Original Research

Awareness and Utilization of Artificial Intelligence in Smile Design and Prosthetic Planning: A Cross-Sectional Survey among Dental Professionals

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ABSTRACT

Background: The integration of artificial intelligence (AI) in dentistry, particularly in smile design and prosthetic planning, represents a significant advancement in digital dentistry. Despite growing technological capabilities, there remains a knowledge gap in clinical awareness and adoption. **Aim:** To assess the awareness, current utilization, and perceptions of AI-based tools for smile design and prosthetic planning among dental professionals. **Materials and Methods:** A cross-sectional online survey was conducted using a structured questionnaire. The survey was distributed among general dentists, prosthodontists, periodontists, oral surgeons, and postgraduate students across India. Responses were analyzed to evaluate awareness levels, usage trends, perceived advantages, and barriers to adoption. **Results:** Out of 320 respondents, 68% were aware of AI applications in smile design, while only 23% had implemented AI tools in clinical practice. The most commonly cited advantages were improved accuracy (76%) and enhanced patient communication (64%). Barriers included cost, lack of training, and limited access to AI-integrated systems. **Conclusion:** Although awareness of AI in smile design and prosthetic planning is increasing, clinical adoption remains low. Continued professional education, cost reduction, and academic curriculum integration may accelerate the adoption of AI technologies in routine prosthodontic and esthetic practice.

KEYWORDS: *Artificial intelligence, digital dentistry, prosthetic planning, smile design*

INTRODUCTION

The evolution of digital technologies has significantly advanced prosthodontic procedures by improving precision, streamlining clinical workflows, and enhancing esthetic outcomes. Among these innovations, artificial intelligence (AI) has emerged as a transformative tool, offering data-driven support in diagnosis, planning, and treatment execution.[1,2] AI leverages algorithms capable of analyzing complex datasets, thereby assisting clinicians in making more informed, efficient, and predictable clinical decisions.

In the field of smile design, AI-enabled software evaluates facial features, dental symmetry, gingival contours, and occlusion to generate personalized digital simulations of proposed treatments. These visual previews can improve patient communication, foster trust, and increase case acceptance.[3] Similarly, in prosthetic planning, AI plays a role in evaluating digital scans, interpreting imaging data, assisting in implant positioning, and creating customized prosthetic designs. Software platforms such as Digital Smile Design (DSD), (Madrid, Spain), 3Shape Smile Design by 3Shape A/S (Copenhagen, Denmark), and Exocad by exocad GmbH (Darmstadt, Germany) incorporate machine learning

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capabilities to enhance the accuracy and consistency of treatment planning.[4,5]

While global interest in AI applications in dentistry is increasing, the level of integration and familiarity with these technologies varies widely. In India, the use of digital tools in dental education and practice is growing, yet the actual clinical awareness and adoption of AI, particularly in esthetic and prosthetic workflows, remains inadequately documented. Assessing current trends in AI usage, along with the challenges and perceptions among dental professionals, is essential to bridge this gap and inform targeted training and implementation strategies. Therefore, this study aims to evaluate the awareness, utilization, perceived advantages, and barriers associated with AI in smile design and prosthetic planning among Indian dental professionals.

Materials and Methods

Ethical clearance was obtained prior to the commencement of the study. A descriptive, cross-sectional survey was conducted between March and May 2025 using a structured, pre-validated questionnaire, which was distributed online to dental professionals across India via professional networks and social media platforms. Snowball sampling was employed to enhance participant reach, and a minimum required sample size of 320 was determined based on previous studies. The inclusion criteria comprised registered dental professionals (BDS/MDS), postgraduate students from any dental specialty, and practitioners with clinical experience in esthetic or prosthetic dentistry, while undergraduate students, retired professionals, and non-clinicians were excluded. Participation was entirely voluntary and anonymous. The questionnaire consisted of 24 close-ended questions covering demographics, awareness, and clinical use of AI in smile design and prosthetic planning, perceived benefits and barriers, and interest in future AI training.

Results

A total of 320 responses were obtained and analyzed using descriptive statistics expressed in percentages. The professional distribution showed that prosthodontists formed the largest group (31%), followed by general dentists (27%), periodontists and oral surgeons (22%), and postgraduate students (20%). Regarding clinical experience, 41% of respondents had 5–10 years of experience, 38% had less than 5 years, and 21% had more than 10 years of practice.

The results indicate a high level of awareness among dental professionals regarding the application of AI in smile design (68%) and prosthetic planning (54%). This reflects a growing exposure and interest in emerging digital tools within dental practice. However, only 23% of the respondents reported actual usage of AI-integrated tools in clinical settings, revealing a considerable gap between awareness and adoption. The most frequently mentioned platforms included DSD, 3Shape Smile Design, and Exocad, which are well-established tools known for their user-friendly interfaces and capabilities in esthetic planning [Table 1].

Respondents identified several obstacles hindering the implementation of AI in clinical practice. The most commonly cited barrier was the high system cost (72%), followed by a lack of training (66%). Other notable concerns included limited access to AI-compatible software (43%) and apprehension about technological dependence (28%). These findings emphasize the need for more affordable and accessible AI solutions, along with targeted educational programs [Table 2]. The data revealed strong enthusiasm for AI integration in dentistry, with 81% of respondents interested in AI workshops, 69% planning future adoption, and 78% supporting its inclusion in postgraduate curricula, highlighting a clear demand for enhanced digital literacy in prosthodontics and smile design.

Discussion

This study highlights growing awareness of AI in smile design and prosthetic planning among dental professionals in India. A majority (68%) were aware of AI in smile design, and 54% recognized its role in prosthetic workflows, aligning with trends reported by Michelinakis *et al*.[6] and Coachman and Paravina.[5] However, only 23% had used AI tools clinically, suggesting a significant gap between

Table 1: Awareness and usage of AI tools in dentistry (*n*=320)

Parameter	Response	*n* (%)
Aware of AI in smile design	Yes	218 (68%)
Aware of AI in prosthetic planning	Yes	173 (54%)
Currently use AI in clinical practice	Yes	74 (23%)
Common platforms used	DSD, 3Shape, Exocad	-

AI=Artificial intelligence, DSD=Digital Smile Design

Table 2: Perceived barriers to AI adoption

Barrier	*n* (%)
High system cost	230 (72%)
Lack of training	211 (66%)
Limited access to AI software	137 (43%)
Concern over technological dependence	90 (28%)

AI=Artificial intelligence

awareness and practical adoption, a challenge also noted by Schwendicke *et al*.[1]

Participants reported key benefits of AI integration: Improved treatment accuracy (76%), better patient communication (64%), and reduced clinical/laboratory errors (58%). These findings are supported by Joda and Gallucci,[3] who noted AI's contribution to personalized treatment planning and esthetic predictability.

High system cost (72%) and lack of training (66%) emerged as primary barriers. This mirrors findings by Alotaibi and Kassim,[7] and Schlenz *et al*.,[8] emphasizing the need for accessible technology and digital education. Despite these barriers, 81% of respondents expressed interest in AI workshops and 78% supported its inclusion in postgraduate curricula—consistent with studies from the UK and Germany highlighting the growing demand for digital literacy among young professionals.[9,10]

This study is limited by potential selection bias due to online, snowball-based sampling and the reliance on self-reported data, which may be influenced by recall or social desirability bias. Its cross-sectional design limits causal inference, and the findings may not be generalizable beyond the Indian dental community.

Conclusion

The study reveals a promising level of awareness among dental professionals in India regarding the application of AI in smile design and prosthetic planning. However, actual clinical adoption remains limited due to barriers such as high costs, lack of training, and restricted software access. The strong interest in AI-focused education and training underscores the need for integrating digital literacy into dental curricula and continuing professional development. Addressing these challenges through collaborative efforts can accelerate the effective incorporation of AI technologies into routine prosthodontic practice, ultimately enhancing treatment outcomes and patient care.

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Conflicts of interest

There are no conflicts of interest.

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