerini ve Türkiye'de kullanım yaygınlıklarını değerlendirmektir. Demografik bilgiler, genel dijital diş hekimliği, ağız içi tarayıcılar ve 3B yazıcılar olmak üzere dört alt grupta 27 sorudan oluşan bu ankete katılan farklı branşlardaki 1782 diş hekimine anket linki e-posta ile gönderilmiştir. Anketi yanıtlayan toplam diş hekimi sayısı 305 olarak belirlenmiştir. Yaş dağılımına bakıldığında katılımcıların %21.3 (n=65)'i 23-28 yaş arası, %32.1 (n=98)'i 29-35 yaş arası, %46.6 (n=142) 36 yaş ve üzerindeydi. İşyerlerinde ağız içi tarayıcı ve 3B yazıcı kullanımında istatistiksel olarak anlamlı fark bulundu (p<0.001, p<0.001). Ağız içi tarayıcı kullanımında branşlara göre istatistiksel olarak anlamlı fark bulundu. Restoratif diş hekimlerinin %54.5'inin ağız içi tarayıcı kullanma oranı diğer branşlara göre daha yüksek (p<0.001) iken, ortodontistlerin 3B yazıcıları daha aktif kullandıkları (%47.9, p=0.001) bulundu. Çalışmamızın sonuçlarına göre, diş hekimlerinin genellikle ağız içi tarayıcılar ve 3B yazıcılar hakkında bireysel çabalarla bilgi edindiği ve Türkiye'de az sayıda diş hekiminin bu teknolojileri günlük uygulamalarına entegre edebildiği görülmüştür.

Anahtar kelimeler: Ağız içi tarayıcı; 3 boyutlu yazıcı; Dijital diş hekimliği.

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INTRODUCTION

Developments in digital dentistry have led to the increased use of new technologies in health sciences. Within the framework of adapting to digital platforms with the developing technology, it is predicted that diagnosis and treatment planning and options in dentistry will move from the traditional approach to digital dentistry. While introducing intraoral and facial scanners and developments in digital radiology have improved the effectiveness, accuracy, consistency, and predictability of treatment planning, 3D printing systems have brought a new perspective to treatment (1,2). In addition to all these developments, digital education with training tools and interactive video presentations have enabled the development of patient-dentist and dentist-dentist communication (3-5).

Dental records have been transitioned to digital media through the recent developments of asother medical records (6). Obtaining dental models, which is one of these records, can be done by indirect or direct techniques, and 3D digital models obtained by direct intraoral scanning have significant advantages compared to traditional plaster models obtained by indirect techniques (1,7). With advantages such as maintaining integrity and quality, ease of storage, rapid and effective access in the clinic, making communication with colleagues or different fields of expertise easier, and digital dental models significantly facilitate clinical management (8-10). Furthermore, it is beneficial for patients who are at risk of aspiration and respiratory distress, such as those with a facial reflex, lip and palate cleft, or syndrome (5,11,12). Although digital technology is used in the production of targeted study models, training models, volumetric images using Cone Beam Computed Tomography (CBCT), and the production of 3D dental casts. Besides, the use of digital models has some disadvantages: high cost, inability to work by transferring to the articulator, additional training, equipment, and information support are some of them (13-16). Dentists may be forced to resort to traditional treatments due to these unfortunate conditions.

The present study evaluated the prevalence and knowledge level of dentists on intraoral scanners and 3D printers in our nation by questionnaire. Ünüvar et al. (14) reviewed 388 questionnaires for evaluating the use of digital models by orthodontists and concluded that orthodontists widely use digital model technology. In another study, oral and maxillofacial surgeons' knowledge of 3D printers was assessed, and it was discovered that 62.2% of those who lived in Germany used 3D printers. These new technical fields are constantly evolving; thus, studies should be conducted more regularly, and information about dentists' practices and access to these technologies should be updated. In addition, no research has been conducted to evaluate the knowledge of dentists living in Türkiye about intraoral scanners and 3D printers and examine thoughts on the future role of these technologies in dentistry. The purpose of the study was to evaluate dentists' knowledge levels and usage prevalence of intraoral scanners and 3D printers. The study also aimed to assess dentists' intraoral scanners' usage areas and benefits, 3D printers' applications and production technologies, their accessibility to these technologies, and their views on the role of intraoral scanners and 3D printers in future dentistry.

MATERIALS AND METHODS

This study was approved by the University of Health Science Scientific Research Ethics Committee on 06.05.2021 (acceptance number: 2021/203). The research was done in complete compliance with the Helsinki Declaration. The purpose of the survey was to investigate the knowledge level and frequency of the use of 3D printers and intraoral scanners among dentists in Türkiye. For this reason, the survey questions were designed to consist of 4 subgroups of demographic information (Figure I), general digital dentistry (Figure II), intraoral scanners (Figure III), and 3D printers (Figure IV), and the questionnaire form was prepared using Google Forms (Google Forms, 2020, Alphabet, USA).

DEMOGRAPHIC INFORMATION
Gender
o Female o Male
Your Age
o 23-28 o 29-35 o 36 and over
City where you live
....
Do you have a Specialization/Ph.D. in the area that you have or are currently doing?
o No, I do not have any o Oral, Dental and Maxillofacial Surgery o Oral, Dental and Maxillofacial Radiology o Pediatric Dentistry o Endodontics o Orthodontics o Periodontology o Prosthetic Dentistry o Restorative Dentistry o Other
In which institution do you work as a dentist/specialist?
o I am working as a specialist/lecturer/faculty member at the university o I am a graduate/doctoral student at the university o I work in one of the institutions that provide oral and dental health services under the Ministry of Health o I work in an institution that provides private oral and dental health services o I work in my own private practice
How many years are you in dentistry?
o 0-5 years o 6-10 years o 11 years and over

Figure I: Demographic information

GENERAL DIGITAL DENTISTRY
How do you keep the diagnosis or treatment models you receive from your patients in your archive?
o I keep plaster models directly o I scan plaster models and transfer them to digital media o I scan the inside of the mouth and transfer it to digital media o I do not maintain any archives of diagnosis or treatment models o Other
Would you consider attending any course on intraoral scanners?
o Yes o No
Would you consider attending any course on 3D printers?
o Yes o No
If you do not use an intraoral scanner and 3D printer, what are the reason(s)? (You can tick more than one option.)
o Being costly o Maintenance of equipment and the need for regular updates o Not learning the system o Thinking that there is no difference compared to the conventional system o Not applicable to every case o Not available at my institution o Other

Figure II: General digital dentistry

INTRAORAL SCANNERS
Do you use intraoral scanners in your clinical practice?
o Yes o No
Where did you get your current knowledge about intraoral scanners? (You can tick more than one option.)
o I do not know about intraoral scanners o I took it as a course in undergraduate/graduate education at the university o I attended a course or seminar o I learned it myself from the internet o Other
Is an intraoral scanner used in your current institution?
o Yes o No
What do you think are the advantage/advantages of using intraoral scanners in dentistry? (You can tick more than one option.)
o I have no information o It reflects the oral environment more clearly than the impression materials used o No need for physical storage o The planned treatment result can be shown to the patient at the beginning of the treatment o Opportunity and ease of transfer between dentists and institutions o Elimination of biological and mechanical complications of impression materials o Minimizing the difficulties experienced while taking measurements o Other
If you are using an intraoral scanner, which procedure(s) do you use it for? (You can tick more than one option.)
o In prosthetic restorations such as crowns and bridges o Inlay and onlay production o In surgical applications such as abutments and implants o For surgical guide o Night plaque production for bruxism o In the production of orthodontic clear aligner treatment o Other
How many years have you been using intraoral scanners?
o 0-1 year o 2-3 years o 4-5 years o 6-10 years o 11 years and over
Do you think that an intraoral scanner should be used in the institution?
o Yes o No
Would you consider using an intraoral scanner in your future professional life?
o Yes o No

Figure III: Intraoral scanners

3D PRINTERS
Do you use 3D printers in your clinical practice?
o Yes o No
Where did you get your current knowledge about 3D printers? (You can tick more than one option.)
o I do not know about 3D printers o I took it as a course in undergraduate/graduate education at the university o I attended a course or seminar o I learned it myself from the internet. o Other
Is a 3D printer used in your current institution?
o Yes o No
How many years have you been using 3D printers?
o 0-1 year o 2-3 years o 4-5 years o 6-10 years o 11 years and over
What do you think are the advantage or advantages of using 3D printers in dentistry? (You can tick more than one option.)
o I have no information o Fast modeling o Shortening of appointment times o Minimizing the margin of error as a result of personalized design o Reduction of time in the design cycle o Ability to make precise prints o Other
Do you know about the printing technologies of 3D printers? If your answer is yes, which one(s) do you know about? (You can tick more than one option.)
o No, I do not o Stereo-lithography (SLA) technology o Digital Light Processing (DLP) technology o Selective Laser Sintering (SLS) technology o Multijet technology, also called Polyjet o Fused Deposition Modeling (FDM) technology o Other
Do you think that 3D printers should be used in your institution?
o Yes o No
Would you consider using a 3D printer in your future professional life?
o Yes o No
Do you think that the use of intraoral scanners and 3D printers will play a major role in the future of dentistry?
o Yes o No

Figure IV: 3D printers

The descriptive section determined gender, age, branches, workplace, and incumbency. In the second section, questions such as the types of archiving, diagnosis, and treatment models, the desire of the participants to receive training on these two technologies, and the reasons for not using these two systems were asked. More detailed questions regarding intraoral scanners and 3D printers were included in the following sections. The presence/absence and advantages/disadvantages of the systems with individuals' learning sources were questioned in the last section. In addition, options were added to some questions where participants could add their comments.

The survey was sent to 1782 dentists, including members of the local professional societies along with the survey's objective and ethics committee form. Two reminder e-mails were sent to the participants to increase the feedback rate. The data were converted into numerical values in the computer environment and made suitable for analysis.

Statistical Analysis

Statistical analyzes were performed with SPSS 26 (IBM SPSS Statistics, SPSS 26.0 version, United States) statistical software. Frequency and percentage were used in the descriptive statistics of the variables examined within the scope of the research. Pearson Chi-square test was used to compare group distributions. A p value of <0.05 was considered statistically significant.

RESULTS

The total number of dentists participating in research by answering the questionnaire completely and correctly was determined as 305. Considering the distribution of the ages, %21.3 (n=65) of the participants were 23-28 years, %32.1 (n=98) were 29-35 years, and %46.6 (n=142) were 36 and over years. While 37% (n=113) of the participants were male, 63% (n=192) were female and when their specialties were evaluated, it was observed that 47.2% (n=144) were orthodontists, 20.7% (n=63) were general practitioners, 12.5% (n=38) were prosthodontists, 5%, 2 (n=16) pediatric dentists, 4.6% (n=14) oral and maxillofacial surgeon and radiologist, 3.6% (n=11) restorative dentistry specialist, 3.3% (n=10) were periodontologists and 3% (n=9) were endodontists. 24.6% of the dentists within the scope of the research work in private health institutions, 22.3% in institutions affiliated with the Ministry of Health, and 53.1% in the university hospital.

Regarding Table I, most dentists want to receive information on intraoral scanners and 3D printers (n=265, n=266). Almost half of the dentists in the survey do not keep any records of their patients' diagnoses and treatments. Additionally, 33.4% keep the models directly, 20% transfer them to the digital environment after intraoral scanning, and 1.6% scan the plaster models and transfer them to the digital media. When the distribution of the reasons for not preferring the intraoral scanners and 3D printers in the clinic, the generality stated that intraoral scanners and 3D printers are not in the workplace (n=149). 40.5% stated that these devices are costly, and 30% stated that they did not know these new technological systems (Table I). While 37.2% of dentists have learned about intraoral scanners from the internet,

Table I. General digital dentistry information of the dentists participating in the survey

General digital dentistry information		n	%
Archive Records	No archive record	137	4.9
	Archiving with plaster models	102	33.4
	Archiving with an intraoral scanner	61	20.0
	Archiving with plaster model scanner	5	1.6
Consider taking a course about intraoral scanners	No	40	13.1
	Yes	265	86.9
Consider taking a course about 3D printers	No	32	10.7
	Yes	266	89.3
Reasons the not using the intraoral scanner and 3D printer*	Not available in working place	149	65.6
	Being costly	92	40.5
	Not learning the system	68	30.0
	Maintenance of equipment and the need for regular system updates	35	15.4
	Not applicable to every case	25	11.0
	Thinking that no differences between conventional systems	1	0.4
	Not applicable for private clinics where only one dentist	1	0.4

*Multiple selections

33.2% from courses and seminars, 19.1% from postgraduate and graduate education, and 25.8% do not knowabout intraoral scanners (Table II). Table II also shows the usage time and the advantages of intraoral scanners. The majority of participants (n=237) said the physical storage area was unnecessary and that the planned treatment result could be shown to the patient at the start of treatment (n=212). In addition, 68.8% claimed to minimize difficulties while taking an impression, 68.1% eliminated biological and mechanical complications of impression materials, and 60.4% represented oral enlargement better than impression (Table II).

When the purpose of using intraoral scanners by dentists is evaluated, 75.5% (n=71) of the dentists are in the production of clear aligners, 35.1% (n=33) in the prosthetic restorations (Table II). Approximately half of the dentists within the scope of the study use intraoral scanners in the workplace. In addition, most dentists think that intraoral scanners should be used in the institution, and they think of using intraoral scanners in the future (n=290, n=295) (Table II). While 40.0% of the dentists

Table II. The usage and knowledge levels of the participants about intraoral scanners in the survey

		n	%
Usage of the intraoral scanners in working place	No	211	69.2
	Yes	94	30.8
Using time of the intraoral scanners in working place	0-1 year	34	36.2
	2-3 years	44	46.8
	4-5 years	11	11.7
	6-10 years	5	5.3
Resource for learning the use of intraoral scanners *	Learning from the internet myself	111	37.2
	Learning from the courses	99	33.2
	No information about intraoral scanners	77	25.8
	Learning from the undergraduate education	57	19.1
	Other (company courses etc.)	11	3.7
Advantages of the intraoral scanners*	No need for physical storage	237	79.5
	Shown the planned results of the treatment at the beginning	212	71.1
	Elimination of the difficulties of the taking impression	205	68.8
	Elimination of the biological and mechanical complications of the impression materials	203	68.1
	Reflects of the oral environment better than impression materials	180	60.4
	The opportunity of the data transfer between dentists and institutions	92	30.9
Aim for the usage of the intraoral scanners*	Orthodontics clear aligner treatment	71	75.5
	Prosthetic restorations	33	35.1
	Inlay and on lay restorations	32	34.0
	Surgical applications	17	18.1
	Surgical guide	12	12.8
	Night plaque production for bruxism	12	12.8
	Other	12	12.8
Availability of the intraoral scanners in the workplace	No	168	55.1
	Yes	137	44.9
Considering the necessary of the intraoral scanners in the workplace	No	15	4.9
	Yes	290	95.1
Considering of the usage intraoral scanners in the future	No	10	3.3
	Yes	295	96.7

*Multiple selections

stated that they did not know about 3D printers, 38.7% knew about 3D printers from the internet, and 23.6% (n=72) from courses and seminars (Table III). Table III also shows the usage time of 3D printers. 202 dentists stated minimizing the margin of error as a result of personalized design, 189 dentists stated fast modeling, 157 dentists stated doing precise printing, 154 dentists stated the reduction of the time in the design cycle, and 134 dentists stated the shortening of the appointment times as the advantages of the 3D printers (Table III). In addition, when considering which 3D printer technologies the dentists know about, 22.3% (n=68) of the dentists have knowledge about Stereolithography (SLA) technology, and 15.7% (n=48) Digital Light Processing (DLP) technology (Table III). 3D printers are used in 31.1% (n=95) of dentists' institutions, and most participants think that 3D printers should be used in their workplace (n=259). In addition, 89.2% (n=272) of dentists consider using 3D printers in the future, and 97.7% (n=298) state that intraoral scanners and 3D printers will play a significant role in dentistry in the future (Table III). Also, 40.4% (n=38) of dentists who use intraoral scanners employ 3D printers in their practice.

The distribution of the archiving status of the diagnosis and treatment models of the patients differs statistically significantly according to their incumbency (p<0.001). The rate of not keeping archives was half of the dentists with 11 years of experience or more (n=76); this rate was determined as 24.1% of dentists with 6-10 years of experience and 36.8% of dentists with 0-5 years of experience (Table IV). As another finding of our study, a statistically significant difference was found in terms of duty period to get training about intraoral scanners of the dentists within the scope of the study (p=0.004). While 96.1% of dentists with 0-5 years experience want to be trained on intraoral scanners, this rate decreased to 90.2% (6-10 years experience) and 81.3%(11 years or more). (Table IV). There was also a statistically significant variation in the distribution of dentists' usage of 3D printers in clinical practice according to their duty time in the study. (p=0.002) (Table IV).

As seen in Table V, a statistically significant difference was found in branches in the distribution of intraoral scanners in clinical practice by dentists (p<0.001). Accordingly, orthodontists and restorative dentists' preference for intraoral scanners in clinical practice was higher than others. Similarly, a statistically significant difference was found regarding branches in the distribution of dentists' use of 3D printers in clinical practice (p=0.001). The use rate of 3D printers in clinical practice by orthodontists and prosthetic dentists is higher than others Table VI shows the dentists' use of intraoral scanners and 3D printers in different workplaces. As shown in Table VI, a statistically significant difference was

Table III. The usage and knowledge levels of the participants about 3D printers in the survey

		n	%
Usage of the 3D printers in working place	No	238	78.0
	Yes	67	22.0
Using time of the 3D printers in the workplace	0-1 year	40	59.7
	2-3 years	18	26.9
	4-5 years	3	4.5
	6-10 years	2	3.0
	11 years and over	4	6.0
Resource for learning the use of 3d printers *	No information about 3D printers	122	40.0
	Learning from the internet myself	118	38.7
	Learning from the courses	72	23.6
	Learning from the undergraduate education	50	16.4
	Other (company courses etc.)	4	1.3
Advantages of the 3D printers*	Minimizing the margin of the errors with personalized production	202	66.4
	Rapid prototyping	189	62.2
	Making sensitive printing	157	51.6
	Reduction of the design cycle time	154	50.7
	Shortening the frequency of the appointments	134	44.1
Known of the 3D printer Technologies*	No information about the technologies	217	71.1
	Stereolithography (SLA) technology	68	22.3
	Digital Light Processing (DLP) technology	48	15.7
	Selective Laser Sintering (SLS) technology	48	15.7
	Fused Deposition Modelling (FDM) technology	23	7.5
	Multijet (Polyjet) technology,	22	7.2
Availability of the 3D printers in the workplace	No	210	68.9
	Yes	95	31.1
Considering the necessary of the 3D printers in the workplace	No	46	15.1
	Yes	259	84.9
Considering of the usage 3D printers in the future	No	33	10.8
	Yes	272	89.2
Considering that intraoral scanners and 3D printers play a major role in the future	No	7	2.3
	Yes	298	97.7

*Multiple selections

Table IV. Associating dentists' opinions about the intraoral scanner and 3d printer with the incumbency

		Incumbency			*p
		0-5 years n (%) 1	6-10 years n (%) 2	11 ve years and over n (%) 3	
Archive records	Archiving with an intraoral scanner	7 (9.2)	9 (14.8)	45 (27.1)	**<0.001 (1-2)**
	Archiving with plaster model scanner	0 (0.0)	2 (40)	3 (1.8)	
	Archiving with a plaster model	41 (53.9)	19 (18.6)	42 (25.3)	
	No archive records	28 (36.8)	33 (24.1)	76 (45.8)	
	Total	*76 (100.0)*	*63 (100.0)*	*166 (100.0)*	
Consider taking a course about the intraoral scanners	No	3 (3.9)	6 (9.5)	31 (18.7)	**0.004 (1-2)**
	Yes	73 (96.1)	57 (90.5)	135 (81.3)	
	Total	*76 (100.0)*	*63 (100.0)*	*166 (100.0)*	
Consider taking a course about the 3D printers	No	4 (5.5)	6 (9.8)	22 (13.4)	0.188
	Yes	69 (94.5)	55 (90.2)	142 (86.6)	
	Total	73 (100.0)	61 (100.0)	164 (100.0)	
Usage of the intraoral scanner in the workplace	No	58 (76.3)	48 (76.2)	105 (63.3)	0.054
	Yes	18 (23.7)	15 (23.8)	61 (36.7)	
	Total	*76 (100.0)*	*63 (100.0)*	*166 (100.0)*	
Usage of the 3D printers in working place	No	67 (88.2)	59 (93.7)	125 (75.3)	**0.001 (2-3)**
	Yes	9 (11.8)	4 (6.3)	41 (24.7)	
	Total	*76 (100.0)*	*63 (100.0)*	*166 (100.0)*	

*Fisher Exact Test with Bonferroni method, comparing columns.

Table V. Associating dentists' opinions about the intraoral scanner and 3d printer with the profession

		Profession								*p
		1 n(%)	2 n(%)	3 n(%)	4 n(%)	5 n(%)	6 n(%)	7 n(%)	8 n(%)	
Usage of the intraoral scanner in working place	No	13 (92.9)	16 (100.0)	8 (88.9)	75 (52.1)	8 (80.0)	29 (76.6)	5 (45.5)	57 (52.1)	**<0.001**
	Yes	1 (7.1)	0 (0.0)	1 (11.1)	69 (47.9)	2 (20.0)	9 (23.7)	6 (54.5)	6 (9.5)	
	Total	*14 (100.0)*	*16 (100.0)*	*9 (100.0)*	*144 (100.0)*	*10 (100.0)*	*38 (100.0)*	*11 (100.0)*	*63 (100.0)*	
Usage of the 3D printer in working place	No	13 (92.9)	14 (87.5)	8 (88.9)	103 (71.5)	9 (90.0)	32 (84.2)	10 (90.9)	62 (98.4)	**0.001**
	Yes	1 (7.1)	2 (12.5)	1 (11.1)	41 (28.5)	1 (10.0)	6 (15.8)	1 (9.1)	1 (11.1)	
	Total	*14 (100.0)*	*16 (100.0)*	*9 (100.0)*	*144 (100.0)*	*10 (100.0)*	*38 (100.0)*	*11 (100.0)*	*63 (100.0)*	
Considering of the usage intraoral scanners in the future	No	2 (14.3)	0 (0.0)	2 (22.2)	5 (3.5)	0 (0.0)	1 (2.6)	0 (0.0)	0 (0.0)	**0.035**
	Yes	12 (85.7)	16 (100.0)	7 (77.8)	139 (96.5)	10 (100.0)	37 (97.4)	11 (100.0)	63 (100.0)	
	Total	*14 (100.0)*	*16 (100.0)*	*9 (100.0)*	*144 (100.0)*	*10 (100.0)*	*38 (100.0)*	*11 (100.0)*	*63 (100.0)*	

1: Oral and Maxillofacial Surgery and Radiology, 2: Pediatric dentistry, 3: Endodontic, 4: Orthodontics, 5:Periodontology, 6: Prosthetic dentistry, 7: Restorative dentistry, 8: No branch.
*Pearson Chi-square Tes

Table VI. Evaluation of dentists' usage of the intraoral scanner and 3d printer according to the working place

		Working place			*p
		Private oral health clinic n(%) 1	Oral health services under the ministry of health n(%) 2	University n(%)3	
Availability of the intraoral scanner in the workplace	No	34 (45.3)	68 (100.0)	66 (40.7)	**<0.001 (1-2) (2-3)**
	Yes	41 (54.7)	0 (0.0)	96 (59.3)	
	Total	*75 (100.0)*	*68 (100.0)*	*162 (100.0)*	
Availability of the 3D printer in the workplace	No	59 (78.7)	68 (100.0)	110 (67.9)	**<0.001 (1-2) (2-3)**
	Yes	16 (21.3)	0 (0.0)	52 (32.1)	
	Total	75 (100.0)	68 (100.0)	162 (100.0)	

*Fisher Exact Test with Bonferroni method, comparing columns.

found in the distribution of intraoral scanners and 3D printers used in the institution of dentists ($p<0.001$, $p<0.001$, respectively). The rate of intraoral scanner usage in universities is 59.3% (n=96), and 3D printer usage rates are 32.1% (n=52) compared to other health institutions (Table VI).

DISCUSSION AND CONCLUSION

Developments in Computer Aided Design/ Computer Aided Manufacturing (CAD/CAM) technologies have resulted in a rise in a new era in the health care industry, and hence in dentistry (3,17). Computer-based diagnostic and treatment records have become routine in many public hospitals and universities (18). The current study evaluated dentists' approach and knowledge levels in Türkiye on this technological innovation. The study's primary outcome revealed that dentists independently received intraoral scanners and 3D printers. Only a few dentists in Türkiye could integrate these devices into their daily practice. Pabst et al. (19) evaluated the knowledge of oral and maxillofacial surgeons in Germany regarding 3D printers, while Ünüvar et al. (14) evaluated the use of digital models by orthodontists. However, no study analyzing the knowledge of Turkish considerations on the future role of these technologies; was found in the literature. The purpose of this study was to assess dentists' knowledge of intraoral scanners' usage areas and benefits, 3D printers' applications and production technologies, their accessibility to these technologies, and their views on the role of intraoral scanners and 3D printers in future dentistry.

While Pabst et al. (19) stated that in their survey conducted with oral and maxillofacial surgeons on 3D printers, 65.7% participated from university hospitals, Ünüvar et al. (14) reported that most of the participants in their study were working in university (76.8%). It is seen that the highest participation in our study was from university hospitals with 53.1%, and these findings were compatible with the recent study results.

With the answers given by the dentists participating in our survey to the question of how they archive the models they received from their patients, it was concluded that the majority of the dentists directly archived the plaster models; at least they scanned the models and transferred them to the digital media. Ünüvar et al. (14) reported that half of the orthodontists who participated in the survey used digital models. The fact that the dentists in our study included orthodontists, other branches, and practitioners may explain the discrepancy between the two studies.

Parikh et al. (20) reported that half of the participants learned about 3D printers on their own from the internet, and 60% of the surveyed orthodontists attended courses and meetings about 3D printers. In our study, 40% of the respondents stated that they did not know about 3D printers, while 38.7% learned about 3D printers themselves from the internet. In addition, 23.6% of the participants have learned about 3D printers from courses and seminars. Accordingly, by providing more training to dentists in our country during the post/ undergraduate periods, dentists might be qualified in these technologies and use them more easily in the post -training period without needing a course or internet support (20).

According to our survey findings, only a low minority of participating dentists had access to 3D printers in their professional practice (22%). Pabst et al. (19) stated that only 21.1% of maxillofacial surgeons had this technology in their clinics, whereas 2.5% used it in conjunction with other clinics or departments. Furthermore, Ünüvar et al. (14) revealed that a large part of the participants (86%) was considering utilizing a digital model in the future, which matches the data of the participants in our study who are considering using these systems in the future (96.7% and 89.2%, respectively).

In our study, reasons for not using a 3D printer and intraoral scanner included not having it in their institution (65.6%), it being too precious (40.5%), and not comprehending the system (30%). When Pabst et al.(19) investigated why dentists could not use these technologies in their study, they found that high costs (37.6%) and a lack of resources (33.3%) were the top causes. However, Ünüvar et al. (14)reported the reasons for not using the digital model, the lack of necessary equipment (44.6%), and the cost of the system (28.3%). Reduced system costs or institutional acquisition of these technologies will increase the adoption of these advances as more dentists are exposed to them.

Stereolithography technology was reported as the most preferred printing technic in a similar survey study conducted by Pabst et al. (19) (69.4%). Our study also observed that dentists were more informed on stereolithography technology (22.3%). It is thought that the increase in the number and usability of SLA-based printers in recent years due to the high printing resolution and fast forming speed may be the reason for this. Furthermore, according to the current findings of a study conducted by Pabst et al. (19), university hospitals have a greater rate of using 3D printers than other health institutions, consistent with our findings.

According to our findings, dentists with 11 years of experience have a higher rate of information on oral scanning and digital media transmission. However, less experienced dentists seek further training in this area. In addition, it is seen that the group of dentists using intraoral scanners and 3D printers more in the clinic is the more experienced group of participants. From this, we conclude that dentists have learned and started to use these technologies in the post-graduation period and that more experienced dentists have mastered innovative technologies in this manner.

According to the results of our study, among the branches, the three branches that use the most intraoral scanners are restorative dentistry, orthodontics, and prosthetic dentistry branches (54.5%, 47.9%, and 23.7%, respectively). Regarding the use of 3D printers usage, the branch that uses the most 3D printers is orthodontics (28.5%). We believe that clear aligner treatmentis the most preferred treatment modality in which intraoral scanners are used. The high rate of intraoral scanners and 3D printers used by orthodontists stated above confirms this fact.

Limitation

Similar to other survey studies, our study also has some limitations; sample bias is one of them because survey participation is voluntary. Another limitation of ours is that the members did not receive the survey because they did not have any e-mail address or did not utilize

the one they provided to the organization. The dentists preferring not to use 3D technologies showed limited participation in the study. This situation may be related to the title of the questionnaire in which the term "use of 3D printers"was mentioned.

The current study results represent the usage and knowledge levels of intraoral scanners and 3D printers in Türkiye. Subjects such as cost, labor, time efficiency, and evaluation of these technologies based on cases can be studied in future questionnaires.

According to the results of this study, dentists obtain information about intraoral scanners and 3D printers on their own, and only a few dentists in Türkiye can integrate these devices into their everyday practices. Furthermore, the participants are considering using intraoral scanners and 3D printers, and they want to be well-informed and taught about these technologies. In this context, it is suggested that teaching and practices linked to digital advances in dentistry should be highlighted at the undergraduate, postgraduate, and specialist levels.

Conflict of Interest

There is no conflict of interest.

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