Effect of prophylaxis agents on the shear bond strength of a fissure sealant

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Introduction

The retention and caries-preventive effect of pit and fissure sealant have been well documented for the past 20 years.[1]

Common agreement exists that for a sealant to be retained adequately, the tooth must have a maximum surface area and deep, irregular pits and fissures, and must be clean and dry when the sealant is placed.[2] However, the best method for cleaning the pits and fissures has not been agreed upon. Taylor and Gwinnett[3], García-Godoy and Gwinnett[4,5], and García-Godoy and Medlock[6] showed that pumice particles become lodged in the fissures and are not removed after rinsing with a stream of water. Main et al.[7] demonstrated that the acquired pellicle is removed completely by standard acid-etching and Donnan and Ball[8] concluded that sealant retention was not significantly different with or without a previous pumice prophylaxis before etching.

Although the pumice prophylaxis does not seem necessary for the complete retention of fissure sealants, in some cases of poor oral hygiene a prophylaxis is appropriate. The purpose of this study was to evaluate the effects of different prophylaxis methods on the shear bond strength of a fissure sealant.

Materials and Methods

Sixty noncarious permanent molar teeth were obtained. The buccal enamel surface of each tooth was ground flat with 600 grit SiC paper to provide a uniform surface to which sealant could be applied. Care was taken not to expose dentin in this procedure.

The teeth were immersed in human saliva for 24 hr to allow reformation of the surface pellicle described by Clark and Gibbons.[9]

The teeth then were divided randomly into four groups of 15 teeth each:

- Group 1: Prophylaxis with a rubber cup and water
- Group 2: Prophylaxis with a rubber cup and pumice
- Group 3: Prophylaxis with a rubber cup and a nonfluoridated paste (NuPro®, John son & Johnson, New Brunswick, NJ)
- Group 4: Prophylaxis with a rubber cup and a fluoridated paste (NuPro).

Each tooth was grouped and cleaned accordingly, and then the enamel surface was etched for 30 sec with 37% phosphoric acid and washed thoroughly for 15 sec with water. After drying each specimen with oil-free compressed air for 30 sec, a white, Teflon™ cylinder measuring 3 mm in diameter and 5 mm in length, was secured to the flattened tooth surface with wax and served as a matrix into which the light-cured sealant (Helioseal®, Vivadent, Tonawanda, NY) was flowed. This matrix also provided a uniform surface area on all teeth to which the sealant was applied. The sealant was then cured for three 30-sec intervals, one from the top and two from the sides.

The specimens were thermocycled 100x at 30-sec intervals in deionized water ranging in temperatures from 5°C to 55°C, embedded in dental stone, and sheared with a knife-edged blade on the Instron® testing machine at a crosshead speed of 0.5 mm/min. The force required to break the sealant-enamel bond was recorded in megapascals (MPa).

The data were analyzed using the Analysis of Variance at the 0.01 level of significance and the Student-Newman-Keuls procedure.

Results

The mean (in MPa), standard deviation, and range for each group are presented in the Table. There was no statistically significant difference among the four groups ($P < 0.70$). Although not significant, the shear bond strength was weaker in the "water alone" group and showed the highest standard deviation. The nonfluoridated prophylaxis paste displayed the highest mean and one of the lowest standard deviations. The fluoridated prophylaxis paste yielded the lowest standard deviation. Most of the bonding failures occurred within the sealant (cohesive failure).

Table. Shear bond strength for the different groups.

Group	*Number*	*Mean (MPa)*	*SD*	*Range*
Water	15	6.67	3.42	1.84 – 13.34
Pumice	15	7.28	1.83	3.12 – 10.78
Nonfluoridated	15	8.62	1.92	5.81 – 12.91
Fluoridated	15	7.96	1.81	2.98 – 10.21

Discussion

Treatment with fluorides before and after etching has been proposed to strengthen the enamel by reducing its solubility. The fluoride reacts with the enamel forming calcium fluoride, which acts as a slow releasing agent enhancing the remineralization of the etched enamel and making it more resistant to acid dissolution.[10] However, the formation of reaction products on enamel surface resulting from fluoride treatments (mainly calcium fluoride)[11,12] has been reported to reduce resin bond strength.[13,14] Other studies have shown that incorporating small amounts of fluoride to phosphoric acid solutions or gels[15–19] or applying fluoride acid solutions after acid-etching before resin placement[20] does not significantly influence the bond strength of the adhesive material to the enamel surfaces.

In this study, there was no statistically significant difference among the four prophylaxis groups. In fact, the prophylaxis with water alone rendered the lowest bond strength and highest standard deviation. These results demonstrate that if a prophylaxis is performed before placing a sealant, the use of pumice or either of the pastes used in this study would not affect the sealant bond strength. The shear bond strength of the fissure sealant placed without a previous prophylaxis was not tested in the present study because the amount of bacterial plaque formed in vitro would not be similar to in vivo conditions. The purpose of the study was to evaluate the effect of different prophylaxis methods in the event that tooth cleaning is performed.

The recommendation not to use fluoridated and nonfluoridated prophylaxis pastes before sealant placement seems to be based on inference from studies that have evaluated the clinical performance of fissure sealants placed after a pumice prophylaxis and is not supported by the present study.

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