

Critical Issues in Dental Hygiene Education

Implant Maintenance Curriculum Content in Dental Hygiene Education

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Abstract

Purpose: Dental implants have become a common treatment option for the replacement of missing teeth. The purpose of this study was to identify the curriculum content used for teaching dental implant maintenance within entry-level dental hygiene programs in the United States.

Methods: An electronic questionnaire was distributed via five mailings in March and April of 2020 to accredited entry-level dental hygiene program directors (n=329) in the United States. The survey instrument evaluated curriculum content related to dental implant maintenance within dental hygiene programs at both the associate and baccalaureate levels. Results were analyzed using descriptive statistics and Chi square tests of association ($p=0.01$).

Results: A total of 86 responses were received for a response rate of 26.1%. Most programs (98.80%, n=82) provide didactic instruction on dental implant maintenance, while less than half (45.8%, n=38) include laboratory instruction in maintenance therapy. On average, students worked with 3.41 implant patients during their clinical education (range = 0-20). Most respondents indicated that clinical competencies are not required for implant maintenance. There were no statistically significant differences found in the curriculum content for teaching dental implant maintenance between associate degree/certificate and baccalaureate entry-level programs.

Conclusions: Varied approaches in the assessment and maintenance of peri-implant health were identified among the dental hygiene programs surveyed. These findings may provide an opportunity for program directors to assess their curriculum and create protocols and competencies related to dental implant maintenance. Future research is needed to investigate the curriculum content and evaluate whether programs are implementing maintenance approaches that promote implant health.

Keywords: dental implants, implant maintenance therapy, curriculum, dental hygiene process of care, dental hygiene education

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Introduction

The percentage of the United States (US) population with dental implants for the replacement of missing teeth has increased significantly from 0.7% in 2000 to 5.7% in 2016 and is projected to be as high as 23% by 2026.¹ An estimated 3 million people in the US have at least one dental implant and about 500,000 implants are placed annually.² Dental implants are now considered a viable and predictable treatment option for tooth replacement.¹⁻³ Implants can serve to preserve adjacent teeth and surrounding bone and enhance the masticatory function and quality of life for patients suffering from tooth loss ranging from a single tooth to fully edentulous.¹⁻³

Maintaining peri-implant health is critical for the long-term survival of the implant.^{4,5} Inflammatory diseases caused by biofilm accumulation can compromise the health of

dental implants.^{6,7} Inflammation surrounding an implant that is limited to the adjacent mucosa is defined as peri-implant mucositis, while progression of the inflammation leading to bone loss is defined as peri-implantitis.^{6,7} Dental professionals assess implant health during the process of care and screen for clinical signs of inflammation, bleeding upon probing, increased pocket depths, suppuration, mobility, and radiographic bone loss.^{8,9} Peri-implant health is evidenced by the absence inflammatory signs and symptoms, probing depths of 4-5mm or less, and no radiographic evidence of bone loss.^{6,8} Risk factors for peri-implant mucositis and peri-implantitis include history of periodontal disease, poor biofilm control, irregular maintenance visits, residual cement, occlusal overload, tobacco use, diabetes, and connective tissue

disease.^{5,6,10} Regularly scheduled, nonsurgical maintenance therapy is provided in an effort to address these risk factors.

The prevalence of peri-implant related diseases remains high; rates vary based upon the study and criteria. Peri-implant mucositis affects between 42.5% to 50% of implants while peri-implantitis impacts 12-43% of implants.^{7,11} Research is limited regarding the long-term survival of dental implants and disease rates may be difficult to track;¹² implant failure and survival rates are determined based upon the presence of the implant in the mouth at the time of the study.¹³ Research studies have shown that between 9-16.6% of implants will fail within ten years of placement.¹⁴ Given the high incidence of peri-implant diseases, success and survival rates should be considered when evaluating dental implants and their long term prognosis.¹⁵

As preventive oral health specialists, dental hygienists manage and maintain periodontal health through the diagnostic, preventive and therapeutic services which relate specifically to dental implant maintenance.¹⁶ Continuing care visits play a key role in implant success by reducing bacterial biofilm and promoting implant health; however, the frequency of implant maintenance visits should be based upon individual patient needs.^{4,11,17} Early diagnosis and intervention are crucial components of preventing implant failure. Dental hygienists can play a key role in implant maintenance in addition to facilitating care through patient education and a multidisciplinary approach to referrals.^{5,6,18}

The US dental hygiene educational standards established by the Commission on Dental Accreditation (CODA) do not specifically state how entry-level dental hygiene programs must prepare graduates to assess and maintain dental implants. Standard 2-13 states that “graduates must be competent in providing the dental hygiene process of care,” and Standard 2-14 states that “graduates must be competent in providing dental hygiene care for all types of classifications of periodontal diseases, including patients who exhibit moderate to severe periodontal disease.”¹⁹ The dental hygiene process of care includes the management of oral conditions, with implant maintenance in this category. Dental hygienists must have the knowledge base and clinical skills to assess, plan dental hygiene therapies, implement care, evaluate results, and document the care of implants and management of peri-implant disease.¹⁶ Entry-level dental hygiene programs must decide the extent to which dental implant maintenance is included within their curriculum and the associated clinical requirements.

The integration of implant dentistry into predoctoral dental and dental hygiene curriculum has increased over the past few decades in order to remain current with the needs of

the population.²³⁻²⁸ Curriculum guidelines for dental implant education were first developed for dental hygiene programs in 1995 and can serve as a guide.²⁶ The recommendations include biological and scientific research of implantology, client assessment and education, diagnosis, treatment planning, and implant selection, implant surgery and postsurgical care, implant prosthodontic procedures, implant evaluation and maintenance protocols, and ethical considerations.²⁶ An emphasis was placed on a multidisciplinary approach and the need for highly trained dental hygienists and specialists with advanced education or experiences in implant dentistry.^{20,26,27}

There is a gap in the literature regarding curriculum content related to dental implant maintenance in entry-level dental hygiene programs in the US, however, in a study conducted in the United Kingdom and Ireland the implant maintenance curriculum in dental hygiene and dental therapy programs has been evaluated.²² All programs reported the provision of implant training by way of didactic lecture within their curricula, and over half (n=9) of the 14 programs required students to demonstrate competence related to the non-surgical management of peri-implantitis or peri-implant mucositis.²² Challenges to developing dental implant curriculum within predoctoral dental programs and dental hygiene programs in the United Kingdom and Ireland included a lack of suitable cases, funding, trained staff, time within the program, and high ratios of students to teachers.²⁰⁻²² Difficulties were also cited regarding the challenges related to following peri-implant related diseases that may progress over a longer period of time beyond the duration of enrollment in the educational program.²²

Other studies have shown that dental hygiene practitioners' confidence in monitoring and maintaining peri-implant related tissues may be dependent upon the educational experiences in school, training on the job, and professional development; thus, placing a high level of importance upon the educational experience.^{27,28} Moreover, simulations and clinical experiences have also been shown to affect the confidence and satisfaction levels of dental students regarding their overall educational experience.²⁹ Regardless of the education or hours of training, dental practitioners must stay current by critically evaluating the literature and current evidence to determine the best practices when managing patients with dental implants.

Since curriculum guidelines were first developed,²⁶ dental implant training has steadily increased; however, CODA has not included a standard or specific competency for implant maintenance within entry-level dental hygiene programs. Given the growing number of implants placed each year, inclusion of implant maintenance therapy within the dental hygiene curriculum should be considered. It is essential for

graduates entering the workforce to have the knowledge and clinical skills necessary to provide comprehensive care for patients with dental implants, yet little is known about the curriculum content related to dental implant maintenance in entry-level dental hygiene programs in the US. Therefore, the purpose of this study was to identify the curriculum content used for teaching dental implant maintenance within associate degree/certificate and baccalaureate entry-level programs in the US.

Methods

An exploratory descriptive research design was used to evaluate the dental implant maintenance curriculum content within entry-level dental hygiene programs in the US. The 33-item questionnaire was adapted with permission from a previous study performed to evaluate the current teaching methods of dental implant maintenance within dental hygiene and dental therapy schools in the United Kingdom and Ireland.²²

The following variables were analyzed: didactic instruction (5 items); laboratory experiences (3 items); clinical instruction/experiences and competencies (13 items); barriers (6 items); curriculum and accreditation requirements (4). Demographic items included role in the program and type of educational program/degree awarded. Respondents were also provided with an opportunity to provide open-ended comments on accreditation requirements for implant maintenance.

The instrument was evaluated by five experts in dental and dental hygiene education to establish content validity; a Content Validity Index (CVI) and a score of 0.80 or greater was sought for each item.²⁹ Reliability of the instrument was tested with a test-retest method by a secondary panel of experts to ensure consistency of results. The survey instrument and research questions were analyzed by a statistician to confirm correlation between the two, evaluate validity, and confirm the statistical analysis plan. Feedback provided by all experts was utilized and minor modifications were made. Institutional Review Board approval was granted by the University of Idaho Human Subjects Committee (IRB#-FY2020-218).

Dental hygiene program directors from 329 entry-level dental hygiene programs in the US (n=329) were invited to participate in the electronic survey. Five mailings from March to April 2020 were distributed through an online survey program (Qualtrics; Provo, UT, USA). The self-administered survey contained a consent statement; all responses were confidential. Descriptive statistics and a Chi square test of association were used to analyze the data. Probability was established at 0.01 to prevent a type 1 error.

Results

A total of 86 surveys were returned for a response rate of 26.1% (n=86). Of the surveys returned, 82 were completed and included in the data analysis (n=82). Nearly three quarters (74.7%, n=62) of the respondents identified themselves as program directors, while others (34.9%, n=29) identified themselves as clinic coordinators. Some respondents identified themselves as fulfilling both roles of program directors and clinic coordinators. Most of the respondents (73.5%, n=61) were from associate degree/certificate programs while the remainder (25.3%, n=21) were from baccalaureate programs.

Didactic Instruction

The majority (98.8%, n=82) of respondents indicated that didactic instruction on dental implants was part of the curriculum; approximately 6.25 average contact hours were dedicated to didactic instruction on dental implants (range = 1-24 hours). Regarding specific content, nearly all (98.8%, n=82) respondents indicated didactic instruction on the assessment of peri-implant related diseases, professional implant maintenance (95.2%, n=79), and dental implant self-care (96.4%, n=80). Other topics included within the didactic curriculum were implant types and materials, treatment planning, contraindications, surgical placement, assessment of implant health, rationale for referral, and implant maintenance throughout the dental hygiene process of care. A chi square test of association was used to determine relationships between the responses to the item related to didactic content on implant self-care and the type of degree offered (associate degree/certificate versus baccalaureate). However, the associations between the different types of educational institutions and responses for this item were not statistically significant ($X^2=0.71$, $df = 1$, $p = 0.40$, Cramer's Phi = 0.09).

Laboratory Instruction

Fewer than half (45.8%, n=38) included pre-clinical instruction within the laboratory setting on implant maintenance. Further analysis of the data showed that 41.0% (n=25) of the associate degree/certificate programs and 61% (n=13) of the baccalaureate programs had instruction in the laboratory setting; typodonts were used by 44% (n=23) of the associate degree/certificate programs and in 23% (n=3) of the baccalaureate programs. A chi square test of association was used to determine associations between these responses and degree offered, however the difference was not statistically significant ($X^2 = 1.61$, $df = 1$, $p = 0.21$, Cramer's Phi = -0.21). Programs with laboratory experiences on dental implants indicated whether simulation training was used and over half of the associate degree/certificate programs (52.0%, n=13) and over one quarter of the baccalaureate programs (30.8%, n=4)

used simulators. However, this difference was not statistically significant ($X^2 = 1.56$, $df = 1$, $p = 0.21$, Cramer's Phi = -0.20).

Clinical Experiences

Regarding the number of direct patient experiences, most (87.8%, $n=72$) respondents reported, on average, that students worked with 3.41 patients with implants during their clinical education. Aspects of clinical experiences were analyzed with yes/no responses and categorized by program type. Programs required clinical experiences using radiographs to screen for implant diseases, utilizing hand instrumentation around dental implants, and teaching patients how to use self-care aides to maintain dental implants. However, most programs did not require the use of ultrasonic instrumentation or air polishing for biofilm reduction. Respondents were divided regarding probing implants and providing experiences related to irrigating with antiseptics. Responses to items directed toward clinical experiences are shown in Table I.

A chi square test of association was used to determine relationships between clinical experiences and type of degree offered; however, no outcomes were statistically significant (Table II). Additionally, within the clinical experience items, respondents were asked items related to the performance of clinical competencies and dental implant maintenance skills. Most indicated that dental implant clinical competencies were not required (Table I). Of those who required competencies, the specific assessments were associated with periodontal disease staging and grading, air polishing, debridement, irrigation, instrumentation, and self-care recommendations. Additional areas included the dental hygiene process of care and the assessment of implant health.

Educational Barriers

Over half (58.5%, $n=48$) of the respondents indicated barriers in educating students about dental implant maintenance associated within the curriculum. Examples included lack of trained faculty, calibration, time, patients, and funding; lack of patients was the most concerning barrier cited by nearly three quarters of the respondents (74.4%, $n=61$). A chi square test of association was used to determine whether there was an association between these responses and the type of degree offered. However, the findings were not statistically significant (Table III).

Curriculum Development and Accreditation

Regarding the further development of dental implant maintenance content in the program curriculum, a majority (89.0%, $n=73$) indicated that they would be considering it in the next five years. Further analysis of the data showed that most (90.2%, $n=55$) associate/certificate degree programs

and 85% ($n=18$) baccalaureate programs were supportive of expanding the curriculum. A chi square test of association was used to determine whether there was an association between these responses and type of degree offered; however, the difference was not statistically significant ($X^2=0.32$, $df = 1$, $p = 0.57$, Cramer's Phi = -0.06). Respondents in favor of expanding the curriculum indicated an interest in enhancing laboratory or simulation experiences; expanding didactic instructional hours; and increasing clinical experiences related to air polishing, ultrasonic scaling, and patient education. Respondents also recognized the need to update dental implant curriculum regularly. Respondents not in favor of further developing the curricular content (11.0%, $n=9$) commented the dental implant curriculum is already comprehensive and clearly defined and had recently been updated.

Attitudes towards accreditation requirements for didactic instruction were divided with 51.2% ($n=42$) indicating no change and 48.8% ($n=40$) indicating the need for a change. Regarding the inclusion of a clinical requirement for implant maintenance in the accreditation standards, over half (63.4%, $n=52$) responded "no" and 36.6% ($n=30$) responded "yes." Further analysis of the data showed that 62.3% ($n=38$) of the associate degree/certificate programs and 66.6% ($n=14$) of the baccalaureate programs responded "no" clinical accreditation changes were needed; however, these differences between program types were not statistically significant ($X^2=0.13$, $df = 1$, $p = 0.72$, Cramer's Phi = -0.04). Respondents were provided an opportunity to comment on accreditation standard requirements for implant maintenance in entry-level dental hygiene programs. Notable comments are shown in Table IV.

Discussion

To the best of the authors' knowledge the curricular content specific to dental implant maintenance in entry level dental hygiene programs in the US has not been previously assessed. Inclusion of dental implant maintenance in the dental hygiene curriculum serves to support the approximately 500,000 new implants placed annually in the US.² However, the curricular content and scope related to dental implant maintenance varies. Several key findings from the results are worthy of discussion.

Nearly all respondents indicated their program provides students with direct clinical experiences with implant patients and students on the average had 3.41 patient experiences. The number of patient encounters can vary greatly depending on the location of the program and the populations served. As the projected prevalence of dental implants in the US population is 23% by 2025, providing dental hygiene students with adequate clinical training continues to present challenges. The main barrier cited in this study was the limited number

Table I. Responses to items related to clinical experiences for dental implant maintenance (n=82)

Statement	Associate/Certificate (n=61)*	Bachelor's (n=21)	Associate/Certificate (n=61)*	Bachelor's (n=21)
	Yes	Yes	No	No
	n (%)	n (%)	n (%)	n (%)
Q14. Are students having direct clinical experiences with patients to maintain dental implants?	56 (91.8)	21 (100.0)	5 (8.2)	—
Q16. Does the dental hygiene curriculum require students to probe dental implants as part of the periodontal assessment in the clinical setting?	38 (62.3)	15 (71.4)	23 (37.7)	6 (28.6)
Q17. Are students required to use radiographs to screen for peri-implant related diseases within the clinical setting?	57 (93.4)	20 (95.2)	4 (6.6)	1 (4.8)
Q18. Are students required to assess risk factors for peri-implant related diseases within the clinical setting?	56 (91.80%)	20 (95.2)	5 (8.2)	1 (4.8)
Q19. Does the dental hygiene curriculum require students to produce a biofilm free surface around dental implants with ultrasonic instrumentation within the clinical setting?	18 (29.5)	8 (38.1)	43 (70.5)	13 (61.9)
Q20. Does the dental hygiene curriculum require students to produce a biofilm free surface around dental implants with hand instruments within the clinical setting?	47 (78.3)	17 (81.0)	13 (21.7)	4 (19.0)
Q21. Does the dental hygiene curriculum require students to produce a biofilm free surface around dental implants with air polishing within the clinical setting?	22 (36.1)	8 (38.1)	39 (63.9)	13 (61.9)
Q22. Does the dental hygiene curriculum provide experiences related to irrigation with antiseptics around dental implants to promote peri-implant health within the clinical setting?	31 (51.7)	17 (81.0)	29 (48.3)	4 (19.0)
Q23. Are students required to recommend self-care aids to patients with dental implants within the clinical setting?	59 (98.3)	21 (100.0)	1 (1.7)	—
Q24. Are students required to teach patients how to use the recommended self-care aids to maintain dental implants within the clinical setting?	56 (91.8)	19 (90.5)	5 (8.2)	2 (9.5)
Q25. Does your dental hygiene program require students to perform any clinical competencies related to dental implant maintenance within the clinical setting?	8 (13.1)	2 (9.5)	53 (86.9)	19 (90.5)

* n=60 for Q20, Q22, Q23

Table II. Chi square test of association for items related to dental implant clinical experiences (n=82)

Statement	Valid n	X ² or Exact Test	df	p	Cramer's Phi
Q14. Are students having direct clinical experiences with patients to maintain dental implants?	82	1.83	1	0.18	0.15
Q16. Does the dental hygiene curriculum require students to probe dental implants as part of the periodontal assessment in the clinical setting?	82	0.57	1	0.45	0.08
Q17. Are students required to use radiographs to screen for peri-implant related diseases within the clinical setting?	82	0.09	1	0.77	0.03
Q18. Are students required to assess risk factors for peri-implant related diseases within the clinical setting?	82	0.27	1	0.60	0.06
Q 19. Does the dental hygiene curriculum require students to produce a biofilm free surface around dental implants with ultrasonic instrumentation with the clinical setting?	82	0.53	1	0.47	0.08
Q 20. Does the dental hygiene curriculum require students to produce a biofilm free surface around dental implants with hand instruments within the clinical setting?	81	0.06	1	0.80	0.03
Q 21. Does the dental hygiene curriculum require students to produce a biofilm free surface around dental implants with air polishing within the clinical setting?	82	0.03	1	0.87	0.02
Q 22. Does the dental hygiene curriculum provide experiences related to irrigation with antiseptics around dental implants to promote peri-implant health within the clinical setting?	81	5.53	1	0.02	0.26
Q 23. Are students required to recommend self-care aids to patients with dental implants within the clinical setting?	81	0.35	1	0.55	0.07
Q 24. Are students required to teach patients how to use the recommended self-care aids to maintain dental implants within the clinical setting?	82	0.04	1	0.85	-0.02
Q 25. Does your dental hygiene program require students to perform any clinical competencies related to dental implant maintenance within the clinical setting?	82	0.19	1	0.66	-0.05

Table III. Chi square test of association for items related to dental implant educational barriers (n=82)

Statement	Valid n	X2 or Exact Test	df	p	Cramer's Phi
Q 27. Are there barriers to educating students about dental implant maintenance?	82	0.77	1	0.38	1.00
Q 28. Is a lack of trained faculty a barrier for dental implant maintenance instruction?	82	0.59	1	0.44	-0.09
Q 29. Is a lack of calibration among faculty a barrier for dental implant maintenance instruction?	82	0.03	1	0.85	0.02
Q 30. Is a lack of time within the curriculum a barrier for dental implant maintenance instruction?	82	0.44	1	0.51	0.07
Q 31. Is a lack of patients with dental implants a barrier for dental implant maintenance instruction?	82	0.88	1	0.35	-0.10
Q 32. Is a lack of funding a barrier for dental implant maintenance instruction?	82	1.48	1	0.23	0.13

of patients in the clinic population with dental implants. This may be related to demographics, socioeconomic status of the patient population, or affiliation with a dental school or the type of clinical setting. To overcome this barrier, programs can enhance or foster the learning experience by integrating typodonts with dental implants, or simulation training into their laboratory curriculum. However, only few respondents indicated using this learning approach. A further complication is that student experiences appear to be focused on prevention of dental disease and tooth loss versus maintenance protocols and procedures for patients with dental implants. It is important to provide students with comprehensive clinical experiences which parallel what is found in clinical practice even if it requires additional effort to expand the patient population or alternatively incorporate simulated experiences. Perhaps patients with dental implants should be considered in the same manner as periodontal, special needs, geriatric, radiographic, and pediatric patient experiences and competencies.

The therapeutic services taught to maintain dental implants within the dental hygiene educational setting varied. Considering the high incidence of peri-implant related diseases affecting approximately 50% of implants, early detection and non-surgical management of peri-implant related diseases is an essential aspect of the dental hygiene process of care.⁷ Even though most programs require students to probe implants within the clinical setting, many do not make this a requirement. The literature emphasizes the importance of lightly probing around implants to ensure not to damage the epithelial attachment

Table IV. Open-ended comments regarding accreditation requirements for dental implant maintenance

<i>"The requirements are sufficient and implant care is embedded and it is not necessary to prepare students to maintain implants."</i>
<i>"A clinical accreditation requirement may not be feasible for all students due to limited populations with implants in some populations."</i>
<i>"A simulation or laboratory requirement is more attainable for all programs."</i>
<i>"Students graduate as minimally competent to practice and their dental hygiene education is just the tip of the iceberg of what they will learn in practice and through CE courses; we can't teach everything to competence; some grads will see patients with implants while others might not ever see another implant."</i>
<i>"Accreditation requirements guide instruction and promote competence, one related to dental implant maintenance is important."</i>

with an appropriate periodontal probe suited for titanium to document a baseline pocket depth,¹⁹ although probing around dental implants has historically been questioned in the dental community. It is important to remember that peri-implant probing is considered one of the methods used to assess peri-implant health and screen for peri-implant related diseases.^{4,7,8}

Further, most programs implement hand instrumentation with implant scalers, yet results varied on the use of air polishing devices, ultrasonic implant scalers, and antiseptics

which help to reduce biofilm around implants and reduce inflammation or risk of disease.^{9,30,31} Air polishing could be considered a sustainable treatment option for peri-implant related diseases; however, only a limited number of programs surveyed utilize these devices.^{31,32} Cost of the air polishing devices and powders and the associated aerosols may be a consideration. Ultrasonic devices with an implant scaler tip may also reduce the bacterial biofilm around implants to promote peri-implant health but were not reported as a common component of dental hygiene curriculum.^{30,32} Respondents were divided on the use of antiseptics, and more baccalaureate programs integrated their use over associate/certificate programs. However, chemotherapeutic agents have been cited in the literature as being a necessary adjunct to mechanical debridement for peri-implant disease.³⁰ While the literature supports the use of air polishing devices, ultrasonic scaling devices, and the use of antimicrobials as therapeutic modalities to decontaminate the peri-implant tissue,^{7,30,32} these treatment modalities were not incorporated into all of the education programs in this study.

There was also considerable variation in the overall curriculum content in terms of the number of contact hours dedicated to didactic instruction of dental implants, inclusion of laboratory instruction, number of implant patient encounters, and the type of therapeutic services rendered. A lack of consistency could be linked to a lack of accreditation standards and competencies developed for this area of patient care. As defined by CODA Standards 2-13 and 2-14, students must be competent in implementing the dental hygiene process of care and treating all types of the new classifications of periodontal diseases.¹⁹ The most recent classification of periodontal and implant-related diseases identifies each disease separately, yet the competencies outlined by CODA do not mention dental implants specifically. This lack of a specific standard allows the individual dental hygiene program to determine the required experiences related to implants.^{19,33} It is not known if and how these educational experiences are implemented. A recent study of dental implant maintenance practices among dental hygiene practitioners in the US found there are a variety of approaches to dental implant maintenance.³⁴ In addition, clinicians varied greatly in the way in which they acquired knowledge regarding caring for patients with dental implants.³⁴ The study results also reinforced the need to integrate evidence-based practices and establish standards pertaining to dental implant maintenance beginning with the dental hygiene curricula.³⁴ An accreditation requirement related to dental implant maintenance may help to guide dental hygiene programs in their effort to promote competence. Considering that approximately 9-16.6% of dental implants fail ten years

after placement,¹⁴ dental hygienists educated with the skills to help in the identification and management of peri-implant related diseases could improve the overall success rate.

This study had limitations. The low response rate may increase the possibility of a non-response error.³⁵ Possible causes of the low response rate include issues related to invitational emails for surveys, not taking the time to participate, or issues related to the COVID-19 pandemic. This survey occurred during the spring, 2020 when program directors and clinic coordinators were encumbered by many disruptions in classroom and clinical schedules. To prevent this non-response error, the participants received five invitations to participate in the study, and the online questionnaire was designed to be concise, easy to read and complete. Another consideration was the limited amount of demographic data collected. Additional information regarding the program setting and location would have enriched the understanding of parameters associated with curriculum experiences and barriers associated with dental implant maintenance education.

Future research could include repeating this study with the inclusion of additional demographic questions. This may help to better understand dental implant maintenance curriculum and patient experiences as they pertain to barriers and limitations. Additional research should include the perceptions of dental hygiene clinical faculty and students to determine recommendations for improvement in the didactic, laboratory and clinical experiences. Examining the perspectives of dental hygiene practitioners would provide a dynamic qualitative study to determine their recommendations for clinical guidelines and appropriate educational preparation to promote implant health.

Conclusions

This study examined dental implant maintenance education among associate/certificate and baccalaureate degree, entry-level dental hygiene programs in the US. Study results indicated that various approaches were used to assess and maintain peri-implant health, however data were not statistically significant when analyzing differences between associate/certificate and baccalaureate programs. Findings from this study may provide an opportunity for curriculum assessments and the creation of protocols and competencies related to dental implant maintenance. Future research is needed to investigate the curriculum content and evaluate whether dental hygiene education programs are implementing maintenance approaches that promote implant health.

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References

1. Elani HW, Starr JR, Da Silva JD et al. Trends in dental implant use in the U.S., 1999-2016, and projections to 2026. *J Dent Res.* 2018 Dec;97(13):1424-30.
2. American Academy of Implant Dentistry: What are dental implants? [Internet]. Chicago; American Academy of Implant Dentistry; [cited 2020 Apr 14]. Available from: <https://www.aaaid-implant.org/dental-implants/what-are-dental-implants/>
3. Raikar S, Talukdar P, Kumari S et al. Factors affecting the survival rate of dental implants: a retrospective study. *J Int Soc Prev Community Dent.* 2017 Nov-Dec;7(6):351-355.
4. Gulati M, Govila V, Anand V et al. Implant maintenance: a clinical update. *Int Sch Res Notices.* 2014 Jul 9;2014:908534.
5. Schwarz F, Derks J, Monje A et al. Peri-implantitis. *J Periodontol.* 2018 Jun 21;89: Suppl 1:S267-S290.
6. American Academy of Periodontology. Peri- implant mucositis and peri-implantitis: a clinical understanding of their diagnoses and clinical implications. *J Periodontol.* 2013 Apr 1;84(4):436-443.
7. Figuero E, Graziani F, Sanz I et al. Management of peri-implant mucositis and peri-implantitis. *Periodontol* 2000. 2014 Oct;66(1):255-73.
8. Ashrafi S., Narvedkar AN. A quick reference guide to the evaluation of peri-implant tissues in health and disease. *Access.* 2019 Jan;33(1):8-13.
9. Mishler OP, Shiau, HJ. Management of peri-implant disease: a current appraisal. *J Evid Based Dent Pract.* 2014 Jun;14:Suppl:53-59.
10. Carr BR, Boggess WJ, Coburn JF et al. Is alcohol consumption associated with protection against peri-implantitis? A retrospective cohort analysis. *J Oral Maxillofac Surg.* 2020 Jan 1;78(1):76-81.
11. Cosgarea R, Sculean A, Shibli JA et al. Prevalence of peri-implant diseases - a critical review on the current evidence. *Braz Oral Res.* 2019 Sept 30;33:Suppl 1:e:063.
12. Moraschini V, da C.Poubel LA, Ferreira VF et al. Evaluation of survival and success rates of dental implants reported in longitudinal studies with a follow-up period of at least 10 years: A systematic review. *Int J Oral Maxillofac Surg.* 2015 Nov;44(3):377-388
13. Hickin MP, Shariff JA, Jennette PJ et al. Incidence and determinants of dental implant failure: a review of electronic health records in a U.S. dental school. *J Dent Educ.* 2017 Oct;81(10):1233-1242.
14. Jemt T. Implant failures and age at the time of surgery: a retrospective study on implant treatments in 4585 edentulous jaws. *Clin Implant Dent Relat Res.* 2019 Aug;21(4):514-520.
15. Simonis P, Dufour T, Tenebaum H. Long-term implant survival and success: a 10-16- year follow-up of non-submerged dental implants. *Clin Oral Implants Res.* 2010 Jun 7;21:772-777.
16. American Dental Hygienists' Association. Standards for clinical dental hygiene practice [Internet]. Chicago: American Dental Hygienists' Association; 2016 [cited 2020 Apr 14]. Available from: <https://www.adha.org/resources-docs/2016-Revised-Standards-for-Clinical-Dental-Hygiene-Practice.pdf>
17. Gay IC, Tran DT, Weltman R et al. Role of supportive maintenance therapy on implant survival: a university-based 17 years retrospective analysis. *Int J Dent Hyg.* 2016 Nov;14(4):267-71.
18. Ng E, Lim LP. An overview of different interdental cleaning aids and their effectiveness. *Dent J.* 2019 Jun 1;7(2):56.
19. Commission on Dental Accreditation. Accreditation standards for dental hygiene education programs [Internet]. Chicago: Commission on Dental Accreditation; 2019 Aug [cited 2020 April 14] Available from: https://www.ada.org/-/media/CODA/Files/2020_dental_hygiene_standards.pdf?la=en

20. Atashrazm P, Vallaie N, Rahema R et al. Worldwide predoctoral dental implant curriculum survey. *J Dent (Tehran)*. 2011 winter;8(1):12-18.
21. Addy LD, Lynch CD, Locke M et al. The teaching of implant dentistry in undergraduate dental schools in the United Kingdom and Ireland. *Brit Dent J*. 2008 Dec 13;205 (11):609-14.
22. Chin JS, Addy LD, Rees J et al. Teaching of implant dentistry in dental hygiene and therapy schools in the UK and Ireland. *Br Dent J*. 2019 May;226(9):692-6.
23. Mattheos N, Ivanovski S, Heitz-Mayfield L et al. University teaching of implant dentistry: Guidelines for education of dental undergraduate students and general dental practitioners. an Australian consensus document. *Aust Dent J*. 2010 Sept;55(3):329-32.
24. Barwacz CA, Pantzlaff E, Allareddy V. Graduate periodontics programs' integration of implant provisionalization in core curricula: implementation of CODA standard 4-10.2.d. *J Dent Educ*. 2017 Jun;81(6):696-706.
25. Kihara H, Sun J, Sakai M et al. A survey of dental implant instruction in predoctoral dental curricula in North America. *J Dent Educ*. 2017 Sept;81(9):1085-90.
26. Gurenlian JR, Meffert RM, Kenneth WMJ. Curriculum guidelines in implant dentistry for dental hygiene programs. *Impl Dent*. 1995 Fall;4(3):162-4.
27. Walters H. Are dental hygienists and therapists confident in managing patients with implants? *Dent Health*. 2019 Jan;58(1):27-31.
28. Prasad S, Bansal N. Predoctoral dental students' perceptions of dental implant training: effect of preclinical simulation and clinical experience. *J Dent Educ*. 2017 Apr;81(4):395-403.
29. Yusoff MSB. ABC of content validation and content validity index calculation. *Educ in Med J [Internet]*. 2019 Jun [cited 2020 Jan];11(2):49-54. Available from: <https://doi.org/10.21315/eimj2019.11.2.6>
30. Ephros H, Kim S, & DeFalco R. Peri-implantitis: evaluation and management. *Dent Clin N Am*. 2020 Apr;64(2):305-13.
31. De Siena F, Corbella S, Taschieri S et al. Adjunctive glycine powder air-polishing for the treatment of peri-implant mucositis: an observational clinical trial. *Int J Dent Hyg*. 2015 Aug;13(3):170-6.
32. Wang C, Renvert S, Wang H. Nonsurgical treatment of periimplantitis. *Implant Dent*. 2019 Apr;28(2):155-60.
33. Caton JC, Armitage G, Berglundh T, et al. A new classification scheme for periodontal and peri-implant diseases and conditions: Introduction and key changes from the 1999 classification. *J Clin Periodontol*. 2018 Jun;45: Suppl 20:S1-S8.
34. Zellmer IH, Couch, ET, Berens, L et al. Dental hygienists' knowledge regarding dental implant maintenance care: A national survey. *J Dent Hyg*. 2020 Dec;94(6):6-15.
35. Dillman DA, Smith JD, Melani CL. Internet, phone, mail, and mixed mode surveys: The tailored design method. 4th ed. New Jersey: Wiley Press; 2014. Chapter 1, Sample surveys in our electronic world; p. 1-18.v