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DENTAL IMPLANT MAINTENANCE IN DENTAL HYGIENE PROGRAMS

by

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A thesis

submitted in partial fulfillment

of the requirements for the degree of

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Committee Approval

To the Graduate Faculty:

The members of the committee appointed to examine the thesis of ANNA CHERIE GENTRY find it satisfactory and recommend that it be accepted.

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Human Subjects Committee Approval

March 16, 2020

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Sincerely,

Ralph Baergen, PhD, MPH, CIP
Human Subjects Chair

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Dental Implant Maintenance in Dental Hygiene Programs

Thesis Abstract – Idaho State University (2020)

The purpose of this study is to identify the curriculum content used for teaching dental implant maintenance within entry-level dental hygiene programs in the United States. An electronic questionnaire was distributed by five mailings during the Spring of 2020 to 329 accredited entry-level dental hygiene program directors in the United States. Results were analyzed using descriptive statistics and Chi square tests of association ($p=0.01$). A total of 86 responses were received for a response rate of 26.14%. Most programs 82 (98.8%) provide didactic instruction on dental implant maintenance, while 38 (36.3%) include laboratory instruction. On average students worked with 3.41 implant patients during their clinical education (range = 0-20). There were no statistically significant differences found between associate degree/certificate and baccalaureate entry-level programs. These findings may provide an opportunity for program directors to assess their curriculum and create protocols related to dental implant maintenance.

Key Words: dental implants, maintenance, curriculum content, entry-level dental hygiene program

Chapter 1 Introduction

Introduction

Dental patients who lose a tooth or teeth due to periodontal disease, trauma, or other causes are faced with the decision of how to restore their dentition to masticatory function. In the past, the treatment options to replace a missing tooth included a bridge, a removable partial, a dental implant, or leave the space as is. Implant dentistry has been around for over 50 years and implants remain the standard of care to replace a missing tooth by preserving adjacent teeth and surrounding bone, and by enhancing masticatory function (Elani et al., 2018). Implant placement has transformed the quality of life and masticatory function for edentulous and partially edentulous patients with implant supported restorations (Elani et al., 2018).

According to the American Academy of Implant Dentistry (2018) approximately 3 million people in the United States have dental implants, and the number is expected to increase by about 500,000 annually. The National Examination Surveys estimate the percentage of dental implants has increased significantly from 0.7% in 1999-2000 to 5.7% in 2015-2016 and is projected to be 17% by 2026 (Elani et al., 2018). The risk of tooth loss has decreased over the past decades, yet the U.S. population continues to live longer; therefore, dental implant placement will likely continue to rise in future years (Elani et al., 2018). Implant failure may occur early due to a lack of osseointegration during the first weeks or months of implant placement, but there is also a risk of late failure due to infection or occlusal trauma (Raikar et al., 2017).

The maintenance of dental implants and maintaining implant health is crucial to the survival of dental implants. Inflammatory lesions or conditions which surround an implant consist of two diseases and include peri-implantitis and peri-implant mucositis (Figuro et al.,

2014). The etiology of both diseases is pathological and induced by the accumulation of bacterial induced biofilm in the tissues surrounding an implant (Karlsson et al., 2019). Inflammation surrounding an implant that is limited to the adjacent mucosa refers to the disease known as peri-implant mucositis (Figuerro, et al., 2014). Progression of peri-implant mucositis evidenced by loss of the supporting bone or loss of osseointegration is defined as peri-implantitis (Figuerro et al., 2014).

Dental implants must be properly assessed during the process of care and include the evaluation of bleeding upon probing, the presence of inflammation as evidenced by clinical assessment of the tissue, screening for suppuration, and radiographic evaluation (Mishler & Shiau, 2014). Peri-implant health is evidenced by no bleeding upon probing, no inflammation, no suppuration, probing depths of 5mm or less, and no radiographic evidence of bone loss. Peri-implantitis and peri-implant mucositis are evidenced by one or more of the following: bleeding upon probing, inflammation of the surrounding tissue, suppuration, and/or increased probing depth. In order to determine whether peri-implant mucositis has progressed to peri-implantitis, radiographs depicting the baseline bone level must be compared with and evidenced by current radiographic bone loss (Mishler & Shiau, 2014).

A retrospective study involving 4,049 patients with 24,781 implants placed found the number of implants that failed after 10 years is 9%-16.6 %, and the failure rate does not include implants with underlying complications (Jemt, 2019). A prevalence rate of peri-implant mucositis of 42.9% and peri-implantitis of 45% remain high based upon a systematic review of 35 papers, that included 25 studies at the 9-year mark following implant placement (Cosgarea et al., 2019). The implant survival rate after 25 years is approximately 83.5%; however, if a peri-implant disease remains untreated, it may contribute to implant failure (Cosgarea et al., 2019).

Implant failure occurs due to numerous factors and/or complications that involve and are not limited to implant placement or host related factors which include age, gender, smoking, systemic disease, and oral hygiene habits (Raikar et al., 2017). The nonsurgical management of peri-implant mucositis and peri-implantitis involves mechanical therapy to reduce biofilm in an effort to subside inflammation by use of resin, carbon or titanium curets, special ultrasonic tips, and air powered flow devices with air-abrasive powder systems to remove biofilm (Mishler & Shiau, 2014). The adjunctive use of chemotherapeutics such as chlorhexidine, dentifrices containing triclosan, specialized homecare devices such as interproximal brushes and specialty floss are also indicated to maintain peri-implant health (Mishler & Shiau, 2014). In an effort to manage peri-implantitis adjunctive antimicrobial minocycline microspheres and doxycycline hyclate may also be used in conjunction with effective mechanical bacterial biofilm debridement (Mishler & Shiau, 2014).

Dental hygienists are preventive oral health specialists who treat oral diseases through assessment, diagnosis, planning, implementation, evaluation and documentation (ADHA, 2016a). One aspect of maintaining periodontal health includes the diagnostic, preventive and therapeutic services which relate specifically to dental implant maintenance. Early diagnosis and intervention are crucial components of preventing implant failure and improving the chances of implant survival; thus, the role of dental hygienists is crucial in maintaining implants and facilitating care through patient education and referrals (AAP, 2013). With implant placement on the rise dental hygienists must obtain the knowledge and clinical skills necessary for implant care, yet the dental hygiene educational standards established by the Commission on Dental Accreditation (CODA) does not specify that entry-level dental hygiene programs must prepare dental hygienists to assess and maintain dental implants. Under the competency 2-13 as stated in

the dental hygiene standards outlined by CODA, “graduates must be competent in providing the dental hygiene process of care” by collecting patient data, analyzing assessment findings, and establishing an appropriate care plan to assist the patient in obtaining optimal oral health (CODA, 2020). Moreover, competency 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”. (CODA, 2020). Oral health includes the management of implant health; therefore, dental hygienists must be equipped with the knowledge and clinical skill set to assess, diagnose, plan dental hygiene therapies, implement care, evaluate results, and document the care of implant health and peri-implant diseases. Based on these competencies entry-level dental hygiene programs must decide the extent to which dental implant maintenance is included within their curriculum and clinical requirements.

Statement of the Problem

Dental implants are the standard of care for replacing a missing tooth, and peri-implant diseases inhibit their long-term success. The scope of practice for dental hygienists includes soft tissue management and their clinical role in maintaining dental implants is significant. Yet, little is known about the way in which entry-level dental hygiene programs prepare students to provide comprehensive, preventive, diagnostic, and therapeutic services for dental implants.

Purpose of the Study

The purpose of this study is to identify the curriculum content used for teaching dental implant maintenance within entry-level dental hygiene programs.

Professional Significance of the Study

This study relates to the American Dental Hygienists’ Association (ADHA) National Dental Hygiene Research Agenda as it enhances the body of research related to the profession of

dental hygiene (ADHA, 2016b). Moreover, the aim of this study relates to objective one of the National Dental Hygiene Research Agenda through health promotion and well-being of the public through research (ADHA, 2016b). Furthermore, this study supports the professional development and education areas of research of the conceptual research model. The study relates to the discovery and evaluation phases of research in that dental hygiene education includes ongoing assessment of curricular content (ADHA, 2016b).

Further, this study supports the American Academy of Periodontology (AAP) focus on early diagnosis and intervention for the effective management of peri-implant related disease (AAP, 2013). The AAP advocates for additional research to confirm the most effective treatment modalities for peri-implant related diseases (2013). Continual monitoring and maintenance are essential throughout the process of care.

Research Questions

The following research questions guided the conduct of this study.

1. What is the curriculum content used for teaching dental implant maintenance within entry-level dental hygiene programs?
2. What didactic instruction is provided related to dental implant maintenance within entry-level dental hygiene programs?
3. What laboratory instruction is provided related to dental implant maintenance within entry-level dental hygiene programs?
4. What clinical instruction is provided related to dental implant maintenance within entry-level dental hygiene programs?
5. What diagnostic methods are used to assess periodontal tissues surrounding dental implants in entry-level dental hygiene programs?

6. What therapeutic services are rendered to maintain dental implants in entry-level dental hygiene programs?
7. What home care aids are recommended to patients to maintain implant health within entry-level dental hygiene programs?
8. What home care aids are taught to patients to maintain implant health within the entry-level dental hygiene program?
9. Do entry-level dental hygiene programs require their students to perform a clinical competency related to dental implant maintenance?
10. What are the barriers to preparing students with the knowledge and skills to maintain dental implants?
11. Do dental hygiene educators support an accreditation requirement related to dental implant maintenance for entry-level dental hygiene programs?
12. Is there a statistically significant difference in the curriculum content for teaching dental implant maintenance between associate and baccalaureate entry-level programs?

Hypothesis

1. There is no statistically significant difference in the curriculum content for teaching dental implant maintenance between associate and baccalaureate entry-level programs.

Definitions

Listed below are conceptual and operational definitions specific to this study.

Dental implant - An artificial tooth root that is placed into the jaw bone to replace a missing tooth, and is an option for people who have lost a tooth or teeth due to periodontal disease, injury or another factor (AAP, 2019)

Dental implant maintenance - The act of monitoring and sustaining peri-implant health by clinical and radiographic evaluation of peri-implant tissues and restorations, and ongoing maintenance to enhance and promote the health of peri-implant tissues (Ashrafi & Narvekar, 2019).

Diagnostic methods - Clinical evaluation performed by a registered dental hygienist or dentist which includes soft tissue evaluation of the color, contour, consistency, and texture, clinical probing depths, bleeding upon probing, radiographic evaluation, mobility, and suppuration (Ashrafi & Narvekar, 2019).

Barriers - Challenges, or factors that inhibit or prevent a desired outcome. Educational barriers are factors which prevent desired learning (Sabio & Petges, 2019).

Associate degree - A two-year degree earned at a community college, university, college or career school and requires about sixty college credits to obtain (Business Dictionary, n.d.).

Baccalaureate degree - A post-secondary degree at the undergraduate level that requires about 120 credits to complete (Business Dictionary, n.d.).

Curriculum content - A broad term that includes the knowledge or subject matter, processes and approaches, and attitudes throughout the learning process (Miel, 1956).

Didactic instruction - A teacher-centered method of instruction and may involve lecture, presentations, modeling, or demonstrations (McComas, 2014).

Laboratory instruction - The instruction is student-centered and engages the learners with hands-on activities using lab materials such as a typodont or simulation to practice and apply pre-clinical techniques (National Association of Biology Teachers, n.d.)

Clinical instruction - Hands on learning with students providing direct care for patients while under the supervision of a licensed clinician (National Council of State Boards of Nursing, Inc., 2005).

Accreditation requirement - A requirement that must be fulfilled by an institution and its members that is mandated by the governing board (Accreditation Commission for Health Care, n.d.).

Clinical competency - The application of clinical knowledge and performing clinical skills to demonstrate mastery of an expected learning outcome (National Council of State Boards of Nursing, Inc., 2005).

Therapeutic services - The mechanical removal of bacteria, cement, or calculus around an implant, the delivery of adjunctive antiseptic therapy, antibiotic therapy, and/or laser-assisted therapy (Wang et al., 2019).

Home care aids - The over-the-counter cleaning tools used by patients to reduce biofilm within the peri-implant sulcus which include and are not limited to, manual toothbrush, electric toothbrush, electric water flosser, interdental brush, dental floss, and/or super floss (Tuna, et al., 2018).

Entry-level dental hygiene programs - A program which prepares students for the clinical practice as a dental hygienist by fulfilling requirements for an associate degree, baccalaureate degree, or post-baccalaureate degree (ADEA, 2019). Graduates of entry-level dental hygiene programs which are accredited by CODA are eligible to take the clinical dental hygiene licensing exam that is necessary for clinical practice (ADEA, 2019)

Peri-implant mucositis - The clinical signs of tissue inflammation surrounding the implant: bleeding upon probing, 2mm or more increase in pocket depth, no radiographic bone loss, suppuration, or mobility (Ashrafi & Narvekar, 2019).

Peri-implantitis - The clinical signs of tissue inflammation surrounding the implant: bleeding upon probing, 2mm or more increase in pocket depth, possible suppuration or mobility, and evidenced by radiographic bone loss (Ashrafi & Narvekar, 2019).

Implant Health - For the purpose of this study implant health is measured by the absence of the clinical signs of tissue inflammation surrounding the implant, less than 2mm change in pocket depth from the baseline, no mobility, and no radiographic bone loss, suppuration, or mobility (Ashrafi & Narvekar, 2019).

Summary of Chapter 1

Dental implant placement is the standard of care for replacing missing teeth and their prevalence continues to rise yet peri-implant related diseases remain high. Dental hygienists play a key role in the maintenance of dental implants, yet little is known about the education and implementation of implant maintenance within dental hygiene entry-level programs. Dental hygiene educators have an important role to equip future dental hygienists with the necessary skills to promote oral health. The results of this study will contribute to the body of knowledge as it pertains to the need for dental hygienists to effectively maintain dental implant health.

Chapter 2 Review of the Literature

Introduction

The purpose of this study is to identify the curricular content used for teaching dental implant maintenance within entry-level dental hygiene programs. This study aimed to understand the curriculum and its content related to implant maintenance within the setting of entry-level dental hygiene programs. The topic of dental implant maintenance was searched by utilizing various search engines that include PubMed, Ebscohost, GoogleScholar, and Trip Database. The MESH terms used to search the literature included “dental hygiene program implant guidelines,” “dental implant maintenance,” “implant failure,” “peri-implantitis,” “dental implant,” “implant survival rate,” “peri-implant disease,” and “peri-implant health.” The review of the literature focused on current recommendations for diagnostic measures to assess peri-implant health, dental implant maintenance, and curriculum guidelines for dental schools and dental hygiene programs related to the maintenance of dental implants.

Diagnostic Measures

The American Academy of Periodontology (AAP) publishes reports, clinical guidelines, statements, and classifications written by experts in the field that relate to periodontology. A paper was written under the direction of AAP’s Task Force and approved by the Board of Trustees to review peri-implant mucositis and peri-implantitis in order to foster the ability of clinicians to diagnose these peri-implant diseases and promote disease prevention (AAP, 2013). Both peri-implantitis and peri-implant mucositis possess an inflammatory component in the tissues surrounding an implant. The inflammatory component of peri-implant mucositis may include bleeding upon probing and/or suppuration that most often occur in pockets that are 4mm

or greater in depth. Peri-implant mucositis is common around implants, reversible in nature, and not accompanied by radiographic bone loss (AAP, 2013).

The diagnosis of peri-implantitis includes the presence of peri-implant mucositis in accompaniment with radiographic bone loss. Ideally, baseline data includes a radiograph taken at the time of implant placement, or the depiction of the marginal bone shown at 2mm below the expected level when a baseline radiograph is not present (AAP, 2013). The reported prevalence and incidence of peri-implant related diseases varies in the literature due to differences in the criteria. The etiology of peri-implantitis is similar to periodontitis and occurs due to the accumulation of biofilm, including gram negative bacteria around an implant screw. Prevention of peri-implant mucositis to peri-implantitis requires removal of the biofilm around the implant surface and peri-implant space. In contrast to untreated gingivitis and its progression to periodontitis, peri-implant mucositis does not always progress or lead to peri-implantitis. Moreover, the tissues and space surrounding an implant has less connective tissue in comparison to the tissues surrounding natural teeth, thus possibly contributing to an increased susceptibility to bone loss (AAP, 2013).

The risk factors for peri-implant mucositis and peri-implantitis include history of periodontal disease, poor biofilm control, residual cement, smoking, genetic factors, diabetes, occlusal overload, and the possibility of rheumatoid arthritis, concomitant connective tissue disease and/or alcoholism (AAP, 2013). The identified risk factors may lead to the onset or progression of peri-implant diseases; however, the positive correlation between periodontal disease and implant failure requires further investigation to understand and strengthen the evidence of a relationship. The placement of the implant and surrounding tissue may cause challenges related to difficulty in daily homecare; therefore, a proper implant maintenance

regime and visits with an oral health care provider is essential to promote implant health.

Residual cement may be difficult to detect on a radiograph, and its incomplete removal could be detrimental to the implant health. There is an increased risk of peri-implantitis among smokers in comparison to non-smokers, but future studies are necessary to understand the effect of genetic factors, occlusal overload and diabetes on implant failure (AAP, 2013).

Early diagnosis of peri-implant related disease is crucial, and all clinical data must be utilized because no single tool is capable of diagnosing peri-implantitis (AAP, 2013). Bone loss may result from bacterial or non-bacterial etiologies, and lingual or buccal bone loss may not be visible on a two dimensional and traditional periapical radiograph. Therefore, the diagnostic data related to probing depths, bleeding, suppuration, inflammation, inflammatory markers and radiographic bone loss must be closely monitored overtime. Mobility implies implant failure due to a lack of or loss of osseointegration. Mobility may also occur due to loosening of the implant components that may contribute to bone loss. The earlier the diagnosis the more favorable the outcome so peri-implant mucositis can be effectively treated non-surgically. Clinical implications include the identification of risk factors related to peri-implant diseases, the establishment of a radiographic and clinical baseline for the bone level surrounding the dental implant and implement an ongoing maintenance program to continually monitor and maintain the health of dental implants (AAP, 2013).

The American Academy of Periodontology and the European Federation of Periodontology joined together in 2017 for a workshop to discuss peri-implantitis in relation to the periodontal classifications. In summary of the workshop, a narrative review was written to include the most current and evidence-based practices related to the diagnostic measures of peri-implant related conditions (Schwartz et al., 2017). A review of the literature was conducted

electronically to define and describe peri-implantitis, the conversion of peri-implant mucositis to peri-implantitis, the onset and pattern of disease and its progression, characteristics of peri-implantitis, risk factors or indicators of peri-implantitis, and crestal bone loss in the absence of peri-implantitis (Schwartz et al., 2017).

Peri-implantitis is indicated by the presence of inflammation of the mucosa surrounding an implant in conjunction with loss of bone which supports the implant (Schwartz et al., 2017). A periodontal probe is utilized to identify inflammation of the soft tissue indicated by bleeding upon probing. Radiographs are evaluated to determine the absence or presence of progressive bone loss. An implant with both inflammation and progressive bone loss is classified as peri-implantitis. Though the conversion of peri-mucositis to peri-implantitis has been studied in the past, the progression is not fully understood. The literature suggests the progression of peri-implant mucositis to peri-implantitis may be faster than that of gingivitis to periodontitis. Histologically, peri-implantitis harbors higher levels of neutrophils, granulocytes, and B cells in comparison to the tissue of peri-implant mucositis; however, both are dominated by plasma cells and lymphocytes. Upon histological evaluation lesions associated with peri-implantitis demonstrate larger inflammatory lesions than those of periodontal lesions, and the conversion of peri-mucositis to peri-implantitis is still not fully understood (Schwartz et al., 2017).

Clinical signs of peri-implantitis include edema, redness, mucosal engorgement, bleeding upon probing, suppuration, and increases in pocket depths accompanied by radiographic bone loss (Schwartz et al., 2017). Risk factors for peri-implantitis may include history of periodontal disease, smoking, diabetes, poor biofilm control, and a lack of regular implant maintenance visits. The study concluded there is strong evidence that supports poor plaque control, history of periodontal disease, and infrequent maintenance visits as indicators for the predisposition of peri-

implantitis. The evidence is inconclusive as to whether diabetes is a risk factor for peri-implantitis, and no conclusive findings indicated smoking as a risk factor for the disease. The authors identified the following areas in need of further research which include the need for keratinized mucosa around implants, excess cement, genetic factors, iatrogenic factors, systemic factors, occlusal overload, and titanium particles. The pathological condition of peri-implantitis often occurs during the follow-up period after implant placement, and not all factors relating to its condition are understood (Schwartz et al., 2017).

A retrospective study in the Department of Prosthodontics DY Patil Dental College was conducted due to the increasingly important role of dental implants within dentistry to rehabilitate the oral cavity in the presence of missing teeth (Raikar et al., 2017). The purpose of the study was to evaluate the factors that may affect the survival rate of dental implants. The study included 5200 out of 7010 patients with dental implants, at a 95% confidence interval, which met the inclusion criteria and were placed between June 2008 and April 2015. The ratio of male to female subjects were 2800 to 2400 between the ages of 41 to 60 years. The exclusion criteria included individuals with hormonal imbalances, receiving immunosuppressive therapy, chronic infectious diseases, drug or alcohol addiction, or severe periodontal disease. The factors included name, age, gender, diameter of implant, length of implant, location of implant, and bone quality (Raikar et al., 2017).

The age group with the most implant failures was the oldest group of participants above the age of 60, or 55/1250 at rate of 4.4% (Raikar et al., 2017). Participants between the ages of 41-60 years of age had 45 failures out of 2650 implants and resulted in a failure rate of 1.6%. The findings were not statistically significant ($P = 0.21$). The implant length with the highest number of failures was greater than 11.5mm and the difference was statistically significant in

comparison to the other groups ($P < 0.05$). The implants with a smaller diameter resulted in a higher rate of implant failure. The difference in implant placement and type of bone was also statistically significant ($P < 0.05$), and the highest failure rates were implants placed in the mandibular posterior area and type III bone (3% failure rate). Implants with the highest failure rates were smaller and wider in diameter, but a longer length helped to achieve greater success. Implant size, diameter, bone, and placement may affect implant failure rate; however, other factors include the clinician's skill level, bone height, bone quality and the overall systemic condition of the patient. The limitations of the study include the inclusion of one hospital within one geographic region, moreover, further research and long-term clinical trials are needed to evaluate risk factors and implant diameters in other populations (Raikar et al., 2017).

A retrospective study aimed to evaluate the long-term survival and success of dental implants by following patients between 10 and 16 years after dental implants were placed (Simonis et al., 2010). Implant survival was defined as the existence of a dental implant independent of any biological or technical complications, whereas implant success was defined as the presence of a dental implant without complications over the entire study period. Initially 76 patients were included in this study but 55 patients with a total of 131 implants continued their participation in the study. Three to four months following implant placement, the fixed partial dentures were placed, and the participants were given instructions on how to maintain their dental implants (Simonis et al., 2010).

The implants were evaluated between 10 and 16 years following placement and a questionnaire was dispensed to measure patient satisfaction of their dental implants (Simonis et al., 2010). The clinical measures included age, gender, smoking habits, reason for tooth loss, and type of implant. Clinicians recorded the number and distribution of implants, type and length of

the implants, implant loss, biological complications which include peri-implantitis and mechanical complications related to implant fractures. The clinical examination included a measurement of the plaque index, gingival index, sulcular bleeding index, probing pocket depth, and probing attachment level. A radiographic evaluation and patient questionnaire were also completed (Simonis et al., 2010).

A majority, 83.6%, were nonsmokers, and the most common reason for tooth loss were root fracture, tooth decay, and periodontal disease (Simonis et al., 2010). The findings of the clinical evaluation included 15.8 % of the sites bled upon probing with 77.9% of the total sites had a pocket depth of 3mm or less. The survival rate at 10 years was 89.23% and dropped to 82.94% at 16 years. Twice as many implants were lost due to peri-implantitis in comparison to lack of osseointegration and implant fracture. Peri-implantitis affected 16.94% of the implants placed and patients with a history of periodontal disease had a higher incidence of peri-implantitis at 37.93% compared to 10.53%. The number of implants with mechanical complications included 31.09% of the implants and resulted due to fractures. Patients with a history of periodontal disease and/or a history of smoking had lower survival rate, however the differences were not statistically significant between nonsmokers or individuals without a history of periodontal disease. A majority of the participants were satisfied with their implant restoration at 78.26%. Despite high survival rates of 89.23% and 82.94%, the implant success rate was only 51.97% due to biological and technical complications; therefore, survival and success rates should be considered simultaneously. There were multiple limitations to this retrospective study including a 28% drop-out rate that impacted the analysis of the results and a lack of standardized criteria across multiple studies. The authors of the study did not identify further areas of research

but emphasized the importance of evaluating both implant success and implant survival simultaneously (Simonis et al., 2010).

A retrospective cohort study looked at the association between alcohol consumption and implant health or peri-implantitis and its purpose was to determine whether alcohol consumption affects the health of dental implants. (Car et al., 2019). Inclusion criteria was determined by edentulism and the need for implants between 2006 and 2012, a follow up appointment within five years or more after implant placement, adequate dental records at both preoperative and postoperative appointments, and medical records which indicated the amount of alcohol the individual consumed. Exclusion factors included inadequate medical or dental records, and medical treatment for systemic factors such as bisphosphonate use, head and neck radiation, and/or chemotherapy (Car et al., 2019).

The predictor variable was alcohol consumption which was described as no consumption (0 U per week for men and women), mild consumption (1-3 U per week for women and 1-7 U per week for men), moderate consumption (4-7 U per week for women and 8-14 U per week for men), and heavy consumption (more than 7 U per week for women and more than 14 U per week for men) (Car et al., 2019). A unit of alcohol is equivalent to 10 ml of pure alcohol. The outcome variable measured was the presence of peri-implantitis identified by radiographic evidence of bone loss accompanied by clinical evidence of bleeding upon probing with or without suppuration. Data were collected by retrospectively evaluating radiographs and chart notes at 1, 3, 5- and 10-year follow up visits. Of the 1069 implants placed between 2006 and 2012, 759 implants met the inclusion criteria. Peri-implantitis was present among 141, or 29% of the implants, with 58% of the peri-implantitis cases developing within the first 2 years following implant placement (Car et al., 2019).

The group with the highest incidence of peri-implantitis was that of heavy alcohol consumption at 38% of the 141 implants followed by no alcohol consumption at 20% (Car et al., 2019). Mild and moderate alcohol consumption resulted in the lowest incidences of peri-implantitis at 11% and 6% respectively. The results were statistically significant with heavy alcohol consumption associated with a threefold increase in the incidence of peri-implantitis. The results of the study support the hypothesis of mild to moderate alcohol consumption decreasing the local and systemic inflammatory markers by means of enhanced peri-implant health. Moreover, heavy alcohol consumption was associated with an increased likelihood of developing peri-implantitis, thus heavy alcohol consumption and cessation education should be considered when determining implant placement and reinforced at implant maintenance appointments. The limitations of this study include its inability to control other social factors such as tobacco and illicit drug use; therefore, further research is needed to evaluate the association between alcohol consumption and peri-implantitis with greater accuracy. Recommendations for further research include studies to determine whether alcohol-based mouthwashes deliver the same benefits as alcohol consumption (Car et al., 2019).

The aim of a retrospective study was to collect data from electronic health records (EHRs) and evaluate the incidence and factors associated with implant failure (Hickin et al., 2017). The study evaluated implants placed and removed due to failure from July 2011 through the end of 2014. Implant failure was defined as an implant that was placed and removed during the three-and-a-half-year period. Failure may result due to a lack of osseointegration, presence of terminal bone loss, and poor positioning, however peri-implantitis that did not result in implant removal was not included in the definition of implant failure (Hickin et al., 2017).

Of the 6,129 implants placed in 2,127 patients during the study period only 369 patients were chosen for review based upon their history of presenting with a possible implant failure. A total of 120 patients with 179 implants were removed due to implant failure, but the cause of implant failure was not included in this study (Hickin et al., 2017). The median age of patients with implant failure was 60 years old. Other factors associated with implant failure included type of implant, location of implant placement, implant width and length showed varied rates of implant failures. During the 3.5-year span of the study, the implant failure rate was 2.9%. Increased age and smoking were both associated with an increased risk of implant failure while diabetes and HIV were not associated with an increased risk of implant failure. Antibiotics prescribed during the perioperative stage, as recommended by the Cochrane Systematic Review, decreased the incidence of implant failure. Despite the limitations of this study, future studies evaluating EHRs are needed to build upon the evidence to support and improve the quality of care (Hickin et al., 2017).

A meta-analysis by Shi et. al (2016) searched PubMed, the Cochrane Library, and ClinicalTrials.gov for studies that met the criteria on implant failure rates between patients with well controlled and uncontrolled glycemic levels. Seven studies were chosen, and the results were statistically analyzed; five were prospective studies while two were retrospective in nature. The seven studies included 587 implants among 252 total patients which included 136 patients with well controlled diabetes and 116 patients with poorly controlled diabetes. The groups with well controlled diabetes were identified based upon a glycosylated hemoglobin (HbA1c) of less than 8% while the group with uncontrolled diabetes was indicated by HbA1c of 7%-13.8%. Five studies were described as high quality while two were deemed as moderate quality. Out of the

587 implants 25 failed, yet only 16 of the 25 failures were among patients with uncontrolled diabetes (Shi et al., 2016).

The failure rates of patients with controlled versus uncontrolled diabetes were 3.15% and 5.32% respectively and the pooled analysis did not result in a direct association between glycemic levels and the implant failure rate (Shi et al., 2016). Similarly, there was no significant difference between early and late implant failures between the two groups. Uncontrolled diabetes may affect wound healing, susceptibility to infection, vascular health, and bone metabolism which may adversely affect the osseointegration of a dental implant. The meta-analysis and pooled analysis did not show an association between failure rate and uncontrolled diabetes; however, the study did identify 3 limitations. The classification of well controlled versus uncontrolled varied between the studies so the percentages between controlled and uncontrolled were not consistent. Most of the included studies measured glycemic control by the patient's HbA1c level, but one study measured control by the fasting plasma glucose. Due to the limited number of studies, an analysis of the publication bias was not conducted, nor was the statistical power calculated (Shi et al., 2016).

The study concluded a meta-analysis failed to show a distinction in implant failure rates for patients with and without well controlled diabetes (Shi et al., 2016). Despite the lack of association found between glycemic level and implant failure, the failure rates for each group were not equal, thus people with poorly controlled diabetes may need a longer period of time for healing and osseointegration. Future research is needed including well-controlled and well-designed studies to reduce the effects of extraneous factors (Shi et al., 2016).

Dental Implant Maintenance

Dental implant maintenance is a crucial component of dental hygiene care. A study by Gay et al (2016) performed a retrospective review of 1020 charts during 1995-2012 to evaluate whether preventive and professional dental hygiene maintenance appointments increase implant survival rates. Of the sample 61.5% did not have any dental maintenance, 14.3% had inconsistent maintenance, and 24.2% had regular maintenance. The results of the study showed dental maintenance visits play a key role in implant success. The patients who had regular maintenance visits of at least one time per year had a reduced risk of implant failure by 90% while patients with less than one maintenance visit per year reduced their risk of implant failure by 60% in comparison to the group with no maintenance; however, the difference was not statistically significant.

The limitations of the study include inconsistent or incompletely recorded information pertaining to medical conditions and homecare practices (Gay et al., 2016). Other limitations include unknown data, such as the implant survival status of non-returning patients, the absence of controls for factors such as smoking, presence of periodontal disease, and the type of implant and/or its placement. Further research is needed to clarify their implications. Bacterial biofilm removal enhances the overall periodontal health status of individuals, and improves dental implant survival rate; therefore, the frequency of maintenance should be based upon the individual needs of each patient. This study's large sample size and long-term follow up allowed for the detection of a small difference between groups. The long-term survival of dental implants is multifaceted, and this study established the importance of frequent and ongoing dental maintenance to promote the overall success of dental implants (Gay et al., 2016).

A study by Wang et al (2019) was a narrative review. The purpose of this study was to evaluate recently published studies and examine and evaluate the effectiveness and limitations of various nonsurgical treatment modalities of peri-implantitis. A literature search was conducted in MED-LINE via the PubMed database through December 31, 2017. The search resulted in a limited number of studies comparing a control group that includes mechanical debridement in conjunction with adjunctive therapies to treat peri-implantitis. The results of the study found a nonsurgical maintenance therapy program may promote healing of the peri-implantitis disease state. Early diagnosis and detection of peri-implantitis is advantageous towards a more favorable prognosis, and nonsurgical therapies must precede surgical treatment. Dental hygienists and dentists should collaborate to formulate a supportive maintenance program once an implant has been diagnosed with peri-implantitis disease (Wang et al., 2019).

Following diagnosis of peri-implantitis the modifiable risk factors such as recall frequency, oral hygiene, smoking habits and patient compliance must be addressed, along with the identification of nonmodifiable factors such as systemic and local factors (Wang et al., 2019). The implementation of non-surgical treatments should include mechanical debridement, adjunctive antiseptics, adjunctive antibacterial, and adjunctive laser-assisted therapy. Re-evaluation of the non-surgical treatment must include analyzing treatment outcome, oral hygiene levels, patient compliance, contributing factors, and identification of other patient factors. If the disease is not resolved, non-surgical treatment may be repeated, or surgical treatment should be considered (Wang et al., 2019).

Peri-implantitis can be controlled by nonsurgical treatment which may include a combination of adjunctive therapies to improve the health of peri-implant tissue, reduce pocket depths and bleeding upon probing (Wang et al., 2019). Mechanical debridement with

instruments, ultrasonic scalers, and air-abrasive devices using glycine powder has shown to reduce bleeding but is limited in its capability to reduce the pocket depth. Moreover, adjunctive antiseptic therapies include the use of chlorhexidine gel or applications of povidone-iodine and have both shown to be effective adjunctive treatment modalities. Adjunctive and effective antibacterial therapy of minocycline microspheres is shown to be effective in conjunction with mechanical debridement and chlorhexidine gel (1.0%). Laser-assisted therapy and use of the Er:YAG or erbium hard tissue laser are used to decontaminate the area of infection surrounding an implant; however, some tissue in the pocket surrounding an implant are difficult to access. The use of lasers to enhance the peri-implant health can be technique sensitive, yet the limited amount of research shows their ability to reduce bleeding and pocket depths. It is important to educate the patient about the nature of the disease and collaborate with various dental providers to determine the best treatment modalities according to the individual's needs (Wang et al., 2019).

The authors of the study concluded a combination of adjunctive therapies is beneficial when providing nonsurgical treatment of peri-implantitis and may be necessary at repeated maintenance visits (Wang et al., 2019). If peri-implantitis continues to persist or worsen after the nonsurgical treatment with adjunctive measures and evaluation of risk factors, then surgical measures should be considered. An emphasis was placed on early detection of peri-implant related diseases to promote successful treatment of the disease. Limitations of the study include the inability to control all factors which may affect the outcome; therefore, more well-controlled studies are needed with optimal case selections to support evidence-based approaches for the treatment of peri-implantitis (Wang et al., 2019).

A systematic review by Amerio et al (2019) aimed to evaluate the degree of compliance of patients with supportive periodontal and/or implant therapy and to identify factors which affect compliance. The definition of compliance was not consistent throughout the studies, however compliant patients showed up to 100% of their suggested supportive periodontal therapy, erratic compliers showed up for less than 100% of the suggested supportive periodontal therapy, and non-compliers failed to attend any of the suggested supportive periodontal therapy sessions. Two searches yielded 14,188 papers, and 39 articles included in the systematic review which resulted in 31 cohort studies, four cross sectional studies, three case control studies, and one case series. The rate of compliance showed a high variability between studies and ranged from 3.3% and 86.8% and the principle finding was an unsatisfactory rate of compliance (Amerio et al., 2019).

Smoking was found to be associated with a low level of compliance; however, a lack of information and motivation was also found to be primary reasons for non-compliance with periodontal therapy sessions (Amerio et al., 2019). This systematic review failed to find an association between demographic variables and rates of compliance of periodontal or implant therapy. Compliance was heavily dependent upon the patient's attitude of their own health and the educational and motivational coaching of practitioners. Further research is needed to evaluate attitudes and the psychological traits associated with compliance related to supportive periodontal and implant therapy (Amerio et al., 2019).

Clinical outcomes of peri-implantitis were evaluated in a systematic review of patients who received supportive peri-implant therapy for at least three years (Roccuzzo et al., 2018). The methods included a systematic search of multiple databases to identify studies with more than ten participants that evaluated implant survival, implant success, peri-implantitis recurrence, and

implant loss. The databases searched included MEDLINE, MEDLINE(R), Embase, and The Cochrane Library evaluated implant survival, implant success, peri-implant recurrence, and implant loss. Data were calculated for a survival and success rate using a confidence interval of 95% using Greenwood's formula and those confidence intervals beyond 100% were excluded. Heterogeneity and homogeneity were assessed using the Cochran's Q test and the I-squared respectively (Roccuzzo et al., 2018).

The meta-analysis calculation determined the pooled summary estimate and the confidence interval (Roccuzzo et al., 2018). A systematic search resulted in 5,761 studies with 18 studies selected for qualitative assessment, and 13 studies selected for quantitative assessment. The study did not aim to evaluate the most effective method of treating peri-implantitis, but to evaluate clinical outcomes of supportive periodontal and implant therapy. The implant survival rate at three years was 81.73% to 100%, at four years was 74.09% to 100%, at five years was 76.03% to 100%, and at seven years was 69.63% to 100%. Overall, a majority of the patients benefited from therapy of peri-implantitis by means of regular supportive care which aided in high patient and implant-level survival as identified by a majority of patients with stable bone levels, and clinical improvements of peri-implant tissues. The limitations of this study included the inclusion of single and multiple group studies, the lack of a uniform definition for outcome measures, a clear definition of peri-implantitis, nor a uniform method of radiographic interpretation and probing across studies. Grey literature accounted for 20% of the research included within this study which indicates the possibility of research that may have been overlooked. Other outcome measures that were not able to be assessed included patient satisfaction, tissue appearance, overall tissue health and other confounding factors such as systemic disease, implant design, and implant positioning. The limitations of this study

demonstrate the need for future studies with well-controlled factors. Despite the limitations of this study, the authors concluded peri-implantitis can be successfully treated non-surgically with the incorporation of an effective maintenance program. In order to maintain high survival rates, retreatment, adjunctive modalities, and evaluation of the implant surfaces may be required (Roccuzzo et al., 2018).

Common biological complications which affect implant success and survival include peri-implant mucositis and peri-implantitis (De Siena et al., 2015). An observational controlled clinical trial was performed to compare methods to treat peri-implant mucositis both with and without the use of glycine powder. The inclusion criteria for the study included patients with mandibular full arch implant supported restorations, bleeding upon probing at the implant site, the presence of biofilm accumulation, implant probing depth less than or equal to 3.5 mm, and peri-implant bone resorption less than 3mm as indicated by radiographs. The exclusion criteria included allergies to glycine, the use of antibiotics in the past 6 months, topical antimicrobials used in the last 4 weeks, or the presence of suppuration (De Siena et al., 2015).

The study was nonrandomized, and both the control group and test group received professional oral hygiene services followed by oral hygiene instructions (De Siena et al., 2015). The control was treated with the removal of biofilm using a teflon curet and the test group received subgingival glycine powder dispensed by an AirFlow® device. Bleeding index, plaque index and probing depths were recorded prior to treatment, and at 3 months and 6 months following treatment. Fifteen subjects were in the control group and fifteen subjects were in the test group (De Siena et al., 2015).

Statistical significance was found between the two groups at the six-month mark for pocket depth reduction, bleeding index, and plaque index ($P = 0.00439$). (De Siena et al., 2015).

Both clinical procedures resulted in a reduction of inflammation, and the control group demonstrated a more beneficial effect in the reduction of bleeding, plaque and a more superior effect in the reduction of probing depths. Glycine powder can be safely used as an adjunctive therapy and may be considered a therapeutic treatment option for the maintenance of peri-implant health. The use of glycine powder in air abrasive systems may be more beneficial towards improving peri-implant tissue than professional oral hygiene by mechanical methods; however more randomized and *in vitro* studies are needed to evaluate its effectiveness and effect on mucosal health (De Siena et al., 2015).

The greater sulcular space around an implant in comparison to the space around a natural tooth often leads to the recommendation of a thicker floss such as Superfloss®, Perio floss, or Thorntons® floss to clean around implants (Montevecchi et al., 2016). A case report of a 66-year-old male with upper and lower implant supported dentures was evaluated due spontaneous pain, inflammation, bleeding, and radiographic bone loss around the mandibular implant. A perioscopy system found evidence of a filamentous material subgingival. The subject had been using a spongy floss similar to Superfloss® to clean around the implant. It was deduced the floss may have broken off and become trapped under the gingiva adjacent to the implant which contributed to the radiographic bone loss (Montevecchi et al., 2016).

Following the removal of the filamentous material, the man was instructed to refrain from using floss around his implants and rely solely on interproximal brushes (Montevecchi et al., 2016). At the one year follow up visit and clinical examination the marginal bone was stable, and the site free of inflammation. The author of the study recommends a single thread or braided floss may result in less potential for retention of floss fibers and reduce the risk of peri-implantitis caused by foreign objects such as retained floss. Moreover, this case report

demonstrates the importance of radiographic evaluation of implants on a regular basis to screen for peri-implant related disease. Although the case study is limited in nature, the removal of the irritant in conjunction with a hygiene maintenance program were able to stabilize the bone loss around the implant thus supporting the importance of regular professional implant maintenance. Further research is needed to evaluate the possible drawbacks of spongy floss used to clean around dental implants along with the diagnostic methods and treatment of peri-implantitis (Montevecchi et al., 2016).

A retrospective study aimed to determine whether consistent dental hygiene therapy has an effect on peri-implant health or survival (Hoerler et al., 2017). A database was searched using the terms unhealthy, peri-implantitis, exudate, pocket depth >5mm, and soft tissue inflamed. Patients with maxillary or mandibular full arch fixed prosthesis placed between 1983 and 2014 were included in the study. Both the test and control groups may have been exposed to an experienced dental hygienist with 5 to 30 years of experience who used plastic, gold-tipped, graphite, carbon composite, titanium, and stainless-steel scalers, and implant or metal ultrasonic inserts to clean around implants. Upon review of the dental charts, participants were placed into a consistent hygiene group or inconsistent hygiene group categorized by at minimum biannual hygiene maintenance therapy and once every 3 to 10 years hygiene maintenance therapy respectively. Implant failure and or soft tissue pathology in the presence of implant failure or survival were compared between groups (Hoerler et al., 2017).

The study sample included 332 implants among 55 patients in the consistent hygiene group and 609 implants among 108 participants in the inconsistent hygiene group (Hoerler et al., 2017). Following exclusions 6 of the 49 patients in the consistent hygiene group experienced implant failure at a median of 11.5 years, and 9 of the 100 participants in the inconsistent

hygiene group experienced implant failure at a median of 3.9 years. The survival rate and lack of soft tissue pathology included 22.9% of the consistent hygiene group at a median of 11.3 years, and 17.2% of the inconsistent hygiene group at a median of 4.8 years. The participants in the consistent hygiene group experienced soft tissue pathology at a median of 11.7 years, and at a median of 5.4 years for the inconsistent hygiene group (Hoerler et al., 2017).

Both groups experienced implant failures and soft tissue pathology with no statistical difference between groups; however, the survival rate was higher, and the median year of implant related issues was greater for that of the consistent hygiene group (Hoerler et al., 2017). The study was limited by its retrospective nature and because the effects of implant maintenance on the implant surface were not evaluated. Extraneous factors related to compliance, implant placement, periodontal disease, missing teeth, and caries may have skewed the results. Even though statistical significance was not found between the implant survival of the consistent and inconsistent hygiene groups, dental hygiene therapy may increase the median year at which peri-implant pathology or implant failure occurs. Future research involving randomized controlled studies could further evaluate the association between dental hygiene implant maintenance and instrumentation and its effect on dental implants. Moreover, this study suggests dental hygiene maintenance on a biannual basis may benefit peri-implant health in comparison to dental hygiene therapy on an inconsistent basis (Hoerler et al., 2017).

A systematic review was conducted to examine the literature and evaluate the best oral hygiene techniques to clean around implants (Louropoulou et al., 2014). Due to the importance of patient home care of dental implants, the goal of the study was to identify the best methods for patients to use during their home care routine. Three databases which included MEDLINE-PubMed (172 articles), CENTRAL (219 articles), and EMBASE (308 articles), were chosen to

search for sources which met the criteria through October 2013. The subjects had to be healthy adults over 18 years of age and possess at least one dental implant. The intervention consisted only of self-executed cleaning of implant restorations, and the evaluation of the outcome included plaque, bleeding and gingiva health indices, probing depths, and gingival recession. The study assessed the heterogeneity based upon study design, traits of the participants, clinical outcome restrictions, and funding. Each study was classified and chosen based upon their risk of bias, and due to differences among studies the analysis was descriptive instead of quantitative. A grading system used by two reviewers scored the studies based upon the quality of evidence based upon risk of bias, consistency and accuracy of outcomes and results (Louropoulou et al., 2014).

The searches performed within the three databases yielded 375 full-text articles but only five articles met all of the criteria (Louropoulou et al., 2014). The selected studies consisted of two randomized controlled clinical trials, one controlled trial, and two cohort studies that evaluated self-performed measures for plaque control among patients with implants or fixed prostheses on implants. Study I was a six-week controlled clinical trial comparing a powered toothbrush with a manual toothbrush. The results were not statistically significant, and the materials were provided by companies. Study II was a two-year controlled clinical trial which evaluated a powered toothbrush with the use of a manual toothbrush along with interdental aids. There was a statistical significance between plaque index, gingival index, probing depths, and recession. Study III was a six-month single-blinded randomized controlled trial comparing a sonic toothbrush with a manual toothbrush. The results were not statistically significant, but the sonic toothbrush provided a reduction in inflammation, bleeding, and probing depths. Study IV was a prospective cohort study over 12 months examined an oscillating or rotating toothbrush at

3, 6 and 12 months which found improvements related to bleeding and attachment levels; however, materials were provided by the companies. Study V was a prospective study over 12 months to evaluate the effectiveness of a powered toothbrush, oscillating or rotating, in patients with fixed prostheses on implants. The findings were a reduction in bleeding, pocket depths, and recession; however, funding and involvement of a third party was reported (Louropoulou et al., 2014).

All studies were categorized with having a high risk of bias and its strength of recommendation was rated as weak (Louropoulou et al., 2014). Powered toothbrushes showed an improvement of gingival health around implants over time. This systematic review was comprehensive in its nature, yet the rigorous criteria led to the limitation of the exclusion of many research studies. The numerous differences and variables among the studies also posed limitations due to the difficulty in controlling the variables. Interproximal cleaning was not studied as a separate intervention which also poses limitations to this study. The three controlled trials (Study I, II and III) had different designs which included a parallel design (Study II and II), and a cross over design (I). The short duration of Study I also posed a limitation in its ability to reveal significant differences in its outcome. Study II and III received funding in the form of a grant and study V involved a co-author in the industry both of which may contribute to a limitation of the study. Further research, including well controlled clinical trials, is needed to evaluate various oral hygiene products along with the patients' ability to utilize those devices. A power toothbrush may benefit some patients; however, plaque control is not always dependent upon their use (Louropoulou et al., 2014).

A critical analysis of the literature was performed to evaluate and identify how periodontal treatment modalities can be applied and utilized during current treatments to prevent

and manage peri-implant related diseases (Mishler, & Shiau, 2014). A search of the MEDLINE database from 2005 to 2014 was performed and the search terms were peri-implantitis, peri-implant mucositis and peri-implant diseases. The peri-implant tissue must be properly assessed to determine the condition and state of the tissue health. The presence of bleeding upon probing around an implant is a significant indicator of peri-implant disease and suppuration is associated with bone loss around the implant. Light pressure using a plastic probe should be applied to prevent long term damage to the peri-implant sulcus and its protective seal. Even though the sulcular space varies between that of teeth and implants, probing depths of 5 mm or greater around an implant should be carefully monitored clinically and radiographically to screen for signs of peri-implantitis (Mishler & Shiau, 2014).

Nonsurgical management of peri-implant mucositis requires instruments with less hardness than titanium to prevent scratching or surface changes of the implant screw which may contribute to increased biofilm adherence (Mishler & Shiau, 2014). The use of resin, carbon or titanium curettes and special tips for ultrasonic instrumentation, and air abrasive powder systems with sodium bicarbonate or glycine powder are indicated to remove and manage biofilm accumulation. Chemotherapeutic agents such as chlorhexidine and triclosan dentifrices may help to reduce microbial induced inflammation associated peri-implant related disease. Excellent biofilm control may be enhanced by the use of interproximal aids such as interproximal brushes and promote implant health along with a continual implant maintenance program (Mishler & Shiau, 2014).

The nonsurgical management of peri-implantitis was indicated as similar to that of peri-implant mucositis (Mishler & Shiau, 2014). The adjunctive use of chlorhexidine was indicated for short term use of 6 months or less and shown to be beneficial. Similarly, the use of

antimicrobials such as minocycline microspheres or doxycycline hyclate in conjunction with mechanical removal of biofilm has also been shown to be effective in reducing inflammation related to peri-implantitis. When non-surgical methods do not effectively arrest peri-implantitis surgical techniques such as open flap, debridement may be necessary to decontaminate the implant surface. The use of lasers, both CO2 and Er:YAG lasers, during surgical treatment of implant related diseases have shown effectiveness in helping to decontaminate the implant surface. A limitation of this critical analysis is the inclusion of various studies which differ in design, variables, and controls; this supports the need for future well-controlled and high-quality studies. Preventive measures, early detection, and the establishment of evidence-based protocols for implant maintenance are crucial components for clinicians to employ to enhance the likelihood of implant success and survival (Mishler & Shiau, 2014).

A review of the literature was performed to formulate a clinical update on implant maintenance (Gulati et al., 2014). An electronic search within the PUBMED, Wiley-Blackwell, Elsevier, and Hindawi databases was performed and resulted in 708 articles with 42 included in the review. The search words used were “implant maintenance” and “peri-implant” and “implant care” and “supportive therapy.” There were 19 clinical research studies, 19 clinical reviews, 1 case report and 3 book chapters (Gulati et al., 2014).

The long-term prognosis of dental implants is dependent upon the patient’s home care in collaboration with the dental team (Gulati et al., 2014). An implant maintenance visit was described as including a medical and dental history update, a review of oral hygiene habits, clinical and radiographic evaluation of the implant and surrounding tissues, removal of any biofilm, calculus, or cement, and establishing appropriate maintenance intervals which are ideally 4 times per year. During a maintenance visit a comprehensive evaluation of the implant

should include a biofilm and mucosal assessment, probing depths and documentation of bleeding sites, keratinized tissue width, peri-implant sulcus fluid analysis, suppuration, occlusal overload, radiographic evaluation, and mobility (Gulati et al., 2014).

As a co-therapist, patients with dental implants must be guided and demonstrated proper homecare techniques to promote the long-term success of an implant supported restoration (Gulati et al., 2014). Brushing twice daily with a soft bristled brush, or a gentle power brush, especially for patients with limited dexterity, along with an end tuft brush was the recommendation for removing biofilm from the periodontal tissue surrounding implants. Interproximal and circumferential cleaners include floss of various types, interproximal cleaners, water irrigation, and local chemotherapeutic agents. Various types of floss may be used; however, caution should be considered for those with fibers that may become retained around the implant. Interproximal cleaners include foam tips, interproximal brushes, and wooden picks and should be chosen based upon the space of the interdental area. Interdental brushes with an exposed metal wire must be used with caution as not to scratch the surface of the implant. Water irrigation devices must also be used horizontally and cautiously as not to cause damage to the peri-implant seal. Locally applied chemotherapeutic agents such as chlorhexidine gluconate, plant alkaloids, and phenolic agents may be used safely and do not pose a threat to alterations in the implant surface. Limitations were not identified as it was a clinical review, but the authors concluded the importance of overall health, oral health, professional hygiene maintenance, and patient home care methods which are all factors affecting the success of dental implants (Gulati et al., 2014).

A longitudinal study with a retrospective analysis was performed in Sweden to more fully understand the disease progression of peri-implantitis and the effects of interventions on further

bone loss (Karlsson et al., 2019). Records from 2017, or 70 patients with one or more implants diagnosed with moderate to severe peri-implantitis, were evaluated and included in the study sample. The patients were placed into three groups according to the presence of bleeding and marginal bone loss identified in the patient records. Group A consisted of no bleeding, and an absence of radiographic bone loss. Group B demonstrated bleeding upon probing with 2 mm or less of marginal and radiographic bone loss. Group C included moderate to severe peri-implantitis with bleeding upon probing and more than 2mm of radiographic bone loss. The radiographs were not of diagnostic quality for 7 patients which reduced the number of patients to 63 with a total of 282 implants. Patient files were searched for interventions which included nonsurgical/surgical treatments, systemic antibiotics, and implant removal. Within the first 4 years 3.6% of the implants failed and all were diagnosed with moderate to severe peri-implantitis. The change in marginal bone levels from 2013 to 2017 was greatest among group C at 1.1 ± 2.0 mm and had the greatest predictor of bone loss which included suppuration, bleeding upon probing at 3-4 sites, and greatest progression of bone loss (Karlsson et al., 2019).

All 63 patients received nonsurgical treatment and 17 received surgical treatment with surface debridement using hand instruments, titanium brushes, an ultrasonic device or a combination (Karlsson et al., 2019). Chemical agents were used to treat 11 patients, and systemic antibiotics were prescribed for 8 patients. The average bone loss reduced significantly following surgical interventions (1.4 ± 2.4 mm to 0.2 ± 1.0 mm). Limitations of the study include the heterogeneity of the professional interventions and timing due to the retrospective nature of the study. The authors noted that despite the study's limitations, implant sites with moderate to severe peri-implantitis will continue to lose bone unless properly treated. Sites with advanced peri-implantitis require timely therapy to minimize bone loss and disease progression. Bleeding

upon probing and probing depths should be considered when formulating a diagnosis and the need for surgical intervention to treat peri-implantitis (Karlsson et al., 2019).

The American College of Prosthodontists appointed a panel of experts and collaborated with the American Dental Association, Academy of General Dentistry and the American Dental Hygienists' Association to evaluate two systematic reviews and formulate clinical practice guidelines (CPG) for tooth and implant borne restorations (Bidra et al., 2016). The CPGs included guidelines related to patient recall, professional maintenance and at-home maintenance based upon the analysis of 36 carefully selected studies. The risk of failure of tooth or implant borne restorations were considered throughout the formulation of the CPGs and a peer review evaluation and debate was facilitated to ensure the highest level of quality evidence (Bidra et al., 2016).

Under the CPGs patients were advised to have a dental examination at a minimum of every 6 months, and individuals with a higher risk of complications related to self-care, biological or mechanical complications should be seen more often based upon individualized need (Bidra et al., 2016). The professional biological maintenance should include an extraoral and intraoral exam, oral hygiene instructions, hygiene instructions related to the prostheses, and dental hygiene therapy of natural teeth, tooth-borne restorations, implant borne restorations, or implant abutments. Chlorhexidine gluconate is the oral antimicrobial of choice and should only be used as needed. Hand instruments must be appropriate for the type of implant and accompany polishing with powders such as glycine in air polishing systems. Removable appliances must also be cleaned professionally with appropriate chemical agents. Recommended agents and oral hygiene aids should be recommended based upon the patient's individual needs. Mechanical maintenance ensures the restoration is functioning properly and may include repair or adjustment

to maintain optimal function. With implant supported prostheses, the removal of the prosthesis should be based upon the patient's inability to adequately clean. New prosthetic screws may be beneficial when an implant borne restoration is removed and replaced for professional therapy. Patient education must also include recommendations to prevent future problems that could compromise function or health. An occlusal device may be optimal to prevent problems related to function, and this device should be professionally cleaned, and maintained properly at home, on a regular basis. Topical agents such as toothpaste containing 5000 ppm fluoride or toothpaste with 0.3% triclosan, or short-term use of chlorhexidine gluconate may be beneficial when indicated. Patients with implant-borne removable restorations or implant-borne fixed restorations should be educated about brushing two times a day and the use of home care aids such as dental floss, water flossers, air flossers, interdental brushes or picks, and electric toothbrushes. At home maintenance may also incorporate the use of oral topical agents or antimicrobial mouthwashes as deemed necessary. Patients with removable prostheses must be advised to remove the appliance at night, and those with occlusal devices should be advised to wear the appliance during sleep. Proper cleaning of all removable and fixed restorations is crucial during the professional maintenance visits (Bidra et al., 2016).

The goal and scope of the guidelines were to improve oral health, promote the longevity of natural teeth and implant borne restorations, and enhance the quality of life (Bidra et al., 2016). All recommendations were given a strength of recommendation based upon the category of evidence with A as the highest level of evidence down to D as the lowest level. The potential drawbacks include increased costs and adverse reactions related to topical agents or professional maintenance implementation. The limitations of the CPGs included bias related to the same group of professionals who served as authors for the systematic review and panel members. To

nullify the potential for bias, the group debated and justified each clinical guideline in an open panel meeting. The authors of the systematic review formulated the CPGs and their professional knowledge may also be considered a strength. The CPGs serve as a baseline for a healthy adult, but do not indicate recommendations to manage other conditions such as bruxism, xerostomia, periodontal disease, peri-implant disease, or other conditions. The authors foresee modification of the CPGs when future research provides credible evidence (Bidra et al., 2016).

An *in vitro* study was conducted to evaluate the effectiveness of biofilm removal at two different crowns designed with five different interdental aids by three different groups categorized by dentists, dental hygienists and laypersons (Tuna et al., 2019). The study participants consisted of 10 dentists, 10 dental hygienists and 10 laypersons. The crown designs were conventional crown design (CCD), and alternative crown design (ACD) The ACD's pontic created an additional access path underneath the crown-pontic connector. A dental patient simulator was used, and the crowns and surrounding surfaces were sprayed with a green occlusion spray to simulate biofilm. All participants received verbal instructions on how to use the five cleaning tools which consisted of an electric water flosser, electric interspace brush by Oral B, an interdental brush by GUM, non-waxed dental floss, and Super Floss. Photos were taken and analyzed after each participant used the different cleaning aids and a percentage was calculated to represent the sum of the area cleaned compared to the total area by a cleaning ratio. The Superfloss® demonstrated the highest cleaning efficiency, followed by dental floss, interdental brushes, electric interspace brush, and an electric water flosser (Tuna et al., 2019).

The results of the study found an ACD with a distally placed implant may enhance the ability to clean in comparison to the CCD (Tuna et al., 2019). Laypersons were less effective in removing the simulated biofilm. The Superfloss® and non-waxed dental floss may have been

more effective at removing biofilm due to the unrealistic test models and the ability to clean deep under the gingiva without pain or trauma. The limitations of the study are the in vitro design which may not accurately represent clinical situations and the use of simulated patients. Accessibility, visibility, individual capability, type of gingiva, and amount and properties of the simulated biofilm may also produce limitations. The authors suggest further research should include an in vivo study to evaluate the interproximal tools around the two crown designs. ACD was easier to clean in comparison to CCD restorations with Superfloss,[®] dental floss and interdental brushes. Although flossing and interdental brushes were the most effective home care aids to remove biofilm, complete removal of biofilm was not achieved by any one home care aid (Tuna et al., 2019).

Curriculum Content for Implant Maintenance in Dental and Dental Hygiene Programs

There is limited current and specific literature available evaluating entry-level dental hygiene programs and the curriculum content for implant maintenance. As a result of the scarcity of research, this portion of the literature review will evaluate methods of instruction for implant maintenance over the past 25 years. Moreover, it will include implant instruction related to both dental and dental hygiene programs and extend beyond programs in the United States.

Dental Implant Maintenance in Dental School Curriculum

The placement of dental implants continued to rise and by 1989, a survey found 89% of dental schools incorporated dental implantology into the curriculum at the graduate level, and 73% at the predoctoral level (Curriculum, 1991). A national conference was organized to develop and revise predoctoral curriculum guidelines related to dental implants. The American Association of Dental Schools developed the guidelines in conjunction with the American College of Oral Implantology, the University of Pittsburgh and educators of dental implantology.

The guidelines were formulated to serve as aids to help dental schools develop their curriculum and not intended to be actual requirements. The committee described dental implantology as benefitting from a multidisciplinary approach to help restore appearance, function, and health by replacing missing teeth (Curriculum, 1991).

The curriculum required both didactic and clinical experiences related to dental implants to understand the biological and scientific basis, patient evaluation, diagnosis, treatment planning, implant selection, implant surgery, post-surgical care, implant prosthodontic procedures, and maintenance protocols (Curriculum, 1991). The primary educational goals placed an emphasis on students developing an understanding of dental implantology. The suggested prerequisites were biological sciences, preclinical courses related to fixed and removable prosthodontics and experiences related to diagnostic services, oral pathology, anesthesia, periodontics, oral surgery and prosthodontics. The core content was outlined and included: introduction and overview of dental implants, classification and definitions of dental implants, scientific basis for dental implant therapy, diagnosis and treatment planning, surgical procedures, prosthodontic procedures, maintenance and evaluation procedures, and advanced implant procedures. The subcategories of dental implant maintenance included professional care, patient education and care, corrective procedures, and follow-up care and education (Curriculum, 1991).

Dental implants were not commonplace, and the committee promoted the recognition of the need to include dental implants as a treatment modality to restore function and replace missing teeth (Curriculum, 1991). Other behavioral objectives included identifying and describing different implant modalities, historical contributions, current trends, anatomical considerations for maxillary and mandibular implants, and the importance of imaging. The

objectives also included the need for discussing dental or medical referrals, possible implant complications, solutions, and treatment planning of dental implants. Patient education, criteria for implant selection, the surgical procedures, prosthodontic procedures, maintenance procedures, remedial procedures, and advanced or reconstructive oral and maxillofacial procedures were also emphasized. Lastly, an importance was placed on recognizing the necessity of continuing education in implant dentistry, the acquisition of qualified faculty with appropriate experiences to further develop the dental implant curriculum, and adequate facilities to fulfill the educational goals (Curriculum, 1991).

The American Dental Education Association wrote a report aimed to share instructional methods related to predoctoral implant dentistry (Petropoulos et al., 2006). In 2004 a questionnaire was mailed to the deans of fifty-six dental schools in the U.S. and Canada and included twenty-eight multiple choice questions. The questionnaire found the average number of predoctoral students was seventy-six. The predoctoral programs offering advanced education programs sponsored by the institution included the following: oral and maxillofacial surgery (82%), general dentistry (77%), periodontics (74%), prosthodontics (51%), and none (10%). The percentage of schools incorporating didactic instruction on dental implants was 97%, while 86% of the students received clinical experience and only 51% restored implants in a clinical setting. A vast majority at 88% of the schools reported no requirements related to implant dentistry. The surgical placement of implants was a fairly new topic and some schools identified complications, and reasons why clinical experiences were not offered. Some programs had their students assist or observe a surgical procedure, while other programs considered implant placement to be beyond the scope of a predoctoral student. The type of specialist teaching restorative and surgical

implant dentistry was discussed along with fee structures and challenges to its implementation into the curriculum (Petropoulos et al., 2006).

Limitations were not discussed within ADEA's Association Report (Petropoulos et al., 2006). Implant dentistry has continued to grow in didactic and clinical predoctoral dental educational experiences, yet most schools lack a requirement for the surgical placement of dental implants or the restoration of dental implants. Dental implants are expected to increase in prevalence, and the authors emphasized a growing need for schools to offer didactic and clinical experiences with dental implants into predoctoral programs to adequately prepare students for future practice. Future areas of research were not explicitly stated but implied the need to measure growth and curricular advancement related to predoctoral dental implant education (Petropoulos et al., 2006).

In an effort to more fully prepare newly graduated dentists on the topic of implantology a study was conducted with an aim to evaluate the extent of dental implant educational practices and the attitudes of dental school educators in the U.K. and Ireland (Addy et al., 2008). The materials and methods of the study consisted of an online questionnaire with 35 open and closed style questions. The questionnaire was sent to the department heads of 15 U.K. and Irish dental schools to be completed by the restorative dentistry head or a senior clinical didactic educator responsible for implant dentistry content. The response rate was 100%. The categories evaluated included current teaching, future plans for dental implant undergraduate training in the next 12 months, current challenges to providing implant training at the undergraduate level, and future predictions for implant undergraduate training in the next 5 years. Thirteen of the fifteen schools (87%) reported they provide training in implant dentistry, but only 53% have an actual implant requirement within the curriculum. The training included lecture (60%), phantom head training

(53%), symposium (33%), and patient treatment (26%). Experiences related to treatment planning was at 46%, observation of the implant restorative process at 46%, observation of live implant surgery at 33%; however, 33% of the schools did not provide direct clinical experience in dental implant restorations and no school required any measure of competency (Addy et al., 2008).

Resources and support from implant companies was indicated by 60% of the schools to provide implant training such as the provision of simulated models, implant and restorative materials, and laboratory or clinical staff funding (Addy et al., 2008). The schools did not plan to implement clinical experiences related to the surgical placement of dental implants in the next year, but four planned to introduce the restorative component of dental implantology within their undergraduate program. The challenges of implementing implant training at the undergraduate level included funding, lack of time within the curriculum, and insufficient number of adequately trained staff members. In terms of future predictions for implant undergraduate training, 47% believed there will be a clinical requirement for implant dentistry in the next 5 years. Only one school thought that undergraduates should not be involved in restoring implants while only 3 schools thought undergraduates should be surgically placing implants in the next 5 years. To accommodate the development of an implant program in the future, 20% believed occlusion would require an enhancement of instruction, while 40% foresaw a decrease in removable prosthodontic instruction, 33% indicated a reduction in fixed conventional prosthodontics, and 13% anticipated a reduction in resin retained bridgework (Addy et al., 2008).

The authors discussed the growing demand for dentists upon graduation to address the replacement of missing teeth and the ability to choose between no replacement, bridges, dentures, or implants (Addy et al., 2008). With 46% of the schools providing students with

experience in the treatment planning for dental implants, and the limited amount of instruction in dental implantology within undergraduate programs, the authors expressed concern about underprepared dentists who enter the workforce. Dental implantology is rising in its popularity and demand, yet its curricular component within undergraduate dental programs is limited. Evidence-based practices and a multidisciplinary approach as indicated by 60% of the respondents are at the forefront of dental implantology. The authors expressed the need for improved collaboration with implant companies to increase educational funding and an enhanced dental implant curriculum with greater clinical experiences provided within undergraduate dental schools in the U.K. and Ireland. Limitations or areas of future study were not indicated by the authors, but they emphasized the importance of advocating for and implementing necessary change (Addy et al., 2008).

The Australian Consensus Workshop on Implant Dentistry University Education was formed by leading educators who teach implant dentistry at Australian dental schools (Mattheos et al., 2010). The goals of the workshop aimed to produce current learning outcomes based upon the needs of the population and develop competencies for implant dentistry at the university level. The consensus statements were subdivided into two parts that consisted of undergraduate dental education and implant dentistry education for the general dental practitioner.

Undergraduate curriculum should include the following: diagnostics and treatment planning, surgical placement of dental implants, prosthetic reconstruction of dental implants, dental implant maintenance, and the diagnostic and treatment of biologic or technical complications. The four levels of implant dentistry's educational pathways were described. Level one and two included didactic instruction and basic clinical education. Level three included clinical competency and is often fulfilled by a general dental practitioner. University programs should

include instruction up to level three, while level four is fulfilled by way of specialty educational programs. Incremental learning, clear objectives, mentorship, clinical experience, adequate resources, research methodology, formative and summative assessment, and the inclusion of external examiners and review were recommended for all dental implant programs (Mattheos et al., 2010).

An international study evaluated dental implant education within predoctoral programs throughout the world by sending a survey to 135 randomly selected dental schools (Atashrazm et al., 2011). The survey aimed to glean information about whether implant dentistry is integrated into the curriculum; if so when and to what extent. The 17-question survey inquired why dental implants were not included in the program if the school did not provide dental implant instruction. Other questions discussed topics related to implant dentistry and the department of inclusion, lecture hours, required or recommended textbooks, internet instructional methods, clinical and laboratory courses, observational requirements, student to faculty ratio, implant systems used, types of restorations treated by predoctoral students, whether predoctoral students treat implant patients, and whether prosthodontic faculty are teaching the predoctoral implant dentistry course (Atashrazm et al., 2011).

The response rate was 62% and of these schools 86% indicated they have a predoctoral dental implant curriculum (Atashrazm et al., 2011). The reasons for the exclusion of implant dentistry were lack of financial resources, lack of qualified faculty, inadequate amount of time, and an emphasis placed on post doctorate programs to provide implant training. The student to faculty ratios ranged from 1:15 (29%), 1:10-1:15 (26.5%), 1:5-1:10 (23%), and 1:5 (21.5%). The inclusion of implant dentistry in predoctoral dental school curriculum has grown from 31% in 2000 to 69% of the schools from 2000 to the present. Of the schools that provide dental implant

education a majority of the programs include this topic during the last two years of predoctoral dental program. Fewer than 10 lecture hours on implant dentistry were reported by 39% of the respondents, 11-20 hours by 29%, 21-30 hours by 15% and 31-40 hours by 6%. Clinical hours included 49% of the schools require surgical observation of implant placement, and only 14% require predoctoral students to place implants surgically, but 33% of the schools only require students to restore implant cases (Atashrazm et al., 2011).

Dental implant education in predoctoral programs has continued to grow over the past 30 years, however, institutions continue to face challenges to its inclusion (Atashrazm et al., 2011). Implant dentistry at the predoctoral level is considered to be a multidisciplinary approach and the amount of hands-on instruction is higher in North America and Europe. The authors conclude some countries lack comprehensive curriculum guidelines for implant dentistry. Trained specialists are available, yet numerous programs lack the resources or willingness to modify the current dental school educational curriculum. The authors did not mention limitations or future research within the study (Atashrazm et al., 2011).

A descriptive study by Barwacz et al (2016) aimed to evaluate the implementation of Commission on Dental Accreditation (CODA) Standard 4-10.2.d (Provisionalization on Dental Implants) by U.S. Graduate periodontics programs from 2013 to 2015. A web-based survey was sent to the directors of all U.S. CODA-accredited periodontal graduate programs by a web-based survey tool Qualtrics. The response rate was 52%, and 93.1% of the respondents indicated an implant provisionalization to fulfill the CODA Standard 4-10.2.d, and the remaining 6.9% were planning on implementing those educational programs to fulfill the standard. Preclinical or clinical components, such as simulation, was present at 78% of the programs. The programs with an established formal implant curricula liaison with periodontics faculty (96%), prosthodontics

faculty (63%), and other specialties such as oral surgery, restorative science, AEGD/GPR certificate programs, administrative-level curriculum committees, and external educators not employed by the institution. The survey also evaluated the type of provisional system used, and when provisionalization occurred, however 67% of the respondents indicated the absence of no established requirement regarding the number of provisionalization experiences while 29% lack a formal assessment to assess competence (Barwacz et al., 2016).

The results of the survey did not find a statistical difference in implant provisionalization methods ($p > 0.32$) (Barwacz et al., 2016). Schools within the Western region did not respond to the survey posing a limitation to the study and its generalizability. Another limitation was failure to ask about the level of training of the instructors overseeing the residents during implant provisionalization. Several implant systems were used by the responding programs, and a majority placed implant immediately or delayed by 6 weeks after implant placement and favored a screw-retention over cement-retention. Most programs do not refer cases to fabricate a custom impression which was indicated as an area for potential growth in the future to save chair time and preserve peri-implant tissues. The authors concluded a majority of programs have established formal curricula, clinical protocols and guidelines, and outcomes assessment methods to support competence of the graduating residents. Despite the variance in clinical and didactic instruction further areas of study include collaboration and communication to ensure adequate restorative success to support the peri-implant mucosa (Barwacz et al., 2016).

As the prevalence of dental implants continues to rise, the need for dental implant education must accommodate the demand and need. In 2013 the Commission on Dental Accreditation (CODA) implemented standards for dental schools to include a competency related to dental implantology for all dental programs (Kihara et al., 2017). A study was

performed in 2012 to evaluate the instruction of implant dentistry in dental schools within the U.S. and Canada and other aspects related to implant curricular content, departmental oversight, techniques and materials, and barriers related to implant instruction. The 30-question survey was sent to the dean of curriculum administrator of all 73 predoctoral dental programs in the U.S. and Canada (Kihara et al., 2017).

The overall response rate was 64%. An overwhelming 100% of the respondents reported implant therapy was incorporated into the core curriculum, yet the average number of implants placed by predoctoral students was 206 per year (Kihara et al., 2017). The extent and mode of instruction may vary widely between programs, and the average number of hours dedicated to implant therapy was 17 hours. Of the programs who participated in the study 87% have a laboratory portion of the curriculum to facilitate implant education, but only three of the 47 programs required the predoctoral dental students to place dental implants. Capable, skilled, or mere participation were among the varied expectations, and to fulfill the standards 91% of the respondents reported using a team approach. Even though 43% of the programs reported an absence of an implant requirement, 62% of the programs believed the implant education was sufficient. Barriers to implement implant education included cost, lack of trained faculty, and shortage of patients (Kihara et al., 2017).

To more fully understand the effectiveness of dental implant education the Marquette University School of Dentistry conducted an experimental study to evaluate the students' perspectives of clinical and simulation training (Prasad & Bansal, 2017). The control group consisted of 80 students in the class of 2014 who received implant education by way of didactic instruction only. The university implemented a simulation and laboratory component to the curriculum for the class of 2015. The 80 students in the class of 2015 who received both didactic

and hands on simulation experience related to dental implant education comprised the test group. The 21-question survey was administered to both groups and the questions all contained responses ranging from 5 as the highest and 1 as the lowest to obtain the ordinal data for the bivariate descriptive analysis. The control group and test groups' response rates were 78.7% and 81.3% respectively. Both the control and test groups claimed to have had clinical experience with implant restorative dentistry at 81% and 72% respectively, but confidence levels varied (Prasad & Bansal, 2017).

The descriptive analysis revealed 90.3% in the control group compared with 95.4% in the test group were confident in diagnosis and treatment planning utilizing the cone beam CT scan (Prasad & Bansal, 2017). The test group which received simulation training reported a higher level of confidence over the control group on most of the questions. The satisfaction response was 45.1% for the control group and 55.2% for the test group. The ordinal regression analysis indicated students in the test group were two to three times more likely to be confident in formulating surgical guides in preparation for implant placement. The overall satisfaction was statistically significant between groups ($p < 0.01$) and the test group was four times more confident in diagnostics and treatment planning, six times more confident in creating surgical guides, and nine times more confident in making implant impressions. The satisfaction among the test groups was four times greater than the control group. Clinical experience is important and a critical component in dental implant education at the predoctoral level. Simulation and clinical experience affect the confidence and satisfaction levels of students in relation to their view of their educational experience (Prasad & Bansal, 2017).

Dental Implant Maintenance in Dental Hygiene Curriculum

A consensus conference met to develop curriculum guidelines regarding dental implants for dental hygiene programs in 1995 (Gurenlian et al., 1995). The committee included 58 dental hygiene program directors, 5 committee members, and 6 moderators to formulate curriculum guidelines and educational standards which pertain to dental hygiene implant maintenance. The guidelines were intended to assist dental hygiene programs as a curricular developmental aid, and promote the field of implantology in the reconstruction, maintenance, appearance and health of clients with a multidisciplinary approach. The overview of the curricular guidelines included the following: biological and scientific basis 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 (Gurenlian et al., 1995).

The suggested prerequisites were identified as biological, dental and related sciences, preclinical and clinical courses in preventive oral health, and radiology while working towards completion of oral pathology and periodontics courses (Gurenlian et al., 1995). Primary education goals related to the appreciation of implantology as it pertains to dental hygiene, host response, knowledge related to the process of care in relation to implantology, competencies to perform dental hygiene care and implant maintenance, and the overall role of the dental hygienist during implant therapy. The authors outlined 24 specific behavioral objectives that dental hygienists or dental hygiene students would be able to do which relate to dental implantology. The instructional material and core content were outlined as suggested into instructional modules consisting of introductory implant overview, classification and definitions of dental implants, scientific basis for dental implant therapy, assessment, diagnosis and treatment planning, implant

surgical procedures, prosthodontic procedures, maintenance and evaluation procedures, and the role of interdisciplinary health care providers. The committee concluded the conference by advocating the need for highly trained dental hygienists and specialists with advanced education or experiences in implant dentistry (Gurenlian et al., 1995).

A study was conducted to identify the level of confidence of dental hygienists and dental therapists in monitoring and maintaining peri-implant tissues and identify and treat peri-implantitis (Walters, 2019). A secondary aim of the study was to identify the availability of continuing professional development courses related to dental implants and review the current guidelines for their management. An online survey was dispensed through the British Dental Hygiene and Therapists Network on Facebook and resulted in 173 responses. The remainder of responses were completed manually at the British Society of Dental Hygiene and Therapy South West South Wales Regional Group study day with a total response rate of 195. Each survey was measured based upon the total number of years of experience which included the following five categories: less than one year, 1-5 years, 5-10 years, 10-20 years and 20 or more years (Walters, 2019).

Respondents were asked about training at the University level, management of peri-implant related disease, clinical training with managing peri-implant related diseases, confidence in monitoring, managing, and treating peri-implant mucositis and peri-implantitis, discussing oral hygiene instructions related to implant maintenance, and the extent of continuing professional development (Walters, 2019). The results found most recent graduates had been taught about implant maintenance (63%), but 29.6% had not been taught about implant maintenance despite its inclusion in the General Dental Council Scope of Practice in 2013. Most respondents with 20 or more years of experience indicated little to no training about managing

(3.6%) and treating (0%) peri-implant related diseases at the University level. Confidence was measured on a scale of 1-5 and those with 10-20 years of experience were the most confident in monitoring and maintaining peri-implant tissues which may be attributed to the attendance of CPD sessions. Respondents with less than one year of experience were the least confident in monitoring and maintaining peri-implant tissues. The confidence in recognizing peri-implant mucositis and peri-implantitis was slightly higher overall in comparison to monitoring and maintaining with the highest confidence among those with 10-20 years of experience. The confidence scores of treating peri-implant mucositis and peri-implantitis was the lowest of all the survey questions with similarly the highest confidence score for respondents with 10-20 years of experience. The highest level of confidence across all groups was seen in the area of providing oral hygiene advice to patients with dental implants. As a commitment to life-long learning 66% of respondents have attended a professional development seminar related to dental implant maintenance while 16% had not, and 17% claimed they were planning to attend. A majority at 78.5% believed more courses on dental implant maintenance should be more economically accessible and available (Walters, 2019).

Limitations of the study included the two questions about recognizing and treating peri-implant mucositis and peri-implantitis which may have needed separate questions due to the nature and management of the disease (Walters, 2019). Other limitations include the lack of detail within the questions as they do not determine how dental hygienists and dental therapists assess and maintain dental implants. Thirdly, the grouping of the respondents by years of practice was not consistent or comparable to each other which may have affected or skewed the results. The author summarized the results to conclude that dental hygiene students who graduated within the past 5 years may have received more training than hygienists who

graduated more than 5 years ago. The most confident hygienists have the most years of experience, but the least amount of training while in school, which may be related to professional development courses and learning on the job. Further areas of research include more specific survey questions about the knowledge and skills taught during dental hygiene or dental therapy programs to evaluate the scope and training. Despite the amount of training, dental practitioners must stay current by critically evaluating the literature and evidence to determine the best practices when managing patients with implants. Though the number of patients seen with an implant varies for each practitioner, the average from this survey was 53% of respondents saw 0-5 patients a week with a dental implant which may have affected the practitioner's level of confidence. Despite the numerous variables a multi-disciplinary approach is imperative when maintaining dental implants to provide the highest level of care (Walters, 2019).

Teaching implant dentistry within dental hygiene programs was studied to identify teaching trends in implant dentistry within dental hygiene programs in the UK and Ireland (Chin et al., 2019). The purpose of the study was to evaluate the current instruction, identify areas in need of improvement and identify challenges related to the dental implant curriculum within dental hygiene programs in the UK and Ireland. The study was conducted by dispensing an online questionnaire consisting of 31 questions related to dental implant curriculum to each of the 23 dental hygiene program directors in the UK and Ireland (Chin et al., 2019).

The questionnaire included both 'open' and 'closed' questions and the descriptive statistics were analyzed (Chin et al., 2019). The response rate was 60%, and all programs reported the provision of implant training by way of didactic lecture within their curricula. The teaching format used by 71% was phantom head training, 14% was symposium, and only 14% utilized live patient treatment. Topics relating to implant instruction were peri-implant

maintenance (93%), implant surgery (86%), implant restoration (71%), treatment planning (71%) and other (14%). Four programs did not guarantee clinical learning experiences related to nonsurgical management of peri-implant diseases, but five of the 14 programs required a student to demonstrate competence related to the non-surgical management of peri-implantitis or peri-implant mucositis. The types of instruments used were gold or titanium curets, ultrasonic instruments, graphite curets, and conventional stainless-steel curets. Challenges to implementing and developing the dental implant curriculum consisted of a lack of suitable cases, funding, lack of trained staff, lack of time within the program, and high ratios of students to teachers. Half of the respondents felt that clinical requirements related to the therapy of peri-implant related diseases will develop within the next five years (Chin et al., 2019).

Since these curriculum guidelines were developed, dental implant training has steadily increased over the past 15 years; however, CODA has not included a standard or competence for dental hygiene implant maintenance within entry-level dental hygiene programs. A significant and growing number of implants placed each year indicates a necessity of implant maintenance therapy within the dental hygiene program curriculum. A majority of the literature evaluated dental implant curriculum within predoctoral dental programs; however, research is lacking to evaluate the extent and scope of curriculum related to dental implant maintenance and therapy within entry-level dental hygiene programs in the United States.

Theoretical and Conceptual Framework

The theoretical and conceptual framework for this study is based upon the conceptual framework for the practice of patient-centered care (PCC). The theory of patient-centered care began in 1969 and implemented by Edith Balint, and the theoretical framework continues to evolve (Santana et al., 2017). The Institute of Medicine included patient-centered care as one of

the foundations for high quality healthcare in their 2001 report *Crossing the Quality Chasm*. The framework of person-centered care encompasses a holistic approach to the delivery of care beyond the patient's symptoms and or disease. Patient-centered care integrates patient and family involvement, and health promotion to enhance patient experiences, satisfaction and a favorable outcome (Santana et al., 2017).

A study conducted by Santana et. al (2017) performed a narrative review and synthesized the literature of existing theoretical or conceptual patient/person-centered care framework to formulate a comprehensive perspective of PCC. The three interrelated and interdependent framework components or domains consist of structure, process, and outcome (Santana et al., 2017).

The seven domains which promote PCC within an organization and throughout the process of care include:

- Creating a PCC culture
- Co-designing the development and implementation of educational programs
- Co-designing the development and implementation of health promotion and prevention programs
- Supporting a workforce committed to PCC
- Providing a supportive and accommodating PCC environment
- Developing and integrating structures to support health information technology
- Creating structures to measure and monitor PCC (Santana et al., p. 431).

Within the educational setting, entry-level dental hygiene programs are the health care system and organization. The adoption and implementation of a structure in support of PCC is directly related to both the process and outcome of the PCC framework. At the healthcare and provider

level, the process of PCC builds upon the structural domain and embodies an emphasis on fulfillment of the following four domains: cultivating communication, respectful and compassionate care, engaging patients in managing their care, and the integration of care (Santana et al., 2017, p. 434). Entry-level dental hygiene programs consist of student providers and educators who model the provision of care for their students. The cultivation of care and its processes that are centered around PCC will help enhance the overall delivery of care. Thirdly, the outcome incorporates the patient, healthcare provider and the healthcare systems by way of two important domains which include: access to care, and Patient Reported Outcomes (PROs) (Santana et al., 2017, p. 431). Aspects related to the domains of the outcome includes efficient, timely, and affordable care to improve the overall experience and promote the overall patient health status (Santana et al., 2017).

The entry level dental hygiene programs who adopt the PCC framework and integrate its models into the curriculum will promote the delivery of high-quality care as the graduates provide treatment and prepare to enter the workforce. Within the structure of PCC other important aspects include autonomy, and sensitivity to culture and diversity to promote human dignity and patient rights. A more person-centered approach and theoretical framework within the educational setting of healthcare is paramount to promote the PCC model within all healthcare organizations and across the entire continuum of care.

Summary of Chapter 2

The literature supports a need for dental implant maintenance protocol within entry-level dental hygiene programs. One survey of 195 dental hygienists and dental therapists with fewer years of experience showed less confidence in monitoring, recognizing, treating, and facilitating homecare related to peri-implant disease than those clinicians with 10 or more years of

experience (Walters, 2019). Didactic knowledge is important, yet application and real-life experience is also necessary to reinforce learning and gain mastery of clinical skills. Confidence is gained through practice, and experience gained over time. It may benefit dental hygiene graduates to start the process of diagnosing and managing peri-implant related diseases during dental hygiene educational programs. Clinical and didactic instruction will help to equip dental hygiene students with the knowledge and skills to confidently assess peri-implant health, identify peri-implant diseases, provide implant maintenance, and coach patients in evidence-based home care techniques.

Chapter 3 Methodology

Introduction

The purpose of this study was to identify the curriculum content used for teaching dental implant maintenance within the entry-level dental hygiene programs. The curriculum content for dental implant maintenance within entry-level dental hygiene programs in the United States was explored by means of a descriptive survey. Analysis of curriculum content provided insight on the extent and scope of dental implant instruction among entry-level dental hygiene programs to provide valuable feedback to further the research and development of dental hygiene curriculum. The methodology section included the research questions and a hypothesis which guided this study along with the definition of the research participants, explanation of the research procedure and data collection methods, and a description of the research instrument.

Research Design

The research method was descriptive survey research. Survey research is quantitative, and its design is structured so that information can be gleaned which relates to existing hypotheses or research questions (Leavy, 2017). Surveys provide the ability for participants to answer standardized questions that can be analyzed statistically and also generalized to a larger population (Leavy, 2017). Moreover, this survey research method was classified as cross-sectional because information was gathered at one point in time (Leavy, 2017).

Survey research is a commonly used quantitative design utilized in social sciences, education and healthcare to describe human behavior (Leavy, 2017) (Ponto, 2015). The data collection tool was a questionnaire, also referred to as a survey instrument, because it is able to gather data in a systematic manner from the participants of the study (Jacobson, 2017). The use

of a self-administered online survey allowed the respondents to provide honest answers in a cost effective and efficient manner (Jacobson, 2017).

Research questions

The following research questions guided the conduct of this study.

1. What is the curriculum content used for teaching dental implant maintenance within entry-level dental hygiene programs?
2. What didactic instruction is provided related to dental implant maintenance within entry-level dental hygiene programs?
3. What laboratory instruction is provided related to dental implant maintenance within entry-level dental hygiene programs?
4. What clinical instruction is provided related to dental implant maintenance within entry-level dental hygiene programs?
5. What diagnostic methods are used to assess periodontal tissues surrounding dental implants in entry-level dental hygiene programs?
6. What therapeutic services are rendered to maintain dental implants in entry-level dental hygiene programs?
7. What home care aids are recommended to patients to maintain implant health within entry-level dental hygiene programs?
8. What home care aids are taught to patients to maintain implant health within entry-level dental hygiene programs?
9. Do entry-level dental hygiene programs require their students to perform a clinical competency related to dental implant maintenance?

10. What are the barriers to preparing students with the knowledge and skills to maintain dental implants?
11. Do dental hygiene educators support an accreditation requirement related to dental implant maintenance for entry-level dental hygiene programs?
12. Is there a statistically significant difference in the curriculum content for teaching dental implant maintenance between associate and baccalaureate entry-level programs?

Hypothesis

The hypothesis related to this study was:

There is no statistically significant difference in the curriculum content for teaching dental implant maintenance between associate and baccalaureate entry-level programs.

Variables

The variables examined in this study were curriculum content, didactic instruction, laboratory instruction, clinical instruction, diagnostic methods, therapeutic services, home care aids recommended and taught, clinical competency, barriers to instruction, accreditation requirement, and associate and baccalaureate degree entry-level programs.

Research Context

A sample of all dental hygiene entry-level program directors in the United States were invited to participate in the online questionnaire. To achieve the best results for the purposes of this research project the program director was given the option to decide who the best faculty member was to complete the survey. Entry-level program settings included all community colleges, four-year universities, and career colleges all of which are accredited institutions. The invitation explained the purpose and significance of the study. Following the invitational letter,

each program director received a cover letter via email which explained the instructions to participate (Appendix A). The cover letter contained a digital link to participate in the online questionnaire powered by Qualtrics® (Appendix B). Five mailings were sent out with an invitation to participate in the survey to remind all participants of the necessity for a timely response (Appendix C). An online survey was appropriate for this study because it is a cost-efficient method of collecting data, time efficient in its capacity to quantify data, easy for participants to respond, and provides real time results (Leavy, 2017).

Research Participants

Sample description

The sample consisted of all entry-level dental hygiene program directors in the United States. The 329 programs consisted of only accredited entry level programs at the associate and baccalaureate level and excluded degree completion programs and graduate programs in dental hygiene. To prevent bias, Idaho State University was not included in this study.

Human Subjects Protection

An application and request were sent to the Idaho State University Human Subjects Committee and Institution Review Board (IRB) for approval. The research study qualified for the U. S. Department of Health and Human Services exemption 45CFR 46.101(b)(1) because “the research is only conducted in established or commonly accepted educational settings,” and “normal educational practices” (HHS, n.d.). Moreover, the research only involved educational tests, survey procedures, interview procedures or observation of public behavior and is exempt under 45CFR 46 101(b)(3) from 45 CFR part 46 requirement because the study did not involve human subjects whom are, “elected or appointed public officials” and the confidentiality of all “personally identifiable information will be maintained throughout the research and thereafter”

as required by Federal statute (HHS, n.d.). This study received IRB approval by the Idaho State University Human Subjects Committee according to IRB#-FY2020-218. Following completion of the data analysis, all documents related to data collection will be transferred to the major thesis advisor and kept in a locked file cabinet in the Department of Dental Hygiene at Idaho State University for a minimum of seven years. The documents will then be destroyed according to university protocol.

Data Collection

Procedure and Protocols

The self-designed electronic survey was created from an adaptation of a prior study within the Qualtrics® software program. The former study was performed by Chin et al. (2019) to evaluate the current teaching methods of dental implant maintenance within dental hygiene and dental therapy schools in the U.K. and Ireland. The lead author of the study by Chin et al. (2019) was contacted via email to request the actual survey and permission to utilize it for future research. A response was received by the author granting permission to utilize their survey instrument along with a copy of the survey (Appendix D). For the purpose of this study the questions from the former study by Chin et al. (2019) were thoroughly evaluated and modified to formulate an appropriate survey to implement within entry-level dental hygiene programs in the United States (Appendix C). A cover letter (Appendix A) was sent to all program directors of entry-level dental hygiene programs in the United States to introduce the principal investigator (PI) as a Master of Science in Dental Hygiene Student at Idaho State University, inform them of the study, and ask for their participation in the upcoming survey. The cover letter included a description of the study and an electronic link to the survey (Appendix B). Also, the survey contained a consent statement. Two weeks later the cover letter and link to the survey were

resent to provide participants with a second opportunity to take the survey (Appendix E). About a week later, a third invitational letter and survey link were sent (Appendix F). Another week later a fourth invitational letter and survey link were sent (Appendix G). The Fifth and final invitational letter was sent a week later with the survey link (Appendix H). The online questionnaire process was closed four and a half weeks after the second mailing. The responses were sent electronically to the PI to be entered into a SPSS spreadsheet and prepared for analysis by a statistician.

Instruments

The instrument consisted of a modified survey from Chin et al. (2019). Permission from the author was obtained (Appendix D). The survey was easy to read. The questions were organized in an appropriate manner for ease of completion.

Instrument Validity and Reliability

Validity and reliability were tested to ensure consistency and accuracy of the instrument. A measurement error may occur when the questions or instruments do not accurately represent the intended topic or purpose of the study, or questions do not prompt truthful answers (Ponto, 2015). Both the validity and reliability were tested by a panel of experts in the field to help prevent a measurement error.

Establishing content validity is a crucial component of the research process in order to confirm the appropriateness and relevance of the instrument (Yusoff, 2019). The systematic approach for measuring the content validity of an instrument for a study consists of six steps which include:

- Preparing a content validation form
- Selecting a review panel of experts

- Conducting content validation
- Reviewing domain and items
- Providing a score on each item
- Calculating the CVI (Content validity index) (Yusoff, 2019).

A panel of six experts within the dental hygiene field were selected to rate the relevance of each question within the survey and the corresponding CVI score will need to be at least 0.80 to be considered acceptable. The panel of six experts received the survey with a rating scale of one to four and were each asked to rate each question based upon its relevance (See Appendix I). All questions met the benchmark of 0.80 except for one question which asked about the type of degree the program offered. The question was the basis of the hypothesis, and the pinnacle of statistical analysis. The thesis committee unanimously agreed to keep the question as part of the survey. The question was re-worded, based upon the recommendation of one of the experts, to enhance its relevance.

The reliability was tested with a test-retest method to ensure consistency of results over time utilizing the same survey instrument. Five experts in the field completed the survey (Appendix J). A week later the experts took the same survey a second time (Appendix J). The results of the test-re-test demonstrated reliability with scores ranging from 0.80 to 1.00. Three of the thirty-three survey questions were modified upon completion of the test-re-test to enhance the survey's reliability.

Limitations

The limitations of this study included the potential for a non-response error which is caused by a low response rate (Ponto, 2015). If participants do not take the time to respond, a low response rate will result in data that is biased and unrepresentative of the population.

Possible causes of a non-response error include participants neglecting to read the invitational email, not taking the time to read and act, or issues associated with spam email. In an effort to prevent a non-response error, the participants received multiple invitations to participate in the study, and the online questionnaire was concise and easy to read. Another limitation was the potential for a measurement error due to a lack of validity or reliability. A measurement error can also be caused by an instrument that does not accurately reflect the topics of interest or evokes untruthful answers (Ponto, 2015). In an effort to prevent a measurement error, validity and reliability were established.

Statistical Analysis

The results were analyzed using descriptive statistics and Chi square tests of association ($p=0.01$).

Summary of Chapter 3

Descriptive survey research was completed to evaluate the protocol of implant maintenance within entry-level dental hygiene programs. Areas evaluated included diagnostic methods of peri-implant tissues, dental implant maintenance, therapeutic services rendered, home care aids taught and recommended, clinical competencies related to dental implant maintenance, barriers, accreditation requirement, and entry level dental hygiene programs at the associate and baccalaureate levels. The sample consisted of all entry-level dental hygiene programs at the associate and baccalaureate levels. A self-administered online survey was delivered electronically to all program directors and the results were statistically analyzed. Results and discussion were reported in the form of a manuscript and submitted for publication in the *Journal of Dental Hygiene*. The remaining sections of the thesis reflect the manuscript specifications outlined in the author guidelines located at <https://submit-jdh.adha.org/>.

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Section II: Publishable Manuscript

Title Page

Title: Dental Implant Maintenance in Dental Hygiene Programs

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Abstract

Purpose: The purpose of this study is 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 by five mailings during the Spring 2020 to 329 accredited entry-level dental hygiene program directors in the United States for this exploratory research study. The survey instrument evaluated curriculum content related to dental implant maintenance within entry-level 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 26.14%. Most programs 82 (98.8%) provide didactic instruction on dental implant maintenance, while 38 (36.3%) include laboratory instruction. 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 to assess and maintain peri-implant health were found among dental hygiene programs surveyed. These findings may provide an opportunity for program directors to assess their curriculum and create protocols related to dental implant maintenance. Future research is needed to investigate the curriculum content and evaluate whether programs are implementing an approach to dental implant maintenance that promotes implant health.

Key Words: dental implants, maintenance, curriculum content, entry-level dental hygiene program

Introduction

Implant dentistry has continued to evolve over the past decades as approximately 3 million people in the United States have a dental implant and about 500,000 are placed each year.¹ Implants remain the standard of care to replace a missing tooth by preserving adjacent teeth and surrounding bone, enhancing masticatory function and quality of life for edentulous and/or partially edentulous patients.^{1 2 3} The percentage of Americans with dental implants has increased significantly from 0.7% in 1999-2000 to 5.7% in 2015-2016 and is projected to be 17% by 2026.²

Maintaining implant health is crucial to the survival of dental implants.^{4 5 6 7} Inflammatory diseases caused by biofilm accumulation may compromise the health of dental implants and include peri-implantitis and peri-implant mucositis.^{4 5 6 7 8 9} Inflammation surrounding an implant that is limited to the adjacent mucosa refers to the disease known as peri-implant mucositis and progression of the inflammation causing radiographic bone loss is defined as peri-implantitis.^{4 5 7 9} Dental professionals assess implants during the process of care and screen for bleeding upon probing, increased pocket depths, clinical signs of inflammation, suppuration, mobility, and radiographic bone loss.^{4 5 6 7 9} Peri-implant health is evidenced by no bleeding upon probing, no inflammation, no mobility, no suppuration, probing depths of 4-5mm or less, and no radiographic evidence of bone loss.^{4 5 6} The risk factors for peri-implant mucositis and peri-implantitis include history of periodontal disease, poor biofilm control, residual cement, smoking, genetic factors, diabetes, occlusal overload, and the possibility of rheumatoid arthritis, concomitant connective tissue disease, irregular maintenance visits and/or alcoholism.^{5 6 9 10} Nonsurgical therapies must precede surgical treatment and address modifiable risk factors such

as recall frequency, oral hygiene, smoking, alcoholism, patient compliance, and also identify nonmodifiable factors such as systemic and/or local factors.^{10 11 12}

The prevalence of peri-implant related diseases, or biological complications, remain high and their rates vary based upon the study and criteria. Peri-implant mucositis affects between 42.5% to 50% of implants.^{6 8} The progression of the disease as evidenced by bone loss and known as peri-implantitis is also prevalent impacting 12-43% of implants.^{6 8} Research is limited regarding the long-term survival of dental implants and oftentimes disease rates are difficult to track.¹³ Dental implant survival and failure rates are determined based upon the presence of the implant in the mouth at the time of the study.¹⁴ Research reveals around 9-16.6% of implants will fail within 10 years of placement.¹⁵ Given the high incidence of dental implant diseases, the success rate and survival rate should be taken into consideration when evaluating dental implants and their long term prognosis.¹⁶ Implants may develop complications or even failure due to a lack of osseointegration, infection or occlusal trauma.³

Dental hygienists are preventive oral health specialists who treat oral diseases and one aspect consists of maintaining periodontal health through the diagnostic, preventive and therapeutic services which relate specifically to dental implant maintenance.¹⁷ Dental maintenance visits play a key role in implant success by helping reduce bacterial biofilm and promote implant health; however, the frequency of maintenance visits should be based upon the individual needs of each patient.^{5 18 19 20} Practitioners can help improve patient compliance with implant maintenance through patient education and motivational techniques.¹² Early diagnosis and intervention are crucial components of preventing implant failure; thus, the role of dental hygienists is crucial in maintaining implants, facilitating care through patient education, and referrals with a multidisciplinary approach.^{5 9 21}

The dental hygiene educational standards established by the Commission on Dental Accreditation (CODA) does not specify whether or how entry-level dental hygiene programs must prepare dental hygienists to assess and maintain dental implants. According to competency 2-13, “graduates must be competent in providing the dental hygiene process of care” and competency 2-14 states, “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.²² The dental hygiene process of care includes the management of oral diseases which includes implant maintenance. Dental hygienists must be equipped with the knowledge and clinical skills to assess, diagnose, plan dental hygiene therapies, implement care, evaluate results, and document the care of implant health and peri-implant diseases.¹⁷ Entry-level dental hygiene programs must decide the extent to which dental implant maintenance is included within their curriculum and specific clinical requirements.

The integration of implant dentistry into predoctoral and dental hygiene curriculum has increased over the past few decades to keep up with the needs of the population.^{23 24 25 26 27 28} Curriculum guidelines for dental implant education were developed for dental hygiene programs in 1995 to serve as a guide.²⁹ The recommendations pertained to 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.²⁹ 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.^{23 29 30}

Little is known about the scope of curriculum content related to dental implant maintenance within entry-level dental hygiene programs in the U.S., but a study in the U.K and

Ireland evaluated this topic by conducting an online quantitative research study.²⁵ All programs reported the provision of implant training by way of didactic lecture within their curricula, and all but five of the 14 programs required a student to demonstrate competence related to the non-surgical management of peri-implantitis or peri-implant mucositis.²⁵ The many challenges to developing dental implant curriculum within predoctoral dental programs and dental hygiene programs consisted of a lack of suitable cases, funding, trained staff, time within the program, and high ratios of students to teachers.^{23 24 25} Half of the respondents felt clinical requirements related to the therapy of peri-implant related diseases will develop over the next five years.²⁵ Other studies show the confidence of dental hygienists in monitoring and maintaining peri-implant related tissues may depend upon the educational training, training on the job, and professional development; thus, placing a high level of importance upon the dental hygiene educational experience.^{30 31} Moreover, simulation and clinical experience affect the confidence and satisfaction levels of students in relation to their view of their educational experience.³¹ Regardless of the level or hours of training, dental practitioners must stay current by critically evaluating the literature and evidence to determine the best practices when managing patients with implants.

Since curriculum guidelines were developed, dental implant training has steadily increased; however, CODA has not included a standard or competence for dental hygiene implant maintenance within entry-level dental hygiene programs. A significant and growing number of implants placed each year indicates a necessity for the inclusion of implant maintenance therapy within the dental hygiene curriculum. With implant placement on the rise, it is essential for dental hygienists entering the workforce to obtain the knowledge and clinical skills necessary to provide comprehensive, preventive, diagnostic, and therapeutic services for

dental implants, yet little is known about the curriculum content related to dental implant maintenance in entry-level dental hygiene programs in the United States. Therefore, 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. The null hypothesis tested was there is no statistically significant difference in the curriculum content for teaching dental implant maintenance between associate degree/certificate and baccalaureate entry-level programs.

Methods

An exploratory descriptive research design was used to evaluate the curriculum content for dental implant maintenance within entry-level dental hygiene programs in the United States. The 33-item questionnaire was adapted from a former study performed (Chin et al. 2019) to evaluate the current teaching methods of dental implant maintenance within dental hygiene and dental therapy schools in the U.K. and Ireland. Permission was received by the lead author along with a copy of the survey.

Analysis of curriculum content provided insight on the extent and scope of dental implant instruction by examining the following variables: didactic instruction, laboratory instruction, clinical instruction, clinical competency, barriers, accreditation requirement, type of entry-level degree. The survey instrument was evaluated by experts in the field of dental hygiene education to establish content validity using a Content Validity Index and a score of 0.80 or greater was sought for each item.³² The reliability of the survey 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 made. This study was reviewed and granted IRB approval by the University Human Subjects Committee (IRB#-FY2020-218).

Dental hygiene program directors at 329 entry-level dental hygiene programs (n=329) were invited to participate in the study. Five electronic mailings occurred during the spring of 2020 by distributing a questionnaire powered through Qualtrics® (Provo, UT). The self-administered survey contained a consent statement and all responses were kept confidential. Results of the study were analyzed using descriptive statistics and a chi square test of association. For all statistical analyses performed, probability was established at .01 to prevent a type 1 error.

Results

A total of 86 responses were received for a response rate of 26.14%. Not all items were answered by each participant; however, most items were answered by 82 of the respondents. Of these respondents, 62 (75%) identified themselves as program directors while 29 (35%) identified themselves as clinic coordinators. Some individuals identified themselves as fulfilling both roles of program directors and clinic coordinators. In terms of type of entry-level dental hygiene program, 61 (73.5%) respondents were from associate degree/certificate programs and 21 (25.3%) were from baccalaureate programs; one person (1.2%) chose not to answer this item.

Didactic Instruction

Five items related to didactic instruction of dental implants throughout the dental hygiene curriculum. Eighty-two (98.8%) individuals indicated their dental hygiene curriculum provides didactic instruction on dental implants; one person (1.2%) did not respond to this item. Respondents indicated approximately 6.25 average contact hours were dedicated to didactic instruction of dental implants throughout the dental hygiene curriculum with a range of hours

from 1 to 24. More specifically, 82 (98.8%) respondents indicated their program provides didactic instruction on the assessment of peri-implant related diseases, 79 (95.2%) reported their curriculum provides didactic instruction on professional implant maintenance, and 80 (96.4%) indicated their curriculum includes didactic instruction on at-home dental implant care, while 2 (3.3%) identified their curriculum does not provide instruction on at-home dental implant care. Other topics included within the didactic curriculum were: implant types, treatment planning, contraindications, surgical placement, implant materials, 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 whether there was an association between the responses to the item related to didactic instruction on at-home implant care and degree offered (associate degree/certificate versus baccalaureate). The difference between respondents from associate degree/certificate and baccalaureate programs for this item was not statistically significant ($\chi^2 = .71$, $df = 1$, $p = .40$, Cramer's $\Phi = .09$).

Laboratory Instruction

Three items of the survey pertained to laboratory instruction on dental implant maintenance. Of the 82 individuals responding to this item, thirty-eight (36.3%) programs include pre-clinical instruction within the laboratory setting to provide training for dental implant maintenance. Laboratory training was included by 25 (41%) associate degree/certificate programs and 13 (62%) baccalaureate programs. For the programs that included laboratory training, 11 (44%) of the associate degree/certificate programs and 3 (23.1%) of the baccalaureate programs indicated they used typodonts to prepare students for clinical application of dental implant maintenance. A chi square test of association was used to determine whether there was an association between these responses and degree offered. The difference was not

statistically significant ($X^2=1.61$, $df=1$, $p = .21$, Cramer's Phi = -.21). When the 38 programs that included laboratory training were asked to indicate whether simulation training was used, 13 (52%) of the associate degree/certificate programs and 4 (30.8%) of the baccalaureate programs answered yes. This difference was not statistically significant ($X^2=1.56$, $df=1$, $p = .21$, Cramer's Phi = -.20).

Clinical Experiences

Thirteen survey items were directed toward clinical experiences with patients to maintain dental implants. With regard to the number of direct patient experiences, 72 (87.80%) respondents reported on average, students worked with 3.41 patients with implants during their clinical education (range = 0-20). Table I summarizes responses to the survey items that could be answered either as a yes or no. Most programs do require direct clinical experiences specifically as it relates to using radiographs to screen for implant diseases, using hand instrumentation around dental implants, and recommending and teaching patients how to use home care aides to maintain dental implants. However, most programs do not require students to use ultrasonic instrumentation or air polishing to produce a biofilm free surface around dental implants, and program respondents were divided about probing implants and providing experiences related to irrigating with antiseptics to promote implant health. A chi square test of association was used to determine whether there was an association between these responses and type of degree offered. Results are reported in Table II. As can be seen from this table, no outcomes were statistically significant.

Additionally, within clinical experiences, respondents were asked if they require students to perform clinical competencies related to dental implant maintenance. Most indicated that clinical competencies are not required (Table I). Of those that do require competencies, specific

assessments are associated with periodontal disease staging and grading; air polishing, debridement, irrigation, instrumentation, and home care recommendations; the dental hygiene process of care; and assessment of implant health including evaluation of radiographs and bleeding upon probing.

Barriers

Six survey items pertained to barriers associated with educating students about dental implant maintenance; 48 (58.5%) indicated barriers existed. Examples of barriers included lack of trained faculty, calibration, time, patients, and funding. The barrier that was most concerning to respondents was lack of patients ($n = 61$, 74.4%). A chi square test of association was used to determine whether there was an association between these responses and type of degree offered. Table III demonstrates that differences were not statistically significant.

Curriculum Development and Accreditation

One survey item related to further developing the dental implant maintenance curriculum content in the next five years. Of the 82 respondents to this item, 73 (89%) indicated yes while 9 (11%) responded no. For those responding yes to this item, 55 (90.2%) were from associate degree/certificate programs and 18 (85.7%) from baccalaureate programs. A chi square test of association was used to determine whether there was an association between these responses and type of degree offered. This difference was not statistically significant ($\chi^2 = .32$, $df = 1$, $p = .57$, Cramer's $\Phi = -.06$). Respondents who answered "yes" commented they would be interested in enhancing laboratory or simulation experiences; increasing didactic instructional hours; and increasing clinical experiences related to air polishing, ultrasonic scaling, patient education, and new technology and devices. Respondents also recognized the need for overall curriculum development and the need to update dental implant curriculum regularly. Those who responded

“no” commented the curriculum is already comprehensive and clearly defined, the curriculum related to dental implants had recently been updated, and the program was closing.

Two survey items pertained to accreditation requirements for dental implant maintenance. When asked if there should be an accreditation requirement related to didactic instruction for dental implant maintenance; 42 (51.2%) indicated “no” while 40 (48.8%) answered yes. Of those who answered no, 30 (49.2%) were from associate degree/certificate programs and 12 (57.1%) were from baccalaureate programs. Of the 40 who responded yes, 31 (50.8%) were from associate degree/certificate programs while 9 (42.9%) were from baccalaureate programs. A chi square test of association was used to determine whether there was an association between these responses and type of degree offered. Results were not statistically significant ($X^2=.40$, $df = 1$, $p = .53$, Cramer’s Phi = -.07). The next survey item related to whether or not there should be an accreditation requirement related to clinical instruction for dental implant maintenance; 52(63.4%) responded “no” while 30 (36.6%) indicated yes. Of the 52 who answered no, 38 (62.3%) were from associate degree/certificate programs and 14 (66.7%) were from baccalaureate programs. Of the 30 who answered yes, 23 (37.7%) were from associate degree/certificate programs while 7 (33.3%) were from baccalaureate programs. A chi square test of association was used to determine whether there was an association between these responses and type of degree offered. This difference was not statistically significant ($X^2=.13$, $df = 1$, $p = .72$, Cramer’s Phi = -.04). Respondents were provided an opportunity to comment on accreditation requirements for implant maintenance in entry-level dental hygiene programs. Notable comments included:

“The requirements are sufficient and implant care is embedded and not necessary to prepare students to maintain implants.”

“A clinical accreditation requirement may not be feasible for all students due to limited populations with implants in some populations.”

“A simulation or laboratory requirement is more attainable for all programs.”

“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.”

“Accreditation requirements guide instruction and promote competence and one related to dental implant maintenance is important.”

For all of the statistical analyses performed, 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. Therefore, we fail to reject the null hypothesis for this study.

Discussion

This study focused on understanding the scope of curriculum content related to dental implant maintenance within dental hygiene programs. The findings revealed a majority of respondents reported the inclusion of dental implantology by means of a didactic and/or clinical component within the dental hygiene program’s curriculum. Programs are teaching dental implant maintenance which supports the approximately 500,000 new implants placed each year.¹

⁴ The type of curriculum content and scope related to dental implant maintenance varies. Several key findings from the study’s results are noteworthy points of discussion.

Almost all respondents indicated their program provides students with direct clinical experiences with implant patients. The study shows students are seeing an average of less than

four patients with implants with a wide range of patient experiences. Some students have a broader experience, but many have a very limited exposure to patients with implants. Given the growing and upward trend of implant dentistry, it is questionable that students are receiving adequate training to account for the millions of Americans with implants and the projected increase in implant cases at 17% of Americans by 2026.^{1 4} As evidenced by the results, the main barrier in providing clinical experiences to students related to implant maintenance was the limited number of patients with dental implants. The diverse range in patient experiences with dental implants 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; yet only few programs use this learning approach. It is important to provide students with clinical experiences which parallel the workforce even if it requires more effort to bring implant patients or simulation into the educational setting as is done with periodontal, special needs, geriatric, radiographic, and child experiences.

The clinical experiences related to therapeutic services to maintain dental implants within the dental hygiene educational setting varied (with special attention brought to the use of air polishing ultrasonic implant scalers and antiseptic irrigation). With a high incidence of peri-implant related diseases affecting approximately 50% of implants, early detection and non-surgical management of peri-implant related diseases is a crucial aspect of the dental hygiene process of care.⁶ 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 with an

appropriate periodontal probe suited for titanium to document a baseline pocket depth.¹⁹ Peri-implant probing is one method used to assess peri-implant health and screen for peri-implant related diseases.^{4 6 19} 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.^{7 33 34} Air polishing devices with glycine powder could be considered a sustainable treatment option for peri-implant related diseases; however, only a limited number of programs utilize these devices.^{11 34} Ultrasonic devices with an implant scaler tip may also reduce the bacterial load around implants to promote peri-implant health, but are not a common component of dental hygiene curriculum.^{11 33} The results were divided on the use of antiseptics as more baccalaureate programs integrate their use over associate/certificate programs. Chemotherapeutic agents may be necessary when a candidate requires more than mechanical debridement.³³ The literature supports the use of air polishing devices, ultrasonic scaling devices, and the use of antiseptics as therapeutic modalities to decontaminate the peri-implant tissue, however there is a disconnect between the findings of this study and the evidence within the literature.^{7 11 33 34}

The results also indicated considerable variation in the overall curriculum content related to dental implant maintenance in terms of the number of contact hours dedicated towards didactic instruction of dental implants, the inclusion or exclusion of laboratory instruction, the number of clinical experiences with implant patients, and the type of therapeutic services rendered. A lack of consistency could be linked to an absence of official competencies and standards developed for this topic. As mandated by CODA and standards 2-13 and 2-14, students must be competent in implementing the dental hygiene process of care and treating all types of classifications of periodontal diseases.²² 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 allowing dental hygiene programs to determine required experiences related to implants.³⁵ Since programs do not have to defend educational experiences related to dental implants, the provision or its fulfillment is unknown. An accreditation requirement on dental implants may help to guide dental hygiene programs in their effort to promote competence. At ten years after placement, approximately 9-16.6% of dental implants fail.³⁶ Training and skill advancement will promote identification and management of peri-implant related diseases and possibly improve the success rate.

This study is not without limitations. The primary limitation is a low response rate, which may increase the possibility of a non-response error.³⁷ Possible causes of the low response rate include participants neglecting to read the invitational email, not taking the time to participate, or, more likely, 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. In an effort 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 about type of program setting and location of program would have enriched the understanding of parameters associated with curriculum experiences and barriers associated with dental implant maintenance education in entry-level programs.

To increase further understanding of issues related to dental implant maintenance in dental hygiene entry-level programs, this study could be repeated to increase the response rate. Including additional demographic questions 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 dental implant maintenance instruction.

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 entry-level dental hygiene programs. Varied approaches to assess and maintain peri-implant health were found, however, data were not statistically significant when analyzing differences between associate/certificate and baccalaureate programs. These findings may provide dental hygiene programs with a means to assess their curriculum, calibrate, and establish protocols related to dental implant maintenance. Future research is needed to investigate the curriculum content and evaluate whether programs are implementing an approach to dental implant maintenance that promotes implant health. (Total words 4117)

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Tables

Table I: Frequency responses to questions related to clinical experiences for dental implant maintenance

Statement	Valid n	AS/Certificate Yes Response	BS Yes Response	AS/Certificate No Response	BS No Response
Q14 Are students having direct clinical experiences with patients to maintain dental implants?	82	56 (91.8%)	21 (100%)	5 (8.5%)	0 (0%)
Q16 Does the dental hygiene curriculum at your institution require students to probe dental implants as part of the periodontal assessment in the clinical setting?	82	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?	82	57 (93.4%)	20 (95.2%)	4 (6.6%)	1 (4.8%)
Q 18 Are students required to assess risk factors for peri-implant related diseases within the clinical setting?	82	56 (91.8%)	20 (95.2%)	5 (8.2%)	1 (4.8%)

Q 19 Does the dental hygiene curriculum at your institution require students to produce a biofilm free surface around dental implants with ultrasonic instrumentation within the clinical setting?	82	18 (29.5%)	8 (38.1%)	43 (70.5%)	13 (61.9%)
Q 20 Does the dental hygiene curriculum at your institution require students to produce a biofilm free surface around dental implants with hand instruments within the clinical setting?	81	47 (78.3%)	17 (81.0%)	13 (21.7%)	4 (19.0%)
Q 21 Does the dental hygiene curriculum at your institution require students to produce a biofilm free surface around dental implants with air polishing within the clinical setting?	82	22 (36.1%)	8 (38.1%)	39 (63.9%)	13 (61.9%)
Q 22 Does the dental hygiene curriculum at your institution provide experiences related to irrigation with antiseptics around dental implants to promote peri-implant health within the clinical setting?	81	31 (51.7%)	17 (81.0%)	29 (48.3%)	4 (19%)

Q 23 Are students required to recommend homecare aids to patients with dental implants within the clinical setting?	81	59 (98.3%)	21 (100%)	1 (1.7%)	0 (0%)
Q 24 Are students required to teach patients how to use the recommended homecare aids to maintain dental implants within the clinical setting?	82	56 (91.8%)	19 (90.5%)	5 (8.2%)	2 (9.5%)
Q 25 Does your dental hygiene program require students to perform any clinical competencies related to dental implant maintenance within the clinical setting?	82	8 (13.1%)	2 (9.5%)	53 (86.9%)	19 (90.5%)

Table II: Chi square test of association for questions related to clinical experiences for dental implant maintenance

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 at your institution 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 at your institution 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 at your institution 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 at your institution 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 at your institution 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 homecare aids to patients with dental implants within the clinical setting?	81	0.35	1	1.00	0.07
Q 24 Are students required to teach patients how to use the recommended homecare 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
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Table III: Chi square test of association for questions related to barriers for dental implant maintenance

Statement	Valid n	X^2 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

Appendix A

Introductory Cover Letter

March 23, 2020

Dear Program Director,

I know this is an especially stressful time with covid-19 changing the dynamic of didactic and clinical instruction for our dental hygiene students. However, my colleague, Jacque Freudenthal, and our graduate student, Cherie (Anna) Gentry, were planning to conduct a research study related to dental implant maintenance instruction in entry-level dental hygiene programs (IRB#-FY2020-218). At first, we thought we should hold on our study, but then realized that we cannot allow all processes to stop. Some work is continuing and perhaps we can move forward with sending this questionnaire to you. Who knows, maybe the response rate will be higher!

In the next few days, you will receive a cover letter and link to our survey. The instrument is designed to be easy to complete and brief. It is our hope that you will be able to carve out some time to take the survey. Thank you for your time and consideration. Please be well and safe.

Sincerely,

JoAnn

JoAnn R. Gurenlian, RDH, MS, PhD, AFAAOM
Professor and Graduate Program Director
Past President, International Federation of Dental Hygienists

Appendix B

First Invitational Cover Letter

March 25, 2020

Dear Program Director,

We are investigating dental implant maintenance instruction used in entry-level dental hygiene programs and are asking for your assistance by completing a brief survey to describe the curriculum content used to prepare your students to maintain dental implants. This study has received IRB approval by the Idaho State University Human Subjects Committee (**IRB#-FY2020-218**).

We would appreciate your willingness to give approximately 10 minutes of your time to complete this online questionnaire. If you feel a clinical coordinator, rather than yourself, would be better able to answer the questions about dental implant maintenance instruction (didactic and clinical), please forward this email to them to complete this survey.

By submitting the electronic survey using the link provided, you are giving consent for the use and analysis of your responses. All responses will remain confidential, and the only risk is the time it takes to complete the questionnaire.

If you have any questions regarding participation in this study, please do not hesitate to contact us. Thank you for completing this questionnaire by **Friday, April 3, 2020**.

The link for the survey is https://isu.co1.qualtrics.com/jfe/form/SV_9KwsKU4sOzky9yR

With sincere appreciation,

(Anna) Cherie Gentry, RDH, BS, MSDH(c)
Graduate Student at ISU
gentann2@isu.edu

JoAnn Gurenlian, RDH, MS, PhD, AFAAOM
Professor and Graduate Program Director
gurejoan@isu.edu

Jacqueline Freudenthal, RDH, MHE Professor
Chair, Dept. of Dental Hygiene
freujacq@isu

Appendix C

Survey on Curriculum Content of Dental Implant Maintenance within Entry-Level Dental Hygiene Programs

Please read the following informed consent statement.

I am aware that this survey is for the purpose of academic research. I understand that my identity will remain anonymous. There are minimal risks associated with completing this survey other than the time required to complete it. By completing and submitting this survey for analysis, I hereby give my consent for the data contained within this survey to be utilized for the purposes of academic research.

DEMOGRAPHICS

1. Are you the program director?
 - a. Yes
 - b. No

2. Are you a clinical coordinator?
 - a. Yes
 - b. No

3. What type of entry-level dental hygiene degree does your program offer?
 - a. Associate/Certificate
 - b. Bachelors

DIDACTIC

4. Does your dental hygiene curriculum provide didactic instruction on dental implants?
 - a. Yes
 - b. No (if no go to question 10)

5. Approximately how many contact hours are dedicated towards the didactic instruction of dental implants throughout the dental hygiene curriculum?
 - a. Specify contact hours: _____

6. Does your dental hygiene curriculum provide didactic instruction on the assessment of peri-implant related diseases?
 - a. Yes
 - b. No

7. Does your dental hygiene curriculum provide didactic instruction on professional implant maintenance?
 - a. Yes
 - b. No
8. Does your dental hygiene curriculum include didactic instruction on at-home dental implant care?
 - a. Yes
 - b. No
9. What other topics related to dental implants are covered in the didactic portion of your program? Please feel free to comment in the space provided: _____

LAB

10. Does your dental hygiene program include pre-clinical instruction within the laboratory setting to provide training for dental implant maintenance?
 - a. Yes
 - b. No (Proceed to Question 13)
11. Are typodonts with dental implants used during laboratory training to prepare students for clinical application of dental implant maintenance?
 - a. Yes
 - b. No
12. Is simulation training used to prepare students for clinical application of dental implant maintenance?
 - a. Yes
 - b. No

CLINICAL

13. Are students having direct clinical experiences with patients to maintain dental implants?
 - a. Yes
 - b. No (If no proceed to Question 25)

14. Approximately how many direct patient experiences with dental implant maintenance do students have throughout the program? Please specify the average number: _____
15. Does the dental hygiene curriculum at your institution require students to probe dental implants as part of the periodontal assessment in the clinical setting?
- a. Yes
 - b. No
16. Are students required to use radiographs to screen for peri-implant related diseases within the clinical setting?
- a. Yes
 - b. No
17. Are students required to assess risk factors for peri-implant related diseases within the clinical setting?
- a. Yes
 - b. No
18. Does the dental hygiene curriculum at your institution require students to produce a biofilm free surface around dental implants with ultrasonic instrumentation within the clinical setting?
- a. Yes
 - b. No
19. Does the dental hygiene curriculum at your institution require students to produce a biofilm free surface around dental implants with hand instruments within the clinical setting?
- a. Yes
 - b. No
20. Does the dental hygiene curriculum at your institution require students to produce a biofilm free surface around dental implants with air polishing within the clinical setting?
- a. Yes
 - b. No
21. Does the dental hygiene curriculum at your institution provide experiences related to irrigation with antiseptics around dental implants to promote peri-implant health within the clinical setting?
- a. Yes
 - b. No

22. Are students required to recommend homecare aids to patients with dental implants within the clinical setting?
- a. Yes
 - b. No
23. Are students required to teach patients how to use the recommended homecare aids to maintain dental implants within the clinical setting?
- a. Yes
 - b. No
24. Does your dental hygiene program require students to perform any clinical competencies related to dental implant maintenance within the clinical setting?
- a. Yes
 - b. No
- If Yes, please specify the competencies in the space provided:

BARRIERS

25. Are there barriers to educating students about dental implant maintenance?
- a. Yes
 - b. No (If no proceed to Question 31)
26. Is lack of trained faculty a barrier for dental implant maintenance instruction?
- a. Yes
 - b. No
27. Is lack of calibration among faculty a barrier for dental implant maintenance instruction?
- a. Yes
 - b. No
28. Is lack of time within the curriculum a barrier for dental implant maintenance instruction?
- a. Yes
 - b. No
29. Is a lack of patients with dental implants a barrier for dental implant maintenance instruction?
- a. Yes
 - b. No

30. Is a lack of funding a barrier for dental implant maintenance instruction?

- a. Yes
- b. No

CURRICULUM DEVELOPMENT

31. Will your program further develop the dental implant maintenance curriculum content in the next 5 years?

- a. Yes: Please explain your answer in the space provided
- b. No: Please explain your answer in the space provided

32. Should there be an accreditation requirement related to didactic instruction for dental implant maintenance within entry-level dental hygiene programs?

- a. Yes
- b. No

33. Should there be an accreditation requirement related to clinical instruction for dental implant maintenance within entry-level dental hygiene programs?

- a. Yes
- b. No

Please use the space below to provide any final comments related to accreditation requirements or curriculum development.

Thank you for taking the time to complete and return this survey by (date).

Appendix D

Survey and Permission Request

Dear JoAnn,

Thank you for interest in our article. Apologies for the delay in response. Please find attached the survey as requested. Our survey was transferred to an online questionnaire so there may be some very slight differences, but in the main, this is the survey. Please feel free to amend as necessary.

In answer to your question, the data we collected was qualitative and therefore it was not possible to undertake a statistical test to establish validity and reliability. I hope this helps and all the best with your project! I look forward to the results!

Regards

Miss Siew Chin
Consultant in Restorative Dentistry
jannsiewchin@yahoo.co.uk

Appendix E

Second Reminder Invitational Cover Letter

April 6, 2020

Dear Program Director,

We hope you are doing well amidst the COVID-19 crisis. We know that there are many issues that must be addressed during this busy time, yet we are hoping that you can take a few minutes to assist us with our research project.

Last week we sent you an invitation to participate in a survey related to dental implant maintenance in dental hygiene programs (IRB#-FY2020-218). As a reminder we are asking you or your clinic coordinator to complete this brief survey.

The survey will take approximately 10 minutes of your time to complete. By submitting this electronic survey, you are giving consent for the use and analysis of your responses. All responses will remain confidential, and the only risk is the time it takes to complete the short questionnaire.

If you have any questions regarding participation in this study, please do not hesitate to contact us. Thank you for completing this questionnaire by **Friday April 17th**.

The link for the survey is https://isu.co1.qualtrics.com/jfe/form/SV_9KwsKU4sOzky9yR

With sincere appreciation,

(Anna) Cherie Gentry, RDH, BS, MSDH(c)
Graduate Student at ISU

gentann2@isu.edu

JoAnn Gurenlian, RDH, MS, PhD, AFAAOM
Professor and Graduate Program Director
gurejoan@isu.edu

Jacqueline Freudenthal, RDH, MHE Professor
Chair, Dept. of Dental Hygiene
freujacq@isu

Appendix F

Third Reminder Invitational Cover Letter

April 20, 2020

Dear Program Director,

We know these are trying times navigating through the hurdles of COVID-19, but we are hopeful that you can take a few minutes to assist us with our research project. As a last call reminder, we invite you, or your clinic coordinator, to participate in a brief survey related to dental implant maintenance in dental hygiene programs (IRB#-FY2020-218).

The survey will take approximately 10 minutes of your time to complete. By submitting this electronic survey, you are giving consent for the use and analysis of your responses. All responses will remain confidential, and the only risk is the time it takes to complete the short questionnaire.

If you have any questions regarding participation in this study, please do not hesitate to contact us. Thank you for completing this questionnaire by **Monday April 27th**.

The link for the survey is https://isu.co1.qualtrics.com/jfe/form/SV_9KwsKU4sOzky9yR

With sincere appreciation,

(Anna) Cherie Gentry, RDH, BS, MSDH(c)
Graduate Student at ISU
gentann2@isu.edu

JoAnn Gurenlian, RDH, MS, PhD, AFAAOM
Professor and Graduate Program Director
gurejoan@isu.edu

Jacqueline Freudenthal, RDH, MHE Professor
Chair, Dept. of Dental Hygiene
freujacq@isu

Appendix G

Fourth Reminder Invitational Cover Letter

April 29, 2020

Dear Program Director,

Prior to the semester ending we need 10 minutes or less of your time to complete a brief survey on dental implant maintenance in dental hygiene programs (IRB-FY2020-218). The survey may be completed by you or your clinical coordinator. We truly value and need your feedback.

Thank you to all who have responded; however, the response rate has only increased from 11% to 14%. We were really hoping to hear from more of you. These results may help in standardizing implant education for students, so please consider taking the survey now.

You will also be eligible to enter into a raffle to win an Ultrasonic Implant Scaler.

Click here to take the survey now:

https://isu.co1.qualtrics.com/jfe/form/SV_9KwsKU4sOzky9yR

We have extended the survey to remain open until **Friday, May 8, 2020**.

If you have any questions regarding participation in this study, please do not hesitate to contact us. We appreciate your support in this education study!

(Anna) Cherie Gentry, RDH, BS, MSDH(c)

Graduate Student at ISU

gentann2@isu.edu

JoAnn Gurenlian, RDH, MS, PhD, AFAAOM Professor
and Graduate Program Director

gurejoan@isu.edu

Jacqueline Freudenthal, RDH, MHE Professor
Chair, Dept. of Dental Hygiene

freujacq@isu.edu

Appendix H

Fifth Reminder Invitational Cover Letter

May 6, 2020

Dear Program Director,

This is your final opportunity to provide feedback on our survey related to dental implant maintenance in dental hygiene programs. The survey closes on Friday. Please take 10 minutes or less to complete the survey or ask your clinic coordinator to do so. Your feedback will help standardize implant education for students.

Thanks to those of you who have participated. We have now reached a 24% response rate. We would like to hear from more of you!

You will also be eligible to enter into a raffle to win an Ultrasonic Implant Scaler.

Click here to take the survey now:

https://isu.co1.qualtrics.com/jfe/form/SV_9KwsKU4sOzky9yR

The survey will only remain open until **Friday, May 8, 2020**.

If you have any questions regarding participation in this study, please do not hesitate to contact us. We appreciate your support in this education study!

(Anna) Cherie Gentry, RDH, BS, MSDH(c)

Graduate Student at ISU

gentann2@isu.edu

JoAnn Gurenlian, RDH, MS, PhD, AFAAOM Professor

and Graduate Program Director

gurejoan@isu.edu

Jacqueline Freudenthal, RDH, MHE Professor

Chair, Dept. of Dental Hygiene

freujacq@isu.edu

Appendix I

Survey for Content Validity Index: Curriculum Content of Dental Implant Maintenance within Entry-Level Dental Hygiene Programs

Directions: Please rate each question based upon its relevance by highlighting your response in yellow and providing any comments that you may have. Your responses are greatly appreciated and highly valuable.

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

DEMOGRAPHICS

1. Are you the program director?
 - a. Yes
 - b. No

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

2. Are you a clinical coordinator?
 - a. Yes
 - b. No

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

3. What type of degree does your program offer?
- a. Associate/Certificate
 - b. Bachelors

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

DIDACTIC

4. Does your dental hygiene curriculum provide didactic instruction on dental implants?
- a. Yes
 - b. No (if no go to question 9)

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

5. Approximately how many contact hours are dedicated towards the didactic instruction of dental implants throughout the dental hygiene curriculum?
- a. Specify contact hours: _____

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

6. Does your dental hygiene curriculum provide didactic instruction on the assessment of peri-implant related diseases?
- a. Yes
 - b. No

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

7. Does your dental hygiene curriculum provide didactic instruction on professional implant maintenance?
- a. Yes
 - b. No

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

8. Does your dental hygiene curriculum include didactic instruction on at-home dental implant care?
- a. Yes
 - b. No

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

9. What other topics related to dental implants are covered in the didactic portion of your program? Please feel free to comment in the space provided: _____

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

LAB

10. Does your dental hygiene program include pre-clinical instruction within the laboratory setting to provide training for dental implant maintenance?
- Yes
 - No (Proceed to Question 13)

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

11. Does the laboratory training include the use of typodonts which contain dental implants and are used to prepare students for clinical application of dental implant maintenance?
- Yes
 - No

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

12. Is simulation training used to prepare students for clinical application of dental implant maintenance?

- a. Yes
- b. No

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

CLINICAL

13. Are students having direct clinical experiences with patients to maintain dental implants?

- a. Yes
- b. No (If no proceed to Question 27)

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

14. Approximately how many direct patient experiences with dental implant maintenance do students have throughout the program? Please specify the average number: _____

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

15. Does the dental hygiene curriculum at your institution require the students to probe dental implants within the clinical setting?

- a. Yes
- b. No

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

16. Does the dental hygiene curriculum at your institution require the students to evaluate radiographs to screen for peri-implant related diseases within the clinical setting?
- a. Yes
 - b. No

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

17. Does the dental hygiene curriculum at your institution require the students to evaluate risk factors for peri-implant related diseases within the clinical setting?
- a. Yes
 - b. No

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

18. Does the dental hygiene curriculum at your institution require the students to produce a biofilm free surface around dental implants with ultrasonic instrumentation within the clinical setting?
- a. Yes
 - b. No

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

19. Does the dental hygiene curriculum at your institution require the students to produce a biofilm free surface around dental implants with hand instruments within the clinical setting?
- Yes
 - No

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

20. Does the dental hygiene curriculum at your institution require the students to produce a biofilm free surface around dental implants with air polishing within the clinical setting?
- Yes
 - No

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

21. Does the dental hygiene curriculum at your institution provide experiences related to irrigation with antiseptics around dental implants to promote peri-implant health within the clinical setting?
- Yes
 - No

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

22. Are students required to recommend homecare aids to patients with dental implants within the clinical setting?
- a. Yes
 - b. No

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

23. Are students required to teach patients how to use the recommended homecare aids to maintain dental implants within the clinical setting?
- a. Yes
 - b. No

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

24. Is there a clinical competency related to the diagnostics of peri-implant related diseases within the clinical setting?
- a. Yes
 - b. No

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

25. Is there a clinical competency related to patient education and the use of homecare aids to promote peri-implant health?

- a. Yes
- b. No

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

26. Is there a clinical competency related to therapeutic services rendered to maintain dental implants within the clinical setting?

- a. Yes
- b. No

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

BARRIERS

27. Are there barriers to educating students about dental implant maintenance?

- a. Yes
- b. No (If no proceed to Question 33)

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

28. Is lack of trained faculty a barrier for dental implant maintenance instruction?

- a. Yes
- b. No

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

29. Is lack of calibration among faculty a barrier for dental implant maintenance instruction?

- a. Yes
- b. No

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

30. Is lack of time within the curriculum a barrier for dental implant maintenance instruction?

- a. Yes
- b. No

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

31. Is a lack of patients with dental implants a barrier for dental implant maintenance instruction?

- a. Yes
- b. No

How relevant is this question?

Not relevant
1

Somewhat relevant
2

Quite Relevant
3

Very Relevant
4

Comments:

32. Is a lack of resources/funding a barrier for dental implant maintenance instruction?

- a. Yes
- b. No

How relevant is this question?

Not relevant
1

Somewhat relevant
2

Quite Relevant
3

Very Relevant
4

Comments:

CURRICULUM DEVELOPMENT

33. Will your program further develop the dental implant maintenance curriculum content in the next 5 years?

- a. Yes Please explain your answer in the space provided
- b. No Please explain your answer in the space provided

How relevant is this question?

Not relevant
1

Somewhat relevant
2

Quite Relevant
3

Very Relevant
4

Comments:

34. Should there be an accreditation requirement related to didactic instruction for dental implant maintenance within entry-level dental hygiene programs?
- a. Yes
 - b. No

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

35. Should there be an accreditation requirement related to clinical instruction for dental implant maintenance within entry-level dental hygiene programs?
- a. Yes
 - b. No

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
1	2	3	4

Comments:

36. Please use the space below to provide any final comments related to accreditation requirements or curriculum development.

How relevant is this question?

Not relevant	Somewhat relevant	Quite Relevant	Very Relevant
--------------	-------------------	----------------	---------------

1

2

3

4

Comments:

Thank you for taking the time to complete this survey. Please return your CVI to me by **Friday, March 6th**.

Appendix J

Survey for Test-Re-Test Reliability: Curriculum Content of Dental Implant Maintenance within Entry-Level Dental Hygiene Programs

Directions: Please answer each question by highlighting your responses in yellow. Your responses are greatly appreciated and highly valuable. Please email your completed survey by (date).

DEMOGRAPHICS

1. Are you the program director?
 - a. Yes
 - b. No

2. Are you a clinical coordinator?
 - a. Yes
 - b. No

3. What type of entry-level dental hygiene degree does your program offer?
 - a. Associate/Certificate
 - b. Bachelors

DIDACTIC

4. Does your dental hygiene curriculum provide didactic instruction on dental implants?
 - a. Yes
 - b. No (if no go to question 10)

5. Approximately how many contact hours are dedicated towards the didactic instruction of dental implants throughout the dental hygiene curriculum?
 - a. Specify contact hours: _____

6. Does your dental hygiene curriculum provide didactic instruction on the assessment of peri-implant related diseases?
 - a. Yes
 - b. No

7. Does your dental hygiene curriculum provide didactic instruction on professional implant maintenance?
 - a. Yes
 - b. No
8. Does your dental hygiene curriculum include didactic instruction on at-home dental implant care?
 - a. Yes
 - b. No
9. What other topics related to dental implants are covered in the didactic portion of your program? Please feel free to comment in the space provided: _____

LAB

10. Does your dental hygiene program include pre-clinical instruction within the laboratory setting to provide training for dental implant maintenance?
 - a. Yes
 - b. No (Proceed to Question 13)
11. Are typodonts with dental implants used during laboratory training to prepare students for clinical application of dental implant maintenance?
 - a. Yes
 - b. No
12. Is simulation training used to prepare students for clinical application of dental implant maintenance?
 - a. Yes
 - b. No

CLINICAL

13. Are students having direct clinical experiences with patients to maintain dental implants?
 - a. Yes
 - b. No (If no proceed to Question 25)
14. Approximately how many direct patient experiences with dental implant maintenance do students have throughout the program? Please specify the average number: _____

15. Does the dental hygiene curriculum at your institution require students to probe dental implants as part of the periodontal assessment in the clinical setting?
- a. Yes
 - b. No
16. Are students required to use radiographs to screen for peri-implant related diseases within the clinical setting?
- a. Yes
 - b. No
17. Are students required to assess risk factors for peri-implant related diseases within the clinical setting?
- a. Yes
 - b. No
18. Does the dental hygiene curriculum at your institution require students to produce a biofilm free surface around dental implants with ultrasonic instrumentation within the clinical setting?
- a. Yes
 - b. No
19. Does the dental hygiene curriculum at your institution require students to produce a biofilm free surface around dental implants with hand instruments within the clinical setting?
- a. Yes
 - b. No
20. Does the dental hygiene curriculum at your institution require students to produce a biofilm free surface around dental implants with air polishing within the clinical setting?
- a. Yes
 - b. No
21. Does the dental hygiene curriculum at your institution provide experiences related to irrigation with antiseptics around dental implants to promote peri-implant health within the clinical setting?
- a. Yes
 - b. No

22. Are students required to recommend homecare aids to patients with dental implants within the clinical setting?
- a. Yes
 - b. No
23. Are students required to teach patients how to use the recommended homecare aids to maintain dental implants within the clinical setting?
- a. Yes
 - b. No
24. Does your dental hygiene program require students to perform any clinical competencies related to dental implant maintenance within the clinical setting?
- a. Yes
 - b. No
- If Yes, please specify the competencies in the space provided:

BARRIERS

25. Are there barriers to educating students about dental implant maintenance?
- a. Yes
 - b. No (If no proceed to Question 31)
26. Is lack of trained faculty a barrier for dental implant maintenance instruction?
- a. Yes
 - b. No
27. Is lack of calibration among faculty a barrier for dental implant maintenance instruction?
- a. Yes
 - b. No
28. Is lack of time within the curriculum a barrier for dental implant maintenance instruction?
- a. Yes
 - b. No
29. Is a lack of patients with dental implants a barrier for dental implant maintenance instruction?

- a. Yes
- b. No

30. Is a lack of funding a barrier for dental implant maintenance instruction?

- a. Yes
- b. No

CURRICULUM DEVELOPMENT

31. Will your program further develop the dental implant maintenance curriculum content in the next 5 years?

- a. Yes Please explain your answer in the space provided
- b. No Please explain your answer in the space provided

32. Should there be an accreditation requirement related to didactic instruction for dental implant maintenance within entry-level dental hygiene programs?

- a. Yes
- b. No

33. Should there be an accreditation requirement related to clinical instruction for dental implant maintenance within entry-level dental hygiene programs?

- a. Yes
- b. No

Please use the space below to provide any final comments related to accreditation requirements or curriculum development.

Thank you for taking the time to complete and return this survey by (date).