# Use of occlusal sealant in a community program and caries incidence in high- and low-risk children

**Vânia BALDINI[1], Elaine Pereira da Silva TAGLIAFERRO[2], Gláucia Maria Bovi AMBROSANO[3], Marcelo de Castro MENEGHIM[4], Antonio Carlos PEREIRA[5]**

1- DDS, MSc, Faculty of Dental Medicine, University of Lisboa, Lisboa, Portugal.
2- DDS, MSc, PhD, Post-doctorate, Department of Community Dentistry, Piracicaba Dental School, University of Campinas – UNICAMP, Piracicaba, SP, Brazil.
3- Agr. Eng., MSc, PhD, Professor, Department of Community Dentistry, Piracicaba Dental School, University of Campinas – UNICAMP, Piracicaba, SP, Brazil.
4- DDS, MSc, PhD, Professor, Department of Community Dentistry, Piracicaba Dental School, University of Campinas – UNICAMP, Piracicaba, SP, Brazil.
5- DDS, MPH, DrPH, Professor, Department of Community Dentistry, Piracicaba Dental School, University of Campinas – UNICAMP, Piracicaba, SP, Brazil.

**Corresponding address:** Antonio Carlos Pereira - Faculdade de Odontologia de Piracicaba - UNICAMP - Departamento de Odontologia Social
Av. Limeira, 901 - Piracicaba, SP - 13414-903 - Brazil - Phone: +55 19 2106-5209 - Fax: +55 19 2106-5218 - e-mail: apereira@fop.unicamp.br

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## ABSTRACT

Objective: The aims of this study were to investigate the effectiveness of sealant placement under the guidelines of the Oral Health Promotion Program for Children and Adolescents (Portugal), and to test the influence of clinical and socioeconomic variables on the DMFT increment in 277 children, born in 1997. Material and Methods: A dental hygienist performed the initial examinations and sealant placement (Helioseal, Vivadent) on the permanent first molars in 2005. These activities were registered in dental records that were assessed in 2007. Children were classified according to caries risk at baseline [high (HR: DMFT+dmft>0); low (LR: DMFT+dmft=0) risk] and sealant placement as follows: HR-S and LR-S Groups (with sealant placement); HR-NS and LR-NS Groups (without sealant placement). A calibrated dentist performed the final examination in 2007 at school, based on the World Health Organization recommendations. The variables collected were: dental caries, visible dental plaque, malocclusions, and socioeconomic level (questionnaire sent to children's parents). For univariate (Chi-square or Fisher tests) and multivariate (Multiple logistic regression) analyses the DMFT increment >0 was selected as dependent variable. Results: Approximately 17.0% of the children showed DMFT increment>0 (mean=0.25). High-risk children presented a significant increase in the number of decayed and/or filled teeth. These children had 7.94 more chance of developing caries. Children who did not receive sealant were 1.8 more prone to have DMFT increment >0. Conclusion: It appears that sealant placement was effective in preventing dental caries development. Moreover, the variables "risk" and "sealant placement" were predictors for DMFT increment in the studied children.

**Key words:** Dental caries. Fissure sealants. Preventive dentistry. Risk.

## INTRODUCTION

In recent decades, decreasing prevalence in dental caries has been observed worldwide[9,19,32]. The slower progression of lesions[22], the unequal distribution of disease[2], with about 80% of caries experience is concentrated in 20-30% of the population[10,25,31], and the concentration of new lesions on occlusal surfaces of permanent molars[8,12,26] have also been noted.

Indeed, several studies have shown that occlusal caries account for the majority of the total caries experience in children and adolescents[8,11,12,21,24,25]. An effective procedure for protecting the occlusal surfaces of permanent molars is the application of pit-and-fissure sealants[1,5,14,28], the resin-based type being the most commonly used[3,13].

In Portugal, from 1999 to 2005, the Oral Health Promotion Program for Children and Adolescents (PPSOCA - *Programa de Promoção da Saúde Oral em Crianças e Adolescentes*) included: a) diet and oral hygiene instructions, fluoride mouthrinse fortnightly for all children and adolescents (Basic Oral Health Program); b) sealant placement on all

permanent first molars in children aged up to 7 years, in premolars and second permanent molars in those aged up to 13 years, under a population strategy, attending the maximum number of children according to the financial and human resources available (specific program of sealant placement); and c) restorative care (intervention program).

Since 2005, some modifications have been made and the PPSOCA was re-named as the National Oral Health Program (PNPSO - *Programa Nacional de Saúde Oral*). The most important changes were: toothbrushing in the school environment, individual and community risk assessment for dental caries and specific measures for individuals at high caries risk, such as sealant placement, use of fluoride varnish or chlorhexidine.

The aims of this study were to investigate the effectiveness of a resin-based sealant placement following the PPSOCA guidelines and to test the influence of clinical and socioeconomic variables on caries incidence after 2 years of follow-up.

## MATERIAL AND METHODS

### Ethical aspects

The study was approved by the Research Ethics Committee of the School of Dental Medicine, University of Lisboa (Protocol number 6/2006). An informed consent form was signed by the parents/guardians before starting the survey.

### Study location

In the Sintra region (Portugal), the PPSOCA/PNPSO has been developed by a dental hygienist, which differs from other regions of the country where the first was carried out by nurseries. One out of 5 Health Centers in the Sintra region (Cacem Health Center) assisted the largest number of children, with organized dental records and was thus selected for the study.

### Sample

This study was conducted from 2005 to 2007. The dental records of 854 children who were born in 1997 and attended the PPSOCA at the Cacem Health Center were tracked. Among them, some did not have all their permanent first molars in 2005 (n=71) and others were not available for examination (n=157). Therefore, the final population included 626 children. As much as 349 parents/guardians did not return the informed consent form in 2007, thus 277 children (44.3% response rate) were reexamined in 2007. The sample size was calculated considering the significance level of 5%, DMFT=0.17, standard deviation=0.46, both of them obtained in a pilot study, and power of the test=0.80.

### Children's allocation

The dental records completed in 2005 were evaluated. The DMFT/dmft were calculated and the status of the permanent first molars was recorded. Considering that past caries experience has been an excellent predictor, as shown in several studies[16,18,29,30,33], and has also proved to be a practical and effective predictor for use in community health[6], the children were classified according to caries risk [HR=high caries risk when DMFT+dmft>0; LR=low caries risk when DMFT+dmft=0)] and sealant placement on the permanent first molars, as follows:

HR-S Group: children with DMFT+dmft>0 submitted to sealant placement

LR-S Group: children with DMFT+dmft=0 submitted to sealant placement

HR-NS Group: children with DMFT+dmft>0

LR-NS Group: children with DMFT+dmft=0

### Calibration process, dental examination and sealant placement

A dental hygienist performed the baseline examinations and sealant placement in 2005, and these activities were registered in dental records.

Prior to sealant placement, the permanent first molars were cleaned using a brush attached to a rotary instrument with pumice slurry and washed. The teeth were etched with 37% phosphoric acid for 30 s, washed for 15 s and air-dried. The light-curing fissure sealant Helioseal (Ivoclar, Vivadent, Schaan, Liechtenstein) was then applied directly to the pits and fissures according to the manufacturer's instructions, under isolation with cotton rolls.

In 2007, a dentist evaluated the 2005 dental records and performed the final examination of the sealants after being calibrated and trained in theoretical and practical exercises by two experienced professionals of the School of Dental Medicine, who used the World Health Organization criteria[35] and the Assaf, et al.[4] (2006) criteria. To assess the examiner's consistency, duplicate examinations were conducted in 20 children in a 7-day-interval, reaching a kappa value higher than 0.85. Dental examinations were performed at school in well-lit classrooms, using natural light, dental mirrors and CPI probes with the children seated in front of the examiner. The clinical variables collected were: dental caries, dentofacial anomalies (open bite, cross bite, edge-to-edge bite, overbite, crowding)[35] and visible dental plaque (labial surface of teeth 16, 26, 41, and 21; lingual surface of teeth 36 and 46)[15].

### Questionnaire

A socioeconomic questionnaire based on that of Meneghim, et al.[20] (2007) with some adjustments for spelling, income and education was sent to

**Table 1-** Univariate analysis for association between DMFT increment and independent variables

| Variable | DMFT increment>0 | | p-value* |
|---|---|---|---|
| | Yes n (%) | No n (%) | |
| **Group**** | | | |
| HR-S | 20 (22.2) | 70 (77.8) | 0.0001 |
| LR-S | 1 (1.6) | 63 (98.4) | |
| HR-NS | 22 (31.0) | 49 (69.0) | |
| LR-NS | 4 (7.8) | 47 (92.2) | |
| **First permanent molars sealed** | | | |
| Yes | 21 (13.6) | 133 (86.4) | 0.0921 |
| No | 26 (21.3) | 96 (78.7) | |
| Risk | | | |
| High | 42 (26.1) | 119 (73.9) | <0.0001 |
| Low | 5 (4.4) | 110 (95.6) | |
| **Dental plaque** | | | |
| <2 | 4 (19.0) | 17 (81.0) | 0.592 |
| 2 | 28 (15.4) | 154 (84.6) | |
| >2 | 15 (20.6) | 58 (79.4) | |
| **Spacing** | | | |
| Yes | 10 (20.4) | 39 (79.6) | 0.4877 |
| No | 37 (16.3) | 190 (83.7) | |
| **Crowding** | | | |
| Yes | 9 (18.4) | 40 (81.6) | 0.4459 |
| No | 32 (14.1) | 195 (85.9) | |
| **Overjet** | | | |
| Yes | 3 (10.7) | 25 (89.3) | 0.4365 |
| No | 44 (17.7) | 204 (82.3) | |
| **Overbite** | | | |
| Yes | 0 (0.0) | 14 (100.0) | 0.1376 |
| No | 47 (17.9) | 215 (82.1) | |
| **Crossbite** | | | |
| Yes | 4 (20.0) | 16 (80.0) | 0.7568 |
| No | 43 (16.8) | 213 (83.2) | |
| **Open bite** | | | |
| Yes | 5 (23.8) | 16 (76.2) | 0.3898 |
| No | 42 (16.5) | 213 (83.5) | |
| **Edge-to-edge bite** | | | |
| Yes | 0 (0.0) | 8 (100.0) | 0.3587 |
| No | 47 (17.5) | 221 (82.5) | |
| **Home ownership** | | | |
| Yes | 39 (17.6) | 182 (82.4) | 0.3175 |
| No | 8 (25.0) | 24 (75.0) | |
| **Number of people living in the household** | | | |
| ≤4 people | 36 (17.1) | 174 (82.9) | 0.5397 |
| >4 people | 11 (20.8) | 42 (79.2) | |
| **Mother's education** | | | |
| ≤9 years of schooling | 28 (19.4) | 116 (80.6) | 0.2875 |
| >9 years of schooling | 15 (14.3) | 90 (85.7) | |
| **Monthly family income** | | | |
| Up to 2 minimum wages*** | 15 (16.3) | 77 (83.7) | 0.8791 |
| 2-6 minimum wages | 23 (18.7) | 100 (81.3) | |
| >6 minimum wages | 6 (19.4) | 25 (80.6) | |

*Chi-square or Fisher's Exact tests ($\alpha$=0.05)

**HR: high caries risk; LR: low caries risk; S: sealed permanent first molars; NS: not sealed permanent first molars

***Minimum wage at the time of the data collection=€ 403.00

children's parents. In order to classify the children's socioeconomic level, the following variables were collected: home ownership, number of people living in the household, mother's education, monthly family income, and parents' occupation.

### Data analysis

For univariate and multivariate analyses the DMFT increment >0 was selected as dependent variable. In the univariate analysis (Chi-square or Fisher tests) variables related to treatment group, dental plaque, malocclusion, and socioeconomic level were tested with the dependent variable. Those with $p<0.15$ were selected for the multiple logistic regression. After adjusting the regression model, the values of Odds Ratio, their 95% confidence interval and p-values were estimated. The Kruskal-Wallis and Dunn tests, at a 5% level of significance, were used to compare differences between the study groups as regards the increase in the number of decayed and filled teeth after 2 years. The Mann-Whitney test was used to compare differences between the HR-S and HR-NS groups in relation to DMFT at baseline. All statistical tests were performed using the SPSS (version 13.0) and Statistic (version 6.0) programs.

## RESULTS

The mean DMFT values at baseline/final examination were 0.40/0.73, 0.00/0.02, 0.46/0.89 and 0.00/0.16 for the HR-S, LR-S, HR-NS and LR-NS groups, respectively. There was no statistically significant difference between HR-S and HR-NS in relation to DMFT at baseline ($p>0.05$). Approximately 17.0% (n=47) of the children showed a DMFT increment>0 after 2 years (mean DMFT increment=0.25). Among them, 44.7% (n=21) participated and 55.3% (n=26) did not participate in the specific sealant placement program.

Table 1 shows the univariate analysis for association between DMFT increment >0 and independent variables. Only the variables "group" and "risk" showed statistically significant association with DMFT increment>0. Data distribution showed that among those with DMFT increment the majority (31%) belonged to the HR-NS group. However, when testing the participation in the Sealant Program with DMFT increment, no statistical difference was observed ($p>0.05$).

Table 2 shows the results of the logistic regression analysis. The children who where not submitted to sealant placement were 1.8 more prone to have DMFT increment>0. The high-risk children had 7.94 more chance of developing caries, irrespective of whether or not they had received a sealant in the studied period.

Table 3 shows the increase in the number of decayed and/or filled teeth after 2 years from baseline in the different groups. High-risk children not submitted to sealant placement showed the highest increase in the number of decayed teeth. However, they did not differ from high-risk children submitted to sealant placement. Significant differences ($p<0.05$) were also found between high- and low-risk individuals, irrespective of participation in the sealant program.

Table 4 shows the status of the permanent first molars at baseline and final examinations. There was a clear increase in the number of first molars sealed/restored in the sealant program participants. Moreover, the highest percentage of decayed teeth was observed in high-risk children not submitted to a sealant placement.

**Table 2-** Multiple logistic regression with DMFT increment>0 as dependent variable

| Variable | Estimate | Standard error | Wald chi-square | DMFT increment >0 n (%) | Odds Ratio | 95% Confidence Interval | p-value |
|---|---|---|---|---|---|---|---|
| Intercept | 2.06 | 0.25 | 69.86 | | | | <0.0001 |
| | | | | | | | |
| First permanent molars sealed | | | | | | | |
| Yes | | | | 21 (13.6) | 1 | | |
| No | 0.3 | 0.17 | 3.09 | 26 (21.3) | 1.81 | 0.93-3.50 | 0.0767 |
| | | | | | | | |
| Risk | | | | | | | |
| Low | | | | 5 (4.4) | 1 | | |
| High | -1,03 | 0.25 | 17.63 | 42 (26.1) | 7.94 | 3.01-20.80 | <0.0001 |

AIC (Akaike Information Criteria)=228.83 -2LogL=222.83

**Table 3-** Increase in the number of decayed and filled teeth after 2 years from baseline, according to the groups

| Teeth status | Group* | Mean** | Standard Deviation | Median | Minimum | Maximum |
|---|---|---|---|---|---|---|
| Decayed Teeth | HR-S | 0.09$^{ab}$ | 0.32 | 0 | 0 | 2 |
| | LR-S | 0.02$^{c}$ | 0.12 | 0 | 0 | 1 |
| | HR-NS | 0.14$^{a}$ | 0.35 | 0 | 0 | 1 |
| | LR-NS | 0.04$^{bc}$ | 0.2 | 0 | 0 | 1 |
| Filled Teeth | HR-S | 0.24$^{a}$ | 0.32 | 0 | 0 | 2 |
| | LR-S | 0.00$^{b}$ | 0 | 0 | 0 | 0 |
| | HR-NS | 0.28$^{a}$ | 0.7 | 0 | 0 | 3 |
| | LR-NS | 0.12$^{b}$ | 0.2 | 0 | 0 | 1 |
| Decayed +Filled Teeth | HR-S | 0.33$^{a}$ | 0.69 | 0 | 0 | 3 |
| | LR-S | 0.02$^{b}$ | 0.12 | 0 | 0 | 1 |
| | HR-NS | 0.42$^{a}$ | 0.74 | 0 | 0 | 3 |
| | LR-NS | 0.16$^{b}$ | 0.64 | 0 | 0 | 4 |

*HR: high caries risk; LR: low caries risk; S: sealed permanent first molars; NS: not sealed permanent first molars
**Means followed by distinct letters are statistically different by the Kruskal-Wallis and Dunn tests ($p<0.05$)

**Table 4-** Status (Sound: code 0; decayed: codes 1 and 2; filled: code 3; sealed: code 6 of DMFT index according to the WHO recommendations) for the permanent first molars at baseline and final examinations, according to the groups

| Group* | Tooth | Tooth status n (%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Sound at BL** | Sound at FE** | Decayed at BL | Decayed at FE | Filled at BL | Filled at FE | Sealed at BL | Sealed at FE |
| HR-S | 16 | 85 (94.4) | 24 (26.7) | 4 (4.4) | 4 (4.4) | 0 (0.0) | 7 (7.8) | 1 (1.1) | 55 (61.1) |
| | 26 | 80 (88.9) | 15 (16.7) | 8 (8.9) | 4 (4.4) | 0 (0.0) | 11 (12.2) | 2 (2.2) | 60 (66.7) |
| | 36 | 77 (85.6) | 11 (12.2) | 13 (14.4) | 5 (5.6) | 0 (0.0) | 17 (18.9) | 0 (0.0) | 57 (63.3) |
| | 46 | 79 (87.8) | 11 (12.2) | 9 (10.0) | 6 (6.7) | 1 (1.1) | 12 (13.3) | 1 (1.1) | 61 (67.8) |
| LR-S | 16 | 64 (100.0) | 10 (15.6) | 0 (0.0) | 1 (1.6) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 53 (82.8) |
| | 26 | 64 (100.0) | 8 (12.5) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 56 (87.5) |
| | 36 | 64 (100.0) | 6 (9.4) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 58 (90.6) |
| | 46 | 64 (100.0) | 7 (10.9) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 57 (89.1) |
| HR-NS | 16 | 59 (91.1) | 47 (66.2) | 6 (8.4) | 7 (9.9) | 3 (4.2) | 7 (9.9) | 3 (4.2) | 10 (14.1) |
| | 26 | 62 (87.3) | 45 (63.4) | 3 (4.2) | 9 (12.7) | 1 (1.4) | 5 (7.0) | 5 (7.0) | 12 (16.9) |
| | 36 | 58 (81.7) | 45 (63.4) | 9 (12.7) | 6 (8.4) | 1 (1.4) | 7 (9.9) | 3 (4.2) | 13 (18.3) |
| | 46 | 56 (87.5) | 40 (56.3) | 11 (8.3) | 9 (12.7) | 2 (2.8) | 13 (18.3) | 5 (7.0) | 9 (12.7) |
| LR-NS | 16 | 46 (90.2) | 40 (78.4) | 0 (0.0) | 1 (2.0) | 0 (0.0) | 1 (2.0) | 5 (9.8) | 9 (17.6) |
| | 26 | 46 (90.2) | 39 (76.5) | 0 (0.0) | 1 (2.0) | 0 (0.0) | 1 (2.0) | 5 (9.8) | 10 (19.6) |
| | 36 | 43 (84.3) | 40 (78.4) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 2 (3.9) | 8 (15.7) | 9 (17.6) |
| | 46 | 45 (88.2) | 41 (80.4) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 2 (3.9) | 6 (11.8) | 8 (15.7) |

*HR: high caries risk; LR: low caries risk; S: sealed permanent first molars; NS: not sealed permanent first molars
**BL: baseline; FE: final examination

## DISCUSSION

The results showed that the DMFT increment found in 17% of the children was statistically associated with risk, as shown in Table 1. Moreover, those classified as high-risk children at baseline (DMFT+dmft>0) were about 8 times more likely to have DMFT increment compared with caries-free children (Table 2). These results confirm previous studies that showed past caries experience to be a

strong predictor of future caries[16-18,29,30] and confirm the importance of using the correct risk assessment to identify the most caries-susceptible individuals, thus targeting them for preventive care.

The results also showed a trend towards better results for those submitted to sealant placement (Table 1), which is in line with other studies that demonstrate the effectiveness of sealants in high-risk groups[34]. On the other hand, the DMFT increment in 31% of children without sealant placement (HR-NS group) demonstrates that there is a real need for specific measures for this group and that the population strategy alone (oral health education + fluoride mouthrinse) was not sufficient (Table 1).

As regards low-risk children only 1 child submitted to sealant placement (1.6%) developed caries, while among those without sealant, 4 children (7.8%) developed caries. This difference, however, was not statistically significant ($p>0.05$; Table 3). Therefore, one must calculate the cost-effectiveness of applying sealants in low-risk groups because there may be other preventive measures such as the use of fluoride, toothbrushing instructions, capable of achieving the same results.

This study also assessed the influence of clinical and socioeconomic variables on caries incidence. The presence of plaque is usually linked to high rates of dental caries[17]. This study showed different results (Table 1), probably due to the use of the Simplified Oral Hygiene index without dye. This was done in order to not disturb the school class routines. Variables related to malocclusions were also not statistically associated with DMFT increment (Table 1).

The socioeconomic level has been strongly associated with caries prevalence[27]. Our results differed from published data, possibly because this study was designed to measure caries incidence. However, most children who lived in their own house, with fewer than 4 persons, parents with over 9 years of schooling and families with a monthly income of over 6 minimum wages, showed no increment in DMFT (Table 1), indicating the important role of socioeconomic characteristics in caries development.

The significant increase in the number of decayed and/or filled teeth after 2 years in high-risk individuals (Table 3), with or without sealed permanent molars, demonstrated that these children need specific preventive care, in addition to care targeting all the children. Oulis and Berdouses[23] (2009) evaluated the effectiveness of fissure sealants applied to permanent first molars on caries reduction, in a sample of children with low, moderate and high caries risk. The results demonstrated that the highest percentage of teeth that developed caries was found in the high risk group. The findings indicate that high risk children may demand a great attention from the oral health team, who should bear in mind that high risk and population strategy should be taken together in order to improve the children's overall health[7].

An increase in the number of sealed/filled first molars could be detected in children who had been submitted to the sealant placement (Table 4). The fact that the majority of permanent molars were healthy at baseline demonstrated that this was an excellent time to take preventive measures. At final examination, the HR-NS group showed a higher percentage of decayed permanent molars, demonstrating the importance of having a good team of professionals working on preventive care.

It is important to emphasize that this study was developed within an oral health program targeting Portuguese children from Sintra region. The Cacem Health Center was selected because the largest number of children was treated there and it presented organized dental records, while other health centers in the same region had some problems about that. Though this study had been carried out in a bounded area, probably the results can be inferred for whole region because children live in the same socioeconomic conditions. A limitation that should be mentioned is the difficulty in controlling the dental treatments that each child received besides the PPSOCA protocol, such as sealants placed by other dentists.

In conclusion, it appears that sealant placement was effective in preventing dental caries development. Moreover, the variables "risk" and "sealant placement" were predictors of DMFT increment in the studied children. Therefore, children initially classified as high risk and not submitted to sealant placement presented higher risk of developing caries lesions within a 2 year-period. Finally, the past caries experience was an excellent predictor of future caries and can easily be used in oral health programs.

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