Videotaped Feedback Method to Enhance Learning in Preclinical Operative Dentistry: An Experimental Study

Dipali Yogesh Shah, MDS; Ashwini Manish Dadpe, MDS; Dheeraj Deepak Kalra, MDS; Vikram P. Garcha, MDS

Abstract: The aim of this study was to investigate if a videotaped feedback method enhanced teaching and learning outcomes in a preclinical operative laboratory setting for novice learners. In 2013, 60 dental students at a dental school in India were randomly assigned to two groups: control (n=30) and experimental (n=30). The control group prepared a Class II tooth preparation for amalgam after receiving a video demonstration of the exercise. The experimental group received the same video demonstration as the control group, but they also participated in a discussion and analysis of the control groups’ videotaped performance and then performed the same exercise. The self-evaluation scores (SS) and examiner evaluation scores (ES) of the two groups were compared using the unpaired t-test. The experimental group also used a five-point Likert scale to rate each item on the feedback form. The means of SS (13.65±2.43) and ES (14.75±1.97) of the experimental group were statistically higher than the means of SS (11.55±2.09) and ES (11.60±1.82) of the control group. Most students in the experimental group perceived that this technique enhanced their learning experience. Within the limits of this study, the videotaped feedback using both ideal and non-ideal examples enhanced the students’ performance.

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The practice of restorative dentistry involves the application of principles of human biology, microbiology, and mechanical engineering, along with acquisition of fine technical skills and demonstration of artistic abilities. Preclinical operative training enables students to master various procedures in a simulated environment and forms the foundation for the efficient clinical work expected from them on live patients. The preclinical setting provides students with a controlled environment that enables them to practice at their own pace and achieve proficiency in the mechanical execution of dental procedures.

Traditionally, in preclinical operative dentistry, dental students receive the demonstration of a particular exercise by a qualified teacher. However, detailed visualization of the procedure is often inadequate during the operative procedure. In addition, it is a norm to evaluate the exercise at predefined interim stages, for example, tooth preparation, base, restoration. The instructor assesses the outcome at each stage of the exercise without knowing how the student reaches the endpoint. Hence, valuable opportunities for learner support via timely feedback and intervention during the procedure are lost. This inadequacy may lead to a gap between teaching and learning.

Development of new tools that improve learning skills in dental education is desirable. Advances in technology play an important role in the teaching process. Due to the difficulties experienced by students in a direct demonstration, video-assisted learning is becoming an integral part of dental education. Instructional videos are commonly used as teaching aids in dentistry. Further, the videotaped feedback method can augment existing procedural skill training approaches. This is an accepted method of training and evaluation in sports and to some extent in medicine. Just as a coach uses recorded matches to train athletes to recognize desirable and undesirable strategies, a compilation of dental students’ procedural video recordings can be used to enhance preclinical learning. Research related to
motor skill development shows that discrimination training in recognition of both ideal and non-ideal skills is beneficial for novice learners.7

Although there have been studies based on the use of camera systems for clinical teaching in dentistry,2,8 we have not found studies integrating the use of video demonstration of the ideal technique with videotaped feedback in the preclinical setup. Thus, the overall aim of this study was to develop a new video-assisted teaching-learning aid for novice learners. The specific objectives of the study were to test the hypothesis that the videotaped feedback method enhanced student preclinical performance in novice learners and to evaluate the feedback on the students’ perception of this teaching-learning method.

Materials and Methods

The Institutional Research Committee (protocol number #SDCH/IRB/2013-14/30) of Sinhgad Dental College and Hospital approved the study proposal. Informed consent for the study was obtained from second-year BDS students at Sinhgad Dental College and Hospital, Pune, India, who had completed their preclinical training for Class I amalgam restoration and received an instructional lecture on Class II cavity preparation. Of a total 94 students, 60 students (average age: 19 years, six months) comprised of 47 females and 13 males were randomly selected for the study by the lottery method. Each of the participants received a sub-goal based key-chart covering the important points in a Class II cavity preparation. Later, a computer carried out random allocation of the participants into two groups: the control group and the experimental group, with each group consisting of 30 participants.

The control group students received a video demonstration of an ideal Class II tooth preparation for dental amalgam restoration with the necessary verbal explanation. Battery-operated camcorders mounted on tripods were strategically positioned near each student’s workstation to obtain the best possible view as the control group participants performed the same Class II exercise as in the demonstration video. The trained video data collectors used the cameras in movie mode to record the details of the operative procedure in .mp4 format. The recording started as soon as the students began setting up their instruments and continued until completion of the exercise. Later, the participants self-evaluated their performance using the scoring checklist.

Materials used were a sub-goal based key-chart covering the important points in a Class II cavity preparation; a 12-minute demonstration video of an ideal Class II tooth preparation for dental amalgam in mandibular second premolar on typodont teeth made using an operating microscope (Möller Universal 300); video recording equipment (Sony Camcorder Model no. DCR-SR68/L); a scoring checklist to evaluate Class II tooth preparation based on the key-chart given to the students prior to the study (the chart had been peer-reviewed by eight staff members of the department); 30 edited videotapes of the control groups’ performance (Free Video Cutter Joiner 10.4, Softonic); and feedback forms for the experimental group. The video camera operators undertook a series of guided practice sessions with the cameras prior to the study. A professional video editor, in the presence of the senior investigator who has 13 years of teaching experience in operative dentistry, edited the control groups’ videos. Relevant portions of the recordings that showed either common errors or very accurate technique were included in detail along with the outcome. Each video ranged from one to one and a half minutes.

The experimental group received the same Class II video demonstration with similar verbal cues as the control group. Following this, the experimental group viewed the 30 edited video-clips of the control group, one time each, in a play-pause-discuss manner on an LCD projector. One of the investigators acted as a facilitator for this interactive feedback session that lasted for one hour 15 minutes. For every video shown, the students first gave their input, followed by specific descriptive comments by the facilitator about desirable and undesirable techniques.

The experimental group students then performed the same exercise while being videotaped. They evaluated their own performance using the same scoring checklist as the control group. Participants in the experimental group provided their feedback on a form consisting of a series of statements to which they indicated their level of agreement by means of a five-point Likert scale. Responses were coded 1=strongly disagree, 2=disagree, 3=neither agree nor disagree, 4=agree, and 5=strongly agree. Additionally, the students could write free comments in the empty space provided at the end of the feedback form. While providing the feedback, the students did not disclose their identity.

A single independent subject expert was trained and calibrated to assign scores to the preparations using the same checklist used by the students. At
the end of the exercises, the blinded subject expert evaluated the performance of the students in both the groups. Figure 1 shows a summary of the experimental protocol.

A database was prepared using the scoring checklists and experimental group participants’ feedback responses. The data entered into Microsoft Excel were statistically analyzed using SPSS soft-

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**Figure 1. Summary of the experimental protocol**
Dental education is an amalgamation of didactic and motor skill learning processes. Before working with patients, dental students master skills like tooth preparation and restoration on manikins with typodont teeth. This process provides for the possibility of standardized assessment of procedural skills. In this study, we investigated the potential of videotaped feedback to improve preclinical teaching for novice learners.

A Class II tooth preparation for amalgam, deemed challenging in operative dentistry, was chosen for the study. The experimental group received a video demonstration of an ideal Class II cavity preparation for amalgam. Following this, they saw the edited performance recordings of the control group accompanied by their critical analysis. The reason the experimental group was shown the control group videos rather than their own as in a traditional videotaped feedback was that we wanted to evaluate the technique on novice learners. Otherwise, the control group becomes “test-wise” as they learn something from the first performance, thus distorting the results.

The ability to play-pause-discuss the control group students’ videos enabled us to develop tools of interaction for the experimental group. This resulted in an elevated level of understanding unattainable during simple video demonstration.

The demonstration video provided the frame of reference to compare each recording. These revealed the common errors that occur in terms of technique deviations that lead to undesirable outcomes. This process probably led to a better understanding of what not to do and what can

### Results

The means of the SS (13.65±2.43) and ES (14.75±1.97) of the experimental group were higher than the means of the SS (11.55±2.09) and ES (11.60±1.82) of the control group; the difference was statistically significant (p<0.001) (Table 1). Thus, the student self-assessment and examiner assessment showed that the experimental group performed better than the control group. Table 2 summarizes the feedback from the experimental group. Most students in the experimental group responded that this technique enhanced their performance.

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ES Control</td>
<td>30</td>
<td>11.60</td>
<td>1.82</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Experimental</td>
<td>30</td>
<td>14.75</td>
<td>1.97</td>
<td></td>
</tr>
<tr>
<td>SS Control</td>
<td>30</td>
<td>11.55</td>
<td>2.09</td>
<td>0.006*</td>
</tr>
<tr>
<td>Experimental</td>
<td>30</td>
<td>13.65</td>
<td>2.43</td>
<td></td>
</tr>
</tbody>
</table>

*Statistically significant difference at p<0.05

<table>
<thead>
<tr>
<th>Statement</th>
<th>Mean</th>
<th>SD</th>
<th>Median</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The Class II video demonstration would have been adequate for me to perform the exercise.</td>
<td>2.07</td>
<td>0.98</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2. I had a better understanding of the Class II exercise technique after reviewing procedural videos.</td>
<td>3.83</td>
<td>0.99</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>3. This training technique improved my learning experience.</td>
<td>3.80</td>
<td>0.85</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>4. It was much easier to perform after I knew what errors could happen.</td>
<td>3.47</td>
<td>0.90</td>
<td>3.5</td>
<td>4</td>
</tr>
<tr>
<td>5. I could perform better due to this teaching technique.</td>
<td>4.07</td>
<td>0.78</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>6. This technique provided for a safe and unbiased learning environment.</td>
<td>3.80</td>
<td>0.80</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>7. I am satisfied with the overall quality of course materials.</td>
<td>3.13</td>
<td>0.90</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>8. The presence of a video camera was distracting.</td>
<td>3.53</td>
<td>0.78</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>9. This technique has potential value as procedural-skill learning tool.</td>
<td>3.90</td>
<td>0.84</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>10. I would like to have this teaching method used regularly in preclinical classes.</td>
<td>4.23</td>
<td>0.73</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

Note: Response options to statements were 1=strongly disagree, 2=disagree, 3=neither agree nor disagree, 4=agree, and 5=strongly agree.
go wrong among the experimental group participants, reflected in the improved ES and SS values of the experimental group over the control group (Table 1). Thus, the hypothesis was confirmed.

Self-assessment by students is an indispensable part of formative assessment. It helps them to understand the main learning objectives and thereby achieve educational goals. Correlation between students’ self-assessment and staff evaluation is important. Student inability to apply assessment criteria, interest bias, and the subjectivity of teacher assessments may impede student-teacher agreement. However, in our study, the teacher and student assessments were in alignment. This correlation was possibly because the students already had an objective idea of the requirements of an ideal Class II through the sub-goal-based key-chart they received prior to the study.

The students’ feedback clearly showed a need for adjuncts to improvise task learning in the preclinical setting (Question 1: mode 2). Cognition, integration, and automation are the three steps in the attainment of procedural skills. The videotaped feedback method helps to improve cognition by creating a perceptual awareness of the task. This improvement was evident in our study from the fact that most students in the experimental group developed an increased understanding of the Class II tooth preparation after watching procedural recordings of the control group (Question 2: mode 4).

The videotaped feedback increased observational learning (Question 3: mode 4) by providing accurate sequential visual images that lead to desirable outcomes. Additionally, one can focus on the more difficult aspects of a procedure and simplify it by breaking it down into smaller steps. Rather than learning from their own mistakes through repeated practice, videotaped feedback provided the participants with an opportunity to accelerate their learning curve by knowing what errors could occur (Question 4: mode 4). This method is a useful tool in motor skills teaching and has gained popular acceptance in physical education. Considering that preclinical exercises involve precise hand-motor coordination, it is quite understandable that the performance of most students was improved due to this technique (Question 5: mode 4).

While videotaped feedback is a valuable way of providing feedback, it can be anxiety-provoking for participants to see themselves on video, particularly in front of a teacher and their colleagues. Hence, in our study the control group videos were shown to the experimental group. Another merit of this technique is that it provided a safe learning environment, clearly reflected in the students’ responses to Question 6: mode 4. The participants were undecided about the quality of course materials (Question 7: mode 3). The comments of students desiring better image resolution of the video-recordings can perhaps explain this.

The presence of a video camera proved to be distracting for most participants (Question 8: mode 4). Perhaps a hidden camera would have provided for a better study setup and eliminated the “third eye” effect. However, to create similar simulation environments for both study groups, we recorded the performance of the experimental group. In addition, the recording started during instrument set-ups to reduce participants’ anxiety levels, allowing them to acclimatize, thus minimizing the Hawthorne effect.

The positive responses to Questions 9 and 10 (mode 4) showed that most students were supportive of the use of the videotaped feedback method in the preclinical operative setting. In the open-ended section of the feedback form, we received comments like “I really liked the fact that I knew beforehand where I could go wrong,” “I actually understood how to break contact in a Class II,” and “The session was too long.” While learning motor skills, in addition to the practice itself, appropriate feedback is also one of the key variables that influence learning. According to the dual-coding theory, visual and verbal information have a synergistic effect on cognition and memory. Hence, the videotaped feedback method is superior to the traditionally provided verbal feedback. Additionally, novice learners are highly benefited if provided with a clear understanding of desirable and undesirable outcomes.

In our study, the experimental group became aware of what they needed to do differently to improve the outcome by watching non-ideal videos. In addition, this method of conducting a videotaped feedback session in front of a group was considerably less time-consuming than one-on-one feedback. Since different groups of students can review the same edited recordings of the control group, this method may also prove to be a cost-effective learning tool for future classes. To supplement teaching learning in preclinical dentistry, the instructors may use a collection of such videos. In addition, the positive feedback received from the participants validates the use of this method in preclinical teaching. With video technology rapidly improving, it may be possible to apply this technique in a clinical setup as well. Chadwick et al. evaluated the use of a novel video technology rapidly improving, it may be possible to apply this technique in a clinical setup as well.
head-mounted camera for dental teaching in various environments such as clinics, preclinical prosthetics, and preclinical operative labs and concluded that the teaching technique enhanced the details observed during dental procedures and the quality of feedback to the trainees. In comparison, our study was confined to a single exercise in the preclinical operative curriculum.

The limitations to implementing this videotaped feedback method could be the need for suitable state-of-the-art video equipment as well as technical expertise for good quality videos. Some variations in the effectiveness of this teaching-learning technique may occur depending on factors like quality of the instructor-provided feedback, knowledge, and cognition levels of the learner as well as the frequency of reviewing the videos. In addition, the results were based on a single exercise performed by a limited sample selected from a single dental school and may thus not be generalizable to other dental students. Although the videotaped feedback technique used here resulted in a significant improvement in procedural skills of the experimental group, there is a need to evaluate the sustaining effects of this method.

Conclusion

There is a need to update the strategies for procedural skill training of preclinical dental students to bridge the gap between teaching and learning. This study’s results suggest that videotaped feedback could be a practical method of augmenting discrimination training for novice learners in preclinical teaching. The group that received video demonstration and videotaped feedback definitely showed a better performance in their procedural skills than the group that received only the video demonstration. This experimental teaching-learning method proved to be practical as well as economical. Conducting videotaped feedback in front of a group provided useful insights into the tooth preparation technique that the students, left to their own devices, would not otherwise appreciate. Further, this technique promoted greater interactivity by involving the students in the learning process, encouraging their critical thinking and quest for excellence. Such a teaching-learning method has the potential to encourage students to become self-directed learners not only in dental school but throughout their careers. In light of the findings reported here, further research should be undertaken to include larger sample sizes and randomized controlled trials in varying educational environments.

REFERENCES