Artificial Plaque Removal with Carisolv System: A Clinical Approach

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In the present study, removal of artificial plaque in pits and fissures with the Carisolv system was compared with that of conventional bristle brush method, in vitro. The results indicate that in the dental clinic, complete plaque removal with the Carisolv is possible, and in addition to acid etching, treated cavity was almost free of debris which might increase sealant retention.

Key words: *Carisolv, tooth, dental plaque, tooth prophylaxis*
J Clin Pediatr Dent 31(3):201-203, 2007

INTRODUCTION

Pits and fissures that are not self-cleansing are extremely susceptible to dental caries, because they accumulate organic debris, providing suitable sites for the development of dental caries. Following the cleaning of pits and fissures by conventional techniques such as pumice prophylaxis, air-abrasion, or ultrasonic scaler,[1,2] the use of a sealant material would form a physical barrier between the surface of the tooth and oral environment, therefore reducing the risk of dental caries. However, conventional techniques are not always considered as effective methods for cleaning pits and fissures, because persistence of organic debris following routine cleaning and etching might also play an important role of sealant retention as reported in the previous studies.[3,4] As a possible alternative to the conventional technique, previous study reported chemo-mechanical caries removal systems such as GK-101 for removing pellicle and debris.[5] Carisolv which contained sodium hypochlorite (NaOCl) and three kinds of amino acids (glutamic acid, leucine, and lysine) is considered as one of the most effective chemo-mechanical caries removal system for removing caries in the dental clinic.[6,7] It can be considered that that Carisolv might also be effective in removing organic components of pits and fissures although there is no dissolution study up to date regarding this matter.

In the present study, artificial plaque in pit and fissures were removed by using the Carisolv system, and compared its efficiency with that of the conventional bristle brush method. Prepared cavities following each treatment were subjected to morphological analysis by the scanning electron microscopic (SEM) examination and remaining debris was calculated by a debris score, *in vitro*.

MATERIALS AND METHODS

Preparation of Fissure Grooves

Twenty extracted human permanent teeth with intact occlusal surfaces were used in the study; these teeth were extracted for orthodontic and periodontal reasons. Following an approval for this study by patients, these teeth were brushed and washed with distilled water at room temperature, and then artificial fissure grooves (width: 1 mm, depth: 1 mm) were prepared on the occlusal surface of each tooth by using a 1/4 round carbide bur (Heritage Burs, USA) on a high-speed hand piece according to a previous report.[8]

Preparation of Artificial Plaque

Artificial plaque was prepared according to Nishikado *et al*.[9] It contained 20% of Liquitex (Liquitex Co., USA), 30% of Starch gruel (Fueki-ko, Fueki Co., Yao, Japan), 30% of Poster color (Sakura Co.,Osaka, Japan), and finally 20% of solid food fragments (MR-stock, Nihon-Nosan Co.,Yokohama, Japan) which was originally used for rats were mixed to make it close to the clinical plaque condition. Fissures were then filled with the artificial plaque.

Experimental Procedure

The teeth were divided randomly into 2 groups of 10 teeth each. Fissures of 10 teeth were cleaned by Carisolv (Medi Team, Göteborg AB, Sweden) pre-treatment. The Carisolv gel used for this study was supplied into 2 separate mixtures of the component; prior to use, they were mixed in a container, then applied on the surface of artificial fissure for 30 seconds, gently excavated by using dental explorer, and rinsed with water spray.

Fissures of the remaining 10 teeth were cleaned with a dry, pointed bristle brush with prophylaxis tooth paste (Profylaxpasta CCS, Clean Chemical Sweden A.B., Sweden) using a low-speed handpiece, and rinsed with water. All teeth were then dried with oil-free compressed air for 20 seconds, and subjected to the following inves-

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tigations.

Assessment during Fissure Cleaning

Fissure cleaning with each method was continued until the artificial plaque was removed completely. The time required for fissure cleaning was determined for each treatment method.

Characteristics of the treated Surfaces

To verify the surface characteristics, all cavities were examined macroscopically using a stereoscope (SMZ-10, Nikon, Tokyo, Japan). Each cavity was divided into 2 parts; one half was acid-etched with a 30% phosphoric acid gel (Clearfil etching agent, Kuraray Co., Kurashiki, Japan) for 30 seconds (s), washed with water spray for another 30 s, and dried with air for 20 s. Other half of the cavities were not acid-etched. They were then subjected to the SEM (JSM-T220A, JEOL, Tokyo, Japan) examination for morphological study and analysis of debris score against a 5-point debris scale as described in the Table 1. For SEM examination, specimens were dehydrated with a graded series of aqueous ethanol (70%, 80%, 90%, 100% ethanol) for 24 hours in each solution, dried with liquid CO_2 using a critical point dryer devices (JCPD-3, JEOL, Tokyo, Japan), coated with a platinum layer at a thickness of 15 μm, and observed by SEM at 15 kV.

Table 1. Debris scales used for this study

Grade number	Content
0	Only few small debris like particles remaining at cavity
1	Light coverage of debris, <25% of the cavity
2	Moderate coverage of debris, ■ 25%but<50%of the cavity
3	Heavy coverage of debris, ■ 50%but<75%of the cavity
4	Complete or nearly complete cavity covered by debris

RESULTS

Assessment during Fissure Cleaning

The required mean times for Carisolv and brush-treatments were 130 ± 25 seconds and 160 ± 25 seconds, respectively; there was no statistical significance between the 2 groups (p>0.01).

Characteristics of the Treated Surfaces

Figure 1 shows the photographs of Carisolv treatment by stereoscopic examination; (A) preoperative, and (B) following cavity preparation. It was revealed that Carisolv treatment did not widen and deepen pits and fissures; treated surfaces were smooth and regular. The wall and floor of the cavities were flat and almost clean of debris. SEM analysis showed that cavities that were not subjected to acid etching revealed debris particle scattered on the treated surfaces; enamel structures were not visualized (Fig. 2-A). However, in the acid etched cavities, debris particles were completely removed from the enamel surfaces, and thus the enamel prisms were clearly visible (Fig. 2-B).

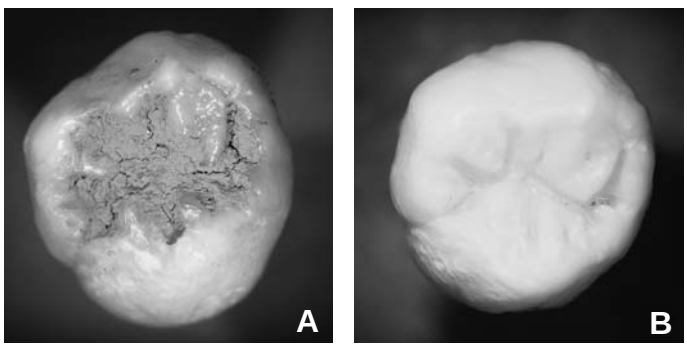

FIGURE 1: Stereoscopic photographs of the cavities following plaque removal with Carisolv (A) preoperative view (B) postoperative view

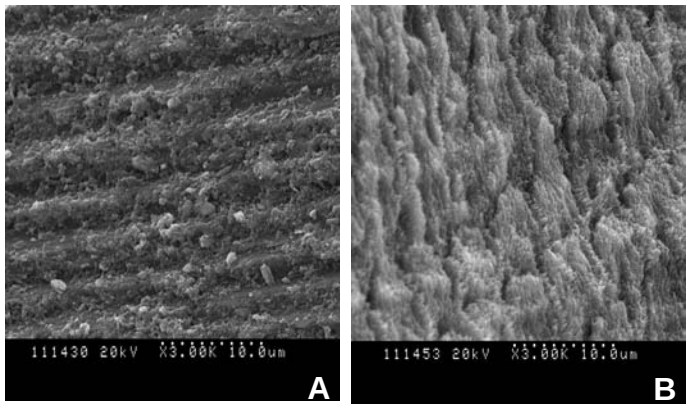

FIGURE 2: SEM photographs of the cavities subjected to Carisolv treatment. (A). un-etched cavities revealed debris-like smear layer scattered on the treated surfaces; enamel structures were not visualized (original magnification x 3000). (B). in the acid etched cavities, debris-like smear layer was completely removed from the enamel surfaces, and thus the enamel prisms were clearly visible (original magnification x 3000).

Figure 3 shows the photographs of bristle brush method with prophylaxis toothpaste treatment (control) by stereoscopic examinations; A) preoperative view, and B) cavity following treatment. The cavity surfaces treated with the bristle brush were regular without increasing the size of the fissures. With SEM, debris particles were also recognized on the treated surfaces of the cavities which were not exposed to acid etching; enamel structures were not visualized (Fig. 4-A). On the other hand, in the acid etched cavities, Debris particle removal was observed and enamel prisms were exposed (Fig. 4-B). Table 2 shows the degree of remaining debris as evaluated by 5-point debris scale. Significant differences were noted between Carisolv and control (p > 0.01).

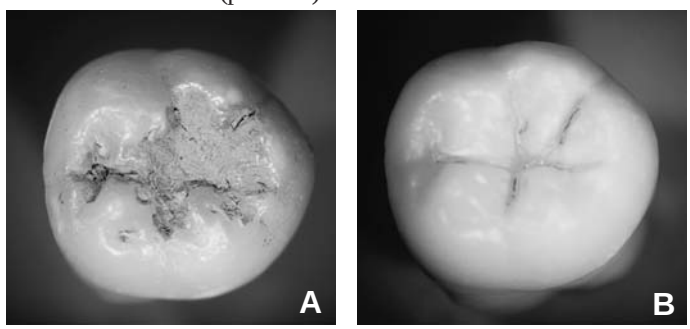

FIGURE 3: Stereoscopic photographs of the cavities following plaque removal with brush method; (A). preoperative view, (B). postoperative view

DISCUSSION

Previous studies have indicated that in the clinic, proper cleaning of pits and fissures followed by long term retention of the sealants is essential for caries reduction. Anatomical fissure structure (such as shallow or deep one) play an important role in sealant penetration and retention.[10] In our case an artificial fissure groove confined to the enamel to the depth of 1 mm for plaque condensation were prepared instead of using natural pits and fissures. This study model is originally based on a previous study[8] and useful for comparing different methods for plaque removal in pits and fissures.

Table 2. Results of remaining debris score

	1	2	3	4	5	6	7	8	9	10	mean	S.D
Carisolv (n=10)												
Un-etched (n=10)	3	2	2	1	1	1	1	1	1	2		1.50 ± 0.71^{a}
Etched (n=10)	1	1	0	0	1	1	0	0	1	2		0.70 ± 0.68^{a}
Bristle brush (n=10)												
Un-etched (n=10)	4	3	3	4	3	3	2	3	3	5		3.30 ± 0.82^{b}
Etched (n=10)	3	2	2	2	2	2	1	2	1	3		2.00 ± 0.67^{b}

[a,b] Significant difference ($p<0.01$)

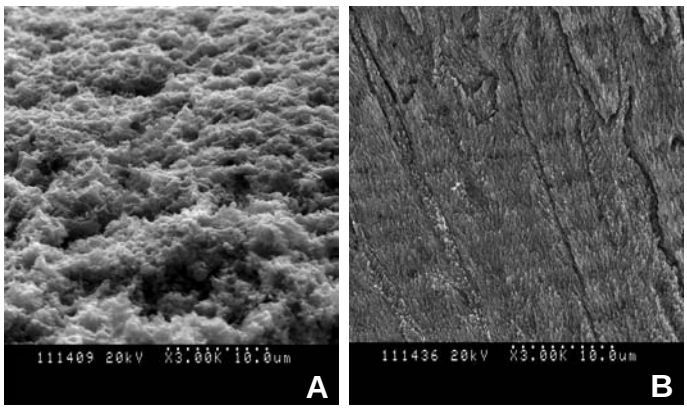

FIGURE 4: SEM photographs of the cavities subjected to brush method. (A). in the un-etched cavities, debris-like smear layer was also recognized; enamel structures were not visualized (original magnification x 3000). (B). in the acid etched cavities, removal of debris-like smear layer was observed and enamel prisms were exposed (original magnification x 3000).

Assessment during Fissure Cleaning

Fissure cleaning with the Carisolv system showed that it was possible to remove artificial plaque in a few minutes; no significant time difference for plaque removal was found between Carisolv and bristle brush methods. In the present study, plaque removal with Carisolv system was performed with a dental explorer instead of Carisolv hand instruments, because the diameters of hand instruments for Carisolv system were wider than the space of fissure groove. Carisolv has the following advantages: (1) Works as a chemical plaque removal and dissolves organic components of debris following a chemical reaction between NaOCl and organic substances and the presence of unetched areas can be minimal with this technique, (2) Antibacterial properties are accomplished by chloramines and sodium hypochlorite present in the product,[11] In contrast, bristle brush with prophylaxis paste frequently maintains residual materials and is unable to clean the enamel walls of the fissures completely.[12] Therefore, it can be considered that Carisolv system might remove plaque effectively and dentist can offer this service to patients as an alternative for prophylaxis.

Characteristics of the treated surfaces

This study was the first to examine the effect of Carisolv system on organic debris removal. SEM results in the present study demonstrated that the Carisolv-treated surfaces subjected to acid-etching possessed some notable features compared to the surfaces without acid-etching. Carisolv-treated surfaces without acid-etching displayed loosely attached debris layer. The debris decreased if cavities were acid etched .The loosely attached debris observed in the present study could interfere with adhesion of composite resin as reported in a previous study.[13] On the other hand, acid-etched cavities were free from debris particles and exposed enamel prisms; these features were almost similar to the structures of the Carisolv-treated surfaces with acid-etching.[14,15] It can be stated that anticipated differences between Carisolv and brush methods could be omitted if these surfaces were etched with phosphoric acid, because it was found that debris which is thought to decrease adhesion between composite resin and tooth structure was dramatically reduced by acid etching. Therefore, following plaque removal with the Carisolv system, it can be recommended that it is necessary to clean the cavity surface using the acid etching or highly acidic self-etching primer to increase sealant retention

ACKNOWLEDGEMENTS

This study was supported in part by Grants-in-Aid for Scientific Research (C) (18592099) from the Japan Society for the Promotion of Science (JSPS), and also supported by MEXT. HITEKU (2005-2009).

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