

A Survey of Dental Implant Instruction in Predoctoral Dental Curricula in North America

Hidemichi Kihara, DDS, PhD; Jie Sun, BA; Maiko Sakai, DMD, MS; Shigemi Nagai, DMD, PhD; John Da Silva, DMD, MPH

Abstract: The aim of this study was to investigate the extent and forms of predoctoral implant dentistry instruction in North American dental schools and to identify future directions and challenges. The survey collected data on curriculum content, departmental oversight, techniques, and materials, as well as current problems to be solved. The 30-question survey was sent in 2012 to the dean or administrator in charge of the predoctoral curriculum of all 73 dental schools in the U.S. and Canada at the time; four reminders were sent. Forty-seven schools responded, for a response rate of 64%. Of the 47 responding schools, 46 (98%) offered didactic instruction (mean of 17 hours); 87% had a laboratory component (mean of 14.46 hours); and 57% had a clinical requirement. In the responding schools, students had an average of 1.85 implant restorative cases and 0.61 surgical cases. Forty-two of the schools (89%) had implemented observation of implant surgery and/or assisting with implant surgery in their curricula. Major challenges reported in implementing a comprehensive predoctoral implant curriculum included expense of implant systems to the schools and to patients, shortage of predoctoral cases, and lack of curriculum time and trained faculty. These results show that implant education for predoctoral dental students continues to expand, with a trend towards more preclinical exercises and clinical experiences and fewer didactic courses.

Dr. Kihara is Visiting Associate Professor, Department of Restorative Dentistry and Biomaterial Sciences, Harvard School of Dental Medicine, and Associate Professor, Department of Prosthodontics and Oral Implantology, School of Dentistry, Iwate Medical University, Japan; Jie Sun is a DMD student, Harvard School of Dental Medicine; Dr. Sakai is Part-Time Faculty Member, Department of Restorative Dentistry and Biomaterials Sciences, Harvard School of Dental Medicine; Dr. Nagai is Associate Professor, Department of Restorative Dentistry and Biomaterials Sciences and Director of Clinical Research, Harvard School of Dental Medicine; and Dr. Da Silva is Associate Professor, Department of Restorative Dentistry and Biomaterials Sciences and Vice Dean, Harvard School of Dental Medicine. Direct correspondence to Dr. Hidemichi Kihara, Department of Restorative Dentistry and Biomaterial Sciences, Harvard School of Dental Medicine, 188 Longwood Avenue, Boston, MA 02115; Hidemichi_Kihara@hsdm.harvard.edu.

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The use of dental implants has been increasing since being shown to be a reliable and effective treatment for the rehabilitation of partially edentulous and edentulous patients.¹⁻⁴ General dental practitioners encounter patients who have undergone implant therapy or are candidates for implant treatment in their daily practice.⁵ Three million people in the U.S. have dental implants, and the number has been growing by 500,000 a year.⁶ The increasing prevalence and high demands of implant therapy call for appropriate implant training in dental curricula.⁷ In a 2004 survey, deans at 97% of responding dental schools in the U.S. and Canada reported that their schools had implemented a didactic component to their implant education.⁸ In 2013, the Commission

on Dental Accreditation (CODA) added competence in providing dental implant prosthodontic therapies to the accreditation standards for dental education programs.⁹

Although the majority of U.S. and Canadian dental schools have been incorporating implant training in their predoctoral education, the content and extent vary from school to school, with less uniformity than in traditional dental disciplines.¹⁰⁻¹² In schools that reported providing clinical restorative experiences in a 2004 survey of deans, only about half of their students actually restored implants, and only 13% of schools reported a clinical competency requirement in restorative implant procedures.⁸ In the annual American Dental Education Association

(ADEA) Survey of Dental School Seniors, 30% or more of seniors in U.S. dental schools have reported having received “inadequate” implant training in the past few years.¹³⁻¹⁵ In 2015, Barwacz et al. published an overview of U.S. predoctoral dental implant programs.¹⁶ They reported that clinical practices and modalities varied significantly by region, but did not describe preclinical laboratory exercises in detail. Another study found that the majority of U.S. dental students planned to provide single implant restorations and implant-supported prostheses for their patients in the future.¹⁷

A comprehensive, well-designed, predoctoral implant curriculum is critical to ensure adequate training for future clinicians. Adequate training will allow new graduates to provide successful implant treatments to their patients. Therefore, a close examination of current implant education for dental students is important to identify challenges and propose solutions for further curriculum improvement. Many studies have been published on predoctoral implant education in North American dental schools.^{7,8,10,12,18-20} However, only one of those assessed implant education that included preclinical laboratory exercises.¹⁰

The aim of this study was to investigate the extent and forms of predoctoral implant dentistry instruction in North American dental schools and to identify future directions and challenges. Curriculum content, departmental jurisdictions, techniques, and materials used were investigated. Complications and problems associated with implant treatment in predoctoral practice settings were also assessed to gain additional insight into the areas requiring improvement as well as future trends in predoctoral implant education.

Materials and Methods

The Institutional Review Board of Harvard Medical School approved this study. For the study, we created a 30-question survey, using the survey from Lim et al.’s study as a reference.¹⁰ Our survey had more questions than theirs on the preclinical laboratory exercises students were experiencing. The survey was reviewed and revised based on feedback by faculty members involved in predoctoral implant education at Harvard School of Dental Medicine as well as the University of Illinois at Chicago, Boston University, and Iwate Medical University. The survey was then pretested and finalized.

In 2012, the survey was sent to the dean or administrator in charge of the predoctoral curriculum at the 73 U.S. and Canadian dental schools listed in the 2011-12 Directory of ADEA Institutional Members and Association Officers.²¹ The survey was administered online using the Qualtrics survey tool available at Harvard University. In instances in which a respondent did not have access to the Qualtrics site, a Word file of the survey was sent, and responses were returned via email. Reminders were sent in the second and fourth weeks and the second and fourth months after the initial invitation, for a total of four reminders to complete the survey.

Results

Of those 73 U.S. and Canadian schools, 47 responded, for a response rate of 64%. Incomplete surveys were received from six schools, but the items to which they responded were included in the analysis. The names of dental schools were recorded for data collection purposes only, and all survey results remained anonymous.

The average number of implants placed by faculty, residents, and predoctoral students in each school per year was 558 (range: 0-5000). The average number of implant restorations by predoctoral students per year was 206 (range: 0-1200). All 47 responding schools (100%) reported that implant education was incorporated into the core curriculum at their institutions. Although 36 schools (76.5%) incorporated implant education into their existing curricula without reducing curricular content, five schools (10.5%) reported they had reduced the prosthodontics curriculum, one school (2%) had reduced the endodontics and occlusion curriculum, and five schools (11%) reduced curricula in the “other” category (laboratory work and orthodontics).

The disciplines involved in the responding schools’ predoctoral implant instruction are listed in Table 1. The top disciplines involved, in descending order, were prosthodontics, periodontics, oral surgery, and implantology. Regarding the philosophy of their implant treatment approach, 43 schools (91.5%) reported using a “team approach” to implant treatment, while three (6%) reported an “individual provider” approach. One school (2%) reported “both” approaches.

Nearly all the schools (n=46; 98%) reported that a didactic implant curriculum was offered for predoctoral students. The time spent in various

components of the schools' didactic implant education is shown in Table 2. Forty-one schools (87%) reported that they had a laboratory component for predoctoral implant education. Table 3 shows the content of the laboratory exercises. Major reasons given for not having a laboratory component were shortage of faculty and lack of curriculum time. Five schools had implemented preclinical implant laboratory exercises between 1990 and 1999, and 26 schools implemented them after 2000. The mean number of hours in laboratory exercises was 14.4 (range: 0-90 hours).

Eleven schools had initiated clinical implant exercises before 1999, and 29 schools implemented them after 2000. The average number of restorative cases was 1.85 (range: 0-25); for surgical cases, the average number was 0.61 (range=0-10). The most commonly used implant systems were Nobel Biocare (31 schools) and Straumann (25 schools), with nine schools using Zimmer and Biomet 3i.

Regarding implant surgical experience, 42 schools (89%) reported that they expected that students have "some participation in implant surgery"; only five schools (11%) reported that they expected "no participation." Thirty-seven schools reported that their students gained experience "assisting implant surgery," and three schools said their students experienced "performing implant surgery." One school reported no surgical experiences for its students.

Regarding implant restoration, students were expected to "be capable of restoring some implant cases" in 32 schools (68%), to "participate in restoring implants" in ten schools (21%), and to "be skilled in restoring implants" in four schools (9%). The procedures in which students participated are listed in Table 4. "Diagnosis and treatment planning" was part of implant instruction in nearly all schools

(n=46; 98%). Common complications of predoctoral implant treatments were "restoration" (reported by 26 schools), "surgery" (24 schools), and "patient management" (seven schools).

Of the 47 schools, 29 (62%) perceived that their students' current level of clinical experiences was adequate for their predoctoral program. Table 5 lists areas that respondents considered to be inad-

Table 1. Disciplines involved in school's implant core curriculum, by number and percentage of total responding schools (n=47)

Discipline	Number	Percentage
Prosthodontics	43	91.5%
Periodontics	32	68.0%
Oral surgery	29	61.7%
Implantology	27	57.4%
Operative dentistry	5	10.6%
Other	3	6.4%
Endodontics	3	6.4%

Note: Respondents could select all that applied. Those who selected "Other" specified "a few basic science courses" and "restorative dentistry."

Table 2. Average time spent in components of didactic implant education at responding schools (n=47)

Component	Average Number of Hours Spent	Minimum	Maximum
Lecture	17	0	72
Problem-based learning	3	0	24
Self-study	3	0	20
Other activities	11	0	90

Note: Responses in "Other activities" were "case-based teaching" and "case presentation."

Table 3. Procedures included in implant laboratory exercises, by number and percentage of responding schools (n=47)

Procedure	Number	Percentage
Implant impression making	41	87.2%
Fabrication of surgical template	35	74.4%
Fabrication of provisional for implants	33	70.2%
Hands-on experiences with definitive restorative materials for implants	27	57.4%
Simulation of surgical implant placement using a plastic/styrofoam jaw	21	44.7%
Fabrication of radiographic template	19	40.4%
Simulation of surgical implant placement using a manikin typodont	10	21.3%
Others	8	17.0%
Simulation of surgical implant placement using a stone cast	1	2.1%

Note: Respondents could select all that applied. Respondents who selected "Others" specified "diagnostic wax-up," "computer lab with virtual treatment planning (Simplant)," "overdenture exercise," and "cast fabrication."

Table 4. Predoctoral students' involvement in implant restorative treatment, by number and percentage of responding schools (n=47)

Response	Number	Percentage
Diagnosis and treatment planning	46	97.9%
Fabrication of provisional for implants	38	80.9%
Implant impression making	45	95.7%
Pouring up models	32	68.1%
Selection of prosthetic components	39	83.0%
Conversion of conventional denture to implant overdenture	34	72.3%
Fabrication of definitive restorations	32	68.1%
Other	1	2.1%

Note: Respondents could select all that applied. Respondent who selected "Other" specified "writing of laboratory work."

Table 5. Areas said to be inadequate in predoctoral clinical implant experiences, by number and percentage of responding schools (n=47)

Area	Number	Percentage
Diagnosis and treatment planning	9	19.1%
Restorative	16	34.0%
Surgical	9	19.1%
Other	2	4.3%

Note: Respondents could select all that applied. Respondents who selected "Other" specified "writing of laboratory work."

Table 6. Clinical requirements in predoctoral implant education, by number and percentage of responding schools (n=47)

Requirement	Number	Percentage
Treatment planning	24	51.1%
Completion of single-tooth implant restorations	23	48.9%
Completion of implant overdenture	18	38.3%
Maintenance/recall	17	36.2%
Surgical observation	15	31.9%
Surgical assistance	10	21.3%
Other	6	12.8%
Completion of implant partial denture	4	8.5%
Completion of implant-supported fixed dental prosthesis	4	8.5%
Completion of implant fixed complete denture	1	2.1%

Note: Respondents could select all that applied. Respondents who selected "Other" specified "assisting in at least 3 restorative dental implants," "students must complete either a STI or an IOD, not both," "completing one restoration," "fabricate surgical and radiographic stent," and "completion of any of restorations."

equate in their predoctoral clinical implant education. Sixteen schools (34%) indicated that the education was "inadequate" with regard to the restoration of implants. Table 6 reports the responding schools' predoctoral clinical requirements that included implant procedures. While 20 schools (43%) reported implant procedures were not a requirement, 38 (81%) reported that predoctoral implant patients participated in recall/maintenance program at their institution, and nine (19%) reported no recall program for implant patients.

Common challenges reported in providing predoctoral implant education were "clinical cost of implants" (31 schools), "shortage of trained faculty" (24 schools), "shortage of patients" (20 schools), and "cost of implant parts" (11 schools). Planned improvements for the future included increased time on treatment planning, surgical experiences, recruitment of patients, and expansion of implant curricular hours. This expansion included number of laboratory and clinical exercises, as well as hiring additional faculty members who are adequately trained in implant surgery and restorative procedures. Digital dentistry simulation systems and surgical template use were also mentioned as areas needing improvement.

Discussion

Dental implants have been increasingly used in oral rehabilitation with high survival rates, predictability, and patient acceptance.^{17,18,22-26} There is a need for well-designed predoctoral implant curricula that adequately prepare dental students to care for patients who can benefit from implant treatments. Not only do students need to understand treatment; they also need to know how to manage complications of treatment.

Implant education was part of the core of the predoctoral curriculum in all of the 47 U.S. and Canadian dental schools that responded to this survey. This percentage is consistent with the trend of an increase in the number of schools' implementing implant curricula over the past decades (33% of respondents in 1974 to 97% of respondents in 2004).^{8,27-29}

Our study found a decrease in hours of the didactic portions of implant education from 20.4 hours (reported in a 2002 survey of U.S. dental schools¹⁰) to the 17 hours in our study. This trend may be attributed to increases in laboratory and clinical exercises and other modes of learning such as problem-based learning, case-based teaching, case presentations,

and hands-on simulations. However, the average number of hours spent on implant laboratory exercises increased by 2.4 hours when compared to the study published in 2002. Therefore, the total number of hours of predoctoral implant education remained the same, about 20 hours, but had increased the use of active methodologies.

Our survey also found that 92% of the 47 U.S. and Canadian schools were using a “team approach” with multiple disciplines and prosthodontists as the core faculty. Prosthodontics was the main discipline involved in Barwacz et al.’s survey published in 2015 as well.¹⁶ This discipline creates a focus on restoratively driven clinical exercises and treatment planning. Furthermore, 42 of the schools (89%) had introduced observation of implant surgery and/or assisting with implant surgery. However, 18 schools (38%) reported needing improvement in the level of clinical experiences for their predoctoral program, especially restorative experiences, diagnosis/treatment planning, and surgical exposures.

Improvements to predoctoral implant education are dependent on synergies among educators, manufacturers, and accreditation standards. High market demand and an implant restorative requirement for accreditation will motivate dental schools to develop curricula to achieve student competence. To increase predoctoral students’ clinical experiences in implant dentistry, educators may need to develop ways to facilitate collaboration between departments and advanced graduate programs. It will be important to find ways to make these treatments more accessible to patients as well. Reducing costs may also require implant manufacturers to work with dental schools to offer their implant systems at reduced rates for preclinical and clinical implant exercises. Students’ implant experiences will still be limited by these factors.

Endeavors to explore and assess the most effective teaching methods in predoctoral implant education should be made to maximize the benefits of the training. Simulation systems for diagnosis and implant surgical experience may become valuable tools to assist predoctoral students in achieving competence in providing implant treatments. Furthermore, these technologies could significantly help to reduce common complications in predoctoral clinical care.

We did not include the use of digital dentistry for surgery and restoration in the survey, which may be a limitation of this study and should be considered

for a future study that might include additional variables such as geographical location, private versus state schools, and number of students per school. We will also need to consider ways to improve the response rate.

Conclusion

The results of our study support previous ones in documenting the increasingly widespread presence of predoctoral implant education in the dental schools of North America. The main changes found in our study were a decrease in didactic lecture hours and an increase in both preclinical exercises and clinical experiences. Our respondents also identified multiple challenges in implementing a comprehensive predoctoral implant curriculum, notably expense of implant systems to the schools and to patients, shortage of predoctoral cases, and lack of curriculum time and trained faculty. As educators continue to modify the structure and content of implant education, new methods of training that incorporate simulation systems should be explored to maximize the outcomes of the predoctoral implant experience.

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