

Peri-Implant Disease Education and Diagnosis in the Pre-Doctoral Curriculum

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This thesis is dedicated to my parents, Dr. Abdel-Karim Shaltoni and Mariam Elizabeth Shaltoni, my late grandparents Jose and Josephina Encarnacion, and my loving wife, Ariane Ganza. Thank you for all the support you have given me throughout my career. I would not be where I am at without you all.

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LIST OF ABBREVIATIONS

AAP – American Academy of Periodontics

BOP – Bleeding on Probing

CAL Clinical Attachment Loss

CIST- Cumulative Interceptive Supportive Therapy

CODA – Commission on Dental Accreditation

D1 – Dental student year 1

D2 – Dental student year 2

D3 – Dental student year 3

D4 – Dental student year 4

GI- Gingival Index

OHI – Oral Hygiene Instructions

PIMT -- Peri-Implant Maintenance Therapy

PD- Probing Depth

USA – United States of America

SUMMARY

The success and widespread use of dental implants in clinical practice along with the concomitant increase in peri-implant disease has precipitated the need to update dental implant education in the USA. This requires improvements in didactics and curriculums in dental schools to prepare dental students for clinical situations pertaining to peri-implant diseases. The objective of this study is to assess how Periodontics Pre-Doctoral Programs in the USA educate dental students to diagnose and classify peri-implant diseases and to determine if a current standard of teaching exists. Surveys were distributed to pre-doctoral program directors across 57 dental schools in the USA via a secure online survey system. The survey consisted of 19 questions pertaining to curriculum structure involving the teaching and diagnosis of peri-implant diseases. A total of 25 program directors (44%) responded and data was analyzed using descriptive statistics. The results indicate that there is no standard curriculum to teach and diagnose peri-implant diseases to dental students among respondents. Without standardized content, heterogeneity exists among dental schools and creates a divergence in dental education. In addition, patients may be more at risk of disease development without standardization and communication between practitioners may be confusing.

I. INTRODUCTION

A. Background

Within the past three decades, dental implants have become the gold standard to replace compromised teeth or address partial or full edentulism. Success rates have been excellent for the past 10 to 15 years approximating the 90th percentile (Moraschini et al., 2015). However, implants are still subject to peri-implant diseases as is the natural dentition. In a study by Mombelli et al. pathogenic bacteria that colonize implants were found to be similar to natural dentition with periodontal pockets (Mombelli et al., 1995). Complimentary studies performed by Pontoriero et al. induced peri-implant mucositis in humans demonstrating a cause-and-effect relationship between bacterial plaque accumulation and development of peri-implant disease. This study provided evidence that plaque accumulation around dental implants leads to increased gingival index (GI), probing depths (PD), and inflammation (Pontoriero et al., 1994). Peri-implantitis models are difficult to reproduce in humans, therefore animal models are used instead. Lang et al. and Schou et al. provided evidence that heavy plaque accumulation and sufficient exposure to bacteria, leads to peri-implant clinical attachment loss (CAL) as well as clinical and radiographic bone loss in monkeys (Lang et al. 1993 and Schou et al, 1993). Peri-implantitis, however, may not develop in all peri-implant sites with mucositis, just as periodontitis may not develop in all sites with gingivitis. To that end, the periodontal community has created analogous similarities of peri-implant mucositis to gingivitis and peri-implantitis to periodontitis (Heitz-Mayfield et al., 2010).

Even with background knowledge of these diseases, clinical studies have provided diverse diagnostic and clinical definitions of peri-implant diseases at the beginning to standardize readers. Behneke et al. describes peri-implantitis to have the following: clinical inflammation

bleeding, redness swelling, pus and continued bone loss (Behneke et al., 2002a). Ekelund et al. suggests that peri-implantitis is a combination of inflammation, pain, and bone loss (Ekelund et al., 2003a). Albrektsson et al. proposed that peri-implantitis leads to marginal bone loss around an implant due to the presence of a foreign body reaction (Albrektsson et al., 2016a). Sanz and Chapple defined peri-implantitis as presence of bone loss greater than or equal to 2mm compared to the radiograph taken at the time of prosthetic replacement, bleeding on probing, and probing depths greater than or equal to 5mm (Sanz and Chapple, 2012a). These studies highlight the lack of standardization, which present challenges to areas such as epidemiology and dental education. In a systematic review by Rakic et al., the Sanz and Chapple definition was utilized to examine the frequency of peri-implantitis. They reported that the prevalence of peri-implantitis was higher at the patient level (18.5%) compared to the implant level (12.5%) (Rakic et al., 2018). Yet, the disease prevalence varies greatly with more than 50% variation depending on the case definition being used (Derks et al., 2015). Thus, emphasis should focus on the use of a strict case definition to minimize heterogeneity of studies and definitions (Tomasi et al., 2012).

The adoption of the 2017 World Classification has implemented definitions for both clinical and case descriptions of peri-implant health and disease: “Peri-implant health is defined and characterized by absence of erythema, bleeding on probing (BOP), swelling and suppuration supplemented by no visual differences between peri-implant and periodontal tissues (Berglundh et al., 2018a).” However, a key difference between natural teeth and peri-implant probing depths is that healthy peri-implant tissues can present with deeper probings. Additionally, peri-implant health can be present on a reduced bone support. Peri-implant mucositis is defined as “bleeding on gentle” probing, erythema, swelling and/or suppuration. Clinical signs of inflammation are required for the diagnosis of peri-implant mucositis. An increase in probing depth can be

observed in peri-implant mucositis because of swelling or decrease in probing resistance”

(Berglundh et al., 2018b). Lastly, peri-implantitis is “a plaque associated pathological condition in tissues around dental implants, characterized by inflammation in the peri-implant mucosa with progressive bone loss. Clinical signs include inflammation, BOP and/or suppuration, increased PDs and/or recession of the mucosal margin in addition to radiographic bone loss compared to previous examinations. At sites presenting with peri-implantitis, probing depth is correlated with bone loss and is an indicator for disease severity. Recognition of bone loss progression may vary between patients” (Berglundh et al., 2018c). TABLE I presents case definitions and diagnostic considerations as proposed by the classification.

TABLE I. PERI IMPLANT HEALTH AND PERI IMPLANT DISEASE CASE DEFINITIONS AND DIAGNOSTIC CONSIDERATIONS	
Peri-implant Health	<ul style="list-style-type: none"> • Absence of clinical signs of inflammation • Absence of bleeding and/or suppuration on gentle probing • No increase in probing depth compared to previous examinations • Absence of bone loss beyond crestal bone level changes resulting from initial bone remodeling
Peri-Implant Mucositis	<ul style="list-style-type: none"> • Presence of bleeding and/or suppuration on gentle probing with or without increased probing depth compared to previous examinations • Absence of bone loss beyond crestal bone levels changes resulting from initial bone remodeling
Peri-Implantitis	<ul style="list-style-type: none"> • Presence of bleeding and/or suppuration on gentle probing • Increased probing depth compared to previous examinations • Presence of bone loss beyond the crestal bone level changes resulting from initial bone remodeling. <p>However, the absence of previous examination data diagnosis of peri-implantitis can be based on the combination of:</p> <ul style="list-style-type: none"> • Presence of bleeding and/or suppuration on gentle probing • Probing depths $\geq 6\text{mm}$ • Bone levels $\geq 3\text{mm}$ apical of the most coronal portion of the intraosseous part of the implant.

(Renvert et al., 2018)

Currently, there is limited information as to how peri-implant disease education is provided to dental students as current research focuses on implant placement and restoration. This topic is important as dental implant education continues to grow within universities and as more clinicians train to place and restore dental implants. Literature by Parrish et al. stated that Creighton University has no postdoctoral residency programs and that students are trained to place and restore implants. During a three-year period, they reported that in one year a total of 242 implants were placed of which 6 failed and were removed. This led to a 97.5% success rate. However, no information was provided as to how many implants were diagnosed with peri-implant disease (Parrish et al., 2013a). Yuan et al. utilized a questionnaire to query dental students about their plans to continue implant education after dental school. Most students planned to offer implant services (62-68%) after graduation whether it involved diagnostic treatment planning, single tooth implants, or implant overdenture (Yuan et al., 2011a). However, none of these studies discuss educational needs to address peri-implant disease diagnosis and management.

The Commission on Dental Accreditation (CODA) is responsible for accrediting dental and dental-related education programs in USA dental schools structure their programs based on a standardized process and requires orientation and inspection every seven years for pre-doctoral programs. Currently under the standard educational program for pre-doctoral programs, CODA states that, “dental students must be competent in providing oral health care within the scope of general dentistry, as defined by the school” (Commission of Dental Accreditation, 2020a). These include a multitude of subsections including: diagnosis, prevention, restorative, periodontics, and endodontics, and emergencies situations. More specifically, the restorative portion includes fixed, removable and dental implant prosthodontic therapies. Currently, requirements do not

specifically mention peri-implant conditions, but can be generalized under subsections recognizing the complexity of patient treatment, identifying when referral is indicated, health promotion and disease prevention. Thus, peri-implant disease may be taught at a minimum with more focus on prosthetic implant restorations as defined in the restorative minimum requirements (Commission of Dental Accreditation, 2020b).

Understanding that there is a disparity in peri-implant disease definitions and a gap in implant education, this study aims to assess how dental students are taught and trained to diagnose peri-implant diseases. In addition, it will determine if a current teaching standard of pre-doctoral students exists or if one needs to be established.

B. Statement of the problem

Currently, there are gaps in knowledge on the topic of peri-implant disease education in the pre-doctoral curriculum in dental schools in the USA. An identified problem is the definition of peri-implant diseases is heterogenous and varies in didactic and clinical training methods among dental schools.

C. Purpose of study

The purpose of this study is to assess how pre-doctoral periodontal programs in the USA are educating their dental students regarding the classification and diagnosis of peri-implant diseases. Secondly, to determine if a current standard of teaching exists or if one needs to be established.

D. Significance of the Problem

There is limited data regarding the teaching methods used in the diagnosis of peri-implant

diseases at dental schools in the USA . This creates issues with standardization of information and care as dental students graduate and become oral health care providers. Lack of standardization can lead to misdiagnosis and the inability to refer for appropriate treatment when needed.

E. Significance of the Study

This study fills gaps in knowledge regarding how pre-doctoral program directors in the USA teach dental students to diagnose peri-implant diseases. It also grants the ability to collect data and determine if a standard method of teaching exists or if one needs to be established.

F. Aim/Objectives

The objectives of this study are to assess how pre-doctoral programs structure their curriculums to teach and diagnose peri-implant diseases to dental students and to determine if a current standard of teaching exists.

II. CONCEPTUAL FRAMEWORK AND RELATED LITERATURE

A.) Peri-Implant Disease Definitions

Authors of clinical research studies provide definitions and parameters to help readers become acquainted with the results, interpret data, and understand the outcomes of the study. However, frequent deviations in parameters between studies can create confusion and lack of understanding regarding disease definitions. For example, Behneke et al. describes peri-implantitis to have the following: clinical inflammation bleeding, redness swelling, pus and continued bone loss (Behneke et al, 2002b). Ekelund et al. suggests that peri-implantitis is a combination of inflammation, pain, and bone loss (Ekelund et al., 2003b). Albrektsson et al. proposed that peri-implantitis leads to marginal bone loss around an implant due to the presence of a foreign body reaction (Albrektsson et al., 2016b). Sanz and Chapple defined peri-implantitis as presence of bone loss greater than or equal to 2mm compared to the radiograph taken at the time of prosthetic replacement, positive bleeding on probing, and probing depths greater than or equal to 5mm (Sanz and Chapple, 2012b). The inconsistencies in definitions can lead to discrepancies in diagnosing disease. More recently, the 2017 World Workshop Classification introduced and defined parameters for peri-implant health and disease. This was defined as follows:

“Peri-implant health is characterized by absence of erythema, bleeding on probing, swelling and suppuration. Peri-implant mucositis is bleeding on gentle probing, erythema, swelling and/or suppuration which may be present. Clinical signs of inflammation are necessary for a diagnosis of peri-implant mucositis. Peri-implantitis is a plaque-associated pathologic condition occurring in tissues around dental implants, characterized by inflammation in the peri-implant mucosa and subsequent progressive loss of supporting bone. Peri-implantitis exhibits signs of clinical inflammation, BOP and or/suppuration, increased probing depths, and/or recession of the mucosal margin in addition to radiographic bone loss compared to previous examinations. Sites presenting with peri-implantitis should correlate probing depths and bone loss as an indicator for severity of disease” (Berglundh et al., 2018d).

When accepted by clinicians and researchers, properly defined characteristics for peri-implant health and disease can help facilitate standardization and reference.

B.) Educational Literature Focusing on Implant Placement and Restoration

Current educational research focuses on implant placement and the restorative process in the pre-doctoral curriculum. Kroeplin and Strub performed a worldwide literature study on the application of implant dentistry in the undergraduate curricula and provided 25 publications between 1974 and 2006. They reported that the percentage of dental schools incorporating implant dentistry in the USA increased from 51% in 1974 to 97% in 2006. All curricula included lectures (1 to 20 hours) and laboratory courses (30% to 42%) with varying levels of clinical experience between surveyed universities (Kroeplin and Strub, 2011a). In the second part of their study, students completed 28 hours of didactic lectures and 64 hours of hands-on clinical seminars. Furthermore, students placed and restored implants as the study continued. Over the duration of two and half years, students treated 51 patients with 97 dental fixtures in the undergraduate program. Seventy-one implants were restored with either single crowns, fixed dental prostheses, overdentures, or a telescopic removable dental prostheses on remaining teeth and placed additional implants. The implant survival rate was approximately 98.9% (Kroeplin and Strub, 2011a). The focus of this study was the student's ability to place implants and restore them at a level similar to an experienced dentist. However, the short duration (< 2 years follow up) poses as a limitation as it does not allow for a long-term evaluation of implant complications, survival and success (> 5 years).

Additional research by Katsaros et al. provided data on student exposure to periodontal and implant placement surgeries at dental schools in USA. It was reported that 97% and 45.5%

of schools allow students to perform periodontal and implant surgery, respectively. However, the actual percentage of surgeries completed by students were 26.4% of periodontal surgeries and of 15.4% implant surgeries. Factors that affected these percentages were the presence and size of a periodontal residency program. If a program was available, there was a negative correlation associated with dental students performing surgery and placing implants (Katsaros et al. 2019). Supporting research on the growth of implant dentistry in universities was performed by Kihara et al. who investigated how North American schools structure their implant curriculum. Administrators responsible for the pre-doctoral curriculum were surveyed in which 64% of participants responded. students completed an average of 1.85 restorative cases and 0.61 surgical cases. Students additionally observed or assisted in implant surgeries and continued with the restorative phase. Challenges identified in establishing a comprehensive plan include the expense of implant systems to the schools and patients, suitable predoctoral cases, and lack of curriculum time and trained faculty. The authors concluded that implant education will continue to expand with trends towards more preclinical exercises and preclinical training and less didactic courses (Kihara et al., 2017).

III. MATERIALS AND METHODS

A.) Study Design

This study was approved by the Institutional Review Board at the University of Illinois at Chicago (2018-0756). An online survey was developed and designed in August 2017 in which 57 surveys were distributed to periodontics pre-doctoral program directors in dental schools in the USA via an online survey system (Qualtrics, SAP America Inc. company, UT, WA, USA). Institutional e-mail program director information was provided by the American Academy of Periodontology (AAP, Chicago, IL, USA). The list of pre-doctoral program directors revealed either a solo position as pre-doctoral program director or combination of pre-doctoral program director and postdoctoral program director and/or chair. Inclusion/exclusion criteria is defined below. A recruitment letter was developed explaining the purpose of the survey and reaffirming study confidentiality. Data collection consisted of three attempts over a six-month period. Reminder emails were distributed through Qualtrics. The survey consisted of 19 multiple choice, fill in the blank, and short answer questions. The questionnaire collected information based on educational content such as lectures, hours, examinations, and types of disciplines providing content. Questions associated with pre-clinical curriculum were based on training through implant workshops/ implant demonstration, year of dental training, clinical parameters (PD, BOP, suppuration, radiographs, etc.) and classifications utilized. Clinical questions evaluated ability to diagnose peri-implant diseases, how data is collected and interpreted, referral, treatment, case follow up, and maintenance/intervals. Survey questions are listed in TABLE II. Data collection was kept anonymous to which respondents were de-identified and given a numerical number for record keeping. In addition, all data responses were protected and de-identified via the Qualtrics system.

TABLE II. LIST OF SURVEY QUESTIONS

Number	Questions	Multiple Choice Answers
Q-1	Do the students in your program receive lectures on peri-implant mucositis and peri-implantitis?	a. Yes b. No
Q-2	In what year(s) of the program do the dental students receive lectures on peri-implant mucositis and peri-implantitis? (please check all that apply)	a. D1 b. D2 c. D3 d. D4
Q-3	How many hours of didactic education do the students receive on peri implant mucositis and peri-implantitis in the pre-doctoral curriculum?	a. 1-2 hours b. 3-4 hours c. ≥ 5 hours
Q-4	Do your students receive hands on pre-clinical implant experience? (i.e. implant workshops/company demos)	a. Yes b. No
Q-5	In what year(s) of the program do the dental students receive hands on pre-clinical implant experience? (please check all that apply)	a. D1 b. D2 c. D3 d. D4
Q-6	What discipline(s) teaches the peri-implant mucositis and peri-implantitis curriculum in the pre-doctoral program? (please check all that apply)	a. Oral Surgery b. Periodontics c. Prosthodontics d. Restorative e. None of the above f. Other, please list:
Q-7	What outcome measures are used to determine student knowledge on peri-implant mucositis and peri-implantitis? (please select all that apply)	a. Written exam b. Oral exam c. Pre-clinical simulation OSCE d. Clinical Patient Based Exam e. None of the above f. Other, please list:

TABLE II. LIST OF SURVEY QUESTIONS

Number	Questions	Multiple Choice Answers
Q-8	How would you rate your student's ability in recognizing and diagnosing Peri-implant mucositis and peri-implantitis on a patient?	<ul style="list-style-type: none"> a. Above average b. Somewhat above average c. Average d. Somewhat below average e. Below average
Q-9	What clinical parameters are taught to students to diagnose peri-implant mucositis? (please check all that apply)	<ul style="list-style-type: none"> a. Clinical signs of gingival inflammation: erythema and edema b. Suppuration c. Probing depth d. Bleeding on gentle probing e. Radiographs f. Other, please list:
Q-10	What clinical parameters are taught to students to diagnose peri-implantitis? (please check all that apply)	<ul style="list-style-type: none"> a. Clinical signs of gingival inflammation: erythema and edema b. Suppuration c. Probing depth d. Bleeding on gentle probing e. Radiographs f. Other, please list:
Q-11	What classification system are your students using to diagnose peri-implant diseases?	<ul style="list-style-type: none"> a. Name the specific classification or systems: b. No specific classification utilized
Q-12	Are pre-doctoral students treating peri-implant diseases in the pre-doctoral clinics?	<ul style="list-style-type: none"> a. Yes, they are treating peri-implant diseases b. No, they are not treating peri-implant diseases c. Other, please list:
Q-13	What type of peri-implant disease is being treated by the students in the pre-doctoral clinic?	<ul style="list-style-type: none"> a. Peri-implant mucositis b. Peri-Implantitis c. Both
Q-14	At what stage of peri-implant disease do your students refer patients to the specialist?	<ul style="list-style-type: none"> a. Peri-implant mucositis b. Peri-Implantitis c. None of the above

TABLE II. LIST OF SURVEY QUESTIONS

Number	Questions	Multiple Choice Answers
Q-15	After the referral is made to the specialist, do the students continue to participate in patient care with the specialist?	a. Yes b. No c. If yes, in what ways:
Q-16	Who follows up with the patient's maintenance care after treatment by the specialist has been completed? (Please check all that apply)	a. Dental student b. Specialist c. Dental hygienist d. Other, please list:
Q-17	At what interval are the patients seen for the implant maintenance appointment post crown delivery?	a. 3 months b. 4 months c. 6 months d. Other, please list:
Q-18	What type of a probe is used to evaluate the peri implant soft tissue?	a. Stainless steel probe b. Plastic probe c. Other, please list:
Q-19	At what time interval are the radiographs updated for patients with implants?	a. 6 months b. 1 year c. Other, please specify:

B.) Inclusion/ Exclusion Criteria

Inclusion criteria consisted of current periodontics pre-doctoral directors of accredited dental schools in the USA. Exclusion criteria include previous pre-doctoral directors, periodontics program department chairs, periodontics post-doctoral directors, periodontics faculty, staff, and adjuncts. Exceptions were made if pre-doctoral directors were also department chairs and post-doctoral program directors.

C.) Data Collection

Survey collection began in August 2018 in which surveys were sent to 57 program directors. Three sets of follow up emails were sent over a six-month period. Each email period had a time limit of 3 weeks before the survey closed and a subsequent survey sent out at a later date. Data collection stopped after the third attempt. Program directors that did not respond after a third request were classified as non-responders. All respondents were de-identified and assigned a number. Data was stored on Qualtrics under a secure login and password.

D.) Data Analysis and Interpretation

The raw data from the survey was compiled and recorded on Qualtrics and converted to MS Excel. Descriptive statistics by frequencies tables with the bar graphs investigated the distribution of the proportions of the response by question and Chi-Square test was used when appropriate. Statistical significance was set at 0.05. The software IBM SPSS Statistician for Windows (Version 22.0, IBM Corp, Armonk, NY, USA) was used for data analysis. Data was presented in tables and histograms.

IV. RESULTS

A total of 57 electronic surveys were sent to USA pre-doctoral periodontics program directors in which 28 surveys were started (49%) and 25 completed (44%). Of those completed, 19 questions were answered completely. All participants responded “yes” (100%) when questioned about their dental students receiving lectures on peri-implant mucositis and peri-implantitis. The year (D) in which students received lectures varied among D1-D4 years. Survey results revealed D3 students received the most lectures (45.45%) followed by D2 (27.27%), D4 (15.91%), and D1 (11.36%) students. Figure 1 depicts the frequency of choices as participants selected multiple options. The hours of didactic education students received was between 1-2 hours (56%), 3-4 hours (36%), and ≥ 5 hours (8%).

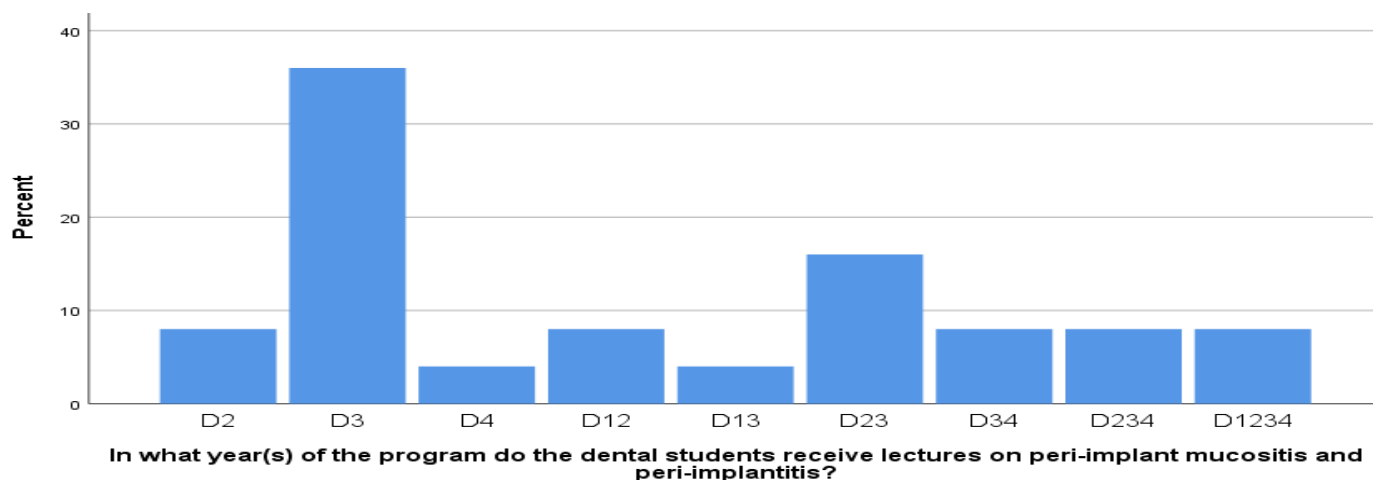
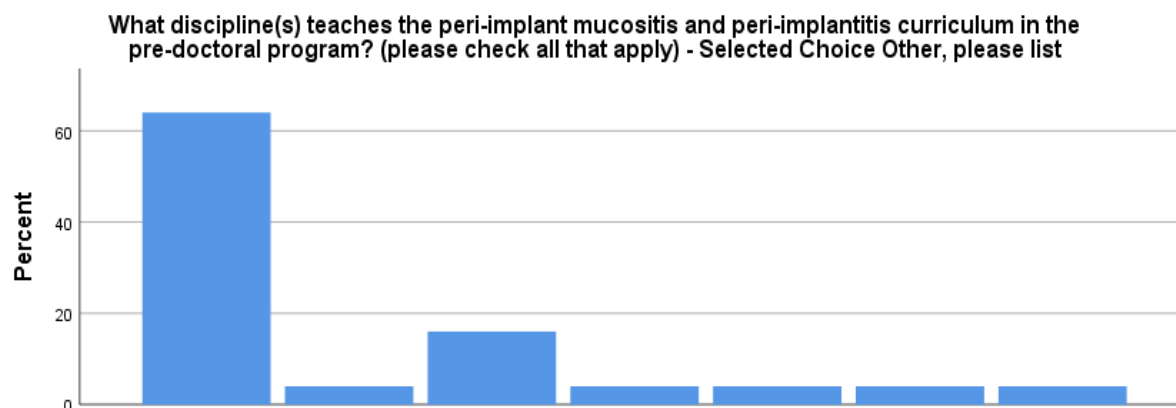


Figure 1. Survey response based on year of dental training students received lectures on peri-implant mucositis and peri-implantitis. The mode indicated D3 students were the most frequent followed by D2 students.

When asked if students received hands-on pre-clinical implant experiences (implant workshops/demonstration), 88% of program directors responded positively. These experiences were distributed between D2 (32%) and D3 (32%). All other responses were a combination of

D1, D2, D3, and D4 students. When questioned which disciplines teach peri-implant diseases, 62% stated “periodontics” and 16% stated a combination of “prosthodontics” and “periodontics departments”. Other options included a combination of “periodontics”, “oral surgery”, “prosthodontics”, and “restorative” disciplines (**Figure 2**).



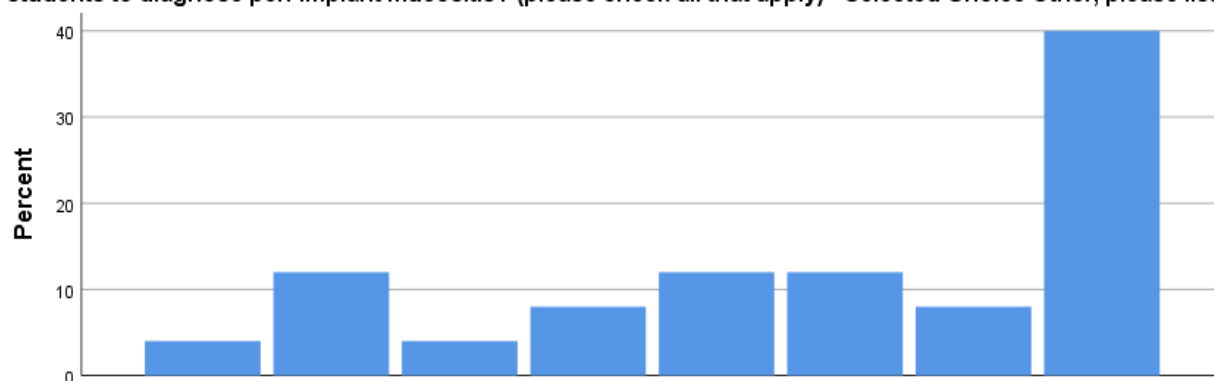
Periodontics	+	+	+	+	+	+	+
Oral Surgery	-	+	-	-	+	+	+
Prosthodontics	-	-	+	-	+	-	+
Restorative	-	-	-	+	-	+	+

Figure 2. Responses based on disciplines providing educational content on peri-implant mucositis and peri-implantitis. Periodontics was the most with a 62% response followed by Prosthodontics 16%.

Outcome measures used to assess students’ knowledge of peri-implant diseases included written examinations (56%), written/clinical examinations (16%), and written/oral examinations (12%). When asked to assess students’ abilities to recognize and diagnose peri-implant mucositis and peri-implantitis, 48% of program directors classified abilities as “average” while 36%

responded “somewhat above average”. Questions pertaining to clinical parameters used to diagnose peri-implant diseases included the following: 40% of respondents stated peri-implant mucositis diagnosis must include clinical signs of gingival inflammation, suppuration, probing depths, bleeding upon probing, and radiographs (**Figure 3**).

What clinical parameters are taught to students to diagnose peri-implant mucositis? (please check all that apply) - Selected Choice Other, please list

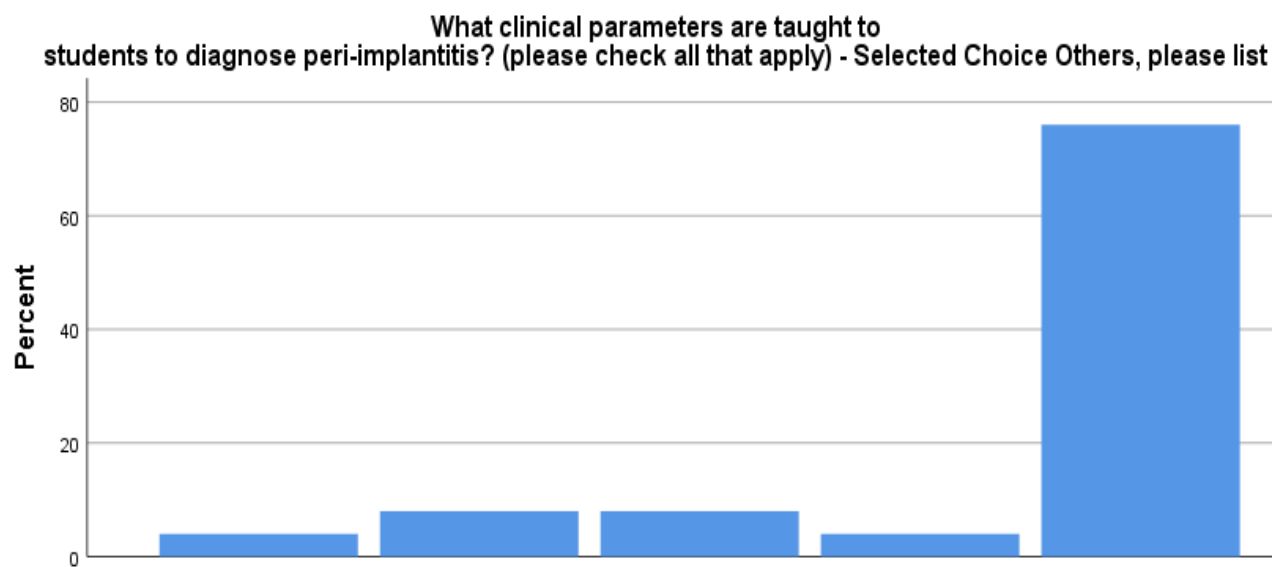


Inflammation	-	+	+	+	+	+	+	+
Bleeding	-	+	+	+	+	+	+	+
Suppuration	-	-	+	-	+	+	-	+
Probing Depth	+	-	-	-	+	-	+	+
Radiographs	-	-	-	+	-	+	+	+

Figure 3 – Clinical parameter responses used to diagnose and teach peri-implant mucositis to dental students.

Clinical signs of gingival inflammation, suppuration, probing, BOP, and radiographs were the most common response (40%).

While 76% of respondents stated that peri-implantitis must include clinical signs of gingival inflammation, suppuration, probing depths, bleeding upon probing and radiographs **(Figure 4)**.



Inflammation	-	+	+	+	+
Bleeding on Probing	-	+	+	+	+
Suppuration	-	-	+	-	+
Probing Depth	-	-	-	+	+
Radiographs	+	+	+	+	+

Figure 4 – Clinical parameter responses used to diagnose and teach peri-implantitis to dental students. Clinical signs of gingival inflammation, suppuration, probing, BOP, and radiographs were the most common response (76%).

Specific questions about which classification is utilized to diagnose peri-implant diseases found that 44% of respondents stated that they were using a specific classification system and 56% stating no specific classification is being taught. Chi-square analysis revealed that this was not statistically significant ($P > .5$). Specific classifications identified were the 2017 World Workshop Classification ($N=10$) and the AAP Positional Paper ($N=1$) (**Figure 5**). The use of a classification system in pre-doctoral curriculums was not statistically significant ($P=0.549$)

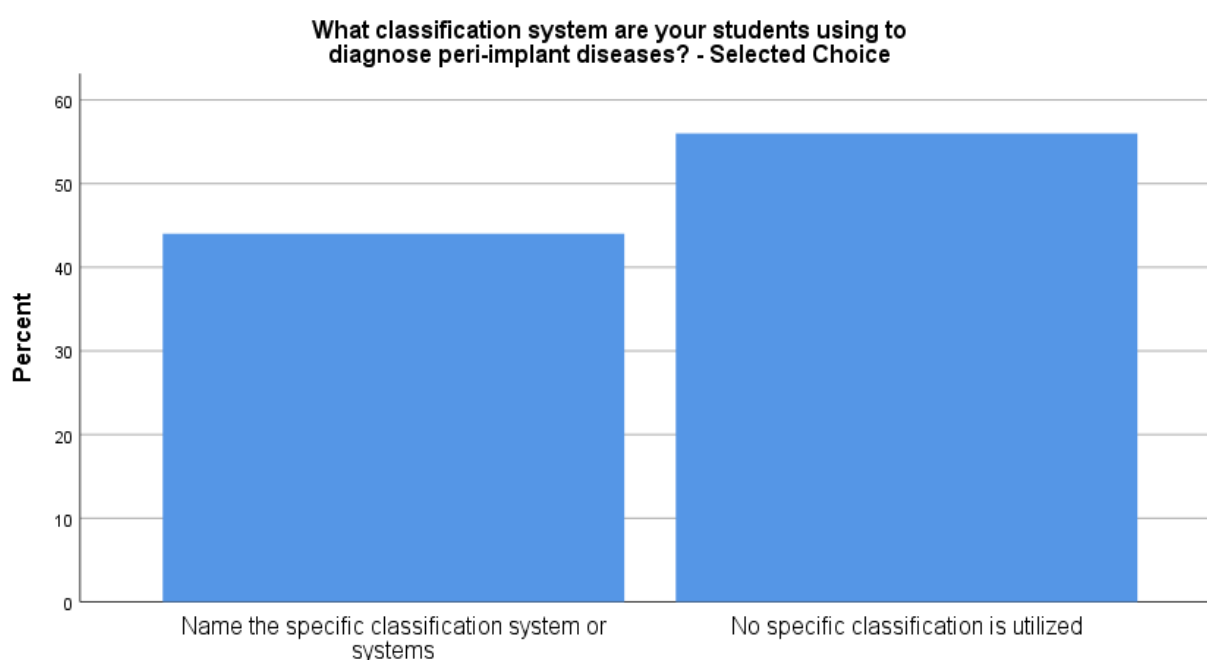


Figure 5 – Bar graph depicting the response to classifications utilized in pre-doctoral curriculums. Use of a classification system was not statistically significant ($p=0.549$).

When questioned if students were treating peri-implant diseases in the pre-doctoral clinics, 80% of program directors responded “yes”. Specifically, program directors reported that 78% of their students were treating peri-implant mucositis, 22% were treating both peri-implant mucositis and peri-implantitis, and no students were treating peri-implantitis alone. Chi-Squared test revealed that there is statistically significant difference in the distribution of the type of peri-

implant disease being treated by students in the pre-doctoral (p-value=0.007) (**Figure 6**). When asked what cases are referred to a specialist or residency programs to treat peri-implant diseases, 92% responded peri-implantitis and 8% peri-implant mucositis (**Figure 7**). At this point, 84% of program directors responded that students continue to participate in the treatment of patients through surgical assisting and/or maintenance methods, and 16% of program directors stated that students did not continue with care after being referred.

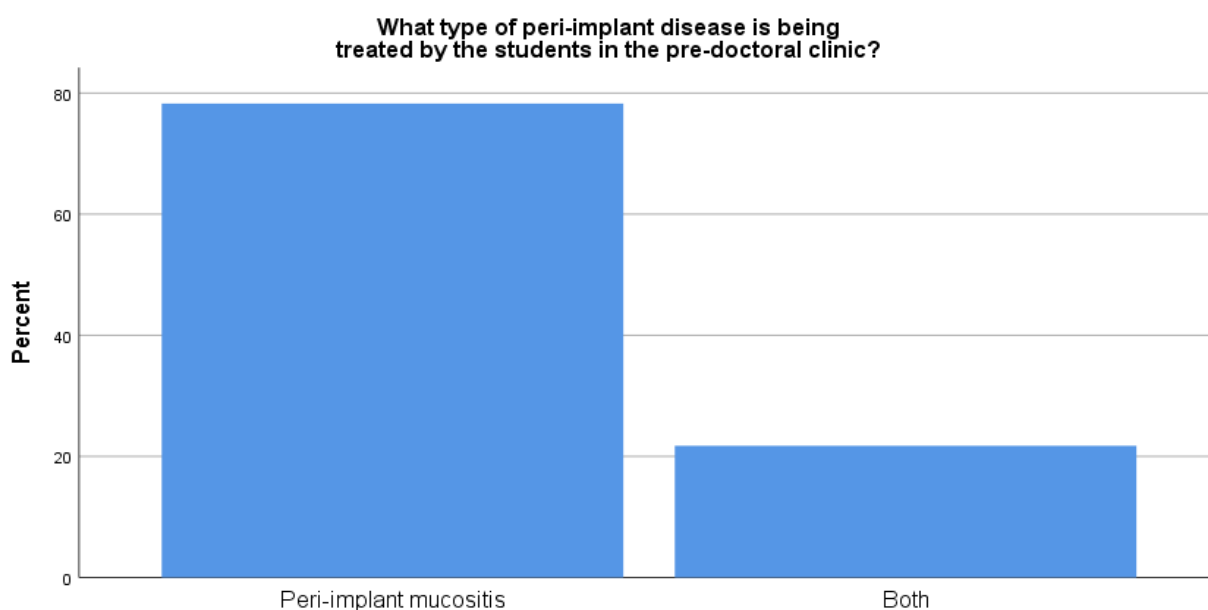


Figure 6 – Percentage of students treating peri-implant diseases. Seventy eight percent of directors stated that students were treating peri-implant mucositis and 22% were treating both peri-implant mucositis and peri-implantitis. No programs indicated that students were treating peri-implantitis alone.

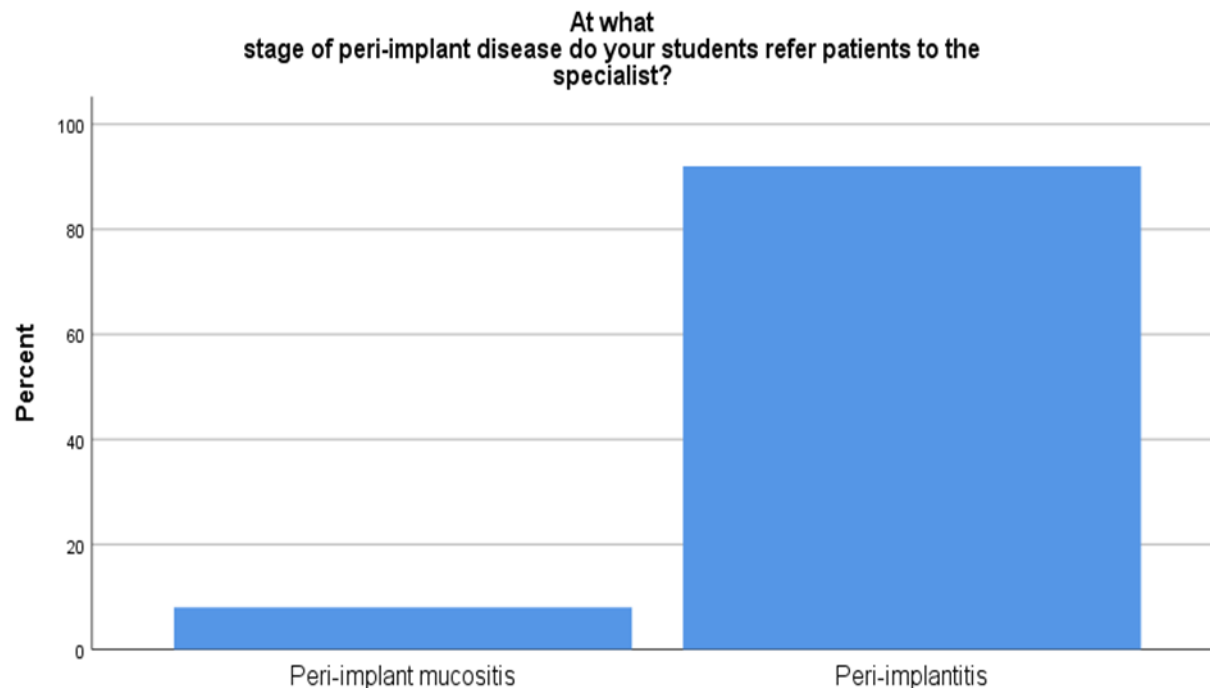


Figure 7 – Percentage of students referring implant diseases to specialist. Ninety two percent of directors stated that students were referring peri-implantitis and 8% were referring peri-implant mucositis.

When asked who follows up with maintenance care after treatment, 25% stated the dental students, 21% stated a combination of dental students, specialists and hygienists, 17% stated the specialist, 17% stated a combination of the dental students and specialist, and 17% stated a combination of the dental students and hygienists. Maintenance interval questions reported that patients seen for implant maintenance post crown delivery included, 3-month maintenance (36%), 4-month maintenance (20%), 6-month maintenance (16%), and (28%) responded “other”. Responses from other included: Depending on patient’s needs or 3-4 months during the first year, and 6 months after the first year.

When asked what type of probe is used to evaluate peri-implant soft tissue, 32% responded stainless steel probes, 52% responded plastic probes, and 16% responded other indicating both (**Figure 8**). Lastly, when questioned at what time intervals implant radiographs were updated, 84% responded at 1 year follow up, 12% stated “other”, and 4% responded at 6 months Those selecting “other” further specified the follow time intervals: based off faculty recommendation, immediately after restoration and at 1 year, and based off ADA guidelines.

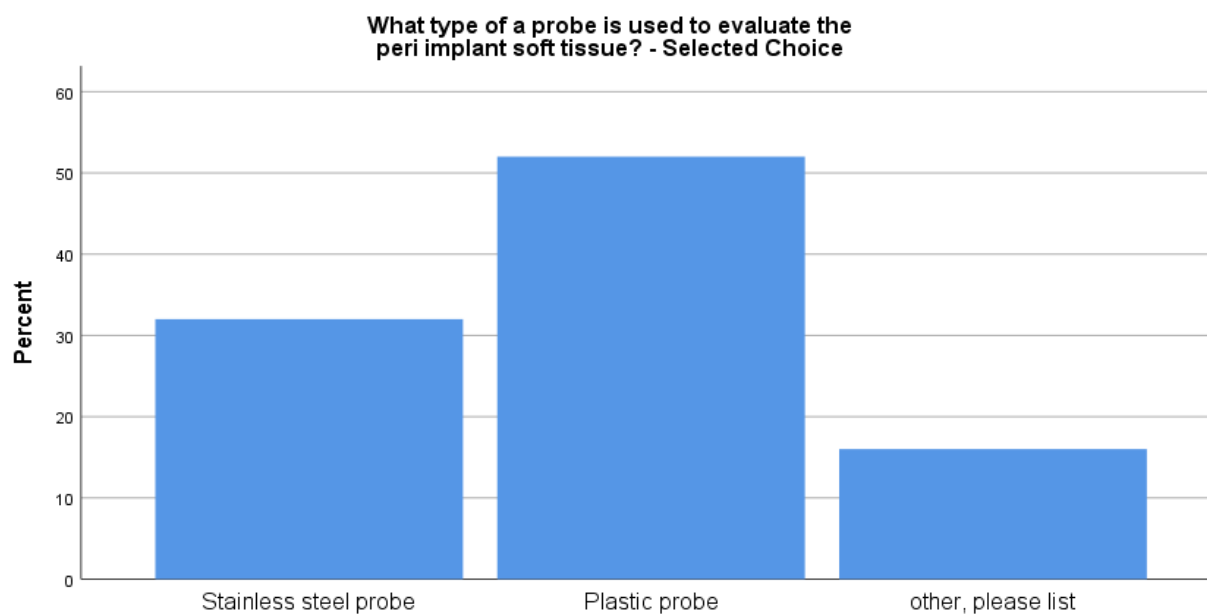


Figure 8 – Percentage of universities utilizing stainless steel, plastic, and other types of probes. Thirty-two percent of directors stated stainless steel probes, 52% plastic probes, and 16 responded other indicating both.

V. DISCUSSION

The purpose of this study was to investigate how pre-doctoral periodontal programs in the USA educate their dental students to diagnose peri-implant diseases. Additionally, the results of the study were utilized to observe trends and determine if a standardized curriculum exists for teaching peri-implant diseases. From the data collected, one can conclude that there is no current standard of how programs educate dental students to recognize and diagnose peri-implant diseases. This can potentially lead to pitfalls within a student's educational needs due to the heterogeneity of content and teaching methods presented.

A. Peri-Implant Definitions and Implant Education Literature

To the best of the researchers' knowledge, limited data is available on the topic of education and peri-implant disease that exists in the pre-doctoral curricula at dental schools in the USA. This area is an important topic as institutions are revising their curriculums to adopt the 2017 World Classification. Implementation of the new staging and grading system for periodontal disease, and definitions of implant health and disease are providing both educators and clinicians more direction for teaching and clinical practice. Currently, the 2017 World Classification definitions of health and disease are as follows:

“Peri-implant health is characterized by absence of erythema, bleeding on probing, swelling and suppuration. Peri-implant mucositis is bleeding on gentle probing, erythema, swelling and/or suppuration which may be present. Clinical signs of inflammation are necessary for a diagnosis of peri-implant mucositis. Peri-implantitis is a plaque-associated pathologic condition occurring in tissues around dental implants, characterized by inflammation in the peri-implant mucosa and subsequent progressive loss of supporting bone. Peri-implantitis exhibits

signs of clinical inflammation, BOP and or/suppurative, increased probing depths, and/or recession of the mucosal margin in addition to radiographic bone loss compared to previous examinations. Sites presenting with peri-implantitis should correlate probing depths and bone loss as an indicator for severity of disease” (Berglundh et al., 2018e).

The new definitions on disease correlate well with previous consensus statements such as the Seventh European Workshop on Periodontology. This consensus provided key diagnostic criteria for implant diseases such as peri-implant mucositis presenting with BOP with a gentle force of 0.25N. Peri-implantitis was characterized by BOP, changes in alveolar crest, and the presence of a periodontal pocket. In addition, peri-implantitis may be initiated and/or maintained by iatrogenic factors (Lang and Berglundh, 2011). The 2017 World Classification provides a more detailed description for diseases, especially peri-implantitis. The new descriptors will allow clinicians, researchers, and educators access to standardized information for their intended use. In education this means that instructors can utilize up-to-date definitions useful for teaching diagnosis of peri-implant health and disease to students.

Currently there is extensive educational research in pre-doctoral implant education, particularly in the placement and restoration of dental implants. Conversely, there is limited data addressing the emerging prevalence of peri-implant diseases and education in dental schools in the USA. Kroeplin and Strub performed a worldwide literature study of implant dentistry in the undergraduate curricula and provided 25 publications between 1974 and 2006. In their research, undergraduate programs increased the rate they implemented implant dentistry from 51% in 1974 to 97% by 2006 in the USA all curricula included lectures (1 to 20 hours) and laboratory courses (30% to 42%) with varying levels of clinical experience between surveyed universities. Their study showed a tremendous increase in the percentage of schools implementing dental

implant education into existing programs (Kroeplin and Strub, 2011b). In comparison, we asked program directors if students received pre-clinical implant training to which 88% of participants responded positively. This is in agreement with a previous study which also found programs increasing the amount of didactic and pre-clinical training students are receiving (Yuan et al, 2011b). In the second part of Kroeplin and Strub's study, students completed 28 hours of didactic lectures and 64 hours of hands-on clinical seminars. Furthermore, students placed and restored implants as the study continued. Over the duration of two and half years, students treated 51 patients with 97 dental fixtures in the undergraduate program. Seventy-one implants were restored with either single crowns, fixed dental prostheses, overdentures, or a telescopic removable dental prostheses on remaining teeth and placed additional implants. The implant survival rate was approximately 98.9% (Kroeplin and Strub, 2011b). The focus of this study was the students' ability to place and restore dental implants to levels similar to an experienced dentist. However, the short duration (< 2 years follow up) poses as a limitation as it does not allow for a long-term evaluation of implant success, complications, and survival (> 5 years). Moreover, if placing and restoring dental implants is the main objective, one question to pose would be how these programs institute maintenance and follow up care to monitor biologic and/or mechanical complications. Thus, although a body of literature supports placement and restoration of dental implants by dental students, more research with longer follow-up times are required to determine if current educational methodologies are sufficient to assess the pre-doctoral student's abilities to diagnose, treat, and refer patients with peri-implant disease.

B. Didactic and Pre-Clinical Education

Data from disciplines that teach peri-implant diseases state that periodontics and prosthodontic departments are primarily involved in providing implant dentistry education. When asked which disciplines teach peri-implant diseases, 62% stated “periodontics” and 16% stated a combination of “prosthodontics” and “periodontics departments”. Multidisciplinary involvement in teaching peri-implant diseases allows students to gain a well-rounded understanding on disease etiologies. Periodontally, peri-implantitis diseases can be defined by the inflammatory process around an implant induced by plaque, calculus, and/or iatrogenic factors. Sarmiento et al. discusses peri-implantitis and identifies various etiologies to which they created a classification for peri-implantitis pathogenesis. Based on their findings, they found a majority of bone loss around implants were related to biofilm, iatrogenic factors, exogenous irritants (cement, smoking, food debris) absence of keratinized tissue, and extrinsic pathology. Of 152 patients and 270 implants included in their study, pathogenic bacteria affected 102 patients and 213 implants, 14 patients and 15 implants were affected by exogenous irritants, 20 patients and 23 implants were affected by Iatrogenic factors, 5 patients and 6 implants affected by an extrinsic pathology, and 11 patients and 13 implants affected by absence of keratinized tissue (Sarmiento, 2011). Prosthetically, peri-implant diseases can be characterized by iatrogenic factors, unhygienic crown contours, emergence profiles, and excess cement. Pesce performed a systemic review on prosthetic risk factors for peri-implantitis and questioned how prosthetic factors such as excess cement and ill-fitting components were considered in the etiology of peri-implantitis. They noted that articles on prosthetic risk factors for peri-implantitis are scarce and excess cement seems to be associated with mucositis and potentially peri-implantitis, especially in patients with a history of periodontal disease (Pesce, 2015). Interdisciplinary education for

dental students varies amongst universities. Some universities have specialty prosthodontics and periodontics departments to elaborate on these topics, however universities that do not have specialty programs may not have the same resources to educate students (Parrish et al, 2013b). Thus, it is up to faculty, whether a specialist or general dentist, to provide information in a traditional setting such as a didactic series. One additional question that could have been asked in this survey could be what advanced specialty programs are available in the university for students to learn and discuss dental implant health and disease. This would have allowed for more background information as universities with advance specialty programs have concomitant resources for dental education. However, it is not known if and how faculty in the specialty programs interact with students and faculty members of predoctoral programs and their role in predoctoral dental education. Further study is warranted.

Assessments are required to test students' knowledge of peri-implant diseases. Responses indicate that written, clinical, oral exams and simulations are utilized. Written exams are typically the gold standard to assess student knowledge (Tabish, 2008). However, there is no clear understanding as to how this information applies to clinical scenarios. When students begin patient care, it is up to their clinical faculty to reinforce their didactic knowledge into critical thinking situations. Currently, there is no data as to how this can be improved or expanded upon. Program directors responded that they would rate their students' performance to diagnose disease as average (48%) and somewhat above average (36%). This collection of data infers that program directors are relatively confident that students can transition into clinical practice moderately to moderately well, but as mentioned before there is no measure as to determine pace of transition or methods to improve it.

C. Diagnosis and Clinical Training

When specifically asked which classification system is utilized to diagnose peri-implant diseases, more than half of participants stated that they do not use a specific classification (56%), while the remaining responded using a specific classification (44%). Responses for specific classifications included the 2017 World Classification (91%) and an AAP positional paper (9%). It should be noted that data collection was surveyed during the release of the 2017 World Classification and implementation into curriculums may be premature before its reporting and proper utilization in a pre-doctoral setting. From this data, one can see that there are disparities of classifications utilized. As mentioned, the heterogeneity of classifications and lack of classification sources can create a problem when it comes to standardize teaching methods. With the lack of a standardized classification system, epidemiology and prevalence studies report varying results, and academics do not have a consensus on the proper definition to teach students.

The clinical parameters and tools used to diagnose peri-implant diseases were surveyed. Responses included clinical signs of gingival inflammation, suppuration, probing, bleeding, and radiographs. When specifically asked about peri-implant mucositis, participants explained that radiographs are utilized to rule out radiographic crestal bone changes that would indicate peri-implantitis. However, 32% of participants indicated radiographs were used for diagnosis of peri-implant mucositis versus 68% that did not utilize radiographs. This is an area where standardization is required. Utilizing the current definition of peri-implant mucositis (2017 World Classification), the clinical description consists of BOP, erythema, swelling and/or suppuration. Radiographs are not typically indicated for peri-implant mucositis. Nevertheless the participants make a valid response. Gingival signs of inflammation may be coupled with

radiographic bone loss in which an additional diagnostic component to rule out peri-implantitis is required. With this knowledge, all participants then stated that radiographs are required for diagnosing peri-implantitis.

Regarding clinical experience when managing peri-implant diseases, a majority of participants indicated that dental students are actively involved in the treatment of peri-implant diseases (84%). It was reported that 72% of programs allow students to treat peri-implant mucositis and 20% are treating peri-implantitis. However, 8% withheld from answering and no further clarification was provided as to how students were treating peri-implant diseases. The methods used to treat peri-implant diseases in the pre-doctoral curriculum is another area in which more research is indicated. Currently, the 2017 World Classification concluded that resolution of clinical signs after treatment for peri-implant mucositis may take more than 3 weeks following reinstitution of plaque/biofilm control (Berglundh et al, 2018f). Jepsen et al. reported that home and professional mechanical plaque control is effective in managing peri-implant mucositis (Jepsen et al., 2015). Thus, students should be educating/counseling their patients on proper oral hygiene instructions (OHI) and effectively debriding sites with powered and manual instruments. Participants were then asked what cases are referred out to specialists and residency programs, in which 92% of students were referring peri-implantitis and 8% were referring peri-implant mucositis. 84% reported that students continued care for patients whether it was via surgical assisting peri-implantitis cases, maintenance after treatment, or completing the restorative phase of treatment after disease containment. An interesting finding was that 20% of participants stated that their students were treating peri-implantitis, without specifying how treatment was provided. As it stands, there is no standard protocol to treat peri-implantitis as the disease etiology is not well understood. Treatment methods continue to be heavily investigated

and protocols proposed by specialists are still in their early stages and require more longitudinal data before a predictable treatment is presented (Froum et al., 2018, Schwarz et al, 2015, and Wilson, 2018). One protocol that can be implemented in predoctoral programs is the Cumulative Interceptive Supportive Therapy (CIST) protocol. This protocol can help students understand when referral to specialist is required. For example, CIST protocols A and B allow for mechanical debridement + polishing and the use of antiseptics such as chlorhexidine for PDs that range from ≤ 3 mm to 5 mm. Protocols C and D require radiographic evaluation when PD are greater than 5 mm (Lang et al., 2004). Protocols A and B can be treated by dental students and referrals can be made for protocols C and D once the student has acquired the proper diagnostic information.

Appropriate follow-up care and maintenance is equally important as the treatment of peri-implant disease. Results showed that 24% program directors stated that follow-up care was continued by students after treatment, 16% by the specialist, and 60% stated a combination of dental students, specialists, and dental hygienists. Follow-up care is generally determined by university clinic directors or their respective programs due to constant changes in providers as students and residents graduate. Importantly, a well-conceived maintenance program with multiple providers may be indicated when there is no consistent provider. Programs should aim to create consistent maintenance appointments for patients so that care within a university setting does not negatively affect regular patient recall appointments. As mentioned previously, maintenance therapy is integral in preventative care, especially after the dental implant has been restored. In a systematic review by Monje et al, maintenance therapy to prevent peri-implant disease was examined. The review concluded that implant therapy should not only include placement and restoration of dental implants but also peri-implant maintenance therapy (PIMT)

to prevent biologic complications, therefore increasing the long-term success rate. Their findings suggest that a minimum recall PIMT interval of 5 to 6 months is recommended (Monje et al, 2016a). When participants were asked what maintenance intervals do patient's follow post implant crown insertion, it was reported that 36% stated 3 months, 20% stated 4 months, and 16% said 6 months. Twenty eight percent of respondents reported "other" where they stated it was based on the patient's needs and increasing intervals of 3, 4, 6 months based on patient compliance. The variation in answers show that each institution creates personalized maintenance visits. Depending on the needs and compliance of the patient, their intervals will be assessed and determined by the student and faculty. Additionally, Monje et al. stressed that biologic complications may still occur despite the establishment of PIMT (Monje et al., 2016b). Thus, it is imperative that patient, clinical, and implant related factors are thoroughly explored.

As it is reported in the 2017 World Classification, "it is necessary to probe peri-implant tissues to assess the presence of BOP, to monitor probing depth changes, and mucosal marginal migration" (Berglundh et al., 2018g). In this study, it was reported that 32% of programs used stainless steel probes, 52% used plastic probes, and 16% used both stainless steel and plastic probes to measure peri-implant tissues. The marked difference between the two groups may come from the notion that the use of a stainless-steel probe may scratch or damage the implant surface, increasing the risk of peri-implant diseases. Plastic probes have a gentler surface and is thought to minimize any abrasions to the implant surface. Consequently, plastic probes are not as rigid as stainless-steel probes, which may lead to probe deflection or inaccurate readings in the hands of dental students. Abrahamsson and Solini performed a beagle dog study in which they compared periodontal probing in normal and peri-implant periodontium. The results of their study showed that probe tip penetration in healthy soft tissue of teeth and implants are similar

when a force of 0.2 N is applied (Abrahamsson and Soldini, 2006). Therefore, the use of a light probing force around implants is a helpful diagnostic measure in the maintenance of dental implants.

Limited data exists in the literature that compares plastic and stainless-steel periodontal probes in measuring peri-implant tissues. An *in vitro* study performed by Fakhravar et al., looked at probing and scaling instruments at the implant abutment interface and found that probing around implants with a metal probe does not have an effect on abutment surfaces. However, utilizing metal or plastic scalers and plastic probes can result in surface roughness. They concluded that the rounded end of a metal periodontal probe burnished the machine surface of the abutment and thus reduced the effect of surface roughness. Plastic instruments may be more abrasive because plastic particles and debris of the abutment can attach to the surface through mechanical and electrostatic forces. This is based on charge differences of metal and plastic that leads to more surface roughness (Fakhravar et al., 2012). More research is required in order to verify if stainless or plastic probes negatively affect the implant surface and whether one is more efficient than the other.

Follow up radiographs after implant restoration were highly recommended after one year. Program directors emphasized that a majority of their students will take radiographs at one year post insertion in order to determine progression of bone loss. Unfortunately, no updated criteria is present except for Albrektsson et al. implant success criteria which stated that an implant is deemed successful once vertical bone loss is less than 0.2 mm one year after implant placement (Albrektsson et al., 1986). This statement holds today and is seen in this response pool, however this criterion is based on the original Branemark, smooth surface implants. Today, a majority of implant companies will treat their implant surfaces with either additive or subtractive methods,

and present with a rough surface. A new success criterion should be evaluated and proposed for newer types of implant designs and materials.

D. Study Limitations and Future Research Areas

Within the confines of this study, the greatest limitation was the response rate and sample size (n=25). Out of 57 surveys that were sent out, 23 were completed and 2 partially completed. A greater response rate would lead to a higher statistical power and accuracy. The most impactful outcome of the study was the difference of peri-implant classifications utilized by programs. As previously mentioned, data collection occurred during the release of the 2017 World Classification and responses may not implement complete integration into pre-doctoral curriculum. This does necessarily imply that programs are currently modifying their programs to reflect the new definitions and classification. It is prudent upon the educational community to address the definition of peri-implant disease and standardize teaching modalities. Addition of these changes can impact education and epidemiological studies that will continue to shape future research. An educational change that can be explored is the CODA standardization of periodontics and implant therapy. Changes in CODA can help universities structure their curriculums and create an improvement in standardization. Furthermore, defining and expanding upon periodontics and implants, both restoratively and periodontically, will play a pivotal role in student education. A well-rounded student is molded early in their educational training, therefore, a standardized education is essential for their development. Suggested future studies can survey post-doctoral program implementation of the new classification into their curriculums. Furthermore, studies can evaluate how these programs assess the clinical and didactic progression of post-doctoral residents.

VI. CONCLUSION

In conclusion, data pooled from twenty-five US pre-doctoral periodontal programs show that there is currently no standard method to teach dental students how to diagnose peri-implant diseases. Currently, to the researcher's knowledge, there is limited to no evidence that links peri-implant disease training and dental education. Evidence from this study assessed how programs teach their dental students and, additionally, provides awareness to address gaps in dental education. With the 2017 World Workshop Classification there is more direction as to help pre-doctoral programs define and diagnose peri-implant health and disease; however, a standardization of content is recommended to improve the education of dental students and the dental academic community.

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APPENDIX

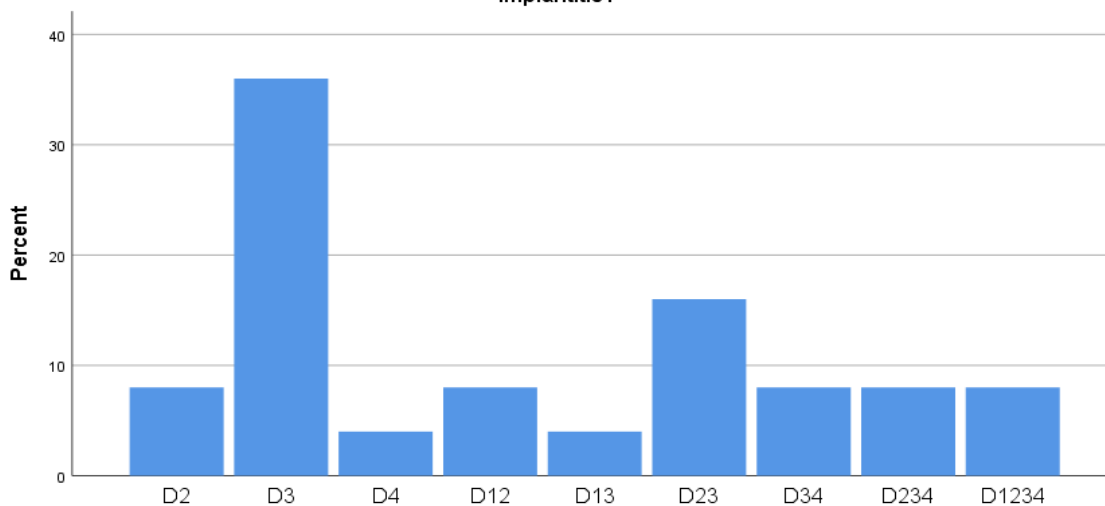
Q1-Do the students in your program receive lectures on peri-implant mucositis and peri-implantitis?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	25	100.0	100.0	100.0

Q2- In what year(s) of the program do the dental students receive lectures on peri-implant mucositis and peri-implantitis?
Mode-D3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	D2	2	8.0	8.0	8.0
	D3	9	36.0	36.0	44.0
	D4	1	4.0	4.0	48.0
	D12	2	8.0	8.0	56.0
	D13	1	4.0	4.0	60.0
	D23	4	16.0	16.0	76.0
	D34	2	8.0	8.0	84.0
	D234	2	8.0	8.0	92.0
	D1234	2	8.0	8.0	100.0
	Total	25	100.0	100.0	

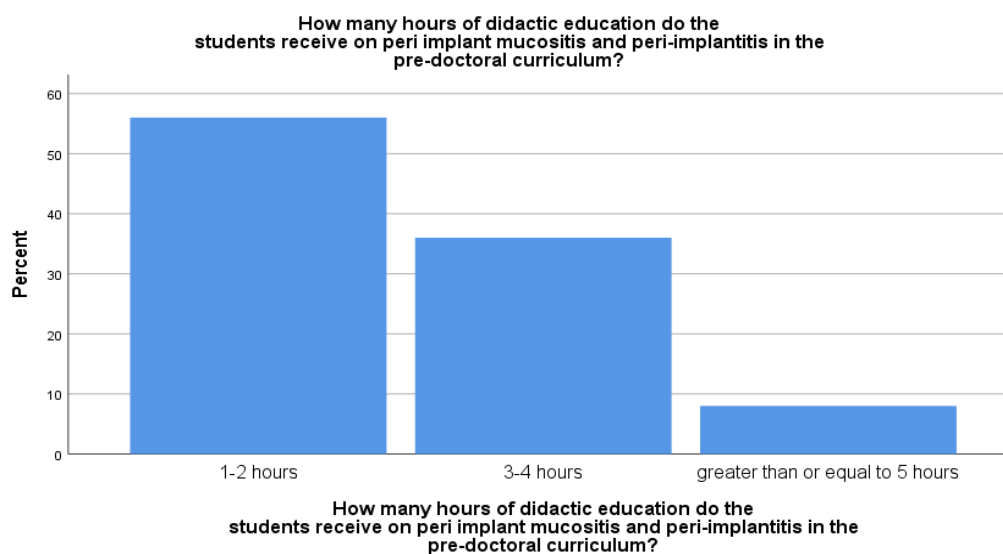
In what year(s) of the program do the dental students receive lectures on peri-implant mucositis and peri-implantitis?



In what year(s) of the program do the dental students receive lectures on peri-implant mucositis and peri-implantitis?

Q3-How many hours of didactic education do the students receive on peri implant mucositis and peri-implantitis in the pre-doctoral curriculum?

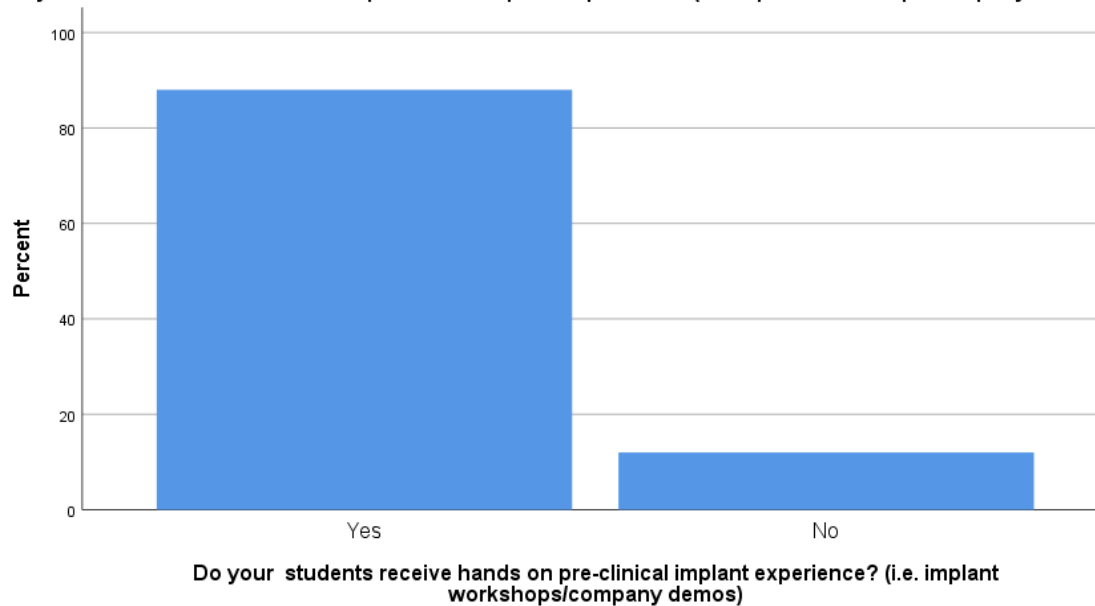
Mode		1-2 hours			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-2 hours	14	56.0	56.0 More than half	56.0
	3-4 hours	9	36.0	36.0	92.0
	greater than or equal to 5 hours	2	8.0	8.0	100.0
	Total	25	100.0	100.0	



Q4- Do your students receive hands on pre-clinical implant experience? (i.e. implant workshops/company demos)

Mode		Yes			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	22	88.0	88.0	88.0
	No	3	12.0	12.0	100.0
	Total	25	100.0	100.0	

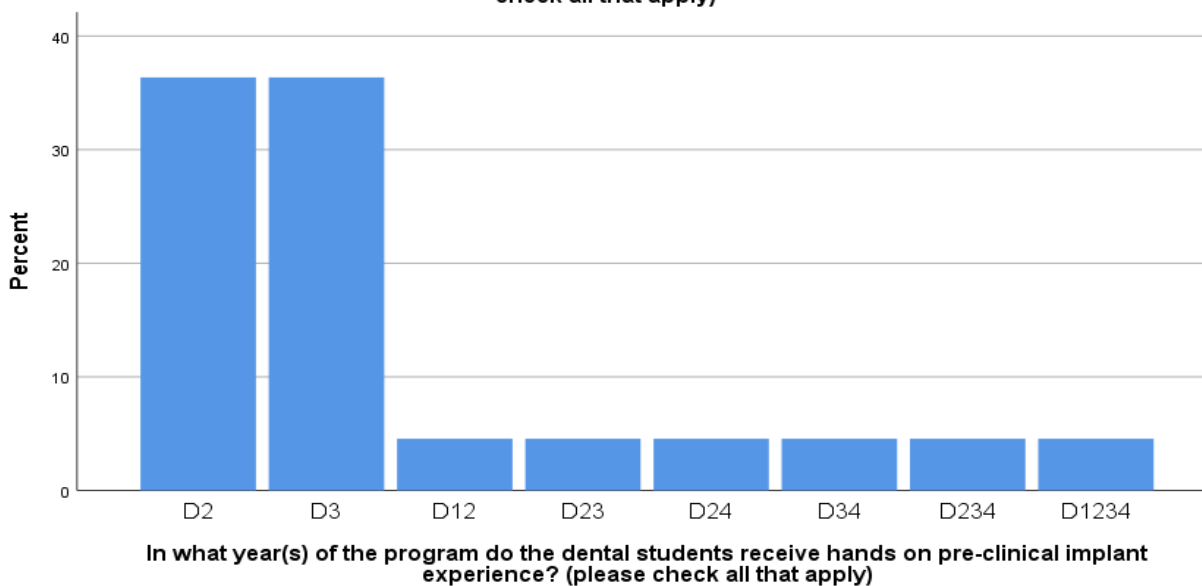
Do your students receive hands on pre-clinical implant experience? (i.e. implant workshops/company demos)



Q5- In what year(s) of the program do the dental students receive hands on pre-clinical implant experience?
(please check all that apply)

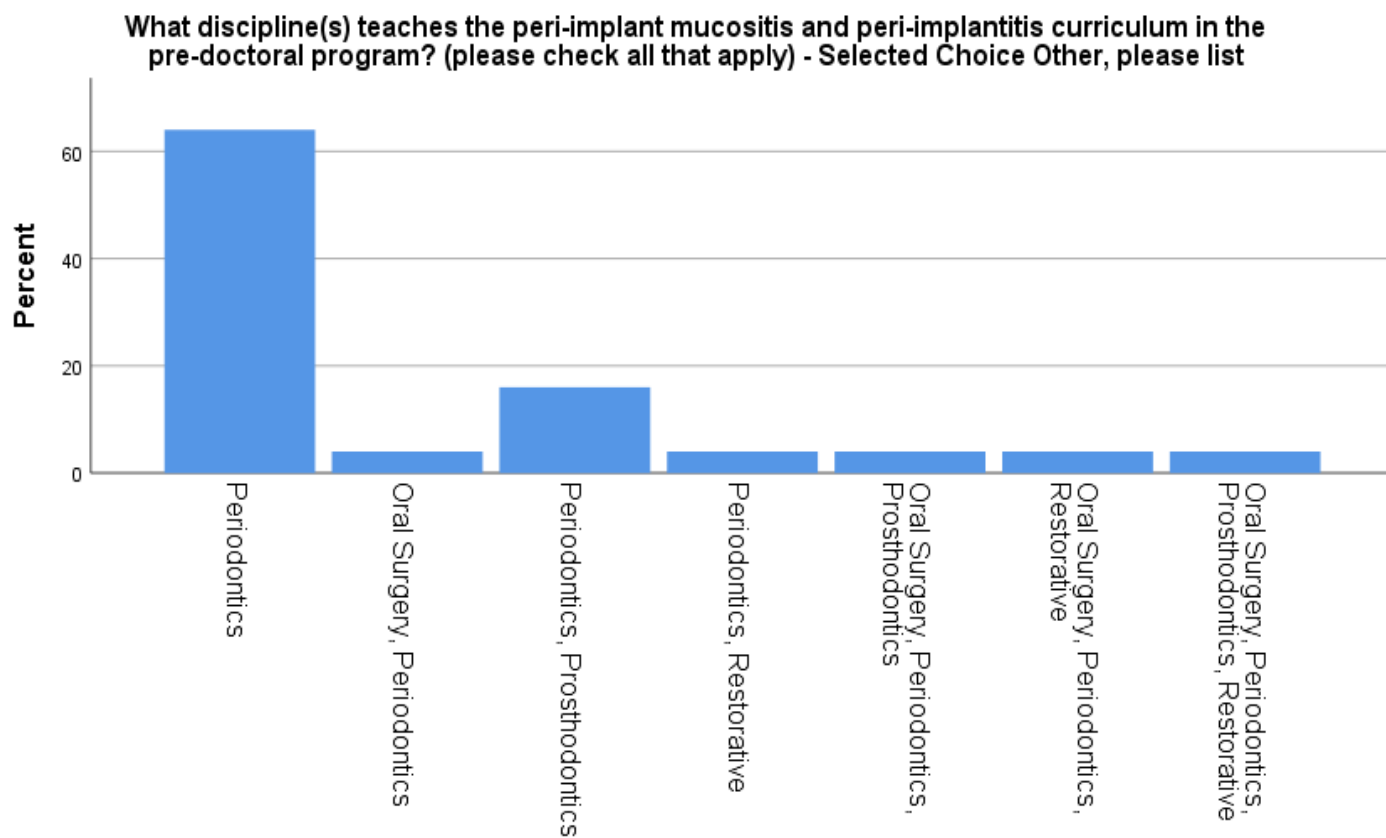
Mode		D2 and D3			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	D2	8	32.0	36.4	36.4
	D3	8	32.0	36.4	72.7
	D12	1	4.0	4.5	77.3
	D23	1	4.0	4.5	81.8
	D24	1	4.0	4.5	86.4
	D34	1	4.0	4.5	90.9
	D234	1	4.0	4.5	95.5
	D1234	1	4.0	4.5	100.0
	Total	22	88.0	100.0	
Missing	System	3	12.0		
Total		25	100.0		
Out of 22, 8 responded D2 and D3 individually					

In what year(s) of the program do the dental students receive hands on pre-clinical implant experience? (please check all that apply)



Q6 - What discipline(s) teaches the peri-implant mucositis and peri-implantitis curriculum in the pre-doctoral program? (please check all that apply)

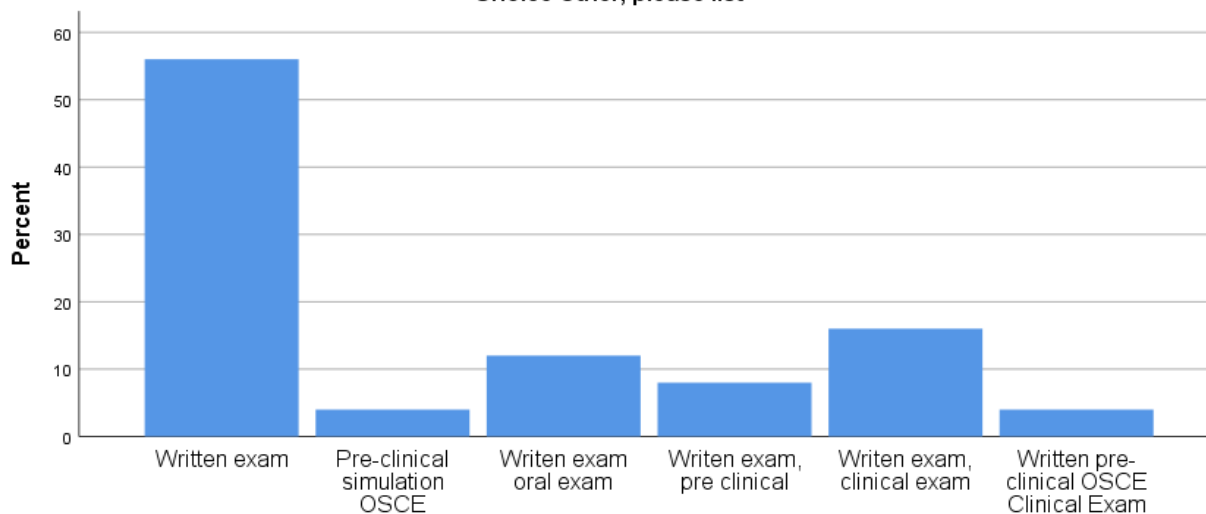
Mode		Periodontics			
		Frequency	Percent	Valid Percentage	Cumulative percentage
Valid	Periodontics	16	64.0	64.0	64.0
	Oral Surgery, Periodontics	1	4.0	4.0	68.0
	Periodontics, Prosthodontics	4	16.0	16.0	84.0
	Periodontics, Restorative	1	4.0	4.0	88.0
	Oral Surgery, Periodontics, Prosthodontics	1	4.0	4.0	92.0
	Oral Surgery, Periodontics, Restorative	1	4.0	4.0	96.0
	Oral Surgery, Periodontics, Prosthodontics, Restorative	1	4.0	4.0	100.0
	Total	25	100.0	100.0	



Q7- What outcome measures are used to determine student knowledge on peri-implant mucositis and peri-implantitis? (please select all that apply) - Selected Choice Other, please list

Mode	Written exam			
	Frequency	Percent	Valid Percent	Cumulative Percent
Written exam	14	56.0	56.0	56.0
Pre-clinical simulation OSCE	1	4.0	4.0	60.0
Written exam oral exam	3	12.0	12.0	72.0
Written exam, pre-clinical	2	8.0	8.0	80.0
Written exam, clinical exam	4	16.0	16.0	96.0
Written pre-clinical OSCE	1	4.0	4.0	100.0
Clinical Exam				
Total	25	100.0	100.0	

What outcome measures are used to determine student knowledge on peri-implant mucositis and peri-implantitis? (please select all that apply) - Selected Choice Other, please list



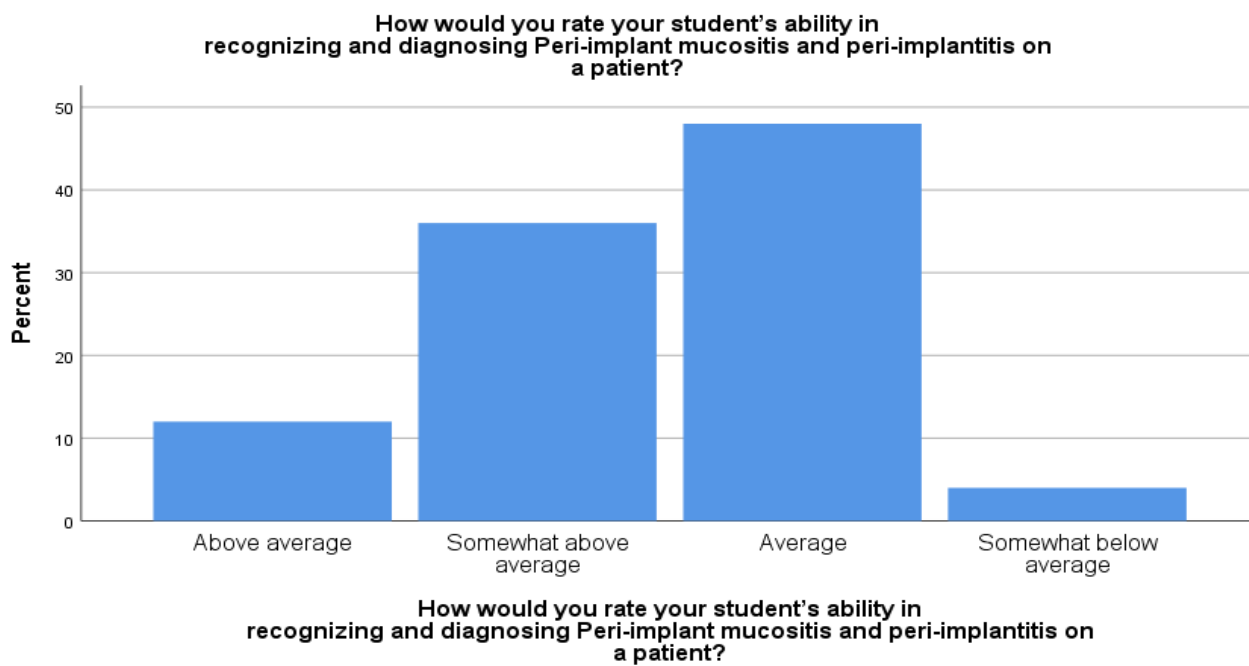
What outcome measures are used to determine student knowledge on peri-implant mucositis and peri-implantitis? (please select all that apply) - Selected Choice Other, please list

Other, please list :

- Pre-Clinical Lab Exercises

Q8- How would you rate your student's ability in recognizing and diagnosing peri-implant mucositis and peri-implantitis on a patient?

Mode	Average			
	Frequency	Percent	Valid Percent	Cumulative Percent
Above average	3	12.0	12.0	12.0
Somewhat above average	9	36.0	36.0	48.0
Average	12	48.0	48.0	96.0
Somewhat below average	1	4.0	4.0	100.0
Total	25	100.0	100.0	

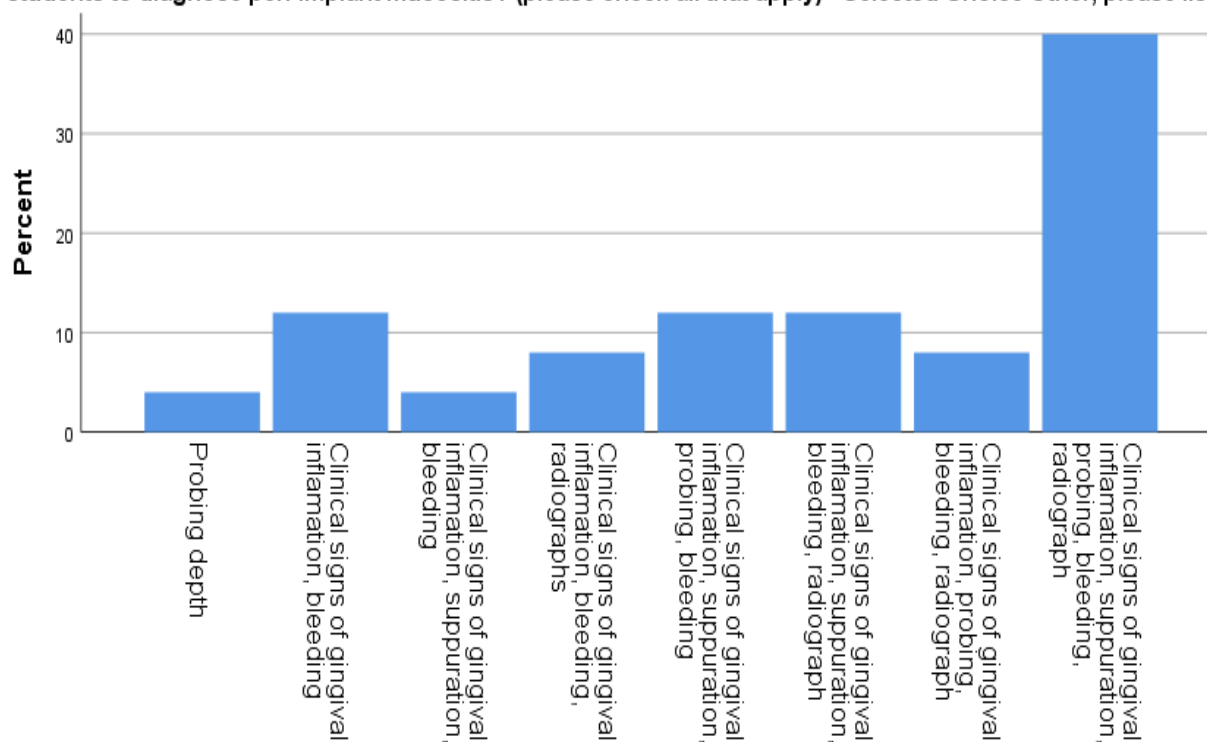


Q9- What clinical parameters are taught to students to diagnose peri-implant mucositis? (please check all that apply)

Selected Choice Other, please list

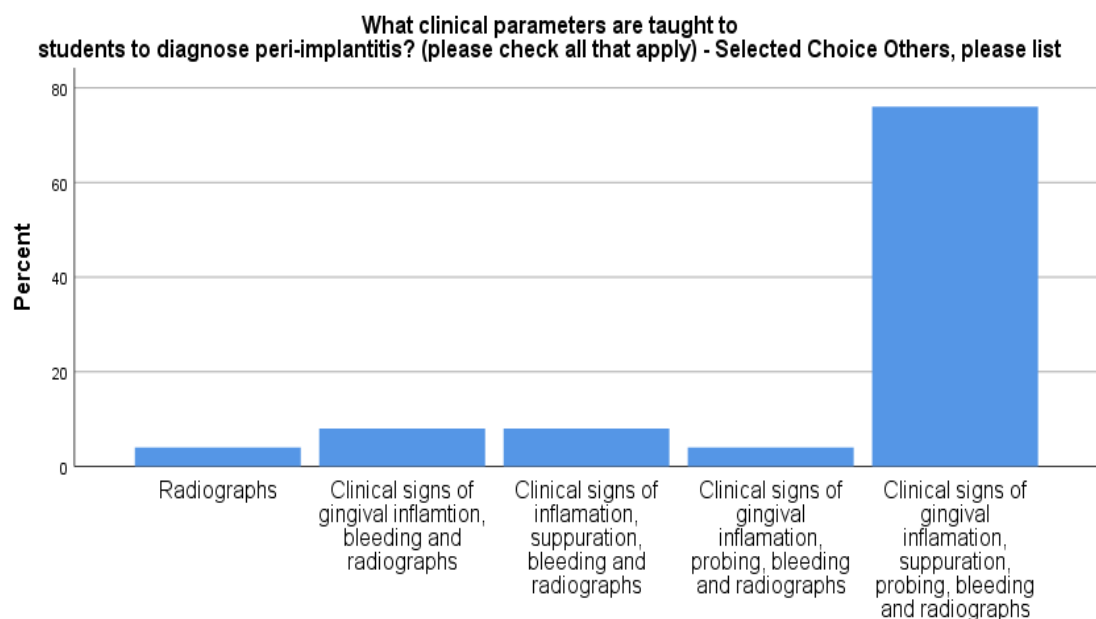
Clinical signs of gingival inflammation, suppuration, probing, bleeding, radiograph				
	Frequency	Percent	Valid Percent	Cumulative Percent
Probing depth	1	4.0	4.0	4.0
Clinical signs of gingival inflammation, bleeding	3	12.0	12.0	16.0
Clinical signs of gingival inflammation, suppuration, bleeding	1	4.0	4.0	20.0
Clinical signs of gingival inflammation, bleeding, radiographs	2	8.0	8.0	28.0
Clinical signs of gingival inflammation, suppuration, probing, bleeding	3	12.0	12.0	40.0
Clinical signs of gingival inflammation, suppuration, bleeding, radiograph	3	12.0	12.0	52.0
Clinical signs of gingival inflammation, probing, bleeding, radiograph	2	8.0	8.0	60.0
Clinical signs of gingival inflammation, suppuration, probing, bleeding, radiograph	10	40.0	40.0	100.0
Total	25	100.0	100.0	

What clinical parameters are taught to students to diagnose peri-implant mucositis? (please check all that apply) - Selected Choice Other, please list



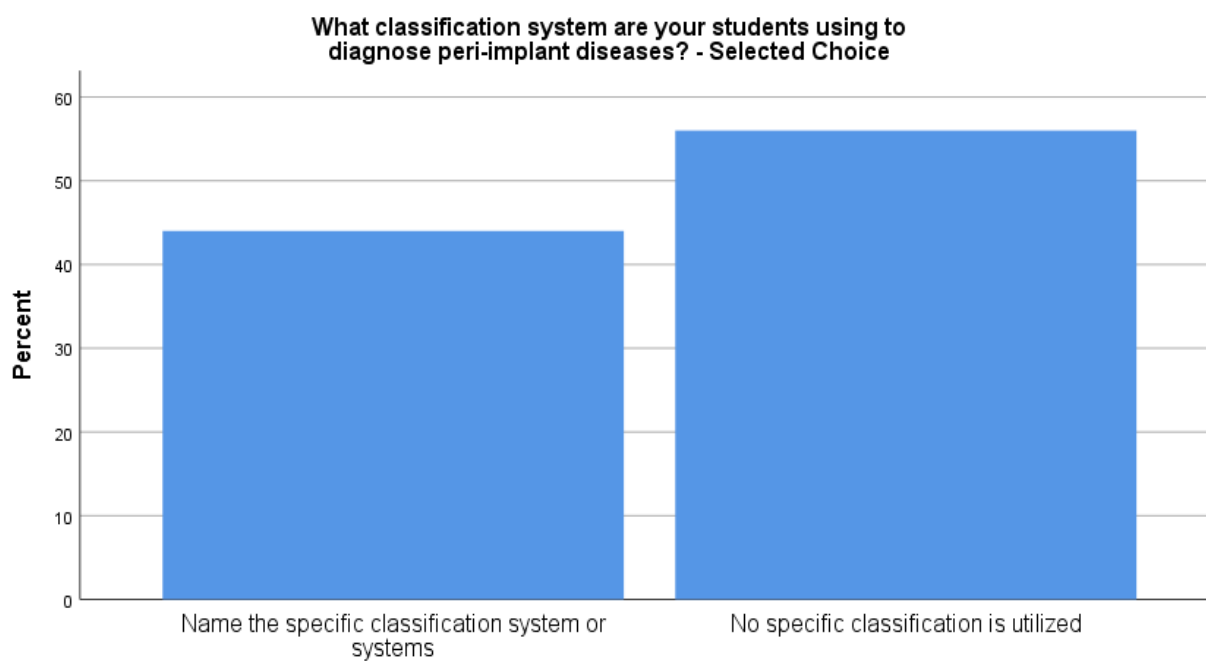
Q10- What clinical parameters are taught to students to diagnose peri-implantitis? (please check all that apply) –
Selected Choice Others, please list.

Mode	Clinical signs of gingival inflammation, suppuration, probing, bleeding and radiographs			
	Frequency	Percent	Valid Percent	Cumulative Percent
Radiographs	1	4.0	4.0	4.0
Clinical signs of gingival inflammation, bleeding and radiographs	2	8.0	8.0	12.0
Clinical signs of inflammation, suppuration, bleeding and radiographs	2	8.0	8.0	20.0
Clinical signs of gingival inflammation, probing, bleeding and radiographs	1	4.0	4.0	24.0
Clinical signs of gingival inflammation, suppuration, probing, bleeding and radiographs	19	76.0	76.0	100.0
Total	25	100.0	100.0	



Q11- What classification system are your students using to diagnose peri-implant diseases? Selected Choice

Mode		No specific classification is utilized			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Name the specific classification system or systems	11	44.0	44.0	44.0
	No specific classification is utilized	14	56.0	56.0	100.0
	Total	25	100.0	100.0	



What classification system are your students using to diagnose peri-implant diseases? - Selected Choice

Listed Classifications:

- 2017 World Classification: 10
- AAP Position Paper: 1

Chi-Square Test/ Frequencies/Test Statistics

Chi-Square .360^a

df 1

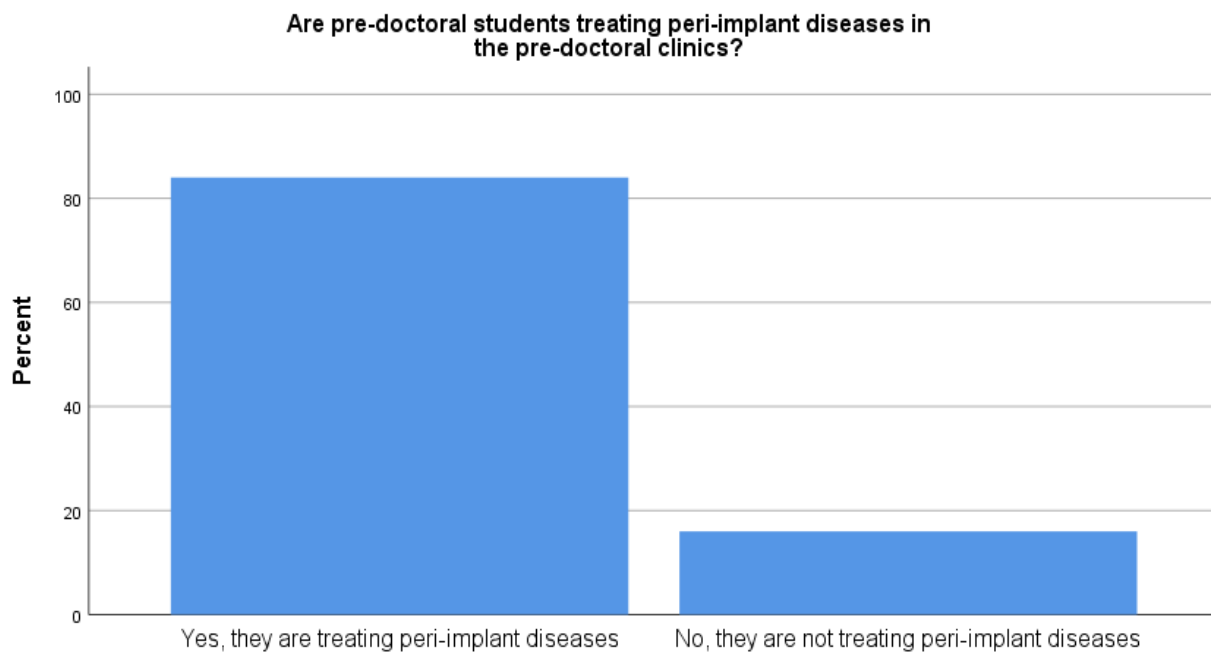
Asymp. Sig. .549

a. 0 cells (.0%) have expected frequencies less than 5.

Q12- Are pre-doctoral students treating peri-implant diseases in the pre-doctoral clinics?

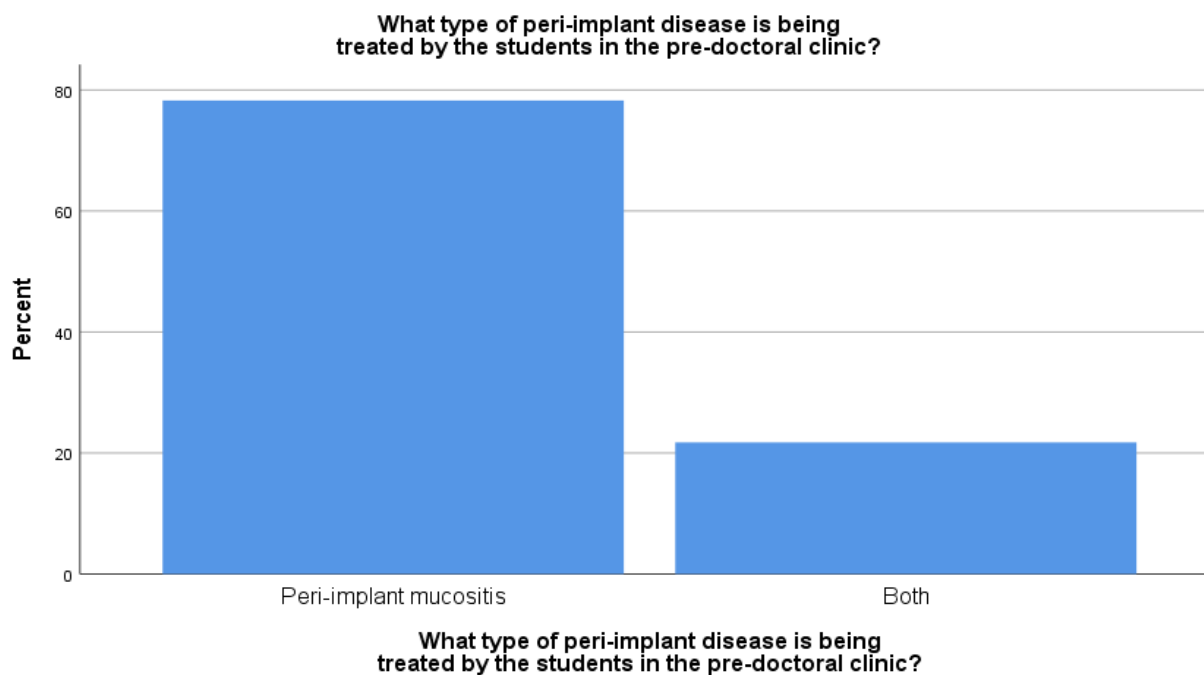
Mode Yes, they are treating peri-implant diseases

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes, they are treating peri-implant diseases	21	84.0	84.0	84.0
	No, they are not treating peri-implant diseases	4	16.0	16.0	100.0
	Total	25	100.0	100.0	



Q13- What type of peri-implant disease is being treated by the students in the pre-doctoral clinic?

Mode		Peri-implant mucositis			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Peri-implant mucositis	18	72.0	78.3	78.3
	Both	5	20.0	21.7	100.0
	Total	23	92.0	100.0	
Missing	System	2	8.0		
Total		25	100.0		



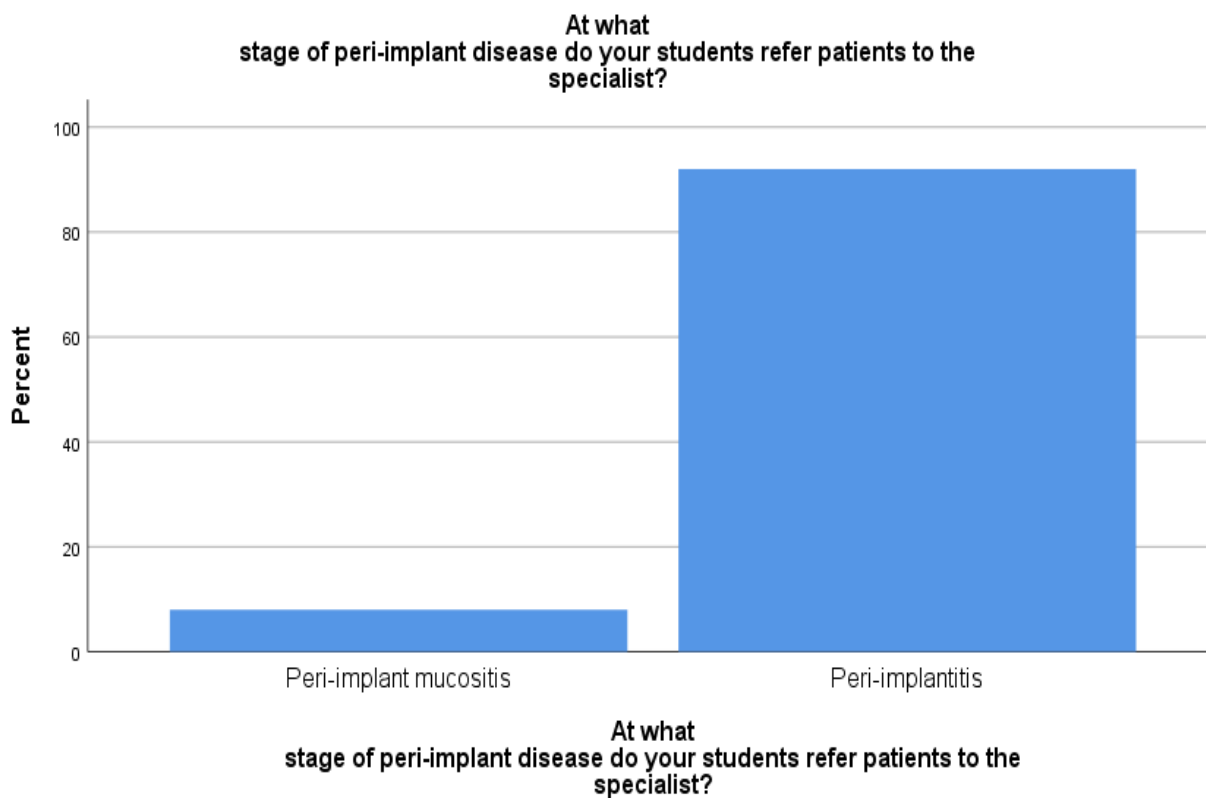
Chi-Square Test/ Frequencies/ Test Statistics

Chi-Square	7.348 ^a
df	1
Asymp. Sig.	.007

a. 0 cells (.0%) have expected frequencies less than 5.

Q14- At what stage of peri-implant disease do your students refer patients to the specialist?

Mode		Peri-implantitis			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Peri-implant mucositis	2	8.0	8.0	8.0
	Peri-implantitis	23	92.0	92.0	100.0
	Total	25	100.0	100.0	



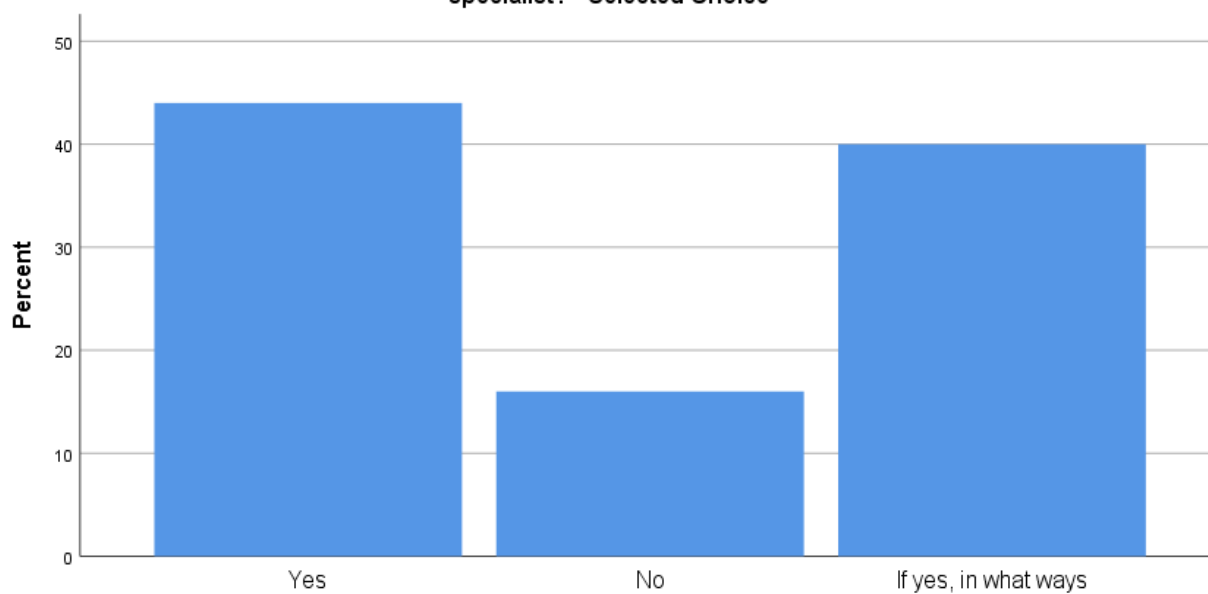
Q15- After the referral is made to the specialist; do the students continue to participate in patient care with the specialist? Selected Choice

Mode		Yes			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	11	44.0	44.0	44.0
	No	4	16.0	16.0	60.0
	If yes, in what ways	10	40.0	40.0	100.0
	Total	25	100.0	100.0	

If yes, in what ways?

- Surgical assisting – 7
- Maintenance – 1
- Continue to follow care – 1
- Restorative - 1

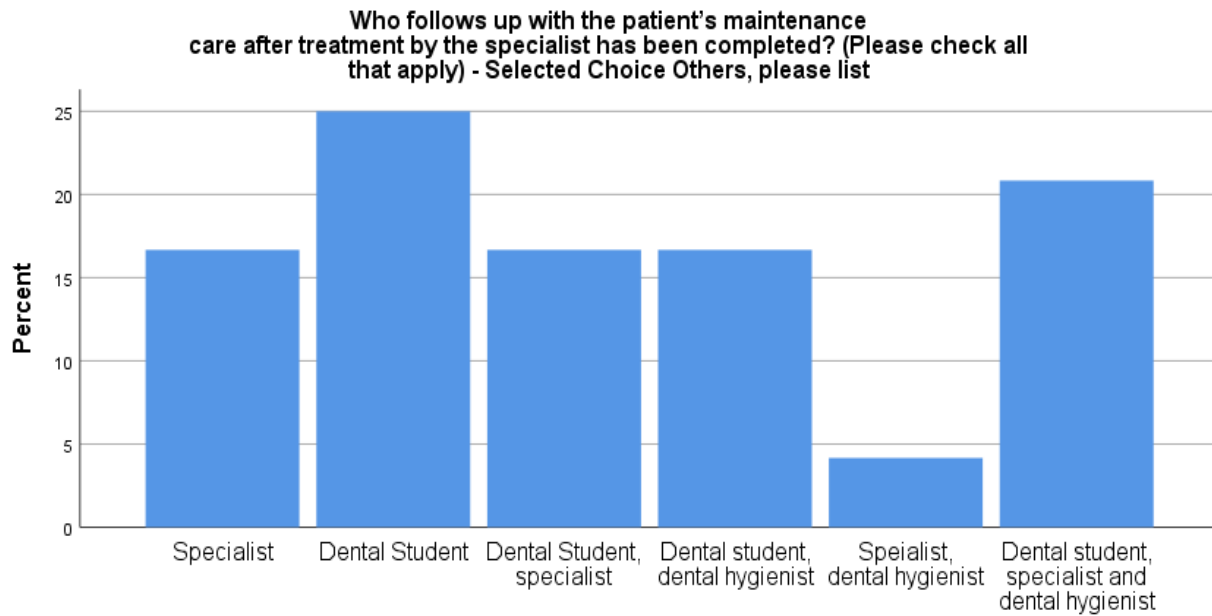
After the referral is made to the specialist, do the students continue to participate in patient care with the specialist? - Selected Choice



After the referral is made to the specialist, do the students continue to participate in patient care with the specialist? - Selected Choice

Q16- Who follows up with the patient's maintenance care after treatment by the specialist has been completed? (Please check all that apply) - Selected Choice Others, please list

Mode	Dental Student	Frequency	Percent	Valid Percent	Cumulative Percent
Specialist		4	16.0	16.7	16.7
Dental Student		6	24.0	25.0	41.7
Dental Student, specialist		4	16.0	16.7	58.3
Dental student, dental hygienist		4	16.0	16.7	75.0
Speialist, dental hygienist		1	4.0	4.2	79.2
Dental student, specialist and dental hygienist		5	20.0	20.8	100.0
Total		24	96.0	100.0	
System missing		1	4.0		
Total		25	100.0		



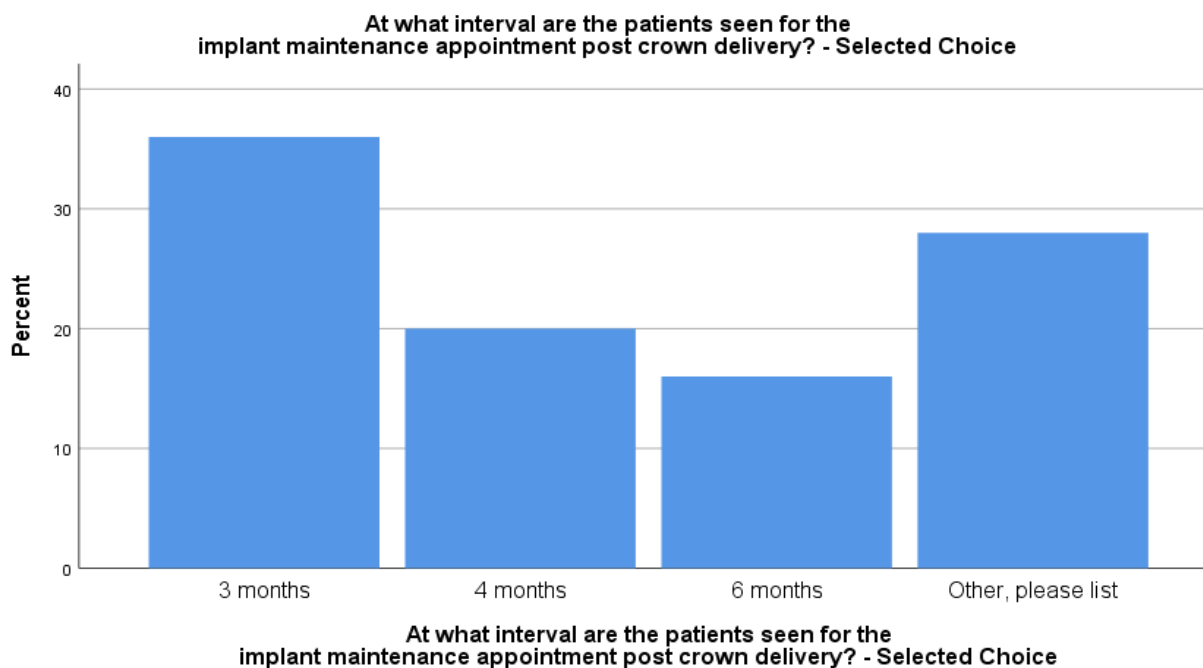
Who follows up with the patient's maintenance care after treatment by the specialist has been completed? (Please check all that apply) - Selected Choice Others, please list

Other:

- General Dentist -2
- Alternating – 2
- Perio resident -1

Q17-At what interval are the patients seen for the implant maintenance appointment post crown delivery?

Mode		3 months			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3 months	9	36.0	36.0	36.0
	4 months	5	20.0	20.0	56.0
	6 months	4	16.0	16.0	72.0
	Other, please list	7	28.0	28.0	100.0
	Total	25	100.0	100.0	

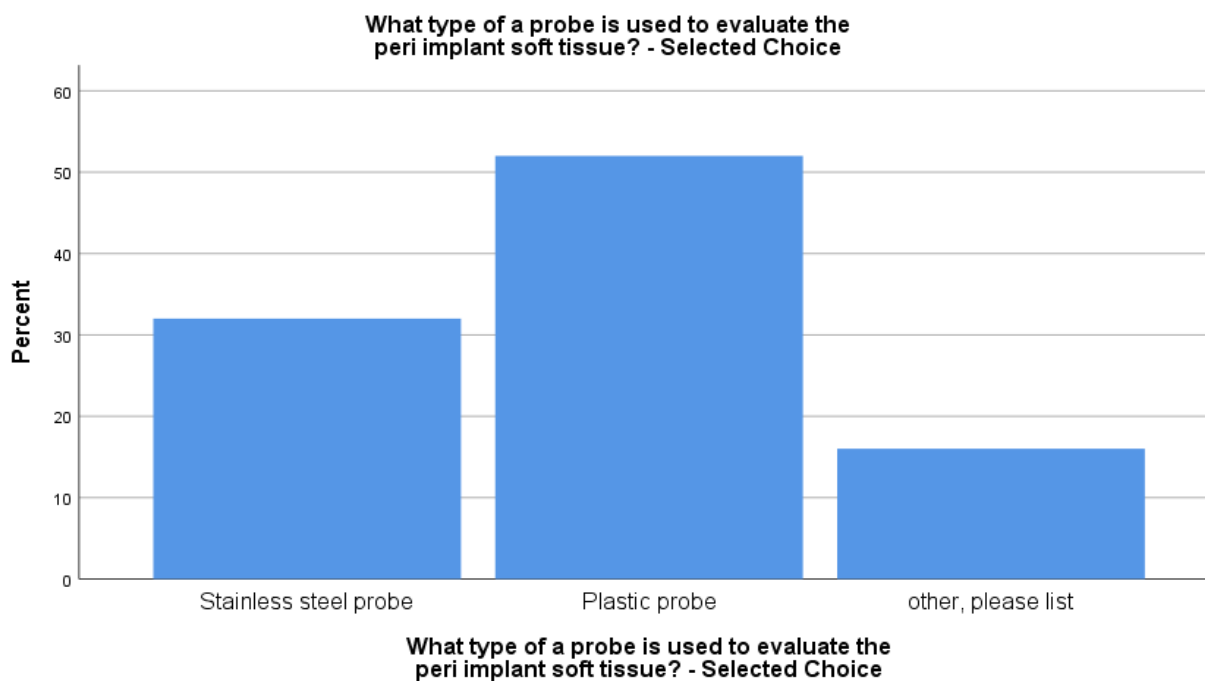


Other:

- Based on patient's needs – 4
- 3-4 months after 1 year, 6 months after 1 year

Q18- What type of a probe is used to evaluate the peri implant soft tissue?

Mode		Plastic probe			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Stainless steel probe	8	32.0	32.0	32.0
	Plastic probe	13	52.0	52.0	84.0
	other, please list	4	16.0	16.0	100.0
	Total	25	100.0	100.0	

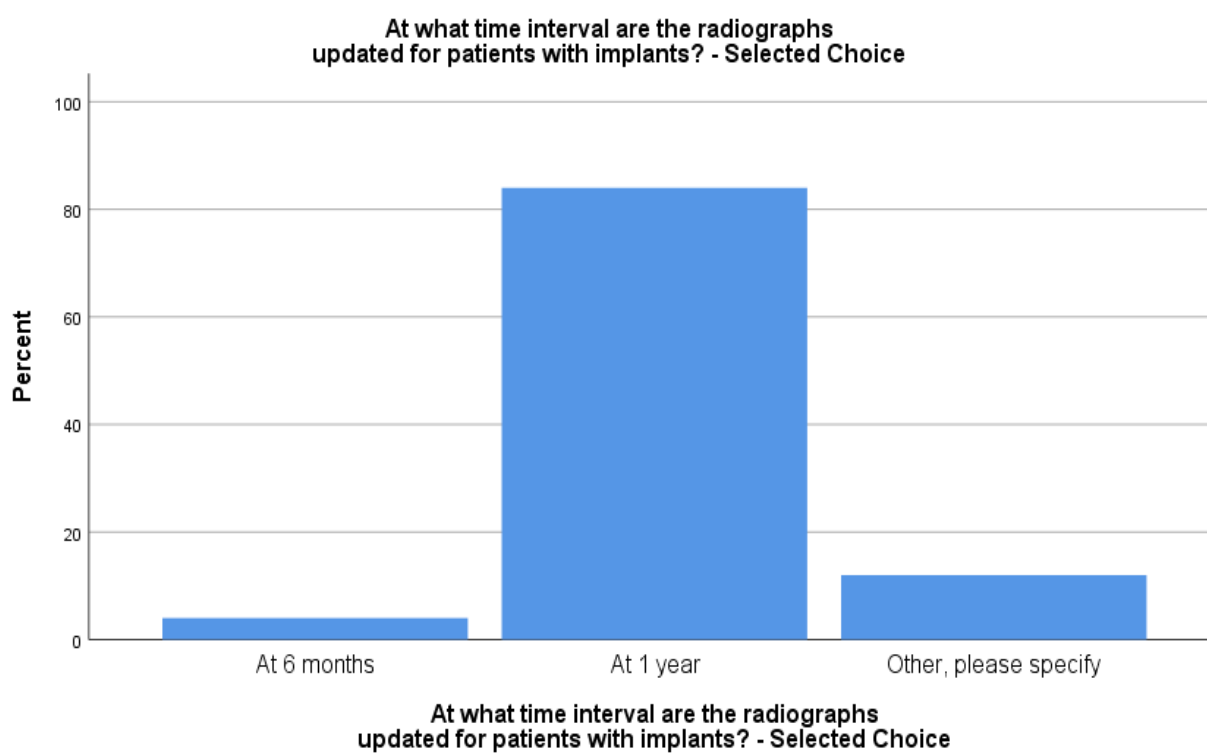


Other:

- Both – 4

Q19- At what time interval are the radiographs updated for patients with implants?

Mode		At 1 year			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	At 6 months	1	4.0	4.0	4.0
	At 1 year	21	84.0	84.0	88.0
	Other, please specify	3	12.0	12.0	100.0
	Total	25	100.0	100.0	



Other:

- Based on faculty recommendations – 1
- Immediately after restoration and at 1 year – 1
- Follows the ADA guidelines - 1

VITA

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Luz Bondoc Scholarship – May 2017
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Midwest Society of Periodontology
American Academy of Osseointegration
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Chicago Muslim Dental Society