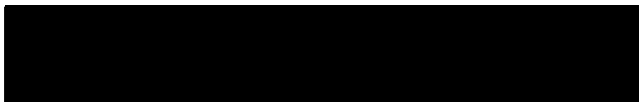


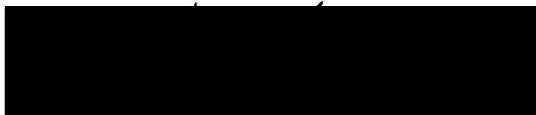
A Survey of Air Force General Dentists Regarding CAD/CAM Usage

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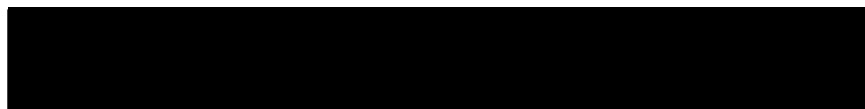
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A Survey of Air Force General Dentists Regarding CAD/CAM Usage

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ABSTRACT

Objectives: The purpose of this study was to survey Air Force (AF) general dentists regarding the amount and type of computer-aided design/computer aided manufacturing (CAD/CAM) training and total number of restorations placed while in dental school. **Methods:** A survey consisting of 6 questions was generated using the website "Survey Monkey". A link to the survey was sent through e-mail to 546 general dentists in the AF Dental Corps of which 306 replied. The survey consisted of two sections including demographics and CAD/CAM usage in dental school. **Results:** A response rate of 56% was achieved. More males were found to have graduated from dental school in 2005 or earlier while more females graduated from dental school between 2010-2013. Dentists who graduated in 2005 or earlier and between 2006-2009 stated they did not receive CAD/CAM training in dental school, while more respondents in the group of graduation years 2014-2017 stated that they did receive training. Regarding types of CAD/CAM training in dental school, there were significant correlations between graduation year and type of training received including lecture, literature review, CAD/CAM elective, pre-clinic exercises, and assisted/observed in clinic. Thirty-four percent of the respondents in the groups of graduation years 2014-2017 stated that they were sufficiently trained compared to other year groups. Eleven percent of the respondents who graduated in 2014-2017 completed 6-10 restorations and 9% completed 11 or more restorations compared to the other year groups. More respondents who graduated from a dental school in the Southwest and Southeast regions of the United States reported completing 6-10 restorations and 11 or more restorations compared to other school regions. **Conclusions:** CAD/CAM is becoming a more prevalent part of dental school curriculum which are mainly utilizing lectures, literature reviews, elective courses, and exposure pre-clinically for training. Most of the respondents did not feel their training was sufficient enough to use CAD/CAM technology independently. More respondents in the groups of graduation years 2014-2017 had restored more CAD/CAM restorations compared to other year groups.

INTRODUCTION

The first CAD/CAM restoration was placed in September 1985 at the University of Zurich Dental School.¹ At the time, it was a revolutionary concept for restorative dentistry that an industrially made ceramic material could be fabricated through using technology to scan a tooth preparation, design the crown proposal, and then mill the final crown. This technological advancement has increased clinical effectiveness by reducing certain procedures requiring two appointments to a single patient visit. Also, the ability for a digital impression to be sent to a dental lab has led to a significant improvement in clinical efficiency and work flow.¹ With dental CAD/CAM technology becoming increasingly popular due to its benefits of time and material savings,² along with its accuracy and excellent esthetics,³ many dental schools across the United States have incorporated the use of CAD/CAM technology in their training programs and clinics.⁴

Even with the advances in CAD/CAM technology, there are currently no published studies evaluating the educational training of providers and usage of the technology in the United States. A recent published study examined the usage of the technology in the United Kingdom and found that 64.4% of their survey respondents indicated that they use CAD/CAM technology to improve the quality of their workflow. However this same study also found that only 33.9% of the respondents indicated that they felt their CAD/CAM training was insufficient.⁵ The Air Force Dental Corps recruits approximately 60-80 dental graduates each year from various dental schools throughout the United States. The CAD/CAM training received may not be standardized or consistent at the different dental schools.² The purpose of this study was to survey incoming dental officers on the amount and type of CAD/CAM training and total number of restorations placed while in dental school.

MATERIALS AND METHODS

A survey was generated consisting of 6 questions (Table 1) that were electronically distributed to 546 general dentists in the AF Dental Corp using the website "Survey Monkey". Before taking the survey, there was a statement regarding the purpose of the survey and that anonymity would be preserved. Most questions were multiple-choice closed questions, but an option was offered for further comments at the end of relevant questions. The survey was available for two months spanning from 1 August 2018 to 30 September 2018 during which three reminders were sent out.

The survey consisted of two sections including demographics and dental school CAD/CAM training. The responses were analyzed using Excel (Microsoft, Redmond WA), and SPSS (IBM, Armonk, NY) software. Survey respondents were placed in one of 4 groups representing their year of graduation from dental school: Group 1: 2005 or earlier, Group 2: 2006 – 2009, Group 3: 2010 – 2013, Group 4: 2014 – 2017. Respondents were also placed in one of 5 regions pertaining to the location of their dental school in the United States:⁶ West, Southwest, Midwest, Southeast, or Northeast.

The questions and responses regarding demographics and CAD/CAM training in dental school were statistically analyzed using Chi-Square testing to determine statistical significance ($\alpha = 0.05$).

Table 1 Survey questions (with responses results)

1. Are you male or female?

- Male (72.7%)
- Female (27.3%)

2. How many years have you been active duty Air Force?

- 1 - 4 Years (45.1%)
- 5 - 8 Years (19.7%)
- 9 - 12 Years (14.5%)
- 13 – 16 Years (8.9%)
- 17 – 20 Years (2.6%)
- 21+ Years (9.2%)

3. Did you receive any CAD/CAM training in dental school?

- Yes (47.4%)
- No (52.6%)

4. Which type of CAD/CAM training did you receive in dental school?

See detailed results in Table 2

- Lecture
- Literature Review
- Elective
- Pre-Clinic (dentoform)
- Online CE
- CE Course (outside of school)
- Assisted/Observed in Clinic
- Manufacturer Training

5. Do you feel your dental school CAD/CAM training was sufficient to operate the CEREC chairside unit independently?

- Yes (24.0%)
- No (76.0%)

6. In your dental school clinic, how many CAD/CAM restorations did you complete?

- 0 (52.6%)
- 1-2 (22.5%)
- 3-5 (12.6%)
- 6-10 (6.1%)
- 11 or more (6.1%)

RESULTS

The total number of completed surveys was 306, which yielded a response rate of 56%. The majority of the respondents were male (72.7%) versus female (27.3%) (n=300). The gender of the respondents was compared to the 4 graduation year groups. Overall, there was a significant association between gender and graduation year groups ($p=0.0009$). More males were in the group of graduation years 2005 or earlier, while more females were in the group of graduation years 2010-2013. There were no associations between gender and dental group regions ($p=0.42$).

When asked if respondents had any type of CAD/CAM training in dental school, 47.4% indicated that they did while 52.6% reportedly did not receive any training (n=291). These numbers were compared to their year of graduation and regional location of their dental school. Overall, there was a significant association between CAD/CAM training and graduation year groups ($p < 0.0001$). Ninety-four percent of the respondents in the group of graduation years 2005 or earlier as well as 88% of the 2006-2009 group stated that they did not receive training in dental school, while 76% of the respondents in the group of graduation years 2014 – 2017 stated that they did receive training. There was no statistical significance found relating CAD/CAM training with dental school region ($p=0.608$).

Respondents were asked what type of CAD/CAM training they participated while in dental school (Table 2) including lecture, literature review, elective, pre-clinic (dentoform), online CE, CE Course (outside of school), assisted/observed in clinic, and manufacturer training (n = 188). Graduation year group was associated with lecture ($p < 0.0001$), literature review ($p < 0.0001$), elective ($p=0.002$), assisted/observed in clinic ($p < 0.0001$), and pre-clinic ($p < 0.0001$), but not with online CE ($p=0.07$), CE Course ($p=0.18$), and manufacturer training ($p=0.10$). None of the trainings were associated with the dental school region ($p=0.15$).

When asked if respondents felt that their dental school CAD/CAM training was sufficient to operate the CEREC chairside unit independently, the majority (76. %) felt they were not proficient compared to 24. % whom felt like they were sufficiently trained (n=192). Graduation year group was associated with the perception of sufficient training ($p=0.0005$), but not with the dental school region ($p=0.31$). Thirty four percent of the respondents in the groups of graduation years 2014-2017 stated that they were sufficiently trained compared to other year groups.

In regards to the amount of CAD/CAM restorations completed in dental school, more than half of the respondents (52.5%) stated that they did not complete any restorations and nearly a quarter (22.5%) only completed one or two. Graduation year group was associated with the number of CAD/CAM restorations completed in dental school ($p < 0.0001$) and also with the dental school region ($p=0.036$). Eleven percent of the respondents in the graduation year group 2014-2017 completed 6-10 restorations and 9% completed 11 or more restorations compared to the other year groups. Fifteen percent of the respondents from dental schools located in the Southwest indicated they completed 6-10 restorations as well as 15% indicated they completed 11 or more restorations compared to other school region groups. Additionally, 12% of the respondents from dental schools in the Southeast indicated they completed 6-10

restorations and 10% indicated they completed 11 or more CAD/CAM restorations compared to other regions.

Table 2: Type of CAD/CAM Training Compared to Graduation Year Group. Numeric value indicates percentage of dentists in the graduation year group (column) who received that respective type of training (row).

	2005 or earlier	2006-2009	2010-2013	2014-2017
Lecture*	33.3	58.3	76.5	93.6
Literature Review*	11.8	30.0	30.0	64.0
Elective*	5.9	12.5	33.3	50.7
Pre-Clinic (dentoform)*	0	12.5	52	84.5
Online CE	5.9	0	0	19.7
CE Course (outside of school)	5.9	30.0	15.0	28.2
Assisted/Observed in Clinic*	10.5	20.0	52.2	74.7
Manufacturer Training	11.1	22.2	21.1	37.8

*Indicates significant data

DISCUSSION

1) Survey Design: A total of 306 responses yielded a response rate of 56%. Typically a response rate of an online survey ranges from 20-30%.⁷ A response rate of 56% in this study permits some meaningful conclusions within the population of general dentists in the USAF. A number of factors could have influenced the response rate: all e-mails addresses were validated through the United States Air Force, multiple reminders were sent out to both dental leadership to all 74 dental clinics, as well as reminders with the link to the survey embedded in a monthly newsletter sent out by the Air Force Medical Operations Agency. Surveys were not sent to specialists to maximize the amount of response from dentists who utilized CAD/CAM technology.

2) Demographics: The majority of the dentists who completed the survey had 1-4 years of experience as a dentist in the Air Force (Table 1). Many dental officers separate from military service at 3-4 years after fulfillment of their initial service obligation. Respondents in the 1-4 year group represents younger dentists who are more likely to use CAD/CAM technology in Air Force dental clinics.

3) Responses from CAD/CAM users: Just less than half (47.4%) of the respondents indicated that they received CAD/CAM training while in dental school. Dentists who had recently graduated from dental school in the 2014-2017 year group reported they received some type of CAD/CAM training in dental school. However dental school graduates of 2005 or earlier were less likely to use CAD/CAM. A 2015 survey found that seventy-six percent of the dental schools in the United States have at least one and many

have 10 CAD/CAM units.⁴ Overall, it appears that dental schools are ramping up their focus on CAD/CAM in their curriculum to adjust to the real world demands of same day crown fabrication.

Regarding the type of CAD/CAM training that the respondents received while in dental school, there were significant correlations between the younger graduation (2014-2017) year group related to lecture, literature review, elective course, pre-clinic (dentoform) however not with online continuing education, CE course or manufacturer training. From this data we can gather that dental schools are using mainly lecture, articles, courses, and pre-clinical courses to teach their dental students about CAD/CAM. Most dental students are likely getting their information about CAD/CAM in their dental school curriculum and not seeking or paying for additional continuing education from online continuing education courses. As shown in Table 2, lecture was the highest percentage across year groups relative to other learning modalities. Also when examining year groups from 2005 or earlier to 2014-2017, there was generally an increase in literature review, CAD/CAM electives, training on pre-clinic dentoform, assisting/observing in clinic, and participating in manufacturer training. This data suggests that dental schools over the course of time have increased the availability for their students to learn about CAD/CAM.

Even though CAD/CAM training has become integrated in most dental school curriculums, only 34% of respondents who graduated from 2014-2017 felt like their training was sufficient to operate the CAD/CAM chairside unit independently. Perhaps this is due to the dentist playing a more active role in the digital laboratory aspect of dentistry instead of making traditional impressions and sending it to the lab. Once the preparation is scanned, the provider can virtually manipulate the proposed restoration using digital techniques, putting the laboratory effort into the dentist's hands. In the process of designing a restoration, there is a learning curve involved to ultimately feel comfortable scanning clinically, and navigating the software. This survey data also supported continued CAD/CAM training after dental school. In the USAF, the majority of dentists attend a 1-year Advanced Education in General Dentistry program where they receive additional training on CAD/CAM technology from dental staff with advanced training.

As expected more graduates from years 2014-2017 restored between 6-10 restorations and 11 or more restorations compared to other groups. This data suggests that dental schools are not merely trying to give their students a one time experience with CAD/CAM, but rather exposing them to multiple opportunities to utilize CAD/CAM clinically. There was also a correlation between the amount of restorations and respondents who graduated from schools in the Southwest and Southeast regions of the United States. The correlation could be due to smaller graduation classes in dental schools in these two regions thus leading to a greater potential to use CAD/CAM. It could also be a result of the management and recruitment of patients in dental schools within these two regions to ensure there is no shortage of clinical cases. Further investigation is required in this area to understand the connection between the amount of CAD/CAM restorations completed and region of the US.

CONCLUSIONS

Within the limits of this study, the following conclusions could be drawn. CAD/CAM is becoming a more prevalent part of dental school curriculum which are mainly utilizing lectures, literature reviews, elective courses, and exposure pre-clinically for training. Most of the respondents did not feel their training was sufficient enough to use CAD/CAM technology independently. More respondents in the groups of graduation years 2014-2017 had restored more CAD/CAM restorations compared to the other year groups.

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