Does Exposure to a Procedural Video Enhance Preclinical Dental Student Performance in Fixed Prosthodontics?


Abstract: To try to alleviate the issue of dental students having an inadequate field of view during live demonstrations of fixed prosthodontic preparations, an instructional video depicting the step-by-step procedures involved in an all-ceramic tooth preparation and provisional crown fabrication (practical exam 1, PE1) was created. Fifty-five second-year dental students were given a personal copy of the video after a lecture and an in-class viewing of the material. Throughout the course, students watched live demonstrations of tooth preparations and then practiced individually on mannequins. The scores achieved by the students on three practical exams (PE1, PE2, and PE3) were compared to those recorded by a class one year prior to the development of the video. The students exposed to the video performed significantly better on PE1 in comparison to the previous year's class, as well as compared to their own performance on the other two practical exams that had no supplementary teaching aids. A significant, moderate-level correlation was detected between exposure to the video and PE1. Ninety-six percent of the students reported on their end-of-year evaluation that the video helped them to prepare for PE1. The results of this study suggest that instructional videos may aid in the teaching of fixed prosthodontics.

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In North American dental schools, students are given only four years to learn hundreds of concepts and many procedural skills including those involved in fixed prosthodontics. Fixed prosthodontics requires students to master their hand proficiency during the performance of different crown preparations. However, feedback from students at our school suggests that conventional didactic methods tend to make skill acquisition difficult for preclinical trainees in this area of dentistry.

During the introductory session for the second-year fixed prosthodontics course at the Schulich School of Dentistry (University of Western Ontario, London, Canada), students are given the design specifications for the tooth preparations to be covered during the year. These design specifications are printed on laminated color-coded sheets. Students also receive lectures throughout the year describing each procedure in detail, which are supplemented with still pictures of aspects of these procedures. During the practical sessions for the course in our simulation clinic, the students are typically divided into multiple groups (with around ten students in each), and a row instructor performs a live demonstration of the tooth preparation on a life-sized mannequin. After the live demonstration, students have the opportunity to practice the procedures individually on the mannequins.

Our dental students have regularly complained about how difficult it was for them to visually appreciate the live demonstrations taught in our course since the mannequin’s oral cavity is small. They had to take sequential turns during these demonstrations to be able to get close enough to their row instructor while he or she was performing a particular task. As such, it was rare for each student to be able to watch an instructor perform a given procedure from start to finish.

While having an inadequate field of view is an issue for any dental procedure that students are attempting to learn, it can be a particular hindrance in fixed prosthodontics. Students need to appreciate critical concepts in tooth preparation including 1) the proper positioning of the handpiece and burs to prevent overtapering of opposing walls of a particular tooth or the creation of undercuts at the internal line angles; 2) the use of indirect vision when preparing the lingual wall of a tooth or when...
assessing the marginal fit of a restoration; and 3) the ability to precisely determine how much of the tooth structure has been removed for a given restoration. Therefore, the creation of an instructional aid that may help to alleviate the issue of a lack of visual access is warranted.

Over the past few decades, new technology has been introduced into the dental classroom setting including the use of instructional video and computer-based simulation. Previous studies on these tools as preclinical teaching aids have reported favorable results in terms of both student attitudes and learning outcomes. Video can be especially beneficial if students have the opportunity to refer back to the material repeatedly.

Although instructional videos have been developed in dentistry, to our knowledge, none of these have involved the demonstration of an all-ceramic tooth preparation and/or provisional crown fabrication. Moreover, the relationship between this type of teaching aid and preclinical dental student performance of these procedures has not been previously studied. The purpose of this study was to explore the relationship between exposure to a novel instructional video and preclinical dental student practical exam performance on an all-ceramic tooth preparation and provisional crown fabrication.

## Methods

During the summer of 2005, a thirty-minute instructional video-recording depicting the step-by-step procedures required for the preparation of a maxillary central incisor for an all-ceramic restoration and the fabrication of a provisional restoration in a mannequin, performed in real time by the primary author, was developed. The video centered on this preparation as it is the first one to which the students are exposed.

The recording was divided into two parts. The first part, which lasted nineteen minutes, outlined the ten sequential steps involved in an all-ceramic tooth preparation: 1) fabrication of a heavy polyvinylsiloxane matrix for later fabrication of the provisional restoration; 2) demonstration of the armamentarium required for the tooth preparation; 3) correct positioning of the mannequin along with the optimal positioning of the operator's body while performing the task; 4) cutting of the facial and incisal depth grooves; 5) incisal preparation; 6) facial preparation; 7) lingual preparation; 8) interproximal preparation; 9) preparation of finishing line; and 10) finishing of the preparation.

The second part of the video, which lasted eleven minutes, was divided into four segments depicting the fabrication of the provisional restoration for the prepared tooth: 1) demonstration of the armamentarium used for the procedure; 2) handling of the materials used for the provisional restoration; 3) adjustment of the restoration using burs; and 4) the final assessing and polishing of the restoration. Detailed narration accompanied the video’s content throughout all of its fourteen segments.

In September of 2005, personal copies of the video were made and given to the fifty-five members of the Class of 2008 after they had received a lecture by the course director supplemented with PowerPoint slides. The lecture also included an in-class viewing of the instructional video. Students were encouraged to view the DVD as many times as they wished during the course. Students then attended a three-hour practice session in the simulation clinic where an instructor provided a single live demonstration of the techniques for the group of around ten students. As with the previous years’ classes, the Class of 2008 had the opportunity to practice the procedures on a mannequin in our simulation clinic during their class time and after-hours.

In addition to the preparation of an all-ceramic crown for an anterior maxillary tooth, the class received single lectures followed by live demonstration on several other preparations including a) a full gold crown on a posterior tooth and fabrication of a provisional restoration; b) an anterior tooth for a porcelain-fused-to-metal crown and fabrication of a provisional restoration; c) a posterior tooth for a porcelain-fused-to-metal crown and fabrication of a provisional restoration; d) two anterior teeth for a three-unit, porcelain-fused-to-metal fixed partial denture and fabrication of a provisional restoration; and e) two posterior teeth for a porcelain-fused-to-metal fixed partial denture and fabrication of a provisional restoration.

The students were tested on the all-ceramic crown preparation and provisional restoration (practical exam 1, PE1), the full gold crown preparation and provisional restoration (PE2), and the posterior porcelain-fused-to-metal fixed partial denture and provisional restoration (PE3). The course director and instructors met at the beginning of the course to discuss the assessment instrument used on all PEs. The instrument consisted of twenty-eight items, which were divided among all five instructors. Each instruc-
tor evaluated the same criteria he or she was assigned for the practical examinations for all students. Even though instructors were not blinded, they had no knowledge of the study at the time of the PEs.

A quasi-experimental design (non-equivalent group) was used to explore the relationship between exposure to the video and student practical exam performance. Data from the dental classes were analyzed using SPSS software, version 12.0 (SPSS Inc., Chicago, IL). Final grades for the three PEs for the course are summarized in terms of mean and standard deviation (SD). The relationship between exposure to the instructional DVD and students’ final grade on PE1 was explored with the point-biserial correlation ($r_{bs}$). A split-plot ANOVA was performed, with dental class being treated as a between-subjects factor and practical examination treated as a within-subjects factor. Simple main effects were explored with Tukey’s HSD test.

The grades earned by the previous year’s fixed prosthodontics class (Class of 2007; N=52) were obtained anonymously and compared with those obtained by the Class of 2008 on the three practical exams. The previous year’s class was deemed to be an acceptable comparison group since they received the same number and content of lectures, live demonstrations, and practical examinations. This study’s protocol was reviewed and granted a formal exception by the University of Western Ontario’s Ethics Committee for Research Involving Human Subjects.

**Results**

Split-plot ANOVA revealed a significant interaction of dental class and practical examination on the final grades achieved by the students ($F_{1,105}=25.6; p=.00$). Tests of simple main effects for class across the examinations revealed that, for PE1, the Class of 2008 scored significantly higher grades compared to the Class of 2007 (Tukey’s HSD, $p=.01$; see Table 1). No differences were detected between the two classes for final grades on PE2 and PE3. In terms of within-class performance on their practical examinations, a significant main effect of exam was detected ($F_{2,210}=5.4; p=.005$). Simple main effects analysis revealed that, overall, students performed significantly better on PE1 and PE3 compared to PE2 (Tukey’s HSD, $p=.05$; Table 1). In terms of scores for individual classes, members of the Class of 2008 received their highest mean grade on PE1 ($p<.01$ as compared to PE2 and PE3), while the Class of 2007 performed best on PE3 ($p<.01$ as compared to PE1 and PE2).

While exposure to the instructional video was found to be positively correlated to a moderate degree with final grades on the practical exam on all-ceramic tooth preparation and provisional crown fabrication [$r_{bs}=.48; p=.00; 95\% CI (.30 to .55)$], none were detected between exposure to the video performance on the other two practical exams ($r_{bs}=.03$ and $r_{bs}=-.01$ for PE2 and PE3, respectively).

Feedback obtained from the Class of 2008 revealed that the majority of the students who returned their course evaluation (48/50) felt that the instructional video helped them prepare for the all-ceramic tooth preparation and provisional crown fabrication practical. Comments were received from three students regarding their viewing behavior of the DVD. All three mentioned that they did not watch the material after the first practical exam. In terms of student preferences, only two students indicated

| Table 1. Final grades for preclinical dental students on the three practical exams (PEs) |
|-----------------------------------------|------------------|------------------|------------------|
|                                        | Class of 2008    | Class of 2007    | 95% CI           |
| Examination*                           | Mean (SD)        | Min, Max         | Mean (SD)        | Min, Max         |                                |
| PE1                                    | 87.1 (8.4)*      | 60.0, 97.0       | 77.1 (9.8)       | 45.5, 93.5       | 6.5 to 13.5                 |
| PE2                                    | 80.0 (8.6)       | 57.5, 95.0       | 79.4 (9.1)       | 55.5, 94.5       | -2.8 to 4.0                  |
| PE3                                    | 82.7 (10.0)      | 59.5, 96.5       | 83.0 (11.7)      | 49.5, 98.5       | -4.5 to 3.9                  |

*Procedures examined on PE1: all-ceramic tooth preparation and provisional crown fabrication; PE2: full gold crown preparation and fabrication of a provisional restoration; and PE3: preparation of two teeth for a three-unit bridge and fabrication of a provisional restoration.

*Significantly different from Class 2007 at $p=0.01$.

95% CI for the difference between means.
that, rather than the instructional video, a lecture and in-class demonstration would have been sufficient for the all-ceramic tooth preparation and provisional crown fabrication. Illustrative quotes from students regarding the perceived usefulness of the DVD included the following:

“We can see better on video versus a demonstration with everyone crowding around.”

“[The DVD was a] great tool; you can review the procedure at any time. It’s like having a demonstration over and over again.”

“The DVD allowed us to review at home.”

“The crown prep video was great introduction to fixed... Helped familiarize me with the sequences and materials to use.”

When asked for any suggestions on how the instructional DVD may be improved, feedback received from students included allowing students to view the video via the Internet and creating additional videos for more procedures. For example:

“Having the content up on the web would be better than having the DVD.”

“It would be great to have DVDs for every single procedure we do.”

Discussion

The results of this study indicate that students who were given a personal copy of a video depicting the preparation of an all-ceramic restoration and fabrication of a provisional restoration performed significantly better on a practical examination of the procedure compared to students who took the fixed prosthodontics course one year prior to the video’s development. Moreover, a significant, moderate-level correlation was detected between exposure to the instructional video and performance on the procedure’s practical exam.

Previous work has shown that instructional media is associated with improved knowledge in dental courses.1 Our study demonstrated that procedural skills of dental trainees may also be enhanced with this type of teaching aid. The video was designed to help alleviate the issue of impaired visual access for students in the course. End-of-year feedback from the students suggested that we achieved at least some success in this regard, as the majority of students reported that the DVD helped them to prepare for the all-ceramic tooth preparation and provisional crown fabrication practical exam, and there were some comments, as well, that specifically highlighted the student having an improved field of view. Previous studies did not detect differences in student preference and/or practical performance when comparing live versus prerecorded instruction. However, these depicted procedures when fabricating removable partial dentures, and the involved techniques were performed outside of the mouth.5,6

The Class of 2008 was found to perform significantly better on the first practical exam compared to the other practical exams in the course. As this study did not collect any detailed information regarding student viewing behavior of the DVD, including the estimated total time that they spent watching the video, it may be that the students were more motivated to master the all-ceramic tooth preparation and provisional crown fabrication as it was the first design they were required to perform during the year. Informal feedback from three course evaluations did indicate that at least these students stopped watching their DVDs once the first practical examination was over. However, it is also possible that the drop in scores shown by the Class of 2008 for the subsequent preparations may have been due, again, to a lack of visual access. Despite the fact that the first two practical examinations tested students on preparations that were similar in terms of the reduction of tooth structure, they varied in location (anterior area of the mouth for PE1 versus posterior area of the mouth for PE2 and PE3).

A limitation of the present study is absence of data related to how the students utilized the recording as part of their preparation for the first exam. This includes not only the time they spent watching the video beyond their initial exposure to it during class, but also how it may have influenced their behavior while practicing on their mannequins. The question of how the video-recording may help to shape procedural skill acquisition is one that warrants exploration in a future study.

To our knowledge, this study is the first to explore the relationship between exposure to an instructional video and preclinical dental student practical exam performance on all-ceramic tooth preparation and provisional crown fabrication. Although further research is needed, the results of this study suggest that instructional videos may aid the teaching of fixed prosthodontics. School administrators may wish to
consider developing alternative course materials for this area of dentistry using current technology.

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