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Molar bands Vs bonds: Does bonding cements have role in microbial colonization

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Abstract: *Introduction:* Dental plaque is organized in a biofilm complex that provides protection and nutrients for periodontopathic and cariogenic bacteria. Several factors can affect microbial colonization, including restorations, orthodontic brackets and bands. *Aims and Objectives:* The aim of this study was to investigate changes in subgingival cariogenic microbiota before and one month after the placement of orthodontic bands and bondable molar tubes using four different bonding materials. *Materials and Methods:* Thirty patients undergoing orthodontic treatment of age group between 12 to 25 years, were randomly selected from post graduate clinic. All first molars were banded or bonded randomly quadrant wise, using four different materials (fluoride releasing and non-fluoride releasing adhesives, chemically cured and light cured GIC). Subgingival microbial samples were taken from mesio-proximal site of the selected teeth before and one month after the placement of bands and bondable molar tubes. The samples were then inoculated on selective culture media to evaluate for Streptococcus mutans and Lactobacilli. Colonies of Streptococcus mutans and Lactobacilli were counted under digital colony counter. *Results:* Increased colonization of Streptococcus mutans and Lactobacilli were seen around molar bands as compared to bonding on molars, irrespective of the material being used for banding and bonding ($P < 0.05$). *Conclusions:* Bacterial colonization around molar bands was significantly higher compared to molar bonding, irrespective of the material being used for banding and bonding. Hence, molar bonding may be a better option as against molar banding to reduce the risk of caries and gingival diseases around the orthodontic appliances. Use of fluoride releasing and non-fluoride releasing adhesives, chemically cured and light cured GIC does not make any difference in the bacterial colonization.

Keywords: Lactobacilli, Molar bands, Molar bondable tubes, Streptococcus mutans

Introduction

Development of carious lesions during fixed orthodontic appliance therapy is an extremely rapid process. Dental caries is a situation of imbalance between demineralization and remineralization. The dissolution is caused by organic acids produced by bacteria in the plaque. Thus, an increased cariogenic challenge is formed around orthodontic brackets and underneath the bands especially on facial and lingual surfaces [1].

Fixed orthodontic appliances hinder cleaning of teeth and favor the retention of dental plaque resulting in a change in the intraoral environment, leading to increased bacterial density [2-3]. Streptococcus mutans (S. mutans) has been identified as a major cariogenic microorganism [4], whereas, Lactobacillus species (spp.) that are encountered in different stages of caries progression are considered secondary invaders of existing carious lesions [5]. The number of S. mutans can increase upto five fold during orthodontic treatment [3]. High numbers of colony-forming units of Lactobacillus spp. have been associated with use of orthodontic appliances and known to play a role in the increased levels of plaque seen in many orthodontic patients [6].

After the introduction of acid etching of enamel by Buonocore in 1955, direct bonding of orthodontic brackets to incisors, canines, and premolars is now carried out routinely as part of fixed appliance treatment. However, bands remain the most common means of attaching components to molars compared to bonding of buccal tubes. The decision to band or bond a molar may be influenced by several factors including a history of congenital

cardiac defect, rheumatic fever or prosthetic cardiac valve placement [7], the height of the clinical crown, or the need to use headgear. Bonding rather than banding molars however, reduces chairside time and leads to less plaque accumulation and gingival inflammation [8], there by reducing the risk of enamel demineralization.

Aims and Objectives:

1. To compare the subgingival cariogenic microbial colonization before and one month after the placement of orthodontic bands and bondable molar tubes using four different materials.
2. To assess the degree of subgingival cariogenic microbial colonization between
   - Two banding cements
     - Glass ionomer cement -GC FUJI, GC corporation India
     - Light cure resin modified glass ionomer cement- Ortho LC, GC FUJI, GC corporation India
   - Two bonding materials
     - Non-fluoridated composites-Transbond XT, 3M UNITEK India.
     - Fluoride releasing composites - Quick cure, Reliance Orthodontic products, Itasca.

Material and Methods

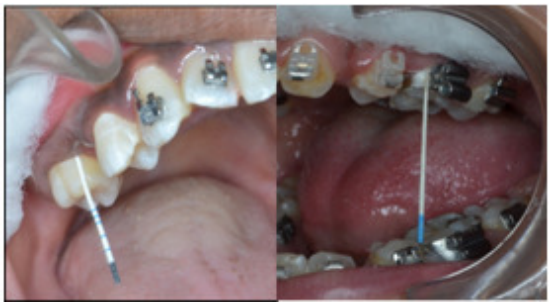
Thirty patients undergoing orthodontic treatment were randomly selected from post graduate clinic of Department of Orthodontics and Dentofacial Orthopedics. Inclusion criteria were patients between 12 to 25 years, requiring orthodontic treatment and having good periodontal condition. Exclusion criteria were patients with periodontitis, antibiotic intake in the previous three months, pregnancy and systemic illness.

An informed consent was signed from the patient or the parents. All patients went through oral prophylaxis at the start of the study and routine oral hygiene instructions were given. The following teeth were selected for bonding and banding: Upper right first molar, Upper left first molar, Lower right first molar, and Lower left first molar. The selected teeth were banded and bonded randomly quadrant wise, using four different materials:

- Non fluoridated composite (Transbond XT, 3M UNITEK India)
- Fluoride releasing light cured composite (Quick cure, Reliance Orthodontic products, Itasca)
- Glass ionomer cement (GC FUJI, GCcorporation India)
- Resin modified glass ionomer cement (Ortho LC, GC corporation India)

Subgingival microbial samples were taken from mesio-proximal site of the selected teeth before and one month after the placement of orthodontic bands and bondable molar tubes. Sterile paper points (40 size) were inserted to the bottom of the periodontal sulcus and kept in place for 15sec [9] (Fig.1).

Fig-1: Collection of samples



The paper points were placed in screw cap vials containing 10ml of 10% sterile thioglycollate broth transport media. The samples were then inoculated on culture media to evaluate for S. mutans and Lactobacilli (Fig 2 and 3) in the microbiology laboratory. Samples were inoculated on Mitis Salivarius Bacitracin (MSB) agar to estimate the colony count of streptococci. 1% potassium tellurite solution was added to make the solution selective for streptococci and 0.2 U/ml of sterile bacitracin was added to the solution to make the medium highly selective for S. mutans [3].

Fig-2: Microbial colonization of S. mutans

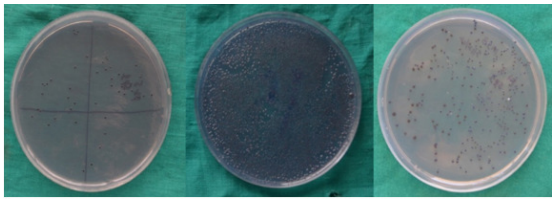
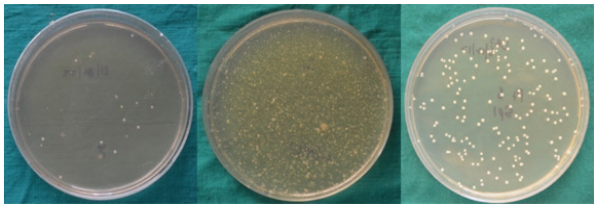


Fig-3: Microbial colonization of Lactobacilli species



For evaluating Lactobacilli, the samples were inoculated on lactobacillus selective (LBS) agar which is highly selective for lactobacilli [10]. 100 microlitre of the broth was transferred under sterile conditions onto the sterile MSB agar and lactobacillus selective agar plates. It was then uniformly spread over the surface of the medium using a sterile L shaped spreader. After 10min, the MSB agar plates were incubated at 37^0c with additional 5% carbondioxide for 48 hrs. Lactobacillus selective agar plates were incubated under anaerobic conditions in the incubator at 37^o c for 48hrs. Colonies were counted under digital colony counter.

Statistical Analysis: Data was entered in Microsoft excel and analysed using SPSS (Statistical Package for Social Science, Ver.10.0.5) package. The results were averaged (mean + standard deviation) and normality of data was tested using Kolmogorov-Smirnov and Shapiro-Wilk test. Pairwise comparison of the groups was done using one way Anova test and paired 't' test.

Results

S. mutans and lactobacilli CFU counts in subgingival plaque (at the initiation of treatment and one month after the installation of the orthodontic appliances) show that all patients presented a moderate risk of developing caries throughout the evaluation period. All the p-values by Kolmogorov-Smirnov and Shapiro-Wilk tests are more than 0.05 (p>0.05) (Table 1). Hence, all the values of baseline and 1 month CFU counts of two organisms in four groups follow a normal distribution. Therefore, the parametric tests were applied. One way Anova (Table 2 and 4) and paired t test (Table 3 and 5) showed statistically significant differences among the log CFU in subgingival plaque after one month of placing orthodontic appliances.

Table-1: Tests of normality of baseline and 1 month log CFU counts of two organisms in four groups

Micro organisms	time	Groups	Kolmogorov-Smirnov test			Shapiro-Wilk test		
			Statistic	df	p-value	Statistic	df	p-value
S. Mutans CFU	Baseline	GC Fuji	0.1000	30	0.2000	0.9750	30	0.6760
		Ortho LC	0.1010	30	0.2000	0.9640	30	0.3980
		Transbond XT	0.1180	30	0.0543	0.9350	30	0.0670
		Quick cure	0.1140	30	0.2000	0.9590	30	0.2870
	1 month	GC Fuji	0.0760	30	0.2000	0.9770	30	0.7540
		Ortho LC	0.1010	30	0.2000	0.9620	30	0.3510
		Transbond XT	0.1570	30	0.0570	0.9360	30	0.0690
		Quick cure	0.1240	30	0.2000	0.9600	30	0.3050
Lactobacilli CFU	Baseline	GC Fuji	0.1420	30	0.1240	0.9380	30	0.0790
		Ortho LC	0.1220	30	0.2000	0.9430	30	0.1080
		Transbond XT	0.1130	30	0.2000	0.9680	30	0.4850
		Quick cure	0.1500	30	0.0830	0.9480	30	0.1540
	1 month	GC Fuji	0.1280	30	0.2000	0.9390	30	0.0830
		Ortho LC	0.1210	30	0.2000	0.9440	30	0.1140
		Transbond XT	0.1190	30	0.2000	0.9680	30	0.4840
		Quick cure	0.1370	30	0.1570	0.9490	30	0.1580

Table-2: Comparison of four groups with respect tolog CFU (in ml) of S. Mutans at baseline and 1 month time points by one way ANOVA				
Groups	**Baseline log CFU**		**1 month log CFU**	
	Mean	**SD**	**Mean**	**SD**
GC FUJI	1.66	0.48	2.56	0.48
Ortho LC	1.67	0.35	2.56	0.35
Transbond XT	1.66	0.35	2.26	0.35
Quick cure	1.66	0.34	2.26	0.33
F-value	0.0079		6.2775	
P-value	0.9990		0.0006*	
Pair wise comparisons of four groups by Tukeys multiple posthoc procedures				
GC Fuji vs Ortho LC	p=0.9996		p=0.9998	
GC Fuji vs Transbond XT	p=0.9998		p=0.0138*	
GC Fuji vs Quick cure	p=0.9998		p=0.0153*	
Ortho LC vs Transbond XT	p=0.9991		p=0.0131*	
Ortho LC vs Quick cure	p=0.9995		p=0.0146*	
Transbond XT vs Quick cure	p=0.9998		p=0.9998	
*p<0.05				

Table-3: Comparison of baseline and 1 monthlog CFU (in ml) of S. Mutansin four groups by paired t test								
Groups	**Time**	**Mean**	**Std.Dv.**	**Mean Diff.**	**SD Diff.**	**% of change**	**Paired t**	**p-value**
GC Fuji	Baseline	1.66	0.48					
	1 month	2.56	0.48	-0.90	0.01	-54.12	-380.2330	0.0001*
Ortho LC	Baseline	1.67	0.35					
	1 month	2.56	0.35	-0.89	0.05	-53.25	-105.4934	0.0001*
Transbond XT	Baseline	1.66	0.35					
	1 month	2.26	0.35	-0.60	0.01	-36.10	-385.0666	0.0001*
Quick cure	Baseline	1.66	0.34					
	1 month	2.26	0.33	-0.60	0.01	-36.14	-390.6499	0.0001*
*p<0.05								

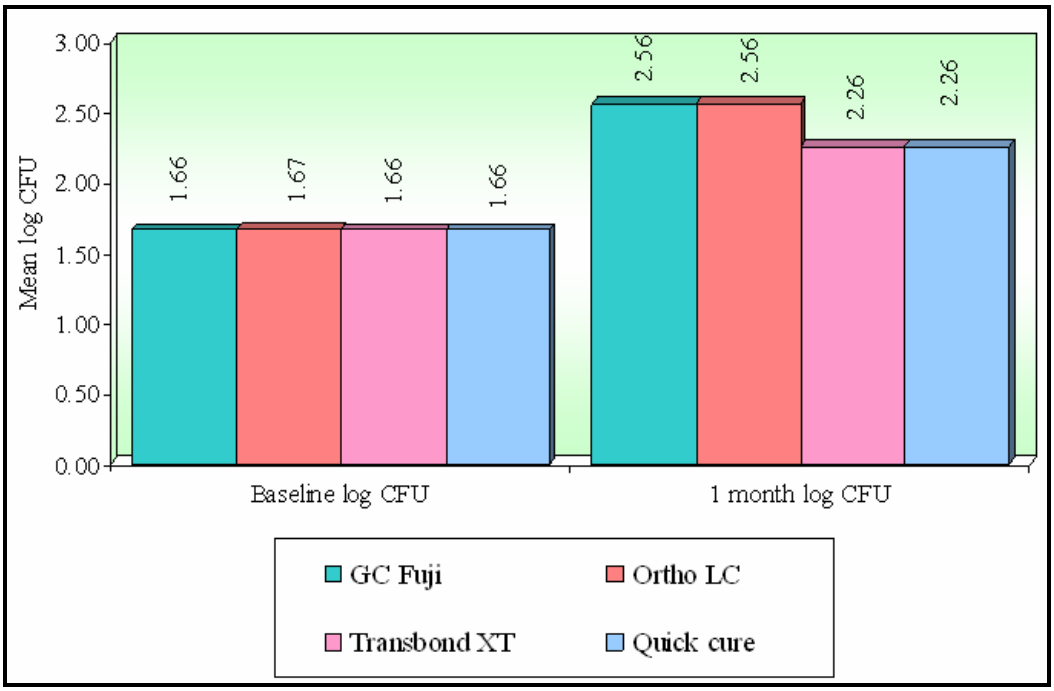
Table-4: Comparison of four groups with respect tologCFU (in ml) of Lactobacilli at baseline and 1 month time points by one way ANOVA				
Groups	**Baseline log CFU**		**1 month log CFU**	
	Mean	**SD**	**Mean**	**SD**
GC Fuji	1.68	0.25	2.38	0.25
Ortho LC	1.66	0.21	2.36	0.21
Transbond XT	1.66	0.19	2.14	0.19
Quick cure	1.60	0.27	2.08	0.26
F-value	0.7220		13.3996	
P-value	0.5408		0.0001*	
Pair wise comparisons of four groups by Tukeys multiple posthoc procedures				
GC Fuji vs Ortho LC	p=0.9874		p=0.9902	
GC Fuji vs Transbond XT	p=0.9790		p=0.0005*	
GC Fuji vs Quick cure	p=0.5064		p=0.0001*	
Ortho LC vs Transbond XT	p=0.9999		p=0.0012*	
Ortho LC vs Quick cure	p=0.7138		p=0.0002*	
Transbond XT vs Quick cure	p=0.7511		p=0.8175	
*p<0.05				

Table-5: Comparison of baseline and 1 monthlogCFU (in ml) of Lactobacilli in four groups by paired t test

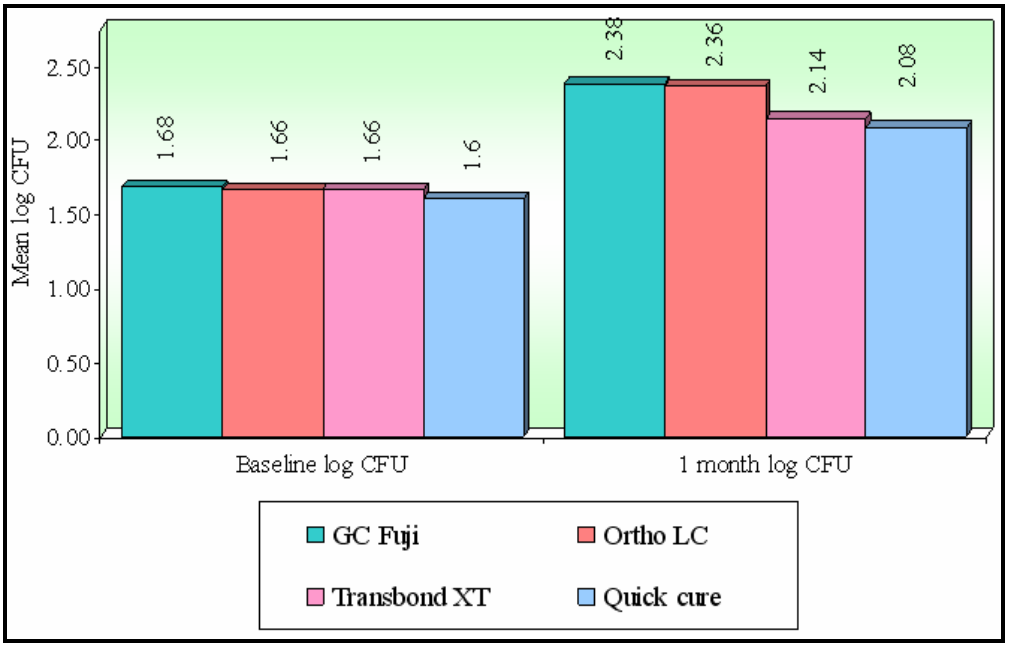
Groups	Time	Mean	Std.Dv.	Mean Diff.	SD Diff.	% of change	Paired t	p-value
GC Fuji	Baseline	1.68	0.25	-0.70	0.00	-41.54	-1548.1642	0.0001*
	1 month	2.38	0.25					
Ortho LC	Baseline	1.66	0.21	-0.70	0.01	-42.14	-674.5192	0.0001*
	1 month	2.36	0.21					
Transbond XT	Baseline	1.66	0.19	-0.48	0.00	-28.79	-593.7389	0.0001*
	1 month	2.14	0.19					
Quick cure	Baseline	1.60	0.27	-0.49	0.04	-30.35	-66.3195	0.0001*
	1 month	2.08	0.26					
*p<0.05								

It was observed that the log CFU means in the biofilm adjacent to Transbond XT and Quick cure 30 days after the start of the treatment was significantly lower than the log CFU means in the biofilm adjacent to GC Fugi and Ortho LC. It was observed same for both type of bacterial colonization. The results also revealed that there were no statistically significant differences among the log CFU means in the biofilm of attachments retained with Transbond XT and Quick cure and for the bands cemented with GC Fuji and Ortho LC. Log CFu and the respective means in the biofilm of teeth banded and bonded with Gc Fuji. Ortho LC, Transbond XT and Quickcure at two intervels of the study are given in graphs 1 and 2.

Graph-1: Comparison of four groups with respect to log CFU (in ml) of S. Mutans at baseline and 1 month time.



Graph-2: Comparison of four groups with respect tolog CFU (in ml) of Lactobacilli at baseline and 1 month time points



Discussion

There has been advent of an array of orthodontic adhesives having different physical, mechanical properties and different chemical compositions. These various properties directly or indirectly affect the harboring of oral microbes on their surface. This adherence of microbiota on surface of orthodontic adhesive is dependent on many properties of an adhesive viz. surface roughness, surface energy, contact angle, release of fluoride, method of cure (light cure / chemical cure) etc. Seating cemented orthodontic bands compromises oralhealth by increasing plaque formation on banded teeth [8]. Therefore in this study, we compared the subgingival cariogenic microbial colonization before and one month after the placement of bands and bondable molar tubes in patients scheduled for orthodontic treatment.

In our clinical study statistically significant differences were found between types of material used to bond and band orthodontic attachments (table 2). The CFU of S. mutans around orthodontic bands were increased compared to bondable molar tubes after one month (Table 3 and Graph 1). These results are closely related to the results obtained by Rosenbloom et al. who found that number of S.mutans can increase upto five fold during orthodontic treatment [3]. Similarly, the colonization of Lactobacilli around orthodontic bands was increased, as compared to bondable molar tubes after one month (Table 4,5 and Graph 2). Kupietzky et al. found that high numbers of colony forming units of Lactobacilli have been associated with the use of orthodontic appliances and known to play a role in the increased levels of plaque seen in many orthodontic patients [6]. Our result was similar to the results obtained by Owen who found that presence of orthodontic appliances in the mouth does increase the Lactobacilli count and the degree of increase is dependent upon the number of bands [11].

Study by Peros [10] and Sanpei et al [12] showed significant increase in cariogenic microorganisms S. mutans and Lactobacillus spp in saliva after commencing fixed orthodontic therapy. The 6th to 12th week of orthodontic therapy is a period of the most intensive intraoral growth of S. mutans and Lactobacillus spp and a time of very intensive salivary functions physiologic response. The results of our study were consistent with these studies. The comparison of results between fluoride releasing and non fluoride releasing adhesives (Transbond XT and Quick cure)

were not statistically significant (p>0.05) for both S.mutans and Lactobacilli colonization. This can be explained by the fact that the fluoride releasing orthodontic bonding adhesive may release fluoride at a rate that affects enamel demineralization rather than bacterial adhesion. Low levels of fluoride may be enough to protect enamel against demineralization but may have little effect on inhibiting growth and adhesion of the cariogenic streptococci [13]. Similar findings were obtained by a study done by Mervyn [14] which concluded that level of fluoride release from these orthodontic bonding materials may be too low to cause a significant inhibitory effect on early colonization of dental plaque bacteria. The nature of the conditioning film on the substratum surface is an important factor affecting early biofilm formation.

In this study, GIC and RMGIC (GC Fuji and Ortho LC) used for banding, did not show any statistically significant (p>0.05) difference in the number of colonization of both S. mutans and Lactobacilli. The antibacterial activity measured in this study does not correlate entirely with the fluoride content of the cements. For example, the glass ionomer cement did not exhibit a long-lasting antibacterial property, indicating that other factors might also be involved in the measurable effect [15]. Although this is not its most important property, fluoride released from conventional glass ionomer and resin-modified glass ionomer is believed to contribute to antibacterial activity. Fluoride ions might have a bacteriostatic effect on early colonizers [16-17]. Fluoride release from GIC was directly associated with its antimicrobial activity, that is, when pH is close to neutral (7.1-7.3) and the amount of fluoride is 140 ± 225 ppm. Therefore, GIC may be effective for a short period of time (maybe for only a few days), as shown in the study done by Rodriguez et al. [18] Tinanoff [19] found no association between the amount of fluoride released and antimicrobial activity of resin-modified GIC in vitro. On the contrary, the bacterial growth inhibiting effect seemed to be associated with GIC acid release. The reduction in resin-modified GIC pH and the size of bacterial growth inhibition areas have a direct correlation. The maximum amount of acid release from resin-modified GIC and its greatest antimicrobial activity were found immediately after the material was used. As time passes, less acid is released and bacterial growth inhibition decreases.

In general, placement of orthodontic bands, bondable molar tubes or other orthodontic components influences the accumulation and increased colonization of cariogenic and periodontopathic micro organisms. Thus, patients are more prone for development of caries and periodontal diseases. Special oral hygiene care should be given to orthodontic patients to prevent caries and periodontal disease during active treatment.

Conclusion

Bacterial colonization around molar bands was significantly higher compared to molar bonding. Hence, molar bonding may be a better option as against molar banding to reduce the risk of caries and gingival diseases around the orthodontic appliances. Use of fluoride releasing and non-fluoride releasing adhesives, chemically cured and light cured GIC does not make any difference in the bacterial colonization.

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