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Adhesion of *Streptococcus mutans* on glazed IPS e.max press, glazed feldspatic and dental enamel

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ABSTRACT

Despite several researches done to determine accuracy of microbial growth in the restoration treatment, the mechanisms for these reports is still unclear.The aim of the study was to comparison adhesion of the *Streptococcus mutans* on glazed IPS e.max press, glazed feldspatic and dental enamel. The in vitro study was done on 15 samples: 5 glazed IPS e.max, 5 glazed feldspatic and 5 dental enamels for vicinity of the bacterial suspension containing *Streptococcus mutans* (10×10^6 cell/mLit). After 48 hours, *Streptococcus mutans* colonies were counted with the naked eye. The mean *Streptococcus mutans* attached to dental enamel was 24.4±8.44 (P<0.001). The *Streptococcus mutans* attached to glazed IPS e.max was 1.8±0.83. The *Streptococcus mutans* attached to glazed feldspatic was 1.4±0.54. No significant differences observed between the IPS e.max and feldspatic (P<0.8). The results showed *Streptococcus mutans* adhesion to enamel was higher than glazed IPS e.max and glazed feldspatic ceramic material.

KEY WORDS: IPS E.MAX, FELDSPATIC, *STREPTOCOCCUS MUTANS*

INTRODUCTION

There is a rich ecosystem in the oral cavity, with a countless number of microorganisms. Although both periodontal disease and dental caries are considered multifactorial diseases, the bacteria in the dental plaque are the main factor in their onset and progression. Increased oral microbiota of *Streptococcus mutans* and *Lactobacillus* is associated with the onset of tooth demineralization and periodontal disease. This condition is much more frequent in orthodontic patients with greater risk of colonization by these microorganisms (Brusca et al. 2007, Harikrishnan et al. 2013, Nascimento et al. 2014 Jalalian et al. 2015Duymus et al. 2016).

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Despite several researches done to determine accuracy of microbial growth in the restoration treatment, the mechanisms for these reports is still unclear However the saliva composition and secretion rate also influence plaque formation (Gameiro et al. 2009).Porcelain has excellent esthetic properties and biocompatibility, and major emphasis in research have been directed toward the enhancement of its strength and aesthetic properties (Rashid, 2014).

Scarce reports exist on bacterial adhesion to porcelain restorations (Kamala and Annapurni, 2006). A previous research stated the best results were obtained through glazing, since it provided a surface topography with minimal bacterial affinity (Sarac et al. 2006). Additionally, it is demonstrated that polished surfaces had lower bacterial adhesion than glazed surfaces (Kawai et al. 2000). In a similar study, Jalalian et al. (2015) reported the adhesion of *Streptococcus mutans* to the enamel was higher than that to polished IPS e.max Press and polished feldspathic porcelain. However, there is no report comparing effect of porcelains with natural dental enamel. So, the aim of the current study was to determine adhesion of the *Streptococcus mutans* on glazed IPS e.max press, glazed feldspatic and dental enamel adhesion using in vitro condition.

MATERIAL AND METHODS

The *in vitro* study was done on 15 samples: 5 glazed IPS e.max, 5 glazed feldspatic and 5 dental enamels for vicinity of the bacterial suspension containing *Streptococcus mutans* (10^9 cell/mLit). The samples had diameter 5× 2mm in laboratory, then phosphate base fabricated. The feldspatic samples fabricated using feldspatic powders (lvocular, Germany) based on manufacture instructions. Ito fabricate IPS e.max press samples, 2 × 5 mm were blocks produced. The dental enamels obtained from normal premolar using diamond disks. The samples glazed at 625°C beginning temperature and increased each 20 minutes until final 920°C, then cooled in fresh air. Samples washed using distilled water then autoclave.

STUDY PROTOCOL

To increase hygiene condition, all samples were located into ultrasonic system for 15 min and then transferred into 70 % alcohol for 30 min. the being sterile of the samples was tested using BHI condition for 24 h. Saliva samples obtained from 2 healthy patients which had no medication for last 3 months without dental caries or periodontal disease. The saliva samples sterile using autoclave (Garcez et al. 2011). Then samples coated with saliva, put into glass vials and immersed in 2mL of *Streptococcus mutans* (PTCCI 683) suspension (×10^9 CFU) and incubated in 37 °C and 5% CO_2 for 24 h. Samples washed 3 times with normal saline, immersed into 2 mL of normal saline and shacked for 2 min (Fournier et al. 1998). Obtained suspension cultured on blood agar and incubated in 37 °C with 5% CO_2 for 48h and the colonies counted (Kantoriski et al. 2006). After 48 hours, *Streptococcus mutans* colonies were counted with the naked eye.

STATISTICAL ANALYSIS

Data for bacteria load was analyzed by one way analysis of variance (ANOVA) using SPSS 16.0 for Windows and is presented as mean ± Sd. For treatments showing a main effect by ANOVA, means were compared using Tukey HSD test. $P<0.05$ was considered as significant differences between treatments.

RESULTS AND DISCUSSION

As seen in table, the mean *Streptococcus mutans* attached to dental enamel was 24.4±8.44 ($P<0.001$). The *Streptococcus mutans* attached to glazed IPS e.max was 1.8±0.83. The *Streptococcus mutans* attached to glazed feldspatic was 1.4±0.54. No significant differences observed between the IPS e.max and feldspatic ($P<0.8$).

Table 1. The adhesion of streptococcus mutans on different restoration

	adhesion	C.V
Feldspatic	1.4±0.54	38.57
IPS e.max	1.8±0.83	46.11
Dental enamel	24.4±8.44	34.59
P value	0.001	

As observed in the current study, *Streptococcus mutans* attached was lower in glazed feldspatic< IPS e.max, dental enamel. However, no significant difference observed between glazed feldspatic and IPS e.max. Bacteria-dental interactions typical of enamel or cementum surfaces, *in vivo* biofilm formation on restorative surfaces have physiochemical and biochemical interactions (Hara and Zero, 2010). Pathogenic communities involving *Bifidobacterium dentium*, *Scardovia wiggsiae*, *Bifidobacterium longum*, *Bifidobacterium adolecentis*, *Prevotella spp*, *Selenomonas spp* and *Lactobacilli spp* have also been demonstrated to be complicit in the etiology of dental caries (Zhang et al. 2015). *Streptococcus mutans* has been demonstrated as the primary etiologic agent in caries initiation and reductionist approach can elucidate vital information regarding its interaction with restoration surfaces; however, additional studies may also use a more holistic approach (Wessel et al. 2014).

The first stage of colonization by an organism involves adherence of the organism to a host surface. From this viewpoint, evaluation of *Streptococcus mutans* adhesion and colonization to tooth surfaces and restorative materials are of most importance for their success (Lassila et al. 2009). Eick et al. (2004) demonstrated that no correlation found between surface roughness and the number of *Streptococcus mutans*. In the oral environment, the adsorption of salivary proteins to the tooth or restorative surface precedes and promotes bacterial adherence. They can form an acquired salivary pellicle to which bacteria and structural substrates may bind (Keulemans et al. 2009). Plaque accumulation was more influenced by the presence of a salivary pellicle than by material type. Viability, however, was influenced by material composition, in this case, differentiated by glass content (Dittmer et al. 2015).

Feldspathic porcelains are usually used as a veneering material for metal ceramic restorations and provide excellent esthetics and compressive strength (Duymus et al. 2016). Otherwise, the rough porcelain surface is prone to adhesion and retention of oral microorganisms causing excessive plaque accumulation, gingival irritation, increased surface staining and poor esthetics of the restored teeth and thereby increasing the risk of dental caries and periodontal disease (Hengtrakool et al. 2011).

The oral cavity is a complex, aqueous environment where the restorative material is in contact with saliva (Hengtrakool et al. 2011). Other factors such as low pH due to acidic foods and drinks may influence the material's mechanical and physical characteristics (Honorio et al. 2008). The availability and long-term success of prosthesis, depends upon the protection of the polished surface. The degradation of surface finish will cause the formation of surface cracks and after a while, leaving the porcelain metal sub-structure. In addition, surface deterioration will facilitate the involvement of plaque and microorganisms (Honorio et al. 2008).

Karayazgan et al. (2010) reported that the level of adhesion of Candida albicans to the polished surface of feldspathic porcelain was 3.4 ± 0.25 colonies/mm^2. In a similar study, enamel used as the control for assessment of the adhesion of *Streptococcus mutans* to uncoated and saliva-coated glass ceramics and composites (Kantorski et al. 2008) and their report was consistent with the findings of the current study. In a research on the adhesion to different the ceramics, composites and amalgam concluded the bacterial affinity was equal in all groups of ceramics assessed (Kawai et al. 2000). In conclusion the results showed *Streptococcus mutans* adhesion to enamel was higher than glazed IPS e.max and glazed feldspatic ceramic material. According to the findings of the present study, polished IPS e.max Press and polished feldspathic porcelain exhibit similar characteristics in terms of bacterial adhesion and either one can be the choice material.

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