

# The importance of oral health education in patients receiving orthodontic treatment

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## Abstract

**Introduction:** Evaluation of the effectiveness of a well-targeted educational campaign specially designed toward the improvement of oral health and maintenance of removable orthodontic appliances should be considered during an orthodontic treatment.

**Objectives:** The objective of this study was to assess the impact of the oral hygiene protocol on oral health through assessing plaque accumulation on the removable orthodontic appliance, to establish the impact of oral hygiene protocol on oral health through assessing the patients' plaque accumulation on the tooth surface and gingival bleeding, and to evaluate the degree of halitosis between the intervention and control groups.

**Materials and Methods:** The study involved 80 patients who were equally assigned to the intervention and control removable orthodontic treatment groups. Data were collected by means of questionnaires, soft-tissue examination, breath checker, and staining the appliance with methylene blue disclosing solution.

**Results:** The plaque score of both groups at Review 2 emphasized a significant difference ( $P = 0.021$ ), yet neither differences at baseline ( $P = 0.989$ ) nor Review 1 ( $P = 0.786$ ) were found. The odor score of both groups at Review 2 showed a significant difference ( $P = 0.012$ ). All interventional patients and only 10% of the control group patients were aware of appliance removal during sport. There was no significant difference ( $P = 0.211$ ) between the responses of patients concerning the cleaning method of the appliance. The patients showed a higher user rate of mouthwash, and they were more successful with respect to when it should be used.

**Conclusion:** The effectiveness of an educational session has been demonstrated in some aspects of the research.

**Keywords:** Educational campaign, halitosis, oral hygiene, patient compliance, plaque, removable orthodontic treatment

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**Submission:** 11-09-2018; **Accepted:** 17-11-2018

## INTRODUCTION

Orthodontics is a dental specialty which aids in correction of the alignment of teeth, with respect to the skeletal form, and soft-tissue relationship of the patient undertaking the treatment.

Today's perspective of oral health-related quality of life consists of the negligible impacts of the oral conditions that might have an effect on the personal esthetical views, self-perceived dental features, and on social interactions.<sup>[1-3]</sup> Klages *et al.* accentuated that individuals who are deeply

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Quick Response Code:	Website: <a href="http://www.jorr.org">www.jorr.org</a>
	DOI: 10.4103/jorr.jorr_24_18

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**How to cite this article:** Alzoubi EE, Borg VT, Gatt G, Aguis AM, Attard N. The importance of oral health education in patients receiving orthodontic treatment. *J Oral Res Rev* 2019;11:12-9.

conscious about their self-presentation in front of others and tend to self-judge themselves have a tendency to have a lower oral health-related quality of life with regard to social anxieties, due to their dentofacial esthetics and dental-related self-confidence.<sup>[4]</sup>

The concept of self-perception with regard to an individual's dental appearance plays a crucial role in the determination to seek orthodontic attention. The ideology of the proper alignment of the natural dentition tends to be the most motivating aspect of an orthodontic treatment in patients undergoing such treatment.<sup>[2]</sup>

## MATERIALS AND METHODS

Ethical approval for this study was obtained from the Research Ethics Committee on February 18, 2018.

The design of this study is a longitudinal study, the target population of this research comprised a total of 80 individuals among which 40 patients were in the intervention group and the other 40 patients were in the control group. All participants involved in the study were randomly selected from the orthodontics waiting list.

The inclusion criteria included any healthy patients between 9 and 16 years old with no previous history of orthodontic treatment, compliant patient, and no history of trauma. While the exclusion criteria included any type of debilitating systematic diseases such as diabetes or any other predisposition to gingival inflammation, noncompliant patients, previous history of orthodontic treatment, and history of trauma.

All participants were provided with a questionnaire which evaluates the sociodemographic factors, knowledge related to oral health, and proper care of the appliance. A "six-pocket periodontal" analysis was performed on all participants by one dental hygienist to ensure interexaminer error was minimized. The six-pocket periodontal analysis was recorded at baseline before the delivery of appliance and 1 month and 12 months after the delivery of the orthodontic appliance. In addition, all participants in the study were given an oral hygiene logbook to record the usage and frequency of mechanical or chemical plaque removal hygiene aids which were being use of at each household.

The "Tanita Breath Checker" device was used to estimate the odor in an individual's breath which has a direct association with the level of oral microbiota. The utilization of the "Tanita Breath Checker" device was conducted as follows: the cap of the device was put in an upright position

while the sensor was turned on. The device was shaken for five times to remove any moisture or odor left in the device from previous usages. The device was then placed 1 cm away from the patient's mouth, succeeding the participant was instructed to exhale a deep breath for four continuous seconds. To obtain the most accurate reading, the patients were instructed to rinse their mouth after toothbrushing or after using a mouthwash or else wait at least 10 min before undergoing the odor examination. The patient's breath odor level was recorded as it appeared for several seconds on the display screen. This procedure had been pertained upon the fit of the orthodontic appliance to serve as a baseline value, and during the review, sessions to compare the odor levels in the patient's oral cavity.

The intervention group started to receive an educational session on ideal oral hygiene measures, prevention of dental diseases, and care of the orthodontic appliance from when the orthodontic appliance was fitted in the patient's mouth. This session was given by the main investigator, using a power-point presentation, pamphlets to the participants, and an educational video that was made for this purpose. The educational video was edited and montaged by graphic design expert. The intention of these visual representations was to emphasize the importance of improved oral hygiene procedures and distributing the knowledge of how to take proper care of the orthodontic brace during treatment. The control group was given standard information which was given by the dentist on daily basis focusing on how to clean and care for the removable appliance but did not receive educational video material.

To quantify the percentage of plaque accumulation, during each review appointment, a biofilm of disclosing agent solution was spread evenly onto the acrylic surface of the upper removable appliance of all the registered participants. The orthodontic appliance used by the participants was rinsed in water to remove any debris and stained with methylene blue disclosing solution (methylene blue, 0.25% m/v in distilled water, Wako Pure Chemical Industries, Ltd.) for 1 min. The stained upper removable appliance was cleaned in an ultrasonic bath (ULTRA 3 Manfredi Dental Ultrasonic Bath; Manufactured in 2006; Torino, Italy) in distilled water for 30 s, and images for each upper removable appliance were taken from a vertically upright position above the appliance using a digital camera (Canon EOS Digital Rebel XT<sub>i</sub>/EOS 400D Digital) in a standardized manner.

The captured images were manipulated using an image editing and retouching software Adobe Photoshop CS3 (Adobe, Systems Inc. San José, California). Each removable

appliance image was set to a maximum contrast to have all plaque areas identified. Each image was refined and the appropriate number of levels which best represented the plaque areas were selected. The plaque area was covered in black color while the remaining surface of the orthodontic appliance was covered in red, pink, and white color. This was then continued by making use of the procedure which Coulthwaite *et al.* had described; yet modified on to an upper removable appliance instead of a complete denture.<sup>[5]</sup> The removable appliance area was selected, and then the stained area was identified and selected using custom tools by following the method described by Coulthwaite *et al.*<sup>[4,5]</sup> The appropriate color range was chosen and the number of pixels within the selected range was divided by the total number of pixels found on the surface area of the appliance and then multiplied by 100% to generate a percentage plaque index.

### Statistical analysis

The sample size in each group was 40 patients and due to nonnormal distributions at the different intervals ( $P < 0.05$  in Shapiro–Wilk’s test), the ordinal scale of some scores and the observational design of the study, a nonparametric Brunner–Langer model for longitudinal data was performed. This method assessed changes during the follow-up, and the effect of the group by means of an ANOVA-type test. Assessing the accuracy of “Tanita Breath Checker” Cronbach’s alpha test was used to assess the intrameasurement error.

The Mann–Whitney and Chi-squared test of independence were used to assess the homogeneity of groups by sociodemographic profile and items of the questionnaire about oral health and appliance care. Fisher’s exact test was used if proportion of expected cases was large in contingency tables. Significance level used in the analysis has been 5% ( $\alpha = 0.05$ ).

## RESULTS

### Demographics

The two groups of patients were similar, as shown in Table 1. The differences between the two groups were shown to be statistically insignificant. Both groups showed gender distribution homogeneity.

### Clinical assessment

#### Plaque score

Although there were no differences at baseline between the two groups and no differences at 4 weeks of treatment, yet there was a statistically and clinical difference between the control and the intervention groups at the end of the study, as shown in Figure 1. In fact, both groups initially

**Table 1: Demographical data**

	Control	Intervention	P
Age	SD 1.7 13.4	SD 1.8 12.7	0.25
Gender			
Females	20	22	0.75
Males	20	18	0.70
	<b>Guardian</b>		
Age	43.4	40.1	0.06
Marital status (%)			1.00
Married	95	95	
Single	5	0	
Divorced	0	5	
Education (%)			
Secondary	70	75	0.72
Tertiary	30	25	
Employment status (%)			
Employed	60	60	1.00
Unemployed	40	40	

SD: Standard deviation

showed a reduction in plaque score; however, only the interventional group continued to show a reduction in plaque score. The control group actually regressed after 12 months.

#### Bleeding score

The study group showed 63% of the patients had bleeding. This decreased to 52% by the first review, and then to 38% until the second review.

The control group started with a higher rate of bleeding compared to the interventional group, as illustrated in Figure 2. However, this was not statistically significant. The changes throughout the study were also not significantly different.

#### Odor level

The distribution of the odor scores in the two groups is shown for the different intervals in Table 2. A very good intraexaminer reliability of “Tanita Breath Checker” Cronbach’s alpha test was 0.81.

The study group showed a persistent improvement in the odor scores, whereas the control group showed a modest decrease at the first review but regressed at the second review to reach a statistically significant level at  $P < 0.05$ .

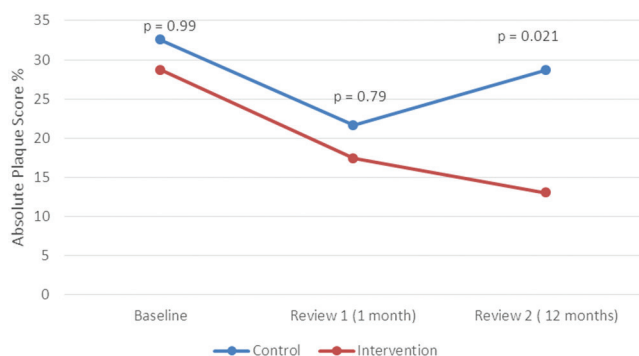
#### Plaque deposited on the appliance

The plaque deposition on the appliance for the entire sample size at the first review, as determined by the methods described above, was found to be covering 10.5% of the appliance, increasing to 13.5% by the second review.

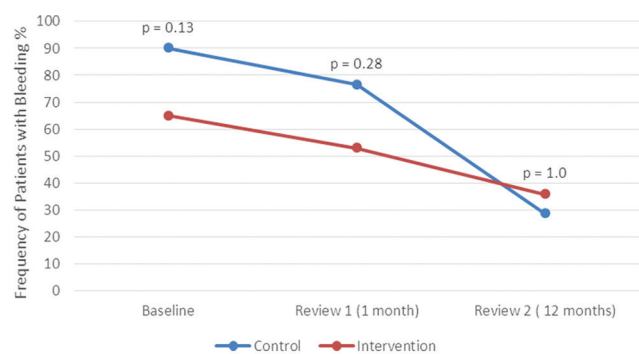
The intervention group showed practically insignificant differences between the first ( $P = 0.299$ ) and the second

**Table 2: Mean scores of odor**

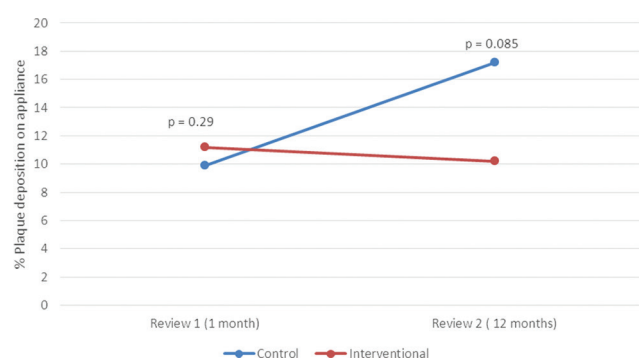
	Control			Interventional		
	Baseline	Review 1	Review 2	Baseline	Review 1	Review 2
None	0	0	0	5.0	0	0
Slight	25.0	23.5	21.4	0	0	35.7
Moderate	15.0	17.6	0	30.0	52.9	50.0
Heavy	20.0	47.1	35.7	45.0	41.2	7.1
Strong	15.0	0	35.7	20.0	5.9	7.1
Intense	25.0	11.8	7.1	0	0	0



**Figure 1: Plaque score differences at different reviews**



**Figure 2: Bleeding score differences at different reviews**



**Figure 3: The plaque deposition on the appliance over the period of treatment at 1 month and 12 months**

( $P = 0.085$ ) review. On the other hand, the control group had more plaque deposition covering the appliance by the end of the study as illustrated in Figure 3; the difference between the two groups at the second review was not significantly different.

### Knowledge of orthodontic appliance care assessment

During the analysis of the raw data, some prominent features between the two study groups were evident. Such differences were conspicuous in the first question which assessed the knowledge of the patients when it comes to the critical moment to the removal of the appliance, and in the last question of the questionnaire which evaluated how patients should clean the removable appliance. With regard to Question 1, only 10% of the control group answered correctly, with nearly 90% claiming that they would not know. Meanwhile, all of the patients in the intervention group answered correctly. On the other hand, although an educational campaign was prepared for the intervention group, there was no significant difference between the responses of the two study groups concerning Question 5. Table 3 illustrates the total percentage of patients in both groups who answered in the appropriate answers.

### Knowledge on oral health assessment

During the analysis of the raw data gathered from this particular questionnaire, Question 7 revealed a prominent contradiction between the two study groups. Question 7 was designed to evaluate the patients' knowledge on when they should make use of a mouthwash. A considerable level of proper knowledge about the use of a mouthwash was established within the intervention group (70%) when compared to the control group (20%). This finding was known to be statistically significant ( $P = 0.005$ ). As illustrated in Table 4, the rest of the questions divulged different percentages between the two study groups yet no statistically significant difference was attained [Appendix 1].

### DISCUSSION

The targeted participants for this research study comprised 80 individuals among which 40 patients were in the intervention group and the other 40 patients were in the control group. All participants involved in the study were randomly selected from the orthodontics register at the Dental Surgery Department. However, only upper removable orthodontic patients were recruited to be part of the study.

The intervention group received an educational session on proper oral hygiene measures, prevention of dental diseases



**Table 3: Knowledge on orthodontic appliance care assessment**

Question	Control (%)	Intervention (%)	P
Q1: Removing the appliance	10	100	<0.001
Q2: Cleaning frequency	90	100	1.000
Q3: Appliance damage	100	100	-
Q4: Appliance storage	100	95	1.000
Q5: Cleaning methods	65	60	0.211

**Table 4: Knowledge on oral health assessment**

Question	Intervention (%)	Control (%)	P
1	50	70	0.97
2	85	85	1.00
3	85	65	0.14
4	90	70	0.43
5	50	55	0.73
6	100	85	0.23
7	70	20	0.005*
8	100	100	-
9	90	85	0.80
10	20	0	0.10
11	60	30	0.60

\*Significant

and care of the orthodontic appliance from when the orthodontic appliance was fitted in the patient's oral cavity through the means of a power-point presentation, videos, and pamphlets. The intention of these visual representations was to emphasize the importance of improved oral hygiene procedures and distributing the knowledge of how to take proper care of the orthodontic brace during treatment. On the other hand, the control group received routine educational material and information about the care of the orthodontic appliance but without the educational videos and PowerPoint presentation. To date, no studies evaluated the significance of oral health education in adolescents undergoing removable orthodontic treatment. This study accentuates the fact that an educational oral hygiene health protocol improved all aspects of the patients' oral hygiene including the level of plaque accumulation on the tooth surfaces and upon the removable appliance, gingival bleeding, and the degree of halitosis during the 3-month period of data collection.

Donaldson *et al.* reported upon the association between the barriers of health inequalities and dental attendance which greatly influenced the nature of the patients' teeth and the attendance to the dental clinic.<sup>[6]</sup> Moreover, Amin *et al.* suggested that guardians with a poor level of education and a minimal income are less aware of their children's oral health condition and are not knowledgeable enough about dental diseases when compared to guardians with higher socioeconomic status.<sup>[7]</sup> However, in this study, the sociodemographic profile of all guardians seemed to be homogeneous through the aspects of educational level, employment status, and marital status. Such finding is of essential

importance, as while evaluating the effect of each group it was assured that it was not confounded by any other external factors. Previous literature supports the ideology that patients who of a younger age tend to follow the treatment plan more than older patients within the same age groups.<sup>[8]</sup> Simultaneously, the mean percentage of dropouts during the study period was approximately similar in both study groups. In addition, the published literature reveals that females have a higher probability of seeking and receiving orthodontic treatment due to greater esthetical concerns and perceptions of an ideal oral health care than males.<sup>[9]</sup> As a matter of fact, such factor is evident in the present research study because 52.5% of the representative population was females.

Several periodontal indices have been adapted by numerous research studies to expound the patient's level of motivation during the treatment.<sup>[10]</sup> In fact, in the present study, a clinical assessment of the plaque score, bleeding score, plaque deposition on the removable appliance, and odor level were performed for every patient. When estimating the plaque score of the study population at baseline, there was no difference. However, for the control group, a regression was reported at 4 weeks; however, plaque accumulation further increased until the second review session. On the other hand, a progressive reduction of plaque over time was reported with the intervention group. Literature, clearly expressed that individuals with malocclusion are more likely to be related to periodontal disease due to the physically hindered proper oral hygiene.<sup>[11]</sup> The authors in the past years have shown that dental plaque is more likely to accumulate on the surfaces of the posterior dentition being the premolars and molars. This is due to the fact that it might be difficult for the patient to visualize and reach such areas.<sup>[12]</sup> Furthermore, a direct relationship had been established between the patient's oral hygiene status and the extend severity of gingival bleeding, which is in accordance with the published literature.<sup>[13]</sup> Concurrently, the present study yielded the same conclusions. Such findings also revealed that the percentage of patients with bleeding in the control group was 90% higher than the 65% in the interventional group.

Moreover, one can state that there has been a positive effect on the education campaign on oral hygiene regarding plaque control and gingival bleeding. Therefore, it would be exemplary to design an educational campaign where a dental professional would educate the patients about the trend of dental plaque accumulation and its direct association with gingival bleeding while developing effective oral hygiene protocols that should be used and also by modifying the patients' preexisting procedures of oral hygiene.

During the present study, the educational campaign also had a positive long-term effect upon the interventional group as the level of anaerobic bacteria which disintegrate the sulfur-containing amino acids decreased (byproducts detected by Tanita breath checker). As a result, the odor level of such group declined progressively during the study period. On the other hand, the control group patients appeared to ignore the standard instructions concerning oral hygiene given by their dentists because after the 1<sup>st</sup> review session the odor level increased. Moreover, the same educational campaign conclusions apply to the level of plaque deposition on the retentive area of the upper removable appliance.

Some clinical studies suggest that fluoridated toothpastes, mouthwashes, gel, and varnishes aid in the prevention of dental caries. This is due to the fact that the fluoride which alters the bacterial chemical reaction in dental plaque, by retarding the production of the acidic by-products. Thus, such process declines the demineralization of the tooth surface, while promoting the remineralization process of the tooth structure. As a matter of fact, researchers suggest that mechanical plaque removal by means of toothbrushing should take place at least twice a day, while making the use of fluoridated toothpaste. Furthermore, dental professionals greatly suggest patients to opt for a noncariogenic diet and drink a lot of water. Eichenauer *et al.* stressed on the fact that the most recommended procedure of cleaning an orthodontic appliance is through mechanical methods with a toothbrush in combination of a toothpaste.<sup>[14]</sup> Thus, such fact must be given further prominence during an educational campaign to reduce the risk of any dental diseases such as fungal infections or dental caries. More or less, in the other questions featured in the questionnaire which was aimed at assessing the knowledge on the appliance care, both groups answered similarly due to continuous educational advices offered to the general public through the media; where, nowadays, health advices are no longer limited to a professional visit during which information is transferred from the health professional to the patients. Yet, the media is continuously spreading preventive health guidelines. It would be substantial benefit to the patients to receive visual educational instructions in addition to verbal ones thus; patients can be motivated to look after their own appliances and oral hygiene. The educational videos and instructions can be incorporated with the treatment plan as a must do task during the treatment course.

## CONCLUSION

- The educational program had a long-term effect upon the patients who were part of the intervention group,

as there was a reduction in the bleeding score, plaque accumulation, and odor level progressively

- Dental professionals are encouraged to organize institutional and community dental educational programs targeted toward the prevention of dental trauma, benefits of regular dental attendance, and proper oral hygiene compliance when a patient is undergoing orthodontic treatment.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

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## APPENDIX

### Appendix 1:

Questionnaire: Oral health-related behavior and knowledge

Age: \_\_\_\_\_ years old

Gender: \_\_\_\_\_

*Please spare a few minutes of your valuable time to answer this questionnaire by ticking your answer.*

Q1) When should you have a dental checkup?

- Every 2 years
- Every year
- Every 6 months
- Every 3 months

Q2) How frequently should you brush your teeth?

- Once a day
- Twice a day
- Once a week
- Never

Q3) Are you aware about inflammations of the gums?

- Yes
- No

Q4) Do you believe that children under the age of 6 years should use a different toothpaste than their parents?

- Yes
- No

Q5) How often should you change your toothbrush?

- Once every 3 months
- Once a year
- When the bristles of the toothbrush are all worn out

Q6) Should a toothpaste contain Fluoride?

- Yes
- No

Q7) When should one use a mouthwash?

- After toothbrushing
- When sanitary facilities and a toothbrush are not available
- Never

Q8) Can smoking cause mouth diseases?

- Yes
- No

Q9) When did you have the last checkup?

- Every 2 years
- Every year
- Every 6 months
- Every 3 months

Q10) Do you make use of interdental brushes, dental floss, or disclosing agents?

Yes       No

Q11) Do you use a mouthwash?

Yes       No