

A MICROBIOLOGICAL EVALUATION OF SALIVA IN ORTHODONTIC PATIENTS USING TWO TYPES OF TOOTHBRUSHES

Doç.Dr.Hülya KILIÇOĞLU*,
Prof.Dr.Melek YILDIRIM*,
Prof.Dr.Güven KÜLEKÇİ**,
Prof.Dr.Aslan GÖKBUGET ***

ÖZET: İKİ FARKLI DIŞ FIRÇASI KULLANAN ORTODONTİ HASTALARININ TÜKÜRÜĞÜNDEKİ MİKROBİYOLOJİK DEĞİŞİKLİKLERİN İNCELENMESİ Sabit ortodontik apereyleri taşıyan bireylerde ağız hijyeni önlemleri büyük önem taşımaktadır. Ağız hijyeninin korunmasında diş fırçalama çok önemlidir. Bu çalışmada yaşları 13-18 arasında değişen, sabit ortodontik tedavi gören 10 hastada iki tip diş fırçasının (Oral B Plus 35 ve Oral B Advantage) sırasıyla mikrobiyal plağu eliminasyonu ile tükürükteki mutans streptokokları ve laktobasil seviyeleri üzerindeki etkisi karşılaştırıldı. Çalışma üç safhada gerçekleştirildi. Her safhada hastalardan tükürük örnekleri toplandı ve bonded-bracket indekslerine bakıldı. Safhalar arasında, tükürük akış hızındaki değişiklikler student t testi ile, tükürükteki mutans streptokokları ve laktobasil seviyelerindeki değişiklikler ise Wilcoxon testi ile değerlendirildi. Tükürük akış hızı ile tükürükteki mutans streptokokları ve laktobasil seviyelerinde istatistiksel düzeyde anlamlı değişiklikler görülmedi. Mikrobiyal plak birikimi 1. ve 2. (p<0.01) ile 1. ve 3. (p<0.01) safhalar arasında anlamlı derecede azalma gösterirken, 2. ve 3. safha arasında (p<0.05) artış görüldü. Sonuç olarak, Oral B Plus 35 diş fırçasının, özellikle üst arka grup dişlerde, Oral B Advantage diş fırçasından daha etkili olduğu görülmüştür. Bununla beraber, ağız gargarası gibi diğer ağız hijyeni koruma yöntemleri de tavsiye edilmektedir.

Anahtar Kelimeler: Sabit apereyler, ağız hijyeni, mikrobiyoloji, diş fırçası

ABSTRACT: A MICROBIOLOGICAL EVALUATION OF SALIVA IN ORTHODONTIC PATIENTS USING TWO TYPES OF TOOTHBRUSHES. Oral hygiene measures are of utmost importance in patients wearing fixed orthodontic appliances. Toothbrushing is very important for the maintenance of oral hygiene. In this study, two different types of toothbrushes (Oral B-Plus 35 and Oral B Advantage) are compared with respect to elimination of microbial

plaque and salivary levels of mutans streptococci and lactobacilli in 10 active orthodontic patients with fixed appliance (ages between 13-18). The study was carried out in three stages. In each stage, salivary samples were collected and bonded bracket index recordings were taken. Salivary flow rate changes were compared using Student t test; and salivary mutans streptococci and lactobacilli level changes and microbial plaque accumulation were compared by Wilcoxon test at each stage of the study. No statistically significant changes were recorded either in salivary flow rates or in salivary mutans streptococci and lactobacilli levels. Microbial plaque accumulation decreased between stages 1 and 2 (p<0.01) and between stages 1 and 3 (p<0.01). It increased between stages 2 and 3 (p<0.05). It was concluded Oral B-Plus 35 toothbrush was more effective than Oral B Advantage toothbrush, especially in upper posterior teeth. However, other oral hygiene measures such as mouth rinse can be recommended.

Key Words: Fixed appliances, oral hygiene, microbiology, toothbrush.

INTRODUCTION

Oral hygiene measures are of utmost importance for patients with fixed orthodontic appliances. Bands, brackets, arch wires, ligatures and elastics used in fixed appliances cause increased accumulation of microbial plaque on the teeth. This, in turn, facilitates formation of dental caries and periodontal problems, with the deterioration of the ecologic balance of the oral flora(1-5). Cariogenic mutans streptococci and lactobacilli increase because the quantity of salivary microorganisms increases by accumulation of microbial plaque(6-9). The orthodontic patients have to remove the microbial plaque from the teeth by regular toothbrushing.

The present study was planned to investigate the effects of Oral-B Advantage and Plus 35 toothbrushes (Oral-B Laboratories Ltd.) (Fig. 1) on the microbial plaque accumulation and salivary levels of mutans streptococci and lactobacilli of patients with fixed orthodontic appliances.

* İ.Ü. Dişhekimliği Fakültesi Ortodonti Anabilim Dalı

** İ.Ü. Dişhekimliği Fakültesi Mikrobiyoloji Anabilim Dalı

*** İ.Ü. Dişhekimliği Fakültesi Periodontoloji Anabilim Dalı

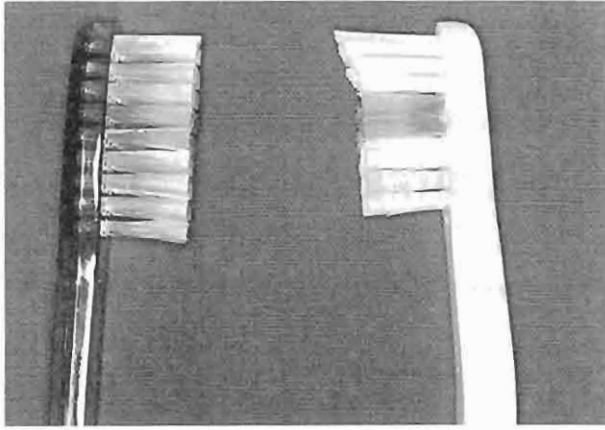


Figure 1: Oral B Advantage and Plus 35 toothbrushes used in study.

Table 1 – Chronological age distribution of the patients

	n	x	SD	Min	Max
Female	7	15.271	2.10	13.036	18.129
Male	3	14.877	2.52	12.817	17.696
Total	10	15.153	2.10	12.817	18.129

Materials and Methods

Ten active orthodontic patients with Edgewise appliances from the Orthodontic Department of the Faculty of Dentistry of Istanbul University included the study. The ages of the patients vary between 13 and 18, distribution of which is shown in Table 1. The following criteria were used in choosing the patients:

- 1) All permanent teeth must be in situ.
- 2) No decalcification or caries must be present.
- 3) Systemic disease must be nonexistent.
- 4) No antibiotic usage must be present in the last three months.

Patients were asked about their dietary habits (i.e. types of food, eating at meal time or between meals)(10). Dietary records taken in the beginning of the study revealed that the patients had a high intake of carbohydrates, especially sweets at and between meals.

The study was realized in three phases:

Phase 1: After the levelling stage of fixed orthodontic therapy (0.016" round SS wires in both arches), patients were instructed to brush their teeth with Oral-B Plus 35 type tooth brush and Ipana toothpaste (Procter & Gamble Ltd.). After 2 weeks, paraffin stimulated saliva samples were obtained from all patients for determining salivary flow rate, mutans streptococci and lactobacilli. The bonded-bracket index was recorded on each patient at the same time.

Phase 2: The Oral-B Plus 35 toothbrushes were renewed (3 for each patient). The patients continued their oral hygiene programme initiated in phase 1. After 2 weeks, the same procedure was repeated on each patient.

Phase 3: The toothbrushes were changed by Oral-B Advantage type toothbrush at this phase (3 for each patient). At end of this phase, after 2 weeks, bonded-bracket records and collected saliva samples were evaluated on each patient.

All of the patients were tested for two weeks in order to equalize the comparison between two different types of toothbrushes and they used Oral B Plus 35 type toothbrush at first phase. The aim was to improve the adaptation of the patients to oral hygiene procedures and tooth brushing. Following this adaptation, different tooth brushes used in the second and third phases were tested under the standardized conditions.

In each phase, patients were motivated to brush their teeth with the Bass method for 3 minutes after each meal.

Salivary flow rate was obtained from collected saliva volume within 5 minutes and evaluated according to the following scale: 0.1 ml saliva/min: xerostomia; 0.7 ml saliva/min: oligosalia; 1 ml saliva/min: normal flow rate(3).

Salivary mutans streptococci counts were determined on MSB agar plates(11). The categories for mutans streptococci were as follows: Score 0: not detected; score 1: $\leq 10^5$ CFU/ml (low); score 2: $>10^5$ or $<10^6$ CFU/ml (moderate); score 3: $\geq 10^6$ CFU/ml (high)(12).

Salivary lactobacilli counts were detected on Rogosa SL agar plates(13). The categories for lactobacilli were as follows: score 0: not detected; score 1: $\leq 10^4$ CFU/ml

(low); score 2: $>10^4$ - $<10^5$ CFU/ml (moderate); scores: $\geq 10^5$ CFU/ml (high)(12).

Bonded Bracket Index:

This index (14) developed to determine the amount of microbial plaque accumulation on teeth with brackets, is used as follows to evaluate plaque accumulation on the buccal tooth surfaces:

- 0: No microbial plaque on the bracket or tooth surface.
- 1: Microbial plaque only on the bracket.
- 2: Microbial plaque on the bracket and tooth surface but no spreading towards the gingiva.
- 3: Microbial plaque on the bracket and tooth surface, spreading towards the papilla.
- 4: Microbial plaque on the bracket and tooth surface, part of the gingiva is covered with plaque.
- 5: Microbial plaque on the bracket and tooth surface. Gingiva is totally covered with plaque.

Microbial plaque was made visible by the Oral-B disclosing tablets prior to bonded-bracket index recordings at the beginning of phase 1 and at the ends of phases 2 and 3.

All scoring was done early in the morning session. The patients were instructed to brush their teeth after breakfast. Each tooth was scored, with the exception of second and third molars and extracted teeth. A total of 606 buccal surfaces were examined. Means of the microbial plaque were calculated for the buccal aspect because the fixed appliance attachments were present on the buccal surfaces only. The buccal aspect was divided into maxillary and mandibular regions while these regions were further subdivided into anterior (canine to canine) and posterior (first premolar to second molar) regions.

Statistical Analysis:

Student t test was used to compare the values obtained from salivary flow rate in the first, second and third phases. Wilcoxon test was used to compare the scores obtained from salivary mutans streptococci and lactobacilli levels and microbial plaque. Statistically significant differences where p is less than 0.05 are marked with (*), and where p is less than 0.01 with (**)(15).

Results

Means (x) and standart deviations (SD) of salivary flow rates at three phases are given in Table 2. No statisticaly significant difference was found in the salivary flow rate between the three phases.

Table 2 – Salivary flow rates in the first, second and third phases of the study

	Phase 1		Phase 2		Phase 3		Student t Test		
	x	SD	x	SD	x	SD	1-2	2-3	1-3
Salivary flow rate (ml/min)	0.98	1.88	1.05	1.45	0.95	1.63	N.S.	N.S.	N.S.

N.S. non significant

Salivary mutans streptococci and lactobacilli ($>10^6$ CFU/ml and $> 10^5$ CFU/ml respectively) levels were high in the three phases of the study No statistically significant changes were recorded either in salivary mutans streptococci or lactobacilli levels between the groups.

Means (x) and standart deviations (SD) of microbial plaque values for the three phases of the study are given in Table 3.

Table 3: Microbial plaque evaluations at the beginning (Phase 1), after use of Plus 35 toothbrush (Phase 2) and after use of Advantage toothbrush (Phase 3).

	Phase 1		Phase 2		Phase 3		Student t Test		
	x	SD	x	SD	x	SD	1-2	2-3	1-3
MAXILLA									
Anterior	2.55	0.82	1.45	0.44	1.43	0.59	**	N.S.	**
Posterior	2.95	0.83	1.55	0.73	1.95	0.61	**	*	**
MANDIBULA									
Anterior	2.48	0.82	1.80	0.55	1.83	0.46	*	N.S.	*
Posterior	2.65	0.53	1.73	0.59	1.98	0.22	**	N.S.	*
Total	2.67	0.60	1.61	0.52	1.77	0.45	**	*	**

p<0.05 (*), p<0.01 (**), N.S.: non significant

Statistically significant ($p<0.01$) decreases took place in the microbial plaque accumulation on maxillary anterior and posterior teeth between phases 1 and 2; and between phases 2 and 3. Even though no statistically significant difference was found in the maxillary anterior teeth between the second and third phases, there was a statistically significant increase ($p<0.05$) in the maxillary posterior teeth for microbial plaque. A statistically significant ($p<0.05$) decrease was found for microbial plaque accumulation on mandibular anterior teeth between phases 1 and 2; and between phases 1 and 3. However, statistically significant decreases were found for mandibular posterior teeth for microbial plaque accumulation between the first and second phases ($p<0.01$) and between the first and third phases ($p<0.05$). No statistically significant difference was seen for microbial plaque accumulation on the mandibular anterior and posterior teeth between the second and third phases.

When all the teeth are considered, statistically significant ($p<0.01$) decreases were found for microbial plaque accumulation between the first and second phases; and the first and third phases. However, statistically significant ($p<0.05$) increase was seen between the second and third phases for microbial plaque accumulation.

Discussion

Dental caries is defined as a special type of infection disease caused by the destruction of the host-parasite balance on the vulnerable tooth surface with counteraction of special bacteria and dietary sugar intake (6). The presence of a fixed appliance greatly complicates tooth cleansing; the archwires and attachment act as barriers to the tooth bristles, thereby increasing caries and periodontal diseases by accumulation of plaque and debris(16,17,22-25). Many different designs of toothbrushes have been suggested despite the fact that clinical trials of different brushes seldom reveal any significant differences in performance(18,28,30,31,32,33), but still various designs are proposed (like "advantage") to overcome these deficiencies. Since crowding and multi-loop arches enhance retentive characteristics, our study was initiated after levelling with 0.016 inch stainless steel round archwires in the mouth to eliminate individual differences and to evaluate the effectiveness of two types of toothbrushes.

Salivary flow rates are not statistically different in three phases of the study and they are evaluated to be normal(3). Caries activity tests are based on the counting of salivary microorganisms(8,19-21). Salivary mutans streptococci and lactobacilli (>106 CFU /ml and >105 CFU/ml respectively) levels are high in the three phases of the study. Krasse(27) regards numbers higher than 106 for mutans streptococci and for higher than 105 lactobacilli counts and as infections. Various investigators have shown that salivary mutans streptococci and lactobacilli levels rise when fixed orthodontic appliances are inserted in the patients' mouths(8,22,26). Bands, brackets, arch wires and composites near the brackets increase microbial plaque accumulation and thus bacteria increase quantitatively(5,8,22,23,26). The high levels of mutans streptococci and lactobacilli in the saliva at three of the phases shows that tooth brushing alone (even though with different toothbrushes) is not effective on decreasing the amount of cariogenic bacteria. Krasse and Emilson(27) also have shown that regular toothbrushing is partially effective in removing mutans streptococci or decreasing their numbers. Burch et al(28) have found that the mechanical cleaning by toothbrushing is not enough to prevent microbial plaque accumulation and formation of gingivitis in patients with fixed appliances. Lactobacilli number in the saliva is a sign of a cariogenic diet and has a direct response to the sugar in the diet. Krasse and Emilson(27) have reported that decreases of sucrose intake decreases mutans streptococci and lactobacilli numbers in the plaque and saliva. Lactobacilli numbers were high in the three phases of the study because the patients consumed sugar (chocolate, sweets, etc) at and between meals in the beginning and during the study. In fact, absence of statistically significant salivary mutans streptococci and lactobacilli levels between the first, second, and third phases shows that toothbrushing is not enough for oral hygiene, and patients have to watch their diets as well. On the other hand, statistically significant decreases ($p<0.05$) were seen in microbial plaque elimination between the first and second; and first and third phases in the maxillary anterior and posterior teeth; a statistically significant decrease ($p<0.05$) was found for maxillary posterior teeth between the second and third phases, whereas no change was found for maxillary anterior teeth. The bristles of

Advantage toothbrush are long at the tip and do not contact the posterior teeth during toothbrushing and do not clean effectively (Figure 1).

Microbial plaque accumulation decreased ($p<0.05$) in mandibular anterior teeth between the first and second, and first and third phases; but not between the second and third phases. Microbial plaque accumulation decreased ($p<0.01$) in mandibular posterior teeth between the first and second phases and ($p<0.05$) between the second and third phases, while no change was seen between the second and third phases. These results showed that the patients who used the same type of toothbrushes (Oral B Plus 35) in phase 1 and phase 2 adapted well to the study. Mainly the results of the second and third phase show the effectiveness of two different types of toothbrushes in plaque elimination.

Clinical controls of the patients may have motivated them to remove microbial plaque ($p<0.01$) between the first and second, and between the first and third phases when all the teeth were considered. The significant increase in the elimination of microbial plaque between phases 2 and 3 shows that Oral B Plus 35 is more effective, especially in the maxillary posterior teeth.

Some studies are being carried out to make oral hygiene better in patients with fixed orthodontic appliances (26,28,31,32,33). However, the results are conflicting. Williams et al (33) have shown that even though orthodontic patients prefer the Orthodontic toothbrush to the classical toothbrush, there is not any significant clinical difference with respect to microbial plaque accumulation and gingivitis. We had similar results in a previous study (31) where the orthodontic and Plus 35 toothbrushes were compared. Some investigators say that electrical toothbrushes are more effective in removing microbial plaque (28,32), whereas Jackson (30) says they are not. It must be kept in mind that the method and the statistical analysis methods may cause variations in results.

Conclusion

Our results showed that Oral B Plus 35 toothbrush was more effective than Oral B Advantage toothbrush, especially in upper posterior teeth. Only toothbrushing is not sufficient to maintain the oral hygiene of patients with fixed appliances. However, other oral hygiene measures

can be recommended. Mouthwashes can add with toothbrushing, Consumption of sugar and sugar containing products must be limited to increase the effectiveness of anticariogenic measures.

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CORRESPONDING ADDRESS:

Doç.Dr.Hülya KILIÇOĞLU
İ.Ü.Dişhekimliği Fakültesi
Ortodonti Anabilim Dalı
34390 Çapa-İstanbul
Phone: 0212 534 58 89
Fax: 0212 631 91 36