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Original article: Comparison of Caries Detection Ability among Dental Students in Two Methods of In-Person and Combined (In-Person and Virtual) Training before and during the Covid-19 Pandemic

Farzane Ostovarrad[1], Ideh Dadgaran[2], Rasoul Tabari-khomeiran[3], Farnaz Taheri[4], Zahra Peyrovi[1], Sina Rahmanpanah[1]*

1. Department of Oral and Maxillofacial Radiology, School of Dentistry, Guilan University of Medical Sciences, Rasht, Iran
2. Medical Education Research Center, Education Development Center, Guilan University of Medical Sciences, Rasht, Iran
3. Social Determinants of Health Research Center, Guilan University of Medical Sciences, Rasht, Iran
4. School of Dentistry, Guilan University of Medical Sciences, Rasht, Iran

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ABSTRACT

Introduction: Since 2020, the world's educational system has been encountered with some problems due to the Covid-19 pandemic and the impossibility of holding classes. The aim of the present study was the comparison of two learning methods of in-person and combined (in-person and virtual) in caries detection ability among dental students before and during covid-19 pandemic.

Materials and Methods: This study was a cross-sectional-analytical research performed on the population of dentistry students who had passed the practical radiology courses as in-person or combined training (n=25). Ten digital bitewing radiographs were given to students to diagnose the presence/absence of caries and if there was, a diagnosis of caries depth. The students' diagnosis was recorded in a special researcher-made checklist and the answers were evaluated based on false and true. SPSS and descriptive statistics and analytical tests at the level of P<0.05 were used to analyze the data.

Results: Students in the In-person education group correctly detected the presence or absence of caries in 89% of cases, while this number was 83.75% in the group of combined education students(P<0.001). Also, students who were in the In-person education group correctly detected the depth of caries in 78.9% of cases, while this number was 70.6% in the group of combined education(P<0.050).

Conclusion: According to the findings of this study, virtual education, if it replaces In-person education, reduces the ability of students in the field of radiographic interpretation of dental caries. The use of combined and virtual education requires improving the infrastructure and reviewing traditional teaching methods.

**** Corresponding Authors:***
Sina Rahmanpanah (MS.c.)
Address: *Department of Oral and Maxillofacial Radiology, School of Dentistry, Guilan University of Medical Sciences, Rasht, Iran.*
Tel: *+989126773559*
E-mail: *Cena.rahmanpanah@gmail.com*

1. Introduction

The outbreak of the SRAS-CoV2 virus for the first time in late 2019 disrupted all human activities. This disruption in the education of students was strongly felt and caused educational affairs to be temporarily closed and further, virtual education took the place of In-person education all over the world. To a great extent, before the implementation of the vaccination program against Covid-19 and relatively now, the main way to deal with this virus is focused on preventive measures and breaking the chain of transmission, including observing social distance, using masks, avoiding unnecessary travel, not participating in gatherings and identifying, treating and isolating patients from society (1, 2). With the emergence of the infectious disease covid-19, due to the high spread of the disease through respiratory droplets and close contact, it was decided to control the disease by preventing the gathering of people in educational spaces, which challenged the world's In-person and regular education system and led to the development and expansion of education was based on a virtual platform (3-5). Currently, the use of computers in dental education is increasing. E-learning has changed from a difficult environment to a useful online environment due to the increase in internet speed, accessibility and connectivity (6-13). There are different definitions for virtual or electronic education. Virtual education often refers to the use of computers and the internet and digital technologies in teaching and learning (14). The combination of In-person and non-In-person training using electronic tools as educational aids is called combined training. The advantages of this educational system include high educational quality, student and teacher-centeredness, quality orientation, simultaneous use of human and electronic facilities, flexibility, emphasis on controlled self-learning, and use of time and place according to the conditions (15). The process of industrialization of societies has caused changes in human life and changes in eating habits. In the field of oral and dental, this change has caused a significant increase in caries as one of the most common microbial diseases by increasing the consumption of sugary substances (6). Caries detection methods include clinical examination (visual-tactile), radiography and fiber-optic. In clinical examinations of teeth, two main goals are followed: one is to check for the presence of caries and the other is to check the progress of caries. In addition to clinical tests, radiographic techniques, especially the bitewing technique, are the main tools for accurate diagnosis of interdental caries (16). Interproximal caries detection in radiography depends on sufficient demineralization of the tooth, which causes a visible change in radiographic density. The amount of this demineralization is about 40% (17).

It has been shown in various studies that virtual education can be a suitable substitute for In-person education in such a way that there is no significant difference between the students' learning and skills at the end of the course (18-21). Even in some cases, virtual trainings have been able to achieve better results and show a significant increase in students' knowledge compared to the In-person training group (22, 23). Although the amount of practical and clinical work during the period of the covid pandemic has decreased significantly(24), but by applying In-person and virtual integrated training methods, the existing deficiencies can be compensated to some extent. According to the conducted studies, students also show a greater desire for virtual and combined education methods (21). In a study, it was reported that 94% of learners who completed virtual education courses believe that they learn more compared to In-person education (25). In various studies, the effect of virtual education on educational activities has been done, but few studies have been done on clinical activities and practical skills of students (26-30).

Since the absence of patients in the dental school can affect the education and practical skills of students during the covid-19 pandemic, this study aims to investigate the performance of clinical skills of students in caries diagnosis. In this study, we aim to investigate the effect of virtual training on dental caries diagnosis skills compared to In-person training and identify possible advantages or disadvantages.

2. Materials and Methods

The present study was designed as a cross-sectional-analytical study supported by Guilan

University of Medical Sciences, School of Dentistry (IR.GUMS.REC.1400.583). Necessary explanations about the study were given to the participants and verbal informed consent was obtained from them. Also, the participants were assured that they can withdraw from the study at any time and that their non-cooperation will not cause disruption in their study process. This study's sample size was determined using the appropriate statistical formula for sample size estimation. The appropriate sample size for this study was determined to be 50 students ($\alpha = 0.05$, $\beta = 0.02$). Twenty five dental students on 11^{th} semester who had completed the practical radiology units in the Faculty of Dentistry in person and also 25 students on 9^{th} semester who had completed the practical radiology units in the form of combined training (virtual and In-person) were included in the study. The students in the combined training group had passed nearly half of the topics in person and the other half virtually. Both groups had passed the same practical radiology units. The selected bite wing images should be of suitable quality and should not have overlapping interproximal surfaces in the radiographic view and also should include first and second premolars and first and second molars. Exclusion criteria include lack of willingness and lack of consent to participate in the study. In order to check the accuracy of caries diagnosis by students, a checklist was used in which the presence or absence of caries and also the depth of caries are recorded. The number of 10 digital bitewing images that were in good condition in terms of quality were extracted from the patients' files and mounted on the viewbox under the same conditions for each student, and from each the test was taken individually and in isolation according to the prepared checklist. Each applicant evaluated 10 digital bitewing radiographs, with each radiograph containing multiple teeth. Each tooth's occlusal, mesial and distal surfaces were assessed separately, resulting in a total of 173 surfaces and 4325 measurements across all applicants. The time to evaluate the images was considered the same for all students, and at the end of the test, the correct answer was not given to the student. The criteria for the presence or absence of caries and the depth of decay (at the level of enamel or DEJ or dentine) was the consensus of the professors (golden standard). It should be noted that the professors, observed bitewing images under the same conditions observed by the students. This diagnosis was recorded in the special data collection sheet against the corresponding image code.

Data analysis

After collecting the data, the data was entered into the SPSS version 27 software, and the descriptive objectives of the research were evaluated using descriptive statistics (frequency and percentage) and the analytical objectives were evaluated using relevant statistical tests including chi-square. The significance level of the tests was considered 0.050 in all cases.

3. Results

Table 1 presents the students who were in the In-person education group had correctly identified the presence or absence of caries in 89% of cases, while this number was 83.75% in the students of the combined education group. The result of the Chi-square test showed that there is a statistically significant relationship between the method of education and the diagnosis of caries ($P<0.001$). Also the students who were in the In-person training group had diagnosed the correct depth of caries in 78.9% of cases, while this number was 70.6% in the students of the combined education group. The result of the chi-square test showed that there is a statistically significant relationship ($P<0.050$).

Table 2 shows that female students correctly detected the presence or absence of caries in 86.5% of the cases, while this number was 86.2% in male students. The result of the chi-square test showed that there is no statistically significant relationship between the gender of the students and the diagnosis of caries ($P>0.050$). Also female students correctly detected the depth of caries in 76.3% of cases. while this number was 73.4% in male students. The result of the chi-square test showed there is no statistically significant relationship between the gender of the students and the diagnosis of caries depth ($P>0.050$).

Table 1. Distribution of the absolute and relative frequency of responses of the research units according to the diagnosis of the presence and depth of caries in all the examined teeth

	Caries detection						Caries depth detection					
	True		False		Sum		True		False		Sum	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Combined education	3622	83.75	703	16.25	4325	100	173	70.6	72	29.4	245	100
In-person education	3851	89	474	11	4325	100	224	78.9	60	21.1	284	100
Test	P<0.001						P=0.028					

Table 2. Distribution of the absolute and relative frequency of the responses of the research units according to the detection of the presence and depth of caries in all the examined teeth, separating male and female students

	Caries detection						Caries depth detection					
	True		False		Sum		True		False		Sum	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Female	4371	86.5	681	13.5	5052	100	229	76.3	71	23.7	300	100
Male	3102	86.2	496	13.8	3598	100	168	73.4	61	26.6	229	100
Test	P=0.670						P=0.430					

Table 3 presents that in the combined training group, female students correctly identified the presence or absence of caries in 83.9% of cases, while this number was 83.5% in male students. The result of the chi-square test showed that there is no statistically significant relationship between the gender of the students and the detection of caries (P>0.050). Also female students correctly detected the depth of caries in 71.8% of cases. while this number was 68.75% in male students. The result of the chi-square test showed that there is no statistically significant relationship between the gender of the students and the diagnosis of caries depth (P>0.050).

Table 4 shows that female students correctly diagnosed the presence or absence of caries in 89.4% of the cases, while this number was 88.6% in male students. The result of the chi-square test showed that there is no statistically significant relationship between the gender of the students and the diagnosis of caries (P>0.050). Also female students correctly detected the depth of caries in 80.8% of cases. while this number was 76.7% in male students. The result of the chi-square test showed that there is no statistically significant relationship between the gender of the students and the detection of caries depth (P>0.050).

Table 3. Absolute and relative frequency distribution of the responses of the research units in the combined education group according to the detection of the presence and depth of caries in all the examined teeth, separating male and female students

Combined education	Caries detection						Caries depth detection					
	True		False		Sum		True		False		Sum	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Female	2206	83.9	424	16.1	2630	100	107	71.8	42	28.2	149	100
Male	1416	83.5	279	16.5	1695	100	66	68.75	30	31.25	96	100
Test	P=0.750						P=0.600					

Table 4. Distribution of the absolute and relative frequency of the responses of the research units in the in-person education group according to the diagnosis of the presence and depth of caries in all the examined teeth, separating male and female students

In-person education	Caries detection						Caries depth detection					
	True		False		Sum		True		False		Sum	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Female	2165	89.4	257	10.6	2422	100	122	80.8	29	19.2	151	100
Male	1686	88.6	217	11.4	1903	100	102	76.7	31	23.3	133	100
Test	P=0.400						P=0.390					

4. Discussion

After the announcement of the World Health Organization on March 11, 2020 regarding the pandemic of the Covid-19 disease caused by the SARS-CoV2 virus, in addition to the profound health and social effects, educational processes were also severely disrupted (31, 32). One of the very important alternative solutions which was proposed and used at the world level, according to the observance of social distancing, was electronic or virtual education (33, 34). Due to the contagiousness and high prevalence of this disease, most of the schools and universities around the world were forced to close their In-person activities and switch from In-person education to virtual (electronic) education by changing the teaching methods (35). According to the mentioned materials and considering that institutions and universities, including universities of medical sciences, are concerned about increasing the effectiveness and efficiency of their educational programs, one of the ways to determine this effectiveness and efficiency is to measure the students' learning rate (36). In this study, the ability to detect caries was compared in dental students of Guilan University of Medical Sciences in two methods of In-person and combined (In-person-virtual) education during the period before and during the covid-19 pandemic. For this purpose, 50 dentistry students (25 people in the In-person training group and 25 people in the combined training group) were selected. According to the results of the present study, a general comparison in the two groups in the correct diagnosis of the presence/absence of caries and also in relation to the depth of caries showed that the students of the In-person group correctly detected the presence or absence of caries (89%) and the depth of caries (78.9%) more than the students of the combined group (83.75% for presence or absence of caries and 70.6% for the depth of caries) and this difference is statistically significant. The findings of the study by Hakami et al. regarding orthodontics showed that the students of the virtual group scored significantly higher than the students of the In-person class group, but at the end of the course, there was no significant difference in terms of skill and knowledge between the two groups (18). The findings of this study are contrary to the present study. The reason for this difference can be due to the difference in the nature of the studied subjects and the way students are evaluated in the two studies. On the other hand, this difference can be due to the higher quality of teaching and the higher quality of supervision on students' learning in two studies. In another study conducted by Soltanimehr et al., it was found that the virtual training method was superior to the theoretical training of radiographic interpretation of bony lesions in dental students (22). This study also somewhat contradicts the results of our study in comparison of the efficiency of the virtual method. Although the virtual and combined education method has many advantages, its successful implementation requires a suitable platform, the existence of suitable communication tools, training and preparation of professors and students for this type of education and their proper communication with each other. In fact, although these modern methods have many advantages over the traditional method, there are many factors that affect its success, the failure of which increases the failure rate of education, and as mentioned, this issue can be more important for students of medical sciences, including dentistry (37). According to a systematic review conducted by Wilcha, the main strength of virtual education is the variety of resources available on the web. This study also showed that new interactive forms of virtual education are being developed to enable students to communicate with patients from home (38). Therefore, the better efficiency of the In-person training method than the combined training method in the present study can be due to the lack of proper implementation of the combined training method.

It is suggested to design similar studies with a larger sample size and more number and variety of stereotypes. It can even be suggested to compare the learning rate of other theoretical and practical courses in dental students or other fields who have been trained with different In-person, virtual and combined methods. Also, considering the superiority of In-person education method over

combined education in this study, it can be suggested to design studies that use field and qualitative research methods and conduct interviews with students, professors and related officials to determine the challenges and problems in implementing the combined education method.

5. Conclusion

According to the findings of this study, virtual education, if it replaces In-person education, reduces the ability of students in the field of radiographic interpretation of dental caries. The use of combined and virtual education requires improving the infrastructure and reviewing traditional teaching methods. Future research should focus on optimizing combined educational strategies to enhance learning outcomes in clinical skill.

Ethical Considerations

The study was approved by the internal ethical review board of the Guilan University of Medical Sciences (IR.GUMS.REC.1400.583)

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None

Authors' Contribution

Farzane Ostovarrad: Conceptualization, Funding Acquisition, Methodology, Project administration, Resources, Supervision, Writing-Original draft **Ideh Dadgaran:** Data curation, Validation **Rasoul Tabari-khomeiran:** Formal analysis, Visualization, **Farnaz Taheri:** Investigation, Software **Zahra Peyrovi:** Software, Writing-review & editing **Sina rahmanpanah:** Writing-Original draft, Writing-review & editing

Conflict of Interests

The authors declare no conflict of interest

Availability of data and material

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request

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