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Plaque Index in Multi-Bracket Fixed Appliances

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ABSTRACT

Objective: To compare the plaque index in patients receiving multi-bracket fixed orthodontic treatment for various factors like age, gender, socio-economic status, brushing practices, meal habits, types of brackets, types of ligations, use of mouthwash and duration of treatment.

Study Design: Cross-sectional analytical study.

Place and Duration of Study: Orthodontics Clinic, The Aga Khan University Hospital, from September to November 2011.

Methodology: Socio-demographic and clinical modalities were defined and recorded for 131 patients having multi-bracket fixed appliances. The plaque index of subjects were recorded according to the Silness and Loe plaque index method. Independent sample t-test was used to see difference in plaque index in factors having two variables. One way ANOVA and Post-Hoc Tukey tests were used to see difference in plaque index in factors having three variables. Kappa statistics was used to assess inter examiner reliability. P-value of ≤ 0.05 was taken to be significant.

Results: The sample comprised of 37% males (n = 48) and 63% females (n = 83). The plaque index had statistically significant association with practice of brushing i.e., timing of brushing (p=0.001), method of brushing (p=0.08), type of ligatures (p=0.05) and frequency of visits (p=0.01).

Conclusion: The plaque accumulation is significantly decreased in subjects who brush the teeth twice or more than twice a day and those who brush their teeth after breakfast. The use of interdental brush and stainless steel ligatures had significantly low plaque. Subjects presenting with more frequent appointments of short-period had significantly less plaque.

Key Words: Plaque index. Fixed appliances. Oral hygiene. Multi-brackets.

INTRODUCTION

Maintenance of good oral hygiene is extremely important during the fixed appliance orthodontic treatment. However, this necessity is challenged by the multi-bracket fixed appliances that are required for the correction of orthodontic malocclusion. The complex dimension of these brackets potentiates the accumulation of dental plaque around them.[1] Various oral hygiene maintenance practices have been suggested to affect the cleaning ability of the patients. This includes the demonstration of the brushing technique around and between the brackets, various designs of brushes such as the interdental and electric brushes, the use of mouth washes and super floss. Despite of these oral hygiene maintenance instructions, the clinical experience as well as literature[2,3] has shown the accumulation of dental plaque on the teeth. The dental plaque thus accumulated harbor a diverse microflora which produces toxic products and acids. As a result, the tooth structure and the supporting structures are jeopardized whereas the hazards can range from simple gingivitis and white spot lesions to severe interdental bone loss and carious cavitations. It has been estimated that some 60% of dental infections, including gingivitis, white spot lesions, dental caries and periodontal disease are due to microbial biofilms.[4]

In addition to the inefficient brushing practices, there are other factors that can affect the plaque accumulation. Some of these factors are related to the clinical practices such as the type of brackets, type of ligation, duration of orthodontic treatment and frequency of patient appointments.[5-12] The others are related to the patient socio-demographic factors like eating habits, age, gender and Socio-economic Status (SES). The ceramic brackets are shown to accumulate more plaque due to their large size and surface wettability as compared to the metallic brackets.[5] The elastomeric modules used to hold the wire in the bracket slot have shown to be associated with increased plaque accumulation and bacterial retention.[6,7] Age of the patient can also affect the plaque accumulation, whereas research shows that adolescent are more prone to plaque accumulation.[8,9] The use of interdental brush, mouthwash and frequent brushing at least twice daily help to reduce the plaque significantly.[10-12]

As there are number of factors that can influence the plaque accumulation around the brackets, therefore, it is rational to know all those factors that can help in reducing the plaque and those which are associated with increased plaque retention. The incorporation of these factors in orthodontic clinical practice and patient education will help to avoid the hazards of dental plaque. Therefore, the objective of this study was to compare the

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plaque index in patients receiving multi-bracket fixed orthodontic treatment for various factors like age, gender, socio-economic status, brushing practices, meal habits, types of brackets, types of ligations, use of mouthwash and duration of treatment.

METHODOLOGY

This was a cross-sectional analytical study carried out at Orthodontics Clinics, The Aga Khan University Hospital, Karachi, from September to November 2011. After the proposed study was approved by institutional review board, a total of 131 subjects for the sample were recruited based on convenient sampling from the patients who came for orthodontic treatment. The inclusion criteria were intact set of teeth and treatment with multi-bracket fixed appliance for at least one month of wear. The subjects who had restored teeth, smoking habit, mentally handicapped or having craniofacial syndromes and anomalies were excluded. Informed consent of the patients was taken before recruitment in the study.

Plaque Index (PI) for each subject was recorded according to the Silness and Loe plaque index method.[18] Six teeth, three from maxilla (12, 14, 26) and three from mandible (32, 34, 46), were used to record the plaque index for the subjects. Plaque accumulation was graded as 0 = no plaque, 1 = mild plaque that is only disclosed with dental probe, 2 = moderate plaque around the gingival margin that can be seen with naked eye and 4 = abundance of soft debris around the gingival margin and brackets. The plaque on each of the 6 teeth was graded then summed up and divided by six to obtain the plaque index for the subject. To rule out measurement errors, 20 subjects were randomly selected and the plaque index was recorded by another investigator at the same visit after the principle investigator has recorded.

The other socio-demographic and clinical practice variables like age, gender, meal habits, socio-economic status, brushing practice, brushing timings, brushing type, use of mouthwash, scaling of teeth, type of brackets, type of ligation, frequency of visits and duration of treatment were also recorded for study subjects.

The data were checked for normality and simple summary statistics were generated. Independent sample t-test was applied to determine the difference in plaque index in factors having two variables such as gender, timing of brushing, use of mouthwash, type of brackets, type of ligation and meal habits. One way ANOVA was applied for the difference in plaque index among the factors having three variables such as age, socio-economic status, duration of treatment and frequency of brushing. Post-Hoc Tukey test was applied to further determine the statistically significant difference shown by one way ANOVA. Kappa statistics were used to assess the inter examiner reliability.

RESULTS

The total sample size of 131 subjects comprised of 37% males (n = 48) and 63% females (n = 83). The mean PI of the male subjects was 1.52 ± 0.61 and that of female was 1.38 ± 0.54. Table I shows the difference in the plaque for the factors like gender, timing of brushing, method of brushing, use of mouthwash, scaling of teeth, eating habits, type of brackets, type of ligation and frequency of visits. A statistically significant difference in plaque was seen with timing of brushing (p = 0.001), method of brushing (p = 0.03) and frequency of visits (p = 0.01). The plaque index was significantly lower in subjects who brushed the teeth after breakfast. The subjects who used inter dental brush in addition to the normal brush had lower plaque index. The wire ligatures showed less plaque index than the elastomeric modules. The subjects who visited the orthodontics clinic within 3 weeks have decreased values of plaque index as compared to those subjects with appointment gap of ≥ 4 weeks. The factors like gender, use of mouthwash, type of brackets, eating habits and scaling of teeth showed no statistically significant difference in plaque index between the groups.

Table II show the difference in PI in factors having three variables. The results showed no statistically significant

Table I: Comparison of plaque index in factors having two variables such as gender, timing of brushing, method of brushing, use of mouthwash, scaling of teeth, eating habits, type of brackets, type of ligation and frequency of visits.

Variable	Number of subjects (N)	Plaque index Mean ± SD	p-value
Gender			
Males	48	1.52 ± 0.61	0.18
Females	83	1.38 ± 0.54	
Timing of brushing			
Before breakfast	81	1.57 ± 0.54	0.001*
After breakfast	50	1.22 ± 0.56	
Method of brushing			
Normal brushing	92	1.50 ± 0.57	0.03*
Normal + interdental	39	1.27 ± 0.54	
Use of mouthwash			
Yes	31	1.29 ± 0.51	0.104
No	100	1.48 ± 0.58	
Scaling of teeth			
Yes	17	1.24 ± 0.44	0.13
No	114	1.46 ± 0.58	
Eating habits			
≤ 3 times per day	30	1.33 ± 0.49	0.26
≥ 4 times per day	101	1.46 ± 0.59	
Type of brackets			
Metallic	97	1.44 ± 0.59	0.72
Ceramic	34	1.40 ± 0.52	
Type of ligation			
SS wire	13	1.15 ± 0.58	0.05
Elastic	118	1.46 ± 0.56	
Frequency of visits			
≤ 3 weeks	48	1.28 ± 0.56	0.01*
≥ 4 weeks	83	1.52 ± 0.56	

N = 131; Independent sample t-test; Level of significance ≤ 0.05*

Table II: Comparison of plaque index in factors having three variables such as age, socio-economic status, duration of treatment and practice of brushing.

Variable	Number of subjects (N)	Plaque index Mean ± SD	p-value
Age			
10 - 14 years	64	1.46 ± 0.63	0.08
15 - 20 years	41	1.53 ± 0.49	
≥ 21 years	26	1.21 ± 0.50	
Socio-economic status			
Lower class	15	1.48 ± 0.49	0.55
Middle class	67	1.38 ± 0.58	
Upper Class	49	1.49 ± 0.58	
Duration of treatment			
1 - 12 months	33	1.37 ± 0.62	0.62
13 - 24 months	60	1.48 ± 0.55	
> 25 months	38	1.41 ± 0.56	
Practice of brushing			
Once per day	38	1.71 ± 0.53	0.002*
Twice per day	76	1.33 ± 0.56	
> twice per day	17	1.27 ± 0.54	

N = 131;   One way ANOVA;   Level of significance ≤ 0.05*

difference in plaque index for the factors like age, socio-economic status and duration of the treatment. However, a statistically significant difference in plaque index was seen for the practice of brushing (p = 0.002). This finding was further analyzed by Post-Hoc Tukey test and the results showed that the subjects who brush their teeth twice or more than twice a day have significantly less plaque compared to those who brush the teeth once a day (p = 0.001 and p = 0.002 respectively). The plaque index score were agreed on 71.4% of the first and second examinations, giving a Kappa value of 0.69 indicative of good agreement.

DISCUSSION

The accumulation of dental plaque around the fixed appliance and oral hygiene maintenance has been the main focus of concern for the researchers. In the present study, it was attempted to address the factors which can affect the plaque around the fixed appliances. The results of this study showed significant difference in PI for the factors such as timing of brushing, type of brushing, frequency of brushing, type of ligation and frequency of visits. The other factors like age, gender, SES, meal habits, use of mouthwash, type of brackets, scaling of teeth and duration of treatment were statistically insignificant.

A number of researchers have worked on various socio-demographic and clinical factors to find out their relation to the plaque accumulation. Some studies have found that the adolescent exhibit higher level of plaque as compared to the adults.[8,17] If the age factor has any relation with the plaque accumulation, then similar oral hygiene instructions to all age groups may not be very effective. In this study, the difference in plaque accumu-lation among different age groups were compared and found to be statistically insignificant although, all the three groups had moderate levels of plaque. Male subjects in the study showed more plaque levels as compared to females, however, the difference was statistically insignificant. These findings were in accordance with results of study carried out by Grazyna and Joanna who also showed a higher but insignificant plaque levels for the male subjects.[13] The socio-economic status of the subjects was statistically insignificant regarding the difference in PI in this study. Similar findings were also reported by another study for the SES.[14]

The subjects, after putting the fixed appliances, are instructed about the type, timing and frequency of brushing in order to maintain optimal oral hygiene. The usual instructions are for the brushing of teeth at least twice daily before going to bed and after the breakfast. The use of interdental brush to clean between the brackets is also prescribed. In this study, a significant decrease of plaque levels was found in subjects who brush the teeth twice or more than twice daily as compared to those who brush once per day. Further-more, the subjects who used the interdental brush in addition to the normal brush have reduced plaque levels when compared to the subjects who only used the normal brushing for cleaning their teeth. Similar findings were also shown by Ariane *et al*. in their study for the use of interdental brush.[9] The brushing timing was also important, as the subjects who brushed their teeth after the breakfast have significantly reduced the levels of plaque than the subjects who exercised brushing before the breakfast in a study the use of mouthwash, have been shown to reduce the level of plaque and gingivitis.[15] However, in this study, we found no significant difference in PI for the use of mouthwash. Although, it should be noted that the levels of plaque were reduced in subjects who were using the mouthwash.

The clinical practices like frequency of visits were shown in this study to be statistically significant while the type of ligation was marginally significant. The subjects in whom stainless steel ligatures were used for ligation showed a reduced level of plaque as compared to the elastomeric ligatures. It should be noted, however, that in practice, elastomeric materials are used for ligation and the stainless steel ligature are only used for the anchorage/ holding purpose for some duration of treatment (at least three months). Therefore, the number of subjects were much less in wire ligature group (n = 17) as compared to elastomeric ligature group (n = 114). Similarly, other studies have also shown that the elastomeric ligature are more prone to retention of the plaque and microbes.[6,7] In present study, subjects who were appointed within 3 weeks of interval between their visits had significantly less plaque than those in whom the interval between visits was four or more weeks. In

another study, the authors reported that the subjects who were more punctual in the appointments had 3 times higher odds to comply with better oral hygiene as compared to those who had missed appointment and long duration of gap between the appointments.[11]

The stainless steel brackets have shown for their greater affinity for salivary proteins and microbes.[20,21] The ceramic brackets have been shown in studies to accumulate more plaque as compared to the metallic brackets.[5,19] However, in this study there was no significant difference in PI between the two type of brackets. A more recent and controlled study have shown a significantly lower amount of biofilm on ceramic brackets than on stainless steel brackets.[15] This may be due to the fact that the subjects with ceramic brackets are more conscious about the esthetics and oral hygiene. In clinical practice, the decision of bracket selection is more dependent on the basis of oral hygiene maintenance rather than the type of brackets. Duration of treatment in our study was also insignificant in relation to the amount of plaque. This means that if the brushing practices are exercised precisely and regularly, then the amount of plaque can be kept at minimum no matter how long the duration of treatment extends. Furthermore, it has been shown in a study by Glans *et al*. that brushing dexterity improves with duration of the treatment.[16] Although it should be kept in the mind that loss of interest and compliance are associated with long duration of orthodontic treatment.

From the discussion above, it seems that the maintenance of good oral hygiene during fixed orthodontic treatment is more dependent of the brushing practices and less on the clinical practices. The subjects who comply with the use of normal and interdental brushing, the timing of brushing and frequency of brushing is less prone to plaque accumulation. The subjects with missed appointments show less interest and compliance, therefore, the oral hygiene must be improved with extra measures like professional cleaning, electric brushes and super flossing. The elastomeric module accumulate more plaque, must be used with caution in patients with poor oral hygiene as shown in this and other studies[6,7]. Therefore, patients education on oral hygiene maintenance must be a part of the orthodontic treatment. For these reasons, proper methods of instructions in the form of verbal, brochures and video tapes must be devised and incorporated in clinical practice.

CONCLUSION

The plaque accumulation was significantly less in subjects who brushed their teeth twice or more than twice-a-day. The subjects who brushed the teeth after the breakfast and used interdental brush had low levels of plaque. The subjects presenting with short gaps between appointments had significantly less plaque. There was more plaque accumulation by elastomeric ligatures than stainless steel ligatures. There was no significant difference in plaque accumulation for the variable like age, gender, socio-economic status, scaling, eating habits, use of mouthwash, type of brackets and duration of treatment.

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