

Research Paper: Comparing the Effect of Multimedia and Practical Education on the Oral Hygiene of Orthodontic Patients



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ABSTRACT

Introduction: Brackets and other fixed orthodontic appliances not only make tooth brushing more difficult, but also provide a suitable environment for the accumulation of plaque. To prevent this situation, dentists usually educate their patients to control the plaque formation and maintain good oral hygiene. This study aims to compare the effect of multimedia and practical education on the knowledge and practice of oral hygiene in patients with the fixed orthodontics appliances.

Materials and Methods: In this educational trial study, based on inclusion criteria, 60 patients aged 12-35 years with orthodontic brackets bonded to their upper jaw teeth for less than 6 months were consecutively selected from referrals to the specialty dental clinic of the International Branch of Guilan University of Medical Sciences. The samples were randomly divided in two groups of 30 subjects: practical education group and multimedia education group. Plaque and gingival indices and knowledge of the patients before and 2 months after the training were compared. To compare the knowledge score, gingival index and plaque index before and after the training and also to compare the changes in these variables in the two groups, t-test analysis was performed.

Results: The knowledge level, the gingival index and plaque index of both educational groups improved after education compared to before the education ($P < 0.001$). There was no significant difference between two groups with regard to changes in the variables of knowledge level ($P = 0.823$), plaque index ($P = 0.66$), and gingival index ($P = 0.292$).

Conclusion: Both educational methods improved the hygiene and the awareness of the dental practice. Therefore, learning by a validated multimedia in the presence of an expert to answer the questions is as effective as the practical approach for the oral health and hygiene of orthodontic patients.

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1. Introduction

Orthodontic treatment with fixed appliances alters the oral environment, increases plaque amount, and changes the composition of the oral flora [1-3]. The presence of brackets and other components not only makes tooth brushing and oral hygiene difficult, but also provides a suitable environment for the rapid accumulation of plaque and increases the acidic products which lead to the enamel demineralization and periodontal disease [4-7]. Enamel demineralization and gingival inflammation are the most prevalent consequences of biofilm formation in orthodontics, affecting 50% to 70% of the patients with fixed appliances [8, 9]. These complications can affect oral health and patients' quality of life. Thus, it is essential to maintain good oral hygiene during orthodontic treatment [10-13].

The control and encouragement of oral hygiene during orthodontic treatment is the responsibility of the orthodontist, and this responsibility should not be left to the patient or general dentist. The mechanical removal of biofilms through brushing and using dental floss is the most effective method for preventing dental and gingival problems [12]. Following oral hygiene guidelines significantly reduces the dental plaque formation [3] and educating these instructions at each orthodontic session is more effective than teaching them solely at the first session [14]. In this regard, dentists usually provide written and verbal instructions for controlling the plaque and preserving the patient's oral hygiene.

Many studies have been conducted to enhance the effect of these instructions [4, 10]. In majority of cases, it was found that verbal counseling is not enough to reduce the number of plaques, and we need to seek new solutions to improve patients' poor oral hygiene [15]. One of the most common and effective methods is health education through the patient's practice [16]. According to Leal et al. practical oral hygiene education on children has greater impact compared to video and model training [15].

Despite the documented beneficial effects of the practical method in different studies [15-17], this method has its own limitations. Practical oral hygiene education is a complex and time-consuming procedure. In face-to-face education, it is difficult to motivate both the trainer and the trainee to repeat the same practice over and over. In addition, embarrassed of being observed by a trainer, the trainee cannot fully concentrate on education that could eventually minimize the quality of education. Therefore,

using alternative methods, which do not have these limitations, can be helpful [18].

Today, many researchers all over the world and in Iran have studied the effects of different education methods. These studies have been accompanied by the evolution of educational technology in recent years. According to the literature review, the number of studies on the effectiveness of different educational methods in the field of health have significantly increased in Iran. In these studies, methods such as posters, pamphlets, print, spoken media and so on are often compared, but multimedia education has been less taken into consideration [19, 20].

Since we live in the era of technological advancements, we must be aware of the available audiovisual tools, their quality, features, and impact on learning [17]. According to Nielsen et al. study, using video greatly influences patients' knowledge and ability [21]. One of the advantages of video compared to the other medium is that its information can be viewed repeatedly without additional cost [22]. Lim et al. studied the effect of health education by video, pamphlets, and self-education. Their results showed no statistically significant difference between groups and trainings in reducing the plaque index and gingival bleeding [16]. On the other hand, in the study of Lees et al. the use of video did not have any effect on oral hygiene [22]. Because of these contradictory results and the limitations of the practical method in teaching, this study aimed to compare the effect of multimedia and practical education methods on the knowledge and practice of oral hygiene in patients with fixed orthodontics appliances.

2. Materials and Methods

In this study, 60 patients aged 12-35 years with orthodontic brackets bonded to their upper jaw teeth by the same specialist with the same bracket size, system and material (3M Unitek, Gemini metal bracket, 022 MBT Rx, Cuspid hooks) were consecutively selected among referrals to the specialty dental clinic of the International Branch of Guilan University of Medical Sciences. It should be noted that same type of bracket and bonding system (3M Unitek, Self-cure) was used for all patients.

The inclusion criteria for the study subjects were as follows: Fitted with maxillary fixed appliances for less than 6 months; With knowledge score of less than 66.6% of the total of 10 questions of knowledge questionnaire; Lack of systemic diseases, periodontal problems, bleeding disorders, immunosuppressive diseases, and genetic problems associated with periodontal disease such as

Down syndrome or Papillon-Lefèvre syndrome; Under no antibiotics treatment; No electric toothbrush use; Without severe crowding; and With enough literacy.

The criteria for excluding subjects from the study were as follows: Disregarding the lessons taught during orthodontic treatment; and Losing interest to continue the study. Before the training, the study subjects should answer a questionnaire containing 10 questions related to oral health care like brushing, dental floss, mouthwash and interdental brush to assess their knowledge on orthodontic oral hygiene. For correct answers, 1 point and for incorrect answers, 0 point was given. The total score ranges between 0 and 10. In order to determine the state of knowledge, the scores below 33.3% (0-3) of the maximum achievable score (10 score) were considered as weak knowledge, scores between 33.3% and 66.6% (4-7) average knowledge and scores higher than 66.6% as a good knowledge.

For assessment of the questionnaire's validity, CVR and CVI indices were used. In order to determine these indices, a panel of 5 experts was used. The CVR index for necessity was above 90% for all questions. Therefore, the necessity of the questions was valid for determining the knowledge. In relation to the CVI index, based on the panel's comments, the simplicity, relevance and clarity of the questions were 75% to 100%. Questions that had a CVR of 70% to 80% and CVI of 80% to 90% were seriously reviewed, and questions above 90% remained unchanged. To assess the reliability of the tool, an equivalent questionnaire was used. In this way, 10 patients were given these equivalent forms with different sequences. Then, the correlation between the scores of these forms was calculated, which was statistically significant ($r=0.85$, $P<0.001$). Also, the test-retest reliability coefficient of these equivalent forms was 0.93 that indicates high reliability of the questionnaire.

After obtaining subjects' informed consent, they grouped into practical education group and multimedia education group of each 30 subjects according to randomized quadruple blocks. In this method, according to the pattern, subjects were assigned to each group, respectively. For example, the first subject was assigned to the multimedia group, the second one to the multimedia group, the third one to the practical group and to the end according to the pattern. To avoid selection bias, the investigator was blinded to the allocation, and the researcher managing the random sequence did not participate in allocation or measurement.

To consider the ethical issues and patients' equal rights, all groups received routine oral hygiene instructions after the study. Before training, gingival index of 6 anterior teeth of all volunteers based on Loe and Silness method and plaque index of the same teeth based on Greene and Vermillion method were assessed [22] at the first session. The practical education group received practical hygiene education on an individual basis by an experienced specialist.

In the multimedia education group, oral hygiene was shown through an educational video in the presence of an experienced specialist and CD reviews. The content of the oral hygiene education of both groups was similar. The duration of education for both groups was 15 minutes. The validity of practical and multimedia education was checked by two faculty members in each field of orthodontics and periodontics. All patients were required to brush their teeth 3 times a day and each jaw for 2 minutes and use the same type of toothbrush, toothpaste, interdental toothbrush, dental floss and mouthwash (Oral B).

Two months after education, the gingival index, plaque index and patients' knowledge through questionnaire were assessed again. To create motivation and continuation of the hygiene program, the exposed areas with disclosing agent were shown to the patients and their deficiencies or progress in oral hygiene was explained to them. For statistical analysis, the obtained data were entered into SPSS version 21. For comparison of socio-demographic variables between two groups, the Chi-square test and Fisher exact test were used.

Mann-Whitney U test was used to compare the knowledge score between two groups. Paired t-test was used to compare knowledge score, the gingival and plaque indices before and after the education in each group. The Independent sample t-test and ANOVA was used to compare the gingival and plaque indices between groups (based on Shapiro-Wilk test, the distribution of the studied quantitative variables, followed the normal distribution) ($P>0.05$). The level of significance was set at $P<0.05$.

3. Results

According to Table 1, the sex frequency distribution ($P=0.417$), mother educational level ($P=0.519$), father educational level ($P=0.266$), orthodontic history ($P=0.99$), and the crowding of the teeth ($P=0.63$) in the two study groups were similar and did not show any significant difference.

Table 2 compares the status based on the cut-off points defined in this study (lower than 33.3% weak knowledge, 33.6%-66.6% average knowledge and upper than 66.6% good knowledge). Based on **Table 2**, the knowledge status of both educational groups has improved from the pre-training level to the post-training period. It was statistically significant in the multimedia group ($P<0.001$) and in the practical group ($P<0.001$), as well as before and after training in general ($P<0.001$). However, there was no significant difference in knowledge

level between the two groups before ($P=0.3$) and after ($P=0.59$) the training.

Table 3 compares the gingival and plaque indices and their changes through training by 2 educational methods. According to the information of **Table 3**, there was no significant difference in the plaque index before education ($P=0.036$) and after education ($P=0.092$). The changes in this index did not show any significant difference between multimedia and practical methods as well ($P=0.66$). Also there was no significant difference in the

Table 1. Relative and cumulative frequency distribution of subjects' characteristics

Individual-Social Variable	Multimedia Education		Practical Education		Total		P*	
	No.	%	No.	%	No.	%		
Sex	Male	12	40.0	9	30.0	21	35.0	0.417
	Female	18	60.0	21	70.0	39	65.0	
	Total	30	100	30	100	60	100	
Mother's education	Under diploma	3	10.0	6	20.0	9	15.0	0.519
	Diploma	19	63.3	18	60.0	37	61.7	
	Academic	8	26.7	6	20.0	14	23.3	
	Total	30	100	30	100	60	100	
Father's education	Under diploma	7	23.3	6	20.0	13	21.7	0.266
	Diploma	10	33.3	16	53.3	26	43.3	
	Academic	13	43.3	8	26.7	21	35.0	
	Total	30	100	30	100	60	100	
Patient's education	Under diploma	11	36.7	13	43.3	24	40.0	0.798
	Diploma	8	26.7	6	20.0	14	23.3	
	Academic	11	36.7	11	36.7	22	36.7	
	Total	30	100	30	100	60	100	
Orthodontic history	Yes	5	16.7	5	16.7	10	16.7	0.990
	No	25	83.3	25	83.3	50	83.3	
	Total	30	100	30	100	60	100	
Crowding	Mild	6	20	4	13.3	10	16.7	0.63
	Intermediate	2	6.7	1	3.3	3	5	
	None	22	73.3	25	83.3	47	78.3	
	total	30	100	30	100	60	100	

* The Chi-square test, Fisher Exact test

Table 2. Comparison of subjects' knowledge before and after the education according to educational method

Knowledge	Multimedia Education		Practical Education		Total		P*	
	No.	%	No.	%	No.	%		
Before the education	Weak	16	53.3	12	40.0	28	46.7	0.30
	Average	14	46.7	18	60.0	32	53.3	
	Good	0	0.0	0	0.0	0	0.0	
	Total	30	100	30	100	60	100	
After the education	Weak	1	3.3	0	0.0	1	1.7	0.59
	Average	9	30.0	10	33.3	19	31.7	
	Good	20	66.7	20	66.7	40	66.7	
	Total	30	100	30	100	60	100	
P	0.0001		0.0001		0.0001			

*Mann-Whitney U test



gingival index before the education (P=0.921) and after it (P=0.215). The changes in this index did not show any significant difference between two multimedia and practical methods as well (P=0.292).

Table 4 presents the changes in the gingival index, plaque index and knowledge of the patients by training

in each educational group. Based on this information, the knowledge situation, the gingival index and plaque index of both educational groups improved after the education compared to before it. From statistical point of view, there was significant difference between the multimedia group (P<0.001) and the practical group (P<0.001) before and after the training.

Table 3. Comparison of gingival and plaque indices before and after the education with respect to the educational method

Educational Method		No.	Mean	SD	P*
Basic plaque index	Multimedia	30	75.27	18.86	0.306
	Practical	30	79.90	15.74	
Plaque index after 2 months	Multimedia	30	41.73	19.72	0.092
	Practical	30	33.07	19.51	
Plaque index changes	Multimedia	30	33.53	28.79	0.066
	Practical	30	46.83	26.11	
Basic gingival index	Multimedia	30	1.00	0.38	0.921
	Practical	30	1.01	0.37	
Gingival index after 2 months	Multimedia	30	0.41	0.29	0.215
	Practical	30	0.32	0.26	
Gingival index changes	Multimedia	30	0.59	0.38	0.292
	Practical	30	0.69	0.35	

*The Independent t-test



Table 4. Comparison of the changes in the gingival index, plaque index and patients knowledge by training in each educational group

	Educational Method	No.	Mean	SD	P*
Multimedia	Basic plaque index	30	75.26	18.85	0.0001
	Plaque index after education	30	41.73	19.72	
	Gingival index after education	30	0.41	0.29	
	Basic gingival index	30	0.99	0.38	0.0001
	Basic knowledge	30	31.66	11.76	0.0001
	Knowledge after education	30	69.66	16.70	
Practical	Basic plaque index	30	79.90	15.74	0.0001
	Plaque index after education	30	33.06	19.51	
	Basic gingival index	30	1.00	0.37	0.0001
	Gingival index after education	30	0.32	0.26	
	Basic knowledge	30	35.33	11.95	0.0001
	Knowledge after education	30	71.00	12.41	

* The paired t-test



According to [Table 5](#), which compares the changes in the knowledge score, plaque and gingival indices, among the individual-social variables, the changes in the knowledge score were significant only on the basis of mother education in the practical group ($P=0.042$). According to the data of [Table 5](#), the increase in the knowledge score in the subjects under the diploma level was higher than the subjects with mothers with diploma and college education level. Thus, increasing the level of mother education decreases the level of the knowledge score. Based on the [Table 5](#), changes in gingival and plaque indices were significant only in the practical education group in terms of gender. As males showed significantly more decrease in the plaque index and gingival index than females ($P=0.007$ and $P=0.043$, respectively).

4. Discussion

The results of the present study indicate that education through both the practical and multimedia education methods reduces the gingival and plaque indices and increases the knowledge on oral hygiene, while Lees et al. study indicate that video education did not improve oral hygienic and knowledge level significantly [22]. Perhaps the reason for this contradiction in the results is the difference in video presentation to the patients.

In the present study, the multimedia education was shown in the presence of a specialist and the patient's questions were answered, while in the study of Lees, patients were asked to watch the video tutorial at home. In addition, in the present study whatever the patients needed to receive in practical education was covered by multimedia education. In addition to the animations and videos, all written information was also recorded by voice that provided dual visual and audio education.

Similar to the study of Lees et al. we used Greene and Vermillion method and Loe and Silness method to determine the plaque index and gingival index, respectively in the present study, because these indicators have been recently used in the studies for oral hygiene and are accurate.

Zotti et al. [23], Marini et al. [14], Peng et al. [10], and Smiech-Slomkowska et al. [3] studied patients with the fixed orthodontics of 2 jaws, but in the current study due to the interactions of the upper teeth with lower brackets, the problems of the bite, and in general the better acceptance of the brackets in the upper jaw by the patients, we evaluated the patients who had maxillary fixed orthodontics to avoid the interference in the time difference between treatment of lower and upper jaws on the results of the study.

Table 5. Comparison of the changes in the knowledge score, plaque and gingival indices with respect to the individual-social variable

Educational Method		Knowledge Changes			Gingival Index Changes			Plaque Index Changes			
		Mean	SD	P	Mean	SD	P	Mean	SD	P*	
Video	Sex	Male	41.67	16.42	0.19	0.58	0.34	0.978	37.25	17.80	0.573
		Female	33.33	16.80		0.59	0.41		31.06	34.54	
	Age	<20 years old	36.00	18.44	0.833	0.65	0.31	0.349	34.53	25.49	0.853
		>20 years old	37.33	15.80		0.52	0.43		32.53	32.63	
	Mother's education	Underdiploma	40.00	30.00	0.129	0.65	0.23	0.769	17.33	14.05	0.583**
		Diploma	32.11	15.84		0.61	0.39		34.32	32.22	
		Academic	46.25	10.61		0.50	0.40		37.75	23.96	
	Father's education	Underdiploma	34.29	19.02	0.1	0.64	0.38	0.843	23.86	13.09	0.147**
		Diploma	29.00	16.63		0.53	0.33		25.00	39.78	
		Academic	43.85	13.87		0.60	0.43		45.31	21.56	
	Patient education	Underdiploma	41.82	17.79	0.254	0.59	0.32	0.271	38.91	21.53	0.351**
		Diploma	28.75	17.27		0.75	0.21		20.75	28.44	
		Academic	37.27	14.89		0.46	0.49		37.45	34.56	
	Orthodontichistory	Yes	28.00	13.04	0.214	0.29	0.40	0.057	28.60	26.17	0.682
		No	38.40	17.24		0.64	0.35		34.52	29.69	
Mild		28.33	17.22	0.68		0.26	27.17		32.60		
Crowding	Intermediate	40.00	0.00	0.413	0.35	0.78	0.569	29.00	35.36	0.804**	
	Does not have	38.64	17.26		0.58	0.38		35.68	28.53		
Practical	Sex	Male	37.78	20.48	0.674	0.88	0.31	0.043	65.78	13.11	0.007
		Female	34.76	16.62		0.60	0.34		38.71	26.25	
	Age	<20 years old	34.74	17.75	0.710	0.71	0.32	0.588	42.16	30.44	0.203
		>20 years old	37.27	17.94		0.64	0.40		54.91	14.02	
	Mother's education	Underdiploma	48.33	18.35	0.042	0.96	0.38	0.069	51.33	12.91	0.307**
		Diploma	35.56	16.88		0.59	0.28		50.28	27.43	
		Academic	23.33	10.33		0.70	0.41		32.00	29.98	
	Father's education	Underdiploma	50.00	16.73	0.077	0.91	0.36	0.216	53.50	15.91	0.226**
		Diploma	32.50	18.07		0.62	0.38		39.19	31.49	
		Academic	31.25	12.46		0.65	0.23		57.13	15.06	
	Patient education	Underdiploma	30.77	19.77	0.422	0.71	0.38	0.5	39.69	34.23	0.338**
		Diploma	40.00	15.49		0.80	0.20		58.50	17.73	
	Orthodontichistory	Yes	36.00	8.94	0.964	0.59	0.07	0.512	53.80	14.89	0.523
		No	35.60	18.95		0.70	0.38		45.44	27.84	
		Mild	45.00	10.00		1.02	0.34		41.00	13.34	
Crowding	Intermediate	20.00	10.33	0.039	1.10	0.36	0.039	50.00	13.06	0.895**	
	Does not have	34.80	18.28		0.61	0.32		47.64	28.19		

(*Independent t-test, **ANOVA)

There was no significant difference between educational methods in this study, which is in line with the studies of Lees et al. and Lim et al. In Lees et al. study [22], patients with fixed orthodontics had been divided into three groups. Group 1 received written oral hygiene instruction, group 2 received a videocassette, and group 3 attended an educational visit with a dental hygienist. The results revealed no significant differences between educational groups with regard to knowledge improvement on oral hygiene procedures, and plaque and gingival indexes that was in line with present study.

Lim et al. studied the effects of various methods of oral hygiene education on gingival health. Subjects were divided into personal instruction, self-education manual, video, and combination group [16]. After 2 weeks, 4 months, and then 10 months, the results showed significant reductions in the mean percentages of plaque and bleeding when compared with the baseline. No significant differences were found between the groups. Their study confirmed the effectiveness of oral hygiene in improving gingival health, but the indifference in the results of various oral hygiene education methods indicates that the method of instruction is not crucially important to the end result. The findings of this study confirmed the results of Lim et al.

In contrast with our study, this study presented effectiveness of one method over the others. In Peng et al. study [10], the study patients were categorized in these groups based on type of oral hygiene instructions: group A, images showing the severe outcome of biofilm accumulation such as gingival inflammation and enamel demineralization; group B biofilm disclosing agents; group C combination of A and B and group D or control group. They concluded that use of images showing the severe outcome of biofilm accumulation improved the oral hygiene of patients with fixed orthodontics.

Zotti et al. evaluated the effectiveness of a mobile app in oral hygiene improvement of orthodontic patients and indicated that in study group, the plaque index, gingival index and occurrence of new white spot and caries were significantly lower than the control group [23].

In Ay et al. study, patients were divided into five groups: verbal information, verbal information with demonstration on model, verbal information with demonstration on model and self-application by the patient, verbal information using the illustration catalog, and verbal information using the illustration catalog and self-application by the patient [17]. All periodontal measurements revealed significant decreases after 4

weeks in all groups. They found verbal information using the illustration catalog and self-application by the patient was more effective in reducing plaque index, gingival index, and BOP (bleeding on probing) scores than those in the other groups. They recommended self-application of oral hygiene motivation method under the supervision of an orthodontist to be more effective in the reduction of plaque index and inflammatory markers in patients with fixed orthodontics.

Acharya et al. conducted a study to evaluate the effect of three different motivational methods on oral hygiene of orthodontic patients: conventional plaque control (group 1), chair side motivational techniques with conventional plaque control (group 2), and phase contrast microscopy with conventional plaque control (group 3). They showed that gingivitis scores significantly decreased in group 3, thus a phase contrast microscope might be an effective approach in motivation of oral hygiene maintenance [4].

In the present study, changes in plaque index and gingival index in the practical group were significantly higher in males than females. In Peng et al. study, men also had better gingival index than women, while the plaque index was similar among them, which is related to the hormonal differences between men and women [10].

Because this study was done on patients with fixed orthodontic appliances, outcomes of this study may not be valid for patients with clear removable appliances. Another limitation of this study may be the lack of supervising the patients at all time to check their complying with the instruction given. Also in future, similar studies with longer follow-up should be conducted.

5. Conclusions

Both educational methods improved the hygiene and the knowledge of the dental practice. Therefore, if learning is accomplished through a validated multimedia in the presence of an expert to answer the questions it will be as effective as the practical approach for the oral health and hygiene of orthodontic patients.

Ethical Considerations

Compliance with ethical guidelines

This educational trail study was approved by the Ethics Review Committee of Guilan University of Medical Sciences (IR.GUMS.REC.1395.323).

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Authors contributions

All authors contributed in preparing this article.

Conflict of interest

The authors declare no conflict of interest.

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