Original Article

Effectiveness of Periodontal Flap Surgery Multimedia Instructional Program Compared to Standard Lecture

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Abstract

Background and Aim: The aim of this study was to compare the knowledge and skill performance obtained by dental students exposed to two different instructional modalities for periodontal flap surgery: a Computer-Assisted Learning (CAL) multimedia software program and traditional lecture.

Materials and Methods: In this experimental study, fifty volunteer fourth-year dental students with similar grade point average (GPA) scores, with the age range of 22 to 27 years, were divided into two groups (n=25). They all completed a pretest. The test group used a multimedia software, while the control group attended a lecture with the same educational content. Immediately after the lecture and after the students of the software group have finished watching the program, they completed a test consisting of 14 questions. Then, they were all assigned to perform some skills of periodontal flap surgery on an animal model. The performance of each student was assessed using a questionnaire of 13 items. Data were analyzed using independent samples t-test, Fisher's exact test, and Pearson's chi-squared test.

Results: There were no differences in prior knowledge between the two groups at the baseline. The software group had a final average exam score of 12.8±1.50, and the lecture group had an average score of 10.24±1.36; the difference was statistically significant (P<0.001). The CAL group had superior performance in some skills related to periodontal flap surgery (9.98±4.63 and 4.26±4.07, respectively; P<0.000).

Conclusion: The multimedia software program can be used as an adjunct to traditional education or as a means of self-instruction in teaching periodontal flap surgery techniques.

Key Words: Education, Dental, Learning, Periodontics, Computer-Assisted Instruction

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Received: 28 April 2018
Accepted: 13 Sep 2018

➢ **Cite this article as:** Sarlati F, Zare Z, Laiji N, Shariatmadar Ahmadi R, Moghaddas O, Zokaei N. Effectiveness of Periodontal Flap Surgery Multimedia Instructional Program Compared to Standard Lecture. J Islam Dent Assoc Iran. 2018; 30(4):145-152. DOI: 10.30699/JIsdreir.30.4.145

Introduction

Computer-based, self-instructional programs provide a way of giving multimedia presentations that use textual materials, visuals, sound, and motion [1]. Computer-Assisted Learning (CAL) has a number of perceived advantages to both students and teachers. It offers students the advantage of learning at their convenience and pace of learning; it can save faculty's time as well as resources [2]. It also provides an accessible and flexible way of presenting curriculum material [1]. Lecture-based learning is mostly used worldwide as an educational method at dental schools. Nowadays, learners benefit from the combination

of face-to-face learning in seminars, workshops, or lectures with individual, computer-based learning phases and can use the advantages [3,4]. Blended learning leads to better learning outcomes compared to using a traditional teaching method alone and can be implemented in undergraduate curriculum [5,6]. Recent changes in dental school curricula have also added to the value of CAL [7]. Dental students usually wish for more factual and concrete information and a more structured curriculum and organized conditions [8]. Even small changes in how the information is presented can lead to major alterations in learning outcome [9]. Previous studies suggest that in terms of performance, CAL was as good as conventional learning in 98% of the trials and required much less time to achieve the same performance [10]. Periodontics, as one of the most important fields in dentistry, needs the students to develop skills as well as knowledge. Periodontal flap surgery is one of the topics that have a three-dimensional (3D) entity. The use of 3D vision in virtual learning has a considerably positive impact on the performance of students [11]. We designed and implemented a CAL package in periodontal flap surgery techniques using texts, visuals, sound, motions, and 3D animations. The aim of this study was to compare the knowledge and skill attained by fourth-year clinical dental students in two different instructional modalities for periodontal flap surgery techniques. The first one was our CAL multimedia software program, and the second one was a same-content traditional lecture. We tried to validate and evaluate if the software has the same potential to produce effective knowledge and skill as traditional lecture.

Materials and Methods

Fifty fourth-year dental students (30 women and 20 men, age range of 22-27 years) in their 8th semester, from the Dental Branch of Islamic Azad University, Tehran, Iran, were enrolled in the study. This experimental study was approved by the Institutional Committee of Clinical Research Ethics of the university and was in accordance with The Helsinki Declaration of 1975 as revised in 1983. Participants of the study were 4th year volunteer dental students with similar grade point average (GPA) scores [14-16,20] (14-16.20). They were randomly assigned into either the lecture group or the software group (n=25). Randomization was performed by use of sealed envelopes delivered to students randomly without prior identification. The exclusion criteria were any prior experience or knowledge in periodontal flap surgery techniques or experience in assisting, aiding or otherwise performing the procedure. All students completed a pretest consisting of 14 right-or-wrong questions. The questions were designed and approved by three board-certified periodontists (faculty members). The pretest was used to determine the baseline knowledge of the students in each group and confirmed total ignorance regarding the periodontal flap technique. The multimedia software program was designed and developed based on 3D animations, texts, photographic images, illustrations, and audio with a total duration of 45 minutes. The software has been developed as an academic project approved by the Education Development Office (EDO) of the Dental Branch of Islamic Azad University, Tehran, Iran, and the Informatics Society of Iran (Technical confirmation certificate No. 204814). This is a single software that functions on both PC and Mac computers and allows students to use it wherever they have access to an updated computer. When the program is run, the audio narration begins. There is a main menu on the right side of the home page which has three main topics: 1- Classification of flaps (Subtopics: a- Bone exposure after flap reflection, b- Placement of the flap after surgery, and c- Management of the papilla as periodontal flaps can be classified according to the mentioned items); 2- Periodontal flap surgery (Subtopics: a- Incisions, b- Elevation of the flap, and c- 3D animation); 3- The flap techniques for pocket therapy (Subtopics: a- Modified Widman flap and 3D animation, b- Undisplaced flap and 3D animation, c- Palatal flap and 3D animation, d- Apically displaced flap and 3D animation, and e- Distal wedge surgery) [12,13]. The software group attended a class with laptop computers with a multimedia software application for self-education. Each individual had a single laptop. They were given the use of a quiet place and enough time to watch the program but they were not allowed to attend the lecture. No questions or dialogues between them were

allowed. The lecture group attended a same-content lecture. They were allowed to take notes and ask questions but they did not have access to the software program. Immediately after the lecture and after the software group students have finished watching the program, they completed a post-test consisting of the same 14 right-or- wrong pretest questions. Each participant received one point for each item correctly answered. Then, they were all assigned to perform some skills of periodontal flap surgery on an animal model. The mandibles of freshly slaughtered adult sheep were used [14]. The students had basic periodontal surgical instruments at their disposal. The performance of each student was assessed by a blinded, board-certified periodontist (faculty member) using a questionnaire of 13 items. The first five items included five types of instruments that were introduced in the lecture and software. The students were asked to show these five instruments in the surgical tray. Each participant received one point for each item correctly recognized. The students' ability to carry out the remaining eight items (procedures) was rated by the assessment using overall global ratings recommended by the Joint Committee for Higher Surgical Training (JCHST) in general surgery in the United Kingdom [15,16]. Students who were able to perform the procedures unsupervised or did not require supervision but may needed help occasionally, received one point. However students who were either able or unable to perform the procedure under supervision did not receive any point. The validity of all test questions was confirmed by a panel of three board-certified periodontists. All data were entered into SPSS software (version 22; IBM Co., Chicago, IL, USA). Data were analyzed using independent samples t-test, Fisher's exact test, and Pearson's chi-squared test. $P<0.05$ was considered as statistically significant.

Results

A total of 50 students including 30 women (60%) and 20 men (40%) took part in the study. Of these students, 25 were allocated to the CAL group and 25 to the lecture group. There were no statistically significant differences in age and sex between the two groups (Table 1). The pretest confirmed total ignorance regarding the periodontal flap technique. There were no statistically significant differences between the pretest knowledge scores of the two groups ($P=1$). As shown in Table 2, the mean knowledge test score was 12.8 ± 1.50 and 10.24 ± 1.36 in the CAL and lecture groups, respectively, which showed statistically significant differences ($P<0.001$). There were also statistically significant differences between the mean practical test scores in the CAL (9.98 ± 4.63) and lecture groups (4.26 ± 4.07; $P<0.000$).

The knowledge test questions are detailed in Table 3; It also shows how the students in each group answered the questions. The students in the CAL group gave more correct answers to questions number 1, 5, 6, 8, 9, 10, and 11, and the differences were statistically significant between the two groups. All the students in the CAL group gave correct answers to questions number 1 and 11 (100%), while in the lecture group, 22 students (80%) gave correct answers to question number 1, and 20 students (80%) gave correct answers to question number 11. The practical test items are detailed in Table 4. The average proportion of correct performances was superior in the CAL group for items number 1, 4, 5, 6, 7, 8, 9, 11, 12, and 13. The items that showed the greatest differences were items number 6 (Internal bevel incision), 7 (Sulcular incision), 8 (Interdental incision), 9 (Full thickness flap), 10 (Apically displaced flap), 12 (Scaling and Root planing), and 13 (debridement).

Discussion

Computer-Assisted Learning (CAL) or use of instructional software is a big step forward in improving the quality of medical and dental education systems [17]. The objective of this study was to determine the effect of an instructional multimedia software on knowledge and practical skills of dental students in periodontal flap surgery techniques in comparison with standard lecture. Our results showed that students in the software group gained better knowledge and practical skills immediately after the learning session as determined by written and practical assessments. We also observed that some certain items had greater intergroup differences, items such as incisions (internal bevel, sulcular, and interdental) and flap elevation types (full thickness and apically

Table 1. Age and sex of the study groups

Variable	CAL group (N=25)		Lecture group (N=25)		P-value
	Number	Percent	Number	Percent	
Gender					
Female	17	68	13	52	0.248
Male	8	32	12	48	
Age (years)					
<22	18	72	17	68	
22-27	5	20	5	20	0.892
27	2	8	3	12	

CAL= Computer-assisted learning

Table 2. Knowledge test and practical test results

Test scores	CAL group (N=25)		Lecture group (N=25)		P-value
	Mean	SD	Mean	SD	
Knowledge test	12.88	1.50	10.24	1.36	P<0.001
Practical test	9.98	4.63	4.26	4.07	P<0.000

CAL= Computer-assisted learning, SD=Standard deviation

displaced). These results made us presume that this instructional multimedia 3D animation software helped the students to learn the actions that require motion much better. They were able to repeatedly watch the animations during the session, while students of the lecture group were only exposed to two-dimensional (2D) PowerPoint slides. The technique of the surgery was explained to them only once. In standard lectures, students have the opportunity to directly interact with their mentor; however, the mentor's performance during lecture at different times can greatly vary depending on environmental conditions and instructor's mood [17]. Whether CAL proves to be more efficacious than traditional learning or not, its advantage from other perspectives (e.g. learner satisfaction and time efficiency) has been demonstrated in previous studies in health care [18,19]. Brearley Messer et al [20] have evaluated teaching pediatric dentistry by multimedia in a three-year report and have reported that students were very enthusiastic about learning via multimedia although few students disliked this educational approach. Aly and colleagues [7,21] also in their studies on an instructional multimedia program in orthodontics pointed out that not only this multimedia program was as effective as the standard lecture for undergraduate training, but also the majority of undergraduate and postgraduate dental students were very enthusiastic about this form of educational approach.

To the best of our knowledge, there are no previous studies similar to ours. We could find neither any multimedia software regarding periodontal flap surgery nor any instructional software regarding periodontics with characteristics as ours (e.g. 3D animations, texts, illustrations, and audio).

Table 3. Results of the 14 right-or-wrong questions of knowledge test

Questions	CAL group (N=25)			Lecture group (N=25)		
	Answer	Number	Percent	Answer	Number	Percent
1-In a full-thickness flap, all of the soft tissue is reflected to expose the underlying bone.	correct	-	-	correct	3	12
	incorrect	25	100	incorrect	22	88
2- In a full-thickness flap, the bone is covered by a layer of connective tissue that includes the periosteum.	correct	2	8	correct	3	12
	incorrect	23	92	incorrect	22	88
3- Partial thickness flap may be necessary when dehiscence or fenestrations are present	correct	3	12	correct	3	12
	incorrect	22	88	incorrect	22	88
4- A displaced flap is returned and sutured to its original position.	correct	5	20	correct	3	12
	incorrect	20	80	incorrect	22	88
5- The conventional flap is not used when the flap is to be displaced.	correct	14	56	correct	21	84
	incorrect	11	44	incorrect	4	16
6- Undisplaced flap is a type of conventional flap.	correct	3	12	correct	21	84
	incorrect	22	88	incorrect	4	16
7- The internal bevel incision removes the pocket lining.	correct	1	4	correct	4	16
	incorrect	24	96	incorrect	21	84
8- A flap without vertical incision is called an envelop flap.	correct	4	16	correct	13	52
	incorrect	21	84	incorrect	12	48
9- Facial vertical incisions can be made in the center of an interdental papilla.	correct	1	4	correct	13	48
	incorrect	24	96	incorrect	12	52
10- A periosteal elevator is used to elevate the partial thickness flap.	correct	4	16	correct	10	40
	incorrect	21	84	incorrect	15	60
11- Partial thickness flap includes the epithelium and a layer of connective tissue.	correct	-	-	correct	5	20
	incorrect	25	100	incorrect	20	80
12- Flaps are used to increase accessibility to root deposits for scaling and root planing.	correct	2	8	correct	6	24
	incorrect	23	92	incorrect	19	76
13- Modified Widman flap has been described for the removal of the pocket lining.	correct	5	20	correct	4	16
	incorrect	20	80	incorrect	21	84
14- Undisplaced flap can eliminate the pocket.	correct	5	20	correct	6	24
	incorrect	20	80	incorrect	19	76

CAL=Computer-assisted learning

Table 4. Results of the 13 items of practical test

Items		CAL group (N=25)			Lecture group (N=25)		
		Answer	Number	Percent	Answer	Number	Percent
Instruments	1.Periosteal elevator	correct	3	12	correct	9	36
		incorrect	22	88	incorrect	16	64
	2.Sickle scaler	correct	2	8	correct	6	24
		incorrect	23	92	incorrect	19	76
	3.Mccall curette	correct	10	40	correct	9	36
		incorrect	15	60	incorrect	16	64
	4.Gracey curette	correct	6	24	correct	13	52
		incorrect	19	76	incorrect	12	48
	5.Urban knife	correct	4	16	correct	14	56
		incorrect	21	84	incorrect	11	44
6.Internal bevel incision		correct	3	12	correct	19	76
		incorrect	22	88	incorrect	6	24
7.Sulcular incision		correct	3	12	correct	18	72
		incorrect	22	88	incorrect	7	28
8.Interdental incision		correct	8	32	correct	21	84
		incorrect	17	68	incorrect	4	16
9.Full-thickness flap		correct	1	4	correct	19	76
		incorrect	24	96	incorrect	6	24
10.Apically displaced flap		correct	10	40	correct	23	92
		incorrect	15	60	incorrect	2	8
11.Modified Widman flap		correct	10	40	correct	20	80
		incorrect	15	60	incorrect	5	20
12.Scaling and root planing		correct	1	4	correct	14	56
		incorrect	24	96	incorrect	11	44
13.Debridement		correct	2	8	correct	15	60
		incorrect	23	92	incorrect	10	40

CAL=Computer-assisted learning

Ramlogan et al [22] in 2013 compared the knowledge and skill attained by third-year dental students in three clinical exercises in periodontics: 1) Full-Mouth Plaque Scoring (FMPS), 2) Basic Periodontal Examination (BPE), and 3) Full Periodontal Examination (FPE) or six-point charting through video and live lecture instruction. The videos were created by the lecturer in periodontology, and similar to our study, the video lectures were viewed only once by students. They concluded that digital literacy is necessary for effective video development, and the use of video alone in clinical periodontology training may have drawbacks unless supplemented by suitable educational activities [22].

Several studies have evaluated the effectiveness of CAL versus other teaching methods in dentistry although many of them just measured the student's perception of his/her experience with the teaching modality and that was the only outcome for evaluating the effectiveness of the CAL program [23]. Rosenberg et al [1], in a review study, sought to identify high-quality, well designed, randomized controlled studies comparing CAL to other teaching methods. They showed that CAL is as effective as other methods of teaching. Their evidence-based results showed that a CAL program that is at least as effective as other methods of learning has several potential value-added advantages (depending on how the program is designed and the students' ease of access to the CAL modules); Students can learn at

their own pace, CAL lessons can be reviewed several times versus the "one time only" exposure in the lecture hall, and computer-based modules can be used literally 24/7 at convenient times when the student is free of distractions and is alert and ready to learn [1]. Haden et al [23] reported that time shortage is always an issue in endodontics, periodontics, orthodontics, and other clinical departments at dental schools. CAL also has the potential to lessen faculty workload as it allows archived and retrievable instruction [24].

In another review article, Schittek et al [10] reported that the use of CAL may enhance education and provide learning opportunities that cannot be taught by traditional strategies, however in academic learning, CAL should not replace conventional methods but should rather be used as a supplement and for self-directed studies [10]. Our research does not intend to minimize the importance of teachers, and the better results of the software group in our study are assumed to be related to the complexity of periodontal flap surgery techniques and its 3D nature. The results of the study conducted by de Boer et al [11] showed that students working with 3D vision achieved significantly better results than students who worked with 2D vision. Periodontal flap surgery is one of the subjects in the field of periodontics that is very difficult to be taught for the first time. In our study however, both teaching methods provided the same content, and this same content was taught in only one session. The software was viewed only once, and the lecture was presented only once as well. This may indicate that the combination of 3D animation, illustrations, and photographs as well as audio is more efficient than a same-content traditional lecture with 2D PowerPoint presentation.

Despite the fact that the software group reached higher learning outcomes, our study had several limitations. The single session instruction of periodontal flap surgery showed immediate better results, but there was no determination of students' knowledge retention in our preliminary study. However, since no previous study was designed to assess this multimedia software, the aim of this preliminary study was to evaluate the immediate effect of the software. The small number of the students was another shortcoming of our research, but all the students who participated in our study had surely no previous knowledge of the subject. The consensus report from the Global Congress on Dental Education (Dublin, 2007) pointed out that one problem in educational research is how to sufficiently measure the learning outcome. An obvious possibility is to measure learning outcome after a computer-based learning phase using a test [25]. Our participants performed several skills of periodontal flap surgery on animal models. We used sheep mandible as it has been introduced as a feasible training model for the demonstration and exercise of various periodontal surgical techniques for treatment of periodontitis [14]. In fact, we evaluated the translation of this knowledge into clinical practice on animal models, which is a more important outcome than simply measuring knowledge gain alone.

In view of our findings, further studies on a large randomized sample size to determine students' knowledge retention exposed to these two different instructional modalities would be desirable.

Conclusion

Within the limits of this preliminary study, our results suggest that this CAL method is a valid teaching technique and it can be used as an adjunct to traditional education or as a means of self-instruction in teaching periodontal flap surgery techniques. The apparent better efficacy of this software in terms of long-term retention of knowledge acquired now needs to be evaluated by further studies.

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