Introducing CAD/CAM into a Predoctoral Dental Curriculum: A Case Study


Abstract: This article describes the decision making and implementation process used at Indiana University School of Dentistry to incorporate a CAD/CAM system into the predoctoral curriculum and presents data regarding the opinions of students and faculty members after one year. Using a non-validated survey instrument, D1 students rated their experience fabricating a CAD/CAM-generated crown. Eighty-eight of the 105 D1 students (84 percent response rate) responded to the four multiple-choice questions, and a varying number provided written responses. Eighty percent of the responding students rated the overall learning experience as good or excellent, and 43 percent judged that they were prepared to fabricate a crown independently. Students’ comments about the experience were generally positive. The twelve supervising faculty members were also surveyed after the first year. When asked to evaluate the initial quality of the crowns at placement, they rated 89 to 98 percent of them good or excellent on the measures of marginal fit, axial contours, proximal contacts, and occlusal contacts. In their judgment, CAD/CAM-generated crowns were as good as or better than those received from commercial labs. After one year, the school’s experience has been that the performance of these crowns is consistent with the literature and that they are a viable option. Also, the students are enthusiastic about this addition to the curriculum.

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Keywords: dental education, technology, CAD/CAM, dental crown, restorative dentistry

Submitted for publication 9/12/13; accepted 2/8/14

The Cerec system (Sirona, Charlotte, NC, USA) was the first commercially viable computer-assisted design/computer-assisted manufacture (CAD/CAM) available to dental practitioners, being introduced to the profession in 1987. CAD/CAM systems in dentistry generally consist of three components. The first is a device that captures the geometry of the prepared tooth and transforms it into digital data. The second is a software program that provides the user a means to design the prosthesis on the computer screen, and the third is a means of transforming these data into a completed prosthesis.1-3 The initial application for the Cerec was for milled all-ceramic inlays and onlays.3

The advantages of CAD/CAM technology are reported to be the application of new materials, a reduction in labor, better cost-effectiveness, and better quality control.2 Relative to restorations fabricated by a technician, labor is substantially reduced with CAD/CAM-generated restorations, with savings estimated at 60 to 70 percent.3 Over the years, several new all-ceramic materials have been developed for use with CAD/CAM systems.4 Tremendous improvements in physical properties have resulted from the development of these newer materials and improved quality control during the manufacture of the ceramic blocks.3 Both hardware and software for scanning, designing, and milling have also improved over the years. As a result, the use of CAD/CAM systems in dentistry has increased. As of 2011, it was estimated that 10,000 units were in use in the United States and Canada.3 William Blair and Company estimated sales of systems in 2012 at about 2,800 units and predicted a rise to 9,100 units per year in 2017. With the all-ceramic materials presently available, CAD/CAM systems are now routinely being used for fabrication of inlays, onlays, single crowns, veneers, and anterior and posterior fixed partial dentures.

In light of these developments, Indiana University School of Dentistry (IUSD) decided to consider adding a CAD/CAM system to our curriculum. During the decision making process, we were mindful that new products and technologies are introduced to practicing general dentists on an almost continual basis and that many fail to demonstrate value over time. The history of the development of dentin bond-
ing agents is a good example of a fairly common trend. Despite introductions often accompanied by grandiose claims, a typical scenario is that over time the experiences of practitioners and/or the results of university-based research indicate that many of these offer no relative advantage. Soon these are gone, replaced by the next wave. Clinical faculty members are tasked with teaching dental students methods appropriate for their skill level that provide reliable treatment and are consistent with the best evidence available. From this constant flow of new options, one must choose very carefully which will be an important addition to the curriculum. Ideally, additions should be based on research that demonstrates the superiority of a new approach over an older approach. However, there are times the curriculum responds to the existing norms of practice. The history of bonded composite-resin as posterior restorations demonstrates this phenomenon. Despite a lack of evidence of efficacy, patients were so enthusiastic about these more esthetic restorations that their demand drove its use. In turn, dental schools were moved to include posterior composite restorations in their curricula. The goal of our faculty was thus to determine if the addition of a CAD/CAM system was justified either by evidence of its efficacy or by its common usage in dental practices in the United States.

It is our understanding that other dental schools are considering the same move and more will probably consider it in the near future. In the belief that our experience may help others, the purpose of this article is to describe the process IUSD used in deciding to incorporate a CAD/CAM system into our curriculum and its implementation and to present data regarding the opinions of our students and faculty regarding the system after one year. As a means of evaluating this addition to our curriculum, two quality assessment surveys were conducted.

Methods

Many CAD/CAM systems focus on the fabrication of all-ceramic restorations. Some members of the planning committee at our school were of the opinion that at least the initial performance of Cerec restorations was questionable. Accordingly, one of the steps in the decision process was to investigate the efficacy of the all-ceramic materials offered.

The committee thought it important to first identify our educational goals for a CAD/CAM system. Our main goals were that all predoctoral dental students would be provided basic didactic information about CAD/CAM systems in general and about our system in particular. Second, students would be required to fabricate both a posterior and anterior all-ceramic crown in their preclinical years (D1 and D2), and most importantly, they would be able to use the CAD/CAM to fabricate any all-ceramic restorations consistent with the needs of their patient.

Additionally, there were some financial goals that worked synergistically with our teaching goals. We wanted our students to take their CAD/CAM-generated restorations from prep to cementation, i.e., scan, design, mill, sinter, and stain each of their restorations. We also wanted to use all-ceramic crowns whenever the clinical situation made for a favorable prognosis. As a result of milling restorations on site, learning would be enhanced, and our laboratory costs would be reduced. This would, in turn, partially offset the cost of acquiring a system.

Gathering Information

Our first step in the decision process was to use readily-available materials to identify systems and gather manufacturer-based information. From this information, we identified four systems (Table 1) and gathered information about the features of each. To streamline the decision making process and facilitate eventual agreement on a system, we began first by identifying which features we valued most. This approach allowed for a more objective evaluation of features. The intent was to minimize the influence of emotional appeals made during manufacturers’ presentations. We decided to classify each feature in one of three categories: 1) critical—if the system did not have this feature, we were definitely not going to purchase it; 2) important—the feature is highly desirable but not critical, so that a system that did not have one of our important features would have to have all of our critical features and other important features that made the system desirable on balance; and 3) optional—this feature would be nice to have, but not critical or even important.

Two critical features were identified as primary criteria. The first was that we wanted a system that did not routinely call for the use of a powder for impression taking. In terms of educational value, our highest goal was to provide training and experience in the use of a CAD/CAM system to all predoctoral dental students. As a result, we wanted a CAD/CAM system that would have as short a learning curve as possible. In our judgment, the need to use
Since our goal was to provide training and clinical experience in the use of a CAD/CAM system to all predoctoral dental students, we considered three options for implementation. The first, to create a specialized clinic, would involve training a very limited number of faculty members who would supervise a small number of chairs in a dedicated clinic. Limiting the number of faculty members would, by necessity, mean limiting the number of half-days of availability. The second option was to also restrict handling of CAD/CAM cases to a very limited number of trained faculty members but have cases treated in our existing clinics. However, we decided this approach would result in similar constraints on available appointments, i.e., both of these options would require students to match their patients' availability to that of the clinic and/or the faculty.

The third option was to allow students to work with any clinical instructor (as supervising faculty) to provide an all-ceramic, CAD/CAM-generated restoration for any patient for which it was appropriate. Here all supervising faculty members could approve case selection, tooth preparation, and placement of the restoration. Only ten clinical faculty members were chosen to help students with fabrication, approve the final restoration design, and authorize release of an appropriate CAD/CAM block for milling. These ten designated faculty members received training on use of our system and agreed to make themselves readily available, including before class, at lunch, and after the end of the day, and to make CAD/CAM cases a priority. These requirements

### Implementation and Training

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meant they would interrupt other activities to provide support to students in the process of designing, milling, firing, or glazing a CAD/CAM restoration. After consideration, we decided that both of the first two options would create obstacles to scheduling CAD/CAM cases and thus reduce use of the system. Instead, we selected the third option.

Initial faculty training was provided at the company’s headquarters, and further training was provided at USD in the fall of 2011. Those sessions concentrated on designing single posterior restorations. Faculty members were then provided some time to work with the system on their own. After several weeks, D4D Technologies staff returned to provide support to several faculty members working with patients in the faculty practice. Several months later, training staff returned again to review updates to the software and provide training in the design of anterior crowns and veneers.

Typically, a new clinical technique would be first introduced in the D1 preclinical courses. The intent would be to provide a foundation for further training in the second year, and both would support use clinically in the D3 and D4 years. Such a schedule has the advantage of causing the least disruption to the curriculum. However, in this instance, that schedule presented two major drawbacks: it would lead to a delay of two years before the technique was used clinically, and three classes of students would not be provided any opportunity to learn about or use the system. Since our goal was to involve all of our students and provide them an opportunity to learn about and use this new technology, we chose to train all four classes at once. Following this initial experience, training in subsequent years would build, as preferred, from the D1 to D4 years.

The acquisition of the system and faculty training were not completed until late in the fall semester 2011. Training was then offered to all D4 students on a voluntary basis. Multiple opportunities to participate in training were offered during times when students had scheduled free time. Seventy-five percent of the D4 class chose to participate. D3 students were required to participate in training as part of a lecture course in advanced restorative techniques. As with the D4 students, multiple training opportunities were offered using time previously unscheduled in the spring semester 2012.

Training for the D3 and D4 students involved all steps required to capture the digital impression, design the restoration, and prepare it for milling. In the time available, it was not possible to have each student mill a restoration. Rather, one restoration was milled at each training session, and students were able to observe the milling unit in action. Similarly, one restoration at each training session was used to demonstrate/simulate the steps required for firing, staining, and glazing. These two classes had previously been presented information on case selection for all-ceramic restorations and their physical properties.

Initial training for the D1 and D2 classes was the same. Students were required to perform every step from preparation to delivery of an all-ceramic crown on a dentoform tooth. The process included glazing and cementation with a dual-cure resin cement. For preclinical classes, we found it worked best to have one faculty member for every two students working on the CAD/CAM system. Time for this project was created by adjusting the time allocated to other projects. As a result of these decisions, all students were trained within six months of our having obtained the system.

Current Educational Training

In the second semester of the D1 year, students now fabricate an all-ceramic, CAD/CAM-generated full crown on a posterior dentoform tooth. Lectures on CAD/CAM systems, all-ceramic blocks designed for CAD/CAM use, and cementation procedures are also included. In the D2 year, training is extended to include anterior restorations (crowns and veneers), an anterior full crown is fabricated, and again lectures on case selection are provided. In contrast to the training provided to students immediately following acquisition of the system, it is at this point that students receive instruction on incorporating stains during the glazing process.

In the D3 and D4 years, students’ experiences continue in the comprehensive care clinics. The D3 year also includes lectures on esthetic restorations, including all-ceramic restorations. In the two clinical years, without advanced notice to faculty or without any special arrangements as to clinic day or hour, any student with an appropriate case for a milled, all-ceramic restoration can decide to fabricate the restoration using the CAD/CAM system.

Predoctoral Clinics and the One-Day, All-Ceramic Crown

In private practice, the ability to deliver a finished CAD/CAM restoration in one visit is often touted. In reality, this turnaround is very unlikely
to be accomplished by dental students. Before the CAD/CAM unit was purchased, we estimated that preparation of the tooth for a full crown, making an impression, fabricating a provisional, cementing the provisional, record keeping, and operatory cleanup typically took the average first-semester D4 student three hours. However, the possible range for this estimate was large. Variations in complexity of the individual case, the ability of each student, and the number of his or her previous crown experiences were key variables. Prior to acquisition of our CAD/CAM system, the norm for delivery of an all-porcelain crown in our predoctoral clinic was three weeks from impression to cementation. While we did not expect the CAD/CAM system would quickly lead to a one-day crown, we did believe it would help us reduce this delay in delivery. Furthermore, based on this estimate, it was clear that even students using the CAD/CAM system would still be required to fabricate provisional restorations for their patients.

Providing a restoration in one clinic session thus became a long-term goal. To achieve this goal, we chose an incremental approach, involving three levels of advancement. At the first level, the clinical appointments would remain unchanged from present practices. There would be a preparation and impression appointment followed by a cementation appointment. Where the approach would differ for a CAD/CAM-generated restoration would be between appointments. Students would pour and articulate models as usual. But instead of sending the case to a commercial lab, a digital scan would be made of both the model and the inter-occlusal record. The restoration would be designed, approved, and milled prior to the cementation appointment. At this appointment, the restoration would be fitted and occlusal and inter-proximal contacts adjusted; then, the restoration would be fired and glazed as needed. Finally, the restoration would be adhesively cemented. While the final restoration would not be completed in one visit, a student who planned his or her time well could provide a finished all-ceramic crown within two days—a substantial reduction in delivery time.

The second step in advancement would still involve two appointments. The first would be for preparation and fabrication of a provisional, and the second appointment would include both clinical and laboratory procedures. First, both the tooth and the inter-occlusal record would be scanned intra-orally. Then, the restoration would be designed and milled in the laboratory. Returning to the patient, the restoration is fitted and adjusted. Next, it is removed for sintering and glazing and, finally, adhesively cemented. Previous experience with scanning models, designing restorations, milling, firing, and adhesive cementation would enhance students’ skill levels to the point where they could accomplish all these tasks at the second appointment. With pre-planning, the two appointments could easily be scheduled over a two-day period or, given a motivated patient, completed in morning and afternoon appointments. The third and final level of advancement would be for the student to complete all required steps in one clinical appointment.

Many of our students will, by choice or circumstance, graduate with very few clinical experiences with CAD/CAM-generated all-ceramic restorations and thus will remain at the initial skill level. This is still consistent with our goal of maximum exposure. Every student will have at least the minimal skill level required to use the technique after graduation. By contrast, others will seize the opportunity and advance to the highest levels.

The choice to use this incremental approach and to scan models as the first step was essential to accomplishing our goal to provide a baseline from which all of our students can advance after graduation. In our view, choosing instead to capture scans intra- orally even at the very first experience would have required so much faculty time that it would have required us to greatly limit the number of available opportunities.

Assessment Surveys

Even the initial training provided to the D1 class was designed as part of the permanent curriculum. Accordingly, when we sought the opinions of the students regarding their CAD/CAM experience, we chose the D1 class. When D1 students were surveyed as part of our normal course evaluations administered at the end of the D1 year, they also completed a survey about their CAD/CAM experiences. The survey included three questions that required a multiple-choice response and encouraged written comments and two questions that asked only for comments. Eighty-eight of the 105 students responded to the three multiple-choice questions, and a varying number provided written responses. Basic statistics were performed to help summarize the findings, and written comments with similar themes were grouped in order to get a sense of which aspects of training were most important to the students.
Supervising faculty members were also surveyed. Clinical records and schedules identified twelve supervising faculty members who had primarily been involved at the placement appointment for CAD/CAM-generated crowns. To assess the quality of the restorations provided, these individuals were surveyed. They were asked to assess the initial (before any adjustments) marginal fit, axial contours, proximal contacts, and occlusal contacts of the crowns for which they had been supervising faculty. They were asked to compare the quality of the CAD/CAM-generated crowns to those generally provided by the commercial labs used by IUSD. This question included all-metal and porcelain-fused-to-metal crowns. They were also asked to compare the CAD/CAM crowns to all-ceramic crowns provided by our commercial labs. Again basic statistics were performed. The use of both of these quality assessment surveys was approved for publication as exempted data by Indiana University’s Institutional Review Board.

Results

Although there were concerns about the initial performance of Cerec restorations, the available literature indicated that even early all-ceramic inlay and onlay performance was good. When survival rates over a ten-year period for Cerec inlays, direct composite inlays, indirect composite inlays, and indirect ceramic inlays were compared, no significant differences were found. Similarly, when all-ceramic inlays (Mirage, Empress, and Cerec) were compared to gold inlays, over a five-year period there was no significant difference in failure rates.

We anticipated that a CAD/CAM system at IUSD would be used primarily for single crowns. The newer all-ceramic materials represent major improvements in the physical properties relative to those of the feldspathic blocks first available with Cerec. Furthermore, the five-year survival rates of all-ceramic crowns using these newer materials did not differ significantly from those of metal-ceramic crowns. A previous study found that five-year survival rates for reinforced glass ceramics were 95.4 percent, with a 95 percent confidence interval (CI) of 92.4-97.5 percent. By contrast, five-year survival rates for metal-ceramic crowns were 95.6 percent (95 percent CI 93.2-96.9 percent). Annual failure rates were also very similar: 0.89 percent (0.5-1.6 percent) and 0.94 percent (0.6-1.4 percent) for metal-ceramic and reinforced glass ceramic, respectively. These differences were not statistically significant.

In summary, both the clinical performance and the growing popularity of CAD/CAM systems motivated us to continue in our consideration of a CAD/CAM unit for IUSD. Several systems offered reinforced glass ceramic blocks, which have been found to be effective. Specifically, the E4D units offered lithium disilicate ceramic blocks (e.max CAD; Ivoclar Vivadent, Inc., Amherst, NY, USA) for both posterior and anterior crowns.

In the final analysis, identifying our critical features proved to be a very effective approach because it focused our efforts and simplified the decision process. In terms of the use of a powder to enhance the digital impression process, the instructions for two systems did not include this as a general recommendation: E4D and iTero. Two of the systems did not offer in-office milling: Lava and iTero. Two did: Cerec and E4D. Thus, only the E4D system had both of the features we had identified as critical.

When students were asked to assess the quality of the restoration they fabricated in the D1 preclinical course (survey Q #1), 86 percent reported it was good to excellent (Table 2). Their comments indicated that two-thirds of the respondents preferred this exercise to their previous experiences with gold castings. The class also provided excellent feedback on which aspects of the project they found most challenging (Q #2). Eighty percent of the respondents rated their CAD/CAM experience as good or excellent (Q #3), and comments were overwhelming positive and enthusiastic. Students were asked if they felt ready to design a CAD/CAM-generated restoration on their own (Q #4). Despite knowing that they would receive more training in the later years, 43 percent felt ready after this one experience. When provided the opportunity to report any comment they thought would be important to enhancing the CAD/CAM experience (Q #5), the majority made a point of once again expressing their enthusiasm. Several also made some insightful suggestions about how to improve the experience further.

Current Use of the System

The E4D system was fully installed just prior to the spring semester 2012, and student training was completed by the start of summer semester 2012. Members of the Class of 2012 had only their spring semester to fabricate CAD/CAM restorations for their patients. The 2013 graduating class had three
### Table 2. Results from student survey

1. In your opinion, how well did your ceramic crown on #12 fit your preparation? Please use your gold casting project as a basis. (Additional comments are welcome.) (n=88)

<table>
<thead>
<tr>
<th>Excellent</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
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<tbody>
<tr>
<td>31%</td>
<td>55%</td>
<td>11%</td>
<td>3%</td>
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</table>

**Comments**: [65 of 88 (74%) students also submitted comments]

- 43 (66.2%) Preferred their CAD/CAM experience to gold casting experience
- 9 (13.8%) Did not prefer one over the other
- 13 (20.0%) Preferred gold casting experience to CAD/CAM experience

2. If you could redo the project, how would you improve your ceramic crown on #12? Please mark all of the issues listed below that apply. (Additional comments are welcome.) (n=88)

<table>
<thead>
<tr>
<th>Convergence of axially walls</th>
<th>Smoothness of preparation margins</th>
<th>Better CAD restoration design</th>
<th>Occlusal reduction</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>3%</td>
<td>34%</td>
<td>34%</td>
<td>10%</td>
<td>10%</td>
</tr>
</tbody>
</table>

**Comments**: [64 of the 88 (73%) students also submitted comments]

- 5 (7.8%) Specifically noted improved convergence. More convergence was most frequent observation.
- 20 (31.7%) Specifically noted improved margins. Margin smoothness and better control of cervical extension of margins were most frequently noted.
- 6 (9.4%) Specifically noted improved design of their restoration using software. Better contour of restoration was most frequent observation; both over- and undercontoured restorations were listed.
- 7 (10.9%) Specifically noted improved occlusal reduction. Underreduction of preparation was main issue.
- 26 (40.7%) Commented about other issues. The majority noted the project went really well, said they really liked project, or noted a specific issue encountered during project.

3. How would you rate your overall learning experience with the CAD/CAM training and design sessions? (Additional comments are welcome.) (n=88)

<table>
<thead>
<tr>
<th>Excellent</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
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<tbody>
<tr>
<td>29%</td>
<td>51%</td>
<td>19%</td>
<td>0</td>
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</table>

**Comments**: [27 of the 88 (31%) students also submitted comments]

- 4 (14.8%) Had negative comment. Typical comments: went too fast; even with instruction materials, I didn’t really understand a lot of the software program’s functions.
- 23 (85.2%) Had positive comment. Typical comments: CAD/CAM training was great! I learned a lot.

4. Do you feel you can design a case totally on your own? Please comment. (n=61)

**Comments were analyzed and grouped into four categories:**

- 16 (26.2%) I’m ready now.
- 10 (16.4%) Ready if I could use the instruction materials as an aid.
- 29 (47.5%) Would like more practice before doing one clinically.
- 6 (9.8%) Not ready. I am uncomfortable with or lack the confidence to do one clinically.

5. Please feel free to comment on anything you feel is important. (n=7)

**Comments**: [7 of the 88 (8%) students submitted comments]

- 5 (71.4%) Expressed enthusiasm for training and fabrication of the CAD/CAM crown. Typical comments were: great experience; I hope to use this in the future.
- 2 (28.6%) Made suggestions for improving instructions. Typical comments: create a video as a source of additional instruction and/or review; more bench instructors are needed; provide a review session before students begin patient contact in their D3 year.
Clinical Impressions and Cost Considerations

We expected high-quality restorations from this system. To assess whether we were meeting this expectation, the twelve supervising faculty members directly involved with placement of CAD/CAM-generated crowns were surveyed and asked their impressions of the initial quality of restoration delivered to our patients. They were asked to respond to questions about the marginal fit, axial contours, proximal contacts, and occlusal contacts at the time of initial placement, i.e., prior to any adjustments. A very large percentage of all restorations were rated as being good to excellent, with excellent being the predominant response (Table 3). These faculty members were also asked to compare our CAD/CAM-generated crowns to those fabricated by the commercial labs we routinely use. All these faculty members reported the CAD/CAM-generated crowns were as good as or better than those routinely fabricated by commercial labs.

The cost of the ceramic block and wear and tear on the milling diamonds for each CAD/CAM-generated crown (the variable cost) is estimated by D4D Technologies at $40.00. By contrast, our average cost per unit using commercial labs is $170.00. After slightly less than one year, we had completed 125 crowns, a savings of $16,250.00. Since the pur-

Table 3. Results from faculty survey (n=12 for all questions)

In answering the following questions, please consider all the CAD/CAM-generated crowns in which you were the supervising faculty at the placement appointment. Please focus answers on the quality of the restoration before any adjustments.

<table>
<thead>
<tr>
<th>Marginal Fit</th>
<th>Axial Contours</th>
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<tbody>
<tr>
<td>Unacceptable</td>
<td>Unacceptable</td>
</tr>
<tr>
<td>Minimally acceptable</td>
<td>Minimally acceptable</td>
</tr>
<tr>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Excellent</td>
<td>Excellent</td>
</tr>
<tr>
<td>0.8%</td>
<td>0.8%</td>
</tr>
<tr>
<td>1.7%</td>
<td>10.4%</td>
</tr>
<tr>
<td>28.3%</td>
<td>40.4%</td>
</tr>
<tr>
<td>69.2%</td>
<td>48.3%</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Proximal Contacts</th>
<th>Occlusal Contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unacceptable</td>
<td>Unacceptable</td>
</tr>
<tr>
<td>Minimally acceptable</td>
<td>Minimally acceptable</td>
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<tr>
<td>Good</td>
<td>Good</td>
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<tr>
<td>Excellent</td>
<td>Excellent</td>
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<tr>
<td>0.8%</td>
<td>0.8%</td>
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<tr>
<td>2.9%</td>
<td>2.5%</td>
</tr>
<tr>
<td>26.7%</td>
<td>35.4%</td>
</tr>
<tr>
<td>69.6%</td>
<td>61.3%</td>
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</tbody>
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How would you rate the overall quality of our CAD/CAM-generated crowns compared to those from our commercial labs (relative to all-metal and porcelain-fused-to-metal)? (check box)
0 Less than commercial 75% Same as 25% Better than
How would you compare CAD/CAM-generated crowns relative to all-ceramic restorations fabricated at our commercial labs? (check box)
0 Less than commercial 75% Same as 25% Better than
CAD/CAM-generated, all-ceramic restorations were consistent with high-quality care.

Our biggest challenge was how best to integrate the system into our existing curriculum. Simply mimicking CAD/CAM use in private practice would have led us to make intra-oral scans even at the student’s first experience. Instead, we decided to take an incremental approach, starting first with scanning a model and an inter-occlusal record in the laboratory. As students gained accuracy and speed from previous experiences, the scanning procedure would be performed intra-orally. This incremental approach has the added benefit of letting students advance at their own pace and according to their own abilities and interest level.

The data collected provided us an overall impression of the opinions of our D1 students and supervising faculty members. Since our quality assessment surveys were not developed as research tools, no validity or reliability testing was performed. As a result, their value is somewhat limited. In our experience, establishing an outline for the decision process in advance and putting considerable time and thought into setting clear educational goals led to a smooth and efficient decision making process.

Conclusion

After one year, we found our CAD/CAM-generated restorations were of good quality. We also found our system has generated enthusiasm among both preclinical and clinical students. Finally, we believe the addition of this system is consistent with our mission of maintaining an up-to-date curriculum.

REFERENCES


