

MICROLEAKAGE OF TWO FLUORIDE-RELEASING SEALANTS WHEN APPLIED FOLLOWING SALIVA CONTAMINATION

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Abstract. The purpose of this *in vitro* study was to evaluate microleakage of two fluoride-releasing sealants in saliva contaminated and non-contaminated conditions. Twenty-four human third molars were randomly assigned to two groups: saliva contaminated and saliva non-contaminated teeth. In the contaminated group, the teeth were contaminated with 0.02 ml artificial saliva for 20 seconds and blown dry afterward. Each group was divided into two subgroups: Group A, a fluoride-releasing resin sealant marketed as Clinpro[®] and Group B, a glass-ionomer sealant marketed as Fuji VII[™]. After sealant application, all the teeth were thermocycled for 2,000 cycles and coated with nail varnish 1.0 mm from the sealed areas. The teeth were stained with 2% methylene blue dye for 24 hours and sectioned in the bucco-lingual direction. Dye penetration (microleakage) was examined with a 25x polarized light microscope and measured by a computerized-calculated method. Data were compared with the Mann-Whitney *U* test at significance level of $p < 0.05$. A comparison of the two types of sealant revealed microleakage of the glass-ionomer sealant was present but there was no significant difference between the saliva contaminated and saliva non-contaminated teeth. Microleakage of the fluoride-releasing resin sealant was present and was greater among the saliva-contaminated teeth than the saliva non-contaminated teeth. The glass-ionomer sealant had significantly greater microleakage than the fluoride-releasing resin-based sealant in both the saliva-contaminated and saliva non-contaminated teeth.

Keywords: fluoride, glass-ionomer, microleakage, saliva contamination, sealant

INTRODUCTION

Dental caries is one of the most prevalent diseases in children, and the first permanent molars are especially prone to caries because of their anatomical structure

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and early eruption in the mouth (Tandon *et al*, 1989). Weintraub (2001) reported nearly 90% of caries in children occur in pits and fissures. Hata *et al* (1990) found most occlusal caries occurred 1-2 years after tooth eruption. Many children require dental professional visits to manage first permanent molar caries. This can be expensive, time consuming and traumatic for young children. Hence, the prevention of dental caries is important. Early preventive application of fissure sealants and use

of fluoride among primary school children can help reduce the prevalence of caries in these teeth (Al Ghanim *et al*, 1998).

Sealants are material applied to occlusal pits and fissures of caries-susceptible teeth, forming a micromechanically bonded protective layer that reduces access of caries-producing bacteria to their source of nutrients (Simonsen, 2002; Marks *et al*, 2009). The placement of sealant is a highly effective means of preventing pit and fissure caries (Ahovuo-Saloranta *et al*, 2008). There are a variety of pit and fissure sealants which include un-filled and filled resins with and without fluoride release and glass-ionomer cements (Marks *et al*, 2009).

The ability of sealant to bond is extremely important for success. Improper sealing can lead to marginal leakage, resulting in caries underneath the restoration (Kidd, 1976). Saliva contamination of the etched enamel surface before sealant placement is cited as the most common reason for sealant failure (Ripa, 1985; Simonsen, 2002; Rirattanapong *et al*, 2011). The aim of this *in vitro* study was to evaluate the effect of saliva contamination on microleakage in teeth of two different sealants.

MATERIALS AND METHODS

This study was approved by the Ethics Committee of Mahidol University. Twenty-four extracted human third molar teeth free of caries, fluorosis, fissure sealants and restorations, were obtained and kept in 0.9% saline at 4°C until use. The specimens were randomly divided into 2 groups ($n=12$) each: saliva contaminated and saliva non-contaminated teeth. Saliva contamination was carried out by applying 0.2 ml artificial saliva (Macknight-Hane and Whitford, 1992) to the surface pits and fissures of teeth for 10 seconds.

Each group was then divided into 2 sub-groups ($n=6$); molars exposed to Clinpro® fluoride releasing resin sealant and Fuji VII™ glass-ionomer sealant (Table 1). The sealants were applied according to the manufacturers' instructions. The specimens were then thermocycled in water for 2,000 cycles at a temperature of 5°C±2°C and 55°C±2°C with a dwell time of 30 seconds (Thermocycling machine, Model H5B4D, MECC, Japan). The surfaces of the specimens were then coated with nail varnish up to within 1 mm of the sealed area. The specimens were then immersed in 2% methylene blue solution for 24 hours to allow dye penetration into possible gaps between the tooth substance and the sealant. The roots were sectioned 1 mm below the cemento-enamel junction, and the crowns were sectioned with 2 parallel cuts in the bucco-lingual direction through the mesial and distal fissures with a slow speed saw (Accumtom-50, Streuers, Denmark) under copious water spray. After sectioning, 2 surfaces per tooth were analyzed using a polarizing light microscope (Nikon® Model eclipse E400 pol, Tokyo, Japan) at 25x magnification and photographed (Nikon Coolpix 900, Tokyo, Japan). A dye penetration value for each surface was scored using the system of Zyskind *et al* (1998) (Fig 1). The images were evaluated with Image-Pro® Plus (Media Cybernetics, Rockville, MD). To determine intra-examiner reliability, the examiner re-examined 10 (20% of) randomly selected specimens. The results were compared using the Mann-Whitney *U* test. Statistical significance was set at $p<0.05$.

RESULTS

The Kappa test showed the intra-examiner reliability in scoring was of 0.91. The mean scores (±standard devia-

Table 1
Sealant used in this study.

Name of sealant	Type	Manufacturers
Clinpro™ lot no. 20070416	Resin-based light-cured fluoride-containing fissure sealant	3M ESPE, St Paul, MN, USA
Fuji VII® lot no. 0407011	Glass-ionomer cement formulated for fissure sealant	GC Corp, Tokyo, Japan

Table 2
Microleakage in the studied sealants (mean scores ±SD).

	Clinpro™	Fuji VII®
Saliva non-contamination	0.02 ± 0.01	0.77 ± 0.19 ^b
Saliva-contamination	0.17 ± 0.10 ^a	0.77 ± 0.15 ^b

^aSignificant difference with different situations.

^bSignificant difference with different materials.

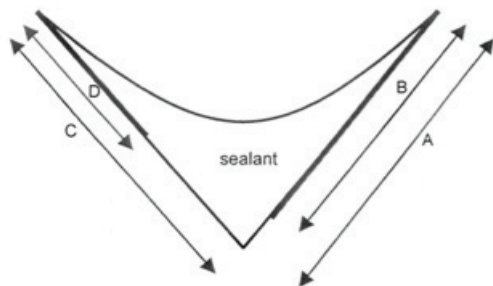


Fig 1—Diagram of microleakage scoring of pit and fissure sealants. A and C, the length of the sealant - tooth interface (mm). B and D, the length of dye penetration (mm). Scoring for microleakage = B+D/A+C.

tions) for both the saliva contaminated and saliva non-contaminated teeth are shown in Table 2. The glass-ionomer sealant had significantly more microleakage than the fluoride releasing resin in both the saliva contaminated and saliva non-contaminated teeth. The saliva contaminated teeth treated with fluoride

releasing resin had more microleakage than the saliva non-contaminated teeth treated with the fluoride releasing resin. The saliva contaminated teeth treated with the glass-ionomer had microleakage that was not significantly greater than the saliva non-contaminated teeth treated with the glass-ionomer.

DISCUSSION

Our findings are consistent with those of Ganesh and Shobha (2007) and Dhar and Taudon (2000) who found the fluoride releasing resin-based sealant performed better in terms of sealing ability than the glass-ionomer sealant. This could be attributed to the fact the enamel was not etched. Adhesion of the glass-ionomer sealant to the enamel surface is depended on the interaction between the polyacid in the cement and the hydroxyapatite in the teeth found only superficially on the enamel surface. The bonding of sealant to enamel may have an impact on sealant retention but have the opposite effect on microleakage. This could have caused the

greater microleakage observed with the glass-ionomer sealant. Our findings also agree with Al-Jobair (2010) who found saliva contamination resulted in greater microleakage with the fluoride releasing resin based sealant than non-contaminated teeth. Saliva produces an organic film that penetrates the enamel microporosities created by acid etching, interfering with the bonding of the sealant material to the etched enamel (Silverstone *et al*, 1985). The glass-ionomer sealant adhered equally well to saliva contaminated and saliva non-contaminated teeth. Adding polymerization to the glass-ionomer sealant allows rapid curing when activated by light or chemicals, making the material less sensitive to moisture contamination (Anusavice and Phillips, 2003).

The glass-ionomer sealant had the most microleakage among both saliva non-contaminated and saliva-contaminated teeth.

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