

# Effect of different bracket types on *streptococcus mutans* count in orthodontic patients using fluoridated toothpaste

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## ABSTRACT

**Background:** Plaque retention during fixed orthodontic therapy is an important cause of developing enamel demineralization. The purpose of this study was to evaluate the effect of different brackets types on the count of *Streptococcus Mutans* in orthodontic patients using conventional fluoridated toothpaste.

**Materials and Methods:** Plaque samples were collected from maxillary 1<sup>st</sup> premolar teeth of twenty right handed patients (using split mouth technique) before bonding, after 48 hrs of bonding using tooth brush only, and after 2 weeks of using fluoridated toothpaste. Stainless steel bracket was bonded on right first premolar while the left one was bonded with sapphire bracket. The calculation of the *Streptococcus Mutans* count was done using the plate counting method utilizing colony counter. The differences between the two types of brackets were determined using the Wilcoxon signed ranks test.

**Results:** The median bacterial count on the right side was insignificantly higher than the left side; *streptococcus mutans* in the plaque sample around the sapphire brackets showed insignificantly less counts than around the stainless steel one, when the patients used tooth brush only or fluoridated toothpastes. Fluoridated toothpastes reduced *streptococcus mutans* insignificantly around both types of brackets.

**Conclusion:** Fluoridated toothpaste acts effectively in reducing *streptococcus mutans* colony counts around sapphire and stainless steel brackets.

**Keywords:** *Streptococcus mutans*, Stainless steel brackets, Sapphire brackets. (Received: 10/10/2019; Accepted: 6/11/2019)

## INTRODUCTION

White spot lesion formation following enamel demineralization is the most popular complication associated with fixed orthodontic appliance therapy. <sup>(1)</sup> It resulted from increased numbers of cariogenic microorganisms in dental biofilm, compromised oral hygiene and decreased pH. <sup>(2)</sup> Although white spot lesion occurs irrespective of orthodontic therapy, patients undergoing orthodontic treatment have oral ecological alterations in which the numbers of cariogenic bacteria, especially *Mutans streptococci* are significantly increased and returned to the ordinary level after the removal of the orthodontic appliance. <sup>(3)</sup> *Streptococcus Mutans* is a potent initiator of enamel demineralization because there are many virulence factors unique to it and play important role in caries initiation. <sup>(4)</sup> First, *S. Mutans* is an anaerobic microorganism which produces lactic acid during its metabolism. Second, it has the ability to bind tooth surfaces in the existence of sucrose via the formation of glucans which are a polysaccharide that helps binding the microorganism to the tooth surface.

The most important virulence factor of *S. Mutans* is the acidophilicity. In contrast to the majority of oral bacteria, *S. Mutans* thrives under acidic environment and becomes the dominant microorganism in cultures with reduced pH. <sup>(5)</sup> Although brushing teeth twice daily is considered effective in bacterial count reduction, the high prevalence of gingival inflammation in orthodontic patients often suggests improper oral hygiene procedures in most patients. <sup>(6)</sup>

There is an important difference in biofilm formation and adhesion of bacteria among orthodontic brackets made from various materials. <sup>(7,8)</sup> The primary affinity of bacteria to surfaces is mostly due to hydrophobic and electrostatic interactions. Surfaces with high surface free energy (SFE) attract bacteria such as *S. Mutans* more easily. <sup>(9)</sup> A study conducted by López *et al.* <sup>(10)</sup> showed a statistically non-significant difference in the *S. Mutans* adhesion to stainless steel, plastic or ceramic brackets. Chemical plaque control procedures are used sometimes for more effective plaque removal <sup>(8)</sup>. Dean *et al.* <sup>(11)</sup> reported that fluoride concentration in biofilms increased significantly after brushing with toothpaste containing fluoride and the primary cariostatic effect of fluoridated toothpastes is the remaining fluoride in the dental biofilm that was not eliminated by tooth brushing.

The objectives of the present study were to determine the levels of *S. Mutans* on sapphire and stainless steel orthodontic brackets in patients undergoing fixed orthodontic therapy brushing their teeth with fluoridated toothpaste.

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**MATERIALS AND METHODS**

Twenty patients accepted to participate in this study. After signing a written consent form, a baseline record of bacterial count was taken from the right and left maxillary 1<sup>st</sup> premolars, then bonding of the maxillary teeth was performed with stainless steel brackets (Pinnacle, Orthotechnology, USA) except the left maxillary 1<sup>st</sup> premolar that was bonded with sapphire bracket (Pure, Orthotechnology, USA) using Resilience bracket adhesive (Orthotechnology, USA) and Light Cure Unit (Woodpecker, China) as shown in Figure 1.

The patients were instructed to brush their teeth with toothbrush only and come in a recall visit after 48 hr. to take another sample from the same teeth. After that, the patients were instructed to brush

their teeth with fluoridated toothpaste (Sensodyne toothpaste, GlaxoSmithKline, USA) twice daily and come again for a recall visit after 2 weeks to take further sample.

The samples taken were pooled plaque collected from the buccal surface of both teeth using a sterilized dental probe (after drying) utilizing the four-pass sampling technique in which a standardized, sterilized instrument's tip is moved circumferentially around the bracket.

Data were analyzed using SPSS program version 25. The descriptive statistics included medians, means, standard deviations, minimum and maximum values, while the inferential statistics included Wilcoxon signed ranks test to detect the side difference and Friedman test to study the effect of time on bacterial count. Probability value was set at 0.05.

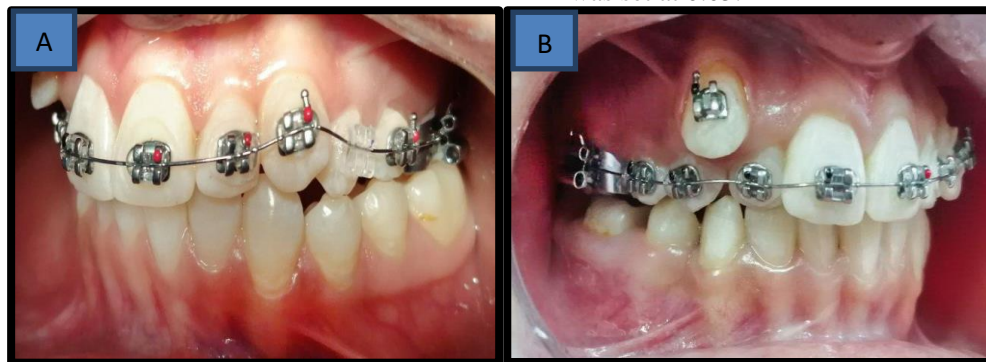


Figure 1: A; Stainless steel bracket bonded on tooth number 14, B; Sapphire bracket bonded on tooth number 24.

**RESULTS**

Table 1 shows the descriptive statistics and side difference of the bacterial count in three periods. Statistically, the bacterial count in the right side was insignificantly higher than the left one in all periods (p>0.05).

Friedman test was used to test the effect of time on *S. Mutans* count. In both sides, bacterial count was decreased insignificantly after using fluoridated toothpastes (Table 1 and 2).

Table 1: Descriptive statistics and side difference of bacterial count before bonding, after 48 hrs of using tooth brush only, and after 2 weeks of using conventional fluoridated toothpastes.

Duration	Side	Descriptive statistics					Side difference	
		Median × 10 <sup>3</sup>	Mean × 10 <sup>3</sup>	S.D. × 10 <sup>3</sup>	Min. × 10 <sup>3</sup>	Max. × 10 <sup>3</sup>	Wilcoxon Signed Ranks Test	p-value
Before bonding	Right	135	279.5	331.2 3	20	840	-0.663	0.508 (NS)
	Left	107.5	175.5	173.6 4	15	575		
After 48 hrs (Brushing only without toothpaste)	Right (SS)	227.5	314.3	319.5 0	8	900	-0.178	0.859 (NS)
	Left (Sapph.)	132.5	258.5	305.3 9	5	950		
After 2 weeks (Brushing with fluoridated toothpastes)	Right (SS)	75	159.5	178.0 2	4	500	-0.357	0.721 (NS)
	Left (Sapph.)	25	251.3 5	514.4 9	3	1600		

SS: Stainless steel, Sapph: Sapphire bracket, NS: non-significant

Table 2: Effect of time on the bacterial count for both sides.

Side	Right side	Left side
Friedman test	3.2	2.6
d.f.	2	2
p-value	0.202 (NS)	0.273 (NS)

## DISCUSSION

The market contains various bracket types made of different biomaterials. The adherence of plaque to the fixed appliance is highly contributed by the type of bracket material as it plays a role in the amount of plaque accumulation and bacterial adhesion as well as in the risk of white spot lesion development.<sup>(8)</sup>

Brackets surface characteristics are shown to affect bacterial adhesion especially surface free energy (also called wettability) and surface roughness. Variations in surface characteristics can explain the differences in the adhesion of *Streptococcus Mutans* to different biomaterials.<sup>(9)</sup>

In the present study, the median bacterial count in the right side was higher than the left side although non-significant but the difference is clear. This can be attributed to the use of right side hand in brushing that cleans the teeth of the left side better than the right one.<sup>(13)</sup>

After 48hr of bonding and brushing with tooth brush only, bacterial count is increased on both sides with a non-significant difference being higher in right side also. This could be due to the fact that the Monocrystalline sapphire bracket (on left side) has a surface roughness less than that of the stainless steel bracket (on the right side).<sup>(7,14,15)</sup> Moreover; Eliades *et al.*<sup>(16)</sup> found that stainless steel offered the highest critical surface tension and total work of adhesion, demonstrating an amplified potential for microorganism attachment on metallic brackets.

In contrast, Fournier *et al.*<sup>(17)</sup> investigated the affinity of *S. Mutans* to different bracket types and found that *S. Mutans* demonstrated weaker adherence to the metal brackets than to plastic or ceramic brackets.

After 2 weeks of using fluoridated toothpastes, the bacterial count decreased markedly with a non-significant side difference. This could be due to anti-caries effect of the fluoride containing toothpaste which results from the formation of calcium fluoride (CaF<sub>2</sub>) in dental plaque and on the enamel surface.<sup>(18,19)</sup>

The effect of time on *Streptococci Mutans* adhesion was examined using Friedman test. By comparing the medians of both sides before bonding and after 48hr, the adhesion of *Streptococcus Mutans* increased with increasing time but there was no statistically significant

difference. This elevation in count could be due to the fact that orthodontic brackets are covered instantly by the salivary pellicle in the oral cavity; therefore, the adhesion of oral microorganisms to the bracket surfaces is governed to a large extent by the properties of the adsorbed salivary protein layer. The salivary pellicle as a binding receptor can promote the adhesion of *S. Mutans*.<sup>(7,20)</sup>

## CONCLUSION

Fluoridated toothpaste is clinically efficient in reducing *S. Mutans* colony counts around sapphire and stainless steel orthodontic brackets.

**Conflict of interest:** None.

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### الخلاصة

الخلفية: ان تجمع الطبقة الجرثومية خلال ارتداء جهاز التقويم الثابت يعد سبب مهم في فقدان معادن الاسنان. الغرض من هذه الدراسة هي فحص تأثير الانواع المختلفة من حاصرات التقويم على اعداد البكتريا المسببة للتسوس في مرضى تقويم الاسنان الثابت الذين يستعملون معجون اسنان حاوي على الفلورايد.

المواد و الطرق: تم جمع عينات الطبقة الجرثومية من الاسنان الطاحنة لمرضى يرتدون التقويم , الحاصرات المعدنية تم تثبيتها على الطاحن رقم 14 الحاصرات المصنوعة من السيراميك تم تثبيتها على الطاحن رقم 24 و تم جمع العينات قبل تثبيت التقويم وبعد 48 ساعه وبعد اسبوعين وخلال الاسبوعين استعمل المرضى معجون اسنان حاوي على الفلورايد. تم تقييم الاختلاف بين المثبتات باستخدام اختبار ولكسون.

النتائج: اظهرت النتائج ان تعداد البكتريا في الجهة اليمنى اكثر من الجهة اليسرى وبدون فوارق معنوية. كانت البكتريا الموجودة في الصفيحة الجرثومية حول الحاصرات المصنوعة من السيراميك اقل من تلك حول الحاصرات المعدنية. قللت معاجين الاسنان الحاوية على الفلورايد من اعداد البكتريا حول الحاصرات المعدنية و الحاصرات المصنوعة من السيراميك. الاستنتاجات: ان معاجين الاسنان الحاوية على الفلورايد فعاله في تقليل اعداد البكتريا حول الحاصرات المعدنية و الحاصرات المصنوعة من السيراميك.