

EFFECTIVENESS OF INTRAORAL RADIOGRAPHY TRAINING KIT FOR DENTAL UNDERGRADUATES: A PRELIMINARY STUDY

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Abstract

Insufficient intraoral radiography training among dental students may lead to an increased radiograph rejection rate at a dental institution which may require a corrective action plan as suggested by the Malaysian Dental Council. The number of trained staff to provide continuous training among dental students in radiographic taking is usually inadequate in most dental institutions, including UKM. To overcome this problem, the intraoral radiography training kit is potentially useful as a self-directed learning aid that students can access anytime for continuous training in intraoral radiography and hence reduce the rejection rate associated with radiographic taking among dental students. This study is aimed to determine the effectiveness of the intraoral radiography training kit and demonstration videos in radiographic taking among dental undergraduates. This type of study is an experimental (parallel group design) to compare the rejection rate between a group of students who are exposed to the radiography training kit (trial group) and a group of students who are not exposed to the intervention (control group). This study involved a convenient sampling of 10 students within the clinical year (Year 4 and Year 5) who had at least one rejected radiograph at undergraduates' polyclinics from March until July 2022. Results showed the mean rank of the radiograph rejection rate in the trial group was lesser than the control group, following the intervention period. In addition, there is a statistically significant difference between the means of radiograph rejection rate before and after exposure to the intraoral radiography training kit (p -value < 0.05). In conclusion, an intraoral radiography training kit is an efficient tool to facilitate dental undergraduates in improving their radiographic skills.

Keywords: Intraoral, Radiography, Dental, Students

Introduction

The type of radiographic investigation for the diagnostic assessment within oral and maxillofacial region imaging is categorized into extraoral and intraoral radiographs. Extraoral radiographs, such as dental panoramic tomography, cephalometric radiograph, and cone beam computed tomography image, give wider coverage of the head anatomy, thus allowing diagnostic evaluation within and beyond the dentoalveolar region. On the other hand, intraoral radiographs such as periapical and bitewing radiographs provide insight limited to teeth and periodontium but are more commonly used since these radiographs are usually adequate for diagnostic evaluation in dentistry. For example, periapical radiographs can be used not only to diagnose caries but also for the diagnosis of periodontal status and periapical lesions.

There are two approaches for acquiring periapical radiographs, which are paralleling technique and bisecting angle technique. The paralleling technique involves placing the film parallel to the long axis of the tooth, whereas the central ray is directed perpendicular to the film. On the other hand, the bisecting angle technique is acquired with the X-ray tube head positioned perpendicular to an imaginary line bisecting the long axis of the tooth and the film (1). Failure to perform the proper radiographic technique described above will result in a radiographic error and possibly jeopardize the quality of the acquired intraoral radiograph. Subsequently, this led to an inability to reach a diagnosis and resulted in repeated radiographic exposure to the patient.

Radiographic technique is not entirely achievable without knowledge, skills, and experience. Previous research had looked into the number of retakes required when dental

students performed periapical radiography (2). Another study has reported the types and frequency of errors incurred when radiographs are taken and processed by undergraduate dental students (3).

According to National Radiological Protection in 2001, a radiograph is considered rejected whenever the radiograph demonstrates a radiographic error that deteriorates the radiograph's diagnostic value. A study among dental undergraduates in 2021 shows that the most common error performed by dental students was misplacing the armamentarium, which resulted in an apical cut (4). Parallel to this study, an earlier study reported that there are five common errors that occur during intraoral radiography which include processing errors, as well as, errors related to misplacement of armamentarium such as cone cutting, incorrect vertical angulation, incorrect horizontal angulation and incorrect film placement (2). An audit study by Patankar et al. (5) has shown that the radiographic errors are mostly due to positioning errors of either the film or the X-ray tube.

According to the Malaysian Dental Council in 2010, corrective action should be conducted whenever the radiograph rejection rate exceeds 10%. In a study at the Faculty of Dentistry, Universiti Kebangsaan Malaysia (UKM) in 2021, the periapical radiograph rejection rate among year 4 dental undergraduates was surprisingly higher than year 3 dental undergraduates, with the radiograph rejection rate reaching 11% (4). This shows that corrective action was needed, as recommended by the Malaysian Dental Council. However, the number of trained staff to provide continuous training among dental students in radiographic taking is usually inadequate in most dental institutions, including UKM. To overcome this problem, the intraoral radiography training kit is potentially useful as a self-directed learning aid that students can access anytime for continuous training in intraoral radiography. Hence can be useful for reducing the rejection rate associated with radiographic taking among dental students. To our knowledge, this is the first study evaluating intraoral radiography training kits as an approach to simulation based education tools.

Simulation based education (SBE) typically has three main components; the pre-simulation brief, the actual simulation activity and the post-simulation debrief (6, 7). In order to create an effective simulation delivery in diagnostic radiography programme, a recent study (8) gathered feedback from simulation education facilitators (SEF) from health courses on the importance of the three components in SBE. Based on the responses from the study, 92% of the SEF felt the pre-brief was extremely important to enable students to understand the procedures they need to perform, whereas 100% of SEF felt that the actual simulation activity (practical hands-on) was extremely important to prepare students for clinical practice and

increase their confidence. In this study, both components (the pre-simulation brief and the actual simulation activity) were implemented for the development of the intraoral radiography training kit. This study is aimed to determine the effectiveness of the intraoral radiography training kit in radiographic taking among dental undergraduates. The first objective of the study is to determine the frequency of intraoral radiography training kit utilization in one-month duration among dental undergraduates. The second objective is to compare the rejection rate between students who are introduced to the intraoral radiography training kit (trial group) and those who are only exposed to demonstration videos (control group).

Materials and Methods

Study design

This type of study is an experimental (parallel group design) to compare the rejection rate between a group of students who are exposed to the intraoral radiography training kit (trial group) and a group of students who are only exposed to demonstration videos (control group).

Sample size

This study involves a convenient sampling of 10 students within the clinical year (Year 4 and Year 5) who had at least one rejected radiograph at undergraduates' polyclinics from March until July 2022. These students were further divided into the trial group (5 students) and the control group (5 students).

Documentation of film intake and rejected radiograph.

Film intake of each clinical year undergraduates was recorded in a film intake form available at each student's polyclinic dispensary counter by a Dental Surgery Assistant in charge. In the presence of a rejected radiograph, a film tag containing student and patient details (student's name, student's registration number, patient's name, patient's registration number and date of the radiograph taken) was attached to the rejected radiograph.

Development of intraoral radiography training kit and demonstration videos.

In this study, two dental students built five intraoral radiography training kits under the supervision of an oral and maxillofacial radiologist and a trained radiographer. Figure 1 demonstrates a completed intraoral radiography training kit consisting of dental cast models, four sets of film holders (endo-ray film holder, bitewing film holder, anterior and posterior periapical film holder) and eight QR codes to access eight demonstration videos. These videos were prepared to demonstrate the correct way of utilizing the film holder and its placement in the mouth.



Figure 1: A set of intraoral radiography training kit

Intervention period and questionnaire distribution.

Starting from December 2022 until January 2023, students in the trial group were introduced to the radiography training kit. Meanwhile, the control group was only introduced to the demonstration videos. Following the intervention period of two months, each student in the control group was provided with a feedback form consisting of respondent details (name, student’s registration number, year of study, gender, email address), student response on the frequency of watching the demonstration videos and questionnaires of student perception of the demonstration videos. Following exposure to the radiography training kit, every student within the trial group was also provided with a feedback form to obtain their response on the frequency of utilizing the radiography training kit and their perception of the training kit. The feedback forms were prepared in Google form and distributed online to the participants for evaluation of the radiography training kit and the demonstration videos. The questions in the feedback form have been validated among lecturers with dental radiology expertise for content validation. Face validation was conducted on five dental undergraduates before the distribution of the feedback form.

Calculation of radiograph rejection rate

The radiograph rejection rate before and after intervention was calculated for each individual within the trial group, as well as, the control group. The rejection rate was calculated by dividing the total number of rejected radiographs with the total number of radiographs intake.

Statistical analysis

The collected data were entered in Microsoft Excel spreadsheet. Descriptive data were expressed as mean, standard deviation. Kruskal Wallis Test (9) was performed to compare the means of radiograph rejection rate between

the control and trial groups. Meanwhile, Wilcoxon Signed-Rank Test (9) was used to compare the means of radiograph rejection rate before and after exposure of the training kit, as well as, to compare the means of radiograph rejection rate before and after exposure of the demonstration videos. A *p*-value of <0.05 was considered to be significant in this study.

Results

A total of 10 research participants involving year 4 (50%) and year 5 (50%) dental undergraduates have consented to this study. Three out of five students in the control group (60%) are from year 4, and 40% are from year 5. Meanwhile, for the trial group, 60% of participants were in year 5, and year 4 accounted for 40% of the total participants.

The findings of this study show no significant difference in the mean rank of radiograph rejection rate between the trial and control group, as demonstrated in Table 1. However, a comparison of the means of radiograph rejection rate before and after exposure to the intraoral radiography training kit among students in the trial group demonstrates a statistically significant difference between the two means (*p*-value < 0.05), as shown in Table 2. On the other hand, the control group demonstrates no significant difference between the means of radiograph rejection rate before and after exposure to the demonstration videos (Table 3).

In the trial group, only 1 participant used the radiography training kit once a month, whereas the remaining students (4 students) practiced the intraoral radiographic technique utilizing the training kit twice to thrice per month. Meanwhile, for the control group, 2 participants watched the demonstration videos once a month, and another 3 students watched the videos two to four times per month.

Table 1: Comparison mean rank of radiograph rejection rate between control group and trial group with Kruskal Wallis test.

	Group	N	Mean Rank	X ²
Before Intervention	Control	5	4.20	p=0.126
	Trial	5	6.80	
After Intervention	Control	5	6.20	p=0.368
	Trial	5	4.80	

Table 2: Wilcoxon signed rank test for comparison means of radiograph rejection rate before and after utilization of the radiography training kit

	N	Mean radiograph rejection rate	Std. Deviation	Wilcoxon (p-value)
Before	5	0.466	0.760	Z=-2.121 (p=0.034)*
After	5	0.250	0.559	

Table 3: Wilcoxon signed rank test for comparison means of radiograph rejection rate before and after watching the demonstration videos

	N	Mean radiograph rejection rate	Std. Deviation	Wilcoxon (p-value)
Before	5	0.287	0.197	Z =-1.35 (p=0.892)
After	5	0.246	0.370	

Table 4 shows that most students (80 - 100%) in the trial group either agree or strongly agree that the radiography training kit is a fun approach to learning radiography, helps to embrace their radiographic knowledge and improves their radiographic skills. Regarding the demonstration videos, 60 - 100% of participants in the control group either agree or strongly agree that the demonstration videos are fun in learning radiography, help to embrace their radiographic knowledge and improve their radiographic skills, as demonstrated in Table 5.

Table 4: Students' perception on the radiography training kit.

Student's Perception On The Radiography Training Kit	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Q1. I found that the radiography training kit is fun for learning radiography.			1(20%)	2 (40%)	2 (40%)
Q2. Utilizing the radiography training kit helps me to embrace radiographic knowledge better.				3 (60%)	2 (40%)
Q3. The radiography training kit improves my radiographic skill.			1(20%)	2 (40%)	2 (40%)

Table 5: Students' perception on the demonstration videos.

Student's Perception On The Demonstration Videos	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Q1. I found that the demonstration videos are fun in learning radiography.			2 (40%)	2 (40%)	1(20%)
Q2. Watching the demonstration videos helps me to embrace radiographic knowledge better.			1 (20%)	3 (60%)	1 (20%)
Q3. The demonstration videos improve my radiographic skill.				4 (80%)	1(20%)

Discussion

Radiograph with sufficient diagnostic quality plays an important role as a form of investigation to derive an accurate diagnosis. The finding of this study shows that the intraoral radiography training kit significantly reduces the radiograph rejection rate among dental undergraduates. However, students in the control group showed a minimal reduction in their radiograph rejection rate following the intervention period. Students in the control group were only provided with demonstration videos. Meanwhile, each student in the trial group was provided with a radiography training kit which not only consisted of demonstration videos but also working models and radiographic instruments for practical learning. Hence, this suggests that in order to improve intraoral radiographic skills, it is paramount to incorporate continuous hands-on practice.

Based on the findings of the questionnaire, it was found that students find the training kit helps them to enhance their knowledge and skill in dental radiography. This is consistent with the finding of the radiograph rejection rate that significantly reduced following the utilization of the radiography training kit among undergraduates within the trial group. However, although this study proves that utilization of the intraoral radiography training kit facilitates

the improvement of radiographic skills among dental undergraduates, this shall not be used to replace real-life, hands-on experience of performing intraoral radiography to the patient. This is because the dental cast models equipped in each training kit do not completely imitate the occlusion and articulation of a real person for intraoral radiography practice.

Despite the high percentage of participants in the control group (60-100%) favoring (agree and strongly agree) that the demonstration videos are fun and help to embrace their knowledge and skills, a comparison of the radiograph rejection rate before and after exposure of the demonstration videos did not demonstrate a significant difference. This finding suggests that observation of demonstration video does not markedly influence the students' skill in intraoral radiography. Nevertheless, the students still appreciate the demonstration videos as their radiography learning aid.

In this study, the sample size is very small. This is due to the fact that, prior to this study, most of the rejected films were unlabeled. Therefore, this contributed to the limitation of recruiting more targeted students requiring intervention as research participants in this study. Moreover, due to the limitation in budget and time, only five intraoral radiography training kits could be developed and available for undergraduates within the trial group. Another limitation of this study is relevant to the size of the intraoral radiography training kit. The bulkiness of the radiography training kit makes it not easy to carry around and possibly restricts the students from using it whenever they want. In this study, all participants in the trial group only performed self-directed learning with the radiography kit when they had free time at home. Digital educational application has been proven as an interactive learning aid that creates a fun environment for learning (10, 11). The application works well across many mobile devices such as smartphones, hence should be more easily accessible anywhere at any time. Therefore, the development of a digital training tool is recommended in future studies as it is potentially useful to provide a better platform for self-directed intraoral radiography training.

Conclusion

The radiograph rejection rate among dental undergraduates has significantly reduced following the utilization of the intraoral radiography training kit. On the other hand, the reduction of radiograph rejection rate following students' exposure to the intraoral radiography demonstration videos is not statistically significant. This study concluded that an intraoral radiography training kit equipped with access to intraoral radiography videos, working models and several sets of film holders is an efficient learning aid in improving radiographic skills among dental undergraduates. The majority of the participants agreed that the training kit and video demonstration had greatly improved their knowledge and skills while simultaneously being accessible and entertaining.

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Competing interests

The authors declare that they have no competing interests.

Ethical Clearance

We obtained approval from the UKM Research Ethics Committee, registered under UKM PPI/111/8/JEP-2022-305.

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