

Biofilm formation on polytetrafluoroethylene coated versus uncoated brackets in a South Indian population

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Abstract

Objective: This study compared the biofilm formation pattern on Polytetrafluoroethylene (PTFE) coated orthodontic brackets with that of uncoated ones. **Methods:** Fifteen teen aged patients were enrolled for eight weeks with their second premolar symmetrically bonded with uncoated and PTFE-coated orthodontic brackets. Upon completion, the elastomeric ligatures were deboned and removed. Rutherford backscattering detection (RBSD) method was adopted and the RBSD photographs were validated. **Results:** Analysis showed a total surface area of 21.7 ± 0.7 mm² per bracket. The biofilm formation was noticed in 4.0 ± 3.6 % (0.9 ± 0.8 mm²) of the bracket surface in case of PTFE-coated brackets versus 22.2 ± 5.4 per cent (4.8 ± 1.2 mm²) on uncoated brackets and in case of PTFE-coated brackets highest amount of biofilm formation was evident in 'mesial surfaces' (6.58 ± 4.4 %) and the lowest on the occlusal surfaces (1.29 ± 1.2 %). The comparisons of the 2 interventions/procedures showed significant differences in all the 5 views ($p=0.001$ for all). **Conclusion:** The research findings suggest that coating the brackets with PTFE reduces biofilm adhesion to a larger extent and minimizes iatrogenic side effects.

Key words: Biofilm formation, Polytetrafluoroethylene coating, Orthodontic brackets, RBSD photographs.

INTRODUCTION

It is well known that fixed orthodontic therapy is an efficient in terms of its result and treatment duration. However, it doo have some limitations. The major limitations of fixed orthodontic therapy are the huge plaque-retetaining areas and difficult to remove mechanically after bonding the brackets to teeth.^[1,2] In general, the influence of the bracket material is known to enhance intraoral biofilm accumulation and their surface properties.^[3] The common measures to overcome these limitations are frequent scaling, application of fluorides topically, prescription of antimicrobial rinses, and the usage of antibacterial monomer-containing adhesive.^[4,5] Enamel sealants are also used minimize enamel demineralization.^[6] All these procedures are advocated for minimizing or eliminating the biofilm formation and enhancing the resistance of hard tissues against bacterial metabolic waste products.^[7]

Polytetrafluoroethylene (PTFE) polymer possesses inherent non-stick properties mainly because of its low surface energy and the minimum friction coefficient. There



has been a similar study in that investigated whether a PTFE coating reduces biofilm formation on orthodontic brackets^[7] and studies are lacking among in Indian population. The rationale behind this study was to know the response to resistance to form a biofilm on PTFE coated brackets among Indian population belongs to coastal Tamil Nadu region of India, because majority patients are from rural regions, and are having compromised oral hygiene practices. Patients selected for this study were instructed to maintain good oral hygiene practice. The methodology of this study was similar to the previous study conducted in Europe^[2] and aimed at comparing the resistance for biofilm formation on PTFE coated dental bracket that are bonded to premolar, with the pattern of biofilm formation on uncoated dental brackets.

MATERIALS AND METHODS

Fifteen teen aged patients receiving orthodontic treatment were enrolled and studied for eight weeks in a South Indian Dental teaching hospital. Among these 15 subjects, each second premolar was symmetrically bonded with an uncoated bracket and a PTFE-coated. The brackets used in this study belong to 3 M Unitek, Gemini series. Upon completion of 8 weeks, the elastomeric ligatures were deboned and removed using standard procedures with the help of debonding orthodontic pliers and arch wire. The brackets were rinsed in water and dried with dry air. In order to quantitatively study the biofilm formation, Rutherford backscattering detection (RBSD) method was adopted thus yielding five RBSD photomicrographs positioned at identical views from mesial, distal, occlusal, cervical, and buccal origins. These RBSD photographs were validated using Scanning Electron Microscopy (SEM) in high magnification. Statistical analysis was carried out using paired t-test (at a significance of $\alpha = 0.05$).

RESULTS AND DISCUSSION

The 150 photomicrographs obtained during the procedures of 15 subjects were analyzed as per the study objectives. The analysis included a total surface area of $21.7 \pm 0.7 \text{ mm}^2$ per bracket. The biofilm formation was noticed in $4.0 \pm 3.6 \%$ ($0.9 \pm 0.8 \text{ mm}^2$) of the bracket surface in case of PTFE-coated brackets versus $22.2 \pm 5.4 \text{ per cent}$ ($4.8 \pm 1.2 \text{ mm}^2$) on uncoated brackets (Table 1). Moreover, in case of PTFE-coated brackets highest amount of biofilm formation was evident in ‘mesial surfaces’ ($6.58 \pm 4.4 \text{ per cent}$) and the lowest on the occlusal surfaces ($1.29 \pm 1.2 \text{ per cent}$) (Figure 1 and Figure 2). The comparisons of the 2 interventions/ procedures showed significant differences in all the 5 views

($p=0.001$ for all).

A significant reduction in bio film formation was noted on the entire surface of PTFE-coated brackets. The research findings suggest that coating the brackets with PTFE reduces biofilm adhesion to a larger extent and reduces iatrogenic side effects. Similarly, uncoated orthodontic showed a high susceptibility to biofilm formation that could potentially lead to damage of oral hard and soft tissues.

The present study was carried out in a particular region and in particular age group individuals. In the current scenario,

Table 1: Comparison of biofilm formation on polytetrafluoroethylene coated and uncoated brackets

Groups		Mean (+SD)	p value	t value
Buccal (n=15)	Uncoated	17.45 (0.28)	0.001*	160.24
	PTFE	2.45 (0.29)		
Occlusal (n=15)	Uncoated	15.92 (0.44)	0.001*	99.816
	PTFE	1.29 (0.46)		
Cervical (n=15)	Uncoated	21.36 (0.38)	0.001*	151.338
	PTFE	6.14 (0.21)		
Mesial (n=15)	Uncoated	28.36 (0.37)	0.001*	190.826
	PTFE	6.58 (0.28)		
Distal (n=15)	Uncoated	29.11 (0.49)	0.001*	177.332
	PTFE	3.57 (0.28)		

Note: Results are significant at $\alpha=0.05$; tests were done using paired t-test

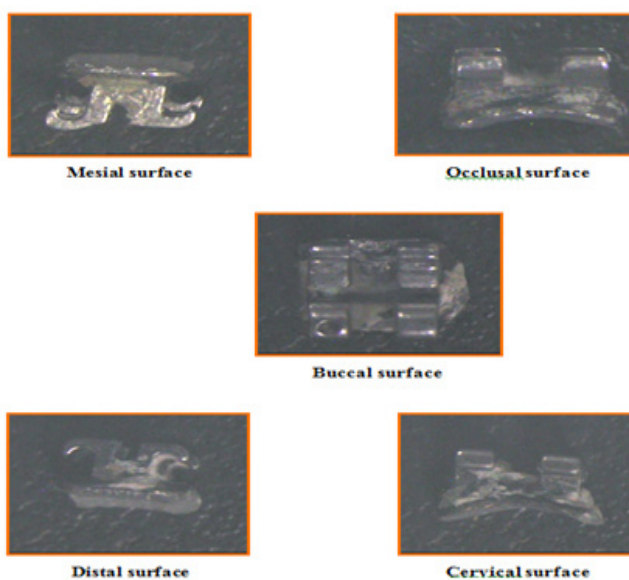


Figure 1: Photomicrographs of biofilm formation on uncoated bracket.

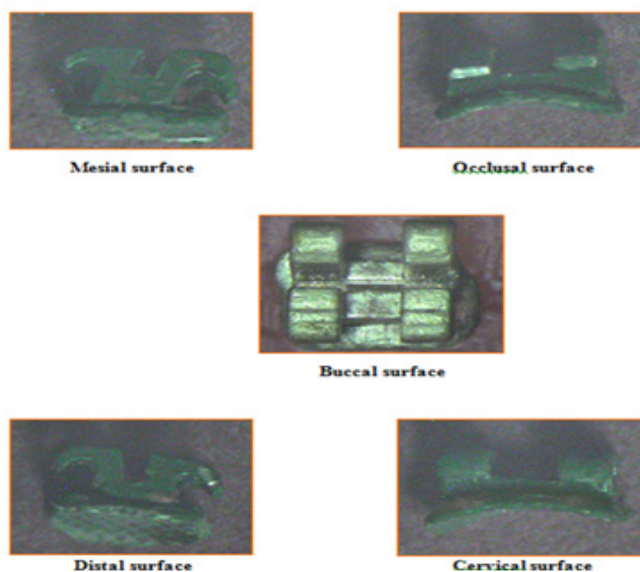


Figure 2: Photomicrographs of biofilm formation on PTFE coated bracket.

patients belonging to all age seek orthodontic therapy and also due to various changes in the oral environment in different age groups and regions around the world the extent of biofilm formation vary. Hence, further studies are required in all age groups to standardize the coated brackets against formation of biofilm which aid in prevention of enamel decalcification. It is recommended that coated brackets could be beneficial in minimizing biofilm formation thereby reducing enamel decalcification but at the same time abrasion resistant material coating is recommended for long-term stability in fixed orthodontic treatment.

CONCLUSION

The findings of the study compared biofilm formation pairwise in relation to respect to the location (buccal,

mesial, distal, cervical, and occlusal). The study findings also showed a lesser extent of biofilm formation on PTFE coated brackets which was similar to previous study². The findings thus proves a correlation between PTFE coating and biofilm adhesion and suggest a potential role in reducing decalcification normally seen with fixed orthodontic appliance therapy.

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None

CONFLICT OF INTEREST

None

REFERENCES

1. Naranjo AA, Trivino ML, Jaramillo A, Betancourth M, Botero JE. Changes in the subgingival microbiota and periodontal parameters before and 3 months after bracket placement. *Am J Orthod Dentofacial Orthop.* 2006;130(3):275:e17-22.
2. Demling A, Elter C, Heidenblut T, Bach FW, Hahn A, Schwestka-Polly R, *et al.* Reduction of biofilm on orthodontic brackets with the use of a polytetrafluoroethylene coating. *Eur J Orthod.* 2010;32(4):414-8.
3. Boyd R L. Longitudinal evaluation of a system for self-monitoring plaque control effectiveness in orthodontic patients. *J Clin Periodontol* 1983; 10: 380-388.
4. Fournier A, Payant L, Bouclin R. Adherence of *Streptococcus mutans* to orthodontic brackets. *Am J Orthod Dentofacial Orthop.* 1998;114(4):414-7.
5. Shafi I. Fluoride varnish reduces white spot lesions during orthodontic treatment. *Evid Based Dent.* 2008;9(3):81.
6. Tufekci E, Casagrande ZA, Lindauer SJ, Fowler CE, Williams KT. Effectiveness of an essential oil mouthrinse in improving oral health in orthodontic patients. *Angle Orthod.* 2008;78(2):294-8.
7. Buren JL, Staley RN, Wefel J, Qian F. Inhibition of enamel demineralization by an enamel sealant, Pro Seal: an in-vitro study. *Am J Orthod Dentofacial Orthop.* 2008;133(4):88-94.

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