Programmatic Assessment of a University-Based Implant Training Program Using Patient-Reported Outcomes


Abstract: The University of Kentucky College of Dentistry (UKCD) established an implant training program that provides training in the use of a single implant system, evidence-based diagnostic and treatment protocols (standardized work practices), and a total quality management system (Implant Quality Assurance Program). The aim of this study was to assess the programmatic effectiveness of the UKCD implant training program by reporting the success and survival of implants placed, using patient-reported outcomes and comparing them to previously established benchmarks. A total of 415 patients (963 implants) were interviewed, approximately 50 percent of all qualified patients. The implant survival rate was 97 percent, and 88 percent of the implants were considered successful (as determined by patient-centric criteria). These outcomes were consistent with the program's previously established benchmarks of 90 percent. These results suggest that work standardization (in the form of specific treatment protocols) and the use of a formal, incremental learning system can result in positive patient outcomes. Clinical outcomes should be monitored in academic dental settings as part of clinical process improvement, and these outcomes can provide a means of assessing the effectiveness of the training program.

As the use of implants to replace missing teeth has become commonplace, there is increasing emphasis on providing adequate education in implantology for dental students. Dental schools have responded by incorporating implant training into their curricula although the content and duration of these programs vary considerably. A survey of U.S. dental schools reported in 2006 that 97 percent of responding schools incorporated implant education into their predoctoral curricula although the content and duration of these programs vary considerably. A recent survey of European dental schools (conducted in conjunction with the 1st European Workshop on Implant Dentistry) found that all those responding incorporated implant education into their training programs. That survey, however, found considerable heterogeneity in the educational experiences offered. Although all schools offered didactic or theoretical implant education, only 44 percent offered training in implant restoration to predoctoral students. Most of the restorations placed during the training programs were single crowns on posterior teeth, while restoration of implant overdentures was included in only 9 to 23 percent of the programs. Over the past two decades, incorporation of clinical implant training in predoctoral curricula has increased considerably. Such clinical programs provide training to dental students in evidence-based diagnosis and treatment planning and management of dental implant cases. A study conducted at the University of Detroit Mercy School of Dentistry showed that students participating in the implant dentistry elective program were more likely to place
and restore dental implants in their dental practices after graduation in comparison to students who did not participate in the program. Similar findings were reported at Creighton University School of Dentistry by Huebner. New York University College of Dentistry instigated a clinical dental implant program for its predoctoral students and found increased student awareness of dental implants as a treatment option. When Kido et al. assessed the effectiveness of a hands-on implant training program for predoctoral students at their university, they found a change in students’ opinions about the replacement of missing teeth, with an increase of approximately 30 percent among those choosing an implant and a decrease of 40 percent of those choosing a fixed bridge. In regards to patient satisfaction, Harrison et al. found a similar level of overall satisfaction among patients for implant treatment performed by students and experienced practitioners.

The subject of assessment of learning outcomes in implant dentistry was recently reviewed as part of the proceedings of the 1st European Workshop on Implant Dentistry. These authors recommended an assessment model described by Miller (Figure 1) and suggested that lower competency levels (“Knows” and “Knows How”) can be assessed by oral or written verbal techniques whereas higher competency levels (“Shows How” or “Does”) are best assessed by self-reflective instruments, such as portfolios or diaries. Presumably, the assessment of overall programmatic effectiveness might be made on the basis of the collective results of the individual learners, although this conclusion is not explicitly stated.

An alternative and novel method of assessing the overall effectiveness of a clinical teaching program is the measurement of actual clinical outcomes that are of interest to the patient (i.e., patient-centered or “patient-centric” outcomes). When this technique is used, clinical quality assurance data are analyzed to assess the effectiveness of neophyte clinicians in caring for their patients. By extension, the effectiveness of the training program may be inferred from these results. Thus, the emphasis shifts from an assessment of the individual resident or student to an assessment of the entire training program. This systems approach emphasizes the role of the system and has been more often used in industry and health care delivery than in health professions education. However, it seems reasonable to use this method to assess clinical educational programs. Weber et al. suggest that such an approach “encourages health care leaders to understand all the processes and struc-

Figure 1. Framework for clinical assessment

tures comprising the system of care and to improve these in a proactive, mutually supportive manner.”

Furthermore, it is likely that involving students and residents in this process of total quality improvement will serve as a useful learning experience with regard to process improvement, a topic likely to be of great interest in their professional lives.

The University of Kentucky College of Dentistry (UKCD) has established an implant training program that provides training in the use of a single implant system, evidence-based diagnostic and treatment protocols (standardized work practices), and a total quality management system (Implant Quality Assurance Program). The aim of this study was to determine the extent to which the UKCD implant training program met benchmarks with regard to implant loss or survival, patient satisfaction or dissatisfaction, and success or failure.

University of Kentucky College of Dentistry Implant Training Program

The UKCD implant training program was formally created in 1999. The basic concept of the program is placement of dental implants by residents or graduate students in periodontology or oral and maxillofacial surgery and restoration of these implants by predoctoral students. The program is defined by several key features: the use of a single implant system (Straumann); rigid protocols for case selection; evidence-based protocols for diagnosis and treatment (work standardization); structured, incremental learning experiences (akin to Toyota job instruction process); comprehensive, system-specific instructional curriculum; dental students involved in treatment planning and restoring; dental students required to assist residents during surgical placement of implants; patients seen for follow-up and maintenance; and ongoing process improvement via the Implant Quality Assurance Program.

In the predoctoral clinic, a new patient undergoes intake examination by a team leader faculty member to assess the complexity and suitability of the implant case before assigning the patient to a predoctoral student. The patient must meet several inclusion and exclusion criteria. For example, patients with poorly controlled diabetes are excluded. Predoctoral students may treatment plan cases with single or multiple anterior or posterior missing teeth with implants. Anterior implant cases are evaluated on a case-by-case basis by team leaders and/or the implant board. For completely edentulous cases, only two implant-supported mandibular overdentures can be treatment planned by the predoctoral students. All other implant-supported overdentures are referred to the prosthodontist at UKCD. Complicated single or multiple posterior implant cases are typically referred to the General Practice Residency (GPR) program or the Faculty Patient Care Clinic at UKCD. The final restoration of the implant is performed by the predoctoral student and supervised by a general dentistry or prosthodontic faculty member.

Another key feature of the program is its reliance on specific, evidence-based treatment guidelines and protocols. Periodontal residents, for example, undergo a series of formal, structured, incremental learning experiences designed to provide a sound basis for subsequent clinical encounters. These experiences are guided by two concepts: evidence-based health care, and the Toyota job instruction (TJI) process. Although most readers will be quite familiar with the precepts of evidence-based health care, many may be unfamiliar with the concept of TJI. Essentially, the basis of the TJI process is standardization of work and training practices.

Standardized work practices following evidence-based diagnostic and treatment guidelines provide the basis for our training program. We use the “Plan-Do-Check-Act” (PDCA) cycle, as defined by Toyota’s training program. The resident is prepared for clinical encounters by exposure to a series of didactic and preclinical learning experiences (the “Plan” phase). For example, the resident memorizes all relevant dimensions of the implant system in use, in addition to the drilling sequences, etc. The new resident then assists senior residents and attending faculty members (who have also been trained in this learning system). The learner completes all or a portion of an implant installation under very close supervision (the “Do” phase), after which follow-up is provided (the “Check” phase). A recent systematic review found that enhanced clinical supervision of residents results in improved patient and educational outcomes. Specific feedback based on the student’s performance is provided, with suggestions about how performance might be improved in future encounters (this is the “Act” phase, in which observations made during the “Check” phase are acted upon). The PDCA cycle has been formalized in our clinical proficiency program, in which residents become “certified”
as proficient in various clinical procedures. This program is analogous to the use of competencies in predoctoral dental education, in which a resident satisfactorily performs at a competent level in delivering care while being observed by a faculty member.

An important feature of the implant training program is the Implant Quality Assurance Program (IQAP), which was created in 2004 as a mechanism for assessing and improving clinical outcomes. It was later used as a means of assessing the educational effectiveness of the implant training program. The first published report on this program appeared in 2010. The IQAP is based on patient-reported outcomes and various clinical and radiographic parameters. The clinical and radiographic findings are considered “surrogate” variables because the patient is usually unaware of them. This report will deal exclusively with patient-centered outcomes.

The goal of the IQAP is to improve patient and educational outcomes by identifying and quantifying suboptimal outcomes and their causes. The classic techniques of process improvement or total quality management were first applied in the industrial setting by W. Edwards Deming and his successors. These techniques have been adapted for use in the health care setting in an effort to improve quality and reduce costs. The quality monitoring cycle consists of several steps, which are essentially identical to those of the PDCA cycle in the context of training. Just as the PDCA cycle can be used to create a mechanism for enhancing learning outcomes, the technique can also be used for process improvement in many settings, including health care. Generally, this technique consists of data acquisition, pattern analysis, interpretation of these patterns, and development of a corrective action plan. The cycle is repeated continuously, so that the efforts of process improvement can be monitored. The PDCA cycle has been widely used in industrial settings (most notably, the Toyota Motor Corporation).

Donabedian identified three components of quality assessment: structure, process, and outcome. Structure refers to the infrastructure necessary for achieving the desired results (which can be physical, such as proper equipment, or conceptual, such as treatment guidelines), process (which refers to the extent to which the guidelines were actually followed), and outcomes (which refer to the actual outcomes of interest). In the context of the IQAP, we have chosen to focus on outcomes as the most meaningful component, but we have also ensured that structure is present and that processes are followed.

The IQAP consists of two broad components: 1) clinical and radiographic assessment and 2) patient-centered outcomes. The clinical and radiographic assessments are performed annually and consist of measurements of probing depths, attachment levels, bleeding, and mobility. Radiographic bone level is assessed with appropriate imaging studies. The results of these assessments are considered surrogate outcomes because the patient is not generally aware of changes in these parameters (e.g., radiographic bone level, probing depth). Patient-centered outcomes are assessed with a formal survey instrument administered by a trained clinician. Patients are interviewed annually during their normal maintenance visits to the clinic. If the patient is not being seen in the UKCD clinics, the survey is administered by telephone. Efforts to reach the patient are not discontinued unless the patient refuses to participate or no current contact information is available.

When the IQAP protocol was developed, benchmarks were needed to serve as a standard for comparison. Benchmarks were based on published reports of programs that used the same system (i.e., Straumann) as that used in our training program. For example, Buser et al. reported eight-year cumulative survival rates of 96.7 percent and success rates of 93.3 percent in a prospective study of 2,359 implants in 1,003 patients. Similarly, Brocard et al. reported a 92 percent survival rate in a seven-year prospective study of 1,022 implants in 440 patients. On the basis of these reports, benchmarks for success and survival in our program were set at 90 percent.

Materials and Methods

Data were collected from patients who had implants installed and restored in the implant training program from January 2000 through December 2006 at UKCD. The protocol was approved by the University of Kentucky Institutional Review Board (an exemption was granted because all data to be used in the statistical analysis were de-identified).

Periodontal residents under the supervision of periodontal faculty interviewed patients either chairside at a scheduled maintenance appointment or by telephone interview. Information obtained included date of service, site in the mouth at which the implant was placed, the clinic at which that treatment was provided, selected medical questions, and questions regarding the patient’s self-reported satisfaction with the implant(s), including appearance, function, and...
comfort. In addition, questions about the patient’s reported surgical experience were recorded. Any suboptimal responses or patient dissatisfaction resulted in an in-depth evaluation and an attempt to rectify the problem. In addition, all suboptimal responses were subjected to analysis to determine how to reduce the probability of such outcomes in the future.

Results

Two main outcomes of interest are reported. The first is implant survival. In this parameter, there were two possibilities: survival or loss. The second main outcome is success or failure. If an implant was to be regarded as successful, the patient had to report satisfaction with the appearance, function, and surgical experience associated with the implant(s). In addition, the patient had to report no pain or mobility associated with the implant. The source of mobility may be due to implant fixture, restoration, or combination of both, and it could not be verified by means of telephone interview. Irrespective of the actual mobility source, the implant was considered a failure if either component was reported to be mobile; this requirement made criteria more stringent. Finally, an implant that was lost was automatically deemed a failure. Note that it was possible (given these definitions) for an implant to be in place and functioning and still be regarded as a failure. That is, if any of the criteria for success were not met (e.g., the patient was not satisfied with the surgical experience, although he or she was satisfied with all other aspects of the implant), then the implant was defined as a failure. Responses were analyzed at the patient level and at the implant level and are provided in means and standard deviation for age and in number and percentage for other variables.

Of all the patients who had their implants installed and restored in the UKCD implant training program, 415 were successfully contacted for this study, approximately 50 percent of the total. Over 99 percent of those patients whom we reached agreed to participate. The average number of implants installed per patient was 2.3±1.9. It should be noted that the standard deviation was somewhat inflated because one patient received sixteen implants and another received twenty-one implants. If these two outliers were disregarded, the average number of implants received was 2.2±1.5. The mean age of the patients was 59.4±13.3 years. Forty-two percent of the patients were men (mean age, 59.7±14.1), and 58 percent were women (mean age 59.1±12.7; p=0.658 by t-test). Forty-six patients (11.1 percent) were smokers; forty-three (10.4 percent) had diabetes.

In the analyses in which the patient was the unit of statistical analysis (i.e., patient-level analysis), 94.5 percent (n=388) expressed overall satisfaction; 93.7 percent (n=389) were satisfied with the appearance of the implant; 94.9 percent (n=394) were satisfied with the surgical experience; and 94.0 percent (n=390) were pleased with the function of the implant. Only 2.9 percent (n=12) reported pain, 3.4 percent (n=14) reported mobility of the implant, and 4.8 percent (n=20) reported loss of one or more implants. Overall, 85.1 percent of the patients responding reported a successful implant experience (353 of 415). As defined in the IQAP, a successful implant is one that is present, non-mobile, and asymptomatic and with which the patient reports satisfaction with regard to appearance, function, and surgical experience.

A total of 963 implants were placed during this period. At the implant level, 95.5 percent of the responding patients expressed overall satisfaction with their implant(s) (n=919); 96.3 percent were satisfied with the appearance of the implant (n=922); 96.1 percent were satisfied with their surgical experience (n=925); and 96.5 percent considered the implants functional (n=923). Only 1.8 percent (n=17) of the implants were associated with persistent pain, and 1.8 percent (n=17) displayed mobility. Twenty-five implants (2.6 percent) were lost. Overall, 861 of the implants (89.4 percent) were considered successful as defined in this report.

Discussion

There is a great deal of interest in assessing and measuring health care outcomes. This movement is driven by perceptions that the quality of the U.S. health care system is uneven. The measurement of patient satisfaction and patient-centered outcomes is receiving increasing emphasis in health care assessment. Such measurement is known as “comparative effectiveness research” and is a patient-centric mechanism for determining “the most efficient way to deliver the right treatment to the right patient at the right time and to translate those discoveries into better and meaningful health outcomes.”

The creation of the Patient-Centered Outcomes Research Institute (PCORI) as part of the 2010 Patient Protection and Affordable Care Act (ACA) is a
highly visible example of the emerging importance of comparative effectiveness research. The mission statement of the PCORI embodies the key concepts of patient-centered outcomes research and its relevance to improving the quality of health care: “PCORI helps people make informed health care decisions, and improves health care delivery and outcomes, by producing and promoting high-integrity, evidence-based information that comes from research guided by patients, caregivers, and the broader health care community.” The key concept is that the patient (both individually and collectively) must have a voice in determining which treatments are most appropriate. Washington and Lipstein have stated that the net effect of this concept will be the generation of “trusted, evidence-based information” that will promote better health care outcomes for all.

Patient-centered outcomes are at the core of our implant quality initiative. Because various criteria have been used to assess “success” in implant dentistry, there is a great deal of heterogeneity in published reports. Papaspyridakos et al. recently conducted a systematic review of these reports and found that the most frequently reported criteria for success (at the implant level) are mobility, pain, radiolucency, and bone loss. At the prosthetic level, the criteria are absence of technical complications, adequate function, and esthetics. Patient-level satisfaction criteria were discomfort and paresthesia, satisfactory esthetics, and functional issues, such as mastication. These authors found that patient satisfaction and prosthetic-level assessments were less frequently performed than implant-level assessments (which, presumably, would involve surrogate variables such as bleeding on probing, probing depth, etc.). The patient is unaware of such surrogate variables. Assumption was made (with various levels of confidence) that these variables are related, in some meaningful way, to survival, comfort, appearance, and function of the implant and the health of the patient.

In this report, patient-reported and patient-centric outcomes were the primary focus. Although there has been much recent interest in the measurement of patient satisfaction, such assessments are challenging. In an extensive review of the literature, Crow et al. found that research on the design of patient satisfaction surveys is “patchy and ad hoc” and that a number of methodological issues are unresolved. Three issues were considered during development of our survey: non-response rates (and ways to decrease them), interaction between patient expectations and satisfaction, and issues relating to scaling.

A written questionnaire was administered either by phone or in person because it has been shown that telephone contact greatly increases response rates in patient satisfaction surveys. The decision was made that all interviews would be conducted in person during the course of normal maintenance visits or by telephone (if the patient was not currently being seen in our clinic). Although we were unable to contact roughly 50 percent of the patients because of outdated or incorrect contact information, we had surprisingly good success among those who were reached. Only two patients refused to be interviewed (although many more requested that the interviewer call back at a more convenient time).

The low rate of non-response may be due to the fact that patients are unusually motivated to speak to someone concerning quality of care, given the fact that they have had a medical device implanted. Most of the patients seeking care in the UKCD predoctoral program do so because this setting is presumed to charge lower fees than private sector dentists while offering high-quality care. Our experience suggests that when a relatively invasive or expensive intervention (e.g., implant installation) fails, the patient usually seeks remediation in our clinics, perhaps in large part because of the patient’s inability to pay for retreatment in the private sector and because of the (correct) perception that UKCD is likely to rectify any suboptimal outcomes caused by operator error.

Varying patient expectations play a role in patient satisfaction, although relatively few studies have actually attempted to quantify this association. Crow et al., in their extensive literature review, reported that only 20 percent of studies considered this factor. Since the inception of the IQAP, our implant protocol has included the use of a relatively detailed informed consent form that identifies risks, benefits, and treatment options. Given the near-universal application of this instrument, we decided that patient expectations are likely to be reasonably accurate. However, incorporating some measure of expectations in future survey instruments is being considered.

With regard to scaling, a variety of options were considered. We ultimately chose to use dichotomous variables for assessment of patient satisfaction rather than the more commonly used Likert scale. This decision was made because, during pilot testing of the survey instrument, which included a Likert scale for overall satisfaction, we found that the dichotomous scale was more conservative, in that patients were somewhat more likely to give a negative response on the dichotomous satisfaction variables than on the Likert
scale for overall satisfaction. A dichotomous variable was used because it provides a more stringent threshold. This choice also helped compensate for the tendency of respondents to give more favorable answers in telephone or face-to-face interviews than on mailed survey instruments.35

Our study has several limitations. First, we were unable to contact all the patients, and the non-respondents may differ systematically in some way from those whom we were able to contact; therefore, these results need to be interpreted with caution. Second, the results were based on telephone interviews, which could have increased self-reported data bias. However, this bias is unlikely since the questionnaire used was the same whether patients were interviewed at chair-side or by telephone interview. Further research, including longitudinal study concerning the outcome of the dental implants at university-based education system, is needed to better understand the competencies required for dental students.

This study of the UKCD implant training program proved to be effective in achieving good patient-reported outcomes and showing good learning outcomes for neophyte clinicians. The use of patient-centered outcomes is a reasonable means of assessing both programmatic effectiveness and the competence of individual students. Key features of the UKCD program that may contribute to these results include the use of standardized training and work practices based on evidence-based treatment guidelines, structured incremental learning experiences, and a single system (which simplifies training and the creation of standardized work practices).

Conclusion

This study found that the survival rate of implants placed by UKCD residents (97 percent) was comparable to published survival rates and is consistent with our benchmark of 90 percent. Overall implant success, as measured by the IQAP survey, was 88.43 percent, which is also consistent with our benchmark of 90 percent. The results of this study suggest that work standardization (in the form of specific treatment protocols) and the use of a formal, incremental learning system can result in positive patient outcomes. Clinical outcomes should be monitored in academic dental settings as part of clinical process improvement; these outcomes can provide a means of assessing the effectiveness of the training program.

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