

The effect of different oral hygiene regimens on the quantity of cariogenic plaque on orthodontic bands with different attachments (A clinical photographic study)

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ABSTRACT

Background: Fixed orthodontic appliances impede the maintenance of oral hygiene and result in plaque accumulation leads to enamel demineralization caused by acids produced by bacteria. Studies on plaque control strategies in orthodontic populations are limited. This might be caused by difficulties in the quantitative evaluation of dental plaque because the teeth have various levels of bracket coverage, and different tooth sizes and malocclusions, making the traditional categorical indices complex. The present study aims to evaluate the effect of different hygiene protocols on plaque quantity on bands with different attachments.

Materials and method: Twenty patients had four bands within the orthodontic appliance. Then randomly divided into four groups of hygiene regimens where group A used chlorhexidine dentifrice, group B used fluoridated dentifrice, group C used chlorhexidine mouthwash along with chlorhexidine dentifrice and group D used chlorhexidine mouthwash in addition to the fluoride dentifrice. Bands were removed four weeks after the appliance been in place, cut out carefully into 2 pieces from the center of the mesial and distal contact areas, biochemical test (clinprocario L-pop) was applied then 80 digital photographs were obtained. Four areas of interest were estimated which are mesially and distally to each attachment (2 mm) in width each. Percentage of plaque in these areas was calculated and statistically analyzed.

Results: Side difference revealed that the plaque accumulated on the right sided bands more than the left, however the difference was not significant. It was also found that the lower bands had insignificantly higher amount of plaque than the upper ones.

Conclusions: The four groups of oral hygiene regimens have no significant different effects on the plaque amount. Moreover, the oral hygiene maintenance is more difficult in the right side than the left side but the difference was not significant. The lower arch accumulated insignificantly more plaque than the upper. Also, difference in attachments has no influence on plaque amount.

Keywords: Cariogenic plaque, plaque quantity, clinprocario L-pop, orthodontic bands, oral hygiene. (J Bagh Coll Dentistry 2013; 25(2):143-148).

INTRODUCTION

Orthodontic treatment can improve the self-image of patients through the provision of better esthetics and a more attractive smile. In addition, orthodontics can in principle have long-term health advantages for patients, since crooked and crowded teeth are difficult to clean and maintain. Despite the post therapy health advantages of orthodontics, the treatment regimen itself creates obstacles for patients, because orthodontic brackets create plaque-retentive sites that impede tooth cleaning. Dental plaque is a causative factor for oral disease, and thus its removal and control are important aspects of oral health maintenance^{1,2}. This plaque can lead to enamel demineralization³ and gingivitis⁴. Previous studies have shown that the rate of decalcification in orthodontic patients is higher than in patients without orthodontic treatment. White spots have been reported in as many as 50% of teeth treated with brackets and in up to 50% of orthodontic patients^{5,6}.

Although various studies have evaluated fluoride treatments for their effects in reducing white spot formation associated with orthodontic treatment⁷, surprisingly only a few studies have assessed plaque prevention by antimicrobials^{4,8,9}.

Most of those studies that investigated plaque focused on hygiene aids¹⁰⁻¹². One reason for the limited number of studies of antimicrobial plaque control in orthodontic populations might be due to the lack of qualified, simple, and convenient measurement methods. Most traditional plaque scoring systems applied to unbracketed dentitions, such as the Löe and Silness index,¹³ the Turesky modification of the Quigley and Hein index¹⁴ or the Navy index¹⁵ are difficult to use in orthodontic populations. This is because they are based on a nonlinear (categorical) scale focused on plaque along the gum line; even after modifications, they lack sensitivity when applied to orthodontic populations. Planimetry-based scales would probably be more appropriate for orthodontic patients, whose plaque accumulates in a variety of orientations driven by the presence of appliances.

In recent years, several objective plaque evaluation methods with digital image analysis

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have been developed¹⁶⁻¹⁸. This study was performed to show the different effect of chemical plaque control agents (CHX, F) on plaque amount in orthodontic bands with different attachments.

MATERIALS AND METHODS

The sample

Twenty patients were included in this study; from those who were attending the postgraduate clinic of Orthodontic Department in College of Dentistry/Baghdad University according to their fitness to the following criteria:

- 1) Patients age 18-25 included eleven females and nine males.
- 2) Good general physical health
- 3) The dental requirement for inclusion was a malocclusion in which orthodontic treatment without teeth extraction was needed.
- 4) No history of any systemic disease.
- 5) No history of any oral habit.
- 6) Good oral hygiene
- 7) The presence of well aligned adjacent teeth on both sides of the first permanent molar without spacing, caries or CI II filling.
- 8) The patients had full set of upper and lower dentition excluding the third molars with no congenital missing or any abnormality in the form of dentition.
- 9) The patients should not take any antibiotic during the experimental study.
- 10) Posterior or anterior cross bite should not be included in the sample.
- 11) The participants should be well educated so they can be motivated.

Materials and equipment

- 1) General dental materials and instruments
- 2) Orthodontic material and instruments
- 3) Orthodontic upper and lower 1st molar bands
- 4) Biochemical test kit ClinproCario L-Pop (CCLP)
- 5) Oral hygiene aids
- 6) The Digitizing and Storage Equipment and Programs

Method

Participants were examined clinically, standard orthodontic records were obtained and Oral hygiene status of the patients was determined. Tooth separation for proper seating of orthodontic bands by elastomeric separators was done, three days later fixed appliance was placed and the patients were randomly divided into four groups of hygiene regimens where group A used chlorhexidine dentifrice, group B used fluoridated dentifrice, group C used chlorhexidine

mouthwash along with chlorhexidine dentifrice and group D used chlorhexidine mouthwash in addition to the flouride dentifrice.

The patients received special oral hygiene instructions included a detailed brushing protocol with a demonstration of the Bass brushing technique. They were told to brush 3 times a day for 2 minutes, using an amount of dentifrice that covers the entire head of the toothbrush; and to brush their teeth after snacks using the brush only. They were also asked not to use other oral hygiene products the next four weeks. The patients were checked two weeks later for their oral hygiene in terms of gingival index, and they were instructed to continue perform their hygiene regimens.

After four weeks the experimental bands were removed and replaced by new ones. Immediately following careful removal from patients' mouths through grasping the band from the attachment by the band remover pliers, the bands were cut out from the middle of the mesial and distal contact areas with metal scissors into two pieces then each piece was flattened out by grasping it from the free ends using Adams pliers and pulled out, any contact with areas of interest were avoided. Furthermore, this procedure took place in an antiseptic environment. The two pieces of the band were placed in a petri dish. The biofilm was stained with a biochemical test for lactic acid (ClinproCario L-Pop; 3M ESPE, Seefeld, Germany) Figure 1. Using this method, the biofilm was identified according to bacteria that produce lactic acid as a key metabolic factor, these being bacteria with a highly cariogenic potential. The bands were positioned on a millimeter paper, waiting for two minutes and photographed. The four areas of interest, each 2 mm in width, were defined and digitally marked with the cursor on each band: the mesial and distal regions of the buccal and lingual attachment. The software calculated the surface area of each marked area. The stained biofilm area was then marked within the four areas using a cursor and the area covered, and calculated by the software again. A ratio was computed from the calculated results, which revealed the quantity of biofilm in the specific areas of interest. (figure2)

RESULTS

The mean values of plaque ratios and standard deviation with different attachments on orthodontic bands in patients following different oral hygiene regimens were estimated in (table 1). The differences among the four groups of oral hygiene were not significant. Side difference in

means of plaque amount on the upper bands from the buccal aspect revealed that the means on the right side were higher than those on the left side in all groups of oral hygiene regimens except for group D where the mean on the right side was lower than that on the left distal to the attachment, although the differences were not significant, lingually button and the cleat on the right and left bands respectively revealed insignificant difference in all groups of hygiene protocols.

On the lower bands buccally, the difference between double tubes on the right and left sides was higher on the right side than the left side in all of four groups, it was significant in 100% of the sample in group A, while 50% of the sample was significant in group B. while plaque amount on the lingual button were insignificantly higher than the lingual cleat.

Regarding arch differences on the right side, the plaque amount on the lower tripple tubes is insignificantly higher than that on the upper double tubes in all groups of hygiene regimens; this is also true for the lingual cleats. The double versus tripple tubes on the left side reveals insignificantly higher amount of plaque on the lower arch. In addition, lingual buttons also accumulated higher amount of plaque on the lower than the upper.

DISCUSSION

Studies on plaque control strategies in orthodontic populations are limited. This might be caused by difficulties in the quantitative evaluation of dental plaque because the teeth have various levels of bracket coverage, and different tooth sizes and malocclusions, making the traditional categorical indices complex. The other approach is measurement of the percentage area covered by plaque using digital image analysis of photographs¹⁹. Digital photographs of disclosed teeth greatly facilitate such analysis. Direct digital measurement of percentage plaque coverage is more complex but is likely to prove more valid and more reproducible than categorical indices. The advantages of a photograph are that it can be assessed at leisure, is a permanent record, and can be viewed on multiple occasions, enabling assessment of reproducibility, which was found to be excellent.

It should be noted that area measurement is not completely immune from an element of subjective judgment and other potential sources of error. These potential errors are probably small in relation to those associated with visual estimation for a categorical index, but they are nevertheless a

factor. In addition, Digital measurement requires longer time and greater technical complexity.

The results of the present study revealed that all the chemical plaque control agents used were of no significant different effect. Furthermore, the use of CHX mouth wash as an adjunct to the CHX or fluoridated tooth pastes had no significant additive influence on the quantity of plaque. This is in agreement with other study which investigated the influence of 0.12% and 0.2% chlorhexidine gluconate on both dental plaque accumulation and salivary *S. mutans* and showed that there is no significant difference between them²⁰. Previous study investigated the effect of 40% chlorhexidine varnish during a 30-month period. They also found that 40% chlorhexidine varnish did not decrease the number of cariogenic bacteria²¹.

In contrast to this study, some previous studies suggested that higher concentrations of antimicrobial agents and multiple treatments extend the time of effectiveness against *S. mutans* and dental plaque²².

Investigation of varnishes with high concentrations of chlorhexidine (40% chlorhexidine) revealed a significantly stronger reduction of *S. mutans* in plaque and saliva compared to low-concentration varnish during a 2-week period which does not agree with this study²³.

The germicidal effect of fluoride on cariogenic bacteria (such as *S. mutans* and lactobacilli) is the inhibition of glycolysis. In addition, fluoride acidifies the interior of cells and inactivates some enzymatic metabolic processes²⁴.

The use of fluoridated tooth paste in combination with CHX mouthwash in this study had no significant effect on the quantity of cariogenic plaque, this finding goes along with the result of other study²⁵ which evaluated the effect of 0.3 % triclosan toothpaste with and without fluoride on enamel demineralization and found that in combination with fluoride, triclosan has no additional protective effect against demineralization. Fluoride did not increase the efficacy of the toothpastes, probably because a possible antimicrobial effect was not complementary or additive to the effect of other antimicrobial compounds of the toothpaste or mouth wash.

Contrary to this study, AhumadoOstenga²⁵ showed that the effects of sodium fluoride (NaF) and chlorhexidine mouth rinse increase with different concentrations depending on the species of lactobacilli. Furthermore, Juric²⁶ disagree with this study when

observed that professional tooth-cleaning and the usage of chewing gum with xylitol and fluoride on a daily basis could be helpful in reducing cariogenic bacteria. This finding is in contrast to the result of Gorelick⁴ when the incidence of white spot formation was measured on banded or bonded teeth in a clinical setting. The lowest incidence was found to be in the lingual surfaces of lower canines, and the highest on labial areas of maxillary incisors. Moreover, this study showed that the right side has higher amount of plaque than the left side, although the difference is not significant. It appeared that the plaque accumulated on the right side more than the left side, which is not uncommon finding that the right side has a higher prevalence of white spot lesions following orthodontic treatment than the left as shown by Gorelick⁴.

According to the results of the present study, the plaque amount was insignificantly higher on the lower arch. The presence of undercuts and tongue interference with performing proper cleansing in the lower arch may probably result in this difference. Also the lower teeth are more exposed to the salivary flow which contains calcium and other minerals and carry the biopolymers which are essential for early pellicle formation and food shedding during mastication, facilitating microbial attachment.

This would also agree with other studies^{27,28} that have found a higher amount of plaque on the right side of right-handed tooth brushers than on the left. The difficulty encountered during brushing on the right side may attribute to plaque accumulation on it. Most of the participants in this study were right handed.

Consequently, it would be ideal to recommend chlorhexidine as a dentifrice, thus combining mechanical cleaning and antiplaque benefit with no added discomfort for patients.

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Table 1: Means, standard deviations and standard errors of the plaque amount ratio with different attachments in different oral hygiene groups.

Groups			Descriptive Statistics										Group differences			
			CHX dentifrice			Fluoridated dentifrice			CHX dentifrice+CHX mw			Fluoridated dentifrice+ CHX mw				
Variables			Mean	S.D.	S.E.	Mean	S.D.	S.E.	Mean	S.D.	S.E.	Mean	S.D.	S.E.	KKW	p-value
Upper right	B	M	29.49	8.70	3.89	35.55	9.02	4.04	30.37	8.89	3.98	28.63	8.55	3.82	1.98	0.575 (NS)
		D	37.56	13.65	6.11	29.16	3.89	1.74	31.09	11.94	5.34	27.16	6.87	3.07	1.90	0.592 (NS)
	L	M	28.46	9.60	4.29	24.97	3.49	1.56	24.51	7.02	3.14	26.44	7.39	3.30	0.60	0.894 (NS)
		D	30.99	10.02	4.48	35.10	9.87	4.41	34.56	15.77	7.05	27.22	11.84	5.30	1.69	0.638 (NS)
Upper left	B	M	28.05	0.85	0.38	25.87	5.80	2.59	25.48	6.34	2.84	25.73	5.64	2.52	2.06	0.559 (NS)
		D	20.67	4.31	1.93	22.70	7.47	3.34	29.15	3.39	1.52	28.47	6.66	2.98	7.06	0.070 (NS)
	L	M	26.17	10.91	4.88	33.18	4.42	1.97	30.40	8.72	3.90	26.41	8.88	3.97	2.10	0.552 (NS)
		D	20.00	10.04	4.49	33.50	12.93	5.78	31.11	14.86	6.64	33.69	14.29	6.39	2.58	0.459 (NS)
Lower right	B	M	43.50	9.92	4.44	34.53	4.40	1.97	33.42	5.28	2.36	31.84	4.68	2.09	6.49	0.090 (NS)
		D	34.86	10.22	4.57	37.80	5.37	2.40	30.93	5.82	2.60	35.97	5.86	2.62	3.36	0.339 (NS)
	L	M	30.94	5.57	2.49	31.87	5.70	2.55	31.82	6.85	3.06	33.34	6.97	3.12	0.78	0.854 (NS)
		D	36.48	12.30	5.50	36.96	4.33	1.94	31.43	4.93	2.21	36.42	4.71	2.11	3.22	0.358 (NS)
Lower left	B	M	38.39	11.21	5.01	24.51	8.82	3.94	27.61	3.22	1.44	29.07	9.10	4.07	5.72	0.126 (NS)
		D	30.63	7.88	3.53	25.75	8.44	3.77	28.70	8.22	3.68	30.92	6.21	2.78	1.74	0.627 (NS)
	L	M	32.00	7.91	3.54	26.28	5.39	2.41	26.56	5.70	2.55	26.30	6.04	2.70	2.65	0.448 (NS)
		D	28.76	5.63	2.52	35.32	8.77	3.92	32.36	7.82	3.50	34.61	6.47	2.89	3.79	0.285 (NS)

NS = P>0.05



Figure 1: Biochemical test kit ClinproCario L-Pop (CCLP)
 (1) CCLP swab containing sucrose (2) Color indicator (3) L-Pop blisters that contains lactate dehydrogenase enzyme (4)Control swabs.

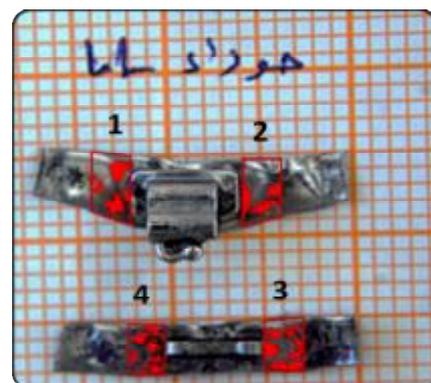


Figure 2: orthodontic band with the four areas of interest
 (1) mesial of the attachment (2) distal of the attachment (3) mesial of the attachment (4) distal of the attachment

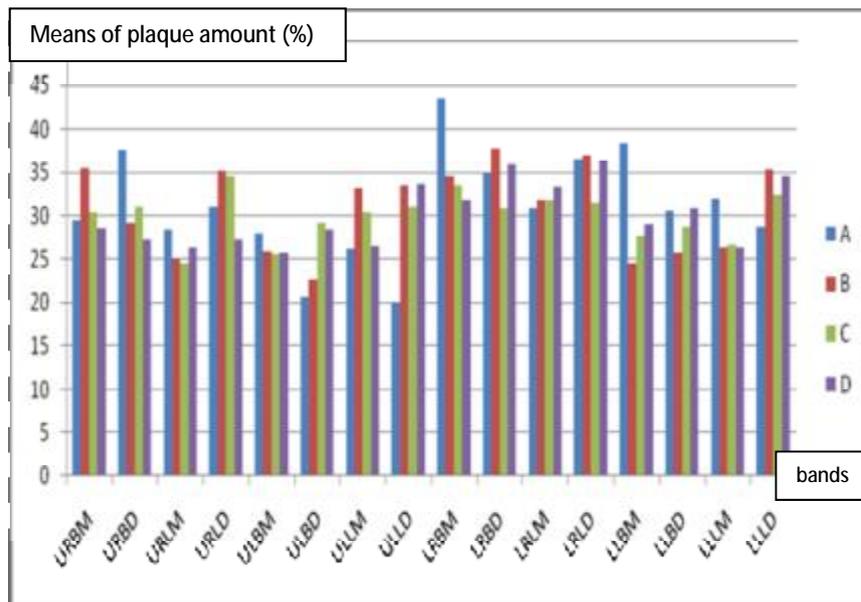


Figure 3: Plaque amount with different attachments in different oral hygiene groups.