

Prevention of occlusal caries using a ozone, sealant and fluoride varnish in children

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SUMMARY

Objectives. To compare ozone with fissure sealants and fluoride varnish in the prevention of occlusal caries in permanent premolars of children in 12 months period.

Methods. A clinical trial was conducted on four groups of 10 years old schoolchildren: a group 1 – control group (n=50); a group 2 (n=21) in which fluoride varnish was applied and re-applied up to 12 months; a group 3 (n=17) in which sealant was applied and reapplied up to 12 months; and a group 4 (n=19) in which ozone was applied and re-applied up to 12 months. Percent caries reduction was studied in these initially healthy molars with complete occlusal eruption: 173 (control), 103 (varnish), 78 (sealants) and 103 (ozone) premolars met inclusion criteria. All patients were examined using DMFT index and Greene – Vermillion index at a baseline and in 6 months with a follow up period of 12 months. Each tooth was considered as the unit of the analysis. Data were analyzed using t-test and the chi-square tests.

Results. The prevalence of caries was: in group 1 – 3.5% (n=6), in group 2 and group 3 – 0% (n=0), in group 4 – 2.9%, (n=3). The changes in occlusal caries incidence between all groups were not statistically significant.

Conclusions. The placement of fissure sealant, application of fluoride varnish, and application of ozone – are recommended to use in prevention of occlusal pit and fissure caries in permanent premolars in children. Furthermore, they are not significantly different from one another in their effectiveness.

Keywords: ozone, fissure sealant, fluoride varnish, prevention, children.

INTRODUCTION

Dental caries is a highly prevalent chronic disease affecting a significant proportion of the world population, including around 60 to 90% of school children and the vast majority of adults (1). Oral health problems may affect psychological, social, and self-esteem functions, i.e. the so-called oral quality of life (OQL) of the individual (2).

Occlusal pit and fissure caries accounts for the majority of lesions in the age group of 8 to 15 – year olds (3). Special preventive methods are therefore needed if further caries reduction is to be obtained. Application of fissure sealants and fluoride varnishes are two preventive procedures for dental caries developed since 1960's (4).

Fluoride varnishes were originally developed to prolong the contact time between fluoride and dental enamel, as they adhere to the tooth surface for longer periods (12 hours or more) in a thin layer, and prevent the immediate loss of fluoride after application (5).

The effectiveness of fissure sealants in preventing caries on pit and fissures of children has been well documented (6). Fissure sealing aims to modify patent pits and fissures into smooth surfaces those are protected from bacterial colonization and exposure to fermentable substrate and can be cleaned easily (7). The superiority of pit and fissure sealants over fluoride varnish application in the prevention of occlusal carious lesions has been reported (8).

One of the preventive strategies to prevent the initiation of caries and to treat the disease is reducing the levels of caries associated bacterial species in dental plaque (9, 10). A novel concept ozone therapy has been introduced for the treatment of caries (11-13). Ozone gas, the tri-atomic state of di-oxygen, was proposed as an antimicrobial agent that could reduce the number of microorganisms on tooth surfaces. In

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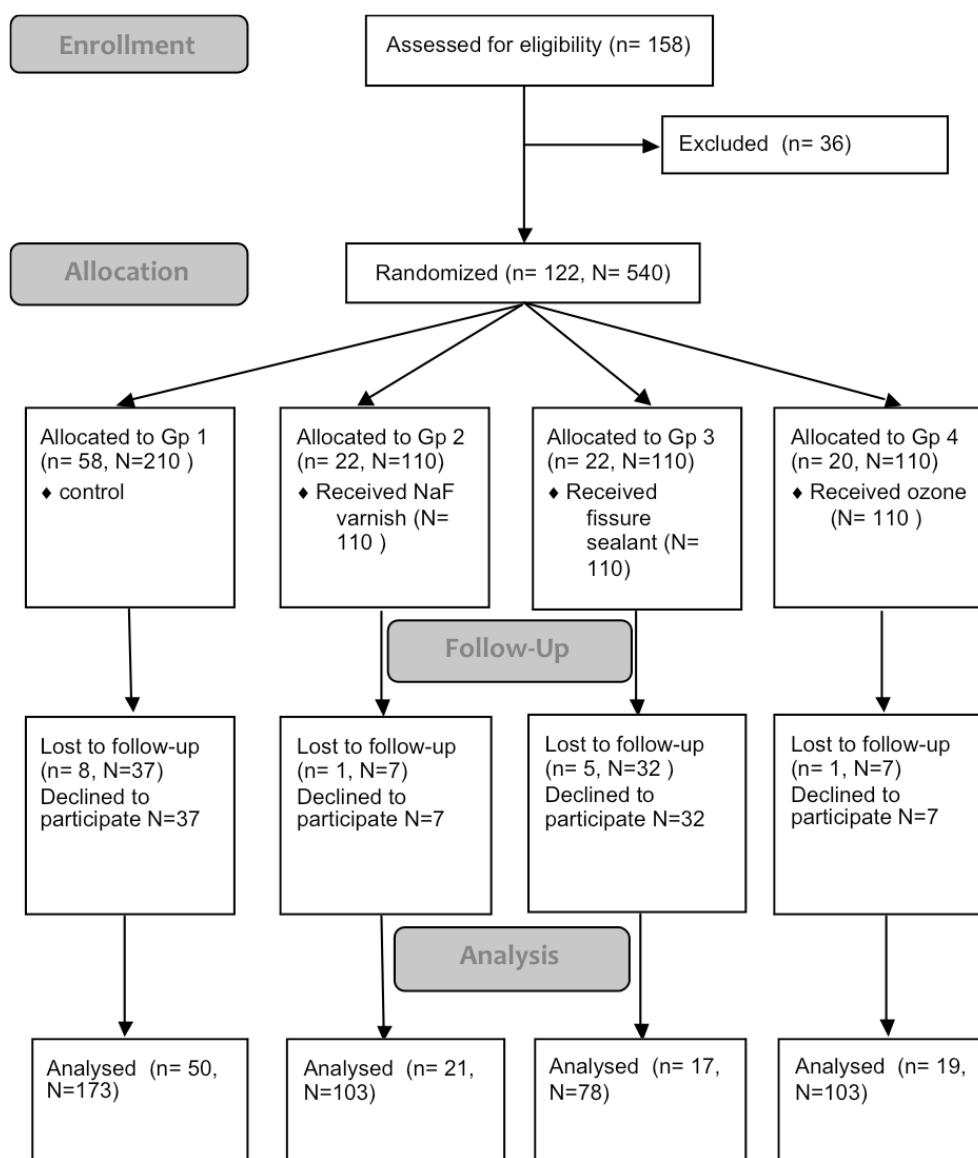


Fig. Flow of participants until 12 months in this study (n= number of participants, N= number of teeth)

dentistry, ozone is claimed to have a sterilizing effect, killing cariogenic bacteria and subsequently leading to the arrest of carious lesion (14, 15). Castillo et al (16) have evaluated the antimicrobial effect of ozone on *S. mutans*. Results showed that ozone application for 10 and 20 seconds produced a significant reduction in the number of bacteria.

There are relative few studies, which compare caries preventive methods with each other. The purpose of this study was to compare ozone with fissure sealants and fluoride varnish in the prevention of occlusal caries in permanent premolars of children in 12 months period.

MATERIALS AND METHODS

Study population

In 2012, 122 children (10 years of age) from Rīga Stradiņš University Institute of Stomatol-

ogy (Latvia), with at least one healthy and fully erupted premolar were selected for the study. Dental caries occurs mostly in molars, that is why was selected premolars. Rīga Stradiņš University Ethics Committee approved study.

Study design

The study design is depicted in Figure. The study was conducted for a period of 12 months.

Power Estimation

In order to detect statistically significant (at 5% significant level) difference in caries incidence rate between ozone and control group, taking into account 3.5% incidence in relevant age group in general population and anticipated 0.1% caries incidence in ozone group, the number of teeth to be prevented in ozone

group should be not less than 22 and number of teeth in control group should be not less than 65. Therefore 20 participants in ozone group and 58 in control group provide study power not less than 80%.

Clinical Examination and Data Collection

Dental status for all teeth was recorded according to WHO criteria (17) and the DMFT values were calculated. Dental caries were diagnosed clinically and detected visually. The recorded status not included sign of early caries. BW radiographs were taken at baseline and after 12 months. The Simplified Oral Hygiene Index (OHI-S) (Greene and Vermillion, 1964) was recorded with the use of disclosing solution (*Curaprox Plaque Finder Liquid, Curadent Swiss, Australia*). One dentist plus an assistant carried out application of the sealant, fluoride varnish and ozone in the clinic.

Information on the child's tooth brushing habits, snacking habits, and family related factors were collected through a questionnaire to identify significant differences among the groups at baseline.

All children were divided among four groups: (1) control; (2) fluoride varnish; (3) fissure sealant and (4) ozone.

Control group

In group (1) selected 173 premolars were examined for occlusal caries without any intervention.

Fluoride varnish

In group (2), fluoride varnish (*Fluocal solute, Septodont, France*) was applied on to 103 premolars occlusal surface with an applicator brush left in place for 1 minute. After the application subject was made to expectorate and advised not to rinse the mouth for 4 hours and also not to brush until the following day.

Sealant application

After prophylaxis and polishing of the selected 78 premolars in group (3), acid etchant (37% orthophosphoric acid) was applied to the pits and fissures and rinsed after 15 seconds. After drying, sealant (*Clinpro 3M ESPE Dental products, St. Paul, USA*) was applied. Articulating paper was used to check for high points and was removed with a micro motor using a polishing bur.

Ozone treatment

In group (4), ozone (*Prozone, W&H, Austria*) was applied on 103 premolars to 6 seconds. After treatment with ozone, remineralizing solution was applied on to occlusal surface with an applicator brush left in place for 1 minute. After the application subject was made to expectorate and advised not to rinse the mouth for 4 hours.

Recall

The teeth were evaluated in all the four groups for occlusal caries (not initial caries lesions) in permanent premolars at 6, 12 months. Varnish was reapplied at 6, 12 months. In group 3 the condition of the sealant on each tooth was assessed as completely retentive, partly lost or completely lost (18). After brushing instructions, fissures were resealed if necessary and not applied in case of evidence of caries. Ozone treatment was repeated on each of these two recall visits. Analysis of the efficacy of the preventive procedures was based on the occlusal caries status or premolars. Dental status for all teeth and the Simplified Oral Hygiene Index (OHI-S) were recorded after 6 and 12 months.

Statistical Analysis

SPSS – Windows v.20 was used for the analysis of the data. When the premolar was considered as

the unit of analysis, only premolars that were healthy and fully erupted at the beginning of the study, and were followed at 12 months, were included in the analysis. A Chi-square test and Fisher exact test have been used to test the significance of difference in the incidence of occlusal surface caries between four groups, and significance of difference in the prevalence of caries risk factors (child's tooth brushing habits, snacking habits, family related factors). Kruskal-Wallis test has been used to find the significance of means DMFT between four groups.

RESULTS

540 premolars in ten years old 122 children were included. 15 children dropped out of the study after 12 months. In total, 107 children (56 boys, 51 girls), with 457 premolars (173 control, 103 varnished, 78 sealed and 103 ozoned) were followed for 12 month.

There were no significant differences in sex, age or baseline caries scores between the 107 followed children and 15 lost to follow up (results not shown).

The control, sealant, fluoride varnish and ozone groups were not significantly different for any of the variables (Table 1). Distribution of the study participants in the four groups according to different caries risk factors at baseline, shown at Table 2.

At baseline average DMFT index in all the four groups show average score – 1.97. After 12 month it increased till 2.96 ($p < 0.001$). Mean Simplified oral hygiene (OHI-S) Green-Vermillion index was 2.21 at baseline, but after 12 month it decreased till 1.90 ($p < 0.001$).

At 12 month follow up 6 occlusal surfaces (3.5%) out of 173 surfaces were carious in control group, 3 surfaces (2.9%) out of 103 surfaces were carious in ozone group. In sealant and fluoride varnish groups were no caries development (0%). Percentage of caries incidence was less when sealant and varnish groups were compared to control group, but it was not statistically significant. The changes in occlusal caries incidence between all groups were no statistically significant ($p = 0.106$).

DISCUSSION

The goals of preventive dentistry are to avoid disease altogether. Minimal Intervention Dentistry attempts to ensure that teeth are kept functional for life (19). Several existing methodologies are available to enable successful prevention of dental caries. Understanding the balance between pathological factors and protective factors is the key (20).

Based on the study findings, DMFT index was 1.97 and can be classified as low caries prevalence according to WHO data. After 12 month it increased till 2.96. This could be explained by the increase in the number of permanent teeth in mixed dentition period. Mean Simplified oral hygiene (OHI-S) Green-Vermillion index was 2.21, although after 12 month it decreased till 1.90, still means fair oral hygiene.

Vanobbergen *et al.* assessed caries risk factors for the mixed dentition. Children were examined

for dental caries at age 7 and at age 10. This study reported that the daily use of sugar-containing drinks between meals increased the risk of having cavitated caries increment (21). Our study reported that the control, sealant, fluoride varnish and ozone groups were not significantly for different caries risk factors at baseline, which could affect the study results.

Occlusal caries incidence in control group at 6 months showed 4 (2.3%) carious surfaces, at 12 months 2 (1.2%) surfaces were carious as compared to study by Uma *et al.* (22), where 14 (8.3%) sur-

Table 1. Decayed, missing, filled and total DMFT at baseline. Results are presented in Mean (IQR)

Parameters	Control group	Sealant group	Varnish group	Ozone group	p value
Decayed (D)	0.76 (0-5.0)	0.94 (0-8.0)	0.48 (0-4.0)	0.47 (0-2.0)	0.592
Missing (M)	0.02 (0-1.0)	0	0.05 (0-1.0)	0.05 (0-1.0)	0.741
Filled (F)	1.32 (0-5.0)	1.65 (0-6.0)	0.67 (0-4.0)	1.42 (0-4.0)	0.227
DMFT	2.1 (0-6.0)	2.59 (0-13.0)	1.19 (0-5.0)	1.95 (0-5.0)	0.200
Green-Vermillion index	2.24 (0.67-4.83)	2.16 (1-3.83)	2.33 (0.67-4.5)	2.01 (0.83-4.33)	0.751

Table 2. Distribution of the study participants in the four groups according to different factors at baseline

Factors	Group				p-value	
	Control	Sealant	Varnish	Ozone		
Family-level						
Family marital status, n (%)						
• Married	38 (74%)	15 (82%)	13 (65%)	15 (83%)	NS	
• Unmarried	5 (10%)	1 (6%)	2 (10%)	0 (0%)		
• Divorced	6 (12%)	1 (6%)	4 (20%)	2 (11%)		
• Widower	1 (2%)	0 (0%)	0 (0%)	0 (0%)		
• Other status	1 (2%)	1 (6%)	1 (5%)	1 (6%)		
Parents education level, n (%)						
• Mother						
- Higher	32 (63%)	12 (67%)	12 (60%)	8 (44%)	p>0.05	
- Secondary	18 (35%)	6 (33%)	8 (40%)	10 (56%)		
- Elementary	1 (2%)	0 (0)	0 (%)	0 (%)		
• Father						
- Higher	20 (40%)	9 (50%)	5 (25%)	5 (28%)		
- Secondary	29 (58%)	9 (50%)	15 (75%)	11 (61%)		
- Elementary	1 (2%)	0 (%)	0 (0%)	2 (11%)		
Parents age, mean (SD)						
• Mother	37.17 (4.60)	38.44 (4.96)	38.95 (3.87)	39.61 (5.68)	NS	
• Father	39.92 (4.28)	41.17 (7.98)	39.90 (4.87)	41.50 (7.69)		
Participant-level						
Snacking habit, n (%)						
• No	3 (30%)	2 (11%)	1 (5%)	4 (22%)	NS	
• Yes	48 (70%)	16 (89%)	19 (95%)	14 (78%)		
• Times, mean (SD)	2.43 (1.17)	2.06 (0.57)	2.63 (1.01)	2.27 (1.16)		
Tooth brushing habit, n (%)						
• Once a day	15 (29%)	8 (44%)	8 (40%)	4 (22%)	NS	
• Twice or more a day	29 (57%)	10 (56%)	11 (55%)	10 (56%)		
• Irregular	7 (14%)	0 (%)	1 (5%)	4 (22%)		
Fluoride toothpaste, n (%)						
• Yes	33 (65%)	13 (72%)	15 (75%)	13 (72%)	NS	
• No	1 (2%)	1 (6%)	0 (0%)	0 (%)		
• Unknown	7 (33%)	4 (22%)	5 (25%)	5 (28%)		

NS – non-significant.

faces, 29 (20.9%) surfaces were carious at 6 and 12 month respectively. At 6 month follow up 3 (2.9%) occlusal surfaces out of 103 surfaces were carious in ozone group. In sealant and fluoride varnish groups were no caries development. Percentage of caries incidence was less when sealant and varnish groups were compared to control group, but it was not statistically significant. For caries, that take a long time to develop, substantial bias may arise in survival analysis if the observation period is relatively short (23).

The advantage of fluoride varnish is its ability to adhere to tooth surfaces, which prolongs contact time between fluoride and enamel and improves fluoride uptake into the surface layers of enamel. Topical fluoride application is technically simple, does not require powered dental equipment, and may be performed by trained health personnel. These are advantages for its use in dental public health programs for prevention of dental caries in schoolchildren.

Sealants are placed to prevent caries initiation and to arrest caries progression by providing a physical barrier that inhibits microorganisms and food particles from collecting in pits and fissures. It is generally accepted that the effectiveness of sealants for caries prevention depends on long-term retention. There is evidence that fissure sealants are

more effective in reducing decay in occlusal surfaces than fluoride varnish (24, 25).

Pertinent literature exists with respect to effectiveness of sealants and varnish in caries prevention as compared to the control. Liu et.al (23) concluded that placement of resin sealant, semi-annual application of NaF varnish, and annual application of silver diamine fluoride solution are all effective in preventing pit and fissure caries in permanent molars. However there are no studies, which compare fluoride varnish, sealants and ozone. Results of the present study cannot be exactly compared with other studies as the study period and the age group of the subjects varies.

CONCLUSIONS.

Based on the 12 month results and within the limitations of this study, it is concluded that the 3 preventive methods – placement of fissure sealant, application of fluoride varnish, and application of ozone – are recommended to be used in prevention of occlusal pit and fissure caries in permanent premolars in children. Furthermore, they are not significantly different from one another in their effectiveness. However, more information is needed from studies on long-term outcomes and economic evaluation.

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