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Effectiveness of plaque indicators and air polishing for the sealing of pits and fissures

ABSTRACT

Aim Sealing of pits and fissures is one of the most effective techniques in caries prevention: however incomplete removal of plaque debris, can cause lack of retention of the sealant.

Materials and methods Sixty first permanent molars were sealed for this study. The teeth were divided into four groups. All teeth were isolated with a dental dam before cleaning and coronal polishing was performed with synthetic bristles or air polishing. Disclosing solution was used to reveal plaque. Three different operators performed cleanings and sealing. **Results**

The results show that the plaque indicator was necessary to ensure complete cleansing of pit and fissures. PROPHYflex3 was the easiest and most effective device for removing plaque and debris. Synthetic bristles failed to thoroughly cleanse the surface in most attempts. **Conclusions** Results suggest that pits and fissures should be cleaned with a plaque indicator and air polishers before placing a sealing material to ensure complete removal of plaque from the tooth.

Key words: Pits and fissures sealing; Air polishing; synthetic bristles.

Introduction

Dental decay is one of the most prevalent and preventable oral diseases of childhood and represents a serious public health problem [Fejerskov, 2004]. Acidogenic bacteria aggregated in dental plaque determine the development of dental caries [Shu, Wong and Miller, 2000].

Epidemiologic studies on caries risk factors with a focus on salivary levels of cariogenic bacteria confirm the positive correlation between the presence of supragingival and coronal plaque accumulation with high levels of *S. mutans* and lactobacilli and the number of dental caries [Rupf et al., 2006; Harris et al., 2004; Carvalho et al., 1989; Beighton, 1996].

Following eruption teeth become susceptible to dental caries and many studies have demonstrated that in permanent dentition caries are most frequently found on the occlusal surface of the first and second molars as a direct result of the structural irregularities associated with occlusal pits and fissures [Margolis and Moreno, 1994; Weintraub, 2001]. In fact, although occlusal surfaces represent only 12% of all exposed areas, 60% of all decays is found in this zone.

Over the last few decades, several advancements have been made in caries prevention, and dental care for children is not predominantly characterised by secondary and tertiary care, with growing attention being given to primary care [Arcella et al., 2002; Petersen and Lennon, 2004]. Inhibition of dental plaque formation, mechanical removal of dental plaque, systemic and topical fluoride, the use of pit and fissure sealants and oral health education programmes have had an unquestionable impact on the prevention of caries [Ripa et al., 1987; Morphis et al., 2000].

Today mechanical plaque removal with toothbrushes and dental floss is the most widely accepted method for dental plaque control, along with other auxiliary products such as dentifrices and mouthwashes. Tooth brushing at least twice a day with a manual or a powered toothbrush help remove plaque and debris. Flossing teeth helps remove plaque from between teeth, and the use of dentifrice helps inhibit the growth of dental plaque by decreasing its adhesion to treated surfaces. Topical fluoride applications seem to be effective on the smooth surfaces of teeth, but less so in pits and fissures. For pits and fissures, the best preventive strategy appears to be the use of sealants [Christensen, 2005; Splieth et al., 2001]. Research has shown that sealants can reduce plaque build-up in pit and fissure of back teeth by more than 60% [Center for Disease Control and Prevention, 2005].

Since the final goal of sealants is to penetrate the pits and fissures of the teeth, incomplete removal of plaque debris prior to etching can cause lack of retention of the sealant or microleakage leading to the deterioration of the material itself, which increases potential for the development of caries [Ellis et al., 1999; Strand and Randal, 1988; Simonsen, 2002; Perdigao, 2005].

The purpose of this study was to evaluate the use of a plaque indicator as a visual aid in order to assure complete removal of debris from all surfaces before the use of a sealant, and to compare the effectiveness of air polishing versus synthetic bristles for complete removal of dental plaque from pits and fissures.

Materials and methods

This pilot study was conducted in accordance with the declaration of Helsinki, and was approved by a Research



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Ethical Committee. The signed and informed consent was obtained from the parents or guardians of all volunteer subjects before examination.

Children aged 7 and 8 years were involved in this study. A dentist carried out the oral examination. Visual assessment of dental caries was based on ICDAS II detection criteria. Caries-free was defined as D1 threshold.

Sixty permanent molars with no detectable caries met the inclusion criteria. Molars with approximal, buccal or lingual surface caries lesions, orthodontic bands, hypoplasia, and teeth eruption stage checked by full occlusion were excluded.

Before recruiting the patients, three operators (dental hygienists) were trained and calibrated by a dental hygienist on the correct use of synthetic bristles and air polishing devices to ensure consistency of results.

The training process was divided into two steps: a theoretical step and a practical step. The theoretical part consisted of a 90 minute class where the anatomy of the first molars occlusal surface, and all devices were described with the aid of slides and videos illustrating the correct techniques and the effects of misuse. For the practical step, each operator was trained on 12 extracted third molars, cleaning 6 teeth with synthetic bristles and 6 teeth with an air polishing device, and finally sealing all teeth. The instructor supervised each operator, in order to standardise the technique for all three dental hygienists.

For the study, all teeth were isolated with a dental dam before cleaning and coronal polishing was performed to completely remove plaque and stains from the surface of the teeth [Van der Weijden et al., 2004].

A disclosing solution was used to reveal plaque.

The teeth were divided into four groups and treated as follows by three dental hygienists.

- Group I: 15 first molars of the upper right quadrant were cleaned with synthetic bristles (nylon Ø 8 mm, Kerr Hawe, Switzerland)
 - Group II: 15 first molars of the upper left quadrant were cleaned with the Prophylflex 3 (Kavo, Germany).
- For both groups, after cleaning, GC Plaque Indicator (GC Dental, China) was used to see if plaque was completely removed.
- Group III: On 15 first molars of the lower left side GC Plaque Indicator was utilized before cleaning; a synthetic bristle was used to clean the crown.

- Group IV: On 15 first molars of the lower right side, GC Plaque Indicator was utilized before cleaning; PROPHYflex 3 was used to clean the crown;

For both groups the plaque indicator was used again after cleaning to assess the complete removal of dental plaque.

For all teeth the same sequence was observed [Lesser, 2001].

- Step 1 - Isolation of the tooth using a rubber dam.
- Step 2 - Preparation of the tooth.
 - Cleaning pit and fissure surfaces utilizing water and synthetic bristles (Fig. 1) or air polishing (Fig. 3) for 30 seconds.
 - Rinsing for 20 seconds.
 - Reevaluation of the surface for residual debris (Fig. 2, 4).
- Step 3 - Drying the surface with air for 20 seconds
- Step 4 - Etching the surface (Etchant 37%, 3M, USA).
 - Applying etchant for 30 seconds on pits and fissures.
- Step 5 - Rinsing and drying the teeth.
 - Rinsing the surface for 60 seconds.
 - Drying teeth with air for 20 seconds.
- Step 6 - Application of sealant material (3M, USA).
 - Application of a light-curing material.
 - Polymerisation for 30 seconds.
 - Evaluation of sealant for any voids, marginal discrepancies or retention problems. If noted, step 2 through 7 were repeated.
- Step 7 - Occlusal evaluation.
 - Check of occlusion with articulating paper.

At the end of step 2, if debris was still present in pits and fissures, a plus sign was marked on a chart and the crown was cleaned for another 30 seconds using the same technique. GC Plaque Indicator was used again to confirm complete removal of debris. If plaque was still present, another plus sign was marked on the chart and debris was removed with the other technique.

The GC Plaque Indicator was used again for a final assessment.

Statistical analysis

All data express the presence/absence of plaque. To assess a global difference between the four treatments data were analyzed with the Friedman test. We performed

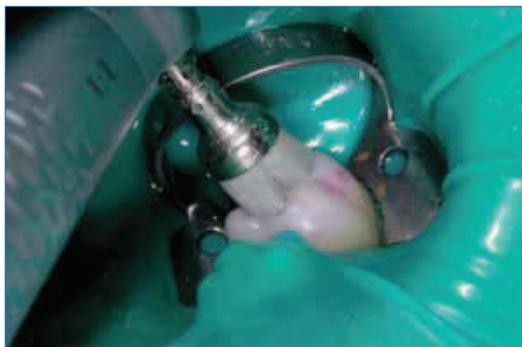


FIG. 1 - Preparation of the tooth using synthetic bristles.



FIG. 2 - Reevaluation of the cleaned surface. Plaque is still present after utilizing the synthetic bristles.



PLAQUE INDICATORS AND AIR POLISHING FOR PITS AND FISSURES SEALING



FIG. 3 - Preparation of the tooth utilizing air polishing.

FIG. 4 - Reevaluation of the cleaned surface. Plaque is absent after utilizing the air polishing device

the Fisher Exact test to evaluate the association between treatments and groups. The p values were 2-sided; a p value lower than 0.05 was considered of statistical significance. All computations were carried out with SPSS software 13.0 (SPSS Inc., Chicago, Illinois).

Results

- Group I On the first and second attempt, all teeth cleaned with the synthetic bristle failed the complete removal of plaque from pits and fissures. Coronal cleaning was then attempted with the use of PROPHYflex 3 and all debris was successfully removed.
- Group II Six teeth (40 percent) were effectively cleaned after the first attempt. Nine teeth needed another passage of PROPHYflex 3 for complete removal of debris.
- Group III After the first attempt, all teeth still had plaque and after the second attempt complete removal of debris was achieved only in one case.
- Group IV All teeth were successfully cleaned after only one attempt.

The Friedman test shows different results for the four treatment groups (p=0.020)

We compared group 1 and 2 at the first attempt to remove plaque. Results show a statistically significant

	Group 1	Group 2	Total
Plaque Absent	0	6	6
Present	15	9	24
Total	15	15	30

TABLE 1 - Count first attempt p=0.017.

Second Attempt	Group 1	Group 2	Total
Failed	15	0	15
Successfull	0	9	9
Total	15	9	24

TABLE 2 - P<0.0001 (the most statistically significant).

difference (p=0.017), where on all the teeth in group 1 plaque remains present (Table 1). At the second attempt, in Group 2 plaque was present on six teeth (p<0.0001) (Table 2). When comparing Group 3 and 4, Group 3 shows that plaque was still present on all teeth at the first attempt, while group 4 shows complete removal of plaque from all teeth (p<0.0001). Results show that the difference was not incidental but rather due to the devices and methods used in the cleanings (Table 3).

Discussion

Proper sealing techniques combined with good oral hygiene habits, correct dietary habits and regular periodical check-ups are essential to prevent caries onset.

The first step in the use of sealants is to clean the tooth surface in order to remove all deposits and organic debris from pits and fissures [Primosch and Barr, 2001].

Visualizing the plaque on the occlusal surface of teeth enables the operator to save time and ensure a successful cleansing of the tooth surface.

The surface can be debrided with prophy cups, bristle brushes or air-powder devices. However, the use of rubber cups or bristle brushes is often laborious, time-consuming and ineffective in completely removing deposits, particularly from pits and fissures. Instead, air polishing systems, have been consistently effective at removing stains and plaque [Atkinson et al., 1987; Brocklehurst et al., 1992].

The system uses a mixture of air, water and sodium bicarbonate that debrides the tooth surface of plaque and stains without causing damage to the enamel structure [Gutman, 1998; Brockmann et al., 1990; Brinkmann, 1998].

	Group 3	Group 4	Total
Plaque Absent	0	15	15
Present	15	0	15
Total	15	15	30

TABLE 3 - Differences between Groups 3 and 4.



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Conclusion

Based on the findings of this pilot study, the following conclusions were reached. The effectiveness of plaque debridement with the PROPHYflex 3 device was far better than that achieved with synthetic bristles. The advantages of using air polishers are: rapid removal of tooth deposits, and improved access to pits and fissures.

GC Plaque Indicator has shown to be a valid and necessary device to ensure complete removal of plaque from pits and fissures. Further studies may be designed to investigate the retention of sealed teeth after the use of an air polishing device or synthetic bristles, and also to assess if small deposits of plaque remain on the occlusal surface.

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