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ORIGINAL RESEARCH

# Perception, awareness, and attitude toward digital dentistry among general dental practitioners: A questionnaire-based survey

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## ABSTRACT

**Background**: Digital dentistry involves using technologies with digital or computer-controlled components to enhance dental procedures, replacing traditional mechanical tools. It includes tools like CAD/CAM systems, 3D imaging, and digital impressions, which improve efficiency, precision, and patient outcomes. By addressing the demand for more comfortable and accurate treatments, digital dentistry helps practices stay competitive in an evolving landscape.

**Aim**: The aim of the study was to assess the perception, awareness, and attitude of dental practitioners toward digital dentistry.

**Material and methodology**: A cross-sectional questionnaire survey was undertaken amongst 120 general dental parctitioners in Ahmedabad that consisted of 12 questions which evaluated their awareness, knowledge and practices towards digital dentistry. Statistical analysis was carried after collecting all the data using Statistical Package for the Social Sciences (SPSS) version.

**Result**: The results show that majority of general dental practitioners have a positive perception of digital dentistry, with moderate knowledge and strong enthusiasm. Despite some barriers like cost and comfort with new methods, there is a general readiness to adopt digital solutions, particularly with enhanced education and support, paving the way for further integration of these technologies in dental practice.

**Conclusion**: This survey revealed that most of general dental practitioners believed that Digital dentistry enhances precision, speed, and patient comfort through advanced technologies and also improves efficiency and outcomes.However, dental education programs, workshops and hands on program should be conducted which will allow a future generation of dentists who are knowledgeable about digital dentistry.


**Keywords**:Digital dentistry, CAD/CAM, General dental practitioners.

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## INTRODUCTION

Digitalization has revolutionized every sector with its broad applications.[1] Digital dentistry uses digital or computer-controlled tools, moving away from traditional mechanical or electrical equipment.[2] Dental practitioners are experiencing shifts in work and workplace dynamics due to the constant evolution of digital technologies.[3]

Digitalization in dentistry offers endless possibilities, from motivating patients and documenting data to digital impressions, virtual articulators, prosthesis planning, shade matching, and CAD restoration fabrication. These technologies are valuable in clinical dentistry, student training, teaching, research, laboratory procedures, and dental studies.[1]

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CAD/CAM prosthetic and implant planning software are transforming dentistry. These advancements, along with improvements in dental materials, are reshaping the field.[4]

Technologies like intraoral scanning, 3D printing, and advanced materials have replaced traditional multistep procedures in restorative and prosthetic dentistry, reducing working time and enhancing treatment outcomes. Digital dentistry is being applied in various clinical areas, including implants, restorations, orthodontics, oral surgery, and rehabilitation. Rapid growth of digital dentistry has expanded clinical possibilities, but its adoption varies among practitioners. Adapting to these innovations is complex, influenced by factors like the technology, users, organizational setting, and socio-political context. Challenges such as high costs, resistance to change, interoperability, and data security must be addressed for broader adoption.[5]

Recent innovations in dentistry use digital technologies to enhance treatment quality and improve the overall patient experience.[6]

The success of new ideas in dentistry is heavily influenced by dentists' attitudes, expectations, workplace relationships, and interests.[7]

This survey aims to assess general dental practitioners' perception, awareness, and attitude toward digital dentistry using a specific questionnaire.

## MATERIALS AND METHOD

This questionnaire based study was done with the aim to assess the perception, awareness, and attitude of dental practitioners toward digital dentistry.

A sample of 120 general dental practitioners were selected for this cross-sectional questionnaire study. Those who gave consent and agreed to take part in the survey were included in the study and those who refused to give consent were excluded from the study. The custom questionnaire was designed, comprising of 12 questions in which all were closed ended questions (Figure 1,2,3) . The questionnaire included multiple-choice questions covering topics such as the knowledge, attitudes, and preferences towards digital dentistry, satisfaction with digital procedures, sources of knowledge, impact of digital techniques on patient care, lab efficiency, and motivation to adopt new technologies. The data was gathered by sending the link of the online google form via WhatsApp to all the study participants. Data were first compiled and tabulated using Microsoft Excel. Descriptive statistics were used to summarize the frequency and percentage distributions of responses for each survey item. For inferential analysis, the Chi-square ($\chi^2$) test was applied to assess the association between categorical variables. A p-value of $<0.05$ was considered statistically significant. All statistical analyses were performed using IBM SPSS version 26.

## RESULTS

Total of 120 general dental practitioner responses were collected and the findings for the various parameters taken into consideration are listed in Tables 1.

Based on data collected, 4 individuals reported low, 83 reported moderate and 33 reported high knowledge.

Out of 120, 116 individuals expressed a positive attitude, with 4 being unsure whereas not a single individual was with a negative attitude.

When asked about reason for preference of conventional techniques 59 individuals found cost-effective, 34 individuals found them more comfortable, 11 individuals were unaware of digital techniques, while 16 individuals used them because of untrained technicians.

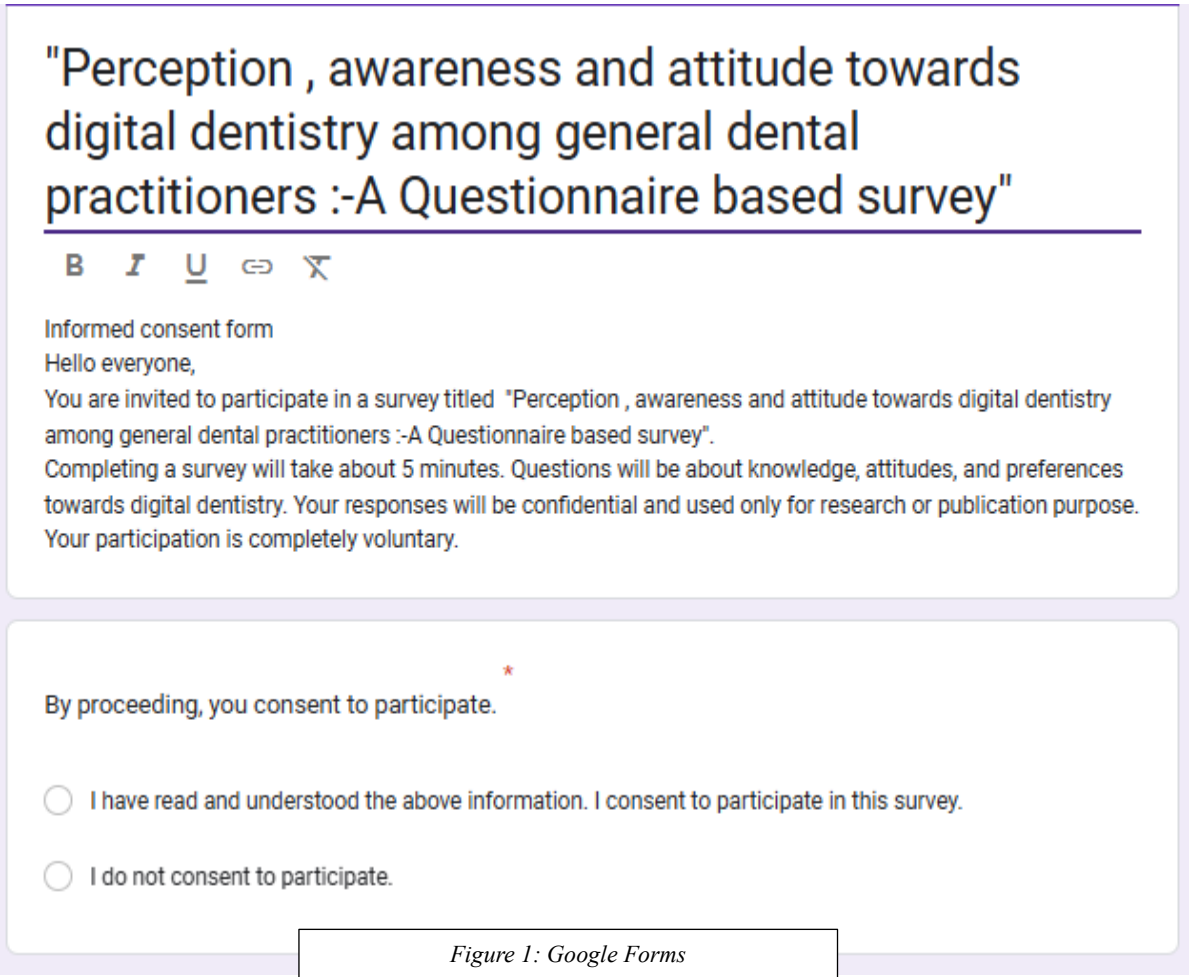
When asked about reason for preference of digital techniques 10 individuals prefer digital techniques because of easy communication with lab technicians, 63 individuals prefer them because of increase in accuracy and precision of work, and 47 individuals prefer them as they reduce chairside time in a busy practice.

From among the listed digital technology, 76 individuals were aware of intraoral scanners,18 individuals were aware of 3D printing, 13 individuals are aware of CAD-CAM, and 13 individuals are aware of T Scan.

Out of 120, 18 individuals were extremely satisfied, 67 individuals were very satisfied, 34 individuals were satisfied, 1 individual was slightly satisfied, and no individuals reported being unsatisfied with the marginal fit, axial contour, proximal contact, and occlusal contact of prosthesis fabricated by the CAD-CAM procedure.

**Table 1: Result showing distribution of perception, awareness and attitude towards digital dentistry in general dental practitioners**

| Sr.no | Question | Choice of answer | No. of participants | In Percentage |
|---|---|---|---|---|
| 1 | What is your current perceived knowledge regarding digital dentistry? | Low | 4 | 3% |
| | | Moderate | 83 | 69% |
| | | High | 33 | 28% |
| 2 | What is your current perceived attitude towards digital dentistry? | Positive | 116 | 96% |
| | | Negative | 0 | 0% |
| | | Not sure | 4 | 4% |
| 3 | Why you prefer conventional techniques? | Cost effective | 59 | 50% |
| | | More comfortable | 34 | 28% |
| | | Unawareness to digital techniques | 11 | 9% |
| | | Untrained technicians | 16 | 13% |
| 4 | Why you prefer digital techniques? | Easy communication with lab technicians | 10 | 8% |
| | | Increases accuracy and precision of work | 63 | 53% |
| | | Reduces chair side time in busy practice | 47 | 39% |
| 5 | From the following digital technology which technique are you aware of? | 3D Printing | 18 | 13% |
| | | CAD-CAM | 13 | 11% |
| | | Intraoral scanner | 76 | 64% |
| | | T Scan | 13 | 10% |
| 6 | Are you satisfied with marginal fit , axial contour, proximal contact , occlusal contact fabricated by CAD - CAM procedure? | extremely satisfied | 18 | 15% |
| | | Satisfied | 34 | 27% |
| | | slightly satisfied | 1 | 1% |
| | | very satisfied | 67 | 57% |
| 7 | Which digital techniques are used for making prosthesis? | 3D Printing | 6 | 5% |
| | | Both | 93 | 76% |
| | | CAD-CAM | 18 | 16% |
| | | None | 3 | 3% |
| 8 | What is attitude of patients to innovative technologies? | interested | 120 | 100% |
| | | not interested | 0 | 0% |
| 9 | Will there be decline in the quality of patient care using digital dentistry? | No | 120 | 100% |
| | | Yes | 0 | 0% |
| 10 | Which sources of knowledge do you use to acquire competency about digital technologies? | college/specialization courses | 7 | 6% |
| | | internet | 33 | 29% |
| | | journals/research courses | 76 | 62% |
| | | others | 4 | 4% |
| 11 | How much do you think digital dentistry has improved work efficiency in the lab? | decrease efficiency | 2 | 2% |
| | | increase efficiency | 116 | 96% |
| | | no difference | 2 | 2% |
| 12 | Using new technologies motivates you? | Yes | 120 | 100% |
| | | No | 0 | 0% |



"Perception , awareness and attitude towards digital dentistry among general dental practitioners :-A Questionnaire based survey"

Informed consent form

Hello everyone,

You are invited to participate in a survey titled "Perception , awareness and attitude towards digital dentistry among general dental practitioners :-A Questionnaire based survey".

Completing a survey will take about 5 minutes. Questions will be about knowledge, attitudes, and preferences towards digital dentistry. Your responses will be confidential and used only for research or publication purpose. Your participation is completely voluntary.

By proceeding, you consent to participate. *

I have read and understood the above information. I consent to participate in this survey.

I do not consent to participate.

*Figure 1: Google Forms*

1.What is your current perceived knowledge regarding digital dentistry?

A. Low
B. Moderate
C. High

2.What is your current perceived attitude towards digital dentistry?

A. Positive
B. Negative
C. Not sure

3.Why you prefer conventional techniques?

A. cost effective
B. more comfortable
C. unawareness to digital techniques
D. untrained technicians

4.Why you prefer digital techniques?

A. easy communication with lab technicians
B. increases accuracy and precision of work
C. reduces chair side time in busy practice

5.From the following digital technology which techniques are you aware of?

A. 3D printing
B. CAD-CAM
C. Intraoral scanner
D. T-scan

6.Are you satisfied with marginal fit, axial contour, proximal contact, occlusal contact fabricated by CAD-CAM procedure?

A. extremely satisfied
B. very satisfied
C. satisfied
D. slightly satisfied
E. not satisfied

*Figure 2: questionnaire (question 1-6)*

7.Which digital techniques are used for making prosthesis?

A. CAD-CAM
B. 3D printing
C. Both
D. None

8.What is attitude of patients to innovative technologies?

A. Interested
B. not interested

9.Will there be decline in the quality of patient care using digital dentistry?

A. Yes
B. No

10.Which sources of knowledge do you use to acquire competency about mentioned technologies?

A. college/specialization courses
B. internet
C. journals/research courses
D. books
E. others

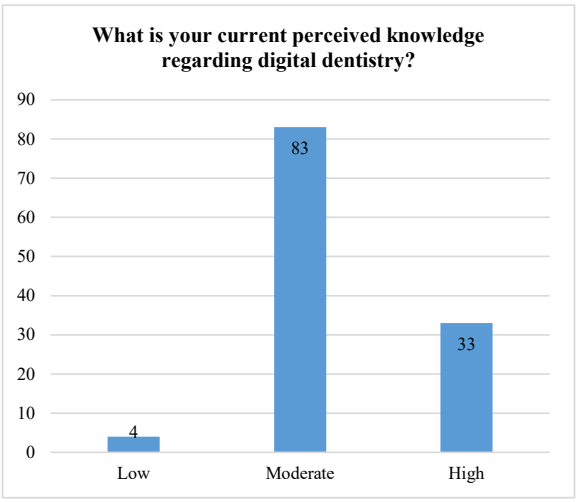
11.How much do you think digital dentistry has improved work efficiency in the lab?

A. Increases efficiency
B. Decreases efficiency
C. No difference

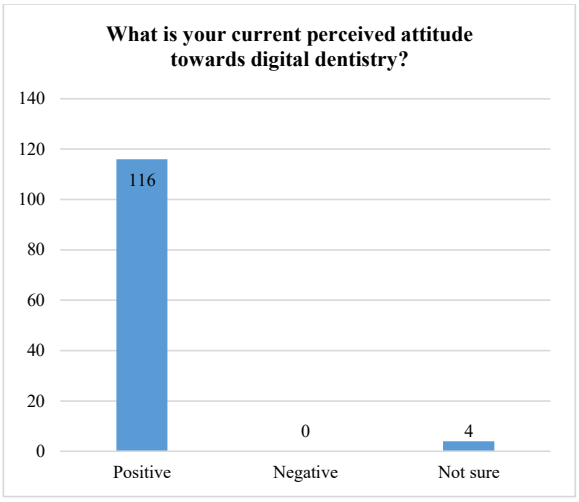
12.Using new technologies motivates you?

A. Yes
B. No

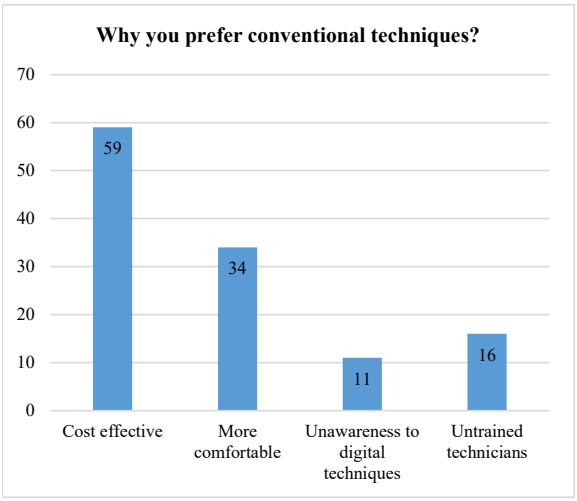
*Figure 3: questionnaire (question 7-12)*



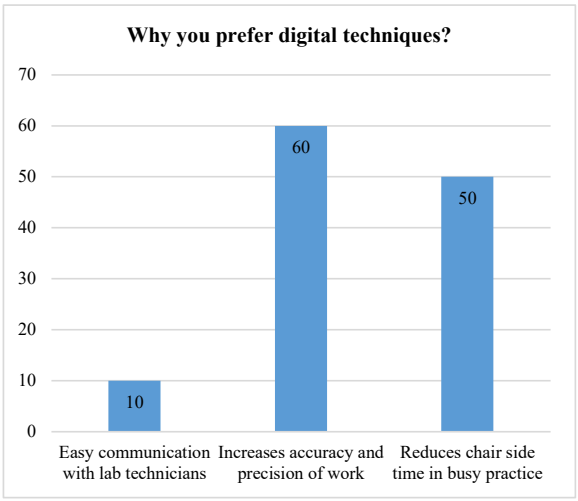

QUESTION 1



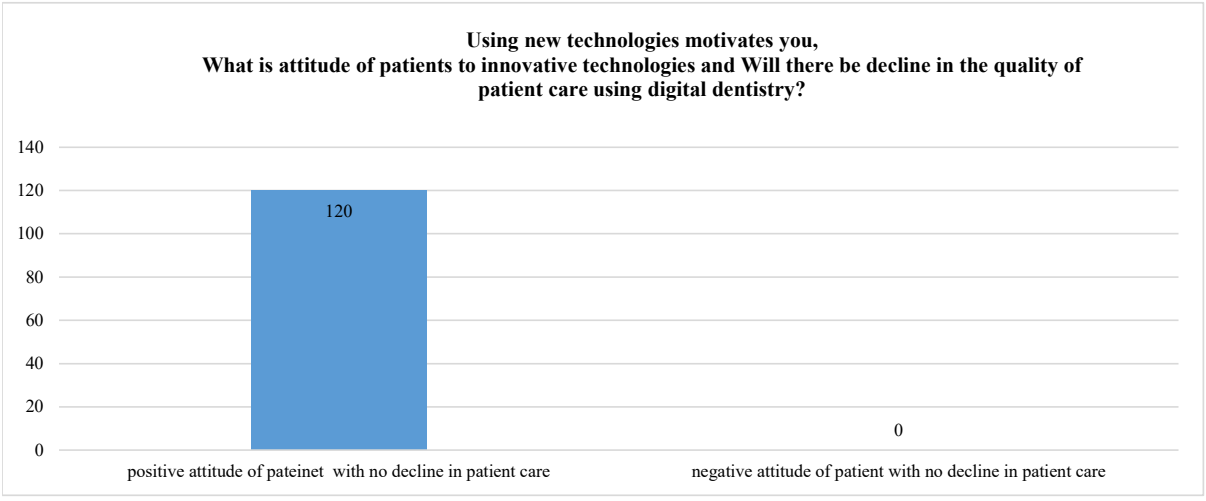

QUESTION 2




QUESTION 3




QUESTION 4




QUESTION 8,9,12

18 individuals used CAD-CAM, 6 individuals used 3D printing, 93 individuals used both CAD-CAM and 3D printing for fabrication of prosthesis, while only 3 individuals do not use any digital techniques for fabrication of prosthesis.

When dental practitioners were asked about the attitude of their patients to innovative technologies it was found that all patients were interested in innovative technologies, with no reported cases of disinterest.

All of the 120 individuals believe that there will be no decline in the quality of patient care. Most of them that is 76 individuals use journals or research courses,7 individuals use college or specialization courses, 33 individuals use the internet as a source of knowledge to acquire competency about digital technologies.

For lab efficiency,116 individuals thought it would increase efficiency, 2 individuals thought it would decrease efficiency, and 2 individuals thought it would make no difference in the lab.

Using new technologies motivated all respondents, with 120 individuals confirming this.

## DISCUSSION

The survey revealed the perceptions, awareness, and attitudes of 120 general dental practitioners toward digital dentistry.

Survey revealed the 120 genaeral dental practitioner's perception, awareness and attitude toward digital dentistry. Based on the responses of dental practitioner's on question 1 result showed that, 69% perceived their knowledge of digital dentistry as moderate, 28% as high, and 3% as low. This aligns with studies by Kakti et al.[6] and Hall et al.[7] Ramesh Nayakar et al. emphasized the importance of digital technology for patient compliance, quick and aesthetic results, and easier information sharing among dentists.[2]

Question 2 result showed that 96% of participants had a positive attitude towards digital dentistry, 4% were unsure, and none had a negative attitude. These results are consistent with findings from Kakti et al.[6]

According to question 3, 50% of participants preferred conventional techniques over digital dentistry due to cost-effectiveness, while 28% cited comfort, 13% lack of trained technicians, and 9% unawareness of digital methods. M. M. van der Zande's study highlights that adoption depends on perceived benefits, personal orientation, social influences, and practice characteristics, leading to varied motivation among early, late, and non-adopters.[8] Ramesh Nayakar reported slow digital adoption among Indian dentists, with 87.78% citing lack of knowledge as the main barrier, outweighing cost concerns 68.15%.[2] This contrasts with Udhayaraja P et al.,[9] who identified high cost as the major barrier, and Tran D et al., who found UK dentists saw limited advantages of digital over conventional techniques.[10]

Analysis of question 4 revealed that 53% of respondents preferred digital techniques for their increased accuracy and precision, 39% valued the reduction in chairside time, and 8% appreciated the improved communication with lab technicians. This aligns with Nassani et al.'s study, where 81% of participants believed chair-side CAD/CAM restorations matched or exceeded the quality of those made by lab technicians.[11]

Based on question 5 the survey revealed that 64% of respondents were aware of intraoral scanners, while 15% were familiar with 3D printing, 11% knew about CAD-CAM, and 10% were aware of T Scan. This highlights the growing popularity of digital dentistry tools. In comparison, a study by Kavarthapu A found that only 59% of dental interns had seen a CAD-CAM machine, with 34% never having the chance to observe one.[12]

According to question 6 the survey found that 57% of respondents were very satisfied with the quality of marginal fit, axial contour, proximal contact, and occlusal contact produced by CAD-CAM procedures, 27% were satisfied, and 15% were extremely satisfied. Only 1% were slightly satisfied. This aligns with findings from Katki et al., who reported that 81.3% of dentists agreed digital dentistry offers better marginal accuracy and crown fit, and 73% of dentists rated the quality of CAD/CAM restorations as very good or excellent.[6]

Data analysis of question 7 revealed that 16% of respondents use CAD-CAM, 5% use 3D printing, 76% use both CAD-CAM and 3D printing, and 3%

use neither. This indicates that most respondents combine both technologies for creating prostheses, with CAD-CAM being more commonly used individually than 3D printing. According to Mona et al., milling is the most frequently used digital technique, followed closely by 3D printing and sintering.[13]

According to question 8 the survey found that all patients expressed interest in innovative technologies, indicating a unanimous positive attitude. This is consistent with a study by Saponaro PC et al., where 70% of patients with new digital complete dentures reported they were "better" than their previous set.[14] Similarly, Yuzbasioglu et al. found that patients were more comfortable with digital impressions compared to conventional techniques.[15]

Analysis of question 9 revealed that all of respondents believed there would be no decline in patient care quality when using digital dentistry. This aligns with Nassani et al.'s findings, where most dentists considered chair-side CAD/CAM systems valuable for time-saving, increasing patient visits, and boosting income.[11] However, a survey by Tran D et al. reported that many respondents did not incorporate CAD/CAM into their workflows due to high initial costs and a lack of perceived advantages over conventional methods.[10]

Question 10 result showed that 62% of respondents used journals and research courses to gain competency in digital dentistry technologies, while 29% relied on the internet, 6% used college or specialization courses, and 4% referred to other sources. Notably, no respondents mentioned using books as a source of information.

According to question 11 the survey found that 96% of respondents believed digital dentistry had improved work efficiency in the lab, while 2% felt it decreased efficiency and another 2% thought it made no difference. According to Acharya A. et al., private lab technicians generally had a better understanding of digital technologies than those in colleges, highlighting the importance of collaboration between dental practitioners and technicians, as well as the need for increased training and research to further enhance digital dentistry adoption.[1]

According to question 12 the survey showed that 100% of respondents felt motivated by using new technologies, indicating a strong positive sentiment toward technological advancements. This aligns with Tay et al.'s survey in New Zealand, which found that efficiency was the primary motivation for adopting newer technologies.[16]

The survey reveals a strong positive attitude and motivation among dental practitioners toward digital dentistry; however, most still rate their knowledge as only moderate. This disconnect points to a significant gap in continuing education, where enthusiasm is not matched by access to structured, hands-on training. Many rely on informal learning, indicating a lack of institutional support and formal programs. Implementing structured digital literacy programs, offering subsidies, and improving infrastructure are critical steps toward translating positive attitudes into widespread clinical adoption.

The survey's findings that 100% of patients showed interest in innovative technologies, 100% of respondents believed digital dentistry would not compromise care quality, and 100% felt motivated by new technologies are overly definitive.Such responses indicate response bias or limited sample diversity. Further qualitative research are needed to fully understand the complexities and challenges in adopting digital dentistry.

## CONCLUSION

Digital dentistry has greatly advanced, generating excitement among dental professionals. A survey assessed dentist knowledge and attitudes toward digital techniques, showing positive views and eagerness to learn more. Dentists have moderate knowledge, but expanding it could improve patient outcomes and satisfaction. While conventional methods are still preferred for cost and comfort, digital techniques are valued for accuracy, precision, and efficiency. The intraoral scanner is the most recognized digital technology, and a combination of 3D printing and CAD-CAM is used for prosthetics. Patients show interest in digital tools, which could enhance satisfaction. Most dentists acquire knowledge through journals, online resources, and research courses, highlighting a shift from traditional books. The study emphasizes the importance of dentists' motivation to adopt digital methods for better patient care.

Under the constraints of this study, the sample size was limited to 120 general dental practitioners, which may not comprehensively represent dental professionals across various regions, specializations, or experience levels. The reliance on self-reported data introduces the possibility of bias, and the absence of longitudinal analysis prevents the tracking of changes over time.Similarly, the questionnaire's design presents limitations. It consists of only 12 closed-ended questions, restricting the depth of responses and omitting qualitative insights into barriers, challenges, and expectations. There is also a potential for response bias, as individuals with a prior interest in digital dentistry may have been more likely to participate. Additionally, the study primarily evaluates perceptions and attitudes rather than objectively measuring clinical effectiveness, efficiency, or long-term impact.

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