E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.31838/ijprt/16.02.672

Research Article

Peri-Implant Oral Biology, Public Health, and Future AI Readiness among Women with Dental Implants in Pakistan

Irfan Qureshi[1*], Hania Ifzaal Aslam[2], Sara Gardezi[3], Humaira Naureen[4], Misbah Saeed Memon[5], Sadaf Shakoor[6]

[1*]Prosthodontist, Diplomate, American Board of Oral Implantology / Implant Dentistry, Dr. Irfan Qureshi's Team of Professionals, Karachi, Pakistan.

[2]Research Intern, Teesside University, Middlesbrough, United Kingdom.

[3]Assistant Professor, Department of Oral Biology, Altamash Institute of Dental Medicine, Karachi, Pakistan.

[4]Assistant Professor and Head of Department of Community Dentistry, Sir Syed College of Medical Sciences, Karachi, Pakistan.

[5]Lecturer, Department of Community Dentistry, Sir Syed College of Medical Sciences, Karachi, Pakistan.

[6]Senior Lecturer, Department of Physiology, Sir Syed College of Medical Sciences, Karachi, Pakistan.

Corresponding Author: Irfan Qureshi

Prosthodontist, Diplomate, American Board of Oral Implantology / Implant Dentistry, Dr. Irfan Qureshi's Team of Professionals, Karachi, Pakistan.

Email: drirfanqureshikcl@gmail.com

Received: 12.07.2026, Revised: 16.09.2026, Accepted: 26.09.2026

ABSTRACT

Background: Dental implants can improve oral function and quality of life, but long-term outcomes depend on effective biofilm control, preventive practices, and regular professional maintenance.

Objective: To assess peri-implant oral-biological findings, preventive oral-health practices, oral health-related quality of life (OHRQoL), and readiness for future AI-assisted dental care among women with dental implants in Pakistan, and to identify factors associated with clinical peri-implant inflammation.

Methods: We conducted a cross-sectional study of 300 women with dental implants. Data were collected on sociodemographic characteristics, implant-maintenance practices, plaque/biofilm accumulation, bleeding on probing, probing depth, clinical peri-implant inflammation, preventive practices, and OHRQoL using the OHIP-14. Associations were examined using appropriate statistical tests and multivariable logistic regression.

Results: Clinical peri-implant inflammation was identified in 105 (35.0%) participants. Plaque accumulation (58.0%), bleeding on probing (42.0%), and probing depth ≥5 mm (24.0%) were common. Inflammation was more frequent among participants with poor preventive practices (48.5%) than among those with good practices (21.4%, $p<0.001$) and among those without regular implant-maintenance visits (45.9% vs. 20.3%, $p<0.001$). Two-thirds (66.0%) were willing to consider future AI-supported implant assessment, with 81.8% preferring dentist review. Substantial plaque, poor preventive practices, and irregular/no maintenance were independently associated with inflammation.

Conclusion: The findings support a preventive public-health model integrating implant-specific hygiene education, regular professional maintenance, early clinical assessment, patient-centered OHRQoL monitoring, and carefully governed future AI-supported care with continued dentist oversight.

Keywords: Dental Implants, Peri-Implant Health, Oral Biology, Public Health, Preventive Dentistry, Oral Health-Related Quality Of Life, Artificial Intelligence, AI Readiness, Pakistan, Women.

INTRODUCTION

Dental implants are an established treatment option for replacing missing teeth and can improve oral function, esthetics, and oral health-related quality of life (OHRQoL) (1). However, implant placement does not eliminate the need for continuing preventive care because peri-implant tissues remain susceptible to biofilm-associated inflammatory changes (2). Inadequate plaque control may contribute to peri-implant mucositis and, in susceptible individuals, progression toward peri-implantitis (3). Contemporary classification systems distinguish peri-implant health, peri-implant

mucositis, and peri-implantitis according to clinical inflammatory findings and evidence of progressive supporting-tissue loss (4). Biofilm accumulation is an important etiological factor in the development of peri-implant inflammatory conditions (5). Bleeding on probing (BOP) and increased peri-implant probing depth are important clinical indicators used during implant maintenance and assessment (6). Epidemiological studies have reported considerable variation in the prevalence of peri-implant diseases across populations, partly because of differences in diagnostic criteria, follow-up periods, implant characteristics, and maintenance practices (7). Consequently, regular preventive monitoring remains important after implant placement, particularly when continuity of professional care and patient-specific oral-hygiene practices vary. OHRQoL provides an additional patient-centered dimension to implant-related oral-health assessment (8). Implant-supported prostheses have been associated with improvements in oral function and patient-reported quality of life (9). Conversely, peri-implant complications and other oral-health problems may negatively affect patients perceived oral-health status (10). The Oral Health Impact Profile-14 (OHIP-14) is a widely used short-form instrument for evaluating the functional, psychological, and social effects of oral conditions on daily life (11). Incorporating OHRQoL into implant-related research can therefore complement clinical assessment by identifying the patient-perceived burden associated with oral-health conditions.

From a public-health perspective, the increasing use of dental implants creates a need for sustainable post-treatment prevention and maintenance strategies rather than focusing exclusively on implant placement and restorative outcomes. Regular supportive peri-implant care has been recommended as an important component of preventing and managing peri-implant diseases (12). Patient oral-hygiene practices and professional maintenance can influence the long-term stability of peri-implant tissues (13). Identifying potentially modifiable behavioral and service-related factors may therefore help inform preventive oral-health programs, maintenance-recall systems, patient education strategies, and early referral pathways. This prevention-oriented approach is consistent with the World Health Organization's Global Oral Health Action Plan 2023–2030, which emphasizes prevention, health promotion, integrated oral-health services, and equitable access to oral healthcare (14). Artificial intelligence (AI) is increasingly being investigated in dentistry, including applications involving diagnostic imaging, treatment planning, risk assessment, and clinical decision support (15). AI-based applications have demonstrated potential for supporting dental diagnosis and image interpretation (16). However, the availability of AI technology does not necessarily ensure patient acceptance or appropriate clinical implementation. Ethical considerations related to privacy, transparency, accountability, data governance, and bias remain important when AI is introduced into healthcare (17). The continuing role of healthcare professionals in supervising and interpreting AI-supported systems is also emphasized in discussions of responsible AI implementation (18). Patient perspectives, digital literacy, and trust are therefore relevant considerations for the future development of digitally supported oral-health services. Importantly, AI-assisted dental care should be distinguished from currently available routine clinical care. In the present study, AI was not deployed as a diagnostic or treatment tool. Instead, the AI component assessed participants' literacy, perceptions, willingness to consider potential future AI-supported assessment or preventive recommendations, and preferences regarding professional oversight. The present study therefore integrates four complementary dimensions: peri-implant oral biology, preventive oral public health, patient-reported OHRQoL, and readiness for future AI-assisted dental care. The study aimed to assess peri-implant clinical findings, preventive practices, OHRQoL, and future AI readiness among women with dental implants in Pakistan and to identify potentially modifiable factors associated with clinical peri-implant inflammation.

MATERIALS AND METHODS

A cross-sectional analytical study was conducted among 300 adult women with dental implants in Karachi, Pakistan. Participants were recruited from dental implant/prosthodontic clinical settings using consecutive sampling. Women aged ≥18 years with at least one dental implant who provided informed consent were eligible. Participants with active implant failure requiring immediate removal, untreated oral malignancy, major craniofacial abnormalities, or inability to participate in the examination were excluded. Written informed consent was obtained before enrollment. Data was collected

through a structured questionnaire and standardized clinical examination. Sociodemographic characteristics, implant-related information, duration and number of implants, restoration type, maintenance history, and preventive oral-health practices were recorded. Preventive practices included tooth and implant cleaning, interdental cleaning, implant-specific hygiene, professional maintenance, and adherence to follow-up recommendations. Clinical assessments included plaque/biofilm accumulation, bleeding on probing (BOP), peri-implant probing depth, and clinical peri-implant inflammation. Probing depth ≥5 mm was recorded as an indicator of increased peri-implant probing depth. For participants with multiple implants, findings were assessed at implant level and summarized at participant level to avoid treating individual implants as independent observations. Oral health-related quality of life was assessed using the validated 14-item Oral Health Impact Profile (OHIP-14), with higher scores indicating greater oral-health impact. Future AI readiness was assessed through questions addressing AI literacy, perceived usefulness, willingness to consider AI-supported implant assessment and preventive recommendations, privacy concerns, and preference for dentist involvement. AI was not used for diagnosis or treatment; the assessment focused solely on participants' perceptions of potential future AI-supported dental care. Data was coded and analyzed using descriptive and inferential statistics. Categorical variables were compared using chi-square or Fisher's exact tests, while continuous variables were analyzed using independent-samples t-tests or appropriate non-parametric tests. Variables associated with peri-implant inflammation in bivariate analysis, together with clinically relevant confounders, were entered into multivariable logistic regression. Adjusted odds ratios with 95% confidence intervals were reported, with $p<0.05$ considered statistically significant. Ethical approval was obtained from the relevant institutional review board, and the study followed the principles of the Declaration of Helsinki. Participation was voluntary, confidentiality was maintained through coded data, and all participants provided informed consent.

RESULTS

A total of 300 women with dental implants were included. The mean age was 42.8±8.7 years, with a range of 25–65 years. Most participants were aged 35–49 years (61.0%). Secondary education was reported by 38.0%, graduate education by 34.3%, and postgraduate education by 27.7%. More than half of participants had had their implants for >2 years. Regular professional implant-maintenance visits were reported by 42.7%, whereas 57.3% reported irregular or no scheduled maintenance. Only 32.0% reported receiving implant-specific hygiene instructions, as shown in Table 1.

Table 1. Participant Characteristics and Implant-Maintenance Profile

Age group		
<35 years	45	15.0
35–49 years	183	61.0
≥50 years	72	24.0
Education		
Secondary	114	38.0
Graduate	103	34.3
Postgraduate	83	27.7
Duration since implant		
6 months–2 years	124	41.3
>2 years	176	58.7
Regular professional implant maintenance		
Yes	128	42.7
No/irregular	172	57.3
Implant-specific maintenance instructions		
Yes	96	32.0
No	204	68.0

Plaque/biofilm accumulation was observed in 174 (58.0%) participants, while BOP was present in 126 (42.0%). A probing depth ≥5 mm was identified in 72 (24.0%) participants. Clinical peri-implant inflammation was identified in 105 (35.0%), whereas 195

(65.0%) had no clinically evident peri-implant inflammation. Among the participants with inflammatory findings, 48 (16.0% of the total study population) had findings suggestive of peri-implantitis. These cases were not classified as confirmed peri-implantitis in the absence of definitive supporting-tissue-loss criteria, as shown in Table 2.

Table 2. Peri-Implant Oral-Biological Findings

Plaque/biofilm accumulation	**174**	**58.0**
Bleeding on probing	126	42.0
Probing depth ≥5 mm	72	24.0
Clinical peri-implant inflammation	105	35.0
No clinically evident peri-implant inflammation	195	65.0
Findings suggestive of peri-implantitis*	48	16.0

Participants with clinical peri-implant inflammation had a higher mean probing depth than those without clinically evident inflammation (4.9±1.3 mm vs. 3.7±1.1 mm, p<0.001). Plaque/biofilm accumulation was substantially more frequent among participants with inflammation than among those without inflammation (80.0% vs. 46.2%, p<0.001). BOP was present in 68.6% of participants with inflammation compared with 27.7% of those without inflammation (p<0.001). A probing depth ≥5 mm was also more common among participants with inflammation (40.0% vs. 15.4%, p<0.001), as shown in Table 3.

Table 3. Oral-Biological Indicators According To Clinical Peri-Implant Inflammation

Mean probing depth, mm	4.9±1.3	3.7±1.1	<0.001
Plaque/biofilm accumulation	84 (80.0%)	90 (46.2%)	<0.001
Bleeding on probing	72 (68.6%)	54 (27.7%)	<0.001
Probing depth ≥5 mm	42 (40.0%)	30 (15.4%)	<0.001

Twice-daily brushing was reported by 62.0% of participants, whereas regular interdental cleaning was reported by 39.7%. Regular professional dental visits were reported by 47.3%, and regular implant-maintenance visits by 42.7%. Only 32.0% reported receiving implant-specific hygiene instructions. Overall, 37.3% of participants were categorized as having good preventive practices, 30.3% as moderate, and 32.3% as poor. Clinical inflammation varied significantly across preventive-practice categories, occurring in 21.4% of participants with good practices, 37.4% with moderate practices, and 48.5% with poor practices (p<0.001). Inflammation was also more frequent among participants with irregular/no scheduled implant-maintenance visits than among those reporting regular maintenance (45.9% vs. 20.3%, p<0.001), as shown in Table 4.

Table 4. Preventive Practices and Clinical Peri-Implant Inflammation

Twice-daily brushing	186 (62.0)	—	—
Regular interdental cleaning	119 (39.7)	—	—
Regular professional dental visits	142 (47.3)	—	—
Regular implant-maintenance visits	128 (42.7)	—	—
Implant-specific hygiene instructions	96 (32.0)	—	—
Overall preventive-practice category			
Good	112 (37.3)	24 (21.4%)	<0.001
Moderate	91 (30.3)	34 (37.4%)	
Poor	97 (32.3)	47 (48.5%)	
Regular implant maintenance			<0.001
Yes	128 (42.7)	26 (20.3%)	
No/irregular	172 (57.3)	79 (45.9%)	

The mean OHIP-14 score was 18.6±8.9 and was significantly higher among participants with clinical peri-implant inflammation and those with poorer preventive practices (p<0.001). Regarding future AI-assisted dental care, 66.0% were willing to consider AI-

supported implant assessment, 57.0% were willing to receive AI-supported preventive recommendations, and 81.8% of AI-accepting participants preferred dentist review or explanation. Higher AI literacy was significantly associated with greater willingness to consider future AI-supported assessment (82.1% vs. 55.7%, p<0.001), while willingness was also higher among participants with clinical inflammation (75.2% vs. 61.0%, p=0.006), as shown in Table 5.

Table 5. Ohrqol and Readiness for Future AI-Assisted Dental Care Among Study Participants (N=300)

OHIP-14 score, overall	**18.6 ± 8.9**	**—**
OHIP-14 score by clinical peri-implant inflammation		
Clinical peri-implant inflammation	23.7 ± 9.6	<0.001
No clinical implant inflammation	15.8 ± 7.1	
OHIP-14 score by preventive-practice category		
Good preventive practices	14.9 ± 6.5	<0.001
Moderate preventive practices	18.4 ± 7.6	
Poor preventive practices	23.1 ± 9.4	
AI literacy		
High	117 (39.0)	—
Moderate	108 (36.0)	
Low	75 (25.0)	
Perceived future usefulness of AI for implant risk assessment	183 (61.0)	—
Willing to consider future AI-supported implant assessment	198 (66.0)	—
Willing to receive future AI-supported preventive recommendations	171 (57.0)	—
Preferred dentist review/explanation among AI-accepting participants	162/198 (81.8)	—
Privacy/data concerns regarding future AI-supported care	63 (21.0)	—
Concern about reduced dentist–patient interaction	54 (18.0)	—
Willingness to consider future AI-supported implant assessment by AI literacy		
High AI literacy	82.1%	<0.001
Moderate/low AI literacy	55.7%	
Willingness to consider future AI-supported implant assessment by clinical inflammation		
Clinical peri-implant inflammation	75.2%	0.006
No clinical implant inflammation	61.0%	

OHIP-14 scores are presented as mean ± SD, with higher scores indicating greater oral-health impact. Percentages for categorical variables are based on N=300 unless otherwise specified. The 81.8% dentist-review preference is calculated among the 198 participants who were willing to consider future AI-supported implant assessment.

Participants with substantial plaque had higher adjusted odds of inflammation (aOR 3.18, 95% CI 1.98–5.11). Poor preventive practices were also independently associated with inflammation (aOR 2.74, 95% CI 1.72–4.37), as were irregular/no implant-maintenance visits (aOR 2.31, 95% CI 1.45–3.69). Age ≥50 years and graduate/postgraduate education were not independently associated with clinical inflammation after adjustment, as shown in Table 6.

Table 6. Multivariable Logistic Regression for Clinical Peri-Implant Inflammation

Substantial plaque accumulation	3.18	1.98–5.11	<0.001
Poor preventive practices	2.74	1.72–4.37	<0.001
Irregular/no implant maintenance	2.31	1.45–3.69	<0.001
Age ≥50 years	1.32	0.79–2.21	>0.05
Graduate/postgraduate education	0.88	0.56–1.39	>0.05

OR = odds ratio; CI = confidence interval. Associations are cross-sectional and should not be interpreted causally.

DISCUSSION

The present study provides an integrated assessment of peri-implant clinical findings, preventive oral-health practices, OHRQoL, and future AI readiness among 300 women with dental implants in Karachi. Clinical peri-implant inflammation was identified in 35.0% of participants, while plaque accumulation, BOP, and probing depth ≥5 mm were observed in 58.0%, 42.0%, and 24.0%, respectively. Although direct comparison with other studies should be made cautiously because of differences in case definitions and examination protocols, the observed burden is consistent with evidence showing that peri-implant inflammatory conditions are common and closely related to biofilm accumulation and inadequate maintenance. Contemporary clinical guidance recommends a structured supportive peri-implant care program with periodic assessment of peri-implant tissues after implant loading (19). A systematic review of studies evaluating prevention and management of peri-implant diseases also identified probing depth and BOP among the most frequently used clinical outcomes, supporting their relevance in routine monitoring (20).

The association between preventive practices and clinical inflammation was particularly important. Inflammation occurred in 48.5% of participants with poor preventive practices compared with 21.4% among those with good practices, while irregular or absent maintenance was associated with a markedly higher proportion of inflammation than regular maintenance. After adjustment, substantial plaque accumulation, poor preventive practices, and irregular/no maintenance remained independently associated with inflammation. These findings are consistent with the preventive emphasis of contemporary implant guidelines, which place patient-performed biofilm control and continuing professional care at the center of peri-implant disease prevention (19). Evidence from systematic reviews indicates that nonsurgical peri-implant treatment can reduce BOP, probing depth, and plaque levels, although complete resolution of mucositis is not consistently achieved, reinforcing the importance of prevention and continuing maintenance rather than treatment only after disease becomes established (21).

The finding that 16.0% of participants had findings suggestive of peri-implantitis should not be interpreted as a confirmed prevalence of peri-implantitis. In accordance with contemporary diagnostic principles, definitive peri-implantitis classification requires evidence of inflammation together with supporting bone loss beyond expected post-remodeling changes (4,5). Therefore, the present findings are more appropriately interpreted as clinical peri-implant inflammation and associated biological indicators. This distinction is particularly important in public-health surveillance because inconsistent case definitions can substantially influence reported disease burden and make comparisons between populations difficult (20).

The OHRQoL findings demonstrate the value of incorporating patient-reported outcomes into implant research. Participants with clinical inflammation had substantially higher OHIP-14 scores than those without inflammation, and scores increased progressively across preventive-practice categories. These findings suggest that peri-implant clinical status may have consequences beyond measurable biological parameters. A recent large Norwegian study similarly found that biological and technical implant complications, poor cleanability, and peri-implant problems were associated with higher OHIP-14 scores, supporting the relationship between implant-related complications and patient-perceived oral-health burden (22). Thus, clinical examination and OHRQoL assessment provide complementary information: the former identifies biological risk and disease indicators, whereas the latter captures how these conditions are experienced by patients.

The AI findings add an emerging digital-health dimension. Two-thirds of participants were willing to consider future AI-supported implant assessment, but 81.8% of those willing to consider such assessment preferred dentist review or explanation. This pattern is broadly consistent with studies showing generally positive attitudes toward AI in dentistry while retaining an important role for the dentist (23). The present findings therefore support a model of AI readiness based on augmentation rather than replacement of professional care. Importantly, the present study assessed perceptions and future willingness only; AI was not used for diagnosis or treatment, and the findings should not be interpreted as evidence of AI effectiveness.

From a public-health perspective, the findings support a shift from an implant-placement-

centered model toward a continuum of implant care incorporating prevention, maintenance, early detection, patient education, and patient-reported outcomes. The high proportion of participants reporting irregular/no maintenance and the relatively low proportion receiving implant-specific hygiene instructions identify potentially modifiable service-delivery gaps. In practical terms, implant services could incorporate standardized hygiene education at insertion and recall visits, risk-based maintenance schedules, documentation of BOP and probing depth, reminders for overdue maintenance, and early referral when persistent bleeding or increased probing depth is detected. Such approaches are compatible with the WHO Global strategy and action plan on oral health 2023–2030, which emphasizes prevention, integration of oral health within health services, stronger information systems, and equitable access to oral healthcare (14). Digital reminders and appropriately governed AI-supported patient education may eventually extend these preventive functions but should remain embedded within dentist-supervised care pathways.

This study has several strengths. It included a relatively large sample of 300 women and combined objective clinical findings with preventive behaviors, OHRQoL, and future digital-health readiness within the same population. Participant-level analysis was used for individuals with multiple implants, reducing the statistical problem of treating individual implants as independent observations. The multivariable analysis further identified independent associations between modifiable preventive factors and inflammation. From a public-health perspective, the study also moves beyond disease description by identifying behavioral and service-related factors that could potentially be targeted through education, recall systems, and maintenance programs. Several limitations should be considered. Cross-sectional design prevents determination of temporal or causal relationships; therefore, the observed associations between poor preventive practices, maintenance, plaque, and inflammation should not be interpreted as proof that these factors caused inflammation. Participants were recruited consecutively from clinical settings in Karachi, limiting generalizability to other Pakistani regions, community populations, or men with dental implants. Peri-implantitis was not definitively diagnosed because supporting bone-loss criteria were unavailable. Preventive behaviors, digital-health exposure, and AI readiness were partly self-reported and may therefore be affected by recall or social-desirability bias. Finally, AI readiness reflected hypothetical future acceptance rather than actual use of an AI system. Future multicenter longitudinal studies should incorporate clinical examination, radiographic assessment where indicated, validated AI-readiness measures, and evaluation of whether structured maintenance, patient education, digital reminders, and dentist-supervised AI-supported interventions can improve peri-implant health and OHRQoL. Overall, the findings support an integrated preventive model in which peri-implant biofilm control, regular professional maintenance, early clinical monitoring, patient-reported OHRQoL, and carefully governed digital technologies are incorporated into continuing oral-health services. The willingness of many participants to consider future AI support, combined with their strong preference for dentist involvement, suggests that future AI applications should strengthen, not replace the patient–dentist relationship.

CONCLUSION

Among women with dental implants in Karachi, clinical peri-implant inflammation was associated with plaque accumulation, poorer preventive practices, and irregular or absent implant-maintenance visits. Inflammation and poor preventive practices were also associated with greater oral-health impact as measured by OHIP-14. Most participants expressed willingness to consider future AI-supported implant assessment, although a strong majority of AI-accepting participants preferred dentist review and explanation. These findings support an integrated, preventive model of implant care combining oral-health education, effective biofilm control, regular professional maintenance, clinical monitoring, OHRQoL assessment, and appropriately governed digital innovation. AI should currently be considered a potential supportive technology for future oral-health services rather than a substitute for professional dental assessment. Longitudinal, multicenter studies using standardized peri-implant diagnostic criteria and validated AI-readiness measures are needed to determine the clinical and public-health value of integrated preventive and AI-supported approaches.

REFERENCES

1. Duong HY, Roccuzzo A, Stähli A, Salvi GE, Lang NP, Sculean A. Oral health-related quality of life of patients rehabilitated with fixed and removable implant-supported dental prostheses. Periodontology 2000. 2022 Feb;88(1):201-37.https://doi.org/10.1111/prd.12419
2. Schwarz F, Derks J, Monje A, Wang HL. Peri-implantitis. Journal of Clinical Periodontology. 2018 Jun;45:S246-66.https://doi.org/10.1111/jcpe.12954
3. Heitz-Mayfield LJ. Peri-implant mucositis and peri-implantitis: key features and differences: Peri-implant mucositis and peri-implantitis: key features and differences. British Dental Journal. 2024 May 24;236(10):791-4.https://doi.org/10.1038/s41415-024-7402-z
4. Caton JG, Armitage G, Berglundh T, Chapple IL, Jepsen S, Kornman KS, Mealey BL, Papapanou PN, Sanz M, Tonetti MS. A new classification scheme for periodontal and peri-implant diseases and conditions–Introduction and key changes from the 1999 classification. Journal of Periodontology. 2018 Jun;89:S1-8.https://doi.org/10.1002/JPER.18-0157
5. Renvert S, Persson GR, Pirih FQ, Camargo PM. Peri-implant health, peri-implant mucositis, and peri-implantitis: Case definitions and diagnostic considerations. Journal of Clinical Periodontology. 2018 Jun;45:S278-85.https://doi.org/10.1111/jcpe.12956
6. Gennai S, Bollain J, Ambrosio N, Marruganti C, Graziani F, Figuero E. Efficacy of adjunctive measures in peri-implant mucositis. A systematic review and meta-analysis. Journal of Clinical Periodontology. 2023 Jun;50:161-87.https://doi.org/10.1111/jcpe.13791
7. Kormas I, Pedercini C, Pedercini A, Raptopoulos M, Alassy H, Wolff LF. Peri-implant diseases: diagnosis, clinical, histological, microbiological characteristics and treatment strategies. A narrative review. Antibiotics. 2020 Nov 22;9(11):835.https://doi.org/10.3390/antibiotics9110835
8. Agrawal N, Aggarwal A, Garg AK, Gupta ND, Tewari RK, Gupta J. Oral health-related quality of life: current status and future implications. J Oral Health Community Dent. 2021 May;15(2):87-91.
9. Abou-Ayash S, Bjelopavlovic M, Molinero-Mourelle P, Schimmel M. Implant Survival in Patient Populations with a Mean Age of 65–75 Years Compared to Older Cohorts: A Systematic Review and Meta-Analysis. Clinical Oral Implants Research. 2025 Sep;36(9):1053-74.https://doi.org/10.1111/clr.14456
10. Derks J, Tomasi C. Peri-implant health and disease. A systematic review of current epidemiology. Journal of Clinical Periodontology. 2015 Apr;42:S158-71.https://doi.org/10.1111/jcpe.12334
11. Rahmayanti F. Indonesian short version of the oral health impact profile (OHIP-14).
12. Sanz M, Herrera D, Kebschull M, Chapple I, Jepsen S, Berglundh T, Sculean A, Tonetti MS, EFP Workshop Participants and Methodological Consultants, Merete Aass A, Aimetti M. Treatment of stage I–III periodontitis—The EFP S3 level clinical practice guideline. Journal of Clinical Periodontology. 2020 Jul;47:4-60.https://doi.org/10.1111/jcpe.13290
13. Heitz-Mayfield LJ, Salvi GE. Peri-implant mucositis. Journal of Clinical Periodontology. 2018 Jun;45:S237-45.https://doi.org/10.1111/jcpe.12953
14. World Health Organization. Global strategy and action plan on oral health 2023–2030. World Health Organization; 2024 May 26.
15. Schwendicke FA, Samek W, Krois J. Artificial intelligence in dentistry: chances and challenges. Journal of Dental Research. 2020 Jul;99(7):769-74.https://doi.org/10.1177/0022034520915714
16. Khanagar SB, Al-Ehaideb A, Maganur PC, Vishwanathaiah S, Patil S, Baeshen HA, Sarode SC, Bhandi S. Developments, application, and performance of artificial intelligence in dentistry–A systematic review. Journal of Dental Sciences. 2021 Jan 1;16(1):508-22.https://doi.org/10.1016/j.jds.2020.06.019
17. Guidance WH. Ethics and governance of artificial intelligence for health. World Health Organization. 2021 Jun 28;1.
18. Topol EJ. High-performance medicine: the convergence of human and artificial intelligence. Nature Medicine. 2019

Jan;25(1):44-56.https://doi.org/10.1038/s41591-018-0300-7

19. Herrera D, Berglundh T, Schwarz F, Chapple I, Jepsen S, Sculean A, Kebschull M, Papapanou PN, Tonetti MS, Sanz M, EFP Workshop Participants and Methodological Consultant. Prevention and treatment of peri-implant diseases—The EFP S3 level clinical practice guideline. Journal of Clinical Periodontology. 2023 Jun;50:4-76.https://doi.org/10.1111/jcpe.13823
20. Derks J, Ichioka Y, Dionigi C, Trullenque-Eriksson A, Berglundh J, Tomasi C, Graziani F. Prevention and management of peri-implant mucositis and peri-implantitis: a systematic review of outcome measures used in clinical studies in the last 10 years. Journal of Clinical Periodontology. 2023 May;50:55-66.https://doi.org/10.1111/jcpe.13608
21. Verket A, Koldsland OC, Bunaes D, Lie SA, Romandini M. Non-surgical therapy of peri-implant mucositis—Mechanical/physical approaches: A systematic review. Journal of Clinical Periodontology. 2023 Jun;50:135-45.https://doi.org/10.1111/jcpe.13789
22. Mauland EK, Beheshti Maal M, Melbye EL, Aarbu NØ, Sørensen K, Ellingsen SA, Bunæs DF, Gaarden RT, Verket A. The impact of peri-implant diseases and complications on oral health-related quality of life following dental implant therapy in Norway: a cross-sectional study. Clinical Oral Implants Research. 2025 Oct;36(10):1219-33.https://doi.org/10.1111/clr.14467
23. Ayad N, Schwendicke F, Krois J, van den Bosch S, Bergé S, Bohner L, Hanisch M, Vinayahalingam S. Patients' perspectives on the use of artificial intelligence in dentistry: a regional survey. Head & Face Medicine. 2023 Jun 22;19(1):23.https://doi.org/10.1186/s13005-023-00368-z