

Oral Hygiene Status among Orthodontic Patients

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Abstract

Aim: The aim of this study was to evaluate the oral hygiene status of patients with fixed orthodontic appliances.

Methods and Materials: The following indices were used to evaluate the oral hygiene status of patients in orthodontic treatment: gingival bleeding index (GBI), plaque index (PI), and ortho-plaque index (OPI). A self-administrated questionnaire was prepared covering oral hygiene practice, oral hygiene cleaning aids, and number of visits to a dental hygienist.

Results: Fifty patients (15–30 years old) were selected for the study from among the orthodontic patients treated at the King Saud University College of Dentistry, Riyadh, Saudi Arabia. Results showed that the PI and OPI were high with mean scores of 65.24 (SD 16.43) and 53.56 (SD 8.74) respectively, while the average GBI was a much lower value at 19.14 (SD 7.95). No significant difference was observed between male and female patients for the PI ($p=0.925$) and for the OPI ($p=0.072$), but a significant difference was observed for the GBI at the 5 percent significance level ($p=0.033$). The result of OPI showed that 20 (40 percent) of the patients had fair oral hygiene, whereas 30 (60 percent) had poor oral hygiene. Only 16 (32 percent) of the participants reported visiting the dental hygienist during their orthodontic treatment, while the remaining 34 (68 percent) did not.

Conclusion: The oral home care of the orthodontic patients surveyed was not at an optimal level, which indicated the need to establish an oral hygiene maintenance program.



Clinical Significance: Inadequate oral home care among orthodontic patients may make them more prone to develop gingivitis during orthodontic treatment. It is, therefore, essential that oral hygiene instructions and a hygiene maintenance program not be overlooked during orthodontic treatment.

Keywords: Bleeding index, disease control, orthodontics, oral hygiene, gingivitis, plaque index, pocket depth

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Introduction

In contemporary dental care, an increasing number of adult patients are seeking orthodontic treatment. Oral hygiene is greatly complicated following the placement of fixed orthodontic appliances. Consequently, patients with fixed orthodontic appliances are at an increased risk to develop dental caries and gingivitis,¹⁻³ which may lead to loss of gingival attachment.⁴ It has been reported that there is a statistically significant increase in stimulated salivary flow rate, pH, buffer capacity, plaque index (PLI) scores, and the levels of lactobacilli after three months of active orthodontic treatment.⁵

Following the placement of fixed appliances, differences were found in the plaque index (PI), bleeding index (BI), and pocket depth (PD) measures, and these values were significantly greater than baseline.⁶ There was a reported shift to a more disease-inducing subgingival microflora with a statistically significant increase in spirochetes and fusiform bacilli.⁶ During the first six months of treatment, a significant modification of oral microbiota was found in subjects with fixed appliances.⁷ Such an outcome suggests that the risk of gingivitis during their months of therapy was high, and the risk of periodontitis could not be excluded.⁷

Manschot⁸ reported one case of a patient in whom orthodontic treatment and poor oral hygiene resulted in severe mucogingival changes, such as gingival recession. Orthodontic appliances per se do not usually cause gingival inflammation, but they can contribute to periodontal disease due to



the increase in microorganisms.⁹ However, plaque accumulation and gingival inflammation both can be equally reduced in well-motivated patients.¹⁰ Therefore, it is very important to emphasize oral hygiene instructions to orthodontic patients treated with a fixed appliance.¹¹

This study was designed to evaluate the oral hygiene level in patients under treatment with fixed orthodontic appliances.

Methods and Materials

Patients in active treatment in the orthodontic clinic at King Saud University, College of Dentistry, Riyadh, Saudi Arabia, were chosen for the study. The selection criteria were:

1. Treatment that consisted of full-mouth fixed orthodontic appliances that had been in place for at least six months.
2. No systemic diseases.
3. No history of taking antibiotics for the last three months.
4. No treatment by a dental hygienist any time during the month preceding the study.

Information about the patient's oral hygiene practices was obtained using a questionnaire designed to be comprehensive for all patients (Table 1). The study did not obtain any confidential demographic information such as income or educational level. The questionnaire did cover oral hygiene practice, oral hygiene tools, and numbers of visits to a dental hygienist.

Examiner Calibration

One examiner conducted the study. Ten subjects who volunteered to participate were examined on two occasions using the three indices (PI, GBI, and OPI) to establish intra-examiner reliability. The Kappa test was used to analyze the intra-examiner reliability and scored 70.4 percent, 78.7 percent, and 80 percent for GBI, PI, and OPI respectively.

Orthodontic Plaque Index

The O'Leary plaque index (PI)¹² and gingival bleeding index (GBI)¹³ were used to determine the present state of the patient's oral hygiene and the gingiva. An orthodontic plaque index (OPI)¹⁴ was used to evaluate plaque levels in the areas cervical to the bracket base and mesial and distal to the bracket body, which are the most critical zones of plaque accumulation. OPI was calculated using the

Table 1. Questionnaire distributed to patients.

1) **Do you use a toothbrush?**
 Yes No

If yes, how many times do use it/day?
 Once/d Twice/d Three times/d Irregular

What type of toothbrush do you use?
 Extra Soft Soft Medium Hard I don't know

Describe brushing technique:

2) **Do you use any of the following cleaning aids and how many times?**

Dental floss
 Once twice three times irregular

Interdental brush
 Once twice three times irregular

Toothpick
 Once twice three times irregular

Miswak
 Once twice three times irregular

3) **Do you use mouthwash? If yes...**
 Once twice three times irregular

Please write the brand name of the mouthwash: _____

4) **Do you consume sugar during orthodontic treatment?**
 Yes Sometimes No, I don't take sugar

5) **Do you eat sticky food?**
 Yes Sometimes No, I don't take sticky food.

6) **Do you go to the dental hygienist during your orthodontic treatment?**
 Yes No

Table 2. Orthodontic plaque index (OPI) form: The numbers of stained sites are added, and these totals are multiplied by the corresponding factor.

Maxillary																
Cervical	Σ	2x														
Central	Σ	3x														
Occlusal/incisal	Σ	1x														
Tooth #			7	6	5	4	3	2	1	1	2	3	4	5	6	7
Mandibular																
Occlusal/incisal	Σ	1x														
Central	Σ	3x														
Cervical	Σ	2x														
Sub total:																
OPI=Sum total-number of teeth x6.																

index formula shown in Table 2 where the factors used were 1, 2, and 3 for occlusal, cervical, and central, respectively. OPI was scored as good (0–25 points), average (26–50 points), or poor (>50 points).

Gingival Bleeding Index

For the gingival bleeding index (GBI),¹³ all four surfaces of the teeth were assessed to determine whether probing elicited bleeding or not. The severity of gingivitis was expressed as a percentage calculated as follows: [(Number of bleeding sites)/(Number of evaluated sites) × 100].

Data Analysis

Data were entered into the computer using the FoxPro program [FoxPro 7.0; Sybase Inc., Dublin, CA, USA], and the Statistical Package for the Social Sciences [SPSS 10; (SPSS Inc., Chicago, IL, USA)] was utilized for the statistical analyses.

One-way analysis of variance (ANOVA) was used to determine differences at the 5 percent significance level ($p < 0.05$).

Results

Fifty subjects, 32 (64 percent) male and 18 (36 percent) female orthodontic patients between 15 and 30 years of age (with a mean age of 19.82 years), participated in this six-month study. The clinical examination of their oral health status showed that the mean value of the plaque index (PI) was 65.24 (SD 16.43), while the bleeding index (GBI) was 19.14 (SD 7.95) and the ortho-plaque index (OPI) was 53.56 (SD 8.74) (Table 3).

Toothbrush and Brushing Frequency (Question 1)

All patients reported using a manual toothbrush to clean their teeth, and Figure 1 shows the frequency of brushing per day. Nine (18 percent) patients brushed once daily, whereas 27 (54 percent) reported brushing twice daily and 11 (22 percent) said they brushed their teeth three times per day. The remaining 3 (6 percent) patients reported brushing infrequently.

Table 3. Mean of PI, GBI, OPI, and Age.

	Min	Max	Mean	Std. Dev
PI	27.8	95.6	65.24	16.43
GBI	5.2	43.8	19.14	7.95
OPI	36.7	73.3	53.56	8.74
Age	15	30	19.82	4.3

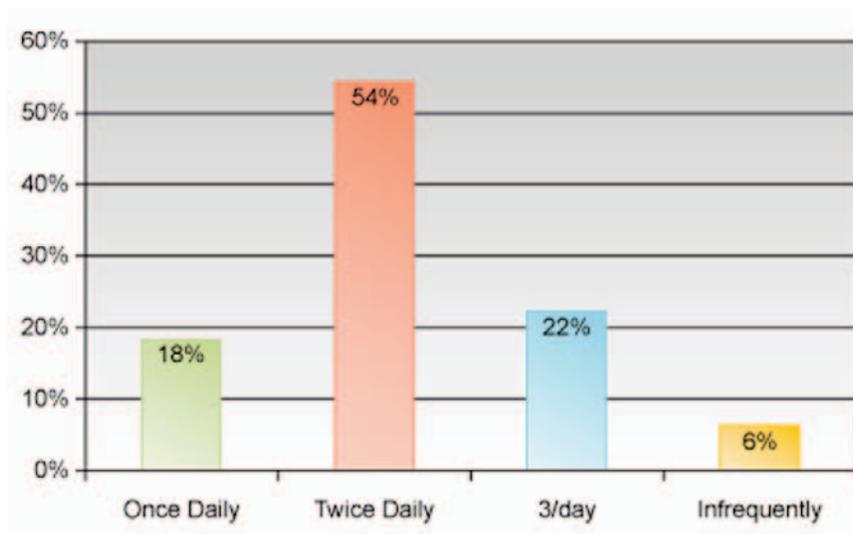


Figure 1. Frequency of toothbrush use per day.

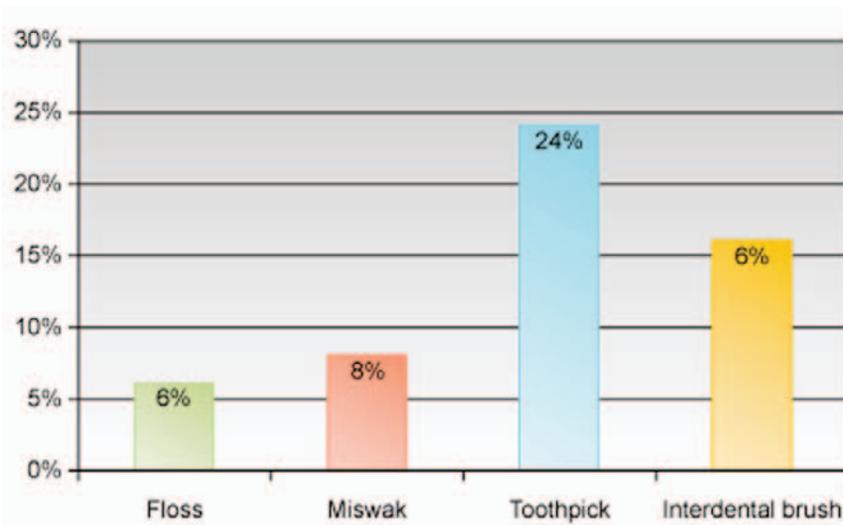


Figure 2. Other oral hygiene aids reportedly used by patients.

Table 4. Adjunct oral hygiene tools used by patients and frequency of using.

Oral Hygiene Tool	Patients		Frequency/day		
	%	No.	1/d	2/d	3/d
Floss	6%	3	8	—	—
Miswak	8%	4	3	1	—
Toothpick	24%	12	3	7	2
Interdental brush	16%	8	7	1	—

A hard toothbrush was used by two (4 percent) of the patients, whereas 15 (30 percent) stated they used a soft brush and 30 (60 percent) reported using a medium toothbrush. One patient reported using an extra-soft toothbrush. Two of the patients could not recall the type of toothbrush they used.

Brushing Technique

The evaluation of brushing techniques revealed that four (8 percent) patients were using a circular movement, 21 (42 percent) used a horizontal movement, and 13 (26 percent) of the patients were using a vertical movement in one direction. The remaining 12 patients were unable to describe their method of brushing, so their technique was considered as irregular.

Oral Hygiene Aids

About half of the patients stated they also were using other oral hygiene tools. Figure 2 shows that 3 patients (6 percent) used dental floss once daily and 12 patients (24 percent) used a toothpick (three used it once daily; seven patients

used it twice daily; the remaining two used it three times a day).

Only four (8 percent) of the patients were miswak users, but three of them used it once daily, whereas the fourth patient used it twice daily. Miswak is a teeth cleaning twig made from a twig of the *Salvadora persica* tree, also known as the arak tree or the peelu tree, and is a part of Islamic hygiene jurisprudence.

Eight (16 percent) patients used an interdental brush with one patient reportedly using it twice a day and seven patients saying they used it twice daily (Table 4). The remaining 23 patients reported not using any oral hygiene aids.

Mouthwash (Question 3)

Of the 50 patients in the study, a total of 17 (34 percent) reported using mouthwash. Out of those 17 patients, 8 reported using a mouthwash containing fluoride.

Sugar Consumption (Question 4)

Of the 50 patients surveyed, 7 (14 percent) indicated they consumed sugar during the treatment, whereas 36 (72 percent) consumed sugar sometimes. The remaining seven reported they did not consume any sugar.

Sticky Food Consumption (Question 5)

Two (4 percent) patients reported eating sticky food (e.g., toffee), whereas 22 (44 percent) were eating sticky foods occasionally. The remaining 26 (52 percent) did not eat any sticky foods.

Visits to a Dental Hygienist (Question 6)

Only 16 (32 percent) of the participants reported being treated by a dental hygienist during their orthodontic treatment, while the remaining 34 (68 percent) did not visit the hygienist.

No significant difference was observed between male and female patients for the plaque index ($p=0.925$) and for the ortho-plaque index ($p=0.072$). On the other hand, a significant

difference was observed for the bleeding index at the 5 percent level ($p=0.033$) (Table 5).

When evaluating the relationship between the three indices and age group, no statistically significant difference was noted for the PI ($p=0.677$), the GBI ($p=0.534$), or the OPI ($p=0.336$) (Table 6). The result of OPI showed that all the patients scored 52 or higher with 20 (40 percent) patients rated as having fair oral hygiene and 30 (60 percent) having poor oral hygiene. None of the patients scored between 0 and 25 and could be classified as having good oral hygiene (Table 6).

There was no significant correlation between the OPI and GBI ($p=0.99$) (Table 7).

Discussion

Patients undergoing orthodontic treatment with fixed appliances are at risk for developing gingival inflammation because of the increased challenge

Table 5. Relationship between indices and gender.

	Sex	N	Mean	Std. Dev	p Value
PI	M	32	65.4	16.76	.925*
	F	18	64.94	16.3	NS
GBI	M	32	20.78	8.49	.033**
	F	18	16.22	6.08	S
OPI	M	32	55.3	8.1	.072*
	F	18	50.46	9.2	NS

*NS: not significant
**S: significant

Table 6. Relationship between indices and age group.

	Age Group	N	Mean	p Value
PI	≤20	26	66.1831	.677
	≥21	24	64.2088	
GBI	≤20	26	19.8269	.537
	≥21	24	18.3975	
OPI	≤20	26	52.4169	.336
	≥21	24	54.8083	

Table 7. Correlation between OPI and GBI.

Index	Correlation	OPI	GBI
OPI	Pearson correlation	1.000	0.236
	Sig. (2-tailed)		0.99
	N	50	50
GBI	Pearson correlation	0.236	1.000
	Sig. (2-tailed)	0.99	
	N	50	50

to oral hygiene. Dental plaque is a primary etiologic factor in gingivitis.¹⁵ The patient's inability to clean his or her teeth adequately around fixed orthodontic devices promotes plaque accumulation that can then lead to gingival inflammation. An overall increase in salivary bacterial counts, especially *Lactobacillus*, has been shown after orthodontic appliance placement.¹⁶ Similarly, twofold and threefold increases in both clinical indexes and numbers of motile organisms have been reported at sites six months after appliance placement,² as well as an early increase in anaerobes and *Prevotella intermedia*, and a decrease in facultative anaerobes.^{3,17} This shift in the subgingival microflora to a periopathogenic population is similar to the microflora in periodontally diseased sites.¹⁸ Irregular alignment of teeth may make plaque control even more difficult. Some studies have found a positive correlation between crowding and periodontal disease,¹⁹ while others have not.²⁰ Nonetheless, effective plaque control is the prime consideration for good oral hygiene. This study sought to evaluate oral practice among orthodontic patients treated at King Saud University, College of Dentistry.

Despite the fact that more than half of the patients (54 percent) were brushing their teeth twice daily, their oral hygiene was unsatisfactory. PI and OPI were high in general, having a mean value of 65.23 and 53.56, respectively. This finding is in agreement with previous studies reporting an increase in tooth surfaces displaying visible plaque following the placement of orthodontic appliances.¹⁹⁻²¹ This is due to the increase in plaque retentive areas and the inability of the patient to perform adequate oral hygiene.²² However, increasing the frequency of toothbrushing does not automatically lead to clean teeth. Consequently, the frequency of toothbrushing alone cannot be used as a measure of the quality of oral hygiene. Levels of education and motivation, as

well as continuous reinforcement of oral hygiene, can improve patient's performance of oral home care. Orthodontic patients, in particular, must be trained in proper oral hygiene maintenance and their brushing procedures must be checked regularly. It is possible to achieve and maintain a high standard of oral health behavior following an intense period of individual oral hygiene education.²³

On the other hand, the results of the current study are understandable because only three (6 percent) patients were using dental floss and eight (16 percent) patients were using an interdental brush. Using a toothbrush alone is not sufficient to clean the teeth (dental arches) with bonded appliances in place. Therefore, the daily use of dental floss with a floss threader and interdental brushes is recommended. Waerhaug²⁴ reported that interdental brushing has the advantage of removing subgingival plaque to a depth of 2.0 to 2.5 mm.

Large portions of the buccal surfaces (and sometimes the lingual surfaces of banded teeth) are covered by adhesive attachments in patients with fixed appliances. Areas cervical to a bracket base and those mesial and distal to the bracket body are the most critical sites for plaque formation. Therefore, it is highly desirable to use an ortho-plaque index to evaluate these surfaces separately when recording the plaque index.

In assessing the brushing methods used, it is clear that patients need motivation and instructions on how to employ an appropriate technique. The so-called scrubbing method has previously been recommended to patients during orthodontic treatment;²¹⁻²² however, the modified Bass technique was superior to the scrub



method²⁵. Many patients place the toothbrush too far coronally; thus the gingival third of the tooth is routinely neglected, which can then lead to an increase in plaque accumulation and the development of gingivitis. Therefore, all patients should be instructed to clean the tooth structure cervical to an orthodontic appliance as well as the remaining coronal surfaces.

Daily oral hygiene can become challenging for some patients in the presence of orthodontic appliances. Accordingly, an electric toothbrush has been recommended for patients with orthodontic appliances. In fact, Heintze et al.¹⁴ concluded that patients with poor oral hygiene might benefit from using an electric toothbrush, especially because dental plaque can be removed easily and fast.

Electric toothbrushes with a rotational brush are significantly more effective in removing supragingival plaque from bracketed teeth compared to a manual toothbrush.²⁶ In fact, the differences in plaque-removing effectiveness were found to be particularly consistent on the proximal surfaces of teeth.²⁶

It is clear from the results of this study that most of the patients (68 percent) assessed did not visit a dental hygienist during their orthodontic treatment. Yet the effectiveness of professional prophylaxis has been demonstrated in patients with fixed orthodontic appliances.²⁷ Consequently, oral hygiene instruction and reinstruction must take place during orthodontic treatment. Also some patients need to be reminded to concentrate on cleaning the cervical area of their teeth below the

brackets. A continuous increase in oral hygiene awareness not only will reduce the prevalence and severity of iatrogenic tissue damage but also will extend the long-term benefits of orthodontic therapy.

The mean value of GBI was 19.14, which is considered a reasonable value. The reason for this outcome could possibly be due to the fact that 32 percent of the patients visited the hygienist during their orthodontic therapy.

Regarding the relationship of the three indices to gender, the results of this study showed that this relationship was not significant for PI and OPI, whereas it was significant for the GBI ($p=0.033$). Even though female patients were more likely to visit the dental hygienist, both males and females had problems maintaining good oral home care practices, as evidenced by their respective scores. On the other hand, 33.3 percent of the female patients were using interproximal aids for cleaning, compared to just 15.6 percent of their male counterparts.

Although diet is more related to dental caries than plaque or gingivitis, it has been demonstrated that the amount of carbohydrates in one's diet and the frequency of intake influence bacterial growth. The mechanism of attachment and the subsequent colonization on tooth surfaces by certain microorganisms also may be made possible by the components of one's diet.²⁸ In this study, 72 percent of the patients reported consuming sugar sometimes. Additional research is recommended to study the relationship between diet and plaque accumulation in orthodontic patients.

Conclusion

Based on the findings of this study, it is evident that patients wearing orthodontic appliances have a problem in maintaining good oral hygiene. Therefore, educating and motivating these patients to maintain their oral health and providing recommendations for oral home care aids to improve their compliance remains the cornerstone for achieving optimal oral hygiene results.

Patients must gain an understanding of what their treatment may be like and what their responsibilities are. They must understand they are partners in their orthodontic treatment

and have an opportunity to improve and then maintain good oral healthcare themselves. But no oral hygiene program will be effective unless orthodontists accept the responsibility for motivating their patients and staff.

When an orthodontist offers guidance in oral hygiene with sincere interest and respect, patients usually respond to this concern and become receptive to improving themselves. It is essential, therefore, that any hygiene problems or limitations noted during orthodontic treatment not be dismissed but addressed immediately.

Clinical Significance

Inadequate oral home care among orthodontic patients may make them more prone to develop gingivitis during orthodontic therapy. It is essential, therefore, that the maintenance of proper oral hygiene during orthodontic treatment not be overlooked.

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