IMPLANT TREATMENT IN AN URBAN GENERAL DENTISTRY RESIDENCY PROGRAM: A 7-YEAR RETROSPECTIVE STUDY

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KEY WORDS

Dental implants
General dentistry
Resident education
Survival rates

Survival rates of multiple implant designs placed in various clinical situations average more than 90%. However, little data have been published on the survival rates of implants placed in dental residency programs. This study reports on the outcome of dental implants placed by first-year general dentistry residents in the University of Florida College of Dentistry–Jacksonville Clinic. The patients for this study received both surgical and restorative implant therapy from 1998 to 2005. A total of 263 patients (147 women, 116 men) were treated with dental implants. On average, a patient was 55.5 years old and received 3 implants. A variety of simple and complex restorative procedures were performed. Advanced general dentistry residents in conjunction with supervisory faculty treated all cases. The cumulative implant survival was 96.6%. Follow-up varied from 6 months to 7 years after placement. Cases included implants not yet loaded as well as implants loaded for 6 years or more. The findings of this study compare favorably with published studies and were unexpected in light of the residents' limited clinical experience.

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INTRODUCTION

Implants are a part of everyday dental medicine. It has been estimated that the number of implants inserted annually worldwide approaches 1 million.[1] Dentists in the United States provided an estimated 1 505 500 implant services in 1999.[2] Although only 8.1% of general dentists have placed an implant, 65% use implants in their routine practices.[3–6] Surgical specialists place the majority of implants in the United States. A total of 89.6% of oral and maxillofacial surgeons, 67.9% of periodontists, and 12% of prosthodontists provide this surgical service.[7]

The average number of implants placed annually by dentists increased from 37.7 in 1995 to 56.2 in 1999.[5] It is estimated the market in the United States will increase from $1 billion in 2004 to more than $1.5 billion by 2009.[8] Both of these increases, approximately 50% each, serve as strong indicators that implant dentistry continues to grow and is

becoming an increasingly accepted treatment modality.

This increased demand for dental implants is a result of a combination of factors, including age, tooth loss, poor performance of conventional prostheses, patients' expectations, endorsement by dentists and dental hygienists, and increasing predictability of implant-supported restorations.[9] It may also be attributed to dentists' knowledge of improved procedures, techniques, and protocols.[10] The American Dental Association (ADA) reported findings likely to speed the integration of dental implants into routine dental practice when they stated that implants may provide a "more predictable outcome" than alternative therapies.[11] Furthermore, the ADA reported that "mandibular [implant] overdenture therapy is highly predictable," and that implants used to replace single posterior missing teeth "without the need for partial or full coverage restorations on the adjacent teeth provide the highest quality of care for patients."[11]

According to the ADA, "the average survival rates of multiple implant designs placed in various clinical situations are more than 90%."[11] Implant success increases with surgical experience of the operator. It has been found that cumulative survival rates increase from 94% to 97% after the operator has completed 9 cases.[12] Cumulative implant survival rates as high as 96% have been reported for implants placed by periodontic, prosthodontic, and oral surgical resident–faculty teams.[13] However, little has been published about the results of implant training at the postgraduate general dentistry level. This study, the second of a series, follows a 4-year retrospective study of implants placed by general dentistry residents with 7-year results.[14]

Materials and Methods

This study analyzes and categorizes the implant experiences of patients treated at the University of Florida College of Dentistry–Jacksonville Clinic (UFCD-J) in a 1-year advanced general dentistry residency program. Eight dental residents received training in all areas of general dentistry, including prosthodontics, oral surgery, orthodontics, periodontics, and implant dentistry, in a supervised clinic. Two hundred and sixty-three patients who received 790 dental implants in the clinic from 1998 to 2005 were included in this study. Study subjects were existing patients who received all treatment at UFCD-J. All patients received a comprehensive evaluation and treatment plan by general dentistry residents in consultation with UFCD-J faculty. Some patients presented to the clinic seeking implant dentistry, but in most cases the treating dental residents recommended dental implant treatment.

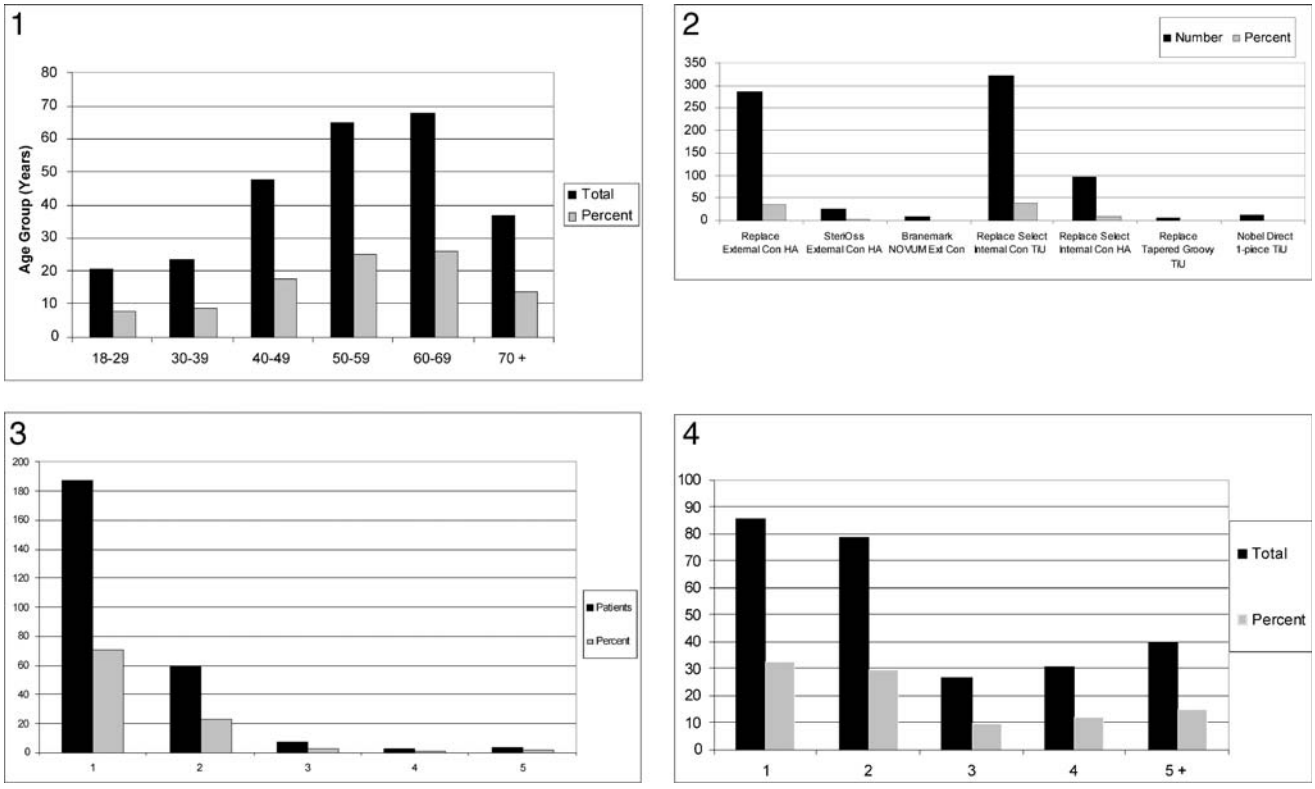
Data were collected from the UFCD-J administrative database. A spreadsheet (Microsoft Excel 2002, Microsoft Corp, Redmond, Wash) was developed to record relevant patient information on a desktop computer. The information was sorted by sex, age, implant system, number of implants per patient, restorative plan, case cost, surgical characteristics, and implant health status.

Results

The population consisted of 147 women (56%) and 116 men (44%). The patients were categorized into 6 age groups (Figure 1). The group with the highest percentage of patients (26%) was between the ages of 60 and 69 years, whereas the group with the lowest percentage of patients (8%) was between 18 and 29 years (the youngest age group). Implants manufactured by 4 different implant companies were used: Ankylos/Xive (Dentsply Friadent GmbH, Mannheim, Germany), Nobel Biocare/SteriOss (Nobel Biocare, Yorba Linda, Calif), Taper-Lock (Zimmer Dental, Carlsbad, Calif), and ITI (Strauman, Andover, Mass). The majority of patients (98%) received implants manufactured by Nobel Biocare. Of these implants, 39% had external connections, 59% had internal connections, and 2% were solid implant–abutment systems (Figure 2).

Most patients (71%) had their implants placed in 1 surgical appointment, whereas 23% had multiple implants placed in 2 implant placement appointments, and 6% required 3 or more implant placement appointments (Figure 3). Single implants were placed in 33% of the patients, 2 implants were placed in 30% of the patients, and 3 to 15 implants were placed in the remaining 37% of the patients (Figure 4).

Figures 5 and 6 present surgical information. Thirteen percent of patients had implants placed at the time of extraction, and 13% had implants immediately loaded at the time of the implant placement. Bone grafts for the purpose of ridge augmentation or to fill the void between the implant body fixture and the walls of the extraction socket were placed in 36% of the patients. Resorbable membranes, Biomend Extend (Zimmer Dental), or Alloderm (Lifecell Corp, Branchburg, NJ), either separate from or in addition to bone grafts, were placed in 13% of the patients. Fifteen



FIGURES 1–4. FIGURE 1. Patient age at surgery. FIGURE 2. Nobel Biocare implant type. FIGURE 3. Surgical appointments per patient. FIGURE 4. Implants per patient.

percent of patients had sinus lifts to allow implant placement.

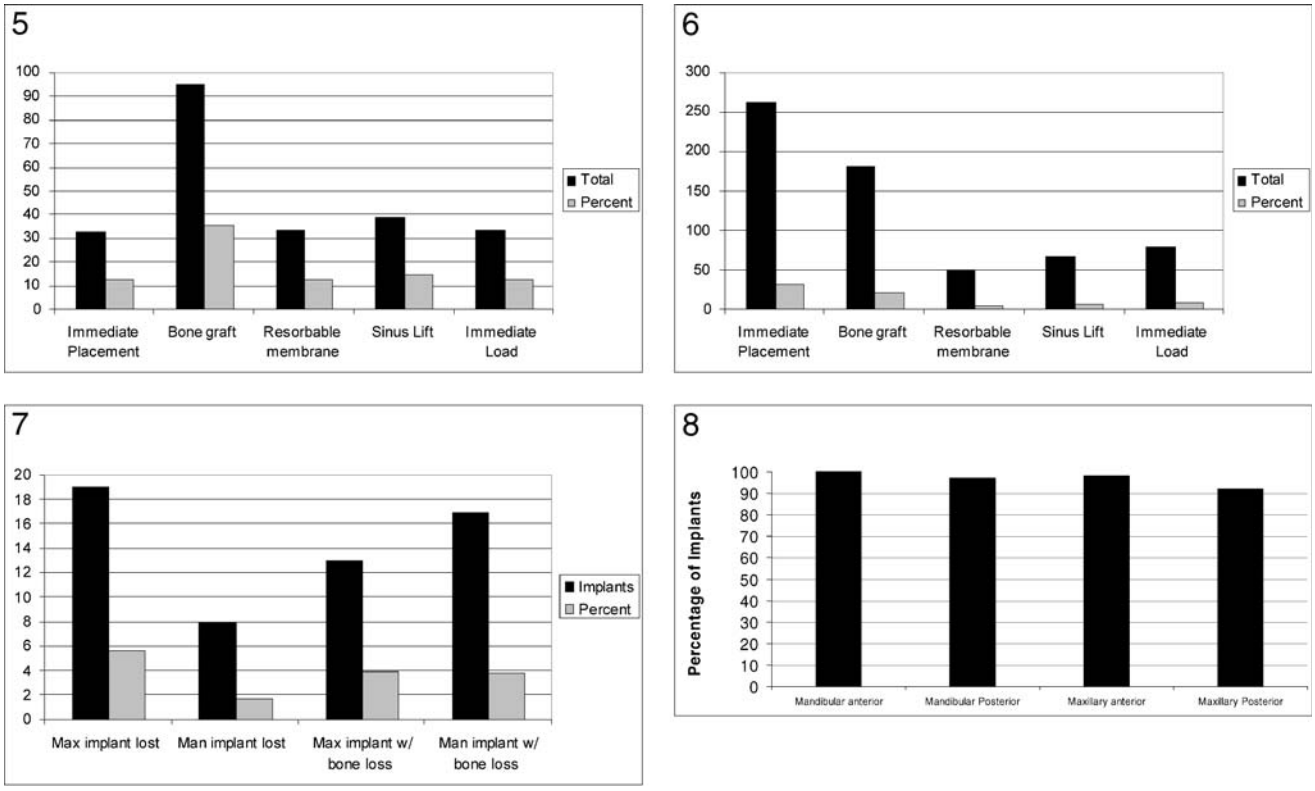
A total of 790 dental implants were placed in 263 patients. The cumulative implant survival was 96.6%. Follow-up varied from 6 months to 7 years after placement. Twenty-seven implants (19 of 333 maxillary implants and 8 of 457 mandibular implants) failed and had to be removed (Figure 7). The locations of the lost implants are summarized below and described in Figure 8:

- 3 of 137 maxillary anterior implants lost = 98% survival
- 16 of 196 maxillary posterior implants lost = 92% survival
- 8 of 293 mandibular posterior implants lost = 97% survival
- 0 of 164 mandibular anterior implants lost = 100% survival

In 15 cases, the implants were removed and replaced with successful implants. In the remaining cases, the site received bone grafting before implant placement or an alternative to implant treatment was planned.

Thirty implants had bone loss requiring treatment. The distribution of bone loss is reported in Figure 9. Of the patients receiving implants, 7% of men and 8% of women experienced bone loss that was successfully halted or reversed with combinations of implant detoxification, bone grafting, and resorbable membranes. Figure 10 shows the distribution of implant restorations. The largest group of implants (35%) was restored with cemented splinted restorations, either fixed partial dentures or adjacent crowns. Eighty-one patients (31%) received this form of treatment on a total of 280 implants. Two hundred twenty-seven implants (29%) were restored with cemented single-tooth restorations in 145 patients (55%). Forty-eight patients (18%) received implant-supported removable dentures on a total of 153 implants (19% of implants). One hundred twenty-six implants were used to support 25 screw-retained fixed prostheses (16% of implants) in 22 patients (8%). To date, 8% (7 men, 15 women) of the study population have not had their implants restored.

The average cost of treatment was $12 520, with a range of $1000 to $37 500. This information provides some insight to the surgical and restorative complexity of the cases included in the study. Although some cases were quite complex, others were relatively simple. Figure 11 shows that the highest percentage of patients, approximately 27%,



FIGURES 5–8. FIGURE 5. Surgical information: patients. FIGURE 6. Surgical information: implants. FIGURE 7. Number of ailing or failed implants and bone loss. FIGURE 8. Implant survivability by location.

spent between $3000 and $6000 for the total cost of the surgical and prosthodontic treatment. Additionally, 21% of the patients spent less than $3000 and 21% of the patients spent between $6000 and $9000. Twenty percent of the patients spent more than $12 000.

DISCUSSION

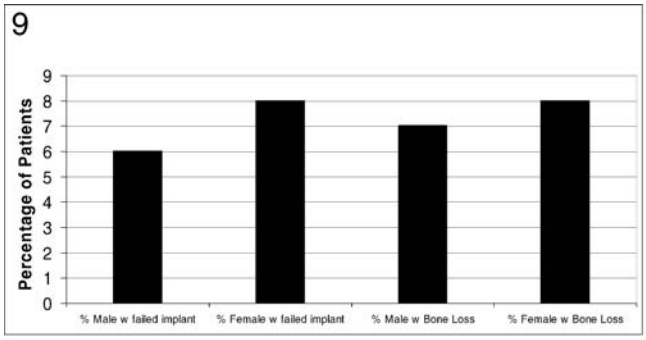
One significant finding in the 4-year study was that women were 4 times as likely to experience excessive marginal bone loss around implants than were men. Sixteen percent of women who received implants had excessive bone loss requiring surgical intervention compared with 4% of the men. This expanded study did not substantiate the results previously found. Instead, 7% of men and 8% of women experienced marginal bone loss.

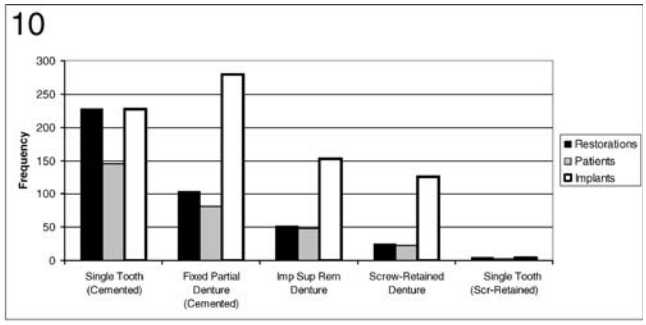
In the earlier study, the age group of 50 to 59 years was the largest, whereas the expanded study found the most patients in the age group of 60 to 69 years. The average case cost increased from $6161 to $12 520 in the 7-year study. This may be due to several causes, such as the increasing case complexity as the residency program faculty gained experience, the increased patient age at treatment, and the increased cost of components and laboratory fees.

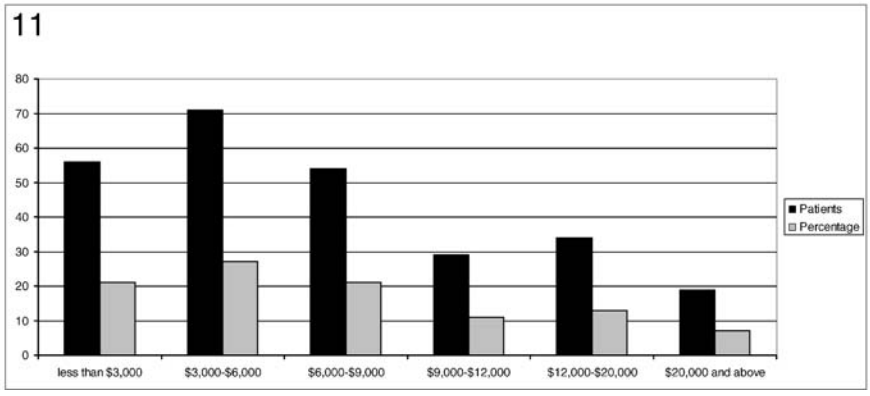
Although only 33 patients (13%) received immediate implants, 264 of the 790 implants (33%) were immediately placed at the time of extraction. This high percentage is because of the numerous advantages of immediately placed implants, including reduction of number of surgeries, prevention of bone loss, preservation of hard and soft supporting tissues, decreased expense, and reduction in the use of bone grafts and resorbable membranes.

The increased trend of immediate loading of implants is reflected by the fact that 34 patients (13%) had 80 implants (10%) loaded at the time of implant placement. This was accomplished with full arch splinted provisional restorations, as well as single-unit provisionals placed onto 1- or 2-piece implants.

One of the largest changes from the earlier study was the type of restoration. The largest single group of restorations remained the single-unit cemented crown: 227 crowns on 227 implants (29%). However, 104







FIGURES 9–11. FIGURE 9. Ailing or failed implants by sex. FIGURE 10. Implant restoration type. FIGURE 11. Cost per patient.

splinted restorations were used to restore 280 implants (35%). One hundred fifty-three implants (19%) supported 51 removable complete dentures. Twenty-five arches were restored with screw-retained fixed dentures supported by 126 implants (16%). Again, this increased complexity of the restorations may be attributed in large part to increased surgical and restorative experience of the residency program faculty, as well as increased patient age at treatment.

The implants placed by general dentistry residents exhibited survivability similar to other reports in the literature. None of the 164 implants placed between the mental foramen were lost. The pattern of implant loss by location parallels the expected quality of bone available in different areas of the mouth.

CONCLUSION

In this study, case complexity increased as faculty gained surgical and restorative experience. Trends toward increased immediate placement (33%) and immediate loading (10%) were demonstrated. Implants placed by advanced general dentistry residents achieved cumulative survival rates as high as those reported for experienced clinicians.

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