Comparative evaluation of different techniques of surface preparation for occlusal sealing


ABSTRACT. Aim Aim of this experiment is the efficacy evaluation of three different types of surface preparation techniques by microleakage assessment of two different sealing materials. Materials and methods Sixty teeth were used for the experiment: half were treated with Admira seal (Voco) and the remaining half with Delton FS+ (Dentsply). Each group was then divided into three subgroups, which underwent three different preparation techniques before sealant placement: mechanical brushing, air abrasion and Intensive bur FG 40D4, respectively. After immersion of the specimens in methylene blue solution, the degree of microleakage was assessed by mean of optic microscope. Results Results show no microleakage in samples treated with air abrasion, followed by the samples treated with mechanical brushing. The teeth prepared by bur treatment before sealant application show a significant number and degree of marginal infiltration. Conclusion It can be concluded that air abrasion technique is able to guarantee a reliable seal of occlusal surfaces.

KEYWORDS: Air abrasion, Sealants, Microleakage, Etching.

Introduction

The development of dental caries is determined by the action of acid substances derived from enzymatic fermentation of food residues in the oral cavity by acidogenic bacteria aggregated in dental plaque [Shu et al., 2000].

Epidemiologic studies on caries risk factors focusing on cariogenic bacteria salivary levels confirm the positive correlation between presence of streptococcus mutans and lactobacilli in saliva and number of dental caries [Beighton et al., 1996].

Virulence factors such as acidogenicity or synthesis of water insoluble glucans [Hanada, 2000] can exert their effects only after bacterial colonisation of dental surfaces [Loeshe, 1986], which cannot occur until teeth eruption into the oral cavity [Fusao et al., 2006].

Following eruption teeth become susceptible to dental caries, independently from race, age and geographical areas; instead its prevalence and distribution are closely related to the socioeconomic level of the considered countries [Sheiham, 1986].

Caries risk factors can be identified and classified as environmental, behavioural, biological and physical. They are usually related to life style, poor or inadequate oral hygiene, low salivary flow, poverty, unbalanced food intake in paediatric patients and insufficient fluoride exposure. The primary preventive approach consists of eliminating or reducing the risk factors, while secondary prevention aims at preserving dental tissues using minimally invasive techniques [Selwitz et al., 2007].

Among the strategies able to prevent or reduce the risk of caries onset, sealing of occlusal pits and fissures is considered an important procedure...
In order to significantly reduce microleakage it is crucial the optimal adaptation of the sealing material, which in turn is strictly related to proper treatment of the enamel prior to sealant application [Chan et al., 1999].

Among the different surface treatments available, recent studies assert that air abrasion followed by orthophosphoric acid etching is able to drastically reduce the occurrence of marginal microleakage [Bevilacqua et al., 2007].

Literature fully demonstrates a reduced caries susceptibility of teeth treated with sealants. This widely used technique has been proven effective but, on the other hand, at the same time it might lead young patients to reduce their oral hygiene practices because of the false security of complete caries protection derived from having their teeth sealed [Mason, 2000].

Aim of this experiment is to evaluate three different superficial preparations and two sealant materials by microleakage assessment.

**Materials and methods**

For the present study 60 molar teeth with sound occlusal surfaces have been used. Following extractions the teeth were cleaned with pumice and water and stored in saline solution at a constant temperature of 6 °C. Teeth were randomly divided into two main groups which underwent treatment with two different sealants. These two groups were subsequently divided into three subgroups, each treated with a different occlusal surface preparation.

In the first group the dental surfaces were prepared with bur Intensive FG 40D4. The second group was treated just with mechanical brushing before sealant application. The third group underwent treatment with a compressed air abrasion system (Kinetic Cavity Preparation), which uses alpha alumina abrasive particles ranging from 27 µm to 50 µm at a variable pressure from 2.7 to 10.8 bar.

Each sample group underwent etching with 37% orthophosphoric acid: the group treated with Admira seal for 15-30 sec using Vocolid gel, while the group treated with Delton FS+ for 15-60 sec. using Delton EZ Etch. Surfaces were fully washed with water for at least 30 sec. Sealants were then applied and light cured by using “Translux energy” halogen lamp for 30 seconds (900 mW/cm²).

After sealing, teeth were stored in saline solution for 24 hours and submitted to 500 thermocycles at 50 °C except the occlusal sealed surfaces, the teeth were completely coated with varnish; thereafter they were immersed in 2% methylene blue solution for 24 hours at room temperature.

The radicular portion of each tooth was embedded in autopolymerising resin in order to supply adequate support. Teeth were then sectioned three times along the buccolingual axis.

Sections were examined by mean of optic microscope and the degree of microleakage assessed according to Ovrebo and Radaal scoring system [1990] (Table 1). Data were statistically analysed using the Pearson’s chi-square test at 95% confidence level.

**Results**

The experiment showed that the best results are achieved with the sealant Delton FS applied on teeth previously treated with air abrasion. The infiltration assessment shows no microleakage in 100% of the sample (score 0). The other two groups, prepared with Intensive bur FG40D4 and mechanical brushing, show a low percentage of infiltrated teeth, 20% and 40% respectively.

Anyway it must be noted that even the infiltrated teeth have a low degree of microleakage (score 1), which demonstrates a relatively superficial penetration at the tooth/sealant interface (Table 2; Fig. 1).

Teeth treated with Admira Seal show comparable results in the two subgroups treated with air abrasion and mechanical brushing. In both groups, in fact, all samples show no dye penetration and they all rate a score of 0.

All the speciemens treated with Intensive bur FD 40D4 are infiltrated with a variable microleakage degree: 40% of the teeth have a score of 2 and 60% a score of 1, respectively (Table 3; Fig. 2).

**Discussion**

In order to prevent caries onset, sealants and defined types of surface preparation are able to guarantee a satisfactory level of protection.
Studies have demonstrated that proper sealing techniques combined with good oral hygiene habits can contribute to the long-term success of sealants [Makhija et al., 2006].

According to modern literature it can be stated that regardless the type of superficial treatment [Lupi-Pegurier et al., 2004], mechanical brushing, air abrasion or the use of burs, each treatment must be followed by orthophosphoric acid etching [Manhart et al., 2004]. Other researches show that some preparation may achieve a better seal than others. Air abrasion followed by etching seems to be the most successful method of preparation [Hatibovic-Kofman et al., 2001].

From the results obtained in this study and as stated above, it emerges that the use of occlusal surface preparation methods such as air abrasion or mechanical brushing can bring the degree of microleakage very close to zero (Fig. 3). In particular the air abrasion technique offers a better seal along the margins of pits and fissures. This can presumably be ascribed to the roughness produced by the abrasion, which allows for a larger surface available for adhesion [Laurell et al., 1995] without creating

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**TABLE 2** - Distribution of microleakage in teeth treated with Delton FS sealant in relation to the type of surface treatment and number of infiltrated teeth.

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<th>Distribution of Microleakage scores</th>
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**TABLE 3** - Distribution of microleakage in teeth treated with Admira seal sealant in relation to the type of surface treatment and number of infiltrated teeth.
structural alterations of the enamel itself [Goracci et al., 1999]. Furthermore, it cannot be overlooked that this technique allows for greater preservation of dental tissue [Obster et al., 1999] and yield fewer collateral effects on soft tissues [Laurell et al., 1995].

The preparation technique with the highest rate of failures is the bur treatment of occlusal surface (Fig. 4). The cause of microleakage can be identified in the microfractures generated by pressure and vibrations produced by the bur at the hydroxyapatite enamel crystals level, with a subsequent higher probability of marginal microleakage.

From the comparison of the results obtained by the two sealants it is clear that Delton FS delivered better results than Admira seal. However it has to be remarked that, regardless of the type of superficial preparation, each treatment must be followed by orthophosphoric acid etching.

As demonstrated by Bevilacqua et al. [2007] in their study, a significant reduction in microleakage can be obtained by the combination of air abrasion followed by orthophosphoric acid etching.

Therefore, the above described techniques ought to be considered as pre-treatments of the dental surface that must be followed by acid conditioning.

**Conclusion**

From the results of the experiment and according to the analysis of literature findings it can be concluded that:

- The sealing method that better preserves the tooth surface from future microleakage is the air abrasion technique.
- Mechanical brushing is the technique that follows air abrasion in rating, and it is capable of conditioning the tooth surface with fairly good results.
- Etching with orthophosphoric acid is crucial for the optimal bonding between tooth and sealant material, and for reducing future failure occurrences.

**References**


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