

Research Paper: Evaluating Attitude and Practice of Dentists Regarding use of Digital and Computer Technology in Dentistry in Rasht



Melida Miri¹, Azadeh Hasanzadeh², Maryam Rabiei³, Yasamin Babaee Hemmati^{2*}

1. School of Dentistry, Guilan University of Medical Sciences, Rasht, Iran
2. Dental Sciences Research Center, Department of Orthodontics, School of Dentistry, Guilan University of Medical Sciences, Rasht, Iran
3. Dental Sciences Research Center, Department of Oral and Maxillofacial Medicine, School of Dentistry, Guilan University of Medical Sciences, Rasht, Iran



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ABSTRACT



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Introduction: Using technology in health care is purposed to increase the quality of treatment, improve communication between medical and dental centers, enhance precision in dental procedures, optimize access to specialists and reduce treatment costs. This study aimed to evaluate attitude and practice of dentists regarding use of digital and computer technology in dentistry in Rasht.

Materials and Methods: This analytical cross-sectional study was conducted on 190 dentists in Rasht using a questionnaire that examined the attitude and practice of dentists in 3 fields of using Administrative and communication digital technologies, clinical and diagnostic digital technologies, and dentists' attitudes on the use of technology and its results. To analyze the data, independent t-test, Mann Whitney test, and Spearman correlation test were used ($\alpha=0.05$).

Results: Eighty-seven dentists (45.7 %) had medium use of Administrative and communication digital technologies, and four of them (9.5 %) had high use. Regarding the use of clinical and diagnostic digital technologies, 179 participants (94.2%) had low use. Most dentists had a high (66.2%) and average (27.4 %) attitude. No significant relationship was observed between dentist's attitudes, the amount of use of digital communication and administrative technologies, and the use of clinical and diagnostic digital technology towards demographic variables. However, the amount of use of clinical and diagnostic digital technology has a significant relationship with the type of degree ($p = 0.006$).

Conclusion: Although the level of digital technology use by dentists in various fields was not high, the attitude of most of them was above average.

Keywords:

*Digital Technology

*Dentists

*Questionnaires

* Corresponding Authors:

Yasamin Babaee Hemmati

Address: Dental Sciences Research Center, Department of Orthodontics, School of Dentistry, Guilan University of Medical Sciences, Rasht, Iran

Tel: +981333486423

E-mail: yasi.10482@gmail.com

1. Introduction

The new state-of-the-art digital dentistry enables exploration of innovations and advancements that have significantly impacted and improved the field (1). The use of technology in healthcare is regarded as the most crucial and essential factor for enhancing quality (2). Research has shown that technology not only integrates information and represents the condition of patients but also improves access to information and clinical records, facilitates electronic-educational communications, and supports comprehensive management, ultimately elevating community health levels (3-5).

Nowadays, the integration of computers and the Internet among dentists, alongside the implementation of information technology, significantly enhances the quality of patient care and communication (6). These advancements facilitate the optimal management of offices and treatment centers, consequently driving changes across various fields of dental science (6).

One of the most significant advantages of digital methods is their speed, which greatly reduces work and calculation errors (7). Digitalization enhances the administration of dental practices by streamlining tasks such as managing master data, appointments, and billing, and by facilitating the digital recording of patient information, including medical histories and radiographs (8). Digital tools and applications for therapeutic planning, as well as aesthetic and functional rehabilitation, are now widespread in routine dental care (9,10). However, the ethical risks and challenges associated with digital dentistry are seldom discussed (11).

The International Medical Informatics Association recommends that medical professionals enhance their knowledge and practice in the field of instrumental, administrative, and communication technologies (12). In dentistry, as in other fields, it often takes time to pass between the production of new technologies and their acceptance and use in practice. Some researchers believe that some dentists are slow to adopt new innovations (13). While others consider dentists to be "innovators in technology" (14). Dentists, in order to use this technology in their field profession, must have sufficient knowledge, positive attitude and acceptable practice (15). Therefore, To Keep up with the speed of technological progress, dentists shall be adequately trained or exposed to such devices (16).

The use and acceptance of digital technologies vary significantly among individuals and organizations (17). Studies indicate that technology use in dentistry is influenced by factors such as the type of technology and innovation, its potential applications, the organizational environment, and social, political, and economic contexts (18-20). Consequently, in the field of digital technology use, the attitudes of users and the extent of technology adoption differ across professional groups (21). These variations may partly result from the type of content and activities being performed and the users' attitudes

towards the technology itself (21, 22).

Digital workflows have been integrated into nearly all dental specialties, encompassing everything from data collection and diagnosis to final treatment (22). Intraoral scanners (IOS) are among the digital technologies currently utilized for patient care (22). Computer-aided design and computer-aided manufacturing (CAD/CAM) enable the creation of models and prosthetic reconstructions (23). Three-dimensional (3D) intraoral imaging data can be combined with 3D radiographic and facial imaging data to facilitate computer-assisted planning for orthognathic surgeries, dental implant surgeries, and orthodontic treatments (23,24). Digital technologies can potentially supplant traditional methods in both implant and orthognathic surgeries (24). In orthodontics, these technologies can support treatment planning and execution, such as with clear aligners (24).

The adoption and use of digital technologies by dental professionals have been explored in numerous studies, providing valuable insights into dentists' motivations for using certain technologies (25-28). Additional research has investigated the use and objectives of various technologies in dentistry (29-32). Often, these studies focus on specific and limited technologies, despite the broad range of digital applications in dentistry. Given this context and the lack of sufficient studies in Iran and Guilan Province, this study aimed to evaluate the attitudes and practices of dentists regarding the use of digital and computer technology in dentistry in Rasht.

2. Materials and Methods

This analytical cross-sectional study was carried out on 190 dentists in Rasht city in 2021. The study protocol was approved by ethics committee of Guilan University of Medical Sciences (IR.GUMS.REC.1400.123). To determine the sample size, according to the attitudes and opinions of dentists in Guilan province regarding the use of digital and computer technology in dentistry, its ratio should be taken into account. For this, a formula is used to estimate the ratio in a society. Considering an error level of 0.05 and the ratio equal to 0.94 and $d=0.05$, the sample size is at least 86.66, which is rounded up to 87 (33).

$$n = \frac{\left(z_{1-\frac{\alpha}{2}} \right)^2 \cdot p(1-p)}{(d)^2} = \frac{(1.96)^2 \cdot 0.94(1-0.94)}{(0.05)^2} = 86.66 \cong 87$$

The data collection tool used in this study was a questionnaire. After designing the questionnaire, it was checked for validity. The Content Validity Ratio (CVR) was used to check the content validity quantitatively, using two coefficients. Ten professors and specialists examined each of the questions and classified them into three categories: necessary, useful but not necessary, and not necessary. To calculate the CVR coefficient, the number of experts who answered "necessary" was divided by 10. To calculate the Content Validity Index

(CVI), dentists commented on the relevance, clarity, and simplicity of the questions. Questions that did not meet the minimum required score were omitted.

According to the results, five questions were omitted. Then, validity values were recalculated. In both cases, the CVR and CVI values above 0.9 were obtained and confirmed. After confirming the validity, the questionnaires were distributed among 10 dentists to check reliability. The reliability value was obtained based on Cronbach's alpha, which was above 0.7, and the reliability of the questionnaire was also confirmed.

Participation of dentists in the study was completely voluntary. After obtaining informed consent, the dentists were assured that their information and all the answers provided would remain confidential, and the results would be reported in general without publishing names. Therefore, the purpose of the study was first explained to the dentists, and they were assured that the obtained information would be kept confidential by the researcher. All the dentists in Rasht city who were willing to complete the questionnaire were included in the study. Lack of consent to participate in the study and failure to continue cooperation and complete the distributed questionnaires caused the dentists to leave the study. This questionnaire included three parts: (1) demographic information of dentists; (2) use of dental technologies including administrative and communication digital technologies, and clinical and diagnostic technologies; and (3) their attitudes about the use of digital technologies and their results in diagnostic and clinical fields. In this questionnaire, after demographic information, six questions in the second part were related to the practice and use of administrative and communication technologies by users, including digital patient information, digital address/financial management, website, digital appointment/reminder, digital information display, and social media. If the dentist used the relevant administrative and communication technologies, he/she received a score of 1; otherwise, he/she received a score of 0. Based on this, the score range was between 0 and 6. Scores were categorized as follows: 0-2 low use, 3-4 medium use, and 5-6 high use. Then, 17 questions related to users' use of clinical and diagnostic technologies, including digital intraoral radiography, digital orthopantomogram, intraoral cameras, intraoral scanners, 3D digital radiology (CBCT), dental microscope, CAD/CAM systems, digital

color determination, and orthodontics digital tracing software. If any technology was used, a score of 1 was given; otherwise, a score of 0 was considered for the user. Based on this, the score range was from 0 to 17. As a result, based on the score obtained, it was divided into three groups: low use (score 0-5), medium use (score 6-11), and high use (score 12-17). In the third part, 13 questions utilizing a 5-point Likert scale were conducted to assess participants' attitudes towards the outcomes of using these technologies. Each question was scored based on the option chosen by the dentist. The options are: I completely disagree, I disagree, I have no opinion, I agree, and I completely agree, ranging from 1 to 5 points. The score range varied between 13 and 65. Based on the percentile method, 13-30 was considered low, 31-48 medium, and 49-65 high.

To check the normality of the groups, the Shapiro-Wilk test was used, and the homogeneity of variances was analyzed by Levene's test. For data analysis in this study, independent t-tests were conducted for quantitative variables if the relevant assumptions were met. If the assumptions were not satisfied, the Mann-Whitney test and Spearman correlation were utilized. The software used was SPSS version 26. The significance level was considered 0.05 in all tests.

3. Results

Among the 190 dentists, the age range of the participants in the study was between 27 and 72 years, with an average age of 45.45 ± 13.51 years. Of all participants, 45.5% were female, and 54.5% were male. Additionally, 69.5% were general practitioners, and 30.5% were specialists. The average work experience was 21.78 ± 13.32 years, with the minimum being 1 year and the maximum being 55 years. The average number of patients seen per day was 8.54 ± 3.39 , with the least and most visits being 2 and 20, respectively. The average daily working hours were 6.37 ± 1.84 , with the minimum being 3 hours and the maximum being 11 hours (Table 1).

The average score for the use of Administrative and communication digital technologies was 2.45 ± 0.93 . 45.8 % had medium use, 9.5 % had high use, and the rest had low use. The average score of using clinical and diagnostic digital technology was 3.12 ± 1.35 (Table 2). Based on the obtained results, 94.2 % had low use and the rest had medium use.

Table 1. The frequency of using administrative and communication digital technologies, the use of clinical and diagnostic digital technologies, and the attitude of using digital technologies

Frequency	Use of Administrative and communication digital technologies	Use of clinical and diagnostic digital technologies	Attitude of use of digital technologies
Low	85	179	12
Medium	87	5	52
High	18	6	126
Total	190	190	190

Table 2. Mean Scores and Standard Deviations (SD) of Participants use in Different Domains of the Questionnaire

Domains	Mean	SD	Minimum	Maximum
Administrative and communication digital technologies	2.45	0.94	1.00	5.00
Diagnostic and clinical technology	3.12	1.35	0.00	7.00



Determining the attitude of dentists regarding the use of technology and its results, the average score of the attitude of the use of technology among the surveyed participants was 50.06 ± 5.42 (Table 3). Based on the results, 66.3 % participants had a high attitude, 6.3% had low attitude and the rest (27.4 %) had an average attitude.

Table 4 presents the results of the analysis of the relationship between the frequency of use of each category of technology studied and the attitude of participants in relation to demographic variables. Based on the results obtained, there was no significant relationship between the attitude of dentists on the use of technology and its outcomes with demographic variables ($p > 0.05$). Similarly, there was no significant relationship

between the amount of use of digital communication and administrative technology with gender ($p = 0.259$), type of degree ($p = 0.599$), work experience ($p = 0.798$), average number of patients visited per day ($p = 0.192$), and daily working hours ($p = 0.771$). Additionally, the results indicated no significant relationship between the amount of use of clinical and diagnostic digital technology with gender ($p = 0.178$), work experience ($p = 0.269$), average number of patients visited per day ($p = 0.921$), and daily working hours ($p = 0.829$). However, there was a significant relationship between the amount of use of clinical and diagnostic digital technology and the type of degree ($p = 0.006$), with specialists having higher use of clinical and diagnostic digital technology.

Table 3. Mean score and standard deviations (SD) of questions related to attitude of use of digital technologies and the results of its application in diagnostic and clinical fields

Questions related to the dentists' attitude	Score (Mean $\pm$ SD)
Digital technologies increase the quality of dental treatment.	4.18 ± 0.56
Digital technologies help reduce mistakes	4.17 ± 0.59
Digital technologies increase the accuracy of diagnosis	4.15 ± 0.62
Working with digital technologies makes treatment easier for dentists.	3.88 ± 0.67
Working with digital technologies reduces the patient's fear.	3.55 ± 0.71
Digital technologies differentiate the dentist from other colleagues.	3.68 ± 0.72
Digital technologies have more uses than I invest in them.	3.72 ± 0.73
Despite the technical problems, I trust digital technologies	3.88 ± 0.66
One of the advantages of working with digital technologies is the easier exchange of information between colleagues.	4.06 ± 0.54
After participating in the training courses, I have enough information about digital technologies to be able to meet my expectations from it.	3.89 ± 0.59
If the digital device fails, the process of clinical work will be disrupted	3.48 ± 0.96
for the types of treatments that I usually do, investing in digital technologies is not cost-effective.	3.49 ± 0.87
I only buy digital technology when I am sure I will use it for a long time.	3.88 ± 0.71
Total score	50.07 ± 5.42



Table 4. Determining the Relationship Between the Frequency of Use of Each Category of Technology Studied and Participants' Attitude and Practice Scores with Demographic Variables

	Gender*	Type of degree	Work experience	Patients visited per day	Daily working hours
Use of Administrative and communication digital technologies	$P=0.259^*$ $Z=-1.12$	$P=0.599^{**}$ $t=-0.52$	$P=0.798^{***}$ $r=-0.03$	$P=0.192^{***}$ $r=-0.15$	$P=0.771^{***}$ $r=-0.03$
Use of clinical and diagnostic digital technology	$P=0.178^*$ $Z=1.35$	$P=0.006^*$ $Z=-2.78$	$P=0.269^{***}$ $r=0.12$	$P=0.921^{***}$ $r=0.01$	$P=0.829^{***}$ $r=-0.02$
Score of attitude and practice	$P=0.724^*$ $Z=0.35$	$P=0.638^{**}$ $t=0.47$	$P=0.267^{***}$ $r=-0.12$	$P=0.796^{***}$ $r=-0.03$	$P=0.905^{***}$ $r=.015$



* Mann-Whitney

**Independent Samples Test

*** Spearman's

4. Discussion

Dentistry professors and faculties are facing a special challenge due to rapid developments in administrative and communication technology. In the age of globalization, where knowledge has no borders, more investment and efforts are needed to take advantage of the potential benefits of new technology on the quality of oral health education (34). Digital technology in dentistry has brought about so many changes in the last few years that every dentist looks at the future with excited anticipation. Due to the ever-increasing technological trends, there is an increasing need to evaluate the breadth and depth of dental applicants' knowledge, attitude, and practice toward digital dentistry. This evaluation can be valuable to adjust educational tools (11). The present study was conducted with the aim of investigating the attitude and practice of dentists in Rasht regarding the use of digital and computer technology in dentistry.

45.8% of participants had medium use, 9.5% had high use, and the rest had low use of digital communication and administrative technologies. 94.2% had low use of clinical and diagnostic digital technologies and the rest had medium use. Additionally, 66.3% of participants had a high attitude, 6.3% had a low attitude, and the remaining 27.3% had an average attitude. Moreover, based on the results obtained, there was no significant relationship between the amount of use of Administrative and communication digital technologies and clinical and diagnostic digital technology with demographic variables. However, the specialists significantly use the clinical and diagnostic digital technology higher. In 2017, van der Zande et al. evaluated dentists' attitudes about the use of digital technologies in dentistry. They showed that 31% of dentists had high technology use and 22% had low use (35). In another study by the same researcher in 2015, the use of fifteen technologies related to management, communication, clinical and diagnostic branches, individual factors, and features of the type of dental procedure was measured among 1,000 specialist and general dentists in the Netherlands. The results showed that 22.5% of users had low use (0 to 4 technologies), 42.2% had medium use (5 to 7 technologies), and 31.3% had high use (8 to 12 technologies). The results of these two studies were not consistent with our study. The difference between these two studies and the present study lies not only in the number of samples but also in the fact that the present study was conducted in Iran, where the technologies used are different. Dentists in these countries have different attitudes towards technology use (36). In Madfa et al.'s study in 2023, 87.0% of general dentists used digital technologies in the field of dentistry. Most of them believed that digital improvements include patient satisfaction, time-saving, improved accuracy compared to previous methods, and a high level of predictability of outcomes. Additionally, in this study, men used digital technologies more than women (37). In a 2014 study among dentists in the Netherlands, 68.7% of dentists had a high and medium usage of digital technologies. High

users were more likely to have a specialization, be younger, and work more hours per week (36).

Schweyen et al.'s study in 2018 investigated the impact of teaching CAD-CAM technology to dentists in the training program. They reported that 94% of participants were interested in the CAD-CAM training program, and almost half of the participants used the knowledge gained to design veneers for patients (33). In Ren et al.'s study in China, the attitudes of dental students towards digital simulation technologies in dentistry were evaluated and compared with traditional teaching methods. The study revealed that most students accepted digital simulation technology due to its wide usefulness. They also believed that the use of these technologies facilitates dental procedures. According to studies, dentists have a positive attitude towards the use of technology and its results, regardless of the fact that various studies were conducted in different countries with different facilities and technologies (38).

Based on the results of the present study, most dentists agree that digital technologies increase the quality of treatment, reduce errors, make diagnosis more accurate, and make treatment easier. In 's study in 2022, it was revealed that 93.8% of students believed that digital dentistry would provide more precise results than conventional dentistry, which is consistent with our study (39). In another study consistent with our results, 98.5% of general dentists stated that digital technology improves the quality of treatment (37). In a 2024 study on the assessment of digital dentistry knowledge and practices among dental students at King Faisal University in Saudi Arabia, 91.7% believed that digital dentistry provides more precise results than conventional dentistry, with men significantly more likely to think this (40). Liu et al.'s study, related to the attitude of dental students about the use of digital technology in dentistry, also revealed that 96% of students completely agreed that the use of digital education systems and digital devices increased their practical ability compared to traditional methods (19).

In the present study, a questionnaire was used to collect data. There was no need to mention the names of the participants, giving them the opportunity to complete the questionnaire without worrying about the lack of correct answers. However, the questionnaire may prompt participants to present their situation more favorably than the actual reality. Additionally, the results of the study cannot be generalized to dentists across the whole country. Nevertheless, the importance of the subject, coupled with the limited number of studies in the field of digital technology in dentistry, makes the results of the present study valuable. More research is needed to investigate dentists' knowledge and attitudes toward the use of digital technology in dentistry, particularly in treatment planning and communication. Furthermore, the study's objectives could be expanded to a larger statistical community, separated by specialized fields. It would be beneficial to explore other factors, such as time-saving with digital technology, how dentists became familiar with digital technology, and their learning sources. Additionally, it could be evaluated whether dentists

believe digital technology will completely replace traditional and conventional dentistry, and their opinions on the digital future in dentistry.

5. Conclusion

More than half of the participants used medium and high levels of digital communication and administrative technologies. Despite the fact that most dentists had a high and medium attitude towards the use of technology and its results, the majority had low use of diagnostic and clinical technologies. However, specialists used clinical and diagnostic digital technology significantly more often compared to others.

Ethical Considerations

The study was approved by the ethical review board of the Guilan University of Medical Sciences (IR.GUMS.REC.1400.123).

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Authors' Contributions

Melida Miri: data curation and Resources **Azadeh**

Hasanzadeh: Writing - Original Draft, Investigation, Writing - Review & Editing **Maryam Rabiei:** conceptualization, methodology, project administration, visualization, and Writing - Review & Editing **Yasamin Babaee Hemmati:** conceptualization, methodology, supervision, Writing - Original Draft, Writing - Review & Editing.

Conflict of Interests

The authors declare no conflict of interest.

Availability of data and material

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request. Also, the datasets supporting the conclusions of this article are included within the article.

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