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# Eleven-Year Report on a Predoctoral Implant Dentistry Program

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## Abstract

**Purpose:** An elective program on implant dentistry was started in the summer of 1994 at the University of Detroit Mercy School of Dentistry (UDM). The program provides comprehensive didactic and clinical training in implant dentistry to a select group of senior dental students. This study describes the program and clinical results of the first 11 years of the elective program in implant dentistry at UDM.

**Materials and Methods:** The program is 1 year long and is offered to a group of 10 senior students out of a class of 72. In addition to a one-semester lecture course offered to all dental students, students in the elective program participate in a one-semester seminar which includes literature review and "hands-on" surgical and prosthodontic components. Patients are assigned during the summer term to students who work in pairs. Students actively participate in diagnosis and treatment planning, assist in surgery, and accomplish the prosthodontic procedures. Prosthodontic services include single-tooth restorations, multiple-unit fixed restorations, overdentures, and full-arch fixed prostheses. A retrospective analysis of the patients treated in the first 11 years of the program was conducted.

**Results:** During the first 11 years of the program, 159 implants were placed in 70 patients. There were a total of 10 failed implants in seven patients (failure rate 6.3%): eight implants prior to loading and two following loading. Minor complications included gold screw loosening, gold screw fracture, porcelain fracture, and soft tissue inflammation, which occurred in less than 5% of the patients.

**Conclusions:** The rates of implant failure and complications in the first 11 years of the elective implant program at UDM appear to be within an acceptable range when compared to other educational programs and studies reported in the dental literature.

Long-term multicenter studies have supported predictability of implant success.[1-3] Chappell found that only 20% of dental schools in 1974 required implant-related lectures for undergraduate and graduate students.[4] Since then, implant dentistry has been incorporated more extensively into predoctoral and postdoctoral curricula.[4-6] The National Institute of Dental Research/National Institute of Health sponsored a consensus conference on dental implants in 1988 which attracted 1300 participants.[5] In 1990, the American College of Implantology and the University of Pittsburgh presented curriculum guidelines for predoctoral implant dentistry, which were published by the American Association of Dental Schools (AADS).[7]

A survey by Weintraub et al in 1995 indicated that 86% of dental schools participating in the survey had implemented a predoctoral implant dentistry program[8] and a similar level of interest was noted by Lim et al in 2005.[9] Petropoulos et al,[10] in a survey of deans of US and Canadian dental schools, reported that 97% of dental schools have didactic instruction, and 86% have clinical implant experience at the predoctoral level; however, only 13% of the schools that provide clinical experience have a predoctoral clinical competency requirement in implant prosthodontic procedures.[10]

There are different approaches for teaching predoctoral implant dentistry.[11] Some schools offer the implant program to all dental students. Those students are involved in both surgical and prosthodontic treatments.[12] Other schools allow only a limited number of students to participate in the implant dentistry program.[11,13-16] Exposure to implant treatment at the predoctoral level has been correlated with an increase in the use of implants in general practice.[16,17]

Despite the inclusion of implant dentistry in the predoctoral curriculum at many schools,[8–10] there are few reports in the dental literature regarding clinical outcomes of these programs.[12,13,15] Bell et al[13] reported the integration of all implants placed in a 1-year pilot study with Calcitek® (Zimmer Dental, Carlsbad, CA) implants. Cummings and Arbree[15] reported no loss of implants or prostheses in a 5-year study with IMZ® (Interpore International, Irvine, CA) implants. Wilcox et al[12] reported a 3-year surgical success rate of 91% and a 5-year surgical success rate of 87% using Lifecore® (Lifecore Biomedical, Chaska, MN) implants.

At the University of Detroit Mercy School of Dentistry (UDM), all students receive basic didactic information regarding implant dentistry in their junior year; however, the current philosophy at UDM is to have implant treatment provided by only a select group of students. This paper describes the program and the clinical results of the first 11 years of the elective program in implant dentistry at UDM.

## Description of the UDM implant program

### Student selection process

The program is 1 year long and is offered to a group of 10 senior students out of a class of 72. Applicants are rated by the faculty in the categories of clinical competence in prosthodontics and restorative dentistry, patient management, performance in oral surgery, and class rank. A numerical value of 1 to 3 is assigned for each category by the clinical faculty on a worksheet. Students are selected based on the total number of points. Faculty include prosthodontists, oral and maxillofacial surgeons, and periodontists. Occasionally, a selected student will decline acceptance to the program if they are concerned about the time commitment for the program or their perceived lack of progress toward graduation requirements.

### Didactic component

In addition to the one-semester lecture course offered to all dental students at the end of their junior year, students in the elective program participate in a one-semester seminar, which includes a literature review and a "hands-on" component in the first semester of their senior year. This course is comprised of 14 sessions of 1.5 hours. Problem-based learning is employed as a didactic teaching method.[14] During the last 30 minutes of these sessions, students meet in small groups to analyze patient cases prepared for the course. Students review the patients' problems, identifying areas where they need to study. The faculty use nondirective questions to facilitate group problem solving and to promote interaction among students. Faculty members from the Departments of Oral and Maxillofacial Surgery and Periodondontology and Dental Hygiene present the didactic material on surgical placement of implants, grafting, and implant maintenance. The prosthodontic aspects are covered by prosthodontists from the Department of Restorative Dentistry. Emphasis is placed on proper case selection, patient management, and post-treatment care.

### Implant surgery simulation

A laboratory project is incorporated in the students' senior year. Prior to this laboratory simulation, a 90-minute lecture is presented to the students. Two students operate in the simulation at each table, and the exercise takes about 90 minutes. A composite mandible is provided for each student with brass fixtures and electrical handpieces. Nobel Biocare® (Yorba Linda, CA) supplies regular platform (3.75-mm width) brass implants in 13-mm length. The proper sequence of instrumentation for implant placement is accomplished with the surgical drills and a screw-form brass implant is placed in a composite mandible.[18]

### Prosthodontic simulation

There is a bank of previously treated patient information at UDM. There are several implant level master casts with gingival simulation materials. Students use trial abutments to select indicated abutments based on the patient clinical findings. In addition, several implant bar wax-ups and their indices are available to emphasize the importance of treatment planning and the laboratory component. Clinical slides are available from the pretreatment phase and at the time of implant uncovery. The type of abutment and type of restoration are discussed in small group seminars.[18] Alternative treatments are presented and analyzed. In addition, students are taught how to obtain intraoral photos.

### Patient selection and assignment

Implant treatments are provided to selected edentulous and partially edentulous patients. Screening and assignment of the patients are coordinated by the program director in consultation with surgical faculty. Smoking patients are not treated in the predoctoral implant program. Patients with complex needs (e.g., need for extensive grafting) are referred to the faculty practice or graduate programs.

Patients are assigned during the summer term to students, who work in pairs. Students actively participate in diagnosis and treatment planning, assist in surgery, and accomplish the prosthodontic procedures. Prosthodontic services include single-tooth restorations, multiple-unit fixed restorations, overdentures, and full-arch fixed prostheses. The program uses only one implant system (Nobel Biocare) in order to simplify stocking and ordering of implant components and to facilitate maintenance of previously treated patients.

### Maintenance

One of the goals of the program is that the students follow the treatment from start to finish within their senior year. Recall patients are seen during the time of healing following implant placement. Students have lectures pertinent to implant maintenance and soft tissue evaluation from the Department of Periodontology and Dental Hygiene. Dental students in the implant program are taught how to perform oral hygiene around dental implants in conjunction with the hygiene faculty.

### Clinical student evaluation

Students are evaluated using standardized criterion-referenced forms for fixed or removable prosthodontic procedures.[19] Grading is accomplished on a pass/fail basis for clinical skills, preparedness, and initiative. Implant placement is performed in the Oral and Maxillofacial Surgery Clinic or Periodontics Clinic, and students receive credit for surgical assistance. Prosthodontic procedures take place on the general clinic floor and are supervised by designated prosthodontic faculty. Students receive credit for a fixed or removable procedure depending on the type of case treated. Competency in treatment planning and restoration of single-tooth implants is expected.

## Materials and methods

Patient records were reviewed for patients who were treated within the elective program in implant dentistry at UDM for the first 11 years of the program (July 1994 through June 2005). Patients who had treatment started within the study period, but who were in progress at the end of June 2005 were not included in the study. Also, patients who started treatment, but did not follow through with the prosthodontic treatment were excluded. This study was approved by the UDM Institutional Review Board.

## Results

During the first 11 years of the program (September 1994 to June 2005), 70 patients were treated with 159 Nobel Biocare implants. Twenty patients were completely edentulous: nine patients received full-arch fixed restorations on five implants, and 11 received overdentures [seven patients with two implants and ball attachments, and four with bars with ERA/Hader type attachments (Sterngold Dental, Attleboro, MA)]. Fifty patients were partially edentulous: 43 received single-tooth implant restorations, and seven received splinted fixed restorations with two or more implants (Fig 1).

Implant length ranged from 10 to 20 mm. The three most commonly used lengths were 13 mm (45.3%), 15 mm (28.9%), and 10 mm (14.5%) (Fig 2). The most common implant width was the regular platform (86.2%), followed by wide platform (12.6%), and narrow platform (1.3%). A two-stage surgical approach was used in 76.7% of the implants, and a single-stage surgical approach was used in 23.3% of the implants. Grafting was used in eight patients: six with an autogenous block graft and two with Bio-Oss® (Osteohealth, Shirley, NY).

All full-arch fixed restorations were made using standard abutments. Multi-unit abutments were used for the multi-abutment fixed restorations. Single-tooth restorations were made most often using a UCLA abutment (60.3%), followed by a prepable titanium abutment (22.4%), multi-unit abutments with an anti-rotational component (8.6%), and ceramic abutments (8.6%). As a result, 69% of single-tooth restorations were screw-retained, and 31% of single-tooth restorations were cemented.

For the purpose of this study, implant failure was defined as clinically detectable mobility of the implant. There were a total of 10 failed implants in seven patients (failure rate 6.3%): eight implants prior to loading and two following loading. Data for the failed implants are summarized in Table 1. Eight regular platform and two wide platform implants were lost. Most of the implant failures occurred prior to loading (80%). In one

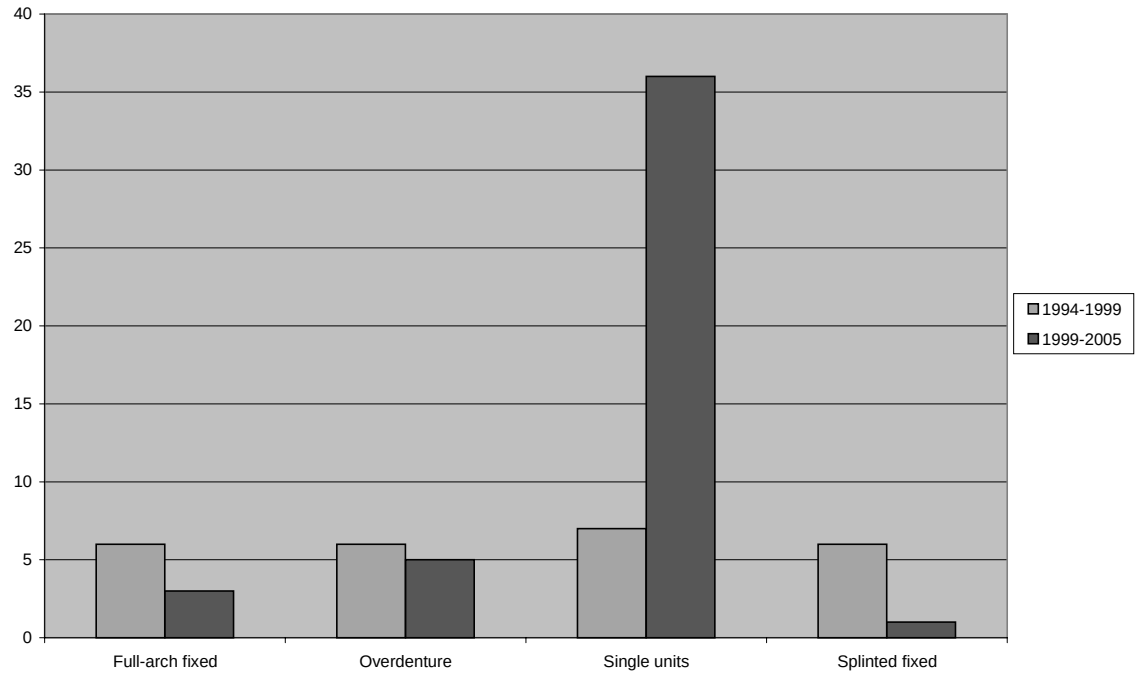


**Figure 1** Comparison of prosthodontic treatment by time period (1994 to 1999 vs. 1999 to 2005).

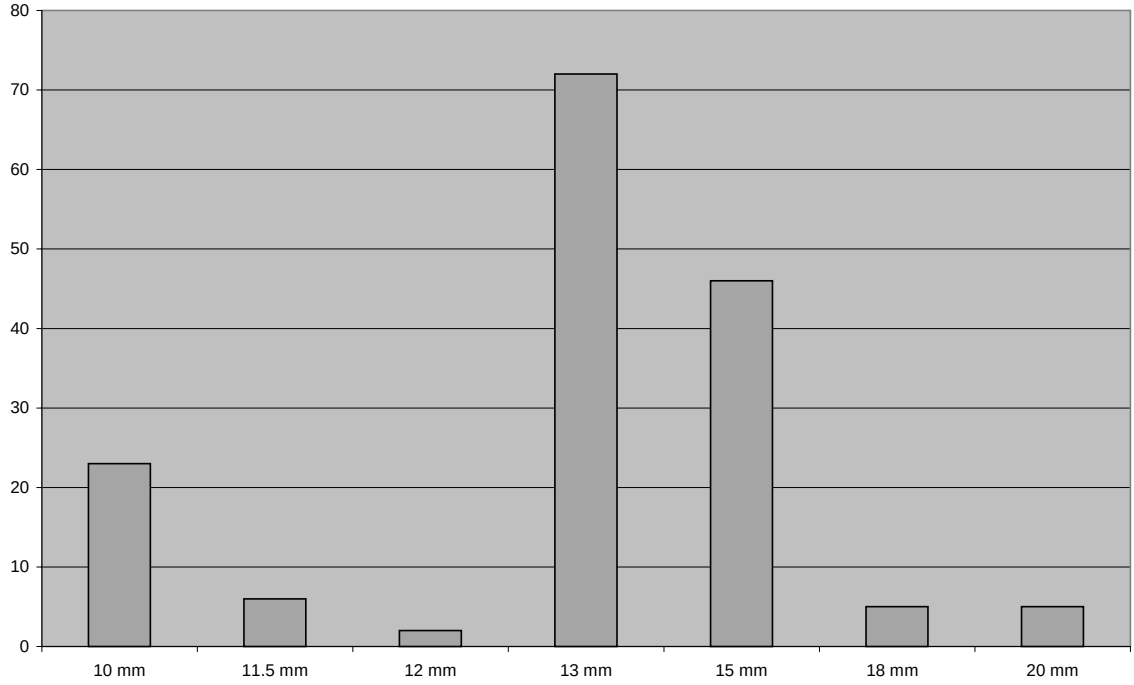


**Figure 2** Number of implants placed, by length.

patient, two implants supporting a two-unit fixed prosthesis in the posterior mandible failed. In this case, the implants were removed and three new implants were placed to support a new two-unit fixed prosthesis. The failure of two implants in another patient led to a change in treatment plan from a full-arch fixed restoration to a bar and overdenture. Minor complications, which occurred in less than 5% of patients, included gold screw loosening, gold screw fracture, porcelain fracture, and soft tissue inflammation.

## Discussion

In the early years of the elective implant program, removable implant-supported prostheses for completely edentulous patients were the predominant service. In recent years, partially edentulous patients have also been treated. Single-tooth implants and implant-supported fixed partial dentures (FPDs) were provided for these patients. During the first 5 years of the program (1994 to 1999), there was an even distribution between the four major case types: single-tooth, fixed (splinted units), overdentures, and full-arch fixed implant restorations. In the 6 years that followed (1999 to 2005), the single-tooth restoration emerged as the primary treatment for 80% of the patient pool (Fig 1). This is consistent with the trend toward single-tooth restoration in predoctoral implant education as reported by Lim et al[9] and Petropoulos et al.[10]

Using a meta-analysis of implants in partial edentulism, Lindh et al reported a pooled survival rate of 93.7% for FPDs and 97.5% for single crowns after 6 to 7 years.[20] Berglundh et al reported an implant loss rate of 2.5% prior to loading

**Table 1** Implant failure data (1994 to 2005)

| Patient | Location | Fail | Platform | Length | Time of failure | Planned restoration | Final restoration | Comments |
|---|---|---|---|---|---|---|---|---|
| 1 | Posterior mandible | 2 | R | 13 | After restoration | Fixed | Fixed | Three implants placed for better support, new restoration |
| 2 | Anterior mandible | 2 | R | 15 | Prior to restoration | Full-arch | Ovd | Bar made on surviving three implants with ovd |
| 3 | Posterior mandible | 1 | W | 10 | Prior to restoration | Single | Single | Graft w. Bio-Oss and new WP implant |
| 4 | Anterior mandible | 2 | R/W | 13 | Prior to restoration | Ovd | Ovd | Canine site RP implant failed, replaced w. WP-also failed, RP in premolar site |
| 5 | Anterior maxilla | 1 | R | 13 | Prior to restoration | Single | Single | New RP implant |
| 6 | Anterior mandible | 1 | R | 13 | Prior to restoration | Single | Single | New RP implant |
| 7 | Posterior mandible | 1 | R | 13 | Prior to restoration | Single | Single | New RP implant |

and 2 to 3% after loading for fixed prostheses and greater than 5% for overdentures.[21] Goodacre et al, in an extensive review of the literature, reported an implant loss rate ranging from 3% for mandibular fixed complete dentures and single crowns to 19% for maxillary overdentures.[22] The rates of implant failure (6.3%) and complications (less than 5%) in the first 11 years of the elective implant program at UDM appear to be within an acceptable range when compared to other educational programs[12,13,15] and implant studies reported in the literature.[20–22]

Some dental schools, such as Creighton University, offer the implant program to all students.[12] At other schools, the opportunity to provide clinical implant treatment may be limited in the predoctoral clinics. The elective implant program selects students who are not only motivated, but also clinically and didactically at the top of their class for participation. This makes the implant training a more meaningful experience for the students, and it enables them to make some independent decisions during the course of patient treatment.

There has been some interest expressed by instructors and dental students to have an implant rotation for the rest of the class not participating in the implant program. This rotation would familiarize students with treatment options available for their future patients following graduation; however, expansion of the elective program would require significant additional resources, including the commitment for an increased allocation of faculty, inventory of implant components, dental materials, and curriculum time.

The elective program in implant dentistry at the UDM is one approach toward the integration of implant dentistry into the dental curriculum. The implementation and operation of a predoctoral implant program should be realistic, simple, and effective. In this program, the incorporation of surgical and prosthodontic simulations is essential for students' performance in the clinic. A concise, focused preclinical exercise including surgical simulation, impression technique, and abutment selection/preparation limited to single-tooth or short-span implant-supported fixed restorations is desirable.

## Conclusions

The rates of implant failure and complications in the first 11 years of the elective implant program at UDM appear to be within an acceptable range when compared to other educational programs and implant studies reported in the literature.

## References


1. Brånemark PI: Osseointegration and its experimental background. J Prosthet Dent 1983;50:399-410
2. Kasemo B: Biocompatibility of titanium implants: Surface science aspects. J Prosthet Dent 1983;49:832-837
3. Hansson HA, Albrektsson T, Branemark PI: Structural aspects of the interface between tissue and titanium implants. J Prosthet Dent 1983;50:108-113
4. Chappell RP: Dental school implant survey. Oral Implantol 1974;5:24-32
5. Bavitz JB: Dental implantology in U.S. dental schools. J Dent Educ 1990;54:205-206
6. Arbree NS, Chapman RJ: Implant education programs in North American dental schools. J Dent Educ 1991;55:378-380
7. American Association of Dental Schools: Curriculum guidelines for predoctoral implant dentistry. J Dent Educ 1991;55:751-753
8. Weintraub AM, Seckinger R, Berthold P, et al: Predoctoral implant dentistry programs in U.S. dental schools. J Prosthodont 1995;4:116-121
9. Lim MV, Afsharzand Z, Rashedi B, et al: Predoctoral implant education in U.S. dental schools. J Prosthodont 2005;14:46-56
10. Petropoulos VC, Arbree NS, Tarnow D, et al: Teaching implant dentistry in the predoctoral curriculum: A report from the ADEA Implant Workshop's survey of deans. J Dent Educ 2006;70:580-588
11. Simons AM, Bell FA, Beirne OR, et al: Undergraduate education in implant dentistry. Implant Dent 1995;4:40-43
12. Wilcox CW, Huebner GR, Mattson JS, et al: Placement and restoration of implants by predoctoral students: The Creighton experience. J Prosthodont 1997;6:61-65
13. Bell FA 3rd, Jones AA, Stewart KL: A clinical implant program in the predoctoral curriculum. J Dent Educ 1991;55:169-171
14. Bell FA, Hendricson WD: A problem-based course in dental implantology. J Dent Educ 1993;57:687-695
15. Cummings J, Arbree NS: Prosthodontic treatment of patients receiving implants by predoctoral students: Five-year follow-up with the IMZ system. J Prosthet Dent 1995;74:56-59
16. Maalhagh-Fard A, Nimmo A, Lepczyk JW, et al: Implant dentistry in predoctoral education: The elective approach. J Prosthodont 2002;11:202-207
17. Huebner GR: Evaluation of a predoctoral implant curriculum: Does such a program influence graduates' practice patterns? Int J Oral Maxillofac Implants 2002;17:543-549
18. Maalhagh-Fard A, Nimmo A: Utilizing surgical and prosthodontic simulations in teaching predoctoral implant dentistry. J Dent Educ 2003;67:222 (ADEA abstract #143)
19. Nimmo A, Knight GW: Patient-centered competency-based education in fixed prosthodontics. J Prosthodont 1996;5:122-128
20. Lindh T, Gunne J, Tillberg A, et al: A meta-analysis of implants in partial edentulism. Clin Oral Implants Res 1998;9:80-90
21. Berglundh T, Persson L, Klinge B: A systematic review of the incidence of biological and technical complications in implant dentistry reported in prospective longitudinal studies of at least 5 years. J Clin Periodontol 2002;29(Suppl. 3):197-212
22. Goodacre CJ, Bernal G, Rungcharassaeng K, et al: Clinical complications with implants and implant prostheses. J Prosthet Dent 2003;90:121-132