



## ARTIFICIAL INTELLIGENCE IN ORAL CARE: A SURVEY ON SMART TOOTHBRUSH USE AND PERIODONTAL HEALTH EDUCATION

### Periodontology

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### ABSTRACT

**Background:** Advancements in digital technologies have introduced artificial intelligence (AI)-based smart toothbrushes that monitor brushing behavior and provide real-time feedback to improve oral hygiene practices. These devices have the potential to enhance plaque control and periodontal health. **Methods:** A descriptive cross-sectional questionnaire-based study was conducted among 90 dental professionals. A structured questionnaire was distributed electronically to assess awareness, usage patterns, and perceived periodontal health benefits of AI-based toothbrushes. **Results:** Among the participants, 70% were female and 30% were male. The majority belonged to the 26–35 year age group. Manual toothbrushes were the most commonly used oral hygiene aids (48.8%), followed by AI-based toothbrushes (32.2%) and conventional powered toothbrushes (18.8%). Approximately 60% of participants reported awareness of AI-based toothbrush technology. Among users, 84.4% reported significant improvement in gum health. **Conclusion:** AI-based toothbrushes represent a promising innovation in preventive dentistry. These devices may enhance brushing practices and periodontal health through real-time feedback and personalized guidance. However, cost and technological complexity may influence their adoption.

### KEYWORDS

Artificial intelligence, Smart toothbrush, Oral hygiene, Periodontal health, Dental professionals

### INTRODUCTION

Regular and effective tooth brushing plays a fundamental role in maintaining oral hygiene and preventing gingival and periodontal diseases. Mechanical plaque control disrupts microbial biofilm on tooth surfaces and gingival tissues, thereby reducing the risk of periodontal inflammation and disease progression.<sup>1–3</sup> However, the effectiveness of tooth brushing largely depends on proper technique, brushing duration, and patient compliance with oral hygiene instructions.<sup>2</sup>

Advancements in dental technology have introduced powered and smart toothbrushes designed to improve plaque removal and enhance brushing efficiency. Previous studies have demonstrated that powered toothbrushes can significantly improve plaque control and gingival health when compared with conventional manual toothbrushes.<sup>4–6</sup>

More recently, artificial intelligence (AI) has been incorporated into smart toothbrush systems to further enhance oral hygiene practices. AI-enabled toothbrushes integrate sensors, machine learning algorithms, and mobile applications to monitor brushing patterns in real time. These systems provide feedback regarding brushing pressure, duration, and coverage of tooth surfaces, enabling users to improve brushing technique and maintain optimal oral hygiene.<sup>1,7</sup>

In addition to improving plaque control, AI-based toothbrushes may also serve as educational tools by providing personalized guidance and promoting preventive oral health behaviors. With the growing interest in digital health technologies, such devices have the potential to support periodontal health education and improve patient compliance with oral hygiene practices.<sup>11,12</sup>

Despite the increasing availability of AI-based toothbrush technologies, there is limited information regarding their awareness, usage patterns, and perceived benefits among dental professionals. Therefore, the present study aimed to evaluate the awareness, adoption, and perceived periodontal health benefits of AI-based toothbrushes among dental professionals using a structured questionnaire-based survey.

### MATERIALS AND METHODS

This descriptive cross-sectional questionnaire-based study was conducted among 90 dental professionals, including postgraduate students, periodontists, and private practitioners. The study aimed to evaluate awareness, usage patterns, and perceived benefits of AI-based toothbrushes.

A structured and pre-validated questionnaire was distributed electronically using Google Forms. The questionnaire consisted of closed-ended questions designed to collect demographic information, awareness of AI-based toothbrushes, type of toothbrush used, perceived improvement in oral hygiene and gum health, and barriers to the use of smart toothbrush technologies.

Participation in the study was voluntary and anonymous. Ethical approval for the study was obtained from the Institutional Review Board of Ahmedabad Dental College and Hospital, Ahmedabad, Gujarat, India.

The collected data were compiled and analyzed using Statistical Package for the Social Sciences (SPSS) version 26. Descriptive statistics were used to summarize the data, and the Chi-square test was applied to evaluate associations between variables. A p-value  $\leq 0.05$  was considered statistically significant.

### RESULTS

A total of 90 dental professionals participated in the study. Among the participants, females constituted 70.0% (n=63) while males accounted for 30.0% (n=27).

The majority of participants belonged to the 26–35 years age group (50%), followed by the 18–25 years age group (24.4%). Manual toothbrushes were the most commonly used oral hygiene aid among participants (48.8%), followed by AI-based toothbrushes (32.2%) and regular electric toothbrushes (18.8%).

Awareness regarding AI-based toothbrushes was reported by 60% of participants. Among those who used AI-based toothbrushes, 84.4% reported significant improvement in gum health, while 12.2% reported moderate improvement. Only 3.3% of participants reported no noticeable change in periodontal health.

The most commonly reported barriers to the adoption of AI-based toothbrushes included high cost and technological complexity.

**Table 1.** Distribution of Participants According to Gender

Gender	Number	Percentage
Female	63	70%
Male	27	30%

**Table 2.** Distribution According to Age Group

Age Group	Number	Percentage
18–25 years	22	24.4%
26–35 years	45	50.0%
36–45 years	15	16.7%
46–55 years	8	8.9%

**Table 3.** Type of Toothbrush Used by Participants

Type	Female (n=63)	Male (n=27)	Total (%)
Manual	31	13	48.8%
Electric	10	7	18.8%
AI-based	22	7	32.2%

**Table 4.** Awareness of AI Toothbrush

Response	Female	Male	Total (%)
Yes	38	16	60%
No	25	11	40%

**Table 5.** Improvement in Gum Health

Response	Female	Male	Total (%)
Significant improvement	55	21	84.4%
Some improvement	6	5	12.2%
No change	2	1	3.3%

**DISCUSSION**

The findings of the present study demonstrate increasing awareness and acceptance of AI-based toothbrushes among dental professionals. A considerable proportion of participants reported familiarity with smart toothbrush technologies and acknowledged their potential benefits in improving oral hygiene practices and periodontal health. Powered toothbrushes have been widely reported to improve plaque removal and gingival health when compared to manual toothbrushes.<sup>6,14</sup> These devices facilitate more consistent brushing movements and improved access to different tooth surfaces, thereby enhancing plaque control.

The integration of artificial intelligence into smart toothbrush technologies further enhances their effectiveness by providing real-time feedback on brushing pressure, duration, and coverage. Recent studies have demonstrated that connected toothbrush systems can improve brushing behavior and oral hygiene compliance by guiding users toward optimal brushing techniques.<sup>12,13</sup> In addition to improving plaque control, AI-enabled toothbrushes may serve as valuable educational tools in preventive dentistry. By providing visual feedback and personalized recommendations through mobile applications, these devices can enhance patient awareness and motivation for maintaining oral hygiene.<sup>16</sup> Despite these advantages, certain barriers to adoption were identified in the present study. Cost and technological complexity were reported as the most common concerns among participants. Similar findings have been reported in previous studies evaluating digital oral health technologies.<sup>17</sup>

Nevertheless, the growing interest in digital oral health technologies suggests that AI-based toothbrushes may play an important role in the future of preventive dentistry. With further advancements and increased accessibility, these devices have the potential to improve patient education, enhance oral hygiene practices, and contribute to the prevention of periodontal diseases.

**CONCLUSION**

AI-based toothbrushes represent an innovative advancement in preventive dentistry. They offer personalized feedback, behavioral monitoring, and educational benefits that may improve oral hygiene practices. Despite limitations related to cost and accessibility, these devices demonstrate significant potential in periodontal health promotion. Future research should focus on clinical effectiveness, long-term patient adherence, and integration with digital dentistry platforms.

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