

The Efficacy of an Endodontic Instructional Multimedia Program for Enhancing the Knowledge and Skills of Dental Students

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Abstract

Background and Aim: Full-scale demonstration of treatment phases on actual patients by an instructor is currently the conventional technique for practical instruction on endodontics. In this method, most students do not get the chance to closely observe the clinical procedure due to the small size of oral cavity. This study aimed at assessing the efficacy of an instructional multimedia program in endodontics for enhancing the knowledge and skills of dental students.

Materials and Methods: In this randomized interventional trial, students taking the course of clinical endodontics were divided into two groups receiving conventional live demonstration alone or in combination with an instructional multimedia (DVD). Baseline knowledge of students and their level of knowledge and skills after the intervention regarding practical endodontics were assessed by a pre-test and post-test, respectively. Data were compared between the two groups using Kruskal Wallis test.

Results: No significant differences were noted between the two groups in terms of knowledge or practical skills of students. However, the multimedia instruction significantly reduced the number of student inquiries to instructors for troubleshooting ($p < 0.001$).

Conclusion: Due to the lack of a significant difference between the two instructional techniques, the multimedia instruction technique may be successfully used as a complement to current conventional techniques for practical instruction on endodontics.

Key Words: Endodontic instruction, Knowledge, Demonstration, Instructional video, Skills, Multimedia

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Introduction

One method of practical instruction on endodontics for dental students is live demonstration of all phases of treatment by a mentor on an actual patient in order for the students to observe. This technique, called demonstration, has some benefits. However, they are usually outweighed by its drawbacks. Due to space limitations and small size of oral cavity, it is not always feasible for all students to precisely observe the treatment steps or it would be very much time-consuming. During the demon-

stration, students can interact with their mentor and ask questions; but as the session ends, direct instruction to students terminates and can no longer be repeated or reviewed. Therefore, students do not have a reference to refer to for possible future troubleshooting. On the other hand, other confounding factors such as the physical environment, patient compliance and cooperation, mentor's mood and high number of students can affect the demonstration and compromise the quality of instruction. This type of instruction is mentor-based

and hardly suitable for problem-based or case-based learning [1].

Observing the treatment phases by students during the mentor's demonstration and number of student inquiries to instructors for troubleshooting are of special significance in clinical dental curriculum. Efforts to improve this process, reducing the risk of errors, and decreasing the confounding factors as well as recording the phases of treatment for possible later review by students can improve the quality of instruction.

Video-assisted education, recording videotapes of the treatment phases and providing students with educational videos are suitable solutions for enhancing the quality of education. Video-assisted clinical instruction in dentistry (VACID) is an instructional modality based on the use of video-clips for dental instruction. Higher quality of instruction by the use of this technique in terms of technical skills [2-3] or simulating the clinical setting [4-5] has been previously documented and confirmed. Students have highly accepted this treatment modality as well [4, 6]. Furthermore, some studies have demonstrated that video-assisted learning has several advantages for instruction of clinical skills in comparison to conventional teaching [7-8].

Nevertheless, a few studies have shown that clinical demonstration is superior to other modes of education and facilitates the students' confidence, communication skills and understanding in the clinical setting [9].

The present study assessed the efficacy of clinical instruction of endodontics using an instructional multi-media program in enhancing the knowledge and skills of dental students.

Materials and Methods

This interventional randomized trial was conducted on dental students taking the course of clinical endodontics 3 for the first time in Shahid Beheshti University of Medical Sciences. A total of 26 dental students were enrolled. After course selection, students were randomly divided into two groups of 13. Since live demonstrations are performed for small groups of students (3-4 students), each group was divided into 3 subgroups of 3 and one subgroup of 4 by the Student Affairs Office of the university.

In order to assess the clinical knowledge of students in all groups, a comprehensive pretest was carried out based on the educational goals for access cavity preparation. In this pretest, clinical slides were shown and students answered the related questions.

After the conduction of pretest, the first group received conventional live demonstration of access cavity preparation on an actual patient by the mentor. Students in this group directly observed treatment phases step by step.

Students in the second group received conventional live demonstration on an actual patient and were allowed to use the educational DVD containing exact demonstration of all phases of treatment and peri-operative errors during access cavity preparation. DVD contents were high definition movies demonstrating the access cavity preparation for maxillary and mandibular molars, searching for canal orifices and peri-operative errors using intra-oral cameras. Several clinical images and radiographs had been included as well. The video was sound tracked by two instructors. In order to prevent bias due to the possible access of the first group students to the DVD, it was kept in the Endodontics Department and only second group students had access to this DVD and were allowed to watch it under the supervision of mentors.

In order to standardize the method of demonstration and clinical instruction of students, the two instructors were provided with comprehensive and documented instructions to ensure complete coverage of the objectives and similarity of educational content.

After the completion of clinical instruction, students' skills in access cavity preparation on actual patients were tested and evaluated in both groups by two instructors blinded to the group allocation of subjects. Students were scored and a post-test based on the educational goals was held similar to the pretest and clinical knowledge score of students was determined. Scores obtained by students in the following domains were compared between the two groups: removal of the pulp chamber roof, under-extension, over-extension, gouging, perforation, detecting the main canals, detecting extra canals and number of student inquiries to instructors for troubleshooting.

Data were analyzed using SPSS version 16 software.

Central dispersion measures (mean and SD) for the practical skills score of students in different groups were calculated and reported separately for different tested domains in access cavity preparation. Considering the ordinal nature of dependent variable (students' scores), statistical comparisons between the two groups were carried out using the Kruskal Wallis test. Non-parametric Mann Whitney U test was performed for pair wise comparison of instructional methods regarding number of student inquiries to instructors for troubleshooting. ANOVA was applied for the analysis of pre-test and post-test data with the consideration of confounding factors as between subject comparison and pre-test score as the covariate. Type one error (α) was set at 0.05. $P \leq 0.05$ was considered statistically significant.

Results

In student group receiving conventional demonstration along with the use of instructional multimedia, the mean score of students in removal of the pulp chamber roof, under-extension, over-extension, gouging, perforation, detecting the main canals, detecting the extra canals and number of student inquiries to instructors for troubleshooting was 1.3529, 1.5882, 1.8824, 1.8529, 1.9412, 1.8529 and 2.0588, respectively (Table 1). Also, the mean pretest and post-test scores of these stu-

dents were 16.3333 (out of 20) and 9.6667 (out of 15), respectively (Table 4). Table 1 presents the central dispersion measures of practical skills score of students receiving conventional demonstration along with access to the instructional multimedia.

In the conventional demonstration method, the mean score of students in removal of the pulp chamber roof, under-extension, over-extension, gouging, perforation, detecting the main canals, detecting the extra canals and number of student inquiries to instructors for troubleshooting was 1.0455, 1.5909, 1.7273, 1.7273, 1.9091, 1.5909, 1.5909, 1.9091 and 3.5909, respectively (Table 2).

The mean pretest and posttest scores of these students were 15.0 (out of 20) and 7.25 (out of 15), respectively (Table 4). Central dispersion measures of practical skills score of students receiving conventional demonstration alone are demonstrated in Table 2.

Scores obtained by students in different aspects of clinical skills of access cavity preparation were compared by non-parametric Kruskal Wallis test; which showed no statistically significant difference between the two instructional methods in improving the students' skills. The only difference was that the use of instructional multi-media significantly reduced the number of student inquiries to instructors for troubleshooting in comparison to conventional method ($p=0.001$) (Table 3).

Table 1. Central dispersion measures for practical skills score of students receiving conventional demonstration along with the use of instructional multimedia

Practical skills domains	Number of teeth	Mean	SD	Minimum	Maximum
Removal of the pulp chamber roof	17	1/3529	0/52335	0	2/0
Under-extension	17	1/5882	0/5073	1/0	2/0
Over-extension	17	1/8824	0/33211	1/0	2/0
Gouging	17	1/8529	0/343	1/0	2/0
Perforation	17	1/9412	0/24254	1/0	2/0
Detecting the main canals	17	1/8529	0/343	1/0	2/0
Detecting the extra canals	17	1/8529	0/343	1/0	2/0
Number of student inquiries to instructors for troubleshooting	17	2/0588	0/72634	1/0	3/5

Good: 2 scores

Average: 1 score

Weak: 0 score

Table 2. Central dispersion measures of practical skills score of students receiving conventional demonstration alone

Practical skills domains	Number of teeth	Mean	SD	Minimum	Maximum
Removal of the pulp chamber roof	11	1/0455	0/47194	0	2/0
Under-extension	11	1/5909	0/43693	1/0	2/0
Over-extension	11	1/7273	0/64667	0	2/0
Gouging	11	1/7273	0/64667	0	2/0
Perforation	11	1/9091	0/30151	1/0	2/0
Detecting the main canals	11	1/5909	0/53936	0	2/0
Detecting the extra canals	11	1/9091	0/30151	1/0	2/0
Number of student inquiries to instructors for troubleshooting	11	3/5909	1/3751	2/5	7/5
<p style="text-align: center;"> Good: 2 scores Average: 1 score Weak: 0 score </p>					

Table 3. Statistical comparison of students taking “clinical endodontics 3” regarding their practical skills scores in different domains

Practical skills domains	Instruction method	Number of teeth	Mean score	Chi square	P .V
Removal of the pulp chamber roof	Multimedia	17	31/0	1/879	0/391
	Conventional	11	23/55		
Under-extension	Multimedia	17	26/65	0/938	0/626
	Conventional	11	25/64		
Over-extension	Multimedia	17	28/26	0/513	0/774
	Conventional	11	26/23		
Gouging	Multimedia	17	26/29	2/797	0/247
	Conventional	11	25/77		
Perforation	Multimedia	17	27/38	2/158	0/34
	Conventional	11	26/5		
Detecting the main canals	Multimedia	17	29/47	4/163	0/125
	Conventional	11	21/45		
Detecting the extra canals	Multimedia	17	27/03	0/366	0/833
	Conventional	11	29/32		
Number of student inquiries to instructors for troubleshooting	Multimedia	17	21/5	14/752	0/001 (Significant)
	Conventional	11	43/91		

Table 4: Central dispersion measures for students' knowledge scores following receiving conventional demonstration and multimedia instruction

Group		Number of teeth	Mean	SD	Minimum	Maximum
Conventional demonstration plus instructional multimedia	Pretest score (out of 20)	13	16/3333	2/44949	12/0	19/0
	Posttest score (out of 15)	13	9/6667	2/87228	5/5	14/5
Conventional demonstration only	Pretest score (out of 20)	13	15/0	2/50998	12/0	19/0
	Posttest score (out of 15)	13	7/25	1/63554	5/0	9/0

Discussion

Computer-assisted learning (CAL) or use of instructional software in the form of CD or DVD are a big step forward in improving the quality of medical and dental education systems. This method is a powerful means of instruction and the combination of audio and video input in multimedia is among the main advantages of this technique [10]. According to the results of several studies, CAL is an acceptable and beneficial modality for instruction of clinical skills yielding results comparable to those of conventional learning [11-12]. Another advantage of CAL is the encouragement of users. Some researchers reported that students using these systems showed an increased interest in educational subjects and hardly had any obstacles in achieving educational goals [13-14]. Standardizing the instruction and decreasing the odds of possible inconsistency between different instructors teaching the same clinical procedure are among other advantages of this technique.

In conventional demonstration technique, students have the opportunity to directly interact with their mentor, ask questions and get answers. However, as the live demonstration session ends, students can no longer access or review the instructed topics. Additionally, in some cases specific patients with unique treatment plans may be presented in these demonstrations. In these cases, students can only go over the procedures if they videotape the whole procedure or take numerous pictures during the treatment [15].

In several investigations on subjects relevant to the present topic, efficacy and positive outcome of CAL have been confirmed and this modality was believed to be at least as beneficial as the conventional method. Aly et al. compared the efficacy of an interactive multimedia courseware package with that of standard lectures with regard to knowledge, understanding, transfer of content, and problem-solving skills of students in orthodontics and found that the instructional multimedia program was at least as effective as the standard lecture of the orthodontic curriculum for undergraduate dental education [16]. These findings were in accord with our study results. Plasschaert et al. evaluated the effectiveness of multimedia instruction in endodontic problem solving and demonstrated no significant differences in students' performance be-

tween the two methods of conventional and multimedia learning and thus, the conventional method can be successfully replaced with the multi-media teaching for instruction of endodontic problem-solving [17].

Khayat et al, in their comparative study of multimedia and conventional education methods for undergraduate training in preclinical endodontics in Shiraz University, School of Dentistry revealed that CAL was at least as effective as the conventional method and was easily applicable [18]. Also, students could efficiently learn the educational content and were sufficiently satisfied. CAL was as perceptible as the conventional teaching. Almost similar results were obtained in the present study as well.

Based on the current findings, application of endodontic multimedia program in the form of a DVD with a combination of film, images and sound showing the phases of endodontic treatment was as effective as the conventional demonstration technique in enhancing the practical skills and knowledge of students. No significant differences were noted between the two groups of students receiving conventional demonstration alone or in combination with the multimedia program regarding their knowledge and skills of access cavity preparation.

Use of instructional multimedia program could significantly reduce the number of student inquiries to instructors for troubleshooting which indicates the advantage of this technique in improving the perception and understanding of students of the educational contents. There is no doubt that decreased number of student inquiries to instructors for troubleshooting improves performance and saves time in the process of treatment. Absence of a significant difference in clinical skills of students in the two understudy groups may be due to the similarity of instruction by mentors in both techniques. However, such result may not always be obtained since the mentor's performance during live demonstration at different times can greatly vary depending on clinical and environmental conditions and instructor's mood. Furthermore, students did not have access to DVDs outside the university and were allowed to watch them only under the supervision of mentors. Thus, there is a possibility that students did not get a chance to comprehensively use the DVDs and benefit from them.

However, aside from the mentioned justifications, our study results regarding the lack of a significant difference between the two methods, were in agreement with the majority of relevant studies.

Another advantage of CAL is reducing the time allocated by the university and mentors for preparation of lectures or problem-solving discussions. Based on the results of a study, application of CAL in pathology curriculum reduced the university lecture hours by approximately 30% [19]. This advantage is highly important considering the time shortage; which is always an issue in endodontics, periodontics, orthodontics and other clinical departments [20].

It appears that complementary instructional techniques and educational videos are important means to improve the quality of education. Undoubtedly, with the application of this technique, equivalent curriculum will be offered in different dental schools to standardize dental education. Furthermore, considering the high volume of new topics and advancements in various dental fields especially the clinical domains such as the endodontics, it is almost impossible to present and transfer all there is to students. Under these circumstances, application of CAL can greatly help in this respect.

Conclusion

Our study results demonstrated that use of instructional multimedia was as effective as the conventional demonstration for learning endodontic clinical skills and enhancing the knowledge of students. No significant differences were detected in knowledge and skills of students in the two groups about access cavity preparation. However, use of multimedia program could significantly reduce the number of student inquiries to instructors for troubleshooting. Therefore, considering the numerous advantages of using educational DVDs, this technique may be applied as a complementary method along side the conventional live demonstration for instruction of endodontic clinical skills.

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