

Survival and Success of Dental Implants Placed in a University Setting

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ABSTRACT

Purpose: The aim of this study was to assess the impact of experience and specialty training on the success and survival of dental implant therapy for single-unit fixed restoration of missing teeth in a university setting.

Methods: A retrospective study was conducted using data from the electronic patient record system at the Adams School of Dentistry. The Office of Computing and Information Systems provided dental records from January 1, 2013 to December 31, 2018, following the inclusion criteria. The records were manually reviewed by one evaluator (TC). Extracted from the records were subjects' demographics; medical, dental, and social history; implant parameters; grafting procedures; and timing of placement/restoration/loading. Also recorded were the specialty training and level of experience, i.e., pre-doctoral student, resident, and faculty; the restoration type; radiographic confirmation of osseointegration before restoration; and occlusal splint fabrication. Fisher's Exact Test was applied to determine if the providers' specialty training and experience had any statistical significance on implant success and survival.

Results: A total of 501 implants were included in the study. Statistically significant were provider training (AEGD versus specialties, implant survival and success), subject's gender (implant survival), implant type/manufacture (implant survival and success), and immediate placement (implant survival). The overall survival rate was 97.0% while the success rate was 85.4%.

Conclusion: The type of clinical training impacted implant outcome, only when comparing AEGD versus specialties. Operator's experience has no significance on the results.

Introduction

Dental implants are a common treatment modality for treating edentulous areas due to their conservative approach, great esthetic outcome, and predictability. The reasons why implants fail, however, are still not fully understood. Associations have been made suggesting that smoking, poorly controlled diabetes, and periodontitis may negatively impact implant success and survival. In this regard, the impact of the level of providers' clinical experience and specialty training on dental implant survival and success has yet to be fully understood.

In a recently published systematic review including approximately 2,700 implants, the 10-year survival rate of dental implants was reported to be 96.4%.¹ Most studies included in that review were completed in a university setting and did not include novice surgeons (i.e., residents or pre-doctoral dental students). Despite this, studies in the university setting have consistently found survival rates exceeding 97%.^{2,3} A 99% 5-year survival rate for single-unit implants was recently reported in a retrospective study² while another study with a mean follow-up time of 5.8 years reported a survival rate of 97.2% for implants placed by graduate and restored by pre-doctoral students.³ When the performance of novice providers is assessed, limited studies are available and usually only include one specialty. When implants placed and restored by pre-doctoral students were evaluated, a survival rate of 99.7% was reported.⁴ However, some of the implants had been in place for only a week, with an average of less than 2 years of function among the implants included in the study.⁴ A limited study by Sonkar *et al.* compared implant outcomes between three different

specialties and levels of training and found that the discipline, residents' year of training, and implant systems had significant associations with implant outcomes.⁵

Despite the experience level of the providers, it seems that dental implants have a high short-term survival rate exceeding 95%. However, limited literature is available on the long-term success of this therapy in reference to provider experience and provider training/specialty with correlation to implant type. Therefore, the purpose of this study is to assess the impact of experience level and specialty training on the success and survival of dental implants as part of the therapy for single-unit fixed restoration of missing teeth. The null hypothesis that the experience level and specialty training do not significantly impact single-unit implant survival and success in a university setting was tested.

Methods and Materials

This retrospective study included dental implants placed at the Adams School of Dentistry (ASOD) between 2013 to 2018. The Institutional Review Board of the University of North Carolina at Chapel Hill approved the study, protocol #22-2338. The Office of Computing and Informational Systems (OCIS) provided the data, which was obtained from the electronic patient record system at the ASOD.

Considered for this study (inclusion criteria) were subjects who had received at least one dental implant from January 1, 2013 to December 31, 2018, were between 18 and 99 years of age, had been seen at least one time after 1 year of implant placement, and had at least one single-unit prosthesis restored at the ASOD clinics.

Not included in this study (exclusion criteria) were subjects who had no radiograph of the implant taken after placement; received a fixed partial denture; received a fixed restoration to replace a full arch, i.e., hybrid denture; or received a removable restoration, i.e., overdenture.

Implant success was defined as the implant being in place and with no radiographic evidence of bone loss during the study timeframe. Implant survival was defined as the implant being in place during the study timeframe. The following data were extracted from the patients' records: subjects' demographics (i.e., age, gender); medical history (i.e., diabetes, bisphosphonate); dental history (i.e., periodontitis); social history (i.e., smoking); implants' brand, size, length, and design; grafting procedures; time of placement (i.e., immediate, early, conventional); type of provider/experience (student, graduate, faculty); specialty of graduate or faculty provider (i.e., Periodontics, Prosthodontics, Advanced Education in General Dentistry [AEGD], Oral Maxillofacial Surgery (OMFS); or General Dentistry); restoration type (screw- or cement-retained); occlusal splint fabrication within a year after restoration delivery; and bone loss (detectable in the radiograph pre- and post-restoration). Bone loss was determined radiographically, i.e., reduction in the crest of bone from the initial height at placement. The analysis was done to track radiographic bone loss, including horizontal and vertical defects. In cases where implants were removed during the second stage surgery, bone loss was assessed based on available radiographs taken at placement, follow-up, and/or day of removal. Five hundred and one implants were enrolled after applying the inclusion and exclusion criteria.

The Fisher's Exact Test was applied to determine statistically significant differences in terms of success and survival for implants placed by faculty versus graduate versus pre-doctoral providers, and implants placed by OMFS, Periodontology, Prosthodontics, and AEGD.

Results

A sample of approximately 1,500 records from 13,000 available records were considered. Among these, 501 records met the inclusion and exclusion criteria. The overall survival rate for implants in this study was 97.0% while the success rate was 85.4%.

Among the implants included in the study, 247 (49.3%) were placed in females and 254 (50.7%) were placed in males. The average subject age was 64.7 years old. Sixteen subjects (3.2%) were considered smokers, 58 (11.6%)

had diabetes, and 28 (5.6%) had a history of bisphosphonate usage. Two hundred and seventy subjects (54.1%) had a history of periodontal disease at the time of placement, determined by the periodontal charting and diagnoses in the patient records. Age, smoking, diabetes, history of bisphosphonate usage, and periodontal disease were not found to be significant with p values of 0.0798, 0.2521, 0.8395, 0.4024, and 0.0850, respectively. Gender was significant for implant survival (p=0.0180). Of the 15 failures, 12 were in female subjects.

Table 1 shows the number of implants placed by each group of providers including the number of failures and survival rate. There was a statistically significant difference between specialty training in regard to implant survival (p<0.0001). The number of days in function for the failed implants ranged from 28 to 1361 days, averaging 469.9 days.

Table 1. Number of implants placed and failures by provider (faculty vs. residents in different specialties and pre-doctoral students).

Provider	# of Implants Placed	# of Failed Implants	Survival Rate
Faculty	284	8	97.2%
Periodontology	227	5	97.8%
Prosthodontics faculty	31	3	90.3%
OMFS faculty	26	0	100%
Residents	212	7	96.7%
Periodontology	143	1	99.3%
Prosthodontics	38	0	100%
OMFS	19	0	100%
AEGD	12	6	50%
Pre-doctoral Students	5	0	100%
Total	501	15	97%

Commented [MP1]: Change order in this table to:

- Periodontology faculty
- Periodontology residents
- Prosthodontics faculty
- Prosthodontics residents
- OMFS faculty
- OMFS residents
- AEGD

What is residents? Which ones?

What is faculty? Which ones? Generalists?

Pre-docs

Commented [MP2R1]: Where are the general dentists and the operative groups here??

The implants placed were 61.3% from Astra including EV, EVPS, EVS, TX, and TXS designs; 31.9% from Straumann including BL, BLT, SP, and TL designs; 3% from Zimmer BioMet including the T3, TSV, and TM designs; 0.2% from CeraRoot (CeraRoot 16); 2.8% from Nobel (NobelActive and NobelReplace); and 0.8% from BioHorizon (RBT design). Nine implants (1.8%) were tissue-level while 492 (98.2%) were bone-level. The average length of the implants placed was 9.9 mm. The implant type/manufacturer was significant for survival and success (p<0.0001). Of the 15 failures, four (of 307) were with Astra implants, six (of 14) were Nobel Biocare, two (of 160) were Straumann, and three (of 11) were Zimmer. Bone loss was noticed around 39 (of 294) Astra implants, two (of four) BioHorizon implants, three (of four) BioMet implants, nine (or 14) Nobel Biocare implants, 13 (of 147) Straumann implants, and three (of 11) Zimmer implants.

Prosthodontics faculty restored 115 implants (24.0%), Operative Dentistry faculty restored 90 implants (18.8%), pre-doctoral students restored 89 implants (18.6%), General Dentistry faculty restored 77 implants (16.1%), graduate students in AEGD and Prosthodontics restored 41 implants each (8.6%), graduate students in Operative Dentistry restored 20 implants (4.2%), and graduate students in Periodontology restored six implants (1.3%).

Forty-seven implants were immediately placed (9.4%), 12 were immediately provisionalized (2.4%), 147 had bone grafts at the time of placement (29.3%), and 163 sites were grafted before implant placement, consisting of either socket preservation or guided bone regeneration (32.5%). Immediate placement was statistically significant for survival (p=0.0086) with five of the 10 immediate placed implants failing.

One hundred and forty-eight restorations (31.0%) were screw-retained while 329 (69.0%) were cement-retained. Additionally, only 20 subjects (4.3%) had a record of an occlusal splint being delivered within 1 year of the insertion of the implant restoration. The average days from implant placement to the time of restoration insertion was 241 days with a median of 185 days. The earliest restoration was placed on day 143 and the latest on day 289 from implant placement.

Of all the implants that had follow-up radiographs (474 implants), 69 showed evidence of radiographic bone loss (14.6%) at some point. Four hundred and seventy-four implants were included in this portion of the study as the other implants did not have radiographs taken within 1 year.

Discussion

Based on the exclusion/inclusion criteria, a total of 501 implants were included in this study. The main objective of this study was to see if clinician experience and specialty training had any impact on implant survival and success. The results showed a statistically significant impact of specialty training, only when considering the AEGD versus specialty programs. The operator's experience had no effect on implant survival and success. Thus, the null hypothesis was partially rejected.

The overall survival rate for implants in this study (97.0%) is similar to that of other studies, while the success rate was 85.4%. The data should be considered with caution considering the limited sample size population. Overall, the survival rates seem to be consistent with the accepted literature values, albeit on the higher end of the accepted ranges.^{1,2} The only surgical parameter that was found to be significant was the immediate placement which had a p-value of 0.0086.

Implant type/manufacturer was found to be significant while other parameters (i.e., diameter and length) were not significant to the survival and success of the implants. The former finding is not in concordance with the current literature and reported implant survival rates.^{1,8}

The findings from this study show that the experience of the provider was not statistically significant but the area of specialty training was, with a caveat. The high failure rates in the AEGD program may have skewed the results and should be carefully assessed. A low number of the total implants placed and the fact that the six failures were in the same subject should be emphasized as it adds bias. There are studies showing that AEGD residents, according to the faculty evaluations, can achieve competency in implant placement and restorations during their AEGD residency.⁶ Another study showed 96.6% survival rate for dental implant cases competently by AEGD residents.⁷ The calculations show that the training was significant for survival and success but only between the AEGD versus other specialties.

One of the limitations of this study was caused by the electronic record-keeping program. Having a standardized note form within an institution would be helpful for accurate data gathering. Another limitation is the low sample size for certain parameters or collected data (for example, multiple implant failures in the same AEGD patient). This could possibly skew the results and a larger sample size would need to be collected to confirm our findings.

Conclusion

Based on the data analysis, we conclude that specialty training may have an impact on implant survival and success. In addition, none of the subjects' demographics were significant for implant survival and success except gender, but only for survival. Implant type/manufacturer was significant for survival and success, but all other implant parameters were not. And surgically, immediate placement was significant for implant survival only.

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